J&T Consulting, Inc.

April 2, 2021

Mr. Brock Bowles
Environmental Protection Specialist
State of Colorado
Division of Reclamation, Mining, & Safety
1313 Sherman Street – Room 215
Denver, CO 80203

RE: Prowers Aggregate Operators, LLC. – West Farm Pit – Permit No. M-2008-078
Amendment No. 2. (AM-02)
Adequacy Review #1 Response

Dear Mr. Bowles,

Prowers Aggregate Operators, LLC. (PAO) has received the Division's adequacy review #1 comments letter dated February 9, 2021. Below are the comments and the corresponding responses that have been provided to address the comments.

Rule 6.2.1(2) – Maps and Exhibits – Adequate as Submitted

***Response:* No response, acknowledged.**

Rule 6.4 – Specific Exhibit Requirements – 112 Operation
6.4.1 Exhibit A – Legal Description – Adequate as Submitted

1) Are the permitted acres to be the same as the affected acres?

***Response:* Yes, the permitted acres are the same as the affected acres.**

6.4.3 Exhibit C – Pre-mining & Mining Plan Map(s) of Affected Lands

2) The topo lines on the maps make it difficult to read. Please remove the topo lines from the second set of maps (4, 5, and 6 of 6) and resubmit the maps.

***Response:* The topo lines have been removed from the second set of maps and the revised maps are attached.**

3) There are several structures located between Phase 7 and Phase 5 mining areas. Please identify the owners of these structures and label them on the Exhibit C map.

***Response:* The structures have been identified and are labeled on the revised maps attached. These structures are owned by GP Irrigated Farms, LLC.**

4) The ownership of the three large triangle shaped bodies of water located in Phase 3, 4, and 5 were not identified. Please identify the owners of these structures on the Exhibit C map.

Response: ***The structures have been identified and are labeled on the revised maps attached. These structures are owned by GP Irrigated Farms, LLC.***

5) The ownership of the ditch between Phase 4 and Phase 7 was not identified. Please identify the ownership of this ditch on the Exhibit C map.

Response: ***The ditch ownership has been identified and is labeled on the revised maps attached. The ditch is owned by GP Irrigated Farms, LLC.***

6) The ownership of the ditch between Phase 2 and Phase 4 was not identified. Please identify the ownership of this ditch on the Exhibit C map.

Response: ***The ditch ownership has been identified and is labeled on the revised maps attached. The ditch is owned by GP Irrigated Farms, LLC.***

7) The ownership of the ditch running east, south of Phases 5, 6, and 7 was not identified. Please identify the ownership of this ditch on the Exhibit C map.

Response: ***The ditch ownership has been identified and is labeled on the revised maps attached. The ditch is not owned by any entity that we could find. According to Mr. Bill Grasmick, who has farmed the property for the last 30 plus years and been associated with the operations at the PAO mine, there is not an owner associated with the drainage ditch.***

8) The ownership of the ditch west of Phase 3 was not identified. Please identify the ownership of this ditch on the Exhibit C map.

Response: ***The ditch ownership has been identified and is labeled on the revised maps attached. The ditch is owned by Lower Arkansas Water Management Associations (LAWMA).***

9) No offset was identified for the north bank of the Phases 7 and 9 ponds. Please clarify the setbacks.

Response: ***The setbacks have been labeled for the offsets at the north bank of the Phase 7 and 9 ponds on the revised maps attached.***

10) The north bank of the Phase 4 pond is adjacent to the Lamar sewer lagoons. It is unclear from the maps provided the distances between the structures and property lines. Please clarify the following:
    a. Distance from the permit boundary to City of Lamar property line
    b. Distance from mining limit to the lagoon berm
    c. Distance from mining limit to the permit boundary

Response: ***The distances have been labeled for the permit boundary to the City of Lamar property line, the distance from the mining limit to the lagoon berm, and the distance from the mining limit to the permit boundary on the revised maps attached.***

11) An area on Exhibit C: Map 4 of 6 is labeled as Highway Realignment Parcel. Please clarify:
    a. Does a second party have jurisdiction over this parcel?
    b. If another party has jurisdiction over this parcel, has a Right of Entry been obtained?
    c. What are the future plans and timeline for the highway realignment project?
    d. What are the anticipated effects to the mining plan/operation when the highway project begins?
    e. How will the mining plans change to accommodate the highway project?

Response: ***a.) Prowers County purchased the property several years ago from another entity that Karl Nyquist is a member of. b.) A right of entry with the County was provided for the property when it was purchased as part of the purchase agreement and entry was allowed as well as farming the area until the highway realignment project was constructed. c.) The future plans are to utilize the property for a bypass around the City of Lamar, however the project has not been funded by the Colorado Department of Transportation (CDOT) at this time. Design of the bypass is in the preliminary design phase. d.) There are not any anticipated effects to the mining plan as there will be access provided under the bridge/bypass at locations where the mining transport equipment will be able to function/travel through. e.) The mining plans will have minimal changes such as potentially realigning a conveyor or stacker south of County Road HH.5 but everything north of HH.5 is not expected to change from the current operations.***

6.4.4 Exhibit D – Mining Plan

12) Please provide specific details on the construction of the slurry walls. For slurry walls already constructed, please provide the final construction drawings. For proposed slurry walls please provide the design specifications and commit to providing the final construction drawings after installation is complete.

Response: ***The slurry walls that have been constructed in Phases 1 and 2 have been provided to the DRMS as well as the approved leak test for each phase from the State Engineer's Office. The design specification is attached for the proposed slurry walls. PAO commits to providing the final construction drawings for the proposed slurry walls once the installation is complete.***

13) Mining and reclamation are anticipated to progress through the 9 phases as shown on the map. Phase 5 will then be mined and reclaimed before the Phase 6 area is mined. The Phase 5 mined area extends from the northern permit boundary to the southern boundary. How will machinery and material be transported through the Phase 5 area when it is in reclamation and the Phase 6 area is actively being mined.

Response: ***The south side of Phase 5 will continue to have mine traffic travel through this area and will have the top of the slope to the permit boundary available for traffic coming to and from Phase 6. There is 50 feet of width that is sufficient to accommodate the mine traffic and slurry wall crossing will be created so that traffic***

can pass across without damage to the slurry wall. We anticipate that this section of Phase 5 will continue to be bonded for the surface reclamation that is required until Phase 6 mining is completed.

14) There is a narrow section of the permit area between Phase 5 and Phase 6 that is approximately 50 feet wide. Is this section wide enough to accommodate large machinery (haul trucks, construction equipment, conveyors, etc.) without causing offsite impacts to the surrounding areas?

Response: ***Yes there is sufficient room to accommodate the necessary traffic and machinery in this area. See also the response to comment 13).***

15) The mining plan map Exhibit C, 4 of 6 shows many structures (ponds, ditches, etc.) within the different phases. All phase areas will be mined and become a water resource pond at the end of mining. It is unclear from the map the timing each structure will be in place, the purpose of each structure and when it will be moved. Please describe the timeline for each Phased area to address the following issues:
    a. Phase 7 & 8 area proposed to be mined but are also listed as a plant site and product stockpiles
    b. The 4 sediment ponds in Phase 9 overlap the slurry wall,
    c. The overland conveyor and scale house are within the Phase 9 slurry wall,
    d. The radial stacker crosses the Highway Realignment Parcel,
    e. There are several sediment/collection ponds in the Phase 2 area and it is not clear which ones are built, being used, or their purpose of each pond,
    f. Where will the overburden and topsoil stockpiles go when the area they are currently in is being mined?

Response: ***a.) Phase 7 will be a plant site and stockpile area for quite some time and depending on market demand will be mined at approximately 23.5 years into the proposed mining plan (Order of mining phases is Phase 1 that has been completed, finishing Phase 2, then Phase 8, Phase 3, Phase 4, Phase 5, Phase 6, Phase 7 and Phase 9). The stockpiles will remain in place until the materials are sold. As discussed in our conference call on February 11th once Phase 6 is mined a decision will be made if the stock piles for the overburden and topsoil need to be pushed back into the pits for Phase 7 and 9 areas as the phases are mined out for reclamation. At that time PAO commits to providing a technical revision to change those phases to be reclaimed by filling in with overburden and topsoil rather than reclaiming as water storage if the overburden and topsoil cannot be sold. b.) The four sediment ponds will remain in place until Phase 9 is getting close to ready to be mined then the north end of the sediment ponds will be cut off and the ponds will be extended to the south to keep the same capacity. Once mining has progressed where the area of the sediment ponds needs to be mined they will be relocated to the bottom of the phase such that they can remain on the bottom of the bedrock until mining is completed. c.) The overland conveyor and scale house will remain in Phase 9 and will be relocated once slurry wall construction is to begin on Phase 9. The conveyor will still cross the slurry wall but it will be temporarily relocated during the slurry wall construction to where the slurry wall is backfilled and then moved back to its current location. The scale house will be relocated inside the slurry wall and remain until the last gravel reserves are mined out at which time it will be removed from the site or left in place for the potential end user of the reservoir for an office. d.) The radial stacker will remain in**

place until the highway bypass is constructed and during construction it will be relocated such that the conveyor will still cross the parcel and deliver material to the stackers on either side of the parcel so product can be delivered to the rail loadout area. e.) The sediment/collection ponds are all being used in Phase 2 and will continue to be used until the Phase 2 mining is completed. The ponds are routinely maintained and cleaned out so they can continue to function in removing the sediment from the water before it is re-used in the washing of materials or discharged back to the Arkansas River. f.) See response for part a.).

16) The wash plant is listed as being in two different locations on Map 4 of 6. What is the timeline for the different locations of the wash plant? Please also describe the locations and timeline for the sediment control structures associated with the wash plant because the locations listed for all the sediment ponds will eventually be mined.

***Response:** There are currently two wash plants so that is why there are two locations shown on Map 4 of 6. As PAO continues to mine the sediment ponds in Phase 9 will remain in place as described in the response for 15. b.). The sediment ponds in Phase 2 will be removed once mining is completed in Phase 2. The wash plant located in Phase 2 will move to a location in the next mining phase which will initially be Phase 8 and then into Phase 3 where sediment ponds may be setup just as they are in Phase 2. When mining is completed they will be removed. The timelines are based on the Phase sequence in the Exhibit D mining plan where Phase 8 will commence mining later this year and then Phase 3 commencing sometime in 2022. Then in seven years the same will occur for Phase 4. This will continue for the next phases as mining is completed in each phase per the Phase sequence. See updated phase sequence in the updated Exhibit D attached.*

17) The fines recovered from cleaning the sediment ponds is stockpiled either adjacent to the ponds or in Phase 9 area. What is the long term plans or disposal plan for the fines after they have been stockpiled and dried?

***Response:** The plan is to include the fines in the overburden material and sale the material as some will be used when mixing fines back into road base products or for fill dirt. As described in the response for 15.a.) a decision will be made after Phase 6 is mined to push materials back into the Phase 7 or Phase 9 area as they are mined if the overburden/fines/topsoil cannot all be sold.*

18) Will explosives be used in conjunction with the mining or reclamation process (Rule 6.4.4(i)?

***Response:** No explosives will be used with the mining or reclamation process.*

6.4.5 Exhibit E – Reclamation Plan

19) A commitment to install a perimeter drain if needed was made. Should a perimeter drain be needed, it will be installed between the slurry wall and permit boundary. What is the proposed typical distance between the slurry wall and permit boundary? Will there be enough room to allow for the installation of a perimeter drain if it should be needed?

Response: ***Twenty-five feet is the minimum distance between the slurry wall and permit boundary. There is enough room to construct a drain in this space as the depth of the drain would likely be between 8 feet and 10 feet deep. A trench box would be utilized for construction and the width of the trench would be 4 feet to 5 feet wide.***

20) A commitment to install a perimeter drain if one is needed to convey ground water around the lined reservoir. What event or measurement will be the determining factor for installation of the perimeter drain?

Response: ***Measurement of the existing monitor wells will continue to be done on a monthly basis as well as the new monitor wells that were installed around Phase 3 and Phase 8. The groundwater model shows the expected groundwater mounding or shadowing around the proposed slurry walls as the phases are mined. Based on the results of the ground water model there is not a need for a perimeter drain at this time. A phased approach will be used to install future monitor wells prior to mining future phases. Future monitor wells will be installed three to four months prior to construction of the future slurry walls in order to obtain ground water levels at monthly intervals and will continue to be measured throughout the life of the mine.***

6.4.6 Exhibit F – Reclamation Plan Map – Adequate as submitted

Response: ***No response, acknowledged.***

6.4.7 Exhibit G – Water Information

21) Groundwater that is encountered during the mining operations will be discharged in accordance with the NPDES permit. The approved NPDES discharge point is located in the Phase 2 area which is about 3 miles from the proposed furthest point of mining (Phase 6). Will the ground water be pumped back to the current discharge point or will a new discharge point be approved?

Response: ***The current discharge point will remain in place for Phase 2 mining and likely for Phase 4 mining. A new discharge point will be applied for to revise the existing permit to add another discharge location for Phase 3 and Phase 8. PAO will provide the approval from CDPHE once it is received for the additional discharge point. There will likely be more discharge points applied for as mining continues to Phase 5 and 6. PAO commits to providing updated approvals from CDPHE when they receive them for the future mining phases.***

22) On Figure Exhibit G-1, a well is identified east of West Farm but is not listed on Table G-1. Please add this well and its pertinent information to Table Exhibit G-1.

Response: ***The well that is identified on the Quad map is no longer there and must not be registered with the State of Colorado as there is not any information for that location. We have provided all the wells that are currently registered with the State Engineer's Office and listed in the groundwater database.***

23) Several slurry walls are proposed to be installed in a linear fashion. The total combined length of all the slurry walls is 3.75 miles, with a couple of breaks in the wall. These

structures will potentially have a significant effect on the ground water in the area. A ground water model is needed to predict the effects the slurry walls will have on the ground water. The Division recommends 5 quarters of monthly ground water level data is needed to create an adequate model. The model needs to address:

a. The impacts of static water levels,
b. The impacts on all wells within 600 feet of the permit,
c. The anticipated mounding and shadowing effects,
d. Breakdown the effect that each slurry wall (Phases) will have on the water level as each slurry wall is built,
e. What the potential impact of mounded water on the several ditches running adjacent and through the permit area,
f. Create ground water contour maps: before and after AM-02 slurry wall construction.

Response: ***a.) This is provided in the ground water model from McGrane Water Engineering. b.) This is provided in the ground water model from McGrane Water Engineering. c.) This is provided in the ground water model from McGrane Water Engineering. d.) This is provided in the ground water model from McGrane Water Engineering. e.) This is provided in the ground water model from McGrane Water Engineering. f.) This is provided in the ground water model from McGrane Water Engineering. The ground water model report is attached.***

24) Six ground water monitoring wells were identified on the monitoring well location map. All the wells are clustered in the vicinity of the current mining area. The current program is inadequate to address the new permit area proposed in AM-02. A new ground water monitoring program needs to be submitted for review. The design needs to be able to monitor water levels at each phase of mining, a commitment to collect data on each well monthly and to submit the data in the Annual Report.

Response: ***There have been seven more monitoring wells installed around Phase 8 and Phase 3. An updated monitor well map is attached as well as the monitoring well readings that have been done on the new wells to date. PAO commits to monitoring all monitor wells on a monthly basis and providing the measurements to the DRMS in the Annual Report each year. As previously stated for comment 20) a phased approach will be used to install future monitor wells prior to mining future phases. Future monitor wells will be installed three to four months prior to construction of the future slurry walls in order to obtain ground water levels at monthly intervals and will continue to be measured throughout the life of the mine. The ground water model that is attached will also be used as a tool for what can be expected for the mounding/shadowing effects of the slurry walls.***

25) On page 1 of Exhibit G it states dry mining will be conducted and that a slurry wall will be installed around the perimeter of each phase. Please clarify when the slurry wall will be installed, before or after mining each phase?

Response: ***The slurry wall for each phase will be installed prior to mining each phase.***

26) On page 1 of Exhibit G it states that the gravel pit will be lined concurrent with mining. Please clarify if this means a lining will be applied to the bottom of the pit or if the lining means the slurry wall?

Response: ***The lining means the slurry wall.***

6.4.8 Exhibit H – Wildlife Information – Adequate as submitted

Response: ***No response, acknowledged.***

6.4.9 Exhibit I – Soils Information – Adequate as submitted

Response: ***No response, acknowledged.***

6.4.10 Exhibit J – Vegetation Information

27) A formal jurisdictional determination has been sent to the ACOE. Please commit to not disturbing any areas that may potentially be jurisdictional before the ACOE has made its determination.

Response: ***PAO commits to not disturbing any areas that may potentially be jurisdictional prior to the ACOE providing an approved jurisdictional determination. PAO commits to sending the ACOE determination to the DRMS once we receive it.***

6.4.11 Exhibit K – Climate – Adequate as submitted

Response: ***No response, acknowledged.***

6.4.12 Exhibit L – Reclamation Costs

28) The topsoil storage piles are proposed to be placed in the Phase 9 area. No topsoil pile locations were identified in the eastern phases of mining. When topsoil is salvaged in the eastern phases (4, 5, & 6), will it be hauled for storage in the Phase 9 area and then hauled back to the eastern phase areas for reclamation? This information is needed to determine haul distance costs for replacement of topsoil.

Response: ***The topsoil will be hauled and stockpiled in Phase 9 and Phase 7. An updated map is provided for the mining plan maps that are attached showing the locations.***

29) The acres recorded on the Reclamation Cost Summary chart, the Summary of Unit Costs worksheets on the Maps in Exhibit C are not consistent. Please update the acreages for consistency.

Response: ***The acres have been updated so they match in the summary chart and the summary of unit cost worksheets as well as the maps in Exhibit C. An updated Exhibit L narrative and chart, updated summary of unit cost worksheets, and the updated maps are attached.***

30) In phases 7, 8, & 9 acres were credited to these tasks, lowering the cost of the task. The source of the credit is labeled as 'credit from above' but it is unclear where above is. The number of acres credited is greater than the number of acres in the phase being restored. Please clarify the source of the credits and explain why the number of acres credited is greater than the acres in the phase.

Response: ***The acres have been updated so the credits make sense. As most of the credits are for the entire surface acres of Phase 7 and Phase 9 being bonded for as the initial non-mining areas, these phases are being used for stockpiling and plant locations prior to being mined so the bond amount is for revegetation/seeding the entire surface which changes once these phases are mined in the future.***

31) Please provide supporting documentation verifying slurry wall construction costs. This can consist of a 3rd party bid.

Response: ***Slurry wall costs for the Phase 3 and Phase 8 slurry walls are shown in the attached 3rd party bid from Odin Construction Solutions. When pro-rating the mobilization, bonds, and mix design costs to each phase the costs per linear foot closely match the bond estimate. I.e.:***

Phase 3 reclamation bond estimate cost per linear foot = $340
Phase 3 bid cost per linear foot = $333
Phase 8 reclamation bond estimate cost per linear foot = $198
Phase 8 bid cost per linear foot = $197

6.4.13 Exhibit M – Other Permits and Licenses (Statement Req'd) – Adequate as submitted

Response: ***No response, acknowledged.***

6.4.14 Exhibit N – Source of Legal Right to Enter

32) A narrow section of permitted land lies between Phases 5 & 6. This strip of land is part of the conservation easement. According to the easement agreement no new roads can be constructed in this area without the permission from The Greenlands Reserve. Has permission been granted to cross this strip of land?

Response: ***When the conservation easements were created the existing roads that were in place were allowed to be used for ingress and egress across the easements. The narrow section is where the existing road was previously before the center pivot irrigation was constructed by GP Irrigated Farms, LLC. GP Irrigated Farms accesses the farm ground at this location and several other locations where the existing roads cross into the conservation easements. The permission to cross was granted when the easement was created so PAO does not need additional permissions to cross at this location.***

6.4.15 Exhibit O – Owner(s) of Record of Affected Land and Substance to be Mined – Adequate as submitted

Response: ***No response, acknowledged.***

6.4.16 Exhibit P – Municipalities Within Two Miles – Adequate as submitted

Response: ***No response, acknowledged.***

6.4.17 Exhibit Q – Proof of Mailing Notices to Board of County Commissioners – Adequate as submitted

Response: ***No response, acknowledged.***

6.4.18 Exhibit R – Proof of Filing with County Clerk and Recorder – Adequate as submitted

Response: ***No response, acknowledged.***

6.4.19 Exhibit S – Permanent Man-made Structures

33) The following structure agreements were not included in the AM-02 application and were not found in the previous amendment application:
   a. Lamar Light and Power
   b. Lamar Canal
   c. Inman Fence
   d. Atmos Energy
   e. AT&SF Railroad

Response: ***a.) This agreement was included and we also provided the certified mail receipt. Per e-mails and conversations with Lamar Light and Power they will not be signing the agreement and they confirmed with an e-mail response you were copied on. A copy of the Agreement is attached. b.) This agreement has been signed by the Lamar Canal. The signed agreement was provided via e-mail to you. A copy of the Agreement is attached. We also delivered another agreement for LAWMA for their ditch on the west side of Phase 3. It was signed by LAWMA. The signed agreement was provided via e-mail to you. A copy of the Agreement is attached. c.) This agreement was included and we also provided the certified mail receipt. Both are attached for reference. d.) This agreement was signed by Atmos Energy and provided via e-mail to you. A copy of the Agreement is attached. e.) This agreement signed by BNSF Railway Company who owns AT&SF and provided to you via e-mail. A copy of the Agreement is attached.***

34) The structure agreement with Prowers County Road Dept. is from 2018 and covers the sections of CR HH.5 and HH 8/10 that are in the current permit area. CR HH 8/10 and CR 11 are within the proposed AM-02 permit area. A structure agreement needs to be submitted that addresses these sections of road.

Response: ***A structure agreement was provided to Prowers County to amend the existing agreement and a copy was provided to the DRMS. As soon as we receive the signed amendment agreement back it will be provided to the DRMS. See the attached agreement that was provided to Prowers County.***

35) There are several structures located between Phase 7 and Phase 5 mining areas. Please identify the owners of these structures and submit a structure agreement for them.

Response: ***Those structures are all owned by GP Irrigated Farms, LLC. A structure agreement was provided to them and they also signed the agreement which was submitted to you. A copy of the Agreement is attached.***

36) The existing structure agreement with the City of Lamar is for the sewer lagoons to the north of the permit area. At the time this agreement was made in 2018, the permit boundary only bordered the western most lagoon. The proposed AM-02 permit boundary will border all 3 sewer lagoons. A new structure agreement with the City needs to be submitted that address all 3 sewer lagoons.

Response: ***The City of Lamar has provided a signed agreement to the DRMS and the City also withdrew their objection. A copy of the Agreement is attached.***

37) The mining plan proposes to relocate an underground power line owned by the SE Colorado Power Association. A structure agreement is needed that explicitly states that Prowers Aggregate has permission to relocate the power line.

Response: ***An agreement was provided to them and they signed the agreement and we provided a copy of that agreement in an e-mail to you. A copy of the Agreement is attached.***

Exhibit A – Slope Stability Report

38) Please provide a copy of the Cesare, Inc. report Figure 1 with the borehole locations labeled on the map.

Response: ***Figure 1 in the Cesare, Inc. report located in the West Farm Pit slope stability report has been updated to show the borehole locations. The revised slope stability report is attached.***

39) Please label the 150' offset for Section 7-1 on the Mine Plan Map 5 of 6.

Response: ***The offset has been labeled on the mine plan map 5 of 6 and is attached.***

40) The operator is committing to the slope stability monitoring recommendations outlined on page 9 of the J&T Consulting, Inc. report. These commitments will be added to the terms and conditions of the permit upon final approval of the permit.

Response: ***PAO commits to following the slope stability monitoring recommendations outlined on page 9 of the slope stability report.***

Thank you for your consideration of our responses to the comments. Please feel free to contact me with any questions or if you need additional information.

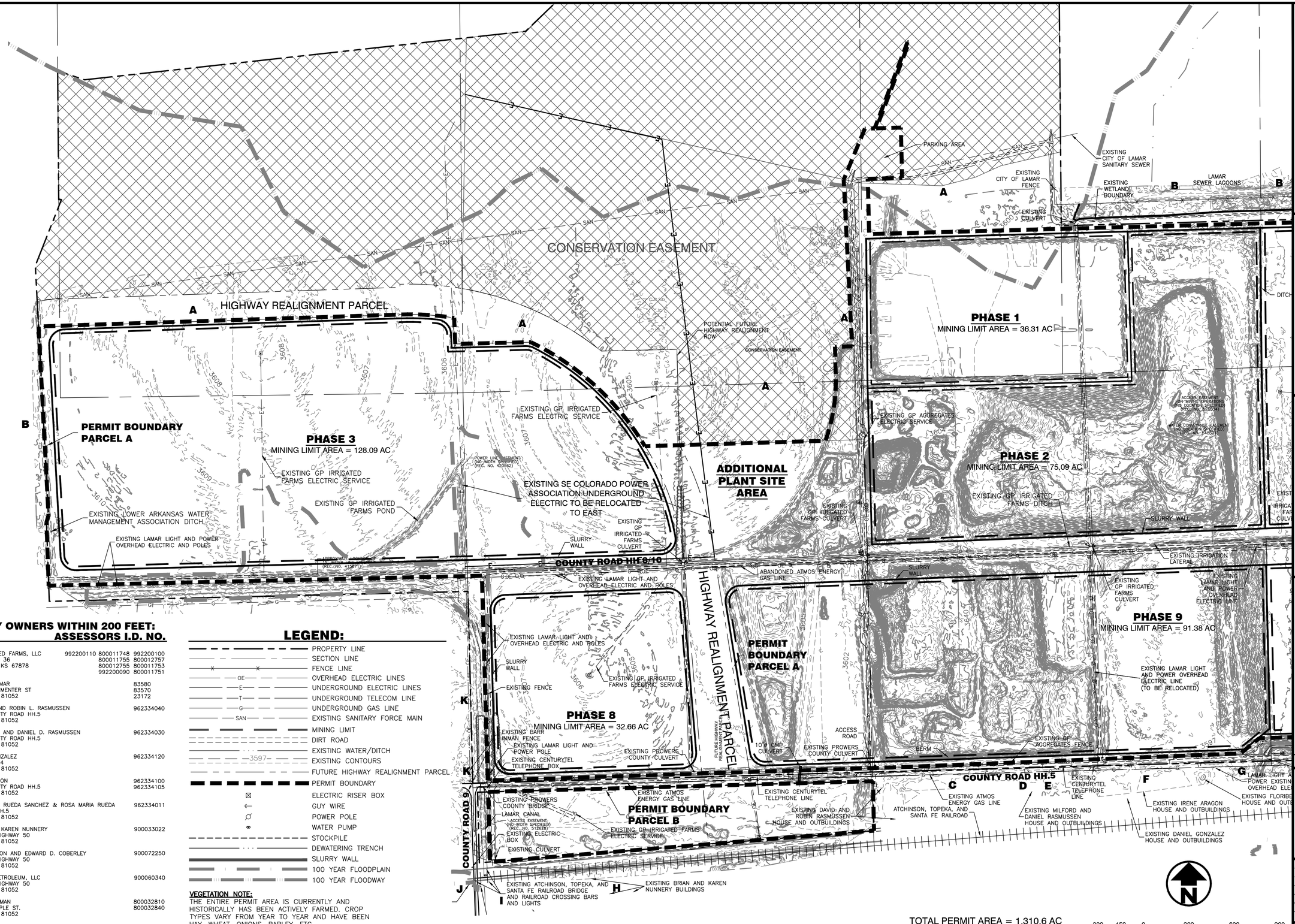
Sincerely,

J.C. York, P.E.

J&T Consulting, Inc.
305 Denver Avenue – Suite D • Fort Lupton CO 80621 • Ph: 303-857-6222 • Fax: 303-857-6224

Attachments:

1. Revised Exhibit C Pre-Mining/Mining Plan Maps
2. Soil-Bentonite Slurry Walls Specification
3. Revised Exhibit D Narrative
4. Revised Exhibit E Narrative
5. McGrane Water Engineering Groundwater Model
6. West Farm Monitoring Well Map
7. Phase 3 & 8 Monitoring Well Readings
8. Revised Exhibit L Narrative and Reclamation Cost Summary Table
9. Reclamation Bond Estimate Calculations
10. Phase 3 and 8 Slurry Wall Construction Cost Data
11. Structure Agreement – Lamar Light and Power
12. Structure Agreement – Lamar Canal
13. Structure Agreement – LAWMA
14. Structure Agreement – Barr H Inman
15. Structure Agreement – Atmos Energy
16. Structure Agreement – BNSF Railway Company (AT&SF Railroad owner)
17. Prowers County Road Department Agreement for Use and Maintenance of County Roads sent to Prowers County for Amendment
18. Structure Agreement – GP Irrigated Farms
19. Agreement – City of Lamar
20. Structure Agreement – Southeast Colorado Power Association
21. Revised West Farm Pit Expansion Slope Stability Report



PROPERTY OWNERS WITHIN 200 FEET:

	NAME	ASSESSORS I.D. NO.
A	GP IRRIGATED FARMS, LLC 732 SE CR 36 SYRACUSE, KS 67878	992200110 800011748 992200100 800011755 800012757 800012755 800011753 992200090 800011751
B	CITY OF LAMAR 102 E. PARMENTER ST LAMAR, CO 81052	83580 83570 23172
C	DAVID D. AND ROBIN L. RASMUSSEN 9626 COUNTY ROAD HH.5 LAMAR, CO 81052	962334040
D	MILFORD Q. AND DANIEL D. RASMUSSEN 9486 COUNTY ROAD HH.5 LAMAR, CO 81052	962334030
E	DANIEL GONZALEZ P.O. BOX 14 LAMAR, CO 81052	962334120
F	IRENE ARAGON 9718 COUNTY ROAD HH.5 LAMAR, CO 81052	962334100 962334105
G	FLORIBERTO RUEDA SANCHEZ & ROSA MARIA RUEDA 9900 CR HH.5 LAMAR, CO 81052	962334011
H	BRIAN AND KAREN NUNNERY 9800 US HIGHWAY 50 LAMAR, CO 81052	900033022
I	GARY HENSON AND EDWARD D. COBERLEY 9181 US HIGHWAY 50 LAMAR, CO 81052	900072250
J	SUTPHIN PETROLEUM, LLC 8825 US HIGHWAY 50 LAMAR, CO 81052	900060340
K	BARR H. INMAN 1105 E MAPLE ST. LAMAR, CO 81052	800032810 800032840

LEGEND:

- PROPERTY LINE
- SECTION LINE
- FENCE LINE
- OVERHEAD ELECTRIC LINES
- UNDERGROUND ELECTRIC LINES
- UNDERGROUND TELECOM LINE
- UNDERGROUND GAS LINE
- EXISTING SANITARY FORCE MAIN
- MINING LIMIT
- DIRT ROAD
- EXISTING WATER/DITCH
- EXISTING CONTOURS
- FUTURE HIGHWAY REALIGNMENT PARCEL
- PERMIT BOUNDARY
- ELECTRIC RISER BOX
- GUY WIRE
- POWER POLE
- WATER PUMP
- STOCKPILE
- DEWATERING TRENCH
- SLURRY WALL
- 100 YEAR FLOODPLAIN
- 100 YEAR FLOODWAY

VEGETATION NOTE:
THE ENTIRE PERMIT AREA IS CURRENTLY AND HISTORICALLY HAS BEEN ACTIVELY FARMED. CROP TYPES VARY FROM YEAR TO YEAR AND HAVE BEEN HAY, WHEAT, ONIONS, BARLEY, ETC.

AQUIFER NOTE:
THE ARKANSAS RIVER ALLUVIAL AQUIFER IS THE KNOWN AQUIFER PRESENT AT THE SITE.

TOTAL PERMIT AREA = 1,310.6 AC
TOTAL MINING AREA = 1,082.5 AC

300 150 0 300 600 900
SCALE IN FEET

J&T Consulting, Inc.
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West Farm Pit

Exhibit C - Pre-Mining Plan Map

Prowers Aggregate Operators, LLC.

M-2008-078

REVISIONS

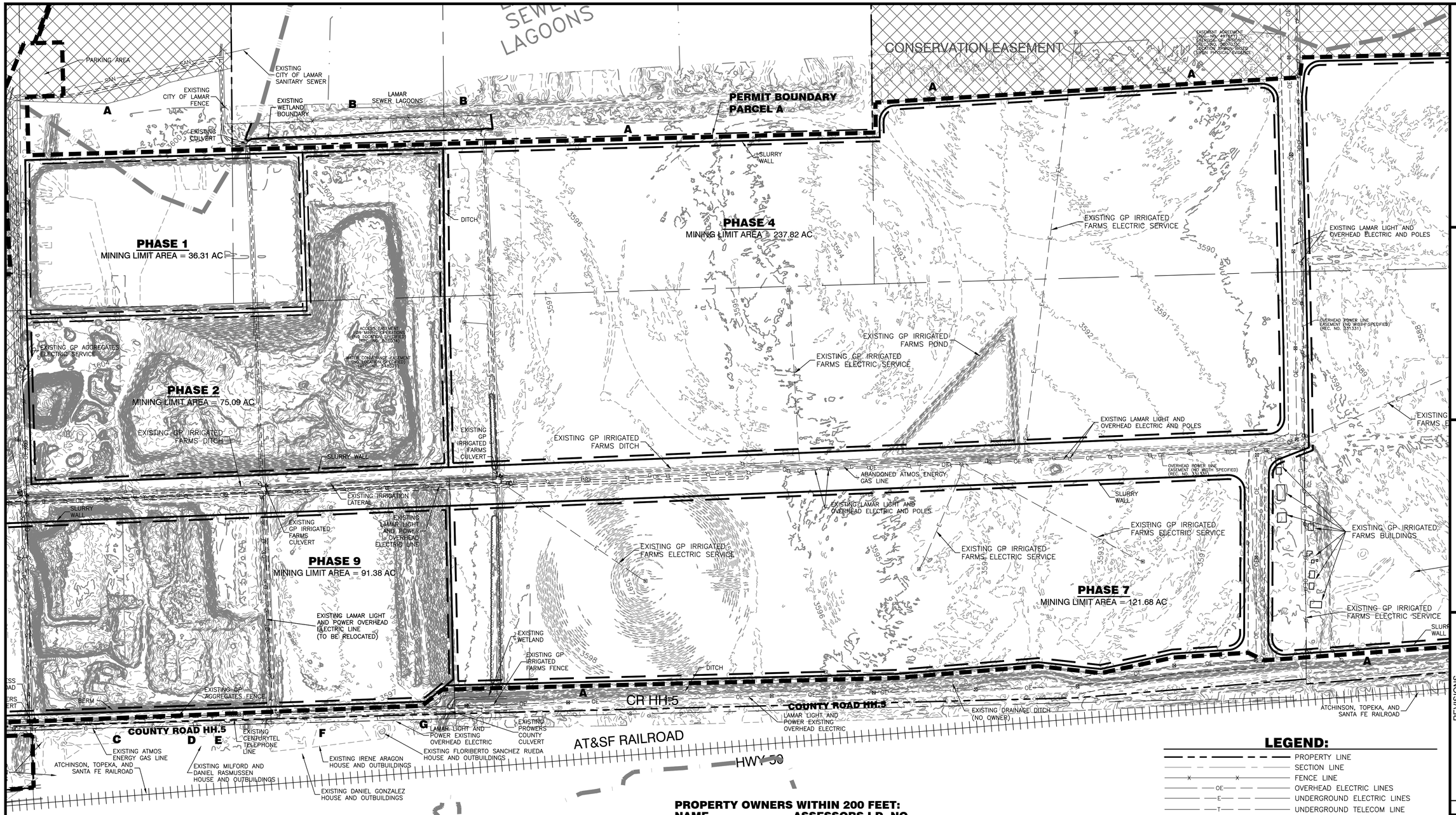
No	Date	By	Chk	Description
9	12/17/18	WSS	TPY	CRMS Comments
10	1.23.19	WSS	TPY	CRMS Comments
11	6/12/19	WSS	TPY	Added Conveyor
12	8/5/19	WSS	TPY	DRMS Adequacy Review No. 1 Response
13	12/4/20	TPY	JCY	2020 Amendment
14	4/1/21	TPY	JCY	2020 Amendment Adequacy Review 1 Comments

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Job #	07115
Date	11.6.20
Drawn By	TPY
Designed By	TPY
Checked By	JCY
File	JT-2020 Mining
Scale	1" = 300'

Sheet: 1 Of: 6

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VEGETATION NOTE:
THE ENTIRE PERMIT AREA IS CURRENTLY AND HISTORICALLY HAS BEEN ACTIVELY FARMED. CROP TYPES VARY FROM YEAR TO YEAR AND HAVE BEEN HAY, WHEAT, ONIONS, BARLEY, ETC.

AQUIFER NOTE:
THE ARKANSAS RIVER ALLUVIAL AQUIFER IS THE KNOWN AQUIFER PRESENT AT THE SITE.

PROPERTY OWNERS WITHIN 200 FEET:

	NAME	ASSESSORS I.D. NO.
A	GP IRRIGATED FARMS, LLC 732 SE CR 36 SYRACUSE, KS 67878	992200110 800011748 992200100 800011755 800012757 800012755 800011753 992200090 800011751
B	CITY OF LAMAR 102 E. PARMENTER ST LAMAR, CO 81052	83580 83570 23172
C	DAVID D. AND ROBIN L. RASMUSSEN 9626 COUNTY ROAD HH.5 LAMAR, CO 81052	962334040
D	MILFORD Q. AND DANIEL D. RASMUSSEN 9486 COUNTY ROAD HH.5 LAMAR, CO 81052	962334030
E	DANIEL GONZALEZ P.O. BOX 14 LAMAR, CO 81052	962334120
F	IRENE ARAGON 9718 COUNTY ROAD HH.5 LAMAR, CO 81052	962334100 962334105
G	FLORIBERTO RUEDA SANCHEZ & ROSA MARIA RUEDA 9900 CR HH.5 LAMAR, CO 81052	962334011

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SCALE IN FEET

LEGEND:

- PROPERTY LINE
- SECTION LINE
- FENCE LINE
- OVERHEAD ELECTRIC LINES
- UNDERGROUND ELECTRIC LINES
- UNDERGROUND TELECOM LINE
- UNDERGROUND GAS LINE
- EXISTING SANITARY FORCE MAIN
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- FUTURE HIGHWAY REALIGNMENT PARCEL
- PERMIT BOUNDARY
- ELECTRIC RISER BOX
- GUY WIRE
- POWER POLE
- WATER PUMP
- STOCKPILE
- DEWATERING TRENCH
- SLURRY WALL
- 100 YEAR FLOODPLAIN
- 100 YEAR FLOODWAY

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West Farm Pit

Exhibit C - Pre-Mining Plan Map

Prowers Aggregate Operators, LLC.

M-2008-078

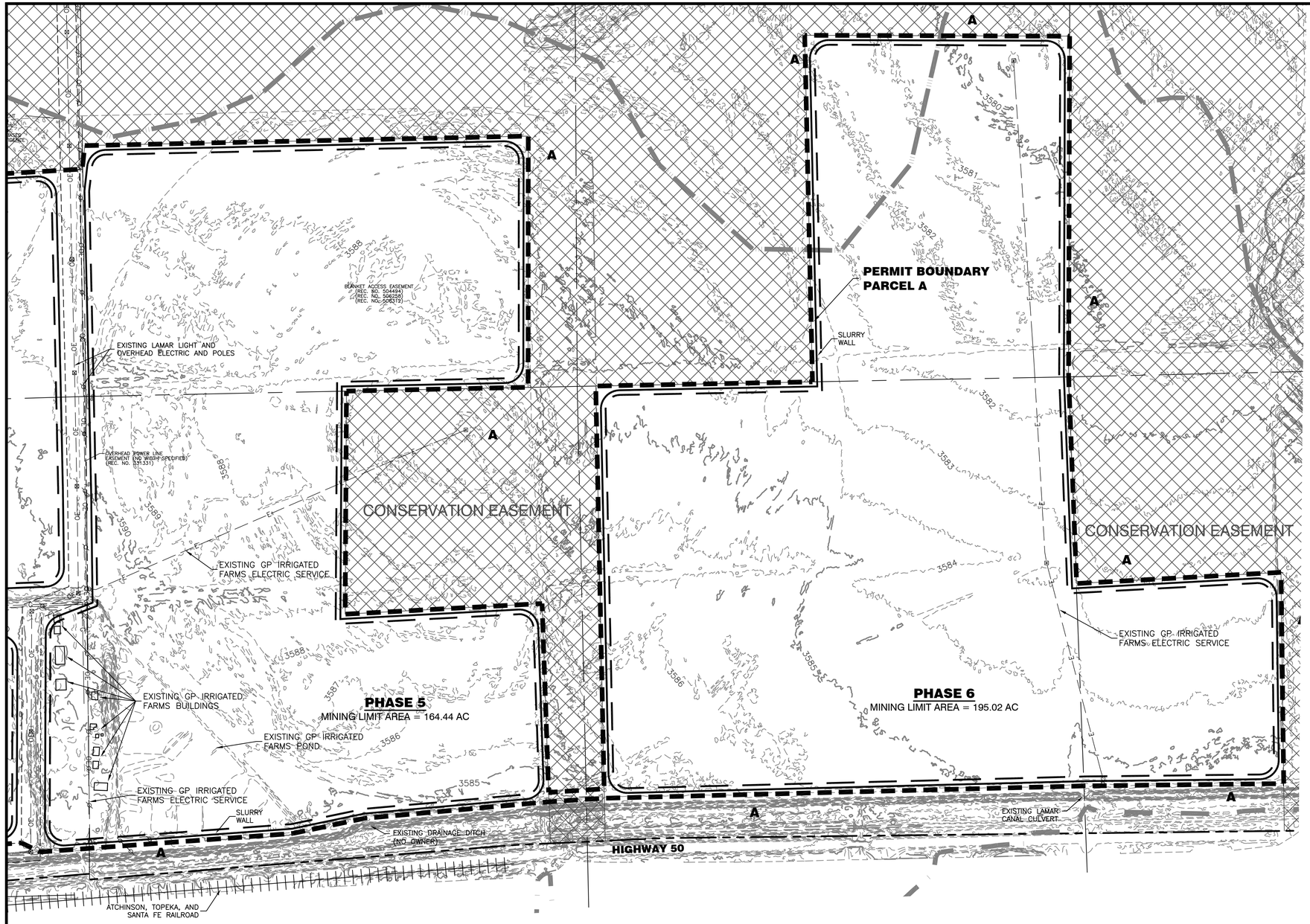
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14	4/1/21	TPY	JCY	2020 Amendment Hearing Packet Comments

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PROPERTY OWNERS WITHIN 200 FEET:

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A	GP IRRIGATED FARMS, LLC 732 SE CR 36 SYRACUSE, KS 67878	992200110 800011748 992200100 800011755 800012757 800012755 800011753 992200090 800011751

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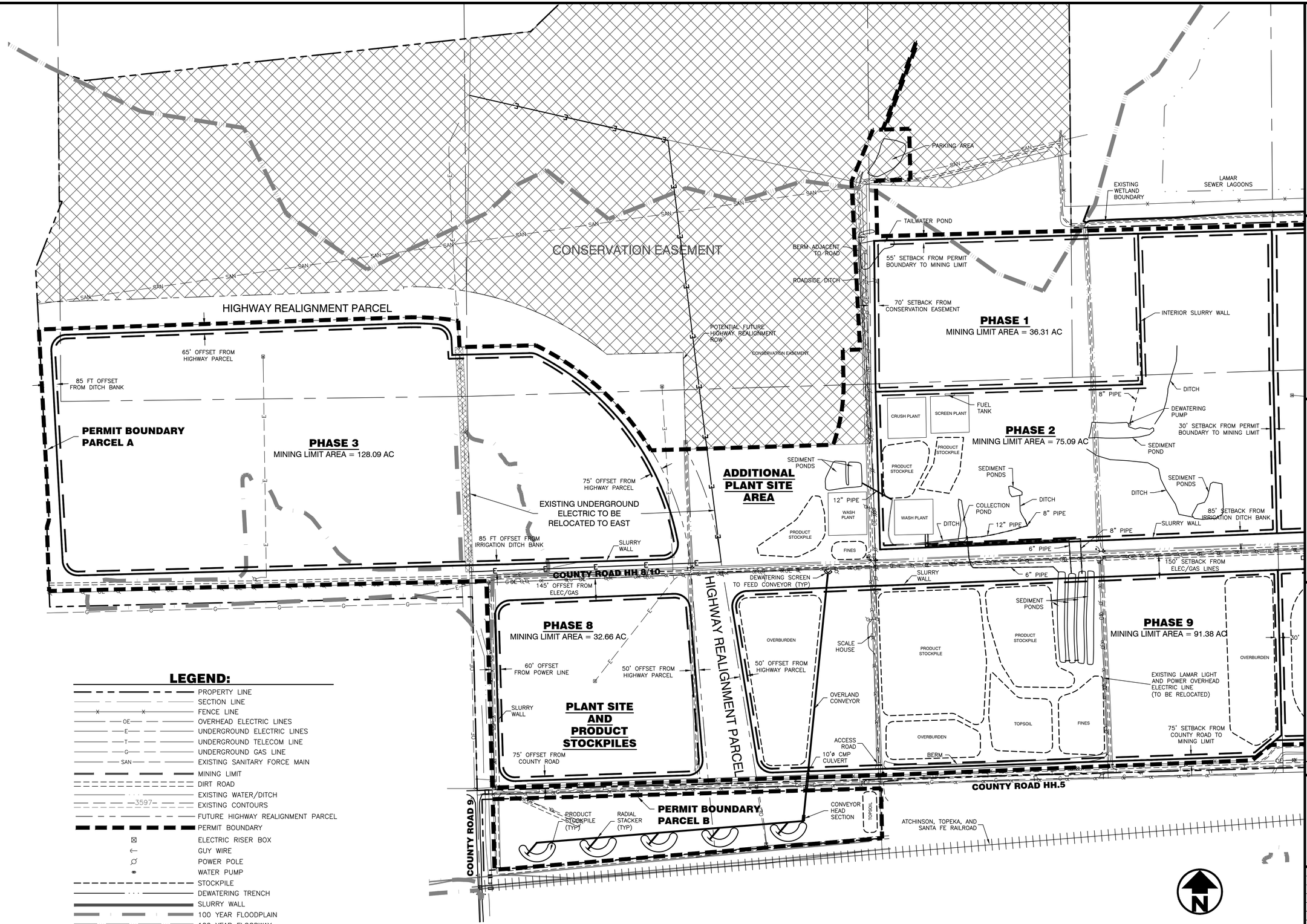
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TOTAL PERMIT AREA = 1,310.6 AC
TOTAL MINING AREA = 1,082.5 AC

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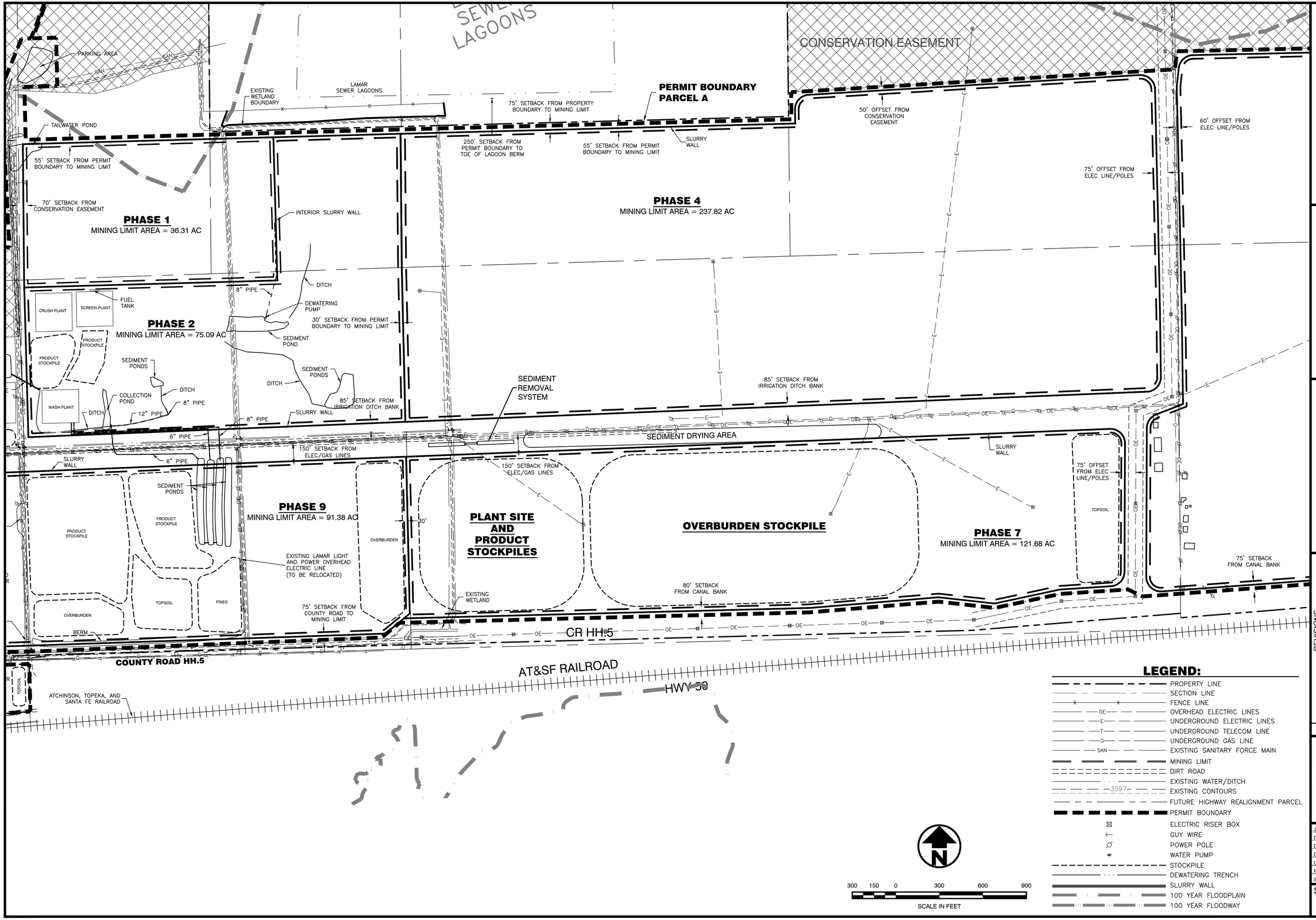
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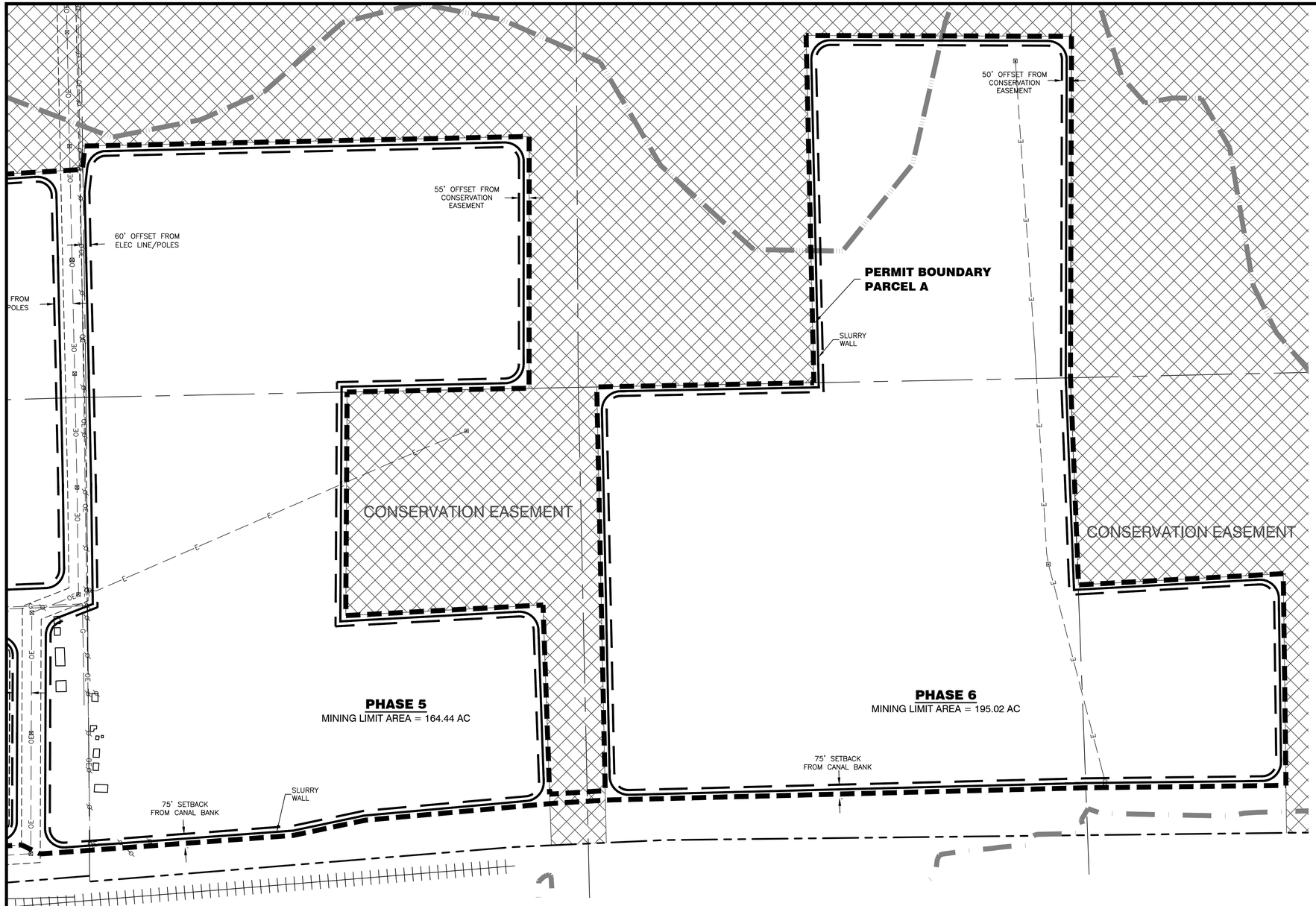
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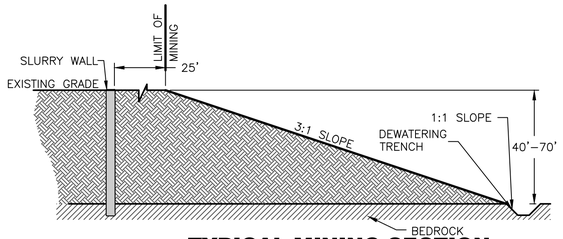
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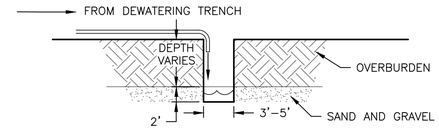
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TYPICAL MINING SECTION



RECHARGE DITCH DETAIL
N.T.S.

RECHARGE NOTE:
RECHARGE DITCH TO BE INSTALLED / OPERATED AROUND PERIMETER OF OPEN MINING AREA(S) AS NEEDED TO RECHARGE SURROUNDING ALLUVIAL AQUIFER.

LEGEND:

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SECTION 31 66 17

SOIL-BENTONITE SLURRY WALLS

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. This section of the specifications includes requirements for the Slurry Trench Cutoff Wall and related work as indicated on the drawings and as hereinafter specified. The work consists of furnishing all plant, labor, equipment, and materials and of performing all operations as required to construct the slurry trench cutoff wall. The slurry wall shall be installed prior to any adjacent pipeline construction.

1.2 REFERENCE STANDARDS

A. The following is a list of standards that will be referenced in this specification. Such referenced standards shall be considered part of these specifications as if fully repeated herein.

REFERENCE	***TITLE OR DESCRIPTION***
API Spec 13A	API Specification for Oil-Well Drilling-Fluid Materials
API RP 13B-1	API Recommended Practice Standard Procedure for Field Testing Water-Based Drilling Fluids
ASTM C 138	Test Method for Unit Weight of Concrete
ASTM C 143	Test Method for Slump of Concrete
ASTM D 422	Particle-Size Analysis of Soils
ASTM D 1140	Materials Finer than No. 200 Sieve
ASTM D 4318	Liquid Limit, Plastic Limit and Plasticity Index of Soils
ASTM D 4380	Density of Bentonite Slurries
ASTM D 4381	Sand Content by Volume of Bentonite Slurries
ASTM D 5084	Hydraulic Conductivity Using a Flexible Wall Permeameter

1.3 ABBREVIATIONS AND DEFINITIONS

A. API - American Petroleum Institute

B. ASTM - American Society for Testing and Materials

C. Slurry Trench - A narrow, vertical-walled trench of specified width excavated by the slurry trench method and backfilled with specified materials to form a cutoff wall of low permeability. The terms "Slurry Trench" and "Slurry Wall" are used interchangeably in these specifications.

D. Slurry Trench Method - A method of excavating a narrow, vertical trench using a slurry mixture to support the trench walls and prevent movement of groundwater into or through the excavated trench.

E. Water-Bentonite Slurry - A stable colloidal suspension of powdered bentonite in water. The terms "slurry" and "water-bentonite slurry" are used interchangeably in these specifications.

F. Soil-Bentonite (SB) Backfill - A homogeneous mixture of specified soil material, bentonite and water. The terms "soil-bentonite backfill" and "backfill" are used interchangeably in these specifications.

G. Slurry Trench Specialist - An individual who has had proven and successful experience in slurry trench construction and is knowledgeable of: (1) the proper methods employed to mix slurry and backfill, (2) the use, testing and control of bentonite as a slurry, (3) construction equipment, (4) excavation and backfill operations, and (5) testing for slurry trench quality control.

H. Working Platform - The working platform is the surface of compacted fill and/or excavated surface from which the slurry wall is constructed. The work platform is to be relatively level, stable.

I. Supplemental Fines – The soil that contains a significant percentage of fines content (passing the - #200 sieve or .075 mm in the largest dimension) that is added to the excavated soil for the purpose of increasing the overall fines content of the soil-bentonite backfill.

J. Key Depth - The depth to which the slurry trench is excavated into less weathered suitable bedrock providing the connection between the slurry wall and the less weathered bedrock.

1.4 SUBMITTALS

A. The following information shall be submitted at least 4 weeks prior to construction.
   1. Qualifications of Contractor
      a. The Contractor, shall submit evidence including resumes and references that he or his subcontractor is experienced and competent to construct a soil-bentonite slurry trench. The slurry trench company shall have at least five years of prior experience in constructing slurry walls, with at least five `SB slurry walls of similar scope and magnitude. The Contractor shall have sufficient competent experienced personnel to carry out the operations specified.
         i. In particular, a slurry trench specialist hired by the Contractor shall supervise the construction, slurry preparation, and Contractor's quality control. The slurry trench specialist shall have at least three years of experience and/or three projects in successful construction of slurry walls, with at least two SB slurry walls of similar scope and magnitude.
      b. The company name, key contact, and qualifications of the Contractor's off-site laboratory shall be submitted. The laboratory will have previous experience with slurry wall backfill materials, experienced laboratory technicians, and flexible wall permeability testing equipment.
   2. Work Plan- The Contractor shall submit a detailed operating plan describing his proposed construction equipment, procedures, and schedules. This shall include, but not be limited to, the Contractor's plan for:

      a. Coordinating the construction, maintenance and removal of working platforms, mixing pads, and haul roads with the Owner, general contractor or other contractors on site.
      b. Equipment set-up and site use layout including storage areas, haul roads and work platform dimensions.

c. Equipment specifications including: make/model/weight of excavator(s), boom and stick diagrams, maximum depth capability of excavator; number and type of backfill mixing equipment; and specifications of slurry mixing and desanding equipment.
d. Procedure for water-bentonite slurry mixing, transportation, recirculation, desanding and use.
e. Procedure for mixing and placing soil-bentonite backfill, including methods for proportioning specified additional dry bentonite.
f. Cold weather construction procedures, per Section 3.6
g. Procedure for trench excavation and backfilling.
h. Procedure for desanding the in-trench slurry.
i. Material properties, sources, and (manufacturer's) certificates of quality.
j. Water shall be tested per Table 1 prior to final approval to ensure that it has appropriate chemistry for slurry wall construction.
k. Quantity of supplemental fines required per lineal foot of slurry trench to achieve the specified backfill properties.
l. Control of drainage, spills, wastes, etc.
m. Clean-up, spoils disposal, slurry disposal

3. Backfill Mix Designs
   a. The Contractor shall obtain samples of the materials to be encountered during trenching, the supplemental fines and the Owner-provided construction water. The Contractor shall perform and submit a mix design that demonstrates that its intended backfill mixture will meet the requirements specified herein without the addition of dry bentonite. However, the production backfill shall include a minimum of 1% dry-added bentonite to account for the differences between laboratory and field conditions.
4. Quality Control Plan
   a. The Contractor shall submit a quality control plan with details on personnel, responsibilities, inspections, and organization for insuring the quality of construction required by these specifications.
5. Bar Chart Schedule and Sequence of Operations
   a. The Contractor shall submit a detailed schedule and sequence of operations in a bar chart format. The submittal shall include a description of the schedule including typical working hours and days; sequence of operations; and maintenance schedule.

B. During Construction - The following reports shall be submitted to the Engineer on a regular schedule during the progress of the work.
1. Reports
   a. Daily reports shall be submitted by noon of the day following the date of the report. Final reports shall be submitted within two to four weeks of the completion of work.
2. Soundings and As-Built Profile
   a. The Contractor shall maintain a record of soundings taken during construction including the depth of the trench, key, and backfill slope obtained each morning and evening. The soundings shall be used to generate an as-built profile of the trench, as constructed. The Contractor shall submit said profile at the completion of construction.

3. Fresh Bentonite Slurry Mix
   a. A record of plant-mixed bentonite slurry quantities, proportions, properties, and admixtures made during construction. Adjustments to the slurry mixture shall be noted.
4. Trench Bentonite Slurry Mix
   a. A record of in-trench bentonite slurry properties made during construction. Procedures and admixtures used to modify slurry properties shall be noted.
5. Soil-Bentonite Backfill Mix

a. A record of SB backfill material quantities, properties, and mix adjustments made during construction. Location of sample and number of molded specimens for laboratory testing shall be noted.

6. Supplement Fines Testing – Results of supplemental fines tests performed on borrow sources samples and/or supplemental fines staged along trench.
7. Quality Control Data
   a. A record of quality control samples, tests and test results.

1.5 JOB SITE CONDITIONS

A. The Contractor shall comply with all safety requirements and procedures.

B. The Contractor shall perform all work with qualified personnel under the continuous supervision of the slurry trench specialist.

C. The Contractor shall exercise extreme care to protect and prevent damage or disruption to existing utilities.

D. The Contractor is responsible to contact all utility owners, including overhead electrical, in the vicinity of the work to coordinate utility locates, de-energize or shielding power lines, and observing the crossing of buries utilities; and protecting all existing utilities from damage.

1.6 PRODUCT DELIVERY, HANDLING, AND STORAGE

1. The Contractor shall deliver all materials to the site in undamaged, unopened containers bearing the manufacturer's original label.
2. The Contractor shall deliver for use only fresh materials to the site.
3. The Contractor shall store and handle materials in accordance with the manufacturer's recommendations.

PART 2 - MATERIALS AND EQUIPMENT

2.1 BENTONITE SLURRY

A. Bentonite slurry shall consist of a stable colloidal suspension of bentonite in water and shall be controlled in accordance with the most current API Recommended Practice 13B-1, Table 1, and the following requirements:

1. At the time of introduction of the slurry into the trench, the slurry shall be a mixture of not less than 5% bentonite in water. Additional bentonite or admixtures may be required depending on the hardness and temperature of the water and the quality of the bentonite. The slurry shall have a minimum apparent viscosity of 40 seconds reading through a Marsh Funnel Viscometer, a pH between 6 and 8 units and a minimum density of 65 pcf, (1.04 gm/cc).
2. The slurry mixture in the trench shall have a unit weight not less than 65 pcf (1.04 gm/cc), not greater than 85 pcf (1.36/gm/cc) or 15 pcf less than the backfill unit weight, or as approved by the Engineer. The sand content shall not be greater than 20%. The sand content shall be lowered by replacing the in trench slurry with fresh slurry or a desander may be used to lower the sand content.

2.2 BENTONITE

A. Bentonite used in preparing slurry shall be pulverized (powder or granular) premium grade sodium-cation montmorillonite and shall meet the most current API Standard 13A, Section 4. The yield of the bentonite shall be 90 barrels per ton.

2.3 WATER

A. Fresh water, free of excessive amounts of deleterious substances that adversely affect the properties of the slurry shall be used to manufacture bentonite slurry. The Owner shall be responsible for providing the source of the construction water for the project. The water's physical properties shall be in accordance with Table 1. It is the responsibility of the Contractor that the slurry resulting from the water shall always meet the standards of this Specification.

2.4 SB BACKFILL

A. The material for trench backfilling shall be composed of fresh slurry, trench slurry, supplemental fines and selected soils obtained from trench spoils. Trench slurry may be disallowed if additives are not acceptable to the Engineer. The backfill mix shall contain a minimum of 1.0% dry-added bentonite by dry unit weight of backfill. The soil shall be friable and free from roots, organic matter, refuse, or other deleterious materials. The backfill shall be thoroughly mixed and reasonably well graded between the following gradation limits:

Screen Size	**Percent Passing**
(U.S. Standard)	**By Dry Weight**
3"	100%
3/8"	65%-100%
No. 20	40%-85%
No. 200	>30%

B. The permeability of the backfill shall be less than 1 x 10^{-7} cm/sec when tested in accordance with ASTM D 5084. The slump of the backfill shall be 3 to 6 inches, and the density of the backfill shall be at least 15 pcf greater than the density of the slurry.

C. The fines in the backfill soil shall have sufficient plasticity so that the material can be rolled by hand into a 1/8" thread without crumbling. The water content of the backfill material shall not exceed 20% prior to blending with bentonite and/or slurry.

D. Excess sand and gravel excavated from the slurry trench will need to be saved for the slurry wall cap or "wasted" and not included in the final backfill mix. The "wasted" sand and gravel shall be replaced with approved supplemental clayey soils. Supplemental clayey soils may have to be stockpiled along the slurry wall alignment. Samples of the borrow material to be used in the backfill will need to be tested well in advance of slurry wall construction to insure an adequate supply of acceptable material is on hand. The Contractor is responsible for identifying any off-site supplemental fines source and delivering the material to the site.

E. Dry bentonite at a minimum rate of 1.0% of the dry weight of backfill material will be added to the backfill prior to mixing.

2.5 SLURRY TRENCH CUTOFF

A. A slurry trench cutoff wall shall be constructed to the lines, grades, and cross sections indicated on the drawings. The trench shall have essentially vertical walls, a minimum width of 36 inches, and shall key a minimum additional depth of 12 inches into the designated stratum as shown on the drawings. A generalized description of the soil profile through which the slurry trench cutoff is to be constructed is shown.

2.6 TOLERANCES

A. The following tolerances shall apply to the slurry trench dimensions and construction.

1. The slurry wall alignment as shown has been chosen to allow a sufficient separation between the slurry wall and the crest of the gravel pit slope. It is critical that the slurry wall be constructed on the shown alignment and not deviate from centerline by more than 1 ft left or right.
2. The slurry trench shall be plumb within 3 degrees of vertical.
3. The depth of the slurry trench shall be measured or surveyed to within 3 inches of the desired elevation.
4. The excavating tool shall be at least as wide as the design width of the slurry trench.
5. Overlaps and changes in direction of the slurry trench shall require a full depth over excavation at least 5 ft beyond the centerline of the trench. In cases where the trench must be re-excavated (for example, due to an extended shutdown, cave-in, rework, etc.) the overlap into acceptable backfill shall be at least 10 ft.

2.7 EQUIPMENT

A. Trench Excavation

1. Excavation of the slurry trench cutoff wall shall be accomplished by use of any suitable earth-moving equipment, or combination thereof, such as a backhoe, clamshell, chisels, and ripper teeth so the trench can be carried to its final depth of cut continuously along the trench alignment. The excavator shall have the capability to excavate at least 5 ft deeper than the maximum depth shown on the plans. Special chopping, chiseling or other suitable equipment may be used as necessary to satisfactorily accomplish the required excavation. The width of the excavating tool shall be equal to or greater than the specified minimum width of the slurry trench. Additional equipment such as airlift pumps and slurry desanders shall be used to clean the trench bottom slurry in accordance with the requirements of the specification. The trench excavation equipment shall be capable of excavating the required key into the designated stratum.

B. Slurry Batching Plant(s)

1. The slurry batching plant shall include the necessary equipment including a high shear mixer capable of producing a colloidal suspension of bentonite in water, pumps, valves, hose, supply lines, and all other equipment as required to adequately supply slurry to the trench and/or the backfill mixing operation. Storage ponds shall be provided to store initially mixed slurry to allow hydration, and to retain a reserve in case substantial slurry loss through underlying pervious zones occurs. All slurry held in storage shall be agitated or recirculated to maintain a homogeneous mix. All slurry for use in the trench or backfill shall be prepared using a suitable mixer. No slurry is to be made in the trench. Mixing of water and bentonite shall continue until all particles are fully hydrated and the resulting slurry is homogeneous.

C. Backfill Mixing and Placing

1. Equipment for mixing and placing backfill may consist of any suitable earthmoving or grading equipment, such as bulldozers, or blade graders or backhoes, or blenders such as a pug mill, that are capable of thoroughly mixing the backfill materials into a homogeneous blend having the required gradation and properties and placing the material in the trench as specified. Soil clods shall be broken to 3 inch maximum size by the backfill preparation equipment and methods employed. Deleterious materials, debris and oversize particles, shall be removed from the backfill before approval for placement.

PART 3 - EXECUTION

3.1 SLURRY TRENCHING

A. Excavation shall proceed continuously from the starting point to the finishing point. Slurry shall be introduced into the trench at the time trenching begins and shall be maintained in the trench during excavation and until backfilled. The Contractor shall maintain the stability of the excavated trench at all times for its full depth. The level of the bentonite slurry shall always be maintained at least 3 ft above groundwater level and shall not be permitted to drop more than 2 ft below the surface of the working platform. The Contractor shall have personnel, equipment, and prepared slurry ready to raise the slurry level at any time. To this end, the Contractor shall have personnel on call as necessary to check the trench levels and to raise the slurry level on weekends and/or holidays.

B. When crossing an existing slurry wall, carefully expose existing slurry wall as shown and clean surface until existing soil-bentonite backfill is neatly exposed.

3.2 KEY DEPTH

A. Unless otherwise directed, the bottom of the slurry trench will be keyed the minimum specified penetration into the specified stratum indicated. If the backhoe or a clamshell is unable to achieve the minimum specified penetration into the less-weathered rock stratum the assistance of ripping teeth, or drop chisels may be necessary.

Excavation refusal is defined as the inability to excavate more than 9 inches of depth over a bottom trench length of 20 feet in a period of 60 minutes with the approved excavator in proper and effective operating condition. If a minimum key depth of 12 inches is not achieved after excavation refusal, excavation shall continue until a second refusal period, or a 12 inch minimum key depth is reached, whichever is sooner.

The depth to the top of the stratum shall be measured after these soils are identified in the excavation spoils. The final depth and key penetration of the trench shall be measured and checked by the Contractor and approved by the Engineer immediately following excavation. Weathered bedrock will be encountered and will not be considered as the less-weathered rock stratum. The onsite approving engineer will determine when the excavation has encountered the weathered and less-weathered rock stratums. Key depth shall be carefully compared to boring logs to assure that the key is excavated into the less-weathered bedrock stratum.

3.3 CLEANING TRENCH BOTTOM

A. Upon completion of excavation, any loose material or cuttings shall be removed from the bottom of the trench with the excavation tools or other suitable means such as air lift pumps. If the unit weight of the slurry in the trench exceeds the specified limits, or becomes unworkable, the heavy slurry shall be removed from the trench by airlift pump, clamshell, or other methods approved by the Engineer or the excess solids shall be removed from the slurry by settling ponds, screening, or desanding. The trench bottom shall be cleaned of debris and excess sand sediment prior to backfilling. The trench shall be sounded immediately before placing backfill, and soundings shall be compared to the trench excavation soundings to verify the bottom. At a minimum, soundings shall be taken each morning and each evening and as given in Section 3.9.H and compared to monitor for cave-ins or excessive settlement. The spacing of the each sounding shall be a maximum of 10 feet along centerline.

3.4 BACKFILL MIXING

A. The backfill shall be mixed on site. If the backfill is mixed beside the trench, the contractor shall control and provide sufficient equipment and work platform space to support slurry spills, trench stability, and mixing equipment operation. Unmixed materials shall not be allowed to fall into the trench. If the backfill is mixed in a remote location, the contractor shall build and maintain adequate haul roads and the mixing pit or pad. The mixing pit or pad shall be lined with compatible soils or other materials to prevent contamination from unsuitable materials. In either case, the contractor shall be responsible for the quality of the backfill.

B. Backfill materials and bentonite may be pre-mixed by blending in mechanical blenders or by windrowing, disk harrowing, bulldozing, blading or by other approved methods. Mixing and blending shall be performed in such a manner as to produce the required gradation of backfill. The backfill material shall be thoroughly mixed into a homogeneous mass, free of large soil clods, lumps or pockets of fines, sand, or gravel.

C. Slurry, dry-added bentonite, trench-excavated soil and supplemental fines shall be mixed until homogeneous, tested for acceptability, and then immediately placed in the trench.

D. The backfill shall be sluiced with bentonite slurry from the trench or fresh bentonite slurry during blending operations. Sluicing with water will not be permitted. Occasional particles of up to 3 inches in their largest dimensions will be permitted. Just prior to placing, the backfill material shall have a slump of 4 to 6 inches. To this end, the materials shall be shall be sampled and tested for permeability, density, and slump after preparation.

3.5 BACKFILL PLACEMENT

A. The backfill shall be placed continuously from the beginning of the trench, in the direction of the excavation, to the end of the trench. The advancing toe of backfill shall be within reach of the trench excavator at all times such that the trench bottom can be cleaned in accordance with Section 3.4.A above. Excavation must permit inspection and measurement immediately after completion and prior to backfilling. Placing operations shall proceed in such fashion that the surface of the backfill below the slurry shall follow a reasonably smooth grade and shall not have hollows, which may trap pockets of slurry during subsequent backfilling. Free dropping of backfill material through the slurry will not be permitted. Initial backfill shall be placed by lowering it to the bottom with clamshell bucket or backhoe until the surface of the backfill rises above the surface of the slurry or by lead-in slope. Additional backfill may then be placed in such manner that the backfill enters the trench by sliding down the forward face of the previously placed backfill. To accomplish this, sufficient backfill shall be piled behind the crest of the existing backfill slope to cause a mudwave action at the face of the backfill. The backfill shall not be dropped or deposited in any manner that will cause segregation.

B. An acceptable substitute for the initial placing of backfill by the use of a clamshell bucket may be a lead-in trench. The lead-in trench shall begin at a point outside of the limits of work and provide sufficient distance for the backfill face to form, by placing the backfill into the trench, before the toe of the backfill reaches the point where the cut-off is required. The lead-in trench shall be 1v: 1h or flatter

3.6 COLD WEATHER CONSTRUCTION REQUIREMENTS

A. No frozen backfill or slurry shall be placed in the soil-bentonite slurry wall trench. All ice forming on the surface of the slurry trench shall be removed prior to the start of each shift. No frozen or frost bearing backfill material shall be placed into the trench. When freezing temperatures exist the Engineer will conduct visual inspections of the slurry in the trench and the soil-bentonite backfill. The inspection may include measurement of the temperature if necessary to evaluate the potential for frozen material. The frequency of these inspections will be a minimum of once per day typically, early in the day prior to the placement of any backfill. Additional inspections may be required if conditions warrant or change.

B. Slurry wall construction work scheduled between November 1st and March 31st will require an additional section in the Work Plan Submittal detailing cold weather construction procedures.

3.7 TREATMENT FOR TOP OF BACKFILL

A. Upon completion of slurry wall construction, a protective cap shall be constructed on top of the slurry wall. The cap shall consist of a non-compacted soil cover placed within one day over each backfilled 100 foot reach. The temporary cover is to be removed after settlement (approximately 2 weeks) and replaced with a compacted soil cover over the completed slurry wall.

3.8 CLEAN-UP

A. After completion of the backfill and capping, all remaining excavated material and slurry shall be removed and the surface shall be cleaned and leveled as directed by the Engineer. Excess slurry shall be disposed by drying, mixing with dry materials or spreading in thin layers on adjacent areas designated by the Engineer. No slurry shall be left in ponds, and all ponds shall be pumped dry and backfilled in a manner approved by the Engineer.

3.9 QUALITY CONTROL

A. Testing services performed by the Contractor and testing services performed by the Owner's Material Testing Agency shall be as stipulated in Table 1 at the end of this section.

B. The Contractor shall provide test equipment and a testing trailer with electricity and water for the Engineer's use. The Owner's QA in no way relieves the Contractor from performing quality work; the Contractor shall perform its own QC testing as designated by "Contractor" in Table 1 and other tests as it deems appropriate.

C. Final acceptance of all materials and placement methods will be based on a review of quality control tests and on visual observations made by the Engineer during construction. The Contractor shall submit testing results per Table 1 on a daily basis to the Engineer.

D. If a test fails to meet the specified criteria, another test shall be performed after Contractor has completed the necessary corrective work. Contractor shall bear the expense of all the necessary corrective action and re-tests performed.

E. The Contractor shall be responsible for demonstrating to the satisfaction of the Engineer that the trench is continuous and keyed the minimum specified depth into the designated stratum. The Engineer will be available onsite to verify these measurements. Trench continuity shall be assured by the action of movement of the trench excavation equipment such that the digging tools can be passed vertically from top to bottom of the trench as well as moved horizontally along the axis of the trench without encountering unexcavated material. Penetration of the bottom of the trench into the designated stratum shall be demonstrated at 10 ft centers by observation of the excavation spoils from the trench and by direct measurement of the top of the designated stratum and the final excavated trench depth to the satisfaction of the Engineer.

F. Materials
   1. Bentonite: Manufacture's Certificate of Compliance with the API specification shall be obtained from the manufacturer for each shipment of bentonite delivered to the site.
   2. Water: Water for slurry mixing shall be tested once for each change in water source as shown in Table 1.
   3. Prepared Backfill: Soil-bentonite backfill shall be tested prior to placement in the trench by conducting tests to determine slump and density. Laboratory testing of the permeability shall be conducted once for every 1500 cu. yards of backfill mixed. Permeability testing shall be performed to verify the prepared material meets specification. Permeability determination may follow placement.
   4. Fresh Slurry: A complete series of tests shall be conducted from the mixer or tank containing fresh slurry ready for introduction in the trench twice per shift and at least once per batch of slurry.
   5. Trench Slurry: Slurry in the trench shall be tested at least twice per shift. Samples shall be obtained from the lower depths of the trench near the excavator.
   6. Slurry Wall Performance: The completed slurry wall will be tested according to the "State Engineer Guidelines for Lining Criteria for Gravel Pits," August 1999, Section 3.1. Water Budget Accounting frequency will be determined from the results of the test.

G. Quality Control Testing Equipment
   1. The field laboratory shall be provided and equipped by the Contractor for use by the Owner's Testing Agency with the following equipment, at a minimum:
   2. Marsh funnel and cup – 2 sets
   3. Mud balance – 2 sets
   4. Sounding cable – 2 sets
   5. Slump cone and rod – 1 set
   6. Sand content kit – 1 set
   7. Standard 3", 3/8", #20 and #200 sieve with hot plate (or microwave oven) and balance – 1 set
   8. Filter Press

H. Soundings shall be taken by the Contractor every 10 ft along the trench centerline using a weighted tape, cable or other device. Soundings shall be recorded to the nearest 0.25 ft. Soundings shall be performed by the Contractor and observed by the Engineer. Soundings shall record the following:
   1. Top of Key, Less-weathered Bedrock Stratum: The top elevation of the key stratum shall be determined based on an examination of cuttings taken during excavation.
   2. Bottom of Excavation: The elevation of the trench shall be determined subject to approval by the Engineer.
   3. Bottom of Excavation Prior to Backfilling; Soundings shall be used to monitor for sidewall collapse and accumulation of sediments.

4. Profile of Backfill Slope: The SB backfill slope and trench bottom shall be sounded at the beginning and end of each shift and converted to an as-built drawing. This drawing shall be reviewed daily as an indication of trench collapse, excessive settlement or sloughing.

I. A qualified off-site laboratory shall be engaged by the Contractor to perform the permeability test called for in Table 1.

J. Flexible wall permeability tests will be conducted on samples of the backfill to determine compliance with these specifications. Samples of the SB backfill will be obtained from the mixing area and will be sent to the off-site laboratory for testing. The test parameters will be as follows:

1. Average Effective Confining Stress = 5 psi.
2. Hydraulic Gradient = 10

K. Documentation

1. Results of all tests performed will be recorded on forms acceptable to the Engineer. These forms will be available to the Engineer at all times for his/her inspection. Copies of all Contractor-required quality control documents will be submitted daily to the Engineer for his verification.
2. Results of all Construction activities shall be recorded daily on a form acceptable to the Engineer. At a minimum, these forms are to include:

    a. The project station both at the starting and ending location for each day for the following:

        i. Top of backfill
        ii. Toe of backfill
        iii. Last completed set

    b. Verified area of excavated material
    c. Contractor's start and stop work times
    d. Contractor's activities
    e. Set summaries that include:
        i. Start and stop time for excavation of the set
        ii. Depth to bedrock
        iii. Depth to bottom of key
        iv. Description of bedrock

3. An as-built profile drawing of the trench bottom and backfill slope shall be continuously maintained by the Contractor. The profile shall indicate the extent of excavation and backfill at the end of each working day. The daily profile shall be drawn in an electronic format or by hand.

L. Performance testing of the completed slurry wall will be completed by the Owner's Representative in accordance with the "State Engineer Guidelines for Lining Criteria for Gravel Pits," August 1999, Section 3.1. These guidelines stipulated a 90-day liner test to determine if the slurry wall keyed into the bedrock will meet the performance standards defined by the State Engineer, thereby releasing the Owner from augmentation responsibilities for the gravel pit. The testing consists of performing a 90-day liner test, used to determine the water balance to demonstrate the inflows (precipitation, groundwater) and outflows (evaporation).

The State Engineer has design and performance standards for the reservoir lining design in terms of maximum allowable groundwater inflow from the perimeter and the bottom of the reservoir. The performance standard allows for groundwater inflow three times greater than the design standard. These standards are presented in Table 1, Item 3.16

The slurry wall performance shall meet this performance standard. Final acceptance of this work will occur after verification of meeting the performance standard. Defects, damages, or imperfections due to faulty materials or workmanship determined by the liner test and/or subsequent investigations shall me immediately remedied, repaired or replaced by the Contractor as defined by 2.6 Tolerances.

SECTION CONTINUES ON FOLLOWING PAGES

Table 1: Soil – Bentonite Slurry Trench Quality Control Testing Plan

Property	Requirement	Min. Test Frequency	Test Method	Comment	Responsibility
3.10 BENTONITE POWDER					
a. YP/PV Ratio	< 3	1 per shipment	API Spec 13A	Premium Grade Certification	Manufacturer
b. Viscometer at 600 rpm	> 30	1 per shipment	API Spec 13A	by Manufacturer	Manufacturer
c. Filtrate Loss	< 15 cc	1 per shipment	API Spec 13A		Manufacturer
d. Moisture Content	< 10%	1 per shipment	API Spec 13A		Manufacturer
e. Residue > 75 micrometers	< 4%	1 per shipment	API Spec 13A		Manufacturer
f. Certification	Meets API 13A, Section 4	1 per shipment	Section 4	90 bbl/ton	Manufacturer
3.11 WATER FOR SLURRY MIXING					
a. pH	6 to 8	1 per source	API RP 13B-1	May be modified for potable	Contractor
b. Hardness	< 200 ppm	1 per source	API RP 13B-1	source or treated w/ additives	Contractor
c. Total Dissolved Solids	< 500 ppm	1 per source	EPA 600		Contractor
3.12 INITIAL BENTONITE SLURRY				Prior to introduction into trench	
a. Viscosity	> 40 seconds	2 per shift	API RP 13B-1		Full QC by Contractor QA by Owner
b. Density	> 65 pcf	2 per shift	ASTM D-4380		Full QC by Contractor QA by Owner
c. Filtrate Loss	< 30 cc	2 per shift	API RP 13B-1		Full QC by Contractor QA by Owner
d. Bentonite content	> 5%	1 per project	Weight-Volume	Demonstration batch	Full QC by Contractor QA by Owner
3.13 IN-TRENCH BENTONITE SLURRY					
a. Unit Weight	65 to 85 pcf	2 per shift	ASTM D-4380	Also > 15 pcf less than SB	Full QC by Contractor QA by Owner
b. Viscosity	> 40 seconds	2 per shift	API RP 13B-1		Full QC by Contractor QA by Owner
c. Sand Content	< 20%	2 per shift	API RP 13B-1		Full QC by Contractor QA by Owner

TABLE 1 CONT'D: SOIL – BENTONITE SLURRY TRENCH QUALITY CONTROL TESTING PLAN					
Property	**Requirement**	**Min. Test Frequency**	**Test Method**	**Comment**	**Responsibility**
3.14 SB BACKFILL MATERIAL					
a. Slump Cone	3 to 6 inches	2 per shift	ASTM C-143		Full QC by Contractor QA by Owner
b. Gradation	3" < 100% 65% < 3/8" < 100% 40% < #20 < 85% 30% > #200	1 per shift	ASTM D-422	Laboratory or Field test	Full QC by Contractor QA by Owner
c. Density	15 pcf > In-trench Slurry	1 per shift	ASTM C-138 or D-4380 Mod		Full QC by Contractor QA by Owner
d. Permeability	< 1 x 10^{-7} cm/sec	1 per 1500 cu. yard	ASTM D-5084	Laboratory test	Full QC by Contractor QA by Owner
3.15 SLURRY WALL PERFORMANCE					
a. Reservoir Perimeter Inflow	Design < 0.03 $ft^3/day/ft^2$ Performance < 0.09 $ft^3/day/ft^2$	1 at the end of construction	"State Engineer Guidelines for Lining Criteria for Gravel Pits" August 1999 Section 3.1	Field Test for Unmined Pits	Owner
a. Reservoir Bottom Inflow	Design < 0.0015 $ft^3/day/ft^2$ Performance < 0.0045 $ft^3/day/ft^2$	1 at the end of construction	"State Engineer Guidelines for Lining Criteria for Gravel Pits" August 1999 Section 3.1	Field Test for Unmined Pits	Owner

END OF SECTION

EXHIBIT D

Mining Plan

Mining Limits

Prowers Aggregate operators, LLC currently operates a gravel mine in the northeast ¼ and the northeast ¼ of the northwest ¼ of Section 33, and the south ½ of the southeast ¼ of Section 28, Township 22 South, Range 46 West of the Sixth Prime Meridian, in Prowers County, Colorado. This amendment adds areas to the permit area to the west and east of the current permit area for product staging and additional mined area, and modifies the limits of the current permit boundary. The site lies approximately ½ mile east of the City of Lamar, and approximately ¼ mile north of State Highway 50. Access to the site is located off of Prowers County Road HH.5. The dominant land use surrounding the property is agricultural.

Aggregate processing plants are located within the mining area as shown on the Mining Plan Map. The area will contain stockpiles and portable equipment as necessary to support the plant operations.

The permit boundary will encompass approximately 1,310.64 acres with approximately 1,082.5 acres being mined. The remaining area will consist of setbacks, road and utility right-of-ways, equipment storage, product processing areas, product storage and loadout areas, and plant site access.

Various setbacks from adjacent roads and man-made structures will be maintained as mining occurs. See Exhibit C, Mining Plan Map, and the Slope Stability Report for the mining limit configuration and information on setbacks and their locations.

Products

Sand and gravel will be the primary product produced from the West Farm Pit site. The principal intended use for the sand and gravel is for road base and construction aggregates.

Subsurface drilling and testing has verified that the West Farm Pit property contains a significant commercial deposit of sand and gravel. The depth of the overburden ranges from 2 to 27 feet. The thickness of the aggregate material ranges from 7 to 60 feet. The overall depth to bedrock ranges from 22 to 67 feet. See Exhibit I, Soils Information, for detailed data on the nature, depth, and thickness of the soil strata present in the property area.

Mining Methods

The deposit will be dry mined. A slurry wall liner will be installed prior to mining commencing. Dewatering trenches will be excavated around inside of the perimeter of the slurry wall for each mining phase after the slurry wall is installed in order to dewater to a depth where mining can commence. The depth of the ditches will vary as the mining progresses deeper into the alluvium in order to maintain the groundwater level below the active mining bottom surface, and therefore minimize the exposed groundwater surface area. The dewatering ditches and process water will flow through a series of sediment settling ponds, from which the water will be discharged into a farm ditch, and then discharged into the Arkansas River.

The equipment and facilities may include, but are not limited to the following:

Processing Equipment
Screens, crusher, conveyors, stackers, and other miscellaneous processing equipment.

Earth Moving Equipment
Dozers, loaders, scrapers, excavators, and compactors will be used for mining and earth moving operations.

Miscellaneous Equipment
Dewatering pumps, electrical trailer, scale, scale house, generator trailer, small portable generators and water trucks will be used as needed.

As mining progresses, topsoil and overburden will be stripped to expose the aggregate product below. Portions of soil and overburden material will be used on-site for reclamation and portions will be sold as construction products; Overburden and topsoil stockpiles will be located within the proposed permit area and placed to minimize impact to potential floodwaters. The stockpiles will be placed outside the floodway but will be within the floodplain.

Mining of the aggregate will progress down to the underlying bedrock. During mining the mining face will have a 3H:1V slope. The processed aggregate material will be temporarily stockpiled near the processing plant site, and then loaded onto trucks or rail cars for delivery.

The wash plants will utilize either water from a well that has been permitted to allow commercial use (see Exhibit G, Lamar Farms Well No. 5) or groundwater pumped from the bottom of the active mining area. The wash plant discharges and all stormwater drainage within the permitted area will be directed to sediment ponds within the permit area to allow sediment to settle from the water before either being discharged (pumped) into a farm ditch, on the north side of the permitted area which drains to the Arkansas River, or recycled and recirculated back to the wash plants after the sediment has been removed.

The wash plant on the west side of the mine receives water from a well to use in washing product. The discharge from this plant is directed to 2 sediment ponds which drain to the east where flows enter a ditch and are collected in a pond in the Phase 2 area. Water from this pond is pumped through a pipe to a series of 3 sediment ponds located in the Phase 9 area.

When the sediment has settled from the water in the 3 sediment ponds in the Phase 9 area, the clean water is recycled and pumped through a pipe to the wash plant in the Phase 2 area to wash product. An additional sediment pond has been constructed in the Phase 9 area to be used when one of the primary 3 ponds is being cleaned, to ensure that 3 sediment ponds are utilized to treat wash plant discharges at all times. All sediment ponds are cleaned as needed and the removed fines stockpiled either adjacent to the ponds or in the fines stockpile in the Phase 9 area.

The discharge from the wash plant in the Phase 2 area is directed to a sediment pond on the pit floor and then pumped through a pipe to the series of 3 sediment ponds in the Phase 9 area.

See the attached stormwater management plan for details on the sediment control measures utilized on the site, maintenance schedules for the control measures, drainage patterns on the site, and discharge monitoring requirements for the site.

All local, State, and Federal rules and regulations will be followed for the storage and handling of any fuel for the facilities.

Mine Phasing

Prowers Aggregate Operators, LLC anticipates mining and reclaiming the West Farm Pit site in 9 phases, progressing through the phases as shown on the Mining Plan Map. The overall time required to complete the mining and reclamation is estimated to be approximately 30 years. Production is expected to be 2,000,000 tons per year with a possible maximum production rate of 2,500,000 tons per year. However, it is possible that due to demand fluctuations, mining could progress slower than anticipated and additional time may be required for mining and reclamation of the site.

The mining and reclamation of Phases 1 is complete. Phase 2 is approximately 60%-70% complete. Using a production rate of 2,000,000 tons per year Phases 2-9 are estimated to be mined according to the following sequence and timeline:

Phase Sequence	Estimated Time Required to Mine Phases (years)	Estimated Total Mining Time (years)
1	Mining Complete	0 years
2	1 year	1 year
8	0.75 years	1.75 years
3	5 years	6.75 years
4	9.5 years	16.25 years
5	2.5 years	18.75 years
6	4.5 years	23.25 years
7	3.75 years	27 years
9	2.75 years	29.75 years

EXHIBIT E

Reclamation Plan

Lined water storage reservoirs will be the final reclaimed use for the West Farm Pit site. The majority of the mining areas will be reclaimed as a water storage reservoir. The remaining area within the proposed permit boundary will consist of reservoir shoreline, unimproved access roads around the reservoir, and reclaimed or otherwise undisturbed land.

Water Storage Reservoir

In general, the mining limits will be mined down to the shale bedrock. The reservoir will be separated from the surrounding alluvial aquifer by a slurry wall liner system as detailed in the cross-section shown on the Reclamation Plan Map. The slurry wall liner will be keyed into the bedrock material and extend upward through the entire height of the alluvium. Design specifications and quality control procedures used during the construction of the slurry wall liner will ensure that the reservoir meets the State Engineer's Office (SEO) performance standards for permeability. The slurry wall liner will be constructed concurrently with the mining activities when a new phase is opened for mining. Currently slurry walls have been constructed, tested, and approved around Phases 1 and 2. See the attached liner approval letters from the Colorado Division of Water Resources.

All reservoir slopes will be reclaimed to at least 3H:1V final grade. Final reclamation by capping with topsoil and re-vegetating above the expected reservoir water level will follow mining activities closely to minimize the amount of disturbance at any one time.

After final reclamation, inlet and outlet facilities for the reservoir(s) will be designed and installed once the operational criteria of the proposed reservoir have been identified.

Reclamation Measures/Materials Handling

Topsoiling and seeding will be done to provide stabilized shorelines around the reservoir(s) and to minimize erosion. There will not be known toxic or hazardous materials in the backfill material. Additionally, it is not likely that acid forming or toxic materials will be encountered during mining. The mining will not leave high walls on the property. In addition, there will be no auger holes, excavations, or shafts left on the property.

Topsoiling

Approximately the top 12 inches of soil on the property is classified as topsoil. This layer includes the root zone of grasses and crops, which will be stripped and stockpiled separately. By using concurrent reclamation techniques, the topsoil is not expected to remain in stockpiles for more than one to five years. If the stockpile remains more than one year, it will be seeded with a fast growing vegetative cover to prevent erosion. Some of the topsoil may be sold as a construction product. Most of the topsoil will be retained on-site to reclaim the reservoir shoreline, and other areas disturbed by mining activities. Where required, topsoil will be replaced to a depth of approximately six inches.

Revegetation

As mining operations are completed, areas for reclamation will be graded and shaped for revegetation. Runoff or excess water from adjacent areas will not be allowed to flow over slopes being graded and seeded. If needed, berms or channels will be constructed to divert excess water and convey it in a safe and non-erosive manner.

For disturbed areas, the reclamation plan includes re-vegetating with appropriate seed mixes to minimize erosion and re-establish natural terrain. The seed mixture below was selected to be long lasting and regenerating, as recommended by the Prowers County Conservation District. The ground will be fine graded prior to seeding and mulch will be applied according to recommendations from the Natural Resource Conservation Service. Reservoir side slopes below the anticipated reservoir water level will not be seeded. The proposed seed mix is shown in the following table.

Seed Mix	**Application Rate***
Alkali Sacaton (Saltalk)	1.5 PLS/ac
Switchgrass (Blackwell or Pathfinder)	4.0 PLS/ac
Blue Grama (Hachita or Lovington)	3.0 PLS/ac
Western Wheatgrass (Arriloa, Barton, Rosana)	16.0 PLS/ac
Sideoats Grama (Vaughn, El Reno Niner)	9.0 PLS/ac
Buffalograss (Texoka, KNO3 treated, or native within 150 miles of site)	6.0 grain or 16.0 bur
*Application rate is for drilling the seed. If seed is to be broadcast, the application rate will be doubled.	

The seed mix will be planted with a drill equipped with depth bands and fluffy seed agitator. The seed will be drilled between November 15 and April 30 for best results. The seeded areas will then be covered dead crop litter from sorghum or milo crop forage, or with straw mulch at a rate of 1,200 to 2,000 pounds per acre.

If a significant invasion of noxious weeds occurs after seeding, the weeds will be mowed before they can go to seed. The areas will be mowed periodically for additional control as needed. Mechanical control will be used as a first priority. Chemical methods will only be used if no other alternative produces acceptable results.

Water – General Requirement

To minimize the effect on the prevailing hydrologic balance, Prowers Aggregate Operators, LLC. will:

a. Comply with all applicable Colorado water laws.
b. Comply with all applicable Federal and State water quality laws and regulations.
c. Comply with all Federal and State requirements for dredge and fill.
d. Re-grade and backfill all sediment and siltation structures after mining is completed.
e. Monitor groundwater levels adjacent to the site and mitigate any damage to adjacent wells that dewatering activities may have. (See Exhibit G)

Groundwater – Specific Requirements

The operation will not affect groundwater quality on or off the site. The operation will comply with State groundwater quality standards. Due to the groundwater being commingled with stormwater and product wash water prior to being discharged, stormwater and groundwater discharge quality standards are being monitored per the approved CDPS discharge permit for the site, Permit No. COG 501574. The CDPS discharge permit is attached for your reference.

The mining and reclamation may affect the groundwater table surrounding the mine site. The proposed mitigation efforts to minimize these impacts are to install a slurry wall around the perimeter of each cell to maintain groundwater levels during the mining, and a perimeter drain if needed to convey groundwater around the lined reservoir after the pit side liner is installed. Prowers Aggregate Operators, LLC proposes that they continue to monitor groundwater levels through both onsite and offsite monitoring wells that they have installed, or have access to before, during, and after the mining and reclamation is complete so that impacts to the groundwater table, from this mining operation, can be identified and addressed. It is the intent of Prowers Aggregate Operators, LLC to operate responsibly and to mitigate any damage to wells that is directly attributable to the mining and reclamation of this site.

Reclamation Timetable

The reclamation of Phase 1 is complete. Phases 2-9, and the other disturbed areas are estimated to be reclaimed according to the following sequence and timeline:

Phase / Location Sequence	Phase / Location Area (acres)	Estimated Time Required to Reclaim Phases (years)	Estimated Total Reclamation Time (years)
Parking Area on the North Side of the Site / Disturbed Areas Adjacent to the Pit Road West of Phase 1 / Along the Ditch to the River North of the Pit	6.25	Reclamation Complete	0
1	36.31	Reclamation Complete	0
2	75.09	1	1
8	32.66	0.75	1.75
3	128.09	5	6.75
4	237.82	9.5	16.25
5	164.44	2.5	18.75
6	195.02	4.5	23.25
7	121.68	3.75	27
9	91.38	2.75	29.75
West Wash Plant and Sediment Pond Area / Parcel B Area	41.29	0.5 (Includes estimated time required for seed to germinate and become established)	30.25

3h:1v final reclaimed slopes will be established concurrently as mining progresses through the phases. At the completion of mining of each phase, topsoil, and seed will be placed above the reservoir water line on all disturbed areas in that phase. At the completion of mining of all phases, topsoil and seed will be placed on the disturbed areas in the west wash plant and sediment pond area, and the Parcel B area.

McGrane Water Engineering, LLC

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March 25, 2021

Mr. JC York
J&T Consulting, Inc.
305 Denver Avenue, Suite D
Ft. Lupton, CO 80621

Via email at: jcyork@j-tconsulting.com

RE: West Farm Gravel Pits DRMS amendment AM-02 - Slurry Wall Assessment

Dear Mr. York:

The West Farm gravel pits are located in Lamar, Colorado in Sections 25-29 and 32-36, Township 22 South, Range 46 West of the 6th principal meridian. There are nine pits as shown on **Figure 1**. The pits are located within a mile of the Arkansas River upstream of the Clay Creek tributary. Part of the reclamation plan is to install slurry walls around each pit.

J&T Consulting, Inc. (JTC) requested that McGrane Water Engineers, LLC. (MWE) evaluate the hydrologic impacts of installing a slurry walls around the pits. Prowers Aggregate Operators, LLC is the permit "Owner." Anticipated impacts include a rise in the water table on the up gradient side of the slurry wall and a decline in the water table on the down-gradient side. Water levels within 10 feet of the surface could flood existing structures such as basements or cause cropland damage and phreatophyte growth. Depending on the amount, a decline in water levels on the down-gradient side could reduce the aquifer saturated thickness and decrease well yields of high capacity agricultural and municipal wells. Ongoing well pumping for mining operations could also affect vicinity well yields if the wells used are up-gradient and drawdown is accelerated by the presence of the slurry walls. Potential mitigation includes installing drains to equalize mounding and shadowing and future pumping further away from neighboring wells. Monitoring is important to evaluate future changes.

Mining and Reclamation Plan

The Phase 1 pit slurry wall was installed in 2014 and the area is now a reclaimed reservoir. Phase 2 mining is ongoing, and the perimeter slurry wall was constructed in 2016. The next phases are Phase 8 and Phase 3, and slurry wall construction is proposed to occur this summer. Phases 4-7 and Phase 9 are planned for the future. The reclamation time table will occur over the next decade as shown in **Table 1**.

Table 1 – Reclamation Time Table

Phase Sequence	Estimated Time Required to Mine Phases (Years)	Estimated Total Mining Time (Years)	Year
1	Mining Complete	0 years	2020
2	1 years	1 years	2021
8	0.75 years	1.75	2022
3	5 years	7 years	2027
4	9.5 years	16.5 years	2037
5	2.5 years	19 years	2039
6	4.5 years	23.5 years	2043
7	3.75 years	27.25 years	2047
9	2.75 years	30 years	2050

Modeling Result Summary

Using the US Geological Survey's MODFLOW program, MWE determined the steady state change in water levels after each phase. The maximum expected increase in water levels is approximately 3 feet, and the maximum decrease is approximately -2 feet. We modeled the phased development using "steady state" which assumes a new equilibrium has been achieved after a modeled stress (installation of a slurry wall). In reality, the changes modeled will not reach steady state until a year or two after a slurry wall installation.

Approximately half of the eight wells that have water level increases have a reported depth to water of less than 10 feet. This suggests that increases in water levels could intersect basements and shallow excavations if they exist. **Table 2** shows those wells that have more than 1 foot of expected change during any phase. **Table 11,** at the end of the report, tabulates modeled water level changes from each pit phase.

Table 2 – Wells with Greater than +/- 1 foot of Modeled Change

Permit Number	Contact Name	Use(s)	Pump Test Yield (gpm)	Static Water Level	Max. Modeled Change over +/- 1 ft (All Phases)	Permit Info
79628-F	GP RESOURCES LLC	Commercial, Industrial	1729	ND	2.5	https://dwr.state.co.us/Tools/WellPermits/3668741E
79629-F/4231-F	GP IRRIGATED FARMS LLC	Irrigation	1600	7	2	https://dwr.state.co.us/Tools/WellPermits/9092586
5061-F	LAMAR FARMS	Irrigation	1200	8	1.5	https://dwr.state.co.us/Tools/WellPermits/9092671
79631-F/5060-F	GP IRRIGATED FARMS LLC	Irrigation	1200	12	2.5	https://dwr.state.co.us/Tools/WellPermits/9092670
6433-R	LAMAR FARMS	Irrigation	1099	8.3	3	https://dwr.state.co.us/Tools/WellPermits/9092768
9302-F	LAMAR UTILITIES BOARD	Irrigation	1012	15	1.5	https://dwr.state.co.us/Tools/WellPermits/9092841
68784-	LAZY Y CROSS LND CO	Stock	30	8	3	https://dwr.state.co.us/Tools/WellPermits/9093720
21283-	BAKER, J R	Domestic	15	18	1	https://dwr.state.co.us/Tools/WellPermits/9093371
74258-	HOSS INMAN JAMES A	Domestic, Stock	15	24	1.5	https://dwr.state.co.us/Tools/WellPermits/9093731
19650-MH	SOUTHEASTERN COLORADO COOP	Monitoring/ Sampling	na	8.45	2	https://dwr.state.co.us/Tools/WellPermits/0019650
75864-F	GP AGGREGATES LLC	Gravel Pit	ND	ND	2.5	https://dwr.state.co.us/Tools/WellPermits/3652084
68785-	LAZY Y CROSS LND CO	Stock	30	6	-2	https://dwr.state.co.us/Tools/WellPermits/9093721
79630-F/4230-F	GP RESOURCES LLC	Commercial, Industrial	na	9	2.5	https://dwr.state.co.us/Tools/WellPermits/3668741A

Wells registered to GP Resources and GP Irrigated Farms are associated with the Owner. One low yielding stock well (permit 68785-F), located on the east side, is expected to experience -2 foot decline. Since well yield is proportional to the saturated thickness and this change is small, we do not expect a noticeable decline in well yield.

The modeled change in water levels is however, sensitive to vicinity pumping. This is because slurry walls act as boundaries to the spreading cones of depression which causes additional drawdown. We evaluated this "interference" effect by adding pumping from three existing agricultural wells to the model baseline and "change" runs. The three wells, pumping at a combined 1788 gallons per minute (gpm), are located approximately 2000 feet west of western pits, reduced the predicted 3 ft high mound to approximately 1 ft. The sensitivity run also demonstrated that the slurry wall interference could also increase down-gradient shadowing effects by a similar amount (approximately -2 feet). Due to the lack of high capacity down-gradient wells, we do not expect amplified shadowing caused by off-site pumping to be an issue.

Despite some uncertainties, we believe the model is the best tool to evaluate impacts caused by pit development for the following reasons:

- The model was constructed using most available data;
- We accounted for the most important inflow and outflow parameters using available data and reasonable assumptions;
- We used site specific test data to determine aquifer properties;
- Modeled water levels (**Figure 9**) appear reasonable compared to past (**Figure 6**) and recent measurements;
- The model mass balances show minimal error; and
- The model results are relatively insensitive to aquifer properties.

Monitoring and Mitigation

We conclude that upgradient slurry walls will most likely benefit upgradient wells by increasing water levels despite the potential for some additional drawdown caused by interference effects. Monitor wells located between the up-gradient Phase 3 and Phase 8 pits have already been installed. We recommend that a select few be monitored throughout the mine life to evaluate the net impacts. We also recommend that the mine owner minimize future pumping on the west side of Phase 3 and 8 pits to reduce the potential for additional interference.

Available Data

We compiled hydrogeologic data from:

- Existing reports from the US Geological Survey and Colorado Division of Water Resources;
- 141 completed registered wells less than 100 feet deep were identified in the Colorado Division of Water Resources (CDWR) Well database (**Appendix A**); and
- Various gravel pit studies that include geologic logs and water levels compiled by JTC;

Figure 2 is a Google Earth image that shows: aerial imagery, the planned pits, the CDWR wells color coded by use (domestic, commercial, industrial, irrigation, and monitoring) and the model boundary. Most of the wells in Lamar are domestic water wells. Numerous irrigation, industrial and stock wells are evenly distributed north and east of the town. **Figure 3** shows the 76 additional soil borings and monitor wells with water level and bedrock depth information.

Hydrogeology

Ground water is present in unconsolidated alluvial deposits on either side of the Arkansas River. Within the model area, the U.S. Geological Survey (Sharpe, 1976) maps Quaternary alluvium (Qa) along the floodplain and older "Broadway" (Qb) alluvium and loess (Qlo) on higher terraces. The alluvial aquifer within the pit area consists of mostly clean, high permeability sand and gravel. **Figure 4** shows the surficial geology and reported well yields from the CDWR well database. Well yields range from 10 to 75 gallons per minute (gpm) for domestic wells and up to 2000 gpm for commercial and irrigation wells. The largest yields are where the alluvium is thickest, closer to the Arkansas River. The Dakota outcrop located just south of the southeast corner of the Phase 6 pit and Hwy 50 supports borehole data that shows deepening gravel deposits to the north. The alluvium adjacent to the perennial streams is hydraulically connected to the streams in most places (Voegeli, 1965).

The non-floodplain deposits are more fine-grained and therefore have lower permeability that the alluvial sediments. Eolian windblown dune deposits (Qe) occur on top of the Dakota sandstone (Kd) bedrock on the south side of the model. The sand dunes act as excellent catchment areas for precipitation which recharges underlying water-bearing formations (Voegeli, 1965). Wells within eolian and bedrock formations typically produce much less than alluvial aquifer wells.

Appendix A contains compiled registered well data from the State's well database including permit number, owner, use, completed well depth, pump test yield, water level when drilled, pump test method and testing water level. Well depths range from 9 to 97 feet and average 43 feet. The depth to water when drilled ranges from 6 to 40 feet. Test data was used to calculate aquifer properties used in the model discussed below.

Water Level Contours

Water table elevations were determined by subtracting the depth to water from surveyed elevations (monitoring wells) or DEM elevations (CDWR wells). **Figure 6** shows the "Baseline Water Table Conditions" compared to the US Geological Survey's map of the water table in

1966 (Nelson et al., 1989). Groundwater flows perpendicular to the contours and generally toward the river. The gradient west to east is controlled by the river where water freely passes to and from the aquifer. Overall, the water table drops from an elevation of approximately 3615 feet on the west to elevation 3565 ft (50 ft) over approximately 6.5 miles. Steeper gradients (closer contours) exist from the north and south, through thinner, lower permeability sediment.

The 1966 water table map shows a modest cone of depression at the 3580 ft contour within the Town of Lamar which was likely caused by agricultural, industrial and municipal pumping. In 2021, pumping on the east side of Lamar has lowered the water table approximately 5 feet between the town and east end of the proposed pits.

Seasonal Water Level Changes

"The water table is not stationary, but varies in a manner somewhat similar to an open reservoir that fills and empties (Voegeli, 1965)." The pit applicants are currently conducting monthly monitoring of numerous monitoring wells around Phase 1, Phase2, Phase 3 and 8 pits. Seasonal monitoring show that the alluvial aquifer fluctuates 1 to 2 feet throughout the year. Numerous USGS hydrographs (Voegeli, 1965) confirm a similar amount of seasonal change caused by river and precipitation recharge, canal seepage and agricultural return flows. Because water level changes caused by seasonal variations are of the same magnitude as those caused by pit slurry walls, we recommend continued monthly monitoring to evaluate and discern the difference.

Hydraulic Conductivity and Transmissivity

The aquifer hydraulic conductivity (K) is the measure of aquifer permeability (ft/dy). The aquifer transmissivity (T) is product of the aquifer K multiplied by the saturated thickness. We estimated transmissivity using specific capacity data (yield divided by the drawdown) obtained from 25 high capacity (>400 gpm) wells that were pump tested as shown in **Appendix A.** Transmissivity can be estimated using the following equation:

Transmissivity (gpd/ft) = 1500 x Specific Capacity (gpm/ft)
Whereas: Specific Capacity (gpm/ft) = Yield (gpm)/ Drawdown (ft)

Source: (Driscoll, Fletcher, 1985)

Yield and calculated drawdown, specific capacity and transmissivity values are shown in **Appendix A**. Well test rates ranged from 500 to 2000 gpm. Drawdowns ranged from 8.7 to 35 feet, and specific capacities ranged from 21 to 200 gpm/ft. The resulting transmissivities range from 31,250 to 300,000 gpd/ft. By dividing the average transmissivity (117,270 gpd/ft) by the average saturated thickness (22 ft), we obtained an average K value of approximately 550 ft/day which is characteristic a clean sand and gravel aquifer (Todd, 1980). **Figure 7** shows the modeled transmissivity which was calculated using saturated thickness multiplied by the

hydraulic conductivity and contoured. The saturated thickness was determined by subtracting the aquifer bottom (**Figure 5**) from the modeled water table. The transmissivity map shows the highest values (approximately 200,000 gpd/ft) are in the deepest portions of the channel (**Figure 5**).

Since there were very few wells completed in the older alluvium (Qb), we assumed its hydraulic conductivity is approximately five times less than the floodplain aquifer (approximately 100 ft/day). According to Todd, 1980, eolian sand has a K of approximately 50 ft/day. We also modeled all bedrock as "no-flow" meaning it effectively has a K of zero. The aquifer properties of geologic units simulated in the model are shown in **Table 3**.

Table 3 – Modeled Hydraulic Conductivity (K) Values

Geologic Unit	Symbol	K (ft/day)
Floodplain Alluvium	Qa	550
Older "Broadway" Alluvium	Qb	100
Eolian sand*	Qe	50
Bedrock (Dakota Sandstone)	Kd	0
***Source:** Todd, 1980 (p. 71)		

Modeling

We used the USGS MODFLOW2000 (Harbaugh et al, 2000) modeling program to evaluate the existing and future groundwater conditions. The model area is approximately 3 miles high and 6 miles wide (west to east) centered on the pits.

Impacts caused by lining gravel pits were computed by applying the principal of superposition (Reilly, Thomas E. et al, 1987). The principal states that solution to individual problems can be added to obtain solutions to more complex problems. It also means that if precipitation and canal recharge, and evapotranspiration are not expected to change significantly, then their influence can be ignored in the evaluation.

Using superposition, we evaluated the effects of nine pits through a series of seven model runs. The runs are done in steady state, which reflect average conditions. The baseline steady state run is meant to reasonably simulate pre-pit conditions. We then ran the model successively turning off the pit group cells to simulate the effect of slurry walls. We then subtract the heads from baseline run from the "pit" run to determine the expected "change."

To simplify this report, we included additional modeling details in **Appendix B** including:

- Model software and construction;
- Boundary condition details and calculations for:

  - The aquifer bottom;
  - Alluvial aquifer inflows and outflows using constant head cells;
  - River cell inflows and outflows;
  - Drain cells; and
- A discussion of model residuals and comparison statistics.

Figure 8 shows modeled boundary conditions around the model area. Some "dry cells" were also encountered in the southeast corner and along the southern boundary where general head boundaries were used to simulate inflow from the eolian sands (Qe). Dry cells are caused when the simulated water table gets too close or below the bedrock surface. Excessive dry cells can affect the model mass balance. To prevent this, we extended the "no-flow" boundary (dark hatched cells) up to 1000 feet north of the Qe/Qa contact (Sharp, 1976). We do not believe this action reduces model accuracy.

Baseline Water Table Comparison

Figure 9 compares the modeled water table contours with the contoured baseline water level conditions shown in **Figure 6.** The model results are also shown with color coded flood effects. By comparing the contours, the model results do not show the strong concave east shape. This is expected because there is no pumping occurring in the model which pull back the contours toward the west. We tried including pumping in the baseline model to better match the contoured data, but the slurry walls caused "interference effects" that significantly reduced up-gradient mounding. As a result, we abandoned pumping in the model runs so we could focus on modeling just mounding and shadowing effects caused by the pits themselves. A pumping sensitivity discussion is included later in this report.

Model Predictive Results

The predicted change in water levels due to successive slurry wall installation was created by subtracting the model heads with slurry walls from the baseline run (**Figure 6**). The results show mounding (blue positive contours) on the up-gradient sides of the pits and shadowing (negative red contours) on the down-gradient sides.

Model Mass Balance

Mass balances for each run lend insight into how changes in water levels affect the hydrologic system. Net inflow into the model and MODFLOW boundary conditions used (in parentheses) include:

- Alluvial aquifer subflow (constant head cells);
- South end subflow from eolian sand (general head boundary); and
- North side subflow from within the alluvial aquifer (constant head cells).

Net outflow to the model includes:

- River gains (river cells); and
- Flow into the unnamed drain located south of the pits and north of Hwy 50 (drain cells).

The Arkansas River and Clay Creek tributaries provide both aquifer inflow and outflow, but the net outflow is to the Arkansas River. Details of how the model boundaries are conceptualized and calculated are included in **Appendix B**.

For the baseline run, the alluvial inflow on the west and north sides (13.46 cubic feet per second) exceeds the outflow of -4.61 cfs out the east end of the model. The difference is made up by river gains (-7.60 cfs) and drain outflow (-3.10 cfs). Alluvial aquifer gains from the south side through eolian deposits is approximately 1.96 cfs which is consistent with operator observations (J&T Consulting, Inc.,March, 2021). **Table 4** summarizes the mass balance and calculated model error (difference between inflows and outflows). The model error in all model runs is less than 0.1 percent which is excellent.

Table 4: Mass Balance – Baseline Conditions (no pit slurry walls) in cfs

Boundary	Inflows	Outflows	Net inflow/outflow
Alluvial aquifer subflow	13.46	-4.61	8.85
S. side subflow	1.96	0.00	1.96
River gains/losses	7.60	-15.29	-7.69
Drain	0.00	-3.10	-3.10
Total:	23.02	-23.00	0.02
		Cumulative Error =	0.09%

Pit Phases 1 and 2 Changes

Figure 10 shows the modeled water level changes after slurry walls are installed around the Phase 1 and 2 pits. The results are that a 1.5 ft mound on the west side and -1.5 ft shadow on the east side of the developed pits.

Table 5 summarizes the mass balance components and net difference between this run and the baseline values shown in **Table 4**. The Phase 1 and 2 slurry wall mounding deflects groundwater to the north, thereby increasing river outflows over half a cfs (-0.54 cfs) compared to the base run. As a result, there is less groundwater moving to the south side of the pits which causes a decrease in drain outflows of an equal amount (0.54 cfs). The changes to alluvial inflows and outflows are insignificant because the model boundaries are far enough away that there is very little effect.

Table 5: Mass Balance – With Phase 1 and 2 Pit Slurry Walls (cfs)

Boundary	Inflows	Outflows	Net inflow/outflow	Change from Base Run
Alluvial aquifer subflow	13.45	-4.61	8.84	-0.01
S. side subflow	1.96	0.00	1.96	0.00
River gains/losses	7.41	-15.64	-8.23	-0.54
Drain	0.00	-2.56	-2.56	0.54
Total:	22.82	-22.81	0.01	-0.01
		Cumulative Error =	0.04%	

Pit Phases 1, 2, 8 and 3 Changes

Figure 11 shows the modeled water level changes after slurry walls are installed around the Phase 1, 2, 8 and 3 pits. The results are that a 3 ft mound and a -1 ft shadow on the west and east sides of the Phase 3 and 8 pits, and a 1 ft mound and -2 ft shadow on the west and east sides of Phases 1 and 2.

The Phases 1, 2, 8 and 3 pit slurry wall mounding on the west side cause a net increase in river outflows of -0.52 cfs to the Arkansas River compared to the base run. As a result, there is less groundwater moving to the south side of the pits which causes a decrease in outflows to the drain of 0.67 cfs. Other minor changes in the mass balance components are insignificant. **Table 6** summarizes the mass balance components and net difference between this run and the baseline values shown in **Table 4**.

Table 6: Mass Balance – With Phase 1, 2, 8 and 3 Pit Slurry Walls (cfs)

Boundary	Inflows	Outflows	Net inflow/outflow	Change from Base Run
Alluvial aquifer subflow	13.37	-4.66	8.71	-0.14
S. side subflow	1.94	0.00	1.94	-0.02
River gains/losses	7.47	-15.68	-8.21	-0.52
Drain	0.00	-2.43	-2.43	0.67
Total:	22.78	-22.77	0.01	
		Cumulative Error =	0.04%	

Pit Phases 1, 2, 8, 3 and 4 Changes

Figure 12 shows the modeled water level changes after slurry walls are installed around the Phase 1, 2, 8, 3 and 4 pits. The results are that a 3 ft mound and a -1 ft shadow on the west and east sides of Phase 3 and 8; and a 1 ft mound and -1.5 ft shadow on the west and east sides of Phases 1, 2 and 4. There is also a 0.5 ft mound and a -1 ft shadow on the north and south sides of Phase 1, 2 and 4.

The Phases 1, 2, 8, 3 and 4 pit slurry wall mounding on the west side cause a net increase in river outflows of -0.92 cfs to the Arkansas River compared to the base run. As a result, there is less groundwater moving to the south side of the pits which causes a decrease in outflows to the drain of 1.08 cfs. Other minor changes in the mass balance components are insignificant. **Table 7** summarizes the mass balance components and net difference between this run and the baseline values shown in **Table 4**.

Table 7: Mass Balance – With Phase 1, 2, 8, 3 and 4 Pit Slurry Walls (cfs)

Boundary	Inflows	Outflows	Net inflow/outflow	Change from Base Run
Alluvial aquifer subflow	13.36	-4.66	8.70	-0.15
S. side subflow	1.94	0.00	1.94	-0.02
River gains/losses	7.05	-15.66	-8.61	-0.92
Drain	0.00	-2.02	-2.02	1.08
Total:	22.35	-22.34	0.01	
	Cumulative Error =		0.04%	

Pit Phases 1, 2, 8, 3, 4 and 5 Changes

Figure 13 shows the modeled water level changes after slurry walls are installed around the Phase 1, 2, 8, 3, 4 and 5 pits. The results are that a 3 ft mound and a -1 ft shadow on the west and east sides of Phase 3 and 8; and a 1 ft mound and -3.5 ft shadow on the west and east sides of Phases 1, 2, 4 and 5. There is also a 0.5 ft mound and a -1 ft shadow on the north and south sides of Phases 1, 2 and 4.

The Phases 1, 2, 8, 3, 4 and 5 pit slurry wall mounding on the west side cause a net increase in river outflows of -0.65 cfs to the Arkansas River compared to the base run. As a result, there is less groundwater moving to the south side of the pits which causes a decrease in outflows to the drain of 0.80 cfs. Other minor changes in the mass balance components are insignificant. **Table 8** summarizes the mass balance components and net difference between this run and the baseline values shown in **Table 4**.

Table 8: Mass Balance – With Phase 1, 2, 8, 3, 4 and 5 Pit Slurry Walls (cfs)

Boundary	Inflows	Outflows	Net inflow/outflow	Change from Base Run
Alluvial aquifer subflow	13.36	-4.66	8.70	-0.15
S. side subflow	1.94	0.00	1.94	-0.02
River gains/losses	7.15	-15.49	-8.34	-0.65
Drain	0.00	-2.30	-2.30	0.80
Total:	22.45	-22.45	0.00	
	Cumulative Error =		0.00%	

Pit Phases 1, 2, 8, 3, 4, 5 and 6 Changes

Figure 14 shows the modeled water level changes after slurry walls are installed around the Phases 1, 2, 8, 3, 4, 5 and 6 pits. The results are that a 3 ft mound and a -1 ft shadow on the west and east sides of Phase 3 and 8; a 1 foot mound on the west side of Phase 1 and 2; a 0.5 ft mound and a -1 foot shadow on the north and south sides of Phases 1, 2 and 4; and a -2.5 ft shadow on the east side of Phases 5 and 6.

The Phases 1, 2, 8, 3, 4, 5 and 6 pit slurry wall mounding on the west side cause a net increase in river outflows of -0.36 cfs to the Arkansas River compared to the base run. As a result, there is less groundwater moving to the south side of the pits which causes a decrease in outflows to the drain of 0.51 cfs. Other minor changes in the mass balance components are insignificant. **Table 9** summarizes the mass balance components and net difference between this run and the baseline values shown in **Table 4**.

Table 9: Mass Balance – With Phase 1, 2, 8, 3, 4, 5 and 6 Pit Slurry Walls (cfs)

Boundary	Inflows	Outflows	Net inflow/outflow	Change from Base Run
Alluvial aquifer subflow	13.36	-4.65	8.71	-0.14
S. side subflow	1.94	0.00	1.94	-0.02
River gains/losses	7.21	-15.26	-8.05	-0.36
Drain	0.00	-2.59	-2.59	0.51
Total:	22.51	-22.50	0.01	
		Cumulative Error =	0.04%	

Pit Phases 1, 2, 8, 3, 4, 5, 6, 7 and 9 Changes

Figure 15 shows the modeled water level changes after slurry walls are installed around the Phases 1, 2, 8, 3, 4, 5, 6, 7 and 9 pits. The results are that a 3 ft mound on the west side of Phase 3 and 8; a 2 ft mound on the west side of Phases 1 and 2; a -2.5 ft shadow on the east side of Phases 5 and 6; a -0.5 ft shadow on the south side of Phase 9; and a 1 to 3 foot rise within the 200 ft wide gap between Phases 1,2 and 4 and Phases 7 and 9.

The Phases 1, 2, 8, 3, 4, 5, 6, 7 and 9 pit slurry wall mounding on the west side cause a net increase in river outflows of -0.79 cfs to the Arkansas River compared to the base run. As a result, there is less groundwater moving to the south side of the pits which causes a decrease in outflows to the drain of 0.97 cfs. Other minor changes in the mass balance components are insignificant. **Table 10** summarizes the mass balance components and net difference between this run and the baseline values shown in **Table 4**.

Table 10: Mass Balance – With Phase 1, 2, 8, 3, 4, 5, 6, 7 and 9 Pit Slurry Walls (cfs)

Boundary	Inflows	Outflows	Net inflow/outflow	Change from Base Run
Alluvial aquifer subflow	13.34	-4.65	8.69	-0.16
S. side subflow	1.93	0.00	1.93	-0.03
River gains/losses	7.14	-15.62	-8.48	-0.79
Drain	0.00	-2.13	-2.13	0.97
Total:	22.41	-22.40	0.01	
		Cumulative Error =	0.04%	

Net Change Summary

We summarized the modeled changes in water levels to registered wells in **Table 11** at the end of the report.

Model Sensitivity

The mounding results are insensitive to the hydraulic conductivity (K) of the aquifer. An increase in K causes a proportional increase in model inflows, but also increases the hydraulic connection with the creek which offsets any additional mounding or shadow effects. Therefore, there is no expected difference in the change contours.

Model results are insensitive to storage properties of the aquifer. Aquifer storage properties are not used in steady state runs. If transient model runs were used, then the time it took to achieve steady state conditions would be affected. To accommodate this variability, we believe steady state will be established approximately 1 to 3 years after the pit walls are constructed.

The model results are very sensitive to the presence of streams, but there is no realistic chance that either river will cease flowing due to strict river administration by the State. We used a conservatively low Arkansas River width of only 50 feet based on the average minimum monthly flows (see **Appendix B** for more details).

Model results are insensitive to streambed leakance. Even using a conservatively low Ksb value of 5.5 ft/day, the river covers a large enough surface area to quickly respond to changes in the groundwater system caused by pit development.

The model is sensitive to pumping. This is because slurry walls act as boundaries to the spreading cone of depression causing additional drawdown in the vicinity of the slurry walls. The effect of this was quantified by adding pumping of three existing agricultural wells located west of the Phase 3 and 8 pits to the baseline model. We pumped the wells at half of their tested rates (assuming a 6 month irrigation season) as shown in **Table 12** totaling 1787.5 gpm (approximately 4 cfs).

Table 12: Off-Site Pumping Sensitivity Run

CDWR Well Permit	Pumping Rate (gpm)
6434-R-R	1000.00
26655-F	450.00
20329-R	337.50
Total:	**1787.50**

Figure 16 shows the results of the pumping sensitivity run with all 9 slurry walls installed. Mounding was reduced on the west side of the Phase 3 and 8 pits from approximately 3 ft (**Figure 15**) to approximately 1 ft. This is because the additional drawdown caused by the slurry wall boundaries allowed more drawdown from future pumping to occur due to the interference caused by the slurry walls. In other areas of the model (east of Phase 6 and south of Phase 9) additional shadowing is predicted. We conclude that continued pumping of existing high capacity wells within approximately 0.5 miles of the pit could reduce up gradient mounding by approximately 2 feet, but also increase downgradient shadowing.

We did not evaluate how continued pumping of wells belonging to the applicant could affect future groundwater levels. We assume wells will be pumped much less due lower demands of gravel washing operations compared to current irrigation. We recommend that the pit owner minimize pumping on the west sides of Phase 3 and 8 to avoid causing additional drawdown at neighboring wells caused by the slurry walls. We also recommend continued monitoring of select Phase 3 and 8 monitoring throughout pit development.

Model Uncertainty

There is uncertainty in our predictions related to measurement and modeling error. Modeled predictions include three types of error: 1) conceptual error (how the model is set up and what boundary conditions are used); 2) parametric error (how aquifer properties are measured and calculated); and 3) predictive error (which includes other influences such as seasonal recharge or climate change variations). It was beyond the scope of this project to quantitatively evaluate the sum of these errors. We do believe however that the model is an accurate tool to evaluate impacts caused by pit development.

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Professional Credentials

The technical material in this report was prepared by or under the supervision and direction of Dennis McGrane P.E, C.P.G., whose seal as a Professional Engineer in the State of Colorado and American Institute of Professional Geologists (AIPG) Certified Profession Geologist (CPG) are affixed below:



Dennis McGrane, P.E., C.P.G.

FIGURES

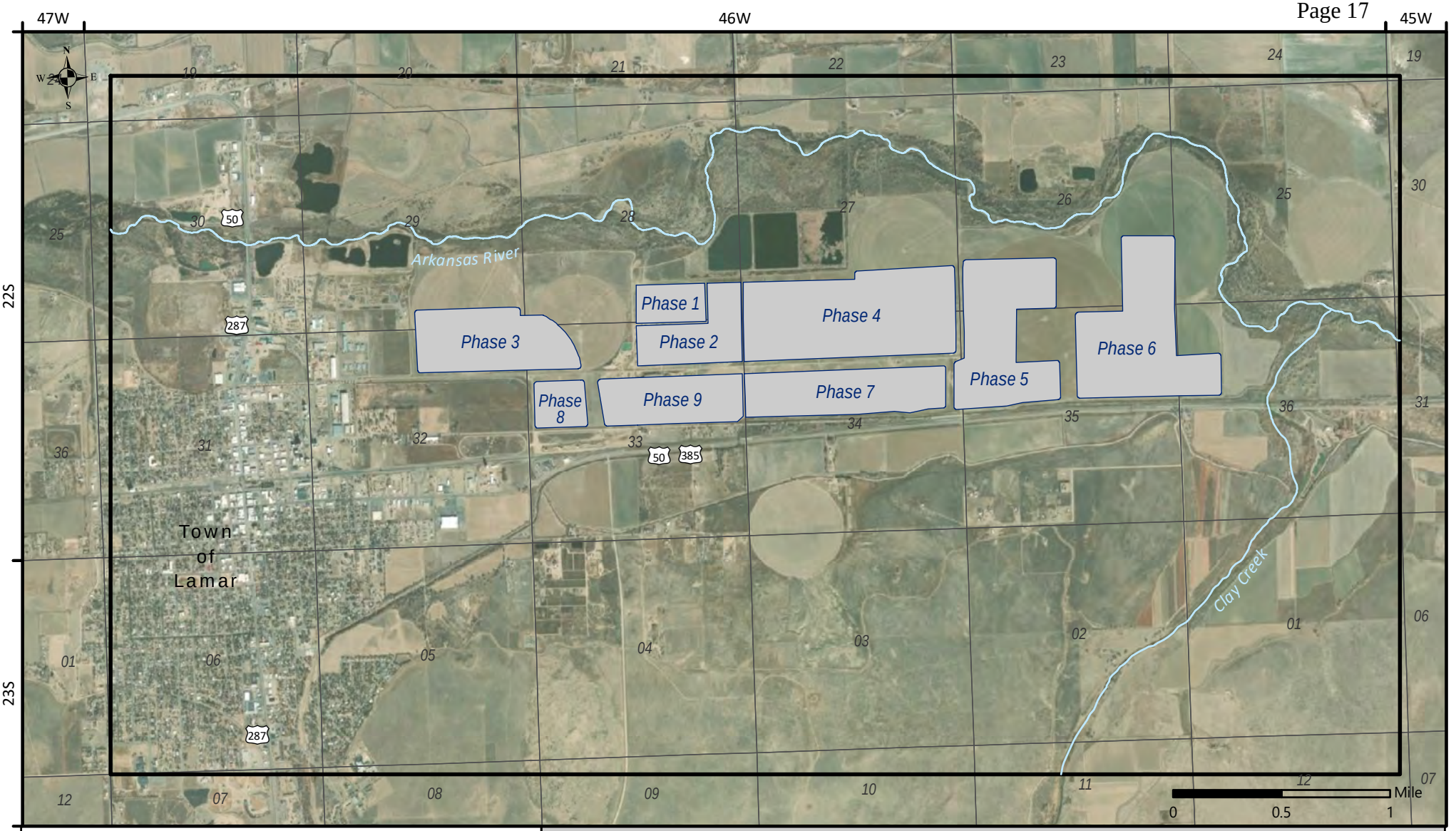


Figure 1
Model Area with Pits

West Farm Pit
Prowers County, Colorado

Map Legend

- Model Extent
- Mining Limits (labeled with phase)

Sources:
J&T Consulting MW/Pit Location GIS Shapefiles, NHD (photorevised), ESRI World Imagery (2020)

Date: March 22, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

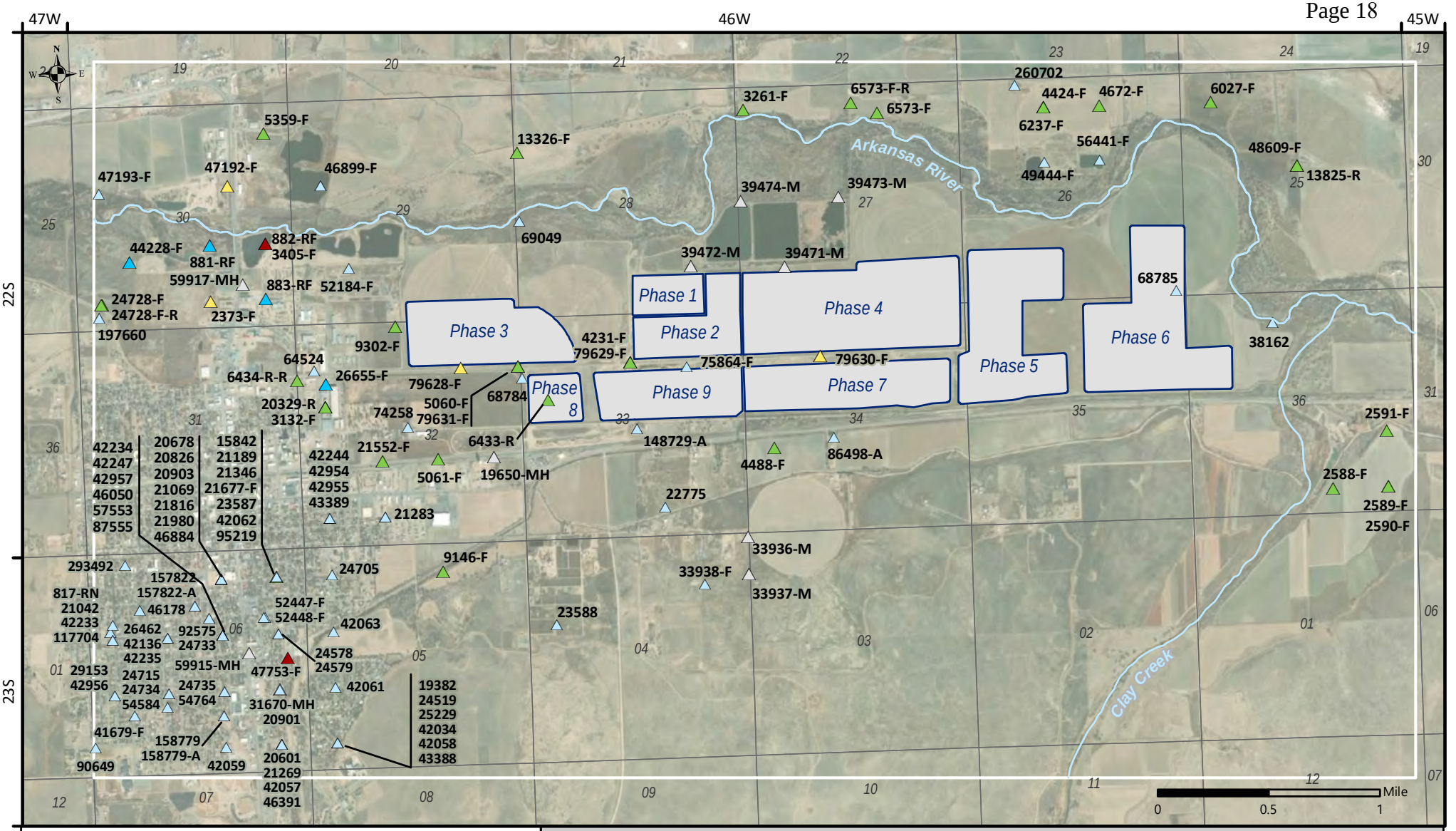


Figure 2
Model Area with Well Permits

West Farm Pit
Prowers County, Colorado

Map Legend

- 2020 Mining Limits (labeled with phase)
- Model Extent

CO-DWR Well (by type)
[labeled with permit number]

- Municipal
- Commercial
- Industrial
- Irrigation
- Domestic/Stock/Other
- Monitoring/Sampling

Sources:
CDSS Well Permit Database, J&T Consulting MW/Pit Location GIS Shapefiles, NHD (photorevised), ESRI World Imagery (2020)

Date: March 22, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

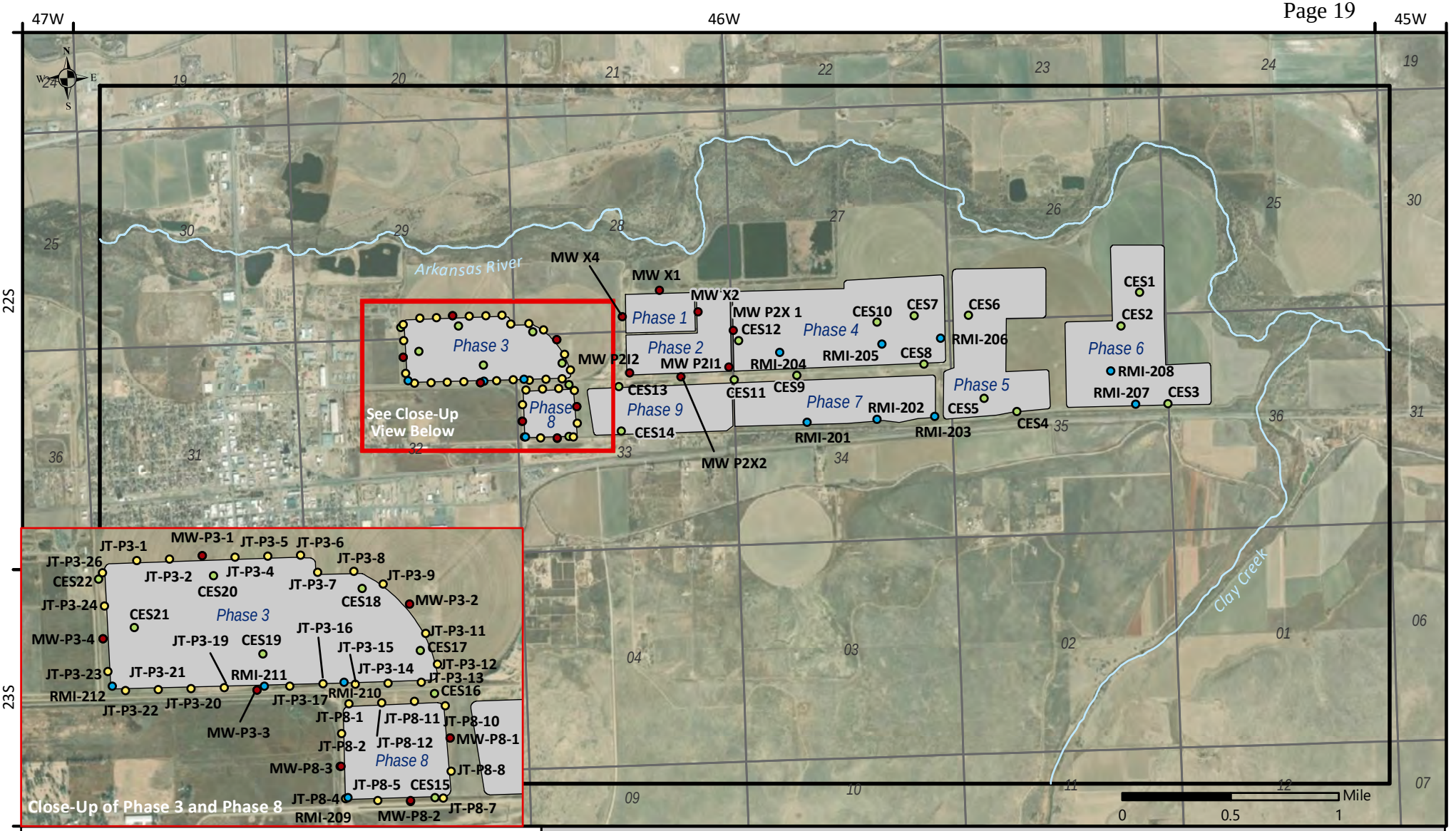


Figure 3
Model Area with Monitoring Wells and Borings

West Farm Pit
Prowers County, Colorado

Map Legend

- Model Extent
- Mining Limits (labeled with phase)
- Monitoring Well (J&T Phase 3 and 8, 2020)
- Boring, Cesare (9-30-2020)
- Boring Logs (Cesare (Dec., 2020)
- Boring-RMI

Sources:
CDSS Well Permit Database, J&T Consulting MW/Pit Location GIS Shapefiles, NHD (photorevised), ESRI World Imagery (2020)

Date: March 22, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

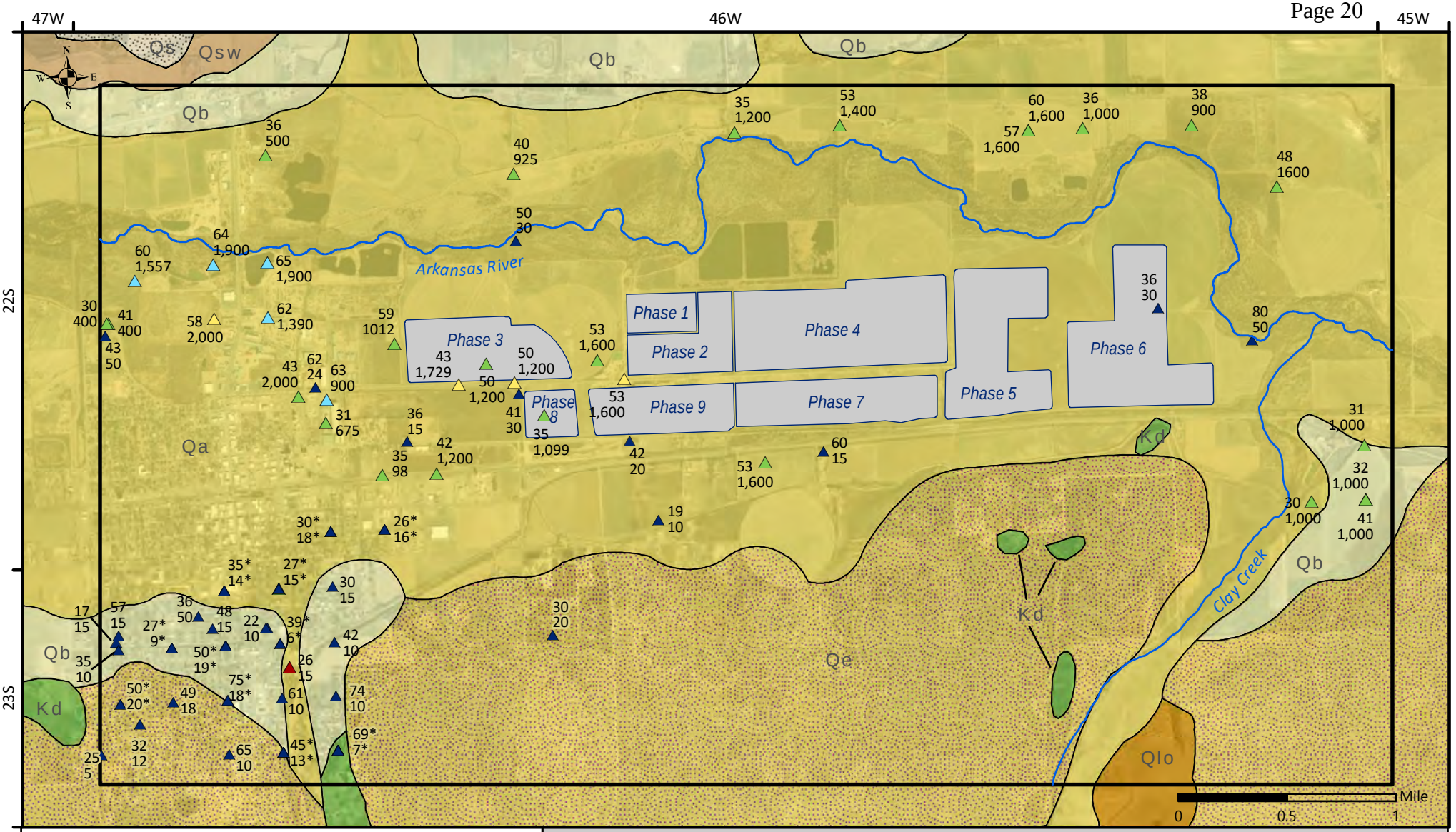


Figure 4
Model Area Geology, Well Depth, and Well Yield

West Farm Pit
Prowers County, Colorado

Map Legend

- Model Extent
- Mining Limits (labeled with phase)

^Modified from 'Geologic Map of the Lamar Quadrangle, Colorado and Kansas' (Sharps, 1976)

CO-DWR Well (labeled with well depth and yield [gpm])

- Municipal
- Commercial
- Industrial
- Irrigation
- Domestic/Stock/Other

*Labels with * = well depth and well yield are an average of all wells at that location.*

Geology of Model Area^

- Qa - Alluvium
- Qsw - Slopewash
- Qe - Eolian Sand
- Qlo - Loess
- Qb - Broadway Alluvium
- Qs - Slocum Alluvium
- Kd - Dakota Sandstone

Sources:
CDSS Well Permit Database; J&T Consulting MW/Pit Location GIS Shapefiles; NHD (photorevised); Geologic Map of the Lamar Quadrangle, Colorado and Kansas (Sharps, 1976); ESRI World Imagery (2020)

Date: March 22, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

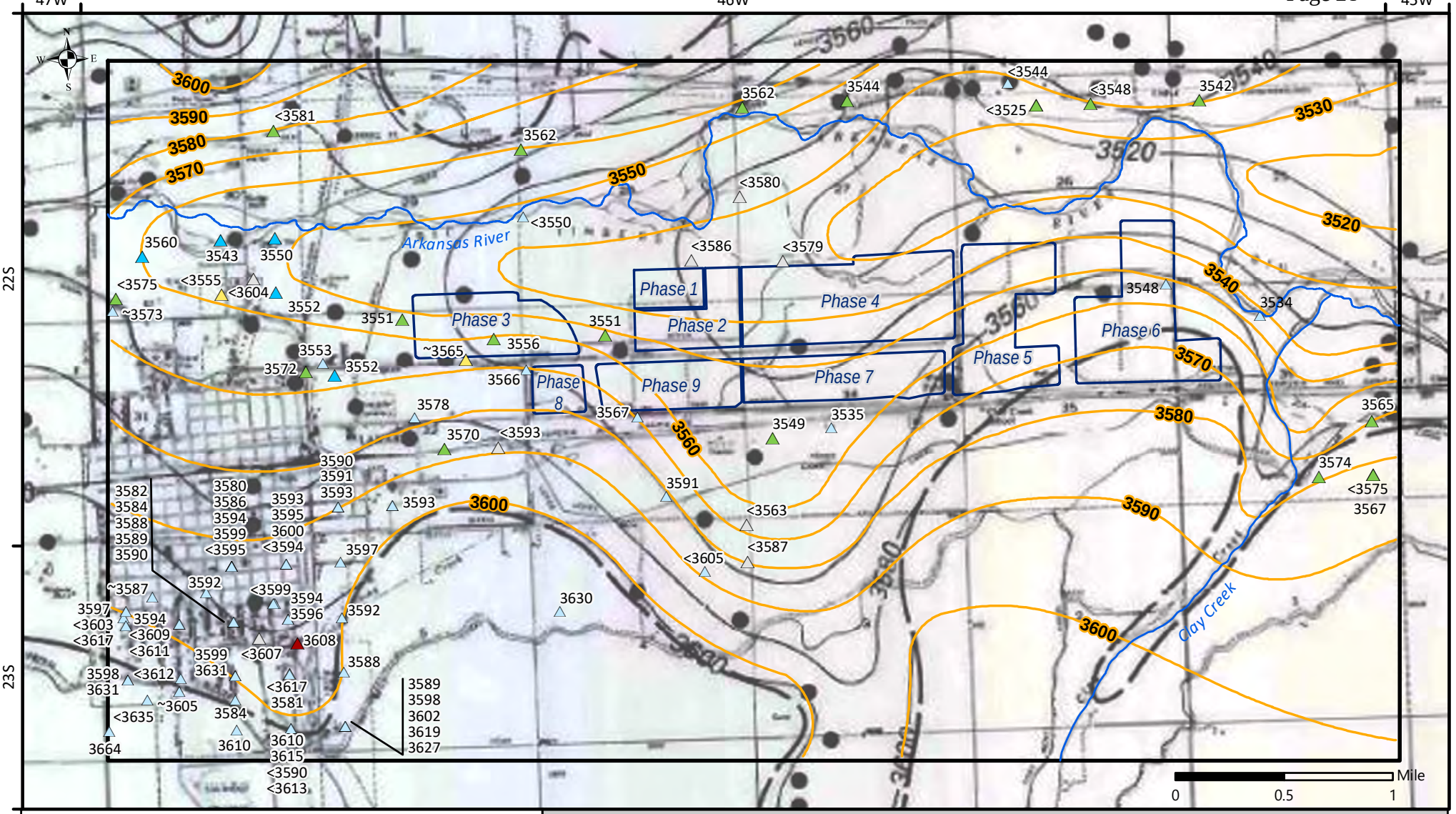


Figure 5
Bedrock Elevation

West Farm Pit
Prowers County, Colorado

Map Legend

- Model Extent
- Mining Limits (labeled with phase)
- Bedrock Elevation Contour (contour interval = 10 ft) *Modified from Nelson et al., 1989

CO-DWR Well (labeled with bedrock elevation)

- Municipal
- Commercial
- Industrial
- Irrigation
- Domestic/Stock/Other
- Monitoring/Sampling

Sources:
CDSS Well Permit Database; J&T Consulting MW/Pit Location GIS Shapefiles; NHD (photorevised); Nelson et al., 1989

Date: March 22, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

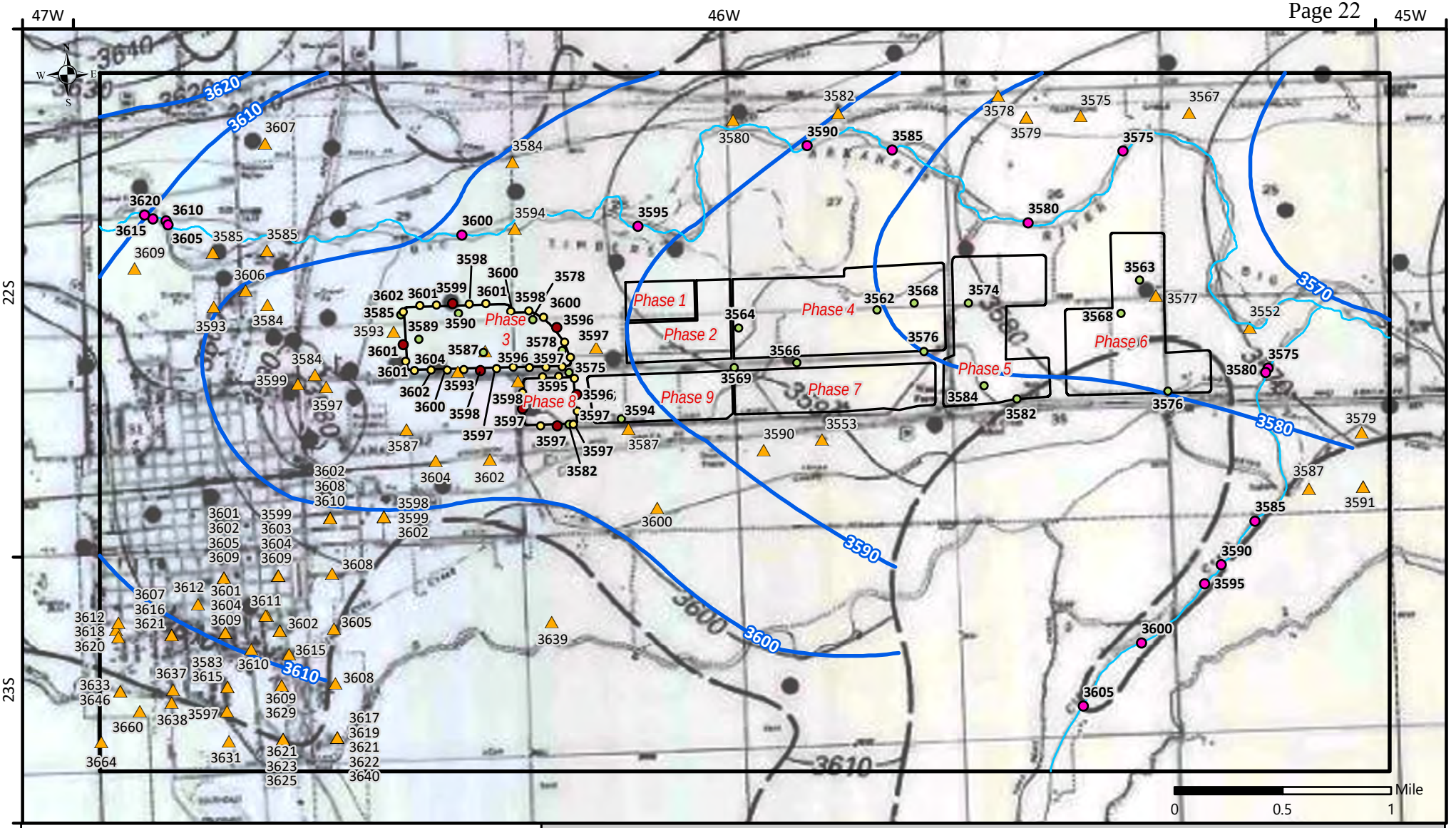


Figure 6
1966 Water Table and Baseline Model Conditions

West Farm Pit
Prowers County, Colorado

Map Legend

- Model Extent
- Mining Limits (labeled with phase)
- Monitoring Well (J&T Phase 3 and 8, 2020)
- Boring, Cesare (9-30-2020)
- Boring Logs (Cesare (Dec., 2020)
- Boring-RMI
- CO-DWR Well
- Water Table Elevation Contour* (contour interval = 10 ft) *Modified from Nelson et al., 1989
- River Elevation* (elevation assigned from USGS 10m DEM)

Sources:
CDSS Well Permit Database; J&T Consulting MW/Pit Location GIS Shapefiles; USGS 10m DEM; NHD (photorevised); Nelson et al., 1989

Date: March 22, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

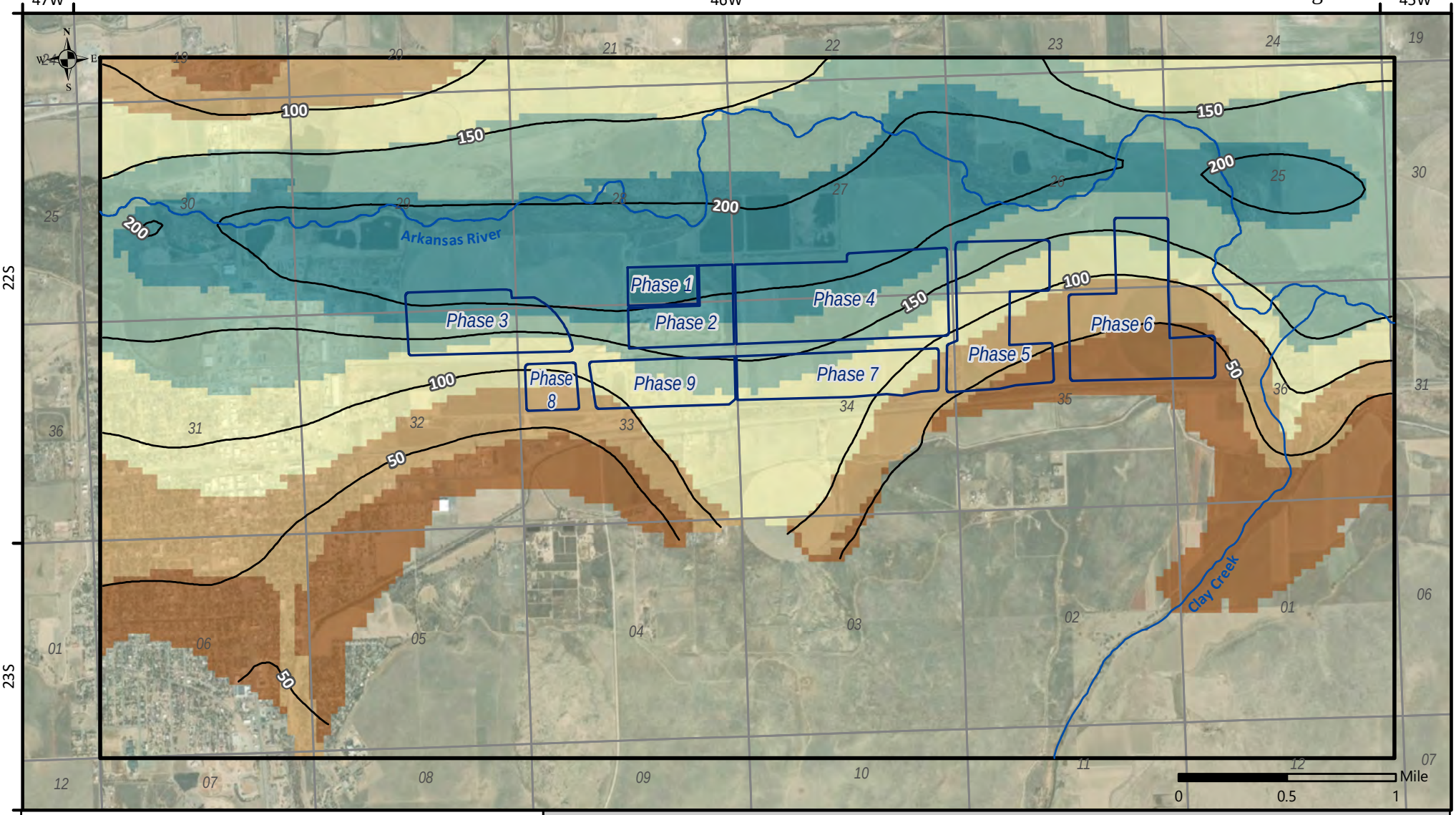


Figure 7
Aquifer Transmissitivy

West Farm Pit
Prowers County, Colorado

Map Legend

- Model Extent
- Mining Limits (labeled with phase)

Modeled Transmissivity (1,000s gpd/ft)

- < 50
- 50 - 100
- 100 - 150
- 150 - 200
- 200 - 248

Transmissivity Contour
Calculated from Revised Nelson (1989) Water Table and Bedrock Contours and a hydraulic conductivity of 550 ft/day (contour interval in 1,000s gpd/ft= 50)

Sources:
CDSS Well Permit Database; J&T Consulting MW/Pit Location GIS Shapefiles; USGS 10m DEM; NHD (photorevised); Nelson et al., 1989

Date: March 22, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

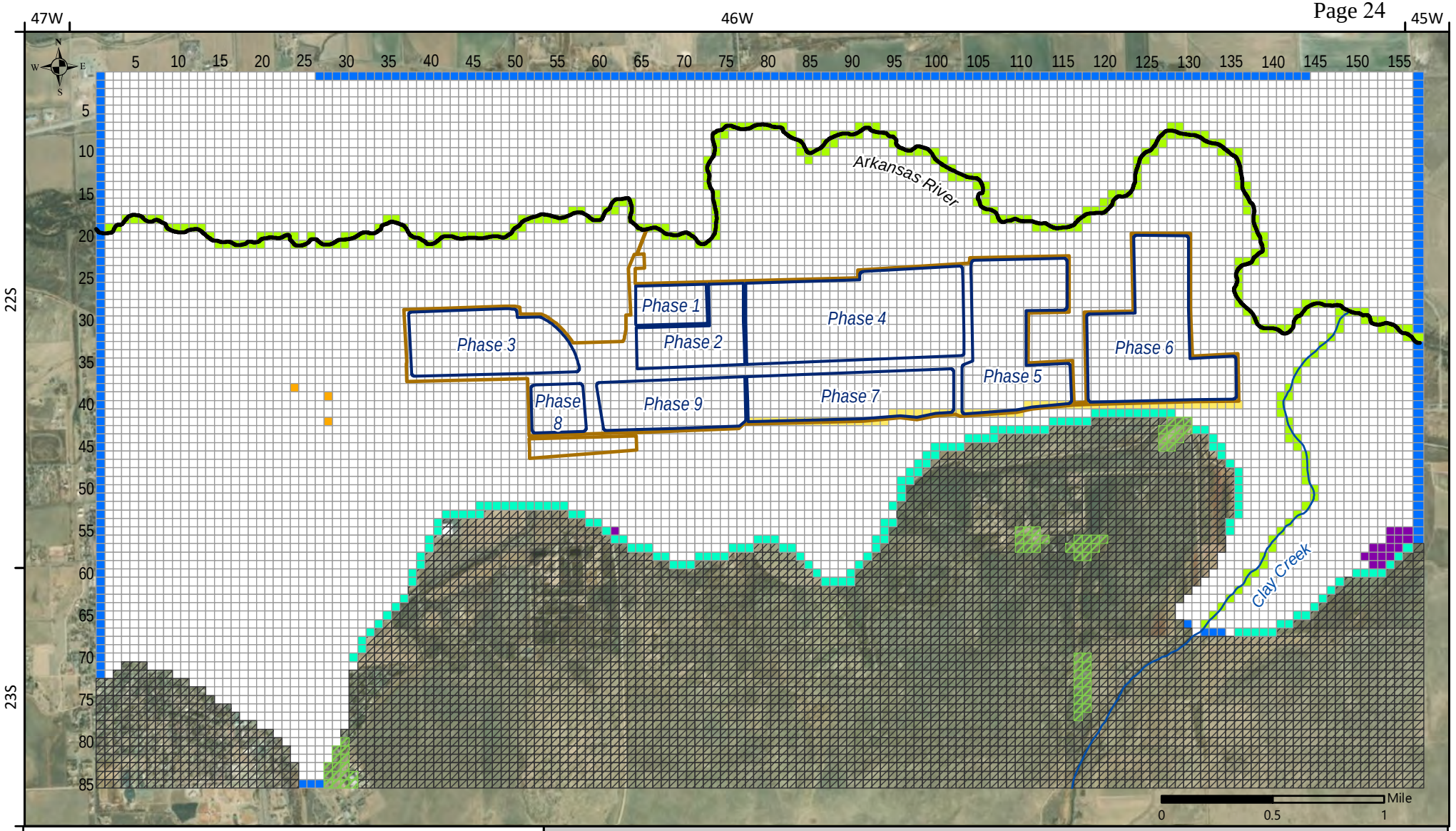


Figure 8
Model Boundary Conditions

West Farm Pit
Prowers County, Colorado

Map Legend

- 2020 Mining Limits (labeled with phase)
- 2020 Permit Boundary

Model Cell Type (row and column are labeled)

- Alluvial Aquifer
- Constant Head Cell
- Dakota Sandstone
- Drain Cell
- Dry Cell
- General Head Cell
- No-Flow Boundary
- Off Site Modeled Well
- River Cell

Sources:
CDSS Well Permit Database 06.07.2020, J&T Consulting MW/Pit Location GIS Shapefiles, March 2021 McGrane Model Outputs, Nelson et al. (1989), NHD (photorevised), ESRI World Imagery

Date: March 22, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

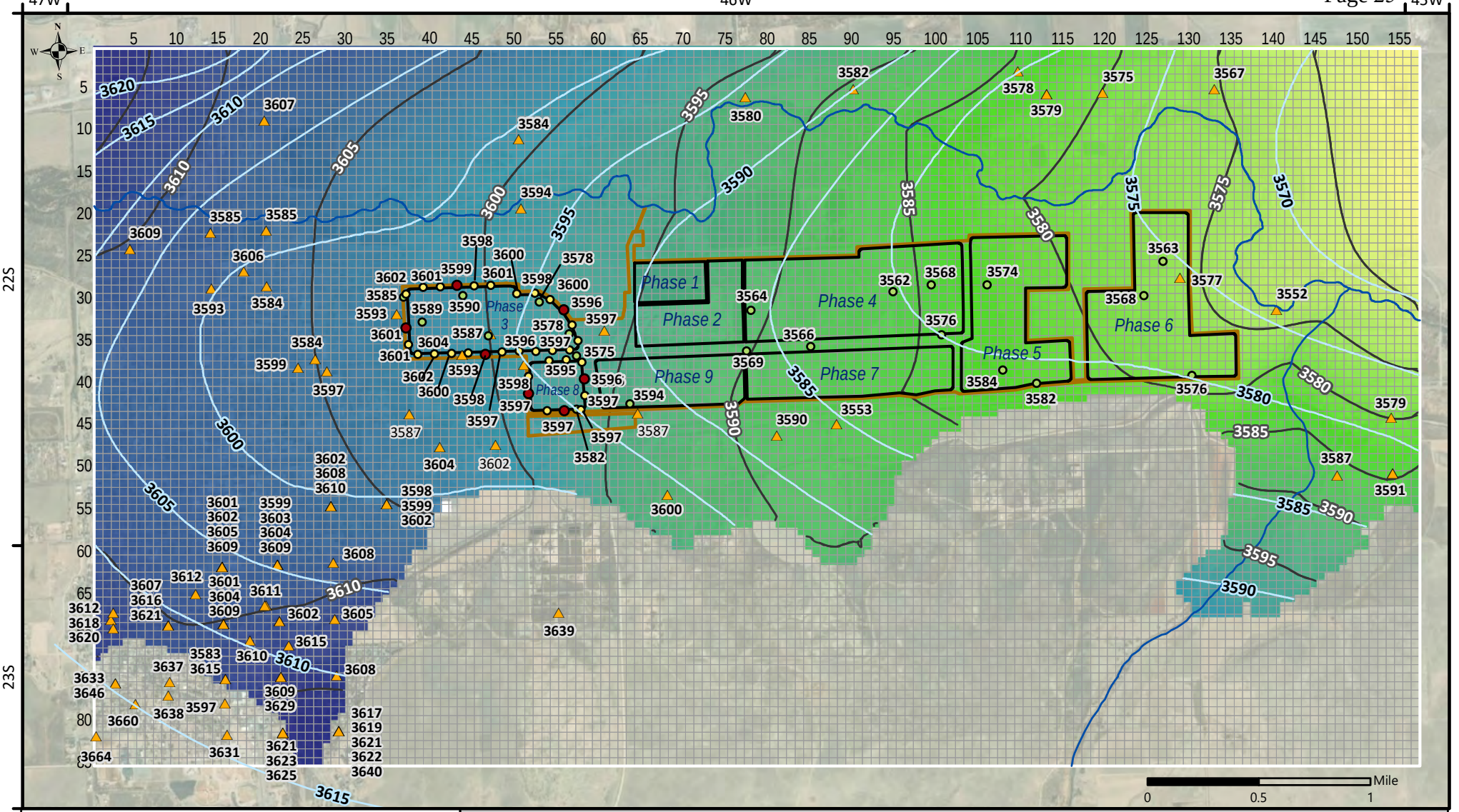


Figure 9
Modeled Water Table Comparison

West Farm Pit
Prowers County, Colorado

Map Legend

- 2020 Mining Limits
- 2020 Permit Boundary
- Model Cell
- Model Extent
- Water Table Elevation Contour - Revised from Nelson et al., 1989 (interval = 5 ft)
- Water Table Elevation Contour - Modeled (interval = 5 ft)
- Modeled Water Table Elevation (ft asl): 3,620' to 3,565'
- Monitoring Well (J&T Phase 3 and 8, 2020)
- Boring, Cesare (9-30-2020)
- Boring Logs (Cesare (Dec., 2020)
- Boring-RMI
- CO-DWR Well

Sources:
CDSS Well Permit Database 06.07.2020, J&T Consulting MW/Pit Location GIS Shapefiles, March 2021 McGrane Model Outputs, Nelson et al. (1989), NHD (photorevised), ESRI World Imagery

Date: March 19, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

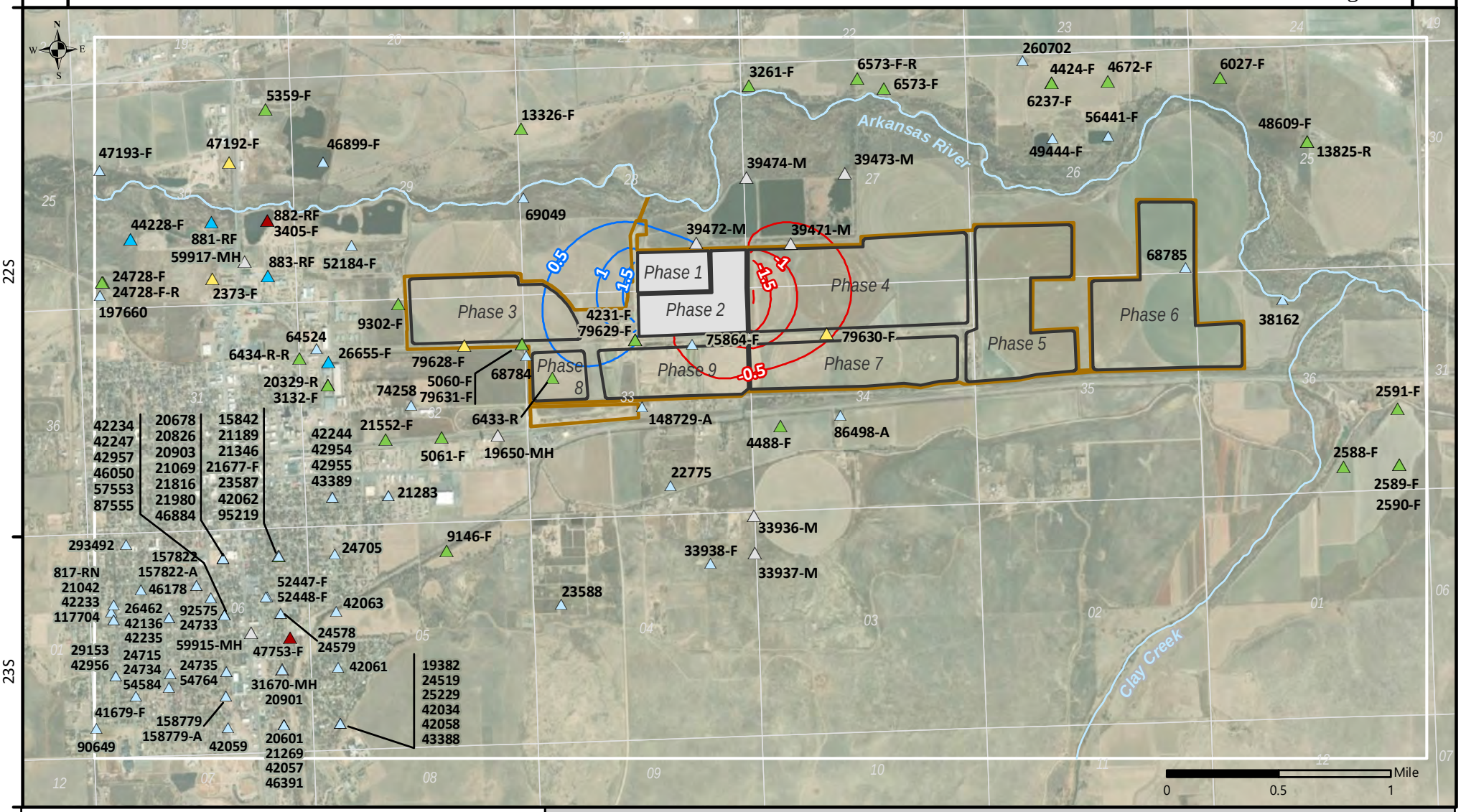


Figure 10
Modeled Changes in Groundwater Conditions - Phase 1 and 2 Pit Slurry Walls

West Farm Pit
Prowers County, Colorado

Map Legend

- 2020 Mining Limits
- Lined Pit
- 2020 Permit Boundary
- Model Extent

Change in Water Level Contour*
- Drawdown
- Mounding

*Contour interval = 0.5 ft

CO-DWR Well (by type)
[labeled with permit number]
- Municipal
- Irrigation
- Commercial
- Domestic/Stock/Other
- Industrial
- Monitoring/Sampling

Sources:
CDSS Well Permit Database 06.07.2020, J&T Consulting MW/Pit Location GIS Shapefiles, March 2021 McGrane Model Outputs, Nelson et al. (1989), NHD (photorevised), ESRI World Imagery

Date: March 22, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

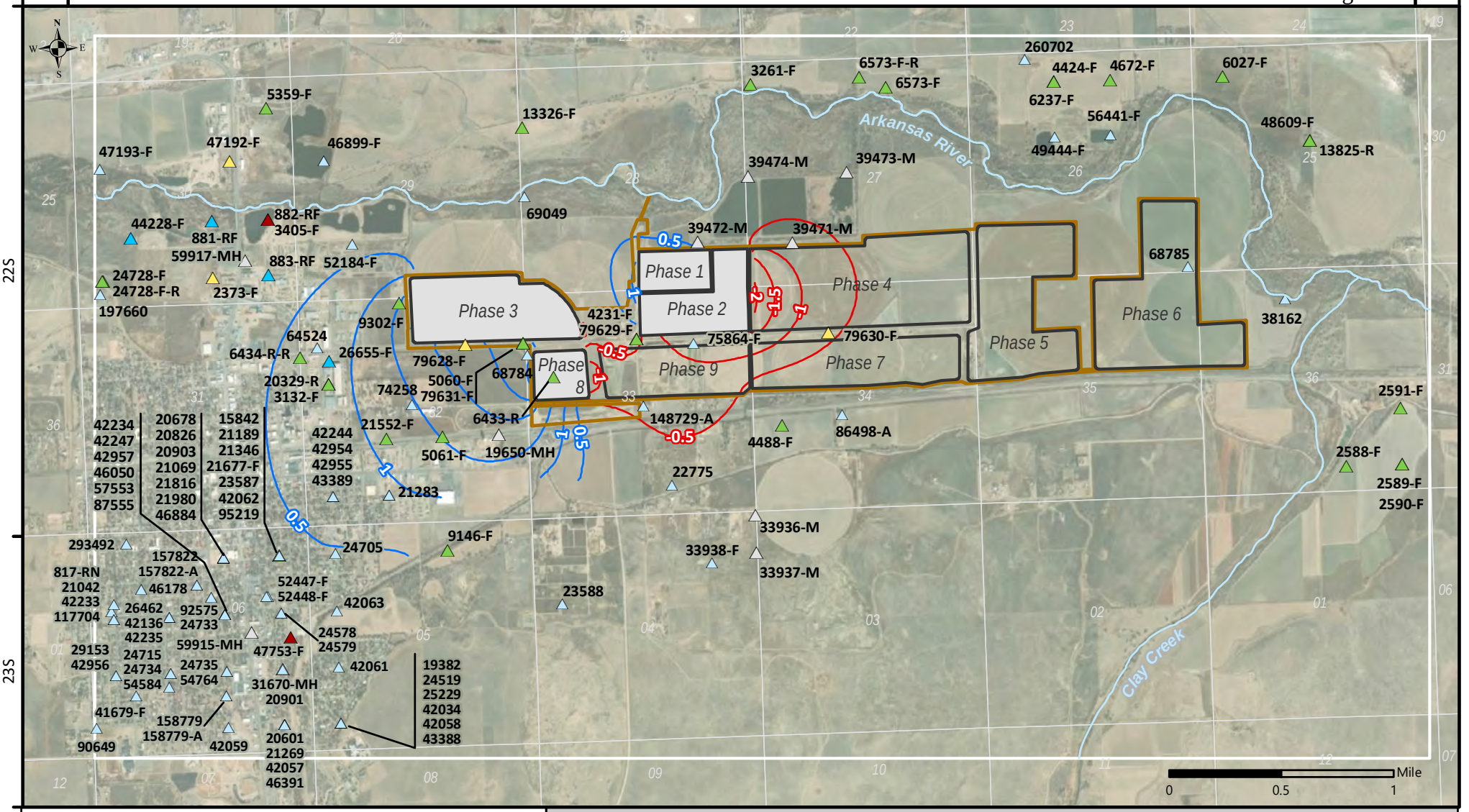


Figure 11
Modeled Changes in Groundwater Conditions - Phase 1, 2, 8 and 3 Pit Slurry Walls

West Farm Pit
Prowers County, Colorado

Map Legend

- 2020 Mining Limits
- Lined Pit
- 2020 Permit Boundary
- Model Extent

Change in Water Level Contour*
- Drawdown
- Mounding

*Contour interval = 0.5 ft

CO-DWR Well (by type)
[labeled with permit number]
- Municipal
- Commercial
- Industrial
- Irrigation
- Domestic/Stock/Other
- Monitoring/Sampling

Sources:
CDSS Well Permit Database 06.07.2020, J&T Consulting MW/Pit Location GIS Shapefiles, March 2021 McGrane Model Outputs, Nelson et al. (1989), NHD (photorevised), ESRI World Imagery

Date: March 22, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

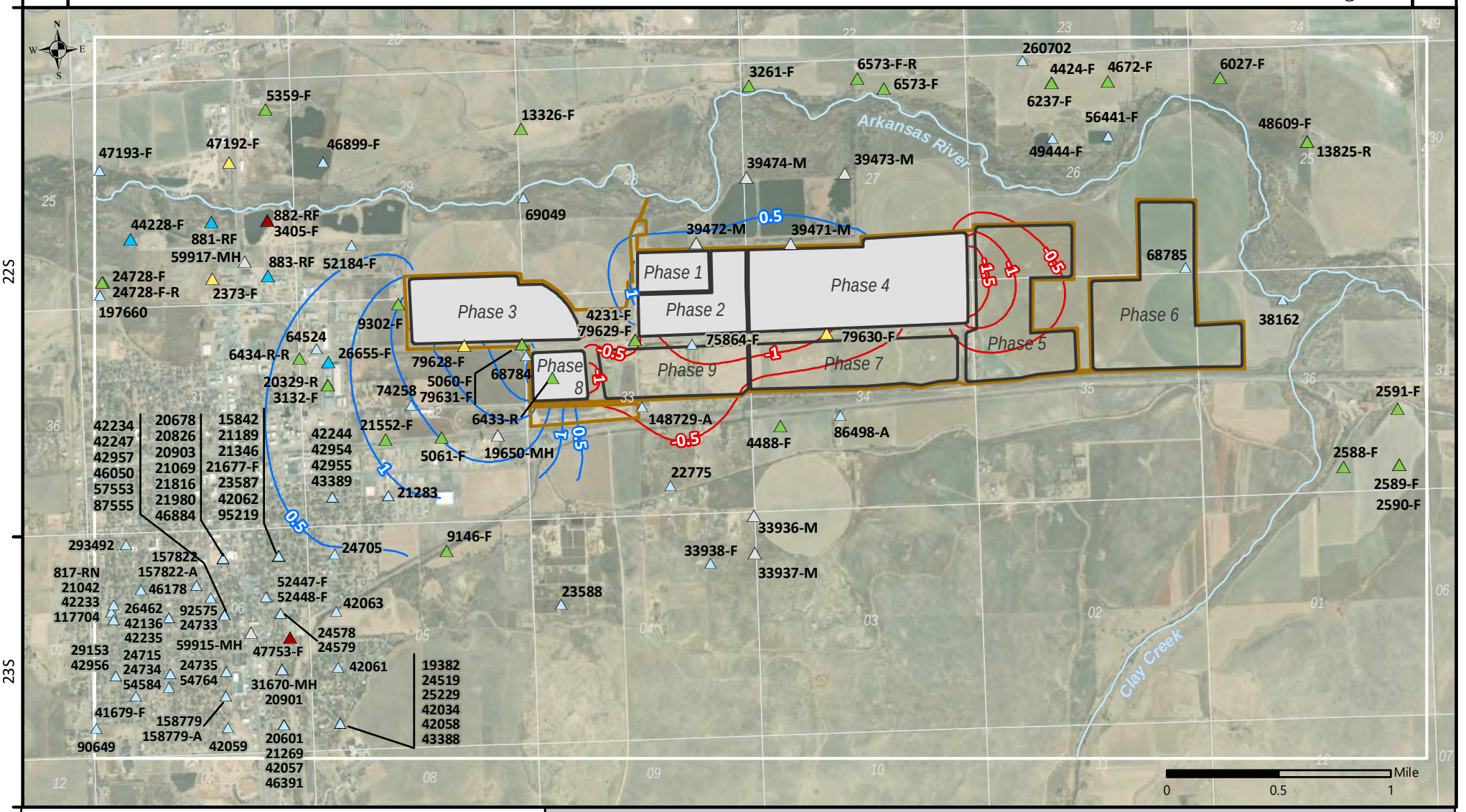


Figure 12
Modeled Changes in Groundwater Conditions - Phase 1, 2, 8, 3 and 4 Pit Slurry Walls

West Farm Pit
Prowers County, Colorado

Map Legend

- 2020 Mining Limits
- Lined Pit
- 2020 Permit Boundary
- Model Extent

Change in Water Level Contour*
- Drawdown
- Mounding

*Contour interval = 0.5 ft

CO-DWR Well (by type)
[labeled with permit number]
- Municipal
- Commercial
- Industrial
- Irrigation
- Domestic/Stock/Other
- Monitoring/Sampling

Sources:
CDSS Well Permit Database 06.07.2020, J&T Consulting MW/Pit Location GIS Shapefiles, March 2021 McGrane Model Outputs, Nelson et al. (1989), NHD (photorevised), ESRI World Imagery

Date: March 22, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

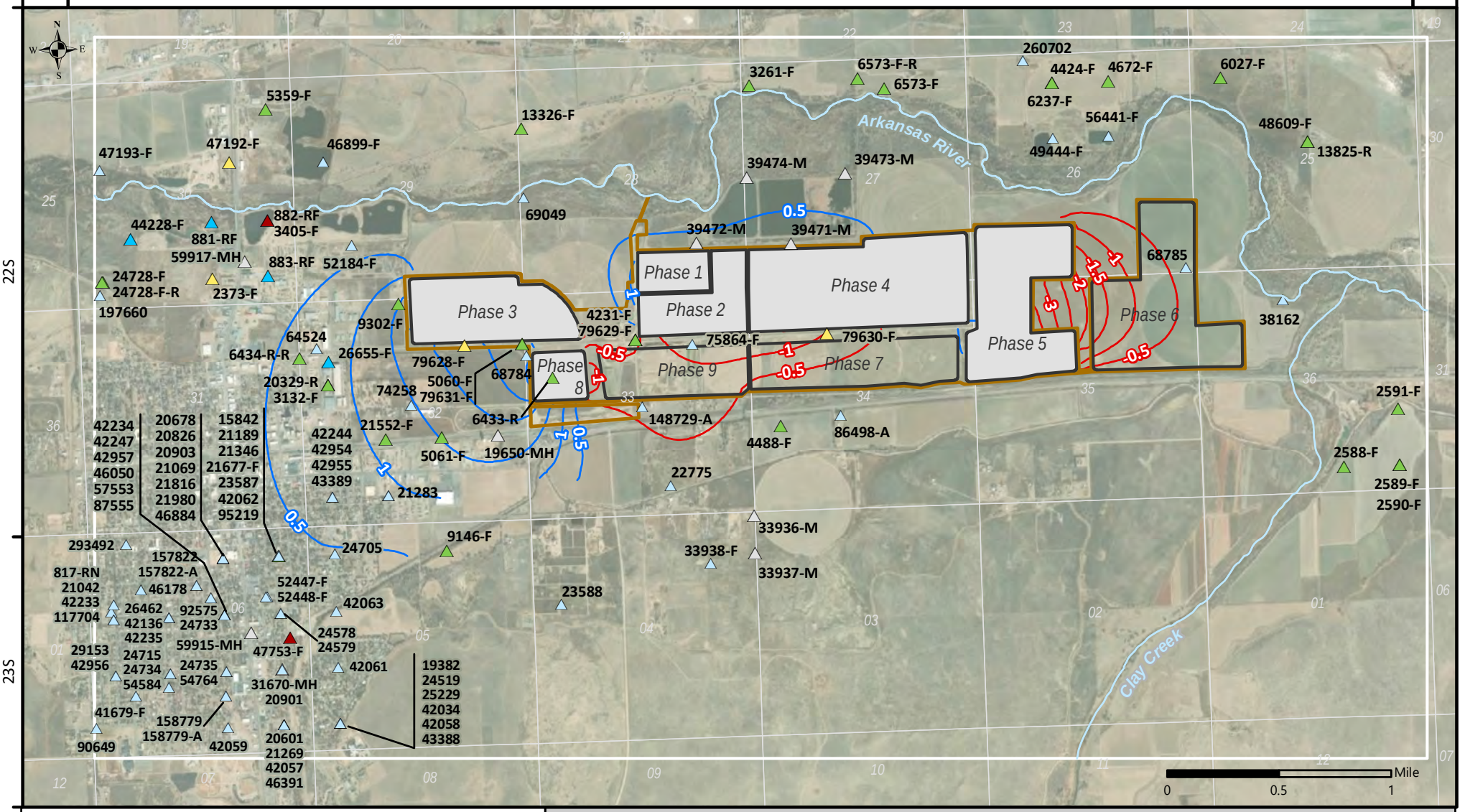


Figure 13
Modeled Changes in Groundwater Conditions - Phase 1, 2, 8, 3, 4 and 5 Pit Slurry Walls

West Farm Pit
Prowers County, Colorado

Map Legend

- 2020 Mining Limits
- Lined Pit
- 2020 Permit Boundary
- Model Extent

Change in Water Level Contour*
- Drawdown
- Mounding

*Contour interval = 0.5 ft

CO-DWR Well (by type)
[labeled with permit number]
- Municipal
- Commercial
- Industrial
- Irrigation
- Domestic/Stock/Other
- Monitoring/Sampling

Sources:
CDSS Well Permit Database 06.07.2020, J&T Consulting MW/Pit Location GIS Shapefiles, March 2021 McGrane Model Outputs, Nelson et al. (1989), NHD (photorevised), ESRI World Imagery

Date: March 22, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

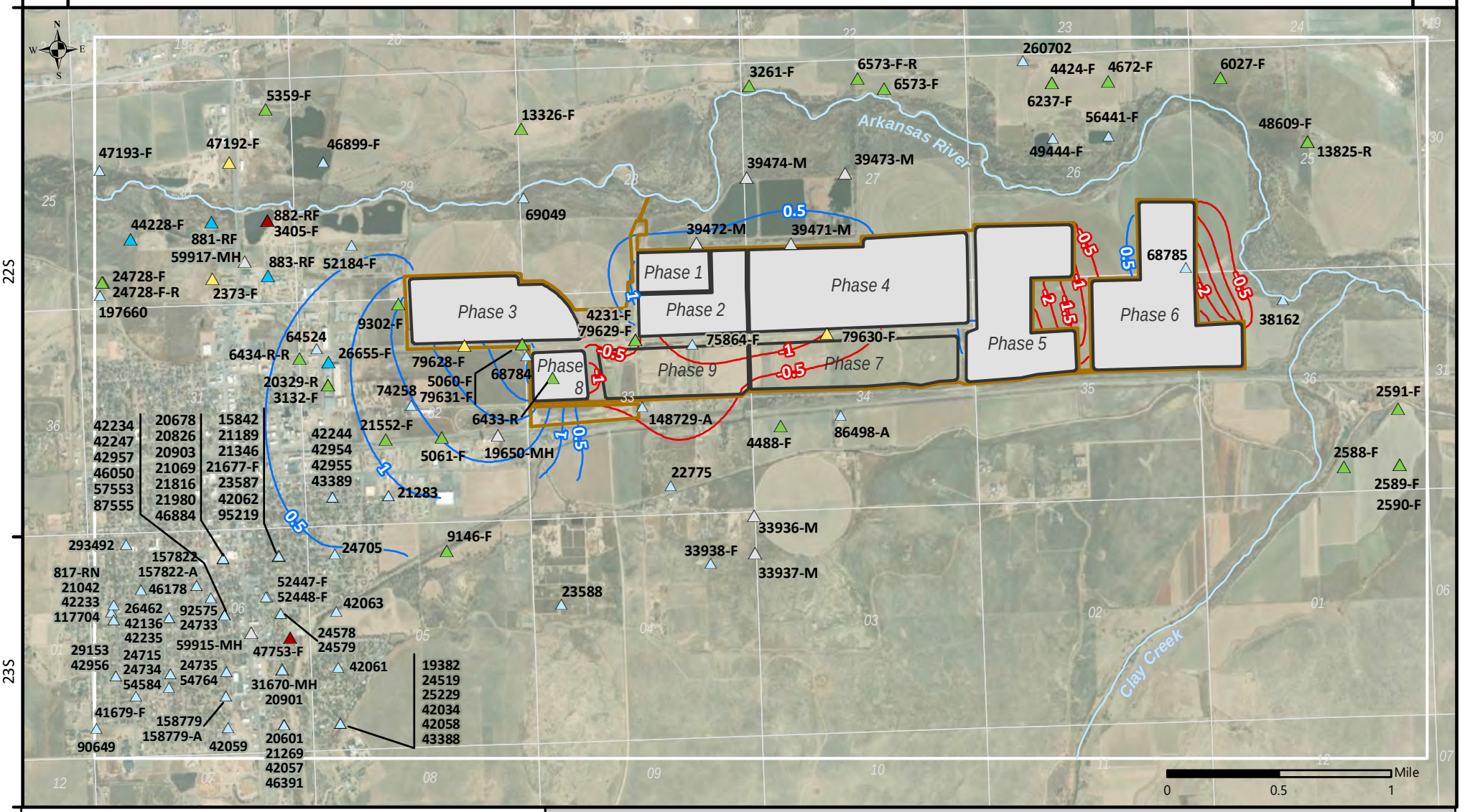


Figure 14
Modeled Changes in Groundwater Conditions - Phase 1, 2, 8, 3, 4, 5 and 6 Pit Slurry Walls

West Farm Pit
Prowers County, Colorado

Map Legend

- 2020 Mining Limits
- Lined Pit
- 2020 Permit Boundary
- Model Extent

Change in Water Level Contour*
- Drawdown
- Mounding

*Contour interval = 0.5 ft

CO-DWR Well (by type)
[labeled with permit number]
- Municipal
- Commercial
- Industrial
- Irrigation
- Domestic/Stock/Other
- Monitoring/Sampling

Sources:
CDSS Well Permit Database 06.07.2020, J&T Consulting MW/Pit Location GIS Shapefiles, March 2021 McGrane Model Outputs, Nelson et al. (1989), NHD (photorevised), ESRI World Imagery

Date: March 22, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

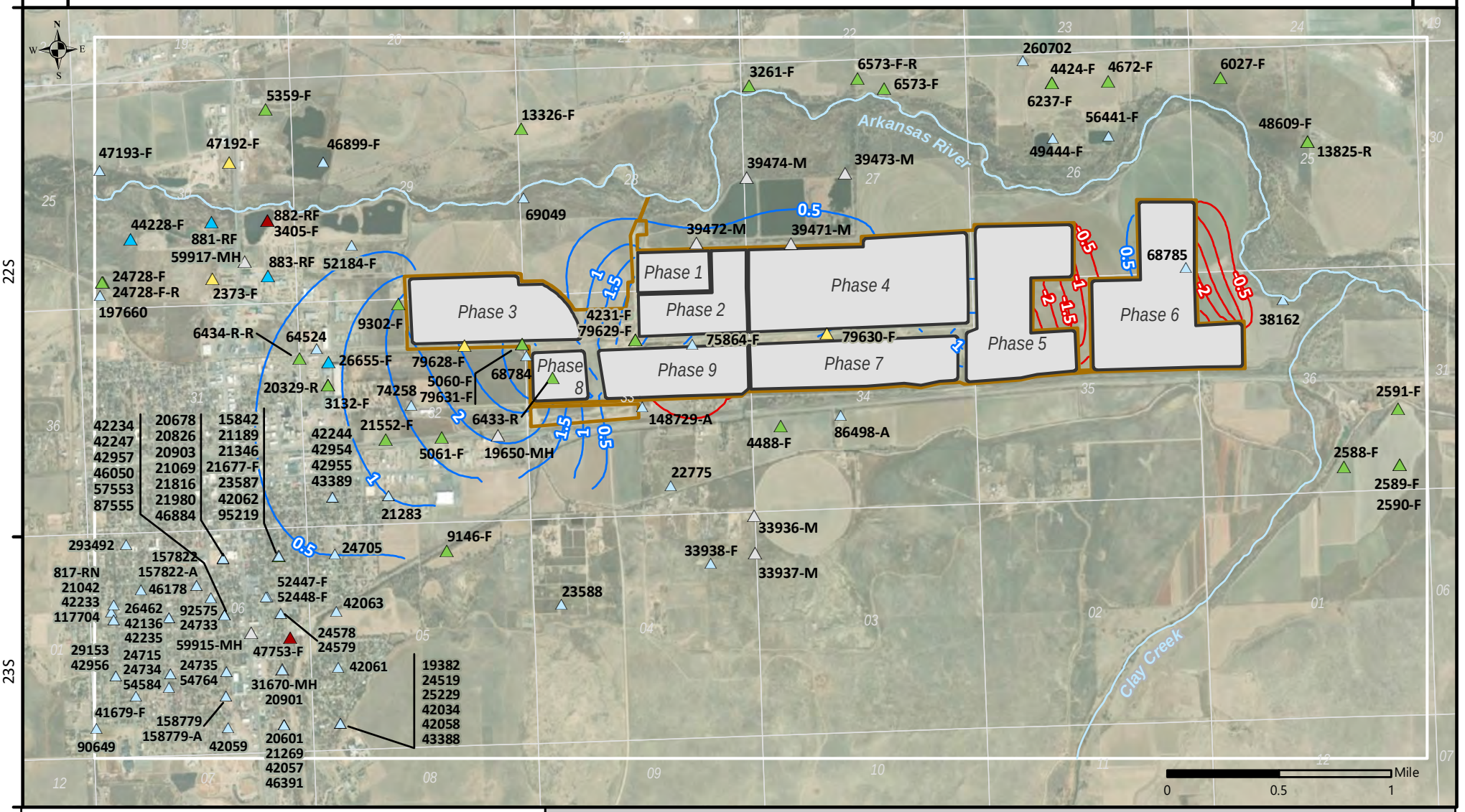


Figure 15
Modeled Changes in Groundwater Conditions - Phase 1, 2, 8, 3, 4, 5, 6, 7 and 9 Pit Slurry Walls

West Farm Pit
Prowers County, Colorado

Map Legend

- 2020 Mining Limits
- Lined Pit
- 2020 Permit Boundary
- Model Extent

Change in Water Level Contour*
- Drawdown
- Mounding

*Contour interval = 0.5 ft

CO-DWR Well (by type)
[labeled with permit number]
- Municipal
- Commercial
- Industrial
- Irrigation
- Domestic/Stock/Other
- Monitoring/Sampling

Sources:
CDSS Well Permit Database 06.07.2020, J&T Consulting MW/Pit Location GIS Shapefiles, March 2021 McGrane Model Outputs, Nelson et al. (1989), NHD (photorevised), ESRI World Imagery

Date: March 30, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

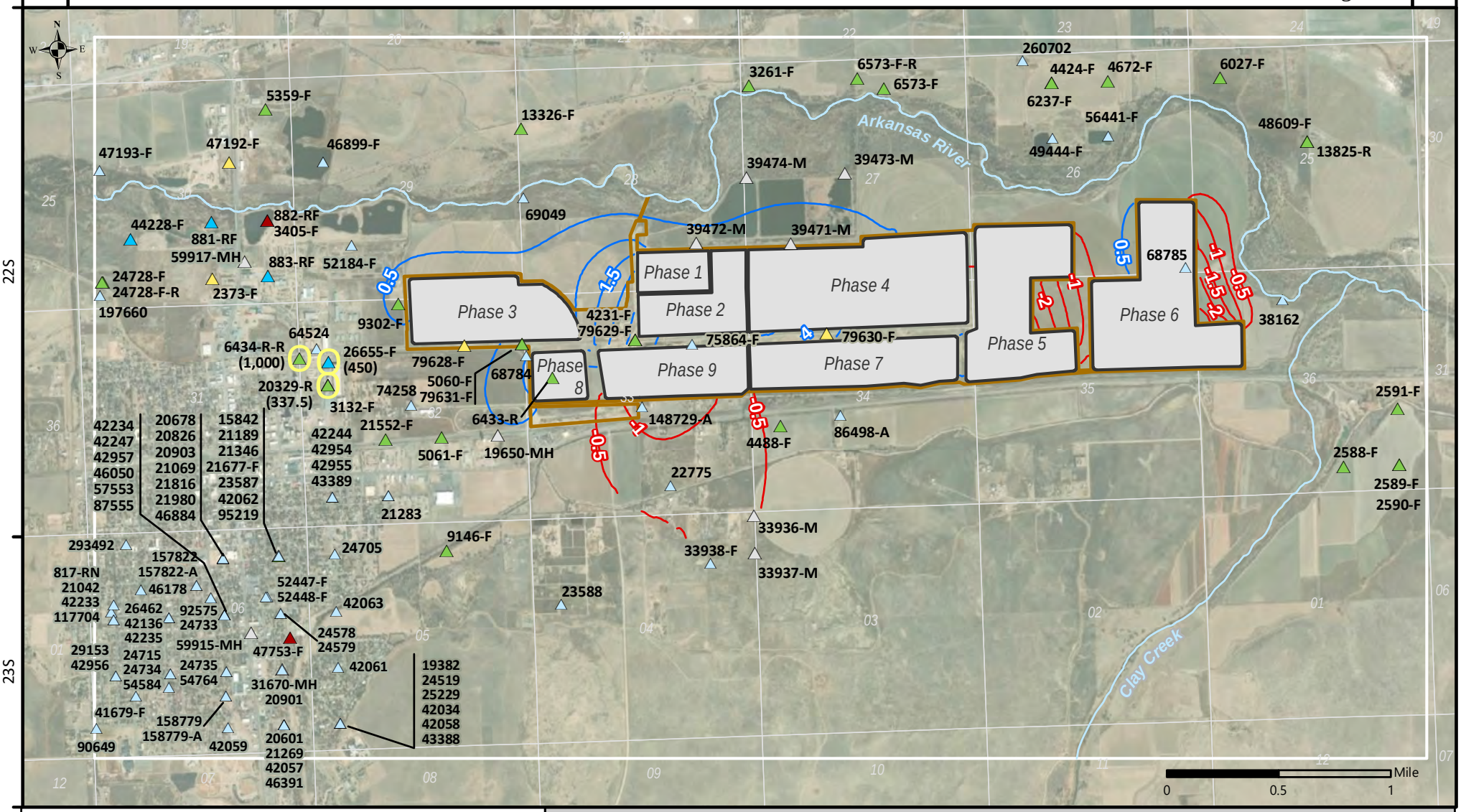


Figure 16
Sensitivity to Off-Site Pumping

West Farm Pit
Prowers County, Colorado

Map Legend

- 2020 Mining Limits
- Lined Pit
- 2020 Permit Boundary
- Model Extent
- Off-Site Pumping Well (well yield [gpm] shown in parenthesis)

Change in Water Level Contour*
- Drawdown
- Mounding

*Contour interval = 0.5 ft

CO-DWR Well (by type)
[labeled with permit number]
- Municipal
- Irrigation
- Commercial
- Domestic/Stock/Other
- Industrial
- Monitoring/Sampling

Sources:
CDSS Well Permit Database 06.07.2020, J&T Consulting MW/Pit Location GIS Shapefiles, March 2021 McGrane Model Outputs, Nelson et al. (1989), NHD (photorevised), ESRI World Imagery

Date: March 30, 2021
Datum/Projection: NAD83/Colorado State Plane South, feet

McGrane Water Engineering, LLC

Table 11: Model Run Summary - Modeled Water Level Changes At Registered Wells

Permit Number	Contact Name	Use(s)	Pump Test Yield (gpm)	Static Water Level	Permit Info
79628-F	GP RESOURCES LLC	Commercial, Industrial	1729	ND	https://dwr.state.co.us/Tools/WellPermits/3668741E
79629-F/ 4231-F	GP IRRIGATED FARMS LLC	Irrigation	1600	7	https://dwr.state.co.us/Tools/WellPermits/9092586
5061-F	LAMAR FARMS	Irrigation	1200	8	https://dwr.state.co.us/Tools/WellPermits/9092671
79631-F/ 5060-F	GP IRRIGATED FARMS LLC	Irrigation	1200	12	https://dwr.state.co.us/Tools/WellPermits/9092670
6433-R	LAMAR FARMS	Irrigation	1099	8.3	https://dwr.state.co.us/Tools/WellPermits/9092768
9302-F	LAMAR UTILITIES BOARD	Irrigation	1012	15	https://dwr.state.co.us/Tools/WellPermits/9092841
68784-	LAZY Y CROSS LND CO	Stock	30	8	https://dwr.state.co.us/Tools/WellPermits/9093720
21283-	BAKER, J R	Domestic	15	18	https://dwr.state.co.us/Tools/WellPermits/9093371
74258-	HOSS INMAN JAMES A	Domestic, Stock	15	24	https://dwr.state.co.us/Tools/WellPermits/9093731
19650-MH	SOUTHEASTERN COLORADO COOP	Monitoring/ Sampling	na	8.45	https://dwr.state.co.us/Tools/WellPermits/0019650
75864-F	GP AGGREGATES LLC	Gravel Pit	ND	ND	https://dwr.state.co.us/Tools/WellPermits/3652084
68785-	LAZY Y CROSS LND CO	Stock	30	6	https://dwr.state.co.us/Tools/WellPermits/9093721
79630-F/ 4230-F	GP RESOURCES LLC	Commercial, Industrial	na	9	https://dwr.state.co.us/Tools/WellPermits/3668741A

Permit Number	Contact Name	Max Modeled Change (+/- 1 ft)					
		Pit Phase: 1 and 2	1,2,8, and 3	1,2,8,3 and 4	1,2,8,3,4 and 5	1,2,8,3,4, 5 and 6	1,2,8,3,4,5,6,7 and 9
		Report Figure: 10	11	12	13	14	15
79628-F	GP RESOURCES LLC	-	2	2	2	2	2.5
79629-F/ 4231-F	GP IRRIGATED FARMS LLC	-	-	-	-	-	2
5061-F	LAMAR FARMS	-	1.5	1.5	1.5	1.5	1.5
79631-F/ 5060-F	GP IRRIGATED FARMS LLC	-	2.5	2.5	2.5	2.5	2.5
6433-R	LAMAR FARMS	-	3	3	3	3	3
9302-F	LAMAR UTILITIES BOARD	-	1.5	1.5	1.5	1.5	1.5
68784-	LAZY Y CROSS LND CO	-	2.5	2.5	2.5	2.5	3
21283-	BAKER, J R	-	-	-	-	-	1
74258-	HOSS INMAN JAMES A	-	1	1	1	1	1.5
19650-MH	JTHEASTERN COLORADO CO	-	1.5	1.5	1.5	1.5	2
75864-F	GP AGGREGATES LLC	-	-	-	-	-1	2.5
68785-	LAZY Y CROSS LND CO	-	-	-	-	-2	-2
79630-F/ 4230-F	GP RESOURCES LLC	-	-	-	-	-	2.5

APPENDIX A - CDWR Well Data

Appendix A - Well Data From the State of Colorado Well Database

Permit Number	Contact Name	Use(s)	Completed Well Depth (ft)	Pump Test Yield (gpm)	Water Level when Drilled (ft)	Saturated Thickness (ft)	Pumping Level (ft bgl)	Drawdown (ft)	Test Method - pump hp	Specific Capacity (gpm/ft)	Transmiss-ivity (gpd/ft)	Hydraulic Conduct-ivity (ft/day)	State Engineer's website link
6434-R-R	GP IRRIGATED FARMS LLC	Irrigation	43	2000	15	27	30	15	pump	133	200000	992	https://dwr.state.co.us/Tools/WellPermits/9092769
2373-F	ARK VALLEY CONCRETE	Commercial	58	2000	20	37	30	10	pump_15hp	200	300000	1085	https://dwr.state.co.us/Tools/WellPermits/9092478
881-RF	LAMAR CITY OF UTILITIES BOARD	Industrial, Muni.	64	1900	17	40	47	30	pump_50hp	63	95000	318	https://dwr.state.co.us/Tools/WellPermits/0917155
882-RF	LAMAR CITY OF BOARD OF UTILITIES	Industrial, Muni.	65	1900	22	35	40	18	pump_50hp	106	158333	606	https://dwr.state.co.us/Tools/WellPermits/0007703
79628-F	GP RESOURCES LLC	Commercial, Ind.	43	1729									https://dwr.state.co.us/Tools/WellPermits/3668741E
13825-R	ROGERS JAMES & CHARLOTTE M	Irrigation	48	1600					tractor				https://dwr.state.co.us/Tools/WellPermits/9093030
79629-F	GP RESOURCES LLC	Commercial, Ind.	53	1600									https://dwr.state.co.us/Tools/WellPermits/3668741B
4231-F	GP IRRIGATED FARMS LLC	Irrigation	53	1600	7	46	46	39	pump_180hp	41	61538	179	https://dwr.state.co.us/Tools/WellPermits/9092586
4488-F	FOUR STATES FEEDYARD INC	Irrigation	53	1600	10	41	45	35	pump_15hp	46	68571	224	https://dwr.state.co.us/Tools/WellPermits/9092608
4424-F	S & S LAND & CATTLE INC	Irrigation	57	1600	6	51	20	14	pump_180hp	114	171429	450	https://dwr.state.co.us/Tools/WellPermits/9092601
6237-F	HATCHETT, B R	Irrigation	60	1600	6	51	30	24	pump	67	100000	262	https://dwr.state.co.us/Tools/WellPermits/9092750
44228-F	VALCO INC	Industrial	60	1557	10	47	40	30	pump_100	52	77850	222	https://dwr.state.co.us/Tools/WellPermits/0376778
6573-F-R	PARMELY, NEIL	Irrigation	53	1400	11	37	26	15	pump_20hp	93	140000	507	https://dwr.state.co.us/Tools/WellPermits/0325018
883-RF	LAMAR CITY OF BOARD OF UTILITIES	Industrial, Muni.	62	1390	28.4	28.6	46	17.6	pump	79	118466	555	https://dwr.state.co.us/Tools/WellPermits/0007704
3261-F	GRUENLOH, MARVIN	Irrigation	35	1200	14	18	29	15	pump	80	120000	892	https://dwr.state.co.us/Tools/WellPermits/9092527
5061-F	LAMAR FARMS	Irrigation	42	1200	8	34	39	31	pump_25hp	39	58065	229	https://dwr.state.co.us/Tools/WellPermits/9092671
5060-F	GP IRRIGATED FARMS LLC	Irrigation	50	1200	12	38	47	35	pump_25hp	34	51429	181	https://dwr.state.co.us/Tools/WellPermits/9092670
79631-F	GP RESOURCES LLC	Commercial, Ind.	50	1200									https://dwr.state.co.us/Tools/WellPermits/3668741D
6433-R	LAMAR FARMS	Irrigation	35	1099	8.3	26.7	17	8.7	pump	126	189483	950	https://dwr.state.co.us/Tools/WellPermits/9092768
9302-F	LAMAR UTILITIES BOARD	Irrigation	59	1012	15	42	24	9	pump	112	168667	538	https://dwr.state.co.us/Tools/WellPermits/9092841
2588-F	CRUIKSHANK, C G	Irrigation	30	1000	16	13	30	14	pump_30hp	71	107143	1103	https://dwr.state.co.us/Tools/WellPermits/9092486
2591-F	CRUICKSHANK, C G	Irrigation	31	1000	16	14	31	15	pump_30hp	67	100000	956	https://dwr.state.co.us/Tools/WellPermits/9092489
2589-F	CRUIKSHANK, C G	Irrigation	32	1000	16	16	32	16	pump_30hp	63	93750	784	https://dwr.state.co.us/Tools/WellPermits/9092487
4672-F	NEWMAN, ERNEST E	Irrigation	36	1000	9	27	19	10	pump	100	150000	744	https://dwr.state.co.us/Tools/WellPermits/9092633
2590-F	CRUIKSHANK, C G	Irrigation	41	1000	16	24	34	18	pump	56	83333	465	https://dwr.state.co.us/Tools/WellPermits/9092488
13326-F	HATCHETT B R & HILDA B H	Irrigation	40	925	15	22	34	19	pump	49	73026	444	https://dwr.state.co.us/Tools/WellPermits/9093005
6027-F	SEILING KENNETH W & LINDA L	Irrigation	38	900	13	25	30	17	pump	53	79412	425	https://dwr.state.co.us/Tools/WellPermits/9092738
26655-F	DRAGON ESP LTD	Industrial	63	900	16	41	26	10	pump_25hp	90	135000	441	https://dwr.state.co.us/Tools/WellPermits/0008879
20329-R	JOHNS LOUISE W MRS	Irrigation	31	675									https://dwr.state.co.us/Tools/WellPermits/9093314
5359-F	DORENKAMP, JOSEPH	Irrigation	36	500	10	26	34	24	pump	21	31250	161	https://dwr.state.co.us/Tools/WellPermits/9092693
24728-F	COW PALACE INC	Irrigation	30	400									https://dwr.state.co.us/Tools/WellPermits/0200313A
24728-F-R	SANDERS, TERRY J	Irrigation	41	400									https://dwr.state.co.us/Tools/WellPermits/0200313
21552-F	EATON DWAIN W & DONNA J	Irrigation	35	98									https://dwr.state.co.us/Tools/WellPermits/9093387
157822--A	HENRY, FRANKLIN S	Domestic	36	50	12	20	30	18	pump				https://dwr.state.co.us/Tools/WellPermits/0315716B
197660-	HARTSHORN MONTE & KAREN	Domestic	43	50									https://dwr.state.co.us/Tools/WellPermits/0403302
38162-	LAMAR FARMS	Stock	80	50	20	37	40	20	bailer				https://dwr.state.co.us/Tools/WellPermits/9093564
21677-F	PASSINI PRIMO & MARGARET	Irrigation	30	30									https://dwr.state.co.us/Tools/WellPermits/9093401
42246-	SULLIVAN, FRED E	Domestic	30	30	15	12	20	5	bailer				https://dwr.state.co.us/Tools/WellPermits/9093610
68785-	LAZY Y CROSS LND CO	Stock	36	30	6	29	18	12	bailer				https://dwr.state.co.us/Tools/WellPermits/9093721
42247-	CRIMOND, RICHARD P	Domestic	41	30	20	19	28	8	bailer				https://dwr.state.co.us/Tools/WellPermits/9093611
68784-	LAZY Y CROSS LND CO	Stock	41	30	8	32	20	12	bailer				https://dwr.state.co.us/Tools/WellPermits/9093720

Appendix A - Well Data From the State of Colorado Well Database (cont)

Permit Number	Contact Name	Use(s)	Completed Well Depth	Pump Test Yield (gpm)	Water Level when Drilled (ft)	Saturated Thickness (ft)	Pumping Level (ft bgl)	Drawdown (ft)	Test Method - pump hp	Specific Capacity (gpm/ft)	Transmiss-ivity (gpd/ft)	Hydraulic Conduct-ivity (ft/day)	State Engineer's website link
69049-	LAZY Y CROSS LAND & CATTLE CO	Stock	50	30	6		18	12	bailer				https://dwr.state.co.us/Tools/WellPermits/9093722
43389-	HALL, JAMES	Domestic	32	25	10	20	15	5	bailer				https://dwr.state.co.us/Tools/WellPermits/9093647
42956-	PRATT, C F	Domestic	67	25	30	27	45	15	bailer				https://dwr.state.co.us/Tools/WellPermits/9093642
64524-	APPEL ILLA JO	Domestic, Stock	62	24	30	27	36	6	bailer				https://dwr.state.co.us/Tools/WellPermits/9093706
21980-	MOUNT OLIVE LUTHERAN CHURCH	Domestic	26	20	19		21	2	bailer				https://dwr.state.co.us/Tools/WellPermits/9093407
23588-	FOUR STATES FEEDYARD INC	Domestic	30	20	16	9							https://dwr.state.co.us/Tools/WellPermits/9093434
21269-	BELLOMY, JAMES	Domestic	32	20	23		32	9	bailer				https://dwr.state.co.us/Tools/WellPermits/9093370
148729--A	RASMUSSEN, DAVID	Domestic	42	20	15	20	41	26	bailer				https://dwr.state.co.us/Tools/WellPermits/0520431
46884-	BRUCKNER, HAZEL T	Domestic	43	20	20	21	30	10	bailer				https://dwr.state.co.us/Tools/WellPermits/9093671
42957-	WHITTEN, B E	Domestic	48	20	20	27	30	10	bailer				https://dwr.state.co.us/Tools/WellPermits/9093643
46050-	DONART, HARRY J	Domestic	48	20	25	20	30	5	bailer				https://dwr.state.co.us/Tools/WellPermits/9093663
87555-	SCHMIDT, LAIL W	Domestic	80	20									https://dwr.state.co.us/Tools/WellPermits/9093790
24735-	ENGLAND, ALTA	Domestic	83	20									https://dwr.state.co.us/Tools/WellPermits/9093456
24715-	YOUNG, ALFRED R	Domestic	49	18	24		30	6	bailer				https://dwr.state.co.us/Tools/WellPermits/9093452
817-RN	WALLACE H T & CLORIA W	Domestic	17	15	14		14	0	bail				https://dwr.state.co.us/Tools/WellPermits/9092442
42235-	BRANNON JR JOHN R	Domestic	22	15	10		20	10	bailer				https://dwr.state.co.us/Tools/WellPermits/9093607
21346-	ROUSE, HARVEY	Domestic	23	15	16	3	16	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093373
21283-	BAKER, J R	Domestic	25	15	18	6	23	5	bailer				https://dwr.state.co.us/Tools/WellPermits/9093371
47753-F	LAMAR CITY OF	Municipal	26	15	18	7	25	7	bailer				https://dwr.state.co.us/Tools/WellPermits/0395314A
42244-	MONTGOMERY, EMERY	Domestic	28	15	18	9	23	5	bailer				https://dwr.state.co.us/Tools/WellPermits/9093608
42955-	CHANDLER, AARON L.	Domestic	28	15	18	9	23	5	bailer				https://dwr.state.co.us/Tools/WellPermits/9093641
24705-	KNOBBE, JESS	Domestic	30	15	16	11	16	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093450
42954-	CLODFELLTER, ROBERT J	Domestic	30	15	12	17	17	5	bailer				https://dwr.state.co.us/Tools/WellPermits/9093640
29153-	COOK, RAYMOND L	Domestic	32	15	17	15							https://dwr.state.co.us/Tools/WellPermits/9093504
20903-	MAUCH, GEORGE	Domestic	35	15	16	11	16	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093353
23587-	AUGUSTINE, BEVERLY J	Domestic	35	15	15	9							https://dwr.state.co.us/Tools/WellPermits/9093433
74258-	HOSS INMAN JAMES A	Domestic, Stock	36	15	24	9	26	2	bailer				https://dwr.state.co.us/Tools/WellPermits/9093731
20826-	TERRILL ORRIE & EMILY	Domestic	41	15	16	19	16	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093344
92575-	ECKLES, ROY	Domestic	48	15									https://dwr.state.co.us/Tools/WellPermits/9093825
117704-	HAYS, C A	Domestic, Stock	57	15	20	15	35	15	bailer				https://dwr.state.co.us/Tools/WellPermits/9093860
86498--A	LAMAR FARMS	Domestic, Stock	60	15	40	17	58	18	bailer				https://dwr.state.co.us/Tools/WellPermits/0235803
54764-	BRANTLEY THOMAS L & JOYCE	Domestic	66	15	30	27	40	10	bailer				https://dwr.state.co.us/Tools/WellPermits/9093690
95219-	PEERY, H E	Domestic	23	14									https://dwr.state.co.us/Tools/WellPermits/9093839
57553-	SWEAT, J B	Domestic	40	14									https://dwr.state.co.us/Tools/WellPermits/9093691
41679-F	AUSTIN, LYNN C	Other	32	11.5	6.5		27	20.5	pump_0.5 hp				https://dwr.state.co.us/Tools/WellPermits/0343259
22775-	SNIFF, LEONARD	Stock	19	10	9	9	9	0	bail				https://dwr.state.co.us/Tools/WellPermits/9093429
52447-F	ASHLEY, STACIE	Other	22	10	10		20	10	pump				https://dwr.state.co.us/Tools/WellPermits/0421314A
52448-F	ASHLEY MICHAEL & STACIE	Other	22	10									https://dwr.state.co.us/Tools/WellPermits/0421314B
21816-	CHURCH OF THE NAZARENE	Domestic	24	10	12	10	12	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093404
15842-	RAY ROBERT W JR	Domestic	25	10	20		20	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093129
42062-	GREEN, ROLAND	Domestic	25	10	10	14	12	2	bailer				https://dwr.state.co.us/Tools/WellPermits/9093600
21189-	DILLON, PHILLIP	Domestic	27	10	20	6	20	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093369
42233-	ECKELS, ROY	Domestic	35	10	20		20	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093605
21069-	HAYS, WAYNE	Domestic	37	10	16	19	16	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093361
46391-	WHITMIRE, CHARLES P	Domestic	40	10	25	11	40	15	air				https://dwr.state.co.us/Tools/WellPermits/9093668
20678-	LEIGHTON, GERALD	Domestic	41	10	16	19							https://dwr.state.co.us/Tools/WellPermits/9093340
42063-	SANCHEZ URIEL SALAZAR	Domestic	42	10	27	13	29	2	bailer				https://dwr.state.co.us/Tools/WellPermits/9093601
42234-	GILBERT, PHIL	Domestic	42	10	28	13	33	5	bailer				https://dwr.state.co.us/Tools/WellPermits/9093606
19382-	RAY ROBERT W JR & MARY E	Domestic	50	10	31	2	40	9	bailer				https://dwr.state.co.us/Tools/WellPermits/9093233
20601-	HARPER BESSIE & JAMES R	Domestic	52	10	25	6	25	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093335
42057-	GARBACZ, SHERRI	Domestic	56	10	21		21	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093595
20901-	SPRINGER, CHARLES	Domestic	61	10	30	27	30	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093351
42059-	WARREN, LEROY	Domestic	65	10	35	22	50	15	bailer				https://dwr.state.co.us/Tools/WellPermits/9093597

Permit Number	Contact Name	Use(s)	Completed Well Depth	Pump Test Yield (gpm)	Water Level when Drilled (ft)	Saturated Thickness (ft)	Pumping Level (ft bgl)	Drawdown (ft)	Test Method - pump hp	Specific Capacity (gpm/ft)	Transmiss-ivity (gpd/ft)	Hydraulic Conduct-ivity (ft/day)	State Engineer's website link
42058-	OXLEY, WAYNE	Domestic	70	10	35	22	45	10	bailer				https://dwr.state.co.us/Tools/WellPermits/9093596
42034-	TURNER, TERRY	Domestic	74	10	30	27	30	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093594
42061-	CURREY, DUDLEY	Domestic	74	10	30	27	40	10	bailer				https://dwr.state.co.us/Tools/WellPermits/9093599
42136-	MERRIFIELD, WILLIAM H	Domestic	39	8	24	13	31	7	bailer				https://dwr.state.co.us/Tools/WellPermits/9093603
43388-	ANDERSON, ELBERT	Domestic	95	8									https://dwr.state.co.us/Tools/WellPermits/9093646
24579-	STICKLIN, BYRON	Domestic	39	7	27	7	27	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093446
24519-	REESE, WARREN E	Domestic	63	7	12	45							https://dwr.state.co.us/Tools/WellPermits/9093442
90649-	SAPP, E J	Domestic	25	5	15	0	15	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093814
24578-	TROY, C B	Domestic	38	5	26	6	26	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093445
25229-	CORNELIUS, G	Domestic	61	5									https://dwr.state.co.us/Tools/WellPermits/9093465
26462-	BEAVERS, J K	Domestic	20	4	15								https://dwr.state.co.us/Tools/WellPermits/9093483
24706-	AUSMUS, VIVIAN	Domestic	24	4	19	4	19	0	bailer				https://dwr.state.co.us/Tools/WellPermits/9093451
52184-F	LAMAR CITY OF	Other	ND										https://dwr.state.co.us/Tools/WellPermits/0447777A
59917-MH	LAMAR CITY OF	Monitoring	9		7.3								https://dwr.state.co.us/Tools/WellPermits/0059917
39472-M	LAMAR CITY OF	Monitoring	10		ND								https://dwr.state.co.us/Tools/WellPermits/0326721B
39471-M	LAMAR CITY OF	Monitoring	13		ND								https://dwr.state.co.us/Tools/WellPermits/0326721A
39474-M	LAMAR CITY OF	Monitoring	13		ND								https://dwr.state.co.us/Tools/WellPermits/0326721D
293492-	HENDRICKS SHARON & JEFF	Domestic	14										https://dwr.state.co.us/Tools/WellPermits/3663362
19650-MH	SOUTHEASTERN COLORADO COOP	Monitoring	15		8.45								https://dwr.state.co.us/Tools/WellPermits/0019650
31670-MH	GELHAUSEN, JAN	Monitoring	22		10								https://dwr.state.co.us/Tools/WellPermits/0031670
9146-F	HOHENSEE, VENDEL	Irrigation	24										https://dwr.state.co.us/Tools/WellPermits/9092837
33938-F	FOX & ASSOC OF CO	Other	25										https://dwr.state.co.us/Tools/WellPermits/0289420C
59915-MH	LAMAR CITY OF	Monitoring	25		22.3								https://dwr.state.co.us/Tools/WellPermits/0059915A
33937-M	FOX & ASSOC OF CO	Monitoring	35										https://dwr.state.co.us/Tools/WellPermits/0289420B
157822-	HENRY, FRANKLIN S	Domestic	35										https://dwr.state.co.us/Tools/WellPermits/0315716A
46178-	BAGGETT, W C	Domestic	40										https://dwr.state.co.us/Tools/WellPermits/9093667
3132-F	JOHN, LOUISE W	Irrigation	43										https://dwr.state.co.us/Tools/WellPermits/9092519
260702-	CEDAR BREAKS ACRES TRUST	Domestic, Stock	44										https://dwr.state.co.us/Tools/WellPermits/0528962
6573-F	PARMELY, NEIL	Irrigation	49						pump_20hp				https://dwr.state.co.us/Tools/WellPermits/9092783
33936-M	FOX & ASSOC OF CO	Monitoring	50										https://dwr.state.co.us/Tools/WellPermits/0289420A
48609-F	RISING, KEITH L	Irrigation	52										https://dwr.state.co.us/Tools/WellPermits/0417690
54584-	HALL JACK & BONEVA C	Domestic	60		27	33							https://dwr.state.co.us/Tools/WellPermits/9093686
79630-F	GP RESOURCES LLC	Commercial, Ind.	63										https://dwr.state.co.us/Tools/WellPermits/3668741A
4230-F	GP IRRIGATED FARMS LLC	Irrigation	63		9	48							https://dwr.state.co.us/Tools/WellPermits/9092585
158779-	BELL, CLYDE W	Domestic, Stock	74										https://dwr.state.co.us/Tools/WellPermits/0315127A
158779--A	BELL, CLYDE W	Domestic, Stock	80										https://dwr.state.co.us/Tools/WellPermits/0315127B
21042-	FELTER, ROBERT C	Domestic	97		20								https://dwr.state.co.us/Tools/WellPermits/9093359
Min			9	4	6	0	9	0		21	31250	161	
Max			97	2000	40	51	58	39		200	300000	1103	
Avg			**43**	**390**	**18**	**22**	**28**	**10**		**78**	**117270**	**548**	

APPENDIX B – MODELING DETAILS

The purpose of this memorandum is to provide additional details on modeling software, grid selection, boundary conditions and a statistical results comparison. Referenced figures are the same as in the report and can be found in the "Figures" section.

Software

We used the USGS MODFLOW2000 (Harbaugh et al, 2000) modeling program to evaluate the existing and future groundwater conditions at the West Farm pit. We used the Groundwater Vistas (GV) version 6.85 Build 11 pre and post processor (Jim and Doug Rumbaugh), preprocessor to construct, run and display model results. We then exported model results to ESRI software to create the report figures.

Model Grid

The model consists of 85 rows and 157 columns using 200 foot square model cells. The model area is approximately 3 miles high and 6 miles wide (west to east) centered on the pits as shown on the report figures.

Boundary Conditions

Boundary Conditions represent locations in the model where water flows in or out due to external factors.

Aquifer Bottom and Slurry Walls

The bottom of the model is bedrock which is simulated using "no-flow" cells, meaning the cells are essentially turned off no flow is simulated. We simulate pits with slurry walls by turning off the cells within the pit, making them also "no-flow" cells.

Alluvial Aquifer Inflow and Outflow

Alluvial Aquifer inflow and outflows are simulated using "constant head" cells along the western, northern and eastern specified head model boundaries. The assigned cell elevations remain constant during the model run and water either flows in or out of them based on the gradient established inside the model. The heads were assigned at the 10 ft contour lines shown on the baseline water table map (**Figure 6)** and extrapolated in between using the GV extrapolation tool.

We used general head boundary (GHB) on the south side of the model to simulate inflow from the Quaternary eolian deposits (Qe). Conceptually, a GHB is a fixed head elevation outside the model. In this case the next 10 foot water table contours on **Figure 6** located outside the model ranging from 3590 to 3610 feet in elevation. The conductance term (COND) is calculated based on the area of the wetted cell side multiplied by the hydraulic conductivity divided by the distance to the GHB, which we calculated as being around 4000 feet outside the model. The flow between the hypothetical boundary and the head in the cell is proportional to the difference

between the head in the cell (determined by the model) and the GHB. The flow into the model is then a function of the head difference x COND.

$$COND = \frac{(L \times W) \times K}{D}$$

whereas:

W = model cell width (200 ft)
L = wetted interface thickness = (40 ft).
K = average hydraulic conductivity of the eolian deposit (50 ft/day)
D = distance to the external head (4,000 ft)

Therefore: $COND = \frac{200\ ft \times 40\ ft * 50\ ft/day}{4000\ ft} = 100\ ft^2/day$

River inflow and outflow

The Arkansas River extends along the west to east axis approximately 1,500 to 4,000 feet from the northern model boundary. Clay Creek is a northward flowing tributary into the Arkansas River. We simulated approximately 1.5 miles of Clay Creek before its confluence with the Arkansas River. We modeled the aquifer's connection to the river using the MODFLOW "River" package which uses a streambed conductance term (COND) to calculated flow between the river and the aquifer based on the head difference between the cell and the river stage multiplied by COND.

$$COND = \frac{(L \times W) \times Ksb}{M}$$

whereas:

W = River width (50 ft)
L = River length (calculated by GWV based on digitize river length in each cell (ft).
Ksb = average hydraulic conductivity of the streambed = K of the aquifer (550/100) (ft/day)
M = River bottom thickness (1 ft)
Therefore: $COND = \frac{River\ length\ in\ cell\ (ft) \times 50\ ft * 5.5\ ft/day}{1\ ft}$

We assume Ksb is $1/100^{th}$ of the K of the aquifer (5.5 ft/day). By assuming heterogeneity of the streambed, we lower the connection between the aquifer and the river. We believe limiting movement to and from the river makes predicted changes in water levels caused by pit slurry walls more conservative (ie. larger than they may be in reality).

We determined the river stage height by based on the mean September - May monthly flow (28.3 cfs) at USGS gage station 07133000 (Arkansas River at Lamar, Co) between 2010 and 2020. We divided the flow by the average river width (50 ft) measured from Google Earth (1/27/2017), to determine the stage height of 0.6 ft. We assigned model river stage elevations where the 10-ft water table contour lines (**Figure 6)** cross the river. Those contours were assigned based on the DEM ground elevation which assumes that a hydraulic connection between the river and aquifer exist. We then invoke the GV interpolating tool to assign stage elevations to each cell. GV subtracts the river stage elevation to determine the river bottom elevation at each river cell. For a gaining stream (where the head in the cell is above the river stage), MODFLOW calculates the flow into the river based on the head difference between the river cell and its stage multiplied by COND. Under losing stream conditions, MODFLOW calculates the flow into the aquifer based on the head difference between the river stage and cell bottom multiplied by COND until a maximum leakance is achieved when the head in the cell drops below the river bottom.

Canals

We did not simulate canal recharge in the model. Since the model is set up as a "change" model, we do not believe that canal recharge is going to change as a result of pit lining.

Drains

We modeled the unnamed drain on the south side of the pits (paralleling Hwy 50) using MODFLOW "Drain" package which uses a streambed conductance term (COND) to calculated flow between the drain and the aquifer based on the head difference between the drain cell and the drain bottom multiplied by COND.

$$COND = \frac{(L \times W) \times Kv}{M}$$

whereas:

W = Drain width (assume 5 ft)
L = Drain length (200 ft per cell)
Kv = average vertical hydraulic conductivity of the drain = Kv of the aquifer (550/10) (ft/day)
M = Drain bottom thickness (1 ft)

$$\text{Therefore: } COND = \frac{200 \text{ (ft)} \times 5 \text{ ft} * 55 \text{ ft/day}}{1 \text{ ft}} = 55000 \text{ ft}^2\text{/day}$$

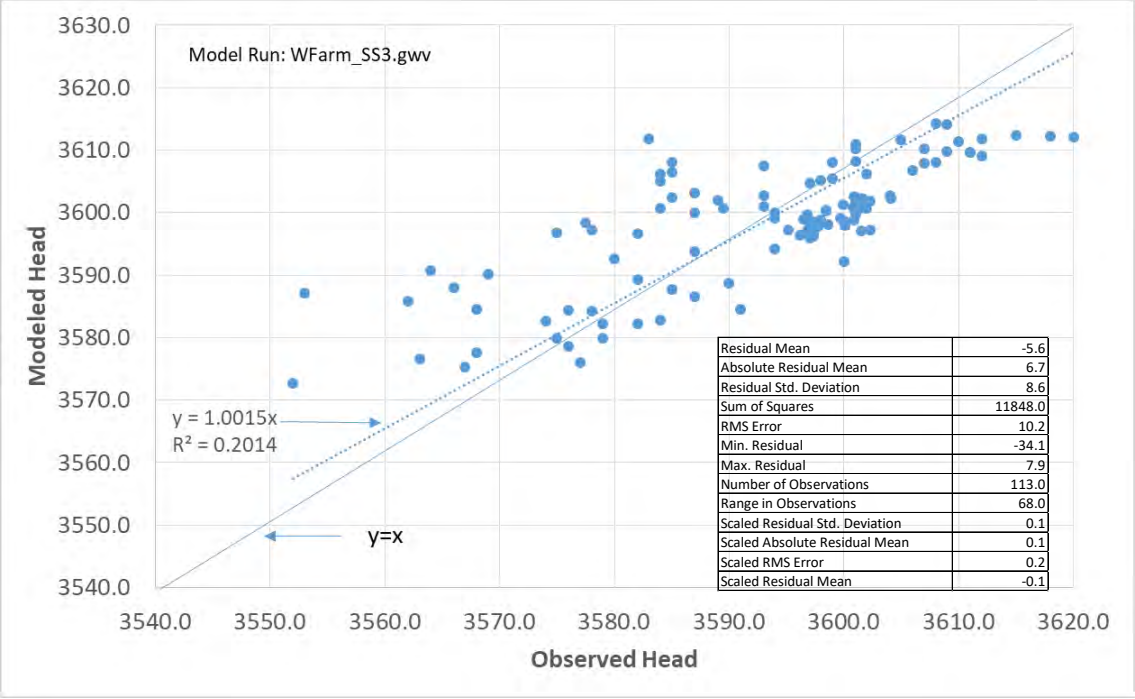
We assume Kv is or 55 ft/day. By assuming the Kv of the drain is only $1/10^{th}$ of the aquifer, we lower the connection between the aquifer and the drain. We believe limiting leakance to the drain makes predicted changes in water levels caused by pit slurry walls more conservative (ie. larger than they may be in reality).

Model Results Statistics

Figure B2 compares modeled water levels in cells with wells to 113 measured water levels, either from the CDWR database or from monitoring wells. For a perfect match, the data would have no scatter and fall along a straight line where y = x and the R^2 = 1.0. However, a perfect match is never expected due to: measurement error; location error, error in the DEM data used to calculate elevations, annual (dry year/wet year) or seasonal variability; and proximity to pumping wells which may cause daily variability. This accounts for the low R^2 (0.20) of the best-fit line. However, the plot of x verses y is very close where y = 1.0015x.

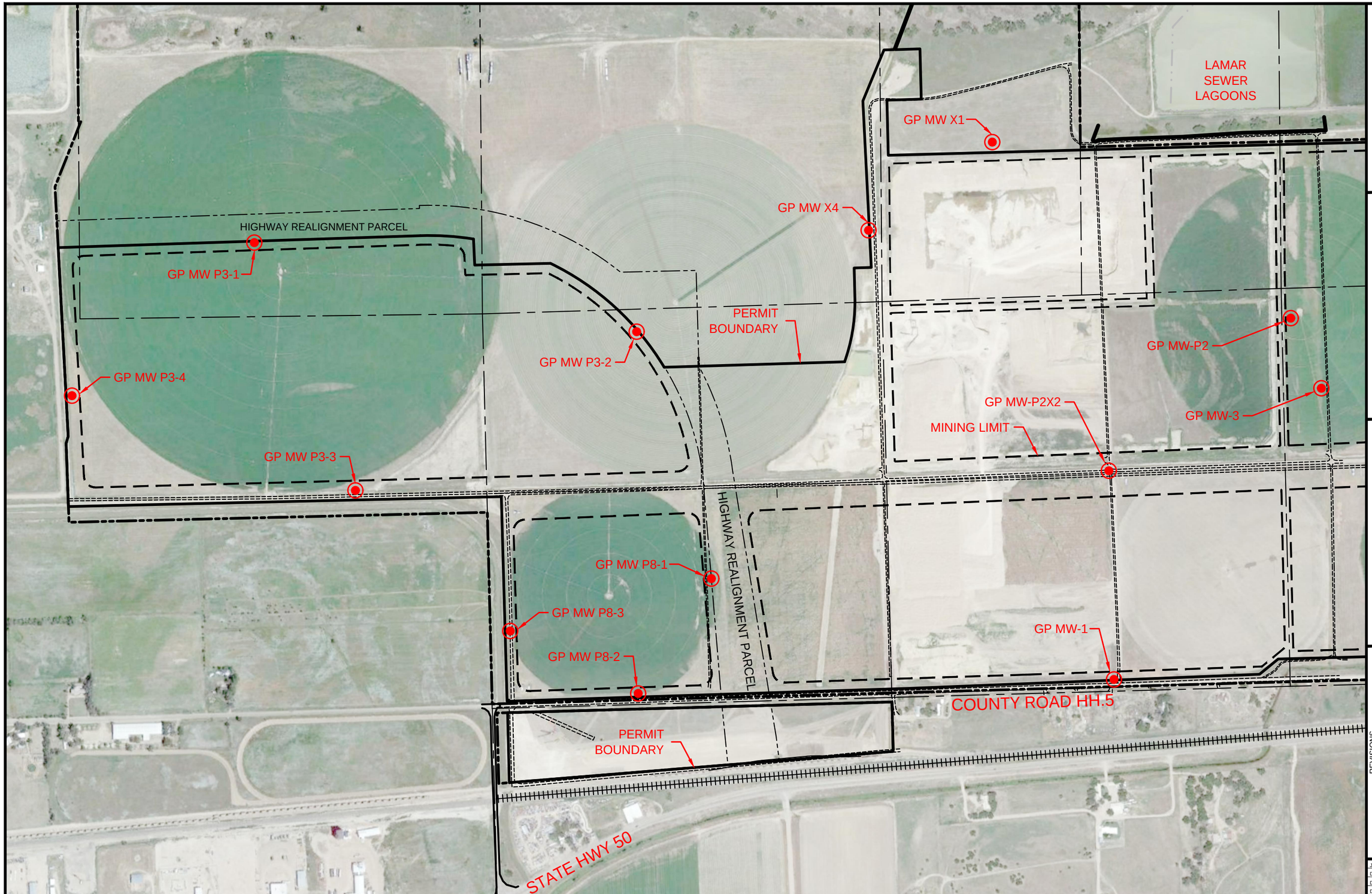
A typical assessment of the degree of "error" in the model calibration is the root-mean-square (RMS) of the residuals (residual means the difference between modeled and observed water level at each well). A rule-of-thumb goal is for the RMS error to be less than 10% of the range in heads across the observed data. Our data set covers observations between 3550 and 3620 ft (a 70 ft range). The scaled RMS values of 10.2 ft which is higher than the 10% goal of 7 ft (70/10). Again, we believe this is due to the many sources of error in the measured data set.

Figure A-1: Observed verses Modeled Water Levels



Despite some uncertainties, we believe the model is the best tool to evaluate impacts caused by pit development for the following reasons:

- The model was constructed using most available data;
- We accounted for the most important inflow and outflow parameters using available data and reasonable assumptions;
- We used site specific test data to determine aquifer properties;
- Modeled water levels (**Figure 9**) appear reasonable compared to past (**Figure 6**) and recent measurements;
- The model mass balances show minimal error; and
  The model results are relatively insensitive to aquifer properties.



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West Farm Pit

Monitoring Well Location Map

Prowers Aggregate
Operators, LLC

REVISIONS

No	Date	By	Chk	Description

Job #	07115
Date	4.2.21
Drawn By	TPY
Designed By	TPY
Checked By	JCY
File	2020 Mon Wells
Scale	As Shown

Sheet: 1 Of: 1

P:\07115 GP Ranches LLC - Lamar\Drawings\Monitoring Wells\2020 Monitoring Well Location Map.dwg, MonitoringLocations, 4/2/2021 10:16:00 AM

Well Designation	MW P3-1			MW P3-2			MW P3-3			MW P3-4			MW P8-1			MW P8-2			MW P8-3		
Description	North Side Phase 3			East Side Phase 3			South Side Phase 3			West Side Phase 3			East Side Phase 8			South Side Phase 8			West Side Phase 8		
Top of Well Elevation (ft)	3609.65			3606.63			3609.97			3611.54			3606.80			3607.88			3609.29		
Ground Elevation (ft)	3607.55			3604.38			3607.72			3609.39			3604.13			3605.13			3606.66		
Date	Depth to Groundwater from Top of Well (ft)	Depth to Groundwater from Ground (ft)	Elevation of Groundwater (ft)	Depth to Groundwater from Top of Well (ft)	Depth to Groundwater from Ground (ft)	Elevation of Groundwater (ft)	Depth to Groundwater from Top of Well (ft)	Depth to Groundwater from Ground (ft)	Elevation of Groundwater (ft)	Depth to Groundwater from Top of Well (ft)	Depth to Groundwater from Ground (ft)	Elevation of Groundwater (ft)	Depth to Groundwater from Top of Well (ft)	Depth to Groundwater from Ground (ft)	Elevation of Groundwater (ft)	Depth to Groundwater from Top of Well (ft)	Depth to Groundwater from Ground (ft)	Elevation of Groundwater (ft)	Depth to Groundwater from Top of Well (ft)	Depth to Groundwater from Ground (ft)	Elevation of Groundwater (ft)
January 8, 2021	10.40	8.30	3599.25	10.10	7.85	3596.53	11.07	8.82	3598.90	10.25	8.10	3601.29									
January 22, 2021	10.75	8.65	3598.90	10.50	8.25	3596.13	11.00	8.75	3598.97	10.50	8.35	3601.04									
February 3, 2021	10.75	8.65	3598.90	10.50	8.25	3596.13	11.25	9.00	3598.72	10.50	8.35	3601.04	10.54	7.87	3596.26	11.00	8.25	3596.88	11.92	9.29	3597.37
February 19, 2021	10.5	8.4	3599.15	10.3	8.05	3596.33	11.5	9.25	3598.47	10.5	8.35	3601.04	11	8.33	3595.8	11	8.25	3596.88	12.25	9.62	3597.04
March 9,2021	10.75	8.65	3598.9	10.5	8.25	3596.13	11.5	9.25	3598.47	10.5	8.35	3601.04	11	8.33	3595.8	11.25	8.5	3596.63	12.25	9.62	3597.04
March 25,2021	10.5	8.4	3599.15	10.25	8	3596.38	10.75	8.5	3599.22	10.25	8.1	3601.29	10.75	8.08	3596.05	11	8.25	3596.88	12.25	9.62	3597.04

EXHIBIT L

Reclamation Cost

Slurry walls have been constructed around Phases 1 and 2, and have been tested to ensure they meet the performance standard in the “State Engineer Guidelines for Lining Criteria for Gravel Pits”. See the attached approval letters from the State of Colorado Division of Water Resources. Phase 8 will be the next area where a slurry wall will be constructed, then Phase 3 Phase 4, Phase 5, and Phase 6. Phases 7-9 will be mined after Phase 6 but the order in which these phases are mined is not determined at this time.

The financial warranty required for each phase of mining includes cost components for the areas of scarification of ground, topsoil placement, and revegetation required for that phase.

Direct costs related to the construction of the reclamation components that have been included in the financial warranty calculations include: Backfill placement, scarifying disturbed ground surfaces, re-applying topsoil over disturbed areas, revegetating disturbed areas, slurry wall construction, and contractor mobilization. The slurry wall costs are based on the average depth of the wall to calculate the per lineal foot cost.

Overhead, profit, and project management costs were then calculated and added to the direct construction costs to arrive at the required financial warranty for each phase.

The financial warranty for all north mining phases and all disturbed areas has been calculated for the maximum anticipated disturbed area for the mine.

Please see the attached calculations for details of the costs and quantities used to determine the financial warranty required for the mine.

The following table summarizes the financial warranty required for each phase, and the cumulative financial warranty that will be provided during any given phase.

Reclamation Cost Summary			
Phase	Disturbed Area (acres)	Financial Warranty Required	Cumulative Financial Warranty
Disturbed Areas, Includes: Disturbed Areas West of Pit Road Adjacent to Phase 1 Ditch to River Parking Area	6.25	$29,739	$29,739
Non-Mining Areas (Surface Only Activity), Includes: West Wash Plant, Stockpile, and Sediment Pond Area Parcel B Area Surface Disturbance for Stockpiles & Plant Site in Phase 7 Surface Disturbance for Stockpiles, Sediment Ponds, and Scale House in Phase 9	336.92	$1,579,669	$1,609,408
Mining Phase 1	41.81	$281,621	$1,891,029
Mining Phase 2	84.18	$567,832	$2,458,861
Mining Phase 8	42.13	$1,177,908	$3,636,769
Mining Phase 3	143.46	$4,395,381	$8,032,150
Mining Phase 4	258.95	$4,400,439	$12,432,588
Mining Phase 5	181.46	$2,971,945	$15,404,533
Mining Phase 6	212.74	$3,632,605	$19,037,138
Mining Phase 7	144.66	$2,371,877	$21,409,015
Mining Phase 9	108.84	$2,693,339	$24,102,355

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Summary of Unit Costs
Costs Taken from TR 5 and Amendment 1 Bond Calculation by DRMS

Direct costs	Full Cost	
Backfill Placement	$3.00	/ cyd
Scarifying Ground	$321.55	/ acre
Re-applying topsoil 12" thick	$2,541.03	/ acre
Revegetating disturbed area	$1,100.32	/ acre
Mobilization	$54,000.00	lump sum

Slurry Wall Cost Breakdown		20% Cost
Slurry Wall Cost (30 foot average depth)	$170 / linear foot	$34 / linear foot
Slurry Wall Cost (35 foot average depth)	$198 / linear foot	$40 / linear foot
Slurry Wall Cost (40 foot average depth)	$227 / linear foot	$45 / linear foot
Slurry Wall Cost (50 foot average depth)	$284 / linear foot	$57 / linear foot
Slurry Wall Cost (60 foot average depth)	$340 / linear foot	$68 / linear foot
Slurry Wall Cost (70 foot average depth)	$397 / linear foot	$79 / linear foot

Overhead and Profit Costs			
Liability insurance		2.02%	of direct cost
Performance bond		1.05%	of direct cost
Profit		10.00%	of direct cost
	Total Overhead Cost	13.07%	of direct cost

Project Management			
Engineering and bidding		2.00%	of direct cost
Management and administration		5.00%	of direct cost
	Total Additional Cost	7.00%	of direct cost

Disturbed Areas (Reclamation of These Areas are Complete)

Reclamation Operation	Quantity	Unit	Unit Cost	Cost
Disturbed Areas West of Pit Road Adjacent to Phase 1 / Ditch to River				
Scarify Ground in Disturbed Area	3.09	ac	$322	$994
Topsoil Disturbed Area	3.09	ac	$2,541	$7,852
Revegetate Disturbed Area	3.09	ac	$1,100	$3,400
Parking Area				
Scarifying Ground in Disturbed Area	3.16	ac	$322	$1,016
Topsoil Placement in Disturbed Area	3.16	ac	$2,541	$8,030
Revegetate Disturbed Area	3.16	ac	$1,100	$3,477
			Total Direct Cost	$24,768
			Overhead and Profit Cost (13.07%)	$3,237
			Contract Cost	$28,005
			Project Management (7.00%)	$1,734
Financial Warranty Required For Disturbed Areas				***$29,739***

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Non-Mining Areas (Surface Only Activity)

Reclamation Operation	Quantity	Unit	Unit Cost	Cost
West Wash Plant, Stockpile, and Sediment Pond Area				
Backfill Sediment Ponds	6,145	cyd	$3.00	$18,435
Scarifying Ground in Disturbed Area	18.24	ac	$322	$5,865
Topsoil Placement in Disturbed Area	18.24	ac	$2,541	$46,348
Revegetate Disturbed Area	18.24	ac	$1,100	$20,070
Parcel B Area				
Scarifying Ground in Disturbed Area	23.05	ac	$322	$7,412
Topsoil Placement in Disturbed Area	23.05	ac	$2,541	$58,571
Revegetate Disturbed Area	23.05	ac	$1,100	$25,362
Radial Stacker Pad Concrete Removal	1.00	LS	$3,000	$3,000
Stockpile and Plant Site Areas (Surface only in Phase 7)				
Scarifying Ground in Disturbed Area	144.66	ac	$322	$46,515
Topsoil Placement in Disturbed Area	144.66	ac	$2,541	$367,585
Revegetate Disturbed Area	144.66	ac	$1,100	$159,172
Stockpile, Sediment Pond Areas, & Scale House Area (Surface only in Phase 9)				
Backfill Sediment Ponds	17,655	cyd	$3.00	$52,965
Scarifying Ground in Disturbed Area	108.84	ac	$322	$34,998
Topsoil Placement in Disturbed Area	108.84	ac	$2,541	$276,566
Removal & Disposal of Conveyer Ties, Wash Screen and Head Unit Pads	1.00	ls	$19,000	$19,000
Revegetate Disturbed Area	108.84	ac	$1,100	$119,759
Mobilization	1.00	ls	$54,000	$54,000
			Total Direct Cost	$1,315,623
			Overhead and Profit Cost (13.07%)	$171,952
			Contract Cost	$1,487,575
			Project Management (7.00%)	$92,094
Financial Warranty Required For Initial Non-Mining Disturbed Areas				***$1,579,669***

Phase 1 (36.31 acres) (Slurry wall has been constructed and leak test approved by State)

Reclamation Operation	Quantity	Unit	Unit Cost	Cost
Topsoil Area Above Water Required for Phase 1	5.01	ac	$2,541	$12,726
Revegetate Area Above Water Required for Phase 1	5.01	ac	$1,100	$5,511
20% Cost of Slurry Wall on South/East side of Phase 1 (70' avg Depth)	2,725	lf	$79	$216,311
			Total Direct Cost	$234,547
			Overhead and Profit Cost (13.07%)	$30,655
			Contract Cost	$265,203
			Project Management (7.00%)	$16,418
Financial Warranty Required For Phase 1				***$281,621***

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Phase 2 (75.09 acres) (Slurry wall has been constructed and leak test approved by State)

Reclamation Operation	Quantity	Unit	Unit Cost	Cost
Active Mining Area				
Topsoil Area Above Water Required for Phase 2	6.08	ac	$2,541	$15,459
Revegetate Area Above Water Required for Phase 2	6.08	ac	$1,100	$6,694
20% Cost of Slurry Wall on Outside of Phase 2 (60' avg Depth)	6,625	lf	$68	$450,765
			Total Direct Cost	$472,917
			Overhead and Profit Cost (13.07%)	$61,810
			Contract Cost	$534,728
			Project Management (7.00%)	$33,104
Additional Financial Warranty Required For Phase 2				***$567,832***

Phase 8 (32.66 acres)

Reclamation Operation	Quantity	Unit	Unit Cost	Cost
Active Mining Area				
Scarifying Ground in Disturbed Area	6.48	ac	$322	$2,084
Topsoil Area Above Water Required for Phase 8	6.48	ac	$2,541	$16,466
Revegetate Area Above Water Required for Phase 8	6.48	ac	$1,100	$7,130
Cost of Slurry Wall Phase 8 (35' avg Depth)	4,814	lf	$198	$955,338
			Total Direct Cost	$981,018
			Overhead and Profit Cost (13.07%)	$128,219
			Contract Cost	$1,109,237
			Project Management (7.00%)	$68,671
Additional Financial Warranty Required For Phase 8				***$1,177,908***

Phase 3 (128.09 acres)

Reclamation Operation	Quantity	Unit	Unit Cost	Cost
Active Mining Area				
Topsoil Area Above Water Required for Phase 3	14.33	ac	$2,541	$36,413
Revegetate Area Above Water Required for Phase 3	14.33	ac	$1,100	$15,768
Cost of Slurry Wall Phase 3 (60' avg Depth)	10,607	lf	$340	$3,608,501
			Total Direct Cost	$3,660,682
			Overhead and Profit Cost (13.07%)	$478,451
			Contract Cost	$4,139,133
			Project Management (7.00%)	$256,248
Additional Financial Warranty Required For Phase 3				***$4,395,381***

Phase 4 (237.82 acres)

Reclamation Operation	Quantity	Unit	Unit Cost	Cost
Active Mining Area				
Topsoil Area Above Water Required for Phase 4	19.80	ac	$2,541	$50,312
Revegetate Area Above Water Required for Phase 4	19.80	ac	$1,100	$21,786
Cost of Slurry Wall Phase 4 (50' avg Depth)	12,673	lf	$284	$3,592,796
			Total Direct Cost	$3,664,894
			Overhead and Profit Cost (13.07%)	$479,002
			Contract Cost	$4,143,896
			Project Management (7.00%)	$256,543
Additional Financial Warranty Required For Phase 4				***$4,400,439***

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Phase 5 (164.44 acres)

Reclamation Operation	Quantity	Unit	Unit Cost	Cost
Active Mining Area				
Topsoil Area Above Water Required for Phase 5	19.12	ac	$2,541	$48,584
Revegetate Area Above Water Required for Phase 5	19.12	ac	$1,100	$21,038
Cost of Slurry Wall Phase 5 (30' avg Depth)	14,142	lf	$170	$2,405,554
			Total Direct Cost	$2,475,177
			Overhead and Profit Cost (13.07%)	$323,506
			Contract Cost	$2,798,682
			Project Management (7.00%)	$173,262
Additional Financial Warranty Required For Phase 5				***$2,971,945***

Phase 6 (195.02 acres)

Reclamation Operation	Quantity	Unit	Unit Cost	Cost
Active Mining Area				
Topsoil Area Above Water Required for Phase 6	20.12	ac	$2,541	$51,126
Revegetate Area Above Water Required for Phase 6	20.12	ac	$1,100	$22,138
Cost of Slurry Wall Phase 6 (35' avg Depth)	14,876	lf	$198	$2,952,142
			Total Direct Cost	$3,025,406
			Overhead and Profit Cost (13.07%)	$395,421
			Contract Cost	$3,420,827
			Project Management (7.00%)	$211,778
Additional Financial Warranty Required For Phase 6				***$3,632,605***

Phase 7 (121.68 acres)

Reclamation Operation	Quantity	Unit	Unit Cost	Cost
Active Mining Area				
Scarifying Ground in Disturbed Area (Credit from Above Surface Only Activity)	(144.66)	ac	$322	-$46,515
Topsoil Area Above Water Required for Phase 7 (Credit from Above)	(144.66)	ac	$2,541	-$367,585
Revegetate Area Above Water Required for Phase 7 (Credit from Above)	(144.66)	ac	$1,100	-$159,172
Scarifying Ground in Disturbed Area	16.23	ac	$322	$5,219
Topsoil Area Above Water Required for Phase 7	16.23	ac	$2,541	$41,241
Revegetate Area Above Water Required for Phase 7	16.23	ac	$1,100	$17,858
Cost of Slurry Wall Phase 7 (40' avg Depth)	10,954	lf	$227	$2,484,367
			Total Direct Cost	$1,975,412
			Overhead and Profit Cost (13.07%)	$258,186
			Contract Cost	$2,233,598
			Project Management (7.00%)	$138,279
Additional Financial Warranty Required For Phase 7				***$2,371,877***

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Phase 9 (91.38 acres)

Reclamation Operation	Quantity	Unit	Unit Cost	Cost
Active Mining Area				
Scarifying Ground in Disturbed Area (Credit from Above Surface Only Activity)	(108.84)	ac	$322	-$34,998
Topsoil Area Above Water Required for Phase 7 (Credit from Above)	(108.84)	ac	$2,541	-$276,566
Revegetate Area Above Water Required for Phase 7 (Credit from Above)	(108.84)	ac	$1,100	-$119,759
Scarifying Ground in Disturbed Area	12.50	ac	$322	$4,019
Topsoil Area Above Water Required for Phase 9	12.50	ac	$2,541	$31,763
Revegetate Area Above Water Required for Phase 9	12.50	ac	$1,100	$13,754
Cost of Slurry Wall Phase 9 (50' avg Depth)	9,259	lf	$284	$2,624,927
			Total Direct Cost	$2,243,141
			Overhead and Profit Cost (13.07%)	$293,178
			Contract Cost	$2,536,319
			Project Management (7.00%)	$157,020

Additional Financial Warranty Required For Phase 9	***$2,693,339***

Total Financial Warranty Required For All Phases	***$24,102,355***

Odin Construction Solutions Slurry Wall Bid Pricing

Phase	SF	Unit	Price	% total	Work Pad	Mob	Bonds	Mix Design	Prorated Mob	Prorated Bond	Prorated Mix	Total Cost	Wall Length	Cost per LF	Cost per SF
3	595,140	$5.25	$3,124,485	78.97%	$50,000				$304,043	$39,486	$11,846	$3,529,860	10,607	$333	$5.93
8	166,390	$5.00	$831,950	21.03%	$20,000				$80,957	$10,514	$3,154	$946,575	4,814	$197	$5.69
Totals	761,530		$3,956,435	100.00%	$70,000	$385,000	$50,000	$15,000				$4,476,435	15,421	$290	$5.88

PROPOSAL

West Farm Pit Phase 3 and Phase 8 Slurry Wall

March 18, 2021 | 4:00 PM MST



Odin

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Odin

March 18, 2021

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305 Denver Avenue, Suite D
Ft. Lupton, CO 80621

Subject: Proposal for West Farm Pit Phase 3 and Phase 8 Slurry Wall — Lamar, CO

Dear Mr. York,

Thank you for considering Odin Construction Solutions (Odin) for the above-referenced project. Odin is pleased to submit this proposal to J&T Consulting, Inc. and Prowers Aggregate Operators, LLC for review and consideration and look forward to presenting our approach to the work at your convenience.

We look forward to delivering to your firm the highest level of safety performance, quality work, and professionalism. In addition to our work in the field, our goal is to provide you with outstanding customer service and deliver your project on time and on budget.

Enclosed is Odin's proposal for the work to be performed on the West Farm Pit Phase 3 and Phase 8 Slurry Wall located in Lamar, Colorado. This Proposal is based on the provided Contract Documents & Technical Specifications dated February 2021, Addendum 1 (dated March 5, 2021), Addendum 2 (dated March 9, 2021), information provided during the site walk, and the terms and conditions provided herein.

We have assembled a team of qualified professionals and model safety performers for this project who have completed numerous slurry wall projects for a wide range of federal, state, municipal, and private sector customers. Our experienced highly qualified staff, and comprehensive safety culture, ensures a unique turn-key solution for this project.

ASSUMPTIONS & CLARIFICATIONS

1. This proposal is conditioned upon the Parties negotiating and executing a mutually agreeable contract agreement which will include this proposal as part of that agreement.
2. Odin's proposal is based on a schedule of working six days per week and ten hours per day.
3. Odin assumes that excess excavated materials from slurry wall installation will be allowed to be disposed of on-site within the mining limits of the slurry wall.
4. Odin assumes that the Engineer will provide personnel for determination of bedrock key-in during project execution.

SERVICES TO BE PROVIDED BY OTHERS

The following services shall be provided by Owner or Others it designates, at no cost to Odin:

1. Sufficient quantity of fines available on-site suitable for backfill within each slurry wall.
2. Availability of a source of suitable mixing water within 300 ft. of our mixing plant. A minimum of 300 gpm would be required.
3. Unimpeded site access to our work area, including access for truck trailers to the staging area.
4. All easements and regulatory agency permits that may be required.
5. Locating, relocating, and repairing of unknown underground utilities or relocating overhead utilities that would interfere with our work.

We look forward to working with you on this project, should you require additional information or discussion of this proposal in detail, please contact me at 720.273.3548.

Sincerely,

Odin Construction Solutions, Inc.



Trey Mangers
Vice President Rocky Mountain Region

01 Bid Form

J&T Consulting, Inc.

Prowers Aggregate Operators, LLC

West Farm Pit Slurry Wall, Phases 3 and 8
2/18/2021

Bid Form

© 2021 **J&T Consulting, Inc.**

Base Bid

Item Number	Description	Quantity	Unit	Unit Price	Total Price
1	Project Mobilization/Demobilization	1	LS	$385,000.00	$385,000.00
2	Payment and Performance Bonds	1	LS	$50,000.00	$50,000.00
3	Slurry Wall Mix Design	1	LS	$15,000.00	$15,000.00
4	Phase 3 Work Pad Construction, Including Mining and Processing of Fines, Clearing of Brush and Top Soil, 75 Foot Width, Complete in Place	1	LS	$50,000.00	$50,000.00
5	Phase 8 Work Pad Construction, Including Mining and Processing of Fines, Clearing of Brush and Top Soil, 75 Foot Width, Complete in Place	1	LS	$20,000.00	$20,000.00
6	Phase 3 Soil/Bentonite Slurry Wall Installation, Including 1% Dry Bentonite Addition, 12 in Minimum Height Temporary Cap, Double Heading Construction Complete in Place	595,140	SF	$5.25	$3,124,485.00
7	Phase 8 Soil/Bentonite Slurry Wall Installation, Including 1% Dry Bentonite Addition, 12 in Minimum Height Temporary Cap, Double Heading Construction Complete in Place	166,390	SF	$5.00	$831,950.00
				Bid Total	$4,476,435.00

Unit Pricing

U1	Additional Excavation for Second Refusal Period, 40 foot Set Length, Complete in Place	1	Per Period	$3,000.00	$3,000.00

Base Bid Total Price in Words four million four hundred seventy-six thousand four hundred thirty-five dollars and zero cents

This bid schedule is understood to be all inclusive of the work shown on the contract documents. Items that are not specifically indicated by an individual bid item are understood to be incidental and included in the lump sum cost of a related bid item.

Signature _____ Louay M. Owaidat, President and CEO

Company Odin Construction Solutions, Inc.

Corporate Address: 4740 Rocklin Road, Rocklin, CA 95677
State of Incorporation: California



02 Bid Bond

SECTION 00 43 13

BID BOND

Any singular reference to Bidder, Surety, Owner or other party shall be considered plural where applicable.

BIDDER *(Name and Address)*:
Odin Construction Solutions, Inc. dba Odin Engineering
4740 Rocklin Road
Rocklin CA 95677

SURETY *(Name and Address of Principal Place of Business)*:
Fidelity and Deposit Company of Maryland
1299 Zurich Way, 5th Floor
Schaumburg, IL 60196-1056

OWNER *(Name and Address)*:
Prowers Aggregate Operators, LLC
7991 Shaffer Parkway, Suite #200
Littleton, CO 80127

BID

Bid Due Date: March 18, 2021
Description *(Project Name and Include Location)*: West Farm Pit Phase 3 & Phase 8 Slurry Wall, Littleton, CO

BOND

Bond Number: N/A
Date *(Not earlier than Bid due date)*: March 16, 2021
Penal sum Five Percent of the Amount Bid (Words) $ 5% of amount bid (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms set forth below, do each cause this Bid Bond to be duly executed by an authorized officer, agent, or representative.

BIDDER	**SURETY**
Odin Construction Solutions, Inc. dba Odin Engineering (Seal)	Fidelity and Deposit Company of Maryland (Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature	Signature (Attach Power of Attorney)
Larry Malek Owaidat	Sara Walliser
Print Name	Print Name
President	Attorney In Fact
Title	Title
Attest: _____	Attest: _____
Signature	Signature
Controller	Samantha Watkins
Title	Title

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

3.2 All Bids are rejected by Owner, or

3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

ACKNOWLEDGMENT

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of Butte

On March 16, 2021 before me, Deanna Quintero, Notary Public
(insert name and title of the officer)

personally appeared Sara Walliser
who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/~~are~~ subscribed to the within instrument and acknowledged to me that ~~he~~/she/~~they~~ executed the same in ~~his~~/her/~~their~~ authorized capacity(~~ies~~), and that by ~~his~~/her/~~their~~ signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____ (Seal)

ARS3 DEANNA QUINTERO
COMM. # 2261479
NOTARY PUBLIC · CALIFORNIA
COUNTY OF BUTTE
Comm. Expires OCT. 6, 2022 ARS3

ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND
POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That the ZURICH AMERICAN INSURANCE COMPANY, a corporation of the State of New York, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, a corporation of the State of Illinois, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND a corporation of the State of Illinois (herein collectively called the "Companies"), by **Robert D. Murray, Vice President**, in pursuance of authority granted by Article V, Section 8, of the By-Laws of said Companies, which are set forth on the reverse side hereof and are hereby certified to be in full force and effect on the date hereof, do hereby nominate, constitute, and appoint **Renee Ramsey, John Hopkins, John J. Weber, Joseph H. Weber, Marissa Robinson, Stephanie Agapoff, Matthew Foster, Mary Collins, Sara Walliser, Jessica Monlux, Elizabeth Collodi, K. Corey Ward, Deanna Quintero, Samantha Watkins, Steven L. Williams, Phil Watkins, and Jennifer Lakmann, all of Chico, California,** its true and lawful agent and Attorney-in-Fact, to make, execute, seal and deliver, for, and on its behalf as surety, and as its act and deed: **any and all bonds and undertakings,** and the execution of such bonds or undertakings in pursuance of these presents, shall be as binding upon said Companies, as fully and amply, to all intents and purposes, as if they had been duly executed and acknowledged by the regularly elected officers of the ZURICH AMERICAN INSURANCE COMPANY at its office in New York, New York., the regularly elected officers of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at its office in Owings Mills, Maryland., and the regularly elected officers of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at its office in Owings Mills, Maryland., in their own proper persons .

The said Vice President does hereby certify that the extract set forth on the reverse side hereof is a true copy of Article V, Section 8, of the By-Laws of said Companies, and is now in force.

IN WITNESS WHEREOF, the said Vice-President has hereunto subscribed his/her names and affixed the Corporate Seals of the said **ZURICH AMERICAN INSURANCE COMPANY, COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and FIDELITY AND DEPOSIT COMPANY OF MARYLAND,** this 21st day of January, A.D. 2021.



ATTEST:
ZURICH AMERICAN INSURANCE COMPANY
COLONIAL AMERICAN CASUALTY AND SURETY COMPANY
FIDELITY AND DEPOSIT COMPANY OF MARYLAND

By: Robert D. Murray
Vice President

By: Dawn E. Brown
Secretary

State of Maryland
County of Baltimore

On this 21st day of January, A.D. 2021, before the subscriber, a Notary Public of the State of Maryland, duly commissioned and qualified, **Robert D. Murray, Vice President and Dawn E. Brown, Secretary** of the Companies, to me personally known to be the individuals and officers described in and who executed the preceding instrument, and acknowledged the execution of same, and being by me duly sworn, deposeth and saith, that he/she is the said officer of the Company aforesaid, and that the seals affixed to the preceding instrument are the Corporate Seals of said Companies, and that the said Corporate Seals and the signature as such officer were duly affixed and subscribed to the said instrument by the authority and direction of the said Corporations.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Official Seal the day and year first above written.



Constance A. Dunn, Notary Public
My Commission Expires: July 9, 2023

EXTRACT FROM BY-LAWS OF THE COMPANIES

"Article V, Section 8, Attorneys-in-Fact. The Chief Executive Officer, the President, or any Executive Vice President or Vice President may, by written instrument under the attested corporate seal, appoint attorneys-in-fact with authority to execute bonds, policies, recognizances, stipulations, undertakings, or other like instruments on behalf of the Company, and may authorize any officer or any such attorney-in-fact to affix the corporate seal thereto; and may with or without cause modify of revoke any such appointment or authority at any time."

CERTIFICATE

I, the undersigned, Vice President of the ZURICH AMERICAN INSURANCE COMPANY, the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY, and the FIDELITY AND DEPOSIT COMPANY OF MARYLAND, do hereby certify that the foregoing Power of Attorney is still in full force and effect on the date of this certificate; and I do further certify that Article V, Section 8, of the By-Laws of the Companies is still in force.

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the ZURICH AMERICAN INSURANCE COMPANY at a meeting duly called and held on the 15th day of December 1998.

RESOLVED: "That the signature of the President or a Vice President and the attesting signature of a Secretary or an Assistant Secretary and the Seal of the Company may be affixed by facsimile on any Power of Attorney...Any such Power or any certificate thereof bearing such facsimile signature and seal shall be valid and binding on the Company."

This Power of Attorney and Certificate may be signed by facsimile under and by authority of the following resolution of the Board of Directors of the COLONIAL AMERICAN CASUALTY AND SURETY COMPANY at a meeting duly called and held on the 5th day of May, 1994, and the following resolution of the Board of Directors of the FIDELITY AND DEPOSIT COMPANY OF MARYLAND at a meeting duly called and held on the 10th day of May, 1990.

RESOLVED: "That the facsimile or mechanically reproduced seal of the company and facsimile or mechanically reproduced signature of any Vice-President, Secretary, or Assistant Secretary of the Company, whether made heretofore or hereafter, wherever appearing upon a certified copy of any power of attorney issued by the Company, shall be valid and binding upon the Company with the same force and effect as though manually affixed.

IN TESTIMONY WHEREOF, I have hereunto subscribed my name and affixed the corporate seals of the said Companies, this 16th day of March, 2021.



Brian M. Hodges, Vice President

TO REPORT A CLAIM WITH REGARD TO A SURETY BOND, PLEASE SUBMIT A COMPLETE DESCRIPTION OF THE CLAIM INCLUDING THE PRINCIPAL ON THE BOND, THE BOND NUMBER, AND YOUR CONTACT INFORMATION TO:

Zurich Surety Claims
1299 Zurich Way
Schaumburg, IL 60196-1056
www.reportsfclaims@zurichna.com
800-626-4577

CALIFORNIA ACKNOWLEDGMENT CIVIL CODE § 1189

A notary public or other officer completing this certificate verifies only the identity of the individual who signed the document to which this certificate is attached, and not the truthfulness, accuracy, or validity of that document.

State of California
County of Placer }

On March 17th 2021 before me, Jordan Brown, Notary Public
Date *Here Insert Name and Title of the Officer*

personally appeared Louay Malek Owaidat
Name(s) of Signer(s)

who proved to me on the basis of satisfactory evidence to be the person(s) whose name(s) is/are subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their authorized capacity(ies), and that by his/her/their signature(s) on the instrument the person(s), or the entity upon behalf of which the person(s) acted, executed the instrument.

JORDAN ALLEN WOLCOTT BROWN
Notary Public – California
Placer County
Commission # 2233454
My Comm. Expires Mar 8, 2022

Place Notary Seal and/or Stamp Above

I certify under PENALTY OF PERJURY under the laws of the State of California that the foregoing paragraph is true and correct.

WITNESS my hand and official seal.

Signature _____
Signature of Notary Public

OPTIONAL

Completing this information can deter alteration of the document or fraudulent reattachment of this form to an unintended document.

Description of Attached Document

Title or Type of Document: _____

Document Date: _____ Number of Pages: _____

Signer(s) Other Than Named Above: _____

Capacity(ies) Claimed by Signer(s)

Signer's Name: _____	Signer's Name: _____
☐ Corporate Officer – Title(s): _____	☐ Corporate Officer – Title(s): _____
☐ Partner – ☐ Limited ☐ General	☐ Partner – ☐ Limited ☐ General
☐ Individual ☐ Attorney in Fact	☐ Individual ☐ Attorney in Fact
☐ Trustee ☐ Guardian or Conservator	☐ Trustee ☐ Guardian or Conservator
☐ Other: _____	☐ Other: _____
Signer is Representing: _____	Signer is Representing: _____

©2019 National Notary Association

03 Subcontractors

SECTION 00 45 13

PROPOSED SUBCONTRACTORS FORM

LIST OF SUBCONTRACTORS

Herewith is the list of subcontractors referenced in the bid submitted by:

(Bidder)

To: (Owner) Prowers Aggregate Operators, LLC

Dated: March 18, 2021, and which is an integral part of the Bid Form.

The following work will be performed (or provided) by subcontractors and coordinated by us:

WORK SUBJECT	NAME
Surveying	Cardinal Points Surveying, Inc.

END OF SECTION

04 Noncollusion Affidavit

SECTION 00 45 19

NONCOLLUSION AFFIDAVIT OF PRIME BIDDER

STATE OF California
COUNTY OF Placer

Louay M. Owaidat, being first duly sworn, deposes and says that:

(1) He is the President of Odin Construction Solutions, Inc., the Bidder that has submitted the attached Bid;

(2) He is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;

(3) Such Bid is genuine and is not a collusive or sham bid;

(4) Neither the said Bidder nor any of its officers, partner, owners agents, representatives, employees or parties in interest, including this affiant, has in any way colluded, conspired, connived, or agreed, directly or indirectly, with any other Bidder, firm or person to submit a collusive or sham Bid in connection with the Contract for which the attached Bid has been submitted or to refrain from bidding in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, or to fix any overhead, profit or cost element of the bid price or the bid price of any other Bidder, or to secure through the collusion, conspiracy, connivance or unlawful agreement any advantage against the Owner or persons interested in the proposed Contract; and

(5) The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this affiant.

Signed: _____

_____

Subscribed and sworn to before me this 18th day of March, 2021, by Louay M. Owaidat, as (Affiant) President, of Odin Construction Solutions, Inc., a (title) (Bidder) Corporation, organized pursuant to (corporation or partnership) the laws of the State of California.

JORDAN ALLEN-WOLCOTT BROWN
Notary Public - California
Placer County
Commission # 2233454
My Comm. Expires Mar 8, 2022

_____
Notary Public

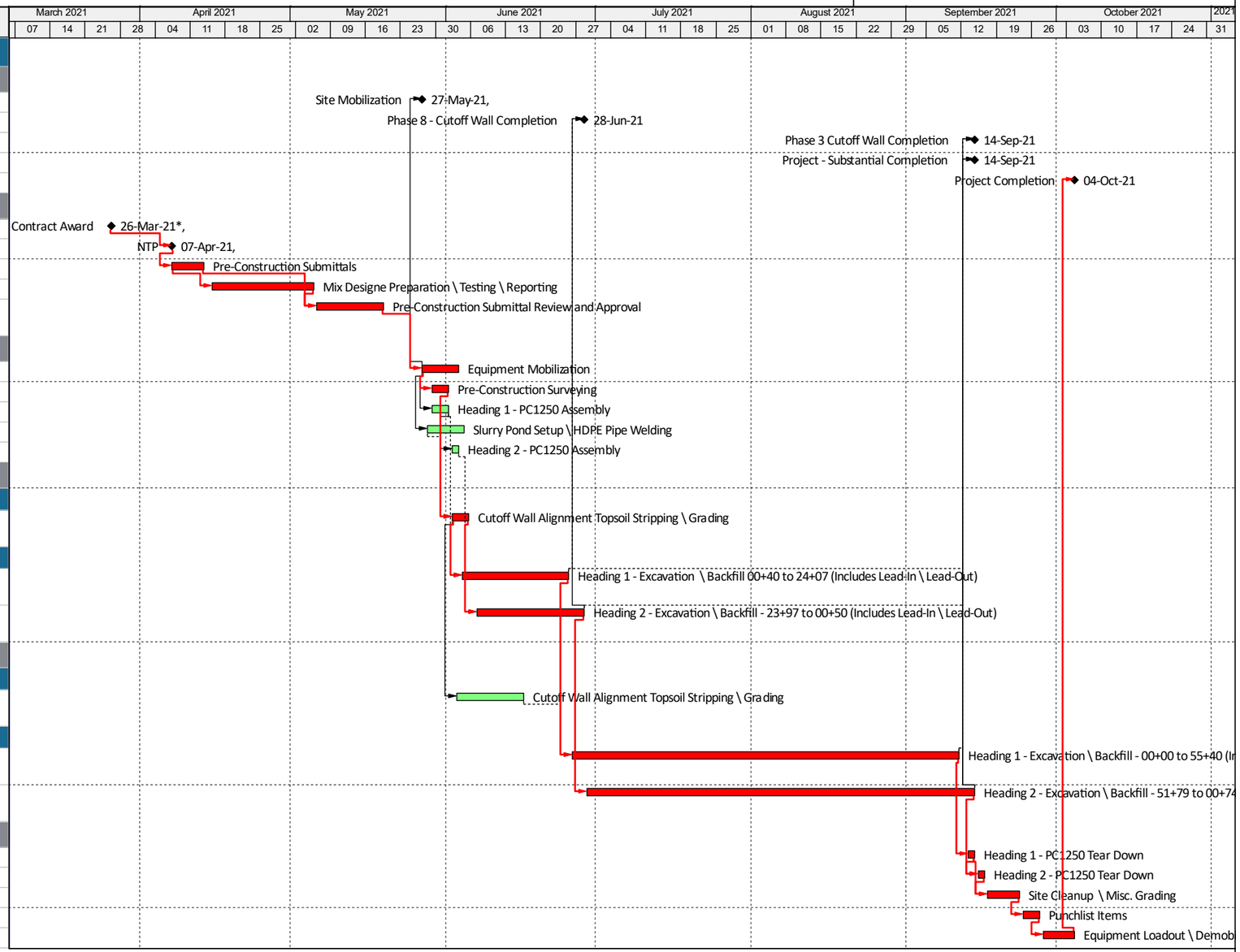
My Commission Expires March 8, 2022

05 Schedule

WEST FARM PIT PHASE 3 AND PHASE 8
SLURRY WALL
Preliminary Construction Schedule

18-Mar-21 09:47

Activity ID	Activity Name	Duration	Start	Finish
West Farm Pit Slurry Wall, Phase 3 and 8		165	26-Mar-21	04-Oct-21
Project Milestones		112	27-May-21	04-Oct-21
MS1000	Site Mobilization	0	27-May-21	
MS1010	Phase 8 - Cutoff Wall Completion	0		28-Jun-21
MS1020	Phase 3 Cutoff Wall Completion	0		14-Sep-21
MS1030	Project - Substantial Completion	0		14-Sep-21
MS1040	Project Completion	0		04-Oct-21
Pre-Construction		39	26-Mar-21	19-May-21
PRC1000	Contract Award	0	26-Mar-21*	
PRC1010	NTP	0	07-Apr-21	
PRC1020	Pre-Construction Submittals	5	07-Apr-21	13-Apr-21
PRC1030	Mix Designe Preparation \ Testing \ Reporting	15	15-Apr-21	05-May-21
PRC1040	Pre-Construction Submittal Review and Approval	10	06-May-21	19-May-21
Mobilization		7	27-May-21	04-Jun-21
M1000	Equipment Mobilization	6	27-May-21	03-Jun-21
M1010	Pre-Construction Surveying	2	29-May-21	01-Jun-21
M1020	Heading 1 - PC1250 Assembly	2	29-May-21	01-Jun-21
M1030	Slurry Pond Setup \ HDPE Pipe Welding	6	28-May-21	04-Jun-21
M1040	Heading 2 - PC1250 Assembly	2	02-Jun-21	03-Jun-21
Phase 8 - Construction		23	02-Jun-21	28-Jun-21
Workpad Construction		4	02-Jun-21	05-Jun-21
WC1000	Cutoff Wall Alignment Topsoil Stripping \ Grading	4	02-Jun-21	05-Jun-21
Soil-Bentonite Cutoff Wall Installation		21	04-Jun-21	28-Jun-21
A1000	Heading 1 - Excavation \ Backfill 00+40 to 24+07 (Includes Lead-In \ Lead-Out)	19	04-Jun-21	25-Jun-21
A1010	Heading 2 - Excavation \ Backfill - 23+97 to 00+50 (Includes Lead-In \ Lead-Out)	19	07-Jun-21	28-Jun-21
Phase 3 - Construction		87	03-Jun-21	14-Sep-21
Workpad Construction		12	03-Jun-21	16-Jun-21
WC1020	Cutoff Wall Alignment Topsoil Stripping \ Grading	12	03-Jun-21	16-Jun-21
Soil-Bentonite Cutoff Wall Installation		67	26-Jun-21	14-Sep-21
A1020	Heading 1 - Excavation \ Backfill - 00+00 to 55+40 (Includes Lead-In \ Lead-Out)	65	26-Jun-21	11-Sep-21
A1030	Heading 2 - Excavation \ Backfill - 51+79 to 00+74 (Includes Lead-In \ Lead-Out)	65	29-Jun-21	14-Sep-21
Demobilization		19	13-Sep-21	04-Oct-21
A1040	Heading 1 - PC1250 Tear Down	2	13-Sep-21	14-Sep-21
A1050	Heading 2 - PC1250 Tear Down	2	15-Sep-21	16-Sep-21
A1060	Site Cleanup \ Misc. Grading	6	17-Sep-21	23-Sep-21
A1070	Punchlist Items	3	24-Sep-21	27-Sep-21
A1080	Equipment Loadout \ Demobilization	6	28-Sep-21	04-Oct-21



Remaining Level of Effort
Remaining Work
Critical Remaining Work

West Farm Pit Slurry Wall, Phase 3 and 8
Preliminary Construction Schedule

Date	Revision	Checked	Approved
12-Mar-21	Preliminary Schedule	SLR	TM
16-Mar-21	Preliminary Schedule Rev 1	SLR	TM
17-Mar-21	Preliminary Schedule Rev 2	SLR	TM

06 Evidence of Authority

Odin

OFFICE OF THE SECRETARY OF STATE
OF THE STATE OF COLORADO

CERTIFICATE OF FACT OF GOOD STANDING

I, Jena Griswold, as the Secretary of State of the State of Colorado, hereby certify that, according to the records of this office,

Odin Construction Solutions, Inc.

is an entity formed or registered under the law of California , has complied with all applicable requirements of this office, and is in good standing with this office. This entity has been assigned entity identification number 20191121945 .

This certificate reflects facts established or disclosed by documents delivered to this office on paper through 03/17/2021 that have been posted, and by documents delivered to this office electronically through 03/18/2021 @ 11:22:53 .

I have affixed hereto the Great Seal of the State of Colorado and duly generated, executed, and issued this official certificate at Denver, Colorado on 03/18/2021 @ 11:22:53 in accordance with applicable law. This certificate is assigned Confirmation Number 13029143 .

Jena Griswold

Secretary of State of the State of Colorado

**********End of Certificate**********

Notice: A certificate issued electronically from the Colorado Secretary of State's Web site is fully and immediately valid and effective. However, as an option, the issuance and validity of a certificate obtained electronically may be established by visiting the Validate a Certificate page of the Secretary of State's Web site, http://www.sos.state.co.us/biz/CertificateSearchCriteria.do entering the certificate's confirmation number displayed on the certificate, and following the instructions displayed. Confirming the issuance of a certificate is merely optional and is not necessary to the valid and effective issuance of a certificate. For more information, visit our Web site, http://www.sos.state.co.us/ click "Businesses, trademarks, trade names" and select "Frequently Asked Questions."

ACTION BY WRITTEN CONSENT OF DIRECTORS OF
OF
ODIN CONSTRUCTION SOLUTIONS, INC.

A California Corporation

The undersigned, being all of the Directors of ODIN CONSTRUCTION SOLUTIONS, INC., a California corporation (the "Company") hereby take the following actions by written consent as authorized by Section 307 of the California Corporations Code:

The Directors having determined that it is reasonable and in the best interests of the Company and its shareholders to appoint additional officers of the Company and grant them authorities to act on behalf of the Company, hereby make the following resolutions:

RESOLVED, that the following persons are appointed to the offices as set forth opposite their names to serve at the pleasure of the Board of Directors, and all such nominees have accepted the appointments:

1. Neal MacArthur Siller, Chief Operating Officer and Vice President

2. Sean Lewis Rhodes, Vice President of Estimating

3. Deborah Frances Bradley, Controller

4. Jordan Allen-Wolcott Brown, Contracts Manager

RESOLVED FURTHER, that the foregoing officers are hereby, authorized to transact, execute and sign all documents as reasonable and necessary on behalf of the Corporation relative to and within the scope of the operations and business of the Corporation, including but not limited to bid forms, non-collusion affidavits, bid bonds, contracts, payment and performance bonds, and any person or organization dealing with the Company may rely on the authority of the foregoing officers in taking an action in the name of the Company unless the person or organization dealing with the Company has actual knowledge that the officer lacks authority to act.

The foregoing actions and resolutions shall be effective as of 1/1, 2019.

LOUAY OWAIDAT

DEBBIE BRADLEY

NEAL SILLER

SEAN RHODES

MIKE RADO

2061692.1



Odin

Rocklin, CA | Denver, CO | Bordentown, NJ | Alpharetta, GA | Houston, TX

www.odinconstruction.com

PROWERS AGGREGATE OPERATORS
9485 County Road HH .5, P.O. Box 965
Lamar, CO 81052
Phone (719) 688-4477

Southeast Colorado Power Association
3601 South Main
Lamar, CO 81052

February 22, 2021

Re: Agreement for Compensation for Damage to Structures within 200 feet of mining activities

To Whom It May Concern:

Prowers Aggregate Operators, LLC has applied for an amendment to their current State of Colorado Division of Reclamation, Mining, and Safety (DRMS) Reclamation Permit M2008-078 to allow sand and gravel mining on property within 200 feet of structures located on your property. The Colorado Mined Land Reclamation Act provides protection for your property, and specific protection for your structures located within 200 feet of the mining activities.

DRMS Permit approval requires a notarized agreement between the applicant and owners of structures within 200 feet of the mining activities, providing compensation for any damage to the structure; or preparation of an engineering evaluation acceptable to the DRMS, demonstrating that such structure(s) shall not be damaged by the mining activities if an agreement cannot be reached.

Southeast Colorado Power Association (SECPA) has agreed to relocate their powerline that crosses the Phase 3 mining area to the east edge of the highway realignment parcel, and has provided the cost required to relocated the power line to Prowers Aggregate Operators. Prowers Aggregate Operators has agreed to pay the costs associated with relocating the power line.

With this letter, Prowers Aggregate Operators, LLC (PAO) requests Southeast Colorado Power Association's (SECPA's) authorization to conduct mining and reclamation activities within 200 feet of SECPA's structure(s). In return for this operation, Prowers Aggregate Operators agrees to add SECPA as an Additional Insured for liability coverage as evidence by current certificate of insurance attached. Your notarized signature below grants permission for PAO to conduct said activities within 200 feet of SECPA's structure(s) and acts as confirmation of PAOs' commitment to provide full compensation to SECPA for its damages as set out herein.

Sincerely,

Karl Nyquist, Manager
Prowers Aggregate Operators, LLC

2/22/21
Date

State of Colorado
County of Jefferson

The foregoing instrument was acknowledged before me this February 22, 2021 (date)
by Karl Nyquist (name of person acknowledging).

(Notary's official signature)

ERICA KUERBIS
Notary Public
State of Colorado
Notary ID # 20204017041
My Commission Expires 05-15-2024

5-15-24
(Commission expiration)

Southeast Colorado Power Association

2-24-2021
Date

State of Colorado
County of Baca

The foregoing instrument was acknowledged before me this February 24th, 2021 (date)
by Marcus Stegman (name of person acknowledging).

(Notary's official signature)

MARCUS STEGMAN
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20174015935
My Commission Expires 04-13-2021

04-13-2021
(Commission expiration)

AGREEMENT

WHEREAS: The City of Lamar, Colorado (City) owns and operates a sewage treatment facility consisting of three inter-connected sewer lagoons on land described as:

> The North 1650 feet of the E ½ of the SE ¼ of Section 28 and the North 1650 Feet of the SW ¼ of Section 27, all in Twp. 22 S, Rng. 46 W. of 6th P. M.; Prowers County, Colorado.

WHEREAS: Prowers Aggregate Operators, LLC (PAO) owns land bordering the south property line of the above described premises for which land PAO has State Permit No. M2008-078 which allows PAO to carry on a mining operation on its land within 200 feet of any structures existing on the City's land; and

WHEREAS: The operation and maintenance of the Lamar City Sewer Lagoons are monitored by the Colorado Department of Health and Environment according to the United States Environmental Protection Agency rules and regulations and statutes:

IT IS HEREBY AGREED AS FOLLOWS:

1. PAO will conduct aggregate mining operations on its real property which borders the City sewer lagoon property described above on the south property line of the said property.
2. Pursuant to Colorado laws and regulations, PAO agrees not to conduct mining activities any closer than within two hundred feet of the structures existing on the City's land, specifically the monitoring well located near the south boundary line of the said City property, and the fence on the south boundary of the said City property, according to Exhibit A, the map attached hereto. PAO will not block or impair in any way the City's access road to the City sewer lagoons from County Road HH.5 as the access road is shown by Exhibit B.
3. PAO agrees to indemnify and hold the City harmless from any and all damages, claims, law suits, expenses, fines or assessments, attorney fees, court costs, administrative agency costs and fees, and/or repairs, provided, the proximate cause of the damages, etc., are PAO's mining operations conducted adjacent to or near the said City sewer lagoons.
4. The City agrees to indemnify and hold PAO harmless from any and all damages, claims, law suits, expenses, fines or assessments, attorney fees, court costs, administrative agency costs and fees, and/or repairs, provided, the proximate cause of the damages, etc., are the City's operations conducted adjacent to or near PAO's mining activities.
5. This Agreement shall be binding on the assigns and successors of the parties hereto and shall run with the title to the lands owned, leased, or operated by the City and PAO in the said Sections 27 and 28.
6. The signors here below state they have lawful authority to enter into this Agreement and to bind the respective parties to this Agreement.

Sincerely,

Karl Nyquist, Manager
Prowers Aggregate Operators, LLC

1/5/21
Date

State of Colorado
County of Jefferson

The foregoing instrument was acknowledged before me this 5th day of January, 2021 (date)
by Karl Nyquist (name of person acknowledging).

(Notary's official signature)

ERICA KUERBIS
Notary Public
State of Colorado
Notary ID # 20204017041
My Commission Expires 05-15-2024

5/15/2024
(Commission expiration)

City of Lamar

2/10/2021
Date

State of Colorado
County of Prowers

The foregoing instrument was acknowledged before me this February 10th 2021 (date)
by Kirk Crespin (name of person acknowledging).

(Notary's official signature)

ELISE PEREZ
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID# 20204008840
MY COMMISSION EXPIRES 03/04/2024

03.04.24
(Commission expiration)

PROWERS AGGREGATE OPERATORS
9485 County Road HH .5, P.O. Box 965
Lamar, CO 81052
Phone (719) 688-4477

GP Irrigated Farms, LLC
732 SE County Road 36
Syracuse, KS 67878

Aug. 23, 2018

Re: Agreement for Compensation for Damage to Structures within 200 feet of mining activities

To Whom It May Concern:

Prowers Aggregate Operators, LLC has applied for an amendment to their current State of Colorado Division of Reclamation, Mining, and Safety (DRMS) Reclamation Permit M2008-078 to allow sand and gravel mining on property within 200 feet of structures located on your property. The Colorado Mined Land Reclamation Act provides protection for your property, and specific protection for your structures located within 200 feet of the mining activities.

DRMS Permit approval requires a notarized agreement between the applicant and owners of structures within 200 feet of the mining activities, providing compensation for any damage to the structure; or preparation of an engineering evaluation acceptable to the DRMS, demonstrating that such structure(s) shall not be damaged by the mining activities if an agreement cannot be reached.

Prowers Aggregate Operators, LLC has had an engineering evaluation performed to determine acceptable setbacks from their proposed mining permit boundary and mining limit to structures adjacent to the mining. The proposed mining slopes and setbacks were analyzed using the SlopeW computer program. SlopeW was designed to analyze the slope stability of earth embankments subjected to several critical situations that may occur during the life of the embankment. The procedure searches for circular shear failures and automatically searches for the lowest safety factor. The required minimum safety factors are based on the current standards used by the Colorado State Engineer's Office (SEO) for high hazard embankment dams, and industry accepted standards for the evaluation of embankments during construction. The safety factors attained using the setbacks shown on the Mining Plan are greater than the required safety factors specified by the SEO for an earth embankment during construction, and an earth embankment subjected to earthquake loading, based on the United States Geological Survey earthquake peak acceleration factors for the area. This evaluation indicated that damage to structures adjacent to the mining should not occur, even during earthquake conditions, which are very unlikely to be present.

With this letter, Prowers Aggregate Operators, LLC requests your authorization to conduct mining and reclamation activities within 200 feet of your structure(s). In return for this authorization, Prowers Aggregate Operators, LLC agrees to provide fair compensation for any damage to your structure(s) resulting from its mining and reclamation activities. Your notarized signature below grants permission for Prowers Aggregate Operators, LLC to conduct mining and reclamation activities within 200 feet of your structure(s), and acknowledges Prowers Aggregate Operators, LLC's commitment to provide fair compensation for any damages to said structure(s) caused by Prowers Aggregate Operators, LLC's mining and reclamation activities.

Sincerely,

Karl Nyquist, Manager
Prowers Aggregate Operators, LLC

8/28/18
Date

The foregoing instrument was acknowledged before me this 28 day of August, 2018 by, Karl Nyquist, as manager

AMY HECKENLIVELY
Notary Public
State of Colorado
Notary ID # 20054041976
My Commission Expires October 27, 2021

Amy Heckenlively
Notary Public

My Commission Expires: 10/27/21

GP Irrigated Farms, LLC

9/26/2018
Date

The foregoing instrument was acknowledged before me this 26th day of September, 2018 by, Jay Hoitsma, as member of GP Irrigated Farms, LLC.

Notary Public

My Commission Expires: 5/26/2021

Ross A. Goubeile
Notary Public
State of Kansas
My Appt. Expires 5.26.2021

PROWERS AGGREGATE OPERATORS
9485 County Road HH .5, P.O. Box 965
Lamar, CO 81052
Phone (719) 688-4477

Prowers County
301 South Main
Lamar, CO 81052

January 5, 2021

Re: Agreement for Compensation for Damage to Structures within 200 feet of mining activities

To Whom It May Concern:

Prowers Aggregate Operators, LLC has applied for an amendment to their current State of Colorado Division of Reclamation, Mining, and Safety (DRMS) Reclamation Permit M2008-078 to allow sand and gravel mining on property within 200 feet of structures located on your property. The Colorado Mined Land Reclamation Act provides protection for your property, and specific protection for your structures located within 200 feet of the mining activities. County Road HH.5 is the structure that is within 200 feet of the mining activities.

DRMS Permit approval requires a notarized agreement between the applicant and owners of structures within 200 feet of the mining activities, providing compensation for any damage to the structure; or preparation of an engineering evaluation acceptable to the DRMS, demonstrating that such structure(s) shall not be damaged by the mining activities if an agreement cannot be reached.

GP Aggregates, LLC (the land owner and Prowers County Special Use Permit holder) and Prowers County have an existing agreement for the use and maintenance of county roads as part of their mining activities at the West Farm Pit. This agreement specifies that the mining operation will maintain the roads and repair any damage to the roads caused by the mining operation. The executed agreement is attached for your reference.

PAO requests that you sign/notarize this letter confirming that the previous agreement is still in affect and is valid for the amended mine layout. A map showing the amended mine layout is attached for your reference.

Sincerely,

Karl Nyquist, Manager
Prowers Aggregate Operators, LLC

1/5/21
Date

State of Colorado
County of Jefferson

The foregoing instrument was acknowledged before me this 5th day of January, 2021 (date)
by Karl Nyquist (name of person acknowledging).

(Notary's official signature)

ERICA KUERBIS
Notary Public
State of Colorado
Notary ID # 20204017041
My Commission Expires 05-15-2024

5/15/2024
(Commission expiration)

Prowers County

Date

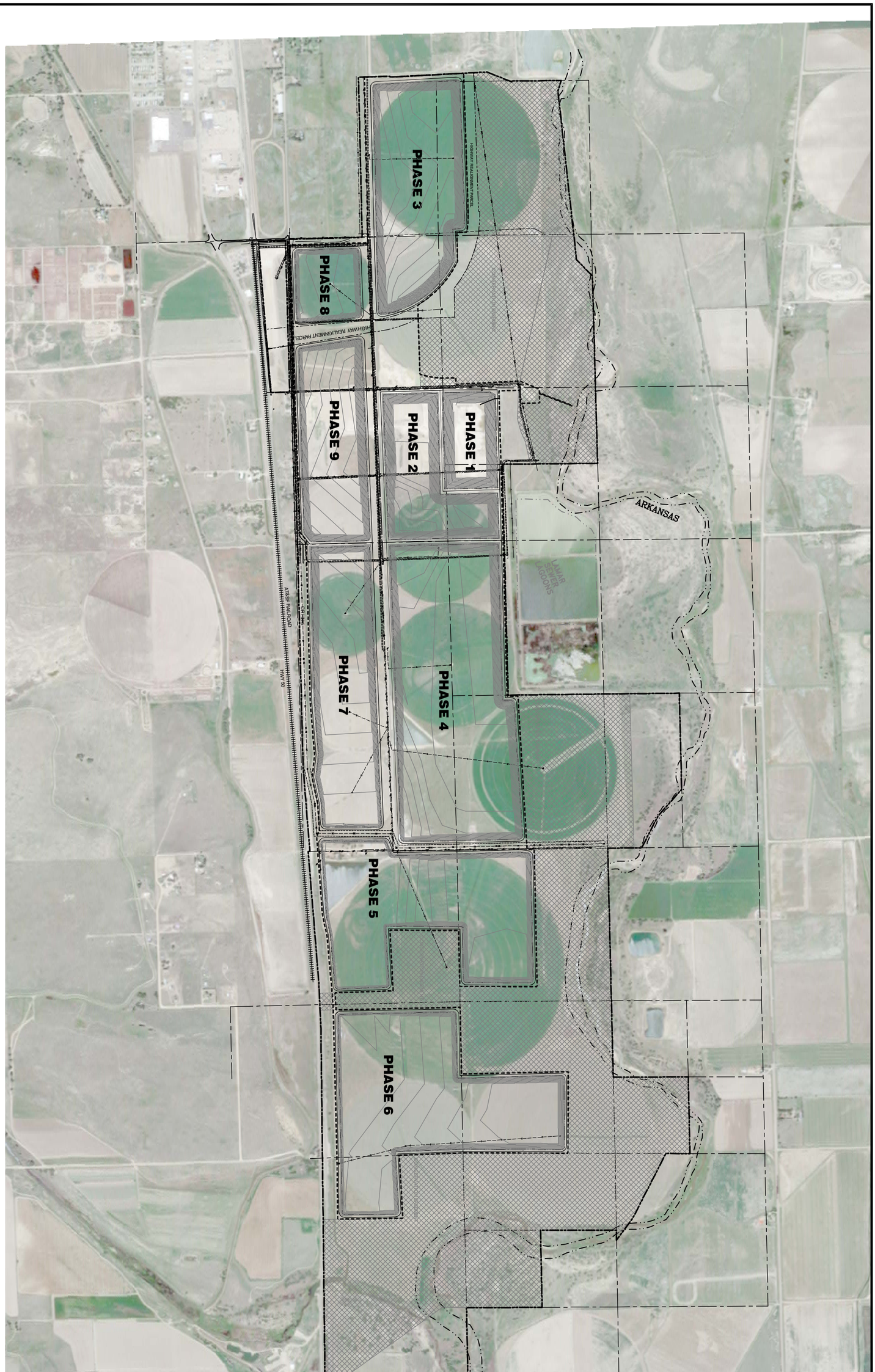
State of Colorado
County of _____

The foregoing instrument was acknowledged before me this _____ (date)
by _____ (name of person acknowledging).

(Notary's official signature)

(Commission expiration)

P:\07115 GP Ranches LLC - Lamar\Drawings\Slope Stability\2020 Expansion\JT-2020 SS Case Location Map.dwg, Amended Layout, 1/5/2021 9:27:46 AM



REVISIONS				
No	Date	By	Chk	Description

Prowers Aggregate Operators, LLC.

M-2008-078

West Farm Pit Expansion

Amended Mine Layout

J&T Consulting, Inc.

305 Denver Avenue - Suite D
Fort Lupton, CO 80621
Ph: 303-857-6222 Fax: 303-857-6224
www.j-tconsulting.com

Job # 07115
Date 1.4.21
Drawn By TPY
Designed By TPY
Checked By JCY
File JT-2020 SS Case Map
Scale 1" = 800'

Sheet: 1 Of: 1

PROWERS COUNTY ROAD DEPARTMENT
AGREEMENT FOR USE AND MAINTENANCE OF COUNTY ROADS

Effective Date: September 30, 2018

GP Aggregates, LLC a Colorado limited liability company whose address is 7991 Shaffer Parkway, suite 200, Littleton, CO 80127, on behalf of itself, its agents and contractors (collectively, "**Permittee**") has requested authorization by the Prowers County Road Department ("**County**") to use certain sections of roadways of Prowers County shown as Roads in the attached Exhibit A incorporated herein by this reference to transport and haul the following:

> Cranes, trucks, tractors, haul trucks, conveyors, construction equipment, construction vehicles, and short- and long-bed trailers; water tanks; meteorological and wind measuring equipment, including anemometer towers and all necessary and proper appliances and fixtures for use in connection with said towers; wind turbine nacelles and blades, steel towers, rock, grain, other commodities, concrete for construction of foundations and support structures, footings, anchors, fences and other fixtures and facilities; electrical transmission and fiber optic wires and cables, steel or wooden poles; and any other improvements, including facilities, machinery and equipment necessary or desirable for The GP gravel pit (the "**Project**").
>
> Permittee requests this authority continue for the length of Permitee's Special Use Permit No. 2017-02

1. <u>Use of County Roads</u>.

1.1 Permittee understands and agrees that, although these roadways are part of the Prowers County road system and are subject to normal traffic use, Permittee, by virtue of its extraordinary use, assumes responsibility for any repairs and maintenance and the for traffic control on such roadways resulting from its use of roadways as haul roads.

1.2 County hereby agrees to Permittee's use of the roadways subject to the conditions contained herein. Permittee is solely responsible for obtaining any other permit or license that County or any other governmental entity may require to operate or move Permittee's vehicles on county roads. This Agreement for Use and Maintenance of Roads (this "**Agreement**") does not relieve Permittee's subcontractors, agents or employees from complying with applicable speed limits, weight restrictions, or other posted restrictions on any Prowers County road.

1.3 Any improvements to or widening of the Roads necessitated by Permittee's operations, including modification of roadway approaches to accommodate transport vehicles, will be considered incidental to the activity performed, shall be made at Permittee's sole expense unless otherwise authorized in addendum to this Agreement, and shall remain in place or be removed at the County's choice. Any such improvement shall be authorized by County permit and shall become the property of County as determined by County.

2. **Maintenance of Roads**. Permittee agrees to maintain the Roads in a safe condition satisfactory to the County. Maintenance shall include dust control and gravel replacement. Any maintenance activities agreed to by the Parties other than as described in this Paragraph 2 will be identified in writing, signed by both Parties, and attached as an addendum to this Agreement.

3. **Assumption of Risk and Liability**.

3.1 County has not made and does not herein make any representation as to the present or future conditions of the Roads or the character of the traffic on such roads. Permittee assumes all risks of damage to property of or injury to, Permittee or anyone acting under the authority granted to Permittee by this Agreement.

3.2 Permittee agrees and covenants to indemnify, defend, and save harmless County for, from, and against any loss, damage, costs, charges, liability, claims, demands, or judgments, whether to persons or property, arising out of any act, action, neglect, omission, or default on the part of Permittee or any person or entity acting under Permittee's authority granted by this Agreement.

3.3 Permittee shall maintain, for the term of this Agreement, Public Liability and Property Damage Insurance. For the term of this Agreement, County shall be named as an additional insurance on Permittee's Public Liability and Property Damage Insurance, and Permittee shall provide to County proof of insurance and proof the additional insured designation.

4. **Termination**. This Agreement may be terminated by County upon any occurrence of:

A. Violation by Permittee of any term of this Agreement.
B. Risk of imminent threat to public health, safety, or welfare as a result of continued use by Permittee of the Roads.
C. Receipt by County of notice from Permittee that Permittee has permanently ceased operations and desires to terminate this Agreement, at which time a post-inspection will be conducted.

4.1 Upon termination of this Agreement, for any reason, Permittee shall immediately discontinue operations covered by this Agreement.

4.2 Termination of this Agreement shall not prejudice County's right to collect damages incurred as a result of Permittee's use of the Roads.

4.3 If, after termination of this Agreement, Permittee desires to resume operation, Permittee shall request to enter into a new road agreement with County.

5. **Notices**. All notices and oral or written communications relating to this Agreement shall be made to the person identified below on behalf of each Party. All written notices shall be deemed given when personally delivered, or in lieu of such personal service, five (5) days after deposit in the United States mail, first class, postage prepaid, certified, or the next business day if sent by reputable overnight courier, provided receipt is obtained and charges prepaid by the delivering party. Any notice shall be addressed as follows:

On behalf of Prowers County:
Mark Dorenkamp
Title: Road & Bridge Supervisor
Phone: 719-336-5536
109 East Sherman
Lamar, CO 81052

On behalf of Permittee:
Karl Nyquist
Title: Manager
Phone: 303-389-6777
7991 Shaffer Parkway, Suite 200
Littleton, CO 80127
Attn: Karl Nyquist

6. **Miscellaneous**.

6.1 Compliance with Laws. Permittee shall comply with all federal, State of Colorado, and local laws and regulations.

6.2 Severability. If any portion of this Agreement is held invalid, it shall have no effect upon the validity of the remaining portions of this Agreement.

6.3 Entire Agreement; Binding Effect; Amendments. This Agreement constitutes the entire agreement of the Parties with regard to its subject matter. This Agreement shall not be modified or amended except in a writing signed by the Parties. This Agreement is binding upon the parties and their respective successors and permitted assigns. This Agreement is only for the benefit of the parties hereto, and no third party shall have any right, claim or interest hereunder. This Agreement will be enforced as written. In the event of any conflict with the provisions of the main agreement, the provisions of this Addendum will control.

6.4 Governing Law; Dispute Resolution. This Agreement shall be governed by and interpreted in accordance with the laws of the State of Colorado. If the parties are unable to resolve amicably any dispute arising out of or in connection with this Agreement, they agree that such dispute shall be resolved in a court of competent jurisdiction located in Prowers County, or if none, then a court of competent jurisdiction located nearest to Prowers County.

6.5 CONSEQUENTIAL DAMAGES. NOTWITHSTANDING ANYTHING TO THE CONTRARY IN THIS AGREEMENT, PERMITEE SHALL NOT BE ENTITLED TO, AND PERMITTEE HEREBY WAIVES ANY AND ALL RIGHTS TO RECOVER, CONSEQUENTIAL, INCIDENTAL AND PUNITIVE OR EXEMPLARY DAMAGES FROM COUNTY, HOWEVER ARISING, WHETHER IN CONTRACT, IN TORT OR OTHERWISE, UNDER OR WITH RESPECT TO ANY ACTION TAKEN IN CONNECTION WITH THIS AGREEMENT.

6.6 Counterparts. This Agreement may be executed in multiple counterparts, all of which shall constitute one and the same Agreement.

6.7 Statutory County. County, which is a statutory county in the State of Colorado, reserves all rights as a statutory entity, including governmental immunity as provided by law.

6.8 Assignment. Permittee may not assign this Agreement without the prior written consent of the County.

6.9 Public Record. In the event County receives a public records demand pursuant to the Colorado Open Records Act for copies of documents which are or may be confidential, or may otherwise

be subject to non-disclosure, County shall give written notice by facsimile and/or email to Permittee. Permittee shall notify County in writing by facsimile and/or email within two (2) working days of notification if any documents requested as a public record should not be disclosed. Permittee shall indemnify and hold harmless County for any public record requests where Permittee requests County not to disclose such records.

6.10 Statutory Limits on Liability. Because County is a public entity, and is subject to statutory limits on spending including funds which have been duly appropriated, County and its officers, agents, employees and representatives shall in no event be liable for damages to Permittee, or any other party, whether based upon breach of contract, tort, strict liability, breach of warranty, or any other claim for relief of whatever nature or description. However, Permittee may be awarded actual damages for breach of contract, specific performance, injunctive relief or other similar non-monetary remedy if proven by Permittee.

6.11 Actions of Permittee. Permittee shall be solely responsible for the acts of Permittee, its employees, and agents. Neither Permittee nor any agent or employee of Permittee shall be or shall be deemed to be an agent or employee of County. Permittee shall have no authorization, express or implied, to bind County to any agreements, liabilities, or understandings. Permittee shall provide and keep in force worker's compensation and unemployment compensation insurance in the amounts required by Colorado law.

6.12 Illegal Aliens. Permittee certifies that Permittee shall comply with the provisions of C.R.S. 8-17.5-101 et seq. Permittee shall not knowingly employ or contract with an illegal alien to perform work under this contract or enter into a contract with a subcontractor that fails to certify to Permittee that the subcontractor shall not knowingly employ or contract with an illegal alien to perform work under this contract. Permittee represents, warrants, and agrees that it (i) has verified that it does not employ any illegal aliens, through participation in the Basic Pilot Employment Verification Program administered by the Social Security Administration and Department of Homeland Security, and (ii) otherwise will comply with the requirements of C.R.S. 8-17.5-102(2)(b). Permittee shall comply with all reasonable requests made in the course of an investigation under C.R.S. 8-17.5-102 by Colorado Department of Labor and Employment. If Permittee fails to comply with any requirement of this provision or C.R.S. 8-17.5-101 et seq., County may terminate this contract for breach, and Permittee shall be liable for actual and consequential damages to County.

6.13 Officials Not To Benefit. No official or employee of County shall directly or indirectly receive or be paid any share or part of this Agreement or any benefit that may arise therefore in violation of Article 29 of the Colorado Constitution. Permittee warrants that it has not retained any company or person (other than a bona fide employee working solely for Permittee) to solicit or secure this Agreement, and that Permittee has not paid or agreed to pay to any company or person, (other than a bona fide employee working for Permittee), any fee, commission, percentage, brokerage fee, gift or any other consideration contingent upon or resulting from the award of this Agreement to Permittee. Upon discovery of any breach or violation of this provision, County shall have the right to terminate this Agreement.

6.14 Governmental Immunity. Notwithstanding any other provision of this Agreement to the contrary, no term or provision of this Agreement shall be construed or interpreted as a limitation to or waiver by County of any applicable provisions of the Colorado Governmental Immunity Act, §24-10-101, *et seq.,* C.R.S., as now or hereafter amended, §24-30-1501, *et seq.,* C.R.S., as now or hereafter

amended, and any other immunity statute. Any provisions of this Agreement, whether or not incorporated herein by reference, shall be controlled, limited and otherwise modified so as to limit any liability of County as provided by said laws.

6.15 **No Presumption of Good Faith and Fair Dealing**. There is no presumption of good faith and fair dealing in the performance of this Agreement by either party.

6.16 **No Third Party Beneficiary Intended**. No provision in this Agreement is intended or shall create any rights with respect to the subject matter of this Agreement in any third party. This Agreement shall be construed to benefit of County and Permittee, and shall not be construed to create third party beneficiary rights in any other party. No person not a party to this Agreement is an intended beneficiary of this Agreement, and no person not a party to this Agreement shall have any right to enforce any term of this Agreement.

IN WITNESS WHEREOF, Permittee and County have caused this Agreement to be signed by their respective and duly authorized officers.

Permittee:

By: _____
Printed Name: Karl Nyquist
Title: Manager

BOARD OF COUNTY COMMISSIONERS
PROWERS COUNTY, COLORADO

By _____
Ron Cook, Chairman

Attest:

By _____
Jana Coen, County Clerk

Date Signed: 10-9-18

EXHIBIT A-1

PROPOSED ROADS USE LIST

1. HH.5 from the pit entrance west to County road 9
2. HH8/10 from east side of pit to County road 9

EXHIBIT A-2

PROPOSED ROADS MAP

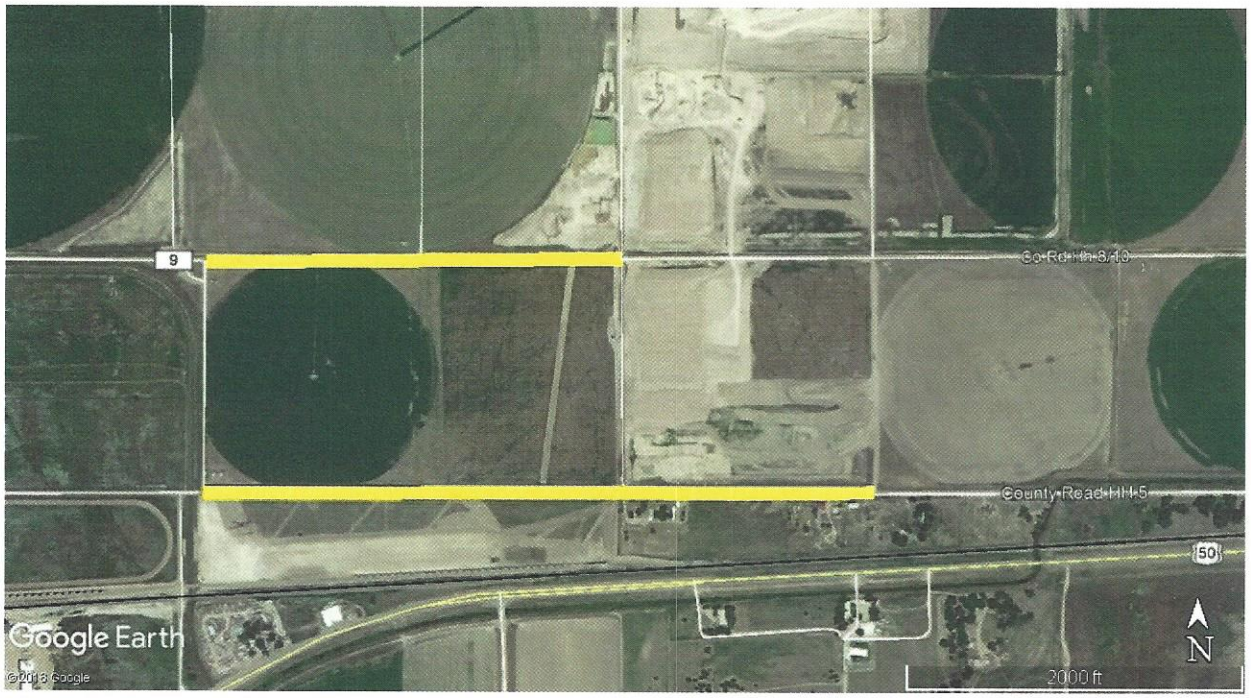


EXHIBIT A-1

PROWERS AGGREGATE OPERATORS
9485 County Road HH .5, P.O. Box 965
Lamar, CO 81052
Phone (719) 688-4477

BNSF Railway Company
2650 Lou Menk Drive, MOB-2
Fort Worth, TX 76131

February 26, 2021

Re: Agreement for Compensation for Damage to Structures within 200 feet of mining activities

To Whom It May Concern:

Prowers Aggregate Operators, LLC has applied for an amendment to their current State of Colorado Division of Reclamation, Mining, and Safety (DRMS) Reclamation Permit M2008-078 to allow sand and gravel mining on property within 200 feet of structures located on your property. The Colorado Mined Land Reclamation Act provides protection for your property, and specific protection for your structures located within 200 feet of the mining activities. The railroad tracks, bridge, and control box are the structures that are within 200 feet of the mining activities.

DRMS Permit approval requires a notarized agreement between the applicant and owners of structures within 200 feet of the mining activities, providing compensation for any damage to the structure; or preparation of an engineering evaluation acceptable to the DRMS, demonstrating that such structure(s) shall not be damaged by the mining activities if an agreement cannot be reached.

With this letter, Prowers Aggregate Operators, LLC requests your authorization to continue to conduct transloading operations (including stockpiling and loading of aggregate commodities) in connection with mining and reclamation activities within 200 feet of your structure(s). In return for this authorization, Prowers Aggregate Operators, LLC agrees to provide fair compensation for any damage to your structure(s) resulting from its mining and reclamation activities. Your notarized signature below grants permission for Prowers Aggregate Operators, LLC to conduct transloading operations in connection with mining and reclamation activities within 200 feet of your structure(s), and acknowledges Prowers Aggregate Operators, LLC's commitment to provide fair compensation for any damages to said structure(s) caused by Prowers Aggregate Operators, LLC's mining and reclamation activities

Sincerely,

Karl Nyquist, Manager
Prowers Aggregate Operators, LLC

2/26/21
Date

State of Colorado
County of Jefferson

The foregoing instrument was acknowledged before me this February 26, 2021 (date)
by Karl Nyquist (name of person acknowledging).

(Notary's official signature)

ERICA KUERBIS
Notary Public
State of Colorado
Notary ID # 20204017041
My Commission Expires 05-15-2024

5-15-2024
(Commission expiration)

BNSF Railway Company

March 5, 2021
Date

State of ~~Colorado~~ TEXAS
County of Tarrant

The foregoing instrument was acknowledged before me this March 5, 2021 (date)
by Rebeca Ortiz (name of person acknowledging).

(Notary's official signature)

JOYIA E. NEVELS
Notary Public, State of Texas
Comm. Expires 03-07-2024
Notary ID 1009330-1

3/7/2024
(Commission expiration)

PROWERS AGGREGATE OPERATORS
9485 County Road HH .5, P.O. Box 965
Lamar, CO 81052
Phone (719) 688-4477

Atmos Energy
209 Sage Street
Lamar, CO 81052

January 5, 2021

Re: Agreement for Compensation for Damage to Structures within 200 feet of mining activities

To Whom It May Concern:

Prowers Aggregate Operators, LLC has applied for an amendment to their current State of Colorado Division of Reclamation, Mining, and Safety (DRMS) Reclamation Permit M2008-078 to allow sand and gravel mining on property within 200 feet of structures located on your property. The Colorado Mined Land Reclamation Act provides protection for your property, and specific protection for your structures located within 200 feet of the mining activities. The gas utility line in County Road HH.5 is the structure that is within 200 feet of the mining activities.

DRMS Permit approval requires a notarized agreement between the applicant and owners of structures within 200 feet of the mining activities, providing compensation for any damage to the structure; or preparation of an engineering evaluation acceptable to the DRMS, demonstrating that such structure(s) shall not be damaged by the mining activities if an agreement cannot be reached.

Prowers Aggregate Operators, LLC has had an engineering evaluation performed to determine acceptable setbacks from their proposed mining permit boundary and mining limit to structures adjacent to the mining. The proposed mining slopes and setbacks were analyzed using Clover Technologies Galena Slope Stability Analysis System. Galena was designed to analyze the slope stability of earth embankments subjected to several critical situations that may occur during the life of the embankment. The procedure searches for circular shear failures and automatically searches for the lowest safety factor. The required minimum safety factors are based on the current Policies of the Colorado Mined Land Reclamation Board (MLRB) criteria for critical and non-critical structures. The safety factors attained using the setbacks shown on the Mining Plan are greater than the required safety factors specified by the MLRB for embankments during static conditions, and embankments subjected to earthquake loading, based on the United States Geological Survey earthquake peak acceleration factors for the area. This evaluation indicated that damage to structures adjacent to the mining should not occur, even during earthquake conditions, which are very unlikely to be present.

With this letter, Prowers Aggregate Operators, LLC requests your authorization to conduct mining and reclamation activities within 200 feet of your structure(s). In return for this authorization, Prowers Aggregate Operators, LLC agrees to provide fair compensation for any damage to your structure(s) resulting from its mining and reclamation activities. Your notarized signature below grants permission for Prowers Aggregate Operators, LLC to conduct mining and reclamation activities within 200 feet of your structure(s), and acknowledges Prowers Aggregate Operators, LLC's commitment to provide fair compensation for any damages to said structure(s) caused by Prowers Aggregate Operators, LLC's mining and reclamation activities.

Sincerely,

Karl Nyquist, Manager
Prowers Aggregate Operators, LLC

1/5/21
Date

State of Colorado
County of Jefferson

The foregoing instrument was acknowledged before me this 5th day of January, 2021 (date)
by Karl Nyquist (name of person acknowledging).

(Notary's official signature)

ERICA KUERBIS
Notary Public
State of Colorado
Notary ID # 20204017041
My Commission Expires 05-15-2024

5/15/2024
(Commission expiration)

Atmos Energy John Willis VP Technical Services

3/8/21
Date

State of Colorado
County of Denver

The foregoing instrument was acknowledged before me this 8th day, of March 2021 (date)
by John Willis (name of person acknowledging).

(Notary's official signature)

ELENA PALNOVA
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20174028881
MY COMMISSION EXPIRES JULY 11, 2021

July 11, 2021
(Commission expiration)

PROWERS AGGREGATE OPERATORS
9485 County Road HH .5, P.O. Box 965
Lamar, CO 81052
Phone (719) 688-4477

Barr H. Inman
1105 E. Maple St.
Lamar, CO 81052

January 5, 2021

Re: Agreement for Compensation for Damage to Structures within 200 feet of mining activities

To Whom It May Concern:

Prowers Aggregate Operators, LLC has applied for an amendment to their current State of Colorado Division of Reclamation, Mining, and Safety (DRMS) Reclamation Permit M2008-078 to allow sand and gravel mining on property within 200 feet of structures located on your property. The Colorado Mined Land Reclamation Act provides protection for your property, and specific protection for your structures located within 200 feet of the mining activities.

DRMS Permit approval requires a notarized agreement between the applicant and owners of structures within 200 feet of the mining activities, providing compensation for any damage to the structure; or preparation of an engineering evaluation acceptable to the DRMS, demonstrating that such structure(s) shall not be damaged by the mining activities if an agreement cannot be reached.

Prowers Aggregate Operators, LLC has had an engineering evaluation performed to determine acceptable setbacks from their proposed mining permit boundary and mining limit to structures adjacent to the mining. The proposed mining slopes and setbacks were analyzed using Clover Technologies Galena Slope Stability Analysis System. Galena was designed to analyze the slope stability of earth embankments subjected to several critical situations that may occur during the life of the embankment. The procedure searches for circular shear failures and automatically searches for the lowest safety factor. The required minimum safety factors are based on the current Policies of the Colorado Mined Land Reclamation Board (MLRB) criteria for critical and non-critical structures. The safety factors attained using the setbacks shown on the Mining Plan are greater than the required safety factors specified by the MLRB for embankments during static conditions, and embankments subjected to earthquake loading, based on the United States Geological Survey earthquake peak acceleration factors for the area. This evaluation indicated that damage to structures adjacent to the mining should not occur, even during earthquake conditions, which are very unlikely to be present.

With this letter, Prowers Aggregate Operators, LLC requests your authorization to conduct mining and reclamation activities within 200 feet of your structure(s). In return for this authorization, Prowers Aggregate Operators, LLC agrees to provide fair compensation for any damage to your structure(s) resulting from its mining and reclamation activities. Your notarized signature below grants permission for Prowers Aggregate Operators, LLC to conduct mining and reclamation activities within 200 feet of your structure(s), and acknowledges Prowers Aggregate Operators, LLC’s commitment to provide fair compensation for any damages to said structure(s) caused by Prowers Aggregate Operators, LLC's mining and reclamation activities.

Sincerely,

Karl Nyquist, Manager
Prowers Aggregate Operators, LLC

1/5/21
Date

State of Colorado
County of Jefferson

The foregoing instrument was acknowledged before me this 5th day of January, 2021 (date)
by Karl Nyquist (name of person acknowledging).

(Notary's official signature)

ERICA KUERBIS
Notary Public
State of Colorado
Notary ID # 20204017041
My Commission Expires 05-15-2024

5/15/2024
(Commission expiration)

Barr H. Inman

Date

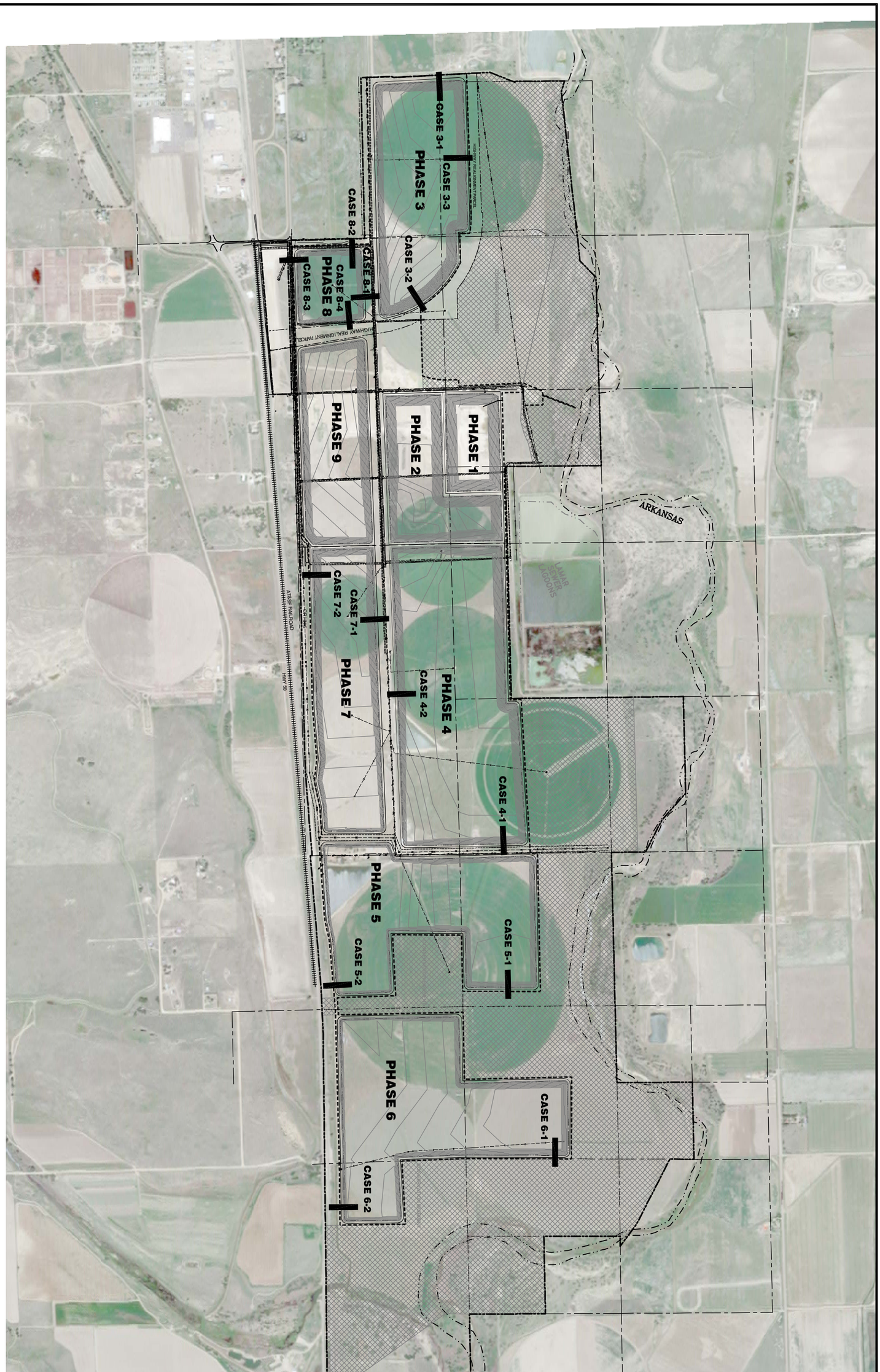
State of Colorado
County of _____

The foregoing instrument was acknowledged before me this _____ (date)
by _____ (name of person acknowledging).

(Notary's official signature)

(Commission expiration)

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Job #	07115
Date	12.3.20
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Designed By	TPY
Checked By	JCY
File	JT-2020 SS Case Map
Scale	1" = 800'

Sheet: 1 Of: 1

REVISIONS

No	Date	By	Chk	Description

Prowers Aggregate Operators, LLC.

M-2008-078

West Farm Pit Expansion

Slope Stability

Case Location Map

J&T Consulting, Inc.

305 Denver Avenue - Suite D
Fort Lupton, CO 80621
Ph: 303-857-6222 Fax: 303-857-6224
www.j-tconsulting.com

PROWERS AGGREGATE OPERATORS
9485 County Road HH .5, P.O. Box 965
Lamar, CO 81052
Phone (719) 688-4477

Lower Arkansas Water
Management Association
Attn: Don Higbee
P.O. Box 1161
Lamar, CO 81052

February 17, 2021

Re: Agreement for Compensation for Damage to Structures within 200 feet of mining activities

To Whom It May Concern:

Prowers Aggregate Operators, LLC has applied for an amendment to their current State of Colorado Division of Reclamation, Mining, and Safety (DRMS) Reclamation Permit M2008-078 to allow sand and gravel mining on property within 200 feet of structures located on your property. The Colorado Mined Land Reclamation Act provides protection for your property, and specific protection for your structures located within 200 feet of the mining activities. The return ditch that is located on the west side of Phase 3 runs north from the Lamar Canal to the Arkansas River is the structure that is within 200 feet of the mining activities as shown on the attached map.

DRMS Permit approval requires a notarized agreement between the applicant and owners of structures within 200 feet of the mining activities, providing compensation for any damage to the structure; or preparation of an engineering evaluation acceptable to the DRMS, demonstrating that such structure(s) shall not be damaged by the mining activities if an agreement cannot be reached.

Prowers Aggregate Operators, LLC has had an engineering evaluation performed to determine acceptable setbacks from their proposed mining permit boundary and mining limit to structures adjacent to the mining. The proposed mining slopes and setbacks were analyzed using Clover Technologies Galena Slope Stability Analysis System. Galena was designed to analyze the slope stability of earth embankments subjected to several critical situations that may occur during the life of the embankment. The procedure searches for circular shear failures and automatically searches for the lowest safety factor. The required minimum safety factors are based on the current Policies of the Colorado Mined Land Reclamation Board (MLRB) criteria for critical and non-critical structures. The safety factors attained using the setbacks shown on the Mining Plan are greater than the required safety factors specified by the MLRB for embankments during static conditions, and embankments subjected to earthquake loading, based on the

United States Geological Survey earthquake peak acceleration factors for the area. This evaluation indicated that damage to structures adjacent to the mining should not occur, even during earthquake conditions, which are very unlikely to be present.

With this letter, Prowers Aggregate Operators, LLC requests your authorization to conduct mining and reclamation activities within 200 feet of your structure(s). In return for this authorization, Prowers Aggregate Operators, LLC agrees to provide fair compensation for any damage to your structure(s) resulting from its mining and reclamation activities. Your notarized signature below grants permission for Prowers Aggregate Operators, LLC to conduct mining and reclamation activities within 200 feet of your structure(s), and acknowledges Prowers Aggregate Operators, LLC's commitment to provide fair compensation for any damages to said structure(s) caused by Prowers Aggregate Operators, LLC's mining and reclamation activities.

Sincerely,

Karl Nyquist, Manager
Prowers Aggregate Operators, LLC

2/18/21
Date

State of Colorado
County of Jefferson

The foregoing instrument was acknowledged before me this February 18, 2021 (date)
by Karl Nyquist (name of person acknowledging).

(Notary's official signature)

ERICA KUERBIS
Notary Public
State of Colorado
Notary ID # 20204017041
My Commission Expires 05-15-2024

5-15-24
(Commission expiration)

Donald F Higbee, Secretary
Lower Arkansas Water Management Association

2/20/21
Date

State of Colorado
County of PROWERS

The foregoing instrument was acknowledged before me this 2/20/2021 (date)
by Donald E. Higbee (name of person acknowledging).

Angela Higbee
(Notary's official signature)

ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20074046402
MY COMMISSION EXPIRES DECEMBER 20, 2023

12-20-2023
(Commission expiration)

PROWERS AGGREGATE OPERATORS
9485 County Road HH .5, P.O. Box 965
Lamar, CO 81052
Phone (719) 688-4477

Lamar Canal
Attn: Don Higbee
P.O. Box 287
310 South 6th Street
Lamar, CO 81052

February 17, 2021

Re: Agreement for Compensation for Damage to Structures within 200 feet of mining activities

To Whom It May Concern:

Prowers Aggregate Operators, LLC has applied for an amendment to their current State of Colorado Division of Reclamation, Mining, and Safety (DRMS) Reclamation Permit M2008-078 to allow sand and gravel mining on property within 200 feet of structures located on your property. The Colorado Mined Land Reclamation Act provides protection for your property, and specific protection for your structures located within 200 feet of the mining activities. The Lamar Canal is located on the south side of Phase 3 and then runs south along Phase 8 and is the ditch that is within 200 feet of the mining operation.

DRMS Permit approval requires a notarized agreement between the applicant and owners of structures within 200 feet of the mining activities, providing compensation for any damage to the structure; or preparation of an engineering evaluation acceptable to the DRMS, demonstrating that such structure(s) shall not be damaged by the mining activities if an agreement cannot be reached.

Prowers Aggregate Operators, LLC has had an engineering evaluation performed to determine acceptable setbacks from their proposed mining permit boundary and mining limit to structures adjacent to the mining. The proposed mining slopes and setbacks were analyzed using Clover Technologies Galena Slope Stability Analysis System. Galena was designed to analyze the slope stability of earth embankments subjected to several critical situations that may occur during the life of the embankment. The procedure searches for circular shear failures and automatically searches for the lowest safety factor. The required minimum safety factors are based on the current Policies of the Colorado Mined Land Reclamation Board (MLRB) criteria for critical and non-critical structures. The safety factors attained using the setbacks shown on the Mining Plan are greater than the required safety factors specified by the MLRB for embankments during static conditions, and embankments subjected to earthquake loading, based on the

United States Geological Survey earthquake peak acceleration factors for the area. This evaluation indicated that damage to structures adjacent to the mining should not occur, even during earthquake conditions, which are very unlikely to be present.

With this letter, Prowers Aggregate Operators, LLC requests your authorization to conduct mining and reclamation activities within 200 feet of your structure(s). In return for this authorization, Prowers Aggregate Operators, LLC agrees to provide fair compensation for any damage to your structure(s) resulting from its mining and reclamation activities. Your notarized signature below grants permission for Prowers Aggregate Operators, LLC to conduct mining and reclamation activities within 200 feet of your structure(s), and acknowledges Prowers Aggregate Operators, LLC's commitment to provide fair compensation for any damages to said structure(s) caused by Prowers Aggregate Operators, LLC's mining and reclamation activities.

Sincerely,

Karl Nyquist, Manager
Prowers Aggregate Operators, LLC

2/18/21
Date

State of Colorado
County of Jefferson

The foregoing instrument was acknowledged before me this February 18, 2021 (date)
by Karl Nyquist (name of person acknowledging).

(Notary's official signature)

ERICA KUERBIS
Notary Public
State of Colorado
Notary ID # 20204017041
My Commission Expires 05-15-2024

5-15-24
(Commission expiration)

Donald F. Higbee, Sec/Treas 2-20-21
Lamar Canal Date

State of Colorado
County of PROWERS

The foregoing instrument was acknowledged before me this 2-20-2021 (date)
by Donald F. Higbee (name of person acknowledging).

(Notary's official signature)

ANGELA HIGBEE
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20074046402
MY COMMISSION EXPIRES DECEMBER 20, 2023

12-20-2023
(Commission expiration)

PROWERS AGGREGATE OPERATORS
9485 County Road HH .5, P.O. Box 965
Lamar, CO 81052
Phone (719) 688-4477

Lamar Light and Power
100 North Second
Lamar, CO 81052

January 5, 2021

Re: Agreement for Compensation for Damage to Structures within 200 feet of mining activities

To Whom It May Concern:

Prowers Aggregate Operators, LLC has applied for an amendment to their current State of Colorado Division of Reclamation, Mining, and Safety (DRMS) Reclamation Permit M2008-078 to allow sand and gravel mining on property within 200 feet of structures located on your property. The Colorado Mined Land Reclamation Act provides protection for your property, and specific protection for your structures located within 200 feet of the mining activities. The electrical power utility line in County Road HH.5 and across the property are the structures that are within 200 feet of the mining activities.

DRMS Permit approval requires a notarized agreement between the applicant and owners of structures within 200 feet of the mining activities, providing compensation for any damage to the structure; or preparation of an engineering evaluation acceptable to the DRMS, demonstrating that such structure(s) shall not be damaged by the mining activities if an agreement cannot be reached.

Prowers Aggregate Operators, LLC has had an engineering evaluation performed to determine acceptable setbacks from their proposed mining permit boundary and mining limit to structures adjacent to the mining. The proposed mining slopes and setbacks were analyzed using Clover Technologies Galena Slope Stability Analysis System. Galena was designed to analyze the slope stability of earth embankments subjected to several critical situations that may occur during the life of the embankment. The procedure searches for circular shear failures and automatically searches for the lowest safety factor. The required minimum safety factors are based on the current Policies of the Colorado Mined Land Reclamation Board (MLRB) criteria for critical and non-critical structures. The safety factors attained using the setbacks shown on the Mining Plan are greater than the required safety factors specified by the MLRB for embankments during static conditions, and embankments subjected to earthquake loading, based on the United States Geological Survey earthquake peak acceleration factors for the area. This evaluation indicated that damage to structures adjacent to the mining should not occur, even during earthquake conditions, which are very unlikely to be present.

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Sincerely,

Karl Nyquist, Manager
Prowers Aggregate Operators, LLC

1/5/21
Date

State of Colorado
County of Jefferson

The foregoing instrument was acknowledged before me this 5th day of January, 2021 (date)
by Karl Nyquist (name of person acknowledging).

(Notary's official signature)

ERICA KUERBIS
Notary Public
State of Colorado
Notary ID # 20204017041
My Commission Expires 05-15-2024

5/15/2024
(Commission expiration)

Lamar Light and Power

Date

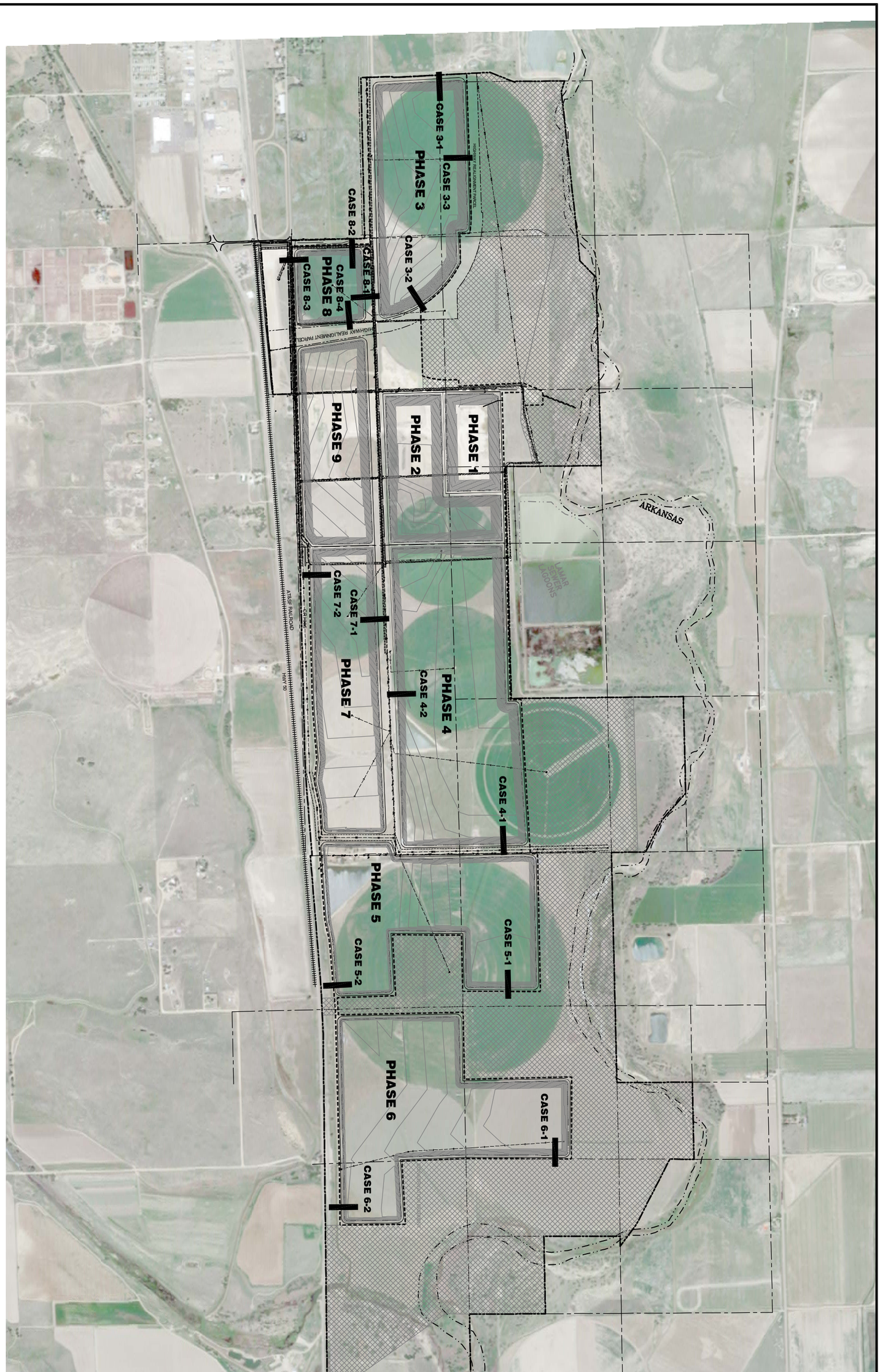
State of Colorado
County of _____

The foregoing instrument was acknowledged before me this _____ (date)
by _____ (name of person acknowledging).

(Notary's official signature)

(Commission expiration)

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SCALE IN FEET

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Job #	07115
Date	12.3.20
Drawn By	TPY
Designed By	TPY
Checked By	JCY
File	JT-2020 SS Case Map
Scale	1" = 800'

Sheet: 1 Of: 1

REVISIONS

No	Date	By	Chk	Description

Prowers Aggregate Operators, LLC.

M-2008-078

West Farm Pit Expansion

Slope Stability

Case Location Map

J&T Consulting, Inc.

305 Denver Avenue - Suite D
Fort Lupton, CO 80621
Ph: 303-857-6222 Fax: 303-857-6224
www.j-tconsulting.com

SLOPE STABILITY REPORT

FOR THE
WEST FARM GRAVEL PIT EXPANSION
PROWERS COUNTY, COLORADO

DECEMBER, 2020
REVISED APRIL, 2021

PREPARED FOR:

PROWERS AGGREGATE OPERATORS, LLC.
9485 COUNTY ROAD HH.5
LAMAR, CO 81052
(719) 688-4477

PREPARED BY:

J&T Consulting, Inc.

305 DENVER AVENUE – SUITE D
FORT LUPTON, CO 80621
PHONE: 303-857-6222

CERTIFICATION:

I hereby certify this slope stability analysis for Prowers Aggregate Operators, LLC, the West Farm Gravel Pit Expansion, located in Prowers County, Colorado was prepared by me or under my direct supervision.



James C. York
Registered Professional Engineer
State of Colorado No. 36846

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II. Overview

III. Geotechnical Data

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Appendix B	Slope Stability Case Cross-Sections
Appendix C	Slope Stability Case Galena Output
Appendix D	Geotechnical Investigation Reports
Appendix E	USGS Map, Oct. 2002 revision – “Peak Acceleration (%g) with a 2% Probability of Exceedance in 50 yrs”

I - INTRODUCTION

Prowers Aggregate Operators, LLC (PAO) proposes to expand the existing West Farm Pit. The property is located east of the City of Lamar, Colorado. More specifically the property is located in the south ½ of Section 26, south ½ of Section 27, south ½ of Section 28, south ½ of Section 29, north ½ of Section 32, southwest ¼ and north ½ of Section 33, north ½ of Section 34, north ½ of Section 35, and the northwest ¼ of Section 36, Township 22 South, Range 46 West of the Sixth Prime Meridian, in Prowers County, Colorado. The property is bounded by private property on the east and west, Prowers County Road HH.5 on the south, and private property and the City of Lamar sewer lagoons on the north. United States Highway 50 is approximately one eighth mile south of the subject property. The proposed mining operation will extract gravel reserves from locations adjacent to man-made structures. The rules and regulations of the Division of Reclamation, Mining and Safety (DRMS) require that any mining within a setback of 200 feet of a man-made structure show thorough engineering analysis that the proposed mining will not cause damage. The accepted method of demonstrating this is through a slope stability analysis. This report contains an overview of the methodology used in the analysis of the mining slopes and their estimated affects on all man-made structures. Recommendations regarding acceptable setbacks from man-made structures have also been included.

II - OVERVIEW

The DRMS mining plan proposes that the property will be mined in 9 phases. Phases 1, 2, and 9 were previously analyzed and addressed for the current permit area and have not been included in this analysis for the expansion. The mining of all phases will occur at 3H:1V slopes. Concurrent reclamation is planned such that the reclamation embankment will be constructed as the mining progresses.

III - GEOTECHNICAL DATA

Geotechnical gravel investigations for the property have been performed by Cesare, Inc. (CES), and Rocky Mountain Industrials, Inc. (RMI). J&T Consulting, Inc. (JT) estimated soil strength parameters based on the information from the CES report, and other stability analyses that have been performed on gravel mining operations located in similar soils. Table 1 below represents a summary of the soil strength parameters that were used in this stability analysis.

Table 1 - Soil Properties

Description	Max dry density (pcf)	Saturated Density (pcf)	Cohesion (psf)	Internal Friction Angle
Overburden	110	131	150	22
Sand and Gravel	110	131	0	35
Weathered Bedrock	125	141	100	18
Stable Bedrock	125	141	2000	20
Slurry Wall	100	110	0	45

IV - DESIGN ANALYSIS AND CRITERIA

The proposed mining slopes were analyzed using Clover Technologies Galena Slope Stability Analysis System, version 7.2. Galena was designed to analyze the slope stability of earth embankments subjected to several critical situations that may occur during the life of the embankment. For this project, fifteen cases were identified as critical during the mining operation. Static and pseudo-static conditions were analyzed in each case.

Pseudo-static peak acceleration factors (peak horizontal acceleration, or PHA) were taken from USGS information for the western United States. The 2% probability of exceedance in 50 years (the most conservative) was used. A peak acceleration factor of 0.06 x gravity was taken from this data. A conservative earthquake loading coefficient of 0.50 x PHA is often used for slope stability analyses (50% of PHA). We used an even more conservative approach and used 70% of the PHA for this area for our earthquake loading coefficient. Hence, 0.70 x 0.06 = 0.042 which was used in the models.

All mining side slopes will be 3H:1V.

Case 3-1 –Ditch Bank to the West of Phase 3.
The proposed setback for mining is 85 feet from the edge of the ditch bank. The mining depth was assumed to be 60 feet in this area based on the bore log information in the geotechnical investigations.

Case 3-2 – Edge of Highway Realignment Parcel to the East of Phase 3.
The proposed setback for mining is 75 feet from the edge of the parcel. The mining depth was assumed to be 65 feet in this area based on bore log information in the geotechnical investigations.

Case 3-3 – Edge of Highway Realignment Parcel to the North of Phase 3.
The proposed setback for mining is 65 feet from the edge of the parcel. The mining depth was assumed to be 56 feet in this area based on bore log information in the geotechnical investigations.

Case 4-1 – Electric Line/Poles to the East of Phase 4.
The proposed setback for mining is 75 feet from the lines/poles. The mining depth was assumed to be 43 feet in this area based on bore log information in the geotechnical investigations.

Case 4-2 – Ditch Bank to the South of Phase 4.
The proposed setback for mining is 85 feet from the edge of the ditch bank. The mining depth was assumed to be 54 feet in this area based on bore log information in the geotechnical investigations.

Case 5-1 – Edge of Conservation Easement to the East of Phase 5.
The proposed setback for mining is 55 feet from the edge of the easement. The mining depth was assumed to be 39 feet in this area based on bore log information in the geotechnical investigations.

Case 5-2 – Canal Bank to the South of Phase 5.
The proposed setback for mining is 75 feet from the edge of the canal bank. The mining depth was assumed to be 17 feet in this area based on bore log information in the geotechnical investigations.

Case 5-3 – Electric Line/Poles to the West of Phase 5.
The proposed setback for mining is 60 feet from the lines/poles. The mining depth was assumed to be 36 feet in this area based on bore log information in the geotechnical investigations.

Case 6-1 – Edge of Conservation Easement to the East of Phase 6.
The proposed setback for mining is 50 feet from the edge of the easement. The mining depth was assumed to be 41 feet in this area based on bore log information in the geotechnical investigations.

Case 6-2 – Canal Bank to the South of Phase 6.
The proposed setback for mining is 75 feet from the edge of the canal bank. The mining depth was assumed to be 25 feet in this area based on bore log information in the geotechnical investigations.

Case 7-1 – Electric/Gas Lines to the North of Phase 7.
The proposed setback for mining is 150 feet from the electric/gas lines. The mining depth was assumed to be 56 feet in this area based on bore log information in the geotechnical investigations.

Case 7-2 – Canal Bank to the South of Phase 7.
The proposed setback for mining is 80 feet from the edge of the canal bank. The mining depth was assumed to be 56 feet in this area based on bore log information in the geotechnical investigations.

Case 8-1 – Electric/Gas Lines to the North of Phase 8.
The proposed setback for mining is 145 feet from the electric/gas lines. The mining depth was assumed to be 37 feet in this area based on bore log information in the geotechnical investigations.

Case 8-2 – Electric Line/Poles West of Phase 8.
The proposed setback for mining is 60 feet from the electric line/poles. The mining depth was assumed to be 38 feet in this area based on bore log information in the geotechnical investigations.

Case 8-3 – County Road HH.5 to the South of Phase 8.
The proposed setback for mining is 75 feet from the edge of the road. The mining depth was assumed to be 29 feet in this area based on bore log information in the geotechnical investigations.

Case 8-4 – Edge of Highway Realignment Parcel to the East of Phase 8.
The proposed setback for mining is 50 feet from the edge of the parcel. The mining depth was assumed to be 36 feet in this area based on bore log information in the geotechnical investigations.

The cross-sections located in Appendix B show the proposed mining slope geometry, estimated phreatic surface, location of the man-made structures relative to the mining slope, and location of the most critical slope failure surface for each case.

V - METHODOLOGY

The mining embankment configuration shown in the computer analysis represents the estimated conditions for this site. If mining conditions differ from the estimated conditions, the slope stability will need to be re-evaluated on a case by case basis. The Bishop Method was used in the computer analysis for determining safety factors. The procedure searches for circular shear failures and automatically searches for the lowest safety factor. 20,000 separate failure surfaces were analyzed for each case. The required minimum safety factors are based on the current standards detailed in the Policies of the Mined Land Reclamation Board (MLRB).

VI - SLOPE STABILITY RESULTS

Per the current policies of the MLRB, critical structures with assumed soil strength values require minimum factors of safety of 1.5 and 1.3 for static and pseud-static analyses respectively. Non-critical structures with assumed soil strength values require minimum factors of safety of 1.3 and 1.15 for static and pseudo-static analyses respectively. Each case analyzed used the appropriate critical or non-critical factors of safety for the structure as shown in the analysis results tables below. The calculated safety factors exceed the minimum required and can be considered indicators of the

mining slope performance under the various conditions. The slopes were analyzed using full and rapid drawdown reservoir conditions. The results of the static condition and pseudo-static condition slope stability analyses are summarized in Table 2 and Table 3 below.

Table 2 – Static Condition Slope Stability Analysis Results

Description	Calculated Factor of Safety	Required Minimum Factor of Safety
Case 3-1 – Ditch Bank West of Phase 3 – Full Reservoir	3.47	1.5
Case 3-1 – Ditch Bank West of Phase 3 – Rapid Drawdown	1.85	1.5
Case 3-2 – Highway Parcel East of Phase 3 – Full Reservoir	2.82	1.3
Case 3-2 – Highway Parcel East of Phase 3 – Rapid Drawdown	1.47	1.3
Case 3-3 – Highway Parcel North of Phase 3 – Full Reservoir	2.62	1.3
Case 3-3 – Highway Parcel North of Phase 3 – Rapid Drawdown	1.37	1.3
Case 4-1 – Electric Line/Poles East of Phase 4 – Full Reservoir	3.15	1.5
Case 4-1 – Electric Line/Poles East of Phase 4 – Rapid Drawdown	1.73	1.5
Case 4-2 – Ditch Bank South of Phase 4 – Full Reservoir	3.11	1.5
Case 4-2 – Ditch Bank South of Phase 4 – Rapid Drawdown	1.66	1.5
Case 5-1 – Conservation Easement East of Phase 5 – Full Reservoir	2.55	1.3
Case 5-1 – Conservation Easement East of Phase 5 – Rapid Drawdown	1.39	1.3
Case 5-2 – Canal Bank South of Phase 5 – Full Reservoir	4.13	1.5
Case 5-2 – Canal Bank South of Phase 5 – Rapid Drawdown	2.69	1.5
Case 5-3 – Electric Line/Poles West of Phase 5 – Full Reservoir	2.96	1.5
Case 5-3 – Electric Line/Poles West of Phase 5 – Rapid Drawdown	1.64	1.5
Case 6-1 – Conservation Easement East of Phase 6 – Full Reservoir	2.60	1.3
Case 6-1 – Conservation Easement East of Phase 6 – Rapid Drawdown	1.39	1.3
Case 6-2 – Canal Bank South of Phase 6 – Full Reservoir	3.85	1.5
Case 6-2 – Canal Bank South of Phase 6 – Rapid Drawdown	2.31	1.5
Case 7-1 – Elec/Gas Lines North of Phase 7 – Full Reservoir	4.38	1.5
Case 7-1 – Elec/Gas Lines North of Phase 7 – Rapid Drawdown	2.40	1.5
Case 7-2 – Canal Bank South of Phase 7 – Full Reservoir	2.99	1.5
Case 7-2 – Canal Bank South of Phase 7 – Rapid Drawdown	1.58	1.5
Case 8-1 – Elec/Gas Lines North of Phase 8 – Full Reservoir	5.42	1.5
Case 8-1 – Elec/Gas Lines North of Phase 8 – Rapid Drawdown	3.15	1.5
Case 8-2 – Elec Line/Poles West of Phase 8 – Full Reservoir	2.93	1.5
Case 8-2 – Elec Line/Poles West of Phase 8 – Rapid Drawdown	1.61	1.5
Case 8-3 – County Road HH.5 South of Phase 8 – Full Reservoir	3.79	1.5
Case 8-3 – County Road HH.5 South of Phase 8 – Rapid Drawdown	2.21	1.5
Case 8-4 – Highway Parcel East of Phase 8 – Full Reservoir	2.82	1.3
Case 8-4 – Highway Parcel East of Phase 8 – Rapid Drawdown	1.59	1.3

Table 3 – Pseudo-Static Condition Slope Stability Analysis Results

Description	Calculated Factor of Safety	Required Minimum Factor of Safety
Case 3-1 – Ditch Bank West of Phase 3 – Full Reservoir	2.57	1.3
Case 3-1 – Ditch Bank West of Phase 3 – Rapid Drawdown	1.54	1.3
Case 3-2 – Highway Parcel East of Phase 3 – Full Reservoir	2.14	1.15
Case 3-2 – Highway Parcel East of Phase 3 – Rapid Drawdown	1.24	1.15
Case 3-3 – Highway Parcel North of Phase 3 – Full Reservoir	1.99	1.15
Case 3-3 – Highway Parcel North of Phase 3 – Rapid Drawdown	1.16	1.15
Case 4-1 – Electric Line/Poles East of Phase 4 – Full Reservoir	2.32	1.3
Case 4-1 – Electric Line/Poles East of Phase 4 – Rapid Drawdown	1.42	1.3
Case 4-2 – Ditch Bank South of Phase 4 – Full Reservoir	2.31	1.3
Case 4-2 – Ditch Bank South of Phase 4 – Rapid Drawdown	1.38	1.3
Case 5-1 – Conservation Easement East of Phase 5 – Full Reservoir	1.92	1.15
Case 5-1 – Conservation Easement East of Phase 5 – Rapid Drawdown	1.17	1.15
Case 5-2 – Canal Bank South of Phase 5 – Full Reservoir	2.72	1.3
Case 5-2 – Canal Bank South of Phase 5 – Rapid Drawdown	2.00	1.3
Case 5-3 – Electric Line/Poles West of Phase 5 – Full Reservoir	2.20	1.3
Case 5-3 – Electric Line/Poles West of Phase 5 – Rapid Drawdown	1.36	1.3
Case 6-1 – Conservation Easement East of Phase 6 – Full Reservoir	1.97	1.15
Case 6-1 – Conservation Easement East of Phase 6 – Rapid Drawdown	1.17	1.15
Case 6-2 – Canal Bank South of Phase 6 – Full Reservoir	2.68	1.3
Case 6-2 – Canal Bank South of Phase 6 – Rapid Drawdown	1.82	1.3
Case 7-1 – Elec/Gas Lines North of Phase 7 – Full Reservoir	3.05	1.3
Case 7-1 – Elec/Gas Lines North of Phase 7 – Rapid Drawdown	1.92	1.3
Case 7-2 – Canal Bank South of Phase 7 – Full Reservoir	2.23	1.3
Case 7-2 – Canal Bank South of Phase 7 – Rapid Drawdown	1.32	1.3
Case 8-1 – Elec/Gas Lines North of Phase 8 – Full Reservoir	3.55	1.3
Case 8-1 – Elec/Gas Lines North of Phase 8 – Rapid Drawdown	2.39	1.3
Case 8-2 – Elec Line/Poles West of Phase 8 – Full Reservoir	2.19	1.3
Case 8-2 – Elec Line/Poles West of Phase 8 – Rapid Drawdown	1.33	1.3
Case 8-3 – County Road HH.5 South of Phase 8 – Full Reservoir	2.70	1.3
Case 8-3 – County Road HH.5 South of Phase 8 – Rapid Drawdown	1.77	1.3
Case 8-4 – Highway Parcel East of Phase 8 – Full Reservoir	2.14	1.15
Case 8-4 – Highway Parcel East of Phase 8 – Rapid Drawdown	1.33	1.15

VII - CONCLUSIONS AND RECOMMENDATIONS

Case 3-1 – The resulting safety factors of 1.85 (static) and 1.54 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.5 (static) and 1.3 (pseudo-static) for critical structures. The resulting safety factors of 3.47 (static) and 2.57 (pseudo-static) during a full reservoir condition also exceed the

minimum required MLRB safety factors for critical structures. The proposed setback of 85 feet from the edge of the ditch bank is satisfactory.
Case 3-2 – The resulting safety factors of 1.47 (static) and 1.24 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.3 (static) and 1.15 (pseudo-static) for non-critical structures. The resulting safety factors of 2.82 (static) and 2.14 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for non-critical structures. The proposed setback of 75 feet from the edge of the highway parcel is satisfactory.

Case 3-3 – The resulting safety factors of 1.37 (static) and 1.16 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.3 (static) and 1.15 (pseudo-static) for non-critical structures. The resulting safety factors of 2.62 (static) and 1.99 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for non-critical structures. The proposed setback of 65 feet from the edge of the highway parcel is satisfactory.

Case 4-1 – The resulting safety factors of 1.73 (static) and 1.42 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.5 (static) and 1.3 (pseudo-static) for critical structures. The resulting safety factors of 3.15 (static) and 2.32 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for critical structures. The proposed setback of 75 feet from the electric line/poles is satisfactory.

Case 4-2 – The resulting safety factors of 1.66 (static) and 1.38 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.5 (static) and 1.3 (pseudo-static) for critical structures. The resulting safety factors of 3.11 (static) and 2.31 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for critical structures. The proposed setback of 85 feet from the edge of the ditch bank is satisfactory.

Case 5-1 – The resulting safety factors of 1.39 (static) and 1.17 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.3 (static) and 1.15 (pseudo-static) for non-critical structures. The resulting safety factors of 2.55 (static) and 1.92 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for non-critical structures. The proposed setback of 55 feet from the edge of the conservation easement is satisfactory.

Case 5-2 – The resulting safety factors of 2.69 (static) and 2.00 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.5 (static) and 1.3 (pseudo-static) for critical structures. The resulting safety factors of 4.13 (static) and 2.72 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for critical structures. The proposed setback of 75 feet from the edge of the canal bank is satisfactory.

Case 5-3 – The resulting safety factors of 1.64 (static) and 1.36 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.5

(static) and 1.3 (pseudo-static) for critical structures. The resulting safety factors of 2.96 (static) and 2.20 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for critical structures. The proposed setback of 60 feet from the electric line/poles is satisfactory.

Case 6-1 – The resulting safety factors of 1.39 (static) and 1.17 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.3 (static) and 1.15 (pseudo-static) for non-critical structures. The resulting safety factors of 2.60 (static) and 1.97 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for non-critical structures. The proposed setback of 50 feet from the edge of the conservation easement is satisfactory.

Case 6-2 – The resulting safety factors of 2.31 (static) and 1.82 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.5 (static) and 1.3 (pseudo-static) for critical structures. The resulting safety factors of 3.85 (static) and 2.68 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for critical structures. The proposed setback of 75 feet from the edge of the canal bank is satisfactory.

Case 7-1 – The resulting safety factors of 2.40 (static) and 1.92 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.5 (static) and 1.3 (pseudo-static) for critical structures. The resulting safety factors of 4.38 (static) and 3.05 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for critical structures. The proposed setback of 150 feet from the electric/gas lines is satisfactory.

Case 7-2 – The resulting safety factors of 1.58 (static) and 1.32 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.5 (static) and 1.3 (pseudo-static) for critical structures. The resulting safety factors of 2.99 (static) and 2.23 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for critical structures. The proposed setback of 80 feet from the edge of the canal bank is satisfactory.

Case 8-1 – The resulting safety factors of 3.15 (static) and 2.39 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.5 (static) and 1.3 (pseudo-static) for critical structures. The resulting safety factors of 5.42 (static) and 3.55 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for critical structures. The proposed setback of 145 feet from the electric/gas lines is satisfactory.

Case 8-2 – The resulting safety factors of 1.61 (static) and 1.33 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.5 (static) and 1.3 (pseudo-static) for critical structures. The resulting safety factors of 2.93 (static) and 2.19 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for critical structures. The proposed setback of 60 feet from the electric line/poles is satisfactory.

Case 8-3 – The resulting safety factors of 2.21 (static) and 1.77 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.5 (static) and 1.3 (pseudo-static) for critical structures. The resulting safety factors of 3.79 (static) and 2.70 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for critical structures. The proposed setback of 75 feet from the edge of road is satisfactory.

Case 8-4 – The resulting safety factors of 1.59 (static) and 1.33 (pseudo-static) during a rapid drawdown condition exceed the minimum required MLRB safety factors of 1.3 (static) and 1.15 (pseudo-static) for non-critical structures. The resulting safety factors of 2.82 (static) and 2.14 (pseudo-static) during a full reservoir condition also exceed the minimum required MLRB safety factors for non-critical structures. The proposed setback of 50 feet from the edge of the highway parcel is satisfactory.

The following recommendations for monitoring of slope stability should be followed:

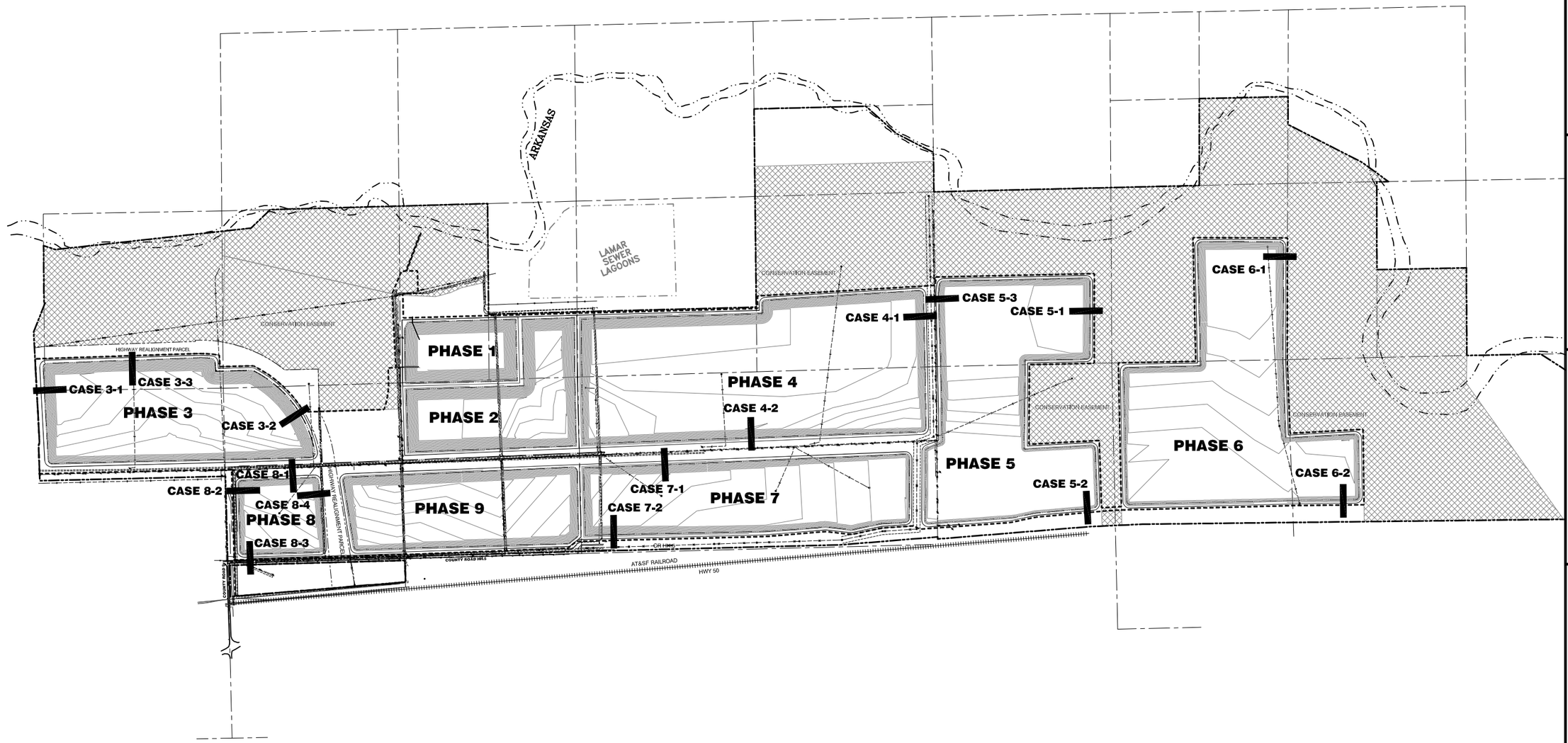
1. A visual inspection of the excavated slopes should be done on a weekly basis for the duration of mining. This inspection should consist of walking the existing ground and looking for any signs of stress cracks or other potential signs of slope failure. Some minor sloughing of slopes is expected on any mine site. The intent of this inspection is to locate potential major slope failures that could potentially extend back into a structure.

2. A visual inspection should be done after a major precipitation event that has saturated the ground using the same procedures. A major precipitation event would be defined as a storm that produces an intensity level reached once in 50 years on the average.

3. If a visual inspection detects signs of a potential slope failure, qualified personnel should be contacted to evaluate and recommend remediation work to stabilize the area.

4. If no visible signs of slope failure are detected during mining, then the inspection period could be reduced to once per 6 months after mining completion, or after every major precipitation event.

APPENDIX A



J&T Consulting, Inc.
305 Denver Avenue - Suite D
Fort Lupton, CO 80621
Ph: 303-857-6222 Fax: 303-857-6224
www.jtconsulting.com

West Farm Pit Expansion

Slope Stability
Case Location Map

Prowers Aggregate Operators, LLC.

M-2008-078

REVISIONS

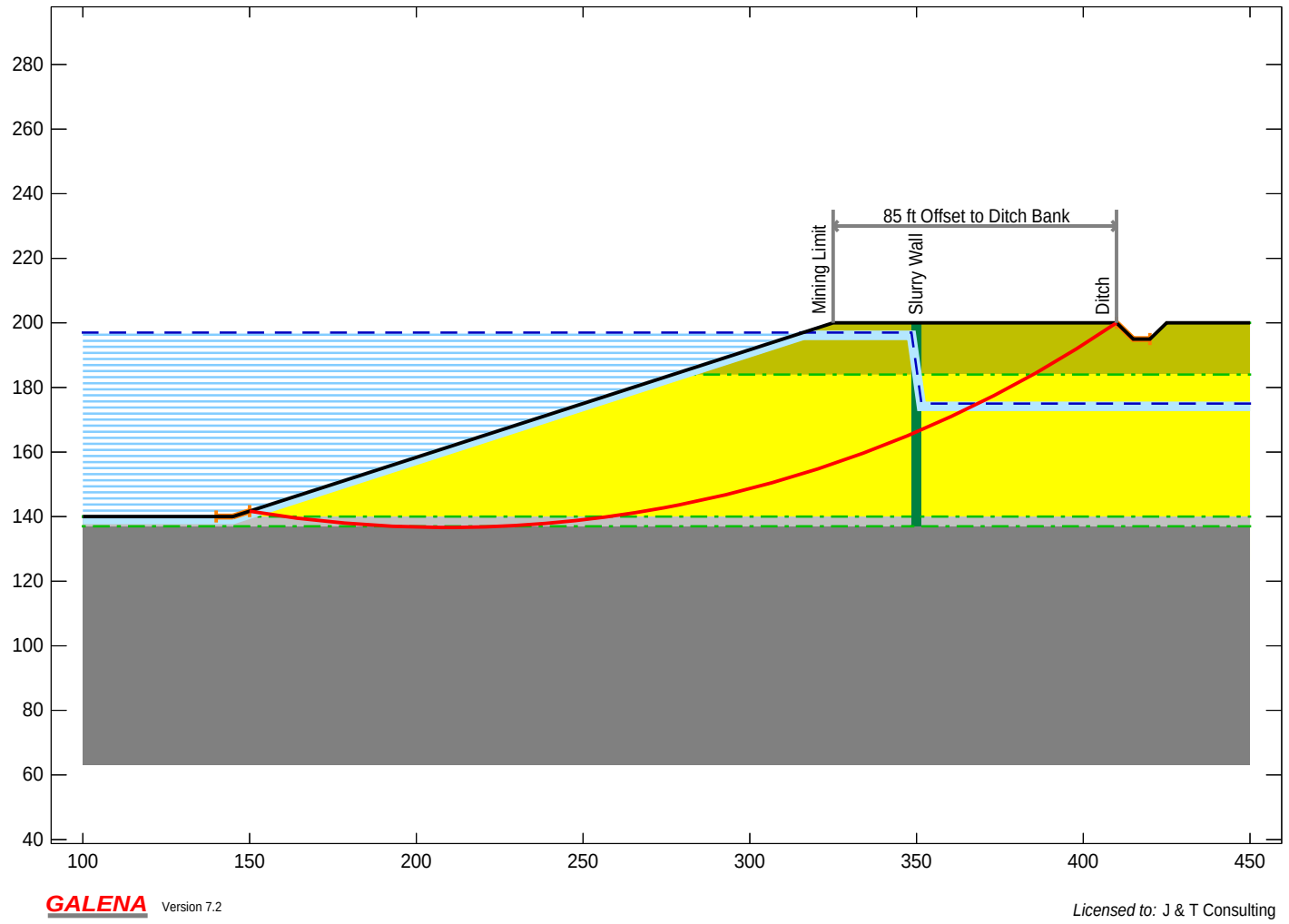
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1	4.1.21	TPY	JCY	Amendment 2 Adequacy Review 1 Comments

Job #	07115
Date	12.3.20
Drawn By	TPY
Designed By	TPY
Checked By	JCY
File	JT-2020 SS Case Map
Scale	1" = 800'

Sheet: 1 Of: 1

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APPENDIX B



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Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Spencer-Wright
Surface: Circular

Results

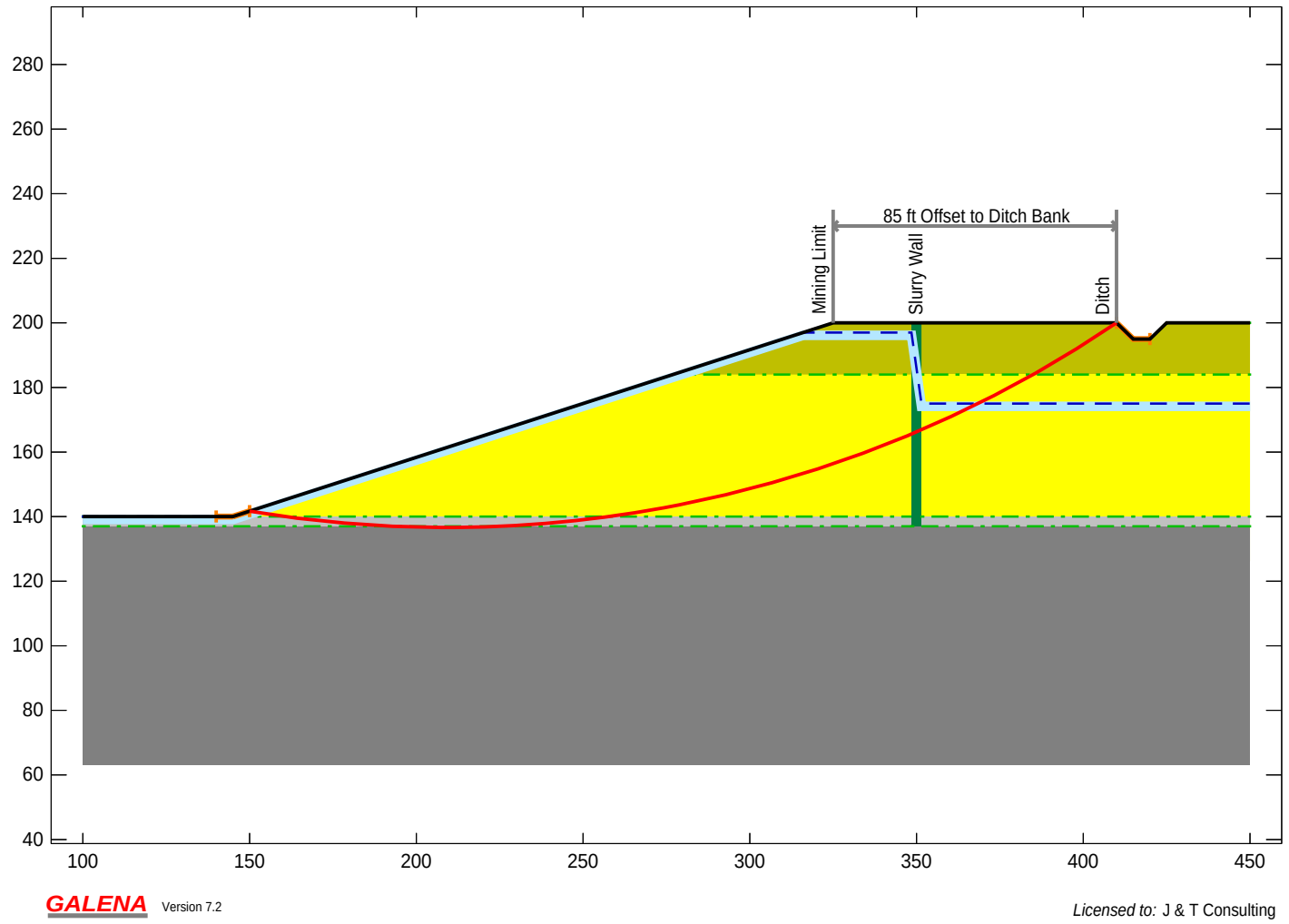
Critical Factor of Safety: 3.47
Interslice Force (Final) Angle: 11.6 °

Project West Farm Pit Expansion
Case 3-1 Full Reservoir

File: C:\Galena Models\Case 3-1\West Farm Expansion Case 3-1 Full Reservoir.gmf

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5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Spencer-Wright
Surface: Circular

Results

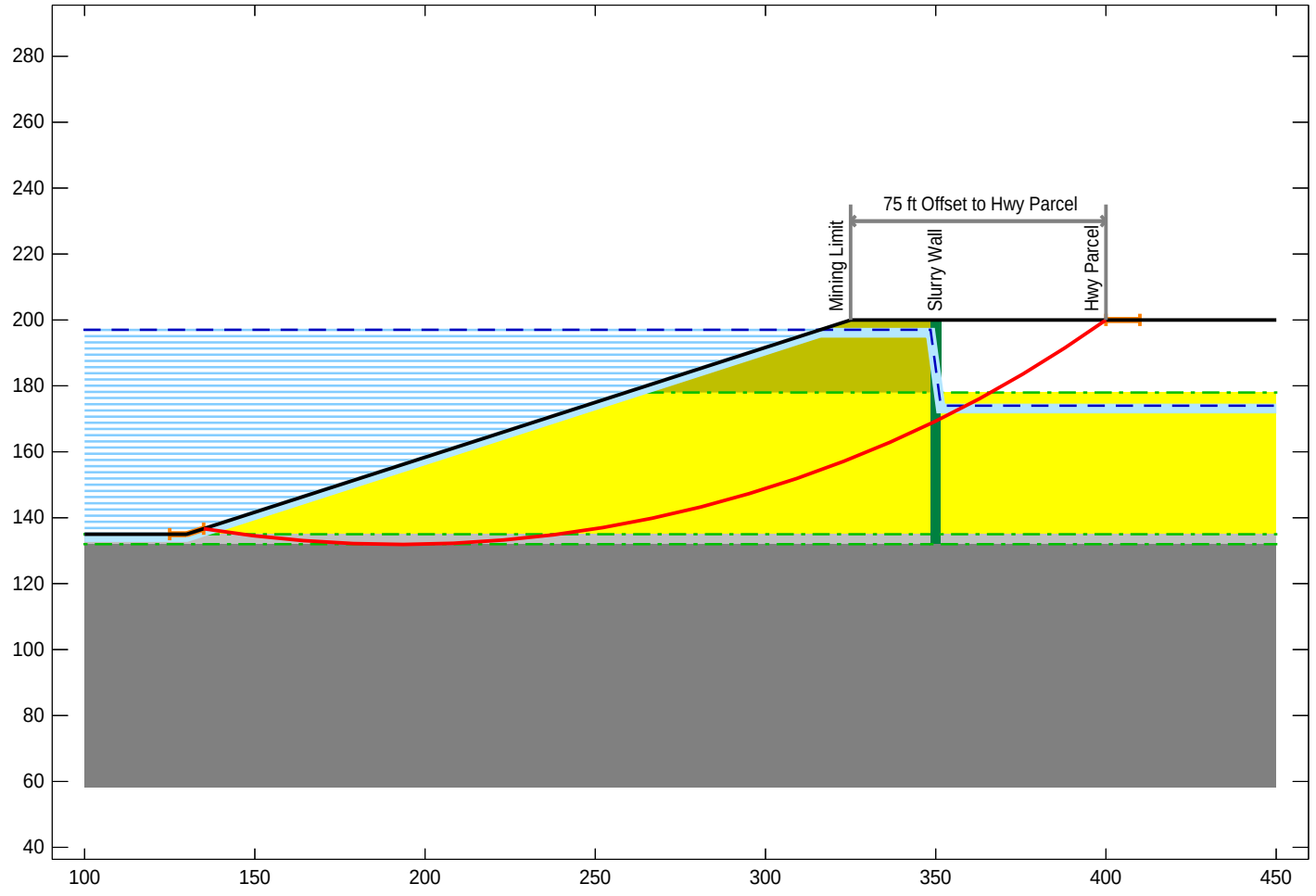
Critical Factor of Safety: 1.85
Interslice Force (Final) Angle: 11.0°

Project West Farm Pit Expansion
Case 3-1 Rapid Drawdown

File: C:\Galena Models\Case 3-1\West Farm Expansion Case 3-1 Rapid Drawdown.gmf

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Material Keys

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5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

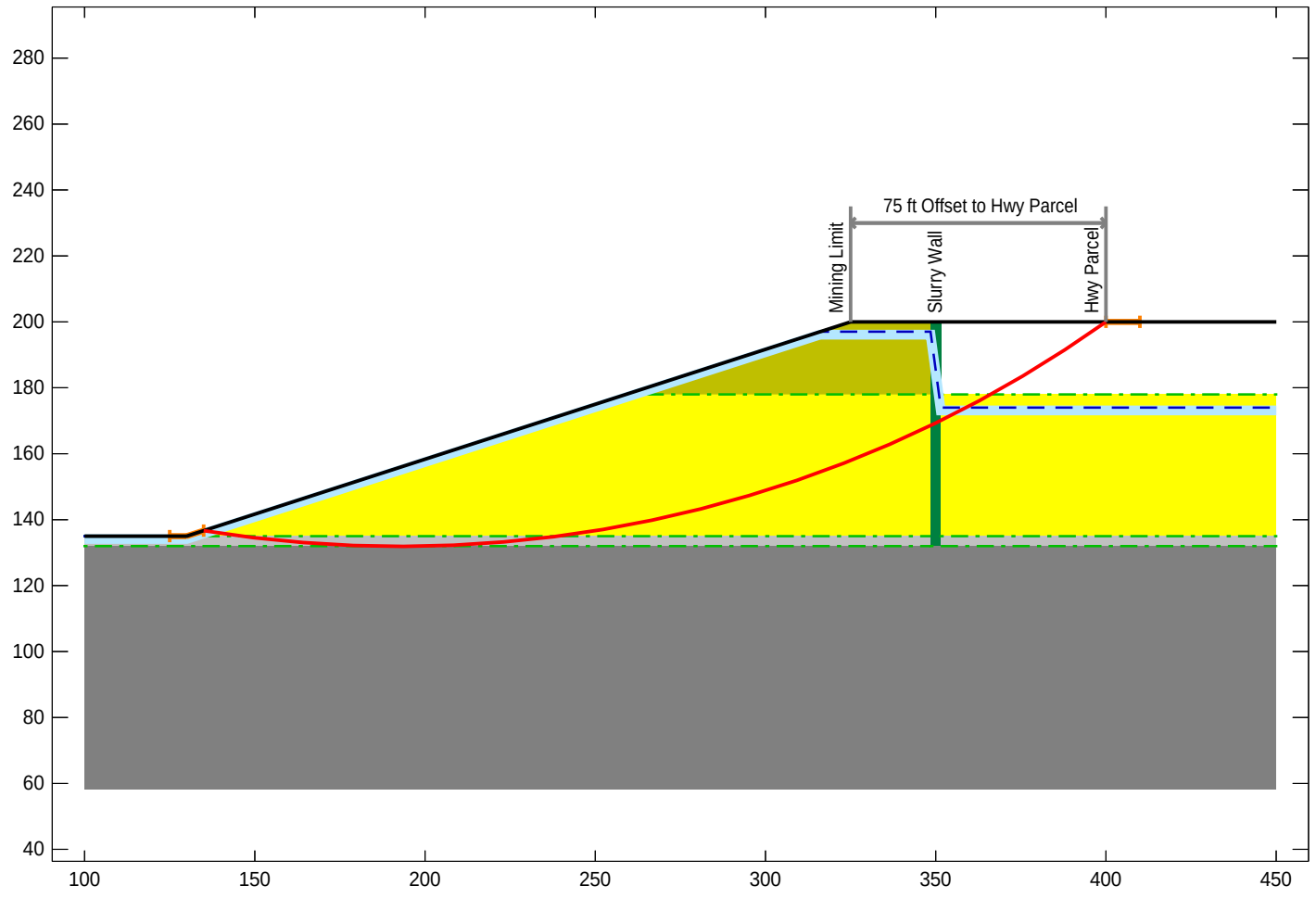
Critical Factor of Safety: 2.82

Project West Farm Pit Expansion
Case 3-2 Full Reservoir

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Material Keys

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5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

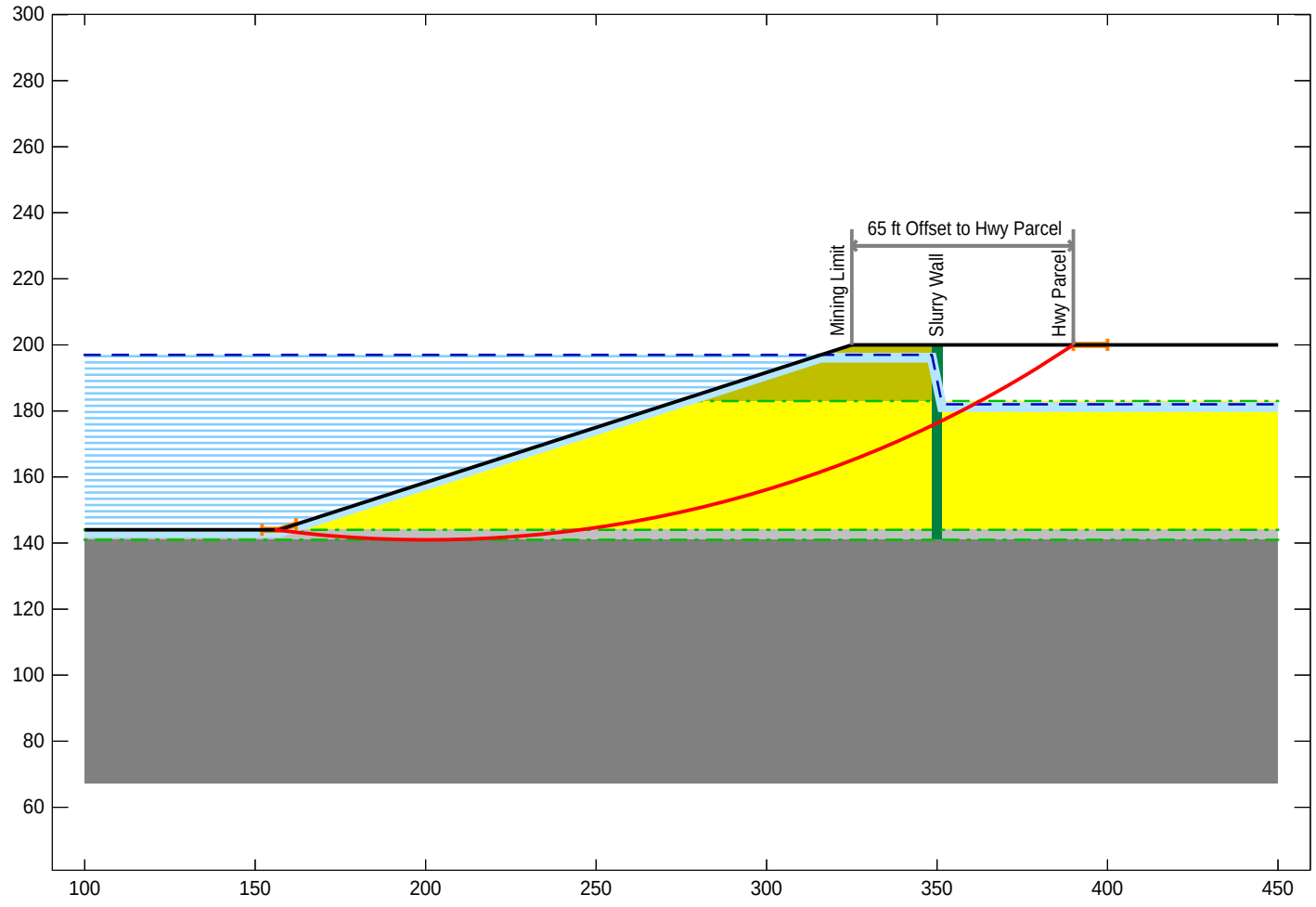
Critical Factor of Safety: 1.47

Project West Farm Pit Expansion
Case 3-2 Rapid Drawdown

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Material Keys

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5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

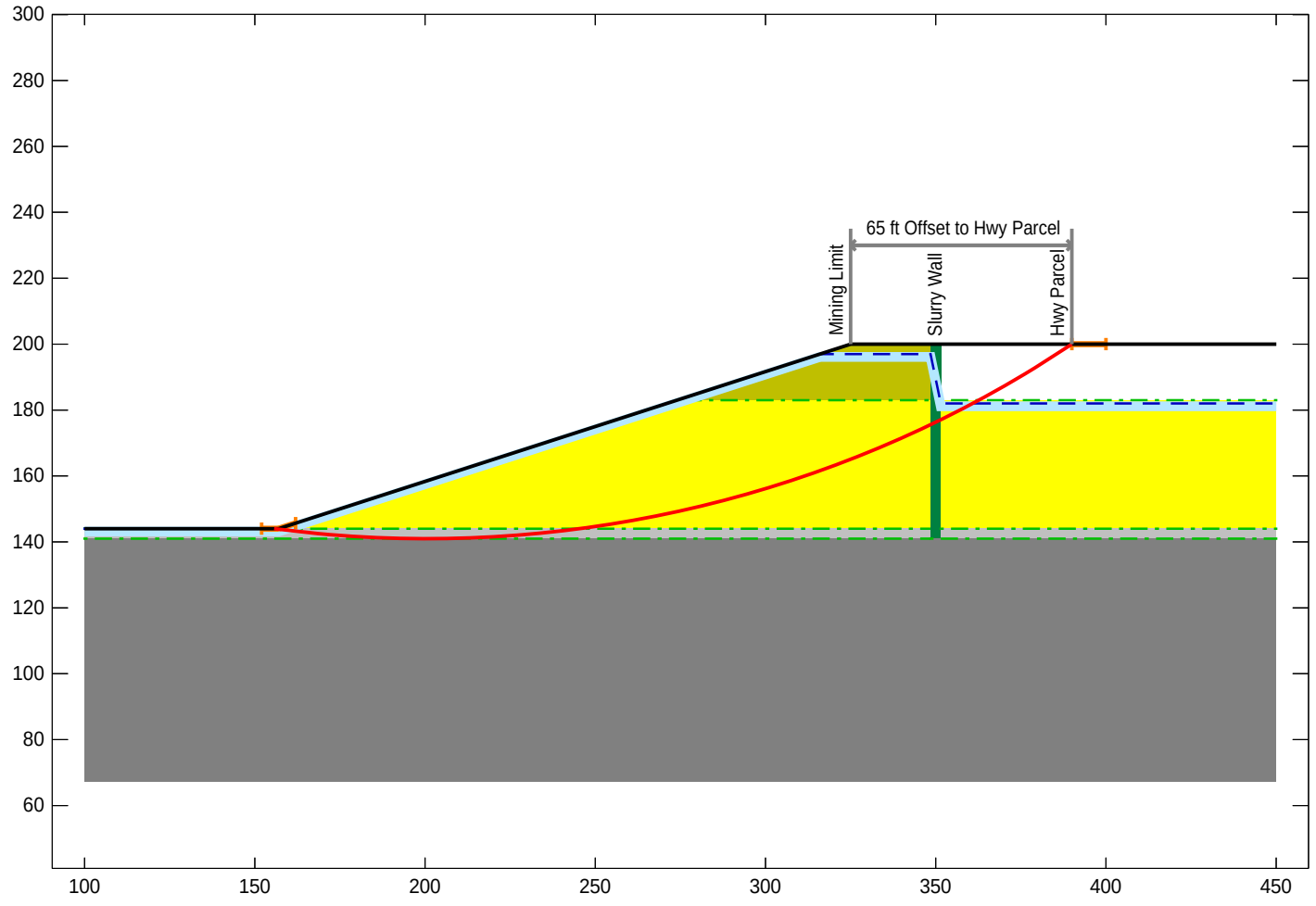
Critical Factor of Safety: 2.62

Project West Farm Pit Expansion
Case 3-3 Full Reservoir

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Material Keys

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5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

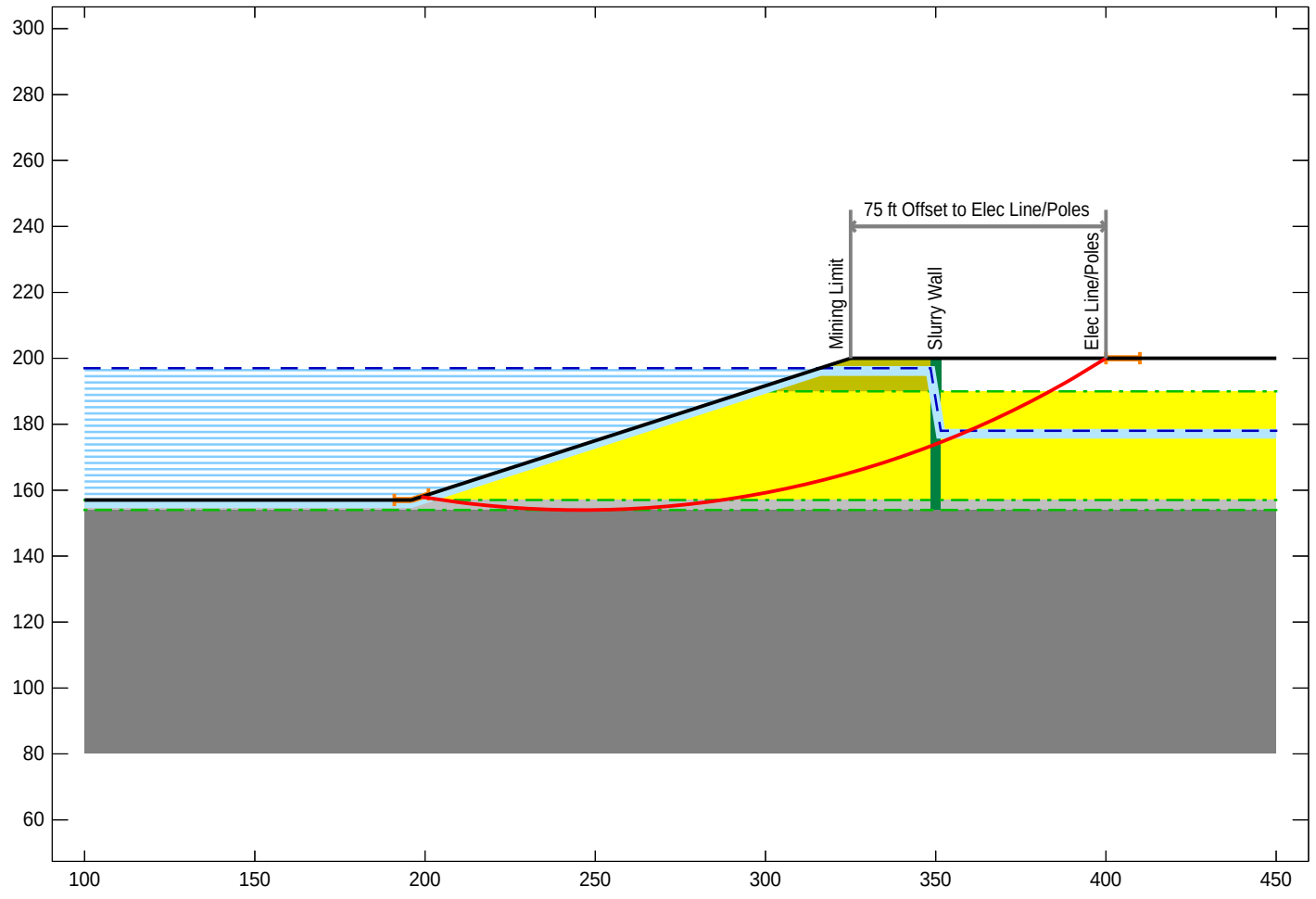
Critical Factor of Safety: 1.37

Project West Farm Pit Expansion
Case 3-3 Rapid Drawdown

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Material Keys

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Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

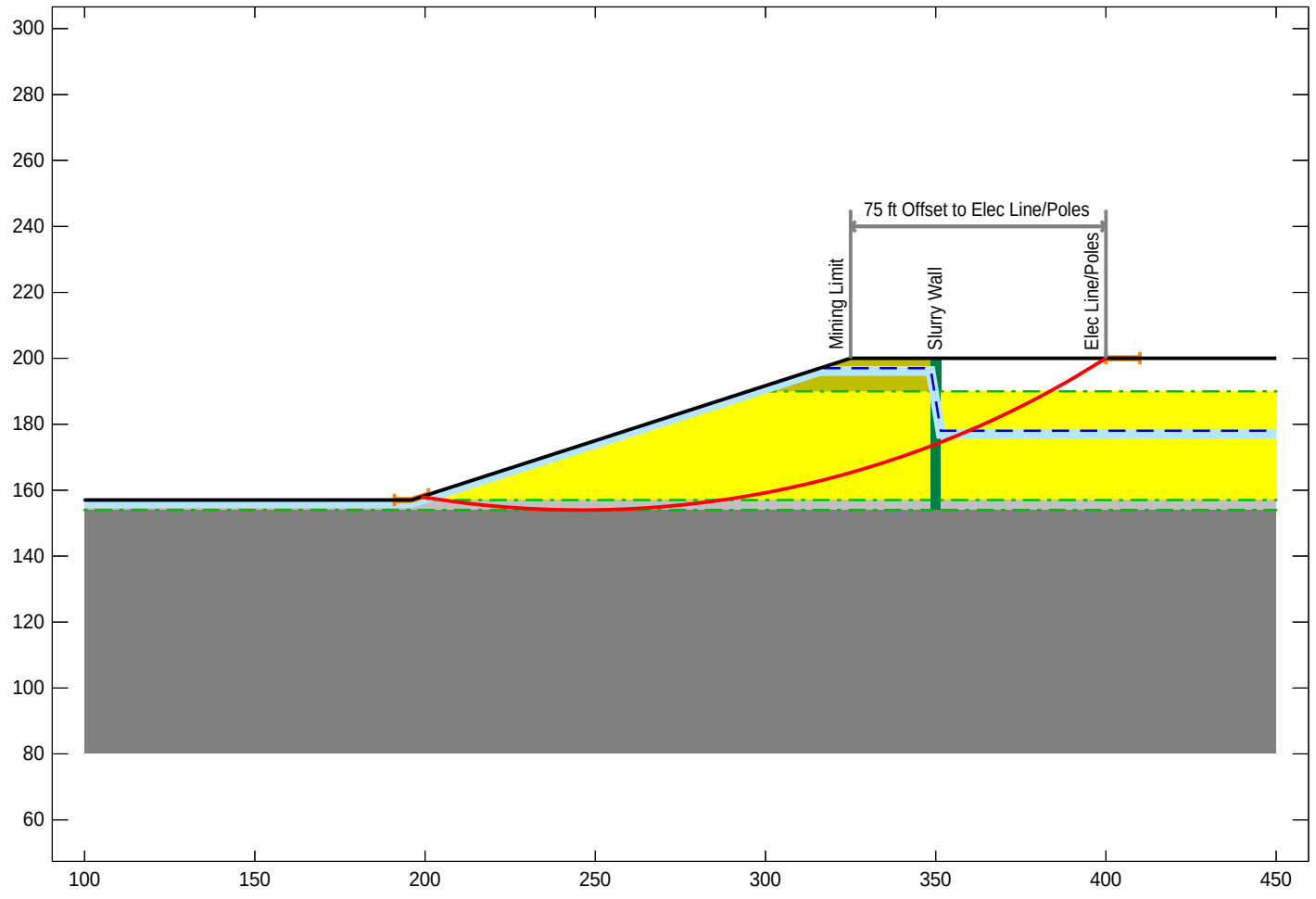
Critical Factor of Safety: 3.15

Project West Farm Pit Expansion
Case 4-1 Full Reservoir

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Material Keys

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4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

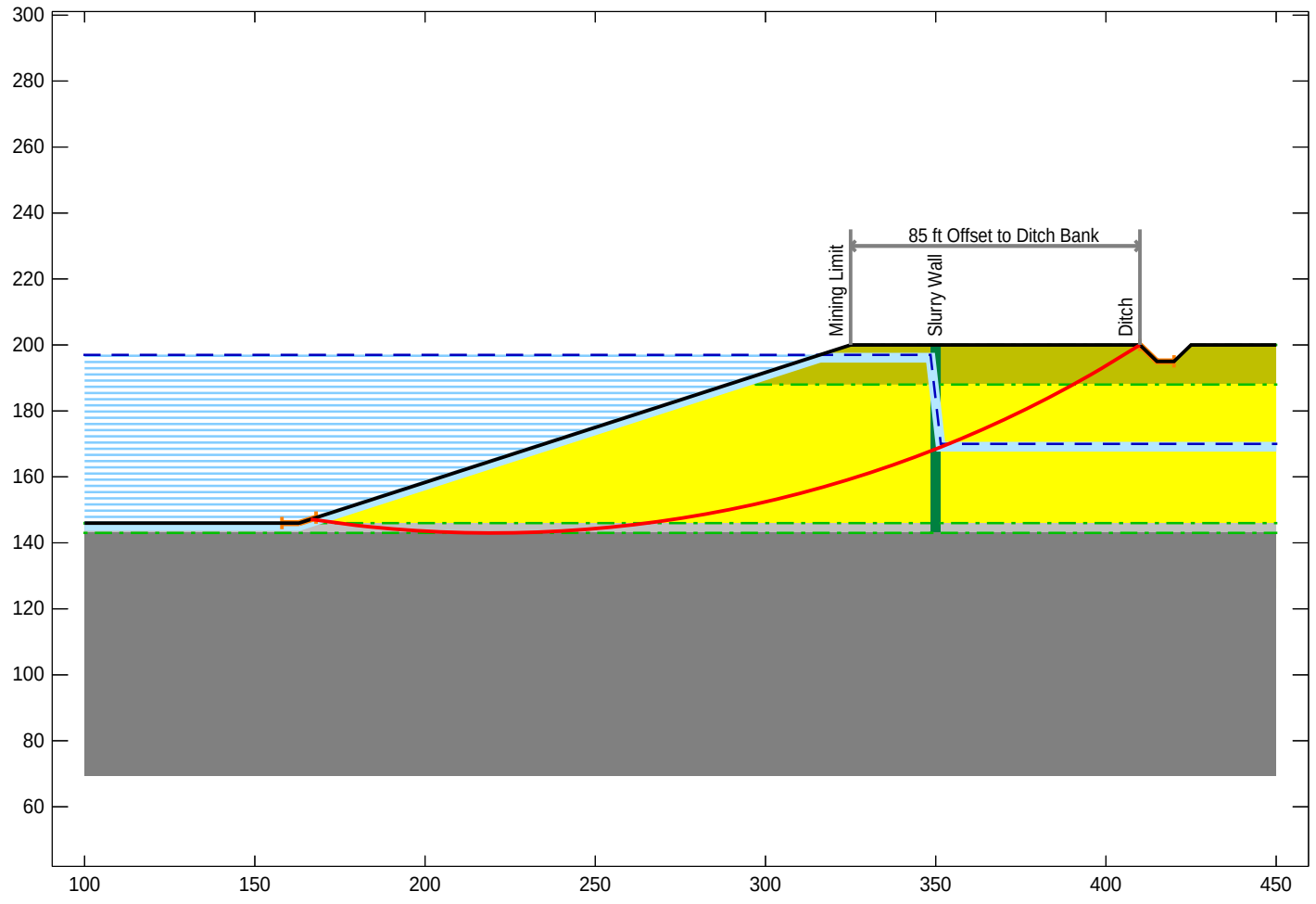
Critical Factor of Safety: 1.73

Project West Farm Pit Expansion
Case 4-1 Rapid Drawdown

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Material Keys

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4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

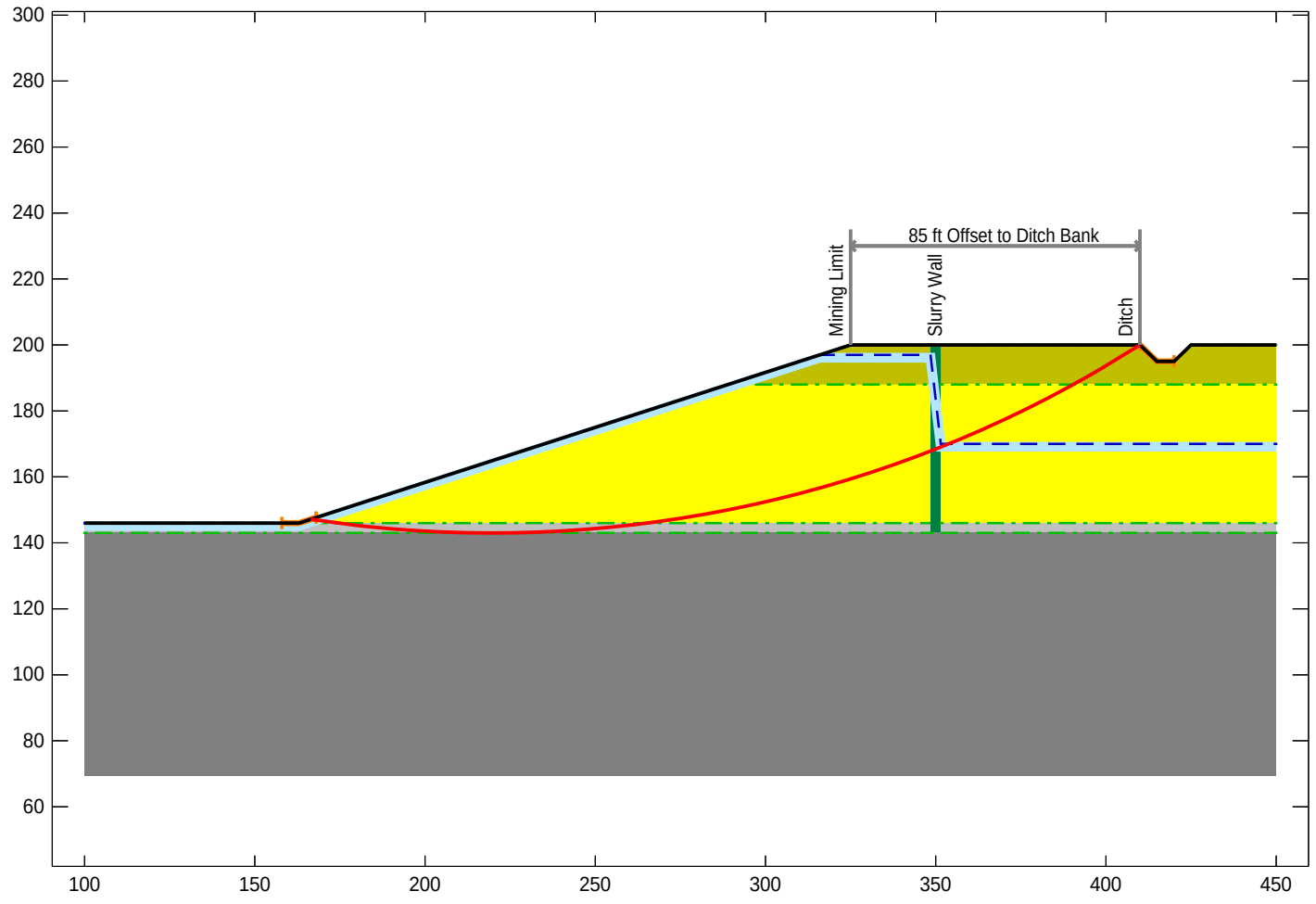
Critical Factor of Safety: 3.11

Project West Farm Pit Expansion
Case 4-2 Full Reservoir

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Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

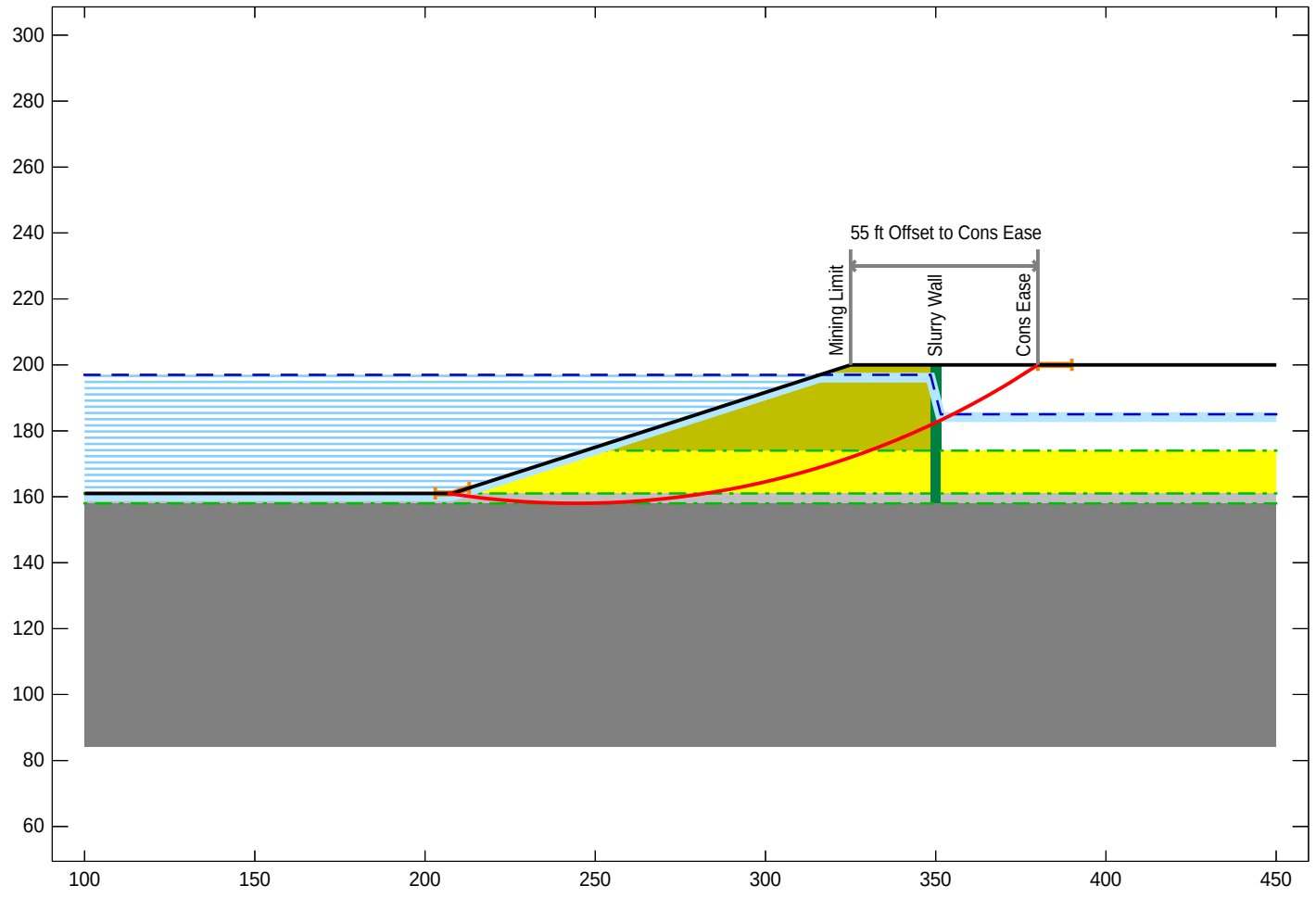
Critical Factor of Safety: 1.66

Project West Farm Pit Expansion
Case 4-2 Rapid Drawdown

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Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

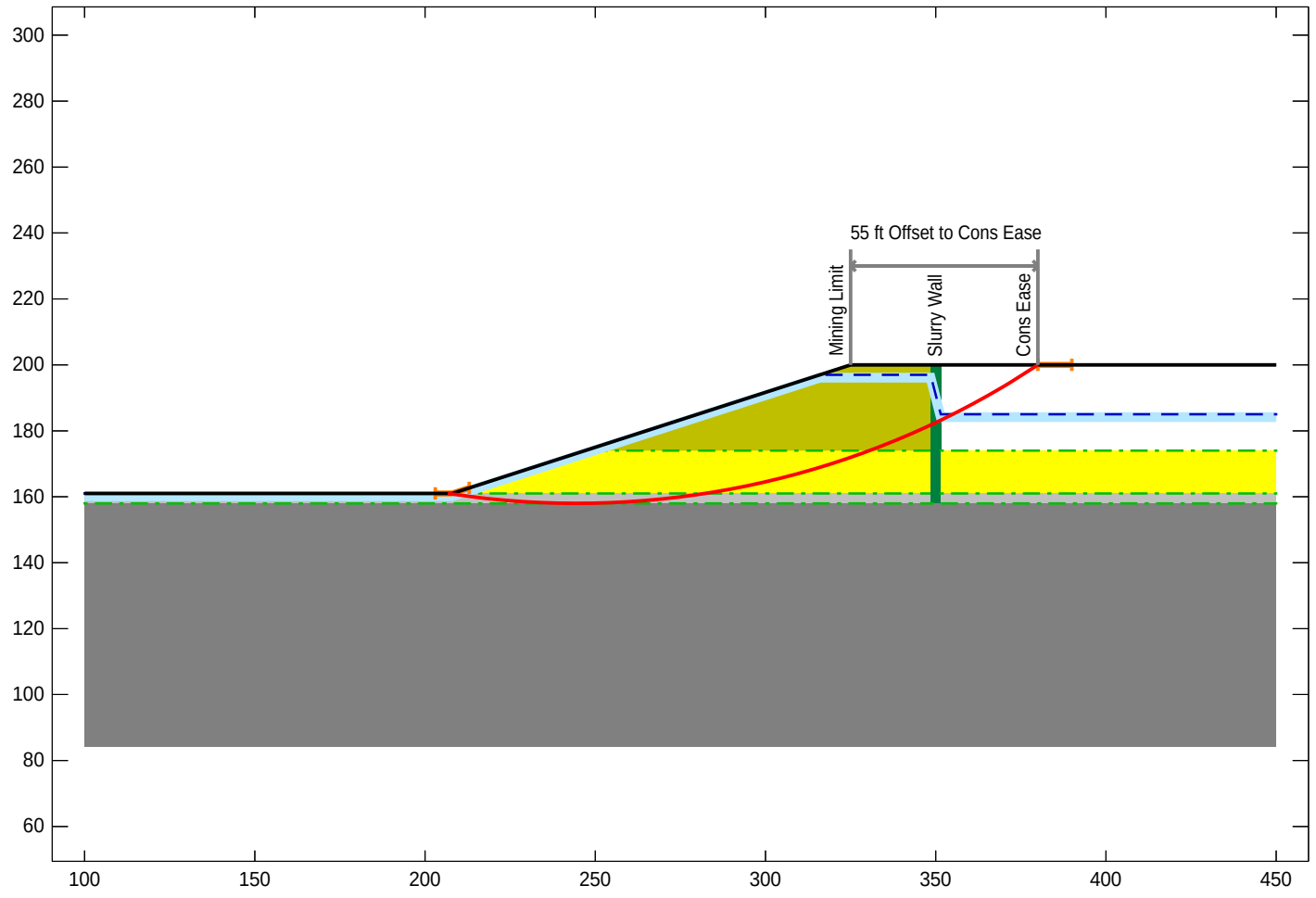
Critical Factor of Safety: 2.55

Project West Farm Pit Expansion
Case 5-1 Full Reservoir

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Material Keys

1: Overburden
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3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

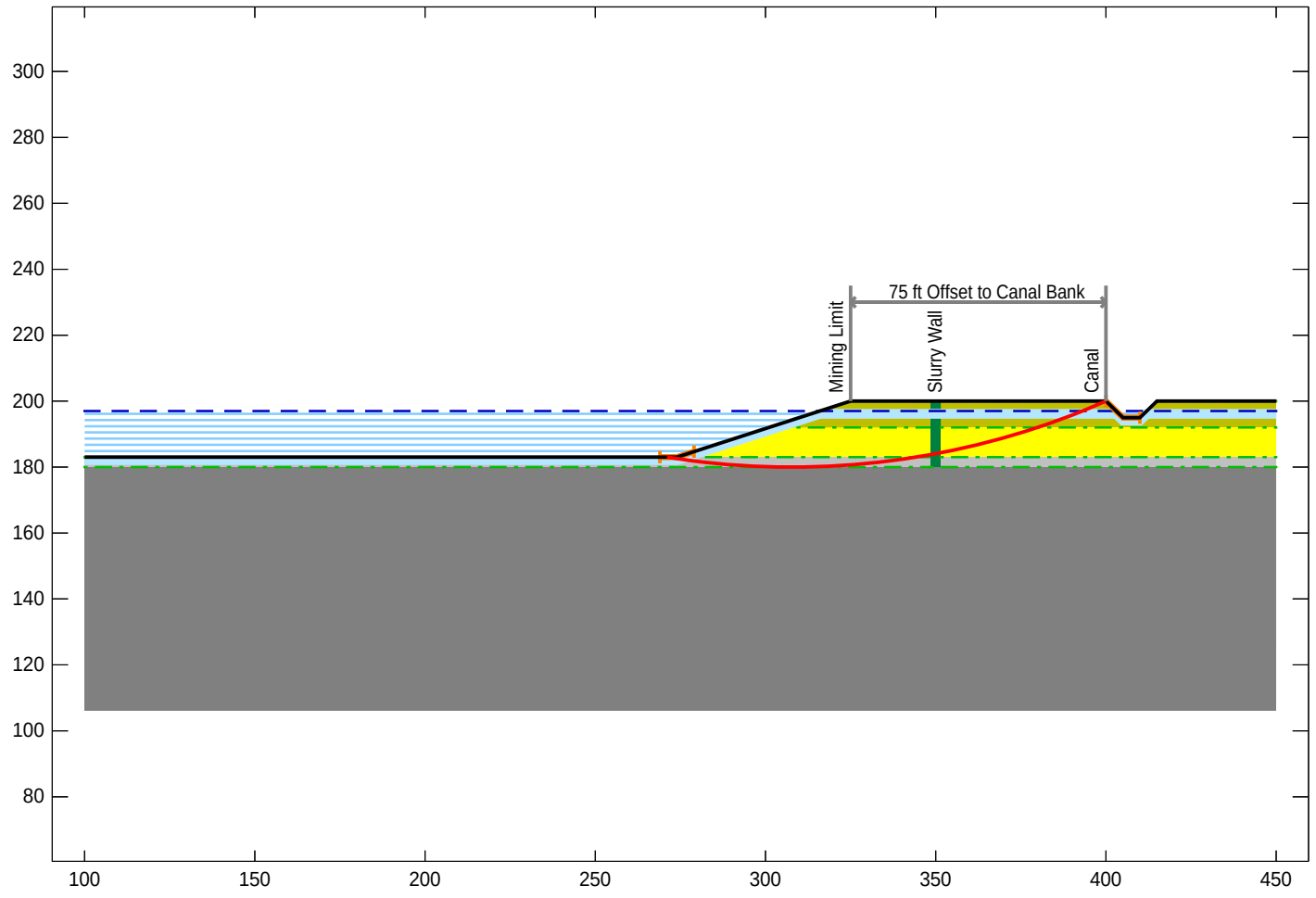
Critical Factor of Safety: 1.39

Project West Farm Pit Expansion
Case 5-1 Rapid Drawdown

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Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

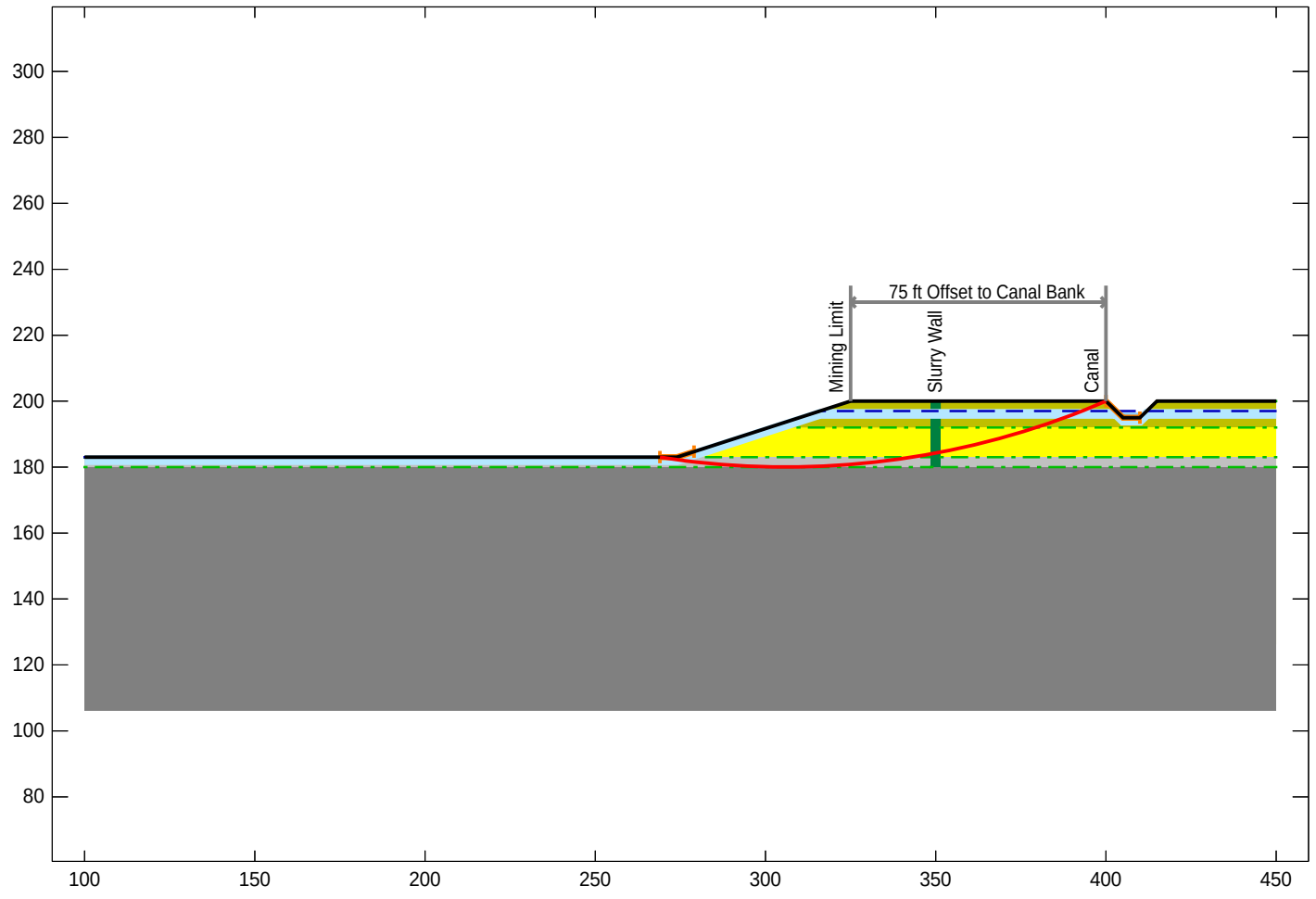
Critical Factor of Safety: 4.13

Project West Farm Pit Expansion
Case 5-2 Full Reservoir

File: C:\Galena Models\West Farm Expansion Case 5-2 Full Reservoir.gmf

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Material Keys

1: Overburden
2: Sand and Gravel
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5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

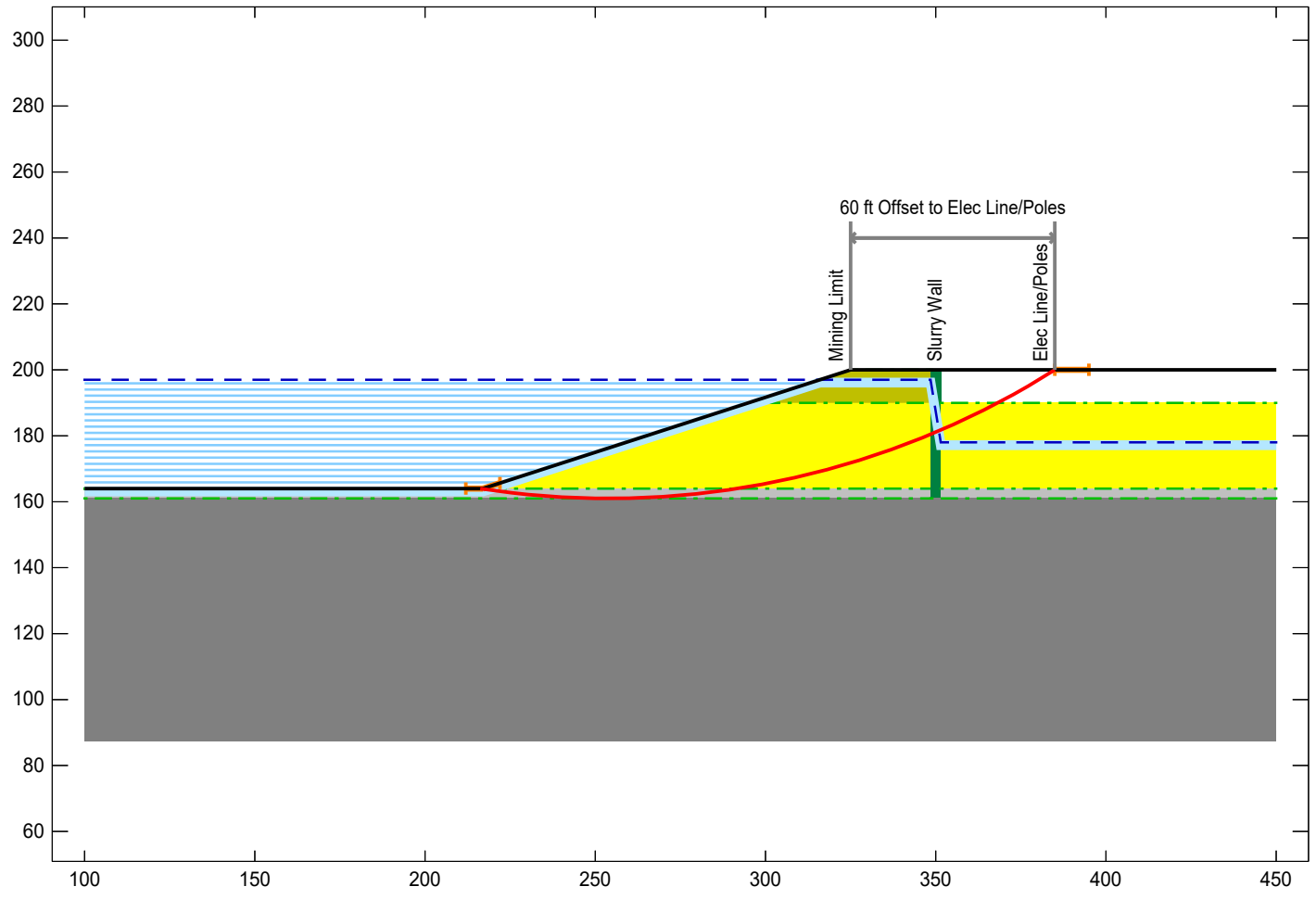
Critical Factor of Safety: 2.69

Project West Farm Pit Expansion
Case 5-2 Rapid Drawdown

File: C:\Galena Models\West Farm Expansion Case 5-2 Rapid Drawdown.gmf

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Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

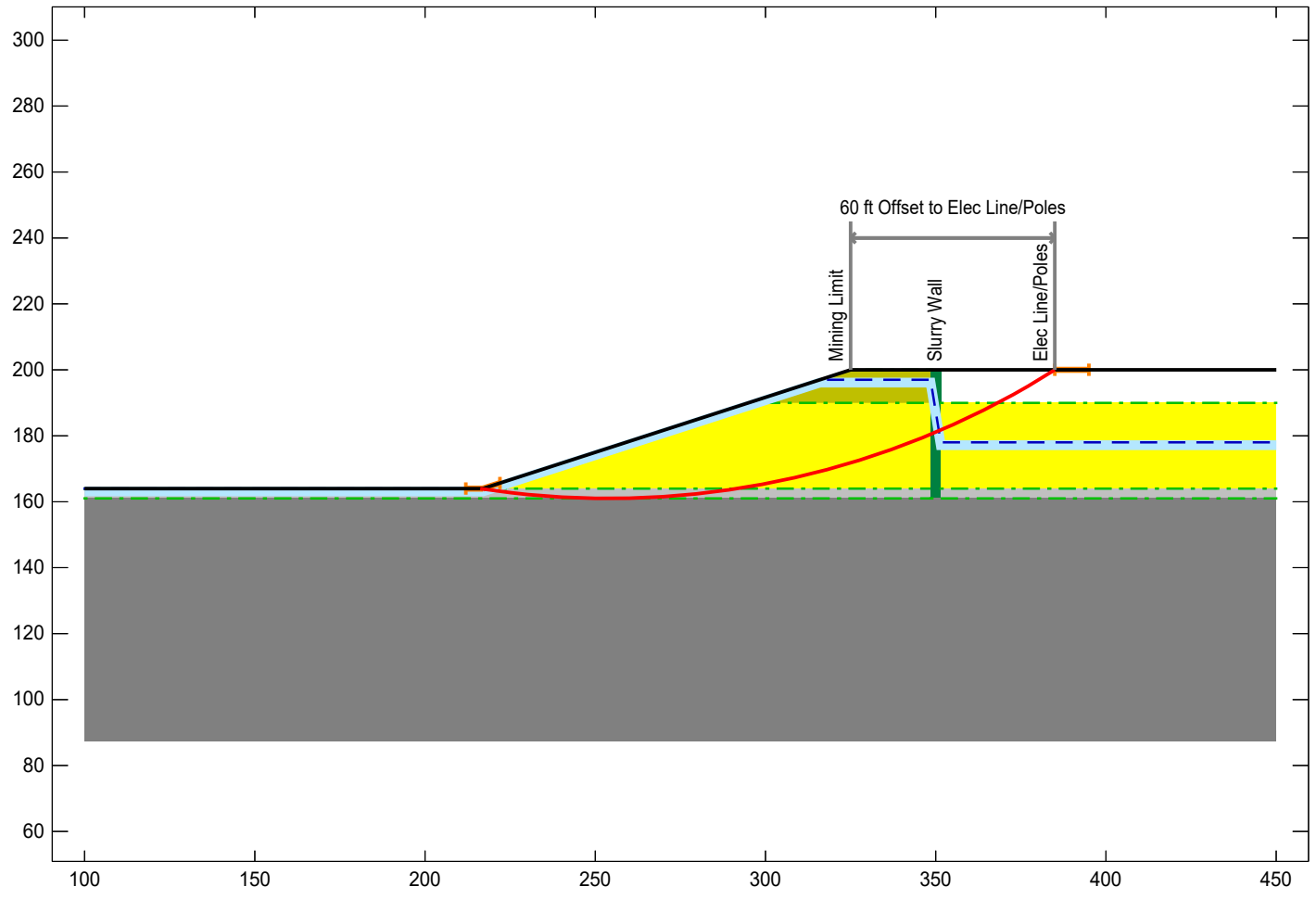
Critical Factor of Safety: 2.96

Project West Farm Pit Expansion
Case 5-3 Full Reservoir

File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Full Reservoir.gmf

Edited: 1 Apr 2021
Processed: 1 Apr 2021

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

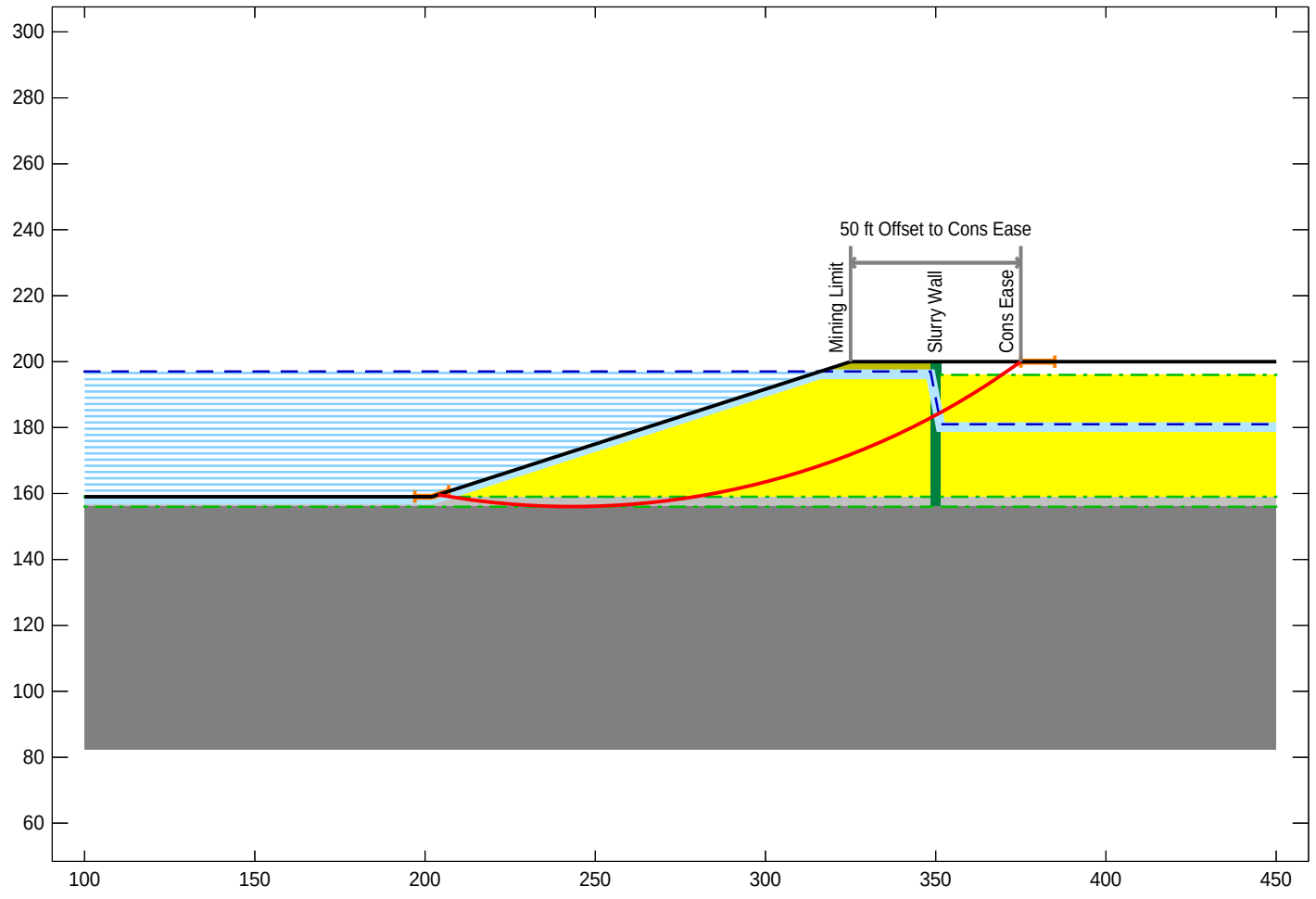
Critical Factor of Safety: 1.64

Project West Farm Pit Expansion
Case 5-3 Rapid Drawdown

File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Rapid Drawdown.gmf

Edited: 1 Apr 2021
Processed: 1 Apr 2021

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

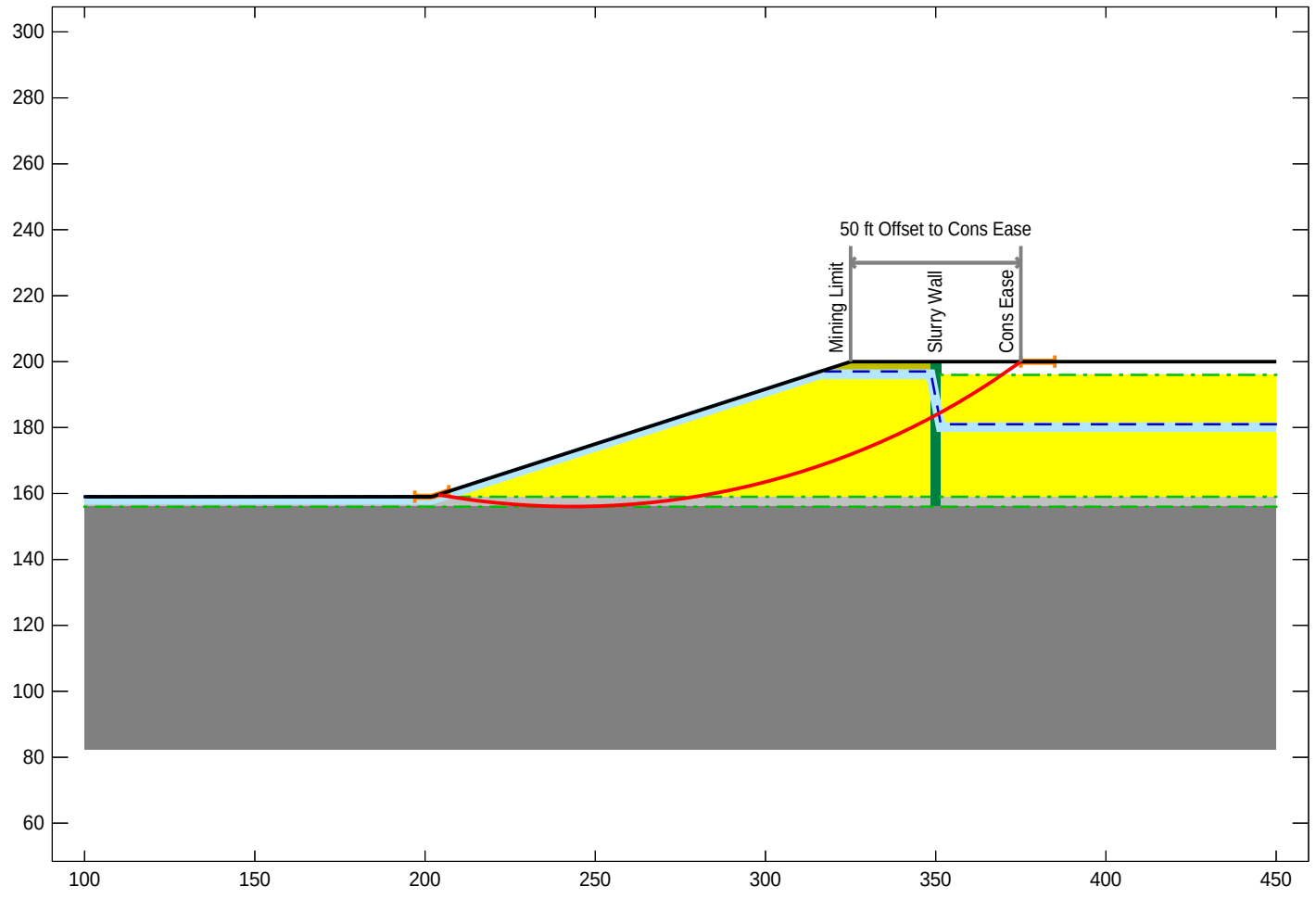
Critical Factor of Safety: 2.60

Project West Farm Pit Expansion
Case 6-1 Full Reservoir

File: C:\Galena Models\West Farm Expansion Case 6-1 Full Reservoir.gmf

Edited: 2 Dec 2020
Processed: 2 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

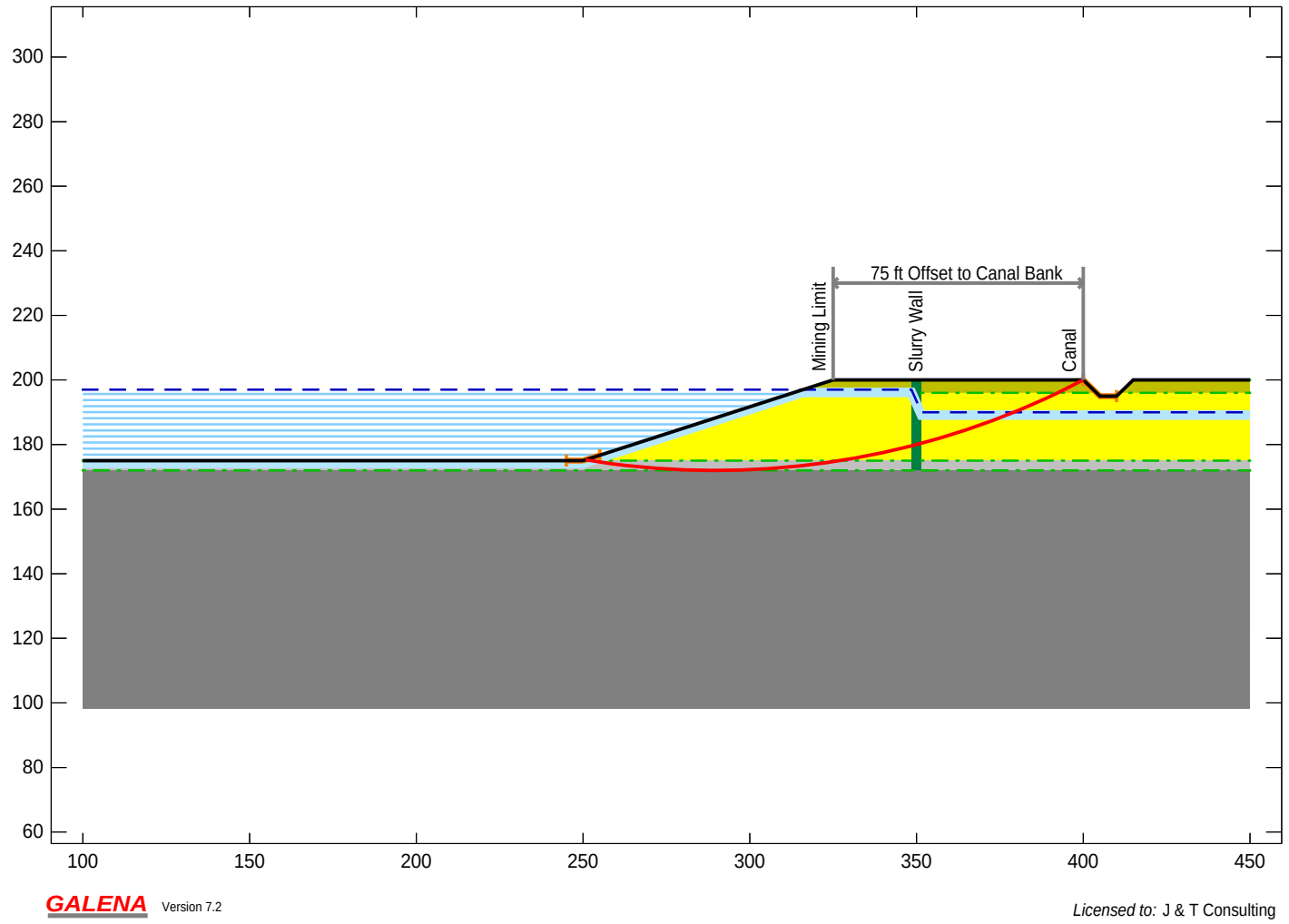
Critical Factor of Safety: 1.39

Project West Farm Pit Expansion
Case 6-1 Rapid Drawdown

File: C:\Galena Models\West Farm Expansion Case 6-1 Rapid Drawdown.gmf

Edited: 2 Dec 2020
Processed: 2 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

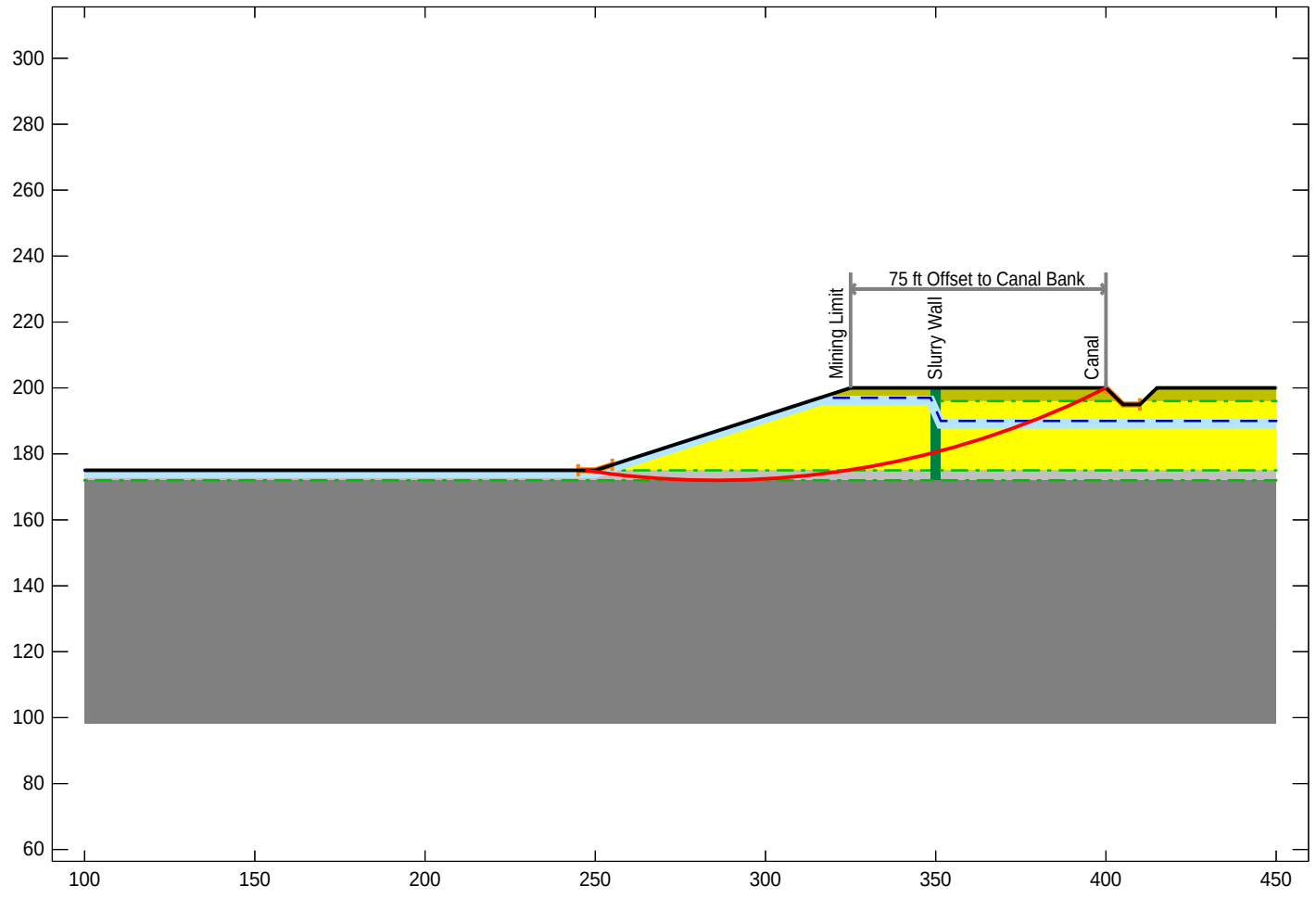
Critical Factor of Safety: 3.85

Project West Farm Pit Expansion
Case 6-2 Full Reservoir

File: C:\Galena Models\West Farm Expansion Case 6-2 Full Reservoir.gmf

Edited: 2 Dec 2020
Processed: 2 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

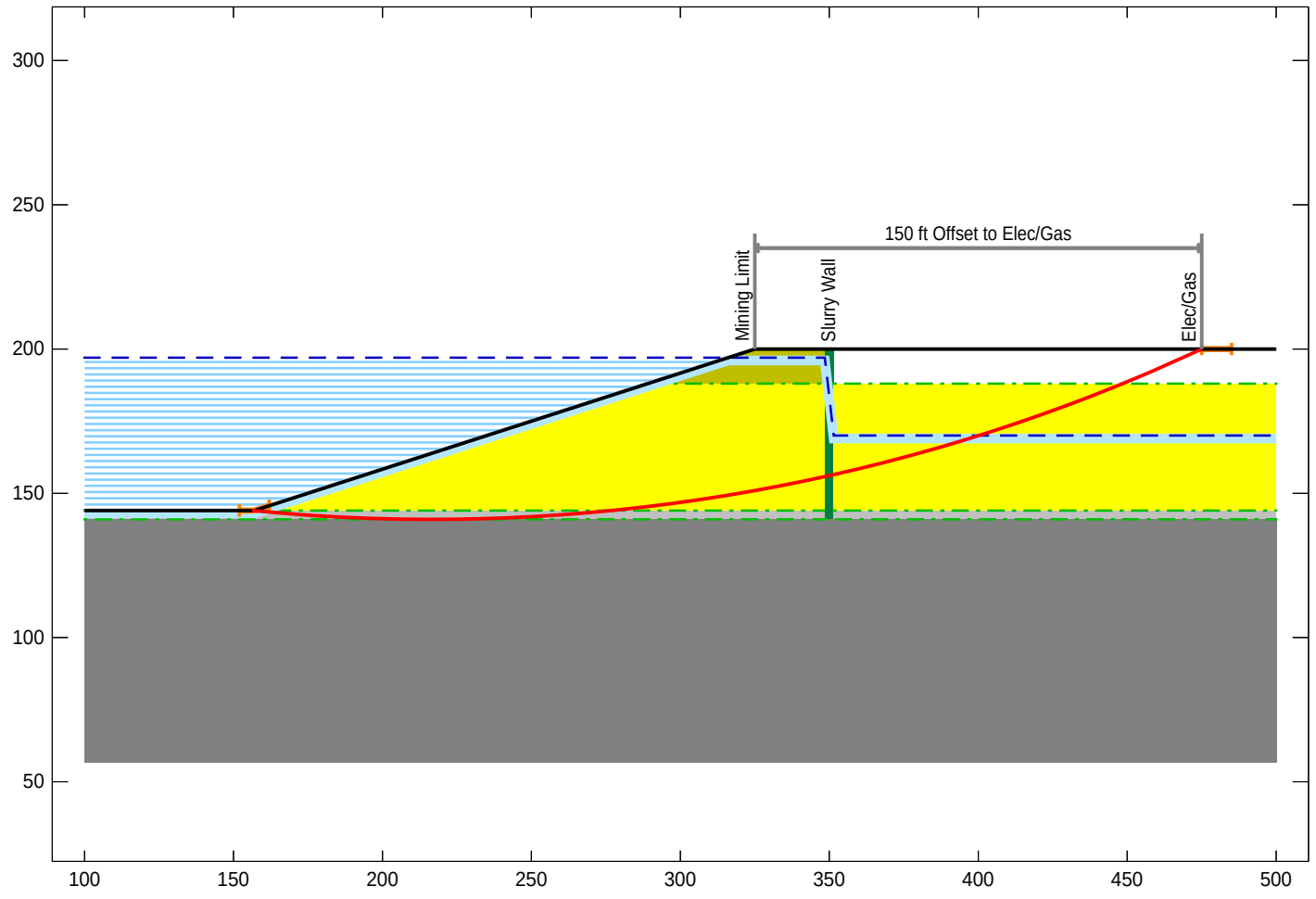
Critical Factor of Safety: 2.31

Project West Farm Pit Expansion
Case 6-2 Rapid Drawdown

File: C:\Galena Models\West Farm Expansion Case 6-2 Rapid Drawdown.gmf

Edited: 2 Dec 2020
Processed: 2 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

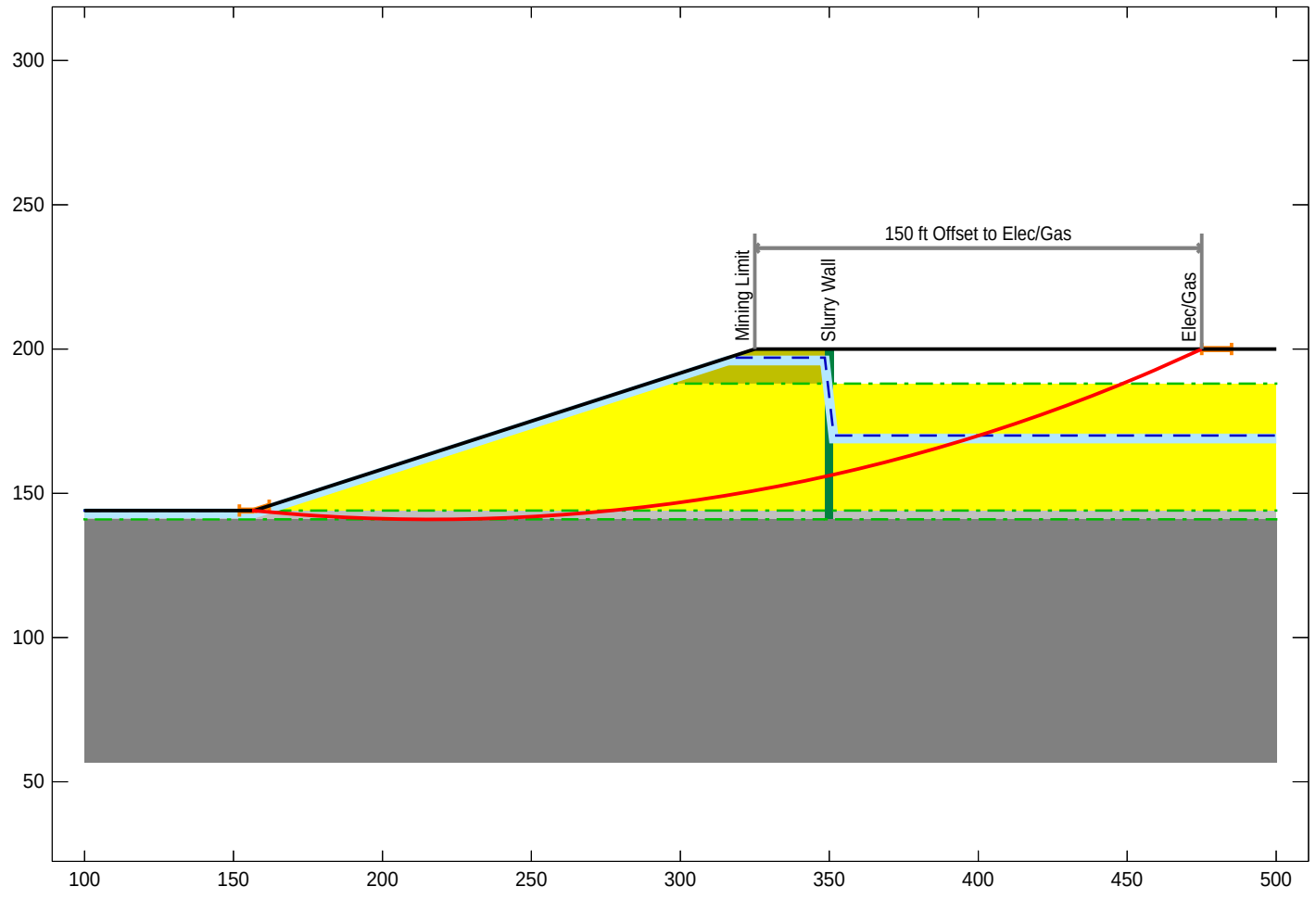
Critical Factor of Safety: 4.38

Project West Farm Pit Expansion
Case 7-1 Full Reservoir

File: C:\Galena Models\West Farm Expansion Case 7-1 Full Reservoir.gmf

Edited: 2 Dec 2020
Processed: 2 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

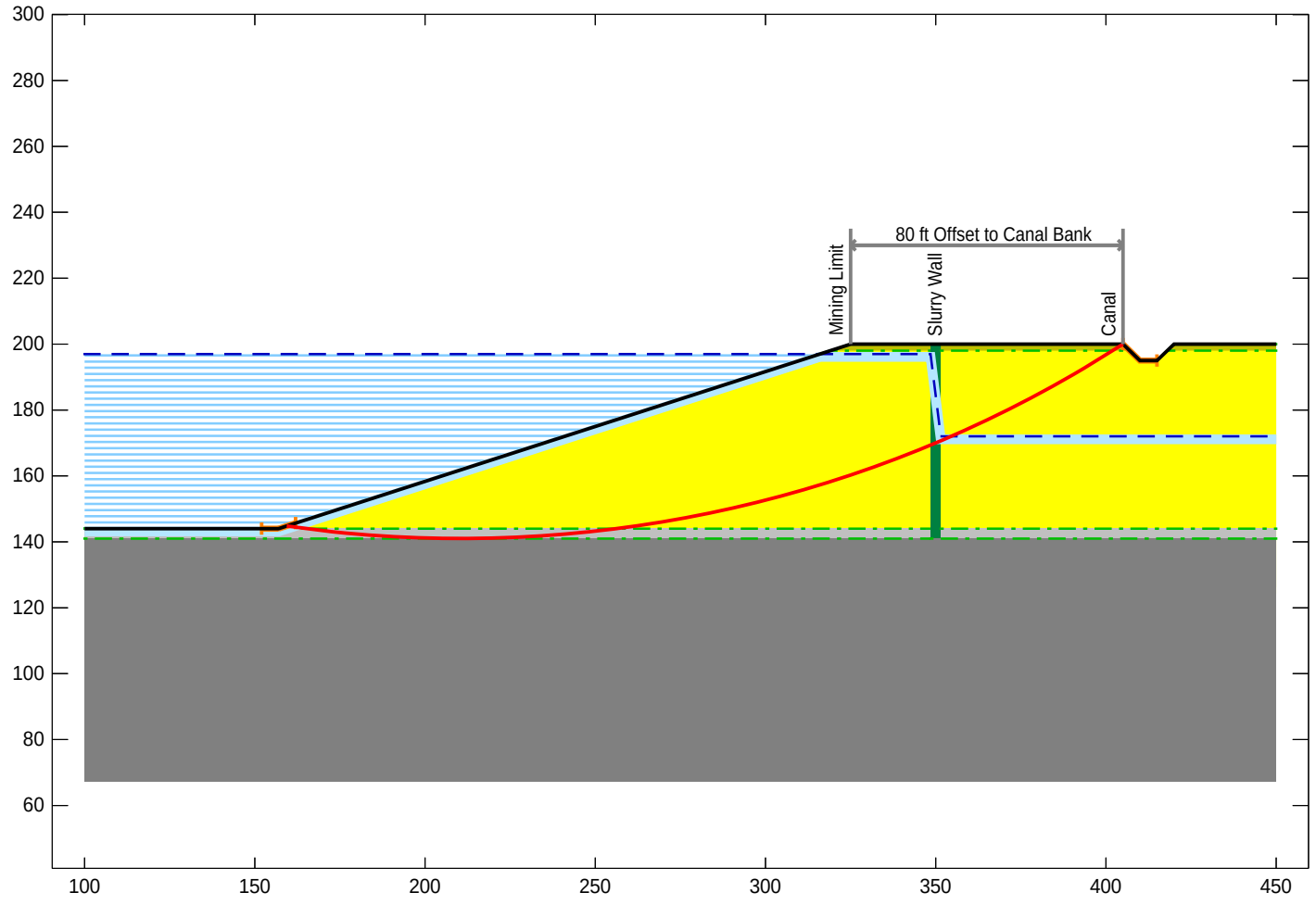
Critical Factor of Safety: 2.40

Project West Farm Pit Expansion
Case 7-1 Rapid Drawdown

File: C:\Galena Models\West Farm Expansion Case 7-1 Rapid Drawdown.gmf

Edited: 2 Dec 2020
Processed: 2 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

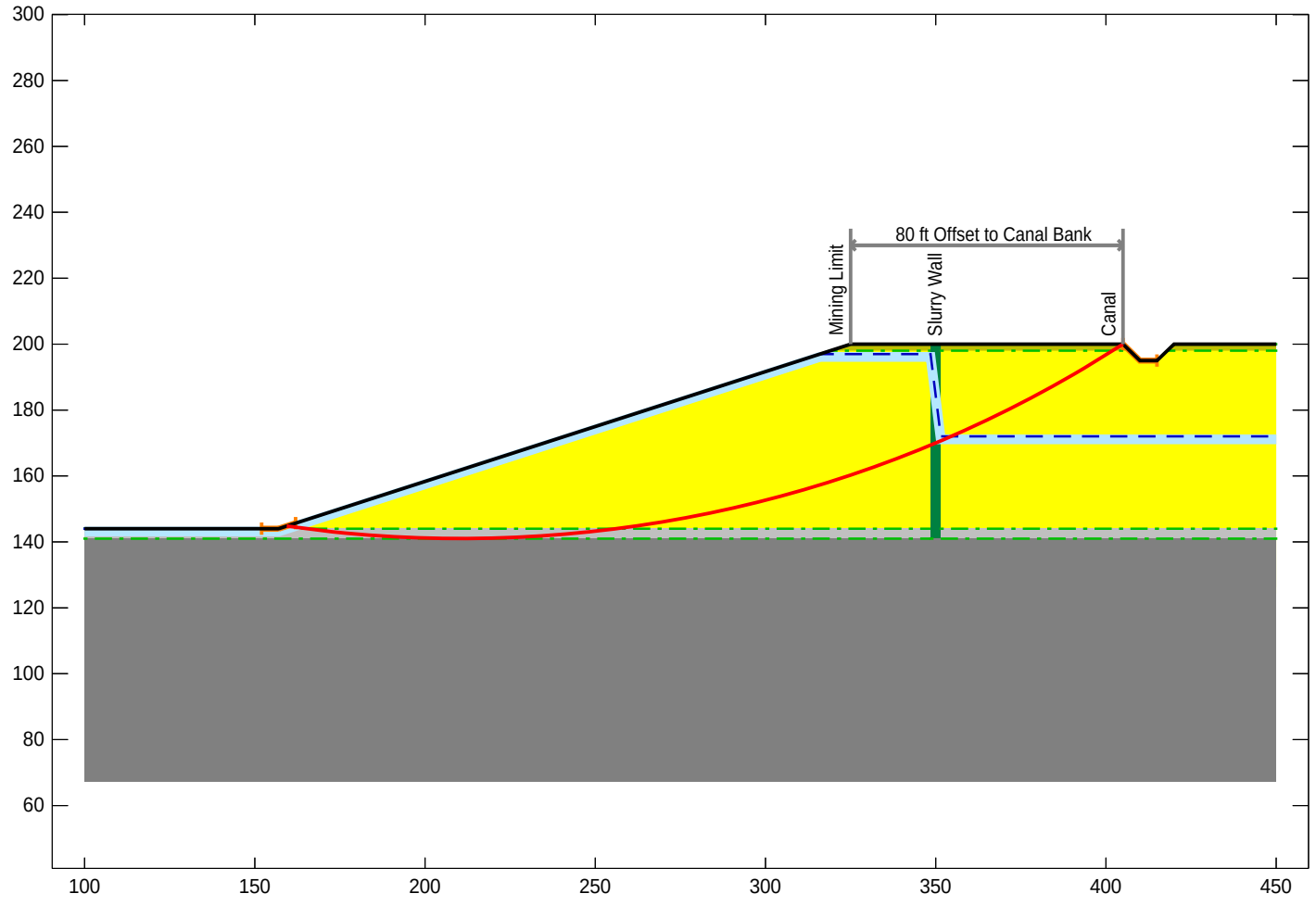
Critical Factor of Safety: 2.99

Project West Farm Pit Expansion
Case 7-2 Full Reservoir

File: C:\Galena Models\Case 7-2\West Farm Expansion Case 7-2 Full Reservoir.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

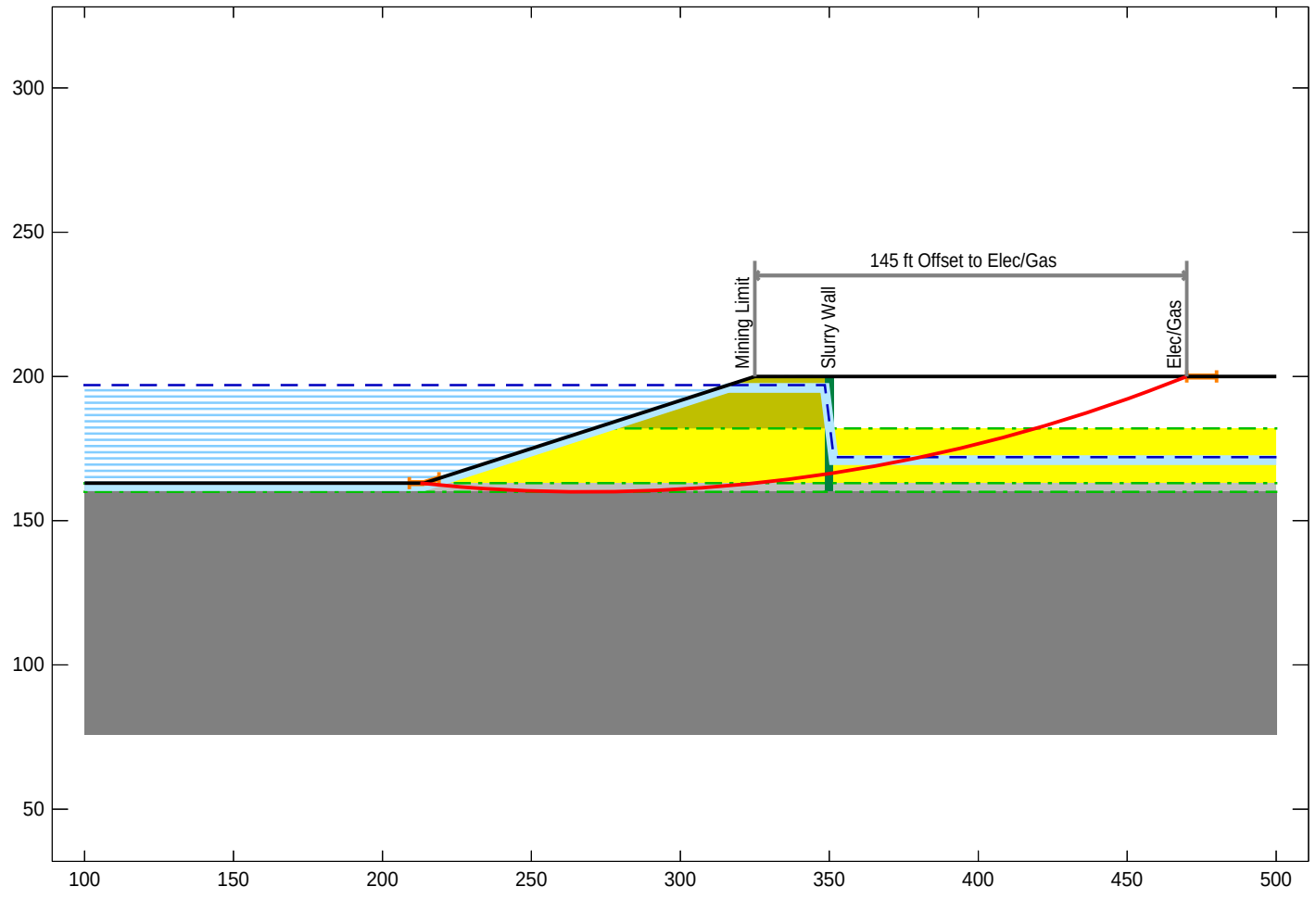
Critical Factor of Safety: 1.58

Project West Farm Pit Expansion
Case 7-2 Rapid Drawdown

File: C:\Galena Models\Case 7-2\West Farm Expansion Case 7-2 Rapid Drawdown.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

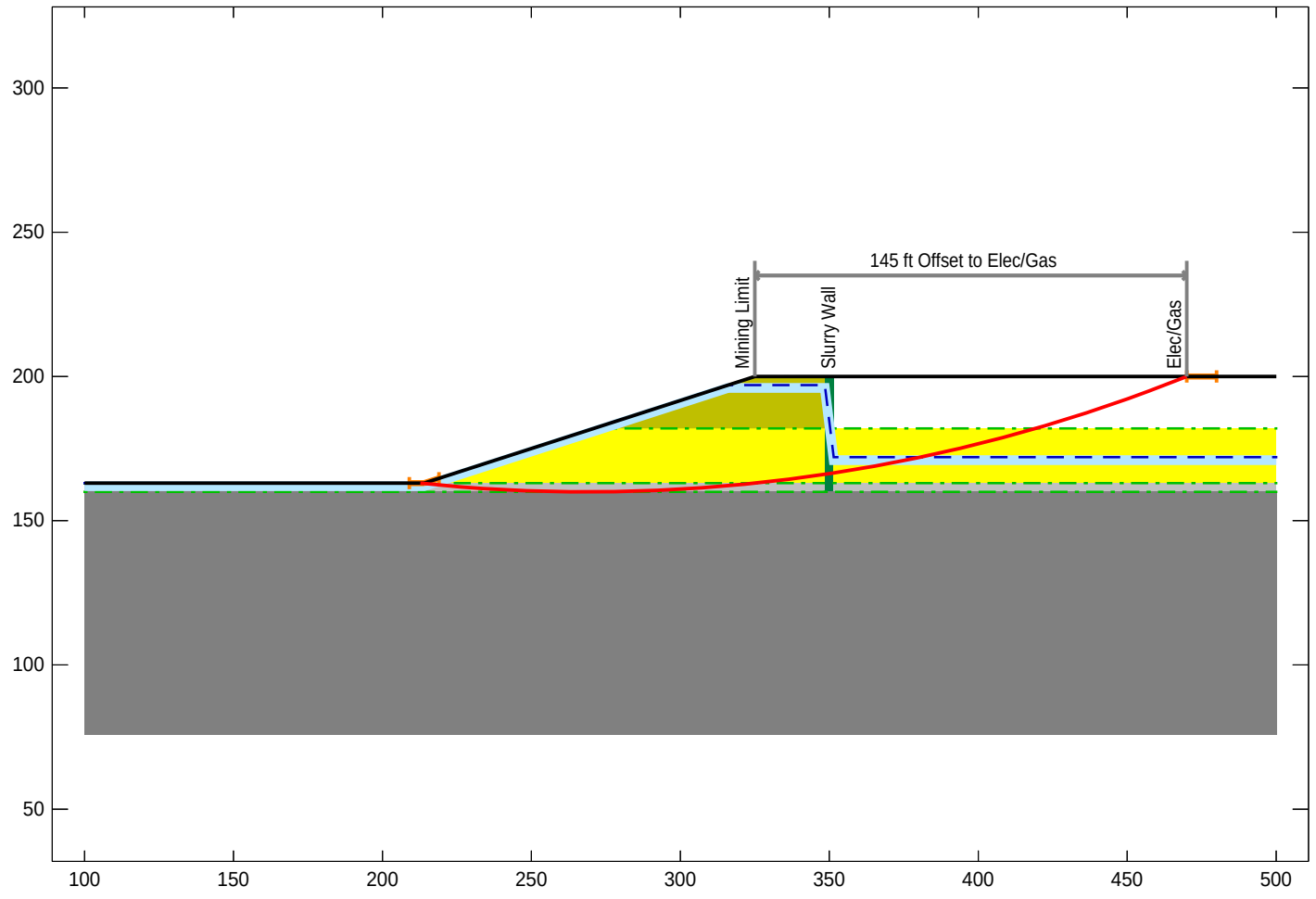
Critical Factor of Safety: 5.42

Project West Farm Pit Expansion
Case 8-1 Full Reservoir

File: C:\Galena Models\West Farm Expansion Case 8-1 Full Reservoir.gmf

Edited: 2 Dec 2020
Processed: 2 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

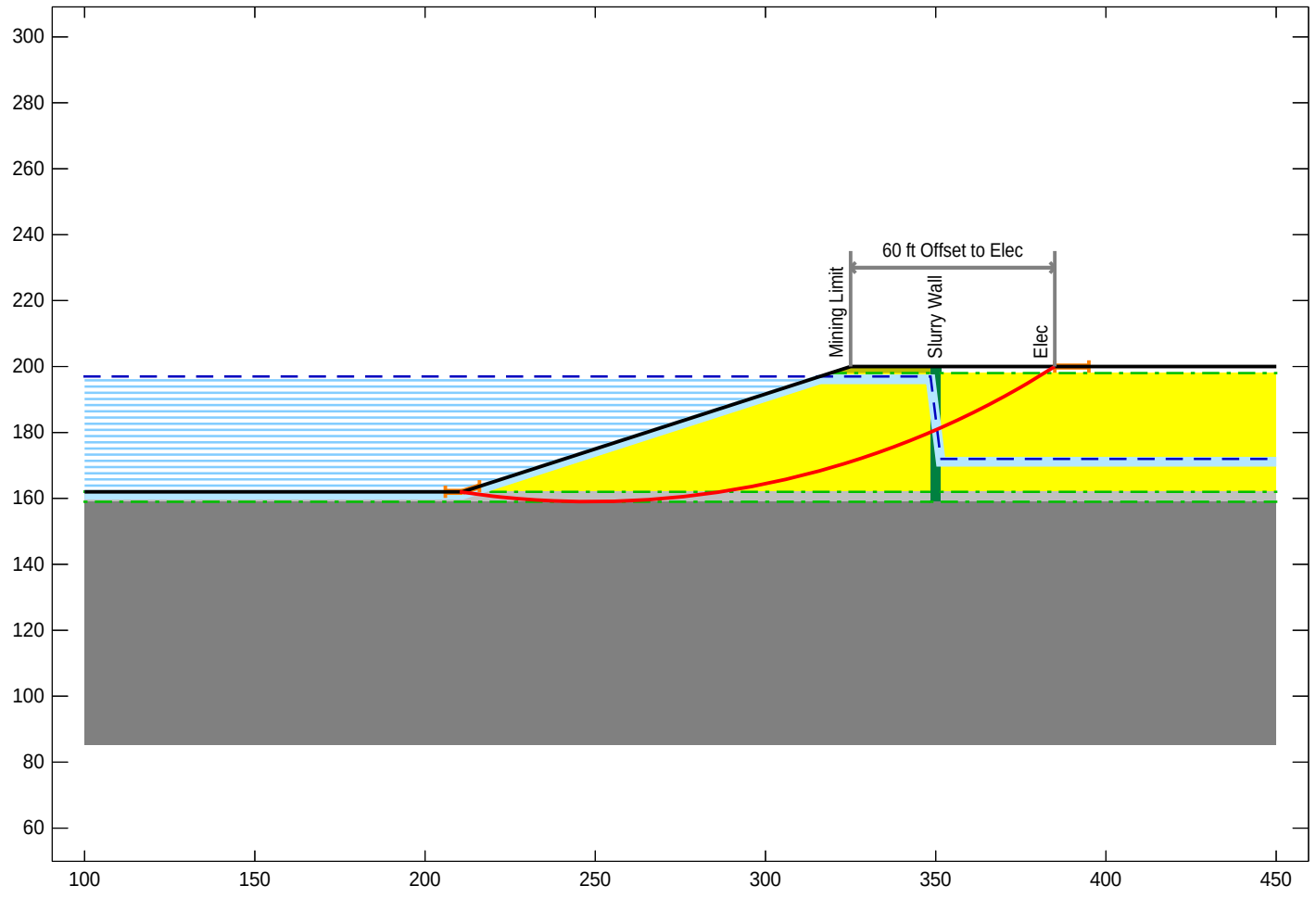
Critical Factor of Safety: 3.15

Project West Farm Pit Expansion
Case 8-1 Rapid Drawdown

File: C:\Galena Models\West Farm Expansion Case 8-1 Rapid Drawdown.gmf

Edited: 2 Dec 2020
Processed: 2 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

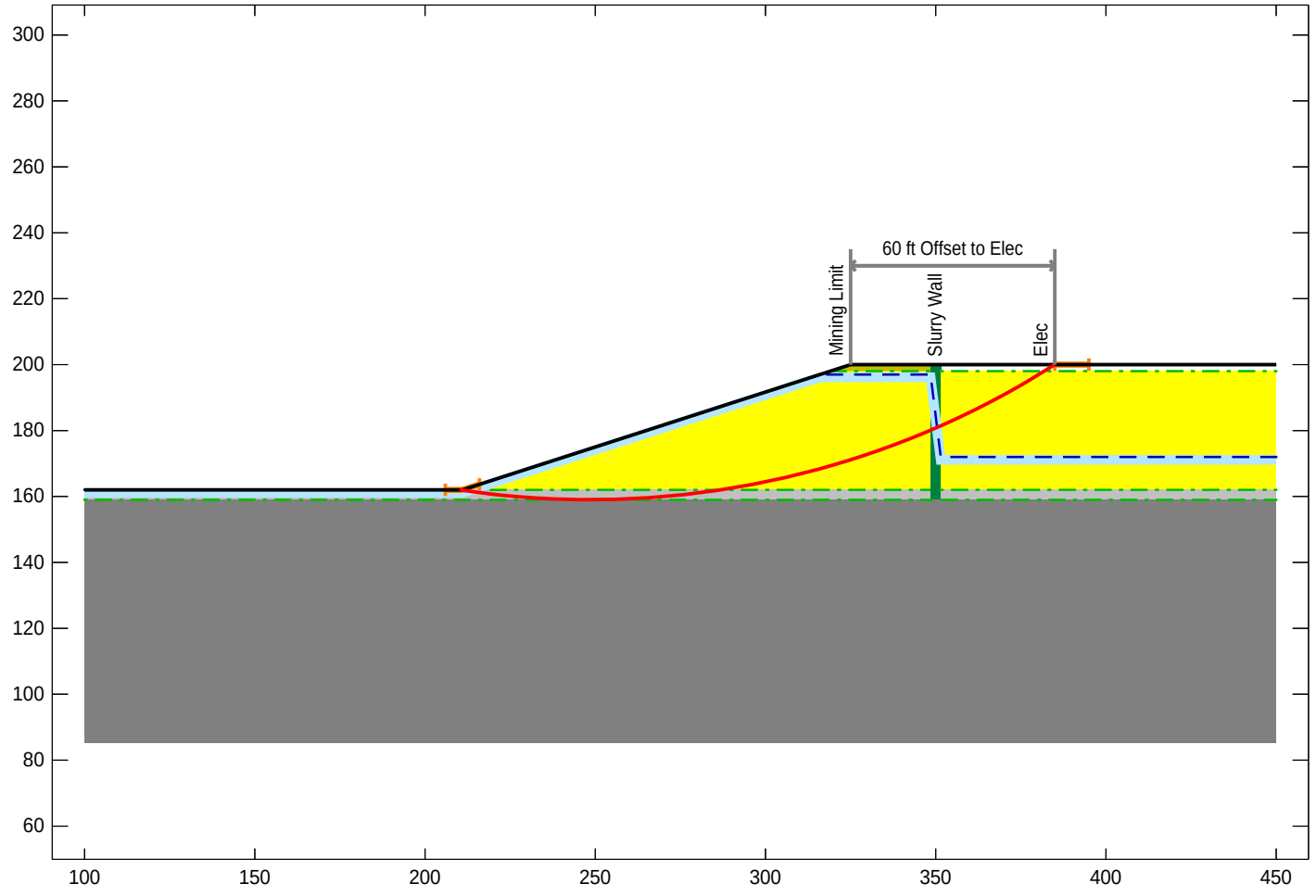
Critical Factor of Safety: 2.93

Project West Farm Pit Expansion
Case 8-2 Full Reservoir

File: C:\Galena Models\West Farm Expansion Case 8-2 Full Reservoir.gmf

Edited: 2 Dec 2020
Processed: 2 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

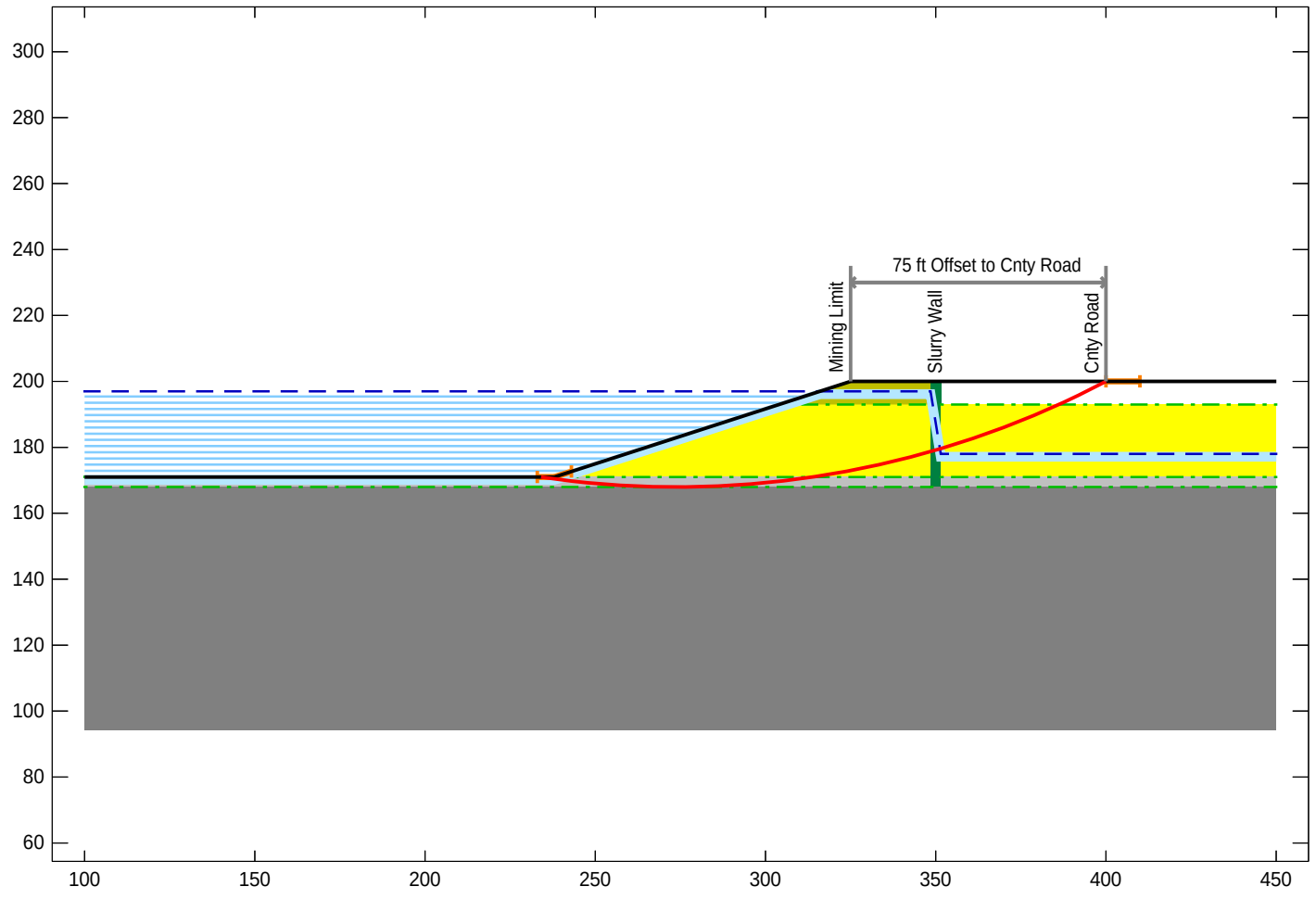
Critical Factor of Safety: 1.61

Project West Farm Pit Expansion
Case 8-2 Rapid Drawdown

File: C:\Galena Models\West Farm Expansion Case 8-2 Rapid Drawdown.gmf

Edited: 2 Dec 2020
Processed: 2 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

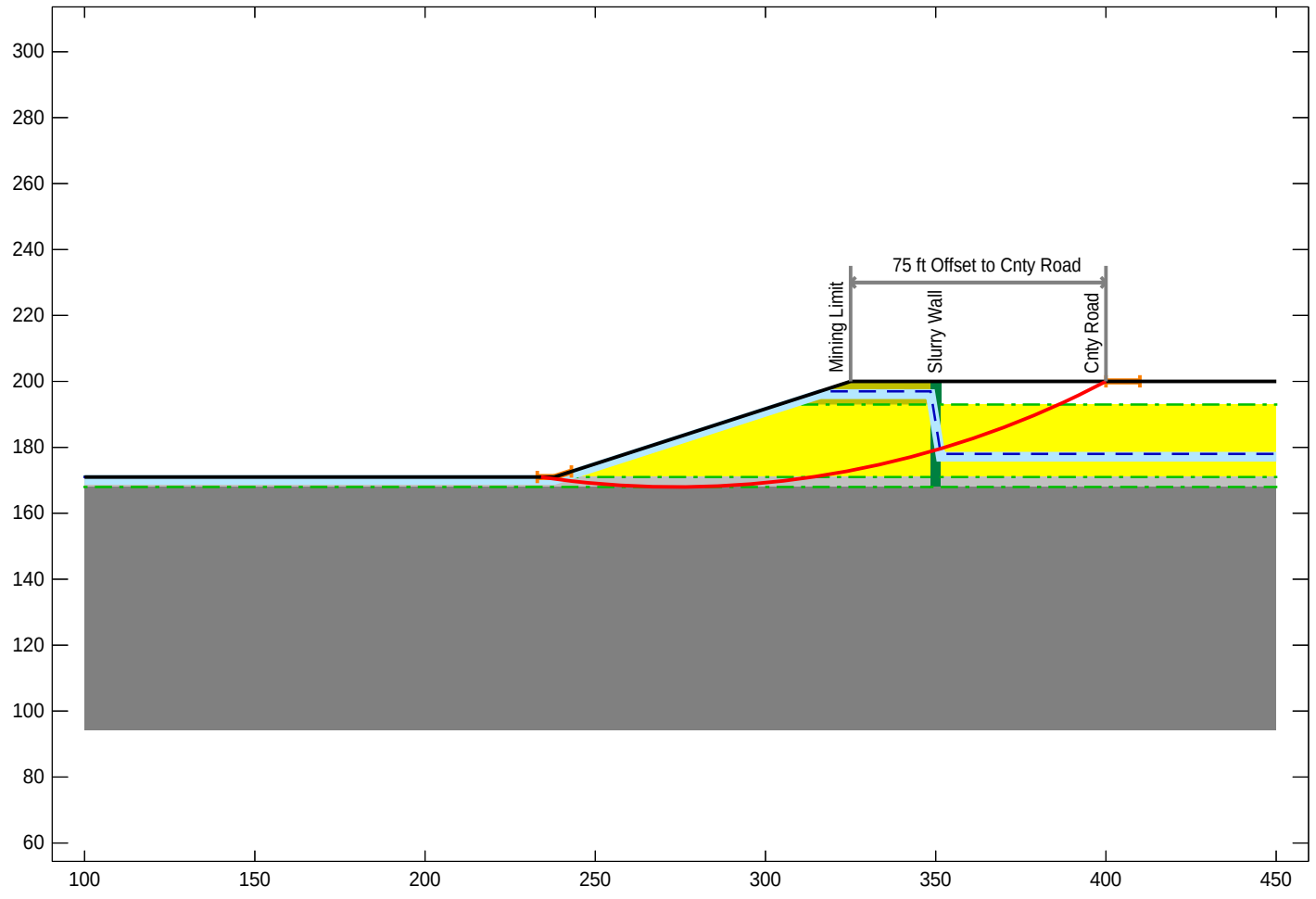
Critical Factor of Safety: 3.79

Project West Farm Pit Expansion
Case 8-3 Full Reservoir

File: C:\Galena Models\West Farm Expansion Case 8-3 Full Reservoir.gmf

Edited: 2 Dec 2020
Processed: 2 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

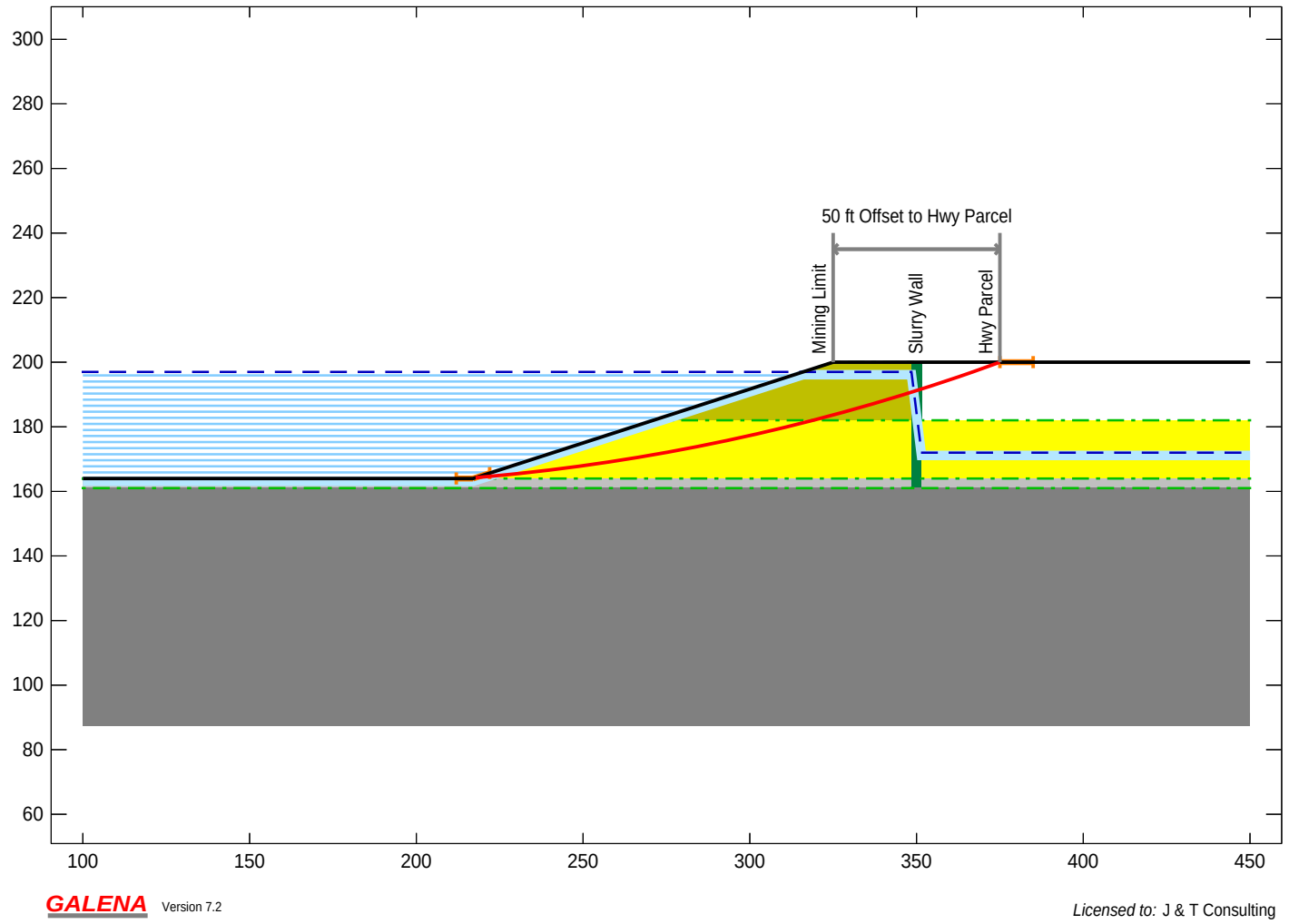
Critical Factor of Safety: 2.21

Project West Farm Pit Expansion
Case 8-3 Rapid Drawdown

File: C:\Galena Models\West Farm Expansion Case 8-3 Rapid Drawdown.gmf

Edited: 2 Dec 2020
Processed: 2 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

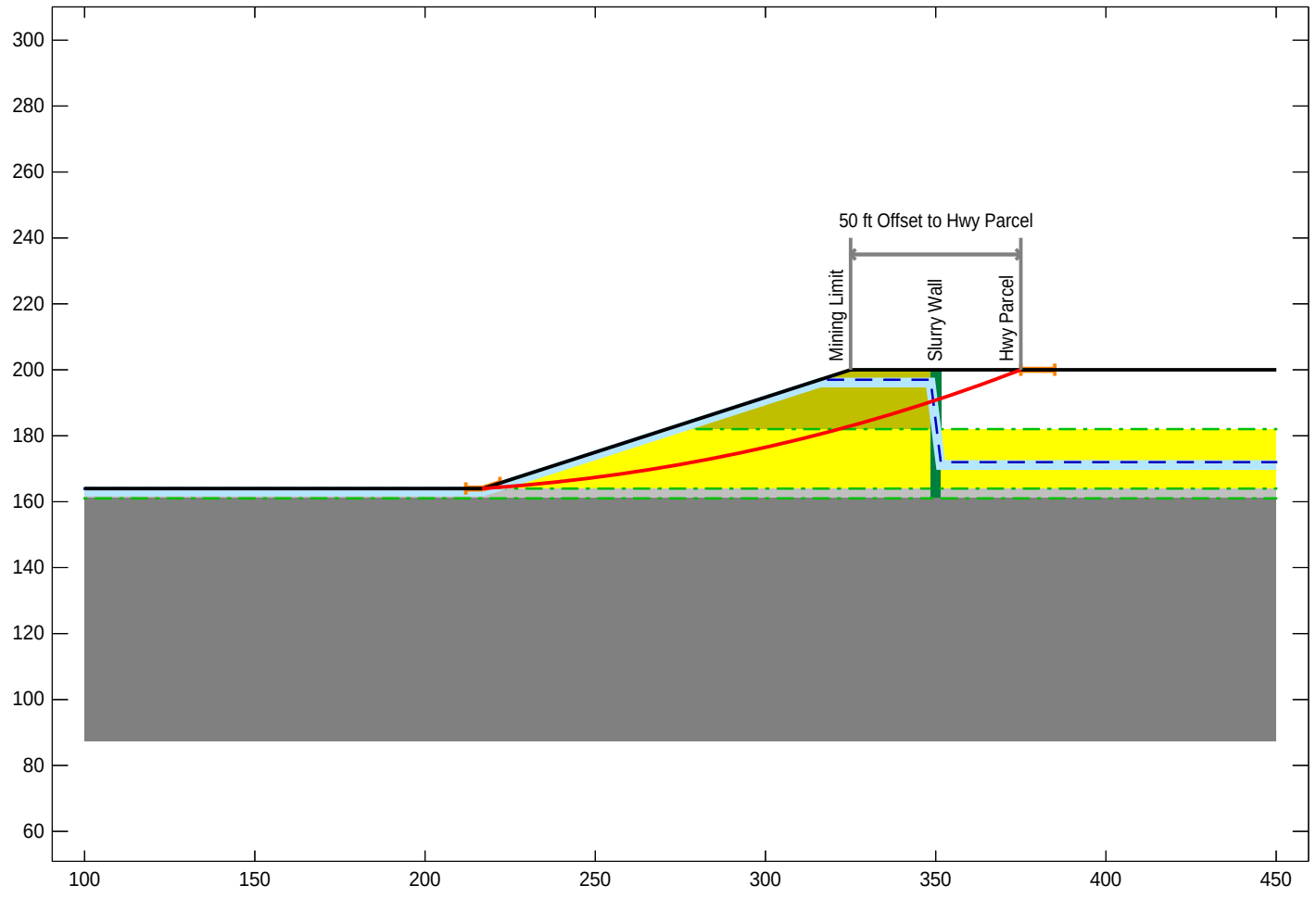
Critical Factor of Safety: 2.82

Project West Farm Pit Expansion
Case 8-4 Full Reservoir

File: C:\Galena Models\Case 8-4\West Farm Expansion Case 8-4 Full Reservoir.gmf

Edited: 3 Dec 2020
Processed: 3 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

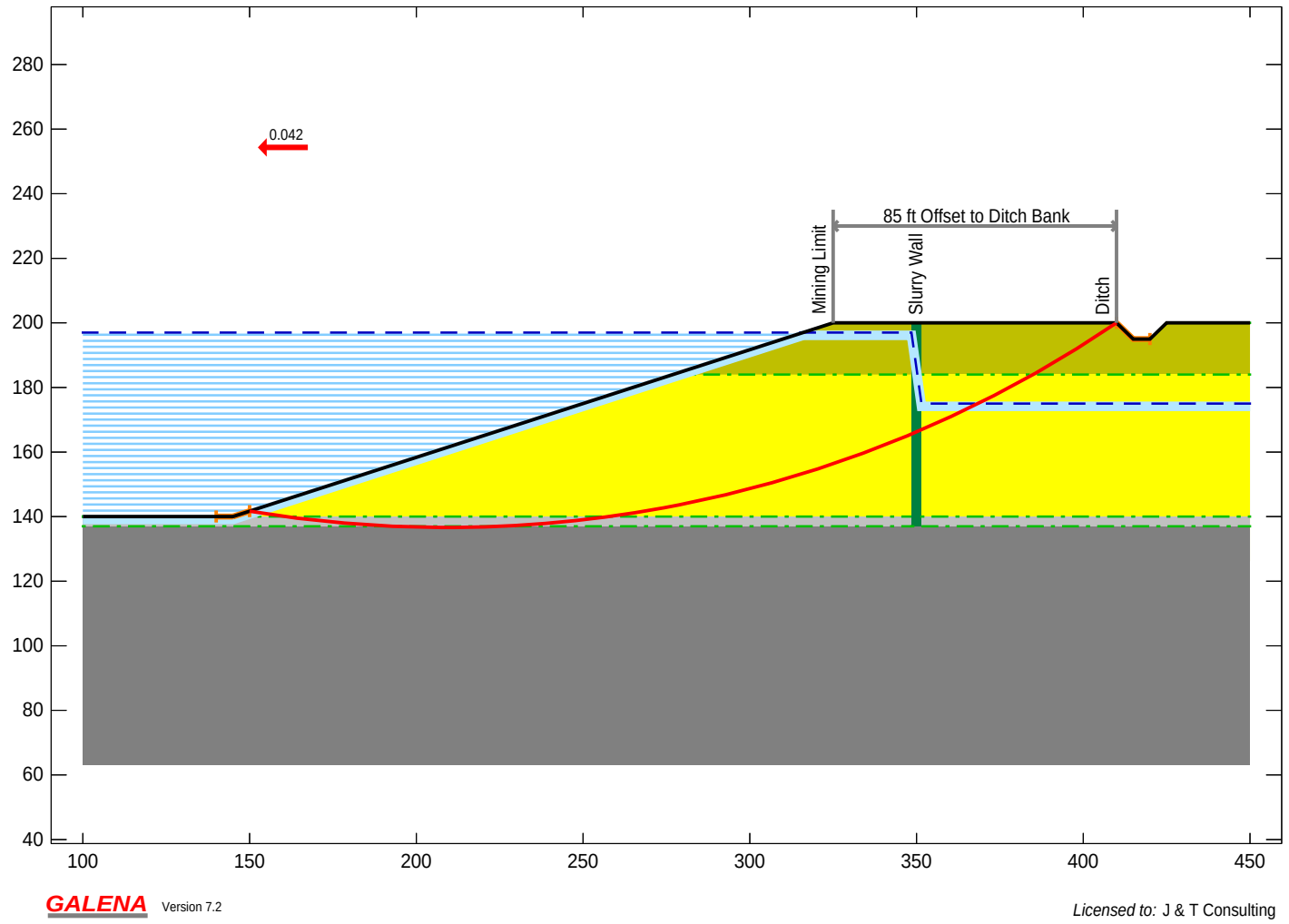
Critical Factor of Safety: 1.59

Project West Farm Pit Expansion
Case 8-4 Rapid Drawdown

File: C:\Galena Models\Case 8-4\West Farm Expansion Case 8-4 Rapid Drawdown.gmf

Edited: 3 Dec 2020
Processed: 3 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Spencer-Wright
Surface: Circular

Results

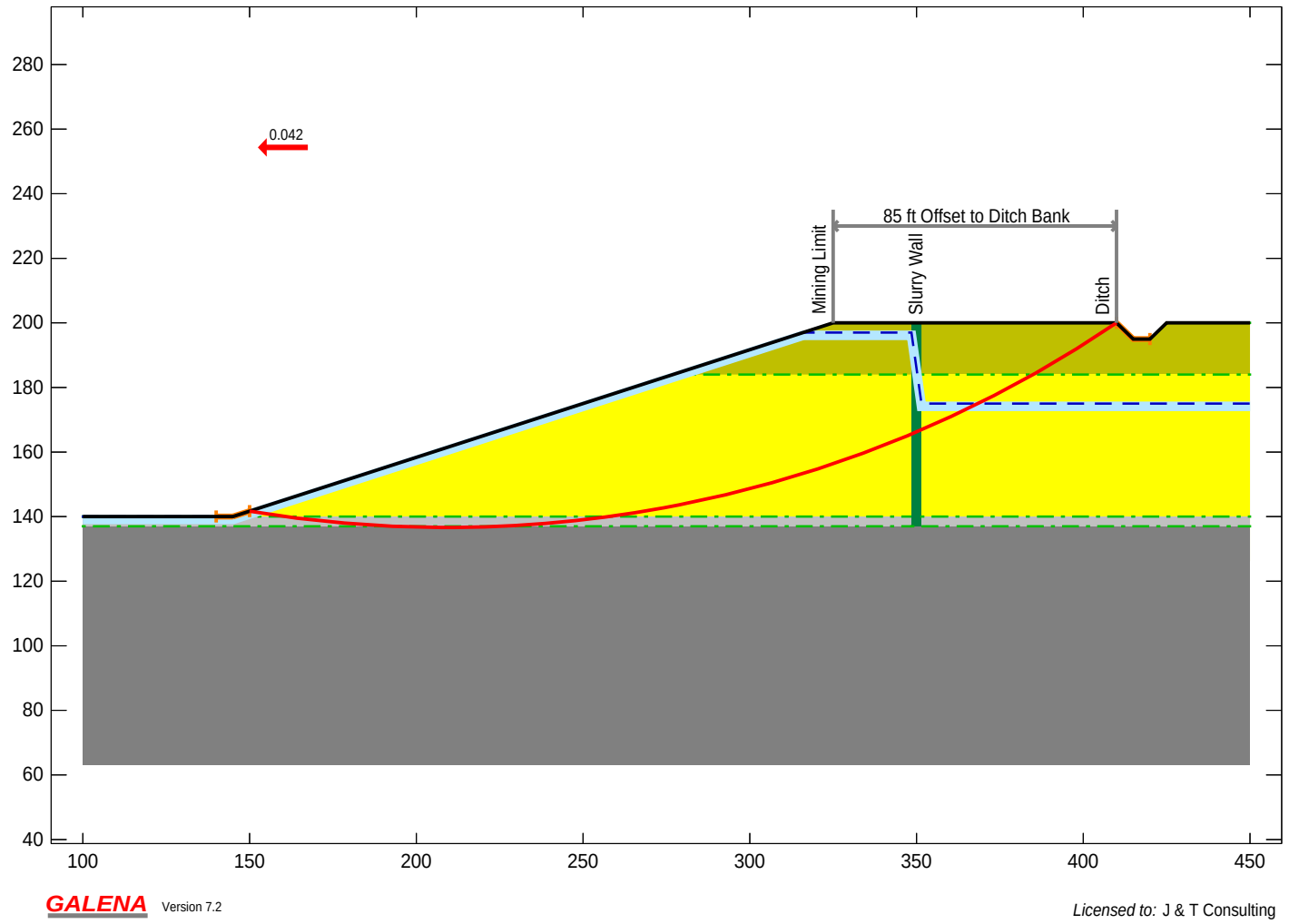
Critical Factor of Safety: 2.57
Interslice Force (Final) Angle: 11.0°

Project West Farm Pit Expansion
Case 3-1 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 3-1\West Farm Expansion Case 3-1 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Spencer-Wright
Surface: Circular

Results

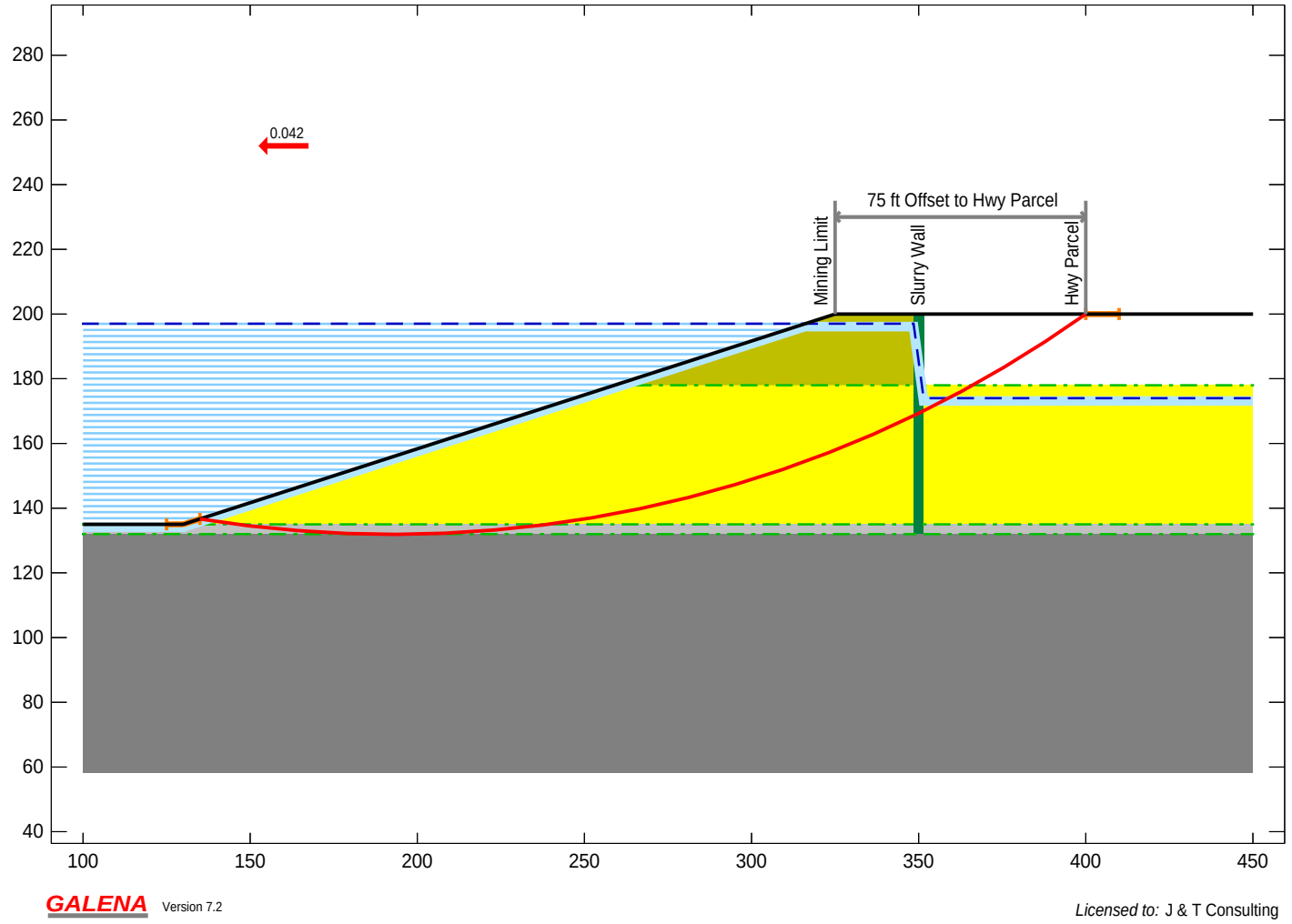
Critical Factor of Safety: 1.54
Interslice Force (Final) Angle: 10.6 °

Project West Farm Pit Expansion
Case 3-1 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 3-1\West Farm Expansion Case 3-1 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

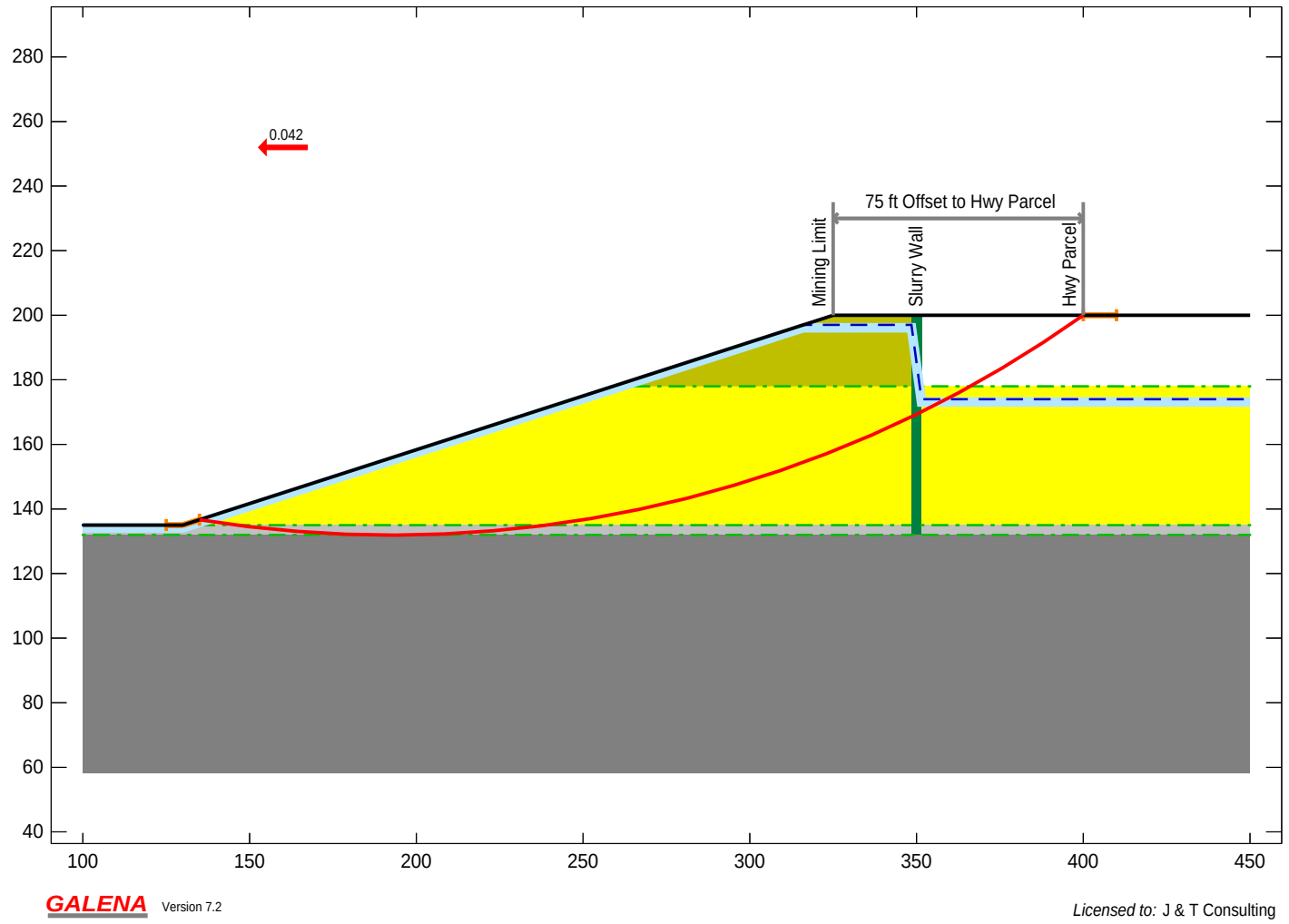
Critical Factor of Safety: 2.14

Project West Farm Pit Expansion
Case 3-2 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 3-2\West Farm Expansion Case 3-2 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

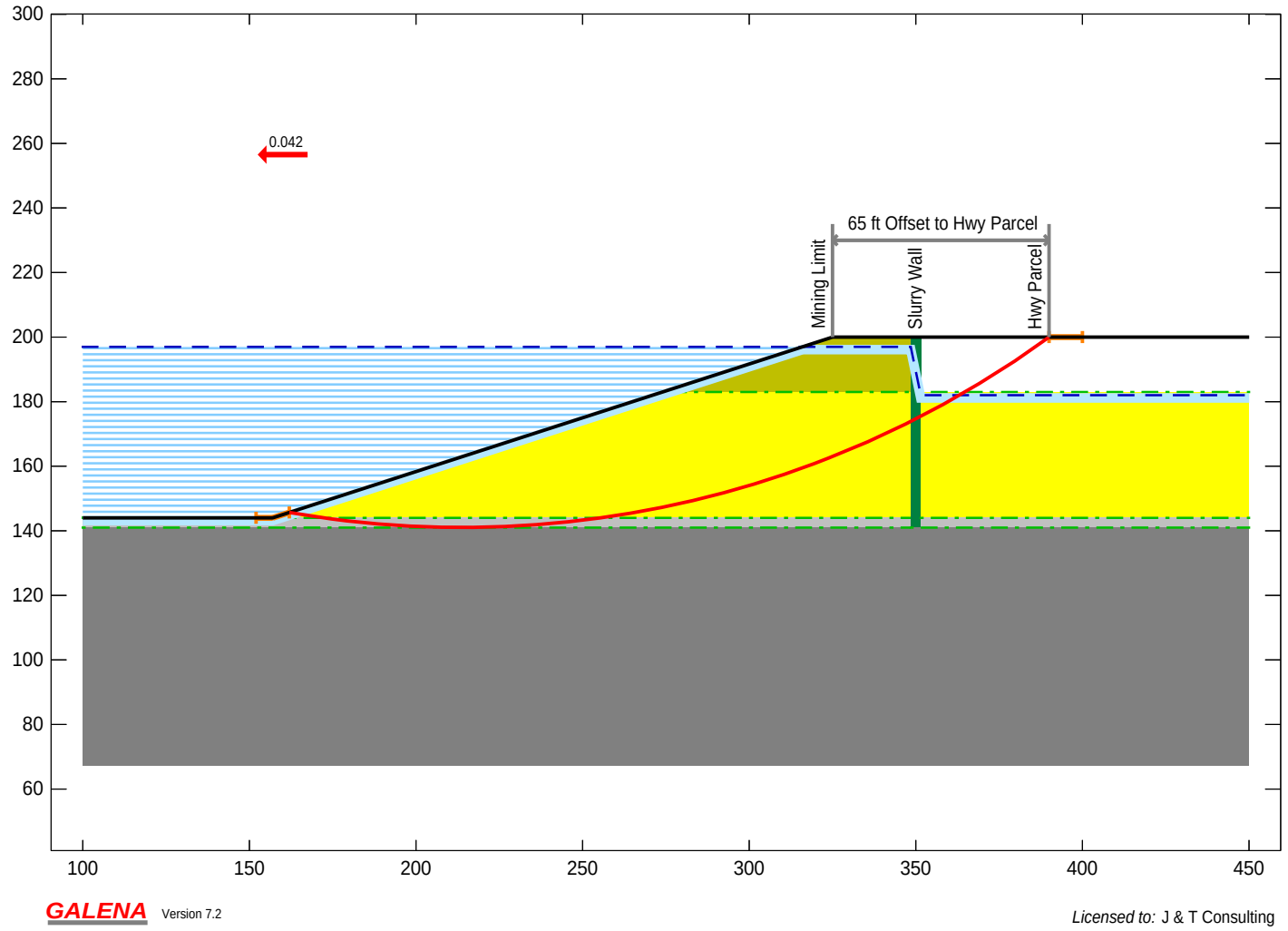
Critical Factor of Safety: 1.24

Project West Farm Pit Expansion
Case 3-2 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 3-2\West Farm Expansion Case 3-2 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

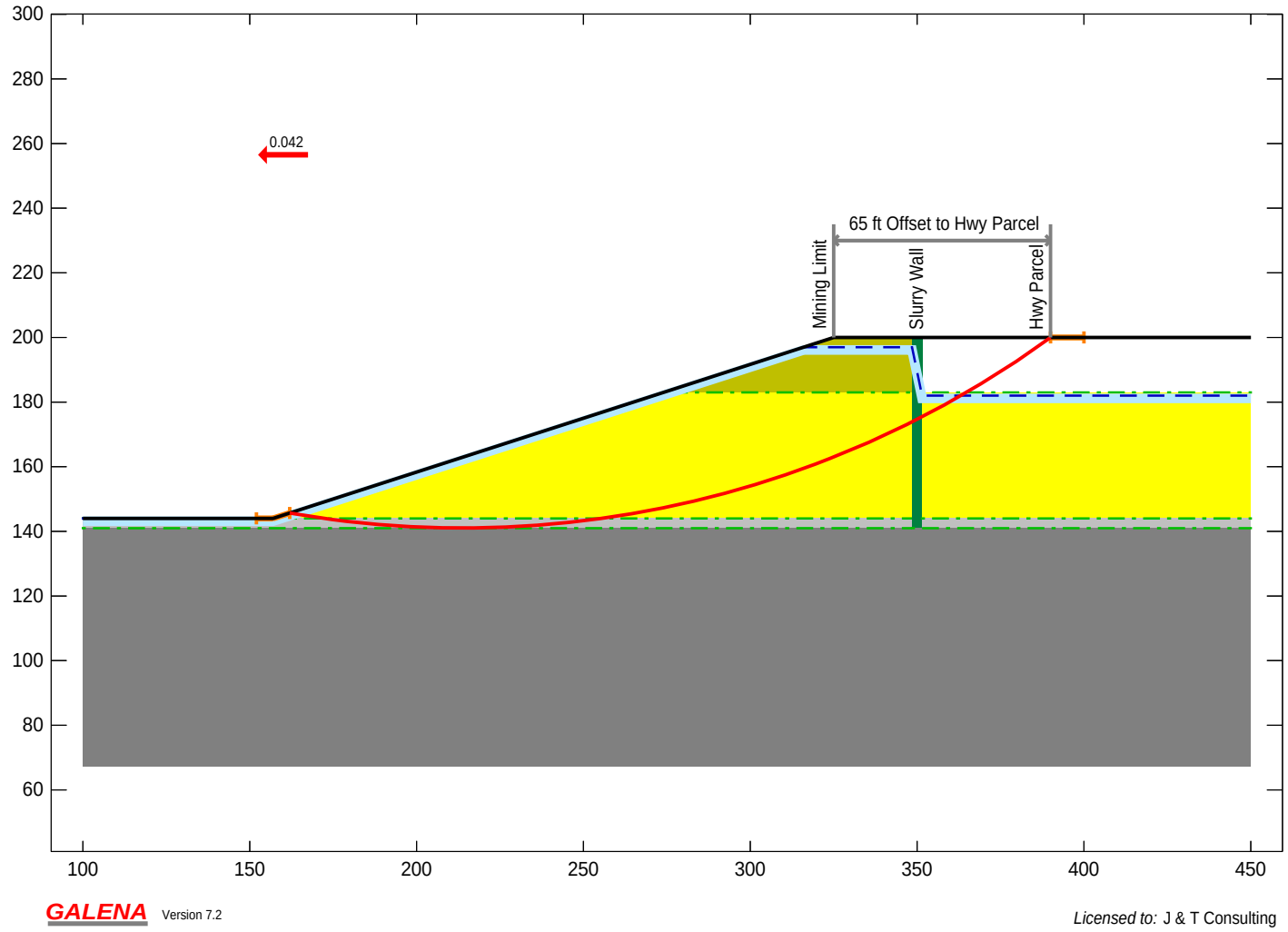
Critical Factor of Safety: 1.99

Project West Farm Pit Expansion
Case 3-3 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 3-3\West Farm Expansion Case 3-3 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

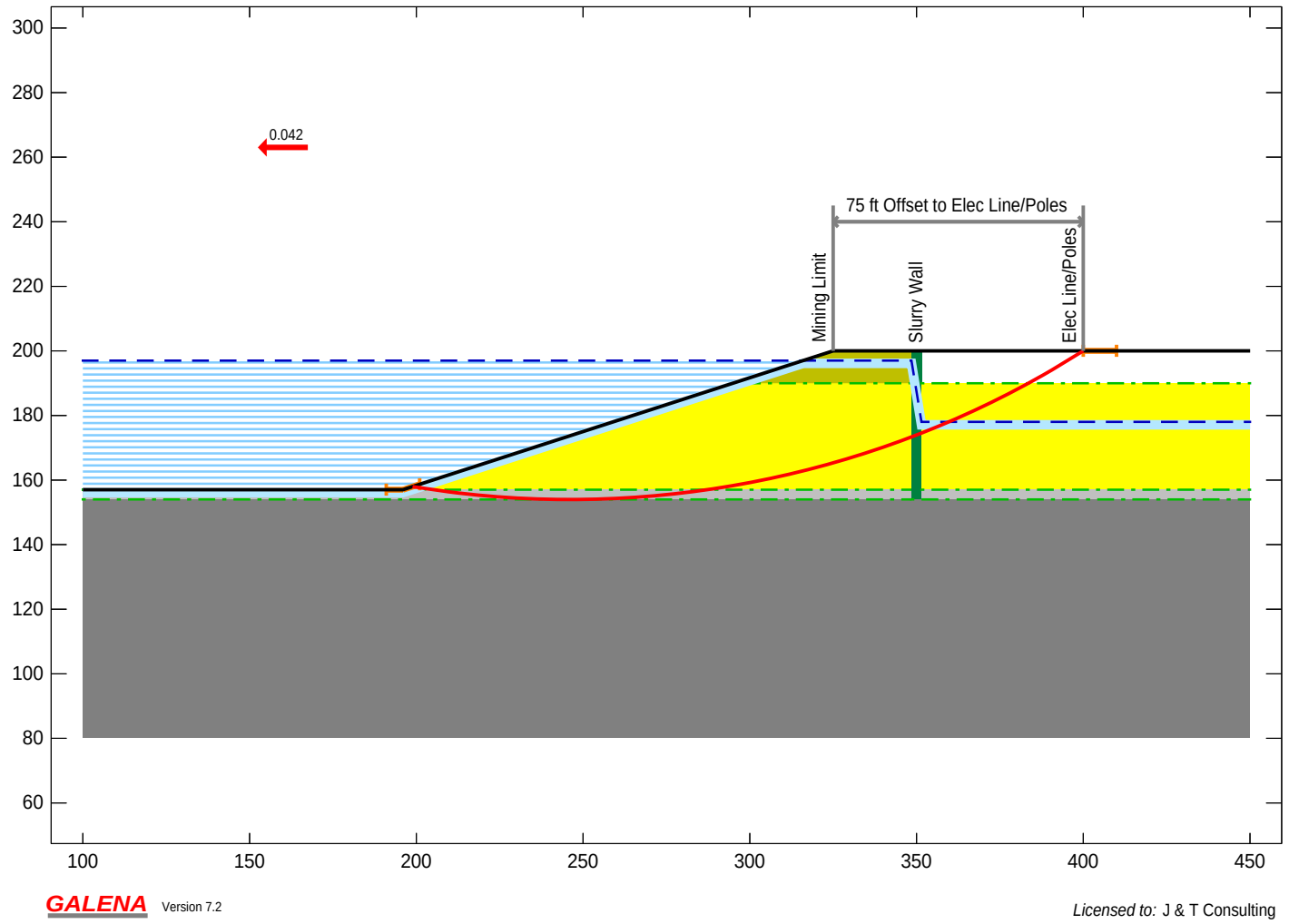
Critical Factor of Safety: 1.16

Project West Farm Pit Expansion
Case 3-3 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 3-3\West Farm Expansion Case 3-3 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

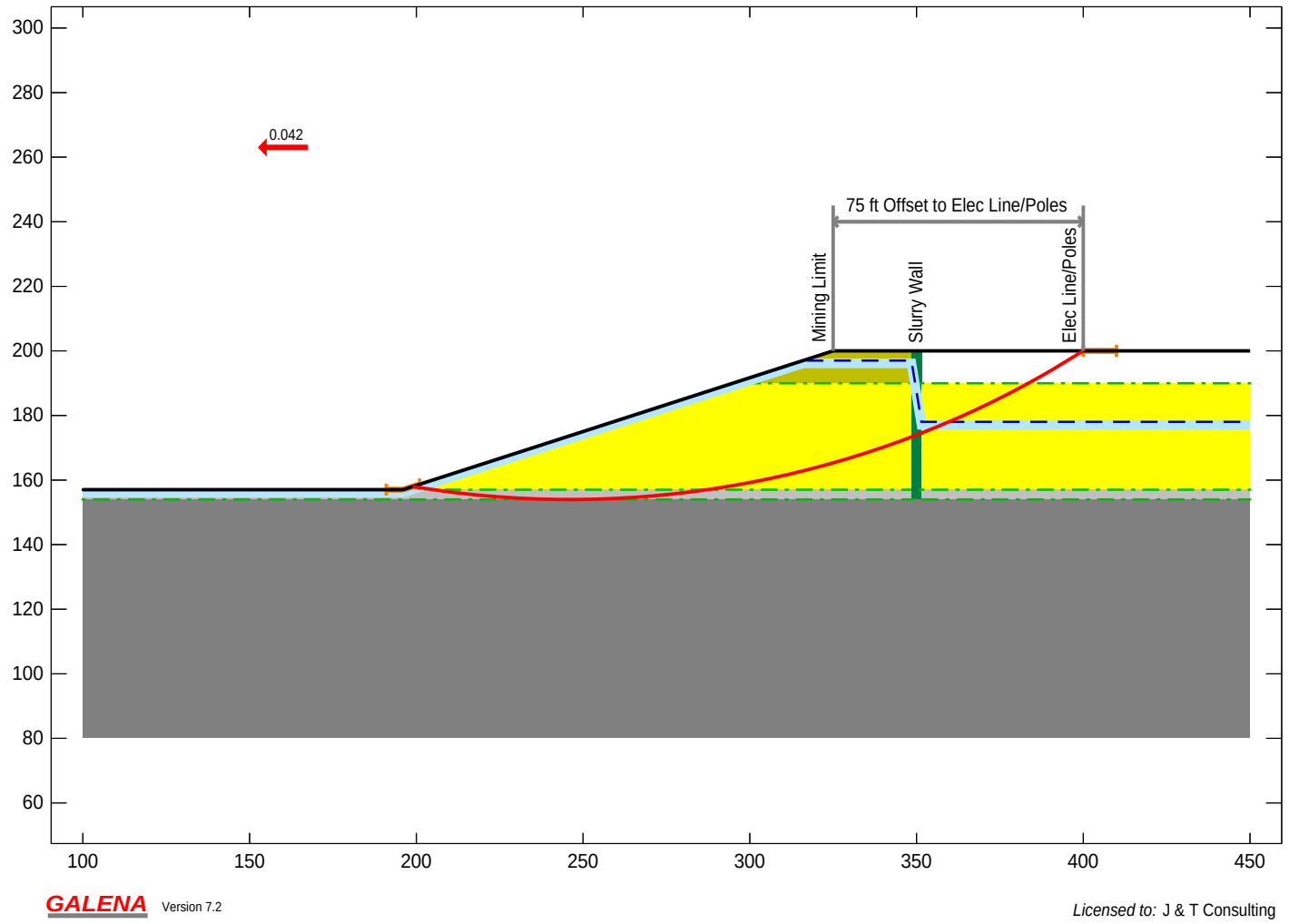
Critical Factor of Safety: 2.32

Project West Farm Pit Expansion
Case 4-1 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 4-1\West Farm Expansion Case 4-1 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

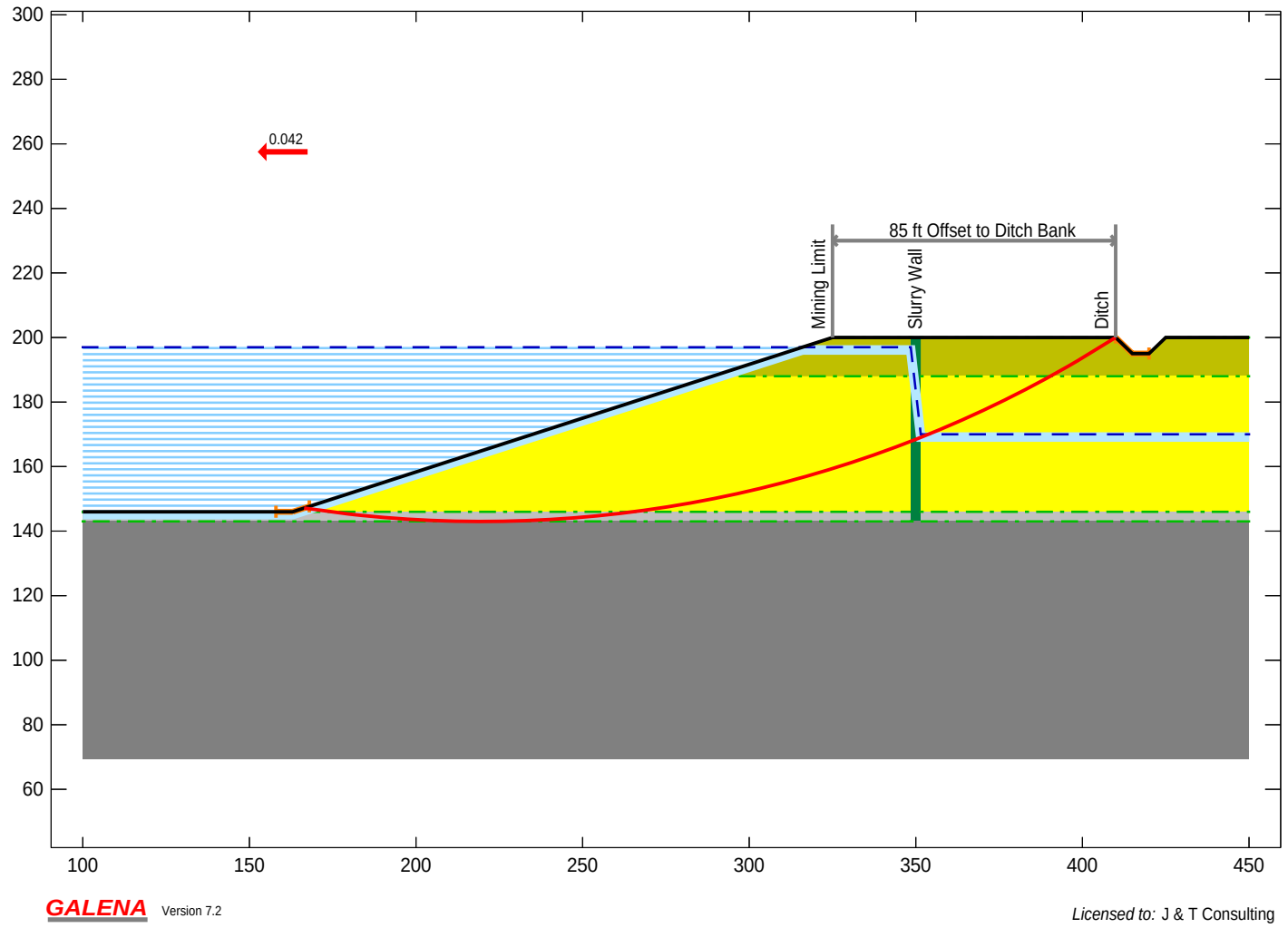
Critical Factor of Safety: 1.42

Project West Farm Pit Expansion
Case 4-1 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 4-1\West Farm Expansion Case 4-1 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

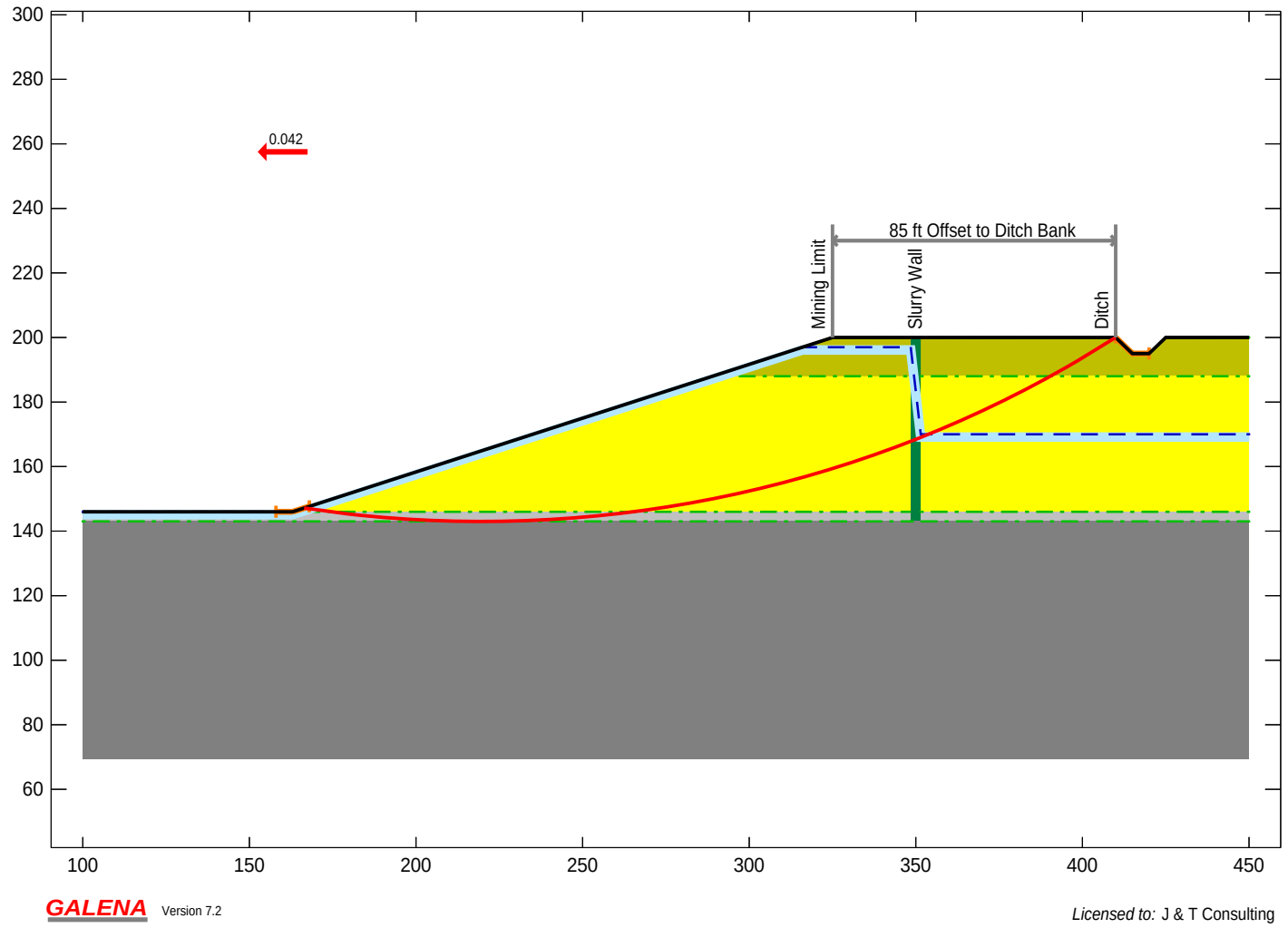
Critical Factor of Safety: 2.31

Project West Farm Pit Expansion
Case 4-2 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 4-2\West Farm Expansion Case 4-2 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

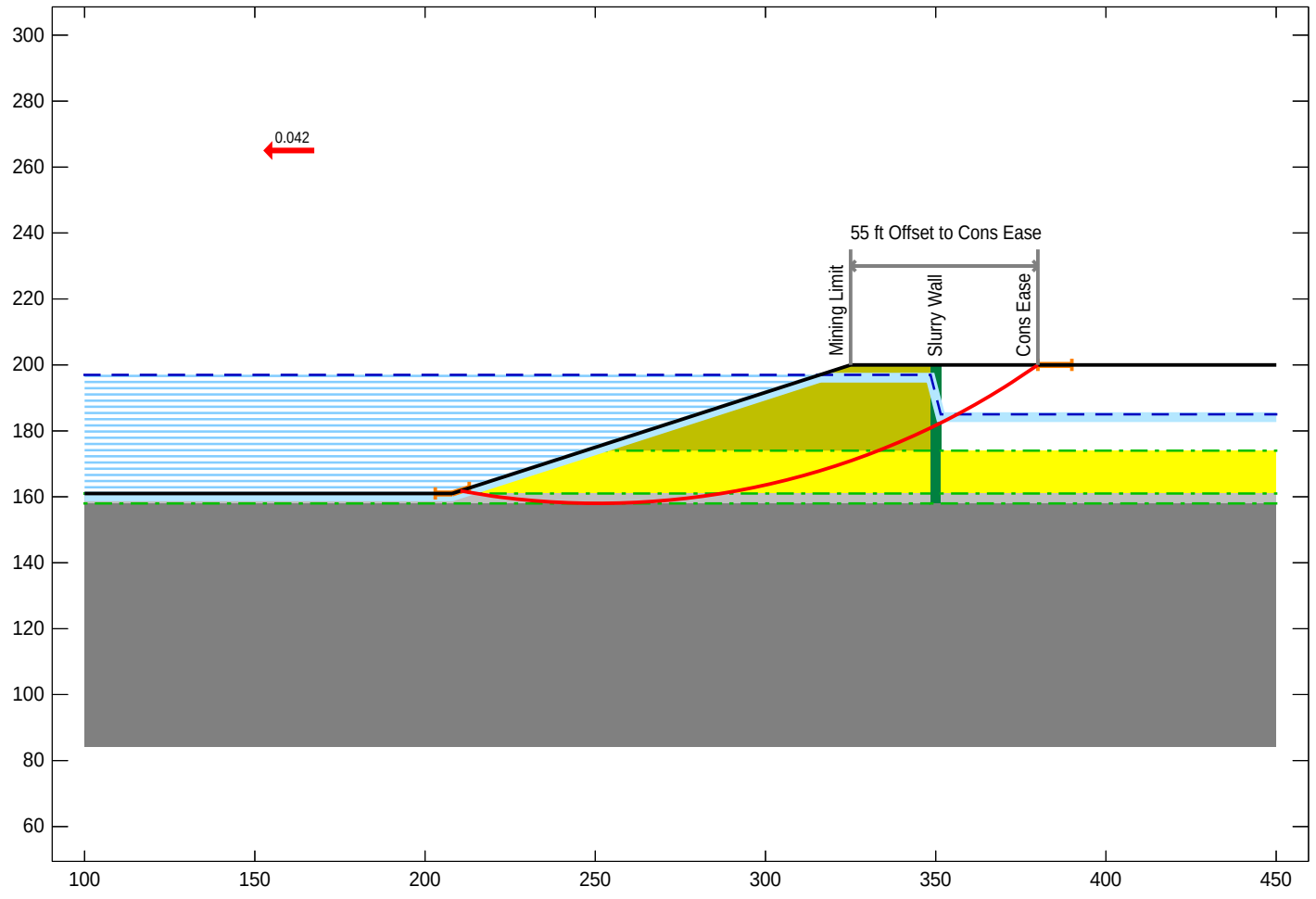
Critical Factor of Safety: 1.38

Project West Farm Pit Expansion
Case 4-2 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 4-2\West Farm Expansion Case 4-2 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

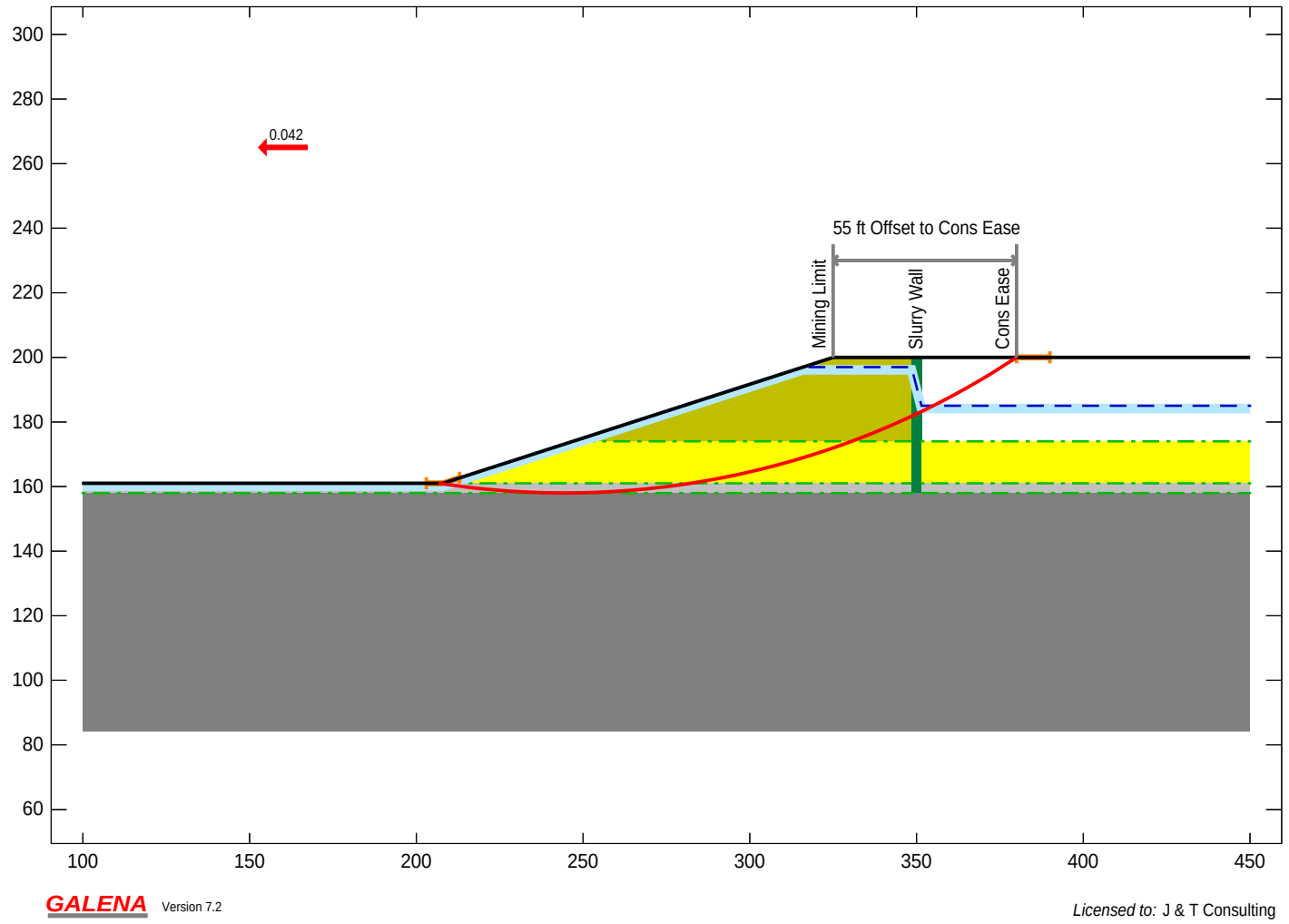
Critical Factor of Safety: 1.92

Project West Farm Pit Expansion
Case 5-1 Full Reservoir

File: C:\Galena Models\Case 5-1\West Farm Expansion Case 5-1 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

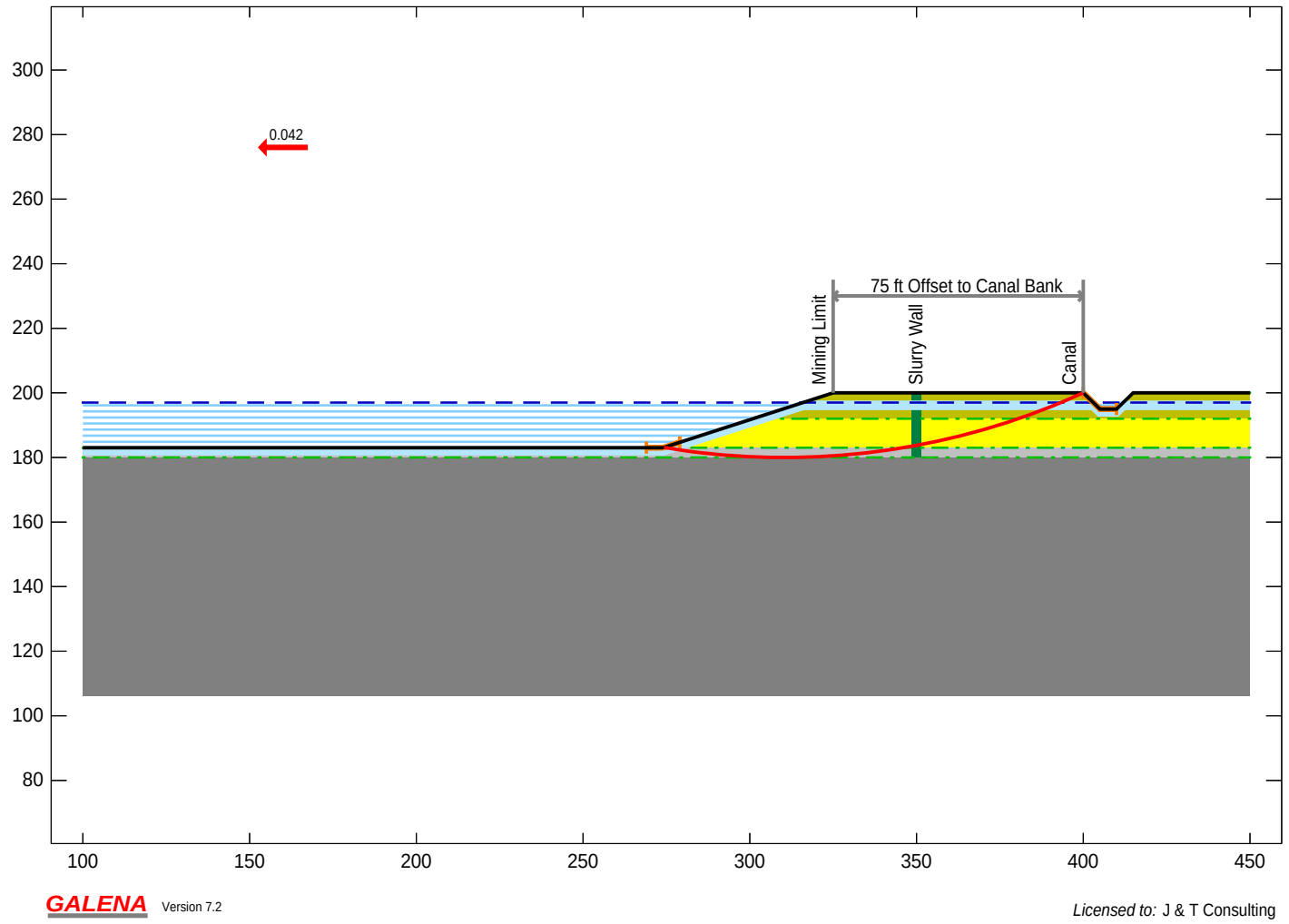
Critical Factor of Safety: 1.17

Project West Farm Pit Expansion
Case 5-1 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 5-1\West Farm Expansion Case 5-1 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

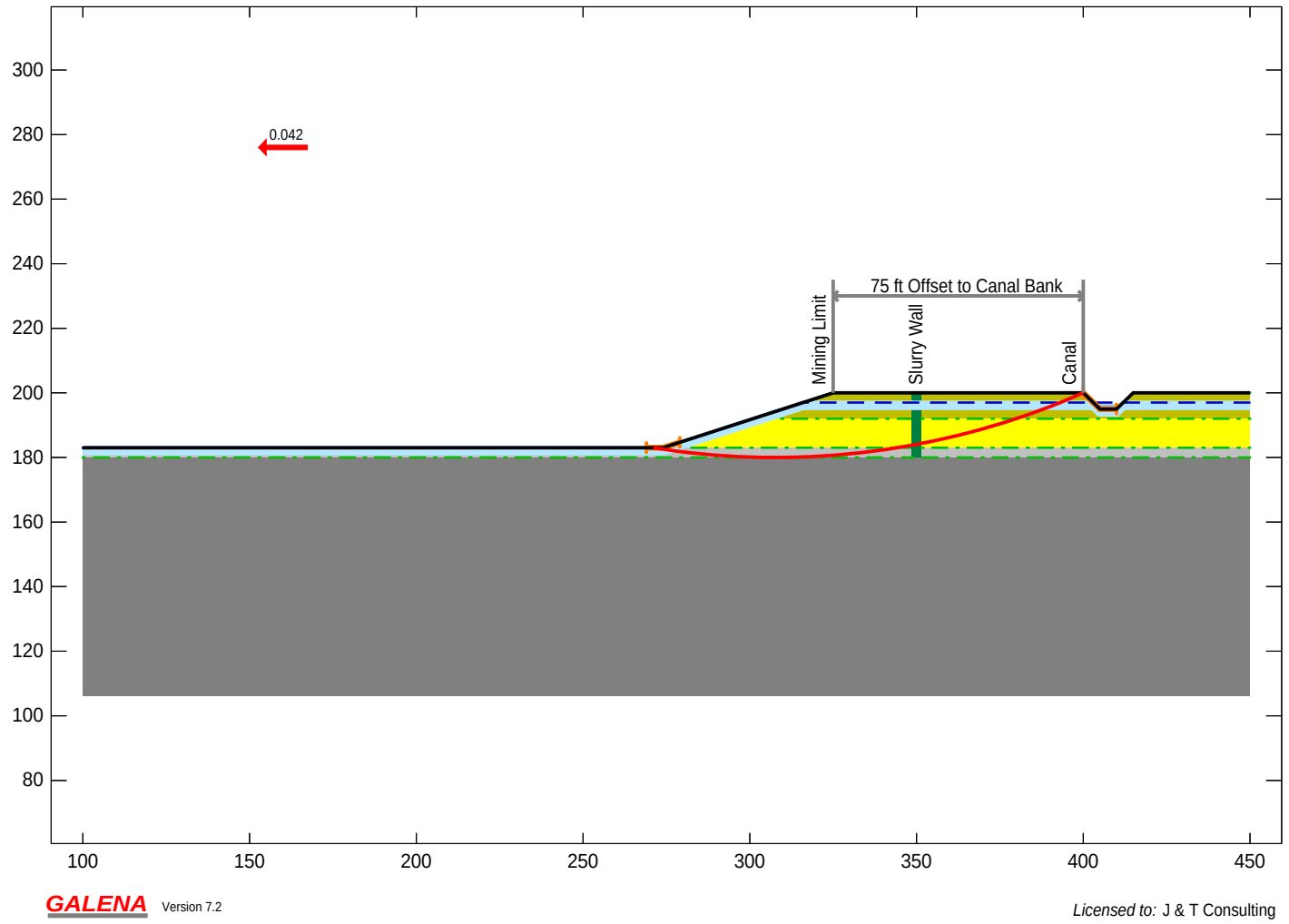
Critical Factor of Safety: 2.72

Project West Farm Pit Expansion
Case 5-2 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 5-2\West Farm Expansion Case 5-2 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

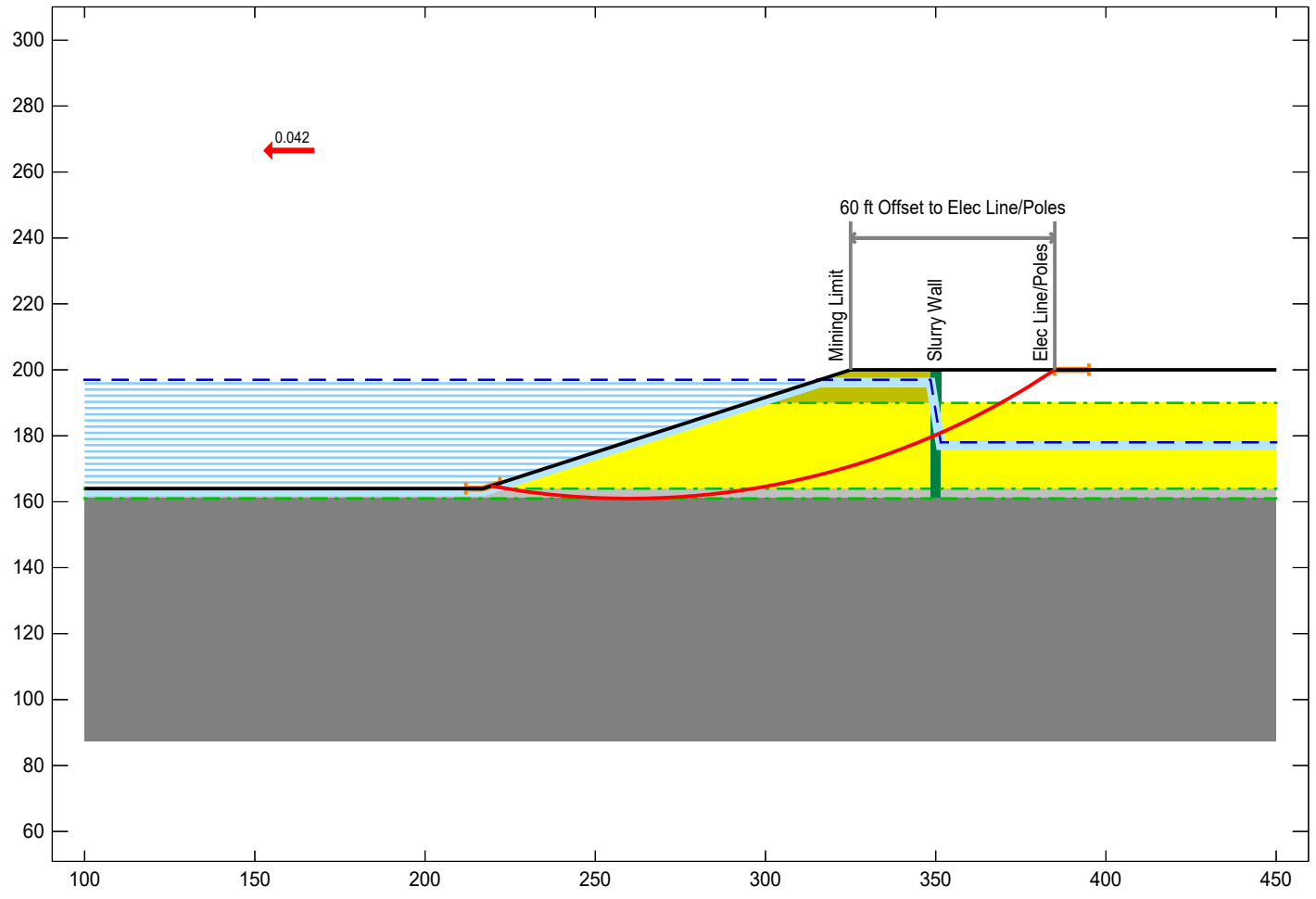
Critical Factor of Safety: 2.00

Project West Farm Pit Expansion
Case 5-2 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 5-2\West Farm Expansion Case 5-2 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

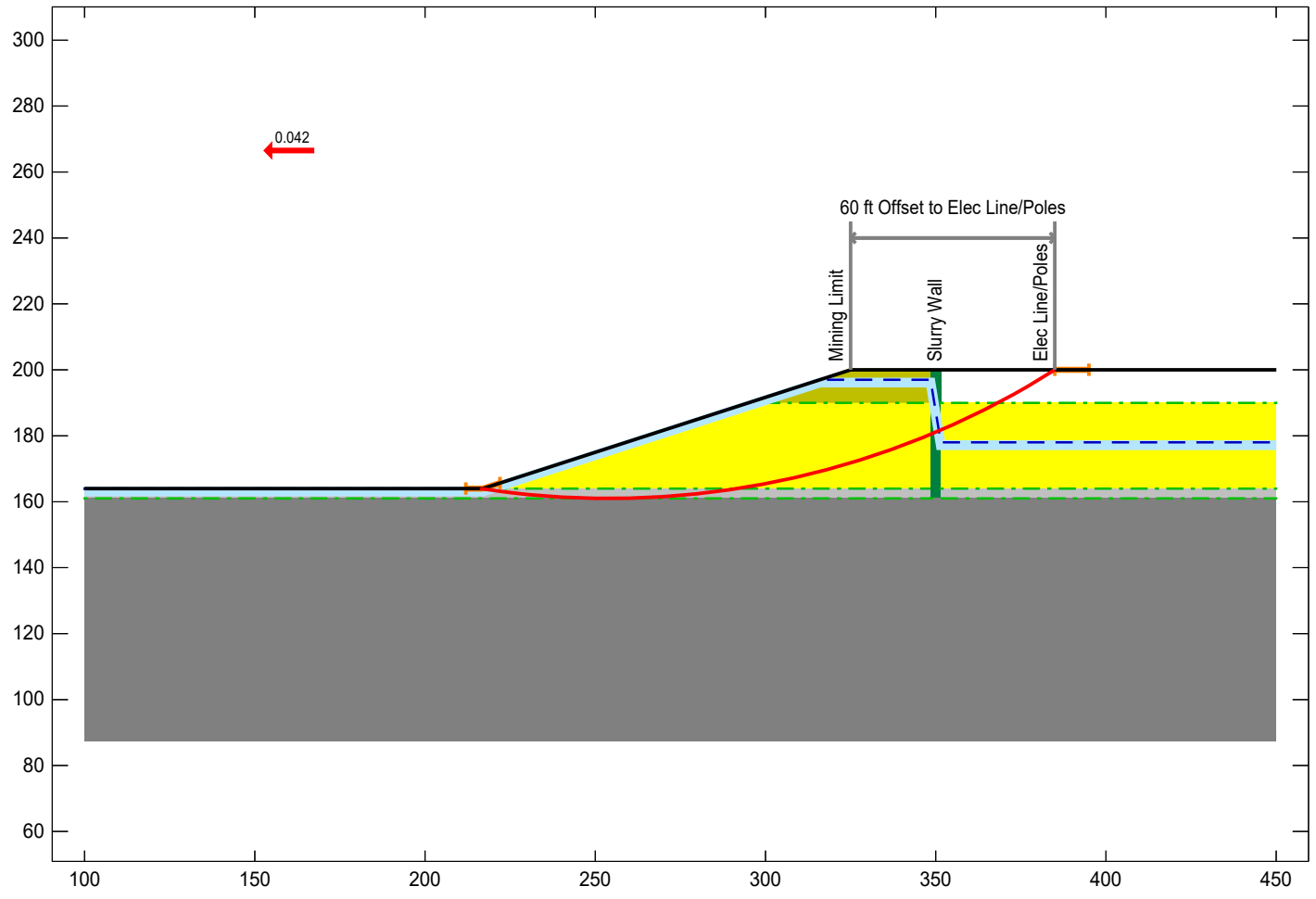
Critical Factor of Safety: 2.20

Project West Farm Pit Expansion
Case 5-3 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Full Reservoir-EQ.gmf

Edited: 1 Apr 2021
Processed: 1 Apr 2021

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

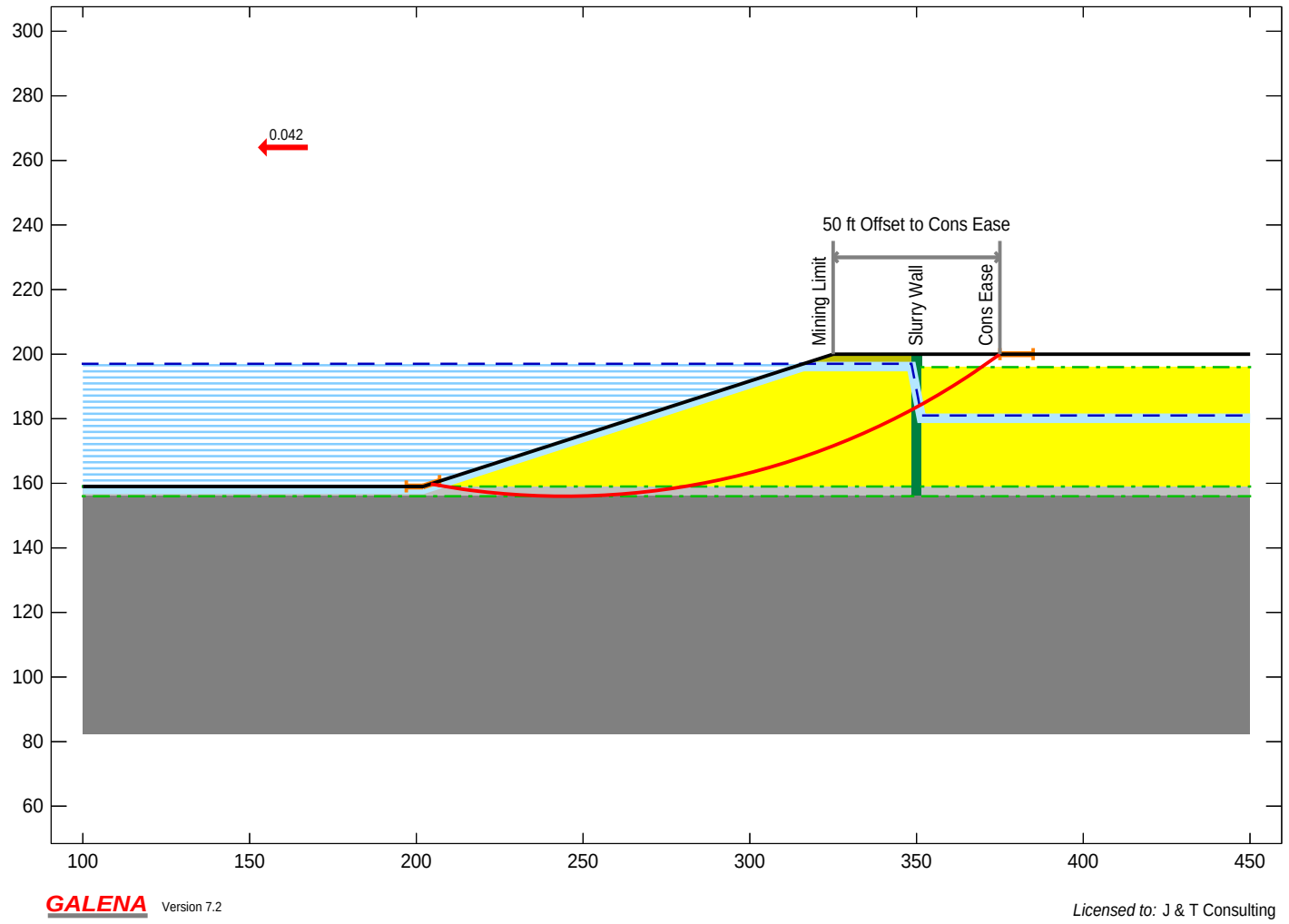
Critical Factor of Safety: 1.36

Project West Farm Pit Expansion
Case 5-3 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Rapid Drawdown-EQ.gmf

Edited: 1 Apr 2021
Processed: 1 Apr 2021

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

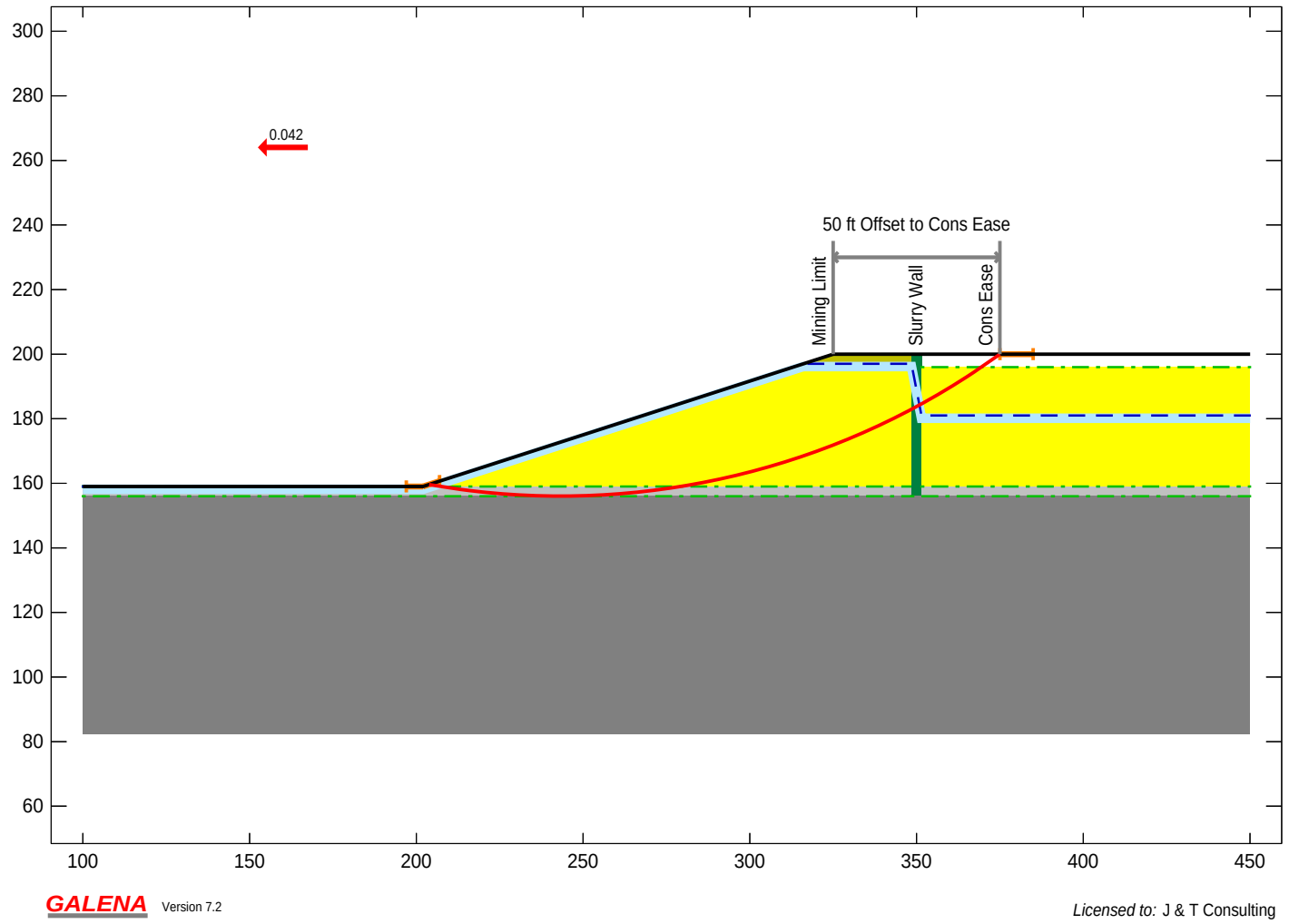
Critical Factor of Safety: 1.97

Project West Farm Pit Expansion
Case 6-1 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 6-1\West Farm Expansion Case 6-1 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

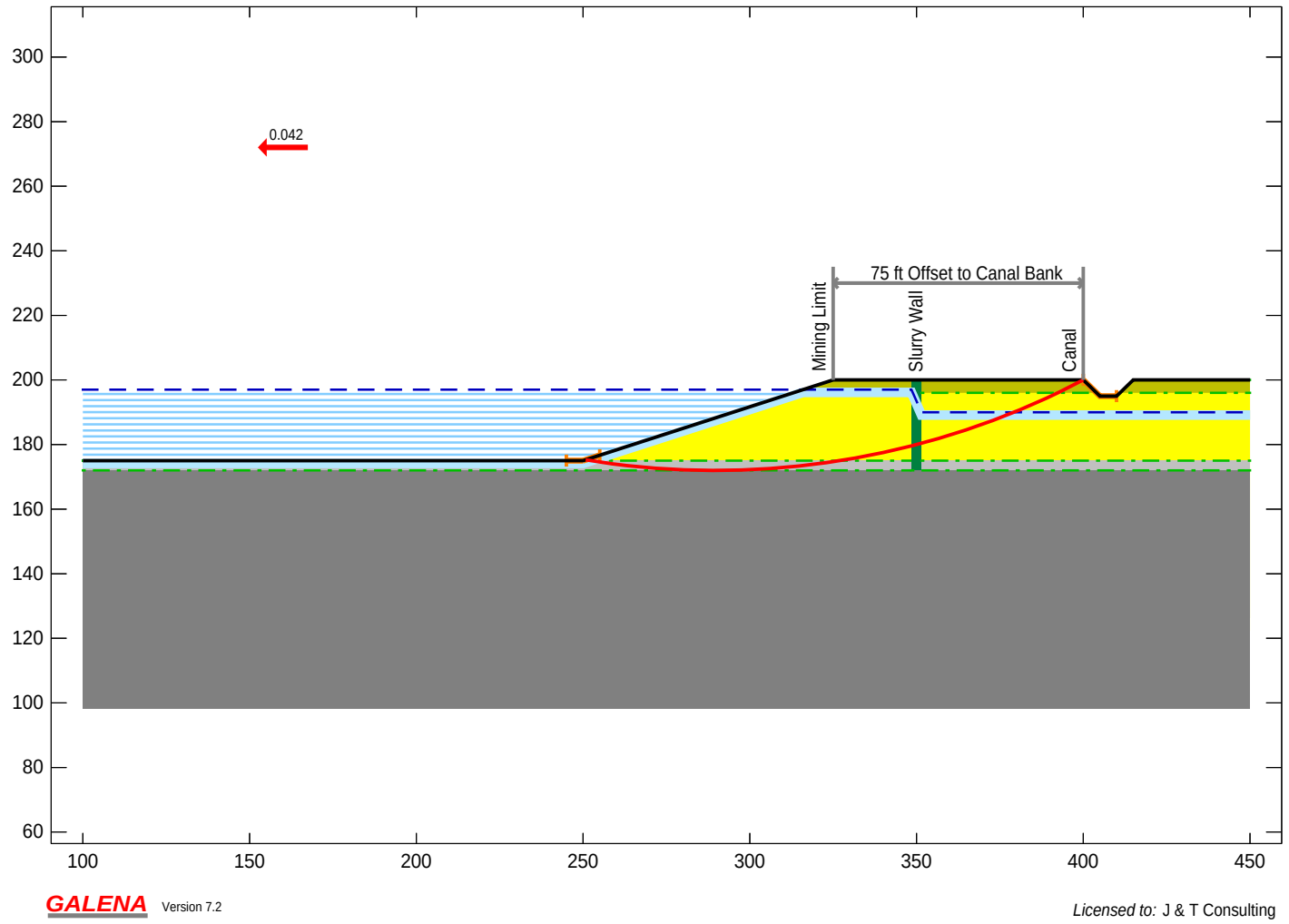
Critical Factor of Safety: 1.17

Project West Farm Pit Expansion
Case 6-1 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 6-1\West Farm Expansion Case 6-1 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

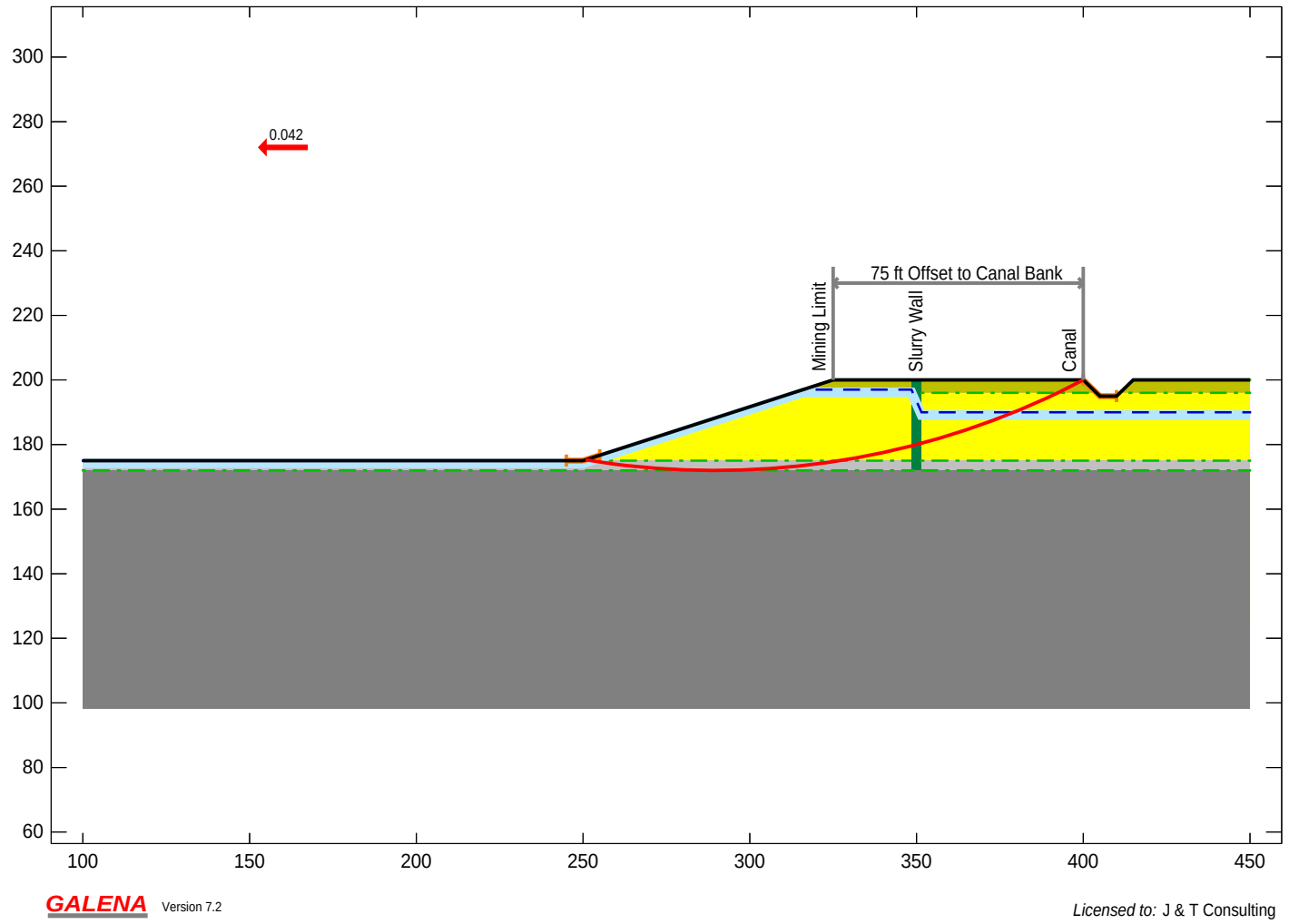
Critical Factor of Safety: 2.68

Project West Farm Pit Expansion
Case 6-2 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 6-2\West Farm Expansion Case 6-2 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

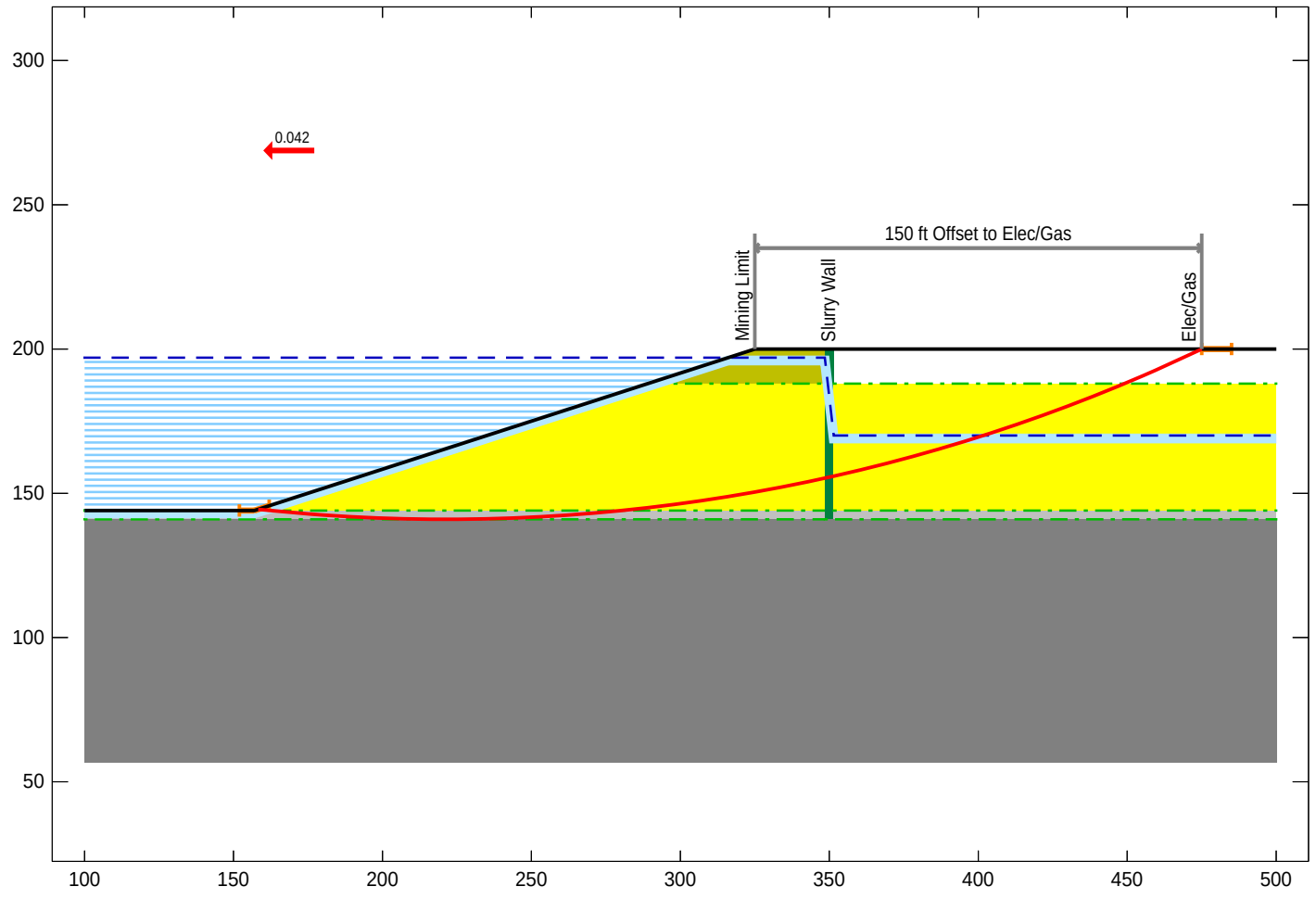
Critical Factor of Safety: 1.82

Project West Farm Pit Expansion
Case 6-2 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 6-2\West Farm Expansion Case 6-2 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

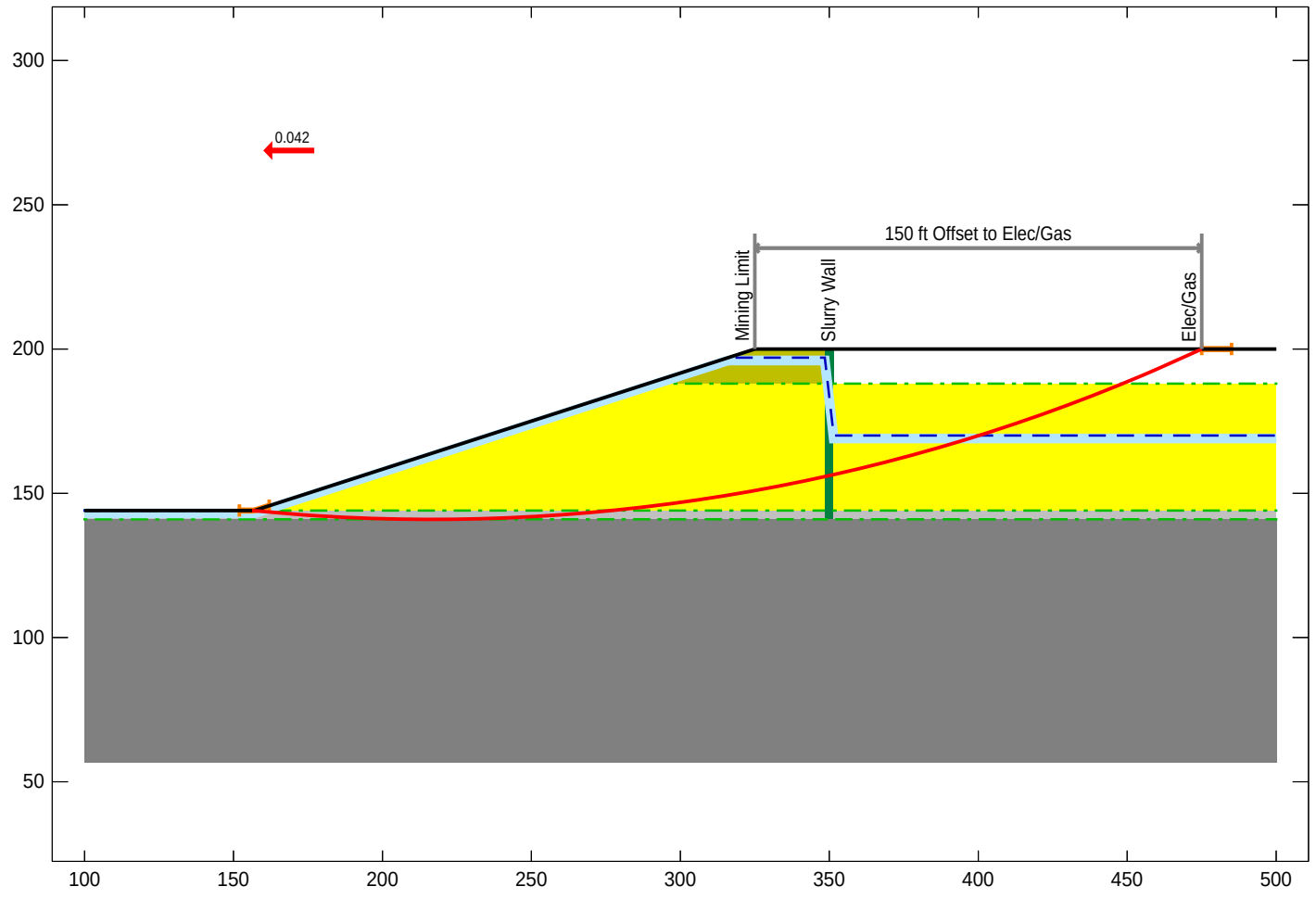
Critical Factor of Safety: 3.05

Project West Farm Pit Expansion
Case 7-1 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 7-1\West Farm Expansion Case 7-1 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

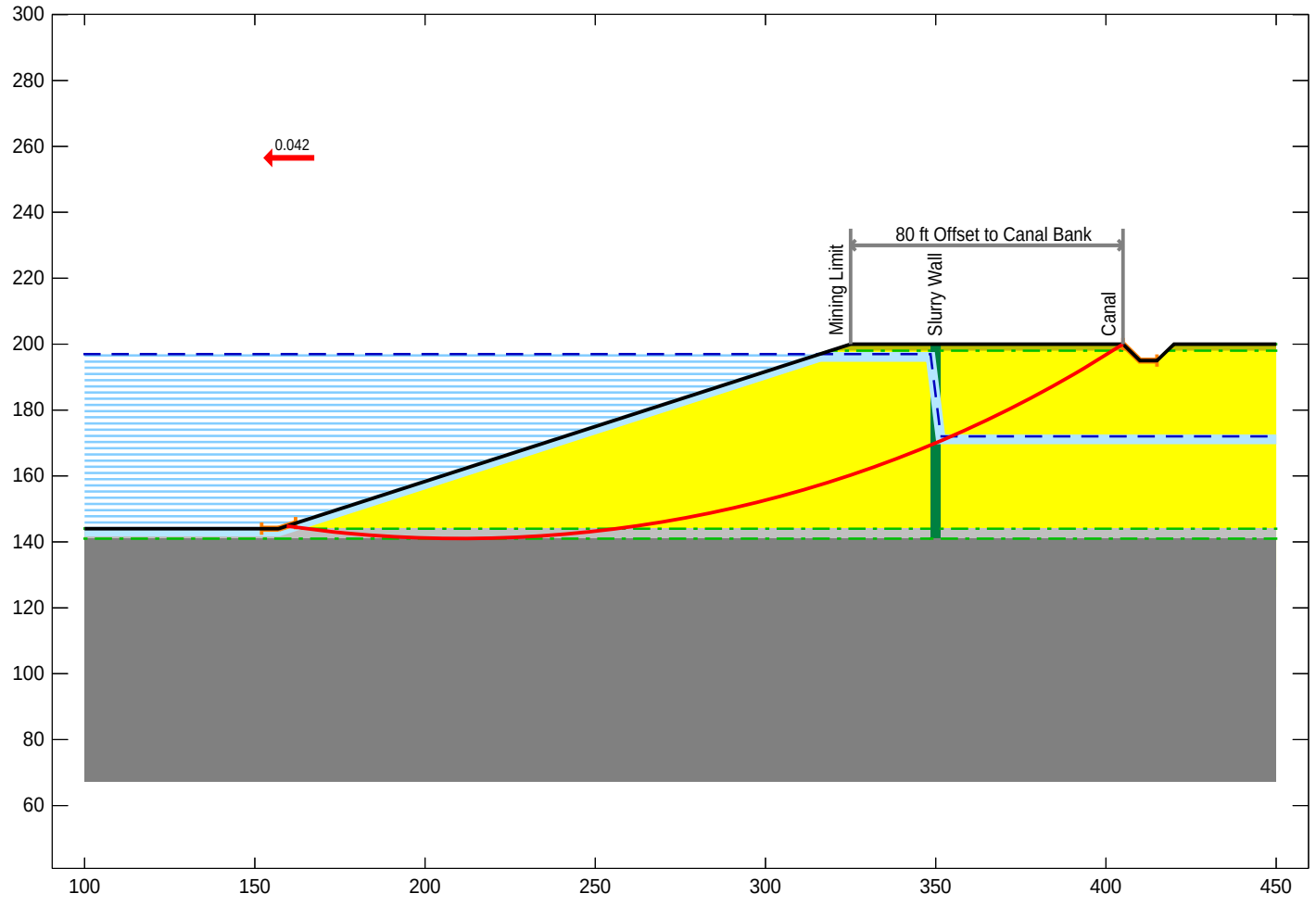
Critical Factor of Safety: 1.92

Project West Farm Pit Expansion
Case 7-1 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 7-1\West Farm Expansion Case 7-1 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

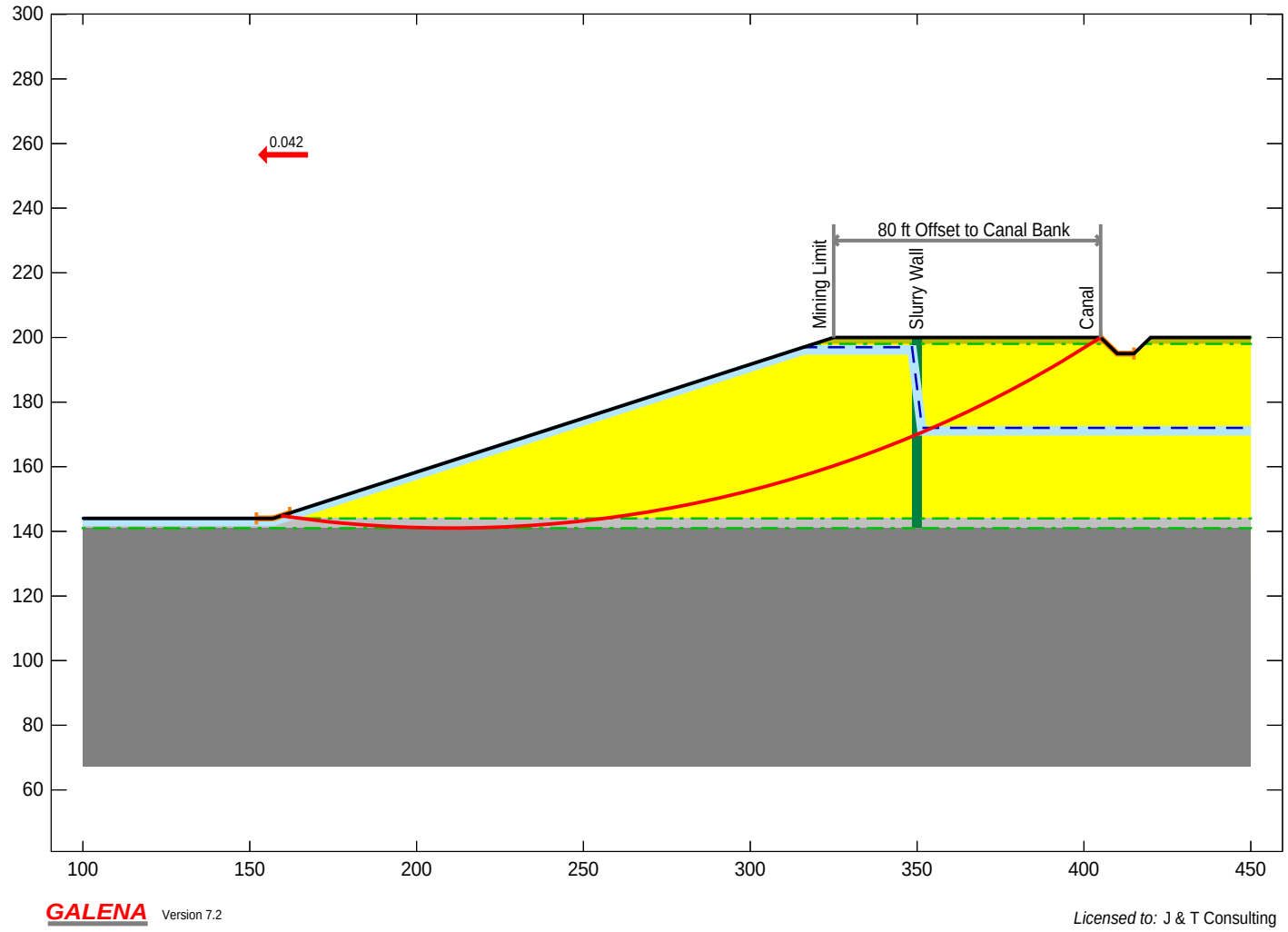
Critical Factor of Safety: 2.23

Project West Farm Pit Expansion
Case 7-2 Full Reservoir

File: C:\Galena Models\Case 7-2\West Farm Expansion Case 7-2 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

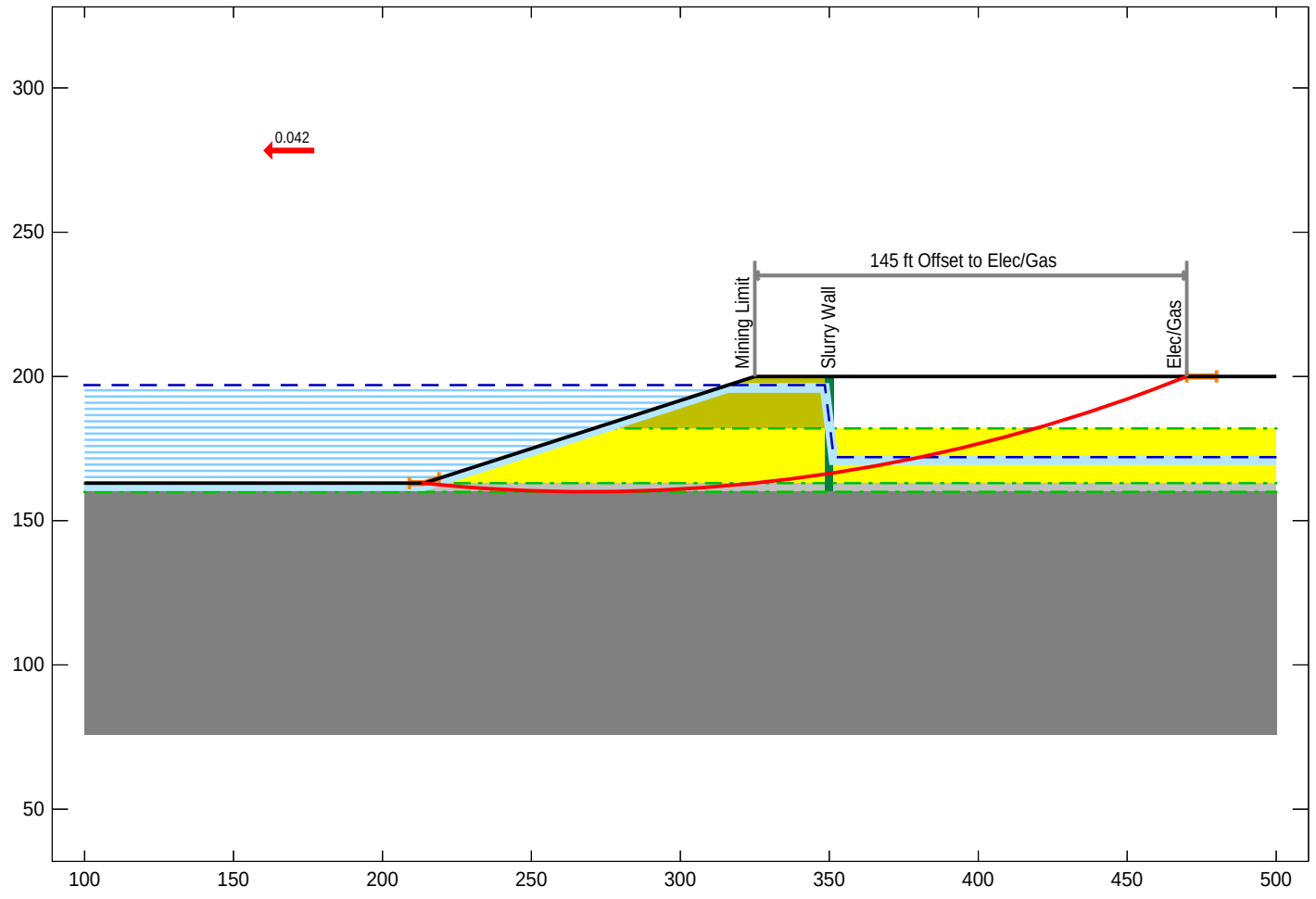
Critical Factor of Safety: 1.32

Project West Farm Pit Expansion
Case 7-2 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 7-2\West Farm Expansion Case 7-2 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

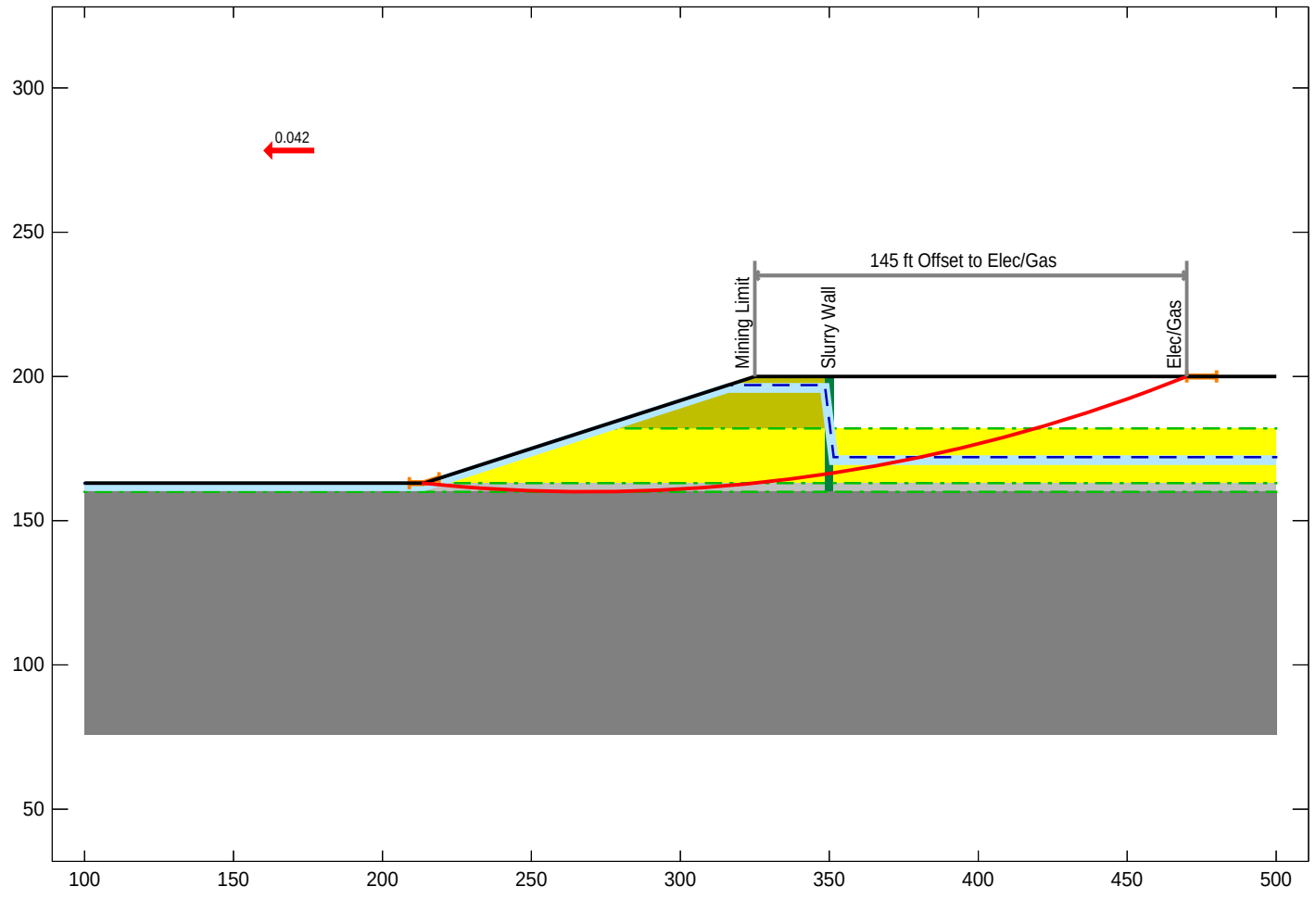
Critical Factor of Safety: 3.55

Project West Farm Pit Expansion
Case 8-1 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 8-1\West Farm Expansion Case 8-1 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

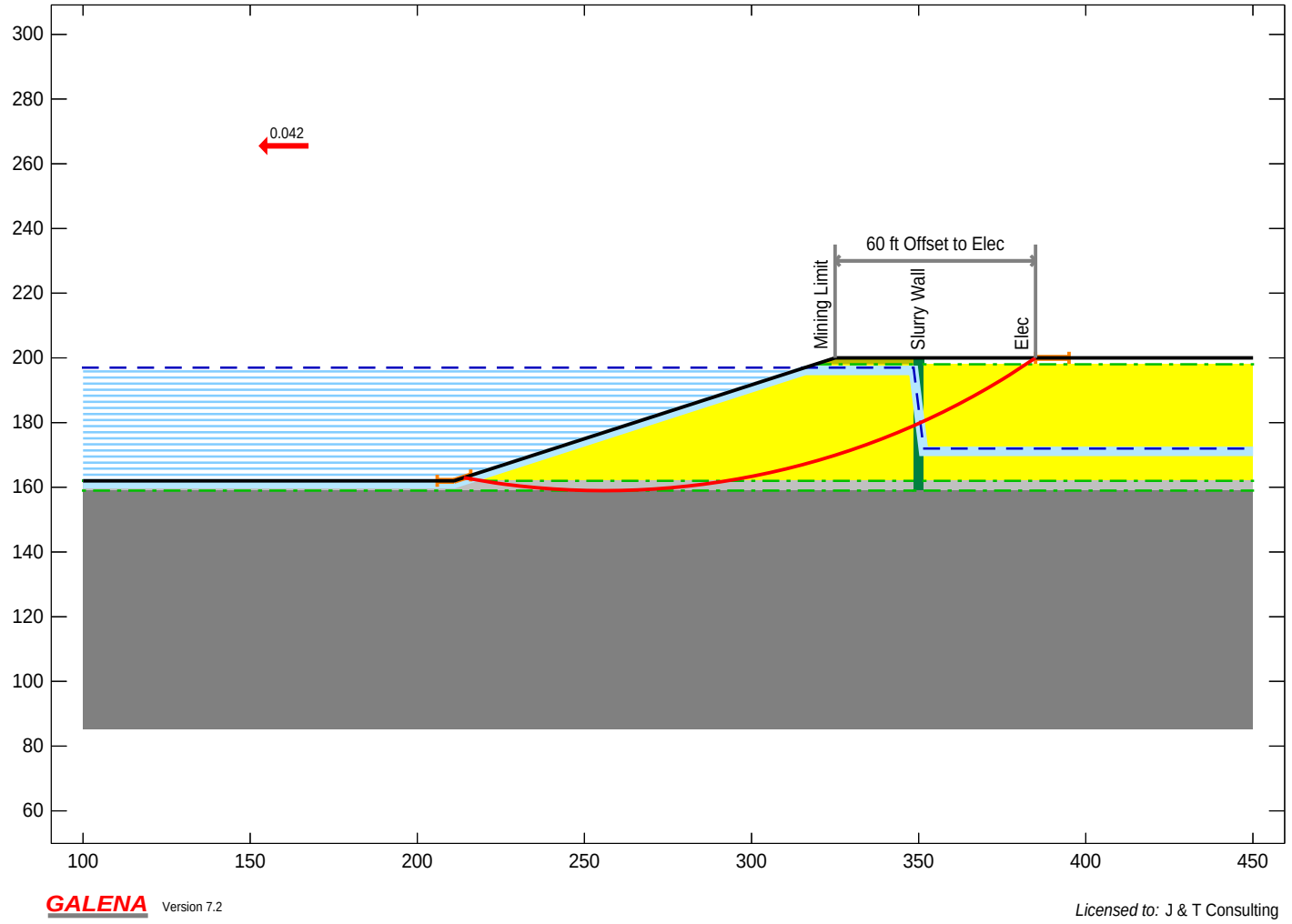
Critical Factor of Safety: 2.39

Project West Farm Pit Expansion
Case 8-1 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 8-1\West Farm Expansion Case 8-1 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

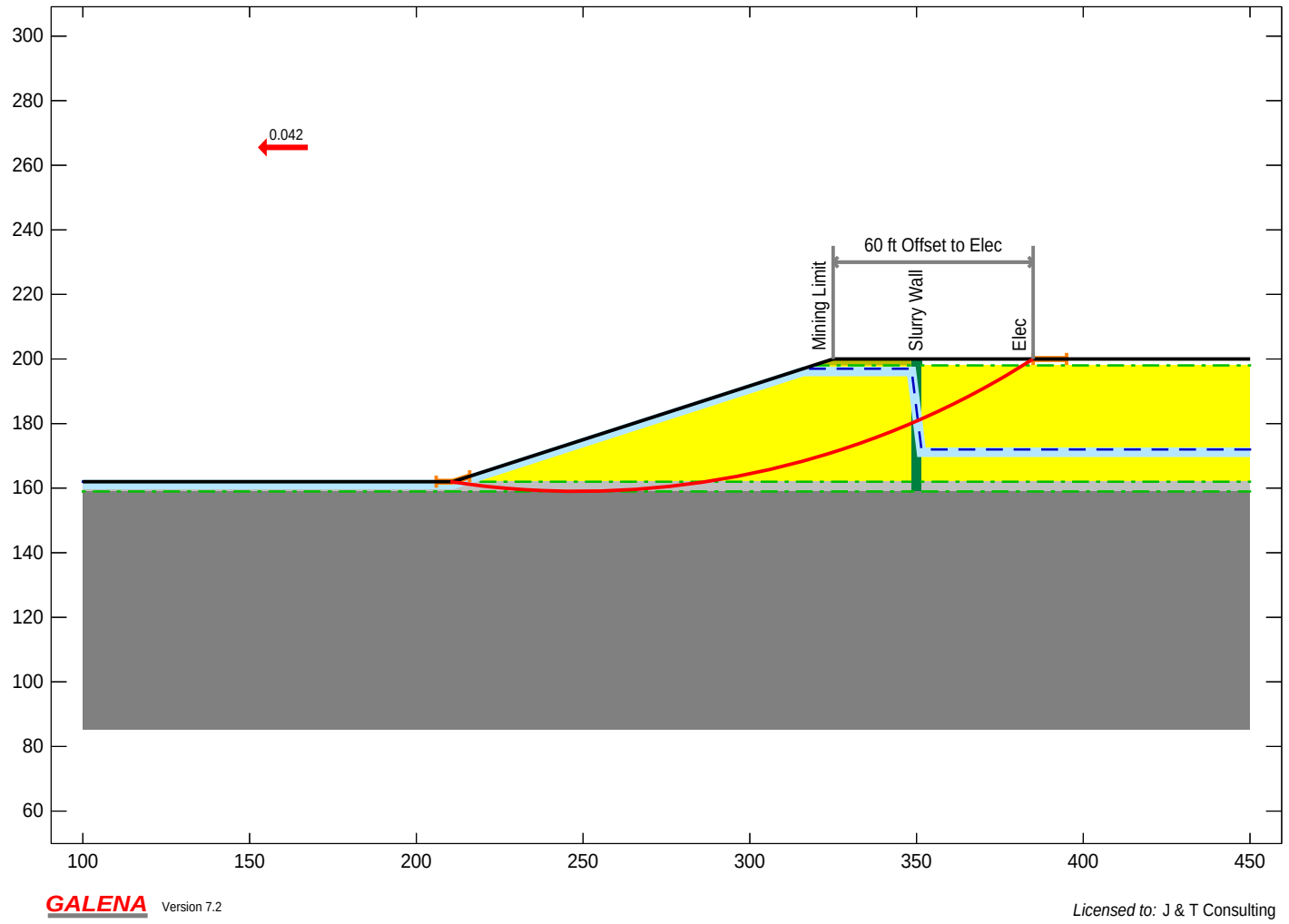
Critical Factor of Safety: 2.19

Project West Farm Pit Expansion
Case 8-2 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 8-2\West Farm Expansion Case 8-2 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

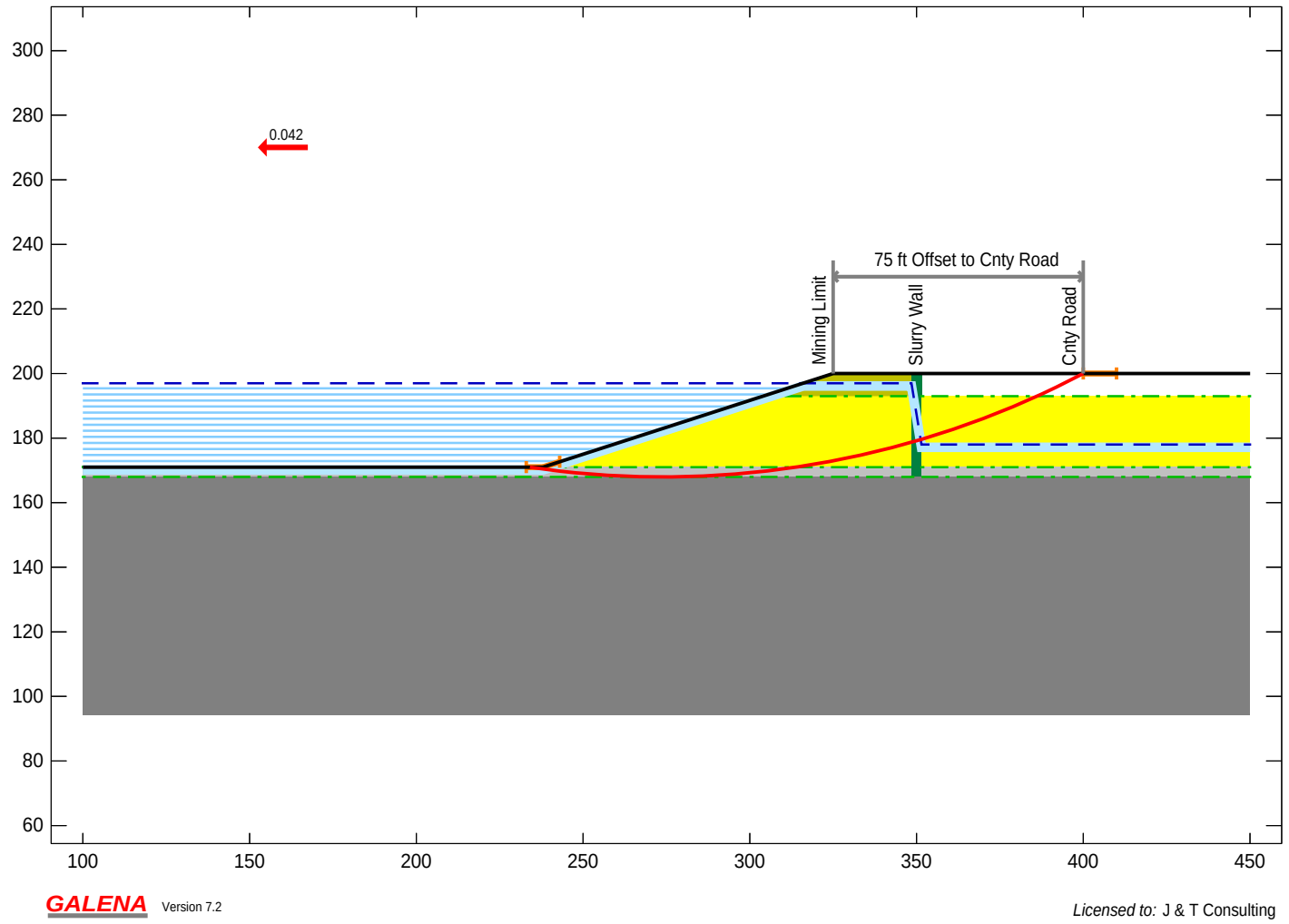
Critical Factor of Safety: 1.33

Project West Farm Pit Expansion
Case 8-2 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 8-2\West Farm Expansion Case 8-2 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

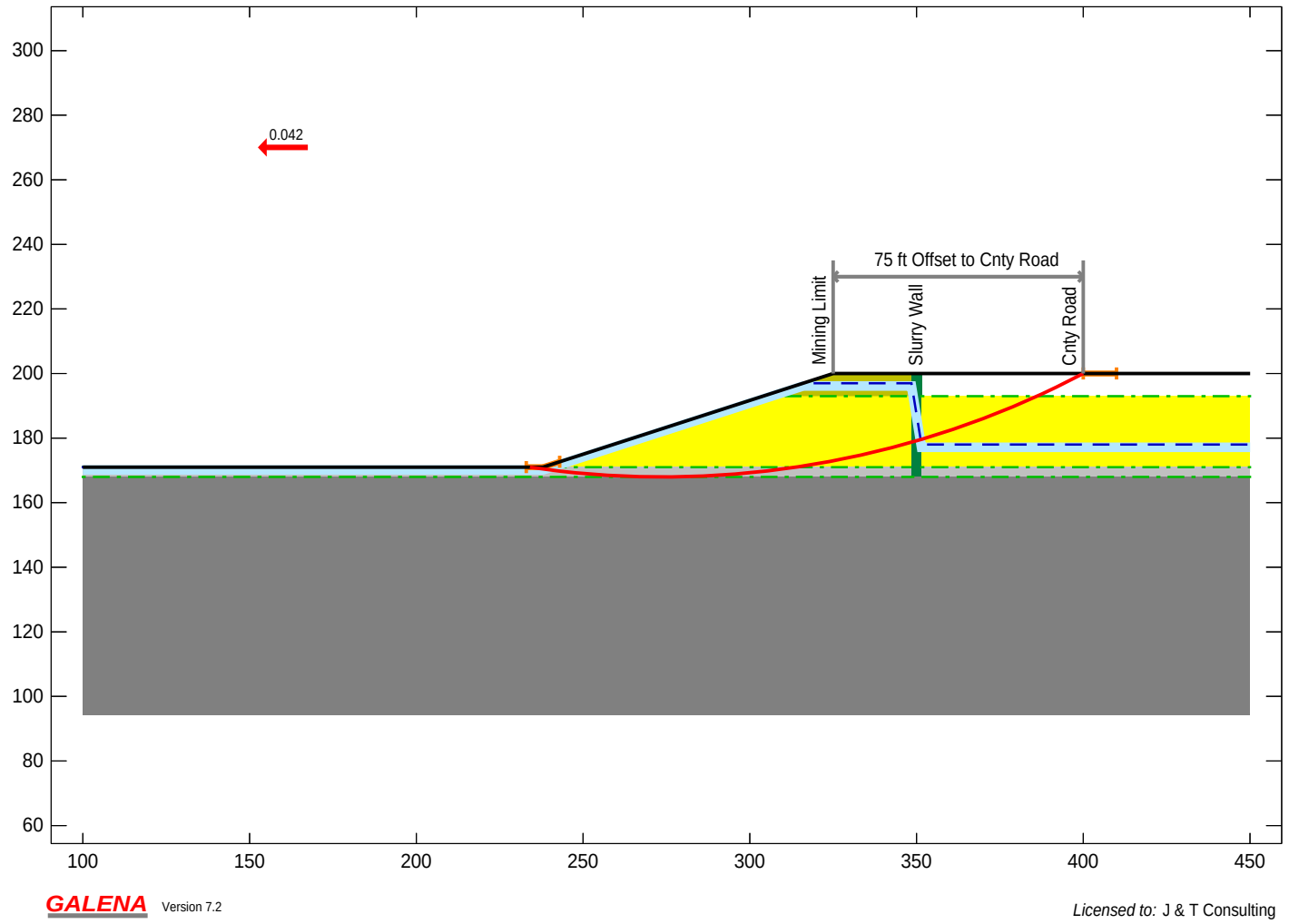
Critical Factor of Safety: 2.70

Project West Farm Pit Expansion
Case 8-3 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 8-3\West Farm Expansion Case 8-3 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

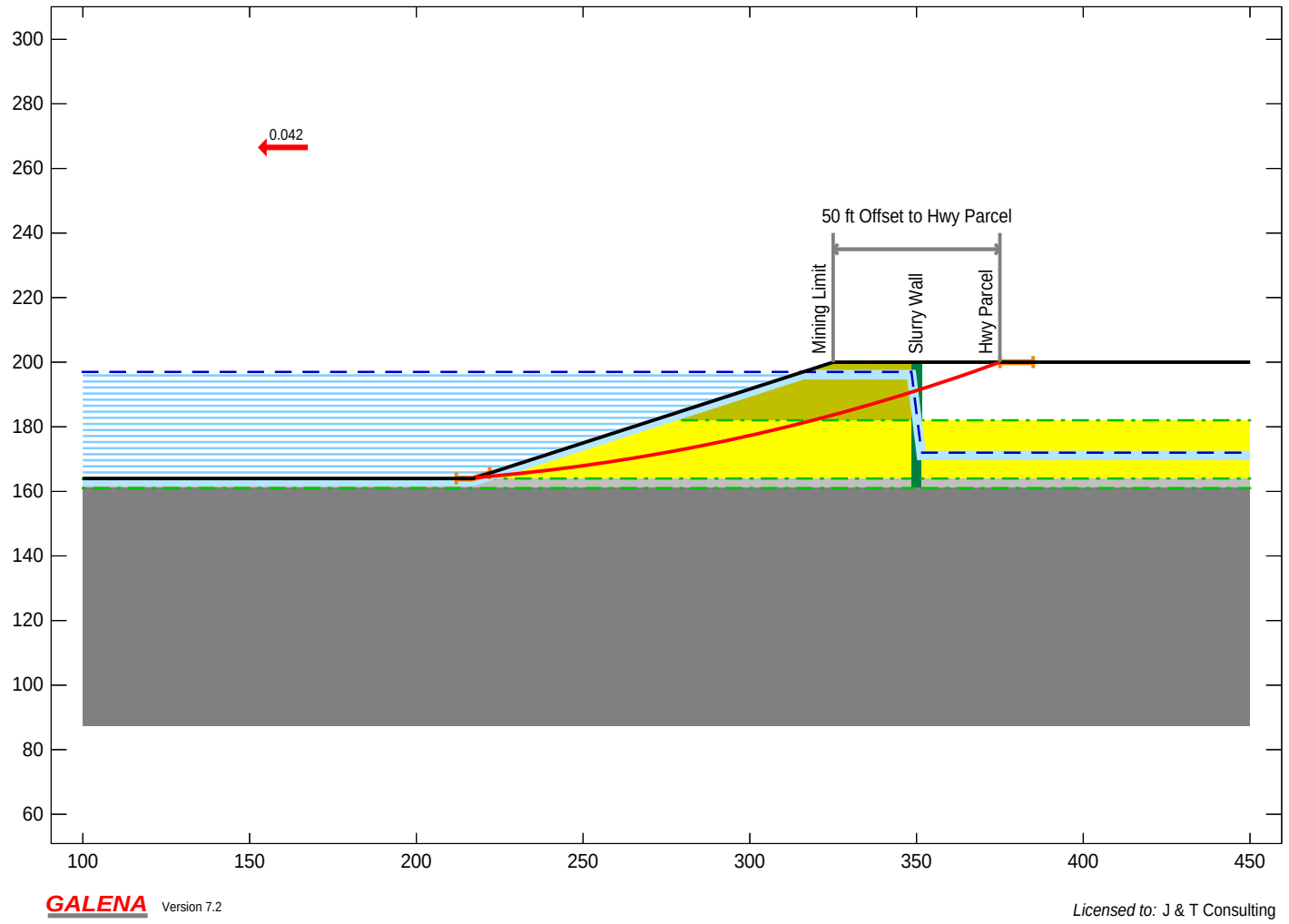
Critical Factor of Safety: 1.77

Project West Farm Pit Expansion
Case 8-3 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 8-3\West Farm Expansion Case 8-3 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

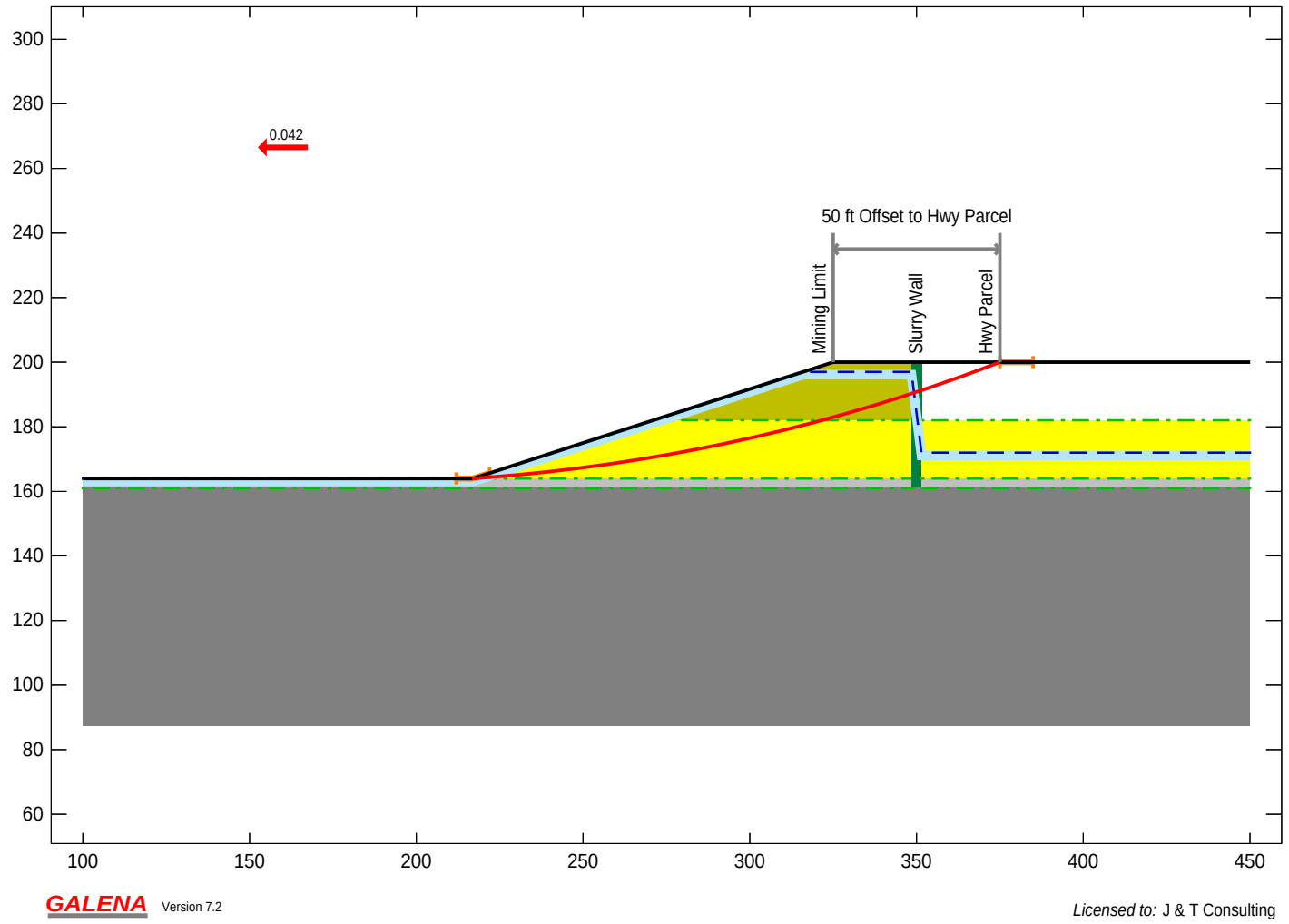
Critical Factor of Safety: 2.14

Project West Farm Pit Expansion
Case 8-4 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 8-4\West Farm Expansion Case 8-4 Full Reservoir-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.



GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

Critical Factor of Safety: 1.33

Project West Farm Pit Expansion
Case 8-4 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 8-4\West Farm Expansion Case 8-4 Rapid Drawdown-EQ.gmf

Edited: 4 Dec 2020
Processed: 4 Dec 2020

J&T Consulting, Inc.

APPENDIX C

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 3-1\West Farm Expansion Case 3-1 Full Reservoir.gmf
Processed: 04 Dec 2020 12:23:00

DATA: Analysis 1 - Case 3-1 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	184.00	348.50	184.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	140.00	348.50	140.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	137.00	348.50	137.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	184.00	450.00	184.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	140.00	450.00	140.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	137.00	450.00	137.00	

Slope Surface (8 points)

100.00	140.00	145.00	140.00	325.00	200.00	410.00	200.00
415.00	195.00						
420.00	195.00	425.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	197.00	145.00	197.00	316.00	197.00	348.50	197.00
351.50	175.00						
450.00	175.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	145.00	YL:	140.00	XR:	415.00	YR: 195.00
Centre:	XC:	238.36	YC:	371.91	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 3-1 Full Reservoir

Spencer-Wright Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 4.891 Final Angle of Interslice Forces (Theta): 10.1 degrees

Analysis Summary

There were: 19859 successful analyses from a total of 20001 trial failure surfaces (Theta filter applied)
127 analyses that failed to produce a valid result
15 analyses rejected due to Theta being outside valid range

Critical (minimum) Factor of Safety: 3.47 Final Angle of Interslice Forces: 11.6 degrees

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	Theta
1	150.00	141.67	410.00	200.00	209.15	486.63	350.00	3.471	11.6
<-- Critical Surface									
2	149.47	141.49	410.00	200.00	208.84	486.42	350.00	3.573	11.6
3	150.00	141.67	410.00	200.00	210.11	482.32	345.92	3.580	11.6
4	150.00	141.67	410.53	199.47	210.17	486.46	350.00	3.582	11.5
5	148.95	141.32	410.00	200.00	208.54	486.21	350.00	3.676	11.5
6	149.47	141.49	410.00	200.00	209.81	482.11	345.92	3.684	11.5
7	149.47	141.49	410.53	199.47	209.87	486.24	350.00	3.686	11.5
8	150.00	141.67	411.05	198.95	211.20	486.28	350.00	3.690	11.4
9	150.00	141.67	410.53	199.47	211.13	482.14	345.92	3.695	11.5
10	150.00	141.67	410.00	200.00	211.08	478.00	341.84	3.696	11.5
11	148.95	141.32	410.00	200.00	209.51	481.89	345.92	3.766	11.5
12	149.47	141.49	410.53	199.47	210.83	481.93	345.92	3.768	11.4
13	148.95	141.32	410.53	199.47	209.56	486.03	350.00	3.776	11.5
14	149.47	141.49	410.00	200.00	210.78	477.79	341.84	3.777	11.5
15	148.42	141.14	410.00	200.00	208.24	485.99	350.00	3.777	11.5
16	149.47	141.49	411.05	198.95	210.89	486.06	350.00	3.780	11.4
17	150.00	141.67	411.58	198.42	212.22	486.09	350.00	3.783	11.3
18	150.00	141.67	410.53	199.47	212.09	477.82	341.84	3.785	11.5
19	150.00	141.67	410.00	200.00	212.06	473.67	337.76	3.788	11.5
20	150.00	141.67	411.05	198.95	212.14	481.96	345.92	3.791	11.4
21	148.42	141.14	410.00	200.00	209.21	481.68	345.92	3.846	11.4
22	148.95	141.32	410.00	200.00	210.48	477.57	341.84	3.846	11.4
23	148.42	141.14	410.53	199.47	209.26	485.81	350.00	3.848	11.4
24	147.89	140.96	410.00	200.00	207.93	485.78	350.00	3.850	11.4
25	148.95	141.32	410.53	199.47	210.52	481.71	345.92	3.854	11.4
26	149.47	141.49	410.00	200.00	211.75	473.45	337.76	3.856	11.5
27	150.00	141.67	410.53	199.47	213.05	473.48	337.76	3.857	11.4
28	149.47	141.49	410.53	199.47	211.79	477.60	341.84	3.860	11.4
29	148.95	141.32	411.05	198.95	210.58	485.85	350.00	3.861	11.3
30	150.00	141.67	410.00	200.00	213.03	469.33	333.67	3.863	11.5
31	150.00	141.67	411.05	198.95	213.09	477.63	341.84	3.863	11.4
32	149.47	141.49	411.05	198.95	211.84	481.74	345.92	3.866	11.4
33	150.00	141.67	411.58	198.42	213.15	481.77	345.92	3.868	11.3
34	149.47	141.49	411.58	198.42	211.91	485.88	350.00	3.872	11.3
35	150.00	141.67	412.11	197.89	213.24	485.91	350.00	3.877	11.2
36	148.42	141.14	410.53	199.47	210.22	481.49	345.92	3.914	11.4
37	148.42	141.14	410.00	200.00	210.18	477.35	341.84	3.914	11.4
38	148.95	141.32	410.00	200.00	211.45	473.24	337.76	3.917	11.4
39	147.37	140.79	410.00	200.00	207.63	485.56	350.00	3.918	11.3
40	147.89	140.96	410.53	199.47	208.95	485.60	350.00	3.921	11.3
41	148.95	141.32	410.53	199.47	211.48	477.38	341.84	3.923	11.4
42	149.47	141.49	410.53	199.47	212.75	473.27	337.76	3.925	11.4
43	149.47	141.49	410.00	200.00	212.73	469.11	333.67	3.930	11.4
44	150.00	141.67	410.53	199.47	214.01	469.14	333.67	3.931	11.4
45	148.95	141.32	411.05	198.95	211.53	481.53	345.92	3.931	11.3
46	147.89	140.96	410.00	200.00	208.90	481.46	345.92	3.931	11.4
47	149.47	141.49	411.05	198.95	212.79	477.41	341.84	3.932	11.3
48	148.42	141.14	411.05	198.95	210.27	485.63	350.00	3.932	11.3
49	150.00	141.67	411.05	198.95	214.04	473.29	337.76	3.936	11.3
50	150.00	141.67	410.00	200.00	214.00	464.98	329.59	3.937	11.4
51	148.95	141.32	411.58	198.42	211.60	485.66	350.00	3.938	11.2
52	149.47	141.49	411.58	198.42	212.85	481.56	345.92	3.938	11.3
53	150.00	141.67	411.58	198.42	214.09	477.44	341.84	3.941	11.3
54	149.47	141.49	412.11	197.89	212.92	485.69	350.00	3.946	11.2
55	150.00	141.67	412.11	197.89	214.16	481.58	345.92	3.950	11.2
56	150.00	141.67	412.63	197.37	214.25	485.72	350.00	3.961	11.1
57	146.84	140.61	410.00	200.00	207.33	485.35	350.00	3.971	11.3
58	147.37	140.79	410.00	200.00	208.60	481.24	345.92	3.972	11.3
59	147.89	140.96	410.00	200.00	209.88	477.14	341.84	3.976	11.4
60	147.37	140.79	410.53	199.47	208.65	485.38	350.00	3.977	11.3
61	147.89	140.96	410.53	199.47	209.91	481.28	345.92	3.979	11.3

62	148.42	141.14	410.00	200.00	211.15	473.02	337.76	3.982	11.4
63	148.95	141.32	410.53	199.47	212.45	473.05	337.76	3.992	11.4
64	148.95	141.32	410.00	200.00	212.43	468.89	333.67	3.996	11.4
65	148.42	141.14	410.53	199.47	211.18	477.17	341.84	3.996	11.3
66	149.47	141.49	410.53	199.47	213.71	468.92	333.67	3.997	11.4
67	148.95	141.32	411.05	198.95	212.48	477.20	341.84	4.000	11.3
68	147.89	140.96	411.05	198.95	209.97	485.42	350.00	4.002	11.2
69	149.47	141.49	410.00	200.00	213.71	464.76	329.59	4.003	11.4
70	149.47	141.49	411.05	198.95	213.74	473.08	337.76	4.003	11.3
71	150.00	141.67	410.53	199.47	214.98	464.79	329.59	4.004	11.4
72	148.95	141.32	411.58	198.42	212.54	481.34	345.92	4.007	11.2
73	148.42	141.14	411.58	198.42	211.29	485.45	350.00	4.007	11.2
74	149.47	141.49	411.58	198.42	213.79	477.22	341.84	4.009	11.2
75	150.00	141.67	411.05	198.95	215.00	468.95	333.67	4.010	11.3
76	150.00	141.67	410.00	200.00	214.98	460.62	325.51	4.012	11.4
77	148.95	141.32	412.11	197.89	212.61	485.48	350.00	4.014	11.1
78	148.42	141.14	411.05	198.95	211.23	481.31	345.92	4.014	11.2
79	150.00	141.67	411.58	198.42	215.04	473.10	337.76	4.015	11.2
80	149.47	141.49	412.11	197.89	213.85	481.37	345.92	4.017	11.2
81	150.00	141.67	412.11	197.89	215.09	477.25	341.84	4.022	11.2
82	146.32	140.44	410.00	200.00	207.02	485.13	350.00	4.024	11.3
83	146.84	140.61	410.00	200.00	208.30	481.03	345.92	4.025	11.3
84	147.37	140.79	410.00	200.00	209.58	476.92	341.84	4.028	11.3
85	149.47	141.49	412.63	197.37	213.94	485.50	350.00	4.029	11.1
86	146.84	140.61	410.53	199.47	208.34	485.17	350.00	4.029	11.3
87	147.37	140.79	410.53	199.47	209.61	481.06	345.92	4.031	11.3
88	147.89	140.96	410.00	200.00	210.86	472.80	337.76	4.033	11.3
89	150.00	141.67	412.63	197.37	215.17	481.39	345.92	4.033	11.1
90	147.89	140.96	410.53	199.47	210.88	476.95	341.84	4.036	11.3
91	148.42	141.14	410.00	200.00	212.13	468.67	333.67	4.041	11.4
92	150.00	141.67	413.16	196.84	215.27	485.53	350.00	4.047	11.0
93	148.42	141.14	410.53	199.47	212.15	472.83	337.76	4.051	11.3
94	147.37	140.79	411.05	198.95	209.66	485.20	350.00	4.052	11.2
95	147.89	140.96	411.05	198.95	210.92	481.09	345.92	4.058	11.2
96	148.95	141.32	410.00	200.00	213.41	464.54	329.59	4.058	11.4
97	148.95	141.32	410.53	199.47	213.41	468.70	333.67	4.059	11.4
98	149.47	141.49	410.53	199.47	214.68	464.57	329.59	4.060	11.3
99	148.42	141.14	411.05	198.95	212.18	476.98	341.84	4.063	11.2

Critical Failure Surface (circle 1)

Intersects: XL: 150.00 YL: 141.67 XR: 410.00 YR: 200.00
Centre: XC: 209.15 YC: 486.63 Radius: R: 350.00
Generated failure surface: (20 points)
150.00 141.67 164.23 139.53 178.53 137.97 192.88 137.01
207.26 136.64
221.65 136.86 236.01 137.67 250.33 139.06 264.58 141.05
278.73 143.62
292.77 146.77 306.67 150.49 320.40 154.78 333.94 159.64
347.27 165.04
360.37 170.99 373.22 177.47 385.78 184.47 398.05 191.99
410.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base						PoreWater
--- Left Hand Side ----								
X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force
Side Force l/h	l'/h								
1	150.00	7.43	-8.6	5.54	5.60	2	0.00	35.0	973.02	19495.48
0.00	0.00	0.00							
2	155.54	22.28	-8.6	5.54	5.60	2	0.00	35.0	2919.06	19786.90
204.11	0.37	0.33							
3	161.08	19.24	-8.6	3.14	3.18	3	100.00	18.0	2527.80	11351.65
816.43	0.28	0.33							
4	164.23	60.51	-6.2	7.15	7.19	3	100.00	18.0	7988.23	25970.75
1270.72	0.27	0.33							
5	171.38	83.11	-6.2	7.15	7.19	3	100.00	18.0	11004.08	26319.23
2412.03	0.27	0.33							
6	178.53	105.06	-3.8	7.18	7.19	3	100.00	18.0	13925.87	26601.95
3902.84	0.26	0.33							
7	185.71	125.69	-3.8	7.18	7.19	3	100.00	18.0	16662.71	26818.19
5382.64	0.26	0.33							
8	192.88	145.55	-1.5	7.19	7.19	4	2000.00	20.0	19289.14	26968.17
7110.08	0.26	0.33							
9	200.07	164.13	-1.5	7.19	7.19	4	2000.00	20.0	21736.16	27051.94
12877.47	0.19	0.33							
10	207.26	181.68	0.9	7.19	7.19	4	2000.00	20.0	24038.50	27068.96
18822.10	0.17	0.33							
11	214.46	198.14	0.9	7.19	7.19	4	2000.00	20.0	26186.69	27020.03
24310.48	0.17	0.33							
12	221.65	74.22	3.2	2.56	2.56	4	2000.00	20.0	9801.83	9593.58
29903.32	0.17	0.33							

13	224.20	178.42	3.2	5.90	5.91	3	100.00	18.0	23540.01	22078.80
31675.07	0.17	0.33								
14	230.11	188.07	3.2	5.90	5.91	3	100.00	18.0	24785.29	21956.06
32323.35	0.18	0.33								
15	236.01	239.94	5.6	7.16	7.19	3	100.00	18.0	31574.48	26475.69
32996.17	0.20	0.33								
16	243.17	252.02	5.6	7.16	7.19	3	100.00	18.0	33106.47	26161.74
33138.68	0.21	0.33								
17	250.33	246.42	7.9	6.71	6.78	3	100.00	18.0	32312.57	24312.66
33278.00	0.22	0.33								
18	257.05	286.87	7.9	7.53	7.61	2	0.00	35.0	37580.42	26805.45
32701.57	0.23	0.33								
19	264.58	243.95	10.3	6.21	6.31	2	0.00	35.0	31957.90	21814.91
33936.59	0.22	0.33								
20	270.79	249.81	10.3	6.21	6.31	2	0.00	35.0	32724.78	21370.80
34271.58	0.22	0.33								
21	277.00	70.78	10.3	1.73	1.76	2	0.00	35.0	9272.79	5886.85
34614.61	0.22	0.33								
22	278.73	290.16	12.6	7.02	7.19	2	0.00	35.0	38010.50	23606.50
34711.79	0.22	0.33								
23	285.75	295.52	12.6	7.02	7.19	2	0.00	35.0	38713.56	22899.59
34275.25	0.21	0.33								
24	292.77	296.78	15.0	6.95	7.19	2	0.00	35.0	38878.67	22128.33
33830.62	0.21	0.33								
25	299.72	299.94	15.0	6.95	7.19	2	0.00	35.0	39292.07	21292.65
32542.71	0.20	0.33								
26	306.67	202.73	17.4	4.67	4.89	2	0.00	35.0	26557.53	13965.53
31241.12	0.20	0.33								
27	311.33	203.18	17.4	4.67	4.89	2	0.00	35.0	26616.86	13520.61
29793.29	0.20	0.33								
28	316.00	191.93	17.4	4.40	4.61	2	0.00	35.0	25142.83	12336.92
28342.23	0.19	0.33								
29	320.40	200.74	19.7	4.60	4.89	2	0.00	35.0	26296.94	12624.72
26950.58	0.19	0.33								
30	325.00	191.20	19.7	4.47	4.75	2	0.00	35.0	25047.47	11784.59
24866.21	0.19	0.33								
31	329.47	184.04	19.7	4.47	4.75	2	0.00	35.0	24109.33	11309.89
22848.12	0.20	0.33								
32	333.94	260.07	22.1	6.67	7.19	2	0.00	35.0	34068.55	16164.19
20901.12	0.21	0.33								
33	340.61	242.05	22.1	6.67	7.19	2	0.00	35.0	31708.66	14951.24
17370.59	0.23	0.33								
34	347.27	42.51	24.4	1.23	1.35	2	0.00	35.0	5568.55	2661.15
14068.62	0.26	0.33								
35	348.50	101.16	24.4	3.00	3.29	5	0.00	45.0	11127.93	4054.54
13360.15	0.27	0.33								
36	351.50	142.12	24.4	4.44	4.87	2	0.00	35.0	18617.37	2138.27
13205.87	0.27	0.33								
37	355.94	133.18	24.4	4.44	4.87	2	0.00	35.0	17446.50	1525.74
12146.56	0.27	0.33								
38	360.37	214.64	26.8	7.95	8.90	2	0.00	35.0	28117.44	1114.02
11225.36	0.27	0.33								
39	368.32	116.35	26.8	4.90	5.48	2	0.00	35.0	15241.26	0.00
9342.50	0.28	0.33								
40	373.22	122.41	29.1	5.86	6.71	2	0.00	35.0	16036.07	0.00
8387.96	0.27	0.27								
41	379.07	103.29	29.1	5.86	6.71	2	0.00	35.0	13530.70	0.00
6971.22	0.26	0.26								
42	384.93	92.08	31.2	6.56	7.67	1	150.00	22.0	12062.60	0.00
5684.33	0.25	0.25								
43	391.49	65.73	31.5	6.56	7.69	1	150.00	22.0	8610.42	0.00
3432.75	0.26	0.26								
44	398.05	35.90	33.8	5.97	7.19	1	150.00	22.0	4702.75	0.00
1695.99	0.27	0.27								
45	404.03	11.97	33.8	5.97	7.19	1	150.00	22.0	1567.59	0.00
479.20	0.35	0.35								
RHS	410.00	--------			-------				----------	
55.89	0.00	0.00								

X-S Area: 7183.01 Path Length: 273.34 X-S Weight: 940979.94

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 3-1\West Farm Expansion Case 3-1 Rapid Drawdown.gmf
Processed: 04 Dec 2020 11:59:36

DATA: Analysis 1 - Case 3-1 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	184.00	348.50	184.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	140.00	348.50	140.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	137.00	348.50	137.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	184.00	450.00	184.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	140.00	450.00	140.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	137.00	450.00	137.00	

Slope Surface (8 points)

100.00	140.00	145.00	140.00	325.00	200.00	410.00	200.00
415.00	195.00						
420.00	195.00	425.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	140.00	145.00	140.00	316.00	197.00	348.50	197.00
351.50	175.00						
450.00	175.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	145.00	YL:	140.00	XR:	415.00	YR: 195.00
Centre:	XC:	238.36	YC:	371.91	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 3-1 Rapid Drawdown

Spencer-Wright Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.633 Final Angle of Interslice Forces (Theta): 10.2 degrees

Analysis Summary

There were: 18665 successful analyses from a total of 20001 trial failure surfaces (Theta filter applied)
9 analyses that failed to produce a valid result
1327 analyses rejected due to Theta being outside valid range

Critical (minimum) Factor of Safety: 1.85 Final Angle of Interslice Forces: 11.0 degrees

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	Theta
1	150.00	141.67	410.00	200.00	209.15	486.63	350.00	1.853	11.0
<-- Critical Surface									
2	149.47	141.49	410.00	200.00	208.84	486.42	350.00	1.910	11.0
3	150.00	141.67	410.00	200.00	210.11	482.32	345.92	1.914	11.0
4	150.00	141.67	410.53	199.47	210.17	486.46	350.00	1.915	10.9
5	148.95	141.32	410.00	200.00	208.54	486.21	350.00	1.968	11.0
6	149.47	141.49	410.00	200.00	209.81	482.11	345.92	1.973	11.0
7	149.47	141.49	410.53	199.47	209.87	486.24	350.00	1.973	10.9
8	150.00	141.67	411.05	198.95	211.20	486.28	350.00	1.976	10.9
9	150.00	141.67	410.53	199.47	211.13	482.14	345.92	1.979	10.9
10	150.00	141.67	410.00	200.00	211.08	478.00	341.84	1.980	11.0
11	148.95	141.32	410.00	200.00	209.51	481.89	345.92	2.020	10.9
12	149.47	141.49	410.53	199.47	210.83	481.93	345.92	2.020	10.9
13	149.47	141.49	410.00	200.00	210.78	477.79	341.84	2.026	11.0
14	148.42	141.14	410.00	200.00	208.24	485.99	350.00	2.026	10.9
15	149.47	141.49	411.05	198.95	210.89	486.06	350.00	2.026	10.9
16	148.95	141.32	410.53	199.47	209.56	486.03	350.00	2.027	10.9
17	150.00	141.67	411.58	198.42	212.22	486.09	350.00	2.029	10.8
18	150.00	141.67	410.00	200.00	212.06	473.67	337.76	2.029	11.0
19	150.00	141.67	410.53	199.47	212.09	477.82	341.84	2.030	10.9
20	150.00	141.67	411.05	198.95	212.14	481.96	345.92	2.033	10.9
21	148.42	141.14	410.00	200.00	209.21	481.68	345.92	2.064	10.9
22	148.95	141.32	410.00	200.00	210.48	477.57	341.84	2.065	10.9
23	147.89	140.96	410.00	200.00	207.93	485.78	350.00	2.067	10.9
24	148.42	141.14	410.53	199.47	209.26	485.81	350.00	2.067	10.9
25	148.95	141.32	410.53	199.47	210.52	481.71	345.92	2.068	10.9
26	149.47	141.49	410.00	200.00	211.75	473.45	337.76	2.070	11.0
27	150.00	141.67	410.53	199.47	213.05	473.48	337.76	2.071	10.9
28	149.47	141.49	410.53	199.47	211.79	477.60	341.84	2.071	10.9
29	150.00	141.67	410.00	200.00	213.03	469.33	333.67	2.072	11.0
30	148.95	141.32	411.05	198.95	210.58	485.85	350.00	2.072	10.8
31	150.00	141.67	411.05	198.95	213.09	477.63	341.84	2.074	10.9
32	149.47	141.49	411.05	198.95	211.84	481.74	345.92	2.075	10.9
33	150.00	141.67	411.58	198.42	213.15	481.77	345.92	2.077	10.8
34	149.47	141.49	411.58	198.42	211.91	485.88	350.00	2.078	10.8
35	150.00	141.67	412.11	197.89	213.24	485.91	350.00	2.081	10.8
36	148.42	141.14	410.00	200.00	210.18	477.35	341.84	2.103	10.9
37	148.95	141.32	410.00	200.00	211.45	473.24	337.76	2.104	10.9
38	147.37	140.79	410.00	200.00	207.63	485.56	350.00	2.105	10.8
39	148.42	141.14	410.53	199.47	210.22	481.49	345.92	2.105	10.9
40	148.95	141.32	410.53	199.47	211.48	477.38	341.84	2.107	10.9
41	147.89	140.96	410.53	199.47	208.95	485.60	350.00	2.108	10.8
42	149.47	141.49	410.53	199.47	212.75	473.27	337.76	2.109	10.9
43	149.47	141.49	410.00	200.00	212.73	469.11	333.67	2.109	10.9
44	148.95	141.32	411.05	198.95	211.53	481.53	345.92	2.111	10.8
45	148.42	141.14	411.05	198.95	210.27	485.63	350.00	2.111	10.8
46	147.89	140.96	410.00	200.00	208.90	481.46	345.92	2.113	10.9
47	149.47	141.49	411.05	198.95	212.79	477.41	341.84	2.113	10.8
48	150.00	141.67	410.53	199.47	214.01	469.14	333.67	2.113	10.9
49	150.00	141.67	410.00	200.00	214.00	464.98	329.59	2.114	11.0
50	148.95	141.32	411.58	198.42	211.60	485.66	350.00	2.115	10.8
51	150.00	141.67	411.05	198.95	214.04	473.29	337.76	2.116	10.9
52	149.47	141.49	411.58	198.42	212.85	481.56	345.92	2.116	10.8
53	150.00	141.67	411.58	198.42	214.09	477.44	341.84	2.118	10.8
54	149.47	141.49	412.11	197.89	212.92	485.69	350.00	2.120	10.7
55	150.00	141.67	412.11	197.89	214.16	481.58	345.92	2.122	10.8
56	150.00	141.67	412.63	197.37	214.25	485.72	350.00	2.128	10.7
57	146.84	140.61	410.00	200.00	207.33	485.35	350.00	2.135	10.8
58	147.37	140.79	410.00	200.00	208.60	481.24	345.92	2.135	10.9
59	147.89	140.96	410.00	200.00	209.88	477.14	341.84	2.138	10.9
60	147.37	140.79	410.53	199.47	208.65	485.38	350.00	2.140	10.8
61	148.42	141.14	410.00	200.00	211.15	473.02	337.76	2.141	10.9

62	147.89	140.96	410.53	199.47	209.91	481.28	345.92	2.141	10.8
63	148.95	141.32	410.53	199.47	212.45	473.05	337.76	2.146	10.9
64	148.42	141.14	410.53	199.47	211.18	477.17	341.84	2.148	10.8
65	148.95	141.32	410.00	200.00	212.43	468.89	333.67	2.149	10.9
66	149.47	141.49	410.53	199.47	213.71	468.92	333.67	2.150	10.9
67	147.89	140.96	411.05	198.95	209.97	485.42	350.00	2.150	10.8
68	149.47	141.49	410.00	200.00	213.71	464.76	329.59	2.150	11.0
69	148.95	141.32	411.05	198.95	212.48	477.20	341.84	2.150	10.8
70	149.47	141.49	411.05	198.95	213.74	473.08	337.76	2.153	10.8
71	148.42	141.14	411.58	198.42	211.29	485.45	350.00	2.154	10.7
72	148.95	141.32	411.58	198.42	212.54	481.34	345.92	2.154	10.8
73	150.00	141.67	410.53	199.47	214.98	464.79	329.59	2.155	10.9
74	149.47	141.49	411.58	198.42	213.79	477.22	341.84	2.156	10.8
75	150.00	141.67	410.00	200.00	214.98	460.62	325.51	2.156	11.0
76	150.00	141.67	411.05	198.95	215.00	468.95	333.67	2.157	10.9
77	148.42	141.14	411.05	198.95	211.23	481.31	345.92	2.158	10.8
78	148.95	141.32	412.11	197.89	212.61	485.48	350.00	2.158	10.7
79	150.00	141.67	411.58	198.42	215.04	473.10	337.76	2.159	10.8
80	149.47	141.49	412.11	197.89	213.85	481.37	345.92	2.160	10.7
81	150.00	141.67	412.11	197.89	215.09	477.25	341.84	2.163	10.8
82	146.32	140.44	410.00	200.00	207.02	485.13	350.00	2.164	10.8
83	146.84	140.61	410.00	200.00	208.30	481.03	345.92	2.165	10.8
84	149.47	141.49	412.63	197.37	213.94	485.50	350.00	2.166	10.7
85	147.37	140.79	410.00	200.00	209.58	476.92	341.84	2.167	10.9
86	150.00	141.67	412.63	197.37	215.17	481.39	345.92	2.168	10.7
87	146.84	140.61	410.53	199.47	208.34	485.17	350.00	2.169	10.8
88	147.89	140.96	410.00	200.00	210.86	472.80	337.76	2.170	10.9
89	147.37	140.79	410.53	199.47	209.61	481.06	345.92	2.170	10.8
90	147.89	140.96	410.53	199.47	210.88	476.95	341.84	2.173	10.8
91	150.00	141.67	413.16	196.84	215.27	485.53	350.00	2.175	10.6
92	148.42	141.14	410.00	200.00	212.13	468.67	333.67	2.175	10.9
93	148.42	141.14	410.53	199.47	212.15	472.83	337.76	2.179	10.9
94	147.37	140.79	411.05	198.95	209.66	485.20	350.00	2.179	10.8
95	148.95	141.32	410.00	200.00	213.41	464.54	329.59	2.181	10.9
96	147.89	140.96	411.05	198.95	210.92	481.09	345.92	2.182	10.8
97	148.95	141.32	410.53	199.47	213.41	468.70	333.67	2.184	10.9
98	149.47	141.49	410.00	200.00	214.69	460.40	325.51	2.185	11.0
99	148.42	141.14	411.05	198.95	212.18	476.98	341.84	2.185	10.8

Critical Failure Surface (circle 1)

Intersects: XL: 150.00 YL: 141.67 XR: 410.00 YR: 200.00
Centre: XC: 209.15 YC: 486.63 Radius: R: 350.00
Generated failure surface: (20 points)
150.00 141.67 164.23 139.53 178.53 137.97 192.88 137.01
207.26 136.64
221.65 136.86 236.01 137.67 250.33 139.06 264.58 141.05
278.73 143.62
292.77 146.77 306.67 150.49 320.40 154.78 333.94 159.64
347.27 165.04
360.37 170.99 373.22 177.47 385.78 184.47 398.05 191.99
410.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base						PoreWater
--- Left Hand Side ----								
X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force
Side Force l/h	l'/h								
1	150.00	7.43	-8.6	5.54	5.60	2	0.00	35.0	973.02	468.70
0.00	0.00	0.00							
2	155.54	22.28	-8.6	5.54	5.60	2	0.00	35.0	2919.06	1406.08
381.38	0.36	0.33							
3	161.08	19.24	-8.6	3.14	3.18	3	100.00	18.0	2527.80	1214.04
1525.53	0.27	0.33							
4	164.23	60.51	-6.2	7.15	7.19	3	100.00	18.0	7988.23	3797.95
2339.38	0.27	0.33							
5	171.38	83.11	-6.2	7.15	7.19	3	100.00	18.0	11004.08	5216.34
4396.49	0.26	0.33							
6	178.53	105.06	-3.8	7.18	7.19	3	100.00	18.0	13925.87	6570.67
7080.19	0.26	0.33							
7	185.71	125.69	-3.8	7.18	7.19	3	100.00	18.0	16662.71	7860.75
9781.69	0.25	0.33							
8	192.88	145.55	-1.5	7.19	7.19	4	2000.00	20.0	19289.14	9085.58
12940.89	0.25	0.33							
9	200.07	164.13	-1.5	7.19	7.19	4	2000.00	20.0	21736.16	10245.19
23883.54	0.18	0.33							
10	207.26	181.68	0.9	7.19	7.19	4	2000.00	20.0	24038.50	11338.39
35162.64	0.16	0.33							
11	214.46	198.14	0.9	7.19	7.19	4	2000.00	20.0	26186.69	12365.50
45621.41	0.16	0.33							
12	221.65	74.22	3.2	2.56	2.56	4	2000.00	20.0	9801.83	4638.92
56277.05	0.16	0.33							

13	224.20	178.42	3.2	5.90	5.91	3	100.00	18.0	23540.01	11150.91
59665.96	0.16	0.33								
14	230.11	188.07	3.2	5.90	5.91	3	100.00	18.0	24785.29	11754.39
60965.54	0.17	0.33								
15	236.01	239.94	5.6	7.16	7.19	3	100.00	18.0	31574.48	15043.65
62301.58	0.18	0.33								
16	243.17	252.02	5.6	7.16	7.19	3	100.00	18.0	33106.47	15800.83
62663.10	0.19	0.33								
17	250.33	246.42	7.9	6.71	6.78	3	100.00	18.0	32312.57	15525.32
62978.46	0.20	0.33								
18	257.05	286.87	7.9	7.53	7.61	2	0.00	35.0	37580.42	18073.96
61889.77	0.21	0.33								
19	264.58	243.95	10.3	6.21	6.31	2	0.00	35.0	31957.90	15471.55
64066.83	0.20	0.33								
20	270.79	249.81	10.3	6.21	6.31	2	0.00	35.0	32724.78	15842.81
64402.92	0.20	0.33								
21	277.00	70.78	10.3	1.73	1.76	2	0.00	35.0	9272.79	4489.17
64743.05	0.20	0.33								
22	278.73	290.16	12.6	7.02	7.19	2	0.00	35.0	38010.50	18555.86
64839.38	0.20	0.33								
23	285.75	295.52	12.6	7.02	7.19	2	0.00	35.0	38713.56	18899.09
63539.22	0.19	0.33								
24	292.77	296.78	15.0	6.95	7.19	2	0.00	35.0	38878.67	19172.66
62214.98	0.19	0.33								
25	299.72	299.94	15.0	6.95	7.19	2	0.00	35.0	39292.07	19376.53
59174.75	0.18	0.33								
26	306.67	202.73	17.4	4.67	4.89	2	0.00	35.0	26557.53	13253.74
56102.19	0.18	0.33								
27	311.33	203.18	17.4	4.67	4.89	2	0.00	35.0	26616.86	13283.34
52868.44	0.18	0.33								
28	316.00	191.93	17.4	4.40	4.61	2	0.00	35.0	25142.83	12336.92
49627.47	0.17	0.33								
29	320.40	200.74	19.7	4.60	4.89	2	0.00	35.0	26296.94	12624.72
46642.94	0.17	0.33								
30	325.00	191.20	19.7	4.47	4.75	2	0.00	35.0	25047.47	11784.59
42547.72	0.17	0.33								
31	329.47	184.04	19.7	4.47	4.75	2	0.00	35.0	24109.33	11309.89
38733.88	0.18	0.33								
32	333.94	260.07	22.1	6.67	7.19	2	0.00	35.0	34068.55	16164.19
35074.99	0.18	0.33								
33	340.61	242.05	22.1	6.67	7.19	2	0.00	35.0	31708.66	14951.24
28459.33	0.20	0.33								
34	347.27	42.51	24.4	1.23	1.35	2	0.00	35.0	5568.55	2661.15
22335.38	0.23	0.33								
35	348.50	101.16	24.4	3.00	3.29	5	0.00	45.0	11127.93	4054.54
21023.30	0.24	0.33								
36	351.50	142.12	24.4	4.44	4.87	2	0.00	35.0	18617.37	2138.27
19822.17	0.24	0.33								
37	355.94	133.18	24.4	4.44	4.87	2	0.00	35.0	17446.50	1525.74
17845.45	0.24	0.33								
38	360.37	214.64	26.8	7.95	8.90	2	0.00	35.0	28117.44	1114.02
16163.51	0.24	0.33								
39	368.32	116.35	26.8	4.90	5.48	2	0.00	35.0	15241.26	0.00
12786.44	0.25	0.33								
40	373.22	122.41	29.1	5.86	6.71	2	0.00	35.0	16036.07	0.00
11170.23	0.24	0.24								
41	379.07	103.29	29.1	5.86	6.71	2	0.00	35.0	13530.70	0.00
8819.79	0.23	0.23								
42	384.93	92.08	31.2	6.56	7.67	1	150.00	22.0	12062.60	0.00
6836.54	0.21	0.21								
43	391.49	65.73	31.5	6.56	7.69	1	150.00	22.0	8610.42	0.00
3508.58	0.20	0.20								
44	398.05	35.90	33.8	5.97	7.19	1	150.00	22.0	4702.75	0.00
1265.76	0.20	0.20								
45	404.03	11.97	33.8	5.97	7.19	1	150.00	22.0	1567.59	0.00
88.98	0.36	0.36								
RHS	410.00	--------		-------					----------	
82.71	0.00	0.00								

X-S Area: 7183.01 Path Length: 273.34 X-S Weight: 940979.94

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 3-2\West Farm Expansion Case 3-2 Full Reservoir.gmf
Processed: 04 Dec 2020 12:30:52

DATA: Analysis 1 - Case 3-2 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	178.00	348.50	178.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	135.00	348.50	135.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	132.00	348.50	132.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	178.00	450.00	178.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	135.00	450.00	135.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	132.00	450.00	132.00	

Slope Surface (4 points)

100.00	135.00	130.00	135.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	130.00	197.00	316.00	197.00	348.50	197.00
351.50	174.00						
450.00	174.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	130.00	YL:	135.00	XR:	405.00	YR: 200.00
Centre:	XC:	220.06	YC:	368.22	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 3-2 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 4.403

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.82

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	135.00	136.67	400.00	200.00	192.56	481.90	350.00	2.818	<-- Critical Surface
2	135.00	136.67	400.53	200.00	192.99	481.83	350.00	2.935	
3	135.00	136.67	401.05	200.00	193.42	481.76	350.00	3.042	
4	134.47	136.49	400.00	200.00	192.27	481.69	350.00	3.118	
5	135.00	136.67	400.00	200.00	193.59	477.59	345.92	3.140	
6	135.00	136.67	401.58	200.00	193.84	481.68	350.00	3.154	
7	134.47	136.49	400.53	200.00	192.70	481.61	350.00	3.165	
8	135.00	136.67	400.53	200.00	194.02	477.51	345.92	3.183	
9	135.00	136.67	402.11	200.00	194.27	481.61	350.00	3.200	
10	134.47	136.49	401.05	200.00	193.12	481.54	350.00	3.208	
11	135.00	136.67	401.05	200.00	194.44	477.44	345.92	3.217	
12	133.95	136.32	400.00	200.00	191.98	481.47	350.00	3.233	
13	134.47	136.49	400.00	200.00	193.30	477.37	345.92	3.238	
14	135.00	136.67	402.63	200.00	194.70	481.54	350.00	3.240	
15	135.00	136.67	400.00	200.00	194.62	473.26	341.84	3.248	
16	134.47	136.49	401.58	200.00	193.55	481.47	350.00	3.250	
17	135.00	136.67	401.58	200.00	194.87	477.36	345.92	3.260	
18	133.95	136.32	400.53	200.00	192.41	481.40	350.00	3.271	
19	134.47	136.49	400.53	200.00	193.73	477.30	345.92	3.278	
20	135.00	136.67	400.53	200.00	195.05	473.19	341.84	3.278	
21	135.00	136.67	403.16	200.00	195.12	481.46	350.00	3.280	
22	134.47	136.49	402.11	200.00	193.98	481.40	350.00	3.294	
23	133.95	136.32	401.05	200.00	192.83	481.33	350.00	3.301	
24	135.00	136.67	402.11	200.00	195.30	477.29	345.92	3.303	
25	134.47	136.49	401.05	200.00	194.15	477.22	345.92	3.309	
26	135.00	136.67	403.68	200.00	195.55	481.39	350.00	3.320	
27	135.00	136.67	401.05	200.00	195.47	473.11	341.84	3.321	
28	133.42	136.14	400.00	200.00	191.69	481.26	350.00	3.327	
29	133.95	136.32	400.00	200.00	193.01	477.15	345.92	3.332	
30	134.47	136.49	402.63	200.00	194.41	481.32	350.00	3.333	
31	134.47	136.49	400.00	200.00	194.33	473.05	341.84	3.340	
32	135.00	136.67	402.63	200.00	195.72	477.21	345.92	3.343	
33	133.95	136.32	401.58	200.00	193.26	481.25	350.00	3.343	
34	134.47	136.49	401.58	200.00	194.58	477.15	345.92	3.352	
35	135.00	136.67	400.00	200.00	195.66	468.93	337.76	3.353	
36	135.00	136.67	404.21	200.00	195.97	481.31	350.00	3.359	
37	133.42	136.14	400.53	200.00	192.11	481.18	350.00	3.365	
38	135.00	136.67	401.58	200.00	195.90	473.03	341.84	3.365	
39	133.95	136.32	400.53	200.00	193.44	477.08	345.92	3.370	
40	134.47	136.49	403.16	200.00	194.83	481.25	350.00	3.372	
41	134.47	136.49	400.53	200.00	194.76	472.97	341.84	3.380	
42	135.00	136.67	403.16	200.00	196.15	477.14	345.92	3.382	
43	135.00	136.67	400.53	200.00	196.08	468.85	337.76	3.384	
44	133.95	136.32	402.11	200.00	193.69	481.18	350.00	3.386	
45	133.42	136.14	401.05	200.00	192.54	481.11	350.00	3.393	
46	134.47	136.49	402.11	200.00	195.01	477.07	345.92	3.395	
47	135.00	136.67	404.74	200.00	196.40	481.24	350.00	3.399	
48	133.95	136.32	401.05	200.00	193.86	477.01	345.92	3.400	
49	135.00	136.67	402.11	200.00	196.32	472.96	341.84	3.407	
50	134.47	136.49	403.68	200.00	195.26	481.17	350.00	3.411	
51	134.47	136.49	401.05	200.00	195.18	472.89	341.84	3.412	
52	132.89	135.96	400.00	200.00	191.40	481.04	350.00	3.420	
53	135.00	136.67	403.68	200.00	196.57	477.06	345.92	3.422	
54	133.42	136.14	400.00	200.00	192.72	476.94	345.92	3.424	
55	133.95	136.32	402.63	200.00	194.11	481.11	350.00	3.425	
56	135.00	136.67	401.05	200.00	196.51	468.77	337.76	3.428	
57	133.95	136.32	400.00	200.00	194.05	472.83	341.84	3.432	
58	134.47	136.49	402.63	200.00	195.43	477.00	345.92	3.434	
59	133.42	136.14	401.58	200.00	192.97	481.04	350.00	3.434	
60	135.00	136.67	405.26	200.00	196.82	481.16	350.00	3.439	
61	133.95	136.32	401.58	200.00	194.29	476.93	345.92	3.442	
62	134.47	136.49	400.00	200.00	195.37	468.71	337.76	3.444	
63	135.00	136.67	402.63	200.00	196.75	472.88	341.84	3.447	
64	134.47	136.49	404.21	200.00	195.68	481.10	350.00	3.450	
65	135.00	136.67	400.00	200.00	196.70	464.59	333.67	3.453	
66	134.47	136.49	401.58	200.00	195.61	472.82	341.84	3.455	
67	132.89	135.96	400.53	200.00	191.82	480.97	350.00	3.457	
68	133.42	136.14	400.53	200.00	193.15	476.86	345.92	3.461	

69	135.00	136.67	404.21	200.00	196.99	476.98	345.92	3.462
70	133.95	136.32	403.16	200.00	194.54	481.03	350.00	3.463
71	134.47	136.49	400.53	200.00	195.80	468.63	337.76	3.468
72	133.95	136.32	400.53	200.00	194.47	472.75	341.84	3.470
73	135.00	136.67	401.58	200.00	196.93	468.70	337.76	3.473
74	134.47	136.49	403.16	200.00	195.85	476.92	345.92	3.473
75	133.42	136.14	402.11	200.00	193.40	480.96	350.00	3.476
76	135.00	136.67	400.53	200.00	197.12	464.51	333.67	3.478
77	135.00	136.67	405.79	200.00	197.25	481.09	350.00	3.478
78	133.95	136.32	402.11	200.00	194.71	476.85	345.92	3.485
79	135.00	136.67	403.16	200.00	197.17	472.80	341.84	3.487
80	135.00	136.67	402.11	200.00	197.35	468.62	337.76	3.488
81	134.47	136.49	404.74	200.00	196.11	481.02	350.00	3.489
82	133.42	136.14	401.05	200.00	193.57	476.79	345.92	3.490
83	132.89	135.96	401.05	200.00	192.25	480.90	350.00	3.494
84	133.95	136.32	401.05	200.00	194.90	472.68	341.84	3.496
85	134.47	136.49	402.11	200.00	196.03	472.74	341.84	3.497
86	133.95	136.32	403.68	200.00	194.96	480.96	350.00	3.502
87	135.00	136.67	404.74	200.00	197.42	476.91	345.92	3.502
88	134.47	136.49	401.05	200.00	196.22	468.55	337.76	3.503
89	135.00	136.67	401.05	200.00	197.54	464.43	333.67	3.509
90	135.00	136.67	403.68	200.00	197.59	472.72	341.84	3.510
91	133.42	136.14	400.00	200.00	193.76	472.61	341.84	3.510
92	134.47	136.49	403.68	200.00	196.28	476.84	345.92	3.512
93	134.47	136.49	402.63	200.00	196.46	472.66	341.84	3.512
94	132.89	135.96	400.00	200.00	192.43	476.72	345.92	3.514
95	133.42	136.14	402.63	200.00	193.82	480.89	350.00	3.515
96	133.95	136.32	400.00	200.00	195.08	468.49	337.76	3.517
97	135.00	136.67	406.32	200.00	197.67	481.01	350.00	3.518
98	134.47	136.49	400.00	200.00	196.41	464.37	333.67	3.521
99	132.37	135.79	400.00	200.00	191.11	480.83	350.00	3.523

Critical Failure Surface (circle 1)

Intersects: XL: 135.00 YL: 136.67 XR: 400.00 YR: 200.00
Centre: XC: 192.56 YC: 481.90 Radius: R: 350.00
Generated failure surface: (20 points)
135.00 136.67 149.58 134.55 164.23 133.05 178.93 132.17
193.66 131.90
208.38 132.26 223.08 133.23 237.72 134.83 252.28 137.03
266.74 139.85
281.06 143.28 295.23 147.30 309.22 151.91 322.99 157.11
336.54 162.89
349.84 169.23 362.85 176.12 375.57 183.56 387.96 191.52
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 46 slices)

Slice	X-S	Base							PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	135.00	7.88	-8.3	5.74	5.80	2	0.00	35.0	1032.78	21988.64	3888.54	1.05
2	140.74	23.65	-8.3	5.74	5.80	2	0.00	35.0	3098.32	22290.28	4136.02	1.05
3	146.48	19.29	-8.3	3.10	3.13	3	100.00	18.0	2534.55	12143.42	4325.28	1.03
4	149.58	62.79	-5.8	7.33	7.36	3	100.00	18.0	8285.52	28869.15	4527.25	1.02
5	156.90	86.17	-5.8	7.33	7.36	3	100.00	18.0	11404.15	29214.04	4803.28	1.02
6	164.23	108.83	-3.4	7.35	7.36	3	100.00	18.0	14416.55	29488.14	5050.99	1.01
7	171.58	130.09	-3.4	7.35	7.36	3	100.00	18.0	17233.82	29691.11	5282.75	1.01
8	178.93	92.92	-1.0	4.66	4.66	3	100.00	18.0	12306.16	18847.86	5449.76	1.00
9	183.58	100.53	-1.0	4.66	4.66	3	100.00	18.0	13307.16	18872.08	5568.20	1.00
10	188.24	126.54	-1.0	5.42	5.42	4	2000.00	20.0	16741.32	21986.35	5708.83	1.00
11	193.66	100.06	1.4	4.01	4.01	4	2000.00	20.0	13230.05	16292.34	5777.57	1.00
12	197.67	141.30	1.4	5.36	5.36	3	100.00	18.0	18668.02	21707.42	5885.28	1.00
13	203.02	150.17	1.4	5.36	5.36	3	100.00	18.0	19822.74	21664.12	5989.17	1.00
14	208.38	219.32	3.8	7.35	7.36	3	100.00	18.0	28914.99	29637.84	6079.12	0.99
15	215.73	233.74	3.8	7.35	7.36	3	100.00	18.0	30767.44	29413.73	6177.41	0.99
16	223.08	246.08	6.2	7.32	7.36	3	100.00	18.0	32336.82	29119.15		

6241.13	0.99									
17	230.40	258.12	6.2	7.32	7.36	3	100.00	18.0	33855.18	28753.18
6294.96	0.99									
18	237.72	41.37	8.6	1.14	1.16	3	100.00	18.0	5420.76	4480.43
6309.29	0.99									
19	238.86	247.55	8.6	6.71	6.79	2	0.00	35.0	32429.22	26038.18
6276.31	0.97									
20	245.57	255.73	8.6	6.71	6.79	2	0.00	35.0	33501.08	25607.57
6293.47	0.97									
21	252.28	263.39	11.0	6.72	6.85	2	0.00	35.0	34504.15	25341.48
6265.31	0.97									
22	259.00	310.91	11.0	7.74	7.88	2	0.00	35.0	40728.71	28475.59
6242.85	0.97									
23	266.74	294.12	13.4	7.16	7.36	2	0.00	35.0	38529.83	25867.44
6171.76	0.97									
24	273.90	298.96	13.4	7.16	7.36	2	0.00	35.0	39163.99	25080.95
6108.70	0.97									
25	281.06	299.33	15.9	7.08	7.36	2	0.00	35.0	39211.62	24225.67
5997.17	0.97									
26	288.14	301.80	15.9	7.08	7.36	2	0.00	35.0	39536.35	23301.37
5894.05	0.97									
27	295.23	299.23	18.3	6.99	7.36	2	0.00	35.0	39199.63	22308.78
5742.23	0.97									
28	302.22	299.40	18.3	6.99	7.36	2	0.00	35.0	39221.07	21248.34
5599.69	0.97									
29	309.22	289.54	20.7	6.78	7.25	2	0.00	35.0	37930.29	19822.94
5409.96	0.98									
30	316.00	296.38	20.7	6.99	7.48	2	0.00	35.0	38826.37	19223.55
5295.20	0.98									
31	322.99	84.46	23.1	2.01	2.18	2	0.00	35.0	11064.48	5366.65
5225.56	0.98									
32	325.00	235.50	23.1	5.77	6.27	2	0.00	35.0	30850.04	14799.71
5058.90	0.98									
33	330.77	221.30	23.1	5.77	6.27	2	0.00	35.0	28989.81	13836.47
4752.78	0.98									
34	336.54	213.33	25.5	5.98	6.62	2	0.00	35.0	27946.20	13508.32
4395.51	0.99									
35	342.52	196.29	25.5	5.98	6.62	2	0.00	35.0	25713.38	12330.00
4042.73	0.99									
36	348.50	41.58	25.5	1.34	1.48	5	0.00	45.0	4574.30	2123.32
3132.19	0.95									
37	349.84	50.42	27.9	1.66	1.88	5	0.00	45.0	5546.33	1256.36
2914.07	0.95									
38	351.50	205.22	27.9	7.34	8.31	2	0.00	35.0	26884.19	1008.56
3249.10	1.00									
39	358.84	99.98	27.9	4.01	4.54	2	0.00	35.0	13097.46	0.00
2886.93	1.00									
40	362.85	73.60	30.3	3.21	3.72	2	0.00	35.0	9641.88	0.00
2623.63	1.01									
41	366.06	97.95	30.3	4.75	5.51	1	150.00	22.0	12831.62	0.00
2462.34	1.07									
42	370.81	84.74	30.3	4.75	5.51	1	150.00	22.0	11101.17	0.00
2126.42	1.07									
43	375.57	89.52	32.7	6.19	7.36	1	150.00	22.0	11726.94	0.00
1701.93	1.09									
44	381.76	64.85	32.7	6.19	7.36	1	150.00	22.0	8495.58	0.00
1224.33	1.09									
45	387.96	38.29	35.1	6.02	7.36	1	150.00	22.0	5015.73	0.00
722.53	1.11									
46	393.98	12.76	35.1	6.02	7.36	1	150.00	22.0	1671.90	0.00
218.15	1.11									
		---		---					---	
X-S Area:		7415.01	Path Length:		279.84		X-S Weight:		971309.69	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 3-2\West Farm Expansion Case 3-2 Rapid Drawdown.gmf
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DATA: Analysis 1 - Case 3-2 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	178.00	348.50	178.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	135.00	348.50	135.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	132.00	348.50	132.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	178.00	450.00	178.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	135.00	450.00	135.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	132.00	450.00	132.00	

Slope Surface (4 points)

100.00	135.00	130.00	135.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	135.00	130.00	135.00	316.00	197.00	348.50	197.00
351.50	174.00						
450.00	174.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	130.00	YL:	135.00	XR:	405.00	YR: 200.00
Centre:	XC:	220.06	YC:	368.22	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 3-2 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.364

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.47

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	135.00	136.67	400.00	200.00	192.56	481.90	350.00	1.473	<-- Critical Surface
2	135.00	136.67	400.53	200.00	192.99	481.83	350.00	1.540	
3	135.00	136.67	401.05	200.00	193.42	481.76	350.00	1.604	
4	134.47	136.49	400.00	200.00	192.27	481.69	350.00	1.646	
5	135.00	136.67	400.00	200.00	193.59	477.59	345.92	1.658	
6	135.00	136.67	401.58	200.00	193.84	481.68	350.00	1.668	
7	134.47	136.49	400.53	200.00	192.70	481.61	350.00	1.673	
8	135.00	136.67	400.53	200.00	194.02	477.51	345.92	1.683	
9	135.00	136.67	402.11	200.00	194.27	481.61	350.00	1.694	
10	134.47	136.49	401.05	200.00	193.12	481.54	350.00	1.700	
11	135.00	136.67	401.05	200.00	194.44	477.44	345.92	1.704	
12	133.95	136.32	400.00	200.00	191.98	481.47	350.00	1.711	
13	134.47	136.49	400.00	200.00	193.30	477.37	345.92	1.715	
14	135.00	136.67	402.63	200.00	194.70	481.54	350.00	1.716	
15	135.00	136.67	400.00	200.00	194.62	473.26	341.84	1.720	
16	134.47	136.49	401.58	200.00	193.55	481.47	350.00	1.723	
17	135.00	136.67	401.58	200.00	194.87	477.36	345.92	1.728	
18	133.95	136.32	400.53	200.00	192.41	481.40	350.00	1.734	
19	134.47	136.49	400.53	200.00	193.73	477.30	345.92	1.737	
20	135.00	136.67	403.16	200.00	195.12	481.46	350.00	1.739	
21	135.00	136.67	400.53	200.00	195.05	473.19	341.84	1.740	
22	134.47	136.49	402.11	200.00	193.98	481.40	350.00	1.747	
23	135.00	136.67	402.11	200.00	195.30	477.29	345.92	1.752	
24	133.95	136.32	401.05	200.00	192.83	481.33	350.00	1.753	
25	134.47	136.49	401.05	200.00	194.15	477.22	345.92	1.757	
26	135.00	136.67	403.68	200.00	195.55	481.39	350.00	1.762	
27	135.00	136.67	401.05	200.00	195.47	473.11	341.84	1.764	
28	133.42	136.14	400.00	200.00	191.69	481.26	350.00	1.765	
29	133.95	136.32	400.00	200.00	193.01	477.15	345.92	1.768	
30	134.47	136.49	402.63	200.00	194.41	481.32	350.00	1.770	
31	134.47	136.49	400.00	200.00	194.33	473.05	341.84	1.773	
32	135.00	136.67	402.63	200.00	195.72	477.21	345.92	1.775	
33	133.95	136.32	401.58	200.00	193.26	481.25	350.00	1.776	
34	135.00	136.67	400.00	200.00	195.66	468.93	337.76	1.780	
35	134.47	136.49	401.58	200.00	194.58	477.15	345.92	1.781	
36	135.00	136.67	404.21	200.00	195.97	481.31	350.00	1.785	
37	133.42	136.14	400.53	200.00	192.11	481.18	350.00	1.787	
38	135.00	136.67	401.58	200.00	195.90	473.03	341.84	1.788	
39	133.95	136.32	400.53	200.00	193.44	477.08	345.92	1.790	
40	134.47	136.49	403.16	200.00	194.83	481.25	350.00	1.792	
41	134.47	136.49	400.53	200.00	194.76	472.97	341.84	1.795	
42	135.00	136.67	403.16	200.00	196.15	477.14	345.92	1.798	
43	133.95	136.32	402.11	200.00	193.69	481.18	350.00	1.800	
44	135.00	136.67	400.53	200.00	196.08	468.85	337.76	1.800	
45	134.47	136.49	402.11	200.00	195.01	477.07	345.92	1.805	
46	133.42	136.14	401.05	200.00	192.54	481.11	350.00	1.806	
47	135.00	136.67	404.74	200.00	196.40	481.24	350.00	1.808	
48	133.95	136.32	401.05	200.00	193.86	477.01	345.92	1.809	
49	135.00	136.67	402.11	200.00	196.32	472.96	341.84	1.812	
50	134.47	136.49	403.68	200.00	195.26	481.17	350.00	1.814	
51	134.47	136.49	401.05	200.00	195.18	472.89	341.84	1.816	
52	132.89	135.96	400.00	200.00	191.40	481.04	350.00	1.818	
53	133.42	136.14	400.00	200.00	192.72	476.94	345.92	1.820	
54	135.00	136.67	403.68	200.00	196.57	477.06	345.92	1.821	
55	133.95	136.32	402.63	200.00	194.11	481.11	350.00	1.822	
56	135.00	136.67	401.05	200.00	196.51	468.77	337.76	1.824	
57	133.95	136.32	400.00	200.00	194.05	472.83	341.84	1.825	
58	134.47	136.49	402.63	200.00	195.43	477.00	345.92	1.827	
59	133.42	136.14	401.58	200.00	192.97	481.04	350.00	1.828	
60	135.00	136.67	405.26	200.00	196.82	481.16	350.00	1.830	
61	134.47	136.49	400.00	200.00	195.37	468.71	337.76	1.832	
62	133.95	136.32	401.58	200.00	194.29	476.93	345.92	1.832	
63	135.00	136.67	402.63	200.00	196.75	472.88	341.84	1.834	
64	134.47	136.49	404.21	200.00	195.68	481.10	350.00	1.837	
65	135.00	136.67	400.00	200.00	196.70	464.59	333.67	1.837	
66	132.89	135.96	400.53	200.00	191.82	480.97	350.00	1.839	
67	134.47	136.49	401.58	200.00	195.61	472.82	341.84	1.839	
68	133.42	136.14	400.53	200.00	193.15	476.86	345.92	1.842	

69	135.00	136.67	404.21	200.00	196.99	476.98	345.92	1.844
70	133.95	136.32	403.16	200.00	194.54	481.03	350.00	1.844
71	133.95	136.32	400.53	200.00	194.47	472.75	341.84	1.847
72	134.47	136.49	400.53	200.00	195.80	468.63	337.76	1.848
73	135.00	136.67	401.58	200.00	196.93	468.70	337.76	1.849
74	134.47	136.49	403.16	200.00	195.85	476.92	345.92	1.849
75	133.42	136.14	402.11	200.00	193.40	480.96	350.00	1.851
76	135.00	136.67	405.79	200.00	197.25	481.09	350.00	1.853
77	135.00	136.67	400.53	200.00	197.12	464.51	333.67	1.853
78	133.95	136.32	402.11	200.00	194.71	476.85	345.92	1.856
79	135.00	136.67	402.11	200.00	197.35	468.62	337.76	1.857
80	135.00	136.67	403.16	200.00	197.17	472.80	341.84	1.857
81	134.47	136.49	404.74	200.00	196.11	481.02	350.00	1.859
82	132.89	135.96	401.05	200.00	192.25	480.90	350.00	1.860
83	133.42	136.14	401.05	200.00	193.57	476.79	345.92	1.861
84	134.47	136.49	402.11	200.00	196.03	472.74	341.84	1.863
85	133.95	136.32	401.05	200.00	194.90	472.68	341.84	1.864
86	133.95	136.32	403.68	200.00	194.96	480.96	350.00	1.866
87	135.00	136.67	404.74	200.00	197.42	476.91	345.92	1.866
88	134.47	136.49	401.05	200.00	196.22	468.55	337.76	1.867
89	133.42	136.14	400.00	200.00	193.76	472.61	341.84	1.869
90	135.00	136.67	403.68	200.00	197.59	472.72	341.84	1.870
91	135.00	136.67	401.05	200.00	197.54	464.43	333.67	1.870
92	132.89	135.96	400.00	200.00	192.43	476.72	345.92	1.871
93	134.47	136.49	402.63	200.00	196.46	472.66	341.84	1.871
94	134.47	136.49	403.68	200.00	196.28	476.84	345.92	1.872
95	133.42	136.14	402.63	200.00	193.82	480.89	350.00	1.873
96	133.95	136.32	400.00	200.00	195.08	468.49	337.76	1.873
97	134.47	136.49	400.00	200.00	196.41	464.37	333.67	1.875
98	135.00	136.67	406.32	200.00	197.67	481.01	350.00	1.876
99	132.37	135.79	400.00	200.00	191.11	480.83	350.00	1.876

Critical Failure Surface (circle 1)

Intersects: XL: 135.00 YL: 136.67 XR: 400.00 YR: 200.00
Centre: XC: 192.56 YC: 481.90 Radius: R: 350.00
Generated failure surface: (20 points)
135.00 136.67 149.58 134.55 164.23 133.05 178.93 132.17
193.66 131.90
208.38 132.26 223.08 133.23 237.72 134.83 252.28 137.03
266.74 139.85
281.06 143.28 295.23 147.30 309.22 151.91 322.99 157.11
336.54 162.89
349.84 169.23 362.85 176.12 375.57 183.56 387.96 191.52
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 46 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	135.00	7.88	-8.3	5.74	5.80	2	0.00	35.0	1032.78	497.11	186.90	1.09
2	140.74	23.65	-8.3	5.74	5.80	2	0.00	35.0	3098.32	1491.31	560.70	1.09
3	146.48	19.29	-8.3	3.10	3.13	3	100.00	18.0	2534.55	1216.61	843.32	1.04
4	149.58	62.79	-5.8	7.33	7.36	3	100.00	18.0	8285.52	3938.42	1151.91	1.03
5	156.90	86.17	-5.8	7.33	7.36	3	100.00	18.0	11404.15	5405.38	1582.85	1.03
6	164.23	108.83	-3.4	7.35	7.36	3	100.00	18.0	14416.55	6803.34	1979.25	1.02
7	171.58	130.09	-3.4	7.35	7.36	3	100.00	18.0	17233.82	8132.24	2365.22	1.02
8	178.93	92.92	-1.0	4.66	4.66	3	100.00	18.0	12306.16	5799.05	2650.34	1.00
9	183.58	100.53	-1.0	4.66	4.66	3	100.00	18.0	13307.16	6274.09	2865.82	1.00
10	188.24	126.54	-1.0	5.42	5.42	4	2000.00	20.0	16741.32	7897.11	3122.91	1.00
11	193.66	100.06	1.4	4.01	4.01	4	2000.00	20.0	13230.05	6245.50	3254.08	0.99
12	197.67	141.30	1.4	5.36	5.36	3	100.00	18.0	18668.02	8819.94	3474.24	0.99
13	203.02	150.17	1.4	5.36	5.36	3	100.00	18.0	19822.74	9373.44	3689.25	0.99
14	208.38	219.32	3.8	7.35	7.36	3	100.00	18.0	28914.99	13715.94	3900.76	0.99
15	215.73	233.74	3.8	7.35	7.36	3	100.00	18.0	30767.44	14617.37	4151.00	0.99
16	223.08	246.08	6.2	7.32	7.36	3	100.00	18.0	32336.82	15446.05		

4355.41	0.98									
17	230.40	258.12	6.2	7.32	7.36	3	100.00	18.0	33855.18	16201.50
4560.36	0.98									
18	237.72	41.37	8.6	1.14	1.16	3	100.00	18.0	5420.76	2611.11
4650.53	0.98									
19	238.86	247.55	8.6	6.71	6.79	2	0.00	35.0	32429.22	15623.64
4663.31	0.94									
20	245.57	255.73	8.6	6.71	6.79	2	0.00	35.0	33501.08	16140.03
4817.45	0.94									
21	252.28	263.39	11.0	6.72	6.85	2	0.00	35.0	34504.15	16744.89
4905.99	0.93									
22	259.00	310.91	11.0	7.74	7.88	2	0.00	35.0	40728.71	19765.68
5031.23	0.93									
23	266.74	294.12	13.4	7.16	7.36	2	0.00	35.0	38529.83	18870.01
5092.03	0.92									
24	273.90	298.96	13.4	7.16	7.36	2	0.00	35.0	39163.99	19180.58
5175.81	0.92									
25	281.06	299.33	15.9	7.08	7.36	2	0.00	35.0	39211.62	19416.35
5190.36	0.92									
26	288.14	301.80	15.9	7.08	7.36	2	0.00	35.0	39536.35	19577.15
5233.32	0.92									
27	295.23	299.23	18.3	6.99	7.36	2	0.00	35.0	39199.63	19662.73
5207.28	0.91									
28	302.22	299.40	18.3	6.99	7.36	2	0.00	35.0	39221.07	19673.47
5210.10	0.91									
29	309.22	289.54	20.7	6.78	7.25	2	0.00	35.0	37930.29	19311.22
5145.03	0.91									
30	316.00	296.38	20.7	6.99	7.48	2	0.00	35.0	38826.37	19223.55
5097.39	0.91									
31	322.99	84.46	23.1	2.01	2.18	2	0.00	35.0	11064.48	5366.65
5003.27	0.90									
32	325.00	235.50	23.1	5.77	6.27	2	0.00	35.0	30850.04	14799.71
4841.70	0.90									
33	330.77	221.30	23.1	5.77	6.27	2	0.00	35.0	28989.81	13836.47
4547.85	0.90									
34	336.54	213.33	25.5	5.98	6.62	2	0.00	35.0	27946.20	13508.32
4187.63	0.90									
35	342.52	196.29	25.5	5.98	6.62	2	0.00	35.0	25713.38	12330.00
3850.28	0.90									
36	348.50	41.58	25.5	1.34	1.48	5	0.00	45.0	4574.30	2123.32
2933.75	0.84									
37	349.84	50.42	27.9	1.66	1.88	5	0.00	45.0	5546.33	1256.36
2630.44	0.83									
38	351.50	205.22	27.9	7.34	8.31	2	0.00	35.0	26884.19	1008.56
2948.74	0.90									
39	358.84	99.98	27.9	4.01	4.54	2	0.00	35.0	13097.46	0.00
2609.69	0.90									
40	362.85	73.60	30.3	3.21	3.72	2	0.00	35.0	9641.88	0.00
2351.15	0.91									
41	366.06	97.95	30.3	4.75	5.51	1	150.00	22.0	12831.62	0.00
2275.33	1.00									
42	370.81	84.74	30.3	4.75	5.51	1	150.00	22.0	11101.17	0.00
1961.57	1.00									
43	375.57	89.52	32.7	6.19	7.36	1	150.00	22.0	11726.94	0.00
1553.58	1.01									
44	381.76	64.85	32.7	6.19	7.36	1	150.00	22.0	8495.58	0.00
1110.16	1.01									
45	387.96	38.29	35.1	6.02	7.36	1	150.00	22.0	5015.73	0.00
638.02	1.02									
46	393.98	12.76	35.1	6.02	7.36	1	150.00	22.0	1671.90	0.00
172.61	1.02									

X-S Area: 7415.01 Path Length: 279.84 X-S Weight: 971309.69

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 3-3\West Farm Expansion Case 3-3 Full Reservoir.gmf
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DATA: Analysis 1 - Case 3-3 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	183.00	348.50	183.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	144.00	348.50	144.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	141.00	348.50	141.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	183.00	450.00	183.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	144.00	450.00	144.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	141.00	450.00	141.00	

Slope Surface (4 points)

100.00	144.00	157.00	144.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	157.00	197.00	316.00	197.00	348.50	197.00
351.50	182.00						
450.00	182.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	157.00	YL:	144.00	XR:	395.00	YR: 200.00
Centre:	XC:	226.05	YC:	384.27	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 3-3 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 4.449

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.62

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	155.68	144.00	390.00	200.00	200.51	474.65	333.67	2.623	<-- Critical Surface
2	158.32	144.44	390.00	200.00	204.54	462.53	321.43	2.623	
3	162.00	145.67	390.00	200.00	213.78	433.91	292.86	2.623	
4	159.89	144.96	390.00	200.00	208.50	450.30	309.18	2.623	
5	160.42	145.14	390.00	200.00	209.82	446.22	305.10	2.624	
6	161.47	145.49	390.00	200.00	212.46	438.02	296.94	2.624	
7	160.95	145.32	390.00	200.00	211.14	442.12	301.02	2.624	
8	157.79	144.26	390.00	200.00	203.22	466.59	325.51	2.624	
9	158.84	144.61	390.00	200.00	205.86	458.46	317.35	2.625	
10	154.11	144.00	390.00	200.00	199.24	478.73	337.76	2.625	
11	157.26	144.09	390.00	200.00	201.90	470.64	329.59	2.626	
12	156.21	144.00	390.00	200.00	200.60	474.71	333.67	2.626	
13	152.53	144.00	390.00	200.00	197.97	482.80	341.84	2.627	
14	157.79	144.26	390.53	200.00	203.66	466.53	325.51	2.628	
15	161.47	145.49	390.53	200.00	212.89	437.94	296.94	2.628	
16	159.37	144.79	390.53	200.00	207.61	454.32	313.27	2.628	
17	159.89	144.96	390.53	200.00	208.93	450.24	309.18	2.628	
18	160.42	145.14	390.53	200.00	210.25	446.15	305.10	2.628	
19	160.95	145.32	390.53	200.00	211.57	442.05	301.02	2.628	
20	154.63	144.00	390.00	200.00	199.32	478.79	337.76	2.629	
21	159.37	144.79	390.00	200.00	207.18	454.38	313.27	2.629	
22	157.26	144.09	390.53	200.00	202.34	470.58	329.59	2.630	
23	158.32	144.44	390.53	200.00	204.97	462.46	321.43	2.630	
24	156.74	144.00	390.00	200.00	200.68	474.77	333.67	2.630	
25	156.21	144.00	390.53	200.00	201.04	474.65	333.67	2.630	
26	153.05	144.00	390.00	200.00	198.06	482.86	341.84	2.631	
27	155.16	144.00	390.00	200.00	199.41	478.84	337.76	2.632	
28	154.63	144.00	390.53	200.00	199.76	478.73	337.76	2.633	
29	158.32	144.44	391.05	200.00	205.41	462.40	321.43	2.633	
30	158.84	144.61	391.05	200.00	206.73	458.33	317.35	2.633	
31	159.37	144.79	391.05	200.00	208.04	454.25	313.27	2.633	
32	158.84	144.61	390.53	200.00	206.29	458.39	317.35	2.634	
33	156.74	144.00	390.53	200.00	201.12	474.71	333.67	2.634	
34	153.58	144.00	390.00	200.00	198.14	482.92	341.84	2.635	
35	153.05	144.00	390.53	200.00	198.50	482.80	341.84	2.635	
36	160.42	145.14	390.00	200.00	208.79	450.52	309.18	2.636	
37	155.68	144.00	390.00	200.00	199.49	478.90	337.76	2.636	
38	155.16	144.00	390.53	200.00	199.85	478.79	337.76	2.636	
39	159.89	144.96	390.00	200.00	207.47	454.60	313.27	2.637	
40	152.00	144.00	390.00	200.00	196.88	486.99	345.92	2.637	
41	161.47	145.49	390.00	200.00	211.43	442.34	301.02	2.637	
42	159.37	144.79	390.00	200.00	206.15	458.67	317.35	2.637	
43	162.00	145.67	390.00	200.00	212.75	438.24	296.94	2.637	
44	158.84	144.61	390.00	200.00	204.83	462.74	321.43	2.638	
45	158.32	144.44	390.00	200.00	203.51	466.80	325.51	2.638	
46	157.79	144.26	390.00	200.00	202.19	470.85	329.59	2.638	
47	154.11	144.00	390.00	200.00	198.23	482.98	341.84	2.638	
48	156.74	144.00	391.05	200.00	201.56	474.65	333.67	2.638	
49	153.58	144.00	390.53	200.00	198.58	482.86	341.84	2.639	
50	157.26	144.09	390.00	200.00	200.87	474.90	333.67	2.639	
51	156.21	144.00	390.00	200.00	199.58	478.96	337.76	2.639	
52	155.68	144.00	390.53	200.00	199.94	478.84	337.76	2.640	
53	155.16	144.00	391.05	200.00	200.29	478.73	337.76	2.640	
54	159.89	144.96	390.53	200.00	207.91	454.53	313.27	2.640	
55	152.53	144.00	390.00	200.00	196.97	487.05	345.92	2.640	
56	159.37	144.79	390.53	200.00	206.59	458.60	317.35	2.641	
57	152.00	144.00	390.53	200.00	197.32	486.94	345.92	2.641	
58	160.95	145.32	390.00	200.00	210.11	446.43	305.10	2.641	
59	160.95	145.32	390.53	200.00	210.54	446.36	305.10	2.641	
60	158.84	144.61	390.53	200.00	205.27	462.67	321.43	2.641	
61	154.63	144.00	390.00	200.00	198.31	483.03	341.84	2.642	
62	161.47	145.49	390.53	200.00	211.86	442.26	301.02	2.642	
63	158.32	144.44	390.53	200.00	203.95	466.73	325.51	2.642	
64	162.00	145.67	390.53	200.00	213.18	438.16	296.94	2.642	
65	157.79	144.26	390.53	200.00	202.63	470.79	329.59	2.642	
66	154.11	144.00	390.53	200.00	198.67	482.92	341.84	2.642	
67	153.58	144.00	391.05	200.00	199.02	482.80	341.84	2.642	
68	156.74	144.00	390.00	200.00	199.66	479.02	337.76	2.643	

69	157.26	144.09	390.53	200.00	201.32	474.84	333.67	2.643
70	153.05	144.00	390.00	200.00	197.05	487.11	345.92	2.644
71	156.21	144.00	390.53	200.00	200.02	478.90	337.76	2.644
72	155.68	144.00	391.05	200.00	200.38	478.79	337.76	2.644
73	152.53	144.00	390.53	200.00	197.41	486.99	345.92	2.644
74	152.00	144.00	391.05	200.00	197.76	486.88	345.92	2.645
75	158.84	144.61	391.05	200.00	205.71	462.61	321.43	2.645
76	155.16	144.00	390.00	200.00	198.40	483.09	341.84	2.645
77	159.37	144.79	391.05	200.00	207.02	458.54	317.35	2.645
78	160.42	145.14	390.53	200.00	209.22	450.45	309.18	2.645
79	158.32	144.44	391.05	200.00	204.39	466.67	325.51	2.646
80	160.42	145.14	391.05	200.00	209.66	450.38	309.18	2.646
81	154.63	144.00	390.53	200.00	198.75	482.98	341.84	2.646
82	160.95	145.32	391.05	200.00	210.97	446.29	305.10	2.646
83	157.79	144.26	391.05	200.00	203.07	470.73	329.59	2.646
84	154.11	144.00	391.05	200.00	199.11	482.86	341.84	2.646
85	153.58	144.00	390.00	200.00	197.14	487.16	345.92	2.647
86	156.74	144.00	390.53	200.00	200.11	478.96	337.76	2.647
87	157.26	144.09	391.05	200.00	201.76	474.78	333.67	2.648
88	156.21	144.00	391.05	200.00	200.46	478.84	337.76	2.648
89	153.05	144.00	390.53	200.00	197.50	487.05	345.92	2.648
90	155.68	144.00	391.58	200.00	200.82	478.73	337.76	2.648
91	155.68	144.00	390.00	200.00	198.48	483.15	341.84	2.648
92	152.53	144.00	391.05	200.00	197.85	486.94	345.92	2.649
93	158.32	144.44	391.58	200.00	204.83	466.61	325.51	2.649
94	155.16	144.00	390.53	200.00	198.84	483.03	341.84	2.649
95	152.00	144.00	390.00	200.00	195.89	491.24	350.00	2.649
96	159.89	144.96	391.58	200.00	208.77	454.39	313.27	2.650
97	157.79	144.26	391.58	200.00	203.51	470.67	329.59	2.650
98	159.89	144.96	391.05	200.00	208.34	454.46	313.27	2.650
99	154.63	144.00	391.05	200.00	199.20	482.92	341.84	2.650

Critical Failure Surface (circle 1)

Intersects: XL: 155.68 YL: 144.00 XR: 390.00 YR: 200.00
Centre: XC: 200.51 YC: 474.65 Radius: R: 333.67
Generated failure surface: (20 points)
155.68 144.00 168.57 142.51 181.50 141.52 194.47 141.03
207.44 141.05
220.40 141.57 233.33 142.59 246.21 144.12 259.03 146.15
271.75 148.67
284.37 151.68 296.86 155.19 309.20 159.17 321.38 163.64
333.38 168.57
345.17 173.97 356.75 179.82 368.09 186.11 379.18 192.84
390.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 44 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	155.68	0.10	-6.6	1.32	1.32	3	100.00	18.0	14.14	4386.99	3322.51	1.02
2	157.00	8.40	-6.6	5.79	5.82	3	100.00	18.0	1128.28	19437.30	3448.07	1.02
3	162.79	23.43	-6.6	5.79	5.82	3	100.00	18.0	3136.19	19680.74	3677.52	1.02
4	168.57	43.16	-4.4	6.47	6.49	3	100.00	18.0	5767.14	22154.59	3898.56	1.01
5	175.04	60.31	-4.4	6.47	6.49	3	100.00	18.0	8044.98	22355.03	4118.06	1.01
6	181.50	76.82	-2.2	6.48	6.49	3	100.00	18.0	10232.61	22504.25	4314.27	1.01
7	187.99	92.40	-2.2	6.48	6.49	3	100.00	18.0	12289.45	22602.80	4497.59	1.01
8	194.47	107.25	0.1	6.49	6.49	3	100.00	18.0	14241.96	22650.60	4656.02	1.00
9	200.95	121.22	0.1	6.49	6.49	3	100.00	18.0	16071.06	22647.12	4803.10	1.00
10	207.44	134.25	2.3	6.48	6.49	3	100.00	18.0	17769.79	22592.64	4923.92	1.00
11	213.92	146.56	2.3	6.48	6.49	3	100.00	18.0	19365.60	22487.19	5034.72	1.00
12	220.40	157.67	4.5	6.47	6.49	3	100.00	18.0	20795.87	22330.70	5118.12	0.99
13	226.87	168.30	4.5	6.47	6.49	3	100.00	18.0	22154.29	22123.38	5192.68	0.99
14	233.33	163.15	6.8	5.94	5.98	3	100.00	18.0	21435.21	20160.04	5237.38	0.99
15	239.27	170.72	6.8	5.94	5.98	3	100.00	18.0	22384.83	19897.71	5272.75	0.99
16	245.20	29.83	6.8	1.01	1.02	2	0.00	35.0	3908.24	3363.18		

5265.71	0.98									
17	246.21	193.34	9.0	6.41	6.49	2	0.00	35.0	25327.14	21196.84
5254.53	0.97									
18	252.62	200.53	9.0	6.41	6.49	2	0.00	35.0	26269.06	20786.81
5265.19	0.97									
19	259.03	205.45	11.2	6.36	6.49	2	0.00	35.0	26913.59	20326.56
5237.83	0.97									
20	265.39	210.91	11.2	6.36	6.49	2	0.00	35.0	27629.84	19816.07
5215.11	0.97									
21	271.75	75.80	13.4	2.25	2.31	2	0.00	35.0	9930.33	6938.68
5171.45	0.97									
22	274.00	176.43	13.4	5.18	5.33	2	0.00	35.0	23111.70	15687.24
5138.63	0.97									
23	279.18	178.96	13.4	5.18	5.33	2	0.00	35.0	23443.71	15275.31
5092.86	0.97									
24	284.37	218.18	15.7	6.24	6.49	2	0.00	35.0	28581.12	17986.04
5002.74	0.97									
25	290.61	220.24	15.7	6.24	6.49	2	0.00	35.0	28851.05	17277.09
4914.49	0.97									
26	296.86	218.89	17.9	6.17	6.49	2	0.00	35.0	28674.02	16519.26
4786.64	0.97									
27	303.03	219.28	17.9	6.17	6.49	2	0.00	35.0	28725.84	15712.53
4666.32	0.97									
28	309.20	241.03	20.1	6.80	7.24	2	0.00	35.0	31574.74	16530.18
4497.64	0.97									
29	316.00	189.63	20.1	5.38	5.73	2	0.00	35.0	24841.66	12281.74
4396.77	0.97									
30	321.38	126.75	22.4	3.62	3.91	2	0.00	35.0	16604.32	7966.40
4334.69	0.97									
31	325.00	142.48	22.4	4.19	4.53	2	0.00	35.0	18664.39	8764.90
4206.50	0.97									
32	329.19	135.26	22.4	4.19	4.53	2	0.00	35.0	17719.31	8278.15
3992.57	0.97									
33	333.38	177.43	24.6	5.90	6.49	2	0.00	35.0	23243.21	10960.59
3695.74	0.98									
34	339.28	161.52	24.6	5.90	6.49	2	0.00	35.0	21158.67	9868.70
3362.46	0.98									
35	345.17	83.80	26.8	3.33	3.73	2	0.00	35.0	10977.40	5160.93
3072.79	0.99									
36	348.50	70.79	26.8	3.00	3.36	5	0.00	45.0	7786.81	2746.84
2308.32	0.94									
37	351.50	112.98	26.8	5.25	5.88	2	0.00	35.0	14799.79	1289.38
2509.10	0.99									
38	356.75	75.15	29.0	3.94	4.50	2	0.00	35.0	9844.29	306.86
2187.08	1.00									
39	360.69	31.53	29.0	1.80	2.06	2	0.00	35.0	4130.04	0.00
1996.60	1.00									
40	362.49	86.55	29.0	5.60	6.41	1	150.00	22.0	11338.40	0.00
1834.61	1.05									
41	368.09	67.67	31.3	5.54	6.49	1	150.00	22.0	8865.35	0.00
1430.51	1.07									
42	373.64	49.01	31.3	5.54	6.49	1	150.00	22.0	6420.71	0.00
1027.30	1.07									
43	379.18	29.04	33.5	5.41	6.49	1	150.00	22.0	3803.81	0.00
603.84	1.09									
44	384.59	9.68	33.5	5.41	6.49	1	150.00	22.0	1267.93	0.00
178.38	1.09									
		---		---					---	
X-S Area:		5411.85	Path Length:		246.47		X-S Weight:		709237.94	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 3-3\West Farm Expansion Case 3-3 Rapid Drawdown.gmf
Processed: 04 Dec 2020 12:34:30

DATA: Analysis 1 - Case 3-3 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	183.00	348.50	183.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	144.00	348.50	144.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	141.00	348.50	141.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	183.00	450.00	183.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	144.00	450.00	144.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	141.00	450.00	141.00	

Slope Surface (4 points)

100.00	144.00	157.00	144.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	144.00	157.00	144.00	316.00	197.00	348.50	197.00
351.50	182.00						
450.00	182.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	157.00	YL:	144.00	XR:	395.00	YR: 200.00
Centre:	XC:	226.05	YC:	384.27	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 3-3 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.417

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.37

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	155.68	144.00	390.00	200.00	200.51	474.65	333.67	1.373	<-- Critical Surface
2	158.32	144.44	390.00	200.00	204.54	462.53	321.43	1.373	
3	162.00	145.67	390.00	200.00	213.78	433.91	292.86	1.373	
4	159.89	144.96	390.00	200.00	208.50	450.30	309.18	1.374	
5	161.47	145.49	390.00	200.00	212.46	438.02	296.94	1.374	
6	160.42	145.14	390.00	200.00	209.82	446.22	305.10	1.374	
7	160.95	145.32	390.00	200.00	211.14	442.12	301.02	1.374	
8	157.79	144.26	390.00	200.00	203.22	466.59	325.51	1.374	
9	158.84	144.61	390.00	200.00	205.86	458.46	317.35	1.374	
10	154.11	144.00	390.00	200.00	199.24	478.73	337.76	1.374	
11	157.26	144.09	390.00	200.00	201.90	470.64	329.59	1.375	
12	156.21	144.00	390.00	200.00	200.60	474.71	333.67	1.375	
13	152.53	144.00	390.00	200.00	197.97	482.80	341.84	1.376	
14	157.79	144.26	390.53	200.00	203.66	466.53	325.51	1.376	
15	161.47	145.49	390.53	200.00	212.89	437.94	296.94	1.376	
16	159.37	144.79	390.53	200.00	207.61	454.32	313.27	1.376	
17	159.89	144.96	390.53	200.00	208.93	450.24	309.18	1.376	
18	160.95	145.32	390.53	200.00	211.57	442.05	301.02	1.376	
19	160.42	145.14	390.53	200.00	210.25	446.15	305.10	1.376	
20	159.37	144.79	390.00	200.00	207.18	454.38	313.27	1.377	
21	154.63	144.00	390.00	200.00	199.32	478.79	337.76	1.377	
22	157.26	144.09	390.53	200.00	202.34	470.58	329.59	1.377	
23	158.32	144.44	390.53	200.00	204.97	462.46	321.43	1.377	
24	156.74	144.00	390.00	200.00	200.68	474.77	333.67	1.378	
25	156.21	144.00	390.53	200.00	201.04	474.65	333.67	1.378	
26	153.05	144.00	390.00	200.00	198.06	482.86	341.84	1.378	
27	155.16	144.00	390.00	200.00	199.41	478.84	337.76	1.379	
28	158.32	144.44	391.05	200.00	205.41	462.40	321.43	1.379	
29	158.84	144.61	391.05	200.00	206.73	458.33	317.35	1.379	
30	154.63	144.00	390.53	200.00	199.76	478.73	337.76	1.379	
31	159.37	144.79	391.05	200.00	208.04	454.25	313.27	1.379	
32	158.84	144.61	390.53	200.00	206.29	458.39	317.35	1.380	
33	156.74	144.00	390.53	200.00	201.12	474.71	333.67	1.380	
34	153.58	144.00	390.00	200.00	198.14	482.92	341.84	1.380	
35	153.05	144.00	390.53	200.00	198.50	482.80	341.84	1.380	
36	160.42	145.14	390.00	200.00	208.79	450.52	309.18	1.381	
37	155.68	144.00	390.00	200.00	199.49	478.90	337.76	1.381	
38	155.16	144.00	390.53	200.00	199.85	478.79	337.76	1.381	
39	159.89	144.96	390.00	200.00	207.47	454.60	313.27	1.381	
40	161.47	145.49	390.00	200.00	211.43	442.34	301.02	1.382	
41	152.00	144.00	390.00	200.00	196.88	486.99	345.92	1.382	
42	159.37	144.79	390.00	200.00	206.15	458.67	317.35	1.382	
43	162.00	145.67	390.00	200.00	212.75	438.24	296.94	1.382	
44	158.84	144.61	390.00	200.00	204.83	462.74	321.43	1.382	
45	158.32	144.44	390.00	200.00	203.51	466.80	325.51	1.382	
46	157.79	144.26	390.00	200.00	202.19	470.85	329.59	1.382	
47	154.11	144.00	390.00	200.00	198.23	482.98	341.84	1.382	
48	156.74	144.00	391.05	200.00	201.56	474.65	333.67	1.382	
49	153.58	144.00	390.53	200.00	198.58	482.86	341.84	1.383	
50	157.26	144.09	390.00	200.00	200.87	474.90	333.67	1.383	
51	156.21	144.00	390.00	200.00	199.58	478.96	337.76	1.383	
52	155.68	144.00	390.53	200.00	199.94	478.84	337.76	1.384	
53	159.89	144.96	390.53	200.00	207.91	454.53	313.27	1.384	
54	155.16	144.00	391.05	200.00	200.29	478.73	337.76	1.384	
55	152.53	144.00	390.00	200.00	196.97	487.05	345.92	1.384	
56	159.37	144.79	390.53	200.00	206.59	458.60	317.35	1.384	
57	160.95	145.32	390.00	200.00	210.11	446.43	305.10	1.384	
58	152.00	144.00	390.53	200.00	197.32	486.94	345.92	1.384	
59	160.95	145.32	390.53	200.00	210.54	446.36	305.10	1.384	
60	158.84	144.61	390.53	200.00	205.27	462.67	321.43	1.384	
61	161.47	145.49	390.53	200.00	211.86	442.26	301.02	1.384	
62	158.32	144.44	390.53	200.00	203.95	466.73	325.51	1.384	
63	154.63	144.00	390.00	200.00	198.31	483.03	341.84	1.385	
64	162.00	145.67	390.53	200.00	213.18	438.16	296.94	1.385	
65	157.79	144.26	390.53	200.00	202.63	470.79	329.59	1.385	
66	154.11	144.00	390.53	200.00	198.67	482.92	341.84	1.385	
67	153.58	144.00	391.05	200.00	199.02	482.80	341.84	1.385	
68	156.74	144.00	390.00	200.00	199.66	479.02	337.76	1.385	

69	157.26	144.09	390.53	200.00	201.32	474.84	333.67	1.386
70	156.21	144.00	390.53	200.00	200.02	478.90	337.76	1.386
71	153.05	144.00	390.00	200.00	197.05	487.11	345.92	1.386
72	155.68	144.00	391.05	200.00	200.38	478.79	337.76	1.386
73	152.53	144.00	390.53	200.00	197.41	486.99	345.92	1.386
74	158.84	144.61	391.05	200.00	205.71	462.61	321.43	1.386
75	152.00	144.00	391.05	200.00	197.76	486.88	345.92	1.386
76	160.42	145.14	390.53	200.00	209.22	450.45	309.18	1.386
77	159.37	144.79	391.05	200.00	207.02	458.54	317.35	1.387
78	155.16	144.00	390.00	200.00	198.40	483.09	341.84	1.387
79	160.42	145.14	391.05	200.00	209.66	450.38	309.18	1.387
80	158.32	144.44	391.05	200.00	204.39	466.67	325.51	1.387
81	160.95	145.32	391.05	200.00	210.97	446.29	305.10	1.387
82	154.63	144.00	390.53	200.00	198.75	482.98	341.84	1.387
83	157.79	144.26	391.05	200.00	203.07	470.73	329.59	1.387
84	154.11	144.00	391.05	200.00	199.11	482.86	341.84	1.387
85	153.58	144.00	390.00	200.00	197.14	487.16	345.92	1.388
86	156.74	144.00	390.53	200.00	200.11	478.96	337.76	1.388
87	157.26	144.09	391.05	200.00	201.76	474.78	333.67	1.388
88	162.00	145.67	391.05	200.00	213.61	438.09	296.94	1.388
89	161.47	145.49	391.05	200.00	212.29	442.19	301.02	1.388
90	156.21	144.00	391.05	200.00	200.46	478.84	337.76	1.388
91	155.68	144.00	391.58	200.00	200.82	478.73	337.76	1.388
92	153.05	144.00	390.53	200.00	197.50	487.05	345.92	1.388
93	155.68	144.00	390.00	200.00	198.48	483.15	341.84	1.389
94	152.53	144.00	391.05	200.00	197.85	486.94	345.92	1.389
95	158.32	144.44	391.58	200.00	204.83	466.61	325.51	1.389
96	155.16	144.00	390.53	200.00	198.84	483.03	341.84	1.389
97	159.89	144.96	391.05	200.00	208.34	454.46	313.27	1.389
98	159.89	144.96	391.58	200.00	208.77	454.39	313.27	1.389
99	152.00	144.00	390.00	200.00	195.89	491.24	350.00	1.389

Critical Failure Surface (circle 1)

Intersects: XL: 155.68 YL: 144.00 XR: 390.00 YR: 200.00
Centre: XC: 200.51 YC: 474.65 Radius: R: 333.67

Generated failure surface: (20 points)

155.68 144.00 168.57 142.51 181.50 141.52 194.47 141.03
207.44 141.05
220.40 141.57 233.33 142.59 246.21 144.12 259.03 146.15
271.75 148.67
284.37 151.68 296.86 155.19 309.20 159.17 321.38 163.64
333.38 168.57
345.17 173.97 356.75 179.82 368.09 186.11 379.18 192.84
390.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 44 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	155.68	0.10	-6.6	1.32	1.32	3	100.00	18.0	14.14	6.30	19.59	1.04
2	157.00	8.40	-6.6	5.79	5.82	3	100.00	18.0	1128.28	527.51	206.65	1.04
3	162.79	23.43	-6.6	5.79	5.82	3	100.00	18.0	3136.19	1471.76	558.95	1.04
4	168.57	43.16	-4.4	6.47	6.49	3	100.00	18.0	5767.14	2701.38	906.23	1.02
5	175.04	60.31	-4.4	6.47	6.49	3	100.00	18.0	8044.98	3774.27	1261.90	1.02
6	181.50	76.82	-2.2	6.48	6.49	3	100.00	18.0	10232.61	4797.13	1589.08	1.01
7	187.99	92.40	-2.2	6.48	6.49	3	100.00	18.0	12289.45	5770.04	1907.93	1.01
8	194.47	107.25	0.1	6.49	6.49	3	100.00	18.0	14241.96	6692.33	2195.36	1.00
9	200.95	121.22	0.1	6.49	6.49	3	100.00	18.0	16071.06	7563.87	2477.33	1.00
10	207.44	134.25	2.3	6.48	6.49	3	100.00	18.0	17769.79	8384.03	2725.39	0.99
11	213.92	146.56	2.3	6.48	6.49	3	100.00	18.0	19365.60	9152.84	2970.42	0.99
12	220.40	157.67	4.5	6.47	6.49	3	100.00	18.0	20795.87	9869.67	3179.50	0.98
13	226.87	168.30	4.5	6.47	6.49	3	100.00	18.0	22154.29	10534.59	3387.60	0.98
14	233.33	163.15	6.8	5.94	5.98	3	100.00	18.0	21435.21	10251.77	3551.36	0.98
15	239.27	170.72	6.8	5.94	5.98	3	100.00	18.0	22384.83	10727.30	3709.17	0.98
16	245.20	29.83	6.8	1.01	1.02	2	0.00	35.0	3908.24	1874.66		

3750.34	0.95									
17	246.21	193.34	9.0	6.41	6.49	2	0.00	35.0	25327.14	12214.14
3798.96	0.94									
18	252.62	200.53	9.0	6.41	6.49	2	0.00	35.0	26269.06	12668.39
3940.24	0.94									
19	259.03	205.45	11.2	6.36	6.49	2	0.00	35.0	26913.59	13069.42
4026.89	0.93									
20	265.39	210.91	11.2	6.36	6.49	2	0.00	35.0	27629.84	13417.23
4134.06	0.93									
21	271.75	75.80	13.4	2.25	2.31	2	0.00	35.0	9930.33	4863.39
4162.01	0.92									
22	274.00	176.43	13.4	5.18	5.33	2	0.00	35.0	23111.70	11318.97
4205.33	0.92									
23	279.18	178.96	13.4	5.18	5.33	2	0.00	35.0	23443.71	11481.58
4265.74	0.92									
24	284.37	218.18	15.7	6.24	6.49	2	0.00	35.0	28581.12	14139.65
4276.77	0.91									
25	290.61	220.24	15.7	6.24	6.49	2	0.00	35.0	28851.05	14273.19
4317.16	0.91									
26	296.86	218.89	17.9	6.17	6.49	2	0.00	35.0	28674.02	14352.95
4301.76	0.90									
27	303.03	219.28	17.9	6.17	6.49	2	0.00	35.0	28725.84	14378.89
4309.55	0.90									
28	309.20	241.03	20.1	6.80	7.24	2	0.00	35.0	31574.74	16018.08
4260.78	0.90									
29	316.00	189.63	20.1	5.38	5.73	2	0.00	35.0	24841.66	12281.74
4227.75	0.90									
30	321.38	126.75	22.4	3.62	3.91	2	0.00	35.0	16604.32	7966.40
4144.81	0.89									
31	325.00	142.48	22.4	4.19	4.53	2	0.00	35.0	18664.39	8764.90
4018.94	0.89									
32	329.19	135.26	22.4	4.19	4.53	2	0.00	35.0	17719.31	8278.15
3813.79	0.89									
33	333.38	177.43	24.6	5.90	6.49	2	0.00	35.0	23243.21	10960.59
3514.99	0.89									
34	339.28	161.52	24.6	5.90	6.49	2	0.00	35.0	21158.67	9868.70
3196.58	0.89									
35	345.17	83.80	26.8	3.33	3.73	2	0.00	35.0	10977.40	5160.93
2908.04	0.89									
36	348.50	70.79	26.8	3.00	3.36	5	0.00	45.0	7786.81	2746.84
2117.22	0.82									
37	351.50	112.98	26.8	5.25	5.88	2	0.00	35.0	14799.79	1289.38
2285.57	0.89									
38	356.75	75.15	29.0	3.94	4.50	2	0.00	35.0	9844.29	306.86
1964.36	0.89									
39	360.69	31.53	29.0	1.80	2.06	2	0.00	35.0	4130.04	0.00
1786.74	0.89									
40	362.49	86.55	29.0	5.60	6.41	1	150.00	22.0	11338.40	0.00
1687.06	0.98									
41	368.09	67.67	31.3	5.54	6.49	1	150.00	22.0	8865.35	0.00
1300.41	0.99									
42	373.64	49.01	31.3	5.54	6.49	1	150.00	22.0	6420.71	0.00
926.31	0.99									
43	379.18	29.04	33.5	5.41	6.49	1	150.00	22.0	3803.81	0.00
528.13	1.00									
44	384.59	9.68	33.5	5.41	6.49	1	150.00	22.0	1267.93	0.00
135.71	1.00									
		---		---					---	
X-S Area:		5411.85	Path Length:		246.47		X-S Weight:		709237.94	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 4-1\West Farm Expansion Case 4-1 Full Reservoir.gmf
Processed: 04 Dec 2020 12:42:11

DATA: Analysis 1 - Case 4-1 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	190.00	348.50	190.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	157.00	348.50	157.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	154.00	348.50	154.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	190.00	450.00	190.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	157.00	450.00	157.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	154.00	450.00	154.00	

Slope Surface (4 points)

100.00	157.00	196.00	157.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	196.00	197.00	316.00	197.00	348.50	197.00
351.50	178.00						
450.00	178.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	196.00	YL:	157.00	XR:	405.00	YR: 200.00
Centre:	XC:	254.94	YC:	399.95	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 4-1 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 5.414

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 3.15

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	198.89	157.96	400.00	200.00	246.02	434.59	280.61	3.152	<-- Critical Surface
2	199.95	158.32	400.00	200.00	248.45	426.41	272.45	3.162	
3	194.68	157.00	400.00	200.00	237.72	463.17	309.18	3.162	
4	199.42	158.14	400.00	200.00	247.24	430.51	276.53	3.163	
5	198.37	157.79	400.00	200.00	243.91	442.95	288.78	3.167	
6	195.21	157.00	400.00	200.00	237.82	463.23	309.18	3.168	
7	193.63	157.00	400.00	200.00	236.64	467.30	313.27	3.168	
8	192.05	157.00	400.00	200.00	235.47	471.36	317.35	3.169	
9	196.26	157.09	400.00	200.00	239.02	459.18	305.10	3.170	
10	197.32	157.44	400.53	200.00	241.89	451.01	296.94	3.170	
11	196.79	157.26	400.00	200.00	240.24	455.13	301.02	3.170	
12	198.89	157.96	400.00	200.00	245.12	438.88	284.69	3.171	
13	197.32	157.44	400.00	200.00	241.47	451.08	296.94	3.173	
14	195.74	157.00	400.00	200.00	237.92	463.29	309.18	3.173	
15	194.16	157.00	400.00	200.00	236.74	467.36	313.27	3.173	
16	192.58	157.00	400.00	200.00	235.56	471.42	317.35	3.174	
17	197.84	157.61	400.53	200.00	243.11	446.95	292.86	3.174	
18	195.21	157.00	400.53	200.00	238.25	463.17	309.18	3.175	
19	191.00	157.00	400.00	200.00	234.40	475.49	321.43	3.175	
20	197.84	157.61	400.00	200.00	242.69	447.02	292.86	3.175	
21	199.42	158.14	400.00	200.00	246.34	434.80	280.61	3.176	
22	195.74	157.00	401.05	200.00	238.77	463.17	309.18	3.176	
23	196.26	157.09	400.53	200.00	239.45	459.12	305.10	3.177	
24	196.79	157.26	400.53	200.00	240.67	455.07	301.02	3.177	
25	194.68	157.00	400.00	200.00	236.83	467.42	313.27	3.178	
26	193.11	157.00	400.00	200.00	235.66	471.48	317.35	3.178	
27	198.37	157.79	400.53	200.00	244.33	442.88	288.78	3.179	
28	191.53	157.00	400.00	200.00	234.49	475.54	321.43	3.179	
29	199.95	158.32	400.00	200.00	247.56	430.72	276.53	3.180	
30	195.74	157.00	400.53	200.00	238.35	463.23	309.18	3.180	
31	194.16	157.00	400.53	200.00	237.17	467.30	313.27	3.180	
32	192.58	157.00	400.53	200.00	235.99	471.36	317.35	3.181	
33	191.00	157.00	400.53	200.00	234.83	475.43	321.43	3.182	
34	197.32	157.44	401.05	200.00	242.31	450.95	296.94	3.182	
35	195.21	157.00	400.00	200.00	236.93	467.48	313.27	3.183	
36	198.89	157.96	400.53	200.00	245.54	438.81	284.69	3.183	
37	200.47	158.49	400.00	200.00	248.77	426.62	272.45	3.183	
38	193.63	157.00	400.00	200.00	235.76	471.54	317.35	3.183	
39	192.05	157.00	400.00	200.00	234.59	475.60	321.43	3.184	
40	198.37	157.79	400.00	200.00	243.01	447.22	292.86	3.185	
41	196.26	157.09	400.00	200.00	238.13	463.42	309.18	3.185	
42	194.68	157.00	400.53	200.00	237.26	467.36	313.27	3.185	
43	193.11	157.00	400.53	200.00	236.09	471.42	317.35	3.186	
44	197.84	157.61	401.05	200.00	243.53	446.89	292.86	3.186	
45	191.53	157.00	400.53	200.00	234.92	475.49	321.43	3.186	
46	199.42	158.14	400.53	200.00	246.76	434.73	280.61	3.186	
47	196.79	157.26	400.00	200.00	239.35	459.38	305.10	3.186	
48	197.32	157.44	400.53	200.00	241.00	455.27	301.02	3.187	
49	195.74	157.00	400.00	200.00	237.02	467.53	313.27	3.188	
50	199.95	158.32	400.53	200.00	247.97	430.64	276.53	3.188	
51	194.16	157.00	400.00	200.00	235.85	471.60	317.35	3.188	
52	192.58	157.00	400.00	200.00	234.69	475.66	321.43	3.189	
53	198.37	157.79	401.05	200.00	244.75	442.82	288.78	3.189	
54	197.32	157.44	400.00	200.00	240.57	455.33	301.02	3.189	
55	198.89	157.96	400.00	200.00	244.23	443.16	288.78	3.190	
56	191.00	157.00	400.00	200.00	233.53	479.72	325.51	3.190	
57	195.21	157.00	400.53	200.00	237.36	467.42	313.27	3.190	
58	196.26	157.09	401.05	200.00	238.99	463.31	309.18	3.190	
59	193.63	157.00	400.53	200.00	236.19	471.48	317.35	3.191	
60	198.89	157.96	401.05	200.00	245.96	438.74	284.69	3.191	
61	192.05	157.00	400.53	200.00	235.02	475.54	321.43	3.191	
62	197.84	157.61	400.53	200.00	242.22	451.22	296.94	3.191	
63	201.00	158.67	400.00	200.00	249.99	422.53	268.37	3.191	
64	199.42	158.14	401.05	200.00	247.18	434.66	280.61	3.192	
65	197.84	157.61	400.00	200.00	241.79	451.28	296.94	3.192	
66	194.68	157.00	401.05	200.00	237.69	467.30	313.27	3.192	
67	196.26	157.09	400.53	200.00	238.56	463.36	309.18	3.192	
68	194.68	157.00	400.00	200.00	235.95	471.65	317.35	3.193	

69	193.11	157.00	401.05	200.00	236.52	471.36	317.35	3.193
70	201.00	158.67	400.53	200.00	250.40	422.45	268.37	3.193
71	193.11	157.00	400.00	200.00	234.78	475.72	321.43	3.193
72	191.53	157.00	401.05	200.00	235.35	475.43	321.43	3.193
73	196.79	157.26	401.05	200.00	240.21	459.26	305.10	3.194
74	196.79	157.26	400.53	200.00	239.78	459.32	305.10	3.194
75	191.53	157.00	400.00	200.00	233.62	479.78	325.51	3.194
76	199.42	158.14	400.00	200.00	245.45	439.09	284.69	3.195
77	195.74	157.00	400.53	200.00	237.46	467.48	313.27	3.195
78	194.16	157.00	400.53	200.00	236.28	471.54	317.35	3.195
79	200.47	158.49	400.53	200.00	249.19	426.55	272.45	3.196
80	192.58	157.00	400.53	200.00	235.12	475.60	321.43	3.196
81	195.21	157.00	401.58	200.00	238.22	467.30	313.27	3.196
82	198.37	157.79	400.53	200.00	243.43	447.16	292.86	3.196
83	195.21	157.00	400.00	200.00	236.04	471.71	317.35	3.197
84	191.00	157.00	400.53	200.00	233.96	479.66	325.51	3.197
85	195.21	157.00	401.05	200.00	237.79	467.36	313.27	3.197
86	193.63	157.00	400.00	200.00	234.87	475.77	321.43	3.198
87	193.63	157.00	401.05	200.00	236.62	471.42	317.35	3.198
88	200.47	158.49	401.05	200.00	249.60	426.47	272.45	3.198
89	197.32	157.44	401.05	200.00	241.42	455.21	301.02	3.198
90	192.05	157.00	401.05	200.00	235.45	475.49	321.43	3.198
91	192.05	157.00	400.00	200.00	233.72	479.83	325.51	3.199
92	196.26	157.09	400.00	200.00	237.24	467.66	313.27	3.200
93	199.95	158.32	400.00	200.00	246.66	435.01	280.61	3.200
94	194.68	157.00	400.53	200.00	236.38	471.60	317.35	3.200
95	199.95	158.32	401.05	200.00	248.39	430.57	276.53	3.200
96	201.00	158.67	401.05	200.00	250.81	422.37	268.37	3.201
97	193.11	157.00	400.53	200.00	235.21	475.66	321.43	3.201
98	196.79	157.26	400.00	200.00	238.46	463.63	309.18	3.201
99	198.37	157.79	400.00	200.00	244.80	438.67	284.69	3.201

Critical Failure Surface (circle 1)

Intersects: XL: 198.89 YL: 157.96 XR: 400.00 YR: 200.00
Centre: XC: 246.02 YC: 434.59 Radius: R: 280.61
Generated failure surface: (20 points)
198.89 157.96 209.84 156.32 220.85 155.11 231.89 154.34
242.95 154.00
254.02 154.09 265.08 154.63 276.11 155.60 287.09 157.00
298.00 158.84
308.84 161.10 319.58 163.79 330.20 166.90 340.69 170.43
351.04 174.37
361.22 178.72 371.22 183.46 381.03 188.59 390.63 194.11
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	198.89	9.99	-8.5	6.43	6.50	2	0.00	35.0	1308.25	16027.30	2576.16	1.05
2	205.32	18.98	-8.5	4.52	4.57	3	100.00	18.0	2502.06	11504.37	2818.10	1.03
3	209.84	35.83	-6.3	5.50	5.53	3	100.00	18.0	4747.41	14154.06	3022.53	1.02
4	215.34	49.25	-6.3	5.50	5.53	3	100.00	18.0	6538.65	14363.08	3235.65	1.02
5	220.85	62.31	-4.0	5.52	5.53	3	100.00	18.0	8277.27	14534.56	3428.97	1.01
6	226.37	74.61	-4.0	5.52	5.53	3	100.00	18.0	9910.27	14668.46	3611.03	1.01
7	231.89	85.52	-1.8	5.47	5.48	3	100.00	18.0	11353.01	14607.72	3771.19	1.00
8	237.36	96.42	-1.8	5.47	5.48	3	100.00	18.0	12790.79	14665.04	3920.46	1.00
9	242.84	109.21	0.5	5.59	5.59	3	100.00	18.0	14472.79	15001.84	4049.73	1.00
10	248.43	119.36	0.5	5.59	5.59	3	100.00	18.0	15800.16	14984.76	4170.44	1.00
11	254.02	127.35	2.8	5.53	5.53	3	100.00	18.0	16835.93	14772.83	4267.46	1.00
12	259.55	136.06	2.8	5.53	5.53	3	100.00	18.0	17962.54	14680.68	4355.71	1.00
13	265.08	143.77	5.0	5.51	5.53	3	100.00	18.0	18951.42	14550.86	4419.95	0.99
14	270.59	151.23	5.0	5.51	5.53	3	100.00	18.0	19902.03	14383.43	4476.89	0.99
15	276.11	157.29	7.3	5.49	5.53	3	100.00	18.0	20662.64	14168.74	4509.12	1.00
16	281.59	163.48	7.3	5.49	5.53	3	100.00	18.0	21434.47	13926.67		

4534.77	1.00									
17	287.08	121.53	9.5	3.96	4.02	2	0.00	35.0	15920.13	9939.97
4504.60	0.98									
18	291.04	124.12	9.5	3.96	4.02	2	0.00	35.0	16259.47	9773.22
4506.27	0.98									
19	295.00	95.87	9.5	3.00	3.05	2	0.00	35.0	12559.12	7301.69
4507.77	0.98									
20	298.00	176.09	11.8	5.42	5.53	2	0.00	35.0	23067.53	12985.33
4476.70	0.98									
21	303.42	179.74	11.8	5.42	5.53	2	0.00	35.0	23545.42	12594.14
4450.19	0.98									
22	308.84	120.51	14.1	3.58	3.69	2	0.00	35.0	15786.75	8164.54
4399.37	0.98									
23	312.42	121.57	14.1	3.58	3.69	2	0.00	35.0	15925.75	7957.93
4362.65	0.98									
24	316.00	122.54	14.1	3.58	3.69	2	0.00	35.0	16052.36	7745.47
4361.19	0.98									
25	319.58	187.13	16.3	5.42	5.65	2	0.00	35.0	24514.12	11428.52
4368.16	0.98									
26	325.00	176.09	16.3	5.20	5.42	2	0.00	35.0	23068.13	10435.37
4282.01	0.98									
27	330.20	169.00	18.6	5.25	5.53	2	0.00	35.0	22139.23	10089.91
4053.37	0.98									
28	335.45	159.75	18.6	5.25	5.53	2	0.00	35.0	20926.60	9480.52
3830.66	0.98									
29	340.69	112.51	20.8	3.90	4.18	2	0.00	35.0	14738.72	6730.53
3607.13	0.99									
30	344.60	106.71	20.8	3.90	4.18	2	0.00	35.0	13978.66	6343.13
3420.36	0.99									
31	348.50	66.29	20.8	2.54	2.72	5	0.00	45.0	7291.38	2554.84
2663.99	0.95									
32	351.04	105.09	23.1	4.25	4.62	2	0.00	35.0	13766.62	784.71
2972.72	0.99									
33	355.29	97.38	23.1	4.25	4.62	2	0.00	35.0	12756.47	261.57
2745.87	0.99									
34	359.54	36.35	23.1	1.68	1.83	2	0.00	35.0	4762.01	0.00
2589.57	0.99									
35	361.22	100.51	25.4	5.00	5.53	2	0.00	35.0	13167.13	0.00
2381.87	1.00									
36	366.22	88.65	25.4	5.00	5.53	2	0.00	35.0	11613.42	0.00
2100.82	1.00									
37	371.22	74.82	27.6	4.90	5.53	2	0.00	35.0	9801.10	0.00
1790.47	1.01									
38	376.13	62.23	27.6	4.90	5.53	2	0.00	35.0	8152.25	0.00
1489.25	1.01									
39	381.03	26.20	29.9	2.45	2.82	2	0.00	35.0	3432.17	0.00
1243.38	1.02									
40	383.48	32.08	29.9	3.57	4.12	1	150.00	22.0	4201.93	0.00
1069.27	1.07									
41	387.05	24.73	29.9	3.57	4.12	1	150.00	22.0	3239.66	0.00
818.57	1.07									
42	390.63	20.70	32.1	4.69	5.53	1	150.00	22.0	2712.06	0.00
507.91	1.09									
43	395.31	6.90	32.1	4.69	5.53	1	150.00	22.0	904.03	0.00
150.85	1.09									
		---			---				---	
X-S Area:		4255.71	Path Length:		210.33		X-S Weight:		557731.94	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 4-1\West Farm Expansion Case 4-1 Rapid Drawdown.gmf
Processed: 04 Dec 2020 12:40:38

DATA: Analysis 1 - Case 4-1 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	190.00	348.50	190.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	157.00	348.50	157.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	154.00	348.50	154.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	190.00	450.00	190.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	157.00	450.00	157.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	154.00	450.00	154.00	

Slope Surface (4 points)

100.00	157.00	196.00	157.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	157.00	196.00	157.00	316.00	197.00	348.50	197.00
351.50	178.00						
450.00	178.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	196.00	YL:	157.00	XR:	405.00	YR: 200.00
Centre:	XC:	254.94	YC:	399.95	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 4-1 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 3.041

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.73

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	198.89	157.96	400.00	200.00	246.02	434.59	280.61	1.725	<-- Critical Surface
2	194.68	157.00	400.00	200.00	237.72	463.17	309.18	1.728	
3	199.95	158.32	400.00	200.00	248.45	426.41	272.45	1.731	
4	199.42	158.14	400.00	200.00	247.24	430.51	276.53	1.731	
5	195.21	157.00	400.00	200.00	237.82	463.23	309.18	1.731	
6	193.63	157.00	400.00	200.00	236.64	467.30	313.27	1.731	
7	192.05	157.00	400.00	200.00	235.47	471.36	317.35	1.732	
8	196.26	157.09	400.00	200.00	239.02	459.18	305.10	1.733	
9	196.79	157.26	400.00	200.00	240.24	455.13	301.02	1.734	
10	194.16	157.00	400.00	200.00	236.74	467.36	313.27	1.735	
11	195.74	157.00	400.00	200.00	237.92	463.29	309.18	1.735	
12	192.58	157.00	400.00	200.00	235.56	471.42	317.35	1.735	
13	191.00	157.00	400.00	200.00	234.40	475.49	321.43	1.735	
14	197.32	157.44	400.00	200.00	241.47	451.08	296.94	1.735	
15	198.37	157.79	400.00	200.00	243.91	442.95	288.78	1.735	
16	195.21	157.00	400.53	200.00	238.25	463.17	309.18	1.736	
17	197.32	157.44	400.53	200.00	241.89	451.01	296.94	1.736	
18	197.84	157.61	400.00	200.00	242.69	447.02	292.86	1.737	
19	196.26	157.09	400.53	200.00	239.45	459.12	305.10	1.737	
20	198.89	157.96	400.00	200.00	245.12	438.88	284.69	1.738	
21	194.68	157.00	400.00	200.00	236.83	467.42	313.27	1.738	
22	193.11	157.00	400.00	200.00	235.66	471.48	317.35	1.738	
23	196.79	157.26	400.53	200.00	240.67	455.07	301.02	1.738	
24	191.53	157.00	400.00	200.00	234.49	475.54	321.43	1.738	
25	197.84	157.61	400.53	200.00	243.11	446.95	292.86	1.739	
26	194.16	157.00	400.53	200.00	237.17	467.30	313.27	1.739	
27	192.58	157.00	400.53	200.00	235.99	471.36	317.35	1.739	
28	195.74	157.00	400.53	200.00	238.35	463.23	309.18	1.739	
29	191.00	157.00	400.53	200.00	234.83	475.43	321.43	1.739	
30	199.42	158.14	400.00	200.00	246.34	434.80	280.61	1.740	
31	195.74	157.00	401.05	200.00	238.77	463.17	309.18	1.740	
32	195.21	157.00	400.00	200.00	236.93	467.48	313.27	1.741	
33	193.63	157.00	400.00	200.00	235.76	471.54	317.35	1.741	
34	198.37	157.79	400.53	200.00	244.33	442.88	288.78	1.741	
35	192.05	157.00	400.00	200.00	234.59	475.60	321.43	1.741	
36	199.95	158.32	400.00	200.00	247.56	430.72	276.53	1.742	
37	197.32	157.44	401.05	200.00	242.31	450.95	296.94	1.742	
38	194.68	157.00	400.53	200.00	237.26	467.36	313.27	1.742	
39	193.11	157.00	400.53	200.00	236.09	471.42	317.35	1.742	
40	191.53	157.00	400.53	200.00	234.92	475.49	321.43	1.742	
41	196.26	157.09	400.00	200.00	238.13	463.42	309.18	1.742	
42	198.89	157.96	400.53	200.00	245.54	438.81	284.69	1.743	
43	196.79	157.26	400.00	200.00	239.35	459.38	305.10	1.744	
44	200.47	158.49	400.00	200.00	248.77	426.62	272.45	1.744	
45	194.16	157.00	400.00	200.00	235.85	471.60	317.35	1.744	
46	195.74	157.00	400.00	200.00	237.02	467.53	313.27	1.744	
47	192.58	157.00	400.00	200.00	234.69	475.66	321.43	1.744	
48	197.84	157.61	401.05	200.00	243.53	446.89	292.86	1.744	
49	191.00	157.00	400.00	200.00	233.53	479.72	325.51	1.744	
50	199.42	158.14	400.53	200.00	246.76	434.73	280.61	1.745	
51	195.21	157.00	400.53	200.00	237.36	467.42	313.27	1.745	
52	193.63	157.00	400.53	200.00	236.19	471.48	317.35	1.745	
53	192.05	157.00	400.53	200.00	235.02	475.54	321.43	1.745	
54	197.32	157.44	400.00	200.00	240.57	455.33	301.02	1.746	
55	199.95	158.32	400.53	200.00	247.97	430.64	276.53	1.746	
56	198.37	157.79	401.05	200.00	244.75	442.82	288.78	1.746	
57	198.37	157.79	400.00	200.00	243.01	447.22	292.86	1.746	
58	193.11	157.00	401.05	200.00	236.52	471.36	317.35	1.746	
59	194.68	157.00	401.05	200.00	237.69	467.30	313.27	1.746	
60	191.53	157.00	401.05	200.00	235.35	475.43	321.43	1.747	
61	197.32	157.44	400.53	200.00	241.00	455.27	301.02	1.747	
62	194.68	157.00	400.00	200.00	235.95	471.65	317.35	1.747	
63	193.11	157.00	400.00	200.00	234.78	475.72	321.43	1.747	
64	196.26	157.09	400.53	200.00	238.56	463.36	309.18	1.747	
65	191.53	157.00	400.00	200.00	233.62	479.78	325.51	1.747	
66	198.89	157.96	401.05	200.00	245.96	438.74	284.69	1.747	
67	197.84	157.61	400.00	200.00	241.79	451.28	296.94	1.748	
68	196.79	157.26	400.53	200.00	239.78	459.32	305.10	1.748	

69	196.26	157.09	401.05	200.00	238.99	463.31	309.18	1.748
70	194.16	157.00	400.53	200.00	236.28	471.54	317.35	1.748
71	195.74	157.00	400.53	200.00	237.46	467.48	313.27	1.748
72	192.58	157.00	400.53	200.00	235.12	475.60	321.43	1.748
73	199.42	158.14	401.05	200.00	247.18	434.66	280.61	1.749
74	191.00	157.00	400.53	200.00	233.96	479.66	325.51	1.749
75	201.00	158.67	400.00	200.00	249.99	422.53	268.37	1.749
76	198.89	157.96	400.00	200.00	244.23	443.16	288.78	1.749
77	197.84	157.61	400.53	200.00	242.22	451.22	296.94	1.749
78	195.21	157.00	400.00	200.00	236.04	471.71	317.35	1.749
79	193.63	157.00	400.00	200.00	234.87	475.77	321.43	1.750
80	193.63	157.00	401.05	200.00	236.62	471.42	317.35	1.750
81	195.21	157.00	401.05	200.00	237.79	467.36	313.27	1.750
82	192.05	157.00	401.05	200.00	235.45	475.49	321.43	1.750
83	196.79	157.26	401.05	200.00	240.21	459.26	305.10	1.750
84	192.05	157.00	400.00	200.00	233.72	479.83	325.51	1.750
85	201.00	158.67	400.53	200.00	250.40	422.45	268.37	1.750
86	200.47	158.49	400.53	200.00	249.19	426.55	272.45	1.751
87	195.21	157.00	401.58	200.00	238.22	467.30	313.27	1.751
88	196.26	157.09	400.00	200.00	237.24	467.66	313.27	1.751
89	194.68	157.00	400.53	200.00	236.38	471.60	317.35	1.751
90	193.11	157.00	400.53	200.00	235.21	475.66	321.43	1.751
91	191.53	157.00	400.53	200.00	234.05	479.72	325.51	1.752
92	199.42	158.14	400.00	200.00	245.45	439.09	284.69	1.752
93	198.37	157.79	400.53	200.00	243.43	447.16	292.86	1.752
94	195.74	157.00	400.00	200.00	236.13	471.77	317.35	1.752
95	197.32	157.44	401.05	200.00	241.42	455.21	301.02	1.752
96	194.16	157.00	400.00	200.00	234.97	475.83	321.43	1.752
97	192.58	157.00	400.00	200.00	233.81	479.89	325.51	1.753
98	200.47	158.49	401.05	200.00	249.60	426.47	272.45	1.753
99	196.79	157.26	400.00	200.00	238.46	463.63	309.18	1.753

Critical Failure Surface (circle 1)

Intersects: XL: 198.89 YL: 157.96 XR: 400.00 YR: 200.00
Centre: XC: 246.02 YC: 434.59 Radius: R: 280.61
Generated failure surface: (20 points)
198.89 157.96 209.84 156.32 220.85 155.11 231.89 154.34
242.95 154.00
254.02 154.09 265.08 154.63 276.11 155.60 287.09 157.00
298.00 158.84
308.84 161.10 319.58 163.79 330.20 166.90 340.69 170.43
351.04 174.37
361.22 178.72 371.22 183.46 381.03 188.59 390.63 194.11
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	198.89	9.99	-8.5	6.43	6.50	2	0.00	35.0	1308.25	630.15	210.45	1.08
2	205.32	18.98	-8.5	4.52	4.57	3	100.00	18.0	2502.06	1197.79	571.02	1.04
3	209.84	35.83	-6.3	5.50	5.53	3	100.00	18.0	4747.41	2249.14	879.06	1.03
4	215.34	49.25	-6.3	5.50	5.53	3	100.00	18.0	6538.65	3091.56	1208.30	1.03
5	220.85	62.31	-4.0	5.52	5.53	3	100.00	18.0	8277.27	3897.56	1513.92	1.02
6	226.37	74.61	-4.0	5.52	5.53	3	100.00	18.0	9910.27	4667.11	1811.78	1.02
7	231.89	85.52	-1.8	5.47	5.48	3	100.00	18.0	11353.01	5338.70	2082.30	1.01
8	237.36	96.42	-1.8	5.47	5.48	3	100.00	18.0	12790.79	6019.51	2345.78	1.01
9	242.84	109.21	0.5	5.59	5.59	3	100.00	18.0	14472.79	6814.73	2584.94	1.00
10	248.43	119.36	0.5	5.59	5.59	3	100.00	18.0	15800.16	7448.38	2821.78	1.00
11	254.02	127.35	2.8	5.53	5.53	3	100.00	18.0	16835.93	7955.80	3028.04	0.99
12	259.55	136.06	2.8	5.53	5.53	3	100.00	18.0	17962.54	8500.10	3230.86	0.99
13	265.08	143.77	5.0	5.51	5.53	3	100.00	18.0	18951.42	9005.91	3402.67	0.99
14	270.59	151.23	5.0	5.51	5.53	3	100.00	18.0	19902.03	9473.25	3573.65	0.99
15	276.11	157.29	7.3	5.49	5.53	3	100.00	18.0	20662.64	9894.74	3712.40	0.98
16	281.59	163.48	7.3	5.49	5.53	3	100.00	18.0	21434.47	10283.86		

3851.43	0.98									
17	287.08	121.53	9.5	3.96	4.02	2	0.00	35.0	15920.13	7689.71
3885.59	0.95									
18	291.04	124.12	9.5	3.96	4.02	2	0.00	35.0	16259.47	7853.72
3968.35	0.95									
19	295.00	95.87	9.5	3.00	3.05	2	0.00	35.0	12559.12	6066.35
4041.17	0.95									
20	298.00	176.09	11.8	5.42	5.53	2	0.00	35.0	23067.53	11225.35
4083.32	0.94									
21	303.42	179.74	11.8	5.42	5.53	2	0.00	35.0	23545.42	11457.91
4167.93	0.94									
22	308.84	120.51	14.1	3.58	3.69	2	0.00	35.0	15786.75	7752.25
4196.29	0.94									
23	312.42	121.57	14.1	3.58	3.69	2	0.00	35.0	15925.75	7820.50
4233.24	0.94									
24	316.00	122.54	14.1	3.58	3.69	2	0.00	35.0	16052.36	7745.47
4266.73	0.94									
25	319.58	187.13	16.3	5.42	5.65	2	0.00	35.0	24514.12	11428.52
4255.36	0.93									
26	325.00	176.09	16.3	5.20	5.42	2	0.00	35.0	23068.13	10435.37
4168.68	0.93									
27	330.20	169.00	18.6	5.25	5.53	2	0.00	35.0	22139.23	10089.91
3932.14	0.93									
28	335.45	159.75	18.6	5.25	5.53	2	0.00	35.0	20926.60	9480.52
3715.55	0.93									
29	340.69	112.51	20.8	3.90	4.18	2	0.00	35.0	14738.72	6730.53
3486.21	0.93									
30	344.60	106.71	20.8	3.90	4.18	2	0.00	35.0	13978.66	6343.13
3305.14	0.93									
31	348.50	66.29	20.8	2.54	2.72	5	0.00	45.0	7291.38	2554.84
2522.94	0.88									
32	351.04	105.09	23.1	4.25	4.62	2	0.00	35.0	13766.62	784.71
2785.45	0.93									
33	355.29	97.38	23.1	4.25	4.62	2	0.00	35.0	12756.47	261.57
2566.20	0.93									
34	359.54	36.35	23.1	1.68	1.83	2	0.00	35.0	4762.01	0.00
2416.56	0.93									
35	361.22	100.51	25.4	5.00	5.53	2	0.00	35.0	13167.13	0.00
2207.89	0.93									
36	366.22	88.65	25.4	5.00	5.53	2	0.00	35.0	11613.42	0.00
1947.37	0.93									
37	371.22	74.82	27.6	4.90	5.53	2	0.00	35.0	9801.10	0.00
1648.48	0.93									
38	376.13	62.23	27.6	4.90	5.53	2	0.00	35.0	8152.25	0.00
1371.15	0.93									
39	381.03	26.20	29.9	2.45	2.82	2	0.00	35.0	3432.17	0.00
1136.93	0.94									
40	383.48	32.08	29.9	3.57	4.12	1	150.00	22.0	4201.93	0.00
991.92	1.02									
41	387.05	24.73	29.9	3.57	4.12	1	150.00	22.0	3239.66	0.00
754.69	1.02									
42	390.63	20.70	32.1	4.69	5.53	1	150.00	22.0	2712.06	0.00
456.85	1.03									
43	395.31	6.90	32.1	4.69	5.53	1	150.00	22.0	904.03	0.00
120.53	1.03									
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X-S Area:		4255.71	Path Length:		210.33		X-S Weight:		557731.94	

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 4-2 Full Reservoir.gmf
Processed: 02 Dec 2020 14:01:24

DATA: Analysis 1 - Case 4-2 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	188.00	348.50	188.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	146.00	348.50	146.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	143.00	348.50	143.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	188.00	450.00	188.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	146.00	450.00	146.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	143.00	450.00	143.00	

Slope Surface (8 points)

100.00	146.00	163.00	146.00	325.00	200.00	410.00	200.00
415.00	195.00						
420.00	195.00	425.00	200.00	450.00	200.00		

Phreatic Surface (5 points)

100.00	197.00	316.00	197.00	348.50	197.00	351.50	170.00
450.00	170.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	163.00	YL:	146.00	XR:	415.00	YR: 195.00
Centre:	XC:	248.05	YC:	381.09	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 4-2 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

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Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 5.365

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 3.11

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	166.42	147.14	410.00	200.00	219.78	488.92	345.92	3.112	<-- Critical Surface
2	166.95	147.32	410.00	200.00	221.02	484.85	341.84	3.116	
3	167.47	147.49	410.00	200.00	222.26	480.77	337.76	3.121	
4	166.42	147.14	410.00	200.00	218.85	493.19	350.00	3.124	
5	168.00	147.67	410.00	200.00	223.51	476.69	333.67	3.126	
6	166.95	147.32	410.00	200.00	220.09	489.13	345.92	3.129	
7	167.47	147.49	410.00	200.00	221.34	485.06	341.84	3.134	
8	168.00	147.67	410.00	200.00	222.58	480.98	337.76	3.140	
9	165.89	146.96	410.00	200.00	218.53	492.98	350.00	3.140	
10	166.95	147.32	410.00	200.00	219.17	493.40	350.00	3.141	
11	166.42	147.14	410.53	199.47	219.93	493.03	350.00	3.144	
12	167.47	147.49	410.00	200.00	220.41	489.34	345.92	3.147	
13	166.95	147.32	410.53	199.47	221.16	488.96	345.92	3.149	
14	168.00	147.67	410.00	200.00	221.65	485.27	341.84	3.153	
15	167.47	147.49	410.53	199.47	222.40	484.89	341.84	3.154	
16	168.00	147.67	410.53	199.47	223.63	480.81	337.76	3.158	
17	167.47	147.49	410.00	200.00	219.48	493.61	350.00	3.159	
18	166.95	147.32	410.53	199.47	220.25	493.23	350.00	3.161	
19	168.00	147.67	410.00	200.00	220.73	489.54	345.92	3.167	
20	167.47	147.49	410.53	199.47	221.48	489.17	345.92	3.168	
21	168.00	147.67	410.53	199.47	222.72	485.10	341.84	3.173	
22	167.47	147.49	410.53	199.47	220.57	493.44	350.00	3.180	
23	168.00	147.67	410.00	200.00	219.80	493.81	350.00	3.182	
24	166.95	147.32	411.05	198.95	221.33	493.07	350.00	3.184	
25	168.00	147.67	410.53	199.47	221.80	489.38	345.92	3.186	
26	167.47	147.49	411.05	198.95	222.56	489.00	345.92	3.187	
27	168.00	147.67	411.05	198.95	223.78	484.92	341.84	3.190	
28	168.00	147.67	410.53	199.47	220.89	493.65	350.00	3.201	
29	167.47	147.49	411.05	198.95	221.65	493.27	350.00	3.201	
30	168.00	147.67	411.05	198.95	222.88	489.20	345.92	3.205	
31	168.00	147.67	411.05	198.95	221.97	493.48	350.00	3.219	
32	167.47	147.49	411.58	198.42	222.73	493.10	350.00	3.219	
33	168.00	147.67	411.58	198.42	223.95	489.03	345.92	3.223	
34	168.00	147.67	411.58	198.42	223.06	493.31	350.00	3.238	
35	168.00	147.67	412.11	197.89	224.14	493.14	350.00	3.257	
36	168.00	147.67	412.63	197.37	225.21	492.96	350.00	3.344	
37	168.00	147.67	412.11	197.89	225.02	488.85	345.92	3.382	
38	167.47	147.49	412.11	197.89	223.81	492.93	350.00	3.402	
39	168.00	147.67	411.58	198.42	224.84	484.74	341.84	3.428	
40	167.47	147.49	411.58	198.42	223.62	488.82	345.92	3.429	
41	166.95	147.32	411.58	198.42	222.41	492.89	350.00	3.444	
42	167.47	147.49	411.05	198.95	223.46	484.71	341.84	3.465	
43	166.95	147.32	411.05	198.95	222.23	488.79	345.92	3.468	
44	168.00	147.67	411.05	198.95	224.69	480.63	337.76	3.484	
45	166.42	147.14	411.05	198.95	221.01	492.86	350.00	3.485	
46	166.95	147.32	410.53	199.47	222.08	484.68	341.84	3.497	
47	166.42	147.14	410.53	199.47	220.85	488.75	345.92	3.503	
48	167.47	147.49	410.53	199.47	223.32	480.60	337.76	3.510	
49	168.00	147.67	410.00	200.00	224.44	472.39	329.59	3.528	
50	165.89	146.96	410.53	199.47	219.61	492.82	350.00	3.528	
51	168.00	147.67	410.53	199.47	224.55	476.51	333.67	3.530	
52	166.42	147.14	410.00	200.00	220.70	484.64	341.84	3.532	
53	166.95	147.32	410.00	200.00	221.95	480.56	337.76	3.534	
54	167.47	147.49	410.00	200.00	223.19	476.48	333.67	3.537	
55	165.89	146.96	410.00	200.00	219.46	488.71	345.92	3.550	
56	165.37	146.79	410.00	200.00	218.21	492.78	350.00	3.608	
57	168.00	147.67	411.58	198.42	225.74	480.45	337.76	3.732	
58	168.00	147.67	412.11	197.89	225.90	484.56	341.84	3.734	
59	168.00	147.67	411.05	198.95	225.59	476.33	333.67	3.737	
60	167.47	147.49	411.58	198.42	224.52	484.53	341.84	3.739	
61	168.00	147.67	412.63	197.37	226.08	488.67	345.92	3.741	
62	167.47	147.49	411.05	198.95	224.37	480.42	337.76	3.741	
63	167.47	147.49	412.11	197.89	224.69	488.64	345.92	3.742	
64	168.00	147.67	410.53	199.47	225.47	472.21	329.59	3.747	
65	167.47	147.49	410.53	199.47	224.24	476.30	333.67	3.748	
66	166.42	147.14	410.00	200.00	221.64	480.35	337.76	3.751	
67	167.47	147.49	412.63	197.37	224.88	492.75	350.00	3.752	

68	165.89	146.96	410.00	200.00	220.39	484.43	341.84	3.752
69	168.00	147.67	413.16	196.84	226.29	492.78	350.00	3.753
70	166.95	147.32	411.58	198.42	223.30	488.61	345.92	3.754
71	166.95	147.32	411.05	198.95	223.14	484.50	341.84	3.754
72	166.95	147.32	410.00	200.00	222.88	476.27	333.67	3.755
73	166.95	147.32	412.11	197.89	223.48	492.72	350.00	3.759
74	166.42	147.14	410.53	199.47	221.76	484.47	341.84	3.761
75	168.00	147.67	410.00	200.00	225.37	468.08	325.51	3.763
76	165.89	146.96	410.53	199.47	220.53	488.54	345.92	3.764
77	166.95	147.32	410.53	199.47	223.00	480.39	337.76	3.767
78	167.47	147.49	410.00	200.00	224.12	472.18	329.59	3.768
79	165.37	146.79	410.00	200.00	219.14	488.50	345.92	3.771
80	165.37	146.79	410.53	199.47	219.29	492.61	350.00	3.772
81	166.42	147.14	411.05	198.95	221.91	488.58	345.92	3.777
82	166.42	147.14	411.58	198.42	222.08	492.69	350.00	3.779
83	165.89	146.96	411.05	198.95	220.69	492.65	350.00	3.781
84	164.84	146.61	410.00	200.00	217.90	492.57	350.00	3.783
85	165.89	146.96	410.00	200.00	221.32	480.14	337.76	3.878
86	165.37	146.79	410.00	200.00	220.08	484.22	341.84	3.879
87	166.42	147.14	410.00	200.00	222.57	476.06	333.67	3.881
88	165.89	146.96	410.53	199.47	221.45	484.26	341.84	3.888
89	166.42	147.14	410.53	199.47	222.68	480.18	337.76	3.890
90	166.95	147.32	410.00	200.00	223.81	471.97	329.59	3.891
91	165.37	146.79	410.53	199.47	220.21	488.33	345.92	3.892
92	166.95	147.32	410.53	199.47	223.92	476.09	333.67	3.897
93	164.84	146.61	410.00	200.00	218.83	488.29	345.92	3.900
94	164.84	146.61	410.53	199.47	218.97	492.40	350.00	3.900
95	166.42	147.14	411.05	198.95	222.82	484.29	341.84	3.904
96	165.89	146.96	411.05	198.95	221.59	488.37	345.92	3.904
97	166.95	147.32	411.05	198.95	224.05	480.21	337.76	3.906
98	167.47	147.49	410.00	200.00	225.06	467.87	325.51	3.906
99	167.47	147.49	410.53	199.47	225.16	472.00	329.59	3.908

Critical Failure Surface (circle 1)

Intersects: XL: 166.42 YL: 147.14 XR: 410.00 YR: 200.00
Centre: XC: 219.78 YC: 488.92 Radius: R: 345.92
Generated failure surface: (20 points)
166.42 147.14 179.72 145.33 193.07 144.03 206.47 143.26
219.89 143.00
233.30 143.27 246.70 144.05 260.06 145.35 273.35 147.17
286.57 149.51
299.68 152.36 312.67 155.71 325.53 159.56 338.22 163.91
350.74 168.75
363.06 174.07 375.16 179.87 387.03 186.12 398.65 192.84
410.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	166.42	4.11	-7.8	4.18	4.22	2	0.00	35.0	538.34	13211.00	3198.55	1.04
2	170.60	12.33	-7.8	4.18	4.22	2	0.00	35.0	1615.00	13361.21	3373.17	1.04
3	174.79	25.08	-7.8	4.93	4.98	3	100.00	18.0	3301.49	15937.23	3565.21	1.02
4	179.72	51.30	-5.5	6.68	6.71	3	100.00	18.0	6786.52	21769.78	3790.06	1.01
5	186.40	70.49	-5.5	6.68	6.71	3	100.00	18.0	9343.89	22040.96	4036.16	1.01
6	193.07	89.10	-3.3	6.70	6.71	3	100.00	18.0	11817.28	22257.47	4258.95	1.01
7	199.77	106.66	-3.3	6.70	6.71	3	100.00	18.0	14143.05	22419.94	4467.96	1.01
8	206.47	123.54	-1.1	6.71	6.71	3	100.00	18.0	16371.86	22527.96	4652.14	1.00
9	213.18	139.40	-1.1	6.71	6.71	3	100.00	18.0	18458.04	22581.55	4823.91	1.00
10	219.89	154.38	1.1	6.71	6.71	3	100.00	18.0	20421.09	22580.93	4969.54	1.00
11	226.60	168.50	1.1	6.71	6.71	3	100.00	18.0	22261.04	22525.53	5103.99	1.00
12	233.30	181.45	3.4	6.70	6.71	3	100.00	18.0	23939.84	22415.43	5211.19	1.00
13	240.00	193.78	3.4	6.70	6.71	3	100.00	18.0	25528.32	22251.13	5308.27	1.00
14	246.70	204.59	5.6	6.68	6.71	3	100.00	18.0	26909.62	22032.45	5377.18	0.99
15	253.38	215.10	5.6	6.68	6.71	3	100.00	18.0	28243.10	21759.52	5436.94	0.99

16	260.06	157.81	7.8	4.72	4.76	3	100.00	18.0	20688.77	15245.23	5464.47	1.00
17	264.77	147.32	7.8	4.29	4.33	2	0.00	35.0	19299.49	13698.95	5449.73	0.98
18	269.06	150.94	7.8	4.29	4.33	2	0.00	35.0	19772.83	13540.23	5469.13	0.98
19	273.35	238.70	10.0	6.61	6.71	2	0.00	35.0	31269.13	20616.29	5456.15	0.98
20	279.96	245.53	10.0	6.61	6.71	2	0.00	35.0	32165.02	20127.56	5451.57	0.98
21	286.57	92.04	12.2	2.43	2.49	2	0.00	35.0	12057.88	7338.94	5420.56	0.98
22	289.00	204.38	12.2	5.34	5.46	2	0.00	35.0	26773.65	15815.45	5397.50	0.98
23	294.34	207.70	12.2	5.34	5.46	2	0.00	35.0	27208.17	15420.28	5365.81	0.98
24	299.68	256.29	14.5	6.50	6.71	2	0.00	35.0	33574.41	18340.63	5291.19	0.98
25	306.18	259.47	14.5	6.50	6.71	2	0.00	35.0	33990.96	17638.84	5218.32	0.98
26	312.67	133.84	16.7	3.33	3.47	2	0.00	35.0	17532.50	8838.74	5131.40	0.98
27	316.00	181.66	16.7	4.50	4.70	2	0.00	35.0	23798.01	11614.52	5110.46	0.98
28	320.50	182.34	16.7	4.50	4.70	2	0.00	35.0	23886.92	11219.01	5123.64	0.98
29	325.00	261.06	18.7	6.61	6.98	2	0.00	35.0	34198.55	15894.72	4967.30	0.98
30	331.61	246.08	18.9	6.61	6.99	2	0.00	35.0	32236.82	14923.57	4679.76	0.98
31	338.22	180.34	21.1	5.14	5.51	2	0.00	35.0	23624.33	11033.37	4389.79	0.99
32	343.36	170.13	21.1	5.14	5.51	2	0.00	35.0	22287.28	10350.56	4140.47	0.99
33	348.50	70.95	21.1	2.24	2.40	5	0.00	45.0	7804.19	2787.31	3228.25	0.95
34	350.74	88.61	23.4	2.89	3.15	2	0.00	35.0	11608.39	122.89	3659.96	0.99
35	353.63	136.59	23.4	4.71	5.13	2	0.00	35.0	17893.91	0.00	3460.39	0.99
36	358.35	127.00	23.4	4.71	5.13	2	0.00	35.0	16637.22	0.00	3217.37	0.99
37	363.06	148.15	25.6	6.05	6.71	2	0.00	35.0	19408.21	0.00	2895.09	1.00
38	369.11	130.62	25.6	6.05	6.71	2	0.00	35.0	17111.37	0.00	2552.47	1.00
39	375.16	110.21	27.8	5.93	6.71	2	0.00	35.0	14437.86	0.00	2174.63	1.01
40	381.10	91.64	27.8	5.93	6.71	2	0.00	35.0	12004.69	0.00	1808.14	1.01
41	387.03	41.98	30.0	3.25	3.75	2	0.00	35.0	5499.99	0.00	1499.79	1.02
42	390.28	45.17	30.0	4.19	4.84	1	150.00	22.0	5917.84	0.00	1288.92	1.07
43	394.46	35.04	30.0	4.19	4.84	1	150.00	22.0	4590.72	0.00	994.05	1.07
44	398.65	30.47	32.2	5.67	6.71	1	150.00	22.0	3992.05	0.00	622.13	1.09
45	404.33	10.16	32.2	5.67	6.71	1	150.00	22.0	1330.68	0.00	188.64	1.09

X-S Area: 6122.06 Path Length: 254.97 X-S Weight: 802280.44

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 4-2 Rapid Drawdown.gmf
Processed: 02 Dec 2020 14:02:16

DATA: Analysis 1 - Case 4-2 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	188.00	348.50	188.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	146.00	348.50	146.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	143.00	348.50	143.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	188.00	450.00	188.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	146.00	450.00	146.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	143.00	450.00	143.00	

Slope Surface (8 points)

100.00	146.00	163.00	146.00	325.00	200.00	410.00	200.00
415.00	195.00						
420.00	195.00	425.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	146.00	163.00	146.00	316.00	197.00	348.50	197.00
351.50	170.00						
450.00	170.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	163.00	YL:	146.00	XR:	415.00	YR: 195.00
Centre:	XC:	248.05	YC:	381.09	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 4-2 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

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Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.925

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.66

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	166.42	147.14	410.00	200.00	219.78	488.92	345.92	1.664	<-- Critical Surface
2	166.95	147.32	410.00	200.00	221.02	484.85	341.84	1.667	
3	167.47	147.49	410.00	200.00	222.26	480.77	337.76	1.669	
4	168.00	147.67	410.00	200.00	223.51	476.69	333.67	1.672	
5	166.42	147.14	410.00	200.00	218.85	493.19	350.00	1.672	
6	166.95	147.32	410.00	200.00	220.09	489.13	345.92	1.675	
7	167.47	147.49	410.00	200.00	221.34	485.06	341.84	1.677	
8	168.00	147.67	410.00	200.00	222.58	480.98	337.76	1.680	
9	165.89	146.96	410.00	200.00	218.53	492.98	350.00	1.682	
10	166.95	147.32	410.00	200.00	219.17	493.40	350.00	1.682	
11	166.42	147.14	410.53	199.47	219.93	493.03	350.00	1.682	
12	167.47	147.49	410.00	200.00	220.41	489.34	345.92	1.685	
13	166.95	147.32	410.53	199.47	221.16	488.96	345.92	1.685	
14	167.47	147.49	410.53	199.47	222.40	484.89	341.84	1.688	
15	168.00	147.67	410.00	200.00	221.65	485.27	341.84	1.688	
16	168.00	147.67	410.53	199.47	223.63	480.81	337.76	1.690	
17	167.47	147.49	410.00	200.00	219.48	493.61	350.00	1.693	
18	166.95	147.32	410.53	199.47	220.25	493.23	350.00	1.693	
19	167.47	147.49	410.53	199.47	221.48	489.17	345.92	1.696	
20	168.00	147.67	410.00	200.00	220.73	489.54	345.92	1.697	
21	168.00	147.67	410.53	199.47	222.72	485.10	341.84	1.699	
22	167.47	147.49	410.53	199.47	220.57	493.44	350.00	1.704	
23	166.95	147.32	411.05	198.95	221.33	493.07	350.00	1.704	
24	168.00	147.67	410.00	200.00	219.80	493.81	350.00	1.706	
25	167.47	147.49	411.05	198.95	222.56	489.00	345.92	1.706	
26	168.00	147.67	410.53	199.47	221.80	489.38	345.92	1.707	
27	168.00	147.67	411.05	198.95	223.78	484.92	341.84	1.708	
28	167.47	147.49	411.05	198.95	221.65	493.27	350.00	1.715	
29	168.00	147.67	410.53	199.47	220.89	493.65	350.00	1.716	
30	168.00	147.67	411.05	198.95	222.88	489.20	345.92	1.717	
31	167.47	147.49	411.58	198.42	222.73	493.10	350.00	1.725	
32	168.00	147.67	411.05	198.95	221.97	493.48	350.00	1.726	
33	168.00	147.67	411.58	198.42	223.95	489.03	345.92	1.727	
34	168.00	147.67	411.58	198.42	223.06	493.31	350.00	1.736	
35	168.00	147.67	412.11	197.89	224.14	493.14	350.00	1.745	
36	168.00	147.67	412.63	197.37	225.21	492.96	350.00	1.794	
37	168.00	147.67	412.11	197.89	225.02	488.85	345.92	1.818	
38	167.47	147.49	412.11	197.89	223.81	492.93	350.00	1.830	
39	168.00	147.67	411.58	198.42	224.84	484.74	341.84	1.847	
40	167.47	147.49	411.58	198.42	223.62	488.82	345.92	1.847	
41	166.95	147.32	411.58	198.42	222.41	492.89	350.00	1.856	
42	167.47	147.49	411.05	198.95	223.46	484.71	341.84	1.869	
43	166.95	147.32	411.05	198.95	222.23	488.79	345.92	1.870	
44	168.00	147.67	411.05	198.95	224.69	480.63	337.76	1.880	
45	166.42	147.14	411.05	198.95	221.01	492.86	350.00	1.880	
46	166.95	147.32	410.53	199.47	222.08	484.68	341.84	1.888	
47	166.42	147.14	410.53	199.47	220.85	488.75	345.92	1.892	
48	167.47	147.49	410.53	199.47	223.32	480.60	337.76	1.896	
49	168.00	147.67	410.00	200.00	224.44	472.39	329.59	1.906	
50	168.00	147.67	410.53	199.47	224.55	476.51	333.67	1.907	
51	165.89	146.96	410.53	199.47	219.61	492.82	350.00	1.907	
52	166.42	147.14	410.00	200.00	220.70	484.64	341.84	1.909	
53	166.95	147.32	410.00	200.00	221.95	480.56	337.76	1.911	
54	167.47	147.49	410.00	200.00	223.19	476.48	333.67	1.912	
55	165.89	146.96	410.00	200.00	219.46	488.71	345.92	1.920	
56	165.37	146.79	410.00	200.00	218.21	492.78	350.00	1.951	
57	168.00	147.67	412.11	197.89	225.90	484.56	341.84	2.023	
58	168.00	147.67	411.58	198.42	225.74	480.45	337.76	2.023	
59	168.00	147.67	412.63	197.37	226.08	488.67	345.92	2.025	
60	167.47	147.49	411.58	198.42	224.52	484.53	341.84	2.027	
61	168.00	147.67	411.05	198.95	225.59	476.33	333.67	2.027	
62	167.47	147.49	412.11	197.89	224.69	488.64	345.92	2.028	
63	167.47	147.49	411.05	198.95	224.37	480.42	337.76	2.029	
64	168.00	147.67	413.16	196.84	226.29	492.78	350.00	2.030	
65	167.47	147.49	412.63	197.37	224.88	492.75	350.00	2.031	
66	168.00	147.67	410.53	199.47	225.47	472.21	329.59	2.033	

67	167.47	147.49	410.53	199.47	224.24	476.30	333.67	2.034
68	166.95	147.32	411.58	198.42	223.30	488.61	345.92	2.035
69	166.95	147.32	411.05	198.95	223.14	484.50	341.84	2.036
70	166.42	147.14	410.00	200.00	221.64	480.35	337.76	2.036
71	166.95	147.32	412.11	197.89	223.48	492.72	350.00	2.037
72	165.89	146.96	410.00	200.00	220.39	484.43	341.84	2.037
73	166.95	147.32	410.00	200.00	222.88	476.27	333.67	2.038
74	166.42	147.14	410.53	199.47	221.76	484.47	341.84	2.042
75	168.00	147.67	410.00	200.00	225.37	468.08	325.51	2.042
76	165.89	146.96	410.53	199.47	220.53	488.54	345.92	2.044
77	166.95	147.32	410.53	199.47	223.00	480.39	337.76	2.045
78	167.47	147.49	410.00	200.00	224.12	472.18	329.59	2.045
79	165.37	146.79	410.00	200.00	219.14	488.50	345.92	2.045
80	165.37	146.79	410.53	199.47	219.29	492.61	350.00	2.049
81	166.42	147.14	411.05	198.95	221.91	488.58	345.92	2.049
82	166.42	147.14	411.58	198.42	222.08	492.69	350.00	2.050
83	164.84	146.61	410.00	200.00	217.90	492.57	350.00	2.052
84	165.89	146.96	411.05	198.95	220.69	492.65	350.00	2.053
85	165.89	146.96	410.00	200.00	221.32	480.14	337.76	2.109
86	165.37	146.79	410.00	200.00	220.08	484.22	341.84	2.111
87	166.42	147.14	410.00	200.00	222.57	476.06	333.67	2.111
88	165.89	146.96	410.53	199.47	221.45	484.26	341.84	2.115
89	166.42	147.14	410.53	199.47	222.68	480.18	337.76	2.116
90	166.95	147.32	410.00	200.00	223.81	471.97	329.59	2.116
91	165.37	146.79	410.53	199.47	220.21	488.33	345.92	2.117
92	164.84	146.61	410.00	200.00	218.83	488.29	345.92	2.119
93	166.95	147.32	410.53	199.47	223.92	476.09	333.67	2.120
94	166.42	147.14	411.05	198.95	222.82	484.29	341.84	2.122
95	164.84	146.61	410.53	199.47	218.97	492.40	350.00	2.123
96	165.89	146.96	411.05	198.95	221.59	488.37	345.92	2.123
97	166.95	147.32	411.05	198.95	224.05	480.21	337.76	2.124
98	167.47	147.49	410.00	200.00	225.06	467.87	325.51	2.125
99	167.47	147.49	410.53	199.47	225.16	472.00	329.59	2.126

Critical Failure Surface (circle 1)

Intersects: XL: 166.42 YL: 147.14 XR: 410.00 YR: 200.00
Centre: XC: 219.78 YC: 488.92 Radius: R: 345.92

Generated failure surface: (20 points)

166.42 147.14 179.72 145.33 193.07 144.03 206.47 143.26
219.89 143.00
233.30 143.27 246.70 144.05 260.06 145.35 273.35 147.17
286.57 149.51
299.68 152.36 312.67 155.71 325.53 159.56 338.22 163.91
350.74 168.75
363.06 174.07 375.16 179.87 387.03 186.12 398.65 192.84
410.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	166.42	4.11	-7.8	4.18	4.22	2	0.00	35.0	538.34	258.80	132.78	1.07
2	170.60	12.33	-7.8	4.18	4.22	2	0.00	35.0	1615.00	776.39	398.35	1.07
3	174.79	25.08	-7.8	4.93	4.98	3	100.00	18.0	3301.49	1579.20	687.78	1.04
4	179.72	51.30	-5.5	6.68	6.71	3	100.00	18.0	6786.52	3216.00	1032.49	1.02
5	186.40	70.49	-5.5	6.68	6.71	3	100.00	18.0	9343.89	4419.19	1419.35	1.02
6	193.07	89.10	-3.3	6.70	6.71	3	100.00	18.0	11817.28	5569.36	1778.41	1.01
7	199.77	106.66	-3.3	6.70	6.71	3	100.00	18.0	14143.05	6666.66	2127.72	1.01
8	206.47	123.54	-1.1	6.71	6.71	3	100.00	18.0	16371.86	7710.21	2446.48	1.00
9	213.18	139.40	-1.1	6.71	6.71	3	100.00	18.0	18458.04	8700.02	2758.08	1.00
10	219.89	154.38	1.1	6.71	6.71	3	100.00	18.0	20421.09	9635.45	3036.76	1.00
11	226.60	168.50	1.1	6.71	6.71	3	100.00	18.0	22261.04	10516.28	3310.49	1.00
12	233.30	181.45	3.4	6.70	6.71	3	100.00	18.0	23939.84	11341.83	3549.32	0.99
13	240.00	193.78	3.4	6.70	6.71	3	100.00	18.0	25528.32	12112.32	3785.09	0.99
14	246.70	204.59	5.6	6.68	6.71	3	100.00	18.0	26909.62	12827.05	3984.32	0.99
15	253.38	215.10	5.6	6.68	6.71	3	100.00	18.0	28243.10	13486.08		

4182.10	0.99									
16	260.06	157.81	7.8	4.72	4.76	3	100.00	18.0	20688.77	9939.47
4318.77	0.98									
17	264.77	147.32	7.8	4.29	4.33	2	0.00	35.0	19299.49	9278.86
4370.89	0.95									
18	269.06	150.94	7.8	4.29	4.33	2	0.00	35.0	19772.83	9506.43
4478.09	0.95									
19	273.35	238.70	10.0	6.61	6.71	2	0.00	35.0	31269.13	15125.37
4561.06	0.95									
20	279.96	245.53	10.0	6.61	6.71	2	0.00	35.0	32165.02	15558.73
4691.72	0.95									
21	286.57	92.04	12.2	2.43	2.49	2	0.00	35.0	12057.88	5877.30
4737.38	0.94									
22	289.00	204.38	12.2	5.34	5.46	2	0.00	35.0	26773.65	13050.11
4794.02	0.94									
23	294.34	207.70	12.2	5.34	5.46	2	0.00	35.0	27208.17	13261.91
4871.83	0.94									
24	299.68	256.29	14.5	6.50	6.71	2	0.00	35.0	33574.41	16516.40
4902.81	0.93									
25	306.18	259.47	14.5	6.50	6.71	2	0.00	35.0	33990.96	16721.30
4963.64	0.93									
26	312.67	133.84	16.7	3.33	3.47	2	0.00	35.0	17532.50	8718.63
4962.07	0.93									
27	316.00	181.66	16.7	4.50	4.70	2	0.00	35.0	23798.01	11614.52
4973.00	0.93									
28	320.50	182.34	16.7	4.50	4.70	2	0.00	35.0	23886.92	11219.01
4981.12	0.93									
29	325.00	261.06	18.7	6.61	6.98	2	0.00	35.0	34198.55	15894.72
4811.00	0.92									
30	331.61	246.08	18.9	6.61	6.99	2	0.00	35.0	32236.82	14923.57
4530.65	0.92									
31	338.22	180.34	21.1	5.14	5.51	2	0.00	35.0	23624.33	11033.37
4234.47	0.92									
32	343.36	170.13	21.1	5.14	5.51	2	0.00	35.0	22287.28	10350.56
3993.30	0.92									
33	348.50	70.95	21.1	2.24	2.40	5	0.00	45.0	7804.19	2787.31
3047.00	0.87									
34	350.74	88.61	23.4	2.89	3.15	2	0.00	35.0	11608.39	122.89
3400.98	0.92									
35	353.63	136.59	23.4	4.71	5.13	2	0.00	35.0	17893.91	0.00
3212.90	0.92									
36	358.35	127.00	23.4	4.71	5.13	2	0.00	35.0	16637.22	0.00
2987.26	0.92									
37	363.06	148.15	25.6	6.05	6.71	2	0.00	35.0	19408.21	0.00
2669.34	0.92									
38	369.11	130.62	25.6	6.05	6.71	2	0.00	35.0	17111.37	0.00
2353.44	0.92									
39	375.16	110.21	27.8	5.93	6.71	2	0.00	35.0	14437.86	0.00
1990.97	0.93									
40	381.10	91.64	27.8	5.93	6.71	2	0.00	35.0	12004.69	0.00
1655.42	0.93									
41	387.03	41.98	30.0	3.25	3.75	2	0.00	35.0	5499.99	0.00
1363.33	0.93									
42	390.28	45.17	30.0	4.19	4.84	1	150.00	22.0	5917.84	0.00
1193.90	1.01									
43	394.46	35.04	30.0	4.19	4.84	1	150.00	22.0	4590.72	0.00
915.91	1.01									
44	398.65	30.47	32.2	5.67	6.71	1	150.00	22.0	3992.05	0.00
560.76	1.03									
45	404.33	10.16	32.2	5.67	6.71	1	150.00	22.0	1330.68	0.00
154.04	1.03									
		---			---				---	
X-S Area:		6122.06	Path Length:		254.97		X-S Weight:		802280.44	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 5-1\West Farm Expansion Case 5-1 Full Reservoir.gmf
Processed: 04 Dec 2020 12:52:22

DATA: Analysis 1 - Case 5-1 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	174.00	348.50	174.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	161.00	348.50	161.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	158.00	348.50	158.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	174.00	450.00	174.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	161.00	450.00	161.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	158.00	450.00	158.00	

Slope Surface (4 points)

100.00	161.00	208.00	161.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	208.00	197.00	316.00	197.00	348.50	197.00
351.50	185.00						
450.00	185.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	208.00	YL:	161.00	XR:	385.00	YR: 200.00
Centre:	XC:	246.36	YC:	408.04	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 5-1 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.634

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.55

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	206.68	161.00	380.00	200.00	244.44	397.80	239.80	2.545	<-- Critical Surface
2	205.11	161.00	380.00	200.00	243.19	401.89	243.88	2.547	
3	209.84	161.61	380.00	200.00	249.64	381.51	223.47	2.547	
4	208.79	161.26	380.00	200.00	247.09	389.71	231.63	2.547	
5	210.37	161.79	380.00	200.00	250.92	377.40	219.39	2.547	
6	209.32	161.44	380.00	200.00	248.37	385.61	227.55	2.548	
7	203.53	161.00	380.00	200.00	241.94	405.97	247.96	2.549	
8	208.26	161.09	380.00	200.00	245.81	393.79	235.71	2.550	
9	207.21	161.00	380.00	200.00	244.54	397.87	239.80	2.550	
10	205.63	161.00	380.00	200.00	243.28	401.95	243.88	2.551	
11	204.05	161.00	380.00	200.00	242.04	406.03	247.96	2.553	
12	208.79	161.26	380.53	200.00	247.52	389.64	231.63	2.554	
13	210.89	161.96	380.00	200.00	252.20	373.27	215.31	2.555	
14	207.74	161.00	380.00	200.00	244.64	397.94	239.80	2.555	
15	206.68	161.00	380.00	200.00	243.48	402.09	243.88	2.555	
16	208.26	161.09	380.53	200.00	246.24	393.72	235.71	2.555	
17	207.21	161.00	380.53	200.00	244.97	397.80	239.80	2.556	
18	206.16	161.00	380.00	200.00	243.38	402.02	243.88	2.556	
19	205.63	161.00	380.53	200.00	243.71	401.89	243.88	2.557	
20	204.58	161.00	380.00	200.00	242.13	406.10	247.96	2.558	
21	204.05	161.00	380.53	200.00	242.46	405.97	247.96	2.559	
22	203.00	161.00	380.00	200.00	240.89	410.18	252.04	2.559	
23	207.74	161.00	380.53	200.00	245.07	397.87	239.80	2.560	
24	208.26	161.09	380.00	200.00	244.84	398.08	239.80	2.561	
25	209.32	161.44	380.53	200.00	248.79	385.54	227.55	2.561	
26	210.37	161.79	380.00	200.00	249.95	381.73	223.47	2.561	
27	207.21	161.00	380.00	200.00	243.58	402.15	243.88	2.561	
28	206.16	161.00	380.53	200.00	243.81	401.95	243.88	2.562	
29	209.84	161.61	380.00	200.00	248.67	385.83	227.55	2.562	
30	205.11	161.00	380.00	200.00	242.23	406.16	247.96	2.562	
31	205.63	161.00	380.00	200.00	242.33	406.23	247.96	2.562	
32	209.32	161.44	380.00	200.00	247.39	389.92	231.63	2.563	
33	213.00	162.67	380.00	200.00	256.32	361.05	203.06	2.563	
34	208.79	161.26	380.00	200.00	246.12	394.00	235.71	2.563	
35	204.58	161.00	380.53	200.00	242.56	406.03	247.96	2.563	
36	204.05	161.00	380.00	200.00	241.09	410.30	252.04	2.564	
37	203.53	161.00	380.00	200.00	240.99	410.24	252.04	2.564	
38	212.47	162.49	380.00	200.00	255.05	365.21	207.14	2.564	
39	203.00	161.00	380.53	200.00	241.32	410.11	252.04	2.565	
40	207.21	161.00	380.53	200.00	244.01	402.09	243.88	2.565	
41	206.68	161.00	380.53	200.00	243.91	402.02	243.88	2.566	
42	211.95	162.32	380.00	200.00	253.77	369.36	211.22	2.566	
43	206.16	161.00	381.05	200.00	244.24	401.89	243.88	2.567	
44	207.74	161.00	380.00	200.00	243.67	402.22	243.88	2.567	
45	205.11	161.00	380.53	200.00	242.66	406.10	247.96	2.567	
46	206.16	161.00	380.00	200.00	242.42	406.29	247.96	2.568	
47	211.42	162.14	380.00	200.00	252.50	373.49	215.31	2.568	
48	211.42	162.14	380.53	200.00	252.91	373.41	215.31	2.568	
49	212.47	162.49	380.53	200.00	255.46	365.12	207.14	2.568	
50	204.58	161.00	381.05	200.00	242.99	405.97	247.96	2.568	
51	211.95	162.32	380.53	200.00	254.19	369.27	211.22	2.569	
52	208.79	161.26	380.53	200.00	246.55	393.93	235.71	2.569	
53	204.58	161.00	380.00	200.00	241.18	410.37	252.04	2.569	
54	203.53	161.00	380.53	200.00	241.42	410.18	252.04	2.569	
55	210.89	161.96	380.53	200.00	251.64	377.54	219.39	2.570	
56	203.00	161.00	381.05	200.00	241.75	410.04	252.04	2.570	
57	203.00	161.00	380.00	200.00	239.95	414.44	256.12	2.571	
58	208.26	161.09	380.53	200.00	245.27	398.01	239.80	2.571	
59	207.74	161.00	380.53	200.00	244.10	402.15	243.88	2.571	
60	206.68	161.00	381.05	200.00	244.34	401.95	243.88	2.572	
61	205.63	161.00	380.53	200.00	242.76	406.16	247.96	2.572	
62	206.16	161.00	380.53	200.00	242.85	406.23	247.96	2.572	
63	205.11	161.00	381.05	200.00	243.09	406.03	247.96	2.573	
64	210.37	161.79	381.05	200.00	250.79	381.57	223.47	2.573	
65	210.89	161.96	380.00	200.00	251.22	377.61	219.39	2.573	
66	204.58	161.00	380.53	200.00	241.61	410.30	252.04	2.573	
67	206.68	161.00	380.00	200.00	242.52	406.36	247.96	2.574	
68	204.05	161.00	380.53	200.00	241.52	410.24	252.04	2.574	

69	209.84	161.61	380.53	200.00	249.09	385.75	227.55	2.574
70	207.74	161.00	381.05	200.00	245.50	397.80	239.80	2.574
71	210.89	161.96	381.05	200.00	252.06	377.46	219.39	2.574
72	209.32	161.44	380.00	200.00	246.42	394.21	235.71	2.574
73	211.95	162.32	381.05	200.00	254.60	369.19	211.22	2.574
74	211.42	162.14	381.05	200.00	253.33	373.33	215.31	2.574
75	210.37	161.79	380.53	200.00	250.37	381.65	223.47	2.574
76	205.11	161.00	380.00	200.00	241.28	410.43	252.04	2.575
77	203.53	161.00	381.05	200.00	241.85	410.11	252.04	2.575
78	203.00	161.00	380.53	200.00	240.38	414.38	256.12	2.575
79	207.74	161.00	381.05	200.00	244.53	402.09	243.88	2.576
80	209.84	161.61	381.05	200.00	249.51	385.68	227.55	2.576
81	208.79	161.26	380.00	200.00	245.15	398.29	239.80	2.576
82	203.53	161.00	380.00	200.00	240.05	414.51	256.12	2.576
83	207.21	161.00	381.05	200.00	244.44	402.02	243.88	2.576
84	209.32	161.44	381.05	200.00	248.24	389.78	231.63	2.576
85	209.32	161.44	380.53	200.00	247.82	389.85	231.63	2.577
86	205.63	161.00	381.05	200.00	243.19	406.10	247.96	2.577
87	207.21	161.00	380.00	200.00	242.61	406.42	247.96	2.578
88	206.68	161.00	380.53	200.00	242.95	406.29	247.96	2.578
89	209.84	161.61	380.00	200.00	247.70	390.13	231.63	2.578
90	205.11	161.00	381.58	200.00	243.51	405.97	247.96	2.578
91	210.37	161.79	380.00	200.00	248.97	386.04	227.55	2.578
92	210.89	161.96	380.00	200.00	250.25	381.94	223.47	2.578
93	208.26	161.09	380.00	200.00	243.87	402.35	243.88	2.579
94	213.00	162.67	380.00	200.00	255.34	365.44	207.14	2.579
95	209.84	161.61	381.58	200.00	249.93	385.61	227.55	2.579
96	205.63	161.00	380.00	200.00	241.37	410.49	252.04	2.579
97	204.05	161.00	381.05	200.00	241.95	410.18	252.04	2.579
98	205.11	161.00	380.53	200.00	241.71	410.37	252.04	2.579
99	208.79	161.26	381.58	200.00	247.40	393.79	235.71	2.579

Critical Failure Surface (circle 1)

Intersects: XL: 206.68 YL: 161.00 XR: 380.00 YR: 200.00
Centre: XC: 244.44 YC: 397.80 Radius: R: 239.80

Generated failure surface: (20 points)

206.68 161.00 216.17 159.68 225.70 158.74 235.26 158.18
244.84 158.01
254.41 158.22 263.97 158.81 273.50 159.78 282.98 161.13
292.40 162.85
301.75 164.96 311.00 167.43 320.15 170.27 329.17 173.48
338.06 177.04
346.80 180.95 355.38 185.21 363.78 189.81 371.99 194.74
380.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base							PoreWater	
Normal	Test									
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force
Stress	Factor									
1	206.68	0.12	-7.9	1.32	1.33	3	100.00	18.0	16.97	2991.82
2264.99	1.03									
2	208.00	4.69	-7.9	4.09	4.12	3	100.00	18.0	633.35	9385.63
2366.01	1.03									
3	212.09	12.57	-7.9	4.09	4.12	3	100.00	18.0	1689.32	9531.82
2542.01	1.03									
4	216.17	24.17	-5.6	4.77	4.79	3	100.00	18.0	3240.24	11221.82
2715.34	1.02									
5	220.94	33.98	-5.6	4.77	4.79	3	100.00	18.0	4547.52	11362.13
2892.38	1.02									
6	225.70	43.48	-3.3	4.78	4.79	3	100.00	18.0	5810.38	11473.82
3051.06	1.01									
7	230.48	52.43	-3.3	4.78	4.79	3	100.00	18.0	6996.30	11557.11
3200.68	1.01									
8	235.26	61.02	-1.0	4.79	4.79	3	100.00	18.0	8131.16	11612.07
3330.61	1.00									
9	240.05	69.09	-1.0	4.79	4.79	3	100.00	18.0	9191.44	11638.29
3452.74	1.00									
10	244.84	33.73	1.2	2.16	2.16	3	100.00	18.0	4482.15	5255.45
3528.09	1.00									
11	247.00	61.25	1.2	3.71	3.71	3	100.00	18.0	8131.74	9001.98
3586.06	1.00									
12	250.71	65.54	1.2	3.71	3.71	3	100.00	18.0	8689.98	8983.43
3659.31	1.00									
13	254.41	90.36	3.5	4.78	4.79	3	100.00	18.0	11963.26	11545.50
3721.45	0.99									
14	259.19	96.57	3.5	4.78	4.79	3	100.00	18.0	12762.30	11457.45
3788.54	0.99									
15	263.97	101.97	5.8	4.76	4.79	3	100.00	18.0	13451.44	11340.89
3833.03	0.99									
16	268.74	107.23	5.8	4.76	4.79	3	100.00	18.0	14116.65	11195.96

3872.64	0.99									
17	273.50	100.89	8.1	4.30	4.34	3	100.00	18.0	13256.64	10003.68
3888.45	0.99									
18	277.80	104.42	8.1	4.30	4.34	3	100.00	18.0	13692.51	9837.73
3899.54	0.99									
19	282.10	21.90	8.1	0.88	0.89	2	0.00	35.0	2869.16	2001.66
3878.60	0.97									
20	282.98	118.80	10.4	4.71	4.79	2	0.00	35.0	15562.87	10590.83
3858.71	0.97									
21	287.69	122.13	10.4	4.71	4.79	2	0.00	35.0	15998.70	10332.74
3850.92	0.97									
22	292.40	123.97	12.7	4.67	4.79	2	0.00	35.0	16239.66	10046.55
3812.07	0.97									
23	297.08	126.33	12.7	4.67	4.79	2	0.00	35.0	16549.36	9732.40
3779.16	0.97									
24	301.75	126.97	15.0	4.63	4.79	2	0.00	35.0	16633.20	9390.48
3714.71	0.96									
25	306.37	128.38	15.0	4.63	4.79	2	0.00	35.0	16818.20	9020.90
3657.02	0.96									
26	311.00	139.77	17.3	5.00	5.23	2	0.00	35.0	18310.21	9405.19
3563.73	0.96									
27	316.00	116.39	17.3	4.15	4.34	2	0.00	35.0	15246.88	7417.75
3521.36	0.96									
28	320.15	136.16	19.5	4.85	5.15	2	0.00	35.0	17836.48	8311.67
3492.15	0.97									
29	325.00	113.77	19.5	4.17	4.43	2	0.00	35.0	14903.71	6704.43
3388.56	0.97									
30	329.17	34.32	21.8	1.31	1.41	2	0.00	35.0	4496.07	2043.62
3242.85	0.97									
31	330.48	95.70	21.8	3.79	4.08	1	150.00	22.0	12537.35	5668.91
3169.54	1.01									
32	334.27	89.94	21.8	3.79	4.08	1	150.00	22.0	11782.75	5281.67
2976.74	1.01									
33	338.06	96.08	24.1	4.37	4.79	1	150.00	22.0	12585.88	5672.38
2742.58	1.02									
34	342.43	87.52	24.1	4.37	4.79	1	150.00	22.0	11465.35	5087.54
2495.09	1.02									
35	346.80	31.58	26.4	1.70	1.89	1	150.00	22.0	4137.53	1846.13
2305.77	1.03									
36	348.50	52.38	26.4	3.00	3.35	5	0.00	45.0	5761.62	1768.19
1693.15	0.93									
37	351.50	54.73	26.4	3.45	3.85	1	150.00	22.0	7170.18	206.15
1902.27	1.03									
38	354.95	60.99	28.5	4.42	5.02	1	150.00	22.0	7989.99	0.00
1636.59	1.05									
39	359.37	50.32	28.7	4.42	5.03	1	150.00	22.0	6591.52	0.00
1343.76	1.05									
40	363.78	36.76	31.0	4.11	4.79	1	150.00	22.0	4815.21	0.00
1038.54	1.06									
41	367.89	26.63	31.0	4.11	4.79	1	150.00	22.0	3489.16	0.00
743.65	1.06									
42	371.99	15.78	33.3	4.00	4.79	1	150.00	22.0	2067.06	0.00
432.58	1.08									
43	376.00	5.26	33.3	4.00	4.79	1	150.00	22.0	689.03	0.00
120.84	1.08									
		---		---					---	
X-S Area:		3076.08	Path Length:		181.97		X-S Weight:		403350.50	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 5-1\West Farm Expansion Case 5-1 Rapid Drawdown.gmf
Processed: 04 Dec 2020 12:51:06

DATA: Analysis 1 - Case 5-1 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	174.00	348.50	174.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	161.00	348.50	161.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	158.00	348.50	158.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	174.00	450.00	174.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	161.00	450.00	161.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	158.00	450.00	158.00	

Slope Surface (4 points)

100.00	161.00	208.00	161.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	161.00	208.00	161.00	316.00	197.00	348.50	197.00
351.50	185.00						
450.00	185.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	208.00	YL:	161.00	XR:	385.00	YR: 200.00
Centre:	XC:	246.36	YC:	408.04	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 5-1 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 1.451

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.39

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	206.68	161.00	380.00	200.00	244.44	397.80	239.80	1.393	<-- Critical Surface
2	205.11	161.00	380.00	200.00	243.19	401.89	243.88	1.394	
3	208.79	161.26	380.00	200.00	247.09	389.71	231.63	1.395	
4	209.84	161.61	380.00	200.00	249.64	381.51	223.47	1.395	
5	203.53	161.00	380.00	200.00	241.94	405.97	247.96	1.395	
6	210.37	161.79	380.00	200.00	250.92	377.40	219.39	1.395	
7	209.32	161.44	380.00	200.00	248.37	385.61	227.55	1.395	
8	207.21	161.00	380.00	200.00	244.54	397.87	239.80	1.396	
9	208.26	161.09	380.00	200.00	245.81	393.79	235.71	1.396	
10	205.63	161.00	380.00	200.00	243.28	401.95	243.88	1.397	
11	204.05	161.00	380.00	200.00	242.04	406.03	247.96	1.398	
12	210.89	161.96	380.00	200.00	252.20	373.27	215.31	1.398	
13	207.74	161.00	380.00	200.00	244.64	397.94	239.80	1.399	
14	208.79	161.26	380.53	200.00	247.52	389.64	231.63	1.399	
15	207.21	161.00	380.53	200.00	244.97	397.80	239.80	1.399	
16	208.26	161.09	380.53	200.00	246.24	393.72	235.71	1.399	
17	206.16	161.00	380.00	200.00	243.38	402.02	243.88	1.399	
18	206.68	161.00	380.00	200.00	243.48	402.09	243.88	1.400	
19	205.63	161.00	380.53	200.00	243.71	401.89	243.88	1.400	
20	204.58	161.00	380.00	200.00	242.13	406.10	247.96	1.400	
21	204.05	161.00	380.53	200.00	242.46	405.97	247.96	1.401	
22	209.32	161.44	380.53	200.00	248.79	385.54	227.55	1.401	
23	203.00	161.00	380.00	200.00	240.89	410.18	252.04	1.401	
24	207.74	161.00	380.53	200.00	245.07	397.87	239.80	1.402	
25	206.16	161.00	380.53	200.00	243.81	401.95	243.88	1.403	
26	208.26	161.09	380.00	200.00	244.84	398.08	239.80	1.403	
27	205.11	161.00	380.00	200.00	242.23	406.16	247.96	1.403	
28	207.21	161.00	380.00	200.00	243.58	402.15	243.88	1.403	
29	205.63	161.00	380.00	200.00	242.33	406.23	247.96	1.404	
30	210.37	161.79	380.00	200.00	249.95	381.73	223.47	1.404	
31	204.58	161.00	380.53	200.00	242.56	406.03	247.96	1.404	
32	209.84	161.61	380.00	200.00	248.67	385.83	227.55	1.404	
33	203.53	161.00	380.00	200.00	240.99	410.24	252.04	1.404	
34	209.32	161.44	380.00	200.00	247.39	389.92	231.63	1.404	
35	208.79	161.26	380.00	200.00	246.12	394.00	235.71	1.404	
36	204.05	161.00	380.00	200.00	241.09	410.30	252.04	1.405	
37	203.00	161.00	380.53	200.00	241.32	410.11	252.04	1.405	
38	213.00	162.67	380.00	200.00	256.32	361.05	203.06	1.406	
39	206.68	161.00	380.53	200.00	243.91	402.02	243.88	1.406	
40	207.21	161.00	380.53	200.00	244.01	402.09	243.88	1.406	
41	212.47	162.49	380.00	200.00	255.05	365.21	207.14	1.406	
42	206.16	161.00	381.05	200.00	244.24	401.89	243.88	1.406	
43	205.11	161.00	380.53	200.00	242.66	406.10	247.96	1.407	
44	211.95	162.32	380.00	200.00	253.77	369.36	211.22	1.407	
45	207.74	161.00	380.00	200.00	243.67	402.22	243.88	1.407	
46	211.42	162.14	380.00	200.00	252.50	373.49	215.31	1.407	
47	204.58	161.00	381.05	200.00	242.99	405.97	247.96	1.407	
48	206.16	161.00	380.00	200.00	242.42	406.29	247.96	1.407	
49	203.53	161.00	380.53	200.00	241.42	410.18	252.04	1.408	
50	204.58	161.00	380.00	200.00	241.18	410.37	252.04	1.408	
51	208.79	161.26	380.53	200.00	246.55	393.93	235.71	1.408	
52	203.00	161.00	381.05	200.00	241.75	410.04	252.04	1.408	
53	207.74	161.00	381.05	200.00	245.50	397.80	239.80	1.408	
54	211.42	162.14	380.53	200.00	252.91	373.41	215.31	1.409	
55	203.00	161.00	380.00	200.00	239.95	414.44	256.12	1.409	
56	210.89	161.96	380.53	200.00	251.64	377.54	219.39	1.409	
57	208.26	161.09	380.53	200.00	245.27	398.01	239.80	1.409	
58	210.89	161.96	380.00	200.00	251.22	377.61	219.39	1.409	
59	211.95	162.32	380.53	200.00	254.19	369.27	211.22	1.409	
60	206.68	161.00	381.05	200.00	244.34	401.95	243.88	1.409	
61	212.47	162.49	380.53	200.00	255.46	365.12	207.14	1.409	
62	205.63	161.00	380.53	200.00	242.76	406.16	247.96	1.409	
63	209.84	161.61	380.53	200.00	249.09	385.75	227.55	1.410	
64	207.74	161.00	380.53	200.00	244.10	402.15	243.88	1.410	
65	205.11	161.00	381.05	200.00	243.09	406.03	247.96	1.410	
66	206.16	161.00	380.53	200.00	242.85	406.23	247.96	1.410	
67	204.05	161.00	380.53	200.00	241.52	410.24	252.04	1.410	
68	209.32	161.44	380.53	200.00	247.82	389.85	231.63	1.410	

69	210.37	161.79	380.53	200.00	250.37	381.65	223.47	1.411
70	206.68	161.00	380.00	200.00	242.52	406.36	247.96	1.411
71	204.58	161.00	380.53	200.00	241.61	410.30	252.04	1.411
72	203.53	161.00	381.05	200.00	241.85	410.11	252.04	1.411
73	205.11	161.00	380.00	200.00	241.28	410.43	252.04	1.411
74	210.37	161.79	381.05	200.00	250.79	381.57	223.47	1.411
75	203.00	161.00	380.53	200.00	240.38	414.38	256.12	1.412
76	209.32	161.44	380.00	200.00	246.42	394.21	235.71	1.412
77	210.89	161.96	381.05	200.00	252.06	377.46	219.39	1.412
78	209.32	161.44	381.05	200.00	248.24	389.78	231.63	1.412
79	203.53	161.00	380.00	200.00	240.05	414.51	256.12	1.412
80	207.21	161.00	381.05	200.00	244.44	402.02	243.88	1.412
81	209.84	161.61	381.05	200.00	249.51	385.68	227.55	1.412
82	207.74	161.00	381.05	200.00	244.53	402.09	243.88	1.412
83	211.42	162.14	381.05	200.00	253.33	373.33	215.31	1.412
84	208.79	161.26	380.00	200.00	245.15	398.29	239.80	1.413
85	211.95	162.32	381.05	200.00	254.60	369.19	211.22	1.413
86	205.63	161.00	381.05	200.00	243.19	406.10	247.96	1.413
87	208.79	161.26	381.05	200.00	246.97	393.86	235.71	1.413
88	205.11	161.00	381.58	200.00	243.51	405.97	247.96	1.413
89	207.21	161.00	380.00	200.00	242.61	406.42	247.96	1.413
90	206.68	161.00	380.53	200.00	242.95	406.29	247.96	1.414
91	204.05	161.00	381.05	200.00	241.95	410.18	252.04	1.414
92	205.63	161.00	380.00	200.00	241.37	410.49	252.04	1.414
93	208.26	161.09	380.00	200.00	243.87	402.35	243.88	1.414
94	205.11	161.00	380.53	200.00	241.71	410.37	252.04	1.414
95	203.53	161.00	381.58	200.00	242.27	410.04	252.04	1.414
96	209.84	161.61	380.00	200.00	247.70	390.13	231.63	1.414
97	208.79	161.26	381.58	200.00	247.40	393.79	235.71	1.414
98	210.37	161.79	380.00	200.00	248.97	386.04	227.55	1.415
99	206.68	161.00	381.58	200.00	244.76	401.89	243.88	1.415

Critical Failure Surface (circle 1)

Intersects: XL: 206.68 YL: 161.00 XR: 380.00 YR: 200.00
Centre: XC: 244.44 YC: 397.80 Radius: R: 239.80
Generated failure surface: (20 points)
206.68 161.00 216.17 159.68 225.70 158.74 235.26 158.18
244.84 158.01
254.41 158.22 263.97 158.81 273.50 159.78 282.98 161.13
292.40 162.85
301.75 164.96 311.00 167.43 320.15 170.27 329.17 173.48
338.06 177.04
346.80 180.95 355.38 185.21 363.78 189.81 371.99 194.74
380.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	206.68	0.12	-7.9	1.32	1.33	3	100.00	18.0	16.97	7.58	23.46	1.04
2	208.00	4.69	-7.9	4.09	4.12	3	100.00	18.0	633.35	295.42	168.14	1.04
3	212.09	12.57	-7.9	4.09	4.12	3	100.00	18.0	1689.32	792.09	431.25	1.04
4	216.17	24.17	-5.6	4.77	4.79	3	100.00	18.0	3240.24	1515.47	695.69	1.03
5	220.94	33.98	-5.6	4.77	4.79	3	100.00	18.0	4547.52	2130.48	973.44	1.03
6	225.70	43.48	-3.3	4.78	4.79	3	100.00	18.0	5810.38	2717.71	1228.59	1.02
7	230.48	52.43	-3.3	4.78	4.79	3	100.00	18.0	6996.30	3277.21	1478.47	1.02
8	235.26	61.02	-1.0	4.79	4.79	3	100.00	18.0	8131.16	3808.58	1703.44	1.00
9	240.05	69.09	-1.0	4.79	4.79	3	100.00	18.0	9191.44	4311.72	1925.38	1.00
10	244.84	33.73	1.2	2.16	2.16	3	100.00	18.0	4482.15	2104.96	2067.22	1.00
11	247.00	61.25	1.2	3.71	3.71	3	100.00	18.0	8131.74	3823.05	2186.09	1.00
12	250.71	65.54	1.2	3.71	3.71	3	100.00	18.0	8689.98	4090.43	2336.27	1.00
13	254.41	90.36	3.5	4.78	4.79	3	100.00	18.0	11963.26	5649.20	2479.80	0.99
14	259.19	96.57	3.5	4.78	4.79	3	100.00	18.0	12762.30	6037.25	2645.75	0.99
15	263.97	101.97	5.8	4.76	4.79	3	100.00	18.0	13451.44	6396.02	2781.81	0.98
16	268.74	107.23	5.8	4.76	4.79	3	100.00	18.0	14116.65	6725.60		

2919.78	0.98									
17	273.50	100.89	8.1	4.30	4.34	3	100.00	18.0	13256.64	6359.32
3021.66	0.98									
18	277.80	104.42	8.1	4.30	4.34	3	100.00	18.0	13692.51	6581.70
3121.45	0.98									
19	282.10	21.90	8.1	0.88	0.89	2	0.00	35.0	2869.16	1380.47
3133.19	0.94									
20	282.98	118.80	10.4	4.71	4.79	2	0.00	35.0	15562.87	7536.81
3158.01	0.93									
21	287.69	122.13	10.4	4.71	4.79	2	0.00	35.0	15998.70	7747.87
3246.43	0.93									
22	292.40	123.97	12.7	4.67	4.79	2	0.00	35.0	16239.66	7928.96
3291.00	0.92									
23	297.08	126.33	12.7	4.67	4.79	2	0.00	35.0	16549.36	8080.17
3353.76	0.92									
24	301.75	126.97	15.0	4.63	4.79	2	0.00	35.0	16633.20	8201.34
3372.31	0.91									
25	306.37	128.38	15.0	4.63	4.79	2	0.00	35.0	16818.20	8292.56
3409.79	0.91									
26	311.00	139.77	17.3	5.00	5.23	2	0.00	35.0	18310.21	9133.03
3403.67	0.91									
27	316.00	116.39	17.3	4.15	4.34	2	0.00	35.0	15246.88	7417.75
3410.46	0.91									
28	320.15	136.16	19.5	4.85	5.15	2	0.00	35.0	17836.48	8311.67
3363.37	0.90									
29	325.00	113.77	19.5	4.17	4.43	2	0.00	35.0	14903.71	6704.43
3260.03	0.90									
30	329.17	34.32	21.8	1.31	1.41	2	0.00	35.0	4496.07	2043.62
3106.87	0.90									
31	330.48	95.70	21.8	3.79	4.08	1	150.00	22.0	12537.35	5668.91
3068.04	0.97									
32	334.27	89.94	21.8	3.79	4.08	1	150.00	22.0	11782.75	5281.67
2879.86	0.97									
33	338.06	96.08	24.1	4.37	4.79	1	150.00	22.0	12585.88	5672.38
2642.15	0.97									
34	342.43	87.52	24.1	4.37	4.79	1	150.00	22.0	11465.35	5087.54
2401.19	0.97									
35	346.80	31.58	26.4	1.70	1.89	1	150.00	22.0	4137.53	1846.13
2208.73	0.98									
36	348.50	52.38	26.4	3.00	3.35	5	0.00	45.0	5761.62	1768.19
1554.47	0.82									
37	351.50	54.73	26.4	3.45	3.85	1	150.00	22.0	7170.18	206.15
1775.69	0.98									
38	354.95	60.99	28.5	4.42	5.02	1	150.00	22.0	7989.99	0.00
1512.98	0.98									
39	359.37	50.32	28.7	4.42	5.03	1	150.00	22.0	6591.52	0.00
1237.34	0.98									
40	363.78	36.76	31.0	4.11	4.79	1	150.00	22.0	4815.21	0.00
943.83	0.99									
41	367.89	26.63	31.0	4.11	4.79	1	150.00	22.0	3489.16	0.00
668.75	0.99									
42	371.99	15.78	33.3	4.00	4.79	1	150.00	22.0	2067.06	0.00
374.38	1.00									
43	376.00	5.26	33.3	4.00	4.79	1	150.00	22.0	689.03	0.00
85.21	1.00									

X-S Area: 3076.08 Path Length: 181.97 X-S Weight: 403350.50

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 5-2 Full Reservoir.gmf
Processed: 02 Dec 2020 14:23:57

DATA: Analysis 1 - Case 5-2 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	192.00	348.50	192.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	183.00	348.50	183.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	180.00	348.50	180.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	192.00	450.00	192.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	183.00	450.00	183.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	180.00	450.00	180.00	

Slope Surface (8 points)

100.00	183.00	274.00	183.00	325.00	200.00	400.00	200.00
405.00	195.00						
410.00	195.00	415.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	197.00	274.00	197.00	316.00	197.00	348.50	197.00
351.50	197.00						
450.00	197.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	274.00	YL:	183.00	XR:	405.00	YR: 195.00
Centre:	XC:	317.50	YC:	429.19	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 5-2 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

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Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 10.645

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 4.13

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	271.11	183.00	400.00	200.00	307.60	403.47	223.47	4.127	<-- Critical Surface
2	270.05	183.00	400.00	200.00	306.76	407.57	227.55	4.128	
3	269.00	183.00	400.00	200.00	305.93	411.67	231.63	4.130	
4	271.63	183.00	400.00	200.00	307.74	403.53	223.47	4.142	
5	272.68	183.00	400.00	200.00	308.58	399.43	219.39	4.142	
6	270.58	183.00	400.00	200.00	306.90	407.63	227.55	4.142	
7	269.53	183.00	400.00	200.00	306.07	411.73	231.63	4.144	
8	274.26	183.09	400.00	200.00	310.27	391.22	211.22	4.146	
9	273.74	183.00	400.00	200.00	309.43	395.33	215.31	4.149	
10	272.16	183.00	400.00	200.00	307.88	403.60	223.47	4.156	
11	271.11	183.00	400.00	200.00	307.04	407.70	227.55	4.157	
12	270.05	183.00	400.00	200.00	306.21	411.79	231.63	4.158	
13	269.00	183.00	400.00	200.00	305.38	415.89	235.71	4.161	
14	274.79	183.26	400.00	200.00	311.26	387.17	207.14	4.163	
15	273.21	183.00	400.00	200.00	308.72	399.50	219.39	4.168	
16	271.63	183.00	400.00	200.00	307.18	407.76	227.55	4.171	
17	272.68	183.00	400.00	200.00	308.01	403.66	223.47	4.171	
18	270.58	183.00	400.00	200.00	306.34	411.85	231.63	4.172	
19	269.53	183.00	400.00	200.00	305.52	415.95	235.71	4.174	
20	274.26	183.09	400.00	200.00	309.70	395.46	215.31	4.176	
21	273.74	183.00	400.00	200.00	308.86	399.56	219.39	4.179	
22	271.63	183.00	400.53	199.47	308.43	407.56	227.55	4.181	
23	270.58	183.00	400.53	199.47	307.61	411.65	231.63	4.181	
24	275.32	183.44	400.00	200.00	312.24	383.12	203.06	4.182	
25	269.53	183.00	400.53	199.47	306.79	415.75	235.71	4.183	
26	272.16	183.00	400.00	200.00	307.31	407.82	227.55	4.186	
27	273.21	183.00	400.00	200.00	308.15	403.72	223.47	4.186	
28	271.11	183.00	400.00	200.00	306.48	411.92	231.63	4.186	
29	270.05	183.00	400.00	200.00	305.66	416.01	235.71	4.188	
30	269.00	183.00	400.00	200.00	304.83	420.10	239.80	4.191	
31	272.68	183.00	400.53	199.47	309.26	403.46	223.47	4.192	
32	274.79	183.26	400.00	200.00	310.69	391.41	211.22	4.194	
33	271.11	183.00	400.53	199.47	307.75	411.72	231.63	4.197	
34	272.16	183.00	400.53	199.47	308.57	407.62	227.55	4.197	
35	270.05	183.00	400.53	199.47	306.93	415.81	235.71	4.198	
36	269.00	183.00	400.53	199.47	306.12	419.91	239.80	4.199	
37	272.68	183.00	400.00	200.00	307.45	407.88	227.55	4.200	
38	271.63	183.00	400.00	200.00	306.62	411.98	231.63	4.200	
39	270.58	183.00	400.00	200.00	305.79	416.07	235.71	4.202	
40	275.84	183.61	400.00	200.00	313.21	379.05	198.98	4.203	
41	273.21	183.00	400.53	199.47	309.40	403.52	223.47	4.204	
42	269.53	183.00	400.00	200.00	304.97	420.16	239.80	4.204	
43	274.79	183.26	400.53	199.47	311.89	391.20	211.22	4.205	
44	274.26	183.09	400.00	200.00	309.14	399.69	219.39	4.205	
45	273.74	183.00	400.00	200.00	308.29	403.78	223.47	4.208	
46	271.63	183.00	400.53	199.47	307.89	411.78	231.63	4.212	
47	270.58	183.00	400.53	199.47	307.08	415.87	235.71	4.212	
48	269.53	183.00	400.53	199.47	306.26	419.97	239.80	4.214	
49	275.32	183.44	400.00	200.00	311.67	387.37	207.14	4.214	
50	272.16	183.00	400.00	200.00	306.75	412.03	231.63	4.214	
51	273.21	183.00	400.00	200.00	307.58	407.94	227.55	4.214	
52	271.11	183.00	400.00	200.00	305.93	416.13	235.71	4.215	
53	273.74	183.00	400.53	199.47	309.54	403.58	223.47	4.216	
54	274.26	183.09	400.53	199.47	310.38	399.48	219.39	4.217	
55	274.79	183.26	400.00	200.00	310.12	395.65	215.31	4.223	
56	272.68	183.00	400.53	199.47	308.71	407.68	227.55	4.223	
57	276.37	183.79	400.00	200.00	314.18	374.98	194.90	4.224	
58	271.11	183.00	400.53	199.47	307.21	415.93	235.71	4.227	
59	275.32	183.44	400.53	199.47	312.86	387.15	207.14	4.227	
60	272.16	183.00	400.53	199.47	308.03	411.84	231.63	4.227	
61	270.05	183.00	400.53	199.47	306.40	420.02	239.80	4.228	
62	269.00	183.00	400.53	199.47	305.60	424.12	243.88	4.230	
63	270.05	183.00	400.00	200.00	305.10	420.22	239.80	4.230	
64	271.63	183.00	400.00	200.00	306.06	416.19	235.71	4.231	
65	270.58	183.00	400.00	200.00	305.24	420.28	239.80	4.231	
66	269.00	183.00	400.00	200.00	304.29	424.31	243.88	4.231	

67	272.68	183.00	400.00	200.00	306.89	412.09	231.63	4.232
68	269.53	183.00	400.00	200.00	304.42	424.37	243.88	4.234
69	273.21	183.00	400.53	199.47	308.85	407.74	227.55	4.234
70	274.26	183.09	400.00	200.00	308.57	403.91	223.47	4.234
71	275.84	183.61	400.00	200.00	312.65	383.31	203.06	4.235
72	274.79	183.26	400.53	199.47	311.35	395.44	215.31	4.236
73	271.63	183.00	400.53	199.47	307.35	415.99	235.71	4.241
74	272.68	183.00	400.53	199.47	308.17	411.90	231.63	4.242
75	270.58	183.00	400.53	199.47	306.54	420.08	239.80	4.242
76	273.74	183.00	400.00	200.00	307.72	408.00	227.55	4.243
77	269.53	183.00	400.53	199.47	305.73	424.17	243.88	4.243
78	275.32	183.44	400.00	200.00	311.11	391.61	211.22	4.244
79	273.21	183.00	400.00	200.00	307.02	412.15	231.63	4.244
80	273.74	183.00	400.53	199.47	308.99	407.80	227.55	4.245
81	272.16	183.00	400.00	200.00	306.19	416.24	235.71	4.245
82	270.05	183.00	401.05	198.95	307.69	419.82	239.80	4.246
83	271.11	183.00	401.05	198.95	308.50	415.73	235.71	4.246
84	274.26	183.09	400.53	199.47	309.83	403.71	223.47	4.246
85	269.00	183.00	401.05	198.95	306.90	423.92	243.88	4.247
86	271.11	183.00	400.00	200.00	305.37	420.34	239.80	4.247
87	270.05	183.00	400.00	200.00	304.55	424.42	243.88	4.250
88	273.21	183.00	401.05	198.95	310.12	407.54	227.55	4.250
89	275.84	183.61	400.53	199.47	313.82	383.09	203.06	4.251
90	274.79	183.26	400.00	200.00	309.56	399.88	219.39	4.252
91	276.89	183.96	400.00	200.00	315.14	370.91	190.82	4.253
92	269.00	183.00	400.00	200.00	303.74	428.51	247.96	4.254
93	272.16	183.00	400.53	199.47	307.49	416.05	235.71	4.255
94	271.11	183.00	400.53	199.47	306.68	420.14	239.80	4.256
95	270.05	183.00	400.53	199.47	305.87	424.23	243.88	4.257
96	275.32	183.44	400.53	199.47	312.32	391.40	211.22	4.257
97	272.16	183.00	401.05	198.95	309.30	411.63	231.63	4.257
98	276.37	183.79	400.00	200.00	313.62	379.25	198.98	4.258
99	269.00	183.00	400.53	199.47	305.07	428.32	247.96	4.260

Critical Failure Surface (circle 1)

Intersects: XL: 271.11 YL: 183.00 XR: 400.00 YR: 200.00
Centre: XC: 307.60 YC: 403.47 Radius: R: 223.47

Generated failure surface: (20 points)

271.11 183.00 277.97 181.97 284.87 181.16 291.78 180.56
298.72 180.18
305.66 180.01 312.60 180.06 319.54 180.32 326.46 180.80
333.37 181.49
340.25 182.40 347.11 183.52 353.92 184.85 360.69 186.40
367.41 188.15
374.07 190.12 380.66 192.28 387.19 194.65 393.63 197.23
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	271.11	0.63	-8.5	2.89	2.93	3	100.00	18.0	88.37	2596.50	908.00	1.02
2	274.00	5.53	-8.5	3.97	4.02	3	100.00	18.0	753.26	3691.22	1026.84	1.02
3	277.97	10.79	-6.7	3.45	3.47	3	100.00	18.0	1455.54	3299.17	1182.35	1.02
4	281.42	16.15	-6.7	3.45	3.47	3	100.00	18.0	2172.24	3387.30	1319.56	1.02
5	284.87	21.40	-4.9	3.46	3.47	3	100.00	18.0	2872.75	3463.72	1447.41	1.01
6	288.33	26.43	-4.9	3.46	3.47	3	100.00	18.0	3541.01	3528.55	1569.41	1.01
7	291.78	31.34	-3.2	3.47	3.47	3	100.00	18.0	4192.86	3581.74	1681.51	1.01
8	295.25	36.01	-3.2	3.47	3.47	3	100.00	18.0	4811.19	3623.29	1788.23	1.01
9	298.72	26.20	-1.4	2.28	2.28	3	100.00	18.0	3497.30	2402.53	1868.96	1.00
10	301.00	28.62	-1.4	2.33	2.33	3	100.00	18.0	3817.48	2456.93	1929.68	1.00
11	303.33	30.56	-1.4	2.33	2.33	3	100.00	18.0	4072.69	2465.12	1990.98	1.00
12	305.66	48.98	0.4	3.47	3.47	3	100.00	18.0	6519.79	3677.96	2056.51	1.00
13	309.13	52.91	0.4	3.47	3.47	3	100.00	18.0	7034.34	3672.80	2132.50	1.00
14	312.60	55.47	2.2	3.40	3.40	3	100.00	18.0	7365.05	3584.46	2196.70	1.00
15	316.00	61.32	2.2	3.54	3.54	3	100.00	18.0	8130.00	3698.88		

2293.94	1.00									
16	319.54	49.77	4.0	2.73	2.74	3	100.00	18.0	6590.31	2833.75
2403.55	1.00									
17	322.27	51.74	4.0	2.73	2.74	3	100.00	18.0	6843.35	2801.47
2495.65	1.00									
18	325.00	28.17	4.0	1.46	1.47	3	100.00	18.0	3723.16	1487.41
2534.59	1.00									
19	326.46	65.72	5.7	3.45	3.47	3	100.00	18.0	8679.80	3471.91
2498.68	1.00									
20	329.92	64.53	5.7	3.45	3.47	3	100.00	18.0	8510.92	3396.79
2450.00	1.00									
21	333.37	62.92	7.5	3.44	3.47	3	100.00	18.0	8286.11	3310.12
2389.51	1.00									
22	336.81	61.35	7.5	3.44	3.47	3	100.00	18.0	8065.83	3211.79
2325.87	1.00									
23	340.25	63.44	9.3	3.67	3.72	3	100.00	18.0	8321.95	3315.83
2247.88	1.00									
24	343.92	53.31	9.3	3.18	3.23	2	0.00	35.0	6983.08	2766.47
2156.79	0.99									
25	347.11	22.78	11.1	1.39	1.42	2	0.00	35.0	2984.20	1182.56
2098.82	0.99									
26	348.50	47.74	11.1	3.00	3.06	5	0.00	45.0	5251.13	2463.08
1707.60	0.97									
27	351.50	37.22	11.1	2.42	2.47	2	0.00	35.0	4875.56	1904.93
1975.13	0.99									
28	353.92	49.95	12.9	3.38	3.47	2	0.00	35.0	6543.61	2547.23
1888.75	0.99									
29	357.30	47.34	12.9	3.38	3.47	2	0.00	35.0	6201.17	2379.92
1789.56	0.99									
30	360.69	44.21	14.6	3.36	3.47	2	0.00	35.0	5791.52	2201.35
1678.02	0.99									
31	364.05	41.26	14.6	3.36	3.47	2	0.00	35.0	5405.62	2011.37
1565.68	0.99									
32	367.41	37.82	16.4	3.33	3.47	2	0.00	35.0	4953.82	1810.10
1441.68	0.99									
33	370.74	34.55	16.4	3.33	3.47	2	0.00	35.0	4525.92	1597.61
1316.38	0.99									
34	374.07	26.99	18.2	2.87	3.02	2	0.00	35.0	3536.21	1208.02
1189.19	1.00									
35	376.93	24.29	18.2	2.87	3.02	2	0.00	35.0	3182.14	1030.49
1069.15	1.00									
36	379.80	6.76	18.2	0.86	0.91	1	150.00	22.0	885.99	274.65
995.26	1.02									
37	380.66	23.24	20.0	3.26	3.47	1	150.00	22.0	3044.89	893.37
897.29	1.03									
38	383.92	19.37	20.0	3.26	3.47	1	150.00	22.0	2538.07	636.50
744.74	1.03									
39	387.19	13.99	21.8	2.94	3.16	1	150.00	22.0	1832.13	347.31
590.17	1.04									
40	390.13	10.54	21.8	2.94	3.16	1	150.00	22.0	1380.67	115.77
439.56	1.04									
41	393.06	1.65	21.8	0.57	0.61	1	150.00	22.0	215.80	0.00
349.91	1.04									
42	393.63	6.62	23.5	3.18	3.47	1	150.00	22.0	866.84	0.00
246.05	1.05									
43	396.82	2.21	23.5	3.18	3.47	1	150.00	22.0	288.94	0.00
71.89	1.05									

X-S Area:	1451.81	Path Length:	131.91	X-S Weight:	190632.58

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 5-2 Rapid Drawdown.gmf
Processed: 02 Dec 2020 14:23:06

DATA: Analysis 1 - Case 5-2 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	192.00	348.50	192.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	183.00	348.50	183.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	180.00	348.50	180.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	192.00	450.00	192.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	183.00	450.00	183.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	180.00	450.00	180.00	

Slope Surface (8 points)

100.00	183.00	274.00	183.00	325.00	200.00	400.00	200.00
405.00	195.00						
410.00	195.00	415.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	183.00	274.00	183.00	316.00	197.00	348.50	197.00
351.50	197.00						
450.00	197.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	274.00	YL:	183.00	XR:	405.00	YR:	195.00
Centre:	XC:	317.50	YC:	429.19	Radius:	R:	250.00	

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 5-2 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

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Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 6.754

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.69

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	269.00	183.00	400.00	200.00	305.93	411.67	231.63	2.686	<-- Critical Surface
2	270.05	183.00	400.00	200.00	306.76	407.57	227.55	2.687	
3	271.11	183.00	400.00	200.00	307.60	403.47	223.47	2.689	
4	269.53	183.00	400.00	200.00	306.07	411.73	231.63	2.697	
5	270.58	183.00	400.00	200.00	306.90	407.63	227.55	2.699	
6	271.63	183.00	400.00	200.00	307.74	403.53	223.47	2.701	
7	272.68	183.00	400.00	200.00	308.58	399.43	219.39	2.704	
8	269.00	183.00	400.00	200.00	305.38	415.89	235.71	2.707	
9	270.05	183.00	400.00	200.00	306.21	411.79	231.63	2.708	
10	271.11	183.00	400.00	200.00	307.04	407.70	227.55	2.710	
11	273.74	183.00	400.00	200.00	309.43	395.33	215.31	2.711	
12	272.16	183.00	400.00	200.00	307.88	403.60	223.47	2.713	
13	274.26	183.09	400.00	200.00	310.27	391.22	211.22	2.714	
14	269.53	183.00	400.00	200.00	305.52	415.95	235.71	2.718	
15	270.58	183.00	400.00	200.00	306.34	411.85	231.63	2.719	
16	273.21	183.00	400.00	200.00	308.72	399.50	219.39	2.721	
17	271.63	183.00	400.00	200.00	307.18	407.76	227.55	2.721	
18	269.53	183.00	400.53	199.47	306.79	415.75	235.71	2.723	
19	272.68	183.00	400.00	200.00	308.01	403.66	223.47	2.724	
20	270.58	183.00	400.53	199.47	307.61	411.65	231.63	2.725	
21	271.63	183.00	400.53	199.47	308.43	407.56	227.55	2.728	
22	269.00	183.00	400.00	200.00	304.83	420.10	239.80	2.728	
23	270.05	183.00	400.00	200.00	305.66	416.01	235.71	2.729	
24	271.11	183.00	400.00	200.00	306.48	411.92	231.63	2.730	
25	273.74	183.00	400.00	200.00	308.86	399.56	219.39	2.731	
26	274.79	183.26	400.00	200.00	311.26	387.17	207.14	2.731	
27	272.16	183.00	400.00	200.00	307.31	407.82	227.55	2.733	
28	269.00	183.00	400.53	199.47	306.12	419.91	239.80	2.733	
29	274.26	183.09	400.00	200.00	309.70	395.46	215.31	2.734	
30	270.05	183.00	400.53	199.47	306.93	415.81	235.71	2.735	
31	272.68	183.00	400.53	199.47	309.26	403.46	223.47	2.736	
32	273.21	183.00	400.00	200.00	308.15	403.72	223.47	2.736	
33	271.11	183.00	400.53	199.47	307.75	411.72	231.63	2.737	
34	269.53	183.00	400.00	200.00	304.97	420.16	239.80	2.739	
35	270.58	183.00	400.00	200.00	305.79	416.07	235.71	2.740	
36	272.16	183.00	400.53	199.47	308.57	407.62	227.55	2.740	
37	271.63	183.00	400.00	200.00	306.62	411.98	231.63	2.741	
38	272.68	183.00	400.00	200.00	307.45	407.88	227.55	2.744	
39	269.53	183.00	400.53	199.47	306.26	419.97	239.80	2.744	
40	270.58	183.00	400.53	199.47	307.08	415.87	235.71	2.746	
41	273.21	183.00	400.53	199.47	309.40	403.52	223.47	2.747	
42	271.63	183.00	400.53	199.47	307.89	411.78	231.63	2.749	
43	275.32	183.44	400.00	200.00	312.24	383.12	203.06	2.750	
44	271.11	183.00	400.00	200.00	305.93	416.13	235.71	2.750	
45	273.74	183.00	400.00	200.00	308.29	403.78	223.47	2.751	
46	274.79	183.26	400.00	200.00	310.69	391.41	211.22	2.752	
47	272.16	183.00	400.00	200.00	306.75	412.03	231.63	2.753	
48	269.00	183.00	400.53	199.47	305.60	424.12	243.88	2.754	
49	274.26	183.09	400.00	200.00	309.14	399.69	219.39	2.754	
50	270.05	183.00	400.53	199.47	306.40	420.02	239.80	2.755	
51	269.00	183.00	400.00	200.00	304.29	424.31	243.88	2.756	
52	273.21	183.00	400.00	200.00	307.58	407.94	227.55	2.756	
53	270.05	183.00	400.00	200.00	305.10	420.22	239.80	2.757	
54	272.68	183.00	400.53	199.47	308.71	407.68	227.55	2.757	
55	271.11	183.00	400.53	199.47	307.21	415.93	235.71	2.757	
56	273.74	183.00	400.53	199.47	309.54	403.58	223.47	2.758	
57	269.53	183.00	400.00	200.00	304.42	424.37	243.88	2.759	
58	274.79	183.26	400.53	199.47	311.89	391.20	211.22	2.760	
59	270.58	183.00	400.00	200.00	305.24	420.28	239.80	2.760	
60	272.16	183.00	400.53	199.47	308.03	411.84	231.63	2.760	
61	269.00	183.00	401.05	198.95	306.90	423.92	243.88	2.762	
62	271.63	183.00	400.00	200.00	306.06	416.19	235.71	2.762	
63	274.26	183.09	400.53	199.47	310.38	399.48	219.39	2.762	
64	270.05	183.00	401.05	198.95	307.69	419.82	239.80	2.764	
65	269.53	183.00	400.53	199.47	305.73	424.17	243.88	2.765	
66	272.68	183.00	400.00	200.00	306.89	412.09	231.63	2.766	

67	270.58	183.00	400.53	199.47	306.54	420.08	239.80	2.766
68	271.11	183.00	401.05	198.95	308.50	415.73	235.71	2.767
69	273.21	183.00	400.53	199.47	308.85	407.74	227.55	2.767
70	271.63	183.00	400.53	199.47	307.35	415.99	235.71	2.769
71	275.84	183.61	400.00	200.00	313.21	379.05	198.98	2.770
72	270.05	183.00	400.00	200.00	304.55	424.42	243.88	2.771
73	269.00	183.00	400.00	200.00	303.74	428.51	247.96	2.772
74	275.32	183.44	400.00	200.00	311.67	387.37	207.14	2.772
75	271.11	183.00	400.00	200.00	305.37	420.34	239.80	2.772
76	272.68	183.00	400.53	199.47	308.17	411.90	231.63	2.772
77	274.79	183.26	400.00	200.00	310.12	395.65	215.31	2.772
78	269.53	183.00	401.05	198.95	307.04	423.98	243.88	2.773
79	272.16	183.00	400.00	200.00	306.19	416.24	235.71	2.774
80	274.26	183.09	400.00	200.00	308.57	403.91	223.47	2.774
81	273.74	183.00	400.00	200.00	307.72	408.00	227.55	2.775
82	269.00	183.00	400.53	199.47	305.07	428.32	247.96	2.775
83	272.16	183.00	401.05	198.95	309.30	411.63	231.63	2.775
84	270.05	183.00	400.53	199.47	305.87	424.23	243.88	2.776
85	270.58	183.00	401.05	198.95	307.84	419.88	239.80	2.776
86	273.21	183.00	401.05	198.95	310.12	407.54	227.55	2.776
87	273.21	183.00	400.00	200.00	307.02	412.15	231.63	2.776
88	273.74	183.00	400.53	199.47	308.99	407.80	227.55	2.777
89	271.11	183.00	400.53	199.47	306.68	420.14	239.80	2.777
90	271.63	183.00	401.05	198.95	308.64	415.79	235.71	2.779
91	272.16	183.00	400.53	199.47	307.49	416.05	235.71	2.780
92	275.32	183.44	400.53	199.47	312.86	387.15	207.14	2.780
93	274.79	183.26	400.53	199.47	311.35	395.44	215.31	2.781
94	274.26	183.09	400.53	199.47	309.83	403.71	223.47	2.782
95	269.00	183.00	401.05	198.95	306.39	428.12	247.96	2.783
96	269.53	183.00	400.00	200.00	303.87	428.57	247.96	2.783
97	270.58	183.00	400.00	200.00	304.69	424.48	243.88	2.783
98	271.63	183.00	400.00	200.00	305.50	420.39	239.80	2.784
99	270.05	183.00	401.05	198.95	307.18	424.03	243.88	2.785

Critical Failure Surface (circle 1)

Intersects: XL: 269.00 YL: 183.00 XR: 400.00 YR: 200.00
Centre: XC: 305.93 YC: 411.67 Radius: R: 231.63

Generated failure surface: (20 points)

269.00 183.00 275.98 181.98 282.98 181.18 290.01 180.59
297.05 180.21
304.09 180.04 311.14 180.10 318.19 180.36 325.22 180.84
332.24 181.54
339.23 182.44 346.19 183.56 353.11 184.89 359.99 186.44
366.82 188.19
373.60 190.14 380.31 192.30 386.95 194.67 393.51 197.24
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base							PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	269.00	0.46	-8.3	2.50	2.53	3	100.00	18.0	64.29	28.75	31.50	1.03
2	271.50	1.37	-8.3	2.50	2.53	3	100.00	18.0	192.88	86.26	83.45	1.03
3	274.00	2.38	-8.3	1.98	2.00	3	100.00	18.0	328.76	149.95	173.52	1.03
4	275.98	8.62	-6.6	3.50	3.53	3	100.00	18.0	1172.00	541.47	341.56	1.02
5	279.48	14.12	-6.6	3.50	3.53	3	100.00	18.0	1906.29	886.78	552.82	1.02
6	282.98	19.49	-4.8	3.51	3.53	3	100.00	18.0	2623.02	1220.77	754.03	1.01
7	286.49	24.65	-4.8	3.51	3.53	3	100.00	18.0	3308.31	1543.39	950.19	1.01
8	290.01	29.68	-3.1	3.52	3.53	3	100.00	18.0	3976.01	1854.51	1135.49	1.01
9	293.53	34.47	-3.1	3.52	3.53	3	100.00	18.0	4610.76	2154.13	1316.44	1.01
10	297.05	44.21	-1.3	3.95	3.96	3	100.00	18.0	5903.21	2759.19	1495.91	1.00
11	301.00	38.47	-1.3	3.09	3.09	3	100.00	18.0	5130.21	2401.32	1661.54	1.00
12	304.09	47.80	0.4	3.52	3.53	3	100.00	18.0	6365.84	2982.95	1804.83	1.00
13	307.62	51.85	0.4	3.52	3.53	3	100.00	18.0	6895.62	3235.74	1955.05	1.00
14	311.14	37.99	2.2	2.43	2.43	3	100.00	18.0	5045.51	2371.99	2071.53	1.00
15	313.57	39.73	2.2	2.43	2.43	3	100.00	18.0	5271.64	2480.84		

2164.42	1.00									
16	316.00	37.31	2.2	2.19	2.19	3	100.00	18.0	4945.82	2279.73
2252.62	1.00									
17	318.19	60.68	3.9	3.41	3.41	3	100.00	18.0	8035.41	3519.15
2346.08	0.99									
18	321.59	63.76	3.9	3.41	3.41	3	100.00	18.0	8430.19	3469.62
2460.94	0.99									
19	325.00	68.77	5.5	3.62	3.64	3	100.00	18.0	9081.04	3630.59
2487.99	0.99									
20	328.62	67.47	5.7	3.62	3.64	3	100.00	18.0	8898.32	3549.99
2437.43	0.99									
21	332.24	63.75	7.4	3.50	3.53	3	100.00	18.0	8394.48	3351.48
2374.20	0.99									
22	335.73	62.16	7.4	3.50	3.53	3	100.00	18.0	8170.88	3251.69
2310.79	0.99									
23	339.23	59.75	9.1	3.46	3.50	3	100.00	18.0	7836.58	3120.53
2234.09	0.99									
24	342.69	58.56	9.1	3.50	3.55	2	0.00	35.0	7671.22	3036.92
2136.41	0.97									
25	346.19	37.45	10.9	2.31	2.35	2	0.00	35.0	4905.40	1939.17
2062.10	0.97									
26	348.50	47.11	10.9	3.00	3.05	5	0.00	45.0	5182.40	2421.79
1665.04	0.95									
27	351.50	24.63	10.9	1.61	1.64	2	0.00	35.0	3226.61	1257.42
1940.27	0.97									
28	353.11	50.64	12.6	3.44	3.53	2	0.00	35.0	6633.28	2578.07
1862.33	0.97									
29	356.55	47.98	12.6	3.44	3.53	2	0.00	35.0	6286.01	2408.56
1764.31	0.97									
30	359.99	44.83	14.4	3.41	3.53	2	0.00	35.0	5872.16	2227.58
1651.57	0.97									
31	363.41	41.84	14.4	3.41	3.53	2	0.00	35.0	5480.82	2035.15
1540.72	0.97									
32	366.82	38.36	16.1	3.39	3.53	2	0.00	35.0	5024.58	1831.37
1416.15	0.97									
33	370.21	35.04	16.1	3.39	3.53	2	0.00	35.0	4590.49	1616.14
1292.68	0.97									
34	373.60	27.09	17.9	2.88	3.03	2	0.00	35.0	3548.57	1208.72
1166.14	0.97									
35	376.48	24.41	17.9	2.88	3.03	2	0.00	35.0	3197.64	1033.09
1049.37	0.97									
36	379.36	7.40	17.9	0.94	0.99	1	150.00	22.0	969.55	299.73
977.41	1.00									
37	380.31	23.59	19.6	3.32	3.53	1	150.00	22.0	3090.80	902.93
877.57	1.01									
38	383.63	19.67	19.6	3.32	3.53	1	150.00	22.0	2576.31	642.79
726.77	1.01									
39	386.95	14.16	21.3	2.98	3.20	1	150.00	22.0	1855.04	349.30
572.93	1.01									
40	389.93	10.68	21.3	2.98	3.20	1	150.00	22.0	1399.71	116.43
424.69	1.01									
41	392.91	1.73	21.3	0.60	0.65	1	150.00	22.0	227.24	0.00
336.03	1.01									
42	393.51	6.72	23.1	3.24	3.53	1	150.00	22.0	880.84	0.00
232.90	1.02									
43	396.76	2.24	23.1	3.24	3.52	1	150.00	22.0	293.61	0.00
62.72	1.02									
		---		---					---	
X-S Area:		1443.06	Path Length:		133.95		X-S Weight:		189499.38	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Full Reservoir.gmf
Processed: 01 Apr 2021 09:51:58

DATA: Analysis 1 - Case 5-3 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	190.00	348.50	190.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	164.00	348.50	164.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	161.00	348.50	161.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	190.00	450.00	190.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	164.00	450.00	164.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	161.00	450.00	161.00	

Slope Surface (4 points)

100.00	164.00	217.00	164.00	325.00	200.00	450.00	200.00

Phreatic Surface (4 points)

100.00	197.00	348.50	197.00	351.50	178.00	450.00	178.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	217.00	YL:	164.00	XR:	390.00	YR: 200.00
Centre:	XC:	255.85	YC:	410.96	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 5-3 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 3.272

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.96

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	216.21	164.00	385.00	200.00	253.94	400.81	239.80	2.957	<-- Critical Surface
2	217.79	164.26	385.00	200.00	256.40	392.66	231.63	2.958	
3	217.26	164.09	385.00	200.00	255.17	396.73	235.71	2.959	
4	218.32	164.44	385.00	200.00	257.63	388.57	227.55	2.959	
5	218.84	164.61	385.00	200.00	258.87	384.47	223.47	2.962	
6	219.37	164.79	385.00	200.00	260.10	380.36	219.39	2.962	
7	216.74	164.00	385.00	200.00	254.04	400.88	239.80	2.962	
8	215.16	164.00	385.00	200.00	252.82	404.95	243.88	2.963	
9	212.00	164.00	385.00	200.00	250.41	413.10	252.04	2.965	
10	215.68	164.00	385.00	200.00	252.92	405.02	243.88	2.970	
11	213.05	164.00	385.00	200.00	251.51	408.96	247.96	2.972	
12	216.74	164.00	385.53	200.00	254.46	400.81	239.80	2.972	
13	215.16	164.00	385.53	200.00	253.24	404.89	243.88	2.973	
14	216.21	164.00	385.00	200.00	253.03	405.08	243.88	2.973	
15	213.58	164.00	385.53	200.00	252.04	408.96	247.96	2.974	
16	217.26	164.09	385.00	200.00	254.25	401.01	239.80	2.974	
17	212.53	164.00	385.00	200.00	250.51	413.16	252.04	2.974	
18	218.32	164.44	385.00	200.00	256.72	392.87	231.63	2.976	
19	214.63	164.00	385.00	200.00	252.72	404.89	243.88	2.976	
20	217.79	164.26	385.00	200.00	255.48	396.94	235.71	2.977	
21	218.84	164.61	385.00	200.00	257.95	388.78	227.55	2.977	
22	215.68	164.00	385.53	200.00	253.35	404.95	243.88	2.978	
23	213.58	164.00	385.00	200.00	251.61	409.02	247.96	2.978	
24	214.11	164.00	385.53	200.00	252.14	409.02	247.96	2.978	
25	219.37	164.79	385.00	200.00	259.18	384.68	223.47	2.979	
26	216.74	164.00	385.00	200.00	253.13	405.15	243.88	2.979	
27	212.00	164.00	385.00	200.00	249.52	417.36	256.12	2.982	
28	220.42	165.14	385.00	200.00	261.64	376.46	215.31	2.983	
29	219.89	164.96	385.00	200.00	260.41	380.58	219.39	2.983	
30	217.79	164.26	385.53	200.00	255.91	396.88	235.71	2.984	
31	220.95	165.32	385.00	200.00	262.87	372.34	211.22	2.985	
32	216.21	164.00	385.53	200.00	253.45	405.02	243.88	2.985	
33	221.47	165.49	385.00	200.00	264.10	368.20	207.14	2.986	
34	215.68	164.00	385.00	200.00	252.02	409.28	247.96	2.986	
35	218.32	164.44	385.53	200.00	257.14	392.79	231.63	2.986	
36	222.00	165.67	385.00	200.00	265.33	364.05	203.06	2.986	
37	214.63	164.00	385.53	200.00	252.24	409.09	247.96	2.987	
38	213.05	164.00	385.00	200.00	250.62	413.23	252.04	2.987	
39	214.11	164.00	385.00	200.00	251.71	409.09	247.96	2.988	
40	212.53	164.00	385.00	200.00	249.62	417.42	256.12	2.988	
41	218.84	164.61	385.53	200.00	258.37	388.71	227.55	2.988	
42	215.68	164.00	386.05	200.00	253.77	404.89	243.88	2.988	
43	216.74	164.00	385.53	200.00	253.55	405.08	243.88	2.988	
44	215.16	164.00	385.53	200.00	252.34	409.16	247.96	2.988	
45	214.11	164.00	386.05	200.00	252.56	408.96	247.96	2.989	
46	213.58	164.00	385.53	200.00	251.14	413.23	252.04	2.989	
47	217.26	164.09	385.53	200.00	254.67	400.95	239.80	2.989	
48	219.37	164.79	385.53	200.00	259.60	384.61	223.47	2.990	
49	214.63	164.00	385.00	200.00	251.82	409.16	247.96	2.991	
50	219.89	164.96	385.53	200.00	260.82	380.50	219.39	2.991	
51	216.21	164.00	385.00	200.00	252.12	409.35	247.96	2.992	
52	217.26	164.09	385.00	200.00	253.34	405.28	243.88	2.992	
53	217.79	164.26	385.00	200.00	254.57	401.22	239.80	2.993	
54	216.21	164.00	386.05	200.00	253.87	404.95	243.88	2.993	
55	220.42	165.14	385.53	200.00	262.05	376.38	215.31	2.993	
56	214.63	164.00	386.05	200.00	252.66	409.02	247.96	2.993	
57	218.32	164.44	385.00	200.00	255.80	397.15	235.71	2.994	
58	213.05	164.00	386.05	200.00	251.46	413.10	252.04	2.994	
59	213.58	164.00	385.00	200.00	250.72	413.29	252.04	2.994	
60	218.84	164.61	385.00	200.00	257.03	393.08	231.63	2.994	
61	220.95	165.32	385.53	200.00	263.28	372.25	211.22	2.994	
62	215.68	164.00	385.53	200.00	252.44	409.22	247.96	2.995	
63	217.26	164.09	386.05	200.00	255.10	400.88	239.80	2.995	
64	217.79	164.26	386.05	200.00	256.33	396.81	235.71	2.995	
65	214.11	164.00	385.53	200.00	251.24	413.29	252.04	2.995	
66	218.32	164.44	386.05	200.00	257.56	392.72	231.63	2.996	
67	212.53	164.00	385.53	200.00	250.94	413.10	252.04	2.997	
68	216.74	164.00	385.00	200.00	252.21	409.41	247.96	2.997	
69	219.37	164.79	385.00	200.00	258.27	388.99	227.55	2.998	
70	218.84	164.61	386.05	200.00	258.78	388.63	227.55	2.998	

71	219.89	164.96	385.00	200.00	259.50	384.90	223.47	2.999
72	215.16	164.00	385.00	200.00	251.92	409.22	247.96	2.999
73	219.37	164.79	386.05	200.00	260.01	384.53	223.47	3.000
74	216.74	164.00	386.05	200.00	253.98	405.02	243.88	3.000
75	212.00	164.00	385.00	200.00	248.64	421.61	260.20	3.000
76	216.21	164.00	385.53	200.00	252.54	409.28	247.96	3.001
77	220.42	165.14	385.00	200.00	260.72	380.79	219.39	3.001
78	214.63	164.00	385.53	200.00	251.34	413.35	252.04	3.001
79	217.79	164.26	385.53	200.00	254.99	401.16	239.80	3.002
80	219.89	164.96	386.05	200.00	261.24	380.42	219.39	3.002
81	215.16	164.00	386.05	200.00	252.77	409.09	247.96	3.002
82	214.11	164.00	385.00	200.00	250.82	413.35	252.04	3.002
83	218.32	164.44	385.53	200.00	256.22	397.08	235.71	3.002
84	217.26	164.09	385.53	200.00	253.76	405.22	243.88	3.002
85	220.42	165.14	386.05	200.00	262.46	376.30	215.31	3.003
86	216.21	164.00	386.58	200.00	254.30	404.89	243.88	3.003
87	215.68	164.00	386.05	200.00	252.87	409.16	247.96	3.003
88	214.63	164.00	386.58	200.00	253.09	408.96	247.96	3.004
89	213.58	164.00	386.05	200.00	251.57	413.16	252.04	3.004
90	214.11	164.00	386.05	200.00	251.67	413.23	252.04	3.004
91	212.53	164.00	386.05	200.00	250.47	417.30	256.12	3.005
92	212.00	164.00	385.53	200.00	249.95	417.30	256.12	3.005
93	217.26	164.09	386.58	200.00	255.52	400.81	239.80	3.005
94	217.79	164.26	386.58	200.00	256.75	396.74	235.71	3.005
95	213.05	164.00	385.00	200.00	249.72	417.48	256.12	3.005
96	212.53	164.00	385.00	200.00	248.74	421.67	260.20	3.006
97	221.47	165.49	385.00	200.00	263.18	372.56	211.22	3.006
98	212.00	164.00	386.05	200.00	250.37	417.23	256.12	3.006
99	218.84	164.61	385.53	200.00	257.45	393.01	231.63	3.006

Critical Failure Surface (circle 1)

Intersects: XL: 216.21 YL: 164.00 XR: 385.00 YR: 200.00
Centre: XC: 253.94 YC: 400.81 Radius: R: 239.80
Generated failure surface: (20 points)

216.21 164.00 225.41 162.72 234.66 161.79 243.93 161.22 253.22 161.01
262.51 161.17 271.79 161.68 281.04 162.55 290.25 163.78 299.40 165.36
308.49 167.30 317.50 169.59 326.41 172.23 335.21 175.21 343.88 178.52
352.43 182.17 360.82 186.15 369.06 190.46 377.12 195.07 385.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 44 slices)

Slice	X-S	Base							PoreWater	
Normal	Test									
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force
Stress	Factor									
1	216.21	0.04	-7.9	0.79	0.80	3	100.00	18.0	6.13	1644.17
2071.82	1.03									
2	217.00	4.65	-7.9	4.21	4.25	3	100.00	18.0	625.65	8852.62
2170.22	1.03									
3	221.21	13.01	-7.9	4.21	4.25	3	100.00	18.0	1746.30	9008.11
2351.37	1.03									
4	225.41	23.53	-5.7	4.62	4.65	3	100.00	18.0	3152.29	10005.61
2525.56	1.02									
5	230.04	32.79	-5.7	4.62	4.65	3	100.00	18.0	4387.21	10139.90
2698.15	1.02									
6	234.66	41.78	-3.5	4.64	4.65	3	100.00	18.0	5582.54	10248.14
2854.03	1.01									
7	239.29	50.26	-3.5	4.64	4.65	3	100.00	18.0	6706.92	10330.36
3000.94	1.01									
8	243.93	58.43	-1.3	4.64	4.65	3	100.00	18.0	7785.90	10386.56
3130.04	1.00									
9	248.58	66.10	-1.3	4.64	4.65	3	100.00	18.0	8795.88	10416.67
3251.17	1.00									
10	253.22	73.37	0.9	4.65	4.65	3	100.00	18.0	9748.21	10420.81
3353.55	1.00									
11	257.87	80.21	0.9	4.65	4.65	3	100.00	18.0	10640.58	10398.78
3448.85	1.00									
12	262.51	86.50	3.2	4.64	4.65	3	100.00	18.0	11457.30	10350.50
3524.58	1.00									
13	267.15	92.49	3.2	4.64	4.65	3	100.00	18.0	12229.32	10276.21
3594.04	1.00									
14	271.79	97.76	5.4	4.63	4.65	3	100.00	18.0	12904.07	10176.05
3643.23	0.99									
15	276.41	102.88	5.4	4.63	4.65	3	100.00	18.0	13554.09	10049.72
3686.85	0.99									
16	281.04	107.09	7.6	4.60	4.65	3	100.00	18.0	14081.67	9897.59
3709.65	0.99									
17	285.64	111.33	7.6	4.60	4.65	3	100.00	18.0	14608.69	9719.49

3727.49	0.99									
18	290.25	31.60	9.8	1.28	1.30	3	100.00	18.0	4140.52	2677.97
3726.89	1.00									
19	291.53	87.28	9.8	3.47	3.53	2	0.00	35.0	11433.87	7195.01
3695.84	0.97									
20	295.00	113.40	9.8	4.40	4.47	2	0.00	35.0	14854.95	8928.54
3694.89	0.97									
21	299.40	119.84	12.0	4.54	4.65	2	0.00	35.0	15699.40	9030.59
3666.35	0.97									
22	303.95	122.32	12.0	4.54	4.65	2	0.00	35.0	16024.04	8749.67
3641.50	0.97									
23	308.49	102.67	14.3	3.75	3.87	2	0.00	35.0	13449.81	7064.16
3592.71	0.97									
24	312.25	103.79	14.3	3.75	3.87	2	0.00	35.0	13596.05	6833.46
3552.40	0.97									
25	316.00	41.65	14.3	1.50	1.54	2	0.00	35.0	5455.74	2657.38
3538.89	0.97									
26	317.50	104.98	16.5	3.75	3.91	2	0.00	35.0	13752.84	6557.21
3534.95	0.97									
27	321.25	105.51	16.5	3.75	3.91	2	0.00	35.0	13821.89	6286.11
3547.64	0.97									
28	325.00	39.32	16.5	1.41	1.47	2	0.00	35.0	5150.51	2284.18
3527.69	0.97									
29	326.41	118.94	18.7	4.40	4.65	2	0.00	35.0	15580.99	6965.77
3389.34	0.98									
30	330.81	112.39	18.7	4.40	4.65	2	0.00	35.0	14722.48	6534.03
3201.80	0.98									
31	335.21	104.00	20.9	4.34	4.65	2	0.00	35.0	13623.42	6077.65
2987.48	0.98									
32	339.55	96.80	20.9	4.34	4.65	2	0.00	35.0	12680.53	5596.81
2779.62	0.98									
33	343.88	94.57	23.1	4.62	5.02	2	0.00	35.0	12388.94	5478.07
2537.94	0.99									
34	348.50	46.34	23.1	2.44	2.65	5	0.00	45.0	5097.74	1367.13
1889.49	0.95									
35	350.94	26.98	23.1	1.49	1.62	2	0.00	35.0	3534.76	0.00
2158.39	0.99									
36	352.43	70.66	25.4	4.20	4.65	2	0.00	35.0	9255.96	0.00
1982.36	0.99									
37	356.63	62.30	25.4	4.20	4.65	2	0.00	35.0	8161.66	0.00
1747.99	0.99									
38	360.82	47.43	27.6	3.68	4.15	2	0.00	35.0	6213.92	0.00
1502.09	1.00									
39	364.51	40.35	27.6	3.68	4.15	2	0.00	35.0	5286.48	0.00
1277.90	1.00									
40	368.19	8.53	27.6	0.87	0.98	1	150.00	22.0	1116.89	0.00
1170.14	1.05									
41	369.06	33.82	29.8	4.03	4.65	1	150.00	22.0	4430.64	0.00
992.36	1.07									
42	373.09	24.51	29.8	4.03	4.65	1	150.00	22.0	3211.37	0.00
711.85	1.07									
43	377.12	14.55	32.0	3.94	4.65	1	150.00	22.0	1906.48	0.00
416.70	1.09									
44	381.06	4.85	32.0	3.94	4.65	1	150.00	22.0	635.49	0.00
119.42	1.09									
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X-S Area:		2921.62	Path Length:		176.54		X-S Weight:		383240.12	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Rapid Drawdown.gmf
Processed: 01 Apr 2021 09:48:57

DATA: Analysis 1 - Case 5-3 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	190.00	348.50	190.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	164.00	348.50	164.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	161.00	348.50	161.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	190.00	450.00	190.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	164.00	450.00	164.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	161.00	450.00	161.00	

Slope Surface (4 points)

100.00	164.00	217.00	164.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	164.00	217.00	164.00	316.00	197.00	348.50	197.00
351.50	178.00						
450.00	178.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	217.00	YL:	164.00	XR:	390.00	YR: 200.00
Centre:	XC:	255.85	YC:	410.96	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 5-3 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 1.830

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.64

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	216.21	164.00	385.00	200.00	253.94	400.81	239.80	1.639	<-- Critical Surface
2	217.26	164.09	385.00	200.00	255.17	396.73	235.71	1.641	
3	217.79	164.26	385.00	200.00	256.40	392.66	231.63	1.641	
4	218.32	164.44	385.00	200.00	257.63	388.57	227.55	1.642	
5	216.74	164.00	385.00	200.00	254.04	400.88	239.80	1.643	
6	215.16	164.00	385.00	200.00	252.82	404.95	243.88	1.643	
7	218.84	164.61	385.00	200.00	258.87	384.47	223.47	1.643	
8	219.37	164.79	385.00	200.00	260.10	380.36	219.39	1.644	
9	212.00	164.00	385.00	200.00	250.41	413.10	252.04	1.644	
10	213.05	164.00	385.00	200.00	251.51	408.96	247.96	1.645	
11	214.63	164.00	385.00	200.00	252.72	404.89	243.88	1.646	
12	215.68	164.00	385.00	200.00	252.92	405.02	243.88	1.647	
13	213.58	164.00	385.00	200.00	251.61	409.02	247.96	1.649	
14	216.74	164.00	385.53	200.00	254.46	400.81	239.80	1.649	
15	215.16	164.00	385.53	200.00	253.24	404.89	243.88	1.649	
16	213.58	164.00	385.53	200.00	252.04	408.96	247.96	1.649	
17	216.21	164.00	385.00	200.00	253.03	405.08	243.88	1.649	
18	212.53	164.00	385.00	200.00	250.51	413.16	252.04	1.649	
19	217.26	164.09	385.00	200.00	254.25	401.01	239.80	1.650	
20	218.32	164.44	385.00	200.00	256.72	392.87	231.63	1.652	
21	215.68	164.00	385.53	200.00	253.35	404.95	243.88	1.652	
22	214.11	164.00	385.53	200.00	252.14	409.02	247.96	1.652	
23	217.79	164.26	385.00	200.00	255.48	396.94	235.71	1.653	
24	218.84	164.61	385.00	200.00	257.95	388.78	227.55	1.653	
25	216.74	164.00	385.00	200.00	253.13	405.15	243.88	1.653	
26	214.11	164.00	385.00	200.00	251.71	409.09	247.96	1.654	
27	212.00	164.00	385.00	200.00	249.52	417.36	256.12	1.654	
28	213.05	164.00	385.00	200.00	250.62	413.23	252.04	1.655	
29	219.37	164.79	385.00	200.00	259.18	384.68	223.47	1.655	
30	214.63	164.00	385.00	200.00	251.82	409.16	247.96	1.656	
31	216.21	164.00	385.53	200.00	253.45	405.02	243.88	1.657	
32	217.79	164.26	385.53	200.00	255.91	396.88	235.71	1.657	
33	214.63	164.00	385.53	200.00	252.24	409.09	247.96	1.657	
34	215.68	164.00	385.00	200.00	252.02	409.28	247.96	1.657	
35	219.89	164.96	385.00	200.00	260.41	380.58	219.39	1.657	
36	220.42	165.14	385.00	200.00	261.64	376.46	215.31	1.658	
37	215.68	164.00	386.05	200.00	253.77	404.89	243.88	1.658	
38	218.32	164.44	385.53	200.00	257.14	392.79	231.63	1.658	
39	212.53	164.00	385.00	200.00	249.62	417.42	256.12	1.658	
40	214.11	164.00	386.05	200.00	252.56	408.96	247.96	1.658	
41	215.16	164.00	385.53	200.00	252.34	409.16	247.96	1.659	
42	216.74	164.00	385.53	200.00	253.55	405.08	243.88	1.659	
43	213.58	164.00	385.53	200.00	251.14	413.23	252.04	1.659	
44	220.95	165.32	385.00	200.00	262.87	372.34	211.22	1.659	
45	213.58	164.00	385.00	200.00	250.72	413.29	252.04	1.659	
46	217.26	164.09	385.53	200.00	254.67	400.95	239.80	1.659	
47	212.53	164.00	385.53	200.00	250.94	413.10	252.04	1.659	
48	218.84	164.61	385.53	200.00	258.37	388.71	227.55	1.659	
49	221.47	165.49	385.00	200.00	264.10	368.20	207.14	1.660	
50	222.00	165.67	385.00	200.00	265.33	364.05	203.06	1.660	
51	215.16	164.00	385.00	200.00	251.92	409.22	247.96	1.661	
52	219.37	164.79	385.53	200.00	259.60	384.61	223.47	1.661	
53	216.21	164.00	385.00	200.00	252.12	409.35	247.96	1.661	
54	216.21	164.00	386.05	200.00	253.87	404.95	243.88	1.661	
55	214.63	164.00	386.05	200.00	252.66	409.02	247.96	1.661	
56	217.26	164.09	385.00	200.00	253.34	405.28	243.88	1.662	
57	213.05	164.00	386.05	200.00	251.46	413.10	252.04	1.662	
58	219.89	164.96	385.53	200.00	260.82	380.50	219.39	1.662	
59	217.79	164.26	385.00	200.00	254.57	401.22	239.80	1.662	
60	217.26	164.09	386.05	200.00	255.10	400.88	239.80	1.663	
61	215.68	164.00	385.53	200.00	252.44	409.22	247.96	1.663	
62	214.11	164.00	385.53	200.00	251.24	413.29	252.04	1.663	
63	217.79	164.26	386.05	200.00	256.33	396.81	235.71	1.663	
64	218.32	164.44	385.00	200.00	255.80	397.15	235.71	1.663	
65	214.11	164.00	385.00	200.00	250.82	413.35	252.04	1.664	
66	220.42	165.14	385.53	200.00	262.05	376.38	215.31	1.664	
67	218.84	164.61	385.00	200.00	257.03	393.08	231.63	1.664	
68	218.32	164.44	386.05	200.00	257.56	392.72	231.63	1.664	

69	220.95	165.32	385.53	200.00	263.28	372.25	211.22	1.665
70	216.74	164.00	385.00	200.00	252.21	409.41	247.96	1.665
71	212.00	164.00	385.53	200.00	249.95	417.30	256.12	1.665
72	213.05	164.00	385.53	200.00	251.04	413.16	252.04	1.665
73	218.84	164.61	386.05	200.00	258.78	388.63	227.55	1.666
74	216.74	164.00	386.05	200.00	253.98	405.02	243.88	1.666
75	212.00	164.00	385.00	200.00	248.64	421.61	260.20	1.666
76	213.05	164.00	385.00	200.00	249.72	417.48	256.12	1.666
77	215.16	164.00	386.05	200.00	252.77	409.09	247.96	1.667
78	219.37	164.79	385.00	200.00	258.27	388.99	227.55	1.667
79	216.21	164.00	385.53	200.00	252.54	409.28	247.96	1.667
80	214.63	164.00	385.53	200.00	251.34	413.35	252.04	1.667
81	219.37	164.79	386.05	200.00	260.01	384.53	223.47	1.667
82	214.63	164.00	386.58	200.00	253.09	408.96	247.96	1.667
83	216.21	164.00	386.58	200.00	254.30	404.89	243.88	1.667
84	219.89	164.96	385.00	200.00	259.50	384.90	223.47	1.667
85	213.58	164.00	386.05	200.00	251.57	413.16	252.04	1.667
86	217.79	164.26	385.53	200.00	254.99	401.16	239.80	1.668
87	214.63	164.00	385.00	200.00	250.92	413.42	252.04	1.668
88	215.68	164.00	386.05	200.00	252.87	409.16	247.96	1.668
89	217.26	164.09	385.53	200.00	253.76	405.22	243.88	1.668
90	214.11	164.00	386.05	200.00	251.67	413.23	252.04	1.668
91	212.53	164.00	386.05	200.00	250.47	417.30	256.12	1.668
92	219.89	164.96	386.05	200.00	261.24	380.42	219.39	1.668
93	218.32	164.44	385.53	200.00	256.22	397.08	235.71	1.669
94	212.00	164.00	386.05	200.00	250.37	417.23	256.12	1.669
95	217.26	164.09	386.58	200.00	255.52	400.81	239.80	1.669
96	217.79	164.26	386.58	200.00	256.75	396.74	235.71	1.669
97	220.42	165.14	385.00	200.00	260.72	380.79	219.39	1.669
98	212.53	164.00	385.00	200.00	248.74	421.67	260.20	1.670
99	220.42	165.14	386.05	200.00	262.46	376.30	215.31	1.670

Critical Failure Surface (circle 1)

Intersects: XL: 216.21 YL: 164.00 XR: 385.00 YR: 200.00
Centre: XC: 253.94 YC: 400.81 Radius: R: 239.80
Generated failure surface: (20 points)
216.21 164.00 225.41 162.72 234.66 161.79 243.93 161.22
253.22 161.01
262.51 161.17 271.79 161.68 281.04 162.55 290.25 163.78
299.40 165.36
308.49 167.30 317.50 169.59 326.41 172.23 335.21 175.21
343.88 178.52
352.43 182.17 360.82 186.15 369.06 190.46 377.12 195.07
385.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 44 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	216.21	0.04	-7.9	0.79	0.80	3	100.00	18.0	6.13	2.74	16.64	1.04
2	217.00	4.65	-7.9	4.21	4.25	3	100.00	18.0	625.65	292.74	159.76	1.04
3	221.21	13.01	-7.9	4.21	4.25	3	100.00	18.0	1746.30	819.85	430.22	1.04
4	225.41	23.53	-5.7	4.62	4.65	3	100.00	18.0	3152.29	1475.53	695.56	1.03
5	230.04	32.79	-5.7	4.62	4.65	3	100.00	18.0	4387.21	2056.47	965.59	1.03
6	234.66	41.78	-3.5	4.64	4.65	3	100.00	18.0	5582.54	2612.09	1215.57	1.01
7	239.29	50.26	-3.5	4.64	4.65	3	100.00	18.0	6706.92	3142.40	1459.63	1.01
8	243.93	58.43	-1.3	4.64	4.65	3	100.00	18.0	7785.90	3647.02	1681.71	1.00
9	248.58	66.10	-1.3	4.64	4.65	3	100.00	18.0	8795.88	4125.93	1899.67	1.00
10	253.22	73.37	0.9	4.65	4.65	3	100.00	18.0	9748.21	4578.83	2094.00	1.00
11	257.87	80.21	0.9	4.65	4.65	3	100.00	18.0	10640.58	5005.64	2285.78	1.00
12	262.51	86.50	3.2	4.64	4.65	3	100.00	18.0	11457.30	5405.97	2452.52	0.99
13	267.15	92.49	3.2	4.64	4.65	3	100.00	18.0	12229.32	5779.94	2618.04	0.99
14	271.79	97.76	5.4	4.63	4.65	3	100.00	18.0	12904.07	6127.33	2757.35	0.99
15	276.41	102.88	5.4	4.63	4.65	3	100.00	18.0	13554.09	6447.96	2896.60	0.99
16	281.04	107.09	7.6	4.60	4.65	3	100.00	18.0	14081.67	6741.75		

3008.68	0.98									
17	285.64	111.33	7.6	4.60	4.65	3	100.00	18.0	14608.69	7008.62
3121.66	0.98									
18	290.25	31.60	9.8	1.28	1.30	3	100.00	18.0	4140.52	2000.92
3175.44	0.98									
19	291.53	87.28	9.8	3.47	3.53	2	0.00	35.0	11433.87	5527.34
3172.12	0.95									
20	295.00	113.40	9.8	4.40	4.47	2	0.00	35.0	14854.95	7181.16
3251.83	0.95									
21	299.40	119.84	12.0	4.54	4.65	2	0.00	35.0	15699.40	7646.39
3304.31	0.94									
22	303.95	122.32	12.0	4.54	4.65	2	0.00	35.0	16024.04	7804.50
3372.64	0.94									
23	308.49	102.67	14.3	3.75	3.87	2	0.00	35.0	13449.81	6610.30
3398.36	0.93									
24	312.25	103.79	14.3	3.75	3.87	2	0.00	35.0	13596.05	6682.18
3435.30	0.93									
25	316.00	41.65	14.3	1.50	1.54	2	0.00	35.0	5455.74	2657.38
3459.62	0.93									
26	317.50	104.98	16.5	3.75	3.91	2	0.00	35.0	13752.84	6557.21
3442.01	0.93									
27	321.25	105.51	16.5	3.75	3.91	2	0.00	35.0	13821.89	6286.11
3450.60	0.93									
28	325.00	39.32	16.5	1.41	1.47	2	0.00	35.0	5150.51	2284.18
3429.27	0.93									
29	326.41	118.94	18.7	4.40	4.65	2	0.00	35.0	15580.99	6965.77
3282.96	0.92									
30	330.81	112.39	18.7	4.40	4.65	2	0.00	35.0	14722.48	6534.03
3100.75	0.92									
31	335.21	104.00	20.9	4.34	4.65	2	0.00	35.0	13623.42	6077.65
2882.45	0.92									
32	339.55	96.80	20.9	4.34	4.65	2	0.00	35.0	12680.53	5596.81
2681.12	0.92									
33	343.88	94.57	23.1	4.62	5.02	2	0.00	35.0	12388.94	5478.07
2438.44	0.92									
34	348.50	46.34	23.1	2.44	2.65	5	0.00	45.0	5097.74	1367.13
1762.82	0.86									
35	350.94	26.98	23.1	1.49	1.62	2	0.00	35.0	3534.76	0.00
2009.92	0.92									
36	352.43	70.66	25.4	4.20	4.65	2	0.00	35.0	9255.96	0.00
1833.62	0.92									
37	356.63	62.30	25.4	4.20	4.65	2	0.00	35.0	8161.66	0.00
1616.84	0.92									
38	360.82	47.43	27.6	3.68	4.15	2	0.00	35.0	6213.92	0.00
1379.99	0.92									
39	364.51	40.35	27.6	3.68	4.15	2	0.00	35.0	5286.48	0.00
1174.03	0.92									
40	368.19	8.53	27.6	0.87	0.98	1	150.00	22.0	1116.89	0.00
1091.80	1.00									
41	369.06	33.82	29.8	4.03	4.65	1	150.00	22.0	4430.64	0.00
917.20	1.01									
42	373.09	24.51	29.8	4.03	4.65	1	150.00	22.0	3211.37	0.00
652.15	1.01									
43	377.12	14.55	32.0	3.94	4.65	1	150.00	22.0	1906.48	0.00
369.81	1.02									
44	381.06	4.85	32.0	3.94	4.65	1	150.00	22.0	635.49	0.00
90.22	1.02									
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X-S Area:		2921.62	Path Length:		176.54		X-S Weight:		383240.12	

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 6-1 Full Reservoir.gmf
Processed: 02 Dec 2020 14:32:07

DATA: Analysis 1 - Case 6-1 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	196.00	348.50	196.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	159.00	348.50	159.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	156.00	348.50	156.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	196.00	450.00	196.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	159.00	450.00	159.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	156.00	450.00	156.00	

Slope Surface (4 points)

100.00	159.00	202.00	159.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	202.00	197.00	316.00	197.00	348.50	197.00
351.50	181.00						
450.00	181.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	202.00	YL:	159.00	XR:	380.00	YR: 200.00
Centre:	XC:	238.76	YC:	406.28	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 6-1 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.748

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.60

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	203.84	159.61	375.00	200.00	243.26	375.43	219.39	2.600	<-- Critical Surface
2	204.37	159.79	375.00	200.00	244.58	371.31	215.31	2.600	
3	203.32	159.44	375.00	200.00	241.95	379.54	223.47	2.604	
4	202.79	159.26	375.00	200.00	240.63	383.64	227.55	2.607	
5	205.95	160.32	375.00	200.00	247.49	363.25	207.14	2.608	
6	203.32	159.44	375.53	200.00	242.37	379.47	223.47	2.610	
7	205.42	160.14	375.00	200.00	246.18	367.40	211.22	2.610	
8	202.79	159.26	375.53	200.00	241.06	383.57	227.55	2.614	
9	204.89	159.96	375.00	200.00	244.87	371.53	215.31	2.614	
10	206.47	160.49	375.00	200.00	248.81	359.09	203.06	2.616	
11	205.95	160.32	375.53	200.00	247.91	363.16	207.14	2.617	
12	204.37	159.79	375.00	200.00	243.55	375.65	219.39	2.617	
13	200.68	159.00	375.00	200.00	237.92	391.75	235.71	2.618	
14	202.26	159.09	375.53	200.00	239.75	387.67	231.63	2.618	
15	203.84	159.61	375.00	200.00	242.24	379.76	223.47	2.620	
16	202.26	159.09	375.00	200.00	239.32	387.74	231.63	2.620	
17	201.21	159.00	375.53	200.00	238.44	391.75	235.71	2.621	
18	203.32	159.44	375.00	200.00	240.93	383.86	227.55	2.623	
19	201.21	159.00	375.00	200.00	238.01	391.82	235.71	2.623	
20	199.11	159.00	375.00	200.00	236.62	395.84	239.80	2.623	
21	201.74	159.00	375.53	200.00	238.54	391.82	235.71	2.625	
22	205.42	160.14	376.05	200.00	247.02	367.23	211.22	2.626	
23	203.84	159.61	375.53	200.00	242.67	379.69	223.47	2.626	
24	197.53	159.00	375.00	200.00	235.34	399.93	243.88	2.626	
25	201.74	159.00	375.00	200.00	238.11	391.89	235.71	2.627	
26	199.63	159.00	375.00	200.00	236.72	395.91	239.80	2.627	
27	205.95	160.32	375.00	200.00	246.47	367.62	211.22	2.629	
28	203.32	159.44	375.53	200.00	241.36	383.79	227.55	2.629	
29	204.89	159.96	375.53	200.00	245.29	371.45	215.31	2.630	
30	204.37	159.79	376.05	200.00	244.40	375.49	219.39	2.630	
31	198.05	159.00	375.00	200.00	235.44	400.00	243.88	2.631	
32	207.00	160.67	375.53	200.00	249.51	359.23	203.06	2.631	
33	200.16	159.00	375.00	200.00	236.82	395.98	239.80	2.632	
34	204.89	159.96	376.05	200.00	245.71	371.37	215.31	2.632	
35	202.79	159.26	375.53	200.00	240.05	387.88	231.63	2.632	
36	201.74	159.00	376.05	200.00	238.97	391.75	235.71	2.632	
37	204.37	159.79	375.53	200.00	243.98	375.57	219.39	2.632	
38	205.42	160.14	375.00	200.00	245.16	371.75	215.31	2.632	
39	199.63	159.00	375.53	200.00	237.15	395.84	239.80	2.632	
40	207.00	160.67	375.00	200.00	249.10	359.32	203.06	2.633	
41	200.68	159.00	375.53	200.00	237.34	395.98	239.80	2.633	
42	202.79	159.26	375.00	200.00	239.62	387.95	231.63	2.633	
43	206.47	160.49	375.00	200.00	247.78	363.47	207.14	2.634	
44	204.89	159.96	375.00	200.00	243.84	375.87	219.39	2.634	
45	198.58	159.00	375.00	200.00	235.53	400.06	243.88	2.635	
46	200.16	159.00	376.05	200.00	237.68	395.84	239.80	2.635	
47	200.68	159.00	375.00	200.00	236.91	396.04	239.80	2.636	
48	204.89	159.96	376.58	200.00	246.13	371.29	215.31	2.636	
49	202.26	159.09	375.53	200.00	238.74	391.96	235.71	2.636	
50	205.42	160.14	375.53	200.00	246.60	367.31	211.22	2.636	
51	206.47	160.49	375.53	200.00	248.20	363.39	207.14	2.636	
52	204.37	159.79	375.00	200.00	242.53	379.98	223.47	2.636	
53	200.16	159.00	375.53	200.00	237.25	395.91	239.80	2.637	
54	198.05	159.00	375.53	200.00	235.87	399.93	243.88	2.637	
55	202.26	159.09	375.00	200.00	238.30	392.03	235.71	2.637	
56	204.37	159.79	376.58	200.00	244.82	375.42	219.39	2.639	
57	207.00	160.67	376.05	200.00	249.92	359.14	203.06	2.639	
58	198.58	159.00	376.05	200.00	236.39	399.93	243.88	2.639	
59	197.00	159.00	375.00	200.00	234.26	404.14	247.96	2.639	
60	201.21	159.00	375.00	200.00	237.00	396.11	239.80	2.640	
61	203.84	159.61	376.58	200.00	243.51	379.53	223.47	2.640	
62	200.68	159.00	376.05	200.00	237.77	395.91	239.80	2.640	
63	206.47	160.49	376.05	200.00	248.61	363.30	207.14	2.640	
64	199.11	159.00	375.00	200.00	235.63	400.13	243.88	2.641	
65	198.58	159.00	375.53	200.00	235.96	400.00	243.88	2.641	
66	205.95	160.32	376.05	200.00	247.31	367.45	211.22	2.642	
67	202.26	159.09	376.05	200.00	239.17	391.90	235.71	2.642	
68	203.32	159.44	376.58	200.00	242.21	383.64	227.55	2.643	

69	204.37	159.79	375.53	200.00	242.96	379.90	223.47	2.643
70	201.74	159.00	375.00	200.00	237.10	396.17	239.80	2.644
71	197.53	159.00	375.00	200.00	234.35	404.21	247.96	2.644
72	199.11	159.00	376.05	200.00	236.49	400.00	243.88	2.644
73	199.63	159.00	375.00	200.00	235.72	400.19	243.88	2.644
74	201.21	159.00	376.05	200.00	237.87	395.98	239.80	2.644
75	203.84	159.61	375.53	200.00	241.65	384.00	227.55	2.645
76	205.42	160.14	376.05	200.00	246.00	371.59	215.31	2.645
77	203.84	159.61	376.05	200.00	243.09	379.61	223.47	2.645
78	199.11	159.00	375.53	200.00	236.06	400.06	243.88	2.646
79	201.21	159.00	375.53	200.00	237.44	396.04	239.80	2.646
80	202.79	159.26	376.58	200.00	240.90	387.74	231.63	2.646
81	203.84	159.61	377.11	200.00	243.94	379.46	223.47	2.646
82	203.84	159.61	375.00	200.00	241.22	384.07	227.55	2.646
83	207.00	160.67	376.58	200.00	250.34	359.05	203.06	2.647
84	197.00	159.00	375.53	200.00	234.69	404.08	247.96	2.647
85	203.32	159.44	375.53	200.00	240.34	388.09	231.63	2.647
86	203.32	159.44	376.05	200.00	241.78	383.71	227.55	2.647
87	205.95	160.32	375.53	200.00	246.89	367.53	211.22	2.647
88	198.05	159.00	375.00	200.00	234.44	404.27	247.96	2.648
89	199.63	159.00	376.05	200.00	236.58	400.06	243.88	2.648
90	202.79	159.26	376.05	200.00	240.48	387.81	231.63	2.648
91	200.16	159.00	375.00	200.00	235.81	400.26	243.88	2.648
92	204.89	159.96	376.05	200.00	244.69	375.71	219.39	2.648
93	206.47	160.49	376.58	200.00	249.03	363.22	207.14	2.648
94	203.32	159.44	375.00	200.00	239.91	388.16	231.63	2.648
95	206.47	160.49	375.00	200.00	246.76	367.84	211.22	2.648
96	202.79	159.26	375.53	200.00	239.03	392.17	235.71	2.649
97	201.74	159.00	376.05	200.00	237.96	396.04	239.80	2.649
98	205.42	160.14	375.53	200.00	245.58	371.67	215.31	2.649
99	203.32	159.44	377.11	200.00	242.63	383.57	227.55	2.650

Critical Failure Surface (circle 1)

Intersects: XL: 203.84 YL: 159.61 XR: 375.00 YR: 200.00
Centre: XC: 243.26 YC: 375.43 Radius: R: 219.39

Generated failure surface: (20 points)

203.84 159.61 213.24 158.11 222.70 157.01 232.20 156.32
241.72 156.05
251.24 156.19 260.75 156.74 270.22 157.71 279.64 159.08
289.00 160.86
298.27 163.05 307.43 165.64 316.47 168.62 325.38 171.99
334.13 175.75
342.71 179.88 351.10 184.38 359.29 189.24 367.26 194.45
375.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 39 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	203.84	3.62	-9.1	3.83	3.88	2	0.00	35.0	474.37	9124.03	2419.82	1.06
2	207.67	18.20	-9.1	5.57	5.64	3	100.00	18.0	2409.11	13539.16	2638.56	1.03
3	213.24	26.98	-6.6	4.73	4.76	3	100.00	18.0	3589.39	11636.84	2857.52	1.02
4	217.97	37.03	-6.6	4.73	4.76	3	100.00	18.0	4932.21	11799.93	3045.30	1.02
5	222.70	46.80	-4.1	4.75	4.76	3	100.00	18.0	6233.92	11932.60	3213.04	1.01
6	227.45	55.95	-4.1	4.75	4.76	3	100.00	18.0	7448.51	12034.57	3371.25	1.01
7	232.20	64.76	-1.6	4.76	4.76	3	100.00	18.0	8613.81	12105.72	3507.98	1.00
8	236.96	72.96	-1.6	4.76	4.76	3	100.00	18.0	9694.69	12146.36	3636.52	1.00
9	241.72	80.69	0.8	4.76	4.76	3	100.00	18.0	10709.78	12156.44	3742.33	1.00
10	246.48	87.92	0.8	4.76	4.76	3	100.00	18.0	11652.60	12135.69	3841.16	1.00
11	251.24	94.49	3.3	4.75	4.76	3	100.00	18.0	12505.38	12084.12	3916.20	0.99
12	256.00	100.71	3.3	4.75	4.76	3	100.00	18.0	13306.71	12002.00	3985.29	0.99
13	260.75	106.06	5.8	4.74	4.76	3	100.00	18.0	13988.80	11889.40	4029.75	0.99
14	265.49	111.25	5.8	4.74	4.76	3	100.00	18.0	14646.37	11746.08	4069.16	0.99
15	270.22	108.38	8.3	4.43	4.48	3	100.00	18.0	14240.99	10893.68	4082.97	0.99
16	274.65	112.06	8.3	4.43	4.48	3	100.00	18.0	14694.73	10712.86		

4092.22	0.99									
17	279.09	129.22	10.5	4.96	5.04	2	0.00	35.0	16927.43	11810.81
4046.86	0.97									
18	284.04	132.72	10.8	4.96	5.04	2	0.00	35.0	17386.63	11524.21
4031.91	0.97									
19	289.00	126.79	13.3	4.63	4.76	2	0.00	35.0	16609.82	10573.69
3985.61	0.97									
20	293.63	128.88	13.3	4.63	4.76	2	0.00	35.0	16883.75	10248.84
3946.48	0.97									
21	298.27	129.01	15.8	4.58	4.76	2	0.00	35.0	16900.81	9894.37
3873.05	0.97									
22	302.85	130.08	15.8	4.58	4.76	2	0.00	35.0	17041.10	9510.00
3807.24	0.97									
23	307.43	158.79	18.3	5.57	5.86	2	0.00	35.0	20802.01	11139.08
3696.33	0.97									
24	313.00	85.59	18.3	3.00	3.16	2	0.00	35.0	11212.78	5722.51
3609.14	0.97									
25	316.00	128.06	20.5	4.50	4.80	2	0.00	35.0	16775.92	8305.27
3545.29	0.97									
26	320.50	127.14	20.7	4.50	4.81	2	0.00	35.0	16655.78	7807.81
3508.93	0.97									
27	325.00	124.15	23.0	4.57	4.96	2	0.00	35.0	16263.60	7488.63
3351.35	0.97									
28	329.57	115.20	23.2	4.57	4.97	2	0.00	35.0	15091.76	6892.60
3106.74	0.98									
29	334.13	99.61	25.7	4.29	4.76	2	0.00	35.0	13049.00	6007.48
2837.47	0.98									
30	338.42	90.75	25.7	4.29	4.76	2	0.00	35.0	11888.23	5393.79
2583.13	0.98									
31	342.71	55.99	28.2	2.89	3.28	2	0.00	35.0	7335.28	3349.81
2343.18	0.99									
32	345.61	51.50	28.2	2.89	3.28	2	0.00	35.0	6746.76	3031.73
2153.31	0.99									
33	348.50	39.11	28.2	2.39	2.71	5	0.00	45.0	4302.40	1185.17
1568.28	0.94									
34	350.89	60.94	30.6	4.20	4.88	2	0.00	35.0	7983.52	0.00
1639.15	1.00									
35	355.09	50.46	30.7	4.20	4.89	2	0.00	35.0	6610.74	0.00
1356.37	1.00									
36	359.29	37.70	33.2	3.99	4.76	2	0.00	35.0	4938.42	0.00
1053.66	1.02									
37	363.28	27.32	33.2	3.99	4.76	2	0.00	35.0	3578.28	0.00
763.46	1.02									
38	367.26	10.33	35.7	2.16	2.66	2	0.00	35.0	1352.71	0.00
524.30	1.03									
39	369.43	11.15	35.7	5.57	6.86	1	150.00	22.0	1460.58	0.00
198.47	1.11									
		---			---				---	
X-S Area:		3178.38	Path Length:		180.93		X-S Weight:		416938.66	

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 6-1 Rapid Drawdown.gmf
Processed: 02 Dec 2020 14:31:16

DATA: Analysis 1 - Case 6-1 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	196.00	348.50	196.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	159.00	348.50	159.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	156.00	348.50	156.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	196.00	450.00	196.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	159.00	450.00	159.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	156.00	450.00	156.00	

Slope Surface (4 points)

100.00	159.00	202.00	159.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	159.00	202.00	159.00	316.00	197.00	348.50	197.00
351.50	181.00						
450.00	181.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	202.00	YL:	159.00	XR:	380.00	YR: 200.00
Centre:	XC:	238.76	YC:	406.28	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 6-1 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 1.482

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.39

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	203.84	159.61	375.00	200.00	243.26	375.43	219.39	1.393	<-- Critical Surface
2	204.37	159.79	375.00	200.00	244.58	371.31	215.31	1.394	
3	203.32	159.44	375.00	200.00	241.95	379.54	223.47	1.395	
4	202.79	159.26	375.00	200.00	240.63	383.64	227.55	1.397	
5	203.32	159.44	375.53	200.00	242.37	379.47	223.47	1.399	
6	205.95	160.32	375.00	200.00	247.49	363.25	207.14	1.399	
7	205.42	160.14	375.00	200.00	246.18	367.40	211.22	1.400	
8	202.79	159.26	375.53	200.00	241.06	383.57	227.55	1.401	
9	206.47	160.49	375.00	200.00	248.81	359.09	203.06	1.401	
10	200.68	159.00	375.00	200.00	237.92	391.75	235.71	1.401	
11	204.89	159.96	375.00	200.00	244.87	371.53	215.31	1.402	
12	202.26	159.09	375.00	200.00	239.32	387.74	231.63	1.403	
13	205.95	160.32	375.53	200.00	247.91	363.16	207.14	1.404	
14	204.37	159.79	375.00	200.00	243.55	375.65	219.39	1.404	
15	202.26	159.09	375.53	200.00	239.75	387.67	231.63	1.404	
16	199.11	159.00	375.00	200.00	236.62	395.84	239.80	1.404	
17	201.21	159.00	375.00	200.00	238.01	391.82	235.71	1.404	
18	201.21	159.00	375.53	200.00	238.44	391.75	235.71	1.405	
19	203.84	159.61	375.00	200.00	242.24	379.76	223.47	1.406	
20	197.53	159.00	375.00	200.00	235.34	399.93	243.88	1.406	
21	199.63	159.00	375.00	200.00	236.72	395.91	239.80	1.407	
22	201.74	159.00	375.00	200.00	238.11	391.89	235.71	1.407	
23	203.32	159.44	375.00	200.00	240.93	383.86	227.55	1.407	
24	201.74	159.00	375.53	200.00	238.54	391.82	235.71	1.408	
25	198.05	159.00	375.00	200.00	235.44	400.00	243.88	1.409	
26	204.89	159.96	375.53	200.00	245.29	371.45	215.31	1.409	
27	205.42	160.14	376.05	200.00	247.02	367.23	211.22	1.409	
28	203.84	159.61	375.53	200.00	242.67	379.69	223.47	1.409	
29	200.16	159.00	375.00	200.00	236.82	395.98	239.80	1.409	
30	199.63	159.00	375.53	200.00	237.15	395.84	239.80	1.410	
31	204.37	159.79	375.53	200.00	243.98	375.57	219.39	1.411	
32	203.32	159.44	375.53	200.00	241.36	383.79	227.55	1.411	
33	202.79	159.26	375.00	200.00	239.62	387.95	231.63	1.411	
34	198.58	159.00	375.00	200.00	235.53	400.06	243.88	1.411	
35	204.37	159.79	376.05	200.00	244.40	375.49	219.39	1.412	
36	207.00	160.67	375.00	200.00	249.10	359.32	203.06	1.412	
37	205.95	160.32	375.00	200.00	246.47	367.62	211.22	1.412	
38	200.68	159.00	375.00	200.00	236.91	396.04	239.80	1.412	
39	201.74	159.00	376.05	200.00	238.97	391.75	235.71	1.412	
40	205.42	160.14	375.53	200.00	246.60	367.31	211.22	1.412	
41	204.89	159.96	376.05	200.00	245.71	371.37	215.31	1.412	
42	202.79	159.26	375.53	200.00	240.05	387.88	231.63	1.412	
43	206.47	160.49	375.00	200.00	247.78	363.47	207.14	1.413	
44	198.05	159.00	375.53	200.00	235.87	399.93	243.88	1.413	
45	200.68	159.00	375.53	200.00	237.34	395.98	239.80	1.413	
46	200.16	159.00	375.53	200.00	237.25	395.91	239.80	1.413	
47	207.00	160.67	375.53	200.00	249.51	359.23	203.06	1.413	
48	202.26	159.09	375.00	200.00	238.30	392.03	235.71	1.413	
49	205.42	160.14	375.00	200.00	245.16	371.75	215.31	1.414	
50	197.00	159.00	375.00	200.00	234.26	404.14	247.96	1.414	
51	200.16	159.00	376.05	200.00	237.68	395.84	239.80	1.414	
52	201.21	159.00	375.00	200.00	237.00	396.11	239.80	1.415	
53	202.26	159.09	375.53	200.00	238.74	391.96	235.71	1.415	
54	204.89	159.96	375.00	200.00	243.84	375.87	219.39	1.415	
55	199.11	159.00	375.00	200.00	235.63	400.13	243.88	1.415	
56	204.89	159.96	376.58	200.00	246.13	371.29	215.31	1.415	
57	198.58	159.00	375.53	200.00	235.96	400.00	243.88	1.415	
58	204.37	159.79	375.00	200.00	242.53	379.98	223.47	1.416	
59	206.47	160.49	375.53	200.00	248.20	363.39	207.14	1.416	
60	198.58	159.00	376.05	200.00	236.39	399.93	243.88	1.416	
61	197.53	159.00	375.00	200.00	234.35	404.21	247.96	1.417	
62	204.37	159.79	376.58	200.00	244.82	375.42	219.39	1.417	
63	200.68	159.00	376.05	200.00	237.77	395.91	239.80	1.417	
64	201.74	159.00	375.00	200.00	237.10	396.17	239.80	1.417	
65	199.63	159.00	375.00	200.00	235.72	400.19	243.88	1.417	
66	203.84	159.61	376.58	200.00	243.51	379.53	223.47	1.417	
67	203.84	159.61	376.05	200.00	243.09	379.61	223.47	1.418	
68	207.00	160.67	376.05	200.00	249.92	359.14	203.06	1.418	

69	199.11	159.00	375.53	200.00	236.06	400.06	243.88	1.418
70	197.00	159.00	375.53	200.00	234.69	404.08	247.96	1.418
71	206.47	160.49	376.05	200.00	248.61	363.30	207.14	1.419
72	201.21	159.00	375.53	200.00	237.44	396.04	239.80	1.419
73	203.32	159.44	376.05	200.00	241.78	383.71	227.55	1.419
74	202.26	159.09	376.05	200.00	239.17	391.90	235.71	1.419
75	198.05	159.00	375.00	200.00	234.44	404.27	247.96	1.419
76	199.11	159.00	376.05	200.00	236.49	400.00	243.88	1.419
77	203.32	159.44	376.58	200.00	242.21	383.64	227.55	1.419
78	205.95	160.32	376.05	200.00	247.31	367.45	211.22	1.419
79	200.16	159.00	375.00	200.00	235.81	400.26	243.88	1.420
80	205.95	160.32	375.53	200.00	246.89	367.53	211.22	1.420
81	203.84	159.61	375.00	200.00	241.22	384.07	227.55	1.420
82	202.79	159.26	376.05	200.00	240.48	387.81	231.63	1.420
83	201.21	159.00	376.05	200.00	237.87	395.98	239.80	1.420
84	204.37	159.79	375.53	200.00	242.96	379.90	223.47	1.420
85	203.32	159.44	375.00	200.00	239.91	388.16	231.63	1.421
86	199.63	159.00	375.53	200.00	236.15	400.13	243.88	1.421
87	202.79	159.26	376.58	200.00	240.90	387.74	231.63	1.421
88	197.53	159.00	375.53	200.00	234.78	404.14	247.96	1.421
89	203.84	159.61	375.53	200.00	241.65	384.00	227.55	1.421
90	205.42	160.14	375.53	200.00	245.58	371.67	215.31	1.421
91	203.84	159.61	377.11	200.00	243.94	379.46	223.47	1.421
92	205.42	160.14	376.05	200.00	246.00	371.59	215.31	1.421
93	201.74	159.00	375.53	200.00	237.53	396.11	239.80	1.421
94	202.79	159.26	375.00	200.00	238.60	392.24	235.71	1.421
95	198.58	159.00	375.00	200.00	234.54	404.34	247.96	1.422
96	197.00	159.00	376.05	200.00	235.12	404.01	247.96	1.422
97	199.63	159.00	376.05	200.00	236.58	400.06	243.88	1.422
98	203.32	159.44	375.53	200.00	240.34	388.09	231.63	1.422
99	200.68	159.00	375.00	200.00	235.90	400.32	243.88	1.422

Critical Failure Surface (circle 1)

Intersects: XL: 203.84 YL: 159.61 XR: 375.00 YR: 200.00
Centre: XC: 243.26 YC: 375.43 Radius: R: 219.39

Generated failure surface: (20 points)

203.84 159.61 213.24 158.11 222.70 157.01 232.20 156.32
241.72 156.05
251.24 156.19 260.75 156.74 270.22 157.71 279.64 159.08
289.00 160.86
298.27 163.05 307.43 165.64 316.47 168.62 325.38 171.99
334.13 175.75
342.71 179.88 351.10 184.38 359.29 189.24 367.26 194.45
375.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 39 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	203.84	3.62	-9.1	3.83	3.88	2	0.00	35.0	474.37	228.84	129.53	1.10
2	207.67	18.20	-9.1	5.57	5.64	3	100.00	18.0	2409.11	1150.19	453.16	1.05
3	213.24	26.98	-6.6	4.73	4.76	3	100.00	18.0	3589.39	1694.75	778.71	1.03
4	217.97	37.03	-6.6	4.73	4.76	3	100.00	18.0	4932.21	2326.23	1066.84	1.03
5	222.70	46.80	-4.1	4.75	4.76	3	100.00	18.0	6233.92	2928.13	1329.94	1.02
6	227.45	55.95	-4.1	4.75	4.76	3	100.00	18.0	7448.51	3500.41	1588.02	1.02
7	232.20	64.76	-1.6	4.76	4.76	3	100.00	18.0	8613.81	4042.49	1818.45	1.01
8	236.96	72.96	-1.6	4.76	4.76	3	100.00	18.0	9694.69	4554.45	2046.37	1.01
9	241.72	80.69	0.8	4.76	4.76	3	100.00	18.0	10709.78	5035.86	2244.46	1.00
10	246.48	87.92	0.8	4.76	4.76	3	100.00	18.0	11652.60	5486.59	2442.14	1.00
11	251.24	94.49	3.3	4.75	4.76	3	100.00	18.0	12505.38	5906.20	2608.20	0.99
12	256.00	100.71	3.3	4.75	4.76	3	100.00	18.0	13306.71	6294.81	2775.62	0.99
13	260.75	106.06	5.8	4.74	4.76	3	100.00	18.0	13988.80	6652.08	2909.97	0.98
14	265.49	111.25	5.8	4.74	4.76	3	100.00	18.0	14646.37	6977.87	3047.15	0.98
15	270.22	108.38	8.3	4.43	4.48	3	100.00	18.0	14240.99	6834.63	3146.97	0.98
16	274.65	112.06	8.3	4.43	4.48	3	100.00	18.0	14694.73	7066.86		

3247.66	0.98									
17	279.09	129.22	10.5	4.96	5.04	2	0.00	35.0	16927.43	8200.77
3263.18	0.93									
18	284.04	132.72	10.8	4.96	5.04	2	0.00	35.0	17386.63	8430.91
3347.86	0.93									
19	289.00	126.79	13.3	4.63	4.76	2	0.00	35.0	16609.82	8129.12
3385.35	0.92									
20	293.63	128.88	13.3	4.63	4.76	2	0.00	35.0	16883.75	8263.20
3441.18	0.92									
21	298.27	129.01	15.8	4.58	4.76	2	0.00	35.0	16900.81	8365.07
3448.36	0.91									
22	302.85	130.08	15.8	4.58	4.76	2	0.00	35.0	17041.10	8434.51
3477.00	0.91									
23	307.43	158.79	18.3	5.57	5.86	2	0.00	35.0	20802.01	10433.61
3457.48	0.90									
24	313.00	85.59	18.3	3.00	3.16	2	0.00	35.0	11212.78	5623.96
3459.33	0.90									
25	316.00	128.06	20.5	4.50	4.80	2	0.00	35.0	16775.92	8305.27
3412.07	0.90									
26	320.50	127.14	20.7	4.50	4.81	2	0.00	35.0	16655.78	7807.81
3368.98	0.90									
27	325.00	124.15	23.0	4.57	4.96	2	0.00	35.0	16263.60	7488.63
3200.93	0.90									
28	329.57	115.20	23.2	4.57	4.97	2	0.00	35.0	15091.76	6892.60
2965.17	0.90									
29	334.13	99.61	25.7	4.29	4.76	2	0.00	35.0	13049.00	6007.48
2694.98	0.89									
30	338.42	90.75	25.7	4.29	4.76	2	0.00	35.0	11888.23	5393.79
2451.98	0.89									
31	342.71	55.99	28.2	2.89	3.28	2	0.00	35.0	7335.28	3349.81
2212.82	0.89									
32	345.61	51.50	28.2	2.89	3.28	2	0.00	35.0	6746.76	3031.73
2032.12	0.89									
33	348.50	39.11	28.2	2.39	2.71	5	0.00	45.0	4302.40	1185.17
1422.42	0.82									
34	350.89	60.94	30.6	4.20	4.88	2	0.00	35.0	7983.52	0.00
1465.05	0.90									
35	355.09	50.46	30.7	4.20	4.89	2	0.00	35.0	6610.74	0.00
1211.76	0.90									
36	359.29	37.70	33.2	3.99	4.76	2	0.00	35.0	4938.42	0.00
932.73	0.90									
37	363.28	27.32	33.2	3.99	4.76	2	0.00	35.0	3578.28	0.00
675.84	0.90									
38	367.26	10.33	35.7	2.16	2.66	2	0.00	35.0	1352.71	0.00
459.81	0.90									
39	369.43	11.15	35.7	5.57	6.86	1	150.00	22.0	1460.58	0.00
152.93	1.02									
		---			---				---	
X-S Area:		3178.38	Path Length:		180.93		X-S Weight:		416938.66	

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 6-2 Full Reservoir.gmf
Processed: 02 Dec 2020 14:40:45

DATA: Analysis 1 - Case 6-2 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	196.00	348.50	196.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	175.00	348.50	175.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	172.00	348.50	172.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	196.00	450.00	196.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	175.00	450.00	175.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	172.00	450.00	172.00	

Slope Surface (8 points)

100.00	175.00	250.00	175.00	325.00	200.00	400.00	200.00
405.00	195.00						
410.00	195.00	415.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	197.00	250.00	197.00	316.00	197.00	348.50	197.00
351.50	190.00						
450.00	190.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	250.00	YL:	175.00	XR:	405.00	YR: 195.00
Centre:	XC:	297.11	YC:	420.52	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 6-2 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

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Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 8.056

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 3.85

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	250.79	175.26	400.00	200.00	289.59	403.62	231.63	3.850	<-- Critical Surface
2	249.74	175.00	400.00	200.00	287.55	411.80	239.80	3.856	
3	251.32	175.44	400.00	200.00	290.66	399.56	227.55	3.856	
4	247.11	175.00	400.00	200.00	285.54	419.96	247.96	3.856	
5	248.68	175.00	400.00	200.00	286.60	415.91	243.88	3.859	
6	251.84	175.61	400.00	200.00	291.74	395.49	223.47	3.863	
7	246.05	175.00	400.00	200.00	284.61	424.07	252.04	3.865	
8	247.63	175.00	400.00	200.00	285.66	420.03	247.96	3.867	
9	249.21	175.00	400.00	200.00	286.73	415.97	243.88	3.870	
10	245.00	175.00	400.00	200.00	283.68	428.18	256.12	3.874	
11	246.58	175.00	400.00	200.00	284.73	424.14	252.04	3.875	
12	250.26	175.09	400.00	200.00	287.80	411.93	239.80	3.875	
13	248.16	175.00	400.00	200.00	285.78	420.09	247.96	3.878	
14	252.37	175.79	400.00	200.00	292.81	391.42	219.39	3.878	
15	252.89	175.96	400.00	200.00	293.88	387.33	215.31	3.881	
16	249.74	175.00	400.00	200.00	286.85	416.04	243.88	3.881	
17	245.53	175.00	400.00	200.00	283.80	428.25	256.12	3.884	
18	253.42	176.14	400.00	200.00	294.94	383.24	211.22	3.884	
19	250.79	175.26	400.00	200.00	288.88	407.88	235.71	3.886	
20	247.11	175.00	400.00	200.00	284.85	424.20	252.04	3.886	
21	253.95	176.32	400.00	200.00	296.00	379.14	207.14	3.888	
22	248.68	175.00	400.00	200.00	285.90	420.15	247.96	3.888	
23	251.32	175.44	400.00	200.00	289.96	403.83	231.63	3.889	
24	254.47	176.49	400.00	200.00	297.06	375.04	203.06	3.893	
25	246.05	175.00	400.00	200.00	283.92	428.31	256.12	3.894	
26	251.84	175.61	400.00	200.00	291.03	399.76	227.55	3.896	
27	251.32	175.44	400.53	199.47	291.10	403.63	231.63	3.899	
28	245.00	175.00	400.00	200.00	283.00	432.41	260.20	3.902	
29	252.37	175.79	400.00	200.00	292.11	395.70	223.47	3.903	
30	249.21	175.00	400.00	200.00	286.02	420.21	247.96	3.905	
31	246.05	175.00	400.53	199.47	285.13	428.12	256.12	3.905	
32	248.68	175.00	400.53	199.47	287.09	419.97	247.96	3.906	
33	248.16	175.00	400.00	200.00	285.09	424.32	252.04	3.907	
34	247.63	175.00	400.00	200.00	284.97	424.26	252.04	3.907	
35	247.63	175.00	400.53	199.47	286.17	424.08	252.04	3.908	
36	250.26	175.09	400.00	200.00	287.09	416.17	243.88	3.909	
37	246.58	175.00	400.00	200.00	284.04	428.37	256.12	3.910	
38	249.74	175.00	400.00	200.00	286.14	420.27	247.96	3.911	
39	249.21	175.00	400.53	199.47	287.22	420.03	247.96	3.912	
40	245.00	175.00	400.53	199.47	284.21	432.23	260.20	3.913	
41	247.11	175.00	400.00	200.00	284.16	428.43	256.12	3.914	
42	245.53	175.00	400.00	200.00	283.12	432.47	260.20	3.914	
43	251.84	175.61	400.53	199.47	292.16	399.56	227.55	3.914	
44	246.58	175.00	400.53	199.47	285.25	428.19	256.12	3.916	
45	252.89	175.96	400.00	200.00	293.18	391.62	219.39	3.917	
46	252.37	175.79	400.53	199.47	293.22	395.49	223.47	3.918	
47	248.68	175.00	400.00	200.00	285.21	424.38	252.04	3.918	
48	248.16	175.00	400.53	199.47	286.29	424.14	252.04	3.919	
49	251.32	175.44	400.00	200.00	289.26	408.08	235.71	3.920	
50	250.79	175.26	400.00	200.00	288.18	412.13	239.80	3.921	
51	253.42	176.14	400.00	200.00	294.24	387.54	215.31	3.921	
52	252.89	175.96	400.53	199.47	294.27	391.41	219.39	3.921	
53	249.74	175.00	400.53	199.47	287.34	420.09	247.96	3.922	
54	246.05	175.00	400.00	200.00	283.23	432.53	260.20	3.923	
55	250.79	175.26	400.53	199.47	289.35	411.94	239.80	3.924	
56	245.53	175.00	400.53	199.47	284.33	432.29	260.20	3.924	
57	253.95	176.32	400.00	200.00	295.30	383.45	211.22	3.926	
58	247.63	175.00	400.00	200.00	284.28	428.49	256.12	3.926	
59	247.11	175.00	400.53	199.47	285.37	428.25	256.12	3.926	
60	253.42	176.14	400.53	199.47	295.33	387.33	215.31	3.927	
61	251.84	175.61	400.00	200.00	290.33	404.03	231.63	3.928	
62	250.26	175.09	400.53	199.47	288.28	415.98	243.88	3.929	
63	248.68	175.00	400.53	199.47	286.41	424.20	252.04	3.930	
64	249.21	175.00	400.00	200.00	285.32	424.44	252.04	3.931	
65	251.32	175.44	400.53	199.47	290.41	407.89	235.71	3.931	
66	245.00	175.00	400.00	200.00	282.32	436.64	264.29	3.931	

67	254.47	176.49	400.00	200.00	296.36	379.35	207.14	3.932
68	253.95	176.32	400.53	199.47	296.38	383.24	211.22	3.933
69	246.05	175.00	400.53	199.47	284.45	432.35	260.20	3.934
70	246.58	175.00	400.00	200.00	283.35	432.59	260.20	3.934
71	247.63	175.00	400.53	199.47	285.49	428.31	256.12	3.937
72	250.26	175.09	400.00	200.00	286.39	420.40	247.96	3.937
73	248.16	175.00	400.00	200.00	284.39	428.55	256.12	3.938
74	255.00	176.67	400.00	200.00	297.42	375.25	203.06	3.938
75	254.47	176.49	400.53	199.47	297.42	379.13	207.14	3.939
76	249.21	175.00	400.53	199.47	286.53	424.26	252.04	3.941
77	245.00	175.00	400.53	199.47	283.55	436.46	264.29	3.943
78	245.53	175.00	400.00	200.00	282.43	436.70	264.29	3.943
79	249.74	175.00	400.00	200.00	285.44	424.50	252.04	3.943
80	246.58	175.00	400.53	199.47	284.58	432.41	260.20	3.945
81	250.79	175.26	400.00	200.00	287.47	416.37	243.88	3.945
82	247.11	175.00	400.00	200.00	283.47	432.65	260.20	3.946
83	250.26	175.09	400.53	199.47	287.59	420.22	247.96	3.946
84	248.16	175.00	400.53	199.47	285.61	428.37	256.12	3.948
85	252.37	175.79	400.00	200.00	291.41	399.97	227.55	3.948
86	251.84	175.61	400.53	199.47	291.48	403.83	231.63	3.948
87	248.68	175.00	400.00	200.00	284.51	428.60	256.12	3.950
88	252.89	175.96	400.00	200.00	292.48	395.90	223.47	3.952
89	245.53	175.00	400.53	199.47	283.67	436.52	264.29	3.953
90	252.37	175.79	400.53	199.47	292.54	399.77	227.55	3.953
91	251.32	175.44	400.00	200.00	288.55	412.33	239.80	3.953
92	246.05	175.00	400.00	200.00	282.55	436.75	264.29	3.954
93	250.79	175.26	400.53	199.47	288.66	416.18	243.88	3.954
94	247.11	175.00	400.53	199.47	284.70	432.47	260.20	3.955
95	247.63	175.00	400.00	200.00	283.58	432.71	260.20	3.957
96	253.42	176.14	400.00	200.00	293.54	391.83	219.39	3.958
97	252.89	175.96	400.53	199.47	293.59	395.70	223.47	3.958
98	249.21	175.00	401.05	198.95	287.74	424.08	252.04	3.958
99	245.00	175.00	401.05	198.95	284.77	436.28	264.29	3.959

Critical Failure Surface (circle 1)

Intersects: XL: 250.79 YL: 175.26 XR: 400.00 YR: 200.00
Centre: XC: 289.59 YC: 403.62 Radius: R: 231.63

Generated failure surface: (20 points)

250.79	175.26	258.81	174.05	266.86	173.11	274.94	172.45	283.04	172.08
291.15	172.00	299.26	172.19	307.35	172.67	315.42	173.44	323.47	174.48
331.46	175.81	339.41	177.41	347.30	179.30	355.12	181.45	362.85	183.88
370.50	186.58	378.05	189.55	385.48	192.77	392.81	196.26	400.00	200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	250.79	0.73	-8.6	1.73	1.75	2	0.00	35.0	95.35	2390.63	1394.24	1.04
2	252.52	5.04	-8.6	3.14	3.18	3	100.00	18.0	667.35	4410.71	1505.50	1.02
3	255.66	9.83	-8.6	3.14	3.18	3	100.00	18.0	1310.07	4505.38	1646.09	1.02
4	258.81	19.31	-6.6	4.03	4.05	3	100.00	18.0	2577.85	5866.52	1794.30	1.02
5	262.83	26.60	-6.6	4.03	4.05	3	100.00	18.0	3551.98	5985.04	1953.70	1.02
6	266.86	33.74	-4.6	4.04	4.05	3	100.00	18.0	4502.80	6085.74	2100.51	1.01
7	270.90	40.50	-4.6	4.04	4.05	3	100.00	18.0	5402.26	6168.44	2239.85	1.01
8	274.94	47.09	-2.6	4.05	4.05	3	100.00	18.0	6276.03	6233.23	2365.88	1.00
9	278.99	53.31	-2.6	4.05	4.05	3	100.00	18.0	7098.18	6280.15	2485.05	1.00
10	283.04	56.60	-0.6	3.88	3.88	3	100.00	18.0	7528.81	6033.98	2588.11	1.00
11	286.92	61.78	-0.6	3.88	3.88	3	100.00	18.0	8208.11	6044.07	2682.74	1.00
12	290.80	73.03	1.2	4.23	4.23	3	100.00	18.0	9691.92	6589.66	2768.84	1.00
13	295.03	78.56	1.4	4.23	4.23	3	100.00	18.0	10412.02	6563.05	2850.54	1.00
14	299.26	80.06	3.4	4.05	4.05	3	100.00	18.0	10596.24	6245.63	2915.87	1.00
15	303.30	84.54	3.4	4.05	4.05	3	100.00	18.0	11174.37	6184.82		

2974.19	1.00									
16	307.35	61.51	5.4	2.82	2.84	3	100.00	18.0	8120.14	4282.49
3011.35	1.00									
17	310.18	63.42	5.4	2.82	2.84	3	100.00	18.0	8362.17	4235.27
3037.93	1.00									
18	313.00	55.96	5.4	2.42	2.44	3	100.00	18.0	7371.16	3597.89
3062.63	1.00									
19	315.42	95.61	7.4	4.02	4.05	3	100.00	18.0	12577.04	5895.19
3106.74	1.00									
20	319.44	98.90	7.4	4.02	4.05	3	100.00	18.0	12986.68	5763.01
3207.14	1.00									
21	323.47	38.58	9.4	1.53	1.56	3	100.00	18.0	5059.41	2173.58
3266.16	1.00									
22	325.00	39.97	9.4	1.59	1.61	3	100.00	18.0	5238.60	2226.57
3262.95	1.00									
23	326.59	119.88	9.4	4.87	4.94	2	0.00	35.0	15704.75	6657.96
3167.21	0.98									
24	331.46	94.55	11.4	3.97	4.05	2	0.00	35.0	12385.52	5259.83
3052.11	0.98									
25	335.44	91.36	11.4	3.97	4.05	2	0.00	35.0	11967.64	5056.76
2948.91	0.98									
26	339.41	87.21	13.4	3.94	4.05	2	0.00	35.0	11425.09	4836.09
2826.28	0.99									
27	343.36	83.50	13.4	3.94	4.05	2	0.00	35.0	10938.83	4597.97
2705.66	0.99									
28	347.30	24.65	15.4	1.20	1.25	2	0.00	35.0	3228.99	1362.54
2614.23	0.99									
29	348.50	59.88	15.4	3.00	3.11	5	0.00	45.0	6586.37	2613.69
2104.77	0.97									
30	351.50	68.87	15.4	3.62	3.75	2	0.00	35.0	9022.43	2117.50
2402.70	0.99									
31	355.12	69.39	17.4	3.87	4.05	2	0.00	35.0	9089.91	2008.50
2249.81	0.99									
32	358.98	64.69	17.4	3.87	4.05	2	0.00	35.0	8474.27	1701.14
2095.17	0.99									
33	362.85	59.04	19.4	3.82	4.05	2	0.00	35.0	7733.89	1376.79
1921.37	1.00									
34	366.68	53.88	19.4	3.82	4.05	2	0.00	35.0	7058.00	1035.37
1750.16	1.00									
35	370.50	47.83	21.4	3.77	4.05	2	0.00	35.0	6266.37	677.12
1561.03	1.00									
36	374.27	42.24	21.4	3.77	4.05	2	0.00	35.0	5533.58	302.08
1373.61	1.00									
37	378.05	10.67	23.5	1.04	1.14	2	0.00	35.0	1398.16	16.07
1242.72	1.01									
38	379.09	29.76	23.5	3.20	3.49	2	0.00	35.0	3898.23	0.00
1129.98	1.01									
39	382.29	25.32	23.5	3.20	3.49	2	0.00	35.0	3317.13	0.00
961.53	1.01									
40	385.48	21.74	25.5	3.39	3.75	2	0.00	35.0	2848.35	0.00
773.89	1.02									
41	388.87	16.28	25.5	3.39	3.75	2	0.00	35.0	2132.72	0.00
579.46	1.02									
42	392.26	11.68	27.2	3.87	4.35	1	150.00	22.0	1530.23	0.00
356.14	1.07									
43	396.13	3.89	27.5	3.87	4.36	1	150.00	22.0	510.08	0.00
105.76	1.07									
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X-S Area:		2210.99	Path Length:		154.06		X-S Weight:		289859.09	

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 6-2 Rapid Drawdown.gmf
Processed: 02 Dec 2020 14:39:57

DATA: Analysis 1 - Case 6-2 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	196.00	348.50	196.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	175.00	348.50	175.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	172.00	348.50	172.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	196.00	450.00	196.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	175.00	450.00	175.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	172.00	450.00	172.00	

Slope Surface (8 points)

100.00	175.00	250.00	175.00	325.00	200.00	400.00	200.00
405.00	195.00						
410.00	195.00	415.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	175.00	250.00	175.00	316.00	197.00	348.50	197.00
351.50	190.00						
450.00	190.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	250.00	YL:	175.00	XR:	405.00	YR: 195.00
Centre:	XC:	297.11	YC:	420.52	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 6-2 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 4.798

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.31

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	247.11	175.00	400.00	200.00	285.54	419.96	247.96	2.310	<-- Critical Surface
2	249.74	175.00	400.00	200.00	287.55	411.80	239.80	2.313	
3	250.79	175.26	400.00	200.00	289.59	403.62	231.63	2.313	
4	248.68	175.00	400.00	200.00	286.60	415.91	243.88	2.314	
5	246.05	175.00	400.00	200.00	284.61	424.07	252.04	2.314	
6	247.63	175.00	400.00	200.00	285.66	420.03	247.96	2.318	
7	251.32	175.44	400.00	200.00	290.66	399.56	227.55	2.319	
8	245.00	175.00	400.00	200.00	283.68	428.18	256.12	2.319	
9	249.21	175.00	400.00	200.00	286.73	415.97	243.88	2.322	
10	246.58	175.00	400.00	200.00	284.73	424.14	252.04	2.322	
11	248.16	175.00	400.00	200.00	285.78	420.09	247.96	2.325	
12	251.84	175.61	400.00	200.00	291.74	395.49	223.47	2.325	
13	245.53	175.00	400.00	200.00	283.80	428.25	256.12	2.326	
14	250.26	175.09	400.00	200.00	287.80	411.93	239.80	2.327	
15	247.11	175.00	400.00	200.00	284.85	424.20	252.04	2.329	
16	249.74	175.00	400.00	200.00	286.85	416.04	243.88	2.329	
17	248.68	175.00	400.00	200.00	285.90	420.15	247.96	2.333	
18	246.05	175.00	400.00	200.00	283.92	428.31	256.12	2.333	
19	252.37	175.79	400.00	200.00	292.81	391.42	219.39	2.335	
20	250.79	175.26	400.00	200.00	288.88	407.88	235.71	2.335	
21	245.00	175.00	400.00	200.00	283.00	432.41	260.20	2.337	
22	251.32	175.44	400.00	200.00	289.96	403.83	231.63	2.339	
23	252.89	175.96	400.00	200.00	293.88	387.33	215.31	2.340	
24	246.05	175.00	400.53	199.47	285.13	428.12	256.12	2.340	
25	247.63	175.00	400.00	200.00	284.97	424.26	252.04	2.343	
26	249.21	175.00	400.00	200.00	286.02	420.21	247.96	2.343	
27	248.16	175.00	400.00	200.00	285.09	424.32	252.04	2.344	
28	247.63	175.00	400.53	199.47	286.17	424.08	252.04	2.344	
29	246.58	175.00	400.00	200.00	284.04	428.37	256.12	2.344	
30	248.68	175.00	400.53	199.47	287.09	419.97	247.96	2.344	
31	245.00	175.00	400.53	199.47	284.21	432.23	260.20	2.345	
32	253.42	176.14	400.00	200.00	294.94	383.24	211.22	2.345	
33	245.53	175.00	400.00	200.00	283.12	432.47	260.20	2.345	
34	251.84	175.61	400.00	200.00	291.03	399.76	227.55	2.346	
35	251.32	175.44	400.53	199.47	291.10	403.63	231.63	2.347	
36	247.11	175.00	400.00	200.00	284.16	428.43	256.12	2.347	
37	249.74	175.00	400.00	200.00	286.14	420.27	247.96	2.348	
38	246.58	175.00	400.53	199.47	285.25	428.19	256.12	2.348	
39	250.26	175.09	400.00	200.00	287.09	416.17	243.88	2.348	
40	249.21	175.00	400.53	199.47	287.22	420.03	247.96	2.349	
41	253.95	176.32	400.00	200.00	296.00	379.14	207.14	2.350	
42	248.16	175.00	400.53	199.47	286.29	424.14	252.04	2.352	
43	246.05	175.00	400.00	200.00	283.23	432.53	260.20	2.352	
44	248.68	175.00	400.00	200.00	285.21	424.38	252.04	2.352	
45	245.53	175.00	400.53	199.47	284.33	432.29	260.20	2.352	
46	252.37	175.79	400.00	200.00	292.11	395.70	223.47	2.353	
47	247.11	175.00	400.53	199.47	285.37	428.25	256.12	2.355	
48	247.63	175.00	400.00	200.00	284.28	428.49	256.12	2.356	
49	249.74	175.00	400.53	199.47	287.34	420.09	247.96	2.356	
50	245.00	175.00	400.00	200.00	282.32	436.64	264.29	2.356	
51	251.84	175.61	400.53	199.47	292.16	399.56	227.55	2.356	
52	254.47	176.49	400.00	200.00	297.06	375.04	203.06	2.356	
53	250.79	175.26	400.00	200.00	288.18	412.13	239.80	2.358	
54	248.68	175.00	400.53	199.47	286.41	424.20	252.04	2.359	
55	246.05	175.00	400.53	199.47	284.45	432.35	260.20	2.359	
56	251.32	175.44	400.00	200.00	289.26	408.08	235.71	2.359	
57	246.58	175.00	400.00	200.00	283.35	432.59	260.20	2.360	
58	250.79	175.26	400.53	199.47	289.35	411.94	239.80	2.360	
59	249.21	175.00	400.00	200.00	285.32	424.44	252.04	2.360	
60	250.26	175.09	400.53	199.47	288.28	415.98	243.88	2.361	
61	252.37	175.79	400.53	199.47	293.22	395.49	223.47	2.362	
62	247.63	175.00	400.53	199.47	285.49	428.31	256.12	2.363	
63	252.89	175.96	400.00	200.00	293.18	391.62	219.39	2.363	
64	245.00	175.00	400.53	199.47	283.55	436.46	264.29	2.363	
65	248.16	175.00	400.00	200.00	284.39	428.55	256.12	2.364	
66	245.53	175.00	400.00	200.00	282.43	436.70	264.29	2.364	

67	250.26	175.09	400.00	200.00	286.39	420.40	247.96	2.366
68	246.58	175.00	400.53	199.47	284.58	432.41	260.20	2.366
69	249.21	175.00	400.53	199.47	286.53	424.26	252.04	2.367
70	251.84	175.61	400.00	200.00	290.33	404.03	231.63	2.367
71	251.32	175.44	400.53	199.47	290.41	407.89	235.71	2.367
72	252.89	175.96	400.53	199.47	294.27	391.41	219.39	2.367
73	247.11	175.00	400.00	200.00	283.47	432.65	260.20	2.368
74	249.74	175.00	400.00	200.00	285.44	424.50	252.04	2.369
75	253.42	176.14	400.00	200.00	294.24	387.54	215.31	2.369
76	248.16	175.00	400.53	199.47	285.61	428.37	256.12	2.370
77	245.53	175.00	400.53	199.47	283.67	436.52	264.29	2.370
78	246.05	175.00	400.00	200.00	282.55	436.75	264.29	2.372
79	245.00	175.00	401.05	198.95	284.77	436.28	264.29	2.372
80	248.68	175.00	400.00	200.00	284.51	428.60	256.12	2.372
81	250.26	175.09	400.53	199.47	287.59	420.22	247.96	2.372
82	250.79	175.26	400.00	200.00	287.47	416.37	243.88	2.373
83	247.11	175.00	400.53	199.47	284.70	432.47	260.20	2.374
84	253.42	176.14	400.53	199.47	295.33	387.33	215.31	2.374
85	253.95	176.32	400.00	200.00	295.30	383.45	211.22	2.375
86	246.58	175.00	401.05	198.95	285.79	432.23	260.20	2.375
87	247.63	175.00	400.00	200.00	283.58	432.71	260.20	2.376
88	245.00	175.00	400.00	200.00	281.64	440.85	268.37	2.376
89	249.21	175.00	401.05	198.95	287.74	424.08	252.04	2.376
90	251.84	175.61	400.53	199.47	291.48	403.83	231.63	2.378
91	247.63	175.00	401.05	198.95	286.70	428.13	256.12	2.379
92	246.58	175.00	400.00	200.00	282.66	436.81	264.29	2.379
93	245.53	175.00	401.05	198.95	284.89	436.34	264.29	2.380
94	250.79	175.26	400.53	199.47	288.66	416.18	243.88	2.380
95	249.21	175.00	400.00	200.00	284.62	428.66	256.12	2.380
96	253.95	176.32	400.53	199.47	296.38	383.24	211.22	2.380
97	251.32	175.44	400.00	200.00	288.55	412.33	239.80	2.381
98	249.74	175.00	400.53	199.47	286.65	424.32	252.04	2.381
99	248.68	175.00	400.53	199.47	285.73	428.43	256.12	2.381

Critical Failure Surface (circle 1)

Intersects: XL: 247.11 YL: 175.00 XR: 400.00 YR: 200.00
Centre: XC: 285.54 YC: 419.96 Radius: R: 247.96

Generated failure surface: (20 points)

247.11 175.00 255.32 173.85 263.56 172.98 271.84 172.38
280.12 172.06
288.41 172.02 296.70 172.25 304.98 172.77 313.23 173.55
321.46 174.62
329.64 175.96 337.78 177.57 345.85 179.45 353.86 181.60
361.79 184.02
369.64 186.70 377.39 189.64 385.04 192.84 392.58 196.30
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 44 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	247.11	0.59	-8.0	2.89	2.92	3	100.00	18.0	82.60	36.91	35.03	1.03
2	250.00	2.75	-8.0	2.66	2.68	3	100.00	18.0	375.78	173.19	149.04	1.03
3	252.66	6.09	-8.0	2.66	2.68	3	100.00	18.0	823.87	383.95	319.38	1.03
4	255.32	15.78	-6.0	4.12	4.15	3	100.00	18.0	2123.07	989.96	523.74	1.02
5	259.44	23.24	-6.0	4.12	4.15	3	100.00	18.0	3119.22	1458.49	767.27	1.02
6	263.56	30.52	-4.1	4.14	4.15	3	100.00	18.0	4088.39	1909.64	997.20	1.01
7	267.70	37.46	-4.1	4.14	4.15	3	100.00	18.0	5009.18	2343.50	1221.06	1.01
8	271.84	44.19	-2.2	4.14	4.15	3	100.00	18.0	5901.15	2759.74	1430.17	1.01
9	275.98	50.58	-2.2	4.14	4.15	3	100.00	18.0	6744.18	3158.44	1634.22	1.01
10	280.12	56.72	-0.3	4.15	4.15	3	100.00	18.0	7552.58	3539.38	1822.50	1.00
11	284.27	62.54	-0.3	4.15	4.15	3	100.00	18.0	8315.70	3902.46	2006.62	1.00
12	288.41	68.04	1.6	4.14	4.15	3	100.00	18.0	9034.50	4247.47	2174.07	1.00
13	292.56	73.28	1.6	4.14	4.15	3	100.00	18.0	9716.07	4574.58	2338.17	1.00
14	296.70	78.11	3.5	4.14	4.15	3	100.00	18.0	10340.99	4883.48	2484.80	0.99
15	300.84	82.76	3.5	4.14	4.15	3	100.00	18.0	10939.59	5174.22		

2628.79	0.99									
16	304.98	84.37	5.5	4.01	4.03	3	100.00	18.0	11134.33	5288.60
2752.89	0.99									
17	308.99	88.19	5.5	4.01	4.03	3	100.00	18.0	11620.02	5528.35
2873.20	0.99									
18	313.00	68.35	7.2	3.00	3.02	3	100.00	18.0	8991.95	4298.96
2964.34	0.99									
19	316.00	63.77	7.4	2.73	2.75	3	100.00	18.0	8378.28	3934.07
3035.35	0.99									
20	318.73	65.28	7.4	2.73	2.75	3	100.00	18.0	8567.55	3873.42
3103.10	0.99									
21	321.46	57.06	9.3	2.34	2.37	3	100.00	18.0	7479.92	3281.45
3150.66	0.99									
22	323.80	29.73	9.3	1.20	1.22	2	0.00	35.0	3894.20	1666.56
3147.58	0.97									
23	325.00	113.37	9.3	4.64	4.70	2	0.00	35.0	14851.05	6287.57
3111.56	0.97									
24	329.64	96.15	11.2	4.07	4.15	2	0.00	35.0	12596.18	5340.39
2994.60	0.96									
25	333.71	92.88	11.2	4.07	4.15	2	0.00	35.0	12167.01	5131.99
2892.20	0.96									
26	337.78	88.68	13.1	4.04	4.15	2	0.00	35.0	11617.69	4906.06
2765.36	0.96									
27	341.81	84.88	13.1	4.04	4.15	2	0.00	35.0	11119.90	4662.59
2646.34	0.96									
28	345.85	53.48	15.0	2.65	2.74	2	0.00	35.0	7005.76	2942.09
2527.22	0.96									
29	348.50	58.31	15.0	3.00	3.11	5	0.00	45.0	6414.19	2507.63
1999.45	0.93									
30	351.50	44.18	15.0	2.36	2.44	2	0.00	35.0	5787.79	1329.49
2308.29	0.96									
31	353.86	70.58	17.0	3.97	4.15	2	0.00	35.0	9245.70	2016.88
2175.21	0.96									
32	357.83	65.78	17.0	3.97	4.15	2	0.00	35.0	8617.64	1704.13
2023.86	0.96									
33	361.79	60.07	18.9	3.92	4.15	2	0.00	35.0	7869.80	1374.31
1848.71	0.96									
34	365.72	54.81	18.9	3.92	4.15	2	0.00	35.0	7180.69	1027.42
1681.70	0.96									
35	369.64	48.71	20.8	3.88	4.15	2	0.00	35.0	6380.73	663.66
1492.73	0.96									
36	373.52	43.00	20.8	3.88	4.15	2	0.00	35.0	5633.57	283.01
1310.41	0.96									
37	377.39	8.72	22.7	0.86	0.93	2	0.00	35.0	1142.04	10.38
1184.68	0.96									
38	378.25	31.55	22.7	3.40	3.68	2	0.00	35.0	4133.67	0.00
1080.01	0.96									
39	381.65	26.73	22.7	3.40	3.68	2	0.00	35.0	3501.40	0.00
914.81	0.96									
40	385.04	21.95	24.6	3.45	3.79	2	0.00	35.0	2875.43	0.00
732.56	0.97									
41	388.49	16.51	24.6	3.45	3.79	2	0.00	35.0	2162.46	0.00
550.92	0.97									
42	391.94	2.49	24.6	0.65	0.71	1	150.00	22.0	325.86	0.00
439.64	1.02									
43	392.58	10.31	26.5	3.71	4.15	1	150.00	22.0	1350.00	0.00
304.89	1.03									
44	396.29	3.44	26.5	3.71	4.15	1	150.00	22.0	449.99	0.00
81.75	1.03									
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X-S Area:		2186.00	Path Length:		157.56		X-S Weight:		286661.69	

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 7-1 Full Reservoir.gmf
Processed: 02 Dec 2020 14:52:49

DATA: Analysis 1 - Case 7-1 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	188.00	348.50	188.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	144.00	348.50	144.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	141.00	348.50	141.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	500.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	188.00	500.00	188.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	144.00	500.00	144.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	141.00	500.00	141.00	

Slope Surface (4 points)

100.00	144.00	157.00	144.00	325.00	200.00	500.00	200.00

Phreatic Surface (6 points)

100.00	197.00	157.00	197.00	316.00	197.00	348.50	197.00
351.50	170.00						
500.00	170.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	157.00	YL:	144.00	XR:	480.00	YR: 200.00
Centre:	XC:	237.81	YC:	637.43	Radius:	R:	500.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 7-1 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 6.026

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 4.38

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	156.21	144.00	475.00	200.00	216.38	736.87	595.92	4.377	<-- Critical Surface
2	155.16	144.00	475.00	200.00	215.46	740.96	600.00	4.379	
3	158.32	144.44	475.00	200.00	221.16	716.51	575.51	4.381	
4	156.74	144.00	475.00	200.00	216.47	736.92	595.92	4.383	
5	155.68	144.00	475.00	200.00	215.55	741.01	600.00	4.385	
6	157.26	144.09	475.00	200.00	217.45	732.86	591.84	4.385	
7	157.79	144.26	475.00	200.00	219.31	724.69	583.67	4.386	
8	156.74	144.00	475.53	200.00	216.90	736.87	595.92	4.387	
9	155.68	144.00	475.53	200.00	215.99	740.96	600.00	4.389	
10	159.89	144.96	475.00	200.00	225.99	696.12	555.10	4.389	
11	157.26	144.09	475.53	200.00	217.88	732.81	591.84	4.389	
12	159.37	144.79	475.00	200.00	224.14	704.32	563.27	4.391	
13	156.21	144.00	475.00	200.00	215.64	741.05	600.00	4.391	
14	158.84	144.61	475.00	200.00	222.29	712.51	571.43	4.392	
15	158.32	144.44	475.00	200.00	220.43	720.69	579.59	4.394	
16	156.21	144.00	475.53	200.00	216.08	741.01	600.00	4.395	
17	157.79	144.26	475.00	200.00	218.57	728.87	587.76	4.395	
18	159.37	144.79	475.53	200.00	224.57	704.27	563.27	4.396	
19	157.79	144.26	475.53	200.00	219.74	724.64	583.67	4.396	
20	156.74	144.00	475.00	200.00	215.73	741.09	600.00	4.397	
21	158.84	144.61	475.53	200.00	222.71	712.46	571.43	4.397	
22	160.95	145.32	475.00	200.00	228.95	683.90	542.86	4.397	
23	156.21	144.00	476.05	200.00	216.51	740.96	600.00	4.399	
24	157.26	144.09	475.00	200.00	216.71	737.03	595.92	4.399	
25	157.79	144.26	475.53	200.00	219.00	728.82	587.76	4.399	
26	160.42	145.14	475.00	200.00	227.11	692.11	551.02	4.400	
27	156.74	144.00	475.53	200.00	216.17	741.05	600.00	4.401	
28	159.89	144.96	475.00	200.00	225.26	700.32	559.18	4.402	
29	158.84	144.61	476.05	200.00	223.14	712.41	571.43	4.402	
30	157.26	144.09	475.53	200.00	217.15	736.99	595.92	4.403	
31	158.32	144.44	476.05	200.00	221.29	720.60	579.59	4.403	
32	158.84	144.61	475.00	200.00	221.55	716.70	575.51	4.404	
33	158.32	144.44	475.53	200.00	220.86	720.65	579.59	4.405	
34	160.42	145.14	475.53	200.00	227.53	692.06	551.02	4.405	
35	156.74	144.00	476.05	200.00	216.61	741.01	600.00	4.405	
36	159.89	144.96	475.53	200.00	225.68	700.27	559.18	4.407	
37	157.79	144.26	476.05	200.00	219.44	728.78	587.76	4.407	
38	158.32	144.44	475.00	200.00	219.70	724.88	583.67	4.407	
39	157.26	144.09	476.05	200.00	217.58	736.95	595.92	4.407	
40	158.84	144.61	475.00	200.00	223.02	708.32	567.35	4.408	
41	159.37	144.79	475.53	200.00	223.83	708.46	567.35	4.408	
42	156.74	144.00	476.58	200.00	217.04	740.96	600.00	4.409	
43	157.79	144.26	475.00	200.00	217.84	733.05	591.84	4.410	
44	162.00	145.67	475.00	200.00	231.91	671.65	530.61	4.411	
45	158.32	144.44	475.53	200.00	220.13	724.83	583.67	4.411	
46	160.95	145.32	475.00	200.00	228.22	688.10	546.94	4.411	
47	157.26	144.09	476.58	200.00	218.01	736.90	595.92	4.412	
48	159.89	144.96	476.05	200.00	226.11	700.21	559.18	4.412	
49	159.37	144.79	475.00	200.00	223.41	708.51	567.35	4.412	
50	157.26	144.09	475.00	200.00	215.98	741.21	600.00	4.412	
51	160.42	145.14	475.00	200.00	226.38	696.31	555.10	4.413	
52	162.00	145.67	475.53	200.00	232.33	671.60	530.61	4.413	
53	159.37	144.79	476.05	200.00	224.26	708.41	567.35	4.413	
54	158.84	144.61	475.53	200.00	221.98	716.65	575.51	4.414	
55	157.79	144.26	475.53	200.00	218.27	733.00	591.84	4.414	
56	158.32	144.44	476.05	200.00	220.56	724.78	583.67	4.415	
57	161.47	145.49	475.00	200.00	230.07	679.88	538.78	4.416	
58	159.37	144.79	475.00	200.00	222.67	712.70	571.43	4.416	
59	157.26	144.09	475.53	200.00	216.41	741.17	600.00	4.417	
60	157.79	144.26	476.58	200.00	219.87	728.73	587.76	4.417	
61	157.79	144.26	476.05	200.00	218.70	732.96	591.84	4.418	
62	160.42	145.14	475.53	200.00	226.80	696.26	555.10	4.418	
63	161.47	145.49	475.53	200.00	230.49	679.83	538.78	4.419	
64	158.84	144.61	475.00	200.00	220.82	720.88	579.59	4.419	
65	159.89	144.96	475.53	200.00	224.95	704.46	563.27	4.420	
66	158.84	144.61	476.58	200.00	222.84	716.55	575.51	4.420	
67	158.32	144.44	475.00	200.00	218.96	729.06	587.76	4.421	
68	157.26	144.09	476.05	200.00	216.85	741.12	600.00	4.421	

69	161.47	145.49	476.05	200.00	230.91	679.77	538.78	4.422
70	159.89	144.96	475.00	200.00	224.53	704.51	563.27	4.422
71	157.79	144.26	476.58	200.00	219.14	732.91	591.84	4.422
72	158.84	144.61	475.53	200.00	221.25	720.84	579.59	4.423
73	159.37	144.79	475.53	200.00	223.10	712.65	571.43	4.423
74	160.95	145.32	475.53	200.00	228.64	688.05	546.94	4.423
75	157.79	144.26	475.00	200.00	217.10	737.22	595.92	4.423
76	158.84	144.61	476.05	200.00	222.41	716.60	575.51	4.424
77	159.89	144.96	476.05	200.00	225.38	704.41	563.27	4.425
78	160.95	145.32	475.00	200.00	227.49	692.30	551.02	4.425
79	158.32	144.44	475.53	200.00	219.40	729.01	587.76	4.426
80	157.26	144.09	476.58	200.00	217.28	741.08	600.00	4.426
81	159.37	144.79	476.58	200.00	224.69	708.36	567.35	4.426
82	158.32	144.44	477.11	200.00	221.42	724.69	583.67	4.426
83	158.32	144.44	476.58	200.00	220.99	724.74	583.67	4.426
84	162.00	145.67	475.00	200.00	231.18	675.87	534.69	4.426
85	160.95	145.32	476.05	200.00	229.07	688.00	546.94	4.426
86	158.84	144.61	476.05	200.00	221.68	720.79	579.59	4.427
87	157.79	144.26	475.53	200.00	217.54	737.18	595.92	4.428
88	159.89	144.96	475.00	200.00	223.79	708.70	567.35	4.428
89	157.79	144.26	477.11	200.00	219.57	732.87	591.84	4.428
90	162.00	145.67	475.53	200.00	231.60	675.81	534.69	4.429
91	160.95	145.32	476.58	200.00	229.49	687.94	546.94	4.429
92	158.32	144.44	476.05	200.00	219.83	728.97	587.76	4.430
93	157.26	144.09	477.11	200.00	217.72	741.03	600.00	4.430
94	160.42	145.14	476.05	200.00	227.22	696.21	555.10	4.430
95	161.47	145.49	475.00	200.00	229.34	684.09	542.86	4.430
96	159.37	144.79	476.58	200.00	223.96	712.56	571.43	4.431
97	162.00	145.67	476.05	200.00	232.02	675.76	534.69	4.431
98	160.42	145.14	475.53	200.00	226.07	700.46	559.18	4.431
99	159.37	144.79	475.00	200.00	221.94	716.89	575.51	4.431

Critical Failure Surface (circle 1)

Intersects: XL: 156.21 YL: 144.00 XR: 475.00 YR: 200.00
Centre: XC: 216.38 YC: 736.87 Radius: R: 595.92
Generated failure surface: (20 points)
156.21 144.00 173.40 142.51 190.62 141.51 207.86 141.02 225.12 141.02
242.36 141.52 259.58 142.52 276.77 144.02 293.90 146.02 310.97 148.51
327.97 151.50 344.86 154.97 361.65 158.93 378.32 163.38 394.85 168.31
411.24 173.71 427.46 179.59 443.50 185.93 459.35 192.74 475.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	156.21	13.25	-5.0	8.59	8.63	3	100.00	18.0	1768.38	28728.30	3442.74	1.01
2	164.80	44.29	-5.0	8.59	8.63	3	100.00	18.0	5897.66	29130.14	3746.16	1.01
3	173.40	74.43	-3.3	8.61	8.63	3	100.00	18.0	9899.93	29464.39	4030.17	1.01
4	182.01	103.43	-3.3	8.61	8.63	3	100.00	18.0	13742.18	29732.25	4298.26	1.01
5	190.62	131.54	-1.6	8.62	8.63	3	100.00	18.0	17456.78	29932.87	4545.84	1.00
6	199.24	158.46	-1.6	8.62	8.63	3	100.00	18.0	21004.52	30066.37	4778.43	1.00
7	207.86	184.38	0.0	8.63	8.63	3	100.00	18.0	24411.25	30132.63	4989.56	1.00
8	216.49	209.17	0.0	8.63	8.63	3	100.00	18.0	27658.23	30131.82	5186.57	1.00
9	225.12	232.77	1.7	8.62	8.63	3	100.00	18.0	30739.59	30063.75	5361.24	1.00
10	233.74	255.39	1.7	8.62	8.63	3	100.00	18.0	33680.15	29928.43	5522.58	1.00
11	242.36	276.56	3.3	8.61	8.63	3	100.00	18.0	36421.06	29726.05	5660.80	1.00
12	250.97	296.96	3.3	8.61	8.63	3	100.00	18.0	39050.95	29456.50	5786.42	1.00
13	259.58	310.67	5.0	8.46	8.49	3	100.00	18.0	40790.96	28679.78	5887.57	1.00
14	268.04	328.29	5.0	8.46	8.49	3	100.00	18.0	43036.71	28288.29	5976.09	1.00
15	276.51	253.12	6.6	6.25	6.29	2	0.00	35.0	33158.87	20656.36	6014.32	0.99
16	282.75	261.58	6.6	6.25	6.29	2	0.00	35.0	34267.22	20373.62		

6059.59	0.99									
17	289.00	211.26	6.6	4.90	4.94	2	0.00	35.0	27675.11	15792.51
6100.46	0.99									
18	293.90	379.09	8.3	8.54	8.63	2	0.00	35.0	49660.75	27104.62
6119.65	0.99									
19	302.44	392.74	8.3	8.54	8.63	2	0.00	35.0	51449.06	26434.14
6149.11	0.99									
20	310.97	237.28	10.0	5.03	5.10	2	0.00	35.0	31083.43	15299.59
6148.23	0.99									
21	316.00	434.84	10.0	9.00	9.14	2	0.00	35.0	56964.05	26694.20
6236.18	0.99									
22	325.00	144.59	10.0	2.97	3.01	2	0.00	35.0	18941.87	8597.27
6291.61	0.99									
23	327.97	402.47	11.6	8.45	8.63	2	0.00	35.0	52723.57	24025.04
6130.17	0.99									
24	336.41	387.79	11.6	8.45	8.63	2	0.00	35.0	50800.43	23089.80
5906.33	0.99									
25	344.86	162.20	13.3	3.64	3.74	2	0.00	35.0	21248.59	9700.06
5724.40	0.99									
26	348.50	131.45	13.3	3.00	3.08	5	0.00	45.0	14459.39	5254.13
4660.39	0.97									
27	351.50	429.11	13.3	10.15	10.43	2	0.00	35.0	56213.75	7983.46
5362.97	0.99									
28	361.65	332.98	14.9	8.33	8.63	2	0.00	35.0	43620.46	5357.63
5045.12	0.99									
29	369.99	314.45	14.9	8.33	8.63	2	0.00	35.0	41192.73	4160.77
4760.07	0.99									
30	378.32	292.51	16.6	8.27	8.63	2	0.00	35.0	38319.34	2899.23
4439.93	1.00									
31	386.59	272.15	16.6	8.27	8.63	2	0.00	35.0	35651.13	1573.01
4124.84	1.00									
32	394.85	158.07	18.3	5.12	5.40	2	0.00	35.0	20706.75	284.61
3840.81	1.00									
33	399.98	163.65	18.3	5.63	5.93	2	0.00	35.0	21438.10	0.00
3617.45	1.00									
34	405.61	153.20	18.3	5.63	5.93	2	0.00	35.0	20068.81	0.00
3386.38	1.00									
35	411.24	201.26	19.9	8.11	8.63	2	0.00	35.0	26365.19	0.00
3072.90	1.01									
36	419.35	177.43	19.9	8.11	8.63	2	0.00	35.0	23243.59	0.00
2709.08	1.01									
37	427.46	150.99	21.6	8.02	8.63	2	0.00	35.0	19780.02	0.00
2319.20	1.01									
38	435.48	125.55	21.6	8.02	8.63	2	0.00	35.0	16447.14	0.00
1928.42	1.01									
39	443.50	62.73	23.2	4.81	5.24	2	0.00	35.0	8217.30	0.00
1597.61	1.02									
40	448.31	59.70	23.2	5.52	6.01	1	150.00	22.0	7820.36	0.00
1348.64	1.05									
41	453.83	46.62	23.2	5.52	6.01	1	150.00	22.0	6106.97	0.00
1050.07	1.05									
42	459.35	42.61	24.9	7.82	8.63	1	150.00	22.0	5581.69	0.00
668.84	1.06									
43	467.18	14.20	24.9	7.82	8.63	1	150.00	22.0	1860.56	0.00
212.78	1.06									
		---			---				---	
X-S Area:		9015.20	Path Length:		327.78		X-S Weight:		1180624.75	

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 7-1 Rapid Drawdown.gmf
Processed: 02 Dec 2020 14:52:04

DATA: Analysis 1 - Case 7-1 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	188.00	348.50	188.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	144.00	348.50	144.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	141.00	348.50	141.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	500.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	188.00	500.00	188.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	144.00	500.00	144.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	141.00	500.00	141.00	

Slope Surface (4 points)

100.00	144.00	157.00	144.00	325.00	200.00	500.00	200.00

Phreatic Surface (6 points)

100.00	144.00	157.00	144.00	316.00	197.00	348.50	197.00
351.50	170.00						
500.00	170.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	157.00	YL:	144.00	XR:	480.00	YR: 200.00
Centre:	XC:	237.81	YC:	637.43	Radius:	R:	500.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 7-1 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 3.352

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.40

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	156.21	144.00	475.00	200.00	216.38	736.87	595.92	2.405	<-- Critical Surface
2	155.16	144.00	475.00	200.00	215.46	740.96	600.00	2.406	
3	158.32	144.44	475.00	200.00	221.16	716.51	575.51	2.408	
4	156.74	144.00	475.00	200.00	216.47	736.92	595.92	2.409	
5	155.68	144.00	475.00	200.00	215.55	741.01	600.00	2.409	
6	157.26	144.09	475.00	200.00	217.45	732.86	591.84	2.410	
7	157.79	144.26	475.00	200.00	219.31	724.69	583.67	2.411	
8	156.74	144.00	475.53	200.00	216.90	736.87	595.92	2.411	
9	155.68	144.00	475.53	200.00	215.99	740.96	600.00	2.412	
10	157.26	144.09	475.53	200.00	217.88	732.81	591.84	2.412	
11	156.21	144.00	475.00	200.00	215.64	741.05	600.00	2.413	
12	159.89	144.96	475.00	200.00	225.99	696.12	555.10	2.414	
13	159.37	144.79	475.00	200.00	224.14	704.32	563.27	2.414	
14	158.84	144.61	475.00	200.00	222.29	712.51	571.43	2.415	
15	156.21	144.00	475.53	200.00	216.08	741.01	600.00	2.416	
16	158.32	144.44	475.00	200.00	220.43	720.69	579.59	2.416	
17	157.79	144.26	475.00	200.00	218.57	728.87	587.76	2.416	
18	156.74	144.00	475.00	200.00	215.73	741.09	600.00	2.417	
19	157.79	144.26	475.53	200.00	219.74	724.64	583.67	2.417	
20	159.37	144.79	475.53	200.00	224.57	704.27	563.27	2.417	
21	156.21	144.00	476.05	200.00	216.51	740.96	600.00	2.418	
22	158.84	144.61	475.53	200.00	222.71	712.46	571.43	2.418	
23	157.26	144.09	475.00	200.00	216.71	737.03	595.92	2.418	
24	157.79	144.26	475.53	200.00	219.00	728.82	587.76	2.419	
25	156.74	144.00	475.53	200.00	216.17	741.05	600.00	2.419	
26	160.95	145.32	475.00	200.00	228.95	683.90	542.86	2.419	
27	160.42	145.14	475.00	200.00	227.11	692.11	551.02	2.421	
28	157.26	144.09	475.53	200.00	217.15	736.99	595.92	2.421	
29	158.84	144.61	476.05	200.00	223.14	712.41	571.43	2.421	
30	159.89	144.96	475.00	200.00	225.26	700.32	559.18	2.421	
31	158.32	144.44	476.05	200.00	221.29	720.60	579.59	2.421	
32	156.74	144.00	476.05	200.00	216.61	741.01	600.00	2.422	
33	158.84	144.61	475.00	200.00	221.55	716.70	575.51	2.422	
34	158.32	144.44	475.53	200.00	220.86	720.65	579.59	2.422	
35	157.79	144.26	476.05	200.00	219.44	728.78	587.76	2.423	
36	157.26	144.09	476.05	200.00	217.58	736.95	595.92	2.423	
37	158.32	144.44	475.00	200.00	219.70	724.88	583.67	2.423	
38	160.42	145.14	475.53	200.00	227.53	692.06	551.02	2.423	
39	158.84	144.61	475.00	200.00	223.02	708.32	567.35	2.424	
40	156.74	144.00	476.58	200.00	217.04	740.96	600.00	2.424	
41	159.89	144.96	475.53	200.00	225.68	700.27	559.18	2.424	
42	157.79	144.26	475.00	200.00	217.84	733.05	591.84	2.425	
43	159.37	144.79	475.53	200.00	223.83	708.46	567.35	2.425	
44	157.26	144.09	476.58	200.00	218.01	736.90	595.92	2.426	
45	158.32	144.44	475.53	200.00	220.13	724.83	583.67	2.426	
46	162.00	145.67	475.00	200.00	231.91	671.65	530.61	2.426	
47	157.26	144.09	475.00	200.00	215.98	741.21	600.00	2.426	
48	159.37	144.79	475.00	200.00	223.41	708.51	567.35	2.427	
49	157.79	144.26	475.53	200.00	218.27	733.00	591.84	2.427	
50	159.89	144.96	476.05	200.00	226.11	700.21	559.18	2.427	
51	158.84	144.61	475.53	200.00	221.98	716.65	575.51	2.428	
52	160.95	145.32	475.00	200.00	228.22	688.10	546.94	2.428	
53	161.47	145.49	475.00	200.00	230.07	679.88	538.78	2.428	
54	159.37	144.79	476.05	200.00	224.26	708.41	567.35	2.428	
55	162.00	145.67	475.53	200.00	232.33	671.60	530.61	2.428	
56	160.42	145.14	475.00	200.00	226.38	696.31	555.10	2.428	
57	158.32	144.44	476.05	200.00	220.56	724.78	583.67	2.428	
58	157.26	144.09	475.53	200.00	216.41	741.17	600.00	2.429	
59	157.79	144.26	476.58	200.00	219.87	728.73	587.76	2.429	
60	159.37	144.79	475.00	200.00	222.67	712.70	571.43	2.429	
61	157.79	144.26	476.05	200.00	218.70	732.96	591.84	2.430	
62	161.47	145.49	475.53	200.00	230.49	679.83	538.78	2.430	
63	158.84	144.61	475.00	200.00	220.82	720.88	579.59	2.431	
64	158.84	144.61	476.58	200.00	222.84	716.55	575.51	2.431	
65	157.26	144.09	476.05	200.00	216.85	741.12	600.00	2.431	
66	160.42	145.14	475.53	200.00	226.80	696.26	555.10	2.431	
67	160.95	145.32	475.53	200.00	228.64	688.05	546.94	2.432	
68	159.89	144.96	475.53	200.00	224.95	704.46	563.27	2.432	

69	158.32	144.44	475.00	200.00	218.96	729.06	587.76	2.432
70	157.79	144.26	476.58	200.00	219.14	732.91	591.84	2.432
71	159.37	144.79	476.58	200.00	224.69	708.36	567.35	2.432
72	157.79	144.26	475.00	200.00	217.10	737.22	595.92	2.433
73	161.47	145.49	476.05	200.00	230.91	679.77	538.78	2.433
74	159.89	144.96	475.00	200.00	224.53	704.51	563.27	2.433
75	158.84	144.61	475.53	200.00	221.25	720.84	579.59	2.433
76	159.37	144.79	475.53	200.00	223.10	712.65	571.43	2.433
77	158.84	144.61	476.05	200.00	222.41	716.60	575.51	2.434
78	157.26	144.09	476.58	200.00	217.28	741.08	600.00	2.434
79	158.32	144.44	475.53	200.00	219.40	729.01	587.76	2.434
80	160.95	145.32	476.05	200.00	229.07	688.00	546.94	2.435
81	158.32	144.44	476.58	200.00	220.99	724.74	583.67	2.435
82	158.32	144.44	477.11	200.00	221.42	724.69	583.67	2.435
83	162.00	145.67	475.00	200.00	231.18	675.87	534.69	2.435
84	159.89	144.96	476.05	200.00	225.38	704.41	563.27	2.435
85	157.79	144.26	475.53	200.00	217.54	737.18	595.92	2.435
86	158.84	144.61	476.05	200.00	221.68	720.79	579.59	2.435
87	160.95	145.32	475.00	200.00	227.49	692.30	551.02	2.436
88	158.84	144.61	477.11	200.00	223.27	716.51	575.51	2.436
89	160.42	145.14	476.05	200.00	227.22	696.21	555.10	2.436
90	157.79	144.26	477.11	200.00	219.57	732.87	591.84	2.436
91	161.47	145.49	475.00	200.00	229.34	684.09	542.86	2.436
92	157.26	144.09	477.11	200.00	217.72	741.03	600.00	2.436
93	158.32	144.44	476.05	200.00	219.83	728.97	587.76	2.437
94	159.89	144.96	475.00	200.00	223.79	708.70	567.35	2.437
95	160.95	145.32	476.58	200.00	229.49	687.94	546.94	2.437
96	162.00	145.67	475.53	200.00	231.60	675.81	534.69	2.437
97	157.79	144.26	476.05	200.00	217.97	737.13	595.92	2.438
98	159.37	144.79	476.58	200.00	223.96	712.56	571.43	2.438
99	160.42	145.14	476.58	200.00	227.65	696.16	555.10	2.438

Critical Failure Surface (circle 1)

Intersects: XL: 156.21 YL: 144.00 XR: 475.00 YR: 200.00
Centre: XC: 216.38 YC: 736.87 Radius: R: 595.92
Generated failure surface: (20 points)
156.21 144.00 173.40 142.51 190.62 141.51 207.86 141.02
225.12 141.02
242.36 141.52 259.58 142.52 276.77 144.02 293.90 146.02
310.97 148.51
327.97 151.50 344.86 154.97 361.65 158.93 378.32 163.38
394.85 168.31
411.24 173.71 427.46 179.59 443.50 185.93 459.35 192.74
475.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	156.21	13.25	-5.0	8.59	8.63	3	100.00	18.0	1768.38	830.18	210.74	1.02
2	164.80	44.29	-5.0	8.59	8.63	3	100.00	18.0	5897.66	2773.84	694.28	1.02
3	173.40	74.43	-3.3	8.61	8.63	3	100.00	18.0	9899.93	4651.99	1156.87	1.01
4	182.01	103.43	-3.3	8.61	8.63	3	100.00	18.0	13742.18	6464.80	1604.91	1.01
5	190.62	131.54	-1.6	8.62	8.63	3	100.00	18.0	17456.78	8211.40	2030.04	1.00
6	199.24	158.46	-1.6	8.62	8.63	3	100.00	18.0	21004.52	9891.83	2442.35	1.00
7	207.86	184.38	0.0	8.63	8.63	3	100.00	18.0	24411.25	11505.37	2830.02	1.00
8	216.49	209.17	0.0	8.63	8.63	3	100.00	18.0	27658.23	13052.09	3206.45	1.00
9	225.12	232.77	1.7	8.62	8.63	3	100.00	18.0	30739.59	14531.27	3556.66	1.00
10	233.74	255.39	1.7	8.62	8.63	3	100.00	18.0	33680.15	15942.88	3897.02	1.00
11	242.36	276.56	3.3	8.61	8.63	3	100.00	18.0	36421.06	17286.43	4209.78	0.99
12	250.97	296.96	3.3	8.61	8.63	3	100.00	18.0	39050.95	18561.84	4513.96	0.99
13	259.58	310.67	5.0	8.46	8.49	3	100.00	18.0	40790.96	19459.21	4787.28	0.99
14	268.04	328.29	5.0	8.46	8.49	3	100.00	18.0	43036.71	20562.89	5051.11	0.99
15	276.51	253.12	6.6	6.25	6.29	2	0.00	35.0	33158.87	15899.38	5217.89	0.97
16	282.75	261.58	6.6	6.25	6.29	2	0.00	35.0	34267.22	16433.13		

5391.34	0.97									
17	289.00	211.26	6.6	4.90	4.94	2	0.00	35.0	27675.11	13271.83
5546.97	0.97									
18	293.90	379.09	8.3	8.54	8.63	2	0.00	35.0	49660.75	23905.87
5694.12	0.97									
19	302.44	392.74	8.3	8.54	8.63	2	0.00	35.0	51449.06	24766.72
5899.15	0.97									
20	310.97	237.28	10.0	5.03	5.10	2	0.00	35.0	31083.43	15032.86
6026.90	0.97									
21	316.00	434.84	10.0	9.00	9.14	2	0.00	35.0	56964.05	26694.20
6163.51	0.97									
22	325.00	144.59	10.0	2.97	3.01	2	0.00	35.0	18941.87	8597.27
6216.28	0.97									
23	327.97	402.47	11.6	8.45	8.63	2	0.00	35.0	52723.57	24025.04
6045.02	0.96									
24	336.41	387.79	11.6	8.45	8.63	2	0.00	35.0	50800.43	23089.80
5824.12	0.96									
25	344.86	162.20	13.3	3.64	3.74	2	0.00	35.0	21248.59	9700.06
5633.76	0.96									
26	348.50	131.45	13.3	3.00	3.08	5	0.00	45.0	14459.39	5254.13
4541.37	0.94									
27	351.50	429.11	13.3	10.15	10.43	2	0.00	35.0	56213.75	7983.46
5229.77	0.96									
28	361.65	332.98	14.9	8.33	8.63	2	0.00	35.0	43620.46	5357.63
4901.44	0.96									
29	369.99	314.45	14.9	8.33	8.63	2	0.00	35.0	41192.73	4160.77
4621.14	0.96									
30	378.32	292.51	16.6	8.27	8.63	2	0.00	35.0	38319.34	2899.23
4292.27	0.96									
31	386.59	272.15	16.6	8.27	8.63	2	0.00	35.0	35651.13	1573.01
3982.99	0.96									
32	394.85	158.07	18.3	5.12	5.40	2	0.00	35.0	20706.75	284.61
3691.25	0.96									
33	399.98	163.65	18.3	5.63	5.93	2	0.00	35.0	21438.10	0.00
3474.63	0.96									
34	405.61	153.20	18.3	5.63	5.93	2	0.00	35.0	20068.81	0.00
3252.68	0.96									
35	411.24	201.26	19.9	8.11	8.63	2	0.00	35.0	26365.19	0.00
2940.79	0.96									
36	419.35	177.43	19.9	8.11	8.63	2	0.00	35.0	23243.59	0.00
2592.62	0.96									
37	427.46	150.99	21.6	8.02	8.63	2	0.00	35.0	19780.02	0.00
2211.32	0.96									
38	435.48	125.55	21.6	8.02	8.63	2	0.00	35.0	16447.14	0.00
1838.72	0.96									
39	443.50	62.73	23.2	4.81	5.24	2	0.00	35.0	8217.30	0.00
1517.64	0.97									
40	448.31	59.70	23.2	5.52	6.01	1	150.00	22.0	7820.36	0.00
1296.52	1.02									
41	453.83	46.62	23.2	5.52	6.01	1	150.00	22.0	6106.97	0.00
1006.99	1.02									
42	459.35	42.61	24.9	7.82	8.63	1	150.00	22.0	5581.69	0.00
634.95	1.02									
43	467.18	14.20	24.9	7.82	8.63	1	150.00	22.0	1860.56	0.00
193.75	1.02									
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X-S Area:		9015.20	Path Length:		327.78		X-S Weight:		1180624.75	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 7-2\West Farm Expansion Case 7-2 Full Reservoir.gmf
Processed: 04 Dec 2020 13:04:39

DATA: Analysis 1 - Case 7-2 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	198.00	348.50	198.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	144.00	348.50	144.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	141.00	348.50	141.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	198.00	450.00	198.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	144.00	450.00	144.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	141.00	450.00	141.00	

Slope Surface (8 points)

100.00	144.00	157.00	144.00	325.00	200.00	405.00	200.00
410.00	195.00						
415.00	195.00	420.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	197.00	157.00	197.00	316.00	197.00	348.50	197.00
351.50	172.00						
450.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	157.00	YL:	144.00	XR:	410.00	YR: 195.00
Centre:	XC:	241.19	YC:	379.40	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 7-2 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 5.104

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.99

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	159.37	144.79	405.00	200.00	210.57	491.02	350.00	2.985	<-- Critical Surface
2	159.89	144.96	405.00	200.00	211.84	486.96	345.92	2.988	
3	160.42	145.14	405.00	200.00	213.10	482.89	341.84	2.990	
4	160.95	145.32	405.00	200.00	214.37	478.82	337.76	2.992	
5	161.47	145.49	405.00	200.00	215.64	474.74	333.67	2.994	
6	162.00	145.67	405.00	200.00	216.91	470.65	329.59	2.996	
7	159.89	144.96	405.00	200.00	210.88	491.23	350.00	3.003	
8	160.95	145.32	405.00	200.00	213.41	483.10	341.84	3.005	
9	161.47	145.49	405.00	200.00	214.68	479.03	337.76	3.007	
10	160.42	145.14	405.00	200.00	212.15	487.17	345.92	3.009	
11	162.00	145.67	405.00	200.00	215.95	474.95	333.67	3.010	
12	159.89	144.96	405.53	199.47	211.95	491.07	350.00	3.015	
13	160.42	145.14	405.00	200.00	211.19	491.44	350.00	3.017	
14	160.42	145.14	405.53	199.47	213.21	487.01	345.92	3.017	
15	160.95	145.32	405.00	200.00	212.46	487.38	345.92	3.019	
16	160.95	145.32	405.53	199.47	214.47	482.94	341.84	3.019	
17	161.47	145.49	405.00	200.00	213.72	483.31	341.84	3.020	
18	161.47	145.49	405.53	199.47	215.73	478.86	337.76	3.022	
19	162.00	145.67	405.53	199.47	216.99	474.78	333.67	3.024	
20	162.00	145.67	405.00	200.00	214.99	479.24	337.76	3.027	
21	160.95	145.32	405.53	199.47	213.53	487.22	345.92	3.033	
22	161.47	145.49	405.53	199.47	214.78	483.15	341.84	3.035	
23	160.95	145.32	405.00	200.00	211.50	491.65	350.00	3.035	
24	160.42	145.14	405.53	199.47	212.27	491.28	350.00	3.037	
25	162.00	145.67	405.53	199.47	216.04	479.07	337.76	3.038	
26	161.47	145.49	405.00	200.00	212.77	487.59	345.92	3.038	
27	162.00	145.67	405.00	200.00	214.03	483.52	341.84	3.041	
28	160.42	145.14	406.05	198.95	213.34	491.12	350.00	3.046	
29	160.95	145.32	405.53	199.47	212.58	491.49	350.00	3.046	
30	161.47	145.49	405.53	199.47	213.84	487.42	345.92	3.048	
31	160.95	145.32	406.05	198.95	214.59	487.05	345.92	3.049	
32	161.47	145.49	406.05	198.95	215.84	482.98	341.84	3.051	
33	162.00	145.67	406.05	198.95	217.09	478.90	337.76	3.053	
34	161.47	145.49	405.00	200.00	211.81	491.85	350.00	3.054	
35	162.00	145.67	405.53	199.47	215.10	483.35	341.84	3.054	
36	162.00	145.67	405.00	200.00	213.08	487.79	345.92	3.058	
37	160.95	145.32	406.05	198.95	213.66	491.32	350.00	3.062	
38	161.47	145.49	406.05	198.95	214.91	487.26	345.92	3.065	
39	161.47	145.49	405.53	199.47	212.89	491.69	350.00	3.066	
40	162.00	145.67	406.05	198.95	216.16	483.19	341.84	3.067	
41	162.00	145.67	405.53	199.47	214.15	487.63	345.92	3.069	
42	162.00	145.67	405.00	200.00	212.12	492.06	350.00	3.073	
43	160.95	145.32	406.58	198.42	214.73	491.16	350.00	3.078	
44	161.47	145.49	406.05	198.95	213.97	491.53	350.00	3.078	
45	161.47	145.49	406.58	198.42	215.97	487.09	345.92	3.080	
46	162.00	145.67	406.58	198.42	217.21	483.01	341.84	3.083	
47	162.00	145.67	406.05	198.95	215.22	487.47	345.92	3.084	
48	162.00	145.67	405.53	199.47	213.21	491.90	350.00	3.086	
49	161.47	145.49	406.58	198.42	215.05	491.37	350.00	3.094	
50	160.95	145.32	407.11	197.89	215.81	490.99	350.00	3.096	
51	162.00	145.67	406.58	198.42	216.29	487.30	345.92	3.097	
52	161.47	145.49	407.11	197.89	217.04	486.92	345.92	3.098	
53	162.00	145.67	406.05	198.95	214.29	491.74	350.00	3.099	
54	162.00	145.67	407.11	197.89	218.27	482.84	341.84	3.100	
55	161.47	145.49	407.11	197.89	216.13	491.20	350.00	3.113	
56	162.00	145.67	406.58	198.42	215.37	491.57	350.00	3.115	
57	162.00	145.67	407.11	197.89	217.36	487.13	345.92	3.115	
58	162.00	145.67	406.58	198.42	218.14	478.72	337.76	3.122	
59	161.47	145.49	406.58	198.42	216.90	482.80	341.84	3.128	
60	162.00	145.67	407.11	197.89	216.45	491.41	350.00	3.130	
61	161.47	145.49	407.63	197.37	217.20	491.03	350.00	3.137	
62	162.00	145.67	407.63	197.37	218.42	486.95	345.92	3.138	
63	160.95	145.32	406.58	198.42	215.66	486.88	345.92	3.143	
64	162.00	145.67	407.63	197.37	217.52	491.24	350.00	3.154	
65	160.42	145.14	406.58	198.42	214.42	490.95	350.00	3.167	
66	162.00	145.67	408.16	196.84	218.59	491.06	350.00	3.171	

67	161.47	145.49	406.05	198.95	216.78	478.69	337.76	3.175
68	160.95	145.32	406.05	198.95	215.53	482.77	341.84	3.181
69	162.00	145.67	406.05	198.95	218.03	474.60	333.67	3.184
70	160.42	145.14	406.05	198.95	214.28	486.84	345.92	3.197
71	160.95	145.32	405.53	199.47	215.42	478.65	337.76	3.225
72	159.89	144.96	406.05	198.95	213.03	490.91	350.00	3.226
73	161.47	145.49	405.53	199.47	216.68	474.57	333.67	3.231
74	160.42	145.14	405.53	199.47	214.16	482.73	341.84	3.234
75	162.00	145.67	405.53	199.47	217.94	470.48	329.59	3.254
76	159.89	144.96	405.53	199.47	212.90	486.80	345.92	3.258
77	160.95	145.32	405.00	200.00	215.33	474.53	333.67	3.279
78	160.42	145.14	405.00	200.00	214.07	478.61	337.76	3.280
79	161.47	145.49	405.00	200.00	216.60	470.44	329.59	3.296
80	159.89	144.96	405.00	200.00	212.80	482.68	341.84	3.299
81	159.37	144.79	405.53	199.47	211.64	490.86	350.00	3.301
82	162.00	145.67	405.00	200.00	217.87	466.35	325.51	3.335
83	159.37	144.79	405.00	200.00	211.53	486.75	345.92	3.339
84	158.84	144.61	405.00	200.00	210.26	490.82	350.00	3.388
85	162.00	145.67	408.68	196.32	219.66	490.88	350.00	3.474
86	161.47	145.49	408.16	196.84	218.27	490.85	350.00	3.497
87	162.00	145.67	407.63	197.37	219.32	482.66	341.84	3.502
88	161.47	145.49	407.11	197.89	217.95	482.63	341.84	3.503
89	162.00	145.67	408.16	196.84	219.48	486.78	345.92	3.512
90	160.95	145.32	407.63	197.37	216.88	490.82	350.00	3.514
91	162.00	145.67	407.11	197.89	219.19	478.55	337.76	3.518
92	161.47	145.49	407.63	197.37	218.10	486.74	345.92	3.519
93	160.95	145.32	406.58	198.42	216.58	482.59	341.84	3.519
94	162.00	145.67	406.58	198.42	219.07	474.42	333.67	3.519
95	161.47	145.49	406.58	198.42	217.83	478.51	337.76	3.522
96	160.95	145.32	407.11	197.89	216.72	486.71	345.92	3.524
97	162.00	145.67	406.05	198.95	218.97	470.30	329.59	3.535
98	161.47	145.49	406.05	198.95	217.72	474.39	333.67	3.535
99	160.42	145.14	407.11	197.89	215.49	490.78	350.00	3.543

Critical Failure Surface (circle 1)

Intersects: XL: 159.37 YL: 144.79 XR: 405.00 YR: 200.00
Centre: XC: 210.57 YC: 491.02 Radius: R: 350.00

Generated failure surface: (20 points)

159.37	144.79	172.81	143.07	186.31	141.87	199.85	141.19	213.40	141.04
226.95	141.41	240.47	142.30	253.95	143.72	267.37	145.66	280.69	148.12
293.92	151.09	307.02	154.58	319.97	158.56	332.76	163.05	345.37	168.02
357.77	173.49	369.95	179.42	381.90	185.83	393.59	192.69	405.00	200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	159.37	8.76	-7.3	6.16	6.21	2	0.00	35.0	1147.37	20389.60	3383.11	1.04
2	165.53	32.94	-7.3	7.28	7.34	3	100.00	18.0	4349.41	24495.27	3660.10	1.02
3	172.81	51.50	-5.1	6.75	6.78	3	100.00	18.0	6829.25	22933.39	3928.09	1.01
4	179.56	70.74	-5.1	6.75	6.78	3	100.00	18.0	9390.27	23187.28	4169.07	1.01
5	186.31	89.35	-2.9	6.77	6.78	3	100.00	18.0	11861.27	23385.83	4386.38	1.01
6	193.08	106.92	-2.9	6.77	6.78	3	100.00	18.0	14184.71	23529.01	4589.89	1.01
7	199.85	123.75	-0.6	6.78	6.78	3	100.00	18.0	16403.68	23616.76	4768.19	1.00
8	206.62	139.57	-0.6	6.78	6.78	3	100.00	18.0	18481.68	23649.04	4934.10	1.00
9	213.40	154.45	1.6	6.77	6.78	3	100.00	18.0	20427.79	23626.06	5073.47	1.00
10	220.18	168.49	1.6	6.77	6.78	3	100.00	18.0	22253.95	23547.42	5201.72	1.00
11	226.95	181.29	3.8	6.76	6.78	3	100.00	18.0	23909.35	23413.04	5302.29	1.00
12	233.71	193.50	3.8	6.76	6.78	3	100.00	18.0	25478.51	23223.45	5392.86	1.00
13	240.47	204.12	6.0	6.74	6.78	3	100.00	18.0	26830.46	22978.62	5454.81	0.99
14	247.21	214.48	6.0	6.74	6.78	3	100.00	18.0	28139.44	22678.56	5507.74	0.99
15	253.95	62.50	8.2	1.91	1.93	3	100.00	18.0	8189.62	6388.83		

5525.78	0.99									
16	255.86	192.72	8.2	5.75	5.81	2	0.00	35.0	25245.70	19074.78
5503.65	0.98									
17	261.61	198.96	8.2	5.75	5.81	2	0.00	35.0	26063.94	18772.91
5523.75	0.98									
18	267.37	237.39	10.4	6.66	6.78	2	0.00	35.0	31097.52	21448.21
5507.25	0.97									
19	274.03	244.00	10.4	6.66	6.78	2	0.00	35.0	31963.93	20928.50
5495.82	0.97									
20	280.69	247.73	12.7	6.61	6.78	2	0.00	35.0	32452.37	20354.44
5445.18	0.97									
21	287.31	252.47	12.7	6.61	6.78	2	0.00	35.0	33074.09	19726.01
5399.22	0.97									
22	293.92	253.89	14.9	6.55	6.78	2	0.00	35.0	33258.99	19043.69
5313.42	0.97									
23	300.47	256.78	14.9	6.55	6.78	2	0.00	35.0	33638.28	18307.49
5233.33	0.97									
24	307.02	177.37	17.1	4.49	4.70	2	0.00	35.0	23235.19	12238.67
5130.49	0.98									
25	311.51	177.88	17.1	4.49	4.70	2	0.00	35.0	23302.82	11833.27
5051.58	0.98									
26	316.00	119.09	17.1	3.00	3.14	2	0.00	35.0	15600.95	7677.30
5014.88	0.98									
27	319.00	238.35	19.0	6.00	6.34	2	0.00	35.0	31223.91	14935.39
4991.35	0.98									
28	325.00	297.30	19.3	7.76	8.22	2	0.00	35.0	38946.07	18119.63
4804.96	0.98									
29	332.76	225.08	21.5	6.30	6.78	2	0.00	35.0	29484.93	13830.97
4454.24	0.98									
30	339.06	209.39	21.5	6.30	6.78	2	0.00	35.0	27430.15	12778.70
4142.72	0.98									
31	345.37	98.04	23.8	3.13	3.42	2	0.00	35.0	12842.67	6043.11
3879.96	0.99									
32	348.50	89.81	23.8	3.00	3.28	5	0.00	45.0	9878.57	2952.55
2985.41	0.95									
33	351.50	82.91	23.8	2.90	3.16	2	0.00	35.0	10861.32	125.81
3404.07	0.99									
34	354.40	92.01	23.8	3.38	3.69	2	0.00	35.0	12053.04	0.00
3236.44	0.99									
35	357.77	152.48	26.0	6.09	6.78	2	0.00	35.0	19974.48	0.00
2942.52	1.00									
36	363.86	134.39	26.0	6.09	6.78	2	0.00	35.0	17605.41	0.00
2593.51	1.00									
37	369.95	113.33	28.2	5.97	6.78	2	0.00	35.0	14845.75	0.00
2208.06	1.01									
38	375.93	94.20	28.2	5.97	6.78	2	0.00	35.0	12340.33	0.00
1835.42	1.01									
39	381.90	72.79	30.4	5.84	6.78	2	0.00	35.0	9535.82	0.00
1434.24	1.02									
40	387.74	52.74	30.4	5.84	6.78	2	0.00	35.0	6909.08	0.00
1039.17	1.02									
41	393.59	24.80	32.6	4.15	4.92	2	0.00	35.0	3248.36	0.00
681.31	1.03									
42	397.73	13.79	32.6	4.15	4.92	2	0.00	35.0	1806.82	0.00
378.96	1.03									
43	401.88	3.12	32.6	3.12	3.71	1	150.00	22.0	409.09	0.00
90.94	1.09									
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X-S Area:		6155.14	Path Length:		257.51		X-S Weight:		806206.38	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 7-2\West Farm Expansion Case 7-2 Rapid Drawdown.gmf
Processed: 04 Dec 2020 13:03:24

DATA: Analysis 1 - Case 7-2 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	198.00	348.50	198.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	144.00	348.50	144.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	141.00	348.50	141.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	198.00	450.00	198.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	144.00	450.00	144.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	141.00	450.00	141.00	

Slope Surface (8 points)

100.00	144.00	157.00	144.00	325.00	200.00	405.00	200.00
410.00	195.00						
415.00	195.00	420.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	144.00	157.00	144.00	316.00	197.00	348.50	197.00
351.50	172.00						
450.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	157.00	YL:	144.00	XR:	410.00	YR: 195.00
Centre:	XC:	241.19	YC:	379.40	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 7-2 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

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Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.769

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.58

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	159.37	144.79	405.00	200.00	210.57	491.02	350.00	1.579	<-- Critical Surface
2	159.89	144.96	405.00	200.00	211.84	486.96	345.92	1.580	
3	160.42	145.14	405.00	200.00	213.10	482.89	341.84	1.581	
4	160.95	145.32	405.00	200.00	214.37	478.82	337.76	1.583	
5	161.47	145.49	405.00	200.00	215.64	474.74	333.67	1.584	
6	162.00	145.67	405.00	200.00	216.91	470.65	329.59	1.585	
7	159.89	144.96	405.00	200.00	210.88	491.23	350.00	1.589	
8	160.95	145.32	405.00	200.00	213.41	483.10	341.84	1.590	
9	161.47	145.49	405.00	200.00	214.68	479.03	337.76	1.592	
10	160.42	145.14	405.00	200.00	212.15	487.17	345.92	1.593	
11	162.00	145.67	405.00	200.00	215.95	474.95	333.67	1.594	
12	159.89	144.96	405.53	199.47	211.95	491.07	350.00	1.596	
13	160.42	145.14	405.00	200.00	211.19	491.44	350.00	1.598	
14	160.42	145.14	405.53	199.47	213.21	487.01	345.92	1.598	
15	160.95	145.32	405.00	200.00	212.46	487.38	345.92	1.599	
16	160.95	145.32	405.53	199.47	214.47	482.94	341.84	1.599	
17	161.47	145.49	405.00	200.00	213.72	483.31	341.84	1.600	
18	161.47	145.49	405.53	199.47	215.73	478.86	337.76	1.600	
19	162.00	145.67	405.53	199.47	216.99	474.78	333.67	1.602	
20	162.00	145.67	405.00	200.00	214.99	479.24	337.76	1.603	
21	160.95	145.32	405.53	199.47	213.53	487.22	345.92	1.607	
22	161.47	145.49	405.53	199.47	214.78	483.15	341.84	1.609	
23	160.95	145.32	405.00	200.00	211.50	491.65	350.00	1.609	
24	160.42	145.14	405.53	199.47	212.27	491.28	350.00	1.609	
25	162.00	145.67	405.53	199.47	216.04	479.07	337.76	1.610	
26	161.47	145.49	405.00	200.00	212.77	487.59	345.92	1.610	
27	162.00	145.67	405.00	200.00	214.03	483.52	341.84	1.612	
28	160.42	145.14	406.05	198.95	213.34	491.12	350.00	1.614	
29	160.95	145.32	405.53	199.47	212.58	491.49	350.00	1.615	
30	160.95	145.32	406.05	198.95	214.59	487.05	345.92	1.616	
31	161.47	145.49	405.53	199.47	213.84	487.42	345.92	1.616	
32	161.47	145.49	406.05	198.95	215.84	482.98	341.84	1.617	
33	162.00	145.67	406.05	198.95	217.09	478.90	337.76	1.618	
34	162.00	145.67	405.53	199.47	215.10	483.35	341.84	1.620	
35	161.47	145.49	405.00	200.00	211.81	491.85	350.00	1.620	
36	162.00	145.67	405.00	200.00	213.08	487.79	345.92	1.622	
37	160.95	145.32	406.05	198.95	213.66	491.32	350.00	1.624	
38	161.47	145.49	406.05	198.95	214.91	487.26	345.92	1.625	
39	161.47	145.49	405.53	199.47	212.89	491.69	350.00	1.627	
40	162.00	145.67	406.05	198.95	216.16	483.19	341.84	1.627	
41	162.00	145.67	405.53	199.47	214.15	487.63	345.92	1.629	
42	162.00	145.67	405.00	200.00	212.12	492.06	350.00	1.632	
43	160.95	145.32	406.58	198.42	214.73	491.16	350.00	1.632	
44	161.47	145.49	406.05	198.95	213.97	491.53	350.00	1.633	
45	161.47	145.49	406.58	198.42	215.97	487.09	345.92	1.634	
46	162.00	145.67	406.58	198.42	217.21	483.01	341.84	1.635	
47	162.00	145.67	406.05	198.95	215.22	487.47	345.92	1.637	
48	162.00	145.67	405.53	199.47	213.21	491.90	350.00	1.639	
49	160.95	145.32	407.11	197.89	215.81	490.99	350.00	1.641	
50	161.47	145.49	406.58	198.42	215.05	491.37	350.00	1.642	
51	161.47	145.49	407.11	197.89	217.04	486.92	345.92	1.643	
52	162.00	145.67	407.11	197.89	218.27	482.84	341.84	1.644	
53	162.00	145.67	406.58	198.42	216.29	487.30	345.92	1.644	
54	162.00	145.67	406.05	198.95	214.29	491.74	350.00	1.646	
55	161.47	145.49	407.11	197.89	216.13	491.20	350.00	1.652	
56	162.00	145.67	407.11	197.89	217.36	487.13	345.92	1.653	
57	162.00	145.67	406.58	198.42	215.37	491.57	350.00	1.654	
58	162.00	145.67	406.58	198.42	218.14	478.72	337.76	1.658	
59	161.47	145.49	406.58	198.42	216.90	482.80	341.84	1.661	
60	161.47	145.49	407.63	197.37	217.20	491.03	350.00	1.662	
61	162.00	145.67	407.11	197.89	216.45	491.41	350.00	1.662	
62	162.00	145.67	407.63	197.37	218.42	486.95	345.92	1.663	
63	160.95	145.32	406.58	198.42	215.66	486.88	345.92	1.670	
64	162.00	145.67	407.63	197.37	217.52	491.24	350.00	1.672	
65	162.00	145.67	408.16	196.84	218.59	491.06	350.00	1.681	
66	160.42	145.14	406.58	198.42	214.42	490.95	350.00	1.684	

67	161.47	145.49	406.05	198.95	216.78	478.69	337.76	1.690
68	160.95	145.32	406.05	198.95	215.53	482.77	341.84	1.693
69	162.00	145.67	406.05	198.95	218.03	474.60	333.67	1.695
70	160.42	145.14	406.05	198.95	214.28	486.84	345.92	1.702
71	160.95	145.32	405.53	199.47	215.42	478.65	337.76	1.719
72	159.89	144.96	406.05	198.95	213.03	490.91	350.00	1.720
73	161.47	145.49	405.53	199.47	216.68	474.57	333.67	1.723
74	160.42	145.14	405.53	199.47	214.16	482.73	341.84	1.724
75	162.00	145.67	405.53	199.47	217.94	470.48	329.59	1.736
76	159.89	144.96	405.53	199.47	212.90	486.80	345.92	1.738
77	160.95	145.32	405.00	200.00	215.33	474.53	333.67	1.750
78	160.42	145.14	405.00	200.00	214.07	478.61	337.76	1.751
79	161.47	145.49	405.00	200.00	216.60	470.44	329.59	1.760
80	159.89	144.96	405.00	200.00	212.80	482.68	341.84	1.762
81	159.37	144.79	405.53	199.47	211.64	490.86	350.00	1.763
82	162.00	145.67	405.00	200.00	217.87	466.35	325.51	1.783
83	159.37	144.79	405.00	200.00	211.53	486.75	345.92	1.785
84	158.84	144.61	405.00	200.00	210.26	490.82	350.00	1.814
85	162.00	145.67	408.68	196.32	219.66	490.88	350.00	1.856
86	161.47	145.49	408.16	196.84	218.27	490.85	350.00	1.870
87	162.00	145.67	407.63	197.37	219.32	482.66	341.84	1.875
88	161.47	145.49	407.11	197.89	217.95	482.63	341.84	1.879
89	162.00	145.67	408.16	196.84	219.48	486.78	345.92	1.879
90	160.95	145.32	407.63	197.37	216.88	490.82	350.00	1.883
91	161.47	145.49	407.63	197.37	218.10	486.74	345.92	1.884
92	162.00	145.67	407.11	197.89	219.19	478.55	337.76	1.885
93	160.95	145.32	406.58	198.42	216.58	482.59	341.84	1.889
94	162.00	145.67	406.58	198.42	219.07	474.42	333.67	1.889
95	161.47	145.49	406.58	198.42	217.83	478.51	337.76	1.891
96	160.95	145.32	407.11	197.89	216.72	486.71	345.92	1.891
97	162.00	145.67	406.05	198.95	218.97	470.30	329.59	1.899
98	161.47	145.49	406.05	198.95	217.72	474.39	333.67	1.899
99	160.42	145.14	407.11	197.89	215.49	490.78	350.00	1.902

Critical Failure Surface (circle 1)

Intersects: XL: 159.37 YL: 144.79 XR: 405.00 YR: 200.00
Centre: XC: 210.57 YC: 491.02 Radius: R: 350.00

Generated failure surface: (20 points)

159.37 144.79 172.81 143.07 186.31 141.87 199.85 141.19
213.40 141.04
226.95 141.41 240.47 142.30 253.95 143.72 267.37 145.66
280.69 148.12
293.92 151.09 307.02 154.58 319.97 158.56 332.76 163.05
345.37 168.02
357.77 173.49 369.95 179.42 381.90 185.83 393.59 192.69
405.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	159.37	8.76	-7.3	6.16	6.21	2	0.00	35.0	1147.37	551.00	192.10	1.07
2	165.53	32.94	-7.3	7.28	7.34	3	100.00	18.0	4349.41	2072.40	614.11	1.04
3	172.81	51.50	-5.1	6.75	6.78	3	100.00	18.0	6829.25	3226.05	1027.47	1.02
4	179.56	70.74	-5.1	6.75	6.78	3	100.00	18.0	9390.27	4431.39	1410.63	1.02
5	186.31	89.35	-2.9	6.77	6.78	3	100.00	18.0	11861.27	5582.66	1765.36	1.01
6	193.08	106.92	-2.9	6.77	6.78	3	100.00	18.0	14184.71	6679.86	2110.53	1.01
7	199.85	123.75	-0.6	6.78	6.78	3	100.00	18.0	16403.68	7722.18	2424.45	1.00
8	206.62	139.57	-0.6	6.78	6.78	3	100.00	18.0	18481.68	8709.61	2731.48	1.00
9	213.40	154.45	1.6	6.77	6.78	3	100.00	18.0	20427.79	9641.49	3004.84	0.99
10	220.18	168.49	1.6	6.77	6.78	3	100.00	18.0	22253.95	10517.69	3273.62	0.99
11	226.95	181.29	3.8	6.76	6.78	3	100.00	18.0	23909.35	11337.45	3506.70	0.99
12	233.71	193.50	3.8	6.76	6.78	3	100.00	18.0	25478.51	12101.01	3737.16	0.99
13	240.47	204.12	6.0	6.74	6.78	3	100.00	18.0	26830.46	12807.71	3930.24	0.98
14	247.21	214.48	6.0	6.74	6.78	3	100.00	18.0	28139.44	13457.58	4122.37	0.98
15	253.95	62.50	8.2	1.91	1.93	3	100.00	18.0	8189.62	3940.34		

4220.72	0.98									
16	255.86	192.72	8.2	5.75	5.81	2	0.00	35.0	25245.70	12150.57
4249.42	0.95									
17	261.61	198.96	8.2	5.75	5.81	2	0.00	35.0	26063.94	12544.39
4387.15	0.95									
18	267.37	237.39	10.4	6.66	6.78	2	0.00	35.0	31097.52	15062.64
4481.52	0.94									
19	274.03	244.00	10.4	6.66	6.78	2	0.00	35.0	31963.93	15482.31
4606.38	0.94									
20	280.69	247.73	12.7	6.61	6.78	2	0.00	35.0	32452.37	15843.90
4675.29	0.93									
21	287.31	252.47	12.7	6.61	6.78	2	0.00	35.0	33074.09	16147.44
4764.86	0.93									
22	293.92	253.89	14.9	6.55	6.78	2	0.00	35.0	33258.99	16392.66
4797.83	0.93									
23	300.47	256.78	14.9	6.55	6.78	2	0.00	35.0	33638.28	16579.61
4852.54	0.93									
24	307.02	177.37	17.1	4.49	4.70	2	0.00	35.0	23235.19	11580.01
4847.37	0.92									
25	311.51	177.88	17.1	4.49	4.70	2	0.00	35.0	23302.82	11613.71
4861.48	0.92									
26	316.00	119.09	17.1	3.00	3.14	2	0.00	35.0	15600.95	7677.30
4869.50	0.92									
27	319.00	238.35	19.0	6.00	6.34	2	0.00	35.0	31223.91	14935.39
4826.97	0.92									
28	325.00	297.30	19.3	7.76	8.22	2	0.00	35.0	38946.07	18119.63
4639.97	0.92									
29	332.76	225.08	21.5	6.30	6.78	2	0.00	35.0	29484.93	13830.97
4284.81	0.91									
30	339.06	209.39	21.5	6.30	6.78	2	0.00	35.0	27430.15	12778.70
3984.26	0.91									
31	345.37	98.04	23.8	3.13	3.42	2	0.00	35.0	12842.67	6043.11
3717.16	0.91									
32	348.50	89.81	23.8	3.00	3.28	5	0.00	45.0	9878.57	2952.55
2771.22	0.85									
33	351.50	82.91	23.8	2.90	3.16	2	0.00	35.0	10861.32	125.81
3145.10	0.91									
34	354.40	92.01	23.8	3.38	3.69	2	0.00	35.0	12053.04	0.00
2987.31	0.91									
35	357.77	152.48	26.0	6.09	6.78	2	0.00	35.0	19974.48	0.00
2696.11	0.91									
36	363.86	134.39	26.0	6.09	6.78	2	0.00	35.0	17605.41	0.00
2376.33	0.91									
37	369.95	113.33	28.2	5.97	6.78	2	0.00	35.0	14845.75	0.00
2008.17	0.92									
38	375.93	94.20	28.2	5.97	6.78	2	0.00	35.0	12340.33	0.00
1669.27	0.92									
39	381.90	72.79	30.4	5.84	6.78	2	0.00	35.0	9535.82	0.00
1294.62	0.92									
40	387.74	52.74	30.4	5.84	6.78	2	0.00	35.0	6909.08	0.00
938.01	0.92									
41	393.59	24.80	32.6	4.15	4.92	2	0.00	35.0	3248.36	0.00
610.30	0.92									
42	397.73	13.79	32.6	4.15	4.92	2	0.00	35.0	1806.82	0.00
339.46	0.92									
43	401.88	3.12	32.6	3.12	3.71	1	150.00	22.0	409.09	0.00
60.27	1.02									
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X-S Area:		6155.14	Path Length:		257.51		X-S Weight:		806206.38	

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 8-1 Full Reservoir.gmf
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DATA: Analysis 1 - Case 8-1 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	182.00	348.50	182.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	163.00	348.50	163.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	160.00	348.50	160.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	500.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	182.00	500.00	182.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	163.00	500.00	163.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	160.00	500.00	160.00	

Slope Surface (4 points)

100.00	163.00	214.00	163.00	325.00	200.00	500.00	200.00

Phreatic Surface (6 points)

100.00	197.00	214.00	197.00	316.00	197.00	348.50	197.00
351.50	172.00						
500.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	214.00	YL:	163.00	XR:	475.00	YR: 200.00
Centre:	XC:	276.80	YC:	659.04	Radius:	R:	500.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 8-1 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 7.474

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 5.42

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	212.68	163.00	470.00	200.00	268.72	686.54	526.53	5.415	<-- Critical Surface
2	213.21	163.00	470.00	200.00	268.83	686.58	526.53	5.416	
3	209.53	163.00	470.00	200.00	266.28	698.78	538.78	5.425	
4	210.58	163.00	470.00	200.00	267.09	694.70	534.69	5.427	
5	213.74	163.00	470.00	200.00	269.54	682.46	522.45	5.427	
6	211.63	163.00	470.00	200.00	267.91	690.62	530.61	5.429	
7	212.68	163.00	470.53	200.00	268.54	690.66	530.61	5.430	
8	212.16	163.00	470.53	200.00	268.43	690.62	530.61	5.430	
9	209.00	163.00	470.00	200.00	265.59	702.90	542.86	5.431	
10	213.21	163.00	470.00	200.00	268.23	690.75	530.61	5.432	
11	210.05	163.00	470.00	200.00	266.39	698.82	538.78	5.433	
12	212.68	163.00	470.00	200.00	268.12	690.71	530.61	5.437	
13	209.00	163.00	470.00	200.00	264.99	707.06	546.94	5.437	
14	210.05	163.00	470.00	200.00	265.80	702.99	542.86	5.438	
15	214.26	163.09	470.00	200.00	270.42	678.40	518.37	5.438	
16	211.11	163.00	470.00	200.00	266.61	698.91	538.78	5.440	
17	209.00	163.00	470.53	200.00	266.00	702.86	542.86	5.440	
18	213.21	163.00	470.53	200.00	269.25	686.54	526.53	5.441	
19	210.05	163.00	470.53	200.00	266.81	698.78	538.78	5.441	
20	212.16	163.00	470.00	200.00	267.42	694.83	534.69	5.442	
21	211.11	163.00	470.53	200.00	267.62	694.70	534.69	5.443	
22	212.16	163.00	471.05	200.00	268.26	694.74	534.69	5.444	
23	211.63	163.00	471.05	200.00	268.15	694.70	534.69	5.445	
24	213.74	163.00	470.00	200.00	268.94	686.63	526.53	5.445	
25	212.68	163.00	470.53	200.00	267.94	694.83	534.69	5.446	
26	209.53	163.00	470.00	200.00	265.10	707.11	546.94	5.447	
27	213.74	163.00	470.00	200.00	268.33	690.80	530.61	5.447	
28	209.53	163.00	470.53	200.00	266.11	702.90	542.86	5.448	
29	209.53	163.00	470.00	200.00	265.69	702.94	542.86	5.448	
30	210.58	163.00	470.00	200.00	265.91	703.03	542.86	5.449	
31	210.58	163.00	470.00	200.00	266.50	698.87	538.78	5.449	
32	214.79	163.26	470.00	200.00	272.06	670.24	510.20	5.449	
33	213.74	163.00	470.53	200.00	269.36	686.58	526.53	5.449	
34	210.58	163.00	470.53	200.00	266.92	698.82	538.78	5.450	
35	211.63	163.00	470.00	200.00	267.31	694.79	534.69	5.451	
36	214.26	163.09	470.53	200.00	270.83	678.36	518.37	5.451	
37	211.11	163.00	470.00	200.00	267.20	694.74	534.69	5.451	
38	211.63	163.00	470.00	200.00	266.71	698.95	538.78	5.451	
39	212.16	163.00	470.53	200.00	267.84	694.79	534.69	5.452	
40	213.21	163.00	470.00	200.00	267.63	694.92	534.69	5.452	
41	212.16	163.00	470.53	200.00	267.24	698.95	538.78	5.452	
42	212.16	163.00	470.00	200.00	268.01	690.66	530.61	5.453	
43	209.53	163.00	470.53	200.00	265.52	707.06	546.94	5.453	
44	212.68	163.00	470.00	200.00	267.52	694.87	534.69	5.454	
45	210.58	163.00	470.53	200.00	266.33	702.99	542.86	5.455	
46	212.68	163.00	471.05	200.00	268.96	690.62	530.61	5.455	
47	209.00	163.00	470.00	200.00	264.40	711.23	551.02	5.456	
48	209.53	163.00	471.05	200.00	266.53	702.86	542.86	5.456	
49	211.63	163.00	470.53	200.00	267.13	698.91	538.78	5.456	
50	213.74	163.00	470.53	200.00	268.75	690.75	530.61	5.457	
51	210.05	163.00	470.00	200.00	265.21	707.15	546.94	5.458	
52	215.32	163.44	470.00	200.00	273.70	662.07	502.04	5.458	
53	214.79	163.26	470.53	200.00	272.48	670.20	510.20	5.458	
54	210.58	163.00	471.05	200.00	267.34	698.78	538.78	5.458	
55	211.11	163.00	471.58	200.00	267.86	698.78	538.78	5.460	
56	213.21	163.00	470.53	200.00	268.65	690.71	530.61	5.460	
57	211.11	163.00	470.00	200.00	266.01	703.07	542.86	5.460	
58	214.26	163.09	470.00	200.00	269.81	682.57	522.45	5.461	
59	212.16	163.00	471.05	200.00	267.66	698.91	538.78	5.461	
60	214.26	163.09	470.00	200.00	269.21	686.74	526.53	5.461	
61	209.00	163.00	470.53	200.00	264.82	711.19	551.02	5.461	
62	213.21	163.00	470.53	200.00	268.05	694.87	534.69	5.462	
63	209.00	163.00	471.05	200.00	265.83	706.98	546.94	5.463	
64	212.16	163.00	470.00	200.00	266.82	699.00	538.78	5.463	
65	210.05	163.00	470.53	200.00	265.63	707.11	546.94	5.463	
66	213.21	163.00	471.05	200.00	269.07	690.66	530.61	5.463	
67	209.00	163.00	470.53	200.00	265.41	707.02	546.94	5.464	
68	210.05	163.00	471.05	200.00	266.64	702.90	542.86	5.464	

69	213.74	163.00	471.05	200.00	269.77	686.54	526.53	5.464
70	210.05	163.00	470.53	200.00	266.22	702.94	542.86	5.465
71	214.79	163.26	470.00	200.00	271.46	674.42	514.29	5.465
72	211.11	163.00	470.53	200.00	266.43	703.03	542.86	5.466
73	211.11	163.00	470.53	200.00	267.03	698.87	538.78	5.466
74	214.26	163.09	470.53	200.00	270.23	682.53	522.45	5.466
75	215.84	163.61	470.00	200.00	275.34	653.90	493.88	5.466
76	211.11	163.00	471.05	200.00	267.45	698.82	538.78	5.466
77	215.32	163.44	470.53	200.00	274.11	662.02	502.04	5.466
78	209.53	163.00	470.00	200.00	264.51	711.27	551.02	5.467
79	211.63	163.00	471.05	200.00	266.96	703.03	542.86	5.467
80	212.68	163.00	470.53	200.00	267.35	699.00	538.78	5.467
81	213.74	163.00	470.00	200.00	267.73	694.96	534.69	5.467
82	211.63	163.00	471.05	200.00	267.55	698.87	538.78	5.468
83	211.63	163.00	470.53	200.00	267.73	694.74	534.69	5.468
84	209.00	163.00	471.05	200.00	265.24	711.14	551.02	5.469
85	212.16	163.00	471.58	200.00	268.67	694.70	534.69	5.469
86	210.58	163.00	470.00	200.00	265.31	707.19	546.94	5.469
87	210.05	163.00	471.05	200.00	266.05	707.06	546.94	5.470
88	209.00	163.00	471.58	200.00	266.25	706.93	546.94	5.471
89	214.26	163.09	470.53	200.00	269.63	686.70	526.53	5.471
90	211.63	163.00	471.58	200.00	267.97	698.82	538.78	5.471
91	211.11	163.00	471.05	200.00	266.85	702.99	542.86	5.471
92	213.21	163.00	471.05	200.00	268.47	694.83	534.69	5.471
93	211.63	163.00	470.00	200.00	266.12	703.12	542.86	5.472
94	213.21	163.00	470.00	200.00	267.03	699.08	538.78	5.472
95	209.53	163.00	470.53	200.00	264.93	711.23	551.02	5.472
96	210.05	163.00	471.58	200.00	267.06	702.86	542.86	5.473
97	214.79	163.26	470.53	200.00	271.88	674.37	514.29	5.473
98	215.32	163.44	470.00	200.00	273.10	666.25	506.12	5.474
99	216.37	163.79	470.00	200.00	276.97	645.71	485.71	5.474

Critical Failure Surface (circle 1)

Intersects: XL: 212.68 YL: 163.00 XR: 470.00 YR: 200.00
Centre: XC: 268.72 YC: 686.54 Radius: R: 526.53
Generated failure surface: (20 points)
212.68 163.00 226.45 161.71 240.24 160.78 254.06 160.21
267.88 160.01
281.70 160.17 295.52 160.69 309.31 161.58 323.08 162.82
336.81 164.43
350.50 166.40 364.12 168.72 377.69 171.41 391.17 174.45
404.58 177.84
417.88 181.58 431.09 185.67 444.18 190.11 457.16 194.88
470.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 44 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	212.68	0.08	-5.4	1.32	1.32	3	100.00	18.0	11.45	2808.93	2132.07	1.01
2	214.00	9.04	-5.4	6.22	6.25	3	100.00	18.0	1210.31	13425.59	2253.64	1.01
3	220.22	25.59	-5.4	6.22	6.25	3	100.00	18.0	3414.31	13653.24	2479.33	1.01
4	226.45	47.05	-3.9	6.90	6.91	3	100.00	18.0	6268.52	15322.16	2703.06	1.01
5	233.35	66.11	-3.9	6.90	6.91	3	100.00	18.0	8797.19	15522.53	2927.04	1.01
6	240.24	84.67	-2.3	6.91	6.91	3	100.00	18.0	11255.20	15683.74	3136.46	1.00
7	247.15	102.53	-2.3	6.91	6.91	3	100.00	18.0	13614.00	15805.96	3334.78	1.00
8	254.06	119.85	-0.8	6.91	6.91	3	100.00	18.0	15896.77	15888.96	3517.93	1.00
9	260.97	136.48	-0.8	6.91	6.91	3	100.00	18.0	18081.99	15932.90	3690.47	1.00
10	267.88	66.96	0.7	3.12	3.12	3	100.00	18.0	8864.27	7201.59	3807.08	1.00
11	271.00	122.09	0.7	5.35	5.35	3	100.00	18.0	16150.19	12330.27	3897.00	1.00
12	276.35	131.31	0.7	5.35	5.35	3	100.00	18.0	17354.10	12309.66	4010.58	1.00
13	281.70	182.48	2.2	6.91	6.91	3	100.00	18.0	24091.97	15829.79	4124.52	1.00
14	288.61	196.59	2.2	6.91	6.91	3	100.00	18.0	25921.09	15717.15	4245.33	1.00
15	295.52	209.77	3.7	6.90	6.91	3	100.00	18.0	27623.52	15565.40	4349.49	1.00
16	302.42	222.58	3.7	6.90	6.91	3	100.00	18.0	29271.13	15374.58		

4444.39	1.00									
17	309.31	227.37	5.2	6.69	6.71	3	100.00	18.0	29860.00	14712.55
4521.23	1.00									
18	316.00	252.68	5.2	7.08	7.11	3	100.00	18.0	33136.75	15308.15
4663.44	1.00									
19	323.08	55.37	6.7	1.51	1.52	3	100.00	18.0	7254.22	3230.83
4787.80	1.00									
20	324.59	223.93	6.7	6.11	6.15	2	0.00	35.0	29334.45	12916.68
4759.85	0.99									
21	330.70	219.55	6.7	6.11	6.15	2	0.00	35.0	28761.61	12641.95
4666.85	0.99									
22	336.81	205.39	8.2	5.84	5.90	2	0.00	35.0	26905.68	11842.83
4557.06	0.99									
23	342.66	200.48	8.2	5.84	5.90	2	0.00	35.0	26262.36	11533.25
4448.04	0.99									
24	348.50	67.40	8.2	2.00	2.02	5	0.00	45.0	7413.90	2823.34
3652.11	0.98									
25	350.50	224.99	9.7	6.81	6.91	2	0.00	35.0	29473.69	2165.16
4238.93	0.99									
26	357.31	217.06	9.7	6.81	6.91	2	0.00	35.0	28435.48	1663.47
4088.29	0.99									
27	364.12	207.53	11.2	6.78	6.91	2	0.00	35.0	27185.84	1123.29
3913.20	0.99									
28	370.91	198.43	11.2	6.78	6.91	2	0.00	35.0	25993.96	544.60
3739.74	0.99									
29	377.69	74.33	12.7	2.63	2.69	2	0.00	35.0	9737.27	49.72
3602.36	1.00									
30	380.31	148.72	12.7	5.43	5.57	2	0.00	35.0	19481.81	0.00
3486.32	1.00									
31	385.74	142.07	12.7	5.43	5.57	2	0.00	35.0	18611.79	0.00
3330.61	1.00									
32	391.17	165.56	14.2	6.70	6.91	2	0.00	35.0	21688.19	0.00
3133.89	1.00									
33	397.87	154.20	14.2	6.70	6.91	2	0.00	35.0	20199.59	0.00
2918.79	1.00									
34	404.58	141.25	15.7	6.65	6.91	2	0.00	35.0	18503.50	0.00
2683.12	1.00									
35	411.23	128.80	15.7	6.65	6.91	2	0.00	35.0	16872.49	0.00
2446.61	1.00									
36	417.88	24.69	17.2	1.36	1.42	2	0.00	35.0	3234.43	0.00
2293.65	1.01									
37	419.24	101.21	17.2	5.92	6.20	1	150.00	22.0	13258.86	0.00
2178.87	1.02									
38	425.17	90.34	17.2	5.92	6.20	1	150.00	22.0	11834.56	0.00
1943.90	1.02									
39	431.09	86.56	18.7	6.55	6.91	1	150.00	22.0	11338.86	0.00
1680.09	1.03									
40	437.64	72.04	18.7	6.55	6.91	1	150.00	22.0	9436.83	0.00
1396.72	1.03									
41	444.18	56.43	20.2	6.49	6.91	1	150.00	22.0	7392.44	0.00
1099.27	1.04									
42	450.67	40.94	20.2	6.49	6.91	1	150.00	22.0	5362.57	0.00
794.70	1.04									
43	457.16	24.64	21.7	6.42	6.91	1	150.00	22.0	3228.00	0.00
477.47	1.05									
44	463.58	8.21	21.7	6.42	6.91	1	150.00	22.0	1076.00	0.00
152.01	1.05									
		---			---				---	
X-S Area:		5483.32	Path Length:		262.67		X-S Weight:		719101.12	

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 8-1 Rapid Drawdown.gmf
Processed: 02 Dec 2020 15:11:08

DATA: Analysis 1 - Case 8-1 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	182.00	348.50	182.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	163.00	348.50	163.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	160.00	348.50	160.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	500.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	182.00	500.00	182.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	163.00	500.00	163.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	160.00	500.00	160.00	

Slope Surface (4 points)

100.00	163.00	214.00	163.00	325.00	200.00	500.00	200.00

Phreatic Surface (6 points)

100.00	163.00	214.00	163.00	316.00	197.00	348.50	197.00
351.50	172.00						
500.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	214.00	YL:	163.00	XR:	475.00	YR: 200.00
Centre:	XC:	276.80	YC:	659.04	Radius:	R:	500.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 8-1 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 4.371

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 3.15

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	212.68	163.00	470.00	200.00	268.72	686.54	526.53	3.147	<-- Critical Surface
2	213.21	163.00	470.00	200.00	268.83	686.58	526.53	3.147	
3	209.53	163.00	470.00	200.00	266.28	698.78	538.78	3.147	
4	210.58	163.00	470.00	200.00	267.09	694.70	534.69	3.149	
5	209.00	163.00	470.00	200.00	265.59	702.90	542.86	3.151	
6	211.63	163.00	470.00	200.00	267.91	690.62	530.61	3.151	
7	210.05	163.00	470.00	200.00	266.39	698.82	538.78	3.152	
8	213.74	163.00	470.00	200.00	269.54	682.46	522.45	3.153	
9	209.00	163.00	470.00	200.00	264.99	707.06	546.94	3.154	
10	212.68	163.00	470.53	200.00	268.54	690.66	530.61	3.155	
11	212.16	163.00	470.53	200.00	268.43	690.62	530.61	3.155	
12	210.05	163.00	470.00	200.00	265.80	702.99	542.86	3.156	
13	209.00	163.00	470.53	200.00	266.00	702.86	542.86	3.156	
14	213.21	163.00	470.00	200.00	268.23	690.75	530.61	3.157	
15	210.05	163.00	470.53	200.00	266.81	698.78	538.78	3.157	
16	211.11	163.00	470.00	200.00	266.61	698.91	538.78	3.157	
17	211.11	163.00	470.53	200.00	267.62	694.70	534.69	3.159	
18	212.68	163.00	470.00	200.00	268.12	690.71	530.61	3.159	
19	212.16	163.00	470.00	200.00	267.42	694.83	534.69	3.160	
20	214.26	163.09	470.00	200.00	270.42	678.40	518.37	3.160	
21	209.53	163.00	470.00	200.00	265.10	707.11	546.94	3.161	
22	213.21	163.00	470.53	200.00	269.25	686.54	526.53	3.161	
23	209.53	163.00	470.00	200.00	265.69	702.94	542.86	3.161	
24	209.53	163.00	470.53	200.00	266.11	702.90	542.86	3.161	
25	210.58	163.00	470.00	200.00	266.50	698.87	538.78	3.162	
26	210.58	163.00	470.00	200.00	265.91	703.03	542.86	3.163	
27	210.58	163.00	470.53	200.00	266.92	698.82	538.78	3.163	
28	212.16	163.00	471.05	200.00	268.26	694.74	534.69	3.163	
29	211.11	163.00	470.00	200.00	267.20	694.74	534.69	3.164	
30	213.74	163.00	470.00	200.00	268.94	686.63	526.53	3.164	
31	211.63	163.00	471.05	200.00	268.15	694.70	534.69	3.164	
32	211.63	163.00	470.00	200.00	267.31	694.79	534.69	3.164	
33	209.53	163.00	470.53	200.00	265.52	707.06	546.94	3.165	
34	211.63	163.00	470.00	200.00	266.71	698.95	538.78	3.165	
35	212.68	163.00	470.53	200.00	267.94	694.83	534.69	3.165	
36	212.16	163.00	470.00	200.00	268.01	690.66	530.61	3.165	
37	209.00	163.00	470.00	200.00	264.40	711.23	551.02	3.166	
38	213.74	163.00	470.00	200.00	268.33	690.80	530.61	3.166	
39	213.74	163.00	470.53	200.00	269.36	686.58	526.53	3.166	
40	209.53	163.00	471.05	200.00	266.53	702.86	542.86	3.166	
41	210.58	163.00	470.53	200.00	266.33	702.99	542.86	3.166	
42	214.26	163.09	470.53	200.00	270.83	678.36	518.37	3.167	
43	214.79	163.26	470.00	200.00	272.06	670.24	510.20	3.167	
44	212.68	163.00	470.00	200.00	267.52	694.87	534.69	3.167	
45	210.05	163.00	470.00	200.00	265.21	707.15	546.94	3.168	
46	210.58	163.00	471.05	200.00	267.34	698.78	538.78	3.168	
47	211.63	163.00	470.53	200.00	267.13	698.91	538.78	3.168	
48	212.16	163.00	470.53	200.00	267.84	694.79	534.69	3.169	
49	209.00	163.00	470.53	200.00	264.82	711.19	551.02	3.169	
50	212.68	163.00	471.05	200.00	268.96	690.62	530.61	3.169	
51	213.21	163.00	470.00	200.00	267.63	694.92	534.69	3.169	
52	212.16	163.00	470.53	200.00	267.24	698.95	538.78	3.169	
53	209.00	163.00	471.05	200.00	265.83	706.98	546.94	3.170	
54	211.11	163.00	470.00	200.00	266.01	703.07	542.86	3.170	
55	209.00	163.00	470.53	200.00	265.41	707.02	546.94	3.170	
56	213.74	163.00	470.53	200.00	268.75	690.75	530.61	3.171	
57	210.05	163.00	470.53	200.00	265.63	707.11	546.94	3.171	
58	210.05	163.00	470.53	200.00	266.22	702.94	542.86	3.171	
59	210.05	163.00	471.05	200.00	266.64	702.90	542.86	3.171	
60	212.16	163.00	470.00	200.00	266.82	699.00	538.78	3.172	
61	214.79	163.26	470.53	200.00	272.48	670.20	510.20	3.172	
62	211.11	163.00	471.58	200.00	267.86	698.78	538.78	3.173	
63	209.53	163.00	470.00	200.00	264.51	711.27	551.02	3.173	
64	213.21	163.00	470.53	200.00	268.65	690.71	530.61	3.173	
65	211.11	163.00	470.53	200.00	267.03	698.87	538.78	3.173	
66	211.11	163.00	470.53	200.00	266.43	703.03	542.86	3.173	
67	211.11	163.00	471.05	200.00	267.45	698.82	538.78	3.173	
68	214.26	163.09	470.00	200.00	269.81	682.57	522.45	3.173	

69	215.32	163.44	470.00	200.00	273.70	662.07	502.04	3.174
70	212.16	163.00	471.05	200.00	267.66	698.91	538.78	3.174
71	209.00	163.00	471.05	200.00	265.24	711.14	551.02	3.174
72	213.21	163.00	471.05	200.00	269.07	690.66	530.61	3.174
73	213.21	163.00	470.53	200.00	268.05	694.87	534.69	3.174
74	214.26	163.09	470.00	200.00	269.21	686.74	526.53	3.174
75	213.74	163.00	471.05	200.00	269.77	686.54	526.53	3.174
76	211.63	163.00	470.53	200.00	267.73	694.74	534.69	3.174
77	209.00	163.00	471.58	200.00	266.25	706.93	546.94	3.175
78	210.58	163.00	470.00	200.00	265.31	707.19	546.94	3.175
79	210.05	163.00	471.05	200.00	266.05	707.06	546.94	3.175
80	214.26	163.09	470.53	200.00	270.23	682.53	522.45	3.176
81	209.53	163.00	470.53	200.00	264.93	711.23	551.02	3.176
82	210.05	163.00	471.58	200.00	267.06	702.86	542.86	3.177
83	214.79	163.26	470.00	200.00	271.46	674.42	514.29	3.177
84	211.11	163.00	471.05	200.00	266.85	702.99	542.86	3.177
85	211.63	163.00	470.00	200.00	266.12	703.12	542.86	3.177
86	212.16	163.00	471.58	200.00	268.67	694.70	534.69	3.177
87	209.00	163.00	470.00	200.00	263.81	715.39	555.10	3.177
88	211.63	163.00	471.05	200.00	267.55	698.87	538.78	3.178
89	212.68	163.00	470.53	200.00	267.35	699.00	538.78	3.178
90	211.63	163.00	471.05	200.00	266.96	703.03	542.86	3.178
91	213.74	163.00	470.00	200.00	267.73	694.96	534.69	3.178
92	210.58	163.00	470.53	200.00	265.73	707.15	546.94	3.178
93	215.32	163.44	470.53	200.00	274.11	662.02	502.04	3.179
94	211.63	163.00	471.58	200.00	267.97	698.82	538.78	3.179
95	213.21	163.00	471.05	200.00	268.47	694.83	534.69	3.179
96	212.68	163.00	470.00	200.00	266.92	699.04	538.78	3.179
97	209.53	163.00	471.05	200.00	265.35	711.19	551.02	3.180
98	214.26	163.09	470.53	200.00	269.63	686.70	526.53	3.180
99	210.05	163.00	470.00	200.00	264.61	711.31	551.02	3.180

Critical Failure Surface (circle 1)

Intersects: XL: 212.68 YL: 163.00 XR: 470.00 YR: 200.00
Centre: XC: 268.72 YC: 686.54 Radius: R: 526.53
Generated failure surface: (20 points)
212.68 163.00 226.45 161.71 240.24 160.78 254.06 160.21
267.88 160.01
281.70 160.17 295.52 160.69 309.31 161.58 323.08 162.82
336.81 164.43
350.50 166.40 364.12 168.72 377.69 171.41 391.17 174.45
404.58 177.84
417.88 181.58 431.09 185.67 444.18 190.11 457.16 194.88
470.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 44 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	212.68	0.08	-5.4	1.32	1.32	3	100.00	18.0	11.45	5.09	11.76	1.01
2	214.00	9.04	-5.4	6.22	6.25	3	100.00	18.0	1210.31	566.68	198.47	1.01
3	220.22	25.59	-5.4	6.22	6.25	3	100.00	18.0	3414.31	1603.75	554.40	1.01
4	226.45	47.05	-3.9	6.90	6.91	3	100.00	18.0	6268.52	2942.54	914.45	1.01
5	233.35	66.11	-3.9	6.90	6.91	3	100.00	18.0	8797.19	4134.47	1282.45	1.01
6	240.24	84.67	-2.3	6.91	6.91	3	100.00	18.0	11255.20	5288.02	1634.63	1.01
7	247.15	102.53	-2.3	6.91	6.91	3	100.00	18.0	13614.00	6403.21	1976.92	1.01
8	254.06	119.85	-0.8	6.91	6.91	3	100.00	18.0	15896.77	7479.61	2302.34	1.00
9	260.97	136.48	-0.8	6.91	6.91	3	100.00	18.0	18081.99	8517.27	2618.75	1.00
10	267.88	66.96	0.7	3.12	3.12	3	100.00	18.0	8864.27	4178.46	2837.72	1.00
11	271.00	122.09	0.7	5.35	5.35	3	100.00	18.0	16150.19	7618.92	3015.70	1.00
12	276.35	131.31	0.7	5.35	5.35	3	100.00	18.0	17354.10	8193.99	3240.54	1.00
13	281.70	182.48	2.2	6.91	6.91	3	100.00	18.0	24091.97	11395.18	3479.48	1.00
14	288.61	196.59	2.2	6.91	6.91	3	100.00	18.0	25921.09	12275.67	3743.75	1.00
15	295.52	209.77	3.7	6.90	6.91	3	100.00	18.0	27623.52	13116.39	3988.57	1.00
16	302.42	222.58	3.7	6.90	6.91	3	100.00	18.0	29271.13	13917.38		

4226.61	1.00									
17	309.31	227.37	5.2	6.69	6.71	3	100.00	18.0	29860.00	14245.74
4441.46	0.99									
18	316.00	252.68	5.2	7.08	7.11	3	100.00	18.0	33136.75	15308.15
4652.50	0.99									
19	323.08	55.37	6.7	1.51	1.52	3	100.00	18.0	7254.22	3230.83
4772.94	0.99									
20	324.59	223.93	6.7	6.11	6.15	2	0.00	35.0	29334.45	12916.68
4731.55	0.98									
21	330.70	219.55	6.7	6.11	6.15	2	0.00	35.0	28761.61	12641.95
4639.06	0.98									
22	336.81	205.39	8.2	5.84	5.90	2	0.00	35.0	26905.68	11842.83
4523.93	0.98									
23	342.66	200.48	8.2	5.84	5.90	2	0.00	35.0	26262.36	11533.25
4415.64	0.98									
24	348.50	67.40	8.2	2.00	2.02	5	0.00	45.0	7413.90	2823.34
3610.86	0.97									
25	350.50	224.99	9.7	6.81	6.91	2	0.00	35.0	29473.69	2165.16
4178.75	0.98									
26	357.31	217.06	9.7	6.81	6.91	2	0.00	35.0	28435.48	1663.47
4029.30	0.98									
27	364.12	207.53	11.2	6.78	6.91	2	0.00	35.0	27185.84	1123.29
3846.94	0.98									
28	370.91	198.43	11.2	6.78	6.91	2	0.00	35.0	25993.96	544.60
3675.07	0.98									
29	377.69	74.33	12.7	2.63	2.69	2	0.00	35.0	9737.27	49.72
3530.69	0.98									
30	380.31	148.72	12.7	5.43	5.57	2	0.00	35.0	19481.81	0.00
3416.60	0.98									
31	385.74	142.07	12.7	5.43	5.57	2	0.00	35.0	18611.79	0.00
3264.00	0.98									
32	391.17	165.56	14.2	6.70	6.91	2	0.00	35.0	21688.19	0.00
3063.91	0.98									
33	397.87	154.20	14.2	6.70	6.91	2	0.00	35.0	20199.59	0.00
2853.61	0.98									
34	404.58	141.25	15.7	6.65	6.91	2	0.00	35.0	18503.50	0.00
2616.93	0.98									
35	411.23	128.80	15.7	6.65	6.91	2	0.00	35.0	16872.49	0.00
2386.26	0.98									
36	417.88	24.69	17.2	1.36	1.42	2	0.00	35.0	3234.43	0.00
2231.69	0.98									
37	419.24	101.21	17.2	5.92	6.20	1	150.00	22.0	13258.86	0.00
2138.01	1.01									
38	425.17	90.34	17.2	5.92	6.20	1	150.00	22.0	11834.56	0.00
1906.80	1.01									
39	431.09	86.56	18.7	6.55	6.91	1	150.00	22.0	11338.86	0.00
1644.27	1.01									
40	437.64	72.04	18.7	6.55	6.91	1	150.00	22.0	9436.83	0.00
1365.85	1.01									
41	444.18	56.43	20.2	6.49	6.91	1	150.00	22.0	7392.44	0.00
1071.45	1.02									
42	450.67	40.94	20.2	6.49	6.91	1	150.00	22.0	5362.57	0.00
772.64	1.02									
43	457.16	24.64	21.7	6.42	6.91	1	150.00	22.0	3228.00	0.00
460.17	1.02									
44	463.58	8.21	21.7	6.42	6.91	1	150.00	22.0	1076.00	0.00
141.34	1.02									
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X-S Area:		5483.32	Path Length:		262.67		X-S Weight:		719101.12	

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 8-2 Full Reservoir.gmf
Processed: 02 Dec 2020 15:24:10

DATA: Analysis 1 - Case 8-2 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	198.00	348.50	198.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	162.00	348.50	162.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	159.00	348.50	159.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	198.00	450.00	198.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	162.00	450.00	162.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	159.00	450.00	159.00	

Slope Surface (4 points)

100.00	162.00	211.00	162.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	211.00	197.00	316.00	197.00	348.50	197.00
351.50	172.00						
450.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	211.00	YL:	162.00	XR:	390.00	YR: 200.00
Centre:	XC:	252.19	YC:	408.58	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 8-2 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 4.099

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.93

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	210.21	162.00	385.00	200.00	248.47	406.99	247.96	2.931	<-- Critical Surface
2	212.32	162.44	385.00	200.00	252.21	394.75	235.71	2.933	
3	212.84	162.61	385.00	200.00	253.46	390.66	231.63	2.933	
4	211.26	162.09	385.00	200.00	249.72	402.91	243.88	2.934	
5	213.37	162.79	385.00	200.00	254.70	386.55	227.55	2.935	
6	208.63	162.00	385.00	200.00	247.25	411.07	252.04	2.935	
7	213.89	162.96	385.00	200.00	255.95	382.44	223.47	2.935	
8	207.05	162.00	385.00	200.00	246.03	415.14	256.12	2.937	
9	210.74	162.00	385.00	200.00	248.57	407.06	247.96	2.938	
10	211.79	162.26	385.00	200.00	250.96	398.84	239.80	2.939	
11	209.16	162.00	385.00	200.00	247.35	411.13	252.04	2.941	
12	209.68	162.00	385.00	200.00	247.45	411.20	252.04	2.942	
13	207.58	162.00	385.00	200.00	246.13	415.20	256.12	2.943	
14	207.58	162.00	385.53	200.00	246.55	415.14	256.12	2.945	
15	206.00	162.00	385.00	200.00	244.92	419.28	260.20	2.945	
16	210.74	162.00	385.53	200.00	249.00	406.99	247.96	2.947	
17	209.16	162.00	385.53	200.00	247.77	411.07	252.04	2.948	
18	208.11	162.00	385.00	200.00	246.23	415.27	256.12	2.949	
19	210.21	162.00	385.00	200.00	247.55	411.26	252.04	2.949	
20	212.84	162.61	385.00	200.00	252.52	394.96	235.71	2.950	
21	212.32	162.44	385.00	200.00	251.28	399.05	239.80	2.951	
22	206.53	162.00	385.00	200.00	245.02	419.34	260.20	2.951	
23	211.79	162.26	385.00	200.00	250.03	403.12	243.88	2.951	
24	208.11	162.00	385.53	200.00	246.65	415.20	256.12	2.952	
25	206.00	162.00	385.53	200.00	245.34	419.21	260.20	2.953	
26	213.89	162.96	385.00	200.00	255.01	386.77	227.55	2.953	
27	211.26	162.09	385.00	200.00	248.78	407.19	247.96	2.953	
28	214.42	163.14	385.00	200.00	256.26	382.66	223.47	2.954	
29	208.63	162.00	385.00	200.00	246.33	415.33	256.12	2.954	
30	209.68	162.00	385.53	200.00	247.87	411.13	252.04	2.955	
31	214.95	163.32	385.00	200.00	257.50	378.54	219.39	2.955	
32	215.47	163.49	385.00	200.00	258.75	374.40	215.31	2.956	
33	216.00	163.67	385.00	200.00	259.99	370.26	211.22	2.956	
34	210.74	162.00	385.00	200.00	247.64	411.32	252.04	2.956	
35	207.05	162.00	385.00	200.00	245.12	419.41	260.20	2.957	
36	213.37	162.79	385.00	200.00	253.77	390.87	231.63	2.957	
37	206.53	162.00	385.53	200.00	245.44	419.28	260.20	2.958	
38	212.32	162.44	385.53	200.00	251.70	398.98	239.80	2.958	
39	211.79	162.26	385.53	200.00	250.45	403.06	243.88	2.959	
40	209.68	162.00	385.00	200.00	246.52	415.46	256.12	2.959	
41	208.63	162.00	385.53	200.00	246.75	415.27	256.12	2.959	
42	209.16	162.00	385.00	200.00	246.43	415.40	256.12	2.960	
43	210.21	162.00	385.53	200.00	247.97	411.20	252.04	2.961	
44	211.26	162.09	385.53	200.00	249.21	407.13	247.96	2.961	
45	213.37	162.79	385.53	200.00	254.19	390.80	231.63	2.961	
46	207.58	162.00	385.00	200.00	245.21	419.47	260.20	2.962	
47	209.68	162.00	386.05	200.00	248.30	411.07	252.04	2.962	
48	213.89	162.96	385.53	200.00	255.43	386.69	227.55	2.962	
49	206.53	162.00	386.05	200.00	245.87	419.21	260.20	2.963	
50	214.42	163.14	385.53	200.00	256.67	382.58	223.47	2.963	
51	208.11	162.00	386.05	200.00	247.08	415.14	256.12	2.964	
52	207.05	162.00	385.53	200.00	245.54	419.34	260.20	2.964	
53	214.95	163.32	385.53	200.00	257.91	378.45	219.39	2.964	
54	206.00	162.00	385.00	200.00	244.01	423.54	264.29	2.964	
55	215.47	163.49	385.53	200.00	259.16	374.32	215.31	2.965	
56	212.84	162.61	385.53	200.00	252.94	394.89	235.71	2.965	
57	210.21	162.00	385.00	200.00	246.62	415.52	256.12	2.966	
58	210.74	162.00	385.53	200.00	248.07	411.26	252.04	2.966	
59	209.16	162.00	385.53	200.00	246.85	415.33	256.12	2.967	
60	211.79	162.26	386.05	200.00	250.88	402.99	243.88	2.967	
61	208.11	162.00	385.00	200.00	245.31	419.53	260.20	2.967	
62	210.21	162.00	386.05	200.00	248.40	411.13	252.04	2.968	
63	211.26	162.09	386.05	200.00	249.63	407.06	247.96	2.969	
64	212.84	162.61	386.05	200.00	253.36	394.82	235.71	2.969	
65	206.53	162.00	385.00	200.00	244.11	423.60	264.29	2.970	
66	207.58	162.00	385.53	200.00	245.64	419.41	260.20	2.970	
67	208.63	162.00	386.05	200.00	247.18	415.20	256.12	2.970	
68	207.05	162.00	386.05	200.00	245.97	419.28	260.20	2.970	

69	208.11	162.00	385.53	200.00	245.74	419.47	260.20	2.970
70	211.79	162.26	385.00	200.00	249.10	407.40	247.96	2.970
71	211.26	162.09	385.00	200.00	247.85	411.46	252.04	2.971
72	213.37	162.79	386.05	200.00	254.60	390.72	231.63	2.971
73	212.32	162.44	385.00	200.00	250.34	403.33	243.88	2.971
74	212.84	162.61	385.00	200.00	251.59	399.26	239.80	2.971
75	213.37	162.79	385.00	200.00	252.84	395.18	235.71	2.972
76	213.89	162.96	386.05	200.00	255.84	386.62	227.55	2.972
77	206.00	162.00	385.53	200.00	244.44	423.48	264.29	2.972
78	214.42	163.14	385.00	200.00	255.32	386.99	227.55	2.972
79	208.63	162.00	385.00	200.00	245.41	419.59	260.20	2.972
80	213.89	162.96	385.00	200.00	254.08	391.09	231.63	2.972
81	210.74	162.00	385.00	200.00	246.72	415.58	256.12	2.972
82	214.42	163.14	386.05	200.00	257.09	382.50	223.47	2.973
83	214.95	163.32	386.05	200.00	258.33	378.37	219.39	2.973
84	209.68	162.00	385.53	200.00	246.95	415.40	256.12	2.973
85	212.32	162.44	386.05	200.00	252.12	398.91	239.80	2.974
86	206.00	162.00	386.05	200.00	244.87	423.41	264.29	2.974
87	207.05	162.00	385.00	200.00	244.21	423.66	264.29	2.975
88	210.74	162.00	386.05	200.00	248.50	411.20	252.04	2.975
89	215.47	163.49	385.00	200.00	257.81	378.76	219.39	2.975
90	209.16	162.00	386.05	200.00	247.28	415.27	256.12	2.976
91	210.21	162.00	386.58	200.00	248.83	411.07	252.04	2.976
92	216.00	163.67	385.00	200.00	259.05	374.62	215.31	2.977
93	208.63	162.00	385.53	200.00	245.84	419.53	260.20	2.977
94	208.63	162.00	386.58	200.00	247.61	415.14	256.12	2.977
95	207.58	162.00	386.05	200.00	246.07	419.34	260.20	2.977
96	206.53	162.00	385.53	200.00	244.54	423.54	264.29	2.977
97	209.16	162.00	385.00	200.00	245.51	419.65	260.20	2.977
98	212.32	162.44	386.58	200.00	252.54	398.84	239.80	2.978
99	211.26	162.09	386.58	200.00	250.06	406.99	247.96	2.978

Critical Failure Surface (circle 1)

Intersects: XL: 210.21 YL: 162.00 XR: 385.00 YR: 200.00
Centre: XC: 248.47 YC: 406.99 Radius: R: 247.96

Generated failure surface: (20 points)

210.21 162.00 219.75 160.70 229.34 159.77 238.95 159.21
248.58 159.03
258.21 159.22 267.83 159.79 277.41 160.72 286.95 162.03
296.44 163.71
305.85 165.76 315.17 168.17 324.40 170.94 333.50 174.07
342.49 177.54
351.32 181.37 360.01 185.53 368.52 190.03 376.86 194.85
385.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 42 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	210.21	0.04	-7.8	0.79	0.80	3	100.00	18.0	5.99	1742.84	2196.38	1.02
2	211.00	4.97	-7.8	4.38	4.42	3	100.00	18.0	668.74	9758.71	2297.27	1.02
3	215.38	13.97	-7.8	4.38	4.42	3	100.00	18.0	1873.38	9923.18	2483.74	1.02
4	219.75	25.16	-5.5	4.79	4.82	3	100.00	18.0	3369.87	10977.73	2662.60	1.02
5	224.55	35.05	-5.5	4.79	4.82	3	100.00	18.0	4687.12	11117.43	2839.32	1.02
6	229.34	44.63	-3.3	4.81	4.82	3	100.00	18.0	5960.67	11228.93	2998.71	1.01
7	234.15	53.67	-3.3	4.81	4.82	3	100.00	18.0	7158.48	11312.52	3148.74	1.01
8	238.95	62.36	-1.1	4.81	4.82	3	100.00	18.0	8306.08	11368.08	3280.29	1.00
9	243.77	70.53	-1.1	4.81	4.82	3	100.00	18.0	9380.32	11395.55	3403.51	1.00
10	248.58	78.25	1.1	4.81	4.82	3	100.00	18.0	10391.00	11395.04	3507.29	1.00
11	253.40	85.51	1.1	4.81	4.82	3	100.00	18.0	11338.25	11366.30	3603.67	1.00
12	258.21	92.18	3.4	4.81	4.82	3	100.00	18.0	12202.51	11309.36	3679.76	1.00
13	263.02	98.53	3.4	4.81	4.82	3	100.00	18.0	13020.07	11224.47	3749.28	1.00
14	267.83	104.09	5.6	4.79	4.82	3	100.00	18.0	13731.30	11111.72	3797.79	0.99
15	272.62	109.50	5.6	4.79	4.82	3	100.00	18.0	14417.35	10970.80	3840.47	0.99
16	277.41	110.95	7.8	4.65	4.69	3	100.00	18.0	14578.40	10526.95		

3861.37	0.99									
17	282.06	115.18	7.8	4.65	4.69	3	100.00	18.0	15103.85	10340.26
3876.87	0.99									
18	286.71	124.65	9.9	4.86	4.94	2	0.00	35.0	16328.63	10655.05
3845.09	0.97									
19	291.57	128.34	10.0	4.86	4.94	2	0.00	35.0	16813.14	10393.31
3840.62	0.97									
20	296.44	127.23	12.3	4.71	4.82	2	0.00	35.0	16667.37	9848.64
3808.49	0.97									
21	301.14	129.80	12.3	4.71	4.82	2	0.00	35.0	17003.63	9541.25
3780.22	0.97									
22	305.85	130.69	14.5	4.66	4.82	2	0.00	35.0	17120.23	9206.40
3723.00	0.97									
23	310.51	132.32	14.5	4.66	4.82	2	0.00	35.0	17333.45	8844.34
3670.36	0.97									
24	315.17	23.68	16.7	0.83	0.87	2	0.00	35.0	3101.56	1550.03
3619.94	0.97									
25	316.00	85.90	16.7	3.00	3.13	2	0.00	35.0	11252.41	5498.71
3617.21	0.97									
26	319.00	155.22	16.7	5.40	5.63	2	0.00	35.0	20333.81	9445.53
3628.88	0.97									
27	324.40	128.81	18.9	4.55	4.82	2	0.00	35.0	16873.50	7596.17
3543.44	0.98									
28	328.95	121.69	18.9	4.55	4.82	2	0.00	35.0	15940.83	7126.47
3346.79	0.98									
29	333.50	112.56	21.2	4.49	4.82	2	0.00	35.0	14744.90	6630.27
3122.13	0.98									
30	337.99	104.75	21.2	4.49	4.82	2	0.00	35.0	13722.02	6107.79
2904.44	0.98									
31	342.49	65.58	23.4	3.01	3.28	2	0.00	35.0	8590.92	3845.27
2699.03	0.99									
32	345.49	61.67	23.4	3.01	3.28	2	0.00	35.0	8078.42	3579.29
2536.97	0.99									
33	348.50	37.38	23.4	1.92	2.10	5	0.00	45.0	4111.66	1101.74
1930.95	0.95									
34	350.42	16.98	23.4	0.90	0.98	5	0.00	45.0	1867.87	0.00
1804.75	0.95									
35	351.32	76.39	25.6	4.34	4.82	2	0.00	35.0	10006.65	0.00
2067.72	1.00									
36	355.67	67.35	25.6	4.34	4.82	2	0.00	35.0	8822.34	0.00
1823.00	1.00									
37	360.01	56.82	27.8	4.26	4.82	2	0.00	35.0	7443.46	0.00
1552.26	1.00									
38	364.27	47.24	27.8	4.26	4.82	2	0.00	35.0	6188.93	0.00
1290.64	1.00									
39	368.52	36.53	30.1	4.17	4.82	2	0.00	35.0	4784.88	0.00
1008.65	1.02									
40	372.69	26.47	30.1	4.17	4.82	2	0.00	35.0	3467.64	0.00
730.98	1.02									
41	376.86	17.78	32.3	4.98	5.89	2	0.00	35.0	2329.17	0.00
406.62	1.03									
42	381.84	3.16	32.3	3.16	3.74	1	150.00	22.0	414.52	0.00
90.74	1.09									
		---			---				---	
X-S Area:		3123.54	Path Length:		182.99		X-S Weight:		409535.38	

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 8-2 Rapid Drawdown.gmf
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DATA: Analysis 1 - Case 8-2 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	198.00	348.50	198.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	162.00	348.50	162.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	159.00	348.50	159.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	198.00	450.00	198.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	162.00	450.00	162.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	159.00	450.00	159.00	

Slope Surface (4 points)

100.00	162.00	211.00	162.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	162.00	211.00	162.00	316.00	197.00	348.50	197.00
351.50	172.00						
450.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	211.00	YL:	162.00	XR:	390.00	YR: 200.00
Centre:	XC:	252.19	YC:	408.58	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 8-2 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.303

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.61

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	210.21	162.00	385.00	200.00	248.47	406.99	247.96	1.607	<-- Critical Surface
2	211.26	162.09	385.00	200.00	249.72	402.91	243.88	1.608	
3	212.32	162.44	385.00	200.00	252.21	394.75	235.71	1.608	
4	208.63	162.00	385.00	200.00	247.25	411.07	252.04	1.608	
5	212.84	162.61	385.00	200.00	253.46	390.66	231.63	1.609	
6	207.05	162.00	385.00	200.00	246.03	415.14	256.12	1.609	
7	213.37	162.79	385.00	200.00	254.70	386.55	227.55	1.610	
8	213.89	162.96	385.00	200.00	255.95	382.44	223.47	1.610	
9	211.79	162.26	385.00	200.00	250.96	398.84	239.80	1.611	
10	210.74	162.00	385.00	200.00	248.57	407.06	247.96	1.611	
11	209.16	162.00	385.00	200.00	247.35	411.13	252.04	1.612	
12	207.58	162.00	385.00	200.00	246.13	415.20	256.12	1.613	
13	209.68	162.00	385.00	200.00	247.45	411.20	252.04	1.614	
14	206.00	162.00	385.00	200.00	244.92	419.28	260.20	1.614	
15	207.58	162.00	385.53	200.00	246.55	415.14	256.12	1.615	
16	210.74	162.00	385.53	200.00	249.00	406.99	247.96	1.616	
17	208.11	162.00	385.00	200.00	246.23	415.27	256.12	1.617	
18	209.16	162.00	385.53	200.00	247.77	411.07	252.04	1.617	
19	206.53	162.00	385.00	200.00	245.02	419.34	260.20	1.618	
20	210.21	162.00	385.00	200.00	247.55	411.26	252.04	1.618	
21	206.00	162.00	385.53	200.00	245.34	419.21	260.20	1.619	
22	212.84	162.61	385.00	200.00	252.52	394.96	235.71	1.619	
23	211.79	162.26	385.00	200.00	250.03	403.12	243.88	1.619	
24	212.32	162.44	385.00	200.00	251.28	399.05	239.80	1.619	
25	208.11	162.00	385.53	200.00	246.65	415.20	256.12	1.620	
26	211.26	162.09	385.00	200.00	248.78	407.19	247.96	1.620	
27	208.63	162.00	385.00	200.00	246.33	415.33	256.12	1.620	
28	209.68	162.00	385.53	200.00	247.87	411.13	252.04	1.620	
29	207.05	162.00	385.00	200.00	245.12	419.41	260.20	1.621	
30	213.89	162.96	385.00	200.00	255.01	386.77	227.55	1.621	
31	206.53	162.00	385.53	200.00	245.44	419.28	260.20	1.622	
32	210.74	162.00	385.00	200.00	247.64	411.32	252.04	1.622	
33	214.42	163.14	385.00	200.00	256.26	382.66	223.47	1.622	
34	214.95	163.32	385.00	200.00	257.50	378.54	219.39	1.623	
35	213.37	162.79	385.00	200.00	253.77	390.87	231.63	1.623	
36	209.16	162.00	385.00	200.00	246.43	415.40	256.12	1.624	
37	212.32	162.44	385.53	200.00	251.70	398.98	239.80	1.624	
38	211.79	162.26	385.53	200.00	250.45	403.06	243.88	1.624	
39	208.63	162.00	385.53	200.00	246.75	415.27	256.12	1.624	
40	215.47	163.49	385.00	200.00	258.75	374.40	215.31	1.624	
41	210.21	162.00	385.53	200.00	247.97	411.20	252.04	1.624	
42	216.00	163.67	385.00	200.00	259.99	370.26	211.22	1.624	
43	207.58	162.00	385.00	200.00	245.21	419.47	260.20	1.625	
44	209.68	162.00	385.00	200.00	246.52	415.46	256.12	1.625	
45	211.26	162.09	385.53	200.00	249.21	407.13	247.96	1.625	
46	209.68	162.00	386.05	200.00	248.30	411.07	252.04	1.625	
47	206.53	162.00	386.05	200.00	245.87	419.21	260.20	1.626	
48	208.11	162.00	386.05	200.00	247.08	415.14	256.12	1.626	
49	207.05	162.00	385.53	200.00	245.54	419.34	260.20	1.626	
50	206.00	162.00	385.00	200.00	244.01	423.54	264.29	1.626	
51	213.37	162.79	385.53	200.00	254.19	390.80	231.63	1.626	
52	213.89	162.96	385.53	200.00	255.43	386.69	227.55	1.627	
53	208.11	162.00	385.00	200.00	245.31	419.53	260.20	1.628	
54	210.74	162.00	385.53	200.00	248.07	411.26	252.04	1.628	
55	214.42	163.14	385.53	200.00	256.67	382.58	223.47	1.628	
56	212.84	162.61	385.53	200.00	252.94	394.89	235.71	1.628	
57	209.16	162.00	385.53	200.00	246.85	415.33	256.12	1.628	
58	211.79	162.26	386.05	200.00	250.88	402.99	243.88	1.629	
59	210.21	162.00	385.00	200.00	246.62	415.52	256.12	1.629	
60	214.95	163.32	385.53	200.00	257.91	378.45	219.39	1.629	
61	210.21	162.00	386.05	200.00	248.40	411.13	252.04	1.629	
62	206.53	162.00	385.00	200.00	244.11	423.60	264.29	1.629	
63	207.58	162.00	385.53	200.00	245.64	419.41	260.20	1.629	
64	215.47	163.49	385.53	200.00	259.16	374.32	215.31	1.629	
65	208.63	162.00	386.05	200.00	247.18	415.20	256.12	1.630	
66	211.26	162.09	386.05	200.00	249.63	407.06	247.96	1.630	
67	207.05	162.00	386.05	200.00	245.97	419.28	260.20	1.630	
68	206.00	162.00	385.53	200.00	244.44	423.48	264.29	1.630	

69	212.84	162.61	386.05	200.00	253.36	394.82	235.71	1.631
70	208.11	162.00	385.53	200.00	245.74	419.47	260.20	1.631
71	211.79	162.26	385.00	200.00	249.10	407.40	247.96	1.631
72	211.26	162.09	385.00	200.00	247.85	411.46	252.04	1.631
73	208.63	162.00	385.00	200.00	245.41	419.59	260.20	1.631
74	212.32	162.44	385.00	200.00	250.34	403.33	243.88	1.632
75	213.37	162.79	386.05	200.00	254.60	390.72	231.63	1.632
76	209.68	162.00	385.53	200.00	246.95	415.40	256.12	1.632
77	212.84	162.61	385.00	200.00	251.59	399.26	239.80	1.632
78	207.05	162.00	385.00	200.00	244.21	423.66	264.29	1.632
79	210.74	162.00	385.00	200.00	246.72	415.58	256.12	1.633
80	213.89	162.96	386.05	200.00	255.84	386.62	227.55	1.633
81	213.37	162.79	385.00	200.00	252.84	395.18	235.71	1.633
82	212.32	162.44	386.05	200.00	252.12	398.91	239.80	1.633
83	210.74	162.00	386.05	200.00	248.50	411.20	252.04	1.633
84	206.00	162.00	386.05	200.00	244.87	423.41	264.29	1.633
85	209.16	162.00	386.05	200.00	247.28	415.27	256.12	1.633
86	213.89	162.96	385.00	200.00	254.08	391.09	231.63	1.633
87	214.42	163.14	386.05	200.00	257.09	382.50	223.47	1.634
88	214.42	163.14	385.00	200.00	255.32	386.99	227.55	1.634
89	210.21	162.00	386.58	200.00	248.83	411.07	252.04	1.634
90	206.53	162.00	385.53	200.00	244.54	423.54	264.29	1.634
91	207.58	162.00	386.05	200.00	246.07	419.34	260.20	1.634
92	208.63	162.00	386.58	200.00	247.61	415.14	256.12	1.634
93	214.95	163.32	386.05	200.00	258.33	378.37	219.39	1.634
94	209.16	162.00	385.00	200.00	245.51	419.65	260.20	1.634
95	208.63	162.00	385.53	200.00	245.84	419.53	260.20	1.635
96	211.26	162.09	386.58	200.00	250.06	406.99	247.96	1.635
97	207.05	162.00	386.58	200.00	246.39	419.21	260.20	1.635
98	207.58	162.00	385.00	200.00	244.30	423.72	264.29	1.635
99	212.32	162.44	386.58	200.00	252.54	398.84	239.80	1.635

Critical Failure Surface (circle 1)

Intersects: XL: 210.21 YL: 162.00 XR: 385.00 YR: 200.00
Centre: XC: 248.47 YC: 406.99 Radius: R: 247.96
Generated failure surface: (20 points)
210.21 162.00 219.75 160.70 229.34 159.77 238.95 159.21
248.58 159.03
258.21 159.22 267.83 159.79 277.41 160.72 286.95 162.03
296.44 163.71
305.85 165.76 315.17 168.17 324.40 170.94 333.50 174.07
342.49 177.54
351.32 181.37 360.01 185.53 368.52 190.03 376.86 194.85
385.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 42 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	210.21	0.04	-7.8	0.79	0.80	3	100.00	18.0	5.99	2.68	16.44	1.04
2	211.00	4.97	-7.8	4.38	4.42	3	100.00	18.0	668.74	312.95	163.85	1.04
3	215.38	13.97	-7.8	4.38	4.42	3	100.00	18.0	1873.38	879.52	443.27	1.04
4	219.75	25.16	-5.5	4.79	4.82	3	100.00	18.0	3369.87	1577.55	716.75	1.02
5	224.55	35.05	-5.5	4.79	4.82	3	100.00	18.0	4687.12	2197.28	994.50	1.02
6	229.34	44.63	-3.3	4.81	4.82	3	100.00	18.0	5960.67	2789.68	1251.38	1.01
7	234.15	53.67	-3.3	4.81	4.82	3	100.00	18.0	7158.48	3354.81	1502.11	1.01
8	238.95	62.36	-1.1	4.81	4.82	3	100.00	18.0	8306.08	3892.22	1729.93	1.00
9	243.77	70.53	-1.1	4.81	4.82	3	100.00	18.0	9380.32	4401.91	1953.51	1.00
10	248.58	78.25	1.1	4.81	4.82	3	100.00	18.0	10391.00	4883.55	2152.46	1.00
11	253.40	85.51	1.1	4.81	4.82	3	100.00	18.0	11338.25	5337.04	2348.80	1.00
12	258.21	92.18	3.4	4.81	4.82	3	100.00	18.0	12202.51	5762.02	2519.06	0.99
13	263.02	98.53	3.4	4.81	4.82	3	100.00	18.0	13020.07	6158.61	2688.10	0.99
14	267.83	104.09	5.6	4.79	4.82	3	100.00	18.0	13731.30	6526.55	2829.85	0.99
15	272.62	109.50	5.6	4.79	4.82	3	100.00	18.0	14417.35	6865.66	2971.58	0.99
16	277.41	110.95	7.8	4.65	4.69	3	100.00	18.0	14578.40	6987.92		

3083.57	0.98									
17	282.06	115.18	7.8	4.65	4.69	3	100.00	18.0	15103.85	7254.82
3195.07	0.98									
18	286.71	124.65	9.9	4.86	4.94	2	0.00	35.0	16328.63	7896.17
3232.35	0.94									
19	291.57	128.34	10.0	4.86	4.94	2	0.00	35.0	16813.14	8133.25
3326.88	0.94									
20	296.44	127.23	12.3	4.71	4.82	2	0.00	35.0	16667.37	8124.72
3381.53	0.93									
21	301.14	129.80	12.3	4.71	4.82	2	0.00	35.0	17003.63	8288.64
3449.75	0.93									
22	305.85	130.69	14.5	4.66	4.82	2	0.00	35.0	17120.23	8422.95
3477.45	0.93									
23	310.51	132.32	14.5	4.66	4.82	2	0.00	35.0	17333.45	8527.85
3520.76	0.93									
24	315.17	23.68	16.7	0.83	0.87	2	0.00	35.0	3101.56	1542.57
3515.69	0.92									
25	316.00	85.90	16.7	3.00	3.13	2	0.00	35.0	11252.41	5498.71
3519.84	0.92									
26	319.00	155.22	16.7	5.40	5.63	2	0.00	35.0	20333.81	9445.53
3526.79	0.92									
27	324.40	128.81	18.9	4.55	4.82	2	0.00	35.0	16873.50	7596.17
3427.86	0.92									
28	328.95	121.69	18.9	4.55	4.82	2	0.00	35.0	15940.83	7126.47
3237.03	0.92									
29	333.50	112.56	21.2	4.49	4.82	2	0.00	35.0	14744.90	6630.27
3008.26	0.92									
30	337.99	104.75	21.2	4.49	4.82	2	0.00	35.0	13722.02	6107.79
2797.69	0.92									
31	342.49	65.58	23.4	3.01	3.28	2	0.00	35.0	8590.92	3845.27
2589.69	0.92									
32	345.49	61.67	23.4	3.01	3.28	2	0.00	35.0	8078.42	3579.29
2433.42	0.92									
33	348.50	37.38	23.4	1.92	2.10	5	0.00	45.0	4111.66	1101.74
1796.27	0.86									
34	350.42	16.98	23.4	0.90	0.98	5	0.00	45.0	1867.87	0.00
1631.75	0.86									
35	351.32	76.39	25.6	4.34	4.82	2	0.00	35.0	10006.65	0.00
1906.21	0.92									
36	355.67	67.35	25.6	4.34	4.82	2	0.00	35.0	8822.34	0.00
1680.61	0.92									
37	360.01	56.82	27.8	4.26	4.82	2	0.00	35.0	7443.46	0.00
1421.00	0.92									
38	364.27	47.24	27.8	4.26	4.82	2	0.00	35.0	6188.93	0.00
1181.51	0.92									
39	368.52	36.53	30.1	4.17	4.82	2	0.00	35.0	4784.88	0.00
916.81	0.92									
40	372.69	26.47	30.1	4.17	4.82	2	0.00	35.0	3467.64	0.00
664.43	0.92									
41	376.86	17.78	32.3	4.98	5.89	2	0.00	35.0	2329.17	0.00
366.94	0.93									
42	381.84	3.16	32.3	3.16	3.74	1	150.00	22.0	414.52	0.00
62.11	1.02									
		---			---				---	
X-S Area:		3123.54	Path Length:		182.99		X-S Weight:		409535.38	

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 8-3 Full Reservoir.gmf
Processed: 02 Dec 2020 15:34:28

DATA: Analysis 1 - Case 8-3 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	193.00	348.50	193.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	171.00	348.50	171.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	168.00	348.50	168.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	193.00	450.00	193.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	171.00	450.00	171.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	168.00	450.00	168.00	

Slope Surface (4 points)

100.00	171.00	238.00	171.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	238.00	197.00	316.00	197.00	348.50	197.00
351.50	178.00						
450.00	178.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	238.00	YL:	171.00	XR:	405.00	YR: 200.00
Centre:	XC:	281.26	YC:	417.23	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 8-3 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 6.013

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 3.79

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	234.05	171.00	400.00	200.00	273.90	432.26	264.29	3.790	<-- Critical Surface
2	233.00	171.00	400.00	200.00	272.93	436.38	268.37	3.795	
3	237.21	171.00	400.00	200.00	276.09	424.15	256.12	3.798	
4	234.58	171.00	400.00	200.00	274.02	432.33	264.29	3.799	
5	235.63	171.00	400.00	200.00	274.99	428.21	260.20	3.801	
6	233.53	171.00	400.00	200.00	273.05	436.44	268.37	3.803	
7	236.68	171.00	400.00	200.00	275.22	428.33	260.20	3.806	
8	235.11	171.00	400.00	200.00	274.13	432.39	264.29	3.808	
9	237.74	171.00	400.00	200.00	276.20	424.22	256.12	3.810	
10	236.16	171.00	400.00	200.00	275.11	428.27	260.20	3.810	
11	238.26	171.09	400.00	200.00	277.20	420.10	252.04	3.811	
12	234.05	171.00	400.00	200.00	273.16	436.50	268.37	3.812	
13	236.16	171.00	400.53	200.00	275.52	428.21	260.20	3.813	
14	233.53	171.00	400.53	200.00	273.46	436.38	268.37	3.815	
15	233.00	171.00	400.00	200.00	272.20	440.61	272.45	3.816	
16	234.58	171.00	400.53	200.00	274.43	432.26	264.29	3.816	
17	235.63	171.00	400.00	200.00	274.25	432.45	264.29	3.816	
18	237.21	171.00	400.00	200.00	275.33	428.40	260.20	3.818	
19	238.79	171.26	400.00	200.00	278.32	416.05	247.96	3.818	
20	234.58	171.00	400.00	200.00	273.28	436.56	268.37	3.820	
21	235.63	171.00	400.53	200.00	274.66	432.39	264.29	3.821	
22	237.74	171.00	400.53	200.00	276.62	424.15	256.12	3.823	
23	234.05	171.00	400.53	200.00	273.58	436.44	268.37	3.823	
24	233.53	171.00	400.00	200.00	272.31	440.67	272.45	3.824	
25	236.68	171.00	400.53	200.00	275.63	428.27	260.20	3.825	
26	235.11	171.00	400.53	200.00	274.54	432.33	264.29	3.825	
27	236.68	171.00	400.00	200.00	274.47	432.57	264.29	3.825	
28	239.32	171.44	400.00	200.00	279.44	411.99	243.88	3.826	
29	233.00	171.00	400.53	200.00	272.61	440.55	272.45	3.827	
30	238.26	171.09	400.53	200.00	277.61	420.04	252.04	3.828	
31	235.11	171.00	401.05	200.00	274.96	432.26	264.29	3.828	
32	235.11	171.00	400.00	200.00	273.39	436.62	268.37	3.828	
33	238.26	171.09	400.00	200.00	276.44	424.35	256.12	3.830	
34	238.79	171.26	400.53	200.00	278.73	415.98	247.96	3.830	
35	237.74	171.00	400.00	200.00	275.45	428.46	260.20	3.830	
36	236.16	171.00	400.00	200.00	274.36	432.51	264.29	3.832	
37	234.05	171.00	400.00	200.00	272.42	440.73	272.45	3.832	
38	236.16	171.00	400.53	200.00	274.77	432.45	264.29	3.833	
39	237.21	171.00	400.53	200.00	275.75	428.33	260.20	3.834	
40	239.84	171.61	400.00	200.00	280.55	407.93	239.80	3.836	
41	233.53	171.00	400.53	200.00	272.73	440.61	272.45	3.836	
42	233.00	171.00	400.00	200.00	271.46	444.84	276.53	3.836	
43	235.63	171.00	400.00	200.00	273.50	436.68	268.37	3.836	
44	234.58	171.00	401.05	200.00	274.10	436.44	268.37	3.836	
45	237.21	171.00	400.00	200.00	274.58	432.63	264.29	3.837	
46	236.68	171.00	401.05	200.00	276.05	428.21	260.20	3.837	
47	234.58	171.00	400.53	200.00	273.69	436.50	268.37	3.838	
48	239.32	171.44	400.53	200.00	279.84	411.92	243.88	3.838	
49	233.00	171.00	401.05	200.00	273.02	440.49	272.45	3.839	
50	238.79	171.26	400.00	200.00	277.56	420.30	252.04	3.839	
51	234.58	171.00	400.00	200.00	272.53	440.79	272.45	3.840	
52	235.63	171.00	401.05	200.00	275.07	432.33	264.29	3.840	
53	234.05	171.00	401.05	200.00	273.99	436.38	268.37	3.840	
54	235.63	171.00	400.53	200.00	273.91	436.62	268.37	3.841	
55	238.26	171.09	400.53	200.00	276.86	424.29	256.12	3.842	
56	233.53	171.00	400.00	200.00	271.58	444.90	276.53	3.844	
57	237.74	171.00	400.53	200.00	275.86	428.40	260.20	3.844	
58	234.05	171.00	400.53	200.00	272.84	440.67	272.45	3.844	
59	240.37	171.79	400.00	200.00	281.67	403.86	235.71	3.845	
60	236.68	171.00	400.53	200.00	274.88	432.51	264.29	3.846	
61	235.11	171.00	400.53	200.00	273.80	436.56	268.37	3.847	
62	237.21	171.00	401.05	200.00	276.16	428.27	260.20	3.847	
63	235.11	171.00	400.00	200.00	272.64	440.85	272.45	3.847	
64	239.84	171.61	400.53	200.00	280.96	407.86	239.80	3.848	
65	233.00	171.00	400.53	200.00	271.88	444.78	276.53	3.848	
66	236.68	171.00	400.00	200.00	275.98	424.09	256.12	3.848	
67	235.11	171.00	401.05	200.00	274.22	436.50	268.37	3.849	
68	239.32	171.44	400.00	200.00	278.68	416.25	247.96	3.849	

69	237.74	171.00	400.00	200.00	274.69	432.69	264.29	3.849
70	236.16	171.00	401.05	200.00	275.19	432.39	264.29	3.849
71	238.26	171.09	400.00	200.00	275.68	428.59	260.20	3.849
72	234.05	171.00	400.00	200.00	271.68	444.96	276.53	3.851
73	233.53	171.00	401.58	200.00	273.55	440.49	272.45	3.852
74	236.16	171.00	400.00	200.00	273.61	436.74	268.37	3.852
75	238.79	171.26	400.53	200.00	277.97	420.24	252.04	3.852
76	234.58	171.00	400.53	200.00	272.95	440.73	272.45	3.852
77	235.63	171.00	401.58	200.00	275.48	432.26	264.29	3.852
78	236.16	171.00	400.53	200.00	274.03	436.68	268.37	3.853
79	233.53	171.00	401.05	200.00	273.14	440.55	272.45	3.854
80	237.21	171.00	400.53	200.00	275.00	432.57	264.29	3.854
81	233.00	171.00	400.00	200.00	270.73	449.06	280.61	3.855
82	235.63	171.00	400.00	200.00	272.75	440.91	272.45	3.855
83	237.21	171.00	400.00	200.00	273.83	436.86	268.37	3.855
84	234.58	171.00	401.58	200.00	274.51	436.38	268.37	3.855
85	233.00	171.00	401.58	200.00	273.43	440.43	272.45	3.856
86	233.53	171.00	400.53	200.00	271.99	444.84	276.53	3.856
87	237.74	171.00	401.05	200.00	276.27	428.33	260.20	3.857
88	234.58	171.00	401.05	200.00	273.36	440.67	272.45	3.857
89	238.26	171.09	401.05	200.00	277.27	424.22	256.12	3.857
90	236.68	171.00	401.05	200.00	275.30	432.45	264.29	3.858
91	234.58	171.00	400.00	200.00	271.79	445.02	276.53	3.858
92	238.79	171.26	400.00	200.00	276.81	424.55	256.12	3.859
93	239.84	171.61	400.00	200.00	279.80	412.20	243.88	3.859
94	237.21	171.00	401.58	200.00	276.57	428.21	260.20	3.860
95	233.00	171.00	401.05	200.00	272.29	444.72	276.53	3.860
96	235.63	171.00	400.53	200.00	273.17	440.85	272.45	3.860
97	236.68	171.00	400.00	200.00	273.72	436.80	268.37	3.860
98	240.89	171.96	400.00	200.00	282.78	399.78	231.63	3.860
99	235.63	171.00	401.05	200.00	274.33	436.56	268.37	3.861

Critical Failure Surface (circle 1)

Intersects: XL: 234.05 YL: 171.00 XR: 400.00 YR: 200.00
Centre: XC: 273.90 YC: 432.26 Radius: R: 264.29

Generated failure surface: (20 points)

234.05 171.00 242.99 169.79 251.97 168.89 260.98 168.29
270.00 168.01
279.02 168.03 288.04 168.36 297.04 168.99 306.01 169.94
314.95 171.18
323.84 172.74 332.67 174.59 341.43 176.75 350.11 179.20
358.71 181.95
367.20 184.99 375.59 188.32 383.86 191.94 392.00 195.83
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	234.05	1.05	-7.7	3.95	3.98	3	100.00	18.0	148.41	6528.68	1663.85	1.02
2	238.00	8.51	-7.7	4.99	5.04	3	100.00	18.0	1157.94	8451.18	1807.36	1.02
3	242.99	17.27	-5.7	4.49	4.51	3	100.00	18.0	2326.57	7723.44	1995.18	1.01
4	247.48	26.01	-5.7	4.49	4.51	3	100.00	18.0	3492.05	7850.41	2162.63	1.01
5	251.97	34.52	-3.8	4.50	4.51	3	100.00	18.0	4623.27	7955.69	2316.80	1.01
6	256.47	42.61	-3.8	4.50	4.51	3	100.00	18.0	5697.12	8039.47	2462.42	1.01
7	260.98	50.45	-1.8	4.51	4.51	3	100.00	18.0	6734.25	8101.70	2593.98	1.00
8	265.49	57.88	-1.8	4.51	4.51	3	100.00	18.0	7713.56	8142.15	2717.66	1.00
9	270.00	64.99	0.1	4.51	4.51	3	100.00	18.0	8648.49	8160.90	2826.62	1.00
10	274.51	71.73	0.1	4.51	4.51	3	100.00	18.0	9530.86	8158.05	2928.31	1.00
11	279.02	78.07	2.1	4.51	4.51	3	100.00	18.0	10357.00	8133.45	3014.66	1.00
12	283.53	84.10	2.1	4.51	4.51	3	100.00	18.0	11140.21	8087.19	3094.31	1.00
13	288.04	89.62	4.0	4.50	4.51	3	100.00	18.0	11852.02	8019.27	3158.10	1.00
14	292.54	94.94	4.0	4.50	4.51	3	100.00	18.0	12534.59	7929.70	3215.69	1.00
15	297.04	76.88	6.0	3.48	3.50	3	100.00	18.0	10134.67	6077.59	3252.98	1.00
16	300.52	79.65	6.0	3.48	3.50	3	100.00	18.0	10484.27	5997.67		

3280.54	1.00									
17	304.00	47.28	6.0	2.01	2.02	3	100.00	18.0	6216.89	3428.87
3302.28	1.00									
18	306.01	91.75	8.0	3.81	3.84	3	100.00	18.0	12049.89	6427.38
3310.33	1.00									
19	309.82	94.56	8.0	3.81	3.84	3	100.00	18.0	12397.09	6299.77
3321.82	1.00									
20	313.62	33.53	8.0	1.32	1.34	2	0.00	35.0	4391.81	2159.94
3310.95	0.98									
21	314.95	26.88	9.9	1.05	1.07	2	0.00	35.0	3521.00	1714.28
3302.89	0.98									
22	316.00	101.65	9.9	3.92	3.98	2	0.00	35.0	13316.02	6276.93
3341.46	0.98									
23	319.92	104.08	9.9	3.92	3.98	2	0.00	35.0	13634.97	6106.97
3418.97	0.98									
24	323.84	31.35	11.9	1.16	1.19	2	0.00	35.0	4106.41	1790.61
3454.24	0.98									
25	325.00	102.03	11.9	3.83	3.92	2	0.00	35.0	13365.85	5772.39
3411.25	0.98									
26	328.83	98.94	11.9	3.83	3.92	2	0.00	35.0	12961.12	5575.39
3307.77	0.98									
27	332.67	108.94	13.8	4.38	4.51	2	0.00	35.0	14271.36	6156.19
3175.22	0.99									
28	337.05	104.22	13.8	4.38	4.51	2	0.00	35.0	13652.61	5852.66
3037.21	0.99									
29	341.43	80.43	15.8	3.54	3.67	2	0.00	35.0	10536.28	4527.65
2893.52	0.99									
30	344.96	76.90	15.8	3.54	3.67	2	0.00	35.0	10073.61	4298.63
2766.03	0.99									
31	348.50	33.90	15.8	1.61	1.68	5	0.00	45.0	3728.85	1350.59
2208.03	0.97									
32	350.11	23.50	17.7	1.14	1.20	5	0.00	45.0	2584.51	283.15
2109.40	0.97									
33	351.25	73.93	17.7	3.73	3.91	2	0.00	35.0	9684.84	0.00
2453.38	0.99									
34	354.98	69.49	17.7	3.73	3.91	2	0.00	35.0	9102.77	0.00
2305.91	0.99									
35	358.71	73.43	19.7	4.25	4.51	2	0.00	35.0	9619.10	0.00
2124.03	1.00									
36	362.95	66.97	19.7	4.25	4.51	2	0.00	35.0	8773.03	0.00
1937.21	1.00									
37	367.20	59.43	21.7	4.19	4.51	2	0.00	35.0	7785.89	0.00
1729.84	1.00									
38	371.40	52.45	21.7	4.19	4.51	2	0.00	35.0	6871.48	0.00
1526.68	1.00									
39	375.59	44.54	23.6	4.13	4.51	2	0.00	35.0	5834.33	0.00
1305.83	1.01									
40	379.72	37.07	23.6	4.13	4.51	2	0.00	35.0	4855.82	0.00
1086.83	1.01									
41	383.86	16.74	25.6	2.22	2.46	2	0.00	35.0	2192.34	0.00
906.51	1.02									
42	386.08	18.62	25.6	2.96	3.28	1	150.00	22.0	2439.09	0.00
766.29	1.05									
43	389.04	14.43	25.6	2.96	3.28	1	150.00	22.0	1890.45	0.00
589.87	1.05									
44	392.00	12.51	27.5	4.00	4.51	1	150.00	22.0	1638.99	0.00
368.54	1.07									
45	396.00	4.17	27.5	4.00	4.51	1	150.00	22.0	546.32	0.00
109.82	1.07									
		---			---				---	
X-S Area:		2581.96	Path Length:		171.44		X-S Weight:		338617.97	

Project: West Farm Pit Expansion
File: C:\Galena Models\West Farm Expansion Case 8-3 Rapid Drawdown.gmf
Processed: 02 Dec 2020 15:33:12

DATA: Analysis 1 - Case 8-3 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	193.00	348.50	193.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	171.00	348.50	171.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	168.00	348.50	168.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	193.00	450.00	193.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	171.00	450.00	171.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	168.00	450.00	168.00	

Slope Surface (4 points)

100.00	171.00	238.00	171.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	171.00	238.00	171.00	316.00	197.00	348.50	197.00
351.50	178.00						
450.00	178.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	238.00	YL:	171.00	XR:	405.00	YR: 200.00
Centre:	XC:	281.26	YC:	417.23	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 8-3 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 3.571

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.21

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	234.05	171.00	400.00	200.00	273.90	432.26	264.29	2.210	<-- Critical Surface
2	233.00	171.00	400.00	200.00	272.93	436.38	268.37	2.212	
3	234.58	171.00	400.00	200.00	274.02	432.33	264.29	2.216	
4	235.63	171.00	400.00	200.00	274.99	428.21	260.20	2.217	
5	237.21	171.00	400.00	200.00	276.09	424.15	256.12	2.218	
6	233.53	171.00	400.00	200.00	273.05	436.44	268.37	2.218	
7	235.11	171.00	400.00	200.00	274.13	432.39	264.29	2.222	
8	236.16	171.00	400.00	200.00	275.11	428.27	260.20	2.223	
9	236.68	171.00	400.00	200.00	275.22	428.33	260.20	2.223	
10	234.05	171.00	400.00	200.00	273.16	436.50	268.37	2.223	
11	233.53	171.00	400.53	200.00	273.46	436.38	268.37	2.225	
12	237.74	171.00	400.00	200.00	276.20	424.22	256.12	2.225	
13	234.58	171.00	400.53	200.00	274.43	432.26	264.29	2.225	
14	233.00	171.00	400.00	200.00	272.20	440.61	272.45	2.226	
15	238.26	171.09	400.00	200.00	277.20	420.10	252.04	2.226	
16	236.16	171.00	400.53	200.00	275.52	428.21	260.20	2.226	
17	235.63	171.00	400.00	200.00	274.25	432.45	264.29	2.228	
18	234.58	171.00	400.00	200.00	273.28	436.56	268.37	2.229	
19	237.21	171.00	400.00	200.00	275.33	428.40	260.20	2.231	
20	234.05	171.00	400.53	200.00	273.58	436.44	268.37	2.231	
21	233.53	171.00	400.00	200.00	272.31	440.67	272.45	2.231	
22	235.11	171.00	400.53	200.00	274.54	432.33	264.29	2.232	
23	238.79	171.26	400.00	200.00	278.32	416.05	247.96	2.232	
24	235.63	171.00	400.53	200.00	274.66	432.39	264.29	2.232	
25	233.00	171.00	400.53	200.00	272.61	440.55	272.45	2.233	
26	237.74	171.00	400.53	200.00	276.62	424.15	256.12	2.233	
27	236.68	171.00	400.53	200.00	275.63	428.27	260.20	2.234	
28	235.11	171.00	401.05	200.00	274.96	432.26	264.29	2.235	
29	235.11	171.00	400.00	200.00	273.39	436.62	268.37	2.235	
30	236.68	171.00	400.00	200.00	274.47	432.57	264.29	2.236	
31	238.26	171.09	400.53	200.00	277.61	420.04	252.04	2.236	
32	236.16	171.00	400.00	200.00	274.36	432.51	264.29	2.237	
33	234.05	171.00	400.00	200.00	272.42	440.73	272.45	2.237	
34	237.74	171.00	400.00	200.00	275.45	428.46	260.20	2.238	
35	239.32	171.44	400.00	200.00	279.44	411.99	243.88	2.238	
36	238.26	171.09	400.00	200.00	276.44	424.35	256.12	2.238	
37	233.53	171.00	400.53	200.00	272.73	440.61	272.45	2.238	
38	233.00	171.00	400.00	200.00	271.46	444.84	276.53	2.239	
39	238.79	171.26	400.53	200.00	278.73	415.98	247.96	2.239	
40	234.58	171.00	400.53	200.00	273.69	436.50	268.37	2.239	
41	236.16	171.00	400.53	200.00	274.77	432.45	264.29	2.240	
42	233.00	171.00	401.05	200.00	273.02	440.49	272.45	2.240	
43	237.21	171.00	400.53	200.00	275.75	428.33	260.20	2.240	
44	234.05	171.00	401.05	200.00	273.99	436.38	268.37	2.240	
45	235.63	171.00	400.00	200.00	273.50	436.68	268.37	2.241	
46	234.58	171.00	401.05	200.00	274.10	436.44	268.37	2.241	
47	236.68	171.00	401.05	200.00	276.05	428.21	260.20	2.241	
48	234.58	171.00	400.00	200.00	272.53	440.79	272.45	2.242	
49	235.63	171.00	401.05	200.00	275.07	432.33	264.29	2.243	
50	237.21	171.00	400.00	200.00	274.58	432.63	264.29	2.243	
51	233.53	171.00	400.00	200.00	271.58	444.90	276.53	2.244	
52	234.05	171.00	400.53	200.00	272.84	440.67	272.45	2.244	
53	235.63	171.00	400.53	200.00	273.91	436.62	268.37	2.245	
54	239.84	171.61	400.00	200.00	280.55	407.93	239.80	2.245	
55	235.11	171.00	400.53	200.00	273.80	436.56	268.37	2.245	
56	238.79	171.26	400.00	200.00	277.56	420.30	252.04	2.245	
57	239.32	171.44	400.53	200.00	279.84	411.92	243.88	2.246	
58	233.00	171.00	400.53	200.00	271.88	444.78	276.53	2.246	
59	238.26	171.09	400.53	200.00	276.86	424.29	256.12	2.246	
60	237.74	171.00	400.53	200.00	275.86	428.40	260.20	2.246	
61	236.68	171.00	400.53	200.00	274.88	432.51	264.29	2.247	
62	235.11	171.00	400.00	200.00	272.64	440.85	272.45	2.247	
63	237.21	171.00	401.05	200.00	276.16	428.27	260.20	2.248	
64	235.11	171.00	401.05	200.00	274.22	436.50	268.37	2.248	
65	233.53	171.00	401.05	200.00	273.14	440.55	272.45	2.249	
66	236.16	171.00	401.05	200.00	275.19	432.39	264.29	2.249	
67	236.68	171.00	400.00	200.00	275.98	424.09	256.12	2.249	
68	234.05	171.00	400.00	200.00	271.68	444.96	276.53	2.249	

69	233.00	171.00	401.58	200.00	273.43	440.43	272.45	2.249
70	236.16	171.00	400.00	200.00	273.61	436.74	268.37	2.249
71	234.58	171.00	400.53	200.00	272.95	440.73	272.45	2.250
72	235.63	171.00	401.58	200.00	275.48	432.26	264.29	2.250
73	233.53	171.00	401.58	200.00	273.55	440.49	272.45	2.250
74	237.74	171.00	400.00	200.00	274.69	432.69	264.29	2.250
75	233.00	171.00	400.00	200.00	270.73	449.06	280.61	2.251
76	238.26	171.09	400.00	200.00	275.68	428.59	260.20	2.251
77	234.58	171.00	401.58	200.00	274.51	436.38	268.37	2.251
78	233.53	171.00	400.53	200.00	271.99	444.84	276.53	2.251
79	236.16	171.00	400.53	200.00	274.03	436.68	268.37	2.252
80	240.37	171.79	400.00	200.00	281.67	403.86	235.71	2.252
81	239.84	171.61	400.53	200.00	280.96	407.86	239.80	2.253
82	235.63	171.00	400.00	200.00	272.75	440.91	272.45	2.253
83	239.32	171.44	400.00	200.00	278.68	416.25	247.96	2.253
84	237.21	171.00	400.53	200.00	275.00	432.57	264.29	2.253
85	233.00	171.00	401.05	200.00	272.29	444.72	276.53	2.253
86	238.79	171.26	400.53	200.00	277.97	420.24	252.04	2.253
87	234.58	171.00	401.05	200.00	273.36	440.67	272.45	2.254
88	234.58	171.00	400.00	200.00	271.79	445.02	276.53	2.254
89	237.74	171.00	401.05	200.00	276.27	428.33	260.20	2.254
90	234.05	171.00	401.05	200.00	273.25	440.61	272.45	2.254
91	236.68	171.00	401.05	200.00	275.30	432.45	264.29	2.255
92	237.21	171.00	400.00	200.00	273.83	436.86	268.37	2.255
93	236.68	171.00	400.00	200.00	273.72	436.80	268.37	2.255
94	238.26	171.09	401.05	200.00	277.27	424.22	256.12	2.255
95	237.21	171.00	401.58	200.00	276.57	428.21	260.20	2.256
96	235.63	171.00	401.05	200.00	274.33	436.56	268.37	2.256
97	233.53	171.00	400.00	200.00	270.84	449.12	280.61	2.256
98	236.16	171.00	401.58	200.00	275.60	432.33	264.29	2.256
99	234.05	171.00	400.53	200.00	272.10	444.90	276.53	2.257

Critical Failure Surface (circle 1)

Intersects: XL: 234.05 YL: 171.00 XR: 400.00 YR: 200.00
Centre: XC: 273.90 YC: 432.26 Radius: R: 264.29
Generated failure surface: (20 points)
234.05 171.00 242.99 169.79 251.97 168.89 260.98 168.29
270.00 168.01
279.02 168.03 288.04 168.36 297.04 168.99 306.01 169.94
314.95 171.18
323.84 172.74 332.67 174.59 341.43 176.75 350.11 179.20
358.71 181.95
367.20 184.99 375.59 188.32 383.86 191.94 392.00 195.83
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	234.05	1.05	-7.7	3.95	3.98	3	100.00	18.0	148.41	66.28	44.26	1.03
2	238.00	8.51	-7.7	4.99	5.04	3	100.00	18.0	1157.94	535.67	240.61	1.03
3	242.99	17.27	-5.7	4.49	4.51	3	100.00	18.0	2326.57	1083.00	527.06	1.02
4	247.48	26.01	-5.7	4.49	4.51	3	100.00	18.0	3492.05	1631.26	788.75	1.02
5	251.97	34.52	-3.8	4.50	4.51	3	100.00	18.0	4623.27	2158.48	1035.38	1.01
6	256.47	42.61	-3.8	4.50	4.51	3	100.00	18.0	5697.12	2664.72	1275.16	1.01
7	260.98	50.45	-1.8	4.51	4.51	3	100.00	18.0	6734.25	3149.71	1498.56	1.01
8	265.49	57.88	-1.8	4.51	4.51	3	100.00	18.0	7713.56	3613.34	1716.27	1.01
9	270.00	64.99	0.1	4.51	4.51	3	100.00	18.0	8648.49	4055.39	1916.46	1.00
10	274.51	71.73	0.1	4.51	4.51	3	100.00	18.0	9530.86	4475.91	2111.99	1.00
11	279.02	78.07	2.1	4.51	4.51	3	100.00	18.0	10357.00	4874.58	2288.97	1.00
12	283.53	84.10	2.1	4.51	4.51	3	100.00	18.0	11140.21	5251.43	2462.20	1.00
13	288.04	89.62	4.0	4.50	4.51	3	100.00	18.0	11852.02	5606.24	2616.02	0.99
14	292.54	94.94	4.0	4.50	4.51	3	100.00	18.0	12534.59	5939.02	2766.89	0.99
15	297.04	76.88	6.0	3.48	3.50	3	100.00	18.0	10134.67	4823.68	2883.19	0.99
16	300.52	79.65	6.0	3.48	3.50	3	100.00	18.0	10484.27	4997.22		

2982.84	0.99									
17	304.00	47.28	6.0	2.01	2.02	3	100.00	18.0	6216.89	2966.37
3061.45	0.99									
18	306.01	91.75	8.0	3.81	3.84	3	100.00	18.0	12049.89	5780.97
3125.81	0.99									
19	309.82	94.56	8.0	3.81	3.84	3	100.00	18.0	12397.09	5957.71
3216.11	0.99									
20	313.62	33.53	8.0	1.32	1.34	2	0.00	35.0	4391.81	2112.31
3245.34	0.97									
21	314.95	26.88	9.9	1.05	1.07	2	0.00	35.0	3521.00	1702.60
3254.80	0.96									
22	316.00	101.65	9.9	3.92	3.98	2	0.00	35.0	13316.02	6276.93
3302.87	0.96									
23	319.92	104.08	9.9	3.92	3.98	2	0.00	35.0	13634.97	6106.97
3377.76	0.96									
24	323.84	31.35	11.9	1.16	1.19	2	0.00	35.0	4106.41	1790.61
3403.52	0.96									
25	325.00	102.03	11.9	3.83	3.92	2	0.00	35.0	13365.85	5772.39
3360.79	0.96									
26	328.83	98.94	11.9	3.83	3.92	2	0.00	35.0	12961.12	5575.39
3258.70	0.96									
27	332.67	108.94	13.8	4.38	4.51	2	0.00	35.0	14271.36	6156.19
3120.60	0.96									
28	337.05	104.22	13.8	4.38	4.51	2	0.00	35.0	13652.61	5852.66
2984.72	0.96									
29	341.43	80.43	15.8	3.54	3.67	2	0.00	35.0	10536.28	4527.65
2836.58	0.95									
30	344.96	76.90	15.8	3.54	3.67	2	0.00	35.0	10073.61	4298.63
2711.32	0.95									
31	348.50	33.90	15.8	1.61	1.68	5	0.00	45.0	3728.85	1350.59
2141.73	0.92									
32	350.11	23.50	17.7	1.14	1.20	5	0.00	45.0	2584.51	283.15
2010.64	0.92									
33	351.25	73.93	17.7	3.73	3.91	2	0.00	35.0	9684.84	0.00
2359.22	0.95									
34	354.98	69.49	17.7	3.73	3.91	2	0.00	35.0	9102.77	0.00
2217.41	0.95									
35	358.71	73.43	19.7	4.25	4.51	2	0.00	35.0	9619.10	0.00
2033.80	0.95									
36	362.95	66.97	19.7	4.25	4.51	2	0.00	35.0	8773.03	0.00
1854.92	0.95									
37	367.20	59.43	21.7	4.19	4.51	2	0.00	35.0	7785.89	0.00
1649.24	0.96									
38	371.40	52.45	21.7	4.19	4.51	2	0.00	35.0	6871.48	0.00
1455.54	0.96									
39	375.59	44.54	23.6	4.13	4.51	2	0.00	35.0	5834.33	0.00
1239.59	0.96									
40	379.72	37.07	23.6	4.13	4.51	2	0.00	35.0	4855.82	0.00
1031.70	0.96									
41	383.86	16.74	25.6	2.22	2.46	2	0.00	35.0	2192.34	0.00
856.76	0.96									
42	386.08	18.62	25.6	2.96	3.28	1	150.00	22.0	2439.09	0.00
728.14	1.02									
43	389.04	14.43	25.6	2.96	3.28	1	150.00	22.0	1890.45	0.00
557.63	1.02									
44	392.00	12.51	27.5	4.00	4.51	1	150.00	22.0	1638.99	0.00
341.71	1.03									
45	396.00	4.17	27.5	4.00	4.51	1	150.00	22.0	546.32	0.00
92.37	1.03									
		---			---				---	
X-S Area:		2581.96	Path Length:		171.44		X-S Weight:		338617.97	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 8-4\West Farm Expansion Case 8-4 Full Reservoir.gmf
Processed: 03 Dec 2020 09:48:13

DATA: Analysis 1 - Case 8-4 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	182.00	348.50	182.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	164.00	348.50	164.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	161.00	348.50	161.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	182.00	450.00	182.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	164.00	450.00	164.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	161.00	450.00	161.00	

Slope Surface (4 points)

100.00	164.00	217.00	164.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	217.00	197.00	316.00	197.00	348.50	197.00
351.50	172.00						
450.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	217.00	YL:	164.00	XR:	380.00	YR: 200.00
Centre:	XC:	192.18	YC:	663.38	Radius:	R:	500.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 8-4 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.977

Analysis Summary

There were: 11023 successful analyses from a total of 20001 trial failure surfaces
8978 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 2.82

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	217.79	164.26	375.00	200.00	166.43	753.87	591.84	2.821	<-- Critical Surface
2	217.26	164.09	375.00	200.00	170.56	733.60	571.43	2.821	
3	217.26	164.09	375.00	200.00	171.47	729.58	567.35	2.821	
4	217.79	164.26	375.00	200.00	165.52	757.88	595.92	2.821	
5	217.26	164.09	375.00	200.00	172.39	725.56	563.27	2.821	
6	217.26	164.09	375.00	200.00	173.30	721.54	559.18	2.822	
7	217.79	164.26	375.00	200.00	164.60	761.90	600.00	2.822	
8	217.26	164.09	375.00	200.00	174.22	717.52	555.10	2.822	
9	217.26	164.09	375.00	200.00	175.13	713.50	551.02	2.823	
10	216.74	164.00	375.00	200.00	180.48	689.28	526.53	2.823	
11	217.26	164.09	375.00	200.00	176.05	709.47	546.94	2.823	
12	216.74	164.00	375.00	200.00	181.39	685.25	522.45	2.823	
13	217.26	164.09	375.00	200.00	176.97	705.45	542.86	2.823	
14	217.26	164.09	375.00	200.00	177.88	701.42	538.78	2.824	
15	216.74	164.00	375.00	200.00	182.31	681.22	518.37	2.824	
16	217.26	164.09	375.00	200.00	178.80	697.40	534.69	2.824	
17	216.74	164.00	375.00	200.00	183.23	677.19	514.29	2.825	
18	217.79	164.26	375.00	200.00	167.34	749.85	587.76	2.825	
19	217.26	164.09	375.00	200.00	179.72	693.37	530.61	2.825	
20	217.79	164.26	375.00	200.00	168.26	745.83	583.67	2.825	
21	216.74	164.00	375.00	200.00	184.14	673.16	510.20	2.825	
22	217.79	164.26	375.00	200.00	169.17	741.81	579.59	2.825	
23	217.26	164.09	375.00	200.00	180.63	689.34	526.53	2.825	
24	217.79	164.26	375.00	200.00	170.08	737.79	575.51	2.825	
25	217.79	164.26	375.00	200.00	171.00	733.77	571.43	2.826	
26	216.74	164.00	375.00	200.00	185.06	669.13	506.12	2.826	
27	217.26	164.09	375.00	200.00	181.55	685.31	522.45	2.826	
28	217.79	164.26	375.00	200.00	171.91	729.75	567.35	2.826	
29	218.32	164.44	375.00	200.00	169.61	741.98	579.59	2.826	
30	217.79	164.26	375.00	200.00	172.82	725.73	563.27	2.826	
31	217.26	164.09	375.00	200.00	182.47	681.29	518.37	2.827	
32	216.74	164.00	375.00	200.00	185.98	665.10	502.04	2.827	
33	217.79	164.26	375.00	200.00	173.74	721.71	559.18	2.827	
34	218.32	164.44	375.00	200.00	168.70	746.00	583.67	2.827	
35	217.79	164.26	375.00	200.00	174.65	717.69	555.10	2.827	
36	217.26	164.09	375.00	200.00	183.39	677.26	514.29	2.827	
37	216.74	164.00	375.00	200.00	186.90	661.06	497.96	2.827	
38	217.79	164.26	375.00	200.00	175.57	713.66	551.02	2.827	
39	218.32	164.44	375.00	200.00	167.79	750.02	587.76	2.827	
40	217.79	164.26	375.00	200.00	176.48	709.64	546.94	2.828	
41	217.26	164.09	375.00	200.00	184.30	673.23	510.20	2.828	
42	218.32	164.44	375.00	200.00	166.88	754.04	591.84	2.828	
43	216.74	164.00	375.00	200.00	187.81	657.03	493.88	2.828	
44	217.79	164.26	375.00	200.00	177.40	705.62	542.86	2.828	
45	217.26	164.09	375.00	200.00	185.22	669.19	506.12	2.829	
46	217.79	164.26	375.00	200.00	178.31	701.59	538.78	2.829	
47	218.32	164.44	375.00	200.00	165.97	758.05	595.92	2.829	
48	216.74	164.00	375.00	200.00	188.73	652.99	489.80	2.829	
49	217.79	164.26	375.00	200.00	179.23	697.56	534.69	2.829	
50	218.32	164.44	375.00	200.00	165.05	762.07	600.00	2.829	
51	217.26	164.09	375.00	200.00	186.14	665.16	502.04	2.829	
52	216.74	164.00	375.00	200.00	164.01	761.68	600.00	2.830	
53	217.79	164.26	375.00	200.00	180.14	693.54	530.61	2.830	
54	216.74	164.00	375.00	200.00	164.92	757.66	595.92	2.830	
55	216.74	164.00	375.00	200.00	165.84	753.64	591.84	2.830	
56	216.74	164.00	375.00	200.00	189.65	648.96	485.71	2.830	
57	216.74	164.00	375.00	200.00	166.75	749.63	587.76	2.830	
58	216.74	164.00	375.00	200.00	167.67	745.61	583.67	2.830	
59	217.26	164.09	375.00	200.00	187.06	661.13	497.96	2.830	
60	217.79	164.26	375.00	200.00	181.06	689.51	526.53	2.830	
61	216.74	164.00	375.00	200.00	168.58	741.59	579.59	2.830	
62	216.74	164.00	375.00	200.00	169.49	737.57	575.51	2.830	
63	218.32	164.44	375.00	200.00	170.53	737.96	575.51	2.830	
64	216.74	164.00	375.00	200.00	170.41	733.55	571.43	2.831	
65	218.32	164.44	375.00	200.00	171.44	733.94	571.43	2.831	
66	216.74	164.00	375.00	200.00	171.32	729.53	567.35	2.831	
67	217.79	164.26	375.00	200.00	181.97	685.48	522.45	2.831	

68	216.74	164.00	375.00	200.00	190.57	644.92	481.63	2.831
69	217.26	164.09	375.00	200.00	164.15	761.73	600.00	2.831
70	217.26	164.09	375.00	200.00	187.98	657.10	493.88	2.831
71	217.26	164.09	375.00	200.00	165.07	757.72	595.92	2.831
72	216.74	164.00	375.00	200.00	172.24	725.50	563.27	2.831
73	218.32	164.44	375.00	200.00	172.35	729.92	567.35	2.831
74	217.26	164.09	375.00	200.00	165.98	753.70	591.84	2.831
75	217.26	164.09	375.00	200.00	166.90	749.68	587.76	2.831
76	216.74	164.00	375.00	200.00	173.15	721.48	559.18	2.831
77	217.26	164.09	375.00	200.00	167.81	745.66	583.67	2.831
78	218.32	164.44	375.00	200.00	173.26	725.90	563.27	2.831
79	217.79	164.26	375.00	200.00	182.89	681.45	518.37	2.831
80	217.26	164.09	375.00	200.00	168.73	741.64	579.59	2.831
81	216.74	164.00	375.00	200.00	174.07	717.46	555.10	2.831
82	217.26	164.09	375.00	200.00	169.64	737.62	575.51	2.832
83	218.32	164.44	375.00	200.00	174.18	721.88	559.18	2.832
84	217.26	164.09	375.00	200.00	188.89	653.06	489.80	2.832
85	216.74	164.00	375.00	200.00	191.49	640.88	477.55	2.832
86	216.74	164.00	375.00	200.00	174.98	713.44	551.02	2.832
87	218.32	164.44	375.00	200.00	175.09	717.86	555.10	2.832
88	217.79	164.26	375.00	200.00	183.81	677.42	514.29	2.832
89	216.74	164.00	375.00	200.00	175.90	709.41	546.94	2.832
90	218.84	164.61	375.00	200.00	171.88	734.11	571.43	2.832
91	218.32	164.44	375.00	200.00	176.00	713.83	551.02	2.832
92	216.74	164.00	375.00	200.00	176.81	705.39	542.86	2.832
93	217.26	164.09	375.00	200.00	189.81	649.03	485.71	2.833
94	217.79	164.26	375.00	200.00	184.72	673.39	510.20	2.833
95	218.32	164.44	375.00	200.00	176.92	709.81	546.94	2.833
96	216.74	164.00	375.00	200.00	177.73	701.36	538.78	2.833
97	216.74	164.00	375.00	200.00	192.41	636.84	473.47	2.833
98	218.84	164.61	375.00	200.00	170.97	738.13	575.51	2.833
99	216.74	164.00	375.00	200.00	178.65	697.34	534.69	2.833

Critical Failure Surface (circle 1)

Intersects: XL: 217.79 YL: 164.26 XR: 375.00 YR: 200.00
Centre: XC: 166.43 YC: 753.87 Radius: R: 591.84

Generated failure surface: (20 points)

217.79 164.26 226.26 165.06 234.73 165.98 243.17 167.03
251.61 168.19
260.02 169.48 268.41 170.88 276.79 172.41 285.14 174.06
293.46 175.82
301.76 177.71 310.04 179.72 318.28 181.84 326.49 184.09
334.67 186.45
342.81 188.92 350.92 191.52 358.98 194.23 367.01 197.06
375.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	217.79	2.15	5.4	4.24	4.26	2	0.00	35.0	281.04	8641.17	2064.24	0.98
2	222.03	6.44	5.4	4.24	4.26	2	0.00	35.0	843.12	8534.99	2107.17	0.98
3	226.26	10.58	6.2	4.23	4.26	2	0.00	35.0	1385.58	8420.19	2145.49	0.98
4	230.49	14.59	6.2	4.23	4.26	2	0.00	35.0	1911.86	8297.84	2180.17	0.98
5	234.73	18.45	7.0	4.22	4.26	2	0.00	35.0	2416.59	8167.38	2209.81	0.98
6	238.95	22.19	7.0	4.22	4.26	2	0.00	35.0	2907.07	8028.92	2236.27	0.98
7	243.17	25.75	7.9	4.22	4.26	2	0.00	35.0	3373.80	7882.66	2257.30	0.98
8	247.39	29.22	7.9	4.22	4.26	2	0.00	35.0	3828.38	7728.01	2275.57	0.98
9	251.61	32.49	8.7	4.21	4.26	2	0.00	35.0	4256.38	7565.12	2288.04	0.97
10	255.81	35.69	8.7	4.21	4.26	2	0.00	35.0	4674.98	7394.39	2298.13	0.97
11	260.02	38.66	9.5	4.20	4.26	2	0.00	35.0	5064.39	7215.68	2302.10	0.97
12	264.22	41.58	9.5	4.20	4.26	2	0.00	35.0	5447.04	7028.94	2304.05	0.97
13	268.41	27.03	10.3	2.59	2.63	2	0.00	35.0	3540.30	4245.54	2300.75	0.97
14	271.00	31.43	10.3	2.89	2.94	2	0.00	35.0	4117.96	4658.51	2296.72	0.97
15	273.89	32.70	10.3	2.89	2.94	2	0.00	35.0	4283.52	4561.61	2292.47	0.97

16	276.79	49.28	11.2	4.18	4.26	2	0.00	35.0	6455.76	6420.73
2280.55	0.97									
17	280.96	51.65	11.2	4.18	4.26	2	0.00	35.0	6766.48	6201.96
2266.31	0.97									
18	285.14	53.73	12.0	4.16	4.26	2	0.00	35.0	7038.99	5975.28
2245.13	0.97									
19	289.30	55.83	12.0	4.16	4.26	2	0.00	35.0	7313.97	5740.67
2222.84	0.97									
20	293.46	57.62	12.8	4.15	4.26	2	0.00	35.0	7547.77	5498.27
2193.40	0.97									
21	297.61	59.44	12.8	4.15	4.26	2	0.00	35.0	7786.92	5247.69
2163.10	0.97									
22	301.76	60.93	13.6	4.14	4.26	2	0.00	35.0	7981.37	4989.09
2125.46	0.97									
23	305.90	62.48	13.6	4.14	4.26	2	0.00	35.0	8184.92	4722.74
2087.18	0.97									
24	310.04	45.94	14.5	2.98	3.08	2	0.00	35.0	6018.29	3246.91
2047.80	0.97									
25	313.02	46.61	14.5	2.98	3.08	2	0.00	35.0	6106.30	3099.22
2014.36	0.97									
26	316.00	36.07	14.5	2.28	2.35	2	0.00	35.0	4725.47	2268.73
2007.14	0.97									
27	318.28	53.83	15.3	3.36	3.48	1	150.00	22.0	7052.13	3195.39
2039.94	1.00									
28	321.64	54.51	15.3	3.36	3.48	1	150.00	22.0	7141.14	2995.81
2063.27	1.00									
29	325.00	24.01	15.3	1.49	1.54	1	150.00	22.0	3144.80	1263.84
2048.81	1.00									
30	326.49	62.66	16.1	4.09	4.26	1	150.00	22.0	8208.39	3272.94
1943.59	1.00									
31	330.58	57.83	16.1	4.09	4.26	1	150.00	22.0	7576.11	2959.46
1792.17	1.00									
32	334.67	52.66	16.9	4.07	4.26	1	150.00	22.0	6898.71	2638.21
1634.01	1.00									
33	338.74	47.62	16.9	4.07	4.26	1	150.00	22.0	6237.78	2309.14
1475.24	1.00									
34	342.81	30.21	17.8	2.85	2.99	1	150.00	22.0	3958.16	1420.46
1334.84	1.00									
35	345.65	27.62	17.8	2.85	2.99	1	150.00	22.0	3618.76	1250.70
1218.27	1.00									
36	348.50	6.60	17.8	0.72	0.76	5	0.00	45.0	726.53	148.07
922.67	0.94									
37	349.22	14.82	17.8	1.69	1.78	5	0.00	45.0	1630.74	0.00
864.57	0.94									
38	350.92	31.48	18.6	4.03	4.26	1	150.00	22.0	4123.52	0.00
958.17	1.01									
39	354.95	26.01	18.6	4.03	4.26	1	150.00	22.0	3407.10	0.00
788.74	1.01									
40	358.98	20.32	19.4	4.01	4.26	1	150.00	22.0	2662.19	0.00
613.52	1.01									
41	363.00	14.65	19.4	4.01	4.26	1	150.00	22.0	1918.86	0.00
437.24	1.01									
42	367.01	8.81	20.2	3.99	4.26	1	150.00	22.0	1154.35	0.00
255.97	1.01									
43	371.01	2.94	20.2	3.99	4.26	1	150.00	22.0	384.78	0.00
72.92	1.01									

X-S Area: 1485.13 Path Length: 161.72 X-S Weight: 194102.33

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 8-4\West Farm Expansion Case 8-4 Rapid Drawdown.gmf
Processed: 03 Dec 2020 09:47:09

DATA: Analysis 1 - Case 8-4 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	182.00	348.50	182.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	164.00	348.50	164.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	161.00	348.50	161.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	182.00	450.00	182.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	164.00	450.00	164.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	161.00	450.00	161.00	

Slope Surface (4 points)

100.00	164.00	217.00	164.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	164.00	217.00	164.00	316.00	197.00	348.50	197.00
351.50	172.00						
450.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	217.00	YL:	164.00	XR:	380.00	YR: 200.00
Centre:	XC:	192.18	YC:	663.38	Radius:	R:	500.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 8-4 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 1.682

Analysis Summary

There were: 11023 successful analyses from a total of 20001 trial failure surfaces
8978 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 1.59

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	216.74	164.00	375.00	200.00	180.48	689.28	526.53	1.592	<-- Critical Surface
2	216.74	164.00	375.00	200.00	181.39	685.25	522.45	1.592	
3	216.74	164.00	375.00	200.00	182.31	681.22	518.37	1.592	
4	216.74	164.00	375.00	200.00	183.23	677.19	514.29	1.593	
5	216.74	164.00	375.00	200.00	184.14	673.16	510.20	1.593	
6	216.74	164.00	375.00	200.00	185.06	669.13	506.12	1.593	
7	216.74	164.00	375.00	200.00	185.98	665.10	502.04	1.593	
8	216.74	164.00	375.00	200.00	186.90	661.06	497.96	1.593	
9	216.74	164.00	375.00	200.00	187.81	657.03	493.88	1.593	
10	216.74	164.00	375.00	200.00	188.73	652.99	489.80	1.593	
11	216.74	164.00	375.00	200.00	189.65	648.96	485.71	1.594	
12	216.74	164.00	375.00	200.00	190.57	644.92	481.63	1.594	
13	217.26	164.09	375.00	200.00	176.05	709.47	546.94	1.594	
14	217.26	164.09	375.00	200.00	175.13	713.50	551.02	1.594	
15	217.26	164.09	375.00	200.00	176.97	705.45	542.86	1.594	
16	217.26	164.09	375.00	200.00	174.22	717.52	555.10	1.594	
17	217.26	164.09	375.00	200.00	177.88	701.42	538.78	1.594	
18	217.26	164.09	375.00	200.00	173.30	721.54	559.18	1.594	
19	217.26	164.09	375.00	200.00	178.80	697.40	534.69	1.594	
20	217.26	164.09	375.00	200.00	172.39	725.56	563.27	1.594	
21	217.26	164.09	375.00	200.00	179.72	693.37	530.61	1.594	
22	217.26	164.09	375.00	200.00	171.47	729.58	567.35	1.594	
23	217.26	164.09	375.00	200.00	170.56	733.60	571.43	1.594	
24	217.26	164.09	375.00	200.00	180.63	689.34	526.53	1.594	
25	216.74	164.00	375.00	200.00	191.49	640.88	477.55	1.594	
26	217.26	164.09	375.00	200.00	181.55	685.31	522.45	1.594	
27	217.26	164.09	375.00	200.00	182.47	681.29	518.37	1.594	
28	217.26	164.09	375.00	200.00	183.39	677.26	514.29	1.594	
29	216.74	164.00	375.00	200.00	192.41	636.84	473.47	1.594	
30	217.26	164.09	375.00	200.00	184.30	673.23	510.20	1.595	
31	217.26	164.09	375.00	200.00	185.22	669.19	506.12	1.595	
32	216.74	164.00	375.00	200.00	193.32	632.80	469.39	1.595	
33	217.26	164.09	375.00	200.00	186.14	665.16	502.04	1.595	
34	217.26	164.09	375.00	200.00	187.06	661.13	497.96	1.595	
35	216.74	164.00	375.00	200.00	194.24	628.76	465.31	1.595	
36	216.74	164.00	375.00	200.00	199.77	604.49	440.82	1.595	
37	217.26	164.09	375.00	200.00	187.98	657.10	493.88	1.595	
38	217.26	164.09	375.00	200.00	188.89	653.06	489.80	1.595	
39	216.74	164.00	375.00	200.00	195.16	624.72	461.22	1.595	
40	217.26	164.09	375.00	200.00	189.81	649.03	485.71	1.596	
41	216.74	164.00	375.00	200.00	198.84	608.54	444.90	1.596	
42	216.74	164.00	375.00	200.00	196.08	620.68	457.14	1.596	
43	217.26	164.09	375.00	200.00	190.73	644.99	481.63	1.596	
44	217.26	164.09	375.00	200.00	191.65	640.95	477.55	1.596	
45	216.74	164.00	375.00	200.00	197.00	616.63	453.06	1.596	
46	216.74	164.00	375.00	200.00	197.92	612.59	448.98	1.596	
47	217.26	164.09	375.00	200.00	192.57	636.91	473.47	1.596	
48	217.79	164.26	375.00	200.00	166.43	753.87	591.84	1.597	
49	217.26	164.09	375.00	200.00	193.49	632.87	469.39	1.597	
50	217.26	164.09	375.00	200.00	194.41	628.83	465.31	1.597	
51	217.79	164.26	375.00	200.00	165.52	757.88	595.92	1.597	
52	216.74	164.00	375.00	200.00	179.56	693.31	530.61	1.597	
53	216.74	164.00	375.00	200.00	178.65	697.34	534.69	1.597	
54	216.74	164.00	375.00	200.00	177.73	701.36	538.78	1.597	
55	216.74	164.00	375.00	200.00	176.81	705.39	542.86	1.597	
56	217.26	164.09	375.00	200.00	195.33	624.79	461.22	1.597	
57	216.74	164.00	375.00	200.00	175.90	709.41	546.94	1.597	
58	216.74	164.00	375.00	200.00	174.98	713.44	551.02	1.597	
59	217.26	164.09	375.00	200.00	199.94	604.56	440.82	1.597	
60	216.74	164.00	375.00	200.00	174.07	717.46	555.10	1.597	
61	216.74	164.00	375.00	200.00	173.15	721.48	559.18	1.598	
62	216.74	164.00	375.00	200.00	172.24	725.50	563.27	1.598	
63	217.79	164.26	375.00	200.00	164.60	761.90	600.00	1.598	
64	217.26	164.09	375.00	200.00	196.25	620.75	457.14	1.598	
65	216.74	164.00	375.00	200.00	171.32	729.53	567.35	1.598	
66	216.74	164.00	375.00	200.00	170.41	733.55	571.43	1.598	
67	216.74	164.00	375.00	200.00	200.69	600.44	436.73	1.598	

68	217.79	164.26	375.00	200.00	176.48	709.64	546.94	1.598
69	217.79	164.26	375.00	200.00	177.40	705.62	542.86	1.598
70	217.79	164.26	375.00	200.00	175.57	713.66	551.02	1.598
71	216.74	164.00	375.00	200.00	169.49	737.57	575.51	1.598
72	217.79	164.26	375.00	200.00	178.31	701.59	538.78	1.598
73	217.79	164.26	375.00	200.00	174.65	717.69	555.10	1.598
74	217.79	164.26	375.00	200.00	179.23	697.56	534.69	1.598
75	217.26	164.09	375.00	200.00	199.01	608.61	444.90	1.598
76	217.79	164.26	375.00	200.00	173.74	721.71	559.18	1.598
77	217.79	164.26	375.00	200.00	180.14	693.54	530.61	1.598
78	217.79	164.26	375.00	200.00	172.82	725.73	563.27	1.598
79	217.79	164.26	375.00	200.00	181.06	689.51	526.53	1.598
80	216.74	164.00	375.00	200.00	168.58	741.59	579.59	1.598
81	217.79	164.26	375.00	200.00	171.91	729.75	567.35	1.598
82	217.26	164.09	375.00	200.00	197.17	616.70	453.06	1.598
83	217.79	164.26	375.00	200.00	181.97	685.48	522.45	1.598
84	217.79	164.26	375.00	200.00	171.00	733.77	571.43	1.598
85	216.74	164.00	375.00	200.00	167.67	745.61	583.67	1.598
86	217.79	164.26	375.00	200.00	182.89	681.45	518.37	1.598
87	217.79	164.26	375.00	200.00	170.08	737.79	575.51	1.598
88	217.79	164.26	375.00	200.00	169.17	741.81	579.59	1.598
89	217.79	164.26	375.00	200.00	183.81	677.42	514.29	1.598
90	216.74	164.00	375.00	200.00	166.75	749.63	587.76	1.598
91	217.79	164.26	375.00	200.00	168.26	745.83	583.67	1.598
92	216.74	164.00	375.00	200.00	201.61	596.39	432.65	1.598
93	217.79	164.26	375.00	200.00	184.72	673.39	510.20	1.598
94	216.74	164.00	375.00	200.00	165.84	753.64	591.84	1.599
95	217.79	164.26	375.00	200.00	167.34	749.85	587.76	1.599
96	217.26	164.09	375.00	200.00	198.09	612.66	448.98	1.599
97	217.79	164.26	375.00	200.00	185.64	669.36	506.12	1.599
98	216.74	164.00	375.00	200.00	164.92	757.66	595.92	1.599
99	217.79	164.26	375.00	200.00	186.55	665.33	502.04	1.599

Critical Failure Surface (circle 1)

Intersects: XL: 216.74 YL: 164.00 XR: 375.00 YR: 200.00
Centre: XC: 180.48 YC: 689.28 Radius: R: 526.53
Generated failure surface: (20 points)

216.74	164.00	225.29	164.66	233.83	165.46	242.35	166.40	250.86	167.48
259.35	168.69	267.82	170.04	276.27	171.54	284.69	173.17	293.08	174.93
301.44	176.83	309.77	178.87	318.07	181.05	326.33	183.35	334.55	185.80
342.73	188.37	350.87	191.08	358.96	193.92	367.00	196.90	375.00	200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 42 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	216.74	1.97	4.4	4.28	4.29	2	0.00	35.0	257.56	123.05	59.20	0.97
2	221.01	6.65	4.4	4.28	4.29	2	0.00	35.0	870.93	416.09	200.19	0.97
3	225.29	11.16	5.3	4.27	4.29	2	0.00	35.0	1462.18	699.54	335.37	0.96
4	229.56	15.53	5.3	4.27	4.29	2	0.00	35.0	2034.63	973.40	466.66	0.96
5	233.83	19.71	6.3	4.26	4.29	2	0.00	35.0	2582.62	1237.63	591.25	0.96
6	238.09	23.77	6.3	4.26	4.29	2	0.00	35.0	3113.98	1492.26	712.89	0.96
7	242.35	27.62	7.2	4.25	4.29	2	0.00	35.0	3618.22	1737.25	827.01	0.95
8	246.61	31.36	7.2	4.25	4.29	2	0.00	35.0	4108.37	1972.58	939.04	0.95
9	250.86	34.87	8.1	4.24	4.29	2	0.00	35.0	4568.30	2198.24	1042.80	0.95
10	255.11	38.30	8.1	4.24	4.29	2	0.00	35.0	5017.17	2414.23	1145.26	0.95
11	259.35	41.47	9.1	4.23	4.29	2	0.00	35.0	5432.59	2620.59	1238.79	0.95
12	263.59	44.58	9.1	4.23	4.29	2	0.00	35.0	5840.12	2817.17	1331.72	0.95
13	267.82	35.44	10.0	3.18	3.23	2	0.00	35.0	4642.42	2245.57	1404.82	0.94
14	271.00	62.17	10.0	5.27	5.35	2	0.00	35.0	8144.18	3939.40	1488.25	0.94
15	276.27	52.68	10.9	4.21	4.29	2	0.00	35.0	6901.48	3348.37	1571.95	0.94

16	280.48	55.16	10.9	4.21	4.29	2	0.00	35.0	7226.37	3505.99
1645.94	0.94									
17	284.69	57.30	11.9	4.20	4.29	2	0.00	35.0	7506.26	3653.79
1709.45	0.94									
18	288.88	59.46	11.9	4.20	4.29	2	0.00	35.0	7789.90	3791.85
1774.03	0.94									
19	293.08	61.26	12.8	4.18	4.29	2	0.00	35.0	8024.91	3920.20
1827.75	0.93									
20	297.26	63.11	12.8	4.18	4.29	2	0.00	35.0	8267.46	4038.68
1882.98	0.93									
21	301.44	64.56	13.7	4.17	4.29	2	0.00	35.0	8457.01	4147.20
1927.03	0.93									
22	305.61	66.10	13.7	4.17	4.29	2	0.00	35.0	8658.47	4246.00
1972.95	0.93									
23	309.77	50.33	14.7	3.11	3.22	2	0.00	35.0	6593.07	3246.52
2002.88	0.93									
24	312.89	51.02	14.7	3.11	3.22	2	0.00	35.0	6683.66	3291.13
2030.40	0.93									
25	316.00	34.28	14.7	2.07	2.14	2	0.00	35.0	4491.20	2165.51
2051.08	0.93									
26	318.07	57.17	15.6	3.42	3.55	2	0.00	35.0	7489.06	3425.39
2058.20	0.92									
27	321.48	59.49	15.6	3.52	3.65	1	150.00	22.0	7792.85	3304.44
2105.47	0.97									
28	325.00	22.37	15.6	1.33	1.38	1	150.00	22.0	2930.16	1190.93
2091.53	0.97									
29	326.33	65.92	16.5	4.11	4.29	1	150.00	22.0	8635.15	3488.18
1984.37	0.97									
30	330.44	60.90	16.5	4.11	4.29	1	150.00	22.0	7977.42	3161.35
1830.24	0.97									
31	334.55	55.46	17.5	4.09	4.29	1	150.00	22.0	7265.24	2825.51
1666.11	0.97									
32	338.64	50.19	17.5	4.09	4.29	1	150.00	22.0	6574.97	2480.79
1503.90	0.97									
33	342.73	32.15	18.4	2.88	3.04	1	150.00	22.0	4212.29	1545.60
1357.16	0.97									
34	345.62	29.38	18.4	2.88	3.04	1	150.00	22.0	3849.35	1363.39
1236.48	0.97									
35	348.50	7.41	18.4	0.77	0.82	5	0.00	45.0	815.24	170.65
907.50	0.87									
36	349.27	14.64	18.4	1.59	1.68	5	0.00	45.0	1610.26	0.00
835.46	0.87									
37	350.87	33.21	19.3	4.05	4.29	1	150.00	22.0	4350.21	0.00
956.85	0.97									
38	354.91	27.46	19.3	4.05	4.29	1	150.00	22.0	3597.19	0.00
785.96	0.97									
39	358.96	21.45	20.3	4.02	4.29	1	150.00	22.0	2810.26	0.00
606.92	0.97									
40	362.98	15.47	20.3	4.02	4.29	1	150.00	22.0	2026.97	0.00
428.89	0.97									
41	367.00	9.30	21.2	4.00	4.29	1	150.00	22.0	1218.89	0.00
244.28	0.98									
42	371.00	3.10	21.2	4.00	4.29	1	150.00	22.0	406.30	0.00
59.24	0.98									

X-S Area: 1574.95 Path Length: 162.95 X-S Weight: 205854.88

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 3-1\West Farm Expansion Case 3-1 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 12:24:23

DATA: Analysis 1 - Case 3-1 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	184.00	348.50	184.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	140.00	348.50	140.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	137.00	348.50	137.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	184.00	450.00	184.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	140.00	450.00	140.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	137.00	450.00	137.00	

Slope Surface (8 points)

100.00	140.00	145.00	140.00	325.00	200.00	410.00	200.00
415.00	195.00						
420.00	195.00	425.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	197.00	145.00	197.00	316.00	197.00	348.50	197.00
351.50	175.00						
450.00	175.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	145.00	YL:	140.00	XR:	415.00	YR:	195.00
Centre:	XC:	238.36	YC:	371.91		Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 3-1 Full Reservoir - Pseudostatic

Spencer-Wright Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 3.551 Final Angle of Interslice Forces (Theta): 9.4 degrees

Analysis Summary

There were: 19802 successful analyses from a total of 20001 trial failure surfaces (Theta filter applied)
151 analyses that failed to produce a valid result
48 analyses rejected due to Theta being outside valid range

Critical (minimum) Factor of Safety: 2.57 Final Angle of Interslice Forces: 11.0 degrees

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	Theta
1	150.00	141.67	410.00	200.00	209.15	486.63	350.00	2.573	11.0
<-- Critical Surface									
2	149.47	141.49	410.00	200.00	208.84	486.42	350.00	2.651	11.0
3	150.00	141.67	410.53	199.47	210.17	486.46	350.00	2.652	10.9
4	150.00	141.67	410.00	200.00	210.11	482.32	345.92	2.656	11.0
5	148.95	141.32	410.00	200.00	208.54	486.21	350.00	2.730	10.9
6	150.00	141.67	411.05	198.95	211.20	486.28	350.00	2.730	10.9
7	149.47	141.49	410.53	199.47	209.87	486.24	350.00	2.732	10.9
8	149.47	141.49	410.00	200.00	209.81	482.11	345.92	2.734	11.0
9	150.00	141.67	410.53	199.47	211.13	482.14	345.92	2.737	10.9
10	150.00	141.67	410.00	200.00	211.08	478.00	341.84	2.742	11.0
11	149.47	141.49	410.53	199.47	210.83	481.93	345.92	2.793	10.9
12	150.00	141.67	411.58	198.42	212.22	486.09	350.00	2.796	10.7
13	148.95	141.32	410.00	200.00	209.51	481.89	345.92	2.798	10.9
14	149.47	141.49	411.05	198.95	210.89	486.06	350.00	2.798	10.8
15	148.95	141.32	410.53	199.47	209.56	486.03	350.00	2.802	10.9
16	149.47	141.49	410.00	200.00	210.78	477.79	341.84	2.805	10.9
17	150.00	141.67	410.53	199.47	212.09	477.82	341.84	2.805	10.9
18	150.00	141.67	411.05	198.95	212.14	481.96	345.92	2.805	10.8
19	148.42	141.14	410.00	200.00	208.24	485.99	350.00	2.807	10.9
20	150.00	141.67	410.00	200.00	212.06	473.67	337.76	2.810	10.9
21	148.42	141.14	410.53	199.47	209.26	485.81	350.00	2.857	10.8
22	148.95	141.32	410.00	200.00	210.48	477.57	341.84	2.858	10.9
23	148.95	141.32	410.53	199.47	210.52	481.71	345.92	2.859	10.9
24	148.42	141.14	410.00	200.00	209.21	481.68	345.92	2.859	10.9
25	150.00	141.67	410.53	199.47	213.05	473.48	337.76	2.859	10.9
26	150.00	141.67	411.58	198.42	213.15	481.77	345.92	2.859	10.7
27	150.00	141.67	411.05	198.95	213.09	477.63	341.84	2.860	10.8
28	148.95	141.32	411.05	198.95	210.58	485.85	350.00	2.860	10.8
29	150.00	141.67	412.11	197.89	213.24	485.91	350.00	2.861	10.7
30	149.47	141.49	410.53	199.47	211.79	477.60	341.84	2.862	10.9
31	149.47	141.49	411.05	198.95	211.84	481.74	345.92	2.862	10.8
32	149.47	141.49	411.58	198.42	211.91	485.88	350.00	2.863	10.7
33	149.47	141.49	410.00	200.00	211.75	473.45	337.76	2.863	10.9
34	147.89	140.96	410.00	200.00	207.93	485.78	350.00	2.863	10.9
35	150.00	141.67	410.00	200.00	213.03	469.33	333.67	2.866	10.9
36	148.42	141.14	410.53	199.47	210.22	481.49	345.92	2.907	10.8
37	148.42	141.14	410.00	200.00	210.18	477.35	341.84	2.910	10.8
38	148.95	141.32	410.53	199.47	211.48	477.38	341.84	2.911	10.8
39	148.95	141.32	410.00	200.00	211.45	473.24	337.76	2.911	10.9
40	149.47	141.49	410.53	199.47	212.75	473.27	337.76	2.911	10.9
41	148.95	141.32	411.05	198.95	211.53	481.53	345.92	2.912	10.8
42	149.47	141.49	411.05	198.95	212.79	477.41	341.84	2.912	10.8
43	149.47	141.49	411.58	198.42	212.85	481.56	345.92	2.913	10.7
44	147.89	140.96	410.53	199.47	208.95	485.60	350.00	2.913	10.8
45	148.95	141.32	411.58	198.42	211.60	485.66	350.00	2.914	10.7
46	150.00	141.67	411.58	198.42	214.09	477.44	341.84	2.914	10.7
47	149.47	141.49	412.11	197.89	212.92	485.69	350.00	2.914	10.6
48	150.00	141.67	410.53	199.47	214.01	469.14	333.67	2.914	10.9
49	148.42	141.14	411.05	198.95	210.27	485.63	350.00	2.914	10.7
50	150.00	141.67	411.05	198.95	214.04	473.29	337.76	2.914	10.8
51	147.37	140.79	410.00	200.00	207.63	485.56	350.00	2.915	10.8
52	150.00	141.67	412.11	197.89	214.16	481.58	345.92	2.915	10.7
53	149.47	141.49	410.00	200.00	212.73	469.11	333.67	2.918	10.9
54	150.00	141.67	412.63	197.37	214.25	485.72	350.00	2.919	10.6
55	150.00	141.67	410.00	200.00	214.00	464.98	329.59	2.922	10.9
56	147.89	140.96	410.00	200.00	208.90	481.46	345.92	2.924	10.8
57	147.37	140.79	410.00	200.00	208.60	481.24	345.92	2.956	10.8

58	146.84	140.61	410.00	200.00	207.33	485.35	350.00	2.956	10.8
59	147.37	140.79	410.53	199.47	208.65	485.38	350.00	2.956	10.8
60	147.89	140.96	410.53	199.47	209.91	481.28	345.92	2.957	10.8
61	147.89	140.96	410.00	200.00	209.88	477.14	341.84	2.957	10.8
62	148.42	141.14	410.00	200.00	211.15	473.02	337.76	2.961	10.8
63	148.95	141.32	410.53	199.47	212.45	473.05	337.76	2.962	10.8
64	148.95	141.32	411.05	198.95	212.48	477.20	341.84	2.964	10.8
65	148.95	141.32	411.58	198.42	212.54	481.34	345.92	2.965	10.7
66	149.47	141.49	410.53	199.47	213.71	468.92	333.67	2.965	10.9
67	149.47	141.49	411.58	198.42	213.79	477.22	341.84	2.965	10.7
68	149.47	141.49	411.05	198.95	213.74	473.08	337.76	2.966	10.8
69	148.95	141.32	412.11	197.89	212.61	485.48	350.00	2.966	10.6
70	148.42	141.14	411.58	198.42	211.29	485.45	350.00	2.966	10.6
71	148.42	141.14	410.53	199.47	211.18	477.17	341.84	2.967	10.8
72	149.47	141.49	412.11	197.89	213.85	481.37	345.92	2.967	10.6
73	147.89	140.96	411.05	198.95	209.97	485.42	350.00	2.968	10.7
74	150.00	141.67	411.58	198.42	215.04	473.10	337.76	2.968	10.7
75	150.00	141.67	410.53	199.47	214.98	464.79	329.59	2.969	10.9
76	150.00	141.67	411.05	198.95	215.00	468.95	333.67	2.969	10.8
77	150.00	141.67	412.11	197.89	215.09	477.25	341.84	2.970	10.7
78	148.95	141.32	410.00	200.00	212.43	468.89	333.67	2.970	10.8
79	149.47	141.49	412.63	197.37	213.94	485.50	350.00	2.971	10.6
80	149.47	141.49	410.00	200.00	213.71	464.76	329.59	2.972	10.9
81	150.00	141.67	412.63	197.37	215.17	481.39	345.92	2.973	10.6
82	148.42	141.14	411.05	198.95	211.23	481.31	345.92	2.976	10.7
83	150.00	141.67	410.00	200.00	214.98	460.62	325.51	2.978	10.9
84	150.00	141.67	413.16	196.84	215.27	485.53	350.00	2.978	10.5
85	146.84	140.61	410.00	200.00	208.30	481.03	345.92	2.996	10.8
86	146.84	140.61	410.53	199.47	208.34	485.17	350.00	2.996	10.7
87	147.37	140.79	410.53	199.47	209.61	481.06	345.92	2.996	10.8
88	146.32	140.44	410.00	200.00	207.02	485.13	350.00	2.997	10.7
89	147.37	140.79	410.00	200.00	209.58	476.92	341.84	2.997	10.8
90	147.89	140.96	410.53	199.47	210.88	476.95	341.84	2.998	10.8
91	147.89	140.96	410.00	200.00	210.86	472.80	337.76	3.000	10.8
92	148.42	141.14	410.00	200.00	212.13	468.67	333.67	3.005	10.9
93	147.37	140.79	411.05	198.95	209.66	485.20	350.00	3.007	10.7
94	148.42	141.14	410.53	199.47	212.15	472.83	337.76	3.007	10.8
95	147.89	140.96	411.05	198.95	210.92	481.09	345.92	3.009	10.7
96	150.00	141.67	411.58	198.42	215.98	468.75	333.67	3.011	10.7
97	149.47	141.49	410.53	199.47	214.68	464.57	329.59	3.011	10.8
98	148.42	141.14	411.05	198.95	212.18	476.98	341.84	3.012	10.7
99	148.95	141.32	410.53	199.47	213.41	468.70	333.67	3.012	10.8

Critical Failure Surface (circle 1)

Intersects: XL: 150.00 YL: 141.67 XR: 410.00 YR: 200.00
Centre: XC: 209.15 YC: 486.63 Radius: R: 350.00
Generated failure surface: (20 points)
150.00 141.67 164.23 139.53 178.53 137.97 192.88 137.01
207.26 136.64
221.65 136.86 236.01 137.67 250.33 139.06 264.58 141.05
278.73 143.62
292.77 146.77 306.67 150.49 320.40 154.78 333.94 159.64
347.27 165.04
360.37 170.99 373.22 177.47 385.78 184.47 398.05 191.99
410.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base						PoreWater	
--- Left Hand Side ----									
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force
Side Force	l/h	l'/h								
1	150.00	7.43	-8.6	5.54	5.60	2	0.00	35.0	973.02	19495.48
0.00	0.00	0.00								
2	155.54	22.28	-8.6	5.54	5.60	2	0.00	35.0	2919.06	19786.90
204.57	0.36	0.33								
3	161.08	19.24	-8.6	3.14	3.18	3	100.00	18.0	2527.80	11351.65
818.28	0.27	0.33								
4	164.23	60.51	-6.2	7.15	7.19	3	100.00	18.0	7988.23	25970.75
1244.55	0.27	0.33								
5	171.38	83.11	-6.2	7.15	7.19	3	100.00	18.0	11004.08	26319.23
2262.26	0.27	0.33								
6	178.53	105.06	-3.8	7.18	7.19	3	100.00	18.0	13925.87	26601.95
3553.12	0.26	0.33								
7	185.71	125.69	-3.8	7.18	7.19	3	100.00	18.0	16662.71	26818.19
4755.58	0.26	0.33								
8	192.88	145.55	-1.5	7.19	7.19	4	2000.00	20.0	19289.14	26968.17
6135.79	0.26	0.33								
9	200.07	164.13	-1.5	7.19	7.19	4	2000.00	20.0	21736.16	27051.94
13001.71	0.16	0.33								
10	207.26	181.68	0.9	7.19	7.19	4	2000.00	20.0	24038.50	27068.96
19987.30	0.15	0.33								

11	214.46	198.14	0.9	7.19	7.19	4	2000.00	20.0	26186.69	27020.03	26432.88	0.15	0.33
12	221.65	74.22	3.2	2.56	2.56	4	2000.00	20.0	9801.83	9593.58	32931.83	0.15	0.33
13	224.20	178.42	3.2	5.90	5.91	3	100.00	18.0	23540.01	22078.80	35005.60	0.15	0.33
14	230.11	188.07	3.2	5.90	5.91	3	100.00	18.0	24785.29	21956.06	35110.90	0.17	0.33
15	236.01	239.94	5.6	7.16	7.19	3	100.00	18.0	31574.48	26475.69	35208.32	0.18	0.33
16	243.17	252.02	5.6	7.16	7.19	3	100.00	18.0	33106.47	26161.74	34614.92	0.20	0.33
17	250.33	246.42	7.9	6.71	6.78	3	100.00	18.0	32312.57	24312.66	33978.16	0.21	0.33
18	257.05	286.87	7.9	7.53	7.61	2	0.00	35.0	37580.42	26805.45	32643.81	0.22	0.33
19	264.58	243.95	10.3	6.21	6.31	2	0.00	35.0	31957.90	21814.91	33625.69	0.22	0.33
20	270.79	249.81	10.3	6.21	6.31	2	0.00	35.0	32724.78	21370.80	33732.73	0.21	0.33
21	277.00	70.78	10.3	1.73	1.76	2	0.00	35.0	9272.79	5886.85	33842.34	0.21	0.33
22	278.73	290.16	12.6	7.02	7.19	2	0.00	35.0	38010.50	23606.50	33873.38	0.21	0.33
23	285.75	295.52	12.6	7.02	7.19	2	0.00	35.0	38713.56	22899.59	33155.11	0.20	0.33
24	292.77	296.78	15.0	6.95	7.19	2	0.00	35.0	38878.67	22128.33	32423.53	0.20	0.33
25	299.72	299.94	15.0	6.95	7.19	2	0.00	35.0	39292.07	21292.65	30840.86	0.19	0.33
26	306.67	202.73	17.4	4.67	4.89	2	0.00	35.0	26557.53	13965.53	29241.36	0.19	0.33
27	311.33	203.18	17.4	4.67	4.89	2	0.00	35.0	26616.86	13520.61	27590.45	0.19	0.33
28	316.00	191.93	17.4	4.40	4.61	2	0.00	35.0	25142.83	12336.92	25935.85	0.19	0.33
29	320.40	200.74	19.7	4.60	4.89	2	0.00	35.0	26296.94	12624.72	24365.31	0.19	0.33
30	325.00	191.20	19.7	4.47	4.75	2	0.00	35.0	25047.47	11784.59	22123.06	0.19	0.33
31	329.47	184.04	19.7	4.47	4.75	2	0.00	35.0	24109.33	11309.89	19969.49	0.20	0.33
32	333.94	260.07	22.1	6.67	7.19	2	0.00	35.0	34068.55	16164.19	17894.15	0.21	0.33
33	340.61	242.05	22.1	6.67	7.19	2	0.00	35.0	31708.66	14951.24	14190.63	0.24	0.33
34	347.27	42.51	24.4	1.23	1.35	2	0.00	35.0	5568.55	2661.15	10733.32	0.29	0.33
35	348.50	101.16	24.4	3.00	3.29	5	0.00	45.0	11127.93	4054.54	9999.47	0.31	0.33
36	351.50	142.12	24.4	4.44	4.87	2	0.00	35.0	18617.37	2138.27	10054.64	0.30	0.33
37	355.94	133.18	24.4	4.44	4.87	2	0.00	35.0	17446.50	1525.74	9348.77	0.30	0.33
38	360.37	214.64	26.8	7.95	8.90	2	0.00	35.0	28117.44	1114.02	8789.49	0.31	0.33
39	368.32	116.35	26.8	4.90	5.48	2	0.00	35.0	15241.26	0.00	7596.43	0.30	0.33
40	373.22	122.41	29.1	5.86	6.71	2	0.00	35.0	16036.07	0.00	7053.95	0.29	0.29
41	379.07	103.29	29.1	5.86	6.71	2	0.00	35.0	13530.70	0.00	6084.43	0.28	0.28
42	384.93	92.08	31.2	6.56	7.67	1	150.00	22.0	12062.60	0.00	5173.56	0.25	0.25
43	391.49	65.73	31.5	6.56	7.69	1	150.00	22.0	8610.42	0.00	3066.93	0.25	0.25
44	398.05	35.90	33.8	5.97	7.19	1	150.00	22.0	4702.75	0.00	1465.29	0.27	0.27
45	404.03	11.97	33.8	5.97	7.19	1	150.00	22.0	1567.59	0.00	369.14	0.36	0.36
RHS	410.00	--------			-------				----------		54.10	0.00	0.00

X-S Area: 7183.01 Path Length: 273.34 X-S Weight: 940979.94

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 3-1\West Farm Expansion Case 3-1 Rapid Drawdown-EQ.gmf
Processed: 04 Dec 2020 12:23:46

DATA: Analysis 1 - Case 3-1 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	184.00	348.50	184.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	140.00	348.50	140.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	137.00	348.50	137.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	184.00	450.00	184.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	140.00	450.00	140.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	137.00	450.00	137.00	

Slope Surface (8 points)

100.00	140.00	145.00	140.00	325.00	200.00	410.00	200.00
415.00	195.00						
420.00	195.00	425.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	140.00	145.00	140.00	316.00	197.00	348.50	197.00
351.50	175.00						
450.00	175.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	145.00	YL:	140.00	XR:	415.00	YR:	195.00
Centre:	XC:	238.36	YC:	371.91		Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 3-1 Rapid Drawdown - Pseudostatic

Spencer-Wright Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.175 Final Angle of Interslice Forces (Theta): 9.8 degrees

Analysis Summary

There were: 18292 successful analyses from a total of 20001 trial failure surfaces (Theta filter applied)
78 analyses that failed to produce a valid result
1631 analyses rejected due to Theta being outside valid range

Critical (minimum) Factor of Safety: 1.54 Final Angle of Interslice Forces: 10.6 degrees

Negative interslice forces exist on one or more slices; examine slice data and consult the GALENA Help utility

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	Theta
1	150.00	141.67	410.00	200.00	209.15	486.63	350.00	1.543	10.6
<-- Critical Surface									
2	149.47	141.49	410.00	200.00	208.84	486.42	350.00	1.592	10.7
3	150.00	141.67	410.53	199.47	210.17	486.46	350.00	1.594	10.6
4	150.00	141.67	410.00	200.00	210.11	482.32	345.92	1.595	10.7
5	148.95	141.32	410.00	200.00	208.54	486.21	350.00	1.642	10.7
6	149.47	141.49	410.53	199.47	209.87	486.24	350.00	1.644	10.6
7	150.00	141.67	411.05	198.95	211.20	486.28	350.00	1.645	10.6
8	149.47	141.49	410.00	200.00	209.81	482.11	345.92	1.645	10.7
9	150.00	141.67	410.53	199.47	211.13	482.14	345.92	1.648	10.6
10	150.00	141.67	410.00	200.00	211.08	478.00	341.84	1.651	10.7
11	149.47	141.49	410.53	199.47	210.83	481.93	345.92	1.684	10.6
12	148.95	141.32	410.00	200.00	209.51	481.89	345.92	1.686	10.7
13	150.00	141.67	411.58	198.42	212.22	486.09	350.00	1.687	10.5
14	149.47	141.49	411.05	198.95	210.89	486.06	350.00	1.688	10.6
15	148.95	141.32	410.53	199.47	209.56	486.03	350.00	1.690	10.6
16	149.47	141.49	410.00	200.00	210.78	477.79	341.84	1.690	10.7
17	148.42	141.14	410.00	200.00	208.24	485.99	350.00	1.691	10.7
18	150.00	141.67	410.53	199.47	212.09	477.82	341.84	1.691	10.7
19	150.00	141.67	410.00	200.00	212.06	473.67	337.76	1.692	10.7
20	150.00	141.67	411.05	198.95	212.14	481.96	345.92	1.693	10.6
21	148.95	141.32	410.00	200.00	210.48	477.57	341.84	1.724	10.6
22	148.42	141.14	410.00	200.00	209.21	481.68	345.92	1.724	10.6
23	148.95	141.32	410.53	199.47	210.52	481.71	345.92	1.725	10.6
24	148.42	141.14	410.53	199.47	209.26	485.81	350.00	1.725	10.6
25	148.95	141.32	411.05	198.95	210.58	485.85	350.00	1.726	10.5
26	150.00	141.67	410.53	199.47	213.05	473.48	337.76	1.727	10.6
27	147.89	140.96	410.00	200.00	207.93	485.78	350.00	1.727	10.6
28	149.47	141.49	410.53	199.47	211.79	477.60	341.84	1.727	10.6
29	150.00	141.67	411.05	198.95	213.09	477.63	341.84	1.728	10.6
30	149.47	141.49	410.00	200.00	211.75	473.45	337.76	1.728	10.7
31	150.00	141.67	411.58	198.42	213.15	481.77	345.92	1.728	10.5
32	149.47	141.49	411.05	198.95	211.84	481.74	345.92	1.728	10.6
33	150.00	141.67	410.00	200.00	213.03	469.33	333.67	1.728	10.7
34	149.47	141.49	411.58	198.42	211.91	485.88	350.00	1.730	10.5
35	150.00	141.67	412.11	197.89	213.24	485.91	350.00	1.730	10.5
36	148.42	141.14	410.00	200.00	210.18	477.35	341.84	1.757	10.6
37	148.42	141.14	410.53	199.47	210.22	481.49	345.92	1.757	10.6
38	148.95	141.32	410.00	200.00	211.45	473.24	337.76	1.757	10.6
39	148.95	141.32	410.53	199.47	211.48	477.38	341.84	1.758	10.6
40	149.47	141.49	410.53	199.47	212.75	473.27	337.76	1.759	10.6
41	147.37	140.79	410.00	200.00	207.63	485.56	350.00	1.759	10.6
42	148.95	141.32	411.05	198.95	211.53	481.53	345.92	1.760	10.5
43	147.89	140.96	410.53	199.47	208.95	485.60	350.00	1.761	10.5
44	148.42	141.14	411.05	198.95	210.27	485.63	350.00	1.761	10.5
45	149.47	141.49	411.05	198.95	212.79	477.41	341.84	1.761	10.6
46	149.47	141.49	410.00	200.00	212.73	469.11	333.67	1.761	10.7
47	148.95	141.32	411.58	198.42	211.60	485.66	350.00	1.762	10.5
48	149.47	141.49	411.58	198.42	212.85	481.56	345.92	1.762	10.5
49	150.00	141.67	410.53	199.47	214.01	469.14	333.67	1.762	10.7
50	150.00	141.67	411.05	198.95	214.04	473.29	337.76	1.763	10.6
51	150.00	141.67	411.58	198.42	214.09	477.44	341.84	1.763	10.5
52	149.47	141.49	412.11	197.89	212.92	485.69	350.00	1.764	10.4
53	150.00	141.67	410.00	200.00	214.00	464.98	329.59	1.764	10.7
54	150.00	141.67	412.11	197.89	214.16	481.58	345.92	1.765	10.5
55	147.89	140.96	410.00	200.00	208.90	481.46	345.92	1.766	10.6

56	150.00	141.67	412.63	197.37	214.25	485.72	350.00	1.768	10.4
57	146.84	140.61	410.00	200.00	207.33	485.35	350.00	1.785	10.5
58	147.37	140.79	410.00	200.00	208.60	481.24	345.92	1.785	10.6
59	147.89	140.96	410.00	200.00	209.88	477.14	341.84	1.787	10.6
60	147.37	140.79	410.53	199.47	208.65	485.38	350.00	1.788	10.5
61	147.89	140.96	410.53	199.47	209.91	481.28	345.92	1.788	10.5
62	148.42	141.14	410.00	200.00	211.15	473.02	337.76	1.789	10.6
63	148.95	141.32	410.53	199.47	212.45	473.05	337.76	1.791	10.6
64	148.95	141.32	411.05	198.95	212.48	477.20	341.84	1.793	10.5
65	148.42	141.14	410.53	199.47	211.18	477.17	341.84	1.793	10.6
66	149.47	141.49	410.53	199.47	213.71	468.92	333.67	1.794	10.6
67	147.89	140.96	411.05	198.95	209.97	485.42	350.00	1.794	10.5
68	148.95	141.32	411.58	198.42	212.54	481.34	345.92	1.794	10.5
69	149.47	141.49	411.05	198.95	213.74	473.08	337.76	1.795	10.6
70	148.42	141.14	411.58	198.42	211.29	485.45	350.00	1.795	10.4
71	149.47	141.49	411.58	198.42	213.79	477.22	341.84	1.795	10.5
72	148.95	141.32	410.00	200.00	212.43	468.89	333.67	1.796	10.6
73	149.47	141.49	410.00	200.00	213.71	464.76	329.59	1.796	10.7
74	148.95	141.32	412.11	197.89	212.61	485.48	350.00	1.796	10.4
75	149.47	141.49	412.11	197.89	213.85	481.37	345.92	1.797	10.4
76	150.00	141.67	410.53	199.47	214.98	464.79	329.59	1.797	10.7
77	150.00	141.67	411.05	198.95	215.00	468.95	333.67	1.798	10.6
78	150.00	141.67	411.58	198.42	215.04	473.10	337.76	1.798	10.5
79	150.00	141.67	412.11	197.89	215.09	477.25	341.84	1.799	10.5
80	148.42	141.14	411.05	198.95	211.23	481.31	345.92	1.800	10.5
81	150.00	141.67	410.00	200.00	214.98	460.62	325.51	1.800	10.7
82	149.47	141.49	412.63	197.37	213.94	485.50	350.00	1.800	10.4
83	150.00	141.67	412.63	197.37	215.17	481.39	345.92	1.802	10.4
84	150.00	141.67	413.16	196.84	215.27	485.53	350.00	1.805	10.3
85	146.32	140.44	410.00	200.00	207.02	485.13	350.00	1.811	10.5
86	146.84	140.61	410.00	200.00	208.30	481.03	345.92	1.811	10.6
87	147.37	140.79	410.00	200.00	209.58	476.92	341.84	1.812	10.6
88	146.84	140.61	410.53	199.47	208.34	485.17	350.00	1.813	10.5
89	147.37	140.79	410.53	199.47	209.61	481.06	345.92	1.813	10.5
90	147.89	140.96	410.00	200.00	210.86	472.80	337.76	1.814	10.6
91	147.89	140.96	410.53	199.47	210.88	476.95	341.84	1.815	10.6
92	148.42	141.14	410.00	200.00	212.13	468.67	333.67	1.817	10.6
93	147.37	140.79	411.05	198.95	209.66	485.20	350.00	1.819	10.5
94	148.42	141.14	410.53	199.47	212.15	472.83	337.76	1.819	10.6
95	147.89	140.96	411.05	198.95	210.92	481.09	345.92	1.820	10.5
96	148.95	141.32	410.00	200.00	213.41	464.54	329.59	1.822	10.7
97	148.42	141.14	411.05	198.95	212.18	476.98	341.84	1.823	10.5
98	148.95	141.32	410.53	199.47	213.41	468.70	333.67	1.823	10.6
99	149.47	141.49	410.53	199.47	214.68	464.57	329.59	1.823	10.6

Critical Failure Surface (circle 1)

Intersects: XL: 150.00 YL: 141.67 XR: 410.00 YR: 200.00
Centre: XC: 209.15 YC: 486.63 Radius: R: 350.00
Generated failure surface: (20 points)

150.00 141.67 164.23 139.53 178.53 137.97 192.88 137.01
207.26 136.64
221.65 136.86 236.01 137.67 250.33 139.06 264.58 141.05
278.73 143.62
292.77 146.77 306.67 150.49 320.40 154.78 333.94 159.64
347.27 165.04
360.37 170.99 373.22 177.47 385.78 184.47 398.05 191.99
410.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base							PoreWater
--- Left Hand Side ----									
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force
Side Force	l/h	l'/h								
1	150.00	7.43	-8.6	5.54	5.60	2	0.00	35.0	973.02	468.70
0.00	0.00	0.00								
2	155.54	22.28	-8.6	5.54	5.60	2	0.00	35.0	2919.06	1406.08
391.49	0.35	0.33								
3	161.08	19.24	-8.6	3.14	3.18	3	100.00	18.0	2527.80	1214.04
1565.95	0.26	0.33								
4	164.23	60.51	-6.2	7.15	7.19	3	100.00	18.0	7988.23	3797.95
2363.15	0.26	0.33								
5	171.38	83.11	-6.2	7.15	7.19	3	100.00	18.0	11004.08	5216.34
4324.21	0.26	0.33								
6	178.53	105.06	-3.8	7.18	7.19	3	100.00	18.0	13925.87	6570.67
6842.04	0.26	0.33								
7	185.71	125.69	-3.8	7.18	7.19	3	100.00	18.0	16662.71	7860.75
9301.11	0.25	0.33								
8	192.88	145.55	-1.5	7.19	7.19	4	2000.00	20.0	19289.14	9085.58
12152.99	0.25	0.33								
9	200.07	164.13	-1.5	7.19	7.19	4	2000.00	20.0	21736.16	10245.19
24413.04	0.16	0.33								

10	207.26	181.68	0.9	7.19	7.19	4	2000.00	20.0	24038.50	11338.39	36956.39
0.15	0.33										
11	214.46	198.14	0.9	7.19	7.19	4	2000.00	20.0	26186.69	12365.50	48574.43
0.15	0.33										
12	221.65	74.22	3.2	2.56	2.56	4	2000.00	20.0	9801.83	4638.92	60341.30
0.15	0.33										
13	224.20	178.42	3.2	5.90	5.91	3	100.00	18.0	23540.01	11150.91	64097.20
0.15	0.33										
14	230.11	188.07	3.2	5.90	5.91	3	100.00	18.0	24785.29	11754.39	64882.75
0.16	0.33										
15	236.01	239.94	5.6	7.16	7.19	3	100.00	18.0	31574.48	15043.65	65673.45
0.18	0.33										
16	243.17	252.02	5.6	7.16	7.19	3	100.00	18.0	33106.47	15800.83	65328.38
0.19	0.33										
17	250.33	246.42	7.9	6.71	6.78	3	100.00	18.0	32312.57	15525.32	64897.78
0.20	0.33										
18	257.05	286.87	7.9	7.53	7.61	2	0.00	35.0	37580.42	18073.96	63071.73
0.20	0.33										
19	264.58	243.95	10.3	6.21	6.31	2	0.00	35.0	31957.90	15471.55	65039.00
0.20	0.33										
20	270.79	249.81	10.3	6.21	6.31	2	0.00	35.0	32724.78	15842.81	65157.39
0.20	0.33										
21	277.00	70.78	10.3	1.73	1.76	2	0.00	35.0	9272.79	4489.17	65274.56
0.19	0.33										
22	278.73	290.16	12.6	7.02	7.19	2	0.00	35.0	38010.50	18555.86	65307.71
0.19	0.33										
23	285.75	295.52	12.6	7.02	7.19	2	0.00	35.0	38713.56	18899.09	63709.23
0.19	0.33										
24	292.77	296.78	15.0	6.95	7.19	2	0.00	35.0	38878.67	19172.66	62081.14
0.18	0.33										
25	299.72	299.94	15.0	6.95	7.19	2	0.00	35.0	39292.07	19376.53	58701.39
0.18	0.33										
26	306.67	202.73	17.4	4.67	4.89	2	0.00	35.0	26557.53	13253.74	55285.69
0.17	0.33										
27	311.33	203.18	17.4	4.67	4.89	2	0.00	35.0	26616.86	13283.34	51800.06
0.17	0.33										
28	316.00	191.93	17.4	4.40	4.61	2	0.00	35.0	25142.83	12336.92	48306.64
0.17	0.33										
29	320.40	200.74	19.7	4.60	4.89	2	0.00	35.0	26296.94	12624.72	45098.18
0.17	0.33										
30	325.00	191.20	19.7	4.47	4.75	2	0.00	35.0	25047.47	11784.59	40782.65
0.16	0.33										
31	329.47	184.04	19.7	4.47	4.75	2	0.00	35.0	24109.33	11309.89	36775.10
0.17	0.33										
32	333.94	260.07	22.1	6.67	7.19	2	0.00	35.0	34068.55	16164.19	32932.00
0.18	0.33										
33	340.61	242.05	22.1	6.67	7.19	2	0.00	35.0	31708.66	14951.24	26041.92
0.20	0.33										
34	347.27	42.51	24.4	1.23	1.35	2	0.00	35.0	5568.55	2661.15	19668.69
0.23	0.33										
35	348.50	101.16	24.4	3.00	3.29	5	0.00	45.0	11127.93	4054.54	18311.07
0.25	0.33										
36	351.50	142.12	24.4	4.44	4.87	2	0.00	35.0	18617.37	2138.27	17235.56
0.25	0.33										
37	355.94	133.18	24.4	4.44	4.87	2	0.00	35.0	17446.50	1525.74	15540.07
0.25	0.33										
38	360.37	214.64	26.8	7.95	8.90	2	0.00	35.0	28117.44	1114.02	14152.33
0.25	0.33										
39	368.32	116.35	26.8	4.90	5.48	2	0.00	35.0	15241.26	0.00	11326.37
0.25	0.33										
40	373.22	122.41	29.1	5.86	6.71	2	0.00	35.0	16036.07	0.00	10046.83
0.24	0.24										
41	379.07	103.29	29.1	5.86	6.71	2	0.00	35.0	13530.70	0.00	8047.74
0.23	0.23										
42	384.93	92.08	31.2	6.56	7.67	1	150.00	22.0	12062.60	0.00	6360.95
0.20	0.20										
43	391.49	65.73	31.5	6.56	7.69	1	150.00	22.0	8610.42	0.00	3152.67
0.19	0.19										
44	398.05	35.90	33.8	5.97	7.19	1	150.00	22.0	4702.75	0.00	1028.52
0.17	0.17										
45	404.03	11.97	33.8	5.97	7.19	1	150.00	22.0	1567.59	0.00	-36.49
0.36	0.36										
RHS	410.00	--------			-------				----------		
64.72	0.00	0.00									

X-S Area: 7183.01 Path Length: 273.34 X-S Weight: 940979.94

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 3-2\West Farm Expansion Case 3-2 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 12:32:00

DATA: Analysis 1 - Case 3-2 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden
Cohesion Phi UnitWeight Ru
150.00 22.0 131.00 Auto
Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel
Cohesion Phi UnitWeight Ru
0.00 35.0 131.00 Auto
Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock
Cohesion Phi UnitWeight Ru
100.00 18.0 141.00 Auto
Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock
Cohesion Phi UnitWeight Ru
2000.00 20.0 141.00 Auto
Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall
Cohesion Phi UnitWeight Ru
0.00 45.0 110.00 Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points) Material beneath: 1 - Overburden
100.00 200.00 348.50 200.00
Profile: 2 (2 points) Material beneath: 2 - Sand and Gravel
100.00 178.00 348.50 178.00
Profile: 3 (2 points) Material beneath: 3 - Weathered Bedrock
100.00 135.00 348.50 135.00
Profile: 4 (2 points) Material beneath: 4 - Stable Bedrock
100.00 132.00 348.50 132.00
Profile: 5 (2 points) Material beneath: 5 - Slurry Wall
348.50 200.00 351.50 200.00
Profile: 6 (2 points) Material beneath: 1 - Overburden
351.50 200.00 450.00 200.00
Profile: 7 (2 points) Material beneath: 2 - Sand and Gravel
351.50 178.00 450.00 178.00
Profile: 8 (2 points) Material beneath: 3 - Weathered Bedrock
351.50 135.00 450.00 135.00
Profile: 9 (2 points) Material beneath: 4 - Stable Bedrock
348.50 132.00 450.00 132.00

Slope Surface (4 points)

100.00 135.00 130.00 135.00 325.00 200.00 450.00 200.00

Phreatic Surface (6 points)

100.00 197.00 130.00 197.00 316.00 197.00 348.50 197.00
351.50 174.00
450.00 174.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R
Intersects: XL: 130.00 YL: 135.00 XR: 405.00 YR: 200.00
Centre: XC: 220.06 YC: 368.22 Radius: R: 250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor: XL XR R
Range of variation: 10.00 10.00 200.00
Trial positions within range: 20 20 50

- -

RESULTS: Analysis 1 - Case 3-2 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 3.362

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.14

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	135.00	136.67	400.00	200.00	192.56	481.90	350.00	2.137	<-- Critical Surface
2	135.00	136.67	400.53	200.00	192.99	481.83	350.00	2.228	
3	135.00	136.67	401.05	200.00	193.42	481.76	350.00	2.312	
4	134.47	136.49	400.00	200.00	192.27	481.69	350.00	2.374	
5	135.00	136.67	400.00	200.00	193.59	477.59	345.92	2.390	
6	135.00	136.67	401.58	200.00	193.84	481.68	350.00	2.398	
7	134.47	136.49	400.53	200.00	192.70	481.61	350.00	2.409	
8	135.00	136.67	400.53	200.00	194.02	477.51	345.92	2.423	
9	135.00	136.67	402.11	200.00	194.27	481.61	350.00	2.433	
10	134.47	136.49	401.05	200.00	193.12	481.54	350.00	2.443	
11	135.00	136.67	401.05	200.00	194.44	477.44	345.92	2.449	
12	135.00	136.67	402.63	200.00	194.70	481.54	350.00	2.463	
13	133.95	136.32	400.00	200.00	191.98	481.47	350.00	2.464	
14	134.47	136.49	400.00	200.00	193.30	477.37	345.92	2.468	
15	134.47	136.49	401.58	200.00	193.55	481.47	350.00	2.474	
16	135.00	136.67	400.00	200.00	194.62	473.26	341.84	2.475	
17	135.00	136.67	401.58	200.00	194.87	477.36	345.92	2.481	
18	135.00	136.67	403.16	200.00	195.12	481.46	350.00	2.492	
19	133.95	136.32	400.53	200.00	192.41	481.40	350.00	2.493	
20	134.47	136.49	400.53	200.00	193.73	477.30	345.92	2.497	
21	135.00	136.67	400.53	200.00	195.05	473.19	341.84	2.499	
22	134.47	136.49	402.11	200.00	193.98	481.40	350.00	2.507	
23	135.00	136.67	402.11	200.00	195.30	477.29	345.92	2.513	
24	133.95	136.32	401.05	200.00	192.83	481.33	350.00	2.516	
25	134.47	136.49	401.05	200.00	194.15	477.22	345.92	2.522	
26	135.00	136.67	403.68	200.00	195.55	481.39	350.00	2.522	
27	135.00	136.67	401.05	200.00	195.47	473.11	341.84	2.531	
28	134.47	136.49	402.63	200.00	194.41	481.32	350.00	2.536	
29	133.42	136.14	400.00	200.00	191.69	481.26	350.00	2.538	
30	133.95	136.32	400.00	200.00	193.01	477.15	345.92	2.542	
31	135.00	136.67	402.63	200.00	195.72	477.21	345.92	2.543	
32	133.95	136.32	401.58	200.00	193.26	481.25	350.00	2.547	
33	134.47	136.49	400.00	200.00	194.33	473.05	341.84	2.548	
34	135.00	136.67	404.21	200.00	195.97	481.31	350.00	2.552	
35	134.47	136.49	401.58	200.00	194.58	477.15	345.92	2.554	
36	135.00	136.67	400.00	200.00	195.66	468.93	337.76	2.558	
37	135.00	136.67	401.58	200.00	195.90	473.03	341.84	2.563	
38	134.47	136.49	403.16	200.00	194.83	481.25	350.00	2.565	
39	133.42	136.14	400.53	200.00	192.11	481.18	350.00	2.567	
40	133.95	136.32	400.53	200.00	193.44	477.08	345.92	2.570	
41	135.00	136.67	403.16	200.00	196.15	477.14	345.92	2.572	
42	134.47	136.49	400.53	200.00	194.76	472.97	341.84	2.577	
43	133.95	136.32	402.11	200.00	193.69	481.18	350.00	2.579	
44	135.00	136.67	404.74	200.00	196.40	481.24	350.00	2.581	
45	135.00	136.67	400.53	200.00	196.08	468.85	337.76	2.582	
46	134.47	136.49	402.11	200.00	195.01	477.07	345.92	2.585	
47	133.42	136.14	401.05	200.00	192.54	481.11	350.00	2.589	
48	133.95	136.32	401.05	200.00	193.86	477.01	345.92	2.594	
49	134.47	136.49	403.68	200.00	195.26	481.17	350.00	2.594	
50	135.00	136.67	402.11	200.00	196.32	472.96	341.84	2.595	
51	135.00	136.67	403.68	200.00	196.57	477.06	345.92	2.602	
52	134.47	136.49	401.05	200.00	195.18	472.89	341.84	2.602	
53	133.95	136.32	402.63	200.00	194.11	481.11	350.00	2.608	
54	135.00	136.67	405.26	200.00	196.82	481.16	350.00	2.611	
55	132.89	135.96	400.00	200.00	191.40	481.04	350.00	2.611	
56	133.42	136.14	400.00	200.00	192.72	476.94	345.92	2.614	
57	135.00	136.67	401.05	200.00	196.51	468.77	337.76	2.614	
58	134.47	136.49	402.63	200.00	195.43	477.00	345.92	2.615	
59	133.42	136.14	401.58	200.00	192.97	481.04	350.00	2.619	
60	133.95	136.32	400.00	200.00	194.05	472.83	341.84	2.620	
61	134.47	136.49	404.21	200.00	195.68	481.10	350.00	2.623	
62	135.00	136.67	402.63	200.00	196.75	472.88	341.84	2.624	
63	133.95	136.32	401.58	200.00	194.29	476.93	345.92	2.625	
64	134.47	136.49	400.00	200.00	195.37	468.71	337.76	2.629	

65	135.00	136.67	404.21	200.00	196.99	476.98	345.92	2.632
66	134.47	136.49	401.58	200.00	195.61	472.82	341.84	2.634
67	135.00	136.67	400.00	200.00	196.70	464.59	333.67	2.636
68	133.95	136.32	403.16	200.00	194.54	481.03	350.00	2.636
69	132.89	135.96	400.53	200.00	191.82	480.97	350.00	2.639
70	135.00	136.67	405.79	200.00	197.25	481.09	350.00	2.640
71	133.42	136.14	400.53	200.00	193.15	476.86	345.92	2.642
72	134.47	136.49	403.16	200.00	195.85	476.92	345.92	2.644
73	135.00	136.67	401.58	200.00	196.93	468.70	337.76	2.647
74	134.47	136.49	400.53	200.00	195.80	468.63	337.76	2.648
75	133.95	136.32	400.53	200.00	194.47	472.75	341.84	2.649
76	133.42	136.14	402.11	200.00	193.40	480.96	350.00	2.650
77	134.47	136.49	404.74	200.00	196.11	481.02	350.00	2.652
78	135.00	136.67	403.16	200.00	197.17	472.80	341.84	2.654
79	135.00	136.67	400.53	200.00	197.12	464.51	333.67	2.655
80	133.95	136.32	402.11	200.00	194.71	476.85	345.92	2.656
81	135.00	136.67	402.11	200.00	197.35	468.62	337.76	2.657
82	135.00	136.67	404.74	200.00	197.42	476.91	345.92	2.662
83	133.42	136.14	401.05	200.00	193.57	476.79	345.92	2.664
84	133.95	136.32	403.68	200.00	194.96	480.96	350.00	2.665
85	134.47	136.49	402.11	200.00	196.03	472.74	341.84	2.665
86	132.89	135.96	401.05	200.00	192.25	480.90	350.00	2.667
87	133.95	136.32	401.05	200.00	194.90	472.68	341.84	2.669
88	135.00	136.67	406.32	200.00	197.67	481.01	350.00	2.670
89	135.00	136.67	403.68	200.00	197.59	472.72	341.84	2.671
90	134.47	136.49	403.68	200.00	196.28	476.84	345.92	2.673
91	134.47	136.49	401.05	200.00	196.22	468.55	337.76	2.673
92	134.47	136.49	402.63	200.00	196.46	472.66	341.84	2.676
93	135.00	136.67	401.05	200.00	197.54	464.43	333.67	2.678
94	133.42	136.14	402.63	200.00	193.82	480.89	350.00	2.679
95	134.47	136.49	405.26	200.00	196.53	480.95	350.00	2.681
96	133.42	136.14	400.00	200.00	193.76	472.61	341.84	2.681
97	135.00	136.67	405.26	200.00	197.84	476.83	345.92	2.684
98	133.95	136.32	402.63	200.00	195.14	476.78	345.92	2.685
99	132.89	135.96	400.00	200.00	192.43	476.72	345.92	2.685

Critical Failure Surface (circle 1)

Intersects: XL: 135.00 YL: 136.67 XR: 400.00 YR: 200.00
Centre: XC: 192.56 YC: 481.90 Radius: R: 350.00

Generated failure surface: (20 points)

135.00 136.67 149.58 134.55 164.23 133.05 178.93 132.17
193.66 131.90
208.38 132.26 223.08 133.23 237.72 134.83 252.28 137.03
266.74 139.85
281.06 143.28 295.23 147.30 309.22 151.91 322.99 157.11
336.54 162.89
349.84 169.23 362.85 176.12 375.57 183.56 387.96 191.52
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 46 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	135.00	7.88	-8.3	5.74	5.80	2	0.00	35.0	1032.78	21988.64	3889.72	1.06
2	140.74	23.65	-8.3	5.74	5.80	2	0.00	35.0	3098.32	22290.28	4139.56	1.06
3	146.48	19.29	-8.3	3.10	3.13	3	100.00	18.0	2534.55	12143.42	4329.37	1.03
4	149.58	62.79	-5.8	7.33	7.36	3	100.00	18.0	8285.52	28869.15	4530.75	1.02
5	156.90	86.17	-5.8	7.33	7.36	3	100.00	18.0	11404.15	29214.04	4807.66	1.02
6	164.23	108.83	-3.4	7.35	7.36	3	100.00	18.0	14416.55	29488.14	5054.00	1.01
7	171.58	130.09	-3.4	7.35	7.36	3	100.00	18.0	17233.82	29691.11	5286.22	1.01
8	178.93	92.92	-1.0	4.66	4.66	3	100.00	18.0	12306.16	18847.86	5450.89	1.00
9	183.58	100.53	-1.0	4.66	4.66	3	100.00	18.0	13307.16	18872.08	5569.41	1.00
10	188.24	126.54	-1.0	5.42	5.42	4	2000.00	20.0	16741.32	21986.35	5714.12	1.00
11	193.66	100.06	1.4	4.01	4.01	4	2000.00	20.0	13230.05	16292.34	5770.43	1.00
12	197.67	141.30	1.4	5.36	5.36	3	100.00	18.0	18668.02	21707.42	5883.38	1.00
13	203.02	150.17	1.4	5.36	5.36	3	100.00	18.0	19822.74	21664.12	5987.18	1.00
14	208.38	219.32	3.8	7.35	7.36	3	100.00	18.0	28914.99	29637.84		

6073.42	0.99									
15	215.73	233.74	3.8	7.35	7.36	3	100.00	18.0	30767.44	29413.73
6171.40	0.99									
16	223.08	246.08	6.2	7.32	7.36	3	100.00	18.0	32336.82	29119.15
6230.93	0.99									
17	230.40	258.12	6.2	7.32	7.36	3	100.00	18.0	33855.18	28753.18
6284.36	0.99									
18	237.72	41.37	8.6	1.14	1.16	3	100.00	18.0	5420.76	4480.43
6294.36	0.99									
19	238.86	247.55	8.6	6.71	6.79	2	0.00	35.0	32429.22	26038.18
6248.43	0.96									
20	245.57	255.73	8.6	6.71	6.79	2	0.00	35.0	33501.08	25607.57
6264.67	0.96									
21	252.28	263.39	11.0	6.72	6.85	2	0.00	35.0	34504.15	25341.48
6228.12	0.96									
22	259.00	310.91	11.0	7.74	7.88	2	0.00	35.0	40728.71	28475.59
6204.71	0.96									
23	266.74	294.12	13.4	7.16	7.36	2	0.00	35.0	38529.83	25867.44
6125.11	0.95									
24	273.90	298.96	13.4	7.16	7.36	2	0.00	35.0	39163.99	25080.95
6061.28	0.95									
25	281.06	299.33	15.9	7.08	7.36	2	0.00	35.0	39211.62	24225.67
5941.49	0.95									
26	288.14	301.80	15.9	7.08	7.36	2	0.00	35.0	39536.35	23301.37
5837.92	0.95									
27	295.23	299.23	18.3	6.99	7.36	2	0.00	35.0	39199.63	22308.78
5678.28	0.95									
28	302.22	299.40	18.3	6.99	7.36	2	0.00	35.0	39221.07	21248.34
5535.71	0.95									
29	309.22	289.54	20.7	6.78	7.25	2	0.00	35.0	37930.29	19822.94
5338.81	0.95									
30	316.00	296.38	20.7	6.99	7.48	2	0.00	35.0	38826.37	19223.55
5222.79	0.95									
31	322.99	84.46	23.1	2.01	2.18	2	0.00	35.0	11064.48	5366.65
5143.75	0.95									
32	325.00	235.50	23.1	5.77	6.27	2	0.00	35.0	30850.04	14799.71
4978.97	0.95									
33	330.77	221.30	23.1	5.77	6.27	2	0.00	35.0	28989.81	13836.47
4677.36	0.95									
34	336.54	213.33	25.5	5.98	6.62	2	0.00	35.0	27946.20	13508.32
4318.59	0.96									
35	342.52	196.29	25.5	5.98	6.62	2	0.00	35.0	25713.38	12330.00
3971.53	0.96									
36	348.50	41.58	25.5	1.34	1.48	5	0.00	45.0	4574.30	2123.32
3057.29	0.91									
37	349.84	50.42	27.9	1.66	1.88	5	0.00	45.0	5546.33	1256.36
2806.30	0.91									
38	351.50	205.22	27.9	7.34	8.31	2	0.00	35.0	26884.19	1008.56
3137.36	0.96									
39	358.84	99.98	27.9	4.01	4.54	2	0.00	35.0	13097.46	0.00
2783.79	0.96									
40	362.85	73.60	30.3	3.21	3.72	2	0.00	35.0	9641.88	0.00
2521.71	0.97									
41	366.06	97.95	30.3	4.75	5.51	1	150.00	22.0	12831.62	0.00
2394.19	1.04									
42	370.81	84.74	30.3	4.75	5.51	1	150.00	22.0	11101.17	0.00
2066.35	1.04									
43	375.57	89.52	32.7	6.19	7.36	1	150.00	22.0	11726.94	0.00
1647.67	1.06									
44	381.76	64.85	32.7	6.19	7.36	1	150.00	22.0	8495.58	0.00
1182.57	1.06									
45	387.96	38.29	35.1	6.02	7.36	1	150.00	22.0	5015.73	0.00
691.50	1.08									
46	393.98	12.76	35.1	6.02	7.36	1	150.00	22.0	1671.90	0.00
201.43	1.08									
		---		---					---	
X-S Area:		7415.01	Path Length:		279.84		X-S Weight:		971309.69	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 3-2\West Farm Expansion Case 3-2 Rapid Drawdown-EQ.gmf
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DATA: Analysis 1 - Case 3-2 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	178.00	348.50	178.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	135.00	348.50	135.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	132.00	348.50	132.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	178.00	450.00	178.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	135.00	450.00	135.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	132.00	450.00	132.00	

Slope Surface (4 points)

100.00	135.00	130.00	135.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	135.00	130.00	135.00	316.00	197.00	348.50	197.00
351.50	174.00						
450.00	174.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	130.00	YL:	135.00	XR:	405.00	YR: 200.00
Centre:	XC:	220.06	YC:	368.22	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 3-2 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.015

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.24

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	135.00	136.67	400.00	200.00	192.56	481.90	350.00	1.243	<-- Critical Surface
2	135.00	136.67	400.53	200.00	192.99	481.83	350.00	1.302	
3	135.00	136.67	401.05	200.00	193.42	481.76	350.00	1.357	
4	134.47	136.49	400.00	200.00	192.27	481.69	350.00	1.395	
5	135.00	136.67	400.00	200.00	193.59	477.59	345.92	1.405	
6	135.00	136.67	401.58	200.00	193.84	481.68	350.00	1.412	
7	134.47	136.49	400.53	200.00	192.70	481.61	350.00	1.418	
8	135.00	136.67	400.53	200.00	194.02	477.51	345.92	1.427	
9	135.00	136.67	402.11	200.00	194.27	481.61	350.00	1.434	
10	134.47	136.49	401.05	200.00	193.12	481.54	350.00	1.441	
11	135.00	136.67	401.05	200.00	194.44	477.44	345.92	1.445	
12	133.95	136.32	400.00	200.00	191.98	481.47	350.00	1.452	
13	135.00	136.67	402.63	200.00	194.70	481.54	350.00	1.454	
14	134.47	136.49	400.00	200.00	193.30	477.37	345.92	1.455	
15	135.00	136.67	400.00	200.00	194.62	473.26	341.84	1.459	
16	134.47	136.49	401.58	200.00	193.55	481.47	350.00	1.461	
17	135.00	136.67	401.58	200.00	194.87	477.36	345.92	1.465	
18	133.95	136.32	400.53	200.00	192.41	481.40	350.00	1.471	
19	135.00	136.67	403.16	200.00	195.12	481.46	350.00	1.473	
20	134.47	136.49	400.53	200.00	193.73	477.30	345.92	1.474	
21	135.00	136.67	400.53	200.00	195.05	473.19	341.84	1.477	
22	134.47	136.49	402.11	200.00	193.98	481.40	350.00	1.481	
23	135.00	136.67	402.11	200.00	195.30	477.29	345.92	1.485	
24	133.95	136.32	401.05	200.00	192.83	481.33	350.00	1.488	
25	134.47	136.49	401.05	200.00	194.15	477.22	345.92	1.491	
26	135.00	136.67	403.68	200.00	195.55	481.39	350.00	1.492	
27	135.00	136.67	401.05	200.00	195.47	473.11	341.84	1.497	
28	133.42	136.14	400.00	200.00	191.69	481.26	350.00	1.499	
29	134.47	136.49	402.63	200.00	194.41	481.32	350.00	1.500	
30	133.95	136.32	400.00	200.00	193.01	477.15	345.92	1.501	
31	135.00	136.67	402.63	200.00	195.72	477.21	345.92	1.505	
32	134.47	136.49	400.00	200.00	194.33	473.05	341.84	1.505	
33	133.95	136.32	401.58	200.00	193.26	481.25	350.00	1.507	
34	134.47	136.49	401.58	200.00	194.58	477.15	345.92	1.511	
35	135.00	136.67	404.21	200.00	195.97	481.31	350.00	1.511	
36	135.00	136.67	400.00	200.00	195.66	468.93	337.76	1.512	
37	135.00	136.67	401.58	200.00	195.90	473.03	341.84	1.517	
38	133.42	136.14	400.53	200.00	192.11	481.18	350.00	1.518	
39	134.47	136.49	403.16	200.00	194.83	481.25	350.00	1.519	
40	133.95	136.32	400.53	200.00	193.44	477.08	345.92	1.520	
41	135.00	136.67	403.16	200.00	196.15	477.14	345.92	1.524	
42	134.47	136.49	400.53	200.00	194.76	472.97	341.84	1.525	
43	133.95	136.32	402.11	200.00	193.69	481.18	350.00	1.527	
44	135.00	136.67	400.53	200.00	196.08	468.85	337.76	1.529	
45	135.00	136.67	404.74	200.00	196.40	481.24	350.00	1.531	
46	134.47	136.49	402.11	200.00	195.01	477.07	345.92	1.531	
47	133.42	136.14	401.05	200.00	192.54	481.11	350.00	1.534	
48	133.95	136.32	401.05	200.00	193.86	477.01	345.92	1.537	
49	135.00	136.67	402.11	200.00	196.32	472.96	341.84	1.537	
50	134.47	136.49	403.68	200.00	195.26	481.17	350.00	1.538	
51	134.47	136.49	401.05	200.00	195.18	472.89	341.84	1.542	
52	135.00	136.67	403.68	200.00	196.57	477.06	345.92	1.543	
53	132.89	135.96	400.00	200.00	191.40	481.04	350.00	1.545	
54	133.95	136.32	402.63	200.00	194.11	481.11	350.00	1.546	
55	133.42	136.14	400.00	200.00	192.72	476.94	345.92	1.547	
56	135.00	136.67	401.05	200.00	196.51	468.77	337.76	1.549	
57	135.00	136.67	405.26	200.00	196.82	481.16	350.00	1.550	
58	134.47	136.49	402.63	200.00	195.43	477.00	345.92	1.550	
59	133.95	136.32	400.00	200.00	194.05	472.83	341.84	1.551	
60	133.42	136.14	401.58	200.00	192.97	481.04	350.00	1.553	
61	133.95	136.32	401.58	200.00	194.29	476.93	345.92	1.556	
62	135.00	136.67	402.63	200.00	196.75	472.88	341.84	1.556	
63	134.47	136.49	404.21	200.00	195.68	481.10	350.00	1.557	
64	134.47	136.49	400.00	200.00	195.37	468.71	337.76	1.557	

65	135.00	136.67	400.00	200.00	196.70	464.59	333.67	1.561
66	134.47	136.49	401.58	200.00	195.61	472.82	341.84	1.562
67	135.00	136.67	404.21	200.00	196.99	476.98	345.92	1.562
68	132.89	135.96	400.53	200.00	191.82	480.97	350.00	1.563
69	133.95	136.32	403.16	200.00	194.54	481.03	350.00	1.564
70	133.42	136.14	400.53	200.00	193.15	476.86	345.92	1.565
71	134.47	136.49	403.16	200.00	195.85	476.92	345.92	1.569
72	135.00	136.67	405.79	200.00	197.25	481.09	350.00	1.569
73	133.95	136.32	400.53	200.00	194.47	472.75	341.84	1.570
74	135.00	136.67	401.58	200.00	196.93	468.70	337.76	1.570
75	134.47	136.49	400.53	200.00	195.80	468.63	337.76	1.571
76	133.42	136.14	402.11	200.00	193.40	480.96	350.00	1.572
77	135.00	136.67	400.53	200.00	197.12	464.51	333.67	1.575
78	134.47	136.49	404.74	200.00	196.11	481.02	350.00	1.576
79	135.00	136.67	403.16	200.00	197.17	472.80	341.84	1.576
80	133.95	136.32	402.11	200.00	194.71	476.85	345.92	1.576
81	135.00	136.67	402.11	200.00	197.35	468.62	337.76	1.577
82	132.89	135.96	401.05	200.00	192.25	480.90	350.00	1.581
83	133.42	136.14	401.05	200.00	193.57	476.79	345.92	1.581
84	134.47	136.49	402.11	200.00	196.03	472.74	341.84	1.582
85	135.00	136.67	404.74	200.00	197.42	476.91	345.92	1.582
86	133.95	136.32	403.68	200.00	194.96	480.96	350.00	1.583
87	133.95	136.32	401.05	200.00	194.90	472.68	341.84	1.584
88	135.00	136.67	403.68	200.00	197.59	472.72	341.84	1.586
89	134.47	136.49	401.05	200.00	196.22	468.55	337.76	1.587
90	134.47	136.49	403.68	200.00	196.28	476.84	345.92	1.588
91	135.00	136.67	406.32	200.00	197.67	481.01	350.00	1.588
92	134.47	136.49	402.63	200.00	196.46	472.66	341.84	1.589
93	135.00	136.67	401.05	200.00	197.54	464.43	333.67	1.589
94	133.42	136.14	400.00	200.00	193.76	472.61	341.84	1.590
95	133.42	136.14	402.63	200.00	193.82	480.89	350.00	1.590
96	132.89	135.96	400.00	200.00	192.43	476.72	345.92	1.592
97	133.95	136.32	400.00	200.00	195.08	468.49	337.76	1.593
98	134.47	136.49	405.26	200.00	196.53	480.95	350.00	1.594
99	133.95	136.32	402.63	200.00	195.14	476.78	345.92	1.594

Critical Failure Surface (circle 1)

Intersects: XL: 135.00 YL: 136.67 XR: 400.00 YR: 200.00
Centre: XC: 192.56 YC: 481.90 Radius: R: 350.00

Generated failure surface: (20 points)

135.00 136.67 149.58 134.55 164.23 133.05 178.93 132.17
193.66 131.90
208.38 132.26 223.08 133.23 237.72 134.83 252.28 137.03
266.74 139.85
281.06 143.28 295.23 147.30 309.22 151.91 322.99 157.11
336.54 162.89
349.84 169.23 362.85 176.12 375.57 183.56 387.96 191.52
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 46 slices)

Slice	X-S	Base						PoreWater	
Normal	Test								
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	135.00	7.88	-8.3	5.74	5.80	2	0.00	35.0	1032.78	497.11	188.31	1.10
2	140.74	23.65	-8.3	5.74	5.80	2	0.00	35.0	3098.32	1491.31	564.91	1.10
3	146.48	19.29	-8.3	3.10	3.13	3	100.00	18.0	2534.55	1216.61	848.01	1.05
4	149.58	62.79	-5.8	7.33	7.36	3	100.00	18.0	8285.52	3938.42	1155.88	1.03
5	156.90	86.17	-5.8	7.33	7.36	3	100.00	18.0	11404.15	5405.38	1587.81	1.03
6	164.23	108.83	-3.4	7.35	7.36	3	100.00	18.0	14416.55	6803.34	1982.64	1.02
7	171.58	130.09	-3.4	7.35	7.36	3	100.00	18.0	17233.82	8132.24	2369.12	1.02
8	178.93	92.92	-1.0	4.66	4.66	3	100.00	18.0	12306.16	5799.05	2651.60	1.00
9	183.58	100.53	-1.0	4.66	4.66	3	100.00	18.0	13307.16	6274.09	2867.16	1.00
10	188.24	126.54	-1.0	5.42	5.42	4	2000.00	20.0	16741.32	7897.11	3128.79	1.01
11	193.66	100.06	1.4	4.01	4.01	4	2000.00	20.0	13230.05	6245.50	3246.20	0.99
12	197.67	141.30	1.4	5.36	5.36	3	100.00	18.0	18668.02	8819.94	3472.15	0.99
13	203.02	150.17	1.4	5.36	5.36	3	100.00	18.0	19822.74	9373.44	3687.05	0.99
14	208.38	219.32	3.8	7.35	7.36	3	100.00	18.0	28914.99	13715.94		

3894.52	0.99									
15	215.73	233.74	3.8	7.35	7.36	3	100.00	18.0	30767.44	14617.37
4144.42	0.99									
16	223.08	246.08	6.2	7.32	7.36	3	100.00	18.0	32336.82	15446.05
4344.35	0.98									
17	230.40	258.12	6.2	7.32	7.36	3	100.00	18.0	33855.18	16201.50
4548.86	0.98									
18	237.72	41.37	8.6	1.14	1.16	3	100.00	18.0	5420.76	2611.11
4634.48	0.97									
19	238.86	247.55	8.6	6.71	6.79	2	0.00	35.0	32429.22	15623.64
4634.36	0.93									
20	245.57	255.73	8.6	6.71	6.79	2	0.00	35.0	33501.08	16140.03
4787.53	0.93									
21	252.28	263.39	11.0	6.72	6.85	2	0.00	35.0	34504.15	16744.89
4868.03	0.92									
22	259.00	310.91	11.0	7.74	7.88	2	0.00	35.0	40728.71	19765.68
4992.30	0.92									
23	266.74	294.12	13.4	7.16	7.36	2	0.00	35.0	38529.83	18870.01
5045.23	0.91									
24	273.90	298.96	13.4	7.16	7.36	2	0.00	35.0	39163.99	19180.58
5128.25	0.91									
25	281.06	299.33	15.9	7.08	7.36	2	0.00	35.0	39211.62	19416.35
5135.45	0.90									
26	288.14	301.80	15.9	7.08	7.36	2	0.00	35.0	39536.35	19577.15
5177.96	0.90									
27	295.23	299.23	18.3	6.99	7.36	2	0.00	35.0	39199.63	19662.73
5145.27	0.89									
28	302.22	299.40	18.3	6.99	7.36	2	0.00	35.0	39221.07	19673.47
5148.06	0.89									
29	309.22	289.54	20.7	6.78	7.25	2	0.00	35.0	37930.29	19311.22
5077.19	0.88									
30	316.00	296.38	20.7	6.99	7.48	2	0.00	35.0	38826.37	19223.55
5028.34	0.88									
31	322.99	84.46	23.1	2.01	2.18	2	0.00	35.0	11064.48	5366.65
4926.56	0.88									
32	325.00	235.50	23.1	5.77	6.27	2	0.00	35.0	30850.04	14799.71
4766.75	0.88									
33	330.77	221.30	23.1	5.77	6.27	2	0.00	35.0	28989.81	13836.47
4477.13	0.88									
34	336.54	213.33	25.5	5.98	6.62	2	0.00	35.0	27946.20	13508.32
4116.70	0.87									
35	342.52	196.29	25.5	5.98	6.62	2	0.00	35.0	25713.38	12330.00
3784.62	0.87									
36	348.50	41.58	25.5	1.34	1.48	5	0.00	45.0	4574.30	2123.32
2868.86	0.80									
37	349.84	50.42	27.9	1.66	1.88	5	0.00	45.0	5546.33	1256.36
2539.01	0.79									
38	351.50	205.22	27.9	7.34	8.31	2	0.00	35.0	26884.19	1008.56
2847.43	0.87									
39	358.84	99.98	27.9	4.01	4.54	2	0.00	35.0	13097.46	0.00
2516.19	0.87									
40	362.85	73.60	30.3	3.21	3.72	2	0.00	35.0	9641.88	0.00
2260.32	0.87									
41	366.06	97.95	30.3	4.75	5.51	1	150.00	22.0	12831.62	0.00
2209.42	0.97									
42	370.81	84.74	30.3	4.75	5.51	1	150.00	22.0	11101.17	0.00
1903.48	0.97									
43	375.57	89.52	32.7	6.19	7.36	1	150.00	22.0	11726.94	0.00
1501.72	0.98									
44	381.76	64.85	32.7	6.19	7.36	1	150.00	22.0	8495.58	0.00
1070.24	0.98									
45	387.96	38.29	35.1	6.02	7.36	1	150.00	22.0	5015.73	0.00
608.72	1.00									
46	393.98	12.76	35.1	6.02	7.36	1	150.00	22.0	1671.90	0.00
156.82	1.00									

X-S Area: 7415.01 Path Length: 279.84 X-S Weight: 971309.69

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 3-3\West Farm Expansion Case 3-3 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 12:36:33

DATA: Analysis 1 - Case 3-3 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	183.00	348.50	183.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	144.00	348.50	144.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	141.00	348.50	141.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	183.00	450.00	183.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	144.00	450.00	144.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	141.00	450.00	141.00	

Slope Surface (4 points)

100.00	144.00	157.00	144.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	157.00	197.00	316.00	197.00	348.50	197.00
351.50	182.00						
450.00	182.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	157.00	YL:	144.00	XR:	395.00	YR: 200.00
Centre:	XC:	226.05	YC:	384.27	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 3-3 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 3.403

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.99

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	162.00	145.67	390.00	200.00	213.78	433.91	292.86	1.987	<-- Critical Surface
2	161.47	145.49	390.00	200.00	212.46	438.02	296.94	1.987	
3	160.95	145.32	390.00	200.00	211.14	442.12	301.02	1.988	
4	160.42	145.14	390.00	200.00	209.82	446.22	305.10	1.988	
5	159.89	144.96	390.00	200.00	208.50	450.30	309.18	1.988	
6	158.32	144.44	390.00	200.00	204.54	462.53	321.43	1.989	
7	161.47	145.49	390.53	200.00	212.89	437.94	296.94	1.990	
8	158.84	144.61	390.00	200.00	205.86	458.46	317.35	1.990	
9	155.68	144.00	390.00	200.00	200.51	474.65	333.67	1.990	
10	160.95	145.32	390.53	200.00	211.57	442.05	301.02	1.990	
11	157.79	144.26	390.00	200.00	203.22	466.59	325.51	1.990	
12	160.42	145.14	390.53	200.00	210.25	446.15	305.10	1.991	
13	159.89	144.96	390.53	200.00	208.93	450.24	309.18	1.991	
14	159.37	144.79	390.53	200.00	207.61	454.32	313.27	1.991	
15	154.11	144.00	390.00	200.00	199.24	478.73	337.76	1.992	
16	157.79	144.26	390.53	200.00	203.66	466.53	325.51	1.992	
17	157.26	144.09	390.00	200.00	201.90	470.64	329.59	1.992	
18	156.21	144.00	390.00	200.00	200.60	474.71	333.67	1.993	
19	159.37	144.79	390.00	200.00	207.18	454.38	313.27	1.993	
20	158.32	144.44	390.53	200.00	204.97	462.46	321.43	1.993	
21	159.37	144.79	391.05	200.00	208.04	454.25	313.27	1.994	
22	157.26	144.09	390.53	200.00	202.34	470.58	329.59	1.994	
23	152.53	144.00	390.00	200.00	197.97	482.80	341.84	1.994	
24	158.84	144.61	391.05	200.00	206.73	458.33	317.35	1.994	
25	158.32	144.44	391.05	200.00	205.41	462.40	321.43	1.994	
26	156.21	144.00	390.53	200.00	201.04	474.65	333.67	1.995	
27	154.63	144.00	390.00	200.00	199.32	478.79	337.76	1.995	
28	156.74	144.00	390.00	200.00	200.68	474.77	333.67	1.996	
29	158.84	144.61	390.53	200.00	206.29	458.39	317.35	1.996	
30	154.63	144.00	390.53	200.00	199.76	478.73	337.76	1.997	
31	153.05	144.00	390.00	200.00	198.06	482.86	341.84	1.997	
32	155.16	144.00	390.00	200.00	199.41	478.84	337.76	1.998	
33	160.42	145.14	390.00	200.00	208.79	450.52	309.18	1.998	
34	156.74	144.00	390.53	200.00	201.12	474.71	333.67	1.998	
35	162.00	145.67	390.00	200.00	212.75	438.24	296.94	1.998	
36	161.47	145.49	390.00	200.00	211.43	442.34	301.02	1.998	
37	153.05	144.00	390.53	200.00	198.50	482.80	341.84	1.999	
38	159.89	144.96	390.00	200.00	207.47	454.60	313.27	1.999	
39	159.37	144.79	390.00	200.00	206.15	458.67	317.35	2.000	
40	153.58	144.00	390.00	200.00	198.14	482.92	341.84	2.000	
41	155.16	144.00	390.53	200.00	199.85	478.79	337.76	2.000	
42	156.74	144.00	391.05	200.00	201.56	474.65	333.67	2.000	
43	162.00	145.67	390.53	200.00	213.18	438.16	296.94	2.000	
44	158.84	144.61	390.00	200.00	204.83	462.74	321.43	2.000	
45	161.47	145.49	390.53	200.00	211.86	442.26	301.02	2.000	
46	159.89	144.96	390.53	200.00	207.91	454.53	313.27	2.000	
47	160.95	145.32	390.53	200.00	210.54	446.36	305.10	2.000	
48	155.68	144.00	390.00	200.00	199.49	478.90	337.76	2.000	
49	158.32	144.44	390.00	200.00	203.51	466.80	325.51	2.001	
50	159.37	144.79	390.53	200.00	206.59	458.60	317.35	2.001	
51	157.79	144.26	390.00	200.00	202.19	470.85	329.59	2.001	
52	160.95	145.32	390.00	200.00	210.11	446.43	305.10	2.001	
53	155.16	144.00	391.05	200.00	200.29	478.73	337.76	2.002	
54	153.58	144.00	390.53	200.00	198.58	482.86	341.84	2.002	
55	152.00	144.00	390.00	200.00	196.88	486.99	345.92	2.002	
56	158.84	144.61	390.53	200.00	205.27	462.67	321.43	2.002	
57	154.11	144.00	390.00	200.00	198.23	482.98	341.84	2.002	
58	155.68	144.00	390.53	200.00	199.94	478.84	337.76	2.003	
59	157.26	144.09	390.00	200.00	200.87	474.90	333.67	2.003	
60	158.32	144.44	390.53	200.00	203.95	466.73	325.51	2.003	
61	160.95	145.32	391.05	200.00	210.97	446.29	305.10	2.003	
62	160.42	145.14	391.05	200.00	209.66	450.38	309.18	2.003	
63	156.21	144.00	390.00	200.00	199.58	478.96	337.76	2.003	
64	157.79	144.26	390.53	200.00	202.63	470.79	329.59	2.003	

65	159.37	144.79	391.05	200.00	207.02	458.54	317.35	2.003
66	153.58	144.00	391.05	200.00	199.02	482.80	341.84	2.003
67	158.84	144.61	391.05	200.00	205.71	462.61	321.43	2.003
68	152.00	144.00	390.53	200.00	197.32	486.94	345.92	2.004
69	160.42	145.14	390.53	200.00	209.22	450.45	309.18	2.004
70	158.32	144.44	391.05	200.00	204.39	466.67	325.51	2.004
71	152.53	144.00	390.00	200.00	196.97	487.05	345.92	2.004
72	154.11	144.00	390.53	200.00	198.67	482.92	341.84	2.004
73	155.68	144.00	391.05	200.00	200.38	478.79	337.76	2.005
74	157.26	144.09	390.53	200.00	201.32	474.84	333.67	2.005
75	162.00	145.67	391.05	200.00	213.61	438.09	296.94	2.005
76	154.63	144.00	390.00	200.00	198.31	483.03	341.84	2.005
77	157.79	144.26	391.05	200.00	203.07	470.73	329.59	2.005
78	159.89	144.96	391.58	200.00	208.77	454.39	313.27	2.005
79	156.21	144.00	390.53	200.00	200.02	478.90	337.76	2.005
80	162.00	145.67	391.58	200.00	214.03	438.01	296.94	2.005
81	152.00	144.00	391.05	200.00	197.76	486.88	345.92	2.005
82	161.47	145.49	391.05	200.00	212.29	442.19	301.02	2.006
83	156.74	144.00	390.00	200.00	199.66	479.02	337.76	2.006
84	158.32	144.44	391.58	200.00	204.83	466.61	325.51	2.006
85	162.00	145.67	392.11	200.00	214.46	437.94	296.94	2.006
86	155.68	144.00	391.58	200.00	200.82	478.73	337.76	2.006
87	154.11	144.00	391.05	200.00	199.11	482.86	341.84	2.006
88	152.53	144.00	390.53	200.00	197.41	486.99	345.92	2.006
89	161.47	145.49	391.58	200.00	212.72	442.12	301.02	2.007
90	158.84	144.61	391.58	200.00	206.14	462.54	321.43	2.007
91	159.89	144.96	391.05	200.00	208.34	454.46	313.27	2.007
92	157.26	144.09	391.05	200.00	201.76	474.78	333.67	2.007
93	161.47	145.49	392.11	200.00	213.14	442.04	301.02	2.007
94	157.79	144.26	391.58	200.00	203.51	470.67	329.59	2.007
95	153.05	144.00	390.00	200.00	197.05	487.11	345.92	2.007
96	154.63	144.00	390.53	200.00	198.75	482.98	341.84	2.007
97	156.21	144.00	391.05	200.00	200.46	478.84	337.76	2.007
98	160.95	145.32	391.58	200.00	211.40	446.22	305.10	2.008
99	155.16	144.00	390.00	200.00	198.40	483.09	341.84	2.008

Critical Failure Surface (circle 1)

Intersects: XL: 162.00 YL: 145.67 XR: 390.00 YR: 200.00
Centre: XC: 213.78 YC: 433.91 Radius: R: 292.86

Generated failure surface: (20 points)

162.00 145.67 174.54 143.69 187.15 142.27 199.81 141.39
212.49 141.05
225.18 141.27 237.85 142.04 250.47 143.36 263.02 145.22
275.48 147.63
287.83 150.57 300.04 154.04 312.08 158.04 323.94 162.56
335.59 167.58
347.01 173.11 358.19 179.13 369.09 185.62 379.70 192.59
390.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base						PoreWater	Normal
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Test Factor
1	162.00	6.88	-8.9	5.30	5.36	2	0.00	35.0	901.27	17310.29	3323.56	1.07
2	167.30	20.64	-8.9	5.30	5.36	2	0.00	35.0	2703.79	17588.98	3564.28	1.07
3	172.59	11.04	-8.9	1.95	1.97	3	100.00	18.0	1449.21	6532.55	3725.99	1.04
4	174.54	47.66	-6.5	6.30	6.35	3	100.00	18.0	6285.53	21247.59	3889.51	1.03
5	180.84	65.41	-6.5	6.30	6.35	3	100.00	18.0	8656.07	21530.27	4138.12	1.03
6	187.15	82.66	-4.0	6.33	6.35	3	100.00	18.0	10951.62	21758.74	4358.52	1.01
7	193.48	98.80	-4.0	6.33	6.35	3	100.00	18.0	13094.12	21933.05	4567.38	1.01
8	199.81	114.32	-1.5	6.34	6.35	3	100.00	18.0	15147.35	22053.15	4745.57	1.00
9	206.15	128.78	-1.5	6.34	6.35	3	100.00	18.0	17052.31	22118.67	4914.63	1.00
10	212.49	142.40	1.0	6.34	6.35	3	100.00	18.0	18837.86	22129.51	5050.94	1.00
11	218.84	155.12	1.0	6.34	6.35	3	100.00	18.0	20497.51	22086.15	5180.19	1.00
12	225.18	166.68	3.5	6.33	6.35	3	100.00	18.0	21995.63	21988.42	5274.99	0.99
13	231.51	177.62	3.5	6.33	6.35	3	100.00	18.0	23404.16	21836.28	5364.51	0.99
14	237.85	187.00	6.0	6.31	6.35	3	100.00	18.0	24599.13	21629.87		

5418.20	0.99									
15	244.16	196.12	6.0	6.31	6.35	3	100.00	18.0	25752.57	21369.23
5468.14	0.99									
16	250.47	139.18	8.4	4.32	4.37	3	100.00	18.0	18245.79	14539.20
5479.50	0.99									
17	254.79	135.72	8.4	4.12	4.16	2	0.00	35.0	17778.93	13679.95
5438.06	0.96									
18	258.91	138.85	8.4	4.12	4.16	2	0.00	35.0	18189.29	13521.42
5449.60	0.96									
19	263.02	189.37	10.9	5.49	5.59	2	0.00	35.0	24807.83	17874.80
5414.33	0.95									
20	268.51	193.60	10.9	5.49	5.59	2	0.00	35.0	25361.62	17505.38
5397.74	0.95									
21	274.00	53.09	10.9	1.48	1.51	2	0.00	35.0	6954.55	4671.11
5387.20	0.95									
22	275.48	223.21	13.4	6.17	6.35	2	0.00	35.0	29240.97	19258.59
5323.65	0.95									
23	281.66	226.84	13.4	6.17	6.35	2	0.00	35.0	29715.41	18676.26
5268.98	0.95									
24	287.83	226.98	15.9	6.10	6.35	2	0.00	35.0	29733.77	18041.00
5161.95	0.94									
25	293.93	228.79	15.9	6.10	6.35	2	0.00	35.0	29971.51	17353.27
5072.11	0.94									
26	300.04	226.67	18.4	6.02	6.35	2	0.00	35.0	29694.04	16613.49
4929.89	0.94									
27	306.06	226.72	18.4	6.02	6.35	2	0.00	35.0	29700.02	15821.71
4805.57	0.94									
28	312.08	147.27	20.9	3.92	4.20	2	0.00	35.0	19292.78	10005.10
4656.07	0.94									
29	316.00	148.33	20.9	3.97	4.25	2	0.00	35.0	19431.35	9729.31
4587.33	0.94									
30	319.97	147.58	20.9	3.97	4.25	2	0.00	35.0	19333.14	9328.61
4554.35	0.94									
31	323.94	39.33	23.3	1.06	1.16	2	0.00	35.0	5151.71	2468.85
4493.16	0.95									
32	325.00	189.79	23.3	5.30	5.77	2	0.00	35.0	24862.88	11818.59
4346.06	0.95									
33	330.30	177.70	23.3	5.30	5.77	2	0.00	35.0	23278.20	10996.49
4067.48	0.95									
34	335.59	177.26	25.8	5.71	6.35	2	0.00	35.0	23220.84	11099.69
3727.96	0.95									
35	341.30	161.47	25.8	5.71	6.35	2	0.00	35.0	21153.01	10005.48
3393.55	0.95									
36	347.01	39.35	28.3	1.49	1.69	2	0.00	35.0	5155.35	2473.20
3150.22	0.95									
37	348.50	75.84	28.3	3.00	3.41	5	0.00	45.0	8342.50	3142.53
2384.50	0.89									
38	351.50	151.63	28.3	6.69	7.60	2	0.00	35.0	19863.19	2214.41
2542.75	0.95									
39	358.19	93.67	30.8	4.82	5.61	2	0.00	35.0	12270.42	502.54
2119.77	0.96									
40	363.01	29.37	30.8	1.68	1.95	2	0.00	35.0	3848.03	0.00
1894.66	0.96									
41	364.69	69.10	30.8	4.40	5.13	1	150.00	22.0	9051.70	0.00
1792.91	1.04									
42	369.09	67.04	33.3	5.31	6.35	1	150.00	22.0	8781.72	0.00
1416.70	1.06									
43	374.40	48.57	33.3	5.31	6.35	1	150.00	22.0	6362.66	0.00
1014.40	1.06									
44	379.70	28.64	35.8	5.15	6.35	1	150.00	22.0	3751.31	0.00
588.03	1.07									
45	384.85	9.55	35.8	5.15	6.35	1	150.00	22.0	1250.43	0.00
164.40	1.07									
		---			---				---	
X-S Area:		5611.62	Path Length:		241.12		X-S Weight:		735123.06	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 3-3\West Farm Expansion Case 3-3 Rapid Drawdown-EQ.gmf
Processed: 04 Dec 2020 12:36:02

DATA: Analysis 1 - Case 3-3 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	183.00	348.50	183.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	144.00	348.50	144.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	141.00	348.50	141.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	183.00	450.00	183.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	144.00	450.00	144.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	141.00	450.00	141.00	

Slope Surface (4 points)

100.00	144.00	157.00	144.00	325.00	200.00	450.00	200.00	

Phreatic Surface (6 points)

100.00	144.00	157.00	144.00	316.00	197.00	348.50	197.00	
351.50	182.00							
450.00	182.00							

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	157.00	YL:	144.00	XR:	395.00	YR:	200.00
Centre:	XC:	226.05	YC:	384.27	Radius:	R:	250.00	

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 3-3 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.059

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.16

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	162.00	145.67	390.00	200.00	213.78	433.91	292.86	1.156	<-- Critical Surface
2	161.47	145.49	390.00	200.00	212.46	438.02	296.94	1.156	
3	160.95	145.32	390.00	200.00	211.14	442.12	301.02	1.156	
4	160.42	145.14	390.00	200.00	209.82	446.22	305.10	1.156	
5	159.89	144.96	390.00	200.00	208.50	450.30	309.18	1.156	
6	158.32	144.44	390.00	200.00	204.54	462.53	321.43	1.157	
7	155.68	144.00	390.00	200.00	200.51	474.65	333.67	1.157	
8	158.84	144.61	390.00	200.00	205.86	458.46	317.35	1.157	
9	157.79	144.26	390.00	200.00	203.22	466.59	325.51	1.157	
10	161.47	145.49	390.53	200.00	212.89	437.94	296.94	1.158	
11	160.95	145.32	390.53	200.00	211.57	442.05	301.02	1.158	
12	160.42	145.14	390.53	200.00	210.25	446.15	305.10	1.158	
13	154.11	144.00	390.00	200.00	199.24	478.73	337.76	1.158	
14	159.89	144.96	390.53	200.00	208.93	450.24	309.18	1.158	
15	159.37	144.79	390.53	200.00	207.61	454.32	313.27	1.158	
16	157.26	144.09	390.00	200.00	201.90	470.64	329.59	1.158	
17	157.79	144.26	390.53	200.00	203.66	466.53	325.51	1.159	
18	156.21	144.00	390.00	200.00	200.60	474.71	333.67	1.159	
19	159.37	144.79	390.00	200.00	207.18	454.38	313.27	1.159	
20	152.53	144.00	390.00	200.00	197.97	482.80	341.84	1.160	
21	158.32	144.44	390.53	200.00	204.97	462.46	321.43	1.160	
22	157.26	144.09	390.53	200.00	202.34	470.58	329.59	1.160	
23	154.63	144.00	390.00	200.00	199.32	478.79	337.76	1.160	
24	159.37	144.79	391.05	200.00	208.04	454.25	313.27	1.160	
25	158.84	144.61	391.05	200.00	206.73	458.33	317.35	1.160	
26	156.21	144.00	390.53	200.00	201.04	474.65	333.67	1.160	
27	158.32	144.44	391.05	200.00	205.41	462.40	321.43	1.160	
28	156.74	144.00	390.00	200.00	200.68	474.77	333.67	1.161	
29	158.84	144.61	390.53	200.00	206.29	458.39	317.35	1.161	
30	153.05	144.00	390.00	200.00	198.06	482.86	341.84	1.161	
31	154.63	144.00	390.53	200.00	199.76	478.73	337.76	1.162	
32	155.16	144.00	390.00	200.00	199.41	478.84	337.76	1.162	
33	156.74	144.00	390.53	200.00	201.12	474.71	333.67	1.162	
34	160.42	145.14	390.00	200.00	208.79	450.52	309.18	1.163	
35	161.47	145.49	390.00	200.00	211.43	442.34	301.02	1.163	
36	162.00	145.67	390.00	200.00	212.75	438.24	296.94	1.163	
37	153.05	144.00	390.53	200.00	198.50	482.80	341.84	1.163	
38	159.89	144.96	390.00	200.00	207.47	454.60	313.27	1.163	
39	153.58	144.00	390.00	200.00	198.14	482.92	341.84	1.163	
40	159.37	144.79	390.00	200.00	206.15	458.67	317.35	1.164	
41	155.16	144.00	390.53	200.00	199.85	478.79	337.76	1.164	
42	155.68	144.00	390.00	200.00	199.49	478.90	337.76	1.164	
43	158.84	144.61	390.00	200.00	204.83	462.74	321.43	1.164	
44	156.74	144.00	391.05	200.00	201.56	474.65	333.67	1.164	
45	158.32	144.44	390.00	200.00	203.51	466.80	325.51	1.164	
46	159.89	144.96	390.53	200.00	207.91	454.53	313.27	1.164	
47	157.79	144.26	390.00	200.00	202.19	470.85	329.59	1.165	
48	152.00	144.00	390.00	200.00	196.88	486.99	345.92	1.165	
49	162.00	145.67	390.53	200.00	213.18	438.16	296.94	1.165	
50	160.95	145.32	390.53	200.00	210.54	446.36	305.10	1.165	
51	161.47	145.49	390.53	200.00	211.86	442.26	301.02	1.165	
52	159.37	144.79	390.53	200.00	206.59	458.60	317.35	1.165	
53	153.58	144.00	390.53	200.00	198.58	482.86	341.84	1.165	
54	160.95	145.32	390.00	200.00	210.11	446.43	305.10	1.165	
55	154.11	144.00	390.00	200.00	198.23	482.98	341.84	1.165	
56	155.16	144.00	391.05	200.00	200.29	478.73	337.76	1.165	
57	157.26	144.09	390.00	200.00	200.87	474.90	333.67	1.165	
58	158.84	144.61	390.53	200.00	205.27	462.67	321.43	1.165	
59	155.68	144.00	390.53	200.00	199.94	478.84	337.76	1.166	
60	156.21	144.00	390.00	200.00	199.58	478.96	337.76	1.166	
61	158.32	144.44	390.53	200.00	203.95	466.73	325.51	1.166	
62	157.79	144.26	390.53	200.00	202.63	470.79	329.59	1.166	
63	152.00	144.00	390.53	200.00	197.32	486.94	345.92	1.166	
64	153.58	144.00	391.05	200.00	199.02	482.80	341.84	1.166	

65	152.53	144.00	390.00	200.00	196.97	487.05	345.92	1.166
66	160.42	145.14	391.05	200.00	209.66	450.38	309.18	1.167
67	160.95	145.32	391.05	200.00	210.97	446.29	305.10	1.167
68	158.84	144.61	391.05	200.00	205.71	462.61	321.43	1.167
69	159.37	144.79	391.05	200.00	207.02	458.54	317.35	1.167
70	154.11	144.00	390.53	200.00	198.67	482.92	341.84	1.167
71	160.42	145.14	390.53	200.00	209.22	450.45	309.18	1.167
72	154.63	144.00	390.00	200.00	198.31	483.03	341.84	1.167
73	157.26	144.09	390.53	200.00	201.32	474.84	333.67	1.167
74	162.00	145.67	391.05	200.00	213.61	438.09	296.94	1.167
75	155.68	144.00	391.05	200.00	200.38	478.79	337.76	1.167
76	158.32	144.44	391.05	200.00	204.39	466.67	325.51	1.167
77	161.47	145.49	391.05	200.00	212.29	442.19	301.02	1.167
78	156.21	144.00	390.53	200.00	200.02	478.90	337.76	1.167
79	156.74	144.00	390.00	200.00	199.66	479.02	337.76	1.167
80	157.79	144.26	391.05	200.00	203.07	470.73	329.59	1.168
81	152.00	144.00	391.05	200.00	197.76	486.88	345.92	1.168
82	152.53	144.00	390.53	200.00	197.41	486.99	345.92	1.168
83	153.05	144.00	390.00	200.00	197.05	487.11	345.92	1.168
84	154.11	144.00	391.05	200.00	199.11	482.86	341.84	1.168
85	162.00	145.67	391.58	200.00	214.03	438.01	296.94	1.168
86	159.89	144.96	391.58	200.00	208.77	454.39	313.27	1.168
87	158.32	144.44	391.58	200.00	204.83	466.61	325.51	1.169
88	154.63	144.00	390.53	200.00	198.75	482.98	341.84	1.169
89	155.16	144.00	390.00	200.00	198.40	483.09	341.84	1.169
90	157.26	144.09	391.05	200.00	201.76	474.78	333.67	1.169
91	155.68	144.00	391.58	200.00	200.82	478.73	337.76	1.169
92	161.47	145.49	391.58	200.00	212.72	442.12	301.02	1.169
93	159.89	144.96	391.05	200.00	208.34	454.46	313.27	1.169
94	158.84	144.61	391.58	200.00	206.14	462.54	321.43	1.169
95	156.21	144.00	391.05	200.00	200.46	478.84	337.76	1.169
96	160.95	145.32	391.58	200.00	211.40	446.22	305.10	1.169
97	157.79	144.26	391.58	200.00	203.51	470.67	329.59	1.169
98	160.42	145.14	391.58	200.00	210.09	450.31	309.18	1.169
99	156.74	144.00	390.53	200.00	200.11	478.96	337.76	1.169

Critical Failure Surface (circle 1)

Intersects: XL: 162.00 YL: 145.67 XR: 390.00 YR: 200.00
Centre: XC: 213.78 YC: 433.91 Radius: R: 292.86

Generated failure surface: (20 points)

162.00 145.67 174.54 143.69 187.15 142.27 199.81 141.39
212.49 141.05
225.18 141.27 237.85 142.04 250.47 143.36 263.02 145.22
275.48 147.63
287.83 150.57 300.04 154.04 312.08 158.04 323.94 162.56
335.59 167.58
347.01 173.11 358.19 179.13 369.09 185.62 379.70 192.59
390.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base						PoreWater	Normal
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Test Factor
1	162.00	6.88	-8.9	5.30	5.36	2	0.00	35.0	901.27	434.59	179.59	1.12
2	167.30	20.64	-8.9	5.30	5.36	2	0.00	35.0	2703.79	1303.76	538.78	1.12
3	172.59	11.04	-8.9	1.95	1.97	3	100.00	18.0	1449.21	697.37	777.20	1.06
4	174.54	47.66	-6.5	6.30	6.35	3	100.00	18.0	6285.53	2993.11	1024.31	1.04
5	180.84	65.41	-6.5	6.30	6.35	3	100.00	18.0	8656.07	4107.92	1406.88	1.04
6	187.15	82.66	-4.0	6.33	6.35	3	100.00	18.0	10951.62	5170.18	1754.51	1.02
7	193.48	98.80	-4.0	6.33	6.35	3	100.00	18.0	13094.12	6179.90	2096.55	1.02
8	199.81	114.32	-1.5	6.34	6.35	3	100.00	18.0	15147.35	7136.17	2399.59	1.01
9	206.15	128.78	-1.5	6.34	6.35	3	100.00	18.0	17052.31	8038.87	2701.07	1.01
10	212.49	142.40	1.0	6.34	6.35	3	100.00	18.0	18837.86	8887.12	2960.19	1.00
11	218.84	155.12	1.0	6.34	6.35	3	100.00	18.0	20497.51	9681.10	3221.13	1.00
12	225.18	166.68	3.5	6.33	6.35	3	100.00	18.0	21995.63	10419.98	3436.97	0.99
13	231.51	177.62	3.5	6.33	6.35	3	100.00	18.0	23404.16	11103.76	3657.44	0.99
14	237.85	187.00	6.0	6.31	6.35	3	100.00	18.0	24599.13	11731.79		

3830.66	0.98									
15	244.16	196.12	6.0	6.31	6.35	3	100.00	18.0	25752.57	12304.09
4010.78	0.98									
16	250.47	139.18	8.4	4.32	4.37	3	100.00	18.0	18245.79	8779.55
4120.23	0.97									
17	254.79	135.72	8.4	4.12	4.16	2	0.00	35.0	17778.93	8561.41
4133.57	0.93									
18	258.91	138.85	8.4	4.12	4.16	2	0.00	35.0	18189.29	8759.02
4228.99	0.93									
19	263.02	189.37	10.9	5.49	5.59	2	0.00	35.0	24807.83	12034.81
4272.43	0.91									
20	268.51	193.60	10.9	5.49	5.59	2	0.00	35.0	25361.62	12303.47
4367.83	0.91									
21	274.00	53.09	10.9	1.48	1.51	2	0.00	35.0	6954.55	3373.80
4428.42	0.91									
22	275.48	223.21	13.4	6.17	6.35	2	0.00	35.0	29240.97	14318.56
4424.30	0.90									
23	281.66	226.84	13.4	6.17	6.35	2	0.00	35.0	29715.41	14550.88
4496.06	0.90									
24	287.83	226.98	15.9	6.10	6.35	2	0.00	35.0	29733.77	14725.73
4496.78	0.89									
25	293.93	228.79	15.9	6.10	6.35	2	0.00	35.0	29971.51	14843.46
4532.73	0.89									
26	300.04	226.67	18.4	6.02	6.35	2	0.00	35.0	29694.04	14903.81
4498.44	0.88									
27	306.06	226.72	18.4	6.02	6.35	2	0.00	35.0	29700.02	14906.81
4499.34	0.88									
28	312.08	147.27	20.9	3.92	4.20	2	0.00	35.0	19292.78	9833.99
4437.06	0.87									
29	316.00	148.33	20.9	3.97	4.25	2	0.00	35.0	19431.35	9729.31
4407.14	0.87									
30	319.97	147.58	20.9	3.97	4.25	2	0.00	35.0	19333.14	9328.61
4369.34	0.87									
31	323.94	39.33	23.3	1.06	1.16	2	0.00	35.0	5151.71	2468.85
4288.69	0.86									
32	325.00	189.79	23.3	5.30	5.77	2	0.00	35.0	24862.88	11818.59
4146.92	0.86									
33	330.30	177.70	23.3	5.30	5.77	2	0.00	35.0	23278.20	10996.49
3880.14	0.86									
34	335.59	177.26	25.8	5.71	6.35	2	0.00	35.0	23220.84	11099.69
3540.28	0.86									
35	341.30	161.47	25.8	5.71	6.35	2	0.00	35.0	21153.01	10005.48
3221.24	0.86									
36	347.01	39.35	28.3	1.49	1.69	2	0.00	35.0	5155.35	2473.20
2976.82	0.86									
37	348.50	75.84	28.3	3.00	3.41	5	0.00	45.0	8342.50	3142.53
2190.04	0.77									
38	351.50	151.63	28.3	6.69	7.60	2	0.00	35.0	19863.19	2214.41
2311.03	0.86									
39	358.19	93.67	30.8	4.82	5.61	2	0.00	35.0	12270.42	502.54
1894.47	0.86									
40	363.01	29.37	30.8	1.68	1.95	2	0.00	35.0	3848.03	0.00
1684.40	0.86									
41	364.69	69.10	30.8	4.40	5.13	1	150.00	22.0	9051.70	0.00
1636.82	0.96									
42	369.09	67.04	33.3	5.31	6.35	1	150.00	22.0	8781.72	0.00
1277.12	0.97									
43	374.40	48.57	33.3	5.31	6.35	1	150.00	22.0	6362.66	0.00
906.23	0.97									
44	379.70	28.64	35.8	5.15	6.35	1	150.00	22.0	3751.31	0.00
507.32	0.98									
45	384.85	9.55	35.8	5.15	6.35	1	150.00	22.0	1250.43	0.00
119.33	0.98									
		---		---					---	
X-S Area:		5611.62	Path Length:	241.12			X-S Weight:		735123.06	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 4-1\West Farm Expansion Case 4-1 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 12:42:41

DATA: Analysis 1 - Case 4-1 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	190.00	348.50	190.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	157.00	348.50	157.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	154.00	348.50	154.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	190.00	450.00	190.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	157.00	450.00	157.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	154.00	450.00	154.00	

Slope Surface (4 points)

100.00	157.00	196.00	157.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	196.00	197.00	316.00	197.00	348.50	197.00
351.50	178.00						
450.00	178.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	196.00	YL:	157.00	XR:	405.00	YR: 200.00
Centre:	XC:	254.94	YC:	399.95	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 4-1 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 4.017

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.32

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	198.89	157.96	400.00	200.00	246.02	434.59	280.61	2.323	<-- Critical Surface
2	199.95	158.32	400.00	200.00	248.45	426.41	272.45	2.328	
3	199.42	158.14	400.00	200.00	247.24	430.51	276.53	2.330	
4	194.68	157.00	400.00	200.00	237.72	463.17	309.18	2.336	
5	198.37	157.79	400.00	200.00	243.91	442.95	288.78	2.336	
6	198.89	157.96	400.00	200.00	245.12	438.88	284.69	2.338	
7	197.32	157.44	400.53	200.00	241.89	451.01	296.94	2.338	
8	195.21	157.00	400.00	200.00	237.82	463.23	309.18	2.340	
9	196.79	157.26	400.00	200.00	240.24	455.13	301.02	2.340	
10	199.42	158.14	400.00	200.00	246.34	434.80	280.61	2.340	
11	197.84	157.61	400.53	200.00	243.11	446.95	292.86	2.340	
12	196.26	157.09	400.00	200.00	239.02	459.18	305.10	2.340	
13	193.63	157.00	400.00	200.00	236.64	467.30	313.27	2.341	
14	197.32	157.44	400.00	200.00	241.47	451.08	296.94	2.341	
15	192.05	157.00	400.00	200.00	235.47	471.36	317.35	2.342	
16	197.84	157.61	400.00	200.00	242.69	447.02	292.86	2.342	
17	199.95	158.32	400.00	200.00	247.56	430.72	276.53	2.342	
18	198.37	157.79	400.53	200.00	244.33	442.88	288.78	2.342	
19	195.21	157.00	400.53	200.00	238.25	463.17	309.18	2.343	
20	195.74	157.00	400.00	200.00	237.92	463.29	309.18	2.343	
21	196.79	157.26	400.53	200.00	240.67	455.07	301.02	2.343	
22	200.47	158.49	400.00	200.00	248.77	426.62	272.45	2.343	
23	196.26	157.09	400.53	200.00	239.45	459.12	305.10	2.344	
24	195.74	157.00	401.05	200.00	238.77	463.17	309.18	2.344	
25	194.16	157.00	400.00	200.00	236.74	467.36	313.27	2.344	
26	198.89	157.96	400.53	200.00	245.54	438.81	284.69	2.344	
27	197.32	157.44	401.05	200.00	242.31	450.95	296.94	2.344	
28	192.58	157.00	400.00	200.00	235.56	471.42	317.35	2.345	
29	199.95	158.32	400.53	200.00	247.97	430.64	276.53	2.346	
30	199.42	158.14	400.53	200.00	246.76	434.73	280.61	2.346	
31	191.00	157.00	400.00	200.00	234.40	475.49	321.43	2.346	
32	197.84	157.61	401.05	200.00	243.53	446.89	292.86	2.347	
33	195.74	157.00	400.53	200.00	238.35	463.23	309.18	2.347	
34	194.16	157.00	400.53	200.00	237.17	467.30	313.27	2.348	
35	194.68	157.00	400.00	200.00	236.83	467.42	313.27	2.348	
36	198.37	157.79	401.05	200.00	244.75	442.82	288.78	2.348	
37	201.00	158.67	400.53	200.00	250.40	422.45	268.37	2.348	
38	198.89	157.96	401.05	200.00	245.96	438.74	284.69	2.348	
39	199.42	158.14	401.05	200.00	247.18	434.66	280.61	2.348	
40	193.11	157.00	400.00	200.00	235.66	471.48	317.35	2.349	
41	201.00	158.67	400.00	200.00	249.99	422.53	268.37	2.349	
42	192.58	157.00	400.53	200.00	235.99	471.36	317.35	2.349	
43	191.00	157.00	400.53	200.00	234.83	475.43	321.43	2.350	
44	198.37	157.79	400.00	200.00	243.01	447.22	292.86	2.350	
45	191.53	157.00	400.00	200.00	234.49	475.54	321.43	2.350	
46	200.47	158.49	401.05	200.00	249.60	426.47	272.45	2.351	
47	200.47	158.49	400.53	200.00	249.19	426.55	272.45	2.351	
48	197.32	157.44	400.53	200.00	241.00	455.27	301.02	2.351	
49	195.21	157.00	400.00	200.00	236.93	467.48	313.27	2.351	
50	194.68	157.00	400.53	200.00	237.26	467.36	313.27	2.351	
51	201.00	158.67	401.05	200.00	250.81	422.37	268.37	2.352	
52	193.63	157.00	400.00	200.00	235.76	471.54	317.35	2.352	
53	196.26	157.09	400.00	200.00	238.13	463.42	309.18	2.352	
54	196.79	157.26	400.00	200.00	239.35	459.38	305.10	2.352	
55	193.11	157.00	400.53	200.00	236.09	471.42	317.35	2.352	
56	198.89	157.96	400.00	200.00	244.23	443.16	288.78	2.352	
57	199.95	158.32	401.58	200.00	248.80	430.50	276.53	2.353	
58	192.05	157.00	400.00	200.00	234.59	475.60	321.43	2.353	
59	191.53	157.00	400.53	200.00	234.92	475.49	321.43	2.353	
60	197.84	157.61	400.53	200.00	242.22	451.22	296.94	2.353	
61	199.95	158.32	401.05	200.00	248.39	430.57	276.53	2.354	
62	197.32	157.44	400.00	200.00	240.57	455.33	301.02	2.354	
63	196.26	157.09	401.05	200.00	238.99	463.31	309.18	2.354	
64	200.47	158.49	401.58	200.00	250.01	426.40	272.45	2.354	

65	195.74	157.00	400.00	200.00	237.02	467.53	313.27	2.355
66	194.68	157.00	401.05	200.00	237.69	467.30	313.27	2.355
67	195.21	157.00	400.53	200.00	237.36	467.42	313.27	2.355
68	196.79	157.26	401.05	200.00	240.21	459.26	305.10	2.355
69	197.84	157.61	400.00	200.00	241.79	451.28	296.94	2.355
70	199.42	158.14	400.00	200.00	245.45	439.09	284.69	2.355
71	194.16	157.00	400.00	200.00	235.85	471.60	317.35	2.356
72	193.11	157.00	401.05	200.00	236.52	471.36	317.35	2.356
73	196.26	157.09	400.53	200.00	238.56	463.36	309.18	2.356
74	193.63	157.00	400.53	200.00	236.19	471.48	317.35	2.356
75	196.79	157.26	400.53	200.00	239.78	459.32	305.10	2.356
76	198.37	157.79	400.53	200.00	243.43	447.16	292.86	2.356
77	199.42	158.14	401.58	200.00	247.59	434.59	280.61	2.357
78	192.58	157.00	400.00	200.00	234.69	475.66	321.43	2.357
79	191.53	157.00	401.05	200.00	235.35	475.43	321.43	2.357
80	192.05	157.00	400.53	200.00	235.02	475.54	321.43	2.357
81	195.21	157.00	401.58	200.00	238.22	467.30	313.27	2.357
82	197.32	157.44	401.05	200.00	241.42	455.21	301.02	2.357
83	199.95	158.32	400.00	200.00	246.66	435.01	280.61	2.358
84	191.00	157.00	400.00	200.00	233.53	479.72	325.51	2.358
85	195.74	157.00	400.53	200.00	237.46	467.48	313.27	2.358
86	195.21	157.00	401.05	200.00	237.79	467.36	313.27	2.359
87	198.89	157.96	400.53	200.00	244.65	443.09	288.78	2.359
88	194.68	157.00	400.00	200.00	235.95	471.65	317.35	2.359
89	194.16	157.00	400.53	200.00	236.28	471.54	317.35	2.359
90	193.63	157.00	401.05	200.00	236.62	471.42	317.35	2.359
91	193.11	157.00	400.00	200.00	234.78	475.72	321.43	2.360
92	197.84	157.61	401.05	200.00	242.64	451.15	296.94	2.360
93	200.47	158.49	400.00	200.00	247.88	430.93	276.53	2.360
94	196.26	157.09	401.58	200.00	239.42	463.25	309.18	2.360
95	192.58	157.00	400.53	200.00	235.12	475.60	321.43	2.361
96	192.05	157.00	401.05	200.00	235.45	475.49	321.43	2.361
97	191.53	157.00	400.00	200.00	233.62	479.78	325.51	2.361
98	201.00	158.67	400.00	200.00	249.09	426.84	272.45	2.361
99	199.42	158.14	400.53	200.00	245.87	439.02	284.69	2.362

Critical Failure Surface (circle 1)

Intersects: XL: 198.89 YL: 157.96 XR: 400.00 YR: 200.00
Centre: XC: 246.02 YC: 434.59 Radius: R: 280.61

Generated failure surface: (20 points)

198.89 157.96 209.84 156.32 220.85 155.11 231.89 154.34
242.95 154.00
254.02 154.09 265.08 154.63 276.11 155.60 287.09 157.00
298.00 158.84
308.84 161.10 319.58 163.79 330.20 166.90 340.69 170.43
351.04 174.37
361.22 178.72 371.22 183.46 381.03 188.59 390.63 194.11
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base							PoreWater	Normal Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress Factor
1	198.89	9.99	-8.5	6.43	6.50	2	0.00	35.0	1308.25	16027.30	2577.53 1.06
2	205.32	18.98	-8.5	4.52	4.57	3	100.00	18.0	2502.06	11504.37	2821.53 1.03
3	209.84	35.83	-6.3	5.50	5.53	3	100.00	18.0	4747.41	14154.06	3025.70 1.02
4	215.34	49.25	-6.3	5.50	5.53	3	100.00	18.0	6538.65	14363.08	3239.55 1.02
5	220.85	62.31	-4.0	5.52	5.53	3	100.00	18.0	8277.27	14534.56	3431.87 1.01
6	226.37	74.61	-4.0	5.52	5.53	3	100.00	18.0	9910.27	14668.46	3614.34 1.01
7	231.89	85.52	-1.8	5.47	5.48	3	100.00	18.0	11353.01	14607.72	3772.79 1.00
8	237.36	96.42	-1.8	5.47	5.48	3	100.00	18.0	12790.79	14665.04	3922.21 1.00
9	242.84	109.21	0.5	5.59	5.59	3	100.00	18.0	14472.79	15001.84	4049.24 1.00
10	248.43	119.36	0.5	5.59	5.59	3	100.00	18.0	15800.16	14984.76	4169.86 1.00
11	254.02	127.35	2.8	5.53	5.53	3	100.00	18.0	16835.93	14772.83	4264.09 0.99
12	259.55	136.06	2.8	5.53	5.53	3	100.00	18.0	17962.54	14680.68	4352.17 0.99
13	265.08	143.77	5.0	5.51	5.53	3	100.00	18.0	18951.42	14550.86	4413.25 0.99
14	270.59	151.23	5.0	5.51	5.53	3	100.00	18.0	19902.03	14383.43	

4469.91	0.99									
15	276.11	157.29	7.3	5.49	5.53	3	100.00	18.0	20662.64	14168.74
4498.71	0.99									
16	281.59	163.48	7.3	5.49	5.53	3	100.00	18.0	21434.47	13926.67
4524.03	0.99									
17	287.08	121.53	9.5	3.96	4.02	2	0.00	35.0	15920.13	9939.97
4478.87	0.97									
18	291.04	124.12	9.5	3.96	4.02	2	0.00	35.0	16259.47	9773.22
4479.98	0.97									
19	295.00	95.87	9.5	3.00	3.05	2	0.00	35.0	12559.12	7301.69
4480.99	0.97									
20	298.00	176.09	11.8	5.42	5.53	2	0.00	35.0	23067.53	12985.33
4443.50	0.96									
21	303.42	179.74	11.8	5.42	5.53	2	0.00	35.0	23545.42	12594.14
4416.30	0.96									
22	308.84	120.51	14.1	3.58	3.69	2	0.00	35.0	15786.75	8164.54
4358.98	0.96									
23	312.42	121.57	14.1	3.58	3.69	2	0.00	35.0	15925.75	7957.93
4321.91	0.96									
24	316.00	122.54	14.1	3.58	3.69	2	0.00	35.0	16052.36	7745.47
4319.44	0.96									
25	319.58	187.13	16.3	5.42	5.65	2	0.00	35.0	24514.12	11428.52
4318.12	0.96									
26	325.00	176.09	16.3	5.20	5.42	2	0.00	35.0	23068.13	10435.37
4231.74	0.96									
27	330.20	169.00	18.6	5.25	5.53	2	0.00	35.0	22139.23	10089.91
3999.40	0.96									
28	335.45	159.75	18.6	5.25	5.53	2	0.00	35.0	20926.60	9480.52
3779.42	0.96									
29	340.69	112.51	20.8	3.90	4.18	2	0.00	35.0	14738.72	6730.53
3553.10	0.96									
30	344.60	106.71	20.8	3.90	4.18	2	0.00	35.0	13978.66	6343.13
3368.88	0.96									
31	348.50	66.29	20.8	2.54	2.72	5	0.00	45.0	7291.38	2554.84
2600.16	0.92									
32	351.04	105.09	23.1	4.25	4.62	2	0.00	35.0	13766.62	784.71
2888.73	0.96									
33	355.29	97.38	23.1	4.25	4.62	2	0.00	35.0	12756.47	261.57
2665.29	0.96									
34	359.54	36.35	23.1	1.68	1.83	2	0.00	35.0	4762.01	0.00
2511.98	0.96									
35	361.22	100.51	25.4	5.00	5.53	2	0.00	35.0	13167.13	0.00
2303.56	0.97									
36	366.22	88.65	25.4	5.00	5.53	2	0.00	35.0	11613.42	0.00
2031.75	0.97									
37	371.22	74.82	27.6	4.90	5.53	2	0.00	35.0	9801.10	0.00
1726.32	0.97									
38	376.13	62.23	27.6	4.90	5.53	2	0.00	35.0	8152.25	0.00
1435.89	0.97									
39	381.03	26.20	29.9	2.45	2.82	2	0.00	35.0	3432.17	0.00
1195.10	0.98									
40	383.48	32.08	29.9	3.57	4.12	1	150.00	22.0	4201.93	0.00
1034.85	1.05									
41	387.05	24.73	29.9	3.57	4.12	1	150.00	22.0	3239.66	0.00
790.14	1.05									
42	390.63	20.70	32.1	4.69	5.53	1	150.00	22.0	2712.06	0.00
485.13	1.06									
43	395.31	6.90	32.1	4.69	5.53	1	150.00	22.0	904.03	0.00
137.32	1.06									
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X-S Area:		4255.71	Path Length:		210.33		X-S Weight:		557731.94	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 4-1\West Farm Expansion Case 4-1 Rapid Drawdown-EQ.gmf
Processed: 04 Dec 2020 12:41:21

DATA: Analysis 1 - Case 4-1 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	190.00	348.50	190.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	157.00	348.50	157.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	154.00	348.50	154.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	190.00	450.00	190.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	157.00	450.00	157.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	154.00	450.00	154.00	

Slope Surface (4 points)

100.00	157.00	196.00	157.00	325.00	200.00	450.00	200.00	

Phreatic Surface (6 points)

100.00	157.00	196.00	157.00	316.00	197.00	348.50	197.00	
351.50	178.00							
450.00	178.00							

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	196.00	YL:	157.00	XR:	405.00	YR: 200.00
Centre:	XC:	254.94	YC:	399.95	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 4-1 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.532

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.42

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	198.89	157.96	400.00	200.00	246.02	434.59	280.61	1.422	<-- Critical Surface
2	199.95	158.32	400.00	200.00	248.45	426.41	272.45	1.426	
3	199.42	158.14	400.00	200.00	247.24	430.51	276.53	1.427	
4	194.68	157.00	400.00	200.00	237.72	463.17	309.18	1.427	
5	195.21	157.00	400.00	200.00	237.82	463.23	309.18	1.430	
6	193.63	157.00	400.00	200.00	236.64	467.30	313.27	1.430	
7	192.05	157.00	400.00	200.00	235.47	471.36	317.35	1.431	
8	196.26	157.09	400.00	200.00	239.02	459.18	305.10	1.431	
9	196.79	157.26	400.00	200.00	240.24	455.13	301.02	1.431	
10	198.37	157.79	400.00	200.00	243.91	442.95	288.78	1.431	
11	197.32	157.44	400.00	200.00	241.47	451.08	296.94	1.432	
12	197.32	157.44	400.53	200.00	241.89	451.01	296.94	1.432	
13	195.74	157.00	400.00	200.00	237.92	463.29	309.18	1.433	
14	198.89	157.96	400.00	200.00	245.12	438.88	284.69	1.433	
15	195.21	157.00	400.53	200.00	238.25	463.17	309.18	1.433	
16	194.16	157.00	400.00	200.00	236.74	467.36	313.27	1.433	
17	197.84	157.61	400.00	200.00	242.69	447.02	292.86	1.433	
18	192.58	157.00	400.00	200.00	235.56	471.42	317.35	1.433	
19	197.84	157.61	400.53	200.00	243.11	446.95	292.86	1.434	
20	196.26	157.09	400.53	200.00	239.45	459.12	305.10	1.434	
21	196.79	157.26	400.53	200.00	240.67	455.07	301.02	1.434	
22	191.00	157.00	400.00	200.00	234.40	475.49	321.43	1.434	
23	199.42	158.14	400.00	200.00	246.34	434.80	280.61	1.434	
24	198.37	157.79	400.53	200.00	244.33	442.88	288.78	1.435	
25	199.95	158.32	400.00	200.00	247.56	430.72	276.53	1.435	
26	194.68	157.00	400.00	200.00	236.83	467.42	313.27	1.435	
27	195.74	157.00	400.53	200.00	238.35	463.23	309.18	1.436	
28	193.11	157.00	400.00	200.00	235.66	471.48	317.35	1.436	
29	194.16	157.00	400.53	200.00	237.17	467.30	313.27	1.436	
30	195.74	157.00	401.05	200.00	238.77	463.17	309.18	1.436	
31	197.32	157.44	401.05	200.00	242.31	450.95	296.94	1.436	
32	192.58	157.00	400.53	200.00	235.99	471.36	317.35	1.436	
33	191.53	157.00	400.00	200.00	234.49	475.54	321.43	1.436	
34	200.47	158.49	400.00	200.00	248.77	426.62	272.45	1.436	
35	198.89	157.96	400.53	200.00	245.54	438.81	284.69	1.437	
36	191.00	157.00	400.53	200.00	234.83	475.43	321.43	1.437	
37	197.84	157.61	401.05	200.00	243.53	446.89	292.86	1.438	
38	199.42	158.14	400.53	200.00	246.76	434.73	280.61	1.438	
39	195.21	157.00	400.00	200.00	236.93	467.48	313.27	1.438	
40	199.95	158.32	400.53	200.00	247.97	430.64	276.53	1.438	
41	193.63	157.00	400.00	200.00	235.76	471.54	317.35	1.438	
42	194.68	157.00	400.53	200.00	237.26	467.36	313.27	1.438	
43	198.37	157.79	401.05	200.00	244.75	442.82	288.78	1.439	
44	192.05	157.00	400.00	200.00	234.59	475.60	321.43	1.439	
45	193.11	157.00	400.53	200.00	236.09	471.42	317.35	1.439	
46	196.26	157.09	400.00	200.00	238.13	463.42	309.18	1.439	
47	191.53	157.00	400.53	200.00	234.92	475.49	321.43	1.439	
48	198.89	157.96	401.05	200.00	245.96	438.74	284.69	1.439	
49	196.79	157.26	400.00	200.00	239.35	459.38	305.10	1.439	
50	199.42	158.14	401.05	200.00	247.18	434.66	280.61	1.440	
51	201.00	158.67	400.00	200.00	249.99	422.53	268.37	1.440	
52	195.74	157.00	400.00	200.00	237.02	467.53	313.27	1.440	
53	201.00	158.67	400.53	200.00	250.40	422.45	268.37	1.440	
54	197.32	157.44	400.00	200.00	240.57	455.33	301.02	1.441	
55	194.16	157.00	400.00	200.00	235.85	471.60	317.35	1.441	
56	198.37	157.79	400.00	200.00	243.01	447.22	292.86	1.441	
57	195.21	157.00	400.53	200.00	237.36	467.42	313.27	1.441	
58	197.32	157.44	400.53	200.00	241.00	455.27	301.02	1.441	
59	192.58	157.00	400.00	200.00	234.69	475.66	321.43	1.441	
60	193.63	157.00	400.53	200.00	236.19	471.48	317.35	1.441	
61	194.68	157.00	401.05	200.00	237.69	467.30	313.27	1.441	
62	193.11	157.00	401.05	200.00	236.52	471.36	317.35	1.442	
63	192.05	157.00	400.53	200.00	235.02	475.54	321.43	1.442	
64	191.00	157.00	400.00	200.00	233.53	479.72	325.51	1.442	

65	200.47	158.49	400.53	200.00	249.19	426.55	272.45	1.442
66	196.26	157.09	400.53	200.00	238.56	463.36	309.18	1.442
67	197.84	157.61	400.00	200.00	241.79	451.28	296.94	1.442
68	191.53	157.00	401.05	200.00	235.35	475.43	321.43	1.442
69	200.47	158.49	401.05	200.00	249.60	426.47	272.45	1.442
70	196.79	157.26	400.53	200.00	239.78	459.32	305.10	1.442
71	198.89	157.96	400.00	200.00	244.23	443.16	288.78	1.442
72	196.26	157.09	401.05	200.00	238.99	463.31	309.18	1.443
73	197.84	157.61	400.53	200.00	242.22	451.22	296.94	1.443
74	194.68	157.00	400.00	200.00	235.95	471.65	317.35	1.443
75	201.00	158.67	401.05	200.00	250.81	422.37	268.37	1.443
76	196.79	157.26	401.05	200.00	240.21	459.26	305.10	1.443
77	193.11	157.00	400.00	200.00	234.78	475.72	321.43	1.443
78	195.74	157.00	400.53	200.00	237.46	467.48	313.27	1.443
79	199.95	158.32	401.05	200.00	248.39	430.57	276.53	1.444
80	194.16	157.00	400.53	200.00	236.28	471.54	317.35	1.444
81	195.21	157.00	401.05	200.00	237.79	467.36	313.27	1.444
82	191.53	157.00	400.00	200.00	233.62	479.78	325.51	1.444
83	199.95	158.32	401.58	200.00	248.80	430.50	276.53	1.444
84	192.58	157.00	400.53	200.00	235.12	475.60	321.43	1.444
85	193.63	157.00	401.05	200.00	236.62	471.42	317.35	1.444
86	199.42	158.14	400.00	200.00	245.45	439.09	284.69	1.444
87	198.37	157.79	400.53	200.00	243.43	447.16	292.86	1.445
88	192.05	157.00	401.05	200.00	235.45	475.49	321.43	1.445
89	195.21	157.00	401.58	200.00	238.22	467.30	313.27	1.445
90	191.00	157.00	400.53	200.00	233.96	479.66	325.51	1.445
91	197.32	157.44	401.05	200.00	241.42	455.21	301.02	1.445
92	200.47	158.49	401.58	200.00	250.01	426.40	272.45	1.445
93	195.21	157.00	400.00	200.00	236.04	471.71	317.35	1.445
94	199.42	158.14	401.58	200.00	247.59	434.59	280.61	1.446
95	193.63	157.00	400.00	200.00	234.87	475.77	321.43	1.446
96	199.95	158.32	400.00	200.00	246.66	435.01	280.61	1.446
97	194.68	157.00	400.53	200.00	236.38	471.60	317.35	1.446
98	192.05	157.00	400.00	200.00	233.72	479.83	325.51	1.446
99	198.89	157.96	400.53	200.00	244.65	443.09	288.78	1.446

Critical Failure Surface (circle 1)

Intersects: XL: 198.89 YL: 157.96 XR: 400.00 YR: 200.00
Centre: XC: 246.02 YC: 434.59 Radius: R: 280.61

Generated failure surface: (20 points)

198.89 157.96 209.84 156.32 220.85 155.11 231.89 154.34
242.95 154.00
254.02 154.09 265.08 154.63 276.11 155.60 287.09 157.00
298.00 158.84
308.84 161.10 319.58 163.79 330.20 166.90 340.69 170.43
351.04 174.37
361.22 178.72 371.22 183.46 381.03 188.59 390.63 194.11
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base							PoreWater	Normal
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Test Factor
1	198.89	9.99	-8.5	6.43	6.50	2	0.00	35.0	1308.25	630.15	212.04	1.09
2	205.32	18.98	-8.5	4.52	4.57	3	100.00	18.0	2502.06	1197.79	574.87	1.05
3	209.84	35.83	-6.3	5.50	5.53	3	100.00	18.0	4747.41	2249.14	882.59	1.03
4	215.34	49.25	-6.3	5.50	5.53	3	100.00	18.0	6538.65	3091.56	1212.64	1.03
5	220.85	62.31	-4.0	5.52	5.53	3	100.00	18.0	8277.27	3897.56	1517.12	1.02
6	226.37	74.61	-4.0	5.52	5.53	3	100.00	18.0	9910.27	4667.11	1815.43	1.02
7	231.89	85.52	-1.8	5.47	5.48	3	100.00	18.0	11353.01	5338.70	2084.05	1.01
8	237.36	96.42	-1.8	5.47	5.48	3	100.00	18.0	12790.79	6019.51	2347.71	1.01
9	242.84	109.21	0.5	5.59	5.59	3	100.00	18.0	14472.79	6814.73	2584.41	1.00
10	248.43	119.36	0.5	5.59	5.59	3	100.00	18.0	15800.16	7448.38	2821.15	1.00
11	254.02	127.35	2.8	5.53	5.53	3	100.00	18.0	16835.93	7955.80	3024.41	0.99
12	259.55	136.06	2.8	5.53	5.53	3	100.00	18.0	17962.54	8500.10	3227.03	0.99
13	265.08	143.77	5.0	5.51	5.53	3	100.00	18.0	18951.42	9005.91	3395.47	0.98
14	270.59	151.23	5.0	5.51	5.53	3	100.00	18.0	19902.03	9473.25		

3566.15	0.98									
15	276.11	157.29	7.3	5.49	5.53	3	100.00	18.0	20662.64	9894.74
3701.29	0.98									
16	281.59	163.48	7.3	5.49	5.53	3	100.00	18.0	21434.47	10283.86
3839.97	0.98									
17	287.08	121.53	9.5	3.96	4.02	2	0.00	35.0	15920.13	7689.71
3859.14	0.94									
18	291.04	124.12	9.5	3.96	4.02	2	0.00	35.0	16259.47	7853.72
3941.33	0.94									
19	295.00	95.87	9.5	3.00	3.05	2	0.00	35.0	12559.12	6066.35
4013.66	0.94									
20	298.00	176.09	11.8	5.42	5.53	2	0.00	35.0	23067.53	11225.35
4049.65	0.93									
21	303.42	179.74	11.8	5.42	5.53	2	0.00	35.0	23545.42	11457.91
4133.57	0.93									
22	308.84	120.51	14.1	3.58	3.69	2	0.00	35.0	15786.75	7752.25
4155.87	0.92									
23	312.42	121.57	14.1	3.58	3.69	2	0.00	35.0	15925.75	7820.50
4192.47	0.92									
24	316.00	122.54	14.1	3.58	3.69	2	0.00	35.0	16052.36	7745.47
4224.95	0.92									
25	319.58	187.13	16.3	5.42	5.65	2	0.00	35.0	24514.12	11428.52
4205.94	0.91									
26	325.00	176.09	16.3	5.20	5.42	2	0.00	35.0	23068.13	10435.37
4119.04	0.91									
27	330.20	169.00	18.6	5.25	5.53	2	0.00	35.0	22139.23	10089.91
3879.53	0.91									
28	335.45	159.75	18.6	5.25	5.53	2	0.00	35.0	20926.60	9480.52
3665.60	0.91									
29	340.69	112.51	20.8	3.90	4.18	2	0.00	35.0	14738.72	6730.53
3434.24	0.90									
30	344.60	106.71	20.8	3.90	4.18	2	0.00	35.0	13978.66	6343.13
3255.62	0.90									
31	348.50	66.29	20.8	2.54	2.72	5	0.00	45.0	7291.38	2554.84
2464.26	0.84									
32	351.04	105.09	23.1	4.25	4.62	2	0.00	35.0	13766.62	784.71
2705.72	0.90									
33	355.29	97.38	23.1	4.25	4.62	2	0.00	35.0	12756.47	261.57
2489.69	0.90									
34	359.54	36.35	23.1	1.68	1.83	2	0.00	35.0	4762.01	0.00
2342.89	0.90									
35	361.22	100.51	25.4	5.00	5.53	2	0.00	35.0	13167.13	0.00
2134.52	0.90									
36	366.22	88.65	25.4	5.00	5.53	2	0.00	35.0	11613.42	0.00
1882.66	0.90									
37	371.22	74.82	27.6	4.90	5.53	2	0.00	35.0	9801.10	0.00
1589.17	0.90									
38	376.13	62.23	27.6	4.90	5.53	2	0.00	35.0	8152.25	0.00
1321.82	0.90									
39	381.03	26.20	29.9	2.45	2.82	2	0.00	35.0	3432.17	0.00
1092.90	0.90									
40	383.48	32.08	29.9	3.57	4.12	1	150.00	22.0	4201.93	0.00
958.33	0.99									
41	387.05	24.73	29.9	3.57	4.12	1	150.00	22.0	3239.66	0.00
726.93	0.99									
42	390.63	20.70	32.1	4.69	5.53	1	150.00	22.0	2712.06	0.00
434.83	1.00									
43	395.31	6.90	32.1	4.69	5.53	1	150.00	22.0	904.03	0.00
107.45	1.00									
		---			---				---	
X-S Area:		4255.71	Path Length:		210.33		X-S Weight:		557731.94	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 4-2\West Farm Expansion Case 4-2 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 12:45:00

DATA: Analysis 1 - Case 4-2 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	188.00	348.50	188.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	146.00	348.50	146.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	143.00	348.50	143.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	188.00	450.00	188.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	146.00	450.00	146.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	143.00	450.00	143.00	

Slope Surface (8 points)

100.00	146.00	163.00	146.00	325.00	200.00	410.00	200.00
415.00	195.00						
420.00	195.00	425.00	200.00	450.00	200.00		

Phreatic Surface (5 points)

100.00	197.00	316.00	197.00	348.50	197.00	351.50	170.00
450.00	170.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	163.00	YL:	146.00	XR:	415.00	YR: 195.00
Centre:	XC:	248.05	YC:	381.09	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 4-2 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 3.966

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.31

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	166.42	147.14	410.00	200.00	219.78	488.92	345.92	2.308	<-- Critical Surface
2	166.95	147.32	410.00	200.00	221.02	484.85	341.84	2.310	
3	167.47	147.49	410.00	200.00	222.26	480.77	337.76	2.313	
4	168.00	147.67	410.00	200.00	223.51	476.69	333.67	2.316	
5	166.42	147.14	410.00	200.00	218.85	493.19	350.00	2.317	
6	166.95	147.32	410.00	200.00	220.09	489.13	345.92	2.320	
7	167.47	147.49	410.00	200.00	221.34	485.06	341.84	2.323	
8	168.00	147.67	410.00	200.00	222.58	480.98	337.76	2.327	
9	166.42	147.14	410.53	199.47	219.93	493.03	350.00	2.328	
10	166.95	147.32	410.00	200.00	219.17	493.40	350.00	2.330	
11	165.89	146.96	410.00	200.00	218.53	492.98	350.00	2.331	
12	166.95	147.32	410.53	199.47	221.16	488.96	345.92	2.331	
13	167.47	147.49	410.00	200.00	220.41	489.34	345.92	2.333	
14	167.47	147.49	410.53	199.47	222.40	484.89	341.84	2.334	
15	168.00	147.67	410.53	199.47	223.63	480.81	337.76	2.336	
16	168.00	147.67	410.00	200.00	221.65	485.27	341.84	2.337	
17	166.95	147.32	410.53	199.47	220.25	493.23	350.00	2.341	
18	167.47	147.49	410.00	200.00	219.48	493.61	350.00	2.343	
19	167.47	147.49	410.53	199.47	221.48	489.17	345.92	2.344	
20	168.00	147.67	410.00	200.00	220.73	489.54	345.92	2.347	
21	168.00	147.67	410.53	199.47	222.72	485.10	341.84	2.348	
22	166.95	147.32	411.05	198.95	221.33	493.07	350.00	2.353	
23	167.47	147.49	410.53	199.47	220.57	493.44	350.00	2.354	
24	167.47	147.49	411.05	198.95	222.56	489.00	345.92	2.354	
25	168.00	147.67	411.05	198.95	223.78	484.92	341.84	2.356	
26	168.00	147.67	410.53	199.47	221.80	489.38	345.92	2.358	
27	168.00	147.67	410.00	200.00	219.80	493.81	350.00	2.359	
28	167.47	147.49	411.05	198.95	221.65	493.27	350.00	2.365	
29	168.00	147.67	411.05	198.95	222.88	489.20	345.92	2.368	
30	168.00	147.67	410.53	199.47	220.89	493.65	350.00	2.369	
31	167.47	147.49	411.58	198.42	222.73	493.10	350.00	2.375	
32	168.00	147.67	411.58	198.42	223.95	489.03	345.92	2.376	
33	168.00	147.67	411.05	198.95	221.97	493.48	350.00	2.378	
34	168.00	147.67	411.58	198.42	223.06	493.31	350.00	2.388	
35	168.00	147.67	412.11	197.89	224.14	493.14	350.00	2.397	
36	168.00	147.67	412.63	197.37	225.21	492.96	350.00	2.458	
37	168.00	147.67	412.11	197.89	225.02	488.85	345.92	2.493	
38	167.47	147.49	412.11	197.89	223.81	492.93	350.00	2.509	
39	168.00	147.67	411.58	198.42	224.84	484.74	341.84	2.534	
40	167.47	147.49	411.58	198.42	223.62	488.82	345.92	2.535	
41	166.95	147.32	411.58	198.42	222.41	492.89	350.00	2.548	
42	167.47	147.49	411.05	198.95	223.46	484.71	341.84	2.568	
43	166.95	147.32	411.05	198.95	222.23	488.79	345.92	2.570	
44	168.00	147.67	411.05	198.95	224.69	480.63	337.76	2.581	
45	166.42	147.14	411.05	198.95	221.01	492.86	350.00	2.584	
46	166.95	147.32	410.53	199.47	222.08	484.68	341.84	2.598	
47	166.42	147.14	410.53	199.47	220.85	488.75	345.92	2.604	
48	167.47	147.49	410.53	199.47	223.32	480.60	337.76	2.607	
49	168.00	147.67	410.53	199.47	224.55	476.51	333.67	2.622	
50	165.89	146.96	410.53	199.47	219.61	492.82	350.00	2.624	
51	168.00	147.67	410.00	200.00	224.44	472.39	329.59	2.624	
52	166.42	147.14	410.00	200.00	220.70	484.64	341.84	2.631	
53	166.95	147.32	410.00	200.00	221.95	480.56	337.76	2.632	
54	167.47	147.49	410.00	200.00	223.19	476.48	333.67	2.633	
55	165.89	146.96	410.00	200.00	219.46	488.71	345.92	2.646	
56	165.37	146.79	410.00	200.00	218.21	492.78	350.00	2.690	
57	168.00	147.67	412.63	197.37	226.08	488.67	345.92	2.760	
58	168.00	147.67	412.11	197.89	225.90	484.56	341.84	2.761	
59	168.00	147.67	413.16	196.84	226.29	492.78	350.00	2.763	
60	168.00	147.67	411.58	198.42	225.74	480.45	337.76	2.766	
61	167.47	147.49	412.11	197.89	224.69	488.64	345.92	2.768	
62	167.47	147.49	412.63	197.37	224.88	492.75	350.00	2.770	
63	167.47	147.49	411.58	198.42	224.52	484.53	341.84	2.772	

64	168.00	147.67	411.05	198.95	225.59	476.33	333.67	2.775
65	167.47	147.49	411.05	198.95	224.37	480.42	337.76	2.779
66	166.95	147.32	412.11	197.89	223.48	492.72	350.00	2.782
67	166.95	147.32	411.58	198.42	223.30	488.61	345.92	2.784
68	168.00	147.67	410.53	199.47	225.47	472.21	329.59	2.788
69	166.95	147.32	411.05	198.95	223.14	484.50	341.84	2.789
70	167.47	147.49	410.53	199.47	224.24	476.30	333.67	2.790
71	166.42	147.14	410.00	200.00	221.64	480.35	337.76	2.799
72	166.95	147.32	410.00	200.00	222.88	476.27	333.67	2.801
73	165.89	146.96	410.00	200.00	220.39	484.43	341.84	2.801
74	166.42	147.14	410.53	199.47	221.76	484.47	341.84	2.801
75	166.42	147.14	411.58	198.42	222.08	492.69	350.00	2.804
76	168.00	147.67	410.00	200.00	225.37	468.08	325.51	2.804
77	166.95	147.32	410.53	199.47	223.00	480.39	337.76	2.805
78	165.89	146.96	410.53	199.47	220.53	488.54	345.92	2.805
79	166.42	147.14	411.05	198.95	221.91	488.58	345.92	2.808
80	167.47	147.49	410.00	200.00	224.12	472.18	329.59	2.809
81	165.37	146.79	410.53	199.47	219.29	492.61	350.00	2.812
82	165.89	146.96	411.05	198.95	220.69	492.65	350.00	2.812
83	165.37	146.79	410.00	200.00	219.14	488.50	345.92	2.814
84	164.84	146.61	410.00	200.00	217.90	492.57	350.00	2.825
85	165.89	146.96	410.00	200.00	221.32	480.14	337.76	2.897
86	166.42	147.14	410.00	200.00	222.57	476.06	333.67	2.898
87	165.37	146.79	410.00	200.00	220.08	484.22	341.84	2.899
88	165.89	146.96	410.53	199.47	221.45	484.26	341.84	2.900
89	166.42	147.14	410.53	199.47	222.68	480.18	337.76	2.900
90	165.37	146.79	410.53	199.47	220.21	488.33	345.92	2.903
91	166.95	147.32	410.53	199.47	223.92	476.09	333.67	2.904
92	166.42	147.14	411.05	198.95	222.82	484.29	341.84	2.905
93	166.95	147.32	410.00	200.00	223.81	471.97	329.59	2.905
94	166.95	147.32	411.05	198.95	224.05	480.21	337.76	2.905
95	165.89	146.96	411.05	198.95	221.59	488.37	345.92	2.906
96	166.95	147.32	411.58	198.42	224.20	484.32	341.84	2.908
97	166.42	147.14	411.58	198.42	222.98	488.40	345.92	2.909
98	167.47	147.49	411.05	198.95	225.28	476.12	333.67	2.910
99	164.84	146.61	410.53	199.47	218.97	492.40	350.00	2.911

Critical Failure Surface (circle 1)

Intersects: XL: 166.42 YL: 147.14 XR: 410.00 YR: 200.00
Centre: XC: 219.78 YC: 488.92 Radius: R: 345.92
Generated failure surface: (20 points)
166.42 147.14 179.72 145.33 193.07 144.03 206.47 143.26
219.89 143.00
233.30 143.27 246.70 144.05 260.06 145.35 273.35 147.17
286.57 149.51
299.68 152.36 312.67 155.71 325.53 159.56 338.22 163.91
350.74 168.75
363.06 174.07 375.16 179.87 387.03 186.12 398.65 192.84
410.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	166.42	4.11	-7.8	4.18	4.22	2	0.00	35.0	538.34	13211.00	3199.33	1.05
2	170.60	12.33	-7.8	4.18	4.22	2	0.00	35.0	1615.00	13361.21	3375.49	1.05
3	174.79	25.08	-7.8	4.93	4.98	3	100.00	18.0	3301.49	15937.23	3568.59	1.03
4	179.72	51.30	-5.5	6.68	6.71	3	100.00	18.0	6786.52	21769.78	3793.11	1.02
5	186.40	70.49	-5.5	6.68	6.71	3	100.00	18.0	9343.89	22040.96	4039.95	1.02
6	193.07	89.10	-3.3	6.70	6.71	3	100.00	18.0	11817.28	22257.47	4261.61	1.01
7	199.77	106.66	-3.3	6.70	6.71	3	100.00	18.0	14143.05	22419.94	4471.00	1.01
8	206.47	123.54	-1.1	6.71	6.71	3	100.00	18.0	16371.86	22527.96	4653.25	1.00
9	213.18	139.40	-1.1	6.71	6.71	3	100.00	18.0	18458.04	22581.55	4825.14	1.00
10	219.89	154.38	1.1	6.71	6.71	3	100.00	18.0	20421.09	22580.93	4968.18	1.00
11	226.60	168.50	1.1	6.71	6.71	3	100.00	18.0	22261.04	22525.53	5102.52	1.00
12	233.30	181.45	3.4	6.70	6.71	3	100.00	18.0	23939.84	22415.43	5206.58	0.99
13	240.00	193.78	3.4	6.70	6.71	3	100.00	18.0	25528.32	22251.13	5303.41	0.99

14	246.70	204.59	5.6	6.68	6.71	3	100.00	18.0	26909.62	22032.45
5368.76	0.99									
15	253.38	215.10	5.6	6.68	6.71	3	100.00	18.0	28243.10	21759.52
5428.17	0.99									
16	260.06	157.81	7.8	4.72	4.76	3	100.00	18.0	20688.77	15245.23
5451.91	0.99									
17	264.77	147.32	7.8	4.29	4.33	2	0.00	35.0	19299.49	13698.95
5426.16	0.97									
18	269.06	150.94	7.8	4.29	4.33	2	0.00	35.0	19772.83	13540.23
5444.98	0.97									
19	273.35	238.70	10.0	6.61	6.71	2	0.00	35.0	31269.13	20616.29
5424.80	0.96									
20	279.96	245.53	10.0	6.61	6.71	2	0.00	35.0	32165.02	20127.56
5419.33	0.96									
21	286.57	92.04	12.2	2.43	2.49	2	0.00	35.0	12057.88	7338.94
5381.07	0.96									
22	289.00	204.38	12.2	5.34	5.46	2	0.00	35.0	26773.65	15815.45
5357.53	0.96									
23	294.34	207.70	12.2	5.34	5.46	2	0.00	35.0	27208.17	15420.28
5325.19	0.96									
24	299.68	256.29	14.5	6.50	6.71	2	0.00	35.0	33574.41	18340.63
5243.20	0.96									
25	306.18	259.47	14.5	6.50	6.71	2	0.00	35.0	33990.96	17638.84
5169.74	0.96									
26	312.67	133.84	16.7	3.33	3.47	2	0.00	35.0	17532.50	8838.74
5075.67	0.96									
27	316.00	181.66	16.7	4.50	4.70	2	0.00	35.0	23798.01	11614.52
5053.60	0.96									
28	320.50	182.34	16.7	4.50	4.70	2	0.00	35.0	23886.92	11219.01
5064.69	0.96									
29	325.00	261.06	18.7	6.61	6.98	2	0.00	35.0	34198.55	15894.72
4902.42	0.96									
30	331.61	246.08	18.9	6.61	6.99	2	0.00	35.0	32236.82	14923.57
4617.84	0.96									
31	338.22	180.34	21.1	5.14	5.51	2	0.00	35.0	23624.33	11033.37
4325.03	0.96									
32	343.36	170.13	21.1	5.14	5.51	2	0.00	35.0	22287.28	10350.56
4079.11	0.96									
33	348.50	70.95	21.1	2.24	2.40	5	0.00	45.0	7804.19	2787.31
3151.59	0.92									
34	350.74	88.61	23.4	2.89	3.15	2	0.00	35.0	11608.39	122.89
3551.54	0.96									
35	353.63	136.59	23.4	4.71	5.13	2	0.00	35.0	17893.91	0.00
3356.78	0.96									
36	358.35	127.00	23.4	4.71	5.13	2	0.00	35.0	16637.22	0.00
3121.03	0.96									
37	363.06	148.15	25.6	6.05	6.71	2	0.00	35.0	19408.21	0.00
2800.19	0.97									
38	369.11	130.62	25.6	6.05	6.71	2	0.00	35.0	17111.37	0.00
2468.81	0.97									
39	375.16	110.21	27.8	5.93	6.71	2	0.00	35.0	14437.86	0.00
2097.11	0.97									
40	381.10	91.64	27.8	5.93	6.71	2	0.00	35.0	12004.69	0.00
1743.68	0.97									
41	387.03	41.98	30.0	3.25	3.75	2	0.00	35.0	5499.99	0.00
1441.96	0.98									
42	390.28	45.17	30.0	4.19	4.84	1	150.00	22.0	5917.84	0.00
1249.49	1.05									
43	394.46	35.04	30.0	4.19	4.84	1	150.00	22.0	4590.72	0.00
961.63	1.05									
44	398.65	30.47	32.2	5.67	6.71	1	150.00	22.0	3992.05	0.00
596.60	1.06									
45	404.33	10.16	32.2	5.67	6.71	1	150.00	22.0	1330.68	0.00
174.24	1.06									

X-S Area: 6122.06 Path Length: 254.97 X-S Weight: 802280.44

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 4-2\West Farm Expansion Case 4-2 Rapid Drawdown-EQ.gmf
Processed: 04 Dec 2020 12:43:58

DATA: Analysis 1 - Case 4-2 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	188.00	348.50	188.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	146.00	348.50	146.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	143.00	348.50	143.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	188.00	450.00	188.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	146.00	450.00	146.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	143.00	450.00	143.00	

Slope Surface (8 points)

100.00	146.00	163.00	146.00	325.00	200.00	410.00	200.00
415.00	195.00						
420.00	195.00	425.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	146.00	163.00	146.00	316.00	197.00	348.50	197.00
351.50	170.00						
450.00	170.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	163.00	YL:	146.00	XR:	415.00	YR:	195.00
Centre:	XC:	248.05	YC:	381.09	Radius:	R:	250.00	

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 4-2 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.440

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.38

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	166.42	147.14	410.00	200.00	219.78	488.92	345.92	1.381	<-- Critical Surface
2	166.95	147.32	410.00	200.00	221.02	484.85	341.84	1.383	
3	167.47	147.49	410.00	200.00	222.26	480.77	337.76	1.385	
4	168.00	147.67	410.00	200.00	223.51	476.69	333.67	1.386	
5	166.42	147.14	410.00	200.00	218.85	493.19	350.00	1.388	
6	166.95	147.32	410.00	200.00	220.09	489.13	345.92	1.390	
7	167.47	147.49	410.00	200.00	221.34	485.06	341.84	1.392	
8	168.00	147.67	410.00	200.00	222.58	480.98	337.76	1.394	
9	166.42	147.14	410.53	199.47	219.93	493.03	350.00	1.395	
10	166.95	147.32	410.00	200.00	219.17	493.40	350.00	1.396	
11	165.89	146.96	410.00	200.00	218.53	492.98	350.00	1.396	
12	166.95	147.32	410.53	199.47	221.16	488.96	345.92	1.397	
13	167.47	147.49	410.00	200.00	220.41	489.34	345.92	1.398	
14	167.47	147.49	410.53	199.47	222.40	484.89	341.84	1.399	
15	168.00	147.67	410.53	199.47	223.63	480.81	337.76	1.400	
16	168.00	147.67	410.00	200.00	221.65	485.27	341.84	1.401	
17	166.95	147.32	410.53	199.47	220.25	493.23	350.00	1.404	
18	167.47	147.49	410.00	200.00	219.48	493.61	350.00	1.405	
19	167.47	147.49	410.53	199.47	221.48	489.17	345.92	1.406	
20	168.00	147.67	410.00	200.00	220.73	489.54	345.92	1.408	
21	168.00	147.67	410.53	199.47	222.72	485.10	341.84	1.408	
22	166.95	147.32	411.05	198.95	221.33	493.07	350.00	1.411	
23	167.47	147.49	410.53	199.47	220.57	493.44	350.00	1.413	
24	167.47	147.49	411.05	198.95	222.56	489.00	345.92	1.413	
25	168.00	147.67	411.05	198.95	223.78	484.92	341.84	1.414	
26	168.00	147.67	410.53	199.47	221.80	489.38	345.92	1.415	
27	168.00	147.67	410.00	200.00	219.80	493.81	350.00	1.416	
28	167.47	147.49	411.05	198.95	221.65	493.27	350.00	1.420	
29	168.00	147.67	411.05	198.95	222.88	489.20	345.92	1.422	
30	168.00	147.67	410.53	199.47	220.89	493.65	350.00	1.423	
31	167.47	147.49	411.58	198.42	222.73	493.10	350.00	1.427	
32	168.00	147.67	411.58	198.42	223.95	489.03	345.92	1.428	
33	168.00	147.67	411.05	198.95	221.97	493.48	350.00	1.429	
34	168.00	147.67	411.58	198.42	223.06	493.31	350.00	1.436	
35	168.00	147.67	412.11	197.89	224.14	493.14	350.00	1.442	
36	168.00	147.67	412.63	197.37	225.21	492.96	350.00	1.482	
37	168.00	147.67	412.11	197.89	225.02	488.85	345.92	1.505	
38	167.47	147.49	412.11	197.89	223.81	492.93	350.00	1.515	
39	168.00	147.67	411.58	198.42	224.84	484.74	341.84	1.531	
40	167.47	147.49	411.58	198.42	223.62	488.82	345.92	1.532	
41	166.95	147.32	411.58	198.42	222.41	492.89	350.00	1.540	
42	167.47	147.49	411.05	198.95	223.46	484.71	341.84	1.553	
43	166.95	147.32	411.05	198.95	222.23	488.79	345.92	1.554	
44	168.00	147.67	411.05	198.95	224.69	480.63	337.76	1.562	
45	166.42	147.14	411.05	198.95	221.01	492.86	350.00	1.563	
46	166.95	147.32	410.53	199.47	222.08	484.68	341.84	1.571	
47	166.42	147.14	410.53	199.47	220.85	488.75	345.92	1.575	
48	167.47	147.49	410.53	199.47	223.32	480.60	337.76	1.577	
49	168.00	147.67	410.53	199.47	224.55	476.51	333.67	1.587	
50	168.00	147.67	410.00	200.00	224.44	472.39	329.59	1.588	
51	165.89	146.96	410.53	199.47	219.61	492.82	350.00	1.589	
52	166.42	147.14	410.00	200.00	220.70	484.64	341.84	1.592	
53	166.95	147.32	410.00	200.00	221.95	480.56	337.76	1.593	
54	167.47	147.49	410.00	200.00	223.19	476.48	333.67	1.594	
55	165.89	146.96	410.00	200.00	219.46	488.71	345.92	1.602	
56	165.37	146.79	410.00	200.00	218.21	492.78	350.00	1.629	
57	168.00	147.67	412.63	197.37	226.08	488.67	345.92	1.680	
58	168.00	147.67	412.11	197.89	225.90	484.56	341.84	1.680	
59	168.00	147.67	413.16	196.84	226.29	492.78	350.00	1.681	
60	168.00	147.67	411.58	198.42	225.74	480.45	337.76	1.683	
61	167.47	147.49	412.11	197.89	224.69	488.64	345.92	1.684	
62	167.47	147.49	412.63	197.37	224.88	492.75	350.00	1.685	

63	167.47	147.49	411.58	198.42	224.52	484.53	341.84	1.686
64	168.00	147.67	411.05	198.95	225.59	476.33	333.67	1.688
65	167.47	147.49	411.05	198.95	224.37	480.42	337.76	1.690
66	166.95	147.32	412.11	197.89	223.48	492.72	350.00	1.693
67	166.95	147.32	411.58	198.42	223.30	488.61	345.92	1.694
68	168.00	147.67	410.53	199.47	225.47	472.21	329.59	1.695
69	167.47	147.49	410.53	199.47	224.24	476.30	333.67	1.696
70	166.95	147.32	411.05	198.95	223.14	484.50	341.84	1.696
71	166.42	147.14	410.00	200.00	221.64	480.35	337.76	1.701
72	166.95	147.32	410.00	200.00	222.88	476.27	333.67	1.702
73	165.89	146.96	410.00	200.00	220.39	484.43	341.84	1.703
74	166.42	147.14	410.53	199.47	221.76	484.47	341.84	1.704
75	168.00	147.67	410.00	200.00	225.37	468.08	325.51	1.705
76	166.95	147.32	410.53	199.47	223.00	480.39	337.76	1.706
77	165.89	146.96	410.53	199.47	220.53	488.54	345.92	1.706
78	166.42	147.14	411.58	198.42	222.08	492.69	350.00	1.706
79	167.47	147.49	410.00	200.00	224.12	472.18	329.59	1.708
80	166.42	147.14	411.05	198.95	221.91	488.58	345.92	1.708
81	165.37	146.79	410.00	200.00	219.14	488.50	345.92	1.709
82	165.37	146.79	410.53	199.47	219.29	492.61	350.00	1.711
83	165.89	146.96	411.05	198.95	220.69	492.65	350.00	1.711
84	164.84	146.61	410.00	200.00	217.90	492.57	350.00	1.716
85	165.89	146.96	410.00	200.00	221.32	480.14	337.76	1.764
86	166.42	147.14	410.00	200.00	222.57	476.06	333.67	1.765
87	165.37	146.79	410.00	200.00	220.08	484.22	341.84	1.766
88	165.89	146.96	410.53	199.47	221.45	484.26	341.84	1.767
89	166.42	147.14	410.53	199.47	222.68	480.18	337.76	1.767
90	166.95	147.32	410.00	200.00	223.81	471.97	329.59	1.769
91	165.37	146.79	410.53	199.47	220.21	488.33	345.92	1.769
92	166.95	147.32	410.53	199.47	223.92	476.09	333.67	1.770
93	166.42	147.14	411.05	198.95	222.82	484.29	341.84	1.771
94	166.95	147.32	411.05	198.95	224.05	480.21	337.76	1.771
95	165.89	146.96	411.05	198.95	221.59	488.37	345.92	1.772
96	164.84	146.61	410.00	200.00	218.83	488.29	345.92	1.773
97	166.95	147.32	411.58	198.42	224.20	484.32	341.84	1.774
98	164.84	146.61	410.53	199.47	218.97	492.40	350.00	1.774
99	166.42	147.14	411.58	198.42	222.98	488.40	345.92	1.775

Critical Failure Surface (circle 1)

Intersects: XL: 166.42 YL: 147.14 XR: 410.00 YR: 200.00
Centre: XC: 219.78 YC: 488.92 Radius: R: 345.92
Generated failure surface: (20 points)
166.42 147.14 179.72 145.33 193.07 144.03 206.47 143.26
219.89 143.00
233.30 143.27 246.70 144.05 260.06 145.35 273.35 147.17
286.57 149.51
299.68 152.36 312.67 155.71 325.53 159.56 338.22 163.91
350.74 168.75
363.06 174.07 375.16 179.87 387.03 186.12 398.65 192.84
410.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base						PoreWater	
Normal	Test								
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	166.42	4.11	-7.8	4.18	4.22	2	0.00	35.0	538.34	258.80	133.69	1.08
2	170.60	12.33	-7.8	4.18	4.22	2	0.00	35.0	1615.00	776.39	401.06	1.08
3	174.79	25.08	-7.8	4.93	4.98	3	100.00	18.0	3301.49	1579.20	691.60	1.04
4	179.72	51.30	-5.5	6.68	6.71	3	100.00	18.0	6786.52	3216.00	1035.91	1.03
5	186.40	70.49	-5.5	6.68	6.71	3	100.00	18.0	9343.89	4419.19	1423.60	1.03
6	193.07	89.10	-3.3	6.70	6.71	3	100.00	18.0	11817.28	5569.36	1781.36	1.02
7	199.77	106.66	-3.3	6.70	6.71	3	100.00	18.0	14143.05	6666.66	2131.11	1.02
8	206.47	123.54	-1.1	6.71	6.71	3	100.00	18.0	16371.86	7710.21	2447.72	1.00
9	213.18	139.40	-1.1	6.71	6.71	3	100.00	18.0	18458.04	8700.02	2759.43	1.00
10	219.89	154.38	1.1	6.71	6.71	3	100.00	18.0	20421.09	9635.45	3035.26	1.00
11	226.60	168.50	1.1	6.71	6.71	3	100.00	18.0	22261.04	10516.28	3308.88	1.00
12	233.30	181.45	3.4	6.70	6.71	3	100.00	18.0	23939.84	11341.83	3544.31	0.99
13	240.00	193.78	3.4	6.70	6.71	3	100.00	18.0	25528.32	12112.32		

3779.80	0.99									
14	246.70	204.59	5.6	6.68	6.71	3	100.00	18.0	26909.62	12827.05
3975.22	0.98									
15	253.38	215.10	5.6	6.68	6.71	3	100.00	18.0	28243.10	13486.08
4172.63	0.98									
16	260.06	157.81	7.8	4.72	4.76	3	100.00	18.0	20688.77	9939.47
4305.29	0.98									
17	264.77	147.32	7.8	4.29	4.33	2	0.00	35.0	19299.49	9278.86
4346.28	0.94									
18	269.06	150.94	7.8	4.29	4.33	2	0.00	35.0	19772.83	9506.43
4452.88	0.94									
19	273.35	238.70	10.0	6.61	6.71	2	0.00	35.0	31269.13	15125.37
4528.79	0.93									
20	279.96	245.53	10.0	6.61	6.71	2	0.00	35.0	32165.02	15558.73
4658.53	0.93									
21	286.57	92.04	12.2	2.43	2.49	2	0.00	35.0	12057.88	5877.30
4697.29	0.92									
22	289.00	204.38	12.2	5.34	5.46	2	0.00	35.0	26773.65	13050.11
4753.45	0.92									
23	294.34	207.70	12.2	5.34	5.46	2	0.00	35.0	27208.17	13261.91
4830.60	0.92									
24	299.68	256.29	14.5	6.50	6.71	2	0.00	35.0	33574.41	16516.40
4854.77	0.91									
25	306.18	259.47	14.5	6.50	6.71	2	0.00	35.0	33990.96	16721.30
4915.00	0.91									
26	312.67	133.84	16.7	3.33	3.47	2	0.00	35.0	17532.50	8718.63
4907.05	0.91									
27	316.00	181.66	16.7	4.50	4.70	2	0.00	35.0	23798.01	11614.52
4916.87	0.91									
28	320.50	182.34	16.7	4.50	4.70	2	0.00	35.0	23886.92	11219.01
4922.91	0.91									
29	325.00	261.06	18.7	6.61	6.98	2	0.00	35.0	34198.55	15894.72
4747.74	0.90									
30	331.61	246.08	18.9	6.61	6.99	2	0.00	35.0	32236.82	14923.57
4470.34	0.90									
31	338.22	180.34	21.1	5.14	5.51	2	0.00	35.0	23624.33	11033.37
4172.25	0.90									
32	343.36	170.13	21.1	5.14	5.51	2	0.00	35.0	22287.28	10350.56
3934.35	0.90									
33	348.50	70.95	21.1	2.24	2.40	5	0.00	45.0	7804.19	2787.31
2976.83	0.84									
34	350.74	88.61	23.4	2.89	3.15	2	0.00	35.0	11608.39	122.89
3298.24	0.89									
35	353.63	136.59	23.4	4.71	5.13	2	0.00	35.0	17893.91	0.00
3114.72	0.89									
36	358.35	127.00	23.4	4.71	5.13	2	0.00	35.0	16637.22	0.00
2895.97	0.89									
37	363.06	148.15	25.6	6.05	6.71	2	0.00	35.0	19408.21	0.00
2580.64	0.89									
38	369.11	130.62	25.6	6.05	6.71	2	0.00	35.0	17111.37	0.00
2275.24	0.89									
39	375.16	110.21	27.8	5.93	6.71	2	0.00	35.0	14437.86	0.00
1919.52	0.89									
40	381.10	91.64	27.8	5.93	6.71	2	0.00	35.0	12004.69	0.00
1596.02	0.89									
41	387.03	41.98	30.0	3.25	3.75	2	0.00	35.0	5499.99	0.00
1310.77	0.89									
42	390.28	45.17	30.0	4.19	4.84	1	150.00	22.0	5917.84	0.00
1155.39	0.99									
43	394.46	35.04	30.0	4.19	4.84	1	150.00	22.0	4590.72	0.00
884.24	0.99									
44	398.65	30.47	32.2	5.67	6.71	1	150.00	22.0	3992.05	0.00
536.05	1.00									
45	404.33	10.16	32.2	5.67	6.71	1	150.00	22.0	1330.68	0.00
140.12	1.00									

X-S Area: 6122.06 Path Length: 254.97 X-S Weight: 802280.44

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 5-1\West Farm Expansion Case 5-1 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 12:52:46

DATA: Analysis 1 - Case 5-1 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	174.00	348.50	174.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	161.00	348.50	161.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	158.00	348.50	158.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	174.00	450.00	174.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	161.00	450.00	161.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	158.00	450.00	158.00	

Slope Surface (4 points)

100.00	161.00	208.00	161.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	208.00	197.00	316.00	197.00	348.50	197.00
351.50	185.00						
450.00	185.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	208.00	YL:	161.00	XR:	385.00	YR: 200.00
Centre:	XC:	246.36	YC:	408.04	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 5-1 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 1.977

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.92

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	210.37	161.79	380.00	200.00	250.92	377.40	219.39	1.920	<-- Critical Surface
2	209.84	161.61	380.00	200.00	249.64	381.51	223.47	1.921	
3	206.68	161.00	380.00	200.00	244.44	397.80	239.80	1.922	
4	208.79	161.26	380.00	200.00	247.09	389.71	231.63	1.922	
5	209.32	161.44	380.00	200.00	248.37	385.61	227.55	1.923	
6	205.11	161.00	380.00	200.00	243.19	401.89	243.88	1.924	
7	210.89	161.96	380.00	200.00	252.20	373.27	215.31	1.924	
8	208.26	161.09	380.00	200.00	245.81	393.79	235.71	1.925	
9	203.53	161.00	380.00	200.00	241.94	405.97	247.96	1.926	
10	207.21	161.00	380.00	200.00	244.54	397.87	239.80	1.926	
11	208.79	161.26	380.53	200.00	247.52	389.64	231.63	1.926	
12	205.63	161.00	380.00	200.00	243.28	401.95	243.88	1.927	
13	208.26	161.09	380.53	200.00	246.24	393.72	235.71	1.927	
14	207.21	161.00	380.53	200.00	244.97	397.80	239.80	1.928	
15	204.05	161.00	380.00	200.00	242.04	406.03	247.96	1.929	
16	213.00	162.67	380.00	200.00	256.32	361.05	203.06	1.929	
17	207.74	161.00	380.00	200.00	244.64	397.94	239.80	1.929	
18	209.32	161.44	380.53	200.00	248.79	385.54	227.55	1.929	
19	205.63	161.00	380.53	200.00	243.71	401.89	243.88	1.930	
20	206.68	161.00	380.00	200.00	243.48	402.09	243.88	1.930	
21	206.16	161.00	380.00	200.00	243.38	402.02	243.88	1.931	
22	212.47	162.49	380.00	200.00	255.05	365.21	207.14	1.931	
23	210.37	161.79	380.00	200.00	249.95	381.73	223.47	1.931	
24	204.05	161.00	380.53	200.00	242.46	405.97	247.96	1.932	
25	207.74	161.00	380.53	200.00	245.07	397.87	239.80	1.932	
26	204.58	161.00	380.00	200.00	242.13	406.10	247.96	1.932	
27	209.84	161.61	380.00	200.00	248.67	385.83	227.55	1.933	
28	212.47	162.49	380.53	200.00	255.46	365.12	207.14	1.933	
29	211.95	162.32	380.00	200.00	253.77	369.36	211.22	1.933	
30	206.16	161.00	380.53	200.00	243.81	401.95	243.88	1.933	
31	211.95	162.32	380.53	200.00	254.19	369.27	211.22	1.933	
32	208.26	161.09	380.00	200.00	244.84	398.08	239.80	1.934	
33	209.32	161.44	380.00	200.00	247.39	389.92	231.63	1.934	
34	211.42	162.14	380.53	200.00	252.91	373.41	215.31	1.934	
35	203.00	161.00	380.00	200.00	240.89	410.18	252.04	1.934	
36	211.42	162.14	380.00	200.00	252.50	373.49	215.31	1.934	
37	207.21	161.00	380.00	200.00	243.58	402.15	243.88	1.934	
38	208.79	161.26	380.00	200.00	246.12	394.00	235.71	1.935	
39	204.58	161.00	380.53	200.00	242.56	406.03	247.96	1.935	
40	210.89	161.96	380.53	200.00	251.64	377.54	219.39	1.936	
41	205.11	161.00	380.00	200.00	242.23	406.16	247.96	1.936	
42	205.63	161.00	380.00	200.00	242.33	406.23	247.96	1.936	
43	206.16	161.00	381.05	200.00	244.24	401.89	243.88	1.936	
44	211.95	162.32	381.05	200.00	254.60	369.19	211.22	1.936	
45	207.21	161.00	380.53	200.00	244.01	402.09	243.88	1.936	
46	206.68	161.00	380.53	200.00	243.91	402.02	243.88	1.937	
47	211.42	162.14	381.05	200.00	253.33	373.33	215.31	1.937	
48	203.00	161.00	380.53	200.00	241.32	410.11	252.04	1.937	
49	210.89	161.96	381.05	200.00	252.06	377.46	219.39	1.937	
50	204.05	161.00	380.00	200.00	241.09	410.30	252.04	1.937	
51	210.37	161.79	381.05	200.00	250.79	381.57	223.47	1.937	
52	203.53	161.00	380.00	200.00	240.99	410.24	252.04	1.937	
53	208.79	161.26	380.53	200.00	246.55	393.93	235.71	1.937	
54	204.58	161.00	381.05	200.00	242.99	405.97	247.96	1.937	
55	205.11	161.00	380.53	200.00	242.66	406.10	247.96	1.938	
56	207.74	161.00	380.00	200.00	243.67	402.22	243.88	1.939	
57	210.89	161.96	380.00	200.00	251.22	377.61	219.39	1.939	
58	209.84	161.61	380.53	200.00	249.09	385.75	227.55	1.939	
59	210.37	161.79	380.53	200.00	250.37	381.65	223.47	1.939	
60	203.00	161.00	381.05	200.00	241.75	410.04	252.04	1.939	
61	206.68	161.00	381.05	200.00	244.34	401.95	243.88	1.939	
62	207.74	161.00	381.05	200.00	245.50	397.80	239.80	1.940	
63	209.84	161.61	381.05	200.00	249.51	385.68	227.55	1.940	
64	208.26	161.09	380.53	200.00	245.27	398.01	239.80	1.940	

65	206.16	161.00	380.00	200.00	242.42	406.29	247.96	1.940
66	203.53	161.00	380.53	200.00	241.42	410.18	252.04	1.940
67	210.89	161.96	381.58	200.00	252.47	377.38	219.39	1.940
68	210.37	161.79	381.58	200.00	251.20	381.50	223.47	1.940
69	209.32	161.44	381.05	200.00	248.24	389.78	231.63	1.941
70	207.74	161.00	380.53	200.00	244.10	402.15	243.88	1.941
71	209.84	161.61	381.58	200.00	249.93	385.61	227.55	1.941
72	205.11	161.00	381.05	200.00	243.09	406.03	247.96	1.941
73	204.58	161.00	380.00	200.00	241.18	410.37	252.04	1.942
74	209.32	161.44	380.53	200.00	247.82	389.85	231.63	1.942
75	205.63	161.00	380.53	200.00	242.76	406.16	247.96	1.942
76	206.16	161.00	380.53	200.00	242.85	406.23	247.96	1.942
77	213.00	162.67	380.00	200.00	255.34	365.44	207.14	1.942
78	209.32	161.44	381.58	200.00	248.67	389.70	231.63	1.942
79	208.79	161.26	381.58	200.00	247.40	393.79	235.71	1.942
80	207.74	161.00	381.05	200.00	244.53	402.09	243.88	1.942
81	203.53	161.00	381.05	200.00	241.85	410.11	252.04	1.943
82	207.21	161.00	381.05	200.00	244.44	402.02	243.88	1.943
83	209.32	161.44	380.00	200.00	246.42	394.21	235.71	1.943
84	203.00	161.00	380.00	200.00	239.95	414.44	256.12	1.943
85	204.58	161.00	380.53	200.00	241.61	410.30	252.04	1.943
86	204.05	161.00	380.53	200.00	241.52	410.24	252.04	1.943
87	208.79	161.26	381.05	200.00	246.97	393.86	235.71	1.943
88	205.11	161.00	381.58	200.00	243.51	405.97	247.96	1.943
89	212.47	162.49	380.00	200.00	254.07	369.58	211.22	1.944
90	209.32	161.44	382.11	200.00	249.09	389.63	231.63	1.944
91	206.68	161.00	380.00	200.00	242.52	406.36	247.96	1.944
92	210.89	161.96	380.00	200.00	250.25	381.94	223.47	1.944
93	205.63	161.00	381.05	200.00	243.19	406.10	247.96	1.944
94	213.00	162.67	380.53	200.00	255.76	365.35	207.14	1.945
95	208.79	161.26	380.00	200.00	245.15	398.29	239.80	1.945
96	203.00	161.00	380.53	200.00	240.38	414.38	256.12	1.945
97	211.95	162.32	380.00	200.00	252.80	373.71	215.31	1.945
98	210.37	161.79	380.00	200.00	248.97	386.04	227.55	1.945
99	212.47	162.49	380.53	200.00	254.48	369.50	211.22	1.945

Critical Failure Surface (circle 1)

Intersects: XL: 210.37 YL: 161.79 XR: 380.00 YR: 200.00
Centre: XC: 250.92 YC: 377.40 Radius: R: 219.39

Generated failure surface: (20 points)

210.37 161.79 219.65 160.25 228.99 159.11 238.37 158.37
247.77 158.03
257.18 158.10 266.58 158.57 275.95 159.44 285.27 160.71
294.53 162.39
303.71 164.45 312.79 166.91 321.76 169.76 330.60 172.99
339.29 176.59
347.82 180.57 356.17 184.90 364.33 189.59 372.27 194.63
380.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress Factor
1	210.37	5.65	-9.4	4.76	4.82	2	0.00	35.0	740.01	10713.22	2308.48 1.08
2	215.13	15.86	-9.4	4.53	4.59	3	100.00	18.0	2094.81	10412.56	2529.97 1.04
3	219.65	26.61	-7.0	4.67	4.70	3	100.00	18.0	3534.28	10872.58	2727.30 1.03
4	224.32	36.54	-7.0	4.67	4.70	3	100.00	18.0	4862.25	11040.12	2917.73 1.03
5	228.99	46.22	-4.5	4.69	4.70	3	100.00	18.0	6152.66	11178.22	3086.45 1.02
6	233.68	55.29	-4.5	4.69	4.70	3	100.00	18.0	7357.75	11286.82	3247.69 1.02
7	238.37	58.47	-2.1	4.31	4.32	3	100.00	18.0	7776.66	10428.62	3379.89 1.01
8	242.69	65.34	-2.1	4.31	4.32	3	100.00	18.0	8683.55	10470.20	3501.01 1.01
9	247.00	12.44	-2.1	0.77	0.77	3	100.00	18.0	1653.03	1881.92	3572.43 1.01
10	247.77	79.95	0.4	4.70	4.70	3	100.00	18.0	10611.94	11435.00	3624.08 1.00
11	252.48	87.17	0.4	4.70	4.70	3	100.00	18.0	11556.22	11425.19	3726.82 1.00
12	257.18	93.79	2.9	4.70	4.70	3	100.00	18.0	12417.71	11385.69	3803.02 0.99
13	261.88	100.05	2.9	4.70	4.70	3	100.00	18.0	13226.01	11316.67	3876.56 0.99
14	266.58	105.50	5.3	4.68	4.70	3	100.00	18.0	13923.56	11218.25	

3922.48	0.99									
15	271.26	110.77	5.3	4.68	4.70	3	100.00	18.0	14593.53	11090.16
3966.94	0.99									
16	275.95	114.98	7.8	4.66	4.70	3	100.00	18.0	15120.12	10932.51
3982.89	0.99									
17	280.61	119.25	7.8	4.66	4.70	3	100.00	18.0	15650.24	10745.50
3998.41	0.99									
18	285.27	41.31	10.2	1.58	1.60	3	100.00	18.0	5414.26	3618.88
3989.11	0.99									
19	286.85	102.06	10.2	3.84	3.90	2	0.00	35.0	13369.79	8681.69
3935.29	0.95									
20	290.69	104.31	10.2	3.84	3.90	2	0.00	35.0	13664.97	8512.88
3929.77	0.95									
21	294.53	127.15	12.7	4.59	4.70	2	0.00	35.0	16657.04	10009.47
3883.88	0.95									
22	299.12	129.43	12.7	4.59	4.70	2	0.00	35.0	16955.17	9705.91
3850.81	0.95									
23	303.71	129.83	15.2	4.54	4.70	2	0.00	35.0	17008.04	9373.79
3777.53	0.94									
24	308.25	131.12	15.2	4.54	4.70	2	0.00	35.0	17176.98	9012.79
3718.53	0.94									
25	312.79	93.16	17.6	3.21	3.37	2	0.00	35.0	12204.38	6211.47
3631.24	0.94									
26	316.00	83.79	17.6	2.88	3.02	2	0.00	35.0	10976.06	5394.81
3600.78	0.94									
27	318.88	83.92	17.6	2.88	3.02	2	0.00	35.0	10993.38	5222.44
3600.25	0.94									
28	321.76	94.30	20.1	3.24	3.45	2	0.00	35.0	12353.07	5735.06
3560.37	0.94									
29	325.00	156.94	20.1	5.60	5.96	2	0.00	35.0	20559.57	9310.45
3424.35	0.94									
30	330.60	64.61	22.5	2.44	2.64	2	0.00	35.0	8464.38	3870.82
3208.80	0.94									
31	333.04	79.27	22.5	3.13	3.39	1	150.00	22.0	10384.40	4721.28
3136.68	1.00									
32	336.16	75.22	22.5	3.13	3.39	1	150.00	22.0	9853.24	4447.37
2973.95	1.00									
33	339.29	95.58	25.0	4.26	4.70	1	150.00	22.0	12520.94	5699.07
2748.99	1.00									
34	343.55	87.11	25.0	4.26	4.70	1	150.00	22.0	11410.96	5115.77
2500.87	1.00									
35	347.82	13.12	27.4	0.68	0.77	1	150.00	22.0	1718.45	778.62
2337.43	1.02									
36	348.50	54.90	27.4	3.00	3.38	5	0.00	45.0	6039.04	1961.68
1708.09	0.89									
37	351.50	76.15	27.4	4.67	5.26	1	150.00	22.0	9976.00	429.77
1897.57	1.02									
38	356.17	56.79	29.9	4.08	4.70	1	150.00	22.0	7439.64	0.00
1587.18	1.03									
39	360.25	47.23	29.9	4.08	4.70	1	150.00	22.0	6186.75	0.00
1313.14	1.03									
40	364.33	36.36	32.4	3.97	4.70	1	150.00	22.0	4762.67	0.00
1013.79	1.04									
41	368.30	26.35	32.4	3.97	4.70	1	150.00	22.0	3451.87	0.00
722.76	1.04									
42	372.27	15.56	34.8	3.86	4.70	1	150.00	22.0	2038.48	0.00
413.02	1.06									
43	376.14	5.19	34.8	3.86	4.70	1	150.00	22.0	679.49	0.00
106.08	1.06									
		---			---				---	
X-S Area:		3144.64	Path Length:		178.77		X-S Weight:		412213.31	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 5-1\West Farm Expansion Case 5-1 Rapid Drawdown-EQ.gmf
Processed: 04 Dec 2020 12:51:42

DATA: Analysis 1 - Case 5-1 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	174.00	348.50	174.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	161.00	348.50	161.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	158.00	348.50	158.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	174.00	450.00	174.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	161.00	450.00	161.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	158.00	450.00	158.00	

Slope Surface (4 points)

100.00	161.00	208.00	161.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	161.00	208.00	161.00	316.00	197.00	348.50	197.00
351.50	185.00						
450.00	185.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	208.00	YL:	161.00	XR:	385.00	YR: 200.00
Centre:	XC:	246.36	YC:	408.04	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 5-1 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 1.210

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.17

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	206.68	161.00	380.00	200.00	244.44	397.80	239.80	1.167	<-- Critical Surface
2	209.84	161.61	380.00	200.00	249.64	381.51	223.47	1.167	
3	210.37	161.79	380.00	200.00	250.92	377.40	219.39	1.167	
4	208.79	161.26	380.00	200.00	247.09	389.71	231.63	1.167	
5	205.11	161.00	380.00	200.00	243.19	401.89	243.88	1.168	
6	209.32	161.44	380.00	200.00	248.37	385.61	227.55	1.168	
7	210.89	161.96	380.00	200.00	252.20	373.27	215.31	1.168	
8	203.53	161.00	380.00	200.00	241.94	405.97	247.96	1.169	
9	208.26	161.09	380.00	200.00	245.81	393.79	235.71	1.169	
10	207.21	161.00	380.00	200.00	244.54	397.87	239.80	1.169	
11	205.63	161.00	380.00	200.00	243.28	401.95	243.88	1.170	
12	208.79	161.26	380.53	200.00	247.52	389.64	231.63	1.170	
13	208.26	161.09	380.53	200.00	246.24	393.72	235.71	1.171	
14	204.05	161.00	380.00	200.00	242.04	406.03	247.96	1.171	
15	207.21	161.00	380.53	200.00	244.97	397.80	239.80	1.171	
16	209.32	161.44	380.53	200.00	248.79	385.54	227.55	1.171	
17	207.74	161.00	380.00	200.00	244.64	397.94	239.80	1.171	
18	205.63	161.00	380.53	200.00	243.71	401.89	243.88	1.172	
19	206.16	161.00	380.00	200.00	243.38	402.02	243.88	1.172	
20	206.68	161.00	380.00	200.00	243.48	402.09	243.88	1.172	
21	204.05	161.00	380.53	200.00	242.46	405.97	247.96	1.173	
22	204.58	161.00	380.00	200.00	242.13	406.10	247.96	1.173	
23	207.74	161.00	380.53	200.00	245.07	397.87	239.80	1.174	
24	210.37	161.79	380.00	200.00	249.95	381.73	223.47	1.174	
25	213.00	162.67	380.00	200.00	256.32	361.05	203.06	1.174	
26	203.00	161.00	380.00	200.00	240.89	410.18	252.04	1.174	
27	206.16	161.00	380.53	200.00	243.81	401.95	243.88	1.175	
28	209.84	161.61	380.00	200.00	248.67	385.83	227.55	1.175	
29	212.47	162.49	380.00	200.00	255.05	365.21	207.14	1.175	
30	208.26	161.09	380.00	200.00	244.84	398.08	239.80	1.175	
31	209.32	161.44	380.00	200.00	247.39	389.92	231.63	1.175	
32	207.21	161.00	380.00	200.00	243.58	402.15	243.88	1.175	
33	204.58	161.00	380.53	200.00	242.56	406.03	247.96	1.176	
34	211.95	162.32	380.00	200.00	253.77	369.36	211.22	1.176	
35	205.11	161.00	380.00	200.00	242.23	406.16	247.96	1.176	
36	208.79	161.26	380.00	200.00	246.12	394.00	235.71	1.176	
37	211.42	162.14	380.00	200.00	252.50	373.49	215.31	1.176	
38	205.63	161.00	380.00	200.00	242.33	406.23	247.96	1.176	
39	203.00	161.00	380.53	200.00	241.32	410.11	252.04	1.177	
40	203.53	161.00	380.00	200.00	240.99	410.24	252.04	1.177	
41	206.16	161.00	381.05	200.00	244.24	401.89	243.88	1.177	
42	206.68	161.00	380.53	200.00	243.91	402.02	243.88	1.177	
43	212.47	162.49	380.53	200.00	255.46	365.12	207.14	1.177	
44	204.05	161.00	380.00	200.00	241.09	410.30	252.04	1.177	
45	211.42	162.14	380.53	200.00	252.91	373.41	215.31	1.177	
46	207.21	161.00	380.53	200.00	244.01	402.09	243.88	1.177	
47	211.95	162.32	380.53	200.00	254.19	369.27	211.22	1.177	
48	210.89	161.96	380.53	200.00	251.64	377.54	219.39	1.177	
49	204.58	161.00	381.05	200.00	242.99	405.97	247.96	1.178	
50	205.11	161.00	380.53	200.00	242.66	406.10	247.96	1.178	
51	207.74	161.00	381.05	200.00	245.50	397.80	239.80	1.178	
52	208.79	161.26	380.53	200.00	246.55	393.93	235.71	1.178	
53	210.89	161.96	380.00	200.00	251.22	377.61	219.39	1.178	
54	207.74	161.00	380.00	200.00	243.67	402.22	243.88	1.178	
55	209.84	161.61	380.53	200.00	249.09	385.75	227.55	1.179	
56	203.00	161.00	381.05	200.00	241.75	410.04	252.04	1.179	
57	203.53	161.00	380.53	200.00	241.42	410.18	252.04	1.179	
58	206.16	161.00	380.00	200.00	242.42	406.29	247.96	1.179	
59	210.37	161.79	380.53	200.00	250.37	381.65	223.47	1.179	
60	206.68	161.00	381.05	200.00	244.34	401.95	243.88	1.179	
61	208.26	161.09	380.53	200.00	245.27	398.01	239.80	1.179	
62	210.37	161.79	381.05	200.00	250.79	381.57	223.47	1.179	
63	210.89	161.96	381.05	200.00	252.06	377.46	219.39	1.180	
64	211.95	162.32	381.05	200.00	254.60	369.19	211.22	1.180	

65	209.32	161.44	380.53	200.00	247.82	389.85	231.63	1.180
66	211.42	162.14	381.05	200.00	253.33	373.33	215.31	1.180
67	204.58	161.00	380.00	200.00	241.18	410.37	252.04	1.180
68	205.11	161.00	381.05	200.00	243.09	406.03	247.96	1.180
69	207.74	161.00	380.53	200.00	244.10	402.15	243.88	1.180
70	205.63	161.00	380.53	200.00	242.76	406.16	247.96	1.180
71	209.84	161.61	381.05	200.00	249.51	385.68	227.55	1.180
72	209.32	161.44	381.05	200.00	248.24	389.78	231.63	1.180
73	206.16	161.00	380.53	200.00	242.85	406.23	247.96	1.181
74	203.00	161.00	380.00	200.00	239.95	414.44	256.12	1.181
75	203.53	161.00	381.05	200.00	241.85	410.11	252.04	1.181
76	204.05	161.00	380.53	200.00	241.52	410.24	252.04	1.181
77	204.58	161.00	380.53	200.00	241.61	410.30	252.04	1.182
78	208.79	161.26	381.05	200.00	246.97	393.86	235.71	1.182
79	207.21	161.00	381.05	200.00	244.44	402.02	243.88	1.182
80	206.68	161.00	380.00	200.00	242.52	406.36	247.96	1.182
81	207.74	161.00	381.05	200.00	244.53	402.09	243.88	1.182
82	209.84	161.61	381.58	200.00	249.93	385.61	227.55	1.182
83	209.32	161.44	380.00	200.00	246.42	394.21	235.71	1.182
84	210.37	161.79	381.58	200.00	251.20	381.50	223.47	1.182
85	210.89	161.96	381.58	200.00	252.47	377.38	219.39	1.182
86	205.11	161.00	381.58	200.00	243.51	405.97	247.96	1.182
87	208.79	161.26	381.58	200.00	247.40	393.79	235.71	1.182
88	209.32	161.44	381.58	200.00	248.67	389.70	231.63	1.182
89	205.63	161.00	381.05	200.00	243.19	406.10	247.96	1.182
90	203.00	161.00	380.53	200.00	240.38	414.38	256.12	1.183
91	205.11	161.00	380.00	200.00	241.28	410.43	252.04	1.183
92	208.79	161.26	380.00	200.00	245.15	398.29	239.80	1.183
93	206.68	161.00	381.58	200.00	244.76	401.89	243.88	1.183
94	213.00	162.67	380.00	200.00	255.34	365.44	207.14	1.183
95	203.53	161.00	381.58	200.00	242.27	410.04	252.04	1.183
96	208.26	161.09	381.05	200.00	245.70	397.94	239.80	1.183
97	210.89	161.96	380.00	200.00	250.25	381.94	223.47	1.183
98	204.05	161.00	381.05	200.00	241.95	410.18	252.04	1.183
99	203.53	161.00	380.00	200.00	240.05	414.51	256.12	1.183

Critical Failure Surface (circle 1)

Intersects: XL: 206.68 YL: 161.00 XR: 380.00 YR: 200.00
Centre: XC: 244.44 YC: 397.80 Radius: R: 239.80

Generated failure surface: (20 points)

206.68 161.00 216.17 159.68 225.70 158.74 235.26 158.18
244.84 158.01
254.41 158.22 263.97 158.81 273.50 159.78 282.98 161.13
292.40 162.85
301.75 164.96 311.00 167.43 320.15 170.27 329.17 173.48
338.06 177.04
346.80 180.95 355.38 185.21 363.78 189.81 371.99 194.74
380.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	206.68	0.12	-7.9	1.32	1.33	3	100.00	18.0	16.97	7.58	25.59	1.05
2	208.00	4.69	-7.9	4.09	4.12	3	100.00	18.0	633.35	295.42	170.79	1.05
3	212.09	12.57	-7.9	4.09	4.12	3	100.00	18.0	1689.32	792.09	434.83	1.05
4	216.17	24.17	-5.6	4.77	4.79	3	100.00	18.0	3240.24	1515.47	698.85	1.03
5	220.94	33.98	-5.6	4.77	4.79	3	100.00	18.0	4547.52	2130.48	977.27	1.03
6	225.70	43.48	-3.3	4.78	4.79	3	100.00	18.0	5810.38	2717.71	1231.19	1.02
7	230.48	52.43	-3.3	4.78	4.79	3	100.00	18.0	6996.30	3277.21	1481.43	1.02
8	235.26	61.02	-1.0	4.79	4.79	3	100.00	18.0	8131.16	3808.58	1704.45	1.01
9	240.05	69.09	-1.0	4.79	4.79	3	100.00	18.0	9191.44	4311.72	1926.49	1.01
10	244.84	33.73	1.2	2.16	2.16	3	100.00	18.0	4482.15	2104.96	2065.86	0.99
11	247.00	61.25	1.2	3.71	3.71	3	100.00	18.0	8131.74	3823.05	2184.66	0.99
12	250.71	65.54	1.2	3.71	3.71	3	100.00	18.0	8689.98	4090.43	2334.77	0.99
13	254.41	90.36	3.5	4.78	4.79	3	100.00	18.0	11963.26	5649.20	2475.39	0.98
14	259.19	96.57	3.5	4.78	4.79	3	100.00	18.0	12762.30	6037.25		

2641.11	0.98									
15	263.97	101.97	5.8	4.76	4.79	3	100.00	18.0	13451.44	6396.02
2773.95	0.98									
16	268.74	107.23	5.8	4.76	4.79	3	100.00	18.0	14116.65	6725.60
2911.60	0.98									
17	273.50	100.89	8.1	4.30	4.34	3	100.00	18.0	13256.64	6359.32
3010.09	0.97									
18	277.80	104.42	8.1	4.30	4.34	3	100.00	18.0	13692.51	6581.70
3109.59	0.97									
19	282.10	21.90	8.1	0.88	0.89	2	0.00	35.0	2869.16	1380.47
3112.89	0.93									
20	282.98	118.80	10.4	4.71	4.79	2	0.00	35.0	15562.87	7536.81
3132.48	0.92									
21	287.69	122.13	10.4	4.71	4.79	2	0.00	35.0	15998.70	7747.87
3220.19	0.92									
22	292.40	123.97	12.7	4.67	4.79	2	0.00	35.0	16239.66	7928.96
3259.38	0.90									
23	297.08	126.33	12.7	4.67	4.79	2	0.00	35.0	16549.36	8080.17
3321.54	0.90									
24	301.75	126.97	15.0	4.63	4.79	2	0.00	35.0	16633.20	8201.34
3335.01	0.89									
25	306.37	128.38	15.0	4.63	4.79	2	0.00	35.0	16818.20	8292.56
3372.08	0.89									
26	311.00	139.77	17.3	5.00	5.23	2	0.00	35.0	18310.21	9133.03
3361.30	0.88									
27	316.00	116.39	17.3	4.15	4.34	2	0.00	35.0	15246.88	7417.75
3366.97	0.88									
28	320.15	136.16	19.5	4.85	5.15	2	0.00	35.0	17836.48	8311.67
3313.43	0.87									
29	325.00	113.77	19.5	4.17	4.43	2	0.00	35.0	14903.71	6704.43
3210.19	0.87									
30	329.17	34.32	21.8	1.31	1.41	2	0.00	35.0	4496.07	2043.62
3054.72	0.87									
31	330.48	95.70	21.8	3.79	4.08	1	150.00	22.0	12537.35	5668.91
3027.41	0.95									
32	334.27	89.94	21.8	3.79	4.08	1	150.00	22.0	11782.75	5281.67
2841.08	0.95									
33	338.06	96.08	24.1	4.37	4.79	1	150.00	22.0	12585.88	5672.38
2602.25	0.95									
34	342.43	87.52	24.1	4.37	4.79	1	150.00	22.0	11465.35	5087.54
2363.87	0.95									
35	346.80	31.58	26.4	1.70	1.89	1	150.00	22.0	4137.53	1846.13
2170.45	0.95									
36	348.50	52.38	26.4	3.00	3.35	5	0.00	45.0	5761.62	1768.19
1504.65	0.78									
37	351.50	54.73	26.4	3.45	3.85	1	150.00	22.0	7170.18	206.15
1725.76	0.95									
38	354.95	60.99	28.5	4.42	5.02	1	150.00	22.0	7989.99	0.00
1464.54	0.96									
39	359.37	50.32	28.7	4.42	5.03	1	150.00	22.0	6591.52	0.00
1195.67	0.96									
40	363.78	36.76	31.0	4.11	4.79	1	150.00	22.0	4815.21	0.00
907.03	0.97									
41	367.89	26.63	31.0	4.11	4.79	1	150.00	22.0	3489.16	0.00
639.65	0.97									
42	371.99	15.78	33.3	4.00	4.79	1	150.00	22.0	2067.06	0.00
351.93	0.97									
43	376.00	5.26	33.3	4.00	4.79	1	150.00	22.0	689.03	0.00
71.47	0.97									

X-S Area: 3076.08 Path Length: 181.97 X-S Weight: 403350.50

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 5-2\West Farm Expansion Case 5-2 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 12:56:33

DATA: Analysis 1 - Case 5-2 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	192.00	348.50	192.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	183.00	348.50	183.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	180.00	348.50	180.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	192.00	450.00	192.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	183.00	450.00	183.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	180.00	450.00	180.00	

Slope Surface (8 points)

100.00	183.00	274.00	183.00	325.00	200.00	400.00	200.00
405.00	195.00						
410.00	195.00	415.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	197.00	274.00	197.00	316.00	197.00	348.50	197.00
351.50	197.00						
450.00	197.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	274.00	YL:	183.00	XR:	405.00	YR:	195.00
Centre:	XC:	317.50	YC:	429.19	Radius:	R:	250.00	

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 5-2 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 6.381

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.72

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	274.26	183.09	400.00	200.00	310.27	391.22	211.22	2.720	<-- Critical Surface
2	271.11	183.00	400.00	200.00	307.60	403.47	223.47	2.722	
3	274.79	183.26	400.00	200.00	311.26	387.17	207.14	2.725	
4	273.74	183.00	400.00	200.00	309.43	395.33	215.31	2.726	
5	270.05	183.00	400.00	200.00	306.76	407.57	227.55	2.726	
6	272.68	183.00	400.00	200.00	308.58	399.43	219.39	2.726	
7	271.63	183.00	400.00	200.00	307.74	403.53	223.47	2.730	
8	269.00	183.00	400.00	200.00	305.93	411.67	231.63	2.731	
9	275.32	183.44	400.00	200.00	312.24	383.12	203.06	2.731	
10	270.58	183.00	400.00	200.00	306.90	407.63	227.55	2.734	
11	274.79	183.26	400.53	199.47	311.89	391.20	211.22	2.736	
12	275.84	183.61	400.00	200.00	313.21	379.05	198.98	2.738	
13	272.16	183.00	400.00	200.00	307.88	403.60	223.47	2.739	
14	269.53	183.00	400.00	200.00	306.07	411.73	231.63	2.739	
15	271.63	183.00	400.53	199.47	308.43	407.56	227.55	2.740	
16	273.21	183.00	400.00	200.00	308.72	399.50	219.39	2.741	
17	274.26	183.09	400.00	200.00	309.70	395.46	215.31	2.741	
18	272.68	183.00	400.53	199.47	309.26	403.46	223.47	2.741	
19	271.11	183.00	400.00	200.00	307.04	407.70	227.55	2.743	
20	270.58	183.00	400.53	199.47	307.61	411.65	231.63	2.743	
21	275.32	183.44	400.53	199.47	312.86	387.15	207.14	2.743	
22	276.37	183.79	400.00	200.00	314.18	374.98	194.90	2.746	
23	274.79	183.26	400.00	200.00	310.69	391.41	211.22	2.746	
24	273.74	183.00	400.00	200.00	308.86	399.56	219.39	2.747	
25	272.68	183.00	400.00	200.00	308.01	403.66	223.47	2.747	
26	270.05	183.00	400.00	200.00	306.21	411.79	231.63	2.747	
27	269.53	183.00	400.53	199.47	306.79	415.75	235.71	2.748	
28	273.21	183.00	400.53	199.47	309.40	403.52	223.47	2.748	
29	272.16	183.00	400.53	199.47	308.57	407.62	227.55	2.748	
30	271.63	183.00	400.00	200.00	307.18	407.76	227.55	2.751	
31	274.26	183.09	400.53	199.47	310.38	399.48	219.39	2.751	
32	271.11	183.00	400.53	199.47	307.75	411.72	231.63	2.752	
33	269.00	183.00	400.00	200.00	305.38	415.89	235.71	2.752	
34	275.84	183.61	400.53	199.47	313.82	383.09	203.06	2.753	
35	275.32	183.44	400.00	200.00	311.67	387.37	207.14	2.753	
36	273.74	183.00	400.53	199.47	309.54	403.58	223.47	2.755	
37	273.21	183.00	400.00	200.00	308.15	403.72	223.47	2.755	
38	270.58	183.00	400.00	200.00	306.34	411.85	231.63	2.755	
39	270.05	183.00	400.53	199.47	306.93	415.81	235.71	2.756	
40	276.89	183.96	400.00	200.00	315.14	370.91	190.82	2.756	
41	274.79	183.26	400.53	199.47	311.35	395.44	215.31	2.757	
42	272.16	183.00	400.00	200.00	307.31	407.82	227.55	2.759	
43	273.21	183.00	401.05	198.95	310.12	407.54	227.55	2.759	
44	269.53	183.00	400.00	200.00	305.52	415.95	235.71	2.760	
45	271.63	183.00	400.53	199.47	307.89	411.78	231.63	2.761	
46	269.00	183.00	400.53	199.47	306.12	419.91	239.80	2.761	
47	275.84	183.61	400.00	200.00	312.65	383.31	203.06	2.761	
48	274.26	183.09	400.00	200.00	309.14	399.69	219.39	2.762	
49	272.68	183.00	400.53	199.47	308.71	407.68	227.55	2.763	
50	271.11	183.00	400.00	200.00	306.48	411.92	231.63	2.763	
51	270.58	183.00	400.53	199.47	307.08	415.87	235.71	2.765	
52	271.11	183.00	401.05	198.95	308.50	415.73	235.71	2.765	
53	275.32	183.44	400.53	199.47	312.32	391.40	211.22	2.765	
54	276.37	183.79	400.53	199.47	314.77	379.03	198.98	2.765	
55	274.26	183.09	401.05	198.95	311.08	403.50	223.47	2.765	
56	272.16	183.00	401.05	198.95	309.30	411.63	231.63	2.767	
57	273.74	183.00	400.00	200.00	308.29	403.78	223.47	2.767	
58	272.68	183.00	400.00	200.00	307.45	407.88	227.55	2.767	
59	274.79	183.26	400.00	200.00	310.12	395.65	215.31	2.767	
60	277.42	184.14	400.00	200.00	316.10	366.83	186.73	2.767	
61	273.74	183.00	401.05	198.95	310.26	407.60	227.55	2.768	
62	270.05	183.00	401.05	198.95	307.69	419.82	239.80	2.768	

63	270.05	183.00	400.00	200.00	305.66	416.01	235.71	2.768
64	276.37	183.79	400.00	200.00	313.62	379.25	198.98	2.769
65	273.21	183.00	400.53	199.47	308.85	407.74	227.55	2.769
66	269.53	183.00	400.53	199.47	306.26	419.97	239.80	2.769
67	272.16	183.00	400.53	199.47	308.03	411.84	231.63	2.769
68	271.63	183.00	400.00	200.00	306.62	411.98	231.63	2.771
69	274.26	183.09	400.53	199.47	309.83	403.71	223.47	2.772
70	269.00	183.00	401.05	198.95	306.90	423.92	243.88	2.772
71	274.79	183.26	401.05	198.95	312.04	399.47	219.39	2.772
72	275.84	183.61	400.53	199.47	313.28	387.35	207.14	2.772
73	271.11	183.00	400.53	199.47	307.21	415.93	235.71	2.773
74	272.68	183.00	401.05	198.95	309.45	411.70	231.63	2.773
75	271.63	183.00	401.05	198.95	308.64	415.79	235.71	2.773
76	269.00	183.00	400.00	200.00	304.83	420.10	239.80	2.773
77	275.32	183.44	400.00	200.00	311.11	391.61	211.22	2.775
78	273.74	183.00	400.53	199.47	308.99	407.80	227.55	2.775
79	273.21	183.00	400.00	200.00	307.58	407.94	227.55	2.775
80	270.58	183.00	400.00	200.00	305.79	416.07	235.71	2.776
81	270.58	183.00	401.05	198.95	307.84	419.88	239.80	2.777
82	270.05	183.00	400.53	199.47	306.40	420.02	239.80	2.777
83	272.68	183.00	400.53	199.47	308.17	411.90	231.63	2.777
84	276.89	183.96	400.00	200.00	314.58	375.18	194.90	2.777
85	274.79	183.26	400.53	199.47	310.80	399.67	219.39	2.779
86	272.16	183.00	400.00	200.00	306.75	412.03	231.63	2.779
87	273.21	183.00	401.05	198.95	309.59	411.76	231.63	2.780
88	269.53	183.00	401.05	198.95	307.04	423.98	243.88	2.780
89	271.63	183.00	400.53	199.47	307.35	415.99	235.71	2.781
90	276.37	183.79	400.53	199.47	314.24	383.29	203.06	2.781
91	269.53	183.00	400.00	200.00	304.97	420.16	239.80	2.781
92	269.00	183.00	400.53	199.47	305.60	424.12	243.88	2.781
93	274.26	183.09	400.00	200.00	308.57	403.91	223.47	2.782
94	275.84	183.61	400.00	200.00	312.09	387.56	207.14	2.783
95	276.89	183.96	400.53	199.47	315.72	374.96	194.90	2.783
96	271.11	183.00	400.00	200.00	305.93	416.13	235.71	2.784
97	270.58	183.00	400.53	199.47	306.54	420.08	239.80	2.785
98	271.11	183.00	401.05	198.95	307.98	419.94	239.80	2.785
99	275.32	183.44	401.05	198.95	312.99	395.42	215.31	2.785

Critical Failure Surface (circle 1)

Intersects: XL: 274.26 YL: 183.09 XR: 400.00 YR: 200.00
Centre: XC: 310.27 YC: 391.22 Radius: R: 211.22

Generated failure surface: (20 points)

274.26 183.09 280.96 182.04 287.69 181.21 294.45 180.59
301.22 180.19
308.00 180.01 314.78 180.04 321.56 180.30 328.32 180.77
335.07 181.46
341.79 182.36 348.48 183.48 355.13 184.81 361.73 186.36
368.28 188.12
374.77 190.08 381.19 192.26 387.54 194.64 393.82 197.22
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 42 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	274.26	0.08	-8.9	0.56	0.57	2	0.00	35.0	10.08	494.00	880.68	1.05
2	274.82	3.15	-8.9	3.07	3.11	3	100.00	18.0	420.16	2761.07	968.66	1.03
3	277.89	7.77	-8.9	3.07	3.11	3	100.00	18.0	1039.66	2854.23	1108.67	1.03
4	280.96	13.63	-7.1	3.37	3.39	3	100.00	18.0	1825.33	3209.70	1245.14	1.02
5	284.33	18.81	-7.1	3.37	3.39	3	100.00	18.0	2517.50	3297.84	1382.48	1.02
6	287.69	23.89	-5.2	3.38	3.39	3	100.00	18.0	3195.80	3374.49	1509.01	1.02
7	291.07	28.74	-5.2	3.38	3.39	3	100.00	18.0	3840.49	3439.70	1630.82	1.02
8	294.45	32.34	-3.4	3.28	3.28	3	100.00	18.0	4318.10	3380.75	1739.35	1.01
9	297.72	36.55	-3.4	3.28	3.28	3	100.00	18.0	4876.17	3420.35	1842.17	1.01
10	301.00	43.50	-1.7	3.50	3.50	3	100.00	18.0	5798.09	3680.03	1937.16	1.00
11	304.50	47.91	-1.5	3.50	3.50	3	100.00	18.0	6378.84	3700.36	2030.39	1.00
12	308.00	50.46	0.3	3.39	3.39	3	100.00	18.0	6711.15	3593.53	2109.55	1.00
13	311.39	54.23	0.3	3.39	3.39	3	100.00	18.0	7204.68	3589.75		

2184.53	1.00									
14	314.78	20.44	2.1	1.22	1.22	3	100.00	18.0	2713.66	1291.97
2227.08	1.00									
15	316.00	48.11	2.1	2.78	2.78	3	100.00	18.0	6382.07	2923.99
2290.84	1.00									
16	318.78	50.40	2.1	2.78	2.78	3	100.00	18.0	6678.34	2906.01
2396.98	1.00									
17	321.56	65.48	4.0	3.44	3.45	3	100.00	18.0	8667.49	3573.40
2501.27	0.99									
18	325.00	64.24	4.0	3.32	3.33	3	100.00	18.0	8493.97	3395.45
2542.83	0.99									
19	328.32	64.30	5.8	3.37	3.39	3	100.00	18.0	8492.44	3398.18
2495.57	0.99									
20	331.69	63.14	5.8	3.37	3.39	3	100.00	18.0	8328.86	3325.41
2447.41	0.99									
21	335.07	61.56	7.7	3.36	3.39	3	100.00	18.0	8108.79	3241.23
2385.00	0.99									
22	338.43	60.04	7.7	3.36	3.39	3	100.00	18.0	7894.68	3145.61
2321.82	0.99									
23	341.79	66.28	9.5	3.83	3.88	3	100.00	18.0	8695.30	3467.20
2239.10	0.99									
24	345.62	47.96	9.5	2.86	2.90	2	0.00	35.0	6283.36	2491.44
2140.41	0.97									
25	348.48	49.03	11.3	3.02	3.08	5	0.00	45.0	5392.82	2542.95
1718.12	0.95									
26	351.50	56.40	11.3	3.63	3.70	2	0.00	35.0	7387.88	2896.79
1975.65	0.97									
27	355.13	48.87	13.2	3.30	3.39	2	0.00	35.0	6401.42	2496.95
1870.57	0.97									
28	358.43	46.31	13.2	3.30	3.39	2	0.00	35.0	6067.05	2333.37
1772.30	0.97									
29	361.73	43.24	15.0	3.28	3.39	2	0.00	35.0	5664.08	2158.66
1658.86	0.97									
30	365.00	40.36	15.0	3.28	3.39	2	0.00	35.0	5287.08	1972.73
1547.64	0.97									
31	368.28	36.97	16.9	3.25	3.39	2	0.00	35.0	4842.95	1775.70
1422.28	0.97									
32	371.52	33.78	16.9	3.25	3.39	2	0.00	35.0	4424.85	1567.61
1298.34	0.97									
33	374.77	26.73	18.7	2.83	2.99	2	0.00	35.0	3501.55	1201.13
1169.47	0.97									
34	377.60	24.01	18.7	2.83	2.99	2	0.00	35.0	3145.91	1022.29
1049.17	0.97									
35	380.43	5.98	18.7	0.76	0.80	1	150.00	22.0	783.16	243.73
978.59	1.01									
36	381.19	22.70	20.5	3.18	3.39	1	150.00	22.0	2973.37	877.69
881.12	1.01									
37	384.37	18.92	20.5	3.18	3.39	1	150.00	22.0	2478.56	626.00
729.58	1.01									
38	387.54	13.70	22.4	2.87	3.10	1	150.00	22.0	1794.79	343.41
574.18	1.02									
39	390.41	10.31	22.4	2.87	3.10	1	150.00	22.0	1350.34	114.47
424.03	1.02									
40	393.29	1.53	22.4	0.53	0.57	1	150.00	22.0	200.70	0.00
335.49	1.02									
41	393.82	6.45	24.2	3.09	3.39	1	150.00	22.0	845.17	0.00
232.95	1.03									
42	396.91	2.15	24.2	3.09	3.39	1	150.00	22.0	281.72	0.00
62.15	1.03									

X-S Area: 1460.43 Path Length: 128.85 X-S Weight: 191698.42

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 5-2\West Farm Expansion Case 5-2 Rapid Drawdown-EQ.gmf
Processed: 04 Dec 2020 12:56:58

DATA: Analysis 1 - Case 5-2 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	192.00	348.50	192.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	183.00	348.50	183.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	180.00	348.50	180.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	192.00	450.00	192.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	183.00	450.00	183.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	180.00	450.00	180.00	

Slope Surface (8 points)

100.00	183.00	274.00	183.00	325.00	200.00	400.00	200.00
405.00	195.00						
410.00	195.00	415.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	183.00	274.00	183.00	316.00	197.00	348.50	197.00
351.50	197.00						
450.00	197.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	274.00	YL:	183.00	XR:	405.00	YR:	195.00
Centre:	XC:	317.50	YC:	429.19	Radius:	R:	250.00	

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 5-2 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 4.738

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.00

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	271.11	183.00	400.00	200.00	307.60	403.47	223.47	2.001	<-- Critical Surface
2	270.05	183.00	400.00	200.00	306.76	407.57	227.55	2.002	
3	269.00	183.00	400.00	200.00	305.93	411.67	231.63	2.003	
4	272.68	183.00	400.00	200.00	308.58	399.43	219.39	2.008	
5	271.63	183.00	400.00	200.00	307.74	403.53	223.47	2.008	
6	274.26	183.09	400.00	200.00	310.27	391.22	211.22	2.009	
7	270.58	183.00	400.00	200.00	306.90	407.63	227.55	2.009	
8	273.74	183.00	400.00	200.00	309.43	395.33	215.31	2.010	
9	269.53	183.00	400.00	200.00	306.07	411.73	231.63	2.010	
10	272.16	183.00	400.00	200.00	307.88	403.60	223.47	2.016	
11	271.11	183.00	400.00	200.00	307.04	407.70	227.55	2.016	
12	274.79	183.26	400.00	200.00	311.26	387.17	207.14	2.017	
13	270.05	183.00	400.00	200.00	306.21	411.79	231.63	2.018	
14	273.21	183.00	400.00	200.00	308.72	399.50	219.39	2.019	
15	271.63	183.00	400.53	199.47	308.43	407.56	227.55	2.019	
16	269.00	183.00	400.00	200.00	305.38	415.89	235.71	2.019	
17	270.58	183.00	400.53	199.47	307.61	411.65	231.63	2.019	
18	269.53	183.00	400.53	199.47	306.79	415.75	235.71	2.020	
19	272.68	183.00	400.53	199.47	309.26	403.46	223.47	2.022	
20	272.68	183.00	400.00	200.00	308.01	403.66	223.47	2.023	
21	271.63	183.00	400.00	200.00	307.18	407.76	227.55	2.024	
22	274.26	183.09	400.00	200.00	309.70	395.46	215.31	2.024	
23	270.58	183.00	400.00	200.00	306.34	411.85	231.63	2.025	
24	273.74	183.00	400.00	200.00	308.86	399.56	219.39	2.025	
25	269.53	183.00	400.00	200.00	305.52	415.95	235.71	2.026	
26	275.32	183.44	400.00	200.00	312.24	383.12	203.06	2.026	
27	272.16	183.00	400.53	199.47	308.57	407.62	227.55	2.027	
28	271.11	183.00	400.53	199.47	307.75	411.72	231.63	2.027	
29	270.05	183.00	400.53	199.47	306.93	415.81	235.71	2.028	
30	273.21	183.00	400.53	199.47	309.40	403.52	223.47	2.029	
31	274.79	183.26	400.53	199.47	311.89	391.20	211.22	2.029	
32	269.00	183.00	400.53	199.47	306.12	419.91	239.80	2.029	
33	273.21	183.00	400.00	200.00	308.15	403.72	223.47	2.031	
34	272.16	183.00	400.00	200.00	307.31	407.82	227.55	2.031	
35	271.11	183.00	400.00	200.00	306.48	411.92	231.63	2.032	
36	274.79	183.26	400.00	200.00	310.69	391.41	211.22	2.033	
37	270.05	183.00	400.00	200.00	305.66	416.01	235.71	2.033	
38	271.63	183.00	400.53	199.47	307.89	411.78	231.63	2.035	
39	269.00	183.00	400.00	200.00	304.83	420.10	239.80	2.035	
40	270.58	183.00	400.53	199.47	307.08	415.87	235.71	2.035	
41	273.74	183.00	400.53	199.47	309.54	403.58	223.47	2.036	
42	274.26	183.09	400.53	199.47	310.38	399.48	219.39	2.036	
43	275.84	183.61	400.00	200.00	313.21	379.05	198.98	2.036	
44	269.53	183.00	400.53	199.47	306.26	419.97	239.80	2.037	
45	272.68	183.00	400.53	199.47	308.71	407.68	227.55	2.038	
46	272.68	183.00	400.00	200.00	307.45	407.88	227.55	2.039	
47	271.11	183.00	401.05	198.95	308.50	415.73	235.71	2.039	
48	275.32	183.44	400.53	199.47	312.86	387.15	207.14	2.039	
49	271.63	183.00	400.00	200.00	306.62	411.98	231.63	2.039	
50	270.05	183.00	401.05	198.95	307.69	419.82	239.80	2.039	
51	274.26	183.09	400.00	200.00	309.14	399.69	219.39	2.040	
52	273.21	183.00	401.05	198.95	310.12	407.54	227.55	2.040	
53	269.00	183.00	401.05	198.95	306.90	423.92	243.88	2.040	
54	270.58	183.00	400.00	200.00	305.79	416.07	235.71	2.040	
55	273.74	183.00	400.00	200.00	308.29	403.78	223.47	2.040	
56	269.53	183.00	400.00	200.00	304.97	420.16	239.80	2.042	
57	272.16	183.00	401.05	198.95	309.30	411.63	231.63	2.042	
58	272.16	183.00	400.53	199.47	308.03	411.84	231.63	2.042	
59	271.11	183.00	400.53	199.47	307.21	415.93	235.71	2.043	
60	275.32	183.44	400.00	200.00	311.67	387.37	207.14	2.043	
61	270.05	183.00	400.53	199.47	306.40	420.02	239.80	2.044	
62	273.21	183.00	400.53	199.47	308.85	407.74	227.55	2.044	

63	269.00	183.00	400.53	199.47	305.60	424.12	243.88	2.045
64	274.79	183.26	400.53	199.47	311.35	395.44	215.31	2.045
65	273.21	183.00	400.00	200.00	307.58	407.94	227.55	2.046
66	272.16	183.00	400.00	200.00	306.75	412.03	231.63	2.046
67	276.37	183.79	400.00	200.00	314.18	374.98	194.90	2.047
68	271.63	183.00	401.05	198.95	308.64	415.79	235.71	2.047
69	270.58	183.00	401.05	198.95	307.84	419.88	239.80	2.047
70	271.11	183.00	400.00	200.00	305.93	416.13	235.71	2.047
71	269.53	183.00	401.05	198.95	307.04	423.98	243.88	2.048
72	273.74	183.00	401.05	198.95	310.26	407.60	227.55	2.048
73	274.79	183.26	400.00	200.00	310.12	395.65	215.31	2.049
74	272.68	183.00	401.05	198.95	309.45	411.70	231.63	2.049
75	274.26	183.09	401.05	198.95	311.08	403.50	223.47	2.049
76	272.68	183.00	400.53	199.47	308.17	411.90	231.63	2.050
77	271.63	183.00	400.53	199.47	307.35	415.99	235.71	2.050
78	275.84	183.61	400.53	199.47	313.82	383.09	203.06	2.050
79	273.74	183.00	400.53	199.47	308.99	407.80	227.55	2.051
80	270.58	183.00	400.53	199.47	306.54	420.08	239.80	2.051
81	274.26	183.09	400.53	199.47	309.83	403.71	223.47	2.051
82	269.53	183.00	400.53	199.47	305.73	424.17	243.88	2.052
83	275.84	183.61	400.00	200.00	312.65	383.31	203.06	2.053
84	271.11	183.00	401.05	198.95	307.98	419.94	239.80	2.055
85	270.05	183.00	400.00	200.00	305.10	420.22	239.80	2.055
86	274.26	183.09	400.00	200.00	308.57	403.91	223.47	2.055
87	270.05	183.00	401.05	198.95	307.18	424.03	243.88	2.055
88	271.63	183.00	400.00	200.00	306.06	416.19	235.71	2.055
89	275.32	183.44	400.53	199.47	312.32	391.40	211.22	2.055
90	272.68	183.00	400.00	200.00	306.89	412.09	231.63	2.055
91	273.21	183.00	401.05	198.95	309.59	411.76	231.63	2.056
92	270.58	183.00	400.00	200.00	305.24	420.28	239.80	2.056
93	269.00	183.00	400.00	200.00	304.29	424.31	243.88	2.056
94	269.00	183.00	401.05	198.95	306.39	428.12	247.96	2.056
95	272.16	183.00	400.53	199.47	307.49	416.05	235.71	2.058
96	272.16	183.00	401.05	198.95	308.78	415.85	235.71	2.058
97	269.53	183.00	400.00	200.00	304.42	424.37	243.88	2.058
98	271.11	183.00	400.53	199.47	306.68	420.14	239.80	2.058
99	273.74	183.00	400.00	200.00	307.72	408.00	227.55	2.059

Critical Failure Surface (circle 1)

Intersects: XL: 271.11 YL: 183.00 XR: 400.00 YR: 200.00
Centre: XC: 307.60 YC: 403.47 Radius: R: 223.47
Generated failure surface: (20 points)

271.11	183.00	277.97	181.97	284.87	181.16	291.78	180.56	298.72	180.18
305.66	180.01	312.60	180.06	319.54	180.32	326.46	180.80	333.37	181.49
340.25	182.40	347.11	183.52	353.92	184.85	360.69	186.40	367.41	188.15
374.07	190.12	380.66	192.28	387.19	194.65	393.63	197.23	400.00	200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	271.11	0.63	-8.5	2.89	2.93	3	100.00	18.0	88.37	39.54	38.61	1.04
2	274.00	5.53	-8.5	3.97	4.02	3	100.00	18.0	753.26	348.83	199.88	1.04
3	277.97	10.79	-6.7	3.45	3.47	3	100.00	18.0	1455.54	677.79	432.64	1.03
4	281.42	16.15	-6.7	3.45	3.47	3	100.00	18.0	2172.24	1014.82	642.69	1.03
5	284.87	21.40	-4.9	3.46	3.47	3	100.00	18.0	2872.75	1340.60	841.37	1.02
6	288.33	26.43	-4.9	3.46	3.47	3	100.00	18.0	3541.01	1655.16	1036.07	1.02
7	291.78	31.34	-3.2	3.47	3.47	3	100.00	18.0	4192.86	1958.34	1218.33	1.01
8	295.25	36.01	-3.2	3.47	3.47	3	100.00	18.0	4811.19	2250.16	1397.58	1.01
9	298.72	26.20	-1.4	2.28	2.28	3	100.00	18.0	3497.30	1635.35	1535.49	1.00
10	301.00	28.62	-1.4	2.33	2.33	3	100.00	18.0	3817.48	1786.69	1644.30	1.00
11	303.33	30.56	-1.4	2.33	2.33	3	100.00	18.0	4072.69	1907.67	1754.14	1.00
12	305.66	48.98	0.4	3.47	3.47	3	100.00	18.0	6519.79	3056.42	1876.72	1.00
13	309.13	52.91	0.4	3.47	3.47	3	100.00	18.0	7034.34	3301.92		

2024.86	1.00									
14	312.60	55.47	2.2	3.40	3.40	3	100.00	18.0	7365.05	3464.09
2156.76	0.99									
15	316.00	61.32	2.2	3.54	3.54	3	100.00	18.0	8130.00	3698.88
2289.02	0.99									
16	319.54	49.77	4.0	2.73	2.74	3	100.00	18.0	6590.31	2833.75
2393.97	0.99									
17	322.27	51.74	4.0	2.73	2.74	3	100.00	18.0	6843.35	2801.47
2485.47	0.99									
18	325.00	28.17	4.0	1.46	1.47	3	100.00	18.0	3723.16	1487.41
2524.14	0.99									
19	326.46	65.72	5.7	3.45	3.47	3	100.00	18.0	8679.80	3471.91
2483.75	0.99									
20	329.92	64.53	5.7	3.45	3.47	3	100.00	18.0	8510.92	3396.79
2435.30	0.99									
21	333.37	62.92	7.5	3.44	3.47	3	100.00	18.0	8286.11	3310.12
2370.67	0.99									
22	336.81	61.35	7.5	3.44	3.47	3	100.00	18.0	8065.83	3211.79
2307.41	0.99									
23	340.25	63.44	9.3	3.67	3.72	3	100.00	18.0	8321.95	3315.83
2225.69	0.99									
24	343.92	53.31	9.3	3.18	3.23	2	0.00	35.0	6983.08	2766.47
2120.52	0.96									
25	347.11	22.78	11.1	1.39	1.42	2	0.00	35.0	2984.20	1182.56
2056.99	0.95									
26	348.50	47.74	11.1	3.00	3.06	5	0.00	45.0	5251.13	2463.08
1666.20	0.93									
27	351.50	37.22	11.1	2.42	2.47	2	0.00	35.0	4875.56	1904.93
1935.41	0.95									
28	353.92	49.95	12.9	3.38	3.47	2	0.00	35.0	6543.61	2547.23
1844.74	0.95									
29	357.30	47.34	12.9	3.38	3.47	2	0.00	35.0	6201.17	2379.92
1747.49	0.95									
30	360.69	44.21	14.6	3.36	3.47	2	0.00	35.0	5791.52	2201.35
1632.98	0.95									
31	364.05	41.26	14.6	3.36	3.47	2	0.00	35.0	5405.62	2011.37
1523.13	0.95									
32	367.41	37.82	16.4	3.33	3.47	2	0.00	35.0	4953.82	1810.10
1397.37	0.95									
33	370.74	34.55	16.4	3.33	3.47	2	0.00	35.0	4525.92	1597.61
1275.15	0.95									
34	374.07	26.99	18.2	2.87	3.02	2	0.00	35.0	3536.21	1208.02
1147.26	0.94									
35	376.93	24.29	18.2	2.87	3.02	2	0.00	35.0	3182.14	1030.49
1030.46	0.94									
36	379.80	6.76	18.2	0.86	0.91	1	150.00	22.0	885.99	274.65
961.15	0.99									
37	380.66	23.24	20.0	3.26	3.47	1	150.00	22.0	3044.89	893.37
861.66	0.99									
38	383.92	19.37	20.0	3.26	3.47	1	150.00	22.0	2538.07	636.50
711.88	0.99									
39	387.19	13.99	21.8	2.94	3.16	1	150.00	22.0	1832.13	347.31
557.44	1.00									
40	390.13	10.54	21.8	2.94	3.16	1	150.00	22.0	1380.67	115.77
409.82	1.00									
41	393.06	1.65	21.8	0.57	0.61	1	150.00	22.0	215.80	0.00
322.20	1.00									
42	393.63	6.62	23.5	3.18	3.47	1	150.00	22.0	866.84	0.00
220.34	1.00									
43	396.82	2.21	23.5	3.18	3.47	1	150.00	22.0	288.94	0.00
53.44	1.00									

X-S Area: 1451.81 Path Length: 131.91 X-S Weight: 190632.58

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Full Reservoir-EQ.gmf
Processed: 01 Apr 2021 09:53:13

DATA: Analysis 1 - Case 5-3 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	190.00	348.50	190.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	164.00	348.50	164.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	161.00	348.50	161.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	190.00	450.00	190.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	164.00	450.00	164.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	161.00	450.00	161.00	

Slope Surface (4 points)

100.00	164.00	217.00	164.00	325.00	200.00	450.00	200.00

Phreatic Surface (4 points)

100.00	197.00	348.50	197.00	351.50	178.00	450.00	178.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	217.00	YL:	164.00	XR:	390.00	YR: 200.00
Centre:	XC:	255.85	YC:	410.96	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 5-3 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.422

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.20

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	219.37	164.79	385.00	200.00	260.10	380.36	219.39	2.201	<-- Critical Surface
2	218.32	164.44	385.00	200.00	257.63	388.57	227.55	2.201	
3	217.79	164.26	385.00	200.00	256.40	392.66	231.63	2.201	
4	218.84	164.61	385.00	200.00	258.87	384.47	223.47	2.202	
5	216.21	164.00	385.00	200.00	253.94	400.81	239.80	2.202	
6	217.26	164.09	385.00	200.00	255.17	396.73	235.71	2.202	
7	216.74	164.00	385.00	200.00	254.04	400.88	239.80	2.206	
8	215.16	164.00	385.00	200.00	252.82	404.95	243.88	2.207	
9	212.00	164.00	385.00	200.00	250.41	413.10	252.04	2.210	
10	216.74	164.00	385.53	200.00	254.46	400.81	239.80	2.211	
11	215.68	164.00	385.00	200.00	252.92	405.02	243.88	2.212	
12	215.16	164.00	385.53	200.00	253.24	404.89	243.88	2.212	
13	213.05	164.00	385.00	200.00	251.51	408.96	247.96	2.213	
14	218.32	164.44	385.00	200.00	256.72	392.87	231.63	2.213	
15	213.58	164.00	385.53	200.00	252.04	408.96	247.96	2.214	
16	218.84	164.61	385.00	200.00	257.95	388.78	227.55	2.214	
17	222.00	165.67	385.00	200.00	265.33	364.05	203.06	2.214	
18	216.21	164.00	385.00	200.00	253.03	405.08	243.88	2.214	
19	219.37	164.79	385.00	200.00	259.18	384.68	223.47	2.214	
20	217.26	164.09	385.00	200.00	254.25	401.01	239.80	2.214	
21	221.47	165.49	385.00	200.00	264.10	368.20	207.14	2.215	
22	220.42	165.14	385.00	200.00	261.64	376.46	215.31	2.215	
23	220.95	165.32	385.00	200.00	262.87	372.34	211.22	2.215	
24	214.63	164.00	385.00	200.00	252.72	404.89	243.88	2.215	
25	217.79	164.26	385.00	200.00	255.48	396.94	235.71	2.216	
26	215.68	164.00	385.53	200.00	253.35	404.95	243.88	2.216	
27	219.89	164.96	385.00	200.00	260.41	380.58	219.39	2.216	
28	212.53	164.00	385.00	200.00	250.51	413.16	252.04	2.217	
29	214.11	164.00	385.53	200.00	252.14	409.02	247.96	2.217	
30	213.58	164.00	385.00	200.00	251.61	409.02	247.96	2.218	
31	217.79	164.26	385.53	200.00	255.91	396.88	235.71	2.219	
32	216.74	164.00	385.00	200.00	253.13	405.15	243.88	2.219	
33	218.32	164.44	385.53	200.00	257.14	392.79	231.63	2.219	
34	218.84	164.61	385.53	200.00	258.37	388.71	227.55	2.219	
35	219.37	164.79	385.53	200.00	259.60	384.61	223.47	2.220	
36	219.89	164.96	385.53	200.00	260.82	380.50	219.39	2.220	
37	220.95	165.32	385.53	200.00	263.28	372.25	211.22	2.220	
38	220.42	165.14	385.53	200.00	262.05	376.38	215.31	2.220	
39	216.21	164.00	385.53	200.00	253.45	405.02	243.88	2.221	
40	215.68	164.00	386.05	200.00	253.77	404.89	243.88	2.222	
41	214.11	164.00	386.05	200.00	252.56	408.96	247.96	2.223	
42	212.00	164.00	385.00	200.00	249.52	417.36	256.12	2.223	
43	214.63	164.00	385.53	200.00	252.24	409.09	247.96	2.223	
44	217.26	164.09	385.53	200.00	254.67	400.95	239.80	2.223	
45	216.74	164.00	385.53	200.00	253.55	405.08	243.88	2.223	
46	215.68	164.00	385.00	200.00	252.02	409.28	247.96	2.225	
47	215.16	164.00	385.53	200.00	252.34	409.16	247.96	2.225	
48	217.79	164.26	386.05	200.00	256.33	396.81	235.71	2.225	
49	214.11	164.00	385.00	200.00	251.71	409.09	247.96	2.225	
50	218.32	164.44	386.05	200.00	257.56	392.72	231.63	2.225	
51	213.05	164.00	385.00	200.00	250.62	413.23	252.04	2.225	
52	216.21	164.00	386.05	200.00	253.87	404.95	243.88	2.225	
53	218.84	164.61	386.05	200.00	258.78	388.63	227.55	2.225	
54	219.37	164.79	386.05	200.00	260.01	384.53	223.47	2.226	
55	217.26	164.09	386.05	200.00	255.10	400.88	239.80	2.226	
56	213.58	164.00	385.53	200.00	251.14	413.23	252.04	2.226	
57	219.89	164.96	386.05	200.00	261.24	380.42	219.39	2.226	
58	220.42	165.14	386.05	200.00	262.46	376.30	215.31	2.226	
59	214.63	164.00	386.05	200.00	252.66	409.02	247.96	2.226	
60	214.63	164.00	385.00	200.00	251.82	409.16	247.96	2.227	
61	218.84	164.61	385.00	200.00	257.03	393.08	231.63	2.227	
62	212.53	164.00	385.00	200.00	249.62	417.42	256.12	2.227	
63	218.32	164.44	385.00	200.00	255.80	397.15	235.71	2.228	
64	217.79	164.26	385.00	200.00	254.57	401.22	239.80	2.228	
65	213.05	164.00	386.05	200.00	251.46	413.10	252.04	2.228	
66	217.26	164.09	385.00	200.00	253.34	405.28	243.88	2.228	

67	219.89	164.96	385.00	200.00	259.50	384.90	223.47	2.228
68	219.37	164.79	385.00	200.00	258.27	388.99	227.55	2.229
69	216.21	164.00	385.00	200.00	252.12	409.35	247.96	2.229
70	215.68	164.00	385.53	200.00	252.44	409.22	247.96	2.229
71	220.42	165.14	385.00	200.00	260.72	380.79	219.39	2.229
72	212.53	164.00	385.53	200.00	250.94	413.10	252.04	2.230
73	214.11	164.00	385.53	200.00	251.24	413.29	252.04	2.230
74	217.79	164.26	386.58	200.00	256.75	396.74	235.71	2.230
75	213.58	164.00	385.00	200.00	250.72	413.29	252.04	2.231
76	218.32	164.44	386.58	200.00	257.97	392.65	231.63	2.231
77	216.74	164.00	386.05	200.00	253.98	405.02	243.88	2.231
78	218.84	164.61	386.58	200.00	259.20	388.56	227.55	2.231
79	221.47	165.49	385.00	200.00	263.18	372.56	211.22	2.231
80	216.21	164.00	386.58	200.00	254.30	404.89	243.88	2.231
81	222.00	165.67	385.00	200.00	264.41	368.42	207.14	2.231
82	219.37	164.79	386.58	200.00	260.42	384.46	223.47	2.231
83	217.26	164.09	386.58	200.00	255.52	400.81	239.80	2.231
84	218.32	164.44	385.53	200.00	256.22	397.08	235.71	2.232
85	214.63	164.00	386.58	200.00	253.09	408.96	247.96	2.232
86	217.79	164.26	385.53	200.00	254.99	401.16	239.80	2.232
87	220.95	165.32	385.00	200.00	261.95	376.68	215.31	2.233
88	215.16	164.00	386.05	200.00	252.77	409.09	247.96	2.233
89	215.16	164.00	385.00	200.00	251.92	409.22	247.96	2.233
90	216.74	164.00	385.00	200.00	252.21	409.41	247.96	2.233
91	219.37	164.79	385.53	200.00	258.68	388.92	227.55	2.233
92	216.21	164.00	385.53	200.00	252.54	409.28	247.96	2.234
93	215.68	164.00	386.05	200.00	252.87	409.16	247.96	2.234
94	218.84	164.61	385.53	200.00	257.45	393.01	231.63	2.234
95	217.26	164.09	385.53	200.00	253.76	405.22	243.88	2.234
96	219.89	164.96	385.53	200.00	259.91	384.82	223.47	2.234
97	216.74	164.00	386.58	200.00	254.40	404.95	243.88	2.234
98	214.11	164.00	386.05	200.00	251.67	413.23	252.04	2.235
99	214.63	164.00	385.53	200.00	251.34	413.35	252.04	2.235

Critical Failure Surface (circle 1)

Intersects: XL: 219.37 YL: 164.79 XR: 385.00 YR: 200.00
Centre: XC: 260.10 YC: 380.36 Radius: R: 219.39

Generated failure surface: (20 points)

219.37 164.79 228.39 163.28 237.47 162.15 246.59 161.39
255.73 161.02
264.88 161.03 274.02 161.42 283.14 162.19 292.21 163.34
301.23 164.87
310.18 166.77 319.05 169.04 327.80 171.68 336.45 174.69
344.96 178.05
353.32 181.76 361.52 185.82 369.54 190.22 377.37 194.95
385.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 42 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	219.37	5.57	-9.5	4.72	4.78	2	0.00	35.0	729.28	9727.17	2120.12	1.07
2	224.08	14.82	-9.5	4.31	4.37	3	100.00	18.0	1957.00	9093.43	2335.17	1.04
3	228.39	25.23	-7.1	4.54	4.57	3	100.00	18.0	3350.96	9706.62	2526.38	1.03
4	232.93	34.67	-7.1	4.54	4.57	3	100.00	18.0	4613.38	9868.36	2712.85	1.03
5	237.47	43.89	-4.7	4.56	4.57	3	100.00	18.0	5842.28	10003.10	2879.69	1.02
6	242.03	52.53	-4.7	4.56	4.57	3	100.00	18.0	6992.17	10110.72	3038.74	1.02
7	246.59	60.91	-2.3	4.57	4.57	3	100.00	18.0	8102.81	10191.12	3176.53	1.01
8	251.16	68.73	-2.3	4.57	4.57	3	100.00	18.0	9135.26	10244.34	3308.06	1.01
9	255.73	76.17	0.1	4.57	4.57	3	100.00	18.0	10115.06	10270.38	3416.98	1.00
10	260.30	83.13	0.1	4.57	4.57	3	100.00	18.0	11026.03	10269.08	3520.96	1.00
11	264.88	89.56	2.4	4.57	4.57	3	100.00	18.0	11864.20	10240.52	3601.17	0.99
12	269.45	95.64	2.4	4.57	4.57	3	100.00	18.0	12650.72	10184.92	3677.62	0.99
13	274.02	101.00	4.8	4.56	4.57	3	100.00	18.0	13339.35	10102.19	3729.32	0.99
14	278.58	106.16	4.8	4.56	4.57	3	100.00	18.0	13998.96	9992.18	3778.30	0.99
15	283.14	110.40	7.2	4.54	4.57	3	100.00	18.0	14531.42	9855.05		

3801.75	0.99									
16	287.67	114.65	7.2	4.54	4.57	3	100.00	18.0	15062.75	9690.88
3823.36	0.99									
17	292.21	72.35	9.6	2.79	2.83	3	100.00	18.0	9489.53	5895.37
3819.89	0.99									
18	295.00	29.43	9.6	1.12	1.14	3	100.00	18.0	3856.43	2345.47
3817.46	0.99									
19	296.12	137.02	9.6	5.11	5.19	2	0.00	35.0	17949.53	10540.69
3776.17	0.96									
20	301.23	122.97	12.0	4.47	4.57	2	0.00	35.0	16109.03	9036.91
3741.30	0.96									
21	305.71	125.39	12.0	4.47	4.57	2	0.00	35.0	16425.63	8765.32
3716.66	0.96									
22	310.18	82.61	14.4	2.91	3.00	2	0.00	35.0	10822.48	5594.63
3664.60	0.95									
23	313.09	83.26	14.4	2.91	3.00	2	0.00	35.0	10907.42	5454.73
3632.19	0.95									
24	316.00	87.87	14.4	3.05	3.14	2	0.00	35.0	11510.46	5560.91
3628.29	0.95									
25	319.05	86.41	16.8	2.98	3.11	2	0.00	35.0	11319.32	5338.33
3619.06	0.95									
26	322.02	86.69	16.8	2.98	3.11	2	0.00	35.0	11356.12	5164.04
3625.47	0.95									
27	325.00	80.60	16.8	2.80	2.93	2	0.00	35.0	10558.65	4704.80
3575.81	0.95									
28	327.80	119.10	19.2	4.32	4.57	2	0.00	35.0	15602.63	7012.07
3404.03	0.95									
29	332.13	112.61	19.2	4.32	4.57	2	0.00	35.0	14752.35	6583.28
3217.51	0.95									
30	336.45	104.11	21.6	4.25	4.57	2	0.00	35.0	13638.88	6129.07
2997.35	0.96									
31	340.70	96.96	21.6	4.25	4.57	2	0.00	35.0	12701.98	5649.21
2790.02	0.96									
32	344.96	75.02	23.9	3.54	3.88	2	0.00	35.0	9827.06	4395.87
2569.34	0.96									
33	348.50	50.78	23.9	2.56	2.81	5	0.00	45.0	5585.33	1520.72
1903.80	0.91									
34	351.06	42.21	23.9	2.25	2.47	2	0.00	35.0	5530.00	0.00
2150.51	0.96									
35	353.32	70.60	26.3	4.10	4.57	2	0.00	35.0	9248.68	0.00
1948.94	0.96									
36	357.42	62.28	26.3	4.10	4.57	2	0.00	35.0	8158.59	0.00
1719.24	0.96									
37	361.52	50.03	28.7	3.81	4.34	2	0.00	35.0	6554.25	0.00
1464.86	0.97									
38	365.33	42.08	28.7	3.81	4.34	2	0.00	35.0	5511.97	0.00
1231.92	0.97									
39	369.14	36.15	30.9	4.12	4.80	1	150.00	22.0	4736.06	0.00
999.55	1.05									
40	373.25	25.92	31.1	4.12	4.81	1	150.00	22.0	3395.05	0.00
705.16	1.05									
41	377.37	14.45	33.5	3.81	4.57	1	150.00	22.0	1892.74	0.00
402.21	1.07									
42	381.19	4.82	33.5	3.81	4.57	1	150.00	22.0	630.92	0.00
107.24	1.07									
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X-S Area:		2984.78	Path Length:		173.83		X-S Weight:		391382.72	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Rapid Drawdown-EQ.gmf
Processed: 01 Apr 2021 09:47:24

DATA: Analysis 1 - Case 5-3 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	190.00	348.50	190.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	164.00	348.50	164.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	161.00	348.50	161.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	190.00	450.00	190.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	164.00	450.00	164.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	161.00	450.00	161.00	

Slope Surface (4 points)

100.00	164.00	217.00	164.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	164.00	217.00	164.00	316.00	197.00	348.50	197.00
351.50	178.00						
450.00	178.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	217.00	YL:	164.00	XR:	390.00	YR: 200.00
Centre:	XC:	255.85	YC:	410.96	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 5-3 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 1.511

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.36

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	216.21	164.00	385.00	200.00	253.94	400.81	239.80	1.358	<-- Critical Surface
2	217.79	164.26	385.00	200.00	256.40	392.66	231.63	1.358	
3	218.32	164.44	385.00	200.00	257.63	388.57	227.55	1.358	
4	217.26	164.09	385.00	200.00	255.17	396.73	235.71	1.358	
5	219.37	164.79	385.00	200.00	260.10	380.36	219.39	1.359	
6	218.84	164.61	385.00	200.00	258.87	384.47	223.47	1.359	
7	216.74	164.00	385.00	200.00	254.04	400.88	239.80	1.360	
8	215.16	164.00	385.00	200.00	252.82	404.95	243.88	1.361	
9	212.00	164.00	385.00	200.00	250.41	413.10	252.04	1.363	
10	213.05	164.00	385.00	200.00	251.51	408.96	247.96	1.363	
11	214.63	164.00	385.00	200.00	252.72	404.89	243.88	1.364	
12	215.68	164.00	385.00	200.00	252.92	405.02	243.88	1.365	
13	216.74	164.00	385.53	200.00	254.46	400.81	239.80	1.365	
14	215.16	164.00	385.53	200.00	253.24	404.89	243.88	1.365	
15	213.58	164.00	385.53	200.00	252.04	408.96	247.96	1.366	
16	213.58	164.00	385.00	200.00	251.61	409.02	247.96	1.366	
17	216.21	164.00	385.00	200.00	253.03	405.08	243.88	1.366	
18	217.26	164.09	385.00	200.00	254.25	401.01	239.80	1.367	
19	218.32	164.44	385.00	200.00	256.72	392.87	231.63	1.367	
20	212.53	164.00	385.00	200.00	250.51	413.16	252.04	1.367	
21	218.84	164.61	385.00	200.00	257.95	388.78	227.55	1.368	
22	215.68	164.00	385.53	200.00	253.35	404.95	243.88	1.368	
23	217.79	164.26	385.00	200.00	255.48	396.94	235.71	1.368	
24	214.11	164.00	385.53	200.00	252.14	409.02	247.96	1.368	
25	219.37	164.79	385.00	200.00	259.18	384.68	223.47	1.368	
26	216.74	164.00	385.00	200.00	253.13	405.15	243.88	1.370	
27	220.42	165.14	385.00	200.00	261.64	376.46	215.31	1.370	
28	219.89	164.96	385.00	200.00	260.41	380.58	219.39	1.370	
29	220.95	165.32	385.00	200.00	262.87	372.34	211.22	1.370	
30	222.00	165.67	385.00	200.00	265.33	364.05	203.06	1.370	
31	214.11	164.00	385.00	200.00	251.71	409.09	247.96	1.370	
32	221.47	165.49	385.00	200.00	264.10	368.20	207.14	1.370	
33	217.79	164.26	385.53	200.00	255.91	396.88	235.71	1.371	
34	213.05	164.00	385.00	200.00	250.62	413.23	252.04	1.371	
35	218.32	164.44	385.53	200.00	257.14	392.79	231.63	1.371	
36	216.21	164.00	385.53	200.00	253.45	405.02	243.88	1.371	
37	212.00	164.00	385.00	200.00	249.52	417.36	256.12	1.372	
38	218.84	164.61	385.53	200.00	258.37	388.71	227.55	1.372	
39	215.68	164.00	386.05	200.00	253.77	404.89	243.88	1.372	
40	214.63	164.00	385.00	200.00	251.82	409.16	247.96	1.372	
41	214.63	164.00	385.53	200.00	252.24	409.09	247.96	1.372	
42	214.11	164.00	386.05	200.00	252.56	408.96	247.96	1.372	
43	219.37	164.79	385.53	200.00	259.60	384.61	223.47	1.373	
44	216.74	164.00	385.53	200.00	253.55	405.08	243.88	1.373	
45	217.26	164.09	385.53	200.00	254.67	400.95	239.80	1.373	
46	215.68	164.00	385.00	200.00	252.02	409.28	247.96	1.373	
47	219.89	164.96	385.53	200.00	260.82	380.50	219.39	1.373	
48	215.16	164.00	385.53	200.00	252.34	409.16	247.96	1.374	
49	220.42	165.14	385.53	200.00	262.05	376.38	215.31	1.374	
50	213.58	164.00	385.53	200.00	251.14	413.23	252.04	1.374	
51	212.53	164.00	385.53	200.00	250.94	413.10	252.04	1.374	
52	220.95	165.32	385.53	200.00	263.28	372.25	211.22	1.374	
53	216.21	164.00	386.05	200.00	253.87	404.95	243.88	1.374	
54	212.53	164.00	385.00	200.00	249.62	417.42	256.12	1.375	
55	213.58	164.00	385.00	200.00	250.72	413.29	252.04	1.375	
56	217.79	164.26	386.05	200.00	256.33	396.81	235.71	1.375	
57	214.63	164.00	386.05	200.00	252.66	409.02	247.96	1.375	
58	217.26	164.09	386.05	200.00	255.10	400.88	239.80	1.375	
59	218.32	164.44	386.05	200.00	257.56	392.72	231.63	1.376	
60	215.16	164.00	385.00	200.00	251.92	409.22	247.96	1.376	
61	213.05	164.00	386.05	200.00	251.46	413.10	252.04	1.376	
62	218.84	164.61	386.05	200.00	258.78	388.63	227.55	1.376	
63	217.26	164.09	385.00	200.00	253.34	405.28	243.88	1.376	
64	216.21	164.00	385.00	200.00	252.12	409.35	247.96	1.376	

65	217.79	164.26	385.00	200.00	254.57	401.22	239.80	1.376
66	218.32	164.44	385.00	200.00	255.80	397.15	235.71	1.377
67	219.37	164.79	386.05	200.00	260.01	384.53	223.47	1.377
68	215.68	164.00	385.53	200.00	252.44	409.22	247.96	1.377
69	218.84	164.61	385.00	200.00	257.03	393.08	231.63	1.377
70	214.11	164.00	385.53	200.00	251.24	413.29	252.04	1.377
71	219.89	164.96	386.05	200.00	261.24	380.42	219.39	1.377
72	220.42	165.14	386.05	200.00	262.46	376.30	215.31	1.378
73	216.74	164.00	386.05	200.00	253.98	405.02	243.88	1.378
74	219.37	164.79	385.00	200.00	258.27	388.99	227.55	1.378
75	214.11	164.00	385.00	200.00	250.82	413.35	252.04	1.378
76	219.89	164.96	385.00	200.00	259.50	384.90	223.47	1.379
77	216.21	164.00	386.58	200.00	254.30	404.89	243.88	1.379
78	215.16	164.00	386.05	200.00	252.77	409.09	247.96	1.379
79	213.05	164.00	385.53	200.00	251.04	413.16	252.04	1.379
80	214.63	164.00	386.58	200.00	253.09	408.96	247.96	1.379
81	217.79	164.26	386.58	200.00	256.75	396.74	235.71	1.379
82	212.00	164.00	385.53	200.00	249.95	417.30	256.12	1.379
83	216.74	164.00	385.00	200.00	252.21	409.41	247.96	1.379
84	217.26	164.09	386.58	200.00	255.52	400.81	239.80	1.380
85	220.42	165.14	385.00	200.00	260.72	380.79	219.39	1.380
86	218.32	164.44	386.58	200.00	257.97	392.65	231.63	1.380
87	217.79	164.26	385.53	200.00	254.99	401.16	239.80	1.380
88	216.21	164.00	385.53	200.00	252.54	409.28	247.96	1.380
89	218.32	164.44	385.53	200.00	256.22	397.08	235.71	1.380
90	215.68	164.00	386.05	200.00	252.87	409.16	247.96	1.380
91	218.84	164.61	386.58	200.00	259.20	388.56	227.55	1.380
92	213.58	164.00	386.05	200.00	251.57	413.16	252.04	1.380
93	214.63	164.00	385.53	200.00	251.34	413.35	252.04	1.381
94	217.26	164.09	385.53	200.00	253.76	405.22	243.88	1.381
95	214.11	164.00	386.05	200.00	251.67	413.23	252.04	1.381
96	219.37	164.79	386.58	200.00	260.42	384.46	223.47	1.381
97	213.05	164.00	385.00	200.00	249.72	417.48	256.12	1.381
98	216.74	164.00	386.58	200.00	254.40	404.95	243.88	1.381
99	212.53	164.00	386.05	200.00	250.47	417.30	256.12	1.381

Critical Failure Surface (circle 1)

Intersects: XL: 216.21 YL: 164.00 XR: 385.00 YR: 200.00
Centre: XC: 253.94 YC: 400.81 Radius: R: 239.80

Generated failure surface: (20 points)

216.21 164.00 225.41 162.72 234.66 161.79 243.93 161.22
253.22 161.01
262.51 161.17 271.79 161.68 281.04 162.55 290.25 163.78
299.40 165.36
308.49 167.30 317.50 169.59 326.41 172.23 335.21 175.21
343.88 178.52
352.43 182.17 360.82 186.15 369.06 190.46 377.12 195.07
385.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 44 slices)

Slice	X-S	Base							PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	216.21	0.04	-7.9	0.79	0.80	3	100.00	18.0	6.13	2.74	18.54	1.04
2	217.00	4.65	-7.9	4.21	4.25	3	100.00	18.0	625.65	292.74	162.12	1.04
3	221.21	13.01	-7.9	4.21	4.25	3	100.00	18.0	1746.30	819.85	433.46	1.04
4	225.41	23.53	-5.7	4.62	4.65	3	100.00	18.0	3152.29	1475.53	698.45	1.03
5	230.04	32.79	-5.7	4.62	4.65	3	100.00	18.0	4387.21	2056.47	969.10	1.03
6	234.66	41.78	-3.5	4.64	4.65	3	100.00	18.0	5582.54	2612.09	1218.02	1.02
7	239.29	50.26	-3.5	4.64	4.65	3	100.00	18.0	6706.92	3142.40	1462.42	1.02
8	243.93	58.43	-1.3	4.64	4.65	3	100.00	18.0	7785.90	3647.02	1682.82	1.01
9	248.58	66.10	-1.3	4.64	4.65	3	100.00	18.0	8795.88	4125.93	1900.89	1.01
10	253.22	73.37	0.9	4.65	4.65	3	100.00	18.0	9748.21	4578.83	2093.05	1.00
11	257.87	80.21	0.9	4.65	4.65	3	100.00	18.0	10640.58	5005.64	2284.76	1.00
12	262.51	86.50	3.2	4.64	4.65	3	100.00	18.0	11457.30	5405.97	2448.94	0.99
13	267.15	92.49	3.2	4.64	4.65	3	100.00	18.0	12229.32	5779.94	2614.27	0.99
14	271.79	97.76	5.4	4.63	4.65	3	100.00	18.0	12904.07	6127.33		

2750.74	0.98									
15	276.41	102.88	5.4	4.63	4.65	3	100.00	18.0	13554.09	6447.96
2889.72	0.98									
16	281.04	107.09	7.6	4.60	4.65	3	100.00	18.0	14081.67	6741.75
2998.76	0.98									
17	285.64	111.33	7.6	4.60	4.65	3	100.00	18.0	14608.69	7008.62
3111.45	0.98									
18	290.25	31.60	9.8	1.28	1.30	3	100.00	18.0	4140.52	2000.92
3162.19	0.97									
19	291.53	87.28	9.8	3.47	3.53	2	0.00	35.0	11433.87	5527.34
3149.53	0.93									
20	295.00	113.40	9.8	4.40	4.47	2	0.00	35.0	14854.95	7181.16
3228.68	0.93									
21	299.40	119.84	12.0	4.54	4.65	2	0.00	35.0	15699.40	7646.39
3276.08	0.92									
22	303.95	122.32	12.0	4.54	4.65	2	0.00	35.0	16024.04	7804.50
3343.82	0.92									
23	308.49	102.67	14.3	3.75	3.87	2	0.00	35.0	13449.81	6610.30
3364.67	0.91									
24	312.25	103.79	14.3	3.75	3.87	2	0.00	35.0	13596.05	6682.18
3401.25	0.91									
25	316.00	41.65	14.3	1.50	1.54	2	0.00	35.0	5455.74	2657.38
3425.03	0.91									
26	317.50	104.98	16.5	3.75	3.91	2	0.00	35.0	13752.84	6557.21
3401.84	0.90									
27	321.25	105.51	16.5	3.75	3.91	2	0.00	35.0	13821.89	6286.11
3408.66	0.90									
28	325.00	39.32	16.5	1.41	1.47	2	0.00	35.0	5150.51	2284.18
3386.73	0.90									
29	326.41	118.94	18.7	4.40	4.65	2	0.00	35.0	15580.99	6965.77
3237.42	0.90									
30	330.81	112.39	18.7	4.40	4.65	2	0.00	35.0	14722.48	6534.03
3057.49	0.90									
31	335.21	104.00	20.9	4.34	4.65	2	0.00	35.0	13623.42	6077.65
2837.91	0.89									
32	339.55	96.80	20.9	4.34	4.65	2	0.00	35.0	12680.53	5596.81
2639.35	0.89									
33	343.88	94.57	23.1	4.62	5.02	2	0.00	35.0	12388.94	5478.07
2396.65	0.89									
34	348.50	46.34	23.1	2.44	2.65	5	0.00	45.0	5097.74	1367.13
1711.50	0.83									
35	350.94	26.98	23.1	1.49	1.62	2	0.00	35.0	3534.76	0.00
1947.56	0.89									
36	352.43	70.66	25.4	4.20	4.65	2	0.00	35.0	9255.96	0.00
1771.75	0.89									
37	356.63	62.30	25.4	4.20	4.65	2	0.00	35.0	8161.66	0.00
1562.28	0.89									
38	360.82	47.43	27.6	3.68	4.15	2	0.00	35.0	6213.92	0.00
1329.68	0.89									
39	364.51	40.35	27.6	3.68	4.15	2	0.00	35.0	5286.48	0.00
1131.22	0.89									
40	368.19	8.53	27.6	0.87	0.98	1	150.00	22.0	1116.89	0.00
1057.98	0.98									
41	369.06	33.82	29.8	4.03	4.65	1	150.00	22.0	4430.64	0.00
884.97	0.98									
42	373.09	24.51	29.8	4.03	4.65	1	150.00	22.0	3211.37	0.00
626.55	0.98									
43	377.12	14.55	32.0	3.94	4.65	1	150.00	22.0	1906.48	0.00
349.83	0.99									
44	381.06	4.85	32.0	3.94	4.65	1	150.00	22.0	635.49	0.00
77.78	0.99									
		---			---				---	
X-S Area:		2921.62	Path Length:		176.54		X-S Weight:		383240.12	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 6-1\West Farm Expansion Case 6-1 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 12:54:45

DATA: Analysis 1 - Case 6-1 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	196.00	348.50	196.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	159.00	348.50	159.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	156.00	348.50	156.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	196.00	450.00	196.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	159.00	450.00	159.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	156.00	450.00	156.00	

Slope Surface (4 points)

100.00	159.00	202.00	159.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	202.00	197.00	316.00	197.00	348.50	197.00
351.50	181.00						
450.00	181.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	202.00	YL:	159.00	XR:	380.00	YR: 200.00
Centre:	XC:	238.76	YC:	406.28	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 6-1 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.074

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.97

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	204.37	159.79	375.00	200.00	244.58	371.31	215.31	1.972	<-- Critical Surface
2	203.84	159.61	375.00	200.00	243.26	375.43	219.39	1.972	
3	203.32	159.44	375.00	200.00	241.95	379.54	223.47	1.976	
4	205.95	160.32	375.00	200.00	247.49	363.25	207.14	1.977	
5	205.42	160.14	375.00	200.00	246.18	367.40	211.22	1.979	
6	203.32	159.44	375.53	200.00	242.37	379.47	223.47	1.979	
7	202.79	159.26	375.00	200.00	240.63	383.64	227.55	1.979	
8	206.47	160.49	375.00	200.00	248.81	359.09	203.06	1.981	
9	205.95	160.32	375.53	200.00	247.91	363.16	207.14	1.981	
10	204.89	159.96	375.00	200.00	244.87	371.53	215.31	1.982	
11	202.79	159.26	375.53	200.00	241.06	383.57	227.55	1.982	
12	204.37	159.79	375.00	200.00	243.55	375.65	219.39	1.985	
13	202.26	159.09	375.53	200.00	239.75	387.67	231.63	1.987	
14	200.68	159.00	375.00	200.00	237.92	391.75	235.71	1.988	
15	205.42	160.14	376.05	200.00	247.02	367.23	211.22	1.988	
16	203.84	159.61	375.00	200.00	242.24	379.76	223.47	1.988	
17	202.26	159.09	375.00	200.00	239.32	387.74	231.63	1.989	
18	201.21	159.00	375.53	200.00	238.44	391.75	235.71	1.989	
19	203.32	159.44	375.00	200.00	240.93	383.86	227.55	1.991	
20	201.21	159.00	375.00	200.00	238.01	391.82	235.71	1.991	
21	203.84	159.61	375.53	200.00	242.67	379.69	223.47	1.991	
22	207.00	160.67	375.53	200.00	249.51	359.23	203.06	1.992	
23	204.89	159.96	375.53	200.00	245.29	371.45	215.31	1.992	
24	199.11	159.00	375.00	200.00	236.62	395.84	239.80	1.992	
25	204.37	159.79	376.05	200.00	244.40	375.49	219.39	1.992	
26	201.74	159.00	375.53	200.00	238.54	391.82	235.71	1.992	
27	204.89	159.96	376.05	200.00	245.71	371.37	215.31	1.992	
28	205.95	160.32	375.00	200.00	246.47	367.62	211.22	1.993	
29	207.00	160.67	375.00	200.00	249.10	359.32	203.06	1.994	
30	204.89	159.96	376.58	200.00	246.13	371.29	215.31	1.994	
31	203.32	159.44	375.53	200.00	241.36	383.79	227.55	1.994	
32	204.37	159.79	375.53	200.00	243.98	375.57	219.39	1.994	
33	201.74	159.00	375.00	200.00	238.11	391.89	235.71	1.994	
34	197.53	159.00	375.00	200.00	235.34	399.93	243.88	1.995	
35	206.47	160.49	375.00	200.00	247.78	363.47	207.14	1.995	
36	199.63	159.00	375.00	200.00	236.72	395.91	239.80	1.995	
37	205.42	160.14	375.53	200.00	246.60	367.31	211.22	1.996	
38	201.74	159.00	376.05	200.00	238.97	391.75	235.71	1.996	
39	207.00	160.67	376.05	200.00	249.92	359.14	203.06	1.996	
40	205.42	160.14	375.00	200.00	245.16	371.75	215.31	1.996	
41	206.47	160.49	375.53	200.00	248.20	363.39	207.14	1.996	
42	202.79	159.26	375.53	200.00	240.05	387.88	231.63	1.997	
43	204.37	159.79	376.58	200.00	244.82	375.42	219.39	1.997	
44	199.63	159.00	375.53	200.00	237.15	395.84	239.80	1.997	
45	206.47	160.49	376.05	200.00	248.61	363.30	207.14	1.998	
46	198.05	159.00	375.00	200.00	235.44	400.00	243.88	1.998	
47	200.16	159.00	375.00	200.00	236.82	395.98	239.80	1.998	
48	204.89	159.96	375.00	200.00	243.84	375.87	219.39	1.998	
49	203.84	159.61	376.58	200.00	243.51	379.53	223.47	1.998	
50	202.79	159.26	375.00	200.00	239.62	387.95	231.63	1.999	
51	200.68	159.00	375.53	200.00	237.34	395.98	239.80	1.999	
52	200.16	159.00	376.05	200.00	237.68	395.84	239.80	1.999	
53	205.95	160.32	376.05	200.00	247.31	367.45	211.22	2.000	
54	207.00	160.67	376.58	200.00	250.34	359.05	203.06	2.000	
55	202.26	159.09	375.53	200.00	238.74	391.96	235.71	2.000	
56	204.37	159.79	375.00	200.00	242.53	379.98	223.47	2.001	
57	200.16	159.00	375.53	200.00	237.25	395.91	239.80	2.001	
58	198.58	159.00	375.00	200.00	235.53	400.06	243.88	2.001	
59	200.68	159.00	375.00	200.00	236.91	396.04	239.80	2.001	
60	198.05	159.00	375.53	200.00	235.87	399.93	243.88	2.001	
61	203.32	159.44	376.58	200.00	242.21	383.64	227.55	2.002	
62	203.84	159.61	377.11	200.00	243.94	379.46	223.47	2.002	
63	206.47	160.49	376.58	200.00	249.03	363.22	207.14	2.002	
64	202.26	159.09	375.00	200.00	238.30	392.03	235.71	2.002	

65	198.58	159.00	376.05	200.00	236.39	399.93	243.88	2.002
66	200.68	159.00	376.05	200.00	237.77	395.91	239.80	2.003
67	205.42	160.14	376.05	200.00	246.00	371.59	215.31	2.003
68	203.84	159.61	376.05	200.00	243.09	379.61	223.47	2.003
69	202.26	159.09	376.05	200.00	239.17	391.90	235.71	2.004
70	205.95	160.32	375.53	200.00	246.89	367.53	211.22	2.004
71	204.37	159.79	375.53	200.00	242.96	379.90	223.47	2.004
72	201.21	159.00	375.00	200.00	237.00	396.11	239.80	2.004
73	202.79	159.26	376.58	200.00	240.90	387.74	231.63	2.004
74	198.58	159.00	375.53	200.00	235.96	400.00	243.88	2.005
75	203.32	159.44	376.05	200.00	241.78	383.71	227.55	2.005
76	203.32	159.44	377.11	200.00	242.63	383.57	227.55	2.005
77	197.00	159.00	375.00	200.00	234.26	404.14	247.96	2.005
78	199.11	159.00	375.00	200.00	235.63	400.13	243.88	2.006
79	204.89	159.96	376.05	200.00	244.69	375.71	219.39	2.006
80	205.42	160.14	376.58	200.00	246.42	371.51	215.31	2.006
81	199.11	159.00	376.05	200.00	236.49	400.00	243.88	2.006
82	201.21	159.00	376.05	200.00	237.87	395.98	239.80	2.006
83	203.84	159.61	375.53	200.00	241.65	384.00	227.55	2.006
84	205.42	160.14	375.53	200.00	245.58	371.67	215.31	2.006
85	202.79	159.26	376.05	200.00	240.48	387.81	231.63	2.007
86	206.47	160.49	377.11	200.00	249.44	363.13	207.14	2.007
87	201.74	159.00	375.00	200.00	237.10	396.17	239.80	2.007
88	201.21	159.00	375.53	200.00	237.44	396.04	239.80	2.008
89	203.84	159.61	375.00	200.00	241.22	384.07	227.55	2.008
90	199.11	159.00	375.53	200.00	236.06	400.06	243.88	2.008
91	207.00	160.67	375.53	200.00	248.49	363.61	207.14	2.008
92	206.47	160.49	375.00	200.00	246.76	367.84	211.22	2.008
93	202.79	159.26	377.11	200.00	241.33	387.67	231.63	2.008
94	203.32	159.44	375.53	200.00	240.34	388.09	231.63	2.008
95	197.53	159.00	375.00	200.00	234.35	404.21	247.96	2.008
96	204.89	159.96	375.53	200.00	244.27	375.79	219.39	2.008
97	205.95	160.32	377.11	200.00	248.14	367.28	211.22	2.008
98	199.63	159.00	375.00	200.00	235.72	400.19	243.88	2.008
99	204.89	159.96	376.58	200.00	245.11	375.63	219.39	2.009

Critical Failure Surface (circle 1)

Intersects: XL: 204.37 YL: 159.79 XR: 375.00 YR: 200.00
Centre: XC: 244.58 YC: 371.31 Radius: R: 215.31

Generated failure surface: (20 points)

204.37 159.79 213.74 158.22 223.17 157.07 232.64 156.33
242.14 156.02
251.64 156.12 261.13 156.64 270.59 157.58 279.99 158.93
289.33 160.70
298.57 162.88 307.72 165.47 316.74 168.45 325.62 171.84
334.34 175.61
342.89 179.76 351.24 184.28 359.39 189.17 367.31 194.41
375.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 39 slices)

Slice	X-S	Base						PoreWater	Normal Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress Factor
1	204.37	5.57	-9.5	4.72	4.78	2	0.00	35.0	730.09	11226.14	2432.71 1.08
2	209.09	16.41	-9.5	4.65	4.72	3	100.00	18.0	2168.05	11301.34	2657.03 1.04
3	213.74	27.19	-7.0	4.72	4.75	3	100.00	18.0	3612.45	11581.70	2858.67 1.03
4	218.46	37.32	-7.0	4.72	4.75	3	100.00	18.0	4966.90	11752.62	3050.94 1.03
5	223.17	47.19	-4.4	4.74	4.75	3	100.00	18.0	6281.71	11892.49	3220.89 1.02
6	227.91	56.41	-4.4	4.74	4.75	3	100.00	18.0	7507.07	12001.50	3382.85 1.02
7	232.64	65.30	-1.9	4.75	4.75	3	100.00	18.0	8685.14	12079.71	3520.58 1.01
8	237.39	73.57	-1.9	4.75	4.75	3	100.00	18.0	9775.78	12126.68	3652.18 1.01
9	242.14	81.38	0.6	4.75	4.75	3	100.00	18.0	10801.77	12142.47	3757.94 1.00
10	246.89	88.66	0.6	4.75	4.75	3	100.00	18.0	11753.07	12127.36	3859.18 1.00
11	251.64	95.30	3.1	4.74	4.75	3	100.00	18.0	12615.25	12081.26	3933.24 0.99
12	256.39	101.57	3.1	4.74	4.75	3	100.00	18.0	13423.50	12003.94	4004.17 0.99
13	261.13	106.96	5.7	4.73	4.75	3	100.00	18.0	14112.02	11895.62	4046.83 0.99
14	265.86	112.19	5.7	4.73	4.75	3	100.00	18.0	14774.78	11756.29	

4087.56	0.99									
15	270.59	116.28	8.2	4.70	4.75	3	100.00	18.0	15283.44	11586.27
4099.18	0.99									
16	275.29	120.46	8.2	4.70	4.75	3	100.00	18.0	15799.56	11385.32
4109.87	0.99									
17	279.99	123.22	10.7	4.67	4.75	2	0.00	35.0	16142.14	11153.80
4044.44	0.95									
18	284.66	126.36	10.7	4.67	4.75	2	0.00	35.0	16552.63	10891.52
4032.38	0.95									
19	289.33	127.77	13.3	4.62	4.75	2	0.00	35.0	16738.01	10598.73
3980.02	0.95									
20	293.95	129.86	13.3	4.62	4.75	2	0.00	35.0	17011.73	10275.73
3940.61	0.95									
21	298.57	129.95	15.8	4.57	4.75	2	0.00	35.0	17022.88	9922.66
3860.55	0.94									
22	303.15	131.00	15.8	4.57	4.75	2	0.00	35.0	17161.34	9539.43
3794.29	0.94									
23	307.72	152.01	18.3	5.28	5.56	2	0.00	35.0	19913.30	10644.62
3679.45	0.94									
24	313.00	86.36	18.3	3.00	3.16	2	0.00	35.0	11312.97	5775.00
3594.48	0.94									
25	316.00	21.25	18.3	0.74	0.78	2	0.00	35.0	2783.20	1390.54
3562.99	0.94									
26	316.74	118.53	20.8	4.13	4.42	2	0.00	35.0	15527.71	7656.75
3517.43	0.94									
27	320.87	117.72	20.8	4.13	4.42	2	0.00	35.0	15421.73	7222.91
3483.11	0.94									
28	325.00	128.06	23.0	4.67	5.07	2	0.00	35.0	16775.28	7733.69
3320.81	0.94									
29	329.67	118.63	23.4	4.67	5.09	2	0.00	35.0	15540.59	7112.05
3071.06	0.94									
30	334.34	99.81	25.9	4.27	4.75	2	0.00	35.0	13075.62	6034.71
2796.48	0.95									
31	338.61	90.94	25.9	4.27	4.75	2	0.00	35.0	11913.76	5419.45
2545.53	0.95									
32	342.89	105.10	28.4	5.61	6.38	2	0.00	35.0	13767.80	6262.75
2215.47	0.95									
33	348.50	40.01	28.4	2.42	2.75	5	0.00	45.0	4401.40	1218.43
1523.74	0.89									
34	350.92	62.03	30.8	4.24	4.93	2	0.00	35.0	8126.26	0.00
1583.44	0.96									
35	355.15	51.27	31.0	4.24	4.94	2	0.00	35.0	6715.83	0.00
1306.89	0.96									
36	359.39	37.72	33.5	3.96	4.75	2	0.00	35.0	4941.22	0.00
1009.85	0.97									
37	363.35	27.33	33.5	3.96	4.75	2	0.00	35.0	3580.53	0.00
731.76	0.97									
38	367.31	10.47	36.0	2.18	2.70	2	0.00	35.0	1371.18	0.00
499.13	0.98									
39	369.50	11.00	36.0	5.50	6.80	1	150.00	22.0	1441.45	0.00
179.90	1.08									
		---		---					---	
X-S Area:		3198.18	Path Length:		180.53		X-S Weight:		419529.16	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 6-1\West Farm Expansion Case 6-1 Rapid Drawdown-EQ.gmf
Processed: 04 Dec 2020 12:53:54

DATA: Analysis 1 - Case 6-1 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	196.00	348.50	196.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	159.00	348.50	159.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	156.00	348.50	156.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	196.00	450.00	196.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	159.00	450.00	159.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	156.00	450.00	156.00	

Slope Surface (4 points)

100.00	159.00	202.00	159.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	159.00	202.00	159.00	316.00	197.00	348.50	197.00
351.50	181.00						
450.00	181.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	202.00	YL:	159.00	XR:	380.00	YR: 200.00
Centre:	XC:	238.76	YC:	406.28	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -- -- -

RESULTS: Analysis 1 - Case 6-1 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 1.240

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.17

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	203.84	159.61	375.00	200.00	243.26	375.43	219.39	1.169	<-- Critical Surface
2	204.37	159.79	375.00	200.00	244.58	371.31	215.31	1.169	
3	203.32	159.44	375.00	200.00	241.95	379.54	223.47	1.172	
4	205.95	160.32	375.00	200.00	247.49	363.25	207.14	1.173	
5	202.79	159.26	375.00	200.00	240.63	383.64	227.55	1.174	
6	203.32	159.44	375.53	200.00	242.37	379.47	223.47	1.174	
7	205.42	160.14	375.00	200.00	246.18	367.40	211.22	1.174	
8	206.47	160.49	375.00	200.00	248.81	359.09	203.06	1.175	
9	202.79	159.26	375.53	200.00	241.06	383.57	227.55	1.176	
10	204.89	159.96	375.00	200.00	244.87	371.53	215.31	1.177	
11	205.95	160.32	375.53	200.00	247.91	363.16	207.14	1.177	
12	200.68	159.00	375.00	200.00	237.92	391.75	235.71	1.177	
13	202.26	159.09	375.00	200.00	239.32	387.74	231.63	1.178	
14	204.37	159.79	375.00	200.00	243.55	375.65	219.39	1.178	
15	202.26	159.09	375.53	200.00	239.75	387.67	231.63	1.179	
16	201.21	159.00	375.00	200.00	238.01	391.82	235.71	1.180	
17	199.11	159.00	375.00	200.00	236.62	395.84	239.80	1.180	
18	203.84	159.61	375.00	200.00	242.24	379.76	223.47	1.180	
19	201.21	159.00	375.53	200.00	238.44	391.75	235.71	1.180	
20	205.42	160.14	376.05	200.00	247.02	367.23	211.22	1.181	
21	203.32	159.44	375.00	200.00	240.93	383.86	227.55	1.182	
22	204.89	159.96	375.53	200.00	245.29	371.45	215.31	1.182	
23	197.53	159.00	375.00	200.00	235.34	399.93	243.88	1.182	
24	201.74	159.00	375.00	200.00	238.11	391.89	235.71	1.182	
25	199.63	159.00	375.00	200.00	236.72	395.91	239.80	1.182	
26	201.74	159.00	375.53	200.00	238.54	391.82	235.71	1.183	
27	203.84	159.61	375.53	200.00	242.67	379.69	223.47	1.183	
28	204.37	159.79	375.53	200.00	243.98	375.57	219.39	1.183	
29	207.00	160.67	375.00	200.00	249.10	359.32	203.06	1.184	
30	204.37	159.79	376.05	200.00	244.40	375.49	219.39	1.184	
31	198.05	159.00	375.00	200.00	235.44	400.00	243.88	1.184	
32	205.42	160.14	375.53	200.00	246.60	367.31	211.22	1.184	
33	204.89	159.96	376.05	200.00	245.71	371.37	215.31	1.184	
34	207.00	160.67	375.53	200.00	249.51	359.23	203.06	1.184	
35	200.16	159.00	375.00	200.00	236.82	395.98	239.80	1.184	
36	199.63	159.00	375.53	200.00	237.15	395.84	239.80	1.184	
37	203.32	159.44	375.53	200.00	241.36	383.79	227.55	1.184	
38	205.95	160.32	375.00	200.00	246.47	367.62	211.22	1.184	
39	206.47	160.49	375.00	200.00	247.78	363.47	207.14	1.184	
40	202.79	159.26	375.00	200.00	239.62	387.95	231.63	1.185	
41	201.74	159.00	376.05	200.00	238.97	391.75	235.71	1.185	
42	204.89	159.96	376.58	200.00	246.13	371.29	215.31	1.185	
43	202.79	159.26	375.53	200.00	240.05	387.88	231.63	1.186	
44	198.58	159.00	375.00	200.00	235.53	400.06	243.88	1.186	
45	205.42	160.14	375.00	200.00	245.16	371.75	215.31	1.186	
46	200.68	159.00	375.00	200.00	236.91	396.04	239.80	1.186	
47	200.16	159.00	375.53	200.00	237.25	395.91	239.80	1.187	
48	198.05	159.00	375.53	200.00	235.87	399.93	243.88	1.187	
49	200.68	159.00	375.53	200.00	237.34	395.98	239.80	1.187	
50	206.47	160.49	375.53	200.00	248.20	363.39	207.14	1.187	
51	204.37	159.79	376.58	200.00	244.82	375.42	219.39	1.187	
52	200.16	159.00	376.05	200.00	237.68	395.84	239.80	1.187	
53	202.26	159.09	375.00	200.00	238.30	392.03	235.71	1.187	
54	207.00	160.67	376.05	200.00	249.92	359.14	203.06	1.188	
55	204.89	159.96	375.00	200.00	243.84	375.87	219.39	1.188	
56	202.26	159.09	375.53	200.00	238.74	391.96	235.71	1.188	
57	203.84	159.61	376.58	200.00	243.51	379.53	223.47	1.188	
58	206.47	160.49	376.05	200.00	248.61	363.30	207.14	1.188	
59	197.00	159.00	375.00	200.00	234.26	404.14	247.96	1.189	
60	201.21	159.00	375.00	200.00	237.00	396.11	239.80	1.189	
61	203.84	159.61	376.05	200.00	243.09	379.61	223.47	1.189	
62	204.37	159.79	375.00	200.00	242.53	379.98	223.47	1.189	
63	198.58	159.00	375.53	200.00	235.96	400.00	243.88	1.189	
64	199.11	159.00	375.00	200.00	235.63	400.13	243.88	1.189	

65	198.58	159.00	376.05	200.00	236.39	399.93	243.88	1.189
66	205.95	160.32	376.05	200.00	247.31	367.45	211.22	1.190
67	200.68	159.00	376.05	200.00	237.77	395.91	239.80	1.190
68	203.32	159.44	376.58	200.00	242.21	383.64	227.55	1.190
69	203.32	159.44	376.05	200.00	241.78	383.71	227.55	1.190
70	205.95	160.32	375.53	200.00	246.89	367.53	211.22	1.190
71	201.74	159.00	375.00	200.00	237.10	396.17	239.80	1.191
72	203.84	159.61	377.11	200.00	243.94	379.46	223.47	1.191
73	207.00	160.67	376.58	200.00	250.34	359.05	203.06	1.191
74	197.53	159.00	375.00	200.00	234.35	404.21	247.96	1.191
75	202.26	159.09	376.05	200.00	239.17	391.90	235.71	1.191
76	199.63	159.00	375.00	200.00	235.72	400.19	243.88	1.191
77	202.79	159.26	376.05	200.00	240.48	387.81	231.63	1.191
78	199.11	159.00	375.53	200.00	236.06	400.06	243.88	1.191
79	201.21	159.00	375.53	200.00	237.44	396.04	239.80	1.191
80	205.42	160.14	376.05	200.00	246.00	371.59	215.31	1.191
81	205.42	160.14	375.53	200.00	245.58	371.67	215.31	1.192
82	204.37	159.79	375.53	200.00	242.96	379.90	223.47	1.192
83	202.79	159.26	376.58	200.00	240.90	387.74	231.63	1.192
84	197.00	159.00	375.53	200.00	234.69	404.08	247.96	1.192
85	199.11	159.00	376.05	200.00	236.49	400.00	243.88	1.192
86	206.47	160.49	376.58	200.00	249.03	363.22	207.14	1.192
87	203.84	159.61	375.00	200.00	241.22	384.07	227.55	1.192
88	201.21	159.00	376.05	200.00	237.87	395.98	239.80	1.192
89	203.32	159.44	377.11	200.00	242.63	383.57	227.55	1.193
90	203.84	159.61	375.53	200.00	241.65	384.00	227.55	1.193
91	198.05	159.00	375.00	200.00	234.44	404.27	247.96	1.193
92	204.89	159.96	375.53	200.00	244.27	375.79	219.39	1.193
93	203.32	159.44	375.00	200.00	239.91	388.16	231.63	1.193
94	200.16	159.00	375.00	200.00	235.81	400.26	243.88	1.193
95	204.89	159.96	376.05	200.00	244.69	375.71	219.39	1.193
96	199.63	159.00	375.53	200.00	236.15	400.13	243.88	1.193
97	201.74	159.00	375.53	200.00	237.53	396.11	239.80	1.193
98	205.42	160.14	376.58	200.00	246.42	371.51	215.31	1.194
99	203.32	159.44	375.53	200.00	240.34	388.09	231.63	1.194

Critical Failure Surface (circle 1)

Intersects: XL: 203.84 YL: 159.61 XR: 375.00 YR: 200.00
Centre: XC: 243.26 YC: 375.43 Radius: R: 219.39

Generated failure surface: (20 points)

203.84 159.61 213.24 158.11 222.70 157.01 232.20 156.32
241.72 156.05
251.24 156.19 260.75 156.74 270.22 157.71 279.64 159.08
289.00 160.86
298.27 163.05 307.43 165.64 316.47 168.62 325.38 171.99
334.13 175.75
342.71 179.88 351.10 184.38 359.29 189.24 367.26 194.45
375.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 39 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	203.84	3.62	-9.1	3.83	3.88	2	0.00	35.0	474.37	228.84	130.73	1.12
2	207.67	18.20	-9.1	5.57	5.64	3	100.00	18.0	2409.11	1150.19	457.33	1.06
3	213.24	26.98	-6.6	4.73	4.76	3	100.00	18.0	3589.39	1694.75	782.62	1.04
4	217.97	37.03	-6.6	4.73	4.76	3	100.00	18.0	4932.21	2326.23	1071.59	1.04
5	222.70	46.80	-4.1	4.75	4.76	3	100.00	18.0	6233.92	2928.13	1333.30	1.02
6	227.45	55.95	-4.1	4.75	4.76	3	100.00	18.0	7448.51	3500.41	1591.84	1.02
7	232.20	64.76	-1.6	4.76	4.76	3	100.00	18.0	8613.81	4042.49	1820.11	1.01
8	236.96	72.96	-1.6	4.76	4.76	3	100.00	18.0	9694.69	4554.45	2048.18	1.01
9	241.72	80.69	0.8	4.76	4.76	3	100.00	18.0	10709.78	5035.86	2243.48	1.00
10	246.48	87.92	0.8	4.76	4.76	3	100.00	18.0	11652.60	5486.59	2441.10	1.00
11	251.24	94.49	3.3	4.75	4.76	3	100.00	18.0	12505.38	5906.20	2603.92	0.99
12	256.00	100.71	3.3	4.75	4.76	3	100.00	18.0	13306.71	6294.81	2771.12	0.99
13	260.75	106.06	5.8	4.74	4.76	3	100.00	18.0	13988.80	6652.08	2901.92	0.98
14	265.49	111.25	5.8	4.74	4.76	3	100.00	18.0	14646.37	6977.87		

3038.80	0.98									
15	270.22	108.38	8.3	4.43	4.48	3	100.00	18.0	14240.99	6834.63
3134.89	0.97									
16	274.65	112.06	8.3	4.43	4.48	3	100.00	18.0	14694.73	7066.86
3235.28	0.97									
17	279.09	129.22	10.5	4.96	5.04	2	0.00	35.0	16927.43	8200.77
3236.90	0.92									
18	284.04	132.72	10.8	4.96	5.04	2	0.00	35.0	17386.63	8430.91
3320.27	0.91									
19	289.00	126.79	13.3	4.63	4.76	2	0.00	35.0	16609.82	8129.12
3351.97	0.90									
20	293.63	128.88	13.3	4.63	4.76	2	0.00	35.0	16883.75	8263.20
3407.25	0.90									
21	298.27	129.01	15.8	4.58	4.76	2	0.00	35.0	16900.81	8365.07
3409.06	0.89									
22	302.85	130.08	15.8	4.58	4.76	2	0.00	35.0	17041.10	8434.51
3437.38	0.89									
23	307.43	158.79	18.3	5.57	5.86	2	0.00	35.0	20802.01	10433.61
3413.02	0.88									
24	313.00	85.59	18.3	3.00	3.16	2	0.00	35.0	11212.78	5623.96
3414.85	0.88									
25	316.00	128.06	20.5	4.50	4.80	2	0.00	35.0	16775.92	8305.27
3362.65	0.87									
26	320.50	127.14	20.7	4.50	4.81	2	0.00	35.0	16655.78	7807.81
3317.12	0.87									
27	325.00	124.15	23.0	4.57	4.96	2	0.00	35.0	16263.60	7488.63
3145.81	0.87									
28	329.57	115.20	23.2	4.57	4.97	2	0.00	35.0	15091.76	6892.60
2913.35	0.87									
29	334.13	99.61	25.7	4.29	4.76	2	0.00	35.0	13049.00	6007.48
2643.44	0.86									
30	338.42	90.75	25.7	4.29	4.76	2	0.00	35.0	11888.23	5393.79
2404.55	0.86									
31	342.71	55.99	28.2	2.89	3.28	2	0.00	35.0	7335.28	3349.81
2166.24	0.86									
32	345.61	51.50	28.2	2.89	3.28	2	0.00	35.0	6746.76	3031.73
1988.82	0.86									
33	348.50	39.11	28.2	2.39	2.71	5	0.00	45.0	4302.40	1185.17
1372.66	0.78									
34	350.89	60.94	30.6	4.20	4.88	2	0.00	35.0	7983.52	0.00
1403.56	0.86									
35	355.09	50.46	30.7	4.20	4.89	2	0.00	35.0	6610.74	0.00
1160.71	0.86									
36	359.29	37.70	33.2	3.99	4.76	2	0.00	35.0	4938.42	0.00
890.57	0.86									
37	363.28	27.32	33.2	3.99	4.76	2	0.00	35.0	3578.28	0.00
645.29	0.86									
38	367.26	10.33	35.7	2.16	2.66	2	0.00	35.0	1352.71	0.00
437.60	0.86									
39	369.43	11.15	35.7	5.57	6.86	1	150.00	22.0	1460.58	0.00
136.20	0.99									
		---			---				---	
X-S Area:		3178.38	Path Length:		180.93		X-S Weight:		416938.66	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 6-2\West Farm Expansion Case 6-2 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 12:57:32

DATA: Analysis 1 - Case 6-2 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	196.00	348.50	196.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	175.00	348.50	175.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	172.00	348.50	172.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	196.00	450.00	196.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	175.00	450.00	175.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	172.00	450.00	172.00	

Slope Surface (8 points)

100.00	175.00	250.00	175.00	325.00	200.00	400.00	200.00
405.00	195.00						
410.00	195.00	415.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	197.00	250.00	197.00	316.00	197.00	348.50	197.00
351.50	190.00						
450.00	190.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	250.00	YL:	175.00	XR:	405.00	YR: 195.00
Centre:	XC:	297.11	YC:	420.52	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 6-2 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 5.374

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.68

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	250.79	175.26	400.00	200.00	289.59	403.62	231.63	2.683	<-- Critical Surface
2	251.32	175.44	400.00	200.00	290.66	399.56	227.55	2.684	
3	251.84	175.61	400.00	200.00	291.74	395.49	223.47	2.685	
4	253.95	176.32	400.00	200.00	296.00	379.14	207.14	2.690	
5	254.47	176.49	400.00	200.00	297.06	375.04	203.06	2.690	
6	253.42	176.14	400.00	200.00	294.94	383.24	211.22	2.690	
7	252.89	175.96	400.00	200.00	293.88	387.33	215.31	2.691	
8	252.37	175.79	400.00	200.00	292.81	391.42	219.39	2.692	
9	249.74	175.00	400.00	200.00	287.55	411.80	239.80	2.692	
10	248.68	175.00	400.00	200.00	286.60	415.91	243.88	2.696	
11	247.11	175.00	400.00	200.00	285.54	419.96	247.96	2.697	
12	249.21	175.00	400.00	200.00	286.73	415.97	243.88	2.704	
13	251.32	175.44	400.53	199.47	291.10	403.63	231.63	2.704	
14	247.63	175.00	400.00	200.00	285.66	420.03	247.96	2.704	
15	250.26	175.09	400.00	200.00	287.80	411.93	239.80	2.704	
16	246.05	175.00	400.00	200.00	284.61	424.07	252.04	2.705	
17	251.32	175.44	400.00	200.00	289.96	403.83	231.63	2.707	
18	250.79	175.26	400.00	200.00	288.88	407.88	235.71	2.708	
19	251.84	175.61	400.00	200.00	291.03	399.76	227.55	2.709	
20	252.89	175.96	400.53	199.47	294.27	391.41	219.39	2.710	
21	252.37	175.79	400.53	199.47	293.22	395.49	223.47	2.710	
22	251.84	175.61	400.53	199.47	292.16	399.56	227.55	2.710	
23	253.42	176.14	400.53	199.47	295.33	387.33	215.31	2.710	
24	249.74	175.00	400.00	200.00	286.85	416.04	243.88	2.711	
25	248.16	175.00	400.00	200.00	285.78	420.09	247.96	2.711	
26	253.95	176.32	400.53	199.47	296.38	383.24	211.22	2.711	
27	252.37	175.79	400.00	200.00	292.11	395.70	223.47	2.711	
28	246.58	175.00	400.00	200.00	284.73	424.14	252.04	2.711	
29	254.47	176.49	400.53	199.47	297.42	379.13	207.14	2.712	
30	245.00	175.00	400.00	200.00	283.68	428.18	256.12	2.712	
31	253.42	176.14	400.00	200.00	294.24	387.54	215.31	2.717	
32	252.89	175.96	400.00	200.00	293.18	391.62	219.39	2.717	
33	253.95	176.32	400.00	200.00	295.30	383.45	211.22	2.717	
34	248.68	175.00	400.00	200.00	285.90	420.15	247.96	2.718	
35	247.11	175.00	400.00	200.00	284.85	424.20	252.04	2.718	
36	254.47	176.49	400.00	200.00	296.36	379.35	207.14	2.718	
37	245.53	175.00	400.00	200.00	283.80	428.25	256.12	2.719	
38	255.00	176.67	400.00	200.00	297.42	375.25	203.06	2.719	
39	248.68	175.00	400.53	199.47	287.09	419.97	247.96	2.719	
40	247.63	175.00	400.53	199.47	286.17	424.08	252.04	2.722	
41	246.05	175.00	400.53	199.47	285.13	428.12	256.12	2.723	
42	249.21	175.00	400.53	199.47	287.22	420.03	247.96	2.723	
43	250.79	175.26	400.53	199.47	289.35	411.94	239.80	2.725	
44	246.05	175.00	400.00	200.00	283.92	428.31	256.12	2.725	
45	251.32	175.44	400.53	199.47	290.41	407.89	235.71	2.727	
46	249.21	175.00	400.00	200.00	286.02	420.21	247.96	2.728	
47	250.26	175.09	400.00	200.00	287.09	416.17	243.88	2.729	
48	248.16	175.00	400.53	199.47	286.29	424.14	252.04	2.729	
49	249.74	175.00	400.53	199.47	287.34	420.09	247.96	2.729	
50	246.58	175.00	400.53	199.47	285.25	428.19	256.12	2.730	
51	251.32	175.44	400.00	200.00	289.26	408.08	235.71	2.730	
52	245.00	175.00	400.53	199.47	284.21	432.23	260.20	2.730	
53	251.84	175.61	401.05	198.95	292.61	403.63	231.63	2.731	
54	252.37	175.79	401.05	198.95	293.66	399.56	227.55	2.731	
55	250.26	175.09	400.53	199.47	288.28	415.98	243.88	2.732	
56	249.74	175.00	400.00	200.00	286.14	420.27	247.96	2.732	
57	248.16	175.00	400.00	200.00	285.09	424.32	252.04	2.732	
58	252.89	175.96	401.05	198.95	294.70	395.49	223.47	2.732	
59	247.63	175.00	400.00	200.00	284.97	424.26	252.04	2.733	
60	245.00	175.00	400.00	200.00	283.00	432.41	260.20	2.733	
61	251.84	175.61	400.00	200.00	290.33	404.03	231.63	2.733	
62	253.42	176.14	401.05	198.95	295.74	391.41	219.39	2.734	

63	250.79	175.26	400.00	200.00	288.18	412.13	239.80	2.734
64	251.84	175.61	400.53	199.47	291.48	403.83	231.63	2.734
65	252.37	175.79	400.53	199.47	292.54	399.77	227.55	2.735
66	253.95	176.32	401.05	198.95	296.78	387.32	215.31	2.736
67	252.89	175.96	400.53	199.47	293.59	395.70	223.47	2.736
68	248.68	175.00	400.53	199.47	286.41	424.20	252.04	2.736
69	247.11	175.00	400.53	199.47	285.37	428.25	256.12	2.736
70	246.58	175.00	400.00	200.00	284.04	428.37	256.12	2.737
71	254.47	176.49	401.05	198.95	297.81	383.22	211.22	2.737
72	253.42	176.14	400.53	199.47	294.65	391.62	219.39	2.737
73	245.53	175.00	400.53	199.47	284.33	432.29	260.20	2.737
74	247.11	175.00	400.00	200.00	284.16	428.43	256.12	2.739
75	253.95	176.32	400.53	199.47	295.70	387.54	215.31	2.739
76	248.68	175.00	400.00	200.00	285.21	424.38	252.04	2.739
77	255.00	176.67	401.05	198.95	298.84	379.12	207.14	2.740
78	254.47	176.49	400.53	199.47	296.74	383.44	211.22	2.740
79	245.53	175.00	400.00	200.00	283.12	432.47	260.20	2.741
80	255.00	176.67	400.53	199.47	297.79	379.34	207.14	2.742
81	252.89	175.96	400.00	200.00	292.48	395.90	223.47	2.742
82	249.21	175.00	401.05	198.95	287.74	424.08	252.04	2.743
83	249.21	175.00	400.53	199.47	286.53	424.26	252.04	2.743
84	247.63	175.00	400.53	199.47	285.49	428.31	256.12	2.743
85	253.42	176.14	400.00	200.00	293.54	391.83	219.39	2.743
86	252.37	175.79	400.00	200.00	291.41	399.97	227.55	2.743
87	246.05	175.00	400.53	199.47	284.45	432.35	260.20	2.744
88	253.95	176.32	400.00	200.00	294.61	387.75	215.31	2.744
89	250.26	175.09	401.05	198.95	288.79	420.04	247.96	2.744
90	250.26	175.09	400.53	199.47	287.59	420.22	247.96	2.744
91	254.47	176.49	400.00	200.00	295.67	383.66	211.22	2.746
92	246.05	175.00	400.00	200.00	283.23	432.53	260.20	2.746
93	250.79	175.26	401.05	198.95	289.84	415.99	243.88	2.747
94	247.63	175.00	400.00	200.00	284.28	428.49	256.12	2.747
95	250.79	175.26	400.53	199.47	288.66	416.18	243.88	2.747
96	249.21	175.00	400.00	200.00	285.32	424.44	252.04	2.748
97	255.00	176.67	400.00	200.00	296.73	379.56	207.14	2.748
98	250.26	175.09	400.00	200.00	286.39	420.40	247.96	2.749
99	246.58	175.00	401.05	198.95	285.79	432.23	260.20	2.750

Critical Failure Surface (circle 1)

Intersects: XL: 250.79 YL: 175.26 XR: 400.00 YR: 200.00
Centre: XC: 289.59 YC: 403.62 Radius: R: 231.63
Generated failure surface: (20 points)

250.79	175.26	258.81	174.05	266.86	173.11	274.94	172.45	283.04	172.08
291.15	172.00	299.26	172.19	307.35	172.67	315.42	173.44	323.47	174.48
331.46	175.81	339.41	177.41	347.30	179.30	355.12	181.45	362.85	183.88
370.50	186.58	378.05	189.55	385.48	192.77	392.81	196.26	400.00	200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base							PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	250.79	0.73	-8.6	1.73	1.75	2	0.00	35.0	95.35	2390.63	1394.61	1.05
2	252.52	5.04	-8.6	3.14	3.18	3	100.00	18.0	667.35	4410.71	1507.92	1.03
3	255.66	9.83	-8.6	3.14	3.18	3	100.00	18.0	1310.07	4505.38	1649.14	1.03
4	258.81	19.31	-6.6	4.03	4.05	3	100.00	18.0	2577.85	5866.52	1797.14	1.02
5	262.83	26.60	-6.6	4.03	4.05	3	100.00	18.0	3551.98	5985.04	1957.10	1.02
6	266.86	33.74	-4.6	4.04	4.05	3	100.00	18.0	4502.80	6085.74	2103.24	1.01
7	270.90	40.50	-4.6	4.04	4.05	3	100.00	18.0	5402.26	6168.44	2242.93	1.01
8	274.94	47.09	-2.6	4.05	4.05	3	100.00	18.0	6276.03	6233.23	2367.80	1.01
9	278.99	53.31	-2.6	4.05	4.05	3	100.00	18.0	7098.18	6280.15	2487.15	1.01
10	283.04	56.60	-0.6	3.88	3.88	3	100.00	18.0	7528.81	6033.98	2588.64	1.00
11	286.92	61.78	-0.6	3.88	3.88	3	100.00	18.0	8208.11	6044.07	2683.30	1.00
12	290.80	73.03	1.2	4.23	4.23	3	100.00	18.0	9691.92	6589.66	2767.65	1.00
13	295.03	78.56	1.4	4.23	4.23	3	100.00	18.0	10412.02	6563.05		

2849.11	1.00									
14	299.26	80.06	3.4	4.05	4.05	3	100.00	18.0	10596.24	6245.63
2912.23	0.99									
15	303.30	84.54	3.4	4.05	4.05	3	100.00	18.0	11174.37	6184.82
2970.39	0.99									
16	307.35	61.51	5.4	2.82	2.84	3	100.00	18.0	8120.14	4282.49
3005.14	0.99									
17	310.18	63.42	5.4	2.82	2.84	3	100.00	18.0	8362.17	4235.27
3031.57	0.99									
18	313.00	55.96	5.4	2.42	2.44	3	100.00	18.0	7371.16	3597.89
3056.13	0.99									
19	315.42	95.61	7.4	4.02	4.05	3	100.00	18.0	12577.04	5895.19
3097.52	0.99									
20	319.44	98.90	7.4	4.02	4.05	3	100.00	18.0	12986.68	5763.01
3197.30	0.99									
21	323.47	38.58	9.4	1.53	1.56	3	100.00	18.0	5059.41	2173.58
3253.17	0.99									
22	325.00	39.97	9.4	1.59	1.61	3	100.00	18.0	5238.60	2226.57
3249.89	0.99									
23	326.59	119.88	9.4	4.87	4.94	2	0.00	35.0	15704.75	6657.96
3144.33	0.97									
24	331.46	94.55	11.4	3.97	4.05	2	0.00	35.0	12385.52	5259.83
3025.47	0.97									
25	335.44	91.36	11.4	3.97	4.05	2	0.00	35.0	11967.64	5056.76
2923.07	0.97									
26	339.41	87.21	13.4	3.94	4.05	2	0.00	35.0	11425.09	4836.09
2797.24	0.97									
27	343.36	83.50	13.4	3.94	4.05	2	0.00	35.0	10938.83	4597.97
2677.72	0.97									
28	347.30	24.65	15.4	1.20	1.25	2	0.00	35.0	3228.99	1362.54
2583.27	0.97									
29	348.50	59.88	15.4	3.00	3.11	5	0.00	45.0	6586.37	2613.69
2068.99	0.94									
30	351.50	68.87	15.4	3.62	3.75	2	0.00	35.0	9022.43	2117.50
2365.24	0.97									
31	355.12	69.39	17.4	3.87	4.05	2	0.00	35.0	9089.91	2008.50
2209.51	0.97									
32	358.98	64.69	17.4	3.87	4.05	2	0.00	35.0	8474.27	1701.14
2056.68	0.97									
33	362.85	59.04	19.4	3.82	4.05	2	0.00	35.0	7733.89	1376.79
1880.91	0.97									
34	366.68	53.88	19.4	3.82	4.05	2	0.00	35.0	7058.00	1035.37
1711.93	0.97									
35	370.50	47.83	21.4	3.77	4.05	2	0.00	35.0	6266.37	677.12
1521.72	0.97									
36	374.27	42.24	21.4	3.77	4.05	2	0.00	35.0	5533.58	302.08
1336.97	0.97									
37	378.05	10.67	23.5	1.04	1.14	2	0.00	35.0	1398.16	16.07
1204.83	0.98									
38	379.09	29.76	23.5	3.20	3.49	2	0.00	35.0	3898.23	0.00
1095.13	0.98									
39	382.29	25.32	23.5	3.20	3.49	2	0.00	35.0	3317.13	0.00
931.88	0.98									
40	385.48	21.74	25.5	3.39	3.75	2	0.00	35.0	2848.35	0.00
747.95	0.99									
41	388.87	16.28	25.5	3.39	3.75	2	0.00	35.0	2132.72	0.00
560.04	0.99									
42	392.26	11.68	27.2	3.87	4.35	1	150.00	22.0	1530.23	0.00
340.31	1.04									
43	396.13	3.89	27.5	3.87	4.36	1	150.00	22.0	510.08	0.00
95.26	1.05									
		---			---				---	
X-S Area:		2210.99	Path Length:		154.06		X-S Weight:		289859.09	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 6-2\West Farm Expansion Case 6-2 Rapid Drawdown-EQ.gmf
Processed: 04 Dec 2020 12:59:03

DATA: Analysis 1 - Case 6-2 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	196.00	348.50	196.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	175.00	348.50	175.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	172.00	348.50	172.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	196.00	450.00	196.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	175.00	450.00	175.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	172.00	450.00	172.00	

Slope Surface (8 points)

100.00	175.00	250.00	175.00	325.00	200.00	400.00	200.00
405.00	195.00						
410.00	195.00	415.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	175.00	250.00	175.00	316.00	197.00	348.50	197.00
351.50	190.00						
450.00	190.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	250.00	YL:	175.00	XR:	405.00	YR:	195.00
Centre:	XC:	297.11	YC:	420.52	Radius:	R:	250.00	

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 6-2 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 3.689

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.82

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	250.79	175.26	400.00	200.00	289.59	403.62	231.63	1.816	<-- Critical Surface
2	251.32	175.44	400.00	200.00	290.66	399.56	227.55	1.818	
3	249.74	175.00	400.00	200.00	287.55	411.80	239.80	1.819	
4	247.11	175.00	400.00	200.00	285.54	419.96	247.96	1.819	
5	248.68	175.00	400.00	200.00	286.60	415.91	243.88	1.821	
6	251.84	175.61	400.00	200.00	291.74	395.49	223.47	1.822	
7	246.05	175.00	400.00	200.00	284.61	424.07	252.04	1.824	
8	247.63	175.00	400.00	200.00	285.66	420.03	247.96	1.825	
9	249.21	175.00	400.00	200.00	286.73	415.97	243.88	1.826	
10	252.37	175.79	400.00	200.00	292.81	391.42	219.39	1.827	
11	245.00	175.00	400.00	200.00	283.68	428.18	256.12	1.828	
12	250.26	175.09	400.00	200.00	287.80	411.93	239.80	1.829	
13	246.58	175.00	400.00	200.00	284.73	424.14	252.04	1.829	
14	252.89	175.96	400.00	200.00	293.88	387.33	215.31	1.829	
15	248.16	175.00	400.00	200.00	285.78	420.09	247.96	1.830	
16	253.42	176.14	400.00	200.00	294.94	383.24	211.22	1.831	
17	249.74	175.00	400.00	200.00	286.85	416.04	243.88	1.832	
18	245.53	175.00	400.00	200.00	283.80	428.25	256.12	1.833	
19	253.95	176.32	400.00	200.00	296.00	379.14	207.14	1.834	
20	250.79	175.26	400.00	200.00	288.88	407.88	235.71	1.834	
21	247.11	175.00	400.00	200.00	284.85	424.20	252.04	1.834	
22	251.32	175.44	400.00	200.00	289.96	403.83	231.63	1.835	
23	251.32	175.44	400.53	199.47	291.10	403.63	231.63	1.835	
24	248.68	175.00	400.00	200.00	285.90	420.15	247.96	1.836	
25	254.47	176.49	400.00	200.00	297.06	375.04	203.06	1.836	
26	251.84	175.61	400.00	200.00	291.03	399.76	227.55	1.839	
27	246.05	175.00	400.00	200.00	283.92	428.31	256.12	1.839	
28	246.05	175.00	400.53	199.47	285.13	428.12	256.12	1.839	
29	248.68	175.00	400.53	199.47	287.09	419.97	247.96	1.840	
30	247.63	175.00	400.53	199.47	286.17	424.08	252.04	1.841	
31	251.84	175.61	400.53	199.47	292.16	399.56	227.55	1.841	
32	252.37	175.79	400.00	200.00	292.11	395.70	223.47	1.842	
33	249.21	175.00	400.53	199.47	287.22	420.03	247.96	1.843	
34	245.00	175.00	400.00	200.00	283.00	432.41	260.20	1.843	
35	252.37	175.79	400.53	199.47	293.22	395.49	223.47	1.844	
36	249.21	175.00	400.00	200.00	286.02	420.21	247.96	1.844	
37	245.00	175.00	400.53	199.47	284.21	432.23	260.20	1.844	
38	246.58	175.00	400.53	199.47	285.25	428.19	256.12	1.845	
39	247.63	175.00	400.00	200.00	284.97	424.26	252.04	1.845	
40	248.16	175.00	400.00	200.00	285.09	424.32	252.04	1.845	
41	250.26	175.09	400.00	200.00	287.09	416.17	243.88	1.846	
42	252.89	175.96	400.53	199.47	294.27	391.41	219.39	1.846	
43	248.16	175.00	400.53	199.47	286.29	424.14	252.04	1.846	
44	249.74	175.00	400.00	200.00	286.14	420.27	247.96	1.847	
45	246.58	175.00	400.00	200.00	284.04	428.37	256.12	1.847	
46	252.89	175.96	400.00	200.00	293.18	391.62	219.39	1.848	
47	249.74	175.00	400.53	199.47	287.34	420.09	247.96	1.848	
48	250.79	175.26	400.53	199.47	289.35	411.94	239.80	1.848	
49	253.42	176.14	400.53	199.47	295.33	387.33	215.31	1.849	
50	245.53	175.00	400.00	200.00	283.12	432.47	260.20	1.849	
51	247.11	175.00	400.00	200.00	284.16	428.43	256.12	1.849	
52	245.53	175.00	400.53	199.47	284.33	432.29	260.20	1.849	
53	253.42	176.14	400.00	200.00	294.24	387.54	215.31	1.850	
54	247.11	175.00	400.53	199.47	285.37	428.25	256.12	1.850	
55	250.26	175.09	400.53	199.47	288.28	415.98	243.88	1.851	
56	248.68	175.00	400.00	200.00	285.21	424.38	252.04	1.851	
57	251.32	175.44	400.00	200.00	289.26	408.08	235.71	1.851	
58	250.79	175.26	400.00	200.00	288.18	412.13	239.80	1.852	
59	253.95	176.32	400.53	199.47	296.38	383.24	211.22	1.852	
60	248.68	175.00	400.53	199.47	286.41	424.20	252.04	1.852	
61	251.32	175.44	400.53	199.47	290.41	407.89	235.71	1.852	
62	253.95	176.32	400.00	200.00	295.30	383.45	211.22	1.853	

63	246.05	175.00	400.00	200.00	283.23	432.53	260.20	1.854
64	246.05	175.00	400.53	199.47	284.45	432.35	260.20	1.855
65	254.47	176.49	400.53	199.47	297.42	379.13	207.14	1.855
66	251.84	175.61	400.00	200.00	290.33	404.03	231.63	1.855
67	247.63	175.00	400.00	200.00	284.28	428.49	256.12	1.855
68	247.63	175.00	400.53	199.47	285.49	428.31	256.12	1.856
69	254.47	176.49	400.00	200.00	296.36	379.35	207.14	1.856
70	249.21	175.00	400.53	199.47	286.53	424.26	252.04	1.857
71	249.21	175.00	400.00	200.00	285.32	424.44	252.04	1.857
72	251.84	175.61	401.05	198.95	292.61	403.63	231.63	1.858
73	245.00	175.00	400.00	200.00	282.32	436.64	264.29	1.858
74	251.84	175.61	400.53	199.47	291.48	403.83	231.63	1.858
75	245.00	175.00	400.53	199.47	283.55	436.46	264.29	1.859
76	249.21	175.00	401.05	198.95	287.74	424.08	252.04	1.859
77	255.00	176.67	400.00	200.00	297.42	375.25	203.06	1.860
78	246.58	175.00	400.00	200.00	283.35	432.59	260.20	1.860
79	246.58	175.00	400.53	199.47	284.58	432.41	260.20	1.860
80	245.00	175.00	401.05	198.95	284.77	436.28	264.29	1.860
81	250.26	175.09	400.53	199.47	287.59	420.22	247.96	1.860
82	250.26	175.09	400.00	200.00	286.39	420.40	247.96	1.861
83	252.37	175.79	401.05	198.95	293.66	399.56	227.55	1.861
84	248.16	175.00	400.53	199.47	285.61	428.37	256.12	1.861
85	246.58	175.00	401.05	198.95	285.79	432.23	260.20	1.861
86	252.37	175.79	400.53	199.47	292.54	399.77	227.55	1.861
87	248.16	175.00	400.00	200.00	284.39	428.55	256.12	1.862
88	250.26	175.09	401.05	198.95	288.79	420.04	247.96	1.862
89	247.63	175.00	401.05	198.95	286.70	428.13	256.12	1.863
90	249.74	175.00	400.00	200.00	285.44	424.50	252.04	1.864
91	245.53	175.00	400.53	199.47	283.67	436.52	264.29	1.864
92	245.53	175.00	400.00	200.00	282.43	436.70	264.29	1.864
93	250.79	175.26	400.53	199.47	288.66	416.18	243.88	1.864
94	252.89	175.96	401.05	198.95	294.70	395.49	223.47	1.864
95	250.79	175.26	400.00	200.00	287.47	416.37	243.88	1.864
96	252.89	175.96	400.53	199.47	293.59	395.70	223.47	1.864
97	252.37	175.79	400.00	200.00	291.41	399.97	227.55	1.865
98	249.74	175.00	401.05	198.95	287.86	424.14	252.04	1.865
99	247.11	175.00	400.53	199.47	284.70	432.47	260.20	1.865

Critical Failure Surface (circle 1)

Intersects: XL: 250.79 YL: 175.26 XR: 400.00 YR: 200.00
Centre: XC: 289.59 YC: 403.62 Radius: R: 231.63
Generated failure surface: (20 points)

250.79	175.26	258.81	174.05	266.86	173.11	274.94	172.45	283.04	172.08
291.15	172.00	299.26	172.19	307.35	172.67	315.42	173.44	323.47	174.48
331.46	175.81	339.41	177.41	347.30	179.30	355.12	181.45	362.85	183.88
370.50	186.58	378.05	189.55	385.48	192.77	392.81	196.26	400.00	200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base							PoreWater	
Normal	Test									
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force
Stress	Factor									
1	250.79	0.73	-8.6	1.73	1.75	2	0.00	35.0	95.36	45.94
56.85	1.07									
2	252.52	5.04	-8.6	3.14	3.18	3	100.00	18.0	667.35	317.92
224.11	1.04									
3	255.66	9.83	-8.6	3.14	3.18	3	100.00	18.0	1310.07	620.35
431.71	1.04									
4	258.81	19.31	-6.6	4.03	4.05	3	100.00	18.0	2577.85	1213.24
653.91	1.03									
5	262.83	26.60	-6.6	4.03	4.05	3	100.00	18.0	3551.98	1671.33
898.53	1.03									
6	266.86	33.74	-4.6	4.04	4.05	3	100.00	18.0	4502.80	2112.17
1127.49	1.02									
7	270.90	40.50	-4.6	4.04	4.05	3	100.00	18.0	5402.26	2535.70
1351.81	1.02									
8	274.94	47.09	-2.6	4.05	4.05	3	100.00	18.0	6276.03	2941.67
1558.97	1.01									
9	278.99	53.31	-2.6	4.05	4.05	3	100.00	18.0	7098.18	3330.12
1762.85	1.01									
10	283.04	56.60	-0.6	3.88	3.88	3	100.00	18.0	7528.81	3532.19
1944.29	1.00									
11	286.92	61.78	-0.6	3.88	3.88	3	100.00	18.0	8208.11	3855.02
2119.66	1.00									
12	290.80	73.03	1.2	4.23	4.23	3	100.00	18.0	9691.92	4557.99
2285.57	1.00									
13	295.03	78.56	1.4	4.23	4.23	3	100.00	18.0	10412.02	4903.47

2454.63	1.00									
14	299.26	80.06	3.4	4.05	4.05	3	100.00	18.0	10596.24	5004.35
2600.36	0.99									
15	303.30	84.54	3.4	4.05	4.05	3	100.00	18.0	11174.37	5284.86
2742.46	0.99									
16	307.35	61.51	5.4	2.82	2.84	3	100.00	18.0	8120.14	3855.53
2844.93	0.99									
17	310.18	63.42	5.4	2.82	2.84	3	100.00	18.0	8362.17	3974.94
2929.87	0.99									
18	313.00	55.96	5.4	2.42	2.44	3	100.00	18.0	7371.16	3507.34
3008.80	0.99									
19	315.42	95.61	7.4	4.02	4.05	3	100.00	18.0	12577.04	5895.19
3083.18	0.99									
20	319.44	98.90	7.4	4.02	4.05	3	100.00	18.0	12986.68	5763.01
3181.99	0.99									
21	323.47	38.58	9.4	1.53	1.56	3	100.00	18.0	5059.41	2173.58
3233.01	0.98									
22	325.00	39.97	9.4	1.59	1.61	3	100.00	18.0	5238.60	2226.57
3229.61	0.98									
23	326.59	119.88	9.4	4.87	4.94	2	0.00	35.0	15704.75	6657.96
3109.42	0.95									
24	331.46	94.55	11.4	3.97	4.05	2	0.00	35.0	12385.52	5259.83
2985.10	0.95									
25	335.44	91.36	11.4	3.97	4.05	2	0.00	35.0	11967.64	5056.76
2883.92	0.95									
26	339.41	87.21	13.4	3.94	4.05	2	0.00	35.0	11425.09	4836.09
2753.52	0.94									
27	343.36	83.50	13.4	3.94	4.05	2	0.00	35.0	10938.83	4597.97
2635.65	0.94									
28	347.30	24.65	15.4	1.20	1.25	2	0.00	35.0	3228.99	1362.54
2536.96	0.94									
29	348.50	59.88	15.4	3.00	3.11	5	0.00	45.0	6586.37	2613.69
2016.56	0.90									
30	351.50	68.87	15.4	3.62	3.75	2	0.00	35.0	9022.43	2117.50
2309.24	0.94									
31	355.12	69.39	17.4	3.87	4.05	2	0.00	35.0	9089.91	2008.50
2149.65	0.93									
32	358.98	64.69	17.4	3.87	4.05	2	0.00	35.0	8474.27	1701.14
1999.50	0.93									
33	362.85	59.04	19.4	3.82	4.05	2	0.00	35.0	7733.89	1376.79
1821.21	0.93									
34	366.68	53.88	19.4	3.82	4.05	2	0.00	35.0	7058.00	1035.37
1655.51	0.93									
35	370.50	47.83	21.4	3.77	4.05	2	0.00	35.0	6266.37	677.12
1464.10	0.93									
36	374.27	42.24	21.4	3.77	4.05	2	0.00	35.0	5533.58	302.08
1283.27	0.93									
37	378.05	10.67	23.5	1.04	1.14	2	0.00	35.0	1398.16	16.07
1149.66	0.93									
38	379.09	29.76	23.5	3.20	3.49	2	0.00	35.0	3898.23	0.00
1044.38	0.93									
39	382.29	25.32	23.5	3.20	3.49	2	0.00	35.0	3317.13	0.00
888.70	0.93									
40	385.48	21.74	25.5	3.39	3.75	2	0.00	35.0	2848.35	0.00
710.45	0.94									
41	388.87	16.28	25.5	3.39	3.75	2	0.00	35.0	2132.72	0.00
531.96	0.94									
42	392.26	11.68	27.2	3.87	4.35	1	150.00	22.0	1530.23	0.00
316.71	1.01									
43	396.13	3.89	27.5	3.87	4.36	1	150.00	22.0	510.08	0.00
79.63	1.01									

X-S Area: 2210.99 Path Length: 154.06 X-S Weight: 289859.09

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 7-1\West Farm Expansion Case 7-1 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 12:59:37

DATA: Analysis 1 - Case 7-1 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	188.00	348.50	188.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	144.00	348.50	144.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	141.00	348.50	141.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	500.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	188.00	500.00	188.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	144.00	500.00	144.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	141.00	500.00	141.00	

Slope Surface (4 points)

100.00	144.00	157.00	144.00	325.00	200.00	500.00	200.00

Phreatic Surface (6 points)

100.00	197.00	157.00	197.00	316.00	197.00	348.50	197.00
351.50	170.00						
500.00	170.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	157.00	YL:	144.00	XR:	480.00	YR: 200.00
Centre:	XC:	237.81	YC:	637.43	Radius:	R:	500.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 7-1 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 4.199

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 3.05

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	158.32	144.44	475.00	200.00	221.16	716.51	575.51	3.048	<-- Critical Surface
2	159.89	144.96	475.00	200.00	225.99	696.12	555.10	3.049	
3	156.21	144.00	475.00	200.00	216.38	736.87	595.92	3.050	
4	155.16	144.00	475.00	200.00	215.46	740.96	600.00	3.052	
5	160.95	145.32	475.00	200.00	228.95	683.90	542.86	3.052	
6	159.37	144.79	475.00	200.00	224.14	704.32	563.27	3.052	
7	157.79	144.26	475.00	200.00	219.31	724.69	583.67	3.053	
8	159.37	144.79	475.53	200.00	224.57	704.27	563.27	3.054	
9	156.74	144.00	475.00	200.00	216.47	736.92	595.92	3.054	
10	158.84	144.61	475.00	200.00	222.29	712.51	571.43	3.054	
11	157.26	144.09	475.00	200.00	217.45	732.86	591.84	3.054	
12	156.74	144.00	475.53	200.00	216.90	736.87	595.92	3.055	
13	157.26	144.09	475.53	200.00	217.88	732.81	591.84	3.055	
14	160.42	145.14	475.00	200.00	227.11	692.11	551.02	3.055	
15	155.68	144.00	475.00	200.00	215.55	741.01	600.00	3.056	
16	158.84	144.61	475.53	200.00	222.71	712.46	571.43	3.056	
17	155.68	144.00	475.53	200.00	215.99	740.96	600.00	3.057	
18	160.42	145.14	475.53	200.00	227.53	692.06	551.02	3.057	
19	162.00	145.67	475.00	200.00	231.91	671.65	530.61	3.057	
20	162.00	145.67	475.53	200.00	232.33	671.60	530.61	3.057	
21	158.32	144.44	475.00	200.00	220.43	720.69	579.59	3.058	
22	158.84	144.61	476.05	200.00	223.14	712.41	571.43	3.058	
23	159.89	144.96	475.00	200.00	225.26	700.32	559.18	3.058	
24	157.79	144.26	475.53	200.00	219.74	724.64	583.67	3.059	
25	156.21	144.00	475.00	200.00	215.64	741.05	600.00	3.060	
26	159.89	144.96	475.53	200.00	225.68	700.27	559.18	3.060	
27	157.79	144.26	475.00	200.00	218.57	728.87	587.76	3.060	
28	158.32	144.44	476.05	200.00	221.29	720.60	579.59	3.060	
29	156.21	144.00	475.53	200.00	216.08	741.01	600.00	3.061	
30	157.79	144.26	475.53	200.00	219.00	728.82	587.76	3.061	
31	159.89	144.96	476.05	200.00	226.11	700.21	559.18	3.062	
32	156.21	144.00	476.05	200.00	216.51	740.96	600.00	3.062	
33	161.47	145.49	475.00	200.00	230.07	679.88	538.78	3.062	
34	160.95	145.32	475.00	200.00	228.22	688.10	546.94	3.062	
35	161.47	145.49	475.53	200.00	230.49	679.83	538.78	3.063	
36	159.37	144.79	475.53	200.00	223.83	708.46	567.35	3.063	
37	161.47	145.49	476.05	200.00	230.91	679.77	538.78	3.063	
38	158.84	144.61	475.00	200.00	221.55	716.70	575.51	3.063	
39	158.32	144.44	475.53	200.00	220.86	720.65	579.59	3.063	
40	156.74	144.00	475.00	200.00	215.73	741.09	600.00	3.064	
41	159.37	144.79	476.05	200.00	224.26	708.41	567.35	3.064	
42	157.26	144.09	475.00	200.00	216.71	737.03	595.92	3.064	
43	157.79	144.26	476.05	200.00	219.44	728.78	587.76	3.064	
44	156.74	144.00	475.53	200.00	216.17	741.05	600.00	3.065	
45	160.42	145.14	475.00	200.00	226.38	696.31	555.10	3.065	
46	157.26	144.09	475.53	200.00	217.15	736.99	595.92	3.066	
47	156.74	144.00	476.05	200.00	216.61	741.01	600.00	3.066	
48	158.84	144.61	475.00	200.00	223.02	708.32	567.35	3.066	
49	160.42	145.14	475.53	200.00	226.80	696.26	555.10	3.067	
50	157.26	144.09	476.05	200.00	217.58	736.95	595.92	3.067	
51	156.74	144.00	476.58	200.00	217.04	740.96	600.00	3.067	
52	160.95	145.32	475.53	200.00	228.64	688.05	546.94	3.067	
53	158.32	144.44	475.00	200.00	219.70	724.88	583.67	3.067	
54	159.37	144.79	475.00	200.00	223.41	708.51	567.35	3.067	
55	157.26	144.09	476.58	200.00	218.01	736.90	595.92	3.067	
56	160.95	145.32	476.05	200.00	229.07	688.00	546.94	3.068	
57	158.32	144.44	475.53	200.00	220.13	724.83	583.67	3.068	
58	160.95	145.32	476.58	200.00	229.49	687.94	546.94	3.068	
59	162.00	145.67	476.58	200.00	232.44	675.70	534.69	3.068	
60	162.00	145.67	475.00	200.00	231.18	675.87	534.69	3.068	
61	158.84	144.61	475.53	200.00	221.98	716.65	575.51	3.068	
62	162.00	145.67	476.05	200.00	232.02	675.76	534.69	3.068	
63	162.00	145.67	475.53	200.00	231.60	675.81	534.69	3.068	
64	158.84	144.61	476.58	200.00	222.84	716.55	575.51	3.068	

65	158.32	144.44	476.05	200.00	220.56	724.78	583.67	3.069
66	159.89	144.96	475.53	200.00	224.95	704.46	563.27	3.069
67	159.37	144.79	476.58	200.00	224.69	708.36	567.35	3.070
68	159.37	144.79	475.00	200.00	222.67	712.70	571.43	3.070
69	157.79	144.26	476.58	200.00	219.87	728.73	587.76	3.070
70	157.79	144.26	475.00	200.00	217.84	733.05	591.84	3.070
71	159.89	144.96	476.05	200.00	225.38	704.41	563.27	3.071
72	160.42	145.14	476.05	200.00	227.22	696.21	555.10	3.071
73	157.79	144.26	475.53	200.00	218.27	733.00	591.84	3.071
74	160.95	145.32	475.00	200.00	227.49	692.30	551.02	3.072
75	161.47	145.49	475.00	200.00	229.34	684.09	542.86	3.072
76	160.42	145.14	476.58	200.00	227.65	696.16	555.10	3.072
77	157.79	144.26	476.05	200.00	218.70	732.96	591.84	3.072
78	158.32	144.44	477.11	200.00	221.42	724.69	583.67	3.073
79	159.89	144.96	475.00	200.00	224.53	704.51	563.27	3.073
80	160.42	145.14	477.11	200.00	228.07	696.10	555.10	3.073
81	161.47	145.49	475.53	200.00	229.76	684.04	542.86	3.073
82	159.37	144.79	475.53	200.00	223.10	712.65	571.43	3.073
83	157.79	144.26	476.58	200.00	219.14	732.91	591.84	3.073
84	161.47	145.49	477.11	200.00	231.02	683.88	542.86	3.073
85	161.47	145.49	476.05	200.00	230.18	683.98	542.86	3.073
86	161.47	145.49	476.58	200.00	230.60	683.93	542.86	3.073
87	158.84	144.61	476.05	200.00	222.41	716.60	575.51	3.074
88	158.84	144.61	477.11	200.00	223.27	716.51	575.51	3.074
89	158.84	144.61	475.00	200.00	220.82	720.88	579.59	3.074
90	157.26	144.09	475.00	200.00	215.98	741.21	600.00	3.074
91	158.32	144.44	476.58	200.00	220.99	724.74	583.67	3.075
92	158.84	144.61	475.53	200.00	221.25	720.84	579.59	3.075
93	159.37	144.79	476.58	200.00	223.96	712.56	571.43	3.075
94	157.26	144.09	475.53	200.00	216.41	741.17	600.00	3.075
95	158.84	144.61	476.05	200.00	221.68	720.79	579.59	3.075
96	159.89	144.96	476.58	200.00	225.80	704.36	563.27	3.076
97	157.79	144.26	477.11	200.00	219.57	732.87	591.84	3.076
98	160.42	145.14	475.53	200.00	226.07	700.46	559.18	3.076
99	157.26	144.09	476.05	200.00	216.85	741.12	600.00	3.077

Critical Failure Surface (circle 1)

Intersects: XL: 158.32 YL: 144.44 XR: 475.00 YR: 200.00
Centre: XC: 221.16 YC: 716.51 Radius: R: 575.51

Generated failure surface: (20 points)

158.32 144.44 175.39 142.82 192.50 141.71 209.64 141.11
226.79 141.02
243.94 141.45 261.06 142.38 278.15 143.82 295.19 145.78
312.16 148.24
329.05 151.20 345.85 154.67 362.53 158.63 379.09 163.09
395.51 168.04
411.78 173.48 427.87 179.40 443.78 185.80 459.50 192.67
475.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 44 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	158.32	4.58	-5.4	4.63	4.65	2	0.00	35.0	600.20	15305.20	3362.97	1.03
2	162.94	20.62	-5.4	6.22	6.25	3	100.00	18.0	2719.39	20790.02	3561.32	1.01
3	169.17	37.20	-5.4	6.22	6.25	3	100.00	18.0	4928.51	21020.19	3788.75	1.01
4	175.39	77.12	-3.7	8.56	8.57	3	100.00	18.0	10228.03	29138.27	4037.56	1.01
5	183.95	106.28	-3.7	8.56	8.57	3	100.00	18.0	14094.34	29434.94	4313.09	1.01
6	192.50	134.56	-2.0	8.57	8.57	3	100.00	18.0	17835.92	29663.94	4566.16	1.00
7	201.07	161.60	-2.0	8.57	8.57	3	100.00	18.0	21404.47	29824.07	4805.15	1.00
8	209.64	187.67	-0.3	8.57	8.57	3	100.00	18.0	24834.56	29915.96	5020.29	1.00
9	218.22	212.56	-0.3	8.57	8.57	3	100.00	18.0	28098.33	29939.43	5222.68	1.00
10	226.79	236.27	1.4	8.57	8.57	3	100.00	18.0	31197.60	29894.13	5399.94	1.00
11	235.36	258.95	1.4	8.57	8.57	3	100.00	18.0	34150.49	29780.86	5565.65	1.00
12	243.94	280.20	3.1	8.56	8.57	3	100.00	18.0	36904.30	29599.83	5705.15	1.00
13	252.50	300.64	3.1	8.56	8.57	3	100.00	18.0	39541.86	29350.00	5834.18	1.00
14	261.06	319.30	4.8	8.54	8.57	3	100.00	18.0	41935.27	29031.96		

5936.03	0.99									
15	269.60	337.47	4.8	8.54	8.57	3	100.00	18.0	44253.81	28645.82
6028.40	0.99									
16	278.15	62.24	6.5	1.53	1.54	3	100.00	18.0	8154.98	5095.93
6069.87	0.99									
17	279.68	390.71	6.5	9.32	9.38	2	0.00	35.0	51183.62	30719.41
6075.33	0.98									
18	289.00	269.83	6.5	6.19	6.23	2	0.00	35.0	35347.75	20044.43
6133.27	0.98									
19	295.19	382.61	8.2	8.49	8.57	2	0.00	35.0	50121.31	27079.13
6151.17	0.98									
20	303.67	396.18	8.2	8.49	8.57	2	0.00	35.0	51899.21	26421.25
6180.63	0.98									
21	312.16	183.50	10.0	3.84	3.90	2	0.00	35.0	24038.03	11780.75
6173.05	0.98									
22	316.00	439.21	10.0	9.00	9.14	2	0.00	35.0	57536.03	26969.83
6259.57	0.98									
23	325.00	199.17	10.0	4.05	4.11	2	0.00	35.0	26091.88	11848.23
6301.52	0.98									
24	329.05	402.55	11.7	8.40	8.57	2	0.00	35.0	52733.76	24042.91
6122.07	0.97									
25	337.45	388.00	11.7	8.40	8.57	2	0.00	35.0	50827.61	23115.81
5900.45	0.97									
26	345.85	119.40	13.4	2.65	2.73	2	0.00	35.0	15640.93	7147.46
5728.04	0.97									
27	348.50	133.04	13.4	3.00	3.08	5	0.00	45.0	14634.87	5358.30
4651.19	0.95									
28	351.50	239.06	13.4	5.52	5.67	2	0.00	35.0	31317.21	4718.53
5426.32	0.97									
29	357.02	231.83	13.4	5.52	5.67	2	0.00	35.0	30370.00	4254.78
5259.27	0.97									
30	362.53	333.31	15.1	8.28	8.57	2	0.00	35.0	43663.41	5487.32
5003.49	0.98									
31	370.81	314.84	15.1	8.28	8.57	2	0.00	35.0	41244.63	4294.12
4720.27	0.98									
32	379.09	292.86	16.8	8.21	8.57	2	0.00	35.0	38364.88	3035.17
4393.29	0.98									
33	387.30	272.54	16.8	8.21	8.57	2	0.00	35.0	35702.35	1710.50
4079.98	0.98									
34	395.51	181.50	18.5	5.86	6.18	2	0.00	35.0	23776.06	377.56
3773.20	0.98									
35	401.37	294.07	18.5	10.41	10.97	2	0.00	35.0	38523.41	0.00
3438.04	0.98									
36	411.78	201.52	20.2	8.05	8.57	2	0.00	35.0	26398.91	0.00
3024.73	0.98									
37	419.82	177.70	20.2	8.05	8.57	2	0.00	35.0	23278.09	0.00
2667.14	0.98									
38	427.87	151.17	21.9	7.96	8.57	2	0.00	35.0	19803.00	0.00
2278.64	0.99									
39	435.83	125.72	21.9	7.96	8.57	2	0.00	35.0	16469.16	0.00
1895.03	0.99									
40	443.78	66.01	23.6	5.04	5.50	2	0.00	35.0	8647.89	0.00
1559.66	0.99									
41	448.82	57.82	23.6	5.34	5.83	1	150.00	22.0	7574.96	0.00
1321.13	1.03									
42	454.16	45.37	23.6	5.34	5.83	1	150.00	22.0	5943.62	0.00
1032.24	1.03									
43	459.50	42.63	25.3	7.75	8.57	1	150.00	22.0	5585.03	0.00
656.12	1.04									
44	467.25	14.21	25.3	7.75	8.57	1	150.00	22.0	1861.67	0.00
204.10	1.04									
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X-S Area:		9083.61	Path Length:		325.84		X-S Weight:		1189461.25	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 7-1\West Farm Expansion Case 7-1 Rapid Drawdown-EQ.gmf
Processed: 04 Dec 2020 13:00:01

DATA: Analysis 1 - Case 7-1 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden
Cohesion Phi UnitWeight Ru
150.00 22.0 131.00 Auto
Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel
Cohesion Phi UnitWeight Ru
0.00 35.0 131.00 Auto
Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock
Cohesion Phi UnitWeight Ru
100.00 18.0 141.00 Auto
Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock
Cohesion Phi UnitWeight Ru
2000.00 20.0 141.00 Auto
Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall
Cohesion Phi UnitWeight Ru
0.00 45.0 110.00 Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points) Material beneath: 1 - Overburden
100.00 200.00 348.50 200.00
Profile: 2 (2 points) Material beneath: 2 - Sand and Gravel
100.00 188.00 348.50 188.00
Profile: 3 (2 points) Material beneath: 3 - Weathered Bedrock
100.00 144.00 348.50 144.00
Profile: 4 (2 points) Material beneath: 4 - Stable Bedrock
100.00 141.00 348.50 141.00
Profile: 5 (2 points) Material beneath: 5 - Slurry Wall
348.50 200.00 351.50 200.00
Profile: 6 (2 points) Material beneath: 1 - Overburden
351.50 200.00 500.00 200.00
Profile: 7 (2 points) Material beneath: 2 - Sand and Gravel
351.50 188.00 500.00 188.00
Profile: 8 (2 points) Material beneath: 3 - Weathered Bedrock
351.50 144.00 500.00 144.00
Profile: 9 (2 points) Material beneath: 4 - Stable Bedrock
348.50 141.00 500.00 141.00

Slope Surface (4 points)

100.00 144.00 157.00 144.00 325.00 200.00 500.00 200.00

Phreatic Surface (6 points)

100.00 144.00 157.00 144.00 316.00 197.00 348.50 197.00
351.50 170.00
500.00 170.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R
Intersects: XL: 157.00 YL: 144.00 XR: 480.00 YR: 200.00
Centre: XC: 237.81 YC: 637.43 Radius: R: 500.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor: XL XR R
Range of variation: 10.00 10.00 200.00
Trial positions within range: 20 20 50

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RESULTS: Analysis 1 - Case 7-1 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.684

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.92

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	156.21	144.00	475.00	200.00	216.38	736.87	595.92	1.920	<-- Critical Surface
2	158.32	144.44	475.00	200.00	221.16	716.51	575.51	1.921	
3	155.16	144.00	475.00	200.00	215.46	740.96	600.00	1.922	
4	159.89	144.96	475.00	200.00	225.99	696.12	555.10	1.923	
5	156.74	144.00	475.00	200.00	216.47	736.92	595.92	1.923	
6	157.79	144.26	475.00	200.00	219.31	724.69	583.67	1.924	
7	157.26	144.09	475.00	200.00	217.45	732.86	591.84	1.924	
8	155.68	144.00	475.00	200.00	215.55	741.01	600.00	1.924	
9	156.74	144.00	475.53	200.00	216.90	736.87	595.92	1.924	
10	159.37	144.79	475.00	200.00	224.14	704.32	563.27	1.925	
11	157.26	144.09	475.53	200.00	217.88	732.81	591.84	1.925	
12	155.68	144.00	475.53	200.00	215.99	740.96	600.00	1.925	
13	158.84	144.61	475.00	200.00	222.29	712.51	571.43	1.926	
14	159.37	144.79	475.53	200.00	224.57	704.27	563.27	1.926	
15	160.95	145.32	475.00	200.00	228.95	683.90	542.86	1.926	
16	156.21	144.00	475.00	200.00	215.64	741.05	600.00	1.927	
17	158.32	144.44	475.00	200.00	220.43	720.69	579.59	1.927	
18	158.84	144.61	475.53	200.00	222.71	712.46	571.43	1.927	
19	157.79	144.26	475.53	200.00	219.74	724.64	583.67	1.928	
20	160.42	145.14	475.00	200.00	227.11	692.11	551.02	1.928	
21	156.21	144.00	475.53	200.00	216.08	741.01	600.00	1.928	
22	157.79	144.26	475.00	200.00	218.57	728.87	587.76	1.928	
23	158.84	144.61	476.05	200.00	223.14	712.41	571.43	1.929	
24	159.89	144.96	475.00	200.00	225.26	700.32	559.18	1.929	
25	156.21	144.00	476.05	200.00	216.51	740.96	600.00	1.929	
26	160.42	145.14	475.53	200.00	227.53	692.06	551.02	1.930	
27	157.79	144.26	475.53	200.00	219.00	728.82	587.76	1.930	
28	162.00	145.67	475.00	200.00	231.91	671.65	530.61	1.930	
29	156.74	144.00	475.00	200.00	215.73	741.09	600.00	1.930	
30	158.32	144.44	476.05	200.00	221.29	720.60	579.59	1.930	
31	157.26	144.09	475.00	200.00	216.71	737.03	595.92	1.931	
32	162.00	145.67	475.53	200.00	232.33	671.60	530.61	1.931	
33	159.89	144.96	475.53	200.00	225.68	700.27	559.18	1.931	
34	156.74	144.00	475.53	200.00	216.17	741.05	600.00	1.931	
35	158.32	144.44	475.53	200.00	220.86	720.65	579.59	1.931	
36	158.84	144.61	475.00	200.00	221.55	716.70	575.51	1.931	
37	157.26	144.09	475.53	200.00	217.15	736.99	595.92	1.932	
38	161.47	145.49	475.00	200.00	230.07	679.88	538.78	1.932	
39	159.37	144.79	475.53	200.00	223.83	708.46	567.35	1.932	
40	157.79	144.26	476.05	200.00	219.44	728.78	587.76	1.932	
41	156.74	144.00	476.05	200.00	216.61	741.01	600.00	1.932	
42	159.89	144.96	476.05	200.00	226.11	700.21	559.18	1.933	
43	160.95	145.32	475.00	200.00	228.22	688.10	546.94	1.933	
44	157.26	144.09	476.05	200.00	217.58	736.95	595.92	1.933	
45	158.84	144.61	475.00	200.00	223.02	708.32	567.35	1.933	
46	161.47	145.49	475.53	200.00	230.49	679.83	538.78	1.933	
47	156.74	144.00	476.58	200.00	217.04	740.96	600.00	1.933	
48	158.32	144.44	475.00	200.00	219.70	724.88	583.67	1.933	
49	159.37	144.79	476.05	200.00	224.26	708.41	567.35	1.934	
50	157.26	144.09	476.58	200.00	218.01	736.90	595.92	1.934	
51	160.42	145.14	475.00	200.00	226.38	696.31	555.10	1.934	
52	161.47	145.49	476.05	200.00	230.91	679.77	538.78	1.934	
53	158.32	144.44	475.53	200.00	220.13	724.83	583.67	1.935	
54	159.37	144.79	475.00	200.00	223.41	708.51	567.35	1.935	
55	158.84	144.61	475.53	200.00	221.98	716.65	575.51	1.935	
56	157.79	144.26	475.00	200.00	217.84	733.05	591.84	1.935	
57	160.95	145.32	475.53	200.00	228.64	688.05	546.94	1.935	
58	158.32	144.44	476.05	200.00	220.56	724.78	583.67	1.936	
59	160.42	145.14	475.53	200.00	226.80	696.26	555.10	1.936	
60	159.37	144.79	476.58	200.00	224.69	708.36	567.35	1.936	
61	157.79	144.26	476.58	200.00	219.87	728.73	587.76	1.936	
62	157.79	144.26	475.53	200.00	218.27	733.00	591.84	1.936	
63	158.84	144.61	476.58	200.00	222.84	716.55	575.51	1.937	
64	159.37	144.79	475.00	200.00	222.67	712.70	571.43	1.937	

65	160.95	145.32	476.05	200.00	229.07	688.00	546.94	1.937
66	162.00	145.67	475.00	200.00	231.18	675.87	534.69	1.937
67	159.89	144.96	475.53	200.00	224.95	704.46	563.27	1.937
68	157.26	144.09	475.00	200.00	215.98	741.21	600.00	1.937
69	157.79	144.26	476.05	200.00	218.70	732.96	591.84	1.938
70	160.95	145.32	476.58	200.00	229.49	687.94	546.94	1.938
71	162.00	145.67	475.53	200.00	231.60	675.81	534.69	1.938
72	160.42	145.14	476.05	200.00	227.22	696.21	555.10	1.938
73	157.26	144.09	475.53	200.00	216.41	741.17	600.00	1.938
74	157.79	144.26	476.58	200.00	219.14	732.91	591.84	1.939
75	158.84	144.61	475.00	200.00	220.82	720.88	579.59	1.939
76	159.89	144.96	476.05	200.00	225.38	704.41	563.27	1.939
77	161.47	145.49	475.00	200.00	229.34	684.09	542.86	1.939
78	159.89	144.96	475.00	200.00	224.53	704.51	563.27	1.939
79	158.84	144.61	477.11	200.00	223.27	716.51	575.51	1.939
80	162.00	145.67	476.05	200.00	232.02	675.76	534.69	1.939
81	158.32	144.44	477.11	200.00	221.42	724.69	583.67	1.939
82	159.37	144.79	475.53	200.00	223.10	712.65	571.43	1.939
83	158.84	144.61	476.05	200.00	222.41	716.60	575.51	1.939
84	160.95	145.32	475.00	200.00	227.49	692.30	551.02	1.940
85	157.26	144.09	476.05	200.00	216.85	741.12	600.00	1.940
86	162.00	145.67	476.58	200.00	232.44	675.70	534.69	1.940
87	158.84	144.61	475.53	200.00	221.25	720.84	579.59	1.940
88	160.42	145.14	476.58	200.00	227.65	696.16	555.10	1.940
89	158.32	144.44	476.58	200.00	220.99	724.74	583.67	1.940
90	161.47	145.49	475.53	200.00	229.76	684.04	542.86	1.940
91	158.32	144.44	475.00	200.00	218.96	729.06	587.76	1.940
92	158.84	144.61	476.05	200.00	221.68	720.79	579.59	1.941
93	157.79	144.26	477.11	200.00	219.57	732.87	591.84	1.941
94	157.26	144.09	476.58	200.00	217.28	741.08	600.00	1.941
95	160.42	145.14	477.11	200.00	228.07	696.10	555.10	1.941
96	159.89	144.96	476.58	200.00	225.80	704.36	563.27	1.941
97	159.37	144.79	476.58	200.00	223.96	712.56	571.43	1.941
98	158.32	144.44	475.53	200.00	219.40	729.01	587.76	1.942
99	161.47	145.49	476.05	200.00	230.18	683.98	542.86	1.942

Critical Failure Surface (circle 1)

Intersects: XL: 156.21 YL: 144.00 XR: 475.00 YR: 200.00
Centre: XC: 216.38 YC: 736.87 Radius: R: 595.92

Generated failure surface: (20 points)

156.21 144.00 173.40 142.51 190.62 141.51 207.86 141.02 225.12 141.02
242.36 141.52 259.58 142.52 276.77 144.02 293.90 146.02 310.97 148.51
327.97 151.50 344.86 154.97 361.65 158.93 378.32 163.38 394.85 168.31
411.24 173.71 427.46 179.59 443.50 185.93 459.35 192.74 475.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	156.21	13.25	-5.0	8.59	8.63	3	100.00	18.0	1768.38	830.18	212.01	1.02
2	164.80	44.29	-5.0	8.59	8.63	3	100.00	18.0	5897.66	2773.84	696.33	1.02
3	173.40	74.43	-3.3	8.61	8.63	3	100.00	18.0	9899.93	4651.99	1158.71	1.01
4	182.01	103.43	-3.3	8.61	8.63	3	100.00	18.0	13742.18	6464.80	1607.22	1.01
5	190.62	131.54	-1.6	8.62	8.63	3	100.00	18.0	17456.78	8211.40	2031.40	1.01
6	199.24	158.46	-1.6	8.62	8.63	3	100.00	18.0	21004.52	9891.83	2443.93	1.01
7	207.86	184.38	0.0	8.63	8.63	3	100.00	18.0	24411.25	11505.37	2830.01	1.00
8	216.49	209.17	0.0	8.63	8.63	3	100.00	18.0	27658.23	13052.09	3206.43	1.00
9	225.12	232.77	1.7	8.62	8.63	3	100.00	18.0	30739.59	14531.27	3554.50	1.00
10	233.74	255.39	1.7	8.62	8.63	3	100.00	18.0	33680.15	15942.88	3894.69	1.00
11	242.36	276.56	3.3	8.61	8.63	3	100.00	18.0	36421.06	17286.43	4204.85	0.99
12	250.97	296.96	3.3	8.61	8.63	3	100.00	18.0	39050.95	18561.84	4508.72	0.99
13	259.58	310.67	5.0	8.46	8.49	3	100.00	18.0	40790.96	19459.21	4779.06	0.99
14	268.04	328.29	5.0	8.46	8.49	3	100.00	18.0	43036.71	20562.89		

5042.50	0.99									
15	276.51	253.12	6.6	6.25	6.29	2	0.00	35.0	33158.87	15899.38
5196.03	0.97									
16	282.75	261.58	6.6	6.25	6.29	2	0.00	35.0	34267.22	16433.13
5368.53	0.97									
17	289.00	211.26	6.6	4.90	4.94	2	0.00	35.0	27675.11	13271.83
5523.50	0.97									
18	293.90	379.09	8.3	8.54	8.63	2	0.00	35.0	49660.75	23905.87
5664.37	0.96									
19	302.44	392.74	8.3	8.54	8.63	2	0.00	35.0	51449.06	24766.72
5868.32	0.96									
20	310.97	237.28	10.0	5.03	5.10	2	0.00	35.0	31083.43	15032.86
5989.54	0.95									
21	316.00	434.84	10.0	9.00	9.14	2	0.00	35.0	56964.05	26694.20
6124.19	0.95									
22	325.00	144.59	10.0	2.97	3.01	2	0.00	35.0	18941.87	8597.27
6175.53	0.95									
23	327.97	402.47	11.6	8.45	8.63	2	0.00	35.0	52723.57	24025.04
5999.21	0.95									
24	336.41	387.79	11.6	8.45	8.63	2	0.00	35.0	50800.43	23089.80
5779.89	0.95									
25	344.86	162.20	13.3	3.64	3.74	2	0.00	35.0	21248.59	9700.06
5585.26	0.95									
26	348.50	131.45	13.3	3.00	3.08	5	0.00	45.0	14459.39	5254.13
4478.81	0.92									
27	351.50	429.11	13.3	10.15	10.43	2	0.00	35.0	56213.75	7983.46
5158.50	0.95									
28	361.65	332.98	14.9	8.33	8.63	2	0.00	35.0	43620.46	5357.63
4824.99	0.94									
29	369.99	314.45	14.9	8.33	8.63	2	0.00	35.0	41192.73	4160.77
4547.22	0.94									
30	378.32	292.51	16.6	8.27	8.63	2	0.00	35.0	38319.34	2899.23
4214.14	0.94									
31	386.59	272.15	16.6	8.27	8.63	2	0.00	35.0	35651.13	1573.01
3907.93	0.94									
32	394.85	158.07	18.3	5.12	5.40	2	0.00	35.0	20706.75	284.61
3612.54	0.94									
33	399.98	163.65	18.3	5.63	5.93	2	0.00	35.0	21438.10	0.00
3399.47	0.94									
34	405.61	153.20	18.3	5.63	5.93	2	0.00	35.0	20068.81	0.00
3182.32	0.94									
35	411.24	201.26	19.9	8.11	8.63	2	0.00	35.0	26365.19	0.00
2871.66	0.94									
36	419.35	177.43	19.9	8.11	8.63	2	0.00	35.0	23243.59	0.00
2531.67	0.94									
37	427.46	150.99	21.6	8.02	8.63	2	0.00	35.0	19780.02	0.00
2155.18	0.94									
38	435.48	125.55	21.6	8.02	8.63	2	0.00	35.0	16447.14	0.00
1792.04	0.94									
39	443.50	62.73	23.2	4.81	5.24	2	0.00	35.0	8217.30	0.00
1476.26	0.94									
40	448.31	59.70	23.2	5.52	6.01	1	150.00	22.0	7820.36	0.00
1268.68	1.00									
41	453.83	46.62	23.2	5.52	6.01	1	150.00	22.0	6106.97	0.00
983.99	1.00									
42	459.35	42.61	24.9	7.82	8.63	1	150.00	22.0	5581.69	0.00
616.92	1.00									
43	467.18	14.20	24.9	7.82	8.63	1	150.00	22.0	1860.56	0.00
183.63	1.00									
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X-S Area:		9015.20	Path Length:		327.78		X-S Weight:		1180624.75	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 7-2\West Farm Expansion Case 7-2 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 13:05:39

DATA: Analysis 1 - Case 7-2 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	198.00	348.50	198.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	144.00	348.50	144.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	141.00	348.50	141.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	198.00	450.00	198.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	144.00	450.00	144.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	141.00	450.00	141.00	

Slope Surface (8 points)

100.00	144.00	157.00	144.00	325.00	200.00	405.00	200.00
410.00	195.00						
415.00	195.00	420.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	197.00	157.00	197.00	316.00	197.00	348.50	197.00
351.50	172.00						
450.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	157.00	YL:	144.00	XR:	410.00	YR: 195.00
Centre:	XC:	241.19	YC:	379.40	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 7-2 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 3.807

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.23

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	159.37	144.79	405.00	200.00	210.57	491.02	350.00	2.229	<-- Critical Surface
2	159.89	144.96	405.00	200.00	211.84	486.96	345.92	2.230	
3	160.42	145.14	405.00	200.00	213.10	482.89	341.84	2.232	
4	160.95	145.32	405.00	200.00	214.37	478.82	337.76	2.233	
5	161.47	145.49	405.00	200.00	215.64	474.74	333.67	2.234	
6	162.00	145.67	405.00	200.00	216.91	470.65	329.59	2.234	
7	159.89	144.96	405.00	200.00	210.88	491.23	350.00	2.242	
8	160.95	145.32	405.00	200.00	213.41	483.10	341.84	2.243	
9	161.47	145.49	405.00	200.00	214.68	479.03	337.76	2.244	
10	162.00	145.67	405.00	200.00	215.95	474.95	333.67	2.245	
11	160.42	145.14	405.00	200.00	212.15	487.17	345.92	2.247	
12	159.89	144.96	405.53	199.47	211.95	491.07	350.00	2.248	
13	160.42	145.14	405.53	199.47	213.21	487.01	345.92	2.249	
14	160.95	145.32	405.53	199.47	214.47	482.94	341.84	2.250	
15	161.47	145.49	405.53	199.47	215.73	478.86	337.76	2.251	
16	162.00	145.67	405.53	199.47	216.99	474.78	333.67	2.252	
17	160.42	145.14	405.00	200.00	211.19	491.44	350.00	2.252	
18	160.95	145.32	405.00	200.00	212.46	487.38	345.92	2.253	
19	161.47	145.49	405.00	200.00	213.72	483.31	341.84	2.254	
20	162.00	145.67	405.00	200.00	214.99	479.24	337.76	2.258	
21	160.95	145.32	405.53	199.47	213.53	487.22	345.92	2.261	
22	161.47	145.49	405.53	199.47	214.78	483.15	341.84	2.262	
23	162.00	145.67	405.53	199.47	216.04	479.07	337.76	2.263	
24	160.42	145.14	405.53	199.47	212.27	491.28	350.00	2.265	
25	160.95	145.32	405.00	200.00	211.50	491.65	350.00	2.266	
26	160.42	145.14	406.05	198.95	213.34	491.12	350.00	2.268	
27	161.47	145.49	405.00	200.00	212.77	487.59	345.92	2.268	
28	160.95	145.32	406.05	198.95	214.59	487.05	345.92	2.269	
29	162.00	145.67	405.00	200.00	214.03	483.52	341.84	2.269	
30	161.47	145.49	406.05	198.95	215.84	482.98	341.84	2.270	
31	162.00	145.67	406.05	198.95	217.09	478.90	337.76	2.271	
32	160.95	145.32	405.53	199.47	212.58	491.49	350.00	2.271	
33	161.47	145.49	405.53	199.47	213.84	487.42	345.92	2.272	
34	162.00	145.67	405.53	199.47	215.10	483.35	341.84	2.276	
35	160.95	145.32	406.05	198.95	213.66	491.32	350.00	2.279	
36	161.47	145.49	405.00	200.00	211.81	491.85	350.00	2.280	
37	161.47	145.49	406.05	198.95	214.91	487.26	345.92	2.281	
38	162.00	145.67	406.05	198.95	216.16	483.19	341.84	2.282	
39	162.00	145.67	405.00	200.00	213.08	487.79	345.92	2.282	
40	161.47	145.49	405.53	199.47	212.89	491.69	350.00	2.286	
41	160.95	145.32	406.58	198.42	214.73	491.16	350.00	2.287	
42	162.00	145.67	405.53	199.47	214.15	487.63	345.92	2.287	
43	161.47	145.49	406.58	198.42	215.97	487.09	345.92	2.288	
44	162.00	145.67	406.58	198.42	217.21	483.01	341.84	2.290	
45	161.47	145.49	406.05	198.95	213.97	491.53	350.00	2.291	
46	162.00	145.67	405.00	200.00	212.12	492.06	350.00	2.295	
47	162.00	145.67	406.05	198.95	215.22	487.47	345.92	2.295	
48	160.95	145.32	407.11	197.89	215.81	490.99	350.00	2.297	
49	161.47	145.49	407.11	197.89	217.04	486.92	345.92	2.297	
50	162.00	145.67	407.11	197.89	218.27	482.84	341.84	2.298	
51	161.47	145.49	406.58	198.42	215.05	491.37	350.00	2.299	
52	162.00	145.67	405.53	199.47	213.21	491.90	350.00	2.301	
53	162.00	145.67	406.58	198.42	216.29	487.30	345.92	2.301	
54	162.00	145.67	406.05	198.95	214.29	491.74	350.00	2.306	
55	161.47	145.49	407.11	197.89	216.13	491.20	350.00	2.309	
56	162.00	145.67	407.11	197.89	217.36	487.13	345.92	2.310	
57	162.00	145.67	406.58	198.42	215.37	491.57	350.00	2.314	
58	162.00	145.67	406.58	198.42	218.14	478.72	337.76	2.320	
59	161.47	145.49	407.63	197.37	217.20	491.03	350.00	2.321	
60	162.00	145.67	407.11	197.89	216.45	491.41	350.00	2.321	
61	162.00	145.67	407.63	197.37	218.42	486.95	345.92	2.322	
62	161.47	145.49	406.58	198.42	216.90	482.80	341.84	2.325	

63	162.00	145.67	407.63	197.37	217.52	491.24	350.00	2.334
64	160.95	145.32	406.58	198.42	215.66	486.88	345.92	2.338
65	162.00	145.67	408.16	196.84	218.59	491.06	350.00	2.342
66	160.42	145.14	406.58	198.42	214.42	490.95	350.00	2.357
67	161.47	145.49	406.05	198.95	216.78	478.69	337.76	2.367
68	160.95	145.32	406.05	198.95	215.53	482.77	341.84	2.371
69	162.00	145.67	406.05	198.95	218.03	474.60	333.67	2.372
70	160.42	145.14	406.05	198.95	214.28	486.84	345.92	2.385
71	159.89	144.96	406.05	198.95	213.03	490.91	350.00	2.408
72	160.95	145.32	405.53	199.47	215.42	478.65	337.76	2.410
73	161.47	145.49	405.53	199.47	216.68	474.57	333.67	2.414
74	160.42	145.14	405.53	199.47	214.16	482.73	341.84	2.417
75	162.00	145.67	405.53	199.47	217.94	470.48	329.59	2.431
76	159.89	144.96	405.53	199.47	212.90	486.80	345.92	2.437
77	160.95	145.32	405.00	200.00	215.33	474.53	333.67	2.455
78	160.42	145.14	405.00	200.00	214.07	478.61	337.76	2.457
79	161.47	145.49	405.00	200.00	216.60	470.44	329.59	2.468
80	159.37	144.79	405.53	199.47	211.64	490.86	350.00	2.470
81	159.89	144.96	405.00	200.00	212.80	482.68	341.84	2.472
82	162.00	145.67	405.00	200.00	217.87	466.35	325.51	2.498
83	159.37	144.79	405.00	200.00	211.53	486.75	345.92	2.504
84	158.84	144.61	405.00	200.00	210.26	490.82	350.00	2.542
85	162.00	145.67	408.68	196.32	219.66	490.88	350.00	2.569
86	161.47	145.49	408.16	196.84	218.27	490.85	350.00	2.593
87	162.00	145.67	407.63	197.37	219.32	482.66	341.84	2.602
88	162.00	145.67	408.16	196.84	219.48	486.78	345.92	2.604
89	161.47	145.49	407.11	197.89	217.95	482.63	341.84	2.610
90	160.95	145.32	407.63	197.37	216.88	490.82	350.00	2.614
91	161.47	145.49	407.63	197.37	218.10	486.74	345.92	2.615
92	162.00	145.67	407.11	197.89	219.19	478.55	337.76	2.619
93	160.95	145.32	407.11	197.89	216.72	486.71	345.92	2.627
94	162.00	145.67	406.58	198.42	219.07	474.42	333.67	2.627
95	160.95	145.32	406.58	198.42	216.58	482.59	341.84	2.628
96	161.47	145.49	406.58	198.42	217.83	478.51	337.76	2.630
97	160.42	145.14	407.11	197.89	215.49	490.78	350.00	2.642
98	162.00	145.67	406.05	198.95	218.97	470.30	329.59	2.644
99	161.47	145.49	406.05	198.95	217.72	474.39	333.67	2.645

Critical Failure Surface (circle 1)

Intersects: XL: 159.37 YL: 144.79 XR: 405.00 YR: 200.00
Centre: XC: 210.57 YC: 491.02 Radius: R: 350.00
Generated failure surface: (20 points)

159.37 144.79 172.81 143.07 186.31 141.87 199.85 141.19
213.40 141.04
226.95 141.41 240.47 142.30 253.95 143.72 267.37 145.66
280.69 148.12
293.92 151.09 307.02 154.58 319.97 158.56 332.76 163.05
345.37 168.02
357.77 173.49 369.95 179.42 381.90 185.83 393.59 192.69
405.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	159.37	8.76	-7.3	6.16	6.21	2	0.00	35.0	1147.37	20389.60	3384.18	1.05
2	165.53	32.94	-7.3	7.28	7.34	3	100.00	18.0	4349.41	24495.27	3663.15	1.03
3	172.81	51.50	-5.1	6.75	6.78	3	100.00	18.0	6829.25	22933.39	3930.93	1.02
4	179.56	70.74	-5.1	6.75	6.78	3	100.00	18.0	9390.27	23187.28	4172.58	1.02
5	186.31	89.35	-2.9	6.77	6.78	3	100.00	18.0	11861.27	23385.83	4388.70	1.01
6	193.08	106.92	-2.9	6.77	6.78	3	100.00	18.0	14184.71	23529.01	4592.54	1.01
7	199.85	123.75	-0.6	6.78	6.78	3	100.00	18.0	16403.68	23616.76	4768.85	1.00
8	206.62	139.57	-0.6	6.78	6.78	3	100.00	18.0	18481.68	23649.04	4934.83	1.00
9	213.40	154.45	1.6	6.77	6.78	3	100.00	18.0	20427.79	23626.06	5071.56	1.00
10	220.18	168.49	1.6	6.77	6.78	3	100.00	18.0	22253.95	23547.42	5199.66	1.00
11	226.95	181.29	3.8	6.76	6.78	3	100.00	18.0	23909.35	23413.04	5297.07	0.99
12	233.71	193.50	3.8	6.76	6.78	3	100.00	18.0	25478.51	23223.45	5387.35	0.99
13	240.47	204.12	6.0	6.74	6.78	3	100.00	18.0	26830.46	22978.62		

5445.73	0.99									
14	247.21	214.48	6.0	6.74	6.78	3	100.00	18.0	28139.44	22678.56
5498.28	0.99									
15	253.95	62.50	8.2	1.91	1.93	3	100.00	18.0	8189.62	6388.83
5512.61	0.99									
16	255.86	192.72	8.2	5.75	5.81	2	0.00	35.0	25245.70	19074.78
5479.19	0.97									
17	261.61	198.96	8.2	5.75	5.81	2	0.00	35.0	26063.94	18772.91
5498.50	0.97									
18	267.37	237.39	10.4	6.66	6.78	2	0.00	35.0	31097.52	21448.21
5474.76	0.96									
19	274.03	244.00	10.4	6.66	6.78	2	0.00	35.0	31963.93	20928.50
5462.43	0.96									
20	280.69	247.73	12.7	6.61	6.78	2	0.00	35.0	32452.37	20354.44
5404.40	0.96									
21	287.31	252.47	12.7	6.61	6.78	2	0.00	35.0	33074.09	19726.01
5357.66	0.96									
22	293.92	253.89	14.9	6.55	6.78	2	0.00	35.0	33258.99	19043.69
5264.56	0.95									
23	300.47	256.78	14.9	6.55	6.78	2	0.00	35.0	33638.28	18307.49
5183.92	0.95									
24	307.02	177.37	17.1	4.49	4.70	2	0.00	35.0	23235.19	12238.67
5074.08	0.95									
25	311.51	177.88	17.1	4.49	4.70	2	0.00	35.0	23302.82	11833.27
4995.01	0.95									
26	316.00	119.09	17.1	3.00	3.14	2	0.00	35.0	15600.95	7677.30
4957.53	0.95									
27	319.00	238.35	19.0	6.00	6.34	2	0.00	35.0	31223.91	14935.39
4926.26	0.95									
28	325.00	297.30	19.3	7.76	8.22	2	0.00	35.0	38946.07	18119.63
4739.58	0.95									
29	332.76	225.08	21.5	6.30	6.78	2	0.00	35.0	29484.93	13830.97
4386.81	0.96									
30	339.06	209.39	21.5	6.30	6.78	2	0.00	35.0	27430.15	12778.70
4079.66	0.96									
31	345.37	98.04	23.8	3.13	3.42	2	0.00	35.0	12842.67	6043.11
3814.89	0.96									
32	348.50	89.81	23.8	3.00	3.28	5	0.00	45.0	9878.57	2952.55
2898.33	0.91									
33	351.50	82.91	23.8	2.90	3.16	2	0.00	35.0	10861.32	125.81
3300.54	0.96									
34	354.40	92.01	23.8	3.38	3.69	2	0.00	35.0	12053.04	0.00
3136.85	0.96									
35	357.77	152.48	26.0	6.09	6.78	2	0.00	35.0	19974.48	0.00
2843.58	0.96									
36	363.86	134.39	26.0	6.09	6.78	2	0.00	35.0	17605.41	0.00
2506.31	0.96									
37	369.95	113.33	28.2	5.97	6.78	2	0.00	35.0	14845.75	0.00
2127.44	0.97									
38	375.93	94.20	28.2	5.97	6.78	2	0.00	35.0	12340.33	0.00
1768.41	0.97									
39	381.90	72.79	30.4	5.84	6.78	2	0.00	35.0	9535.82	0.00
1377.68	0.98									
40	387.74	52.74	30.4	5.84	6.78	2	0.00	35.0	6909.08	0.00
998.19	0.98									
41	393.59	24.80	32.6	4.15	4.92	2	0.00	35.0	3248.36	0.00
652.41	0.99									
42	397.73	13.79	32.6	4.15	4.92	2	0.00	35.0	1806.82	0.00
362.88	0.99									
43	401.88	3.12	32.6	3.12	3.71	1	150.00	22.0	409.09	0.00
78.76	1.06									

X-S Area: 6155.14 Path Length: 257.51 X-S Weight: 806206.38

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 7-2\West Farm Expansion Case 7-2 Rapid Drawdown-EQ.gmf
Processed: 04 Dec 2020 13:05:12

DATA: Analysis 1 - Case 7-2 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	198.00	348.50	198.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	144.00	348.50	144.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	141.00	348.50	141.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	198.00	450.00	198.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	144.00	450.00	144.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	141.00	450.00	141.00	

Slope Surface (8 points)

100.00	144.00	157.00	144.00	325.00	200.00	405.00	200.00
410.00	195.00						
415.00	195.00	420.00	200.00	450.00	200.00		

Phreatic Surface (6 points)

100.00	144.00	157.00	144.00	316.00	197.00	348.50	197.00
351.50	172.00						
450.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	157.00	YL:	144.00	XR:	410.00	YR:	195.00
Centre:	XC:	241.19	YC:	379.40	Radius:	R:	250.00	

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 7-2 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.324

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.32

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	159.37	144.79	405.00	200.00	210.57	491.02	350.00	1.316	<-- Critical Surface
2	159.89	144.96	405.00	200.00	211.84	486.96	345.92	1.317	
3	160.42	145.14	405.00	200.00	213.10	482.89	341.84	1.318	
4	160.95	145.32	405.00	200.00	214.37	478.82	337.76	1.319	
5	161.47	145.49	405.00	200.00	215.64	474.74	333.67	1.320	
6	162.00	145.67	405.00	200.00	216.91	470.65	329.59	1.320	
7	159.89	144.96	405.00	200.00	210.88	491.23	350.00	1.325	
8	160.95	145.32	405.00	200.00	213.41	483.10	341.84	1.326	
9	161.47	145.49	405.00	200.00	214.68	479.03	337.76	1.327	
10	162.00	145.67	405.00	200.00	215.95	474.95	333.67	1.328	
11	160.42	145.14	405.00	200.00	212.15	487.17	345.92	1.328	
12	159.89	144.96	405.53	199.47	211.95	491.07	350.00	1.330	
13	160.42	145.14	405.53	199.47	213.21	487.01	345.92	1.331	
14	160.95	145.32	405.53	199.47	214.47	482.94	341.84	1.332	
15	160.42	145.14	405.00	200.00	211.19	491.44	350.00	1.332	
16	161.47	145.49	405.53	199.47	215.73	478.86	337.76	1.332	
17	160.95	145.32	405.00	200.00	212.46	487.38	345.92	1.333	
18	162.00	145.67	405.53	199.47	216.99	474.78	333.67	1.333	
19	161.47	145.49	405.00	200.00	213.72	483.31	341.84	1.333	
20	162.00	145.67	405.00	200.00	214.99	479.24	337.76	1.336	
21	160.95	145.32	405.53	199.47	213.53	487.22	345.92	1.338	
22	161.47	145.49	405.53	199.47	214.78	483.15	341.84	1.339	
23	162.00	145.67	405.53	199.47	216.04	479.07	337.76	1.341	
24	160.42	145.14	405.53	199.47	212.27	491.28	350.00	1.341	
25	160.95	145.32	405.00	200.00	211.50	491.65	350.00	1.341	
26	161.47	145.49	405.00	200.00	212.77	487.59	345.92	1.342	
27	160.42	145.14	406.05	198.95	213.34	491.12	350.00	1.343	
28	162.00	145.67	405.00	200.00	214.03	483.52	341.84	1.344	
29	160.95	145.32	406.05	198.95	214.59	487.05	345.92	1.344	
30	161.47	145.49	406.05	198.95	215.84	482.98	341.84	1.345	
31	160.95	145.32	405.53	199.47	212.58	491.49	350.00	1.345	
32	162.00	145.67	406.05	198.95	217.09	478.90	337.76	1.346	
33	161.47	145.49	405.53	199.47	213.84	487.42	345.92	1.346	
34	162.00	145.67	405.53	199.47	215.10	483.35	341.84	1.349	
35	161.47	145.49	405.00	200.00	211.81	491.85	350.00	1.351	
36	160.95	145.32	406.05	198.95	213.66	491.32	350.00	1.351	
37	162.00	145.67	405.00	200.00	213.08	487.79	345.92	1.352	
38	161.47	145.49	406.05	198.95	214.91	487.26	345.92	1.352	
39	162.00	145.67	406.05	198.95	216.16	483.19	341.84	1.354	
40	161.47	145.49	405.53	199.47	212.89	491.69	350.00	1.355	
41	162.00	145.67	405.53	199.47	214.15	487.63	345.92	1.356	
42	160.95	145.32	406.58	198.42	214.73	491.16	350.00	1.357	
43	161.47	145.49	406.58	198.42	215.97	487.09	345.92	1.358	
44	162.00	145.67	406.58	198.42	217.21	483.01	341.84	1.359	
45	161.47	145.49	406.05	198.95	213.97	491.53	350.00	1.359	
46	162.00	145.67	405.00	200.00	212.12	492.06	350.00	1.360	
47	162.00	145.67	406.05	198.95	215.22	487.47	345.92	1.362	
48	160.95	145.32	407.11	197.89	215.81	490.99	350.00	1.363	
49	161.47	145.49	407.11	197.89	217.04	486.92	345.92	1.364	
50	162.00	145.67	407.11	197.89	218.27	482.84	341.84	1.365	
51	161.47	145.49	406.58	198.42	215.05	491.37	350.00	1.365	
52	162.00	145.67	405.53	199.47	213.21	491.90	350.00	1.365	
53	162.00	145.67	406.58	198.42	216.29	487.30	345.92	1.366	
54	162.00	145.67	406.05	198.95	214.29	491.74	350.00	1.370	
55	161.47	145.49	407.11	197.89	216.13	491.20	350.00	1.372	
56	162.00	145.67	407.11	197.89	217.36	487.13	345.92	1.373	
57	162.00	145.67	406.58	198.42	215.37	491.57	350.00	1.375	
58	161.47	145.49	407.63	197.37	217.20	491.03	350.00	1.378	
59	162.00	145.67	406.58	198.42	218.14	478.72	337.76	1.378	
60	162.00	145.67	407.63	197.37	218.42	486.95	345.92	1.379	
61	162.00	145.67	407.11	197.89	216.45	491.41	350.00	1.380	
62	161.47	145.49	406.58	198.42	216.90	482.80	341.84	1.382	

63	162.00	145.67	407.63	197.37	217.52	491.24	350.00	1.387
64	160.95	145.32	406.58	198.42	215.66	486.88	345.92	1.390
65	162.00	145.67	408.16	196.84	218.59	491.06	350.00	1.393
66	160.42	145.14	406.58	198.42	214.42	490.95	350.00	1.402
67	161.47	145.49	406.05	198.95	216.78	478.69	337.76	1.409
68	160.95	145.32	406.05	198.95	215.53	482.77	341.84	1.411
69	162.00	145.67	406.05	198.95	218.03	474.60	333.67	1.412
70	160.42	145.14	406.05	198.95	214.28	486.84	345.92	1.420
71	159.89	144.96	406.05	198.95	213.03	490.91	350.00	1.435
72	160.95	145.32	405.53	199.47	215.42	478.65	337.76	1.436
73	161.47	145.49	405.53	199.47	216.68	474.57	333.67	1.439
74	160.42	145.14	405.53	199.47	214.16	482.73	341.84	1.441
75	162.00	145.67	405.53	199.47	217.94	470.48	329.59	1.450
76	159.89	144.96	405.53	199.47	212.90	486.80	345.92	1.453
77	160.95	145.32	405.00	200.00	215.33	474.53	333.67	1.464
78	160.42	145.14	405.00	200.00	214.07	478.61	337.76	1.465
79	161.47	145.49	405.00	200.00	216.60	470.44	329.59	1.473
80	159.37	144.79	405.53	199.47	211.64	490.86	350.00	1.475
81	159.89	144.96	405.00	200.00	212.80	482.68	341.84	1.475
82	162.00	145.67	405.00	200.00	217.87	466.35	325.51	1.492
83	159.37	144.79	405.00	200.00	211.53	486.75	345.92	1.495
84	158.84	144.61	405.00	200.00	210.26	490.82	350.00	1.520
85	162.00	145.67	408.68	196.32	219.66	490.88	350.00	1.541
86	161.47	145.49	408.16	196.84	218.27	490.85	350.00	1.556
87	162.00	145.67	407.63	197.37	219.32	482.66	341.84	1.562
88	162.00	145.67	408.16	196.84	219.48	486.78	345.92	1.564
89	161.47	145.49	407.11	197.89	217.95	482.63	341.84	1.568
90	161.47	145.49	407.63	197.37	218.10	486.74	345.92	1.570
91	160.95	145.32	407.63	197.37	216.88	490.82	350.00	1.570
92	162.00	145.67	407.11	197.89	219.19	478.55	337.76	1.572
93	160.95	145.32	407.11	197.89	216.72	486.71	345.92	1.579
94	162.00	145.67	406.58	198.42	219.07	474.42	333.67	1.579
95	160.95	145.32	406.58	198.42	216.58	482.59	341.84	1.579
96	161.47	145.49	406.58	198.42	217.83	478.51	337.76	1.580
97	160.42	145.14	407.11	197.89	215.49	490.78	350.00	1.588
98	162.00	145.67	406.05	198.95	218.97	470.30	329.59	1.589
99	161.47	145.49	406.05	198.95	217.72	474.39	333.67	1.589

Critical Failure Surface (circle 1)

Intersects: XL: 159.37 YL: 144.79 XR: 405.00 YR: 200.00
Centre: XC: 210.57 YC: 491.02 Radius: R: 350.00
Generated failure surface: (20 points)

159.37	144.79	172.81	143.07	186.31	141.87	199.85	141.19	213.40	141.04
226.95	141.41	240.47	142.30	253.95	143.72	267.37	145.66	280.69	148.12
293.92	151.09	307.02	154.58	319.97	158.56	332.76	163.05	345.37	168.02
357.77	173.49	369.95	179.42	381.90	185.83	393.59	192.69	405.00	200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Test Factor
1	159.37	8.76	-7.3	6.16	6.21	2	0.00	35.0	1147.37	551.00	193.36	1.08
2	165.53	32.94	-7.3	7.28	7.34	3	100.00	18.0	4349.41	2072.40	617.59	1.04
3	172.81	51.50	-5.1	6.75	6.78	3	100.00	18.0	6829.25	3226.05	1030.67	1.03
4	179.56	70.74	-5.1	6.75	6.78	3	100.00	18.0	9390.27	4431.39	1414.61	1.03
5	186.31	89.35	-2.9	6.77	6.78	3	100.00	18.0	11861.27	5582.66	1767.96	1.01
6	193.08	106.92	-2.9	6.77	6.78	3	100.00	18.0	14184.71	6679.86	2113.51	1.01
7	199.85	123.75	-0.6	6.78	6.78	3	100.00	18.0	16403.68	7722.18	2425.19	1.00
8	206.62	139.57	-0.6	6.78	6.78	3	100.00	18.0	18481.68	8709.61	2732.29	1.00
9	213.40	154.45	1.6	6.77	6.78	3	100.00	18.0	20427.79	9641.49	3002.73	0.99
10	220.18	168.49	1.6	6.77	6.78	3	100.00	18.0	22253.95	10517.69	3271.35	0.99
11	226.95	181.29	3.8	6.76	6.78	3	100.00	18.0	23909.35	11337.45	3500.97	0.99
12	233.71	193.50	3.8	6.76	6.78	3	100.00	18.0	25478.51	12101.01	3731.12	0.99
13	240.47	204.12	6.0	6.74	6.78	3	100.00	18.0	26830.46	12807.71		

3920.35	0.98									
14	247.21	214.48	6.0	6.74	6.78	3	100.00	18.0	28139.44	13457.58
4112.07	0.98									
15	253.95	62.50	8.2	1.91	1.93	3	100.00	18.0	8189.62	3940.34
4206.49	0.98									
16	255.86	192.72	8.2	5.75	5.81	2	0.00	35.0	25245.70	12150.57
4223.78	0.94									
17	261.61	198.96	8.2	5.75	5.81	2	0.00	35.0	26063.94	12544.39
4360.67	0.94									
18	267.37	237.39	10.4	6.66	6.78	2	0.00	35.0	31097.52	15062.64
4447.97	0.93									
19	274.03	244.00	10.4	6.66	6.78	2	0.00	35.0	31963.93	15482.31
4571.90	0.93									
20	280.69	247.73	12.7	6.61	6.78	2	0.00	35.0	32452.37	15843.90
4633.79	0.92									
21	287.31	252.47	12.7	6.61	6.78	2	0.00	35.0	33074.09	16147.44
4722.57	0.92									
22	293.92	253.89	14.9	6.55	6.78	2	0.00	35.0	33258.99	16392.66
4748.83	0.91									
23	300.47	256.78	14.9	6.55	6.78	2	0.00	35.0	33638.28	16579.61
4802.99	0.91									
24	307.02	177.37	17.1	4.49	4.70	2	0.00	35.0	23235.19	11580.01
4791.63	0.90									
25	311.51	177.88	17.1	4.49	4.70	2	0.00	35.0	23302.82	11613.71
4805.58	0.90									
26	316.00	119.09	17.1	3.00	3.14	2	0.00	35.0	15600.95	7677.30
4812.82	0.90									
27	319.00	238.35	19.0	6.00	6.34	2	0.00	35.0	31223.91	14935.39
4763.41	0.89									
28	325.00	297.30	19.3	7.76	8.22	2	0.00	35.0	38946.07	18119.63
4576.29	0.89									
29	332.76	225.08	21.5	6.30	6.78	2	0.00	35.0	29484.93	13830.97
4220.06	0.89									
30	339.06	209.39	21.5	6.30	6.78	2	0.00	35.0	27430.15	12778.70
3923.71	0.89									
31	345.37	98.04	23.8	3.13	3.42	2	0.00	35.0	12842.67	6043.11
3655.58	0.89									
32	348.50	89.81	23.8	3.00	3.28	5	0.00	45.0	9878.57	2952.55
2693.27	0.82									
33	351.50	82.91	23.8	2.90	3.16	2	0.00	35.0	10861.32	125.81
3047.13	0.89									
34	354.40	92.01	23.8	3.38	3.69	2	0.00	35.0	12053.04	0.00
2893.07	0.89									
35	357.77	152.48	26.0	6.09	6.78	2	0.00	35.0	19974.48	0.00
2603.83	0.88									
36	363.86	134.39	26.0	6.09	6.78	2	0.00	35.0	17605.41	0.00
2295.00	0.88									
37	369.95	113.33	28.2	5.97	6.78	2	0.00	35.0	14845.75	0.00
1934.08	0.88									
38	375.93	94.20	28.2	5.97	6.78	2	0.00	35.0	12340.33	0.00
1607.68	0.88									
39	381.90	72.79	30.4	5.84	6.78	2	0.00	35.0	9535.82	0.00
1243.40	0.88									
40	387.74	52.74	30.4	5.84	6.78	2	0.00	35.0	6909.08	0.00
900.90	0.88									
41	393.59	24.80	32.6	4.15	4.92	2	0.00	35.0	3248.36	0.00
584.51	0.89									
42	397.73	13.79	32.6	4.15	4.92	2	0.00	35.0	1806.82	0.00
325.12	0.89									
43	401.88	3.12	32.6	3.12	3.71	1	150.00	22.0	409.09	0.00
48.48	0.99									
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X-S Area:		6155.14	Path Length:		257.51		X-S Weight:		806206.38	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 8-1\West Farm Expansion Case 8-1 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 13:06:53

DATA: Analysis 1 - Case 8-1 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	182.00	348.50	182.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	163.00	348.50	163.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	160.00	348.50	160.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	500.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	182.00	500.00	182.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	163.00	500.00	163.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	160.00	500.00	160.00	

Slope Surface (4 points)

100.00	163.00	214.00	163.00	325.00	200.00	500.00	200.00

Phreatic Surface (6 points)

100.00	197.00	214.00	197.00	316.00	197.00	348.50	197.00
351.50	172.00						
500.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	214.00	YL:	163.00	XR:	475.00	YR: 200.00
Centre:	XC:	276.80	YC:	659.04	Radius:	R:	500.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 8-1 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 4.870

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 3.55

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	213.21	163.00	470.00	200.00	268.83	686.58	526.53	3.548	<-- Critical Surface
2	212.68	163.00	470.00	200.00	268.72	686.54	526.53	3.549	
3	213.74	163.00	470.00	200.00	269.54	682.46	522.45	3.554	
4	212.68	163.00	470.53	200.00	268.54	690.66	530.61	3.555	
5	212.16	163.00	470.53	200.00	268.43	690.62	530.61	3.556	
6	211.63	163.00	470.00	200.00	267.91	690.62	530.61	3.558	
7	210.58	163.00	470.00	200.00	267.09	694.70	534.69	3.558	
8	209.53	163.00	470.00	200.00	266.28	698.78	538.78	3.558	
9	214.26	163.09	470.00	200.00	270.42	678.40	518.37	3.559	
10	213.21	163.00	470.00	200.00	268.23	690.75	530.61	3.559	
11	213.21	163.00	470.53	200.00	269.25	686.54	526.53	3.561	
12	214.79	163.26	470.00	200.00	272.06	670.24	510.20	3.561	
13	212.16	163.00	471.05	200.00	268.26	694.74	534.69	3.562	
14	215.32	163.44	470.00	200.00	273.70	662.07	502.04	3.563	
15	212.68	163.00	470.00	200.00	268.12	690.71	530.61	3.563	
16	210.05	163.00	470.00	200.00	266.39	698.82	538.78	3.563	
17	214.26	163.09	470.53	200.00	270.83	678.36	518.37	3.563	
18	209.00	163.00	470.00	200.00	265.59	702.90	542.86	3.564	
19	214.79	163.26	470.53	200.00	272.48	670.20	510.20	3.564	
20	211.63	163.00	471.05	200.00	268.15	694.70	534.69	3.564	
21	215.84	163.61	470.00	200.00	275.34	653.90	493.88	3.564	
22	216.37	163.79	470.00	200.00	276.97	645.71	485.71	3.565	
23	215.32	163.44	470.53	200.00	274.11	662.02	502.04	3.565	
24	211.11	163.00	470.53	200.00	267.62	694.70	534.69	3.565	
25	213.74	163.00	470.53	200.00	269.36	686.58	526.53	3.565	
26	216.89	163.96	470.00	200.00	278.59	637.51	477.55	3.565	
27	210.05	163.00	470.53	200.00	266.81	698.78	538.78	3.565	
28	209.00	163.00	470.53	200.00	266.00	702.86	542.86	3.566	
29	213.74	163.00	470.00	200.00	268.94	686.63	526.53	3.566	
30	212.16	163.00	470.00	200.00	267.42	694.83	534.69	3.566	
31	211.11	163.00	470.00	200.00	266.61	698.91	538.78	3.566	
32	212.68	163.00	470.53	200.00	267.94	694.83	534.69	3.567	
33	210.05	163.00	470.00	200.00	265.80	702.99	542.86	3.567	
34	209.00	163.00	470.00	200.00	264.99	707.06	546.94	3.568	
35	212.68	163.00	471.05	200.00	268.96	690.62	530.61	3.568	
36	213.74	163.00	470.00	200.00	268.33	690.80	530.61	3.568	
37	210.58	163.00	470.53	200.00	266.92	698.82	538.78	3.570	
38	209.53	163.00	470.53	200.00	266.11	702.90	542.86	3.571	
39	213.74	163.00	470.53	200.00	268.75	690.75	530.61	3.571	
40	212.16	163.00	470.53	200.00	267.84	694.79	534.69	3.571	
41	211.11	163.00	471.58	200.00	267.86	698.78	538.78	3.571	
42	213.74	163.00	471.05	200.00	269.77	686.54	526.53	3.572	
43	212.16	163.00	470.53	200.00	267.24	698.95	538.78	3.572	
44	214.79	163.26	470.00	200.00	271.46	674.42	514.29	3.572	
45	213.21	163.00	471.05	200.00	269.07	690.66	530.61	3.572	
46	211.63	163.00	470.00	200.00	267.31	694.79	534.69	3.573	
47	210.58	163.00	471.05	200.00	267.34	698.78	538.78	3.573	
48	212.16	163.00	470.00	200.00	268.01	690.66	530.61	3.573	
49	209.53	163.00	471.05	200.00	266.53	702.86	542.86	3.573	
50	213.21	163.00	470.00	200.00	267.63	694.92	534.69	3.573	
51	210.58	163.00	470.00	200.00	266.50	698.87	538.78	3.573	
52	211.11	163.00	470.00	200.00	267.20	694.74	534.69	3.574	
53	210.58	163.00	470.00	200.00	265.91	703.03	542.86	3.574	
54	211.63	163.00	470.00	200.00	266.71	698.95	538.78	3.574	
55	209.53	163.00	470.00	200.00	265.10	707.11	546.94	3.574	
56	212.68	163.00	470.00	200.00	267.52	694.87	534.69	3.574	
57	211.63	163.00	470.53	200.00	267.13	698.91	538.78	3.574	
58	214.26	163.09	470.53	200.00	270.23	682.53	522.45	3.574	
59	214.26	163.09	470.00	200.00	269.81	682.57	522.45	3.574	
60	215.32	163.44	470.00	200.00	273.10	666.25	506.12	3.574	
61	212.16	163.00	471.05	200.00	267.66	698.91	538.78	3.574	
62	210.58	163.00	470.53	200.00	266.33	702.99	542.86	3.574	
63	209.53	163.00	470.00	200.00	265.69	702.94	542.86	3.574	
64	213.21	163.00	470.53	200.00	268.65	690.71	530.61	3.574	

65	214.79	163.26	470.53	200.00	271.88	674.37	514.29	3.574
66	214.26	163.09	470.00	200.00	269.21	686.74	526.53	3.575
67	209.53	163.00	470.53	200.00	265.52	707.06	546.94	3.575
68	212.16	163.00	471.58	200.00	268.67	694.70	534.69	3.575
69	215.84	163.61	470.00	200.00	274.74	658.08	497.96	3.576
70	213.21	163.00	470.53	200.00	268.05	694.87	534.69	3.576
71	215.32	163.44	470.53	200.00	273.51	666.20	506.12	3.576
72	214.26	163.09	471.05	200.00	270.65	682.48	522.45	3.576
73	214.79	163.26	471.05	200.00	272.29	674.32	514.29	3.577
74	216.37	163.79	470.00	200.00	276.37	649.90	489.80	3.577
75	211.11	163.00	471.05	200.00	267.45	698.82	538.78	3.578
76	215.84	163.61	470.53	200.00	275.15	658.03	497.96	3.578
77	214.26	163.09	470.53	200.00	269.63	686.70	526.53	3.578
78	210.05	163.00	471.05	200.00	266.64	702.90	542.86	3.578
79	211.63	163.00	471.58	200.00	267.97	698.82	538.78	3.578
80	216.89	163.96	470.00	200.00	278.00	641.71	481.63	3.578
81	209.00	163.00	471.05	200.00	265.83	706.98	546.94	3.578
82	215.32	163.44	471.05	200.00	273.93	666.16	506.12	3.578
83	213.21	163.00	471.05	200.00	268.47	694.83	534.69	3.578
84	217.95	164.32	470.00	200.00	281.24	625.30	465.31	3.579
85	217.42	164.14	470.00	200.00	279.62	633.51	473.47	3.579
86	210.58	163.00	472.11	200.00	267.58	702.86	542.86	3.579
87	214.79	163.26	471.58	200.00	272.71	674.28	514.29	3.579
88	216.37	163.79	470.53	200.00	276.78	649.85	489.80	3.579
89	213.21	163.00	471.58	200.00	269.49	690.62	530.61	3.579
90	211.63	163.00	471.05	200.00	267.55	698.87	538.78	3.579
91	211.63	163.00	471.05	200.00	266.96	703.03	542.86	3.579
92	212.68	163.00	471.58	200.00	268.78	694.74	534.69	3.580
93	215.84	163.61	471.05	200.00	275.56	657.98	497.96	3.580
94	216.89	163.96	470.53	200.00	278.40	641.65	481.63	3.580
95	210.05	163.00	471.58	200.00	267.06	702.86	542.86	3.580
96	217.42	164.14	470.53	200.00	280.02	633.45	473.47	3.580
97	210.05	163.00	470.00	200.00	265.21	707.15	546.94	3.580
98	209.00	163.00	470.00	200.00	264.40	711.23	551.02	3.580
99	211.11	163.00	470.00	200.00	266.01	703.07	542.86	3.581

Critical Failure Surface (circle 1)

Intersects: XL: 213.21 YL: 163.00 XR: 470.00 YR: 200.00
Centre: XC: 268.83 YC: 686.58 Radius: R: 526.53

Generated failure surface: (20 points)

213.21 163.00 226.95 161.72 240.71 160.81 254.50 160.25
268.29 160.05
282.09 160.22 295.88 160.75 309.64 161.64 323.38 162.89
337.09 164.50
350.74 166.46 364.34 168.79 377.87 171.47 391.33 174.50
404.71 177.89
417.99 181.62 431.17 185.71 444.24 190.13 457.18 194.90
470.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base							PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	213.21	8.25	-5.3	6.87	6.90	3	100.00	18.0	1102.58	14772.91	2230.49	1.01
2	220.08	28.36	-5.3	6.87	6.90	3	100.00	18.0	3781.31	15047.86	2479.39	1.01
3	226.95	47.97	-3.8	6.88	6.90	3	100.00	18.0	6388.29	15284.02	2713.74	1.01
4	233.83	66.92	-3.8	6.88	6.90	3	100.00	18.0	8902.11	15481.44	2936.97	1.01
5	240.71	85.38	-2.3	6.89	6.90	3	100.00	18.0	11345.45	15639.69	3144.68	1.00
6	247.61	103.13	-2.3	6.89	6.90	3	100.00	18.0	13690.19	15759.39	3342.17	1.00
7	254.50	120.35	-0.8	6.90	6.90	3	100.00	18.0	15959.55	15840.46	3523.25	1.00
8	261.40	136.89	-0.8	6.90	6.90	3	100.00	18.0	18131.87	15882.45	3694.92	1.00
9	268.29	58.11	0.7	2.71	2.71	3	100.00	18.0	7691.92	6235.24	3805.07	1.00
10	271.00	126.44	0.7	5.54	5.55	3	100.00	18.0	16723.54	12761.14	3892.27	1.00
11	276.54	136.32	0.7	5.54	5.55	3	100.00	18.0	18013.68	12737.95	4009.48	1.00
12	282.09	182.62	2.2	6.89	6.90	3	100.00	18.0	24105.28	15774.74	4123.06	1.00
13	288.98	196.64	2.2	6.89	6.90	3	100.00	18.0	25923.53	15661.07	4242.98	1.00
14	295.88	209.74	3.7	6.88	6.90	3	100.00	18.0	27614.92	15508.29		

4344.32	1.00									
15	302.76	222.47	3.7	6.88	6.90	3	100.00	18.0	29252.65	15316.92
4438.32	1.00									
16	309.64	216.19	5.2	6.36	6.38	3	100.00	18.0	28389.04	13967.81
4510.64	1.00									
17	316.00	263.43	5.2	7.38	7.41	3	100.00	18.0	34542.80	15936.75
4654.90	1.00									
18	323.38	59.40	6.7	1.62	1.63	3	100.00	18.0	7781.64	3454.70
4782.20	1.00									
19	325.00	220.98	6.7	6.04	6.08	2	0.00	35.0	28948.02	12744.71
4729.25	0.98									
20	331.04	216.69	6.7	6.04	6.08	2	0.00	35.0	28386.23	12475.27
4637.39	0.98									
21	337.09	200.27	8.2	5.71	5.77	2	0.00	35.0	26234.97	11546.34
4525.27	0.98									
22	342.79	195.57	8.2	5.71	5.77	2	0.00	35.0	25620.20	11250.48
4419.10	0.98									
23	348.50	75.53	8.2	2.24	2.26	5	0.00	45.0	8308.03	3017.98
3613.99	0.97									
24	350.74	224.08	9.7	6.80	6.90	2	0.00	35.0	29354.09	2132.49
4186.18	0.98									
25	357.54	216.17	9.7	6.80	6.90	2	0.00	35.0	28318.71	1632.15
4036.51	0.98									
26	364.34	206.66	11.2	6.77	6.90	2	0.00	35.0	27072.44	1093.53
3856.27	0.98									
27	371.11	197.59	11.2	6.77	6.90	2	0.00	35.0	25884.52	516.70
3684.18	0.98									
28	377.87	66.50	12.7	2.35	2.41	2	0.00	35.0	8711.40	39.91
3545.73	0.98									
29	380.23	152.01	12.7	5.55	5.69	2	0.00	35.0	19913.58	0.00
3433.27	0.98									
30	385.78	145.06	12.7	5.55	5.69	2	0.00	35.0	19002.86	0.00
3276.27	0.98									
31	391.33	164.84	14.2	6.69	6.90	2	0.00	35.0	21594.25	0.00
3075.52	0.98									
32	398.02	153.52	14.2	6.69	6.90	2	0.00	35.0	20111.49	0.00
2864.33	0.98									
33	404.71	140.63	15.7	6.64	6.90	2	0.00	35.0	18422.75	0.00
2628.37	0.98									
34	411.35	128.23	15.7	6.64	6.90	2	0.00	35.0	16798.24	0.00
2396.61	0.98									
35	417.99	22.11	17.2	1.22	1.27	2	0.00	35.0	2895.93	0.00
2245.41	0.99									
36	419.20	102.13	17.2	5.98	6.26	1	150.00	22.0	13379.34	0.00
2147.82	1.01									
37	425.19	91.05	17.2	5.98	6.26	1	150.00	22.0	11927.60	0.00
1913.40	1.01									
38	431.17	86.17	18.7	6.53	6.90	1	150.00	22.0	11288.34	0.00
1649.77	1.02									
39	437.70	71.71	18.7	6.53	6.90	1	150.00	22.0	9394.56	0.00
1370.68	1.02									
40	444.24	56.18	20.2	6.47	6.90	1	150.00	22.0	7359.43	0.00
1076.16	1.02									
41	450.71	40.75	20.2	6.47	6.90	1	150.00	22.0	5338.47	0.00
776.54	1.02									
42	457.18	24.53	21.7	6.41	6.90	1	150.00	22.0	3213.43	0.00
463.57	1.03									
43	463.59	8.18	21.7	6.41	6.90	1	150.00	22.0	1071.14	0.00
143.79	1.03									
		---			---				---	
X-S Area:		5475.76	Path Length:		262.13		X-S Weight:		717890.38	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 8-1\West Farm Expansion Case 8-1 Rapid Drawdown-EQ.gmf
Processed: 04 Dec 2020 13:06:28

DATA: Analysis 1 - Case 8-1 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	182.00	348.50	182.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	163.00	348.50	163.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	160.00	348.50	160.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	500.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	182.00	500.00	182.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	163.00	500.00	163.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	160.00	500.00	160.00	

Slope Surface (4 points)

100.00	163.00	214.00	163.00	325.00	200.00	500.00	200.00

Phreatic Surface (6 points)

100.00	163.00	214.00	163.00	316.00	197.00	348.50	197.00
351.50	172.00						
500.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	214.00	YL:	163.00	XR:	475.00	YR: 200.00
Centre:	XC:	276.80	YC:	659.04	Radius:	R:	500.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 8-1 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 3.318

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.39

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	213.21	163.00	470.00	200.00	268.83	686.58	526.53	2.393	<-- Critical Surface
2	212.68	163.00	470.00	200.00	268.72	686.54	526.53	2.393	
3	209.53	163.00	470.00	200.00	266.28	698.78	538.78	2.396	
4	210.58	163.00	470.00	200.00	267.09	694.70	534.69	2.397	
5	213.74	163.00	470.00	200.00	269.54	682.46	522.45	2.397	
6	211.63	163.00	470.00	200.00	267.91	690.62	530.61	2.397	
7	212.68	163.00	470.53	200.00	268.54	690.66	530.61	2.398	
8	212.16	163.00	470.53	200.00	268.43	690.62	530.61	2.399	
9	209.00	163.00	470.00	200.00	265.59	702.90	542.86	2.400	
10	210.05	163.00	470.00	200.00	266.39	698.82	538.78	2.400	
11	213.21	163.00	470.00	200.00	268.23	690.75	530.61	2.401	
12	214.26	163.09	470.00	200.00	270.42	678.40	518.37	2.401	
13	209.00	163.00	470.53	200.00	266.00	702.86	542.86	2.402	
14	213.21	163.00	470.53	200.00	269.25	686.54	526.53	2.402	
15	210.05	163.00	470.53	200.00	266.81	698.78	538.78	2.402	
16	209.00	163.00	470.00	200.00	264.99	707.06	546.94	2.403	
17	210.05	163.00	470.00	200.00	265.80	702.99	542.86	2.403	
18	211.11	163.00	470.53	200.00	267.62	694.70	534.69	2.403	
19	211.11	163.00	470.00	200.00	266.61	698.91	538.78	2.403	
20	212.68	163.00	470.00	200.00	268.12	690.71	530.61	2.404	
21	212.16	163.00	471.05	200.00	268.26	694.74	534.69	2.404	
22	212.16	163.00	470.00	200.00	267.42	694.83	534.69	2.404	
23	214.79	163.26	470.00	200.00	272.06	670.24	510.20	2.404	
24	211.63	163.00	471.05	200.00	268.15	694.70	534.69	2.405	
25	214.26	163.09	470.53	200.00	270.83	678.36	518.37	2.405	
26	209.53	163.00	470.53	200.00	266.11	702.90	542.86	2.406	
27	213.74	163.00	470.53	200.00	269.36	686.58	526.53	2.406	
28	213.74	163.00	470.00	200.00	268.94	686.63	526.53	2.406	
29	210.58	163.00	470.53	200.00	266.92	698.82	538.78	2.406	
30	212.68	163.00	470.53	200.00	267.94	694.83	534.69	2.407	
31	214.79	163.26	470.53	200.00	272.48	670.20	510.20	2.407	
32	209.53	163.00	470.00	200.00	265.10	707.11	546.94	2.407	
33	209.53	163.00	470.00	200.00	265.69	702.94	542.86	2.407	
34	215.32	163.44	470.00	200.00	273.70	662.07	502.04	2.407	
35	210.58	163.00	470.00	200.00	266.50	698.87	538.78	2.407	
36	213.74	163.00	470.00	200.00	268.33	690.80	530.61	2.407	
37	211.63	163.00	470.00	200.00	267.31	694.79	534.69	2.408	
38	212.68	163.00	471.05	200.00	268.96	690.62	530.61	2.408	
39	211.11	163.00	470.00	200.00	267.20	694.74	534.69	2.408	
40	210.58	163.00	470.00	200.00	265.91	703.03	542.86	2.408	
41	209.53	163.00	471.05	200.00	266.53	702.86	542.86	2.408	
42	212.16	163.00	470.00	200.00	268.01	690.66	530.61	2.408	
43	210.58	163.00	471.05	200.00	267.34	698.78	538.78	2.409	
44	211.63	163.00	470.00	200.00	266.71	698.95	538.78	2.409	
45	209.53	163.00	470.53	200.00	265.52	707.06	546.94	2.409	
46	210.58	163.00	470.53	200.00	266.33	702.99	542.86	2.409	
47	212.68	163.00	470.00	200.00	267.52	694.87	534.69	2.410	
48	212.16	163.00	470.53	200.00	267.84	694.79	534.69	2.410	
49	215.32	163.44	470.53	200.00	274.11	662.02	502.04	2.410	
50	211.63	163.00	470.53	200.00	267.13	698.91	538.78	2.410	
51	215.84	163.61	470.00	200.00	275.34	653.90	493.88	2.410	
52	213.74	163.00	470.53	200.00	268.75	690.75	530.61	2.410	
53	212.16	163.00	470.53	200.00	267.24	698.95	538.78	2.410	
54	211.11	163.00	471.58	200.00	267.86	698.78	538.78	2.411	
55	213.74	163.00	471.05	200.00	269.77	686.54	526.53	2.411	
56	213.21	163.00	470.00	200.00	267.63	694.92	534.69	2.411	
57	213.21	163.00	471.05	200.00	269.07	690.66	530.61	2.411	
58	209.00	163.00	471.05	200.00	265.83	706.98	546.94	2.411	
59	209.00	163.00	470.00	200.00	264.40	711.23	551.02	2.412	
60	213.21	163.00	470.53	200.00	268.65	690.71	530.61	2.412	
61	214.26	163.09	470.00	200.00	269.81	682.57	522.45	2.412	
62	210.05	163.00	471.05	200.00	266.64	702.90	542.86	2.412	
63	214.79	163.26	470.00	200.00	271.46	674.42	514.29	2.412	
64	216.37	163.79	470.00	200.00	276.97	645.71	485.71	2.412	

65	212.16	163.00	471.05	200.00	267.66	698.91	538.78	2.412
66	214.26	163.09	470.53	200.00	270.23	682.53	522.45	2.412
67	210.05	163.00	470.00	200.00	265.21	707.15	546.94	2.412
68	211.11	163.00	471.05	200.00	267.45	698.82	538.78	2.412
69	209.00	163.00	470.53	200.00	264.82	711.19	551.02	2.413
70	214.26	163.09	470.00	200.00	269.21	686.74	526.53	2.413
71	213.21	163.00	470.53	200.00	268.05	694.87	534.69	2.413
72	211.11	163.00	470.00	200.00	266.01	703.07	542.86	2.413
73	212.16	163.00	471.58	200.00	268.67	694.70	534.69	2.413
74	209.00	163.00	470.53	200.00	265.41	707.02	546.94	2.413
75	210.05	163.00	470.53	200.00	265.63	707.11	546.94	2.413
76	210.05	163.00	470.53	200.00	266.22	702.94	542.86	2.413
77	211.11	163.00	470.53	200.00	267.03	698.87	538.78	2.414
78	209.00	163.00	471.58	200.00	266.25	706.93	546.94	2.414
79	212.16	163.00	470.00	200.00	266.82	699.00	538.78	2.414
80	211.63	163.00	470.53	200.00	267.73	694.74	534.69	2.414
81	211.11	163.00	470.53	200.00	266.43	703.03	542.86	2.414
82	210.05	163.00	471.58	200.00	267.06	702.86	542.86	2.414
83	214.79	163.26	470.53	200.00	271.88	674.37	514.29	2.414
84	216.89	163.96	470.00	200.00	278.59	637.51	477.55	2.414
85	214.26	163.09	471.05	200.00	270.65	682.48	522.45	2.415
86	209.00	163.00	471.05	200.00	265.24	711.14	551.02	2.415
87	215.32	163.44	470.00	200.00	273.10	666.25	506.12	2.415
88	210.05	163.00	471.05	200.00	266.05	707.06	546.94	2.415
89	211.63	163.00	471.58	200.00	267.97	698.82	538.78	2.415
90	214.26	163.09	470.53	200.00	269.63	686.70	526.53	2.415
91	211.11	163.00	471.05	200.00	266.85	702.99	542.86	2.415
92	213.21	163.00	471.05	200.00	268.47	694.83	534.69	2.415
93	211.63	163.00	471.05	200.00	267.55	698.87	538.78	2.416
94	211.63	163.00	471.05	200.00	266.96	703.03	542.86	2.416
95	213.21	163.00	471.58	200.00	269.49	690.62	530.61	2.416
96	210.58	163.00	472.11	200.00	267.58	702.86	542.86	2.416
97	212.68	163.00	471.58	200.00	268.78	694.74	534.69	2.416
98	212.68	163.00	470.53	200.00	267.35	699.00	538.78	2.416
99	209.53	163.00	470.00	200.00	264.51	711.27	551.02	2.417

Critical Failure Surface (circle 1)

Intersects: XL: 213.21 YL: 163.00 XR: 470.00 YR: 200.00
Centre: XC: 268.83 YC: 686.58 Radius: R: 526.53
Generated failure surface: (20 points)
213.21 163.00 226.95 161.72 240.71 160.81 254.50 160.25
268.29 160.05
282.09 160.22 295.88 160.75 309.64 161.64 323.38 162.89
337.09 164.50
350.74 166.46 364.34 168.79 377.87 171.47 391.33 174.50
404.71 177.89
417.99 181.62 431.17 185.71 444.24 190.13 457.18 194.90
470.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress Factor
1	213.21	8.25	-5.3	6.87	6.90	3	100.00	18.0	1102.58	516.97	165.55 1.02
2	220.08	28.36	-5.3	6.87	6.90	3	100.00	18.0	3781.31	1777.46	558.20 1.02
3	226.95	47.97	-3.8	6.88	6.90	3	100.00	18.0	6388.29	3000.21	935.43 1.01
4	233.83	66.92	-3.8	6.88	6.90	3	100.00	18.0	8902.11	4185.22	1302.41 1.01
5	240.71	85.38	-2.3	6.89	6.90	3	100.00	18.0	11345.45	5331.96	1652.54 1.01
6	247.61	103.13	-2.3	6.89	6.90	3	100.00	18.0	13690.19	6440.62	1993.71 1.01
7	254.50	120.35	-0.8	6.90	6.90	3	100.00	18.0	15959.55	7510.88	2316.72 1.00
8	261.40	136.89	-0.8	6.90	6.90	3	100.00	18.0	18131.87	8542.54	2631.97 1.00
9	268.29	58.11	0.7	2.71	2.71	3	100.00	18.0	7691.92	3626.45	2839.97 1.00
10	271.00	126.44	0.7	5.54	5.55	3	100.00	18.0	16723.54	7890.55	3012.93 1.00
11	276.54	136.32	0.7	5.54	5.55	3	100.00	18.0	18013.68	8506.91	3245.40 1.00
12	282.09	182.62	2.2	6.89	6.90	3	100.00	18.0	24105.28	11403.66	3485.81 1.00
13	288.98	196.64	2.2	6.89	6.90	3	100.00	18.0	25923.53	12279.07	3748.87 1.00
14	295.88	209.74	3.7	6.88	6.90	3	100.00	18.0	27614.92	13114.73	

3990.53	0.99									
15	302.76	222.47	3.7	6.88	6.90	3	100.00	18.0	29252.65	13911.08
4227.38	0.99									
16	309.64	216.19	5.2	6.36	6.38	3	100.00	18.0	28389.04	13545.92
4434.10	0.99									
17	316.00	263.43	5.2	7.38	7.41	3	100.00	18.0	34542.80	15936.75
4643.73	0.99									
18	323.38	59.40	6.7	1.62	1.63	3	100.00	18.0	7781.64	3454.70
4767.04	0.99									
19	325.00	220.98	6.7	6.04	6.08	2	0.00	35.0	28948.02	12744.71
4700.77	0.97									
20	331.04	216.69	6.7	6.04	6.08	2	0.00	35.0	28386.23	12475.27
4609.42	0.97									
21	337.09	200.27	8.2	5.71	5.77	2	0.00	35.0	26234.97	11546.34
4492.05	0.97									
22	342.79	195.57	8.2	5.71	5.77	2	0.00	35.0	25620.20	11250.48
4386.61	0.97									
23	348.50	75.53	8.2	2.24	2.26	5	0.00	45.0	8308.03	3017.98
3571.82	0.95									
24	350.74	224.08	9.7	6.80	6.90	2	0.00	35.0	29354.09	2132.49
4126.07	0.97									
25	357.54	216.17	9.7	6.80	6.90	2	0.00	35.0	28318.71	1632.15
3977.60	0.97									
26	364.34	206.66	11.2	6.77	6.90	2	0.00	35.0	27072.44	1093.53
3790.36	0.96									
27	371.11	197.59	11.2	6.77	6.90	2	0.00	35.0	25884.52	516.70
3619.84	0.96									
28	377.87	66.50	12.7	2.35	2.41	2	0.00	35.0	8711.40	39.91
3474.66	0.96									
29	380.23	152.01	12.7	5.55	5.69	2	0.00	35.0	19913.58	0.00
3364.13	0.96									
30	385.78	145.06	12.7	5.55	5.69	2	0.00	35.0	19002.86	0.00
3210.29	0.96									
31	391.33	164.84	14.2	6.69	6.90	2	0.00	35.0	21594.25	0.00
3006.50	0.96									
32	398.02	153.52	14.2	6.69	6.90	2	0.00	35.0	20111.49	0.00
2800.05	0.96									
33	404.71	140.63	15.7	6.64	6.90	2	0.00	35.0	18422.75	0.00
2563.34	0.96									
34	411.35	128.23	15.7	6.64	6.90	2	0.00	35.0	16798.24	0.00
2337.31	0.96									
35	417.99	22.11	17.2	1.22	1.27	2	0.00	35.0	2895.93	0.00
2184.69	0.96									
36	419.20	102.13	17.2	5.98	6.26	1	150.00	22.0	13379.34	0.00
2107.08	0.99									
37	425.19	91.05	17.2	5.98	6.26	1	150.00	22.0	11927.60	0.00
1876.46	0.99									
38	431.17	86.17	18.7	6.53	6.90	1	150.00	22.0	11288.34	0.00
1614.20	1.00									
39	437.70	71.71	18.7	6.53	6.90	1	150.00	22.0	9394.56	0.00
1340.02	1.00									
40	444.24	56.18	20.2	6.47	6.90	1	150.00	22.0	7359.43	0.00
1048.59	1.00									
41	450.71	40.75	20.2	6.47	6.90	1	150.00	22.0	5338.47	0.00
754.68	1.00									
42	457.18	24.53	21.7	6.41	6.90	1	150.00	22.0	3213.43	0.00
446.45	1.01									
43	463.59	8.18	21.7	6.41	6.90	1	150.00	22.0	1071.14	0.00
133.23	1.01									

X-S Area: 5475.76 Path Length: 262.13 X-S Weight: 717890.38

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 8-2\West Farm Expansion Case 8-2 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 13:07:49

DATA: Analysis 1 - Case 8-2 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	198.00	348.50	198.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	162.00	348.50	162.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	159.00	348.50	159.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	198.00	450.00	198.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	162.00	450.00	162.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	159.00	450.00	159.00	

Slope Surface (4 points)

100.00	162.00	211.00	162.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	211.00	197.00	316.00	197.00	348.50	197.00
351.50	172.00						
450.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	211.00	YL:	162.00	XR:	390.00	YR: 200.00
Centre:	XC:	252.19	YC:	408.58	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 8-2 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 3.064

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.19

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	213.89	162.96	385.00	200.00	255.95	382.44	223.47	2.186	<-- Critical Surface
2	213.37	162.79	385.00	200.00	254.70	386.55	227.55	2.186	
3	212.84	162.61	385.00	200.00	253.46	390.66	231.63	2.186	
4	212.32	162.44	385.00	200.00	252.21	394.75	235.71	2.187	
5	210.21	162.00	385.00	200.00	248.47	406.99	247.96	2.188	
6	211.26	162.09	385.00	200.00	249.72	402.91	243.88	2.189	
7	208.63	162.00	385.00	200.00	247.25	411.07	252.04	2.191	
8	211.79	162.26	385.00	200.00	250.96	398.84	239.80	2.192	
9	210.74	162.00	385.00	200.00	248.57	407.06	247.96	2.193	
10	207.05	162.00	385.00	200.00	246.03	415.14	256.12	2.193	
11	209.16	162.00	385.00	200.00	247.35	411.13	252.04	2.196	
12	209.68	162.00	385.00	200.00	247.45	411.20	252.04	2.197	
13	207.58	162.00	385.00	200.00	246.13	415.20	256.12	2.198	
14	207.58	162.00	385.53	200.00	246.55	415.14	256.12	2.198	
15	210.74	162.00	385.53	200.00	249.00	406.99	247.96	2.198	
16	216.00	163.67	385.00	200.00	259.99	370.26	211.22	2.198	
17	215.47	163.49	385.00	200.00	258.75	374.40	215.31	2.199	
18	212.84	162.61	385.00	200.00	252.52	394.96	235.71	2.199	
19	214.95	163.32	385.00	200.00	257.50	378.54	219.39	2.199	
20	209.16	162.00	385.53	200.00	247.77	411.07	252.04	2.199	
21	213.89	162.96	385.00	200.00	255.01	386.77	227.55	2.199	
22	214.42	163.14	385.00	200.00	256.26	382.66	223.47	2.200	
23	206.00	162.00	385.00	200.00	244.92	419.28	260.20	2.200	
24	212.32	162.44	385.00	200.00	251.28	399.05	239.80	2.200	
25	211.79	162.26	385.00	200.00	250.03	403.12	243.88	2.202	
26	210.21	162.00	385.00	200.00	247.55	411.26	252.04	2.202	
27	208.11	162.00	385.00	200.00	246.23	415.27	256.12	2.202	
28	208.11	162.00	385.53	200.00	246.65	415.20	256.12	2.203	
29	213.37	162.79	385.00	200.00	253.77	390.87	231.63	2.203	
30	215.47	163.49	385.53	200.00	259.16	374.32	215.31	2.203	
31	206.00	162.00	385.53	200.00	245.34	419.21	260.20	2.204	
32	211.26	162.09	385.00	200.00	248.78	407.19	247.96	2.204	
33	209.68	162.00	385.53	200.00	247.87	411.13	252.04	2.204	
34	214.95	163.32	385.53	200.00	257.91	378.45	219.39	2.204	
35	206.53	162.00	385.00	200.00	245.02	419.34	260.20	2.204	
36	212.32	162.44	385.53	200.00	251.70	398.98	239.80	2.204	
37	214.42	163.14	385.53	200.00	256.67	382.58	223.47	2.205	
38	213.37	162.79	385.53	200.00	254.19	390.80	231.63	2.205	
39	213.89	162.96	385.53	200.00	255.43	386.69	227.55	2.205	
40	211.79	162.26	385.53	200.00	250.45	403.06	243.88	2.206	
41	208.63	162.00	385.00	200.00	246.33	415.33	256.12	2.206	
42	210.74	162.00	385.00	200.00	247.64	411.32	252.04	2.207	
43	209.68	162.00	386.05	200.00	248.30	411.07	252.04	2.208	
44	206.53	162.00	385.53	200.00	245.44	419.28	260.20	2.208	
45	211.26	162.09	385.53	200.00	249.21	407.13	247.96	2.208	
46	207.05	162.00	385.00	200.00	245.12	419.41	260.20	2.208	
47	210.21	162.00	385.53	200.00	247.97	411.20	252.04	2.208	
48	208.63	162.00	385.53	200.00	246.75	415.27	256.12	2.209	
49	212.84	162.61	385.53	200.00	252.94	394.89	235.71	2.209	
50	214.95	163.32	386.05	200.00	258.33	378.37	219.39	2.209	
51	214.42	163.14	386.05	200.00	257.09	382.50	223.47	2.209	
52	211.79	162.26	386.05	200.00	250.88	402.99	243.88	2.210	
53	208.11	162.00	386.05	200.00	247.08	415.14	256.12	2.210	
54	213.89	162.96	386.05	200.00	255.84	386.62	227.55	2.210	
55	212.84	162.61	386.05	200.00	253.36	394.82	235.71	2.210	
56	213.37	162.79	386.05	200.00	254.60	390.72	231.63	2.210	
57	206.53	162.00	386.05	200.00	245.87	419.21	260.20	2.210	
58	209.68	162.00	385.00	200.00	246.52	415.46	256.12	2.210	
59	209.16	162.00	385.00	200.00	246.43	415.40	256.12	2.210	
60	211.26	162.09	386.05	200.00	249.63	407.06	247.96	2.212	
61	207.05	162.00	385.53	200.00	245.54	419.34	260.20	2.212	
62	207.58	162.00	385.00	200.00	245.21	419.47	260.20	2.212	
63	210.21	162.00	386.05	200.00	248.40	411.13	252.04	2.212	
64	210.74	162.00	385.53	200.00	248.07	411.26	252.04	2.213	

65	214.42	163.14	385.00	200.00	255.32	386.99	227.55	2.213
66	209.16	162.00	385.53	200.00	246.85	415.33	256.12	2.214
67	212.32	162.44	386.05	200.00	252.12	398.91	239.80	2.214
68	215.47	163.49	385.00	200.00	257.81	378.76	219.39	2.214
69	216.00	163.67	385.00	200.00	259.05	374.62	215.31	2.214
70	208.63	162.00	386.05	200.00	247.18	415.20	256.12	2.214
71	213.89	162.96	385.00	200.00	254.08	391.09	231.63	2.215
72	213.89	162.96	386.58	200.00	256.26	386.54	227.55	2.215
73	206.00	162.00	385.00	200.00	244.01	423.54	264.29	2.215
74	213.37	162.79	386.58	200.00	255.02	390.65	231.63	2.215
75	212.84	162.61	386.58	200.00	253.78	394.75	235.71	2.215
76	213.37	162.79	385.00	200.00	252.84	395.18	235.71	2.215
77	212.32	162.44	386.58	200.00	252.54	398.84	239.80	2.215
78	207.05	162.00	386.05	200.00	245.97	419.28	260.20	2.215
79	210.21	162.00	385.00	200.00	246.62	415.52	256.12	2.215
80	212.84	162.61	385.00	200.00	251.59	399.26	239.80	2.216
81	212.32	162.44	385.00	200.00	250.34	403.33	243.88	2.216
82	208.11	162.00	385.00	200.00	245.31	419.53	260.20	2.216
83	207.58	162.00	385.53	200.00	245.64	419.41	260.20	2.216
84	211.79	162.26	385.00	200.00	249.10	407.40	247.96	2.216
85	210.21	162.00	386.58	200.00	248.83	411.07	252.04	2.216
86	211.26	162.09	386.58	200.00	250.06	406.99	247.96	2.217
87	210.74	162.00	386.05	200.00	248.50	411.20	252.04	2.217
88	208.11	162.00	385.53	200.00	245.74	419.47	260.20	2.217
89	211.26	162.09	385.00	200.00	247.85	411.46	252.04	2.218
90	208.63	162.00	386.58	200.00	247.61	415.14	256.12	2.218
91	213.89	162.96	385.53	200.00	254.50	391.01	231.63	2.218
92	209.16	162.00	386.05	200.00	247.28	415.27	256.12	2.219
93	209.68	162.00	385.53	200.00	246.95	415.40	256.12	2.219
94	206.53	162.00	385.00	200.00	244.11	423.60	264.29	2.219
95	206.00	162.00	385.53	200.00	244.44	423.48	264.29	2.219
96	214.95	163.32	385.53	200.00	256.98	382.80	223.47	2.219
97	206.00	162.00	386.05	200.00	244.87	423.41	264.29	2.219
98	216.00	163.67	385.53	200.00	259.46	374.54	215.31	2.219
99	215.47	163.49	385.53	200.00	258.22	378.67	219.39	2.219

Critical Failure Surface (circle 1)

Intersects: XL: 213.89 YL: 162.96 XR: 385.00 YR: 200.00
Centre: XC: 255.95 YC: 382.44 Radius: R: 223.47

Generated failure surface: (20 points)

213.89 162.96 223.23 161.38 232.62 160.19 242.05 159.40
251.51 159.02
260.98 159.03 270.44 159.44 279.87 160.26 289.26 161.47
298.59 163.08
307.84 165.08 317.00 167.47 326.05 170.25 334.97 173.41
343.76 176.95
352.38 180.85 360.83 185.11 369.10 189.73 377.16 194.70
385.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 44 slices)

Slice	X-S	Base							PoreWater	Normal Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress Factor
1	213.89	8.13	-9.6	5.68	5.77	2	0.00	35.0	1064.81	12419.17	2257.63 1.07
2	219.58	13.78	-9.6	3.65	3.70	3	100.00	18.0	1816.98	8154.59	2480.32 1.04
3	223.23	27.12	-7.2	4.70	4.73	3	100.00	18.0	3595.70	10608.49	2660.16 1.03
4	227.92	37.26	-7.2	4.70	4.73	3	100.00	18.0	4951.84	10783.86	2854.22 1.03
5	232.62	47.16	-4.8	4.72	4.73	3	100.00	18.0	6271.97	10929.83	3027.65 1.02
6	237.34	56.43	-4.8	4.72	4.73	3	100.00	18.0	7505.82	11046.28	3192.86 1.02
7	242.05	65.42	-2.4	4.73	4.73	3	100.00	18.0	8697.47	11133.33	3335.74 1.01
8	246.78	73.80	-2.4	4.73	4.73	3	100.00	18.0	9803.72	11190.69	3472.03 1.01
9	251.51	81.77	0.1	4.73	4.73	3	100.00	18.0	10852.53	11218.31	3584.53 1.00
10	256.25	89.21	0.1	4.73	4.73	3	100.00	18.0	11826.76	11216.49	3691.86 1.00
11	260.98	96.07	2.5	4.73	4.73	3	100.00	18.0	12721.35	11184.95	3774.18 0.99
12	265.71	102.55	2.5	4.73	4.73	3	100.00	18.0	13560.09	11123.96	3852.57 0.99
13	270.44	108.25	4.9	4.72	4.73	3	100.00	18.0	14291.29	11033.34	3904.93 0.99
14	275.15	113.74	4.9	4.72	4.73	3	100.00	18.0	14991.91	10913.17	

3954.44	0.99									
15	279.87	118.21	7.4	4.69	4.73	3	100.00	18.0	15552.85	10763.50
3977.10	0.99									
16	284.56	122.71	7.4	4.69	4.73	3	100.00	18.0	16114.01	10584.52
3997.84	0.99									
17	289.26	82.84	9.8	3.08	3.13	3	100.00	18.0	10860.67	6885.84
3992.43	0.99									
18	292.34	85.46	9.8	3.12	3.17	2	0.00	35.0	11194.80	6867.64
3946.16	0.96									
19	295.47	87.03	9.8	3.12	3.17	2	0.00	35.0	11400.31	6761.15
3945.21	0.96									
20	298.59	131.34	12.2	4.63	4.73	2	0.00	35.0	17205.43	9871.91
3906.75	0.96									
21	303.21	133.84	12.2	4.63	4.73	2	0.00	35.0	17533.28	9576.20
3878.96	0.96									
22	307.84	119.72	14.6	4.08	4.22	2	0.00	35.0	15683.93	8258.20
3816.31	0.95									
23	311.92	120.92	14.6	4.08	4.22	2	0.00	35.0	15841.11	7977.81
3768.43	0.95									
24	316.00	29.84	14.6	1.00	1.03	2	0.00	35.0	3908.58	1913.52
3748.22	0.95									
25	317.00	59.76	17.1	2.00	2.09	2	0.00	35.0	7828.85	3813.95
3727.86	0.95									
26	319.00	89.86	17.1	3.00	3.14	2	0.00	35.0	11771.45	5571.76
3731.42	0.95									
27	322.00	90.10	17.1	3.00	3.14	2	0.00	35.0	11802.47	5391.38
3735.69	0.95									
28	325.00	31.42	17.1	1.05	1.10	2	0.00	35.0	4115.50	1845.00
3717.68	0.95									
29	326.05	129.22	19.5	4.46	4.73	2	0.00	35.0	16927.45	7667.43
3572.17	0.95									
30	330.51	122.17	19.5	4.46	4.73	2	0.00	35.0	16003.96	7200.80
3376.27	0.95									
31	334.97	112.88	21.9	4.39	4.73	2	0.00	35.0	14786.93	6706.48
3144.66	0.95									
32	339.37	105.12	21.9	4.39	4.73	2	0.00	35.0	13770.43	6184.54
2926.99	0.95									
33	343.76	104.26	24.4	4.74	5.21	2	0.00	35.0	13658.28	6166.58
2664.91	0.96									
34	348.50	41.68	24.4	2.04	2.24	5	0.00	45.0	4584.39	1250.06
1959.17	0.91									
35	350.54	19.01	24.4	0.96	1.06	5	0.00	45.0	2091.27	0.00
1801.45	0.91									
36	351.50	17.06	24.4	0.88	0.97	2	0.00	35.0	2234.81	0.00
2213.96	0.96									
37	352.38	76.43	26.8	4.23	4.73	2	0.00	35.0	10011.79	0.00
2039.42	0.96									
38	356.61	67.41	26.8	4.23	4.73	2	0.00	35.0	8831.20	0.00
1798.93	0.96									
39	360.83	56.73	29.2	4.13	4.73	2	0.00	35.0	7432.27	0.00
1525.60	0.97									
40	364.97	47.19	29.2	4.13	4.73	2	0.00	35.0	6182.16	0.00
1269.00	0.97									
41	369.10	36.38	31.6	4.03	4.73	2	0.00	35.0	4765.21	0.00
987.49	0.98									
42	373.13	26.37	31.6	4.03	4.73	2	0.00	35.0	3454.51	0.00
715.88	0.98									
43	377.16	17.83	34.1	4.88	5.90	2	0.00	35.0	2336.03	0.00
393.13	0.99									
44	382.04	2.96	34.1	2.96	3.57	1	150.00	22.0	387.56	0.00
75.21	1.07									
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X-S Area:		3206.41	Path Length:		179.87		X-S Weight:		420223.78	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 8-2\West Farm Expansion Case 8-2 Rapid Drawdown-EQ.gmf
Processed: 04 Dec 2020 13:07:26

DATA: Analysis 1 - Case 8-2 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	198.00	348.50	198.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	162.00	348.50	162.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	159.00	348.50	159.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	198.00	450.00	198.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	162.00	450.00	162.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	159.00	450.00	159.00	

Slope Surface (4 points)

100.00	162.00	211.00	162.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	162.00	211.00	162.00	316.00	197.00	348.50	197.00
351.50	172.00						
450.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	211.00	YL:	162.00	XR:	390.00	YR: 200.00
Centre:	XC:	252.19	YC:	408.58	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 8-2 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 1.920

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.33

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	210.21	162.00	385.00	200.00	248.47	406.99	247.96	1.333	<-- Critical Surface
2	212.32	162.44	385.00	200.00	252.21	394.75	235.71	1.333	
3	212.84	162.61	385.00	200.00	253.46	390.66	231.63	1.333	
4	213.37	162.79	385.00	200.00	254.70	386.55	227.55	1.334	
5	213.89	162.96	385.00	200.00	255.95	382.44	223.47	1.334	
6	211.26	162.09	385.00	200.00	249.72	402.91	243.88	1.334	
7	208.63	162.00	385.00	200.00	247.25	411.07	252.04	1.335	
8	207.05	162.00	385.00	200.00	246.03	415.14	256.12	1.336	
9	211.79	162.26	385.00	200.00	250.96	398.84	239.80	1.336	
10	210.74	162.00	385.00	200.00	248.57	407.06	247.96	1.337	
11	209.16	162.00	385.00	200.00	247.35	411.13	252.04	1.338	
12	207.58	162.00	385.00	200.00	246.13	415.20	256.12	1.339	
13	209.68	162.00	385.00	200.00	247.45	411.20	252.04	1.340	
14	206.00	162.00	385.00	200.00	244.92	419.28	260.20	1.340	
15	210.74	162.00	385.53	200.00	249.00	406.99	247.96	1.340	
16	207.58	162.00	385.53	200.00	246.55	415.14	256.12	1.341	
17	209.16	162.00	385.53	200.00	247.77	411.07	252.04	1.341	
18	208.11	162.00	385.00	200.00	246.23	415.27	256.12	1.342	
19	212.84	162.61	385.00	200.00	252.52	394.96	235.71	1.342	
20	212.32	162.44	385.00	200.00	251.28	399.05	239.80	1.343	
21	210.21	162.00	385.00	200.00	247.55	411.26	252.04	1.343	
22	211.79	162.26	385.00	200.00	250.03	403.12	243.88	1.343	
23	213.89	162.96	385.00	200.00	255.01	386.77	227.55	1.343	
24	206.53	162.00	385.00	200.00	245.02	419.34	260.20	1.343	
25	206.00	162.00	385.53	200.00	245.34	419.21	260.20	1.344	
26	214.42	163.14	385.00	200.00	256.26	382.66	223.47	1.344	
27	216.00	163.67	385.00	200.00	259.99	370.26	211.22	1.344	
28	214.95	163.32	385.00	200.00	257.50	378.54	219.39	1.344	
29	215.47	163.49	385.00	200.00	258.75	374.40	215.31	1.344	
30	208.11	162.00	385.53	200.00	246.65	415.20	256.12	1.344	
31	211.26	162.09	385.00	200.00	248.78	407.19	247.96	1.344	
32	209.68	162.00	385.53	200.00	247.87	411.13	252.04	1.344	
33	208.63	162.00	385.00	200.00	246.33	415.33	256.12	1.345	
34	213.37	162.79	385.00	200.00	253.77	390.87	231.63	1.345	
35	212.32	162.44	385.53	200.00	251.70	398.98	239.80	1.346	
36	207.05	162.00	385.00	200.00	245.12	419.41	260.20	1.346	
37	211.79	162.26	385.53	200.00	250.45	403.06	243.88	1.346	
38	206.53	162.00	385.53	200.00	245.44	419.28	260.20	1.347	
39	210.74	162.00	385.00	200.00	247.64	411.32	252.04	1.347	
40	213.37	162.79	385.53	200.00	254.19	390.80	231.63	1.347	
41	213.89	162.96	385.53	200.00	255.43	386.69	227.55	1.347	
42	209.68	162.00	386.05	200.00	248.30	411.07	252.04	1.348	
43	210.21	162.00	385.53	200.00	247.97	411.20	252.04	1.348	
44	211.26	162.09	385.53	200.00	249.21	407.13	247.96	1.348	
45	214.42	163.14	385.53	200.00	256.67	382.58	223.47	1.348	
46	208.63	162.00	385.53	200.00	246.75	415.27	256.12	1.348	
47	215.47	163.49	385.53	200.00	259.16	374.32	215.31	1.348	
48	214.95	163.32	385.53	200.00	257.91	378.45	219.39	1.348	
49	209.16	162.00	385.00	200.00	246.43	415.40	256.12	1.348	
50	208.11	162.00	386.05	200.00	247.08	415.14	256.12	1.348	
51	206.53	162.00	386.05	200.00	245.87	419.21	260.20	1.349	
52	212.84	162.61	385.53	200.00	252.94	394.89	235.71	1.349	
53	209.68	162.00	385.00	200.00	246.52	415.46	256.12	1.349	
54	207.58	162.00	385.00	200.00	245.21	419.47	260.20	1.349	
55	207.05	162.00	385.53	200.00	245.54	419.34	260.20	1.350	
56	211.79	162.26	386.05	200.00	250.88	402.99	243.88	1.350	
57	212.84	162.61	386.05	200.00	253.36	394.82	235.71	1.350	
58	206.00	162.00	385.00	200.00	244.01	423.54	264.29	1.350	
59	210.74	162.00	385.53	200.00	248.07	411.26	252.04	1.351	
60	210.21	162.00	386.05	200.00	248.40	411.13	252.04	1.351	
61	213.37	162.79	386.05	200.00	254.60	390.72	231.63	1.351	
62	211.26	162.09	386.05	200.00	249.63	407.06	247.96	1.351	
63	209.16	162.00	385.53	200.00	246.85	415.33	256.12	1.351	
64	213.89	162.96	386.05	200.00	255.84	386.62	227.55	1.351	

65	214.42	163.14	386.05	200.00	257.09	382.50	223.47	1.352
66	208.63	162.00	386.05	200.00	247.18	415.20	256.12	1.352
67	214.95	163.32	386.05	200.00	258.33	378.37	219.39	1.352
68	208.11	162.00	385.00	200.00	245.31	419.53	260.20	1.352
69	207.05	162.00	386.05	200.00	245.97	419.28	260.20	1.352
70	210.21	162.00	385.00	200.00	246.62	415.52	256.12	1.352
71	207.58	162.00	385.53	200.00	245.64	419.41	260.20	1.352
72	212.32	162.44	386.05	200.00	252.12	398.91	239.80	1.353
73	206.53	162.00	385.00	200.00	244.11	423.60	264.29	1.353
74	211.79	162.26	385.00	200.00	249.10	407.40	247.96	1.353
75	214.42	163.14	385.00	200.00	255.32	386.99	227.55	1.353
76	212.32	162.44	385.00	200.00	250.34	403.33	243.88	1.353
77	212.84	162.61	385.00	200.00	251.59	399.26	239.80	1.354
78	213.37	162.79	385.00	200.00	252.84	395.18	235.71	1.354
79	213.89	162.96	385.00	200.00	254.08	391.09	231.63	1.354
80	206.00	162.00	385.53	200.00	244.44	423.48	264.29	1.354
81	211.26	162.09	385.00	200.00	247.85	411.46	252.04	1.354
82	208.11	162.00	385.53	200.00	245.74	419.47	260.20	1.354
83	210.74	162.00	386.05	200.00	248.50	411.20	252.04	1.354
84	210.21	162.00	386.58	200.00	248.83	411.07	252.04	1.354
85	212.32	162.44	386.58	200.00	252.54	398.84	239.80	1.354
86	209.68	162.00	385.53	200.00	246.95	415.40	256.12	1.354
87	212.84	162.61	386.58	200.00	253.78	394.75	235.71	1.354
88	211.26	162.09	386.58	200.00	250.06	406.99	247.96	1.355
89	215.47	163.49	385.00	200.00	257.81	378.76	219.39	1.355
90	208.63	162.00	386.58	200.00	247.61	415.14	256.12	1.355
91	208.63	162.00	385.00	200.00	245.41	419.59	260.20	1.355
92	209.16	162.00	386.05	200.00	247.28	415.27	256.12	1.355
93	213.37	162.79	386.58	200.00	255.02	390.65	231.63	1.355
94	216.00	163.67	385.00	200.00	259.05	374.62	215.31	1.355
95	213.89	162.96	386.58	200.00	256.26	386.54	227.55	1.355
96	206.00	162.00	386.05	200.00	244.87	423.41	264.29	1.355
97	210.74	162.00	385.00	200.00	246.72	415.58	256.12	1.356
98	207.58	162.00	386.05	200.00	246.07	419.34	260.20	1.356
99	207.05	162.00	386.58	200.00	246.39	419.21	260.20	1.356

Critical Failure Surface (circle 1)

Intersects: XL: 210.21 YL: 162.00 XR: 385.00 YR: 200.00
Centre: XC: 248.47 YC: 406.99 Radius: R: 247.96

Generated failure surface: (20 points)

210.21 162.00 219.75 160.70 229.34 159.77 238.95 159.21
248.58 159.03
258.21 159.22 267.83 159.79 277.41 160.72 286.95 162.03
296.44 163.71
305.85 165.76 315.17 168.17 324.40 170.94 333.50 174.07
342.49 177.54
351.32 181.37 360.01 185.53 368.52 190.03 376.86 194.85
385.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 42 slices)

Slice	X-S	Base						PoreWater	
Normal	Test								
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	210.21	0.04	-7.8	0.79	0.80	3	100.00	18.0	5.99	2.68	18.31	1.04
2	211.00	4.97	-7.8	4.38	4.42	3	100.00	18.0	668.74	312.95	166.19	1.04
3	215.38	13.97	-7.8	4.38	4.42	3	100.00	18.0	1873.38	879.52	446.49	1.04
4	219.75	25.16	-5.5	4.79	4.82	3	100.00	18.0	3369.87	1577.55	719.62	1.03
5	224.55	35.05	-5.5	4.79	4.82	3	100.00	18.0	4687.12	2197.28	997.98	1.03
6	229.34	44.63	-3.3	4.81	4.82	3	100.00	18.0	5960.67	2789.68	1253.76	1.02
7	234.15	53.67	-3.3	4.81	4.82	3	100.00	18.0	7158.48	3354.81	1504.81	1.02
8	238.95	62.36	-1.1	4.81	4.82	3	100.00	18.0	8306.08	3892.22	1730.90	1.00
9	243.77	70.53	-1.1	4.81	4.82	3	100.00	18.0	9380.32	4401.91	1954.57	1.00
10	248.58	78.25	1.1	4.81	4.82	3	100.00	18.0	10391.00	4883.55	2151.28	1.00
11	253.40	85.51	1.1	4.81	4.82	3	100.00	18.0	11338.25	5337.04	2347.53	1.00
12	258.21	92.18	3.4	4.81	4.82	3	100.00	18.0	12202.51	5762.02	2515.14	0.99
13	263.02	98.53	3.4	4.81	4.82	3	100.00	18.0	13020.07	6158.61	2683.98	0.99
14	267.83	104.09	5.6	4.79	4.82	3	100.00	18.0	13731.30	6526.55		

2822.79	0.98									
15	272.62	109.50	5.6	4.79	4.82	3	100.00	18.0	14417.35	6865.66
2964.24	0.98									
16	277.41	110.95	7.8	4.65	4.69	3	100.00	18.0	14578.40	6987.92
3073.10	0.98									
17	282.06	115.18	7.8	4.65	4.69	3	100.00	18.0	15103.85	7254.82
3184.31	0.98									
18	286.71	124.65	9.9	4.86	4.94	2	0.00	35.0	16328.63	7896.17
3208.98	0.93									
19	291.57	128.34	10.0	4.86	4.94	2	0.00	35.0	16813.14	8133.25
3302.58	0.93									
20	296.44	127.23	12.3	4.71	4.82	2	0.00	35.0	16667.37	8124.72
3352.01	0.92									
21	301.14	129.80	12.3	4.71	4.82	2	0.00	35.0	17003.63	8288.64
3419.64	0.92									
22	305.85	130.69	14.5	4.66	4.82	2	0.00	35.0	17120.23	8422.95
3442.33	0.91									
23	310.51	132.32	14.5	4.66	4.82	2	0.00	35.0	17333.45	8527.85
3485.20	0.91									
24	315.17	23.68	16.7	0.83	0.87	2	0.00	35.0	3101.56	1542.57
3475.55	0.90									
25	316.00	85.90	16.7	3.00	3.13	2	0.00	35.0	11252.41	5498.71
3478.98	0.90									
26	319.00	155.22	16.7	5.40	5.63	2	0.00	35.0	20333.81	9445.53
3483.94	0.90									
27	324.40	128.81	18.9	4.55	4.82	2	0.00	35.0	16873.50	7596.17
3379.81	0.90									
28	328.95	121.69	18.9	4.55	4.82	2	0.00	35.0	15940.83	7126.47
3191.41	0.90									
29	333.50	112.56	21.2	4.49	4.82	2	0.00	35.0	14744.90	6630.27
2961.39	0.89									
30	337.99	104.75	21.2	4.49	4.82	2	0.00	35.0	13722.02	6107.79
2753.75	0.89									
31	342.49	65.58	23.4	3.01	3.28	2	0.00	35.0	8590.92	3845.27
2545.11	0.89									
32	345.49	61.67	23.4	3.01	3.28	2	0.00	35.0	8078.42	3579.29
2391.21	0.89									
33	348.50	37.38	23.4	1.92	2.10	5	0.00	45.0	4111.66	1101.74
1743.36	0.82									
34	350.42	16.98	23.4	0.90	0.98	5	0.00	45.0	1867.87	0.00
1563.79	0.82									
35	351.32	76.39	25.6	4.34	4.82	2	0.00	35.0	10006.65	0.00
1841.01	0.89									
36	355.67	67.35	25.6	4.34	4.82	2	0.00	35.0	8822.34	0.00
1623.13	0.89									
37	360.01	56.82	27.8	4.26	4.82	2	0.00	35.0	7443.46	0.00
1368.54	0.89									
38	364.27	47.24	27.8	4.26	4.82	2	0.00	35.0	6188.93	0.00
1137.89	0.89									
39	368.52	36.53	30.1	4.17	4.82	2	0.00	35.0	4784.88	0.00
880.47	0.89									
40	372.69	26.47	30.1	4.17	4.82	2	0.00	35.0	3467.64	0.00
638.09	0.89									
41	376.86	17.78	32.3	4.98	5.89	2	0.00	35.0	2329.17	0.00
351.39	0.89									
42	381.84	3.16	32.3	3.16	3.74	1	150.00	22.0	414.52	0.00
50.27	0.99									
		---			---				---	
X-S Area:		3123.54	Path Length:		182.99		X-S Weight:		409535.38	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 8-3\West Farm Expansion Case 8-3 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 13:08:49

DATA: Analysis 1 - Case 8-3 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	193.00	348.50	193.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	171.00	348.50	171.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	168.00	348.50	168.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	193.00	450.00	193.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	171.00	450.00	171.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	168.00	450.00	168.00	

Slope Surface (4 points)

100.00	171.00	238.00	171.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	238.00	197.00	316.00	197.00	348.50	197.00
351.50	178.00						
450.00	178.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R
Intersects: XL: 238.00 YL: 171.00 XR: 405.00 YR: 200.00
Centre: XC: 281.26 YC: 417.23 Radius: R: 250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 8-3 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 4.271

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.70

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	234.05	171.00	400.00	200.00	273.90	432.26	264.29	2.702	<-- Critical Surface
2	237.21	171.00	400.00	200.00	276.09	424.15	256.12	2.704	
3	233.00	171.00	400.00	200.00	272.93	436.38	268.37	2.706	
4	235.63	171.00	400.00	200.00	274.99	428.21	260.20	2.707	
5	234.58	171.00	400.00	200.00	274.02	432.33	264.29	2.708	
6	238.26	171.09	400.00	200.00	277.20	420.10	252.04	2.711	
7	236.68	171.00	400.00	200.00	275.22	428.33	260.20	2.711	
8	233.53	171.00	400.00	200.00	273.05	436.44	268.37	2.712	
9	237.74	171.00	400.00	200.00	276.20	424.22	256.12	2.712	
10	236.16	171.00	400.53	200.00	275.52	428.21	260.20	2.713	
11	235.11	171.00	400.00	200.00	274.13	432.39	264.29	2.714	
12	236.16	171.00	400.00	200.00	275.11	428.27	260.20	2.714	
13	238.79	171.26	400.00	200.00	278.32	416.05	247.96	2.714	
14	234.58	171.00	400.53	200.00	274.43	432.26	264.29	2.717	
15	233.53	171.00	400.53	200.00	273.46	436.38	268.37	2.717	
16	239.32	171.44	400.00	200.00	279.44	411.99	243.88	2.718	
17	234.05	171.00	400.00	200.00	273.16	436.50	268.37	2.718	
18	237.74	171.00	400.53	200.00	276.62	424.15	256.12	2.718	
19	238.79	171.26	400.53	200.00	278.73	415.98	247.96	2.719	
20	237.21	171.00	400.00	200.00	275.33	428.40	260.20	2.719	
21	235.63	171.00	400.00	200.00	274.25	432.45	264.29	2.720	
22	238.26	171.09	400.53	200.00	277.61	420.04	252.04	2.720	
23	235.63	171.00	400.53	200.00	274.66	432.39	264.29	2.721	
24	236.68	171.00	400.53	200.00	275.63	428.27	260.20	2.721	
25	233.00	171.00	400.00	200.00	272.20	440.61	272.45	2.722	
26	239.84	171.61	400.00	200.00	280.55	407.93	239.80	2.722	
27	235.11	171.00	401.05	200.00	274.96	432.26	264.29	2.722	
28	235.11	171.00	400.53	200.00	274.54	432.33	264.29	2.723	
29	234.05	171.00	400.53	200.00	273.58	436.44	268.37	2.723	
30	239.32	171.44	400.53	200.00	279.84	411.92	243.88	2.723	
31	234.58	171.00	400.00	200.00	273.28	436.56	268.37	2.723	
32	238.26	171.09	400.00	200.00	276.44	424.35	256.12	2.725	
33	240.37	171.79	400.00	200.00	281.67	403.86	235.71	2.726	
34	236.68	171.00	400.00	200.00	274.47	432.57	264.29	2.726	
35	236.68	171.00	401.05	200.00	276.05	428.21	260.20	2.727	
36	233.00	171.00	400.53	200.00	272.61	440.55	272.45	2.727	
37	239.84	171.61	400.53	200.00	280.96	407.86	239.80	2.727	
38	233.53	171.00	400.00	200.00	272.31	440.67	272.45	2.727	
39	237.74	171.00	400.00	200.00	275.45	428.46	260.20	2.727	
40	237.21	171.00	400.53	200.00	275.75	428.33	260.20	2.728	
41	236.16	171.00	400.53	200.00	274.77	432.45	264.29	2.729	
42	235.11	171.00	400.00	200.00	273.39	436.62	268.37	2.729	
43	236.16	171.00	400.00	200.00	274.36	432.51	264.29	2.730	
44	238.79	171.26	400.00	200.00	277.56	420.30	252.04	2.730	
45	234.58	171.00	401.05	200.00	274.10	436.44	268.37	2.730	
46	235.63	171.00	401.05	200.00	275.07	432.33	264.29	2.730	
47	238.26	171.09	400.53	200.00	276.86	424.29	256.12	2.731	
48	234.05	171.00	401.05	200.00	273.99	436.38	268.37	2.732	
49	233.00	171.00	401.05	200.00	273.02	440.49	272.45	2.732	
50	234.05	171.00	400.00	200.00	272.42	440.73	272.45	2.733	
51	233.53	171.00	400.53	200.00	272.73	440.61	272.45	2.733	
52	234.58	171.00	400.53	200.00	273.69	436.50	268.37	2.733	
53	237.21	171.00	401.05	200.00	276.16	428.27	260.20	2.733	
54	237.74	171.00	400.53	200.00	275.86	428.40	260.20	2.734	
55	237.21	171.00	400.00	200.00	274.58	432.63	264.29	2.734	
56	235.63	171.00	400.00	200.00	273.50	436.68	268.37	2.734	
57	239.32	171.44	400.00	200.00	278.68	416.25	247.96	2.734	
58	240.89	171.96	400.00	200.00	282.78	399.78	231.63	2.735	
59	235.63	171.00	400.53	200.00	273.91	436.62	268.37	2.736	
60	238.79	171.26	400.53	200.00	277.97	420.24	252.04	2.736	
61	235.63	171.00	401.58	200.00	275.48	432.26	264.29	2.736	
62	241.42	172.14	400.00	200.00	283.88	395.69	227.55	2.736	
63	236.16	171.00	401.05	200.00	275.19	432.39	264.29	2.737	
64	233.00	171.00	400.00	200.00	271.46	444.84	276.53	2.737	

65	236.68	171.00	400.53	200.00	274.88	432.51	264.29	2.737
66	240.89	171.96	400.53	200.00	283.18	399.71	231.63	2.737
67	240.37	171.79	400.53	200.00	282.07	403.79	235.71	2.737
68	235.11	171.00	401.05	200.00	274.22	436.50	268.37	2.738
69	234.58	171.00	400.00	200.00	272.53	440.79	272.45	2.738
70	234.05	171.00	400.53	200.00	272.84	440.67	272.45	2.738
71	238.26	171.09	401.05	200.00	277.27	424.22	256.12	2.739
72	240.37	171.79	401.05	200.00	282.47	403.71	235.71	2.739
73	235.11	171.00	400.53	200.00	273.80	436.56	268.37	2.739
74	233.53	171.00	401.58	200.00	273.55	440.49	272.45	2.739
75	237.21	171.00	401.58	200.00	276.57	428.21	260.20	2.739
76	234.58	171.00	401.58	200.00	274.51	436.38	268.37	2.740
77	239.84	171.61	400.00	200.00	279.80	412.20	243.88	2.740
78	237.74	171.00	401.05	200.00	276.27	428.33	260.20	2.740
79	238.26	171.09	400.00	200.00	275.68	428.59	260.20	2.740
80	239.32	171.44	400.53	200.00	279.09	416.19	247.96	2.740
81	239.84	171.61	401.05	200.00	281.36	407.79	239.80	2.741
82	233.00	171.00	401.58	200.00	273.43	440.43	272.45	2.741
83	237.74	171.00	400.00	200.00	274.69	432.69	264.29	2.741
84	241.95	172.32	400.00	200.00	284.99	391.60	223.47	2.741
85	233.53	171.00	400.00	200.00	271.58	444.90	276.53	2.742
86	236.16	171.00	401.58	200.00	275.60	432.33	264.29	2.742
87	233.53	171.00	401.05	200.00	273.14	440.55	272.45	2.742
88	233.00	171.00	400.53	200.00	271.88	444.78	276.53	2.742
89	236.68	171.00	400.00	200.00	275.98	424.09	256.12	2.742
90	237.21	171.00	400.53	200.00	275.00	432.57	264.29	2.742
91	241.42	172.14	400.53	200.00	284.28	395.62	227.55	2.743
92	236.68	171.00	401.05	200.00	275.30	432.45	264.29	2.743
93	238.79	171.26	401.05	200.00	278.38	420.17	252.04	2.743
94	236.16	171.00	400.53	200.00	274.03	436.68	268.37	2.743
95	235.11	171.00	400.00	200.00	272.64	440.85	272.45	2.743
96	240.89	171.96	401.05	200.00	283.58	399.63	231.63	2.744
97	234.58	171.00	400.53	200.00	272.95	440.73	272.45	2.744
98	236.16	171.00	400.00	200.00	273.61	436.74	268.37	2.745
99	238.79	171.26	400.00	200.00	276.81	424.55	256.12	2.745

Critical Failure Surface (circle 1)

Intersects: XL: 234.05 YL: 171.00 XR: 400.00 YR: 200.00
Centre: XC: 273.90 YC: 432.26 Radius: R: 264.29

Generated failure surface: (20 points)

234.05 171.00 242.99 169.79 251.97 168.89 260.98 168.29
270.00 168.01
279.02 168.03 288.04 168.36 297.04 168.99 306.01 169.94
314.95 171.18
323.84 172.74 332.67 174.59 341.43 176.75 350.11 179.20
358.71 181.95
367.20 184.99 375.59 188.32 383.86 191.94 392.00 195.83
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base							PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	234.05	1.05	-7.7	3.95	3.98	3	100.00	18.0	148.41	6528.68	1665.43	1.03
2	238.00	8.51	-7.7	4.99	5.04	3	100.00	18.0	1157.94	8451.18	1809.43	1.03
3	242.99	17.27	-5.7	4.49	4.51	3	100.00	18.0	2326.57	7723.44	1997.26	1.02
4	247.48	26.01	-5.7	4.49	4.51	3	100.00	18.0	3492.05	7850.41	2165.20	1.02
5	251.97	34.52	-3.8	4.50	4.51	3	100.00	18.0	4623.27	7955.69	2318.78	1.01
6	256.47	42.61	-3.8	4.50	4.51	3	100.00	18.0	5697.12	8039.47	2464.69	1.01
7	260.98	50.45	-1.8	4.51	4.51	3	100.00	18.0	6734.25	8101.70	2595.20	1.00
8	265.49	57.88	-1.8	4.51	4.51	3	100.00	18.0	7713.56	8142.15	2719.01	1.00
9	270.00	64.99	0.1	4.51	4.51	3	100.00	18.0	8648.49	8160.90	2826.51	1.00
10	274.51	71.73	0.1	4.51	4.51	3	100.00	18.0	9530.86	8158.05	2928.20	1.00
11	279.02	78.07	2.1	4.51	4.51	3	100.00	18.0	10357.00	8133.45	3012.76	1.00
12	283.53	84.10	2.1	4.51	4.51	3	100.00	18.0	11140.21	8087.19	3092.29	1.00
13	288.04	89.62	4.0	4.50	4.51	3	100.00	18.0	11852.02	8019.27	3154.01	0.99
14	292.54	94.94	4.0	4.50	4.51	3	100.00	18.0	12534.59	7929.70		

3211.41	0.99									
15	297.04	76.88	6.0	3.48	3.50	3	100.00	18.0	10134.67	6077.59
3246.44	0.99									
16	300.52	79.65	6.0	3.48	3.50	3	100.00	18.0	10484.27	5997.67
3273.82	0.99									
17	304.00	47.28	6.0	2.01	2.02	3	100.00	18.0	6216.89	3428.87
3295.42	0.99									
18	306.01	91.75	8.0	3.81	3.84	3	100.00	18.0	12049.89	6427.38
3301.09	0.99									
19	309.82	94.56	8.0	3.81	3.84	3	100.00	18.0	12397.09	6299.77
3312.37	0.99									
20	313.62	33.53	8.0	1.32	1.34	2	0.00	35.0	4391.81	2159.94
3293.94	0.97									
21	314.95	26.88	9.9	1.05	1.07	2	0.00	35.0	3521.00	1714.28
3281.76	0.97									
22	316.00	101.65	9.9	3.92	3.98	2	0.00	35.0	13316.02	6276.93
3319.51	0.97									
23	319.92	104.08	9.9	3.92	3.98	2	0.00	35.0	13634.97	6106.97
3395.53	0.97									
24	323.84	31.35	11.9	1.16	1.19	2	0.00	35.0	4106.41	1790.61
3425.34	0.97									
25	325.00	102.03	11.9	3.83	3.92	2	0.00	35.0	13365.85	5772.39
3382.50	0.97									
26	328.83	98.94	11.9	3.83	3.92	2	0.00	35.0	12961.12	5575.39
3279.81	0.97									
27	332.67	108.94	13.8	4.38	4.51	2	0.00	35.0	14271.36	6156.19
3144.04	0.97									
28	337.05	104.22	13.8	4.38	4.51	2	0.00	35.0	13652.61	5852.66
3007.24	0.97									
29	341.43	80.43	15.8	3.54	3.67	2	0.00	35.0	10536.28	4527.65
2860.96	0.97									
30	344.96	76.90	15.8	3.54	3.67	2	0.00	35.0	10073.61	4298.63
2734.74	0.97									
31	348.50	33.90	15.8	1.61	1.68	5	0.00	45.0	3728.85	1350.59
2169.90	0.94									
32	350.11	23.50	17.7	1.14	1.20	5	0.00	45.0	2584.51	283.15
2052.46	0.94									
33	351.25	73.93	17.7	3.73	3.91	2	0.00	35.0	9684.84	0.00
2399.44	0.97									
34	354.98	69.49	17.7	3.73	3.91	2	0.00	35.0	9102.77	0.00
2255.21	0.97									
35	358.71	73.43	19.7	4.25	4.51	2	0.00	35.0	9619.10	0.00
2072.25	0.97									
36	362.95	66.97	19.7	4.25	4.51	2	0.00	35.0	8773.03	0.00
1889.98	0.97									
37	367.20	59.43	21.7	4.19	4.51	2	0.00	35.0	7785.89	0.00
1683.49	0.98									
38	371.40	52.45	21.7	4.19	4.51	2	0.00	35.0	6871.48	0.00
1485.78	0.98									
39	375.59	44.54	23.6	4.13	4.51	2	0.00	35.0	5834.33	0.00
1267.67	0.98									
40	379.72	37.07	23.6	4.13	4.51	2	0.00	35.0	4855.82	0.00
1055.07	0.98									
41	383.86	16.74	25.6	2.22	2.46	2	0.00	35.0	2192.34	0.00
877.80	0.99									
42	386.08	18.62	25.6	2.96	3.28	1	150.00	22.0	2439.09	0.00
744.48	1.03									
43	389.04	14.43	25.6	2.96	3.28	1	150.00	22.0	1890.45	0.00
571.44	1.03									
44	392.00	12.51	27.5	4.00	4.51	1	150.00	22.0	1638.99	0.00
353.18	1.05									
45	396.00	4.17	27.5	4.00	4.51	1	150.00	22.0	546.32	0.00
99.84	1.05									
		---			---				---	
X-S Area:		2581.96	Path Length:		171.44		X-S Weight:		338617.97	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 8-3\West Farm Expansion Case 8-3 Rapid Drawdown-EQ.gmf
Processed: 04 Dec 2020 13:08:26

DATA: Analysis 1 - Case 8-3 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	193.00	348.50	193.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	171.00	348.50	171.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	168.00	348.50	168.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	193.00	450.00	193.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	171.00	450.00	171.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	168.00	450.00	168.00	

Slope Surface (4 points)

100.00	171.00	238.00	171.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	171.00	238.00	171.00	316.00	197.00	348.50	197.00
351.50	178.00						
450.00	178.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	238.00	YL:	171.00	XR:	405.00	YR: 200.00
Centre:	XC:	281.26	YC:	417.23	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 8-3 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.862

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.77

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	234.05	171.00	400.00	200.00	273.90	432.26	264.29	1.770	<-- Critical Surface
2	233.00	171.00	400.00	200.00	272.93	436.38	268.37	1.773	
3	237.21	171.00	400.00	200.00	276.09	424.15	256.12	1.775	
4	235.63	171.00	400.00	200.00	274.99	428.21	260.20	1.775	
5	234.58	171.00	400.00	200.00	274.02	432.33	264.29	1.775	
6	233.53	171.00	400.00	200.00	273.05	436.44	268.37	1.777	
7	235.11	171.00	400.00	200.00	274.13	432.39	264.29	1.780	
8	236.16	171.00	400.00	200.00	275.11	428.27	260.20	1.780	
9	236.68	171.00	400.00	200.00	275.22	428.33	260.20	1.780	
10	238.26	171.09	400.00	200.00	277.20	420.10	252.04	1.780	
11	237.74	171.00	400.00	200.00	276.20	424.22	256.12	1.781	
12	236.16	171.00	400.53	200.00	275.52	428.21	260.20	1.781	
13	234.58	171.00	400.53	200.00	274.43	432.26	264.29	1.781	
14	233.53	171.00	400.53	200.00	273.46	436.38	268.37	1.782	
15	234.05	171.00	400.00	200.00	273.16	436.50	268.37	1.782	
16	238.79	171.26	400.00	200.00	278.32	416.05	247.96	1.784	
17	233.00	171.00	400.00	200.00	272.20	440.61	272.45	1.784	
18	235.63	171.00	400.00	200.00	274.25	432.45	264.29	1.784	
19	237.74	171.00	400.53	200.00	276.62	424.15	256.12	1.785	
20	237.21	171.00	400.00	200.00	275.33	428.40	260.20	1.786	
21	235.11	171.00	400.53	200.00	274.54	432.33	264.29	1.786	
22	234.58	171.00	400.00	200.00	273.28	436.56	268.37	1.786	
23	234.05	171.00	400.53	200.00	273.58	436.44	268.37	1.786	
24	235.63	171.00	400.53	200.00	274.66	432.39	264.29	1.787	
25	236.68	171.00	400.53	200.00	275.63	428.27	260.20	1.787	
26	238.26	171.09	400.53	200.00	277.61	420.04	252.04	1.787	
27	235.11	171.00	401.05	200.00	274.96	432.26	264.29	1.788	
28	239.32	171.44	400.00	200.00	279.44	411.99	243.88	1.788	
29	238.79	171.26	400.53	200.00	278.73	415.98	247.96	1.788	
30	233.53	171.00	400.00	200.00	272.31	440.67	272.45	1.788	
31	233.00	171.00	400.53	200.00	272.61	440.55	272.45	1.788	
32	235.11	171.00	400.00	200.00	273.39	436.62	268.37	1.790	
33	238.26	171.09	400.00	200.00	276.44	424.35	256.12	1.791	
34	236.68	171.00	400.00	200.00	274.47	432.57	264.29	1.791	
35	236.16	171.00	400.00	200.00	274.36	432.51	264.29	1.791	
36	237.74	171.00	400.00	200.00	275.45	428.46	260.20	1.791	
37	236.68	171.00	401.05	200.00	276.05	428.21	260.20	1.792	
38	237.21	171.00	400.53	200.00	275.75	428.33	260.20	1.792	
39	239.84	171.61	400.00	200.00	280.55	407.93	239.80	1.792	
40	239.32	171.44	400.53	200.00	279.84	411.92	243.88	1.792	
41	236.16	171.00	400.53	200.00	274.77	432.45	264.29	1.792	
42	234.05	171.00	401.05	200.00	273.99	436.38	268.37	1.792	
43	234.05	171.00	400.00	200.00	272.42	440.73	272.45	1.793	
44	233.00	171.00	401.05	200.00	273.02	440.49	272.45	1.793	
45	234.58	171.00	400.53	200.00	273.69	436.50	268.37	1.793	
46	233.53	171.00	400.53	200.00	272.73	440.61	272.45	1.793	
47	234.58	171.00	401.05	200.00	274.10	436.44	268.37	1.793	
48	235.63	171.00	401.05	200.00	275.07	432.33	264.29	1.793	
49	233.00	171.00	400.00	200.00	271.46	444.84	276.53	1.795	
50	235.63	171.00	400.00	200.00	273.50	436.68	268.37	1.795	
51	238.79	171.26	400.00	200.00	277.56	420.30	252.04	1.795	
52	238.26	171.09	400.53	200.00	276.86	424.29	256.12	1.795	
53	237.21	171.00	400.00	200.00	274.58	432.63	264.29	1.796	
54	240.37	171.79	400.00	200.00	281.67	403.86	235.71	1.796	
55	239.84	171.61	400.53	200.00	280.96	407.86	239.80	1.796	
56	237.74	171.00	400.53	200.00	275.86	428.40	260.20	1.796	
57	237.21	171.00	401.05	200.00	276.16	428.27	260.20	1.797	
58	234.58	171.00	400.00	200.00	272.53	440.79	272.45	1.797	
59	234.05	171.00	400.53	200.00	272.84	440.67	272.45	1.797	
60	235.63	171.00	400.53	200.00	273.91	436.62	268.37	1.797	
61	235.11	171.00	400.53	200.00	273.80	436.56	268.37	1.797	
62	235.63	171.00	401.58	200.00	275.48	432.26	264.29	1.798	
63	236.68	171.00	400.53	200.00	274.88	432.51	264.29	1.798	
64	236.16	171.00	401.05	200.00	275.19	432.39	264.29	1.798	

65	235.11	171.00	401.05	200.00	274.22	436.50	268.37	1.799
66	233.53	171.00	400.00	200.00	271.58	444.90	276.53	1.799
67	233.00	171.00	401.58	200.00	273.43	440.43	272.45	1.799
68	233.00	171.00	400.53	200.00	271.88	444.78	276.53	1.799
69	233.53	171.00	401.05	200.00	273.14	440.55	272.45	1.799
70	233.53	171.00	401.58	200.00	273.55	440.49	272.45	1.800
71	239.32	171.44	400.00	200.00	278.68	416.25	247.96	1.800
72	234.58	171.00	401.58	200.00	274.51	436.38	268.37	1.800
73	238.79	171.26	400.53	200.00	277.97	420.24	252.04	1.800
74	235.11	171.00	400.00	200.00	272.64	440.85	272.45	1.801
75	238.26	171.09	400.00	200.00	275.68	428.59	260.20	1.801
76	236.68	171.00	400.00	200.00	275.98	424.09	256.12	1.801
77	237.21	171.00	401.58	200.00	276.57	428.21	260.20	1.801
78	238.26	171.09	401.05	200.00	277.27	424.22	256.12	1.801
79	237.74	171.00	401.05	200.00	276.27	428.33	260.20	1.801
80	237.74	171.00	400.00	200.00	274.69	432.69	264.29	1.801
81	234.58	171.00	400.53	200.00	272.95	440.73	272.45	1.801
82	236.16	171.00	400.00	200.00	273.61	436.74	268.37	1.802
83	237.21	171.00	400.53	200.00	275.00	432.57	264.29	1.802
84	236.16	171.00	400.53	200.00	274.03	436.68	268.37	1.803
85	236.16	171.00	401.58	200.00	275.60	432.33	264.29	1.803
86	236.68	171.00	401.05	200.00	275.30	432.45	264.29	1.803
87	234.05	171.00	400.00	200.00	271.68	444.96	276.53	1.803
88	240.89	171.96	400.00	200.00	282.78	399.78	231.63	1.804
89	233.53	171.00	400.53	200.00	271.99	444.84	276.53	1.804
90	234.05	171.00	401.05	200.00	273.25	440.61	272.45	1.804
91	234.58	171.00	401.05	200.00	273.36	440.67	272.45	1.804
92	233.00	171.00	401.05	200.00	272.29	444.72	276.53	1.804
93	235.63	171.00	401.05	200.00	274.33	436.56	268.37	1.804
94	235.11	171.00	401.58	200.00	274.63	436.44	268.37	1.804
95	239.32	171.44	400.53	200.00	279.09	416.19	247.96	1.805
96	239.84	171.61	400.00	200.00	279.80	412.20	243.88	1.805
97	240.37	171.79	400.53	200.00	282.07	403.79	235.71	1.805
98	235.63	171.00	400.00	200.00	272.75	440.91	272.45	1.805
99	233.00	171.00	400.00	200.00	270.73	449.06	280.61	1.805

Critical Failure Surface (circle 1)

Intersects: XL: 234.05 YL: 171.00 XR: 400.00 YR: 200.00
Centre: XC: 273.90 YC: 432.26 Radius: R: 264.29

Generated failure surface: (20 points)

234.05 171.00 242.99 169.79 251.97 168.89 260.98 168.29
270.00 168.01
279.02 168.03 288.04 168.36 297.04 168.99 306.01 169.94
314.95 171.18
323.84 172.74 332.67 174.59 341.43 176.75 350.11 179.20
358.71 181.95
367.20 184.99 375.59 188.32 383.86 191.94 392.00 195.83
400.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 45 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	234.05	1.05	-7.7	3.95	3.98	3	100.00	18.0	148.41	66.28	45.96	1.03
2	238.00	8.51	-7.7	4.99	5.04	3	100.00	18.0	1157.94	535.67	242.84	1.03
3	242.99	17.27	-5.7	4.49	4.51	3	100.00	18.0	2326.57	1083.00	529.28	1.02
4	247.48	26.01	-5.7	4.49	4.51	3	100.00	18.0	3492.05	1631.26	791.50	1.02
5	251.97	34.52	-3.8	4.50	4.51	3	100.00	18.0	4623.27	2158.48	1037.49	1.01
6	256.47	42.61	-3.8	4.50	4.51	3	100.00	18.0	5697.12	2664.72	1277.58	1.01
7	260.98	50.45	-1.8	4.51	4.51	3	100.00	18.0	6734.25	3149.71	1499.86	1.01
8	265.49	57.88	-1.8	4.51	4.51	3	100.00	18.0	7713.56	3613.34	1717.70	1.01
9	270.00	64.99	0.1	4.51	4.51	3	100.00	18.0	8648.49	4055.39	1916.35	1.00
10	274.51	71.73	0.1	4.51	4.51	3	100.00	18.0	9530.86	4475.91	2111.87	1.00
11	279.02	78.07	2.1	4.51	4.51	3	100.00	18.0	10357.00	4874.58	2286.97	0.99
12	283.53	84.10	2.1	4.51	4.51	3	100.00	18.0	11140.21	5251.43	2460.08	0.99
13	288.04	89.62	4.0	4.50	4.51	3	100.00	18.0	11852.02	5606.24	2611.74	0.99
14	292.54	94.94	4.0	4.50	4.51	3	100.00	18.0	12534.59	5939.02		

2762.41	0.99									
15	297.04	76.88	6.0	3.48	3.50	3	100.00	18.0	10134.67	4823.68
2876.36	0.99									
16	300.52	79.65	6.0	3.48	3.50	3	100.00	18.0	10484.27	4997.22
2975.83	0.99									
17	304.00	47.28	6.0	2.01	2.02	3	100.00	18.0	6216.89	2966.37
3054.29	0.99									
18	306.01	91.75	8.0	3.81	3.84	3	100.00	18.0	12049.89	5780.97
3116.22	0.98									
19	309.82	94.56	8.0	3.81	3.84	3	100.00	18.0	12397.09	5957.71
3206.29	0.98									
20	313.62	33.53	8.0	1.32	1.34	2	0.00	35.0	4391.81	2112.31
3228.01	0.96									
21	314.95	26.88	9.9	1.05	1.07	2	0.00	35.0	3521.00	1702.60
3233.46	0.95									
22	316.00	101.65	9.9	3.92	3.98	2	0.00	35.0	13316.02	6276.93
3280.70	0.95									
23	319.92	104.08	9.9	3.92	3.98	2	0.00	35.0	13634.97	6106.97
3354.07	0.95									
24	323.84	31.35	11.9	1.16	1.19	2	0.00	35.0	4106.41	1790.61
3374.57	0.94									
25	325.00	102.03	11.9	3.83	3.92	2	0.00	35.0	13365.85	5772.39
3332.00	0.94									
26	328.83	98.94	11.9	3.83	3.92	2	0.00	35.0	12961.12	5575.39
3230.70	0.94									
27	332.67	108.94	13.8	4.38	4.51	2	0.00	35.0	14271.36	6156.19
3089.63	0.94									
28	337.05	104.22	13.8	4.38	4.51	2	0.00	35.0	13652.61	5852.66
2954.96	0.94									
29	341.43	80.43	15.8	3.54	3.67	2	0.00	35.0	10536.28	4527.65
2804.51	0.93									
30	344.96	76.90	15.8	3.54	3.67	2	0.00	35.0	10073.61	4298.63
2680.51	0.93									
31	348.50	33.90	15.8	1.61	1.68	5	0.00	45.0	3728.85	1350.59
2105.17	0.90									
32	350.11	23.50	17.7	1.14	1.20	5	0.00	45.0	2584.51	283.15
1956.67	0.89									
33	351.25	73.93	17.7	3.73	3.91	2	0.00	35.0	9684.84	0.00
2306.54	0.93									
34	354.98	69.49	17.7	3.73	3.91	2	0.00	35.0	9102.77	0.00
2167.90	0.93									
35	358.71	73.43	19.7	4.25	4.51	2	0.00	35.0	9619.10	0.00
1983.66	0.93									
36	362.95	66.97	19.7	4.25	4.51	2	0.00	35.0	8773.03	0.00
1809.18	0.93									
37	367.20	59.43	21.7	4.19	4.51	2	0.00	35.0	7785.89	0.00
1604.74	0.93									
38	371.40	52.45	21.7	4.19	4.51	2	0.00	35.0	6871.48	0.00
1416.27	0.93									
39	375.59	44.54	23.6	4.13	4.51	2	0.00	35.0	5834.33	0.00
1203.27	0.93									
40	379.72	37.07	23.6	4.13	4.51	2	0.00	35.0	4855.82	0.00
1001.47	0.93									
41	383.86	16.74	25.6	2.22	2.46	2	0.00	35.0	2192.34	0.00
829.66	0.93									
42	386.08	18.62	25.6	2.96	3.28	1	150.00	22.0	2439.09	0.00
706.62	1.00									
43	389.04	14.43	25.6	2.96	3.28	1	150.00	22.0	1890.45	0.00
539.46	1.00									
44	392.00	12.51	27.5	4.00	4.51	1	150.00	22.0	1638.99	0.00
326.64	1.01									
45	396.00	4.17	27.5	4.00	4.51	1	150.00	22.0	546.32	0.00
82.58	1.01									
		---			---				---	
X-S Area:		2581.96	Path Length:		171.44		X-S Weight:		338617.97	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 8-4\West Farm Expansion Case 8-4 Full Reservoir-EQ.gmf
Processed: 04 Dec 2020 13:09:42

DATA: Analysis 1 - Case 8-4 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	182.00	348.50	182.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	164.00	348.50	164.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	161.00	348.50	161.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	182.00	450.00	182.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	164.00	450.00	164.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	161.00	450.00	161.00	

Slope Surface (4 points)

100.00	164.00	217.00	164.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	197.00	217.00	197.00	316.00	197.00	348.50	197.00
351.50	172.00						
450.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	217.00	YL:	164.00	XR:	380.00	YR: 200.00
Centre:	XC:	192.18	YC:	663.38	Radius:	R:	500.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 8-4 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.241

Analysis Summary

There were: 11023 successful analyses from a total of 20001 trial failure surfaces
8978 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 2.14

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	217.79	164.26	375.00	200.00	166.43	753.87	591.84	2.137	<-- Critical Surface
2	217.79	164.26	375.00	200.00	165.52	757.88	595.92	2.138	
3	217.26	164.09	375.00	200.00	170.56	733.60	571.43	2.138	
4	217.79	164.26	375.00	200.00	164.60	761.90	600.00	2.138	
5	217.26	164.09	375.00	200.00	171.47	729.58	567.35	2.138	
6	217.26	164.09	375.00	200.00	172.39	725.56	563.27	2.139	
7	217.26	164.09	375.00	200.00	173.30	721.54	559.18	2.139	
8	217.26	164.09	375.00	200.00	174.22	717.52	555.10	2.139	
9	217.26	164.09	375.00	200.00	175.13	713.50	551.02	2.140	
10	217.26	164.09	375.00	200.00	176.05	709.47	546.94	2.140	
11	216.74	164.00	375.00	200.00	180.48	689.28	526.53	2.140	
12	217.26	164.09	375.00	200.00	176.97	705.45	542.86	2.140	
13	217.79	164.26	375.00	200.00	167.34	749.85	587.76	2.140	
14	216.74	164.00	375.00	200.00	181.39	685.25	522.45	2.141	
15	217.26	164.09	375.00	200.00	177.88	701.42	538.78	2.141	
16	217.79	164.26	375.00	200.00	168.26	745.83	583.67	2.141	
17	217.79	164.26	375.00	200.00	169.17	741.81	579.59	2.141	
18	218.32	164.44	375.00	200.00	169.61	741.98	579.59	2.141	
19	217.26	164.09	375.00	200.00	178.80	697.40	534.69	2.141	
20	217.79	164.26	375.00	200.00	170.08	737.79	575.51	2.141	
21	216.74	164.00	375.00	200.00	182.31	681.22	518.37	2.141	
22	217.79	164.26	375.00	200.00	171.00	733.77	571.43	2.141	
23	217.26	164.09	375.00	200.00	179.72	693.37	530.61	2.141	
24	218.32	164.44	375.00	200.00	168.70	746.00	583.67	2.141	
25	217.79	164.26	375.00	200.00	171.91	729.75	567.35	2.142	
26	216.74	164.00	375.00	200.00	183.23	677.19	514.29	2.142	
27	217.79	164.26	375.00	200.00	172.82	725.73	563.27	2.142	
28	217.26	164.09	375.00	200.00	180.63	689.34	526.53	2.142	
29	218.32	164.44	375.00	200.00	167.79	750.02	587.76	2.142	
30	217.79	164.26	375.00	200.00	173.74	721.71	559.18	2.142	
31	216.74	164.00	375.00	200.00	184.14	673.16	510.20	2.142	
32	217.26	164.09	375.00	200.00	181.55	685.31	522.45	2.142	
33	217.79	164.26	375.00	200.00	174.65	717.69	555.10	2.142	
34	218.32	164.44	375.00	200.00	166.88	754.04	591.84	2.142	
35	216.74	164.00	375.00	200.00	185.06	669.13	506.12	2.143	
36	217.79	164.26	375.00	200.00	175.57	713.66	551.02	2.143	
37	217.26	164.09	375.00	200.00	182.47	681.29	518.37	2.143	
38	218.32	164.44	375.00	200.00	165.97	758.05	595.92	2.143	
39	217.79	164.26	375.00	200.00	176.48	709.64	546.94	2.143	
40	216.74	164.00	375.00	200.00	185.98	665.10	502.04	2.143	
41	218.32	164.44	375.00	200.00	165.05	762.07	600.00	2.143	
42	217.26	164.09	375.00	200.00	183.39	677.26	514.29	2.143	
43	217.79	164.26	375.00	200.00	177.40	705.62	542.86	2.143	
44	217.79	164.26	375.00	200.00	178.31	701.59	538.78	2.144	
45	216.74	164.00	375.00	200.00	186.90	661.06	497.96	2.144	
46	217.26	164.09	375.00	200.00	184.30	673.23	510.20	2.144	
47	216.74	164.00	375.00	200.00	164.01	761.68	600.00	2.144	
48	217.79	164.26	375.00	200.00	179.23	697.56	534.69	2.144	
49	216.74	164.00	375.00	200.00	164.92	757.66	595.92	2.144	
50	216.74	164.00	375.00	200.00	165.84	753.64	591.84	2.144	
51	218.32	164.44	375.00	200.00	170.53	737.96	575.51	2.144	
52	216.74	164.00	375.00	200.00	166.75	749.63	587.76	2.144	
53	217.26	164.09	375.00	200.00	185.22	669.19	506.12	2.144	
54	216.74	164.00	375.00	200.00	187.81	657.03	493.88	2.144	
55	218.32	164.44	375.00	200.00	171.44	733.94	571.43	2.144	
56	216.74	164.00	375.00	200.00	167.67	745.61	583.67	2.145	
57	217.79	164.26	375.00	200.00	180.14	693.54	530.61	2.145	
58	216.74	164.00	375.00	200.00	168.58	741.59	579.59	2.145	
59	218.32	164.44	375.00	200.00	172.35	729.92	567.35	2.145	
60	216.74	164.00	375.00	200.00	169.49	737.57	575.51	2.145	
61	217.26	164.09	375.00	200.00	164.15	761.73	600.00	2.145	
62	217.26	164.09	375.00	200.00	165.07	757.72	595.92	2.145	
63	217.79	164.26	375.00	200.00	181.06	689.51	526.53	2.145	

64	216.74	164.00	375.00	200.00	170.41	733.55	571.43	2.145
65	218.32	164.44	375.00	200.00	173.26	725.90	563.27	2.145
66	217.26	164.09	375.00	200.00	186.14	665.16	502.04	2.145
67	217.26	164.09	375.00	200.00	165.98	753.70	591.84	2.145
68	216.74	164.00	375.00	200.00	188.73	652.99	489.80	2.145
69	217.26	164.09	375.00	200.00	166.90	749.68	587.76	2.145
70	216.74	164.00	375.00	200.00	171.32	729.53	567.35	2.145
71	218.84	164.61	375.00	200.00	171.88	734.11	571.43	2.145
72	218.32	164.44	375.00	200.00	174.18	721.88	559.18	2.145
73	217.26	164.09	375.00	200.00	167.81	745.66	583.67	2.145
74	216.74	164.00	375.00	200.00	172.24	725.50	563.27	2.145
75	217.79	164.26	375.00	200.00	181.97	685.48	522.45	2.145
76	217.26	164.09	375.00	200.00	168.73	741.64	579.59	2.145
77	218.32	164.44	375.00	200.00	175.09	717.86	555.10	2.146
78	216.74	164.00	375.00	200.00	173.15	721.48	559.18	2.146
79	217.26	164.09	375.00	200.00	169.64	737.62	575.51	2.146
80	217.26	164.09	375.00	200.00	187.06	661.13	497.96	2.146
81	218.84	164.61	375.00	200.00	170.97	738.13	575.51	2.146
82	216.74	164.00	375.00	200.00	174.07	717.46	555.10	2.146
83	216.74	164.00	375.00	200.00	189.65	648.96	485.71	2.146
84	218.32	164.44	375.00	200.00	176.00	713.83	551.02	2.146
85	217.79	164.26	375.00	200.00	182.89	681.45	518.37	2.146
86	216.74	164.00	375.00	200.00	174.98	713.44	551.02	2.146
87	218.84	164.61	375.00	200.00	170.06	742.15	579.59	2.146
88	218.32	164.44	375.00	200.00	176.92	709.81	546.94	2.146
89	217.26	164.09	375.00	200.00	187.98	657.10	493.88	2.146
90	216.74	164.00	375.00	200.00	175.90	709.41	546.94	2.146
91	217.79	164.26	375.00	200.00	183.81	677.42	514.29	2.146
92	218.84	164.61	375.00	200.00	165.51	762.24	600.00	2.146
93	218.32	164.44	375.00	200.00	177.83	705.78	542.86	2.146
94	216.74	164.00	375.00	200.00	190.57	644.92	481.63	2.147
95	216.74	164.00	375.00	200.00	176.81	705.39	542.86	2.147
96	218.84	164.61	375.00	200.00	169.15	746.17	583.67	2.147
97	218.84	164.61	375.00	200.00	166.42	758.22	595.92	2.147
98	218.84	164.61	375.00	200.00	167.33	754.20	591.84	2.147
99	218.32	164.44	375.00	200.00	178.74	701.76	538.78	2.147

Critical Failure Surface (circle 1)

Intersects: XL: 217.79 YL: 164.26 XR: 375.00 YR: 200.00
Centre: XC: 166.43 YC: 753.87 Radius: R: 591.84
Generated failure surface: (20 points)
217.79 164.26 226.26 165.06 234.73 165.98 243.17 167.03
251.61 168.19
260.02 169.48 268.41 170.88 276.79 172.41 285.14 174.06
293.46 175.82
301.76 177.71 310.04 179.72 318.28 181.84 326.49 184.09
334.67 186.45
342.81 188.92 350.92 191.52 358.98 194.23 367.01 197.06
375.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 43 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	217.79	2.15	5.4	4.24	4.26	2	0.00	35.0	281.04	8641.17	2064.00	0.97
2	222.03	6.44	5.4	4.24	4.26	2	0.00	35.0	843.12	8534.99	2106.43	0.97
3	226.26	10.58	6.2	4.23	4.26	2	0.00	35.0	1385.58	8420.19	2144.10	0.97
4	230.49	14.59	6.2	4.23	4.26	2	0.00	35.0	1911.86	8297.84	2178.24	0.97
5	234.73	18.45	7.0	4.22	4.26	2	0.00	35.0	2416.59	8167.38	2207.08	0.97
6	238.95	22.19	7.0	4.22	4.26	2	0.00	35.0	2907.07	8028.92	2232.98	0.97
7	243.17	25.75	7.9	4.22	4.26	2	0.00	35.0	3373.80	7882.66	2253.06	0.97
8	247.39	29.22	7.9	4.22	4.26	2	0.00	35.0	3828.38	7728.01	2270.75	0.97
9	251.61	32.49	8.7	4.21	4.26	2	0.00	35.0	4256.38	7565.12	2282.14	0.96
10	255.81	35.69	8.7	4.21	4.26	2	0.00	35.0	4674.98	7394.39	2291.66	0.96
11	260.02	38.66	9.5	4.20	4.26	2	0.00	35.0	5064.39	7215.68	2294.45	0.96
12	264.22	41.58	9.5	4.20	4.26	2	0.00	35.0	5447.04	7028.94	2295.83	0.96
13	268.41	27.03	10.3	2.59	2.63	2	0.00	35.0	3540.30	4245.54	2291.38	0.96

14	271.00	31.43	10.3	2.89	2.94	2	0.00	35.0	4117.96	4658.51
2286.99	0.96									
15	273.89	32.70	10.3	2.89	2.94	2	0.00	35.0	4283.52	4561.61
2282.34	0.96									
16	276.79	49.28	11.2	4.18	4.26	2	0.00	35.0	6455.76	6420.73
2269.20	0.96									
17	280.96	51.65	11.2	4.18	4.26	2	0.00	35.0	6766.48	6201.96
2254.42	0.96									
18	285.14	53.73	12.0	4.16	4.26	2	0.00	35.0	7038.99	5975.28
2231.88	0.96									
19	289.30	55.83	12.0	4.16	4.26	2	0.00	35.0	7313.97	5740.67
2209.08	0.96									
20	293.46	57.62	12.8	4.15	4.26	2	0.00	35.0	7547.77	5498.27
2178.26	0.95									
21	297.61	59.44	12.8	4.15	4.26	2	0.00	35.0	7786.92	5247.69
2147.49	0.95									
22	301.76	60.93	13.6	4.14	4.26	2	0.00	35.0	7981.37	4989.09
2108.47	0.95									
23	305.90	62.48	13.6	4.14	4.26	2	0.00	35.0	8184.92	4722.74
2069.76	0.95									
24	310.04	45.94	14.5	2.98	3.08	2	0.00	35.0	6018.29	3246.91
2029.06	0.95									
25	313.02	46.61	14.5	2.98	3.08	2	0.00	35.0	6106.30	3099.22
1995.35	0.95									
26	316.00	36.07	14.5	2.28	2.35	2	0.00	35.0	4725.47	2268.73
1987.47	0.95									
27	318.28	53.83	15.3	3.36	3.48	1	150.00	22.0	7052.13	3195.39
2022.17	0.99									
28	321.64	54.51	15.3	3.36	3.48	1	150.00	22.0	7141.14	2995.81
2044.54	0.99									
29	325.00	24.01	15.3	1.49	1.54	1	150.00	22.0	3144.80	1263.84
2029.76	0.99									
30	326.49	62.66	16.1	4.09	4.26	1	150.00	22.0	8208.39	3272.94
1924.21	0.99									
31	330.58	57.83	16.1	4.09	4.26	1	150.00	22.0	7576.11	2959.46
1773.77	0.99									
32	334.67	52.66	16.9	4.07	4.26	1	150.00	22.0	6898.71	2638.21
1615.75	0.99									
33	338.74	47.62	16.9	4.07	4.26	1	150.00	22.0	6237.78	2309.14
1458.06	0.99									
34	342.81	30.21	17.8	2.85	2.99	1	150.00	22.0	3958.16	1420.46
1317.83	0.99									
35	345.65	27.62	17.8	2.85	2.99	1	150.00	22.0	3618.76	1250.70
1202.09	0.99									
36	348.50	6.60	17.8	0.72	0.76	5	0.00	45.0	726.53	148.07
899.71	0.91									
37	349.22	14.82	17.8	1.69	1.78	5	0.00	45.0	1630.74	0.00
837.29	0.91									
38	350.92	31.48	18.6	4.03	4.26	1	150.00	22.0	4123.52	0.00
938.93	0.99									
39	354.95	26.01	18.6	4.03	4.26	1	150.00	22.0	3407.10	0.00
771.95	0.99									
40	358.98	20.32	19.4	4.01	4.26	1	150.00	22.0	2662.19	0.00
598.63	0.99									
41	363.00	14.65	19.4	4.01	4.26	1	150.00	22.0	1918.86	0.00
425.01	0.99									
42	367.01	8.81	20.2	3.99	4.26	1	150.00	22.0	1154.35	0.00
246.08	1.00									
43	371.01	2.94	20.2	3.99	4.26	1	150.00	22.0	384.78	0.00
65.91	1.00									

X-S Area: 1485.13 Path Length: 161.72 X-S Weight: 194102.33

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 8-4\West Farm Expansion Case 8-4 Rapid Drawdown-EQ.gmf
Processed: 04 Dec 2020 13:09:18

DATA: Analysis 1 - Case 8-4 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	182.00	348.50	182.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	164.00	348.50	164.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	161.00	348.50	161.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	182.00	450.00	182.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	164.00	450.00	164.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	161.00	450.00	161.00	

Slope Surface (4 points)

100.00	164.00	217.00	164.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	164.00	217.00	164.00	316.00	197.00	348.50	197.00
351.50	172.00						
450.00	172.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	217.00	YL:	164.00	XR:	380.00	YR: 200.00
Centre:	XC:	192.18	YC:	663.38	Radius:	R:	500.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 8-4 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 1.403

Analysis Summary

There were: 11023 successful analyses from a total of 20001 trial failure surfaces
8978 analyses terminated due to unacceptable geometry

Critical (minimum) Factor of Safety: 1.33

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	216.74	164.00	375.00	200.00	180.48	689.28	526.53	1.334	<-- Critical Surface
2	216.74	164.00	375.00	200.00	181.39	685.25	522.45	1.334	
3	216.74	164.00	375.00	200.00	182.31	681.22	518.37	1.334	
4	216.74	164.00	375.00	200.00	183.23	677.19	514.29	1.334	
5	216.74	164.00	375.00	200.00	184.14	673.16	510.20	1.335	
6	216.74	164.00	375.00	200.00	185.06	669.13	506.12	1.335	
7	216.74	164.00	375.00	200.00	185.98	665.10	502.04	1.335	
8	216.74	164.00	375.00	200.00	186.90	661.06	497.96	1.335	
9	216.74	164.00	375.00	200.00	187.81	657.03	493.88	1.335	
10	217.26	164.09	375.00	200.00	173.30	721.54	559.18	1.335	
11	217.26	164.09	375.00	200.00	172.39	725.56	563.27	1.335	
12	217.26	164.09	375.00	200.00	174.22	717.52	555.10	1.335	
13	217.26	164.09	375.00	200.00	171.47	729.58	567.35	1.335	
14	217.26	164.09	375.00	200.00	175.13	713.50	551.02	1.335	
15	217.26	164.09	375.00	200.00	170.56	733.60	571.43	1.335	
16	217.26	164.09	375.00	200.00	176.05	709.47	546.94	1.335	
17	217.26	164.09	375.00	200.00	176.97	705.45	542.86	1.335	
18	217.26	164.09	375.00	200.00	177.88	701.42	538.78	1.335	
19	216.74	164.00	375.00	200.00	188.73	652.99	489.80	1.335	
20	217.26	164.09	375.00	200.00	178.80	697.40	534.69	1.335	
21	217.26	164.09	375.00	200.00	179.72	693.37	530.61	1.335	
22	217.26	164.09	375.00	200.00	180.63	689.34	526.53	1.336	
23	216.74	164.00	375.00	200.00	189.65	648.96	485.71	1.336	
24	217.26	164.09	375.00	200.00	181.55	685.31	522.45	1.336	
25	217.26	164.09	375.00	200.00	182.47	681.29	518.37	1.336	
26	216.74	164.00	375.00	200.00	190.57	644.92	481.63	1.336	
27	217.26	164.09	375.00	200.00	183.39	677.26	514.29	1.336	
28	217.26	164.09	375.00	200.00	184.30	673.23	510.20	1.336	
29	216.74	164.00	375.00	200.00	191.49	640.88	477.55	1.336	
30	217.26	164.09	375.00	200.00	185.22	669.19	506.12	1.336	
31	217.26	164.09	375.00	200.00	186.14	665.16	502.04	1.336	
32	216.74	164.00	375.00	200.00	192.41	636.84	473.47	1.336	
33	217.26	164.09	375.00	200.00	187.06	661.13	497.96	1.336	
34	216.74	164.00	375.00	200.00	193.32	632.80	469.39	1.337	
35	217.26	164.09	375.00	200.00	187.98	657.10	493.88	1.337	
36	217.79	164.26	375.00	200.00	166.43	753.87	591.84	1.337	
37	217.26	164.09	375.00	200.00	188.89	653.06	489.80	1.337	
38	216.74	164.00	375.00	200.00	194.24	628.76	465.31	1.337	
39	217.26	164.09	375.00	200.00	189.81	649.03	485.71	1.337	
40	216.74	164.00	375.00	200.00	199.77	604.49	440.82	1.337	
41	216.74	164.00	375.00	200.00	195.16	624.72	461.22	1.337	
42	217.79	164.26	375.00	200.00	165.52	757.88	595.92	1.337	
43	217.26	164.09	375.00	200.00	190.73	644.99	481.63	1.337	
44	217.26	164.09	375.00	200.00	191.65	640.95	477.55	1.338	
45	216.74	164.00	375.00	200.00	196.08	620.68	457.14	1.338	
46	216.74	164.00	375.00	200.00	198.84	608.54	444.90	1.338	
47	217.79	164.26	375.00	200.00	164.60	761.90	600.00	1.338	
48	217.26	164.09	375.00	200.00	192.57	636.91	473.47	1.338	
49	216.74	164.00	375.00	200.00	197.00	616.63	453.06	1.338	
50	216.74	164.00	375.00	200.00	176.81	705.39	542.86	1.338	
51	216.74	164.00	375.00	200.00	177.73	701.36	538.78	1.338	
52	216.74	164.00	375.00	200.00	175.90	709.41	546.94	1.338	
53	216.74	164.00	375.00	200.00	178.65	697.34	534.69	1.338	
54	216.74	164.00	375.00	200.00	174.98	713.44	551.02	1.338	
55	216.74	164.00	375.00	200.00	179.56	693.31	530.61	1.338	
56	216.74	164.00	375.00	200.00	197.92	612.59	448.98	1.338	
57	216.74	164.00	375.00	200.00	174.07	717.46	555.10	1.338	
58	217.26	164.09	375.00	200.00	193.49	632.87	469.39	1.338	
59	216.74	164.00	375.00	200.00	173.15	721.48	559.18	1.338	
60	216.74	164.00	375.00	200.00	172.24	725.50	563.27	1.338	
61	216.74	164.00	375.00	200.00	171.32	729.53	567.35	1.338	
62	217.79	164.26	375.00	200.00	173.74	721.71	559.18	1.338	
63	217.79	164.26	375.00	200.00	174.65	717.69	555.10	1.338	

64	217.79	164.26	375.00	200.00	175.57	713.66	551.02	1.338
65	217.79	164.26	375.00	200.00	172.82	725.73	563.27	1.338
66	216.74	164.00	375.00	200.00	170.41	733.55	571.43	1.338
67	217.79	164.26	375.00	200.00	171.91	729.75	567.35	1.338
68	217.79	164.26	375.00	200.00	176.48	709.64	546.94	1.338
69	217.79	164.26	375.00	200.00	171.00	733.77	571.43	1.338
70	217.79	164.26	375.00	200.00	177.40	705.62	542.86	1.338
71	216.74	164.00	375.00	200.00	169.49	737.57	575.51	1.338
72	217.79	164.26	375.00	200.00	170.08	737.79	575.51	1.338
73	217.79	164.26	375.00	200.00	178.31	701.59	538.78	1.338
74	217.79	164.26	375.00	200.00	169.17	741.81	579.59	1.338
75	217.79	164.26	375.00	200.00	179.23	697.56	534.69	1.338
76	217.26	164.09	375.00	200.00	194.41	628.83	465.31	1.338
77	216.74	164.00	375.00	200.00	168.58	741.59	579.59	1.338
78	217.79	164.26	375.00	200.00	168.26	745.83	583.67	1.338
79	217.79	164.26	375.00	200.00	180.14	693.54	530.61	1.338
80	217.79	164.26	375.00	200.00	167.34	749.85	587.76	1.339
81	216.74	164.00	375.00	200.00	167.67	745.61	583.67	1.339
82	217.79	164.26	375.00	200.00	181.06	689.51	526.53	1.339
83	216.74	164.00	375.00	200.00	166.75	749.63	587.76	1.339
84	217.79	164.26	375.00	200.00	181.97	685.48	522.45	1.339
85	216.74	164.00	375.00	200.00	165.84	753.64	591.84	1.339
86	217.79	164.26	375.00	200.00	182.89	681.45	518.37	1.339
87	217.26	164.09	375.00	200.00	195.33	624.79	461.22	1.339
88	216.74	164.00	375.00	200.00	164.92	757.66	595.92	1.339
89	217.79	164.26	375.00	200.00	183.81	677.42	514.29	1.339
90	216.74	164.00	375.00	200.00	164.01	761.68	600.00	1.339
91	217.79	164.26	375.00	200.00	184.72	673.39	510.20	1.339
92	217.26	164.09	375.00	200.00	199.94	604.56	440.82	1.339
93	217.26	164.09	375.00	200.00	196.25	620.75	457.14	1.339
94	217.79	164.26	375.00	200.00	185.64	669.36	506.12	1.339
95	217.26	164.09	375.00	200.00	169.64	737.62	575.51	1.339
96	217.79	164.26	375.00	200.00	186.55	665.33	502.04	1.339
97	217.26	164.09	375.00	200.00	168.73	741.64	579.59	1.339
98	217.26	164.09	375.00	200.00	167.81	745.66	583.67	1.339
99	217.79	164.26	375.00	200.00	187.47	661.30	497.96	1.339

Critical Failure Surface (circle 1)

Intersects: XL: 216.74 YL: 164.00 XR: 375.00 YR: 200.00
Centre: XC: 180.48 YC: 689.28 Radius: R: 526.53

Generated failure surface: (20 points)

216.74 164.00 225.29 164.66 233.83 165.46 242.35 166.40
250.86 167.48
259.35 168.69 267.82 170.04 276.27 171.54 284.69 173.17
293.08 174.93
301.44 176.83 309.77 178.87 318.07 181.05 326.33 183.35
334.55 185.80
342.73 188.37 350.87 191.08 358.96 193.92 367.00 196.90
375.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 42 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	216.74	1.97	4.4	4.28	4.29	2	0.00	35.0	257.56	123.05	59.01	0.96
2	221.01	6.65	4.4	4.28	4.29	2	0.00	35.0	870.93	416.09	199.54	0.96
3	225.29	11.16	5.3	4.27	4.29	2	0.00	35.0	1462.18	699.54	334.06	0.96
4	229.56	15.53	5.3	4.27	4.29	2	0.00	35.0	2034.63	973.40	464.84	0.96
5	233.83	19.71	6.3	4.26	4.29	2	0.00	35.0	2582.62	1237.63	588.57	0.95
6	238.09	23.77	6.3	4.26	4.29	2	0.00	35.0	3113.98	1492.26	709.66	0.95
7	242.35	27.62	7.2	4.25	4.29	2	0.00	35.0	3618.22	1737.25	822.75	0.95
8	246.61	31.36	7.2	4.25	4.29	2	0.00	35.0	4108.37	1972.58	934.20	0.95
9	250.86	34.87	8.1	4.24	4.29	2	0.00	35.0	4568.30	2198.24	1036.79	0.94
10	255.11	38.30	8.1	4.24	4.29	2	0.00	35.0	5017.17	2414.23	1138.66	0.94
11	259.35	41.47	9.1	4.23	4.29	2	0.00	35.0	5432.59	2620.59	1230.91	0.93
12	263.59	44.58	9.1	4.23	4.29	2	0.00	35.0	5840.12	2817.17	1323.25	0.93
13	267.82	35.44	10.0	3.18	3.23	2	0.00	35.0	4642.42	2245.57	1395.06	0.93

14	271.00	62.17	10.0	5.27	5.35	2	0.00	35.0	8144.18	3939.40	1477.92	0.93
15	276.27	52.68	10.9	4.21	4.29	2	0.00	35.0	6901.48	3348.37	1560.13	0.92
16	280.48	55.16	10.9	4.21	4.29	2	0.00	35.0	7226.37	3505.99	1633.56	0.92
17	284.69	57.30	11.9	4.20	4.29	2	0.00	35.0	7506.26	3653.79	1695.62	0.92
18	288.88	59.46	11.9	4.20	4.29	2	0.00	35.0	7789.90	3791.85	1759.68	0.92
19	293.08	61.26	12.8	4.18	4.29	2	0.00	35.0	8024.91	3920.20	1811.95	0.92
20	297.26	63.11	12.8	4.18	4.29	2	0.00	35.0	8267.46	4038.68	1866.71	0.92
21	301.44	64.56	13.7	4.17	4.29	2	0.00	35.0	8457.01	4147.20	1909.32	0.91
22	305.61	66.10	13.7	4.17	4.29	2	0.00	35.0	8658.47	4246.00	1954.82	0.91
23	309.77	50.33	14.7	3.11	3.22	2	0.00	35.0	6593.07	3246.52	1983.39	0.91
24	312.89	51.02	14.7	3.11	3.22	2	0.00	35.0	6683.66	3291.13	2010.64	0.91
25	316.00	34.28	14.7	2.07	2.14	2	0.00	35.0	4491.20	2165.51	2030.73	0.91
26	318.07	57.17	15.6	3.42	3.55	2	0.00	35.0	7489.06	3425.39	2035.54	0.91
27	321.48	59.49	15.6	3.52	3.65	1	150.00	22.0	7792.85	3304.44	2085.59	0.96
28	325.00	22.37	15.6	1.33	1.38	1	150.00	22.0	2930.16	1190.93	2071.30	0.96
29	326.33	65.92	16.5	4.11	4.29	1	150.00	22.0	8635.15	3488.18	1963.73	0.96
30	330.44	60.90	16.5	4.11	4.29	1	150.00	22.0	7977.42	3161.35	1810.64	0.96
31	334.55	55.46	17.5	4.09	4.29	1	150.00	22.0	7265.24	2825.51	1646.65	0.96
32	338.64	50.19	17.5	4.09	4.29	1	150.00	22.0	6574.97	2480.79	1485.59	0.96
33	342.73	32.15	18.4	2.88	3.04	1	150.00	22.0	4212.29	1545.60	1339.05	0.96
34	345.62	29.38	18.4	2.88	3.04	1	150.00	22.0	3849.35	1363.39	1219.26	0.96
35	348.50	7.41	18.4	0.77	0.82	5	0.00	45.0	815.24	170.65	884.89	0.84
36	349.27	14.64	18.4	1.59	1.68	5	0.00	45.0	1610.26	0.00	808.41	0.84
37	350.87	33.21	19.3	4.05	4.29	1	150.00	22.0	4350.21	0.00	936.15	0.96
38	354.91	27.46	19.3	4.05	4.29	1	150.00	22.0	3597.19	0.00	767.93	0.96
39	358.96	21.45	20.3	4.02	4.29	1	150.00	22.0	2810.26	0.00	590.96	0.96
40	362.98	15.47	20.3	4.02	4.29	1	150.00	22.0	2026.97	0.00	415.83	0.96
41	367.00	9.30	21.2	4.00	4.29	1	150.00	22.0	1218.89	0.00	233.79	0.96
42	371.00	3.10	21.2	4.00	4.29	1	150.00	22.0	406.30	0.00	51.90	0.96

X-S Area: 1574.95 Path Length: 162.95 X-S Weight: 205854.88

APPENDIX D

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

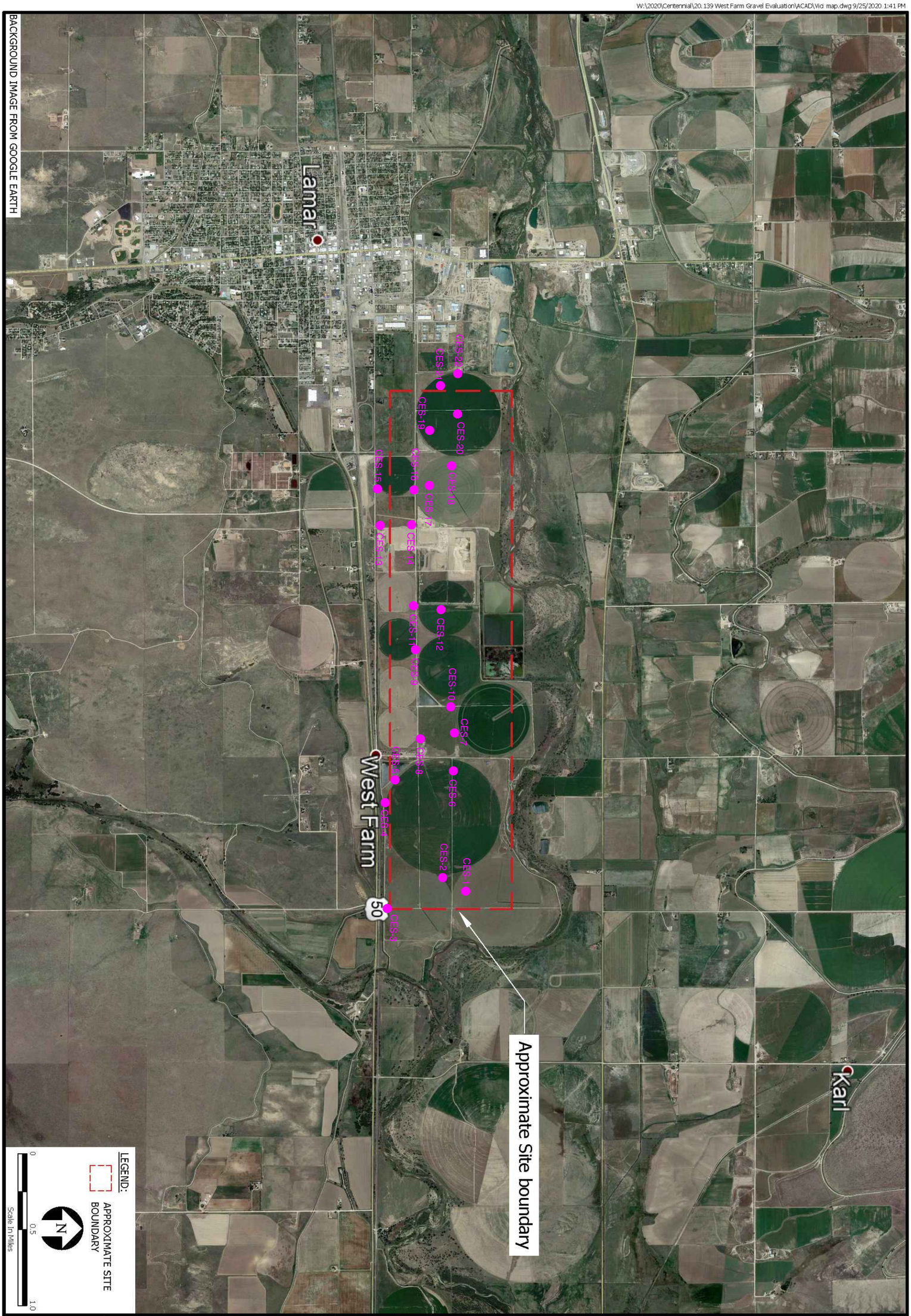
MEMO

Project Name:	West Farm Gravel Evaluation
Project No.	20.139
From:	J. Crystal
Date:	September 30, 2020
Subject:	Boring Logs

Cesare drilled 22 borings to depths ranging from 18 to 69 feet on September 8 through 10, 2020. All borings extended about a foot into bedrock. Occasional grab samples were recovered from auger cuttings of the various soils encountered. Elevations are from the boring location plan you forwarded to Cesare. A vicinity map in Figure 1 and the boring location plan J&T Consulting, Inc. provided are attached with a boring log profile and key to symbols.

Corporate Office: 7108 South Alton Way, Building B • Centennial, CO 80112
Locations: Centennial • Frederick • Silverthorne • Salida/Crested Butte
Phone 303-220-0300 • www.cesareinc.com

W:\2020\Centennial\20.139 West Farm Gravel Evaluation\ACAD\Vici map.dwg 9/25/2020 1:41 PM

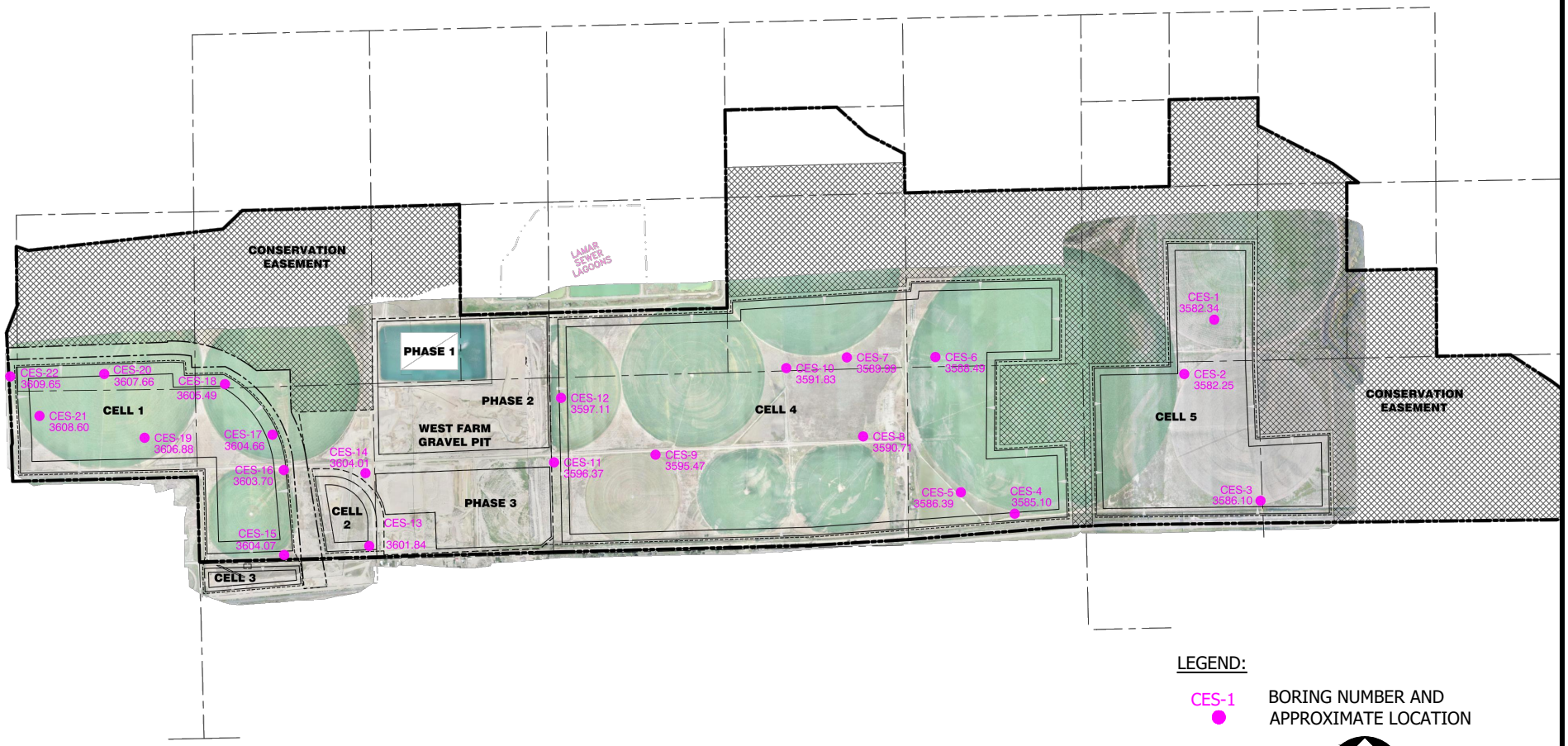


PROJECT NO:	20.139		
PROJECT NAME:	West Farm Gravel Evaluation		
DRAWN BY:	KNZ	CHECKED BY:	JAC2
DWG DATE:	09.25.20	REV. DATE:	--

FIGURE 1
Vicinity Map

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

W:\2020\Centennial\20.139 West Farm Gravel Evaluation\ACAD\Boring Location Map.dwg 9/25/2020 10:21 AM

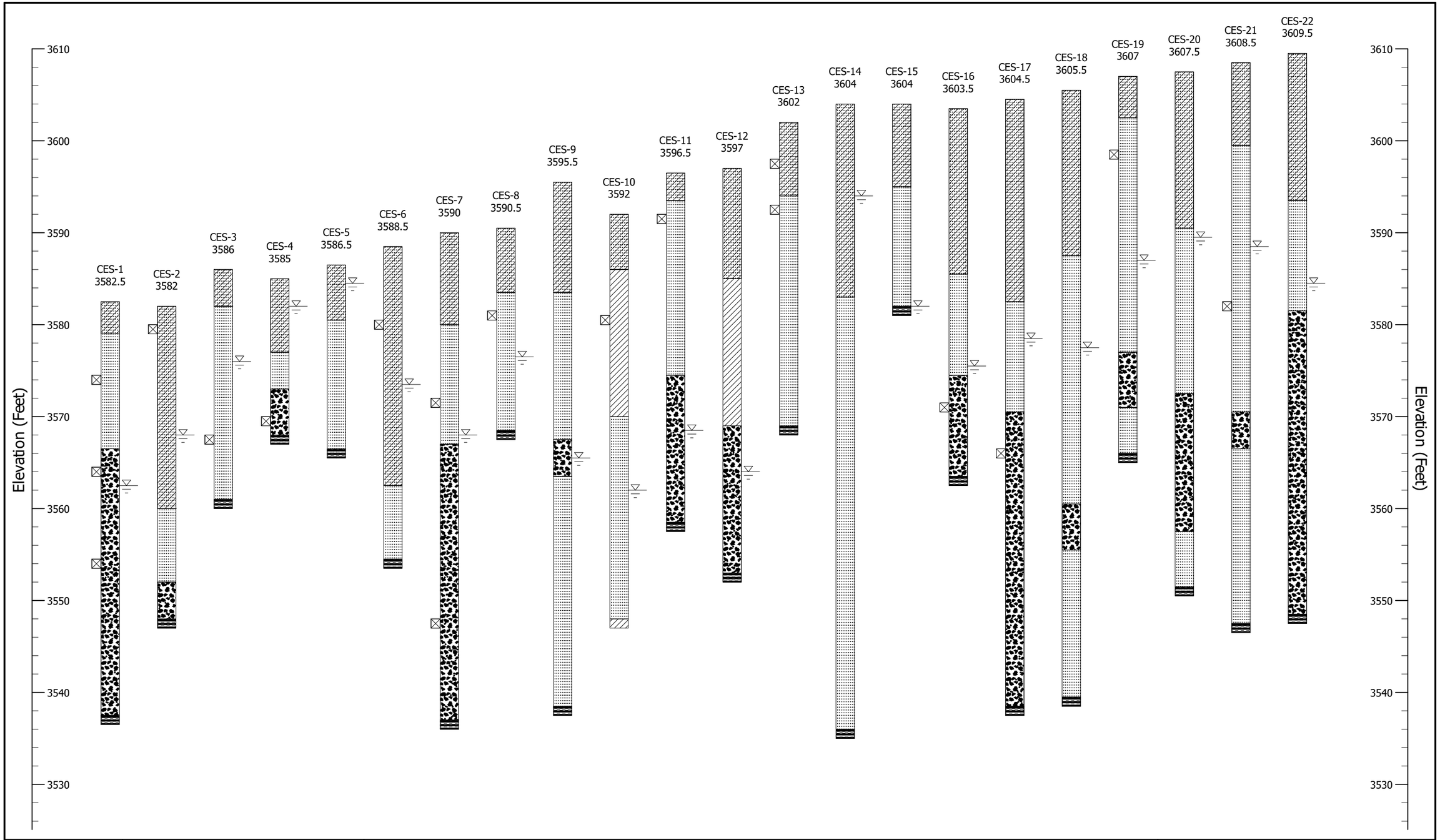


SITE PLAN PROVIDED BY CLIENT

PROJECT NO:	20.139		
PROJECT NAME:	West Farm Gravel Evaluation		
DRAWN BY:	JBE/KNZ	CHECKED BY:	JAC2
DWG DATE:	09.23.20	REV. DATE:	--

Boring Location Plan

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants



PROJECT NO:	20.139
PROJECT NAME:	West Farm Expansion
DWG DATE:	9/30/2020

Boring Logs

CESARE, INC.
Geotechnical Engineers & Construction Materials Consultants

KEY TO SYMBOLS

Symbol Description

Strata symbols



INTERBEDDED: SAND, clayey, slightly moist to wet, medium dense, tan to brown (SC, A-6); CLAY, sandy, slightly moist to wet, stiff to hard for clays, (CL, A-6).



SAND, to with gravel, moist to wet, dense to very dense, tan to brown (SP, SW, A-1-b).



GRAVEL, with sand to sandy, wet, dense to very dense, tan to brown (GP, GW, A-1-a).



CLAY, low to medium plasticity, wet, brown to gray (CL, A-6).



CLAYSTONE, very hard, slightly moist to moist, gray to brown.

Misc. Symbols



Water level during drilling, estimated from auger cutting return at surface during drilling.

Soil Samplers



Grab sample recovered from auger cuttings.

Notes:

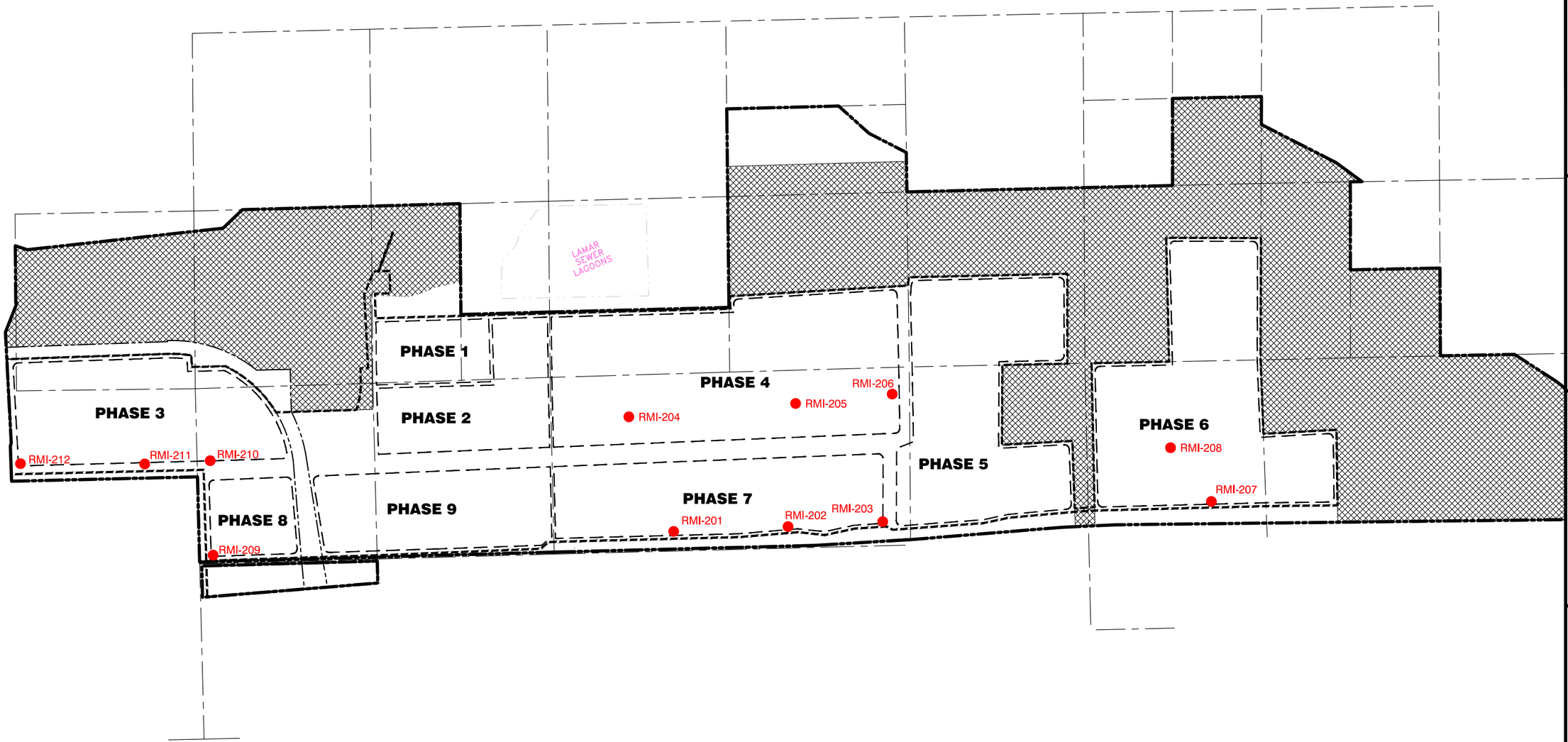
1. Exploratory borings B-1 through B-22 were drilled on September 8, 9, and 10, 2020 using a CME-55 drill rig equipped with 6-inch diameter continuous flight solid stem auger.

2. Elevations shown are rounded to the nearest half foot from surveyed values provided by J&T Consulting, Inc.

3. Borings were backfilled at the completion of each boring.

4. Contacts between soil units are approximate and may be gradational.

4. These logs are subject to the limitations, conclusions, and recommendations in this report.
Project No. 20.139.



LEGEND:

- WEST FARM PROPERTY BOUNDARY
- WEST FARM GRAVEL PIT PERMIT BOUNDARY
- WEST FARM GRAVEL PIT MINING PHASE BOUNDARY

N

800 400 0 800 1600 2400

SCALE IN FEET

J&T Consulting, Inc.
305 Denver Avenue - Suite D
Fort Lupton, CO 80621
Ph: 303-857-6222 Fax: 303-857-6224
www.jtconsulting.com

West Farm Property

Boring Layout

Prowers Aggregate
Operators

REVISIONS

No	Date	By	Chk	Description

Job #	07115
Date	12.4.02
Drawn By	TPY
Designed By	TPY
Checked By	JCY
File	JT-GP Gravel 2015 Est
Scale	1" = 800'

Sheet: 1 Of: 1

P:\07115 GP Ranches LLC - Lamar\Drawings\Plan Sheets\JT-GP 2015 Gravel Estimate.dwg, Borings, 12/3/2020 11:33:46 AM

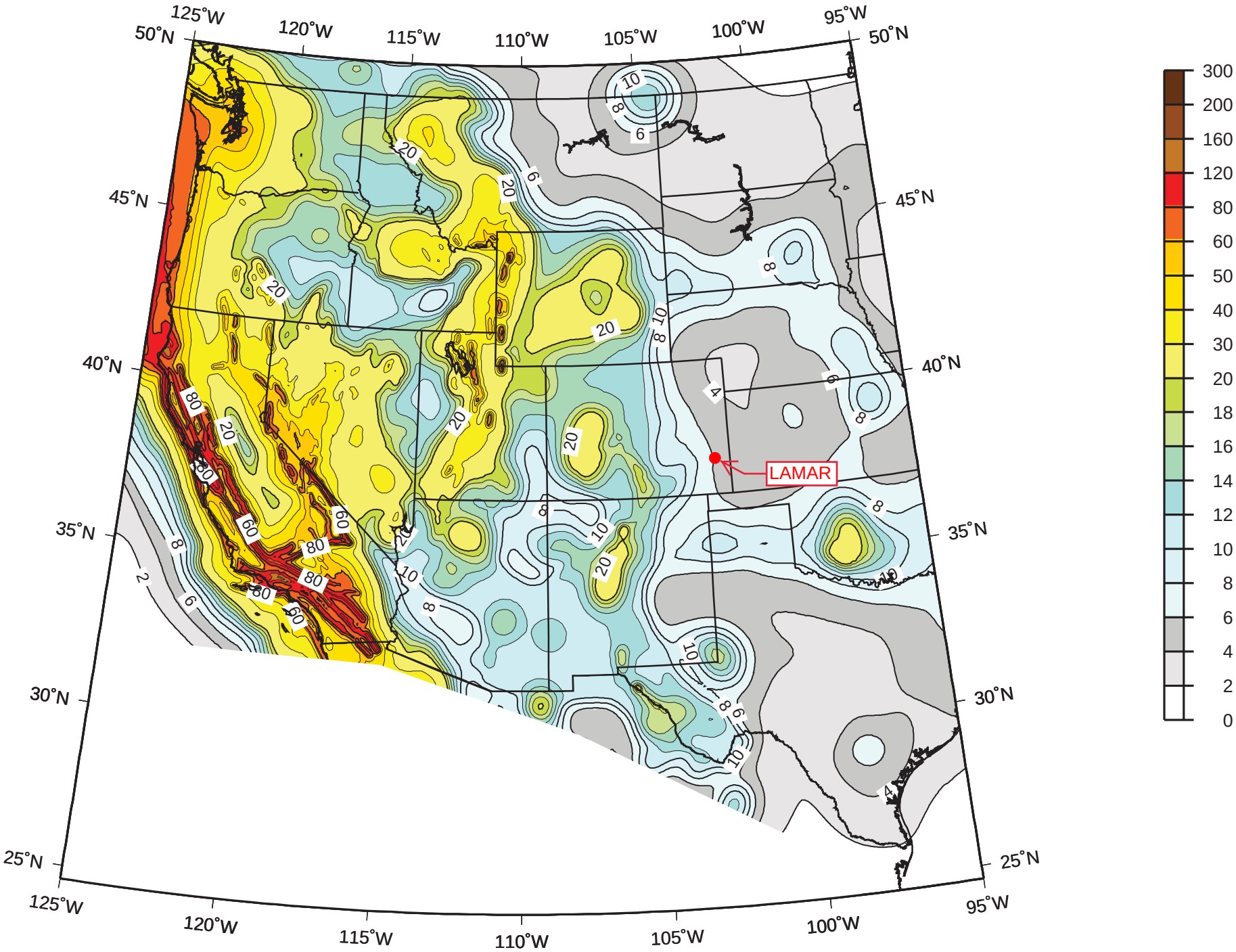
Prowers Aggregates Exploratory Drilling Hole Information and Analysis

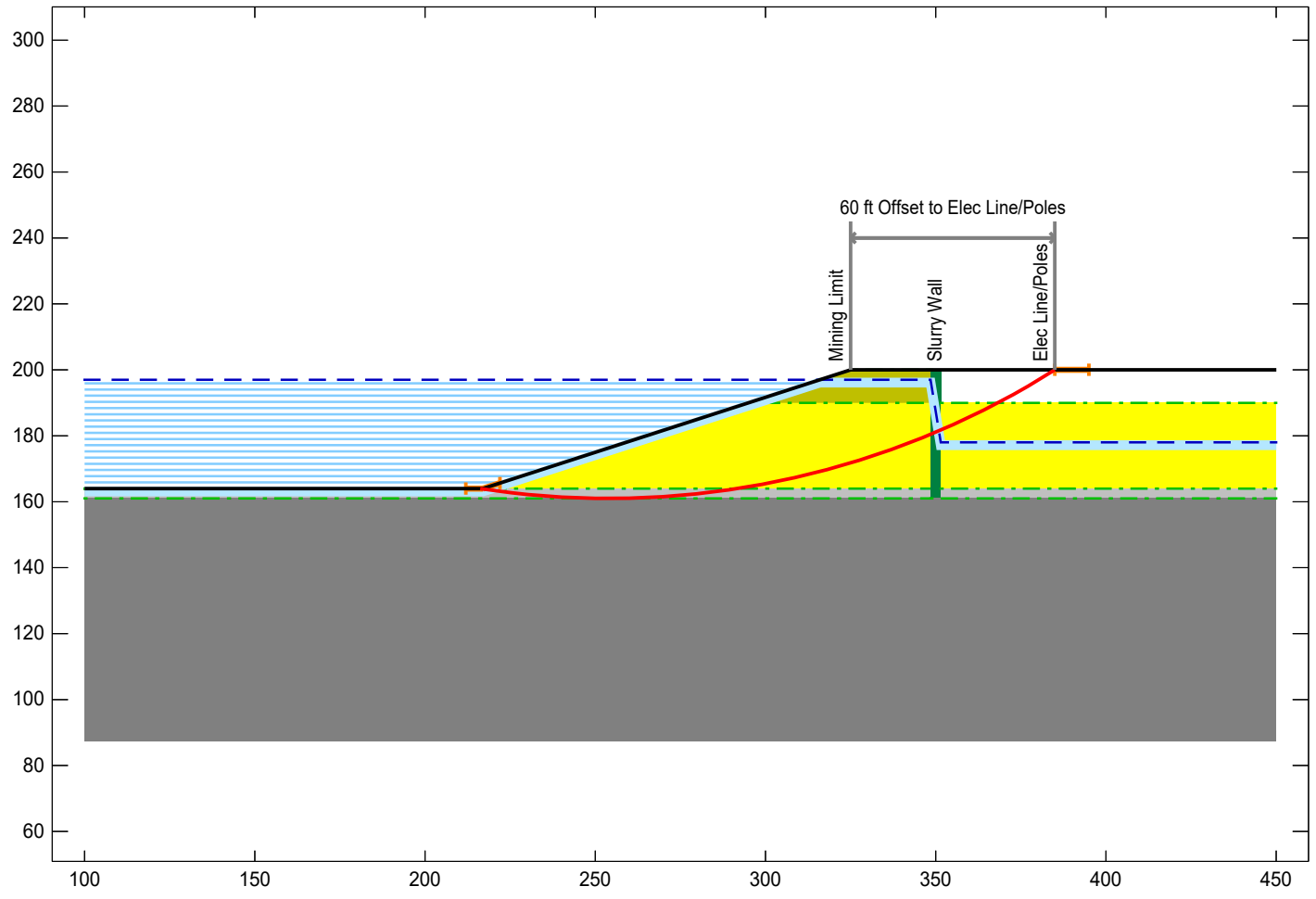
5/26/2020

Hole Number	RMI-201	RMI-202	RMI-203	RMI-204	RMI-205	RMI-206	RMI-207	RMI-208	RMI-209	RMI-210	RMI-211	RMI-212
OB Thickness (feet)	2	7.5	11.5	5	8	8	7	10	7	2	2	12
S&G Thickness (feet)	39	27.5	7.5	46	44	33.5	18	10.5	23	40.5	40	32
TD (feet)	41	35	19	51	52	41.5	25	20.5	30	42.5	42	44

APPENDIX E

Peak Acceleration (%g) with 2% Probability of Exceedance in 50 Years
USGS Map, Oct. 2002rev





GALENA Version 7.2

Licensed to: J & T Consulting

Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

Critical Factor of Safety: 2.96

Project West Farm Pit Expansion
Case 5-3 Full Reservoir

File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Full Reservoir.gmf

Edited: 1 Apr 2021
Processed: 1 Apr 2021

J&T Consulting, Inc.

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Rapid Drawdown.gmf
Processed: 01 Apr 2021 09:48:57

DATA: Analysis 1 - Case 5-3 Rapid Drawdown

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	190.00	348.50	190.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	164.00	348.50	164.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	161.00	348.50	161.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	190.00	450.00	190.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	164.00	450.00	164.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	161.00	450.00	161.00	

Slope Surface (4 points)

100.00	164.00	217.00	164.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	164.00	217.00	164.00	316.00	197.00	348.50	197.00
351.50	178.00						
450.00	178.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	217.00	YL:	164.00	XR:	390.00	YR: 200.00
Centre:	XC:	255.85	YC:	410.96	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 5-3 Rapid Drawdown

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 1.830

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.64

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	216.21	164.00	385.00	200.00	253.94	400.81	239.80	1.639	<-- Critical Surface
2	217.26	164.09	385.00	200.00	255.17	396.73	235.71	1.641	
3	217.79	164.26	385.00	200.00	256.40	392.66	231.63	1.641	
4	218.32	164.44	385.00	200.00	257.63	388.57	227.55	1.642	
5	216.74	164.00	385.00	200.00	254.04	400.88	239.80	1.643	
6	215.16	164.00	385.00	200.00	252.82	404.95	243.88	1.643	
7	218.84	164.61	385.00	200.00	258.87	384.47	223.47	1.643	
8	219.37	164.79	385.00	200.00	260.10	380.36	219.39	1.644	
9	212.00	164.00	385.00	200.00	250.41	413.10	252.04	1.644	
10	213.05	164.00	385.00	200.00	251.51	408.96	247.96	1.645	
11	214.63	164.00	385.00	200.00	252.72	404.89	243.88	1.646	
12	215.68	164.00	385.00	200.00	252.92	405.02	243.88	1.647	
13	213.58	164.00	385.00	200.00	251.61	409.02	247.96	1.649	
14	216.74	164.00	385.53	200.00	254.46	400.81	239.80	1.649	
15	215.16	164.00	385.53	200.00	253.24	404.89	243.88	1.649	
16	213.58	164.00	385.53	200.00	252.04	408.96	247.96	1.649	
17	216.21	164.00	385.00	200.00	253.03	405.08	243.88	1.649	
18	212.53	164.00	385.00	200.00	250.51	413.16	252.04	1.649	
19	217.26	164.09	385.00	200.00	254.25	401.01	239.80	1.650	
20	218.32	164.44	385.00	200.00	256.72	392.87	231.63	1.652	
21	215.68	164.00	385.53	200.00	253.35	404.95	243.88	1.652	
22	214.11	164.00	385.53	200.00	252.14	409.02	247.96	1.652	
23	217.79	164.26	385.00	200.00	255.48	396.94	235.71	1.653	
24	218.84	164.61	385.00	200.00	257.95	388.78	227.55	1.653	
25	216.74	164.00	385.00	200.00	253.13	405.15	243.88	1.653	
26	214.11	164.00	385.00	200.00	251.71	409.09	247.96	1.654	
27	212.00	164.00	385.00	200.00	249.52	417.36	256.12	1.654	
28	213.05	164.00	385.00	200.00	250.62	413.23	252.04	1.655	
29	219.37	164.79	385.00	200.00	259.18	384.68	223.47	1.655	
30	214.63	164.00	385.00	200.00	251.82	409.16	247.96	1.656	
31	216.21	164.00	385.53	200.00	253.45	405.02	243.88	1.657	
32	217.79	164.26	385.53	200.00	255.91	396.88	235.71	1.657	
33	214.63	164.00	385.53	200.00	252.24	409.09	247.96	1.657	
34	215.68	164.00	385.00	200.00	252.02	409.28	247.96	1.657	
35	219.89	164.96	385.00	200.00	260.41	380.58	219.39	1.657	
36	220.42	165.14	385.00	200.00	261.64	376.46	215.31	1.658	
37	215.68	164.00	386.05	200.00	253.77	404.89	243.88	1.658	
38	218.32	164.44	385.53	200.00	257.14	392.79	231.63	1.658	
39	212.53	164.00	385.00	200.00	249.62	417.42	256.12	1.658	
40	214.11	164.00	386.05	200.00	252.56	408.96	247.96	1.658	
41	215.16	164.00	385.53	200.00	252.34	409.16	247.96	1.659	
42	216.74	164.00	385.53	200.00	253.55	405.08	243.88	1.659	
43	213.58	164.00	385.53	200.00	251.14	413.23	252.04	1.659	
44	220.95	165.32	385.00	200.00	262.87	372.34	211.22	1.659	
45	213.58	164.00	385.00	200.00	250.72	413.29	252.04	1.659	
46	217.26	164.09	385.53	200.00	254.67	400.95	239.80	1.659	
47	212.53	164.00	385.53	200.00	250.94	413.10	252.04	1.659	
48	218.84	164.61	385.53	200.00	258.37	388.71	227.55	1.659	
49	221.47	165.49	385.00	200.00	264.10	368.20	207.14	1.660	
50	222.00	165.67	385.00	200.00	265.33	364.05	203.06	1.660	
51	215.16	164.00	385.00	200.00	251.92	409.22	247.96	1.661	
52	219.37	164.79	385.53	200.00	259.60	384.61	223.47	1.661	
53	216.21	164.00	385.00	200.00	252.12	409.35	247.96	1.661	
54	216.21	164.00	386.05	200.00	253.87	404.95	243.88	1.661	
55	214.63	164.00	386.05	200.00	252.66	409.02	247.96	1.661	
56	217.26	164.09	385.00	200.00	253.34	405.28	243.88	1.662	
57	213.05	164.00	386.05	200.00	251.46	413.10	252.04	1.662	
58	219.89	164.96	385.53	200.00	260.82	380.50	219.39	1.662	
59	217.79	164.26	385.00	200.00	254.57	401.22	239.80	1.662	
60	217.26	164.09	386.05	200.00	255.10	400.88	239.80	1.663	
61	215.68	164.00	385.53	200.00	252.44	409.22	247.96	1.663	
62	214.11	164.00	385.53	200.00	251.24	413.29	252.04	1.663	
63	217.79	164.26	386.05	200.00	256.33	396.81	235.71	1.663	
64	218.32	164.44	385.00	200.00	255.80	397.15	235.71	1.663	
65	214.11	164.00	385.00	200.00	250.82	413.35	252.04	1.664	
66	220.42	165.14	385.53	200.00	262.05	376.38	215.31	1.664	
67	218.84	164.61	385.00	200.00	257.03	393.08	231.63	1.664	
68	218.32	164.44	386.05	200.00	257.56	392.72	231.63	1.664	

69	220.95	165.32	385.53	200.00	263.28	372.25	211.22	1.665
70	216.74	164.00	385.00	200.00	252.21	409.41	247.96	1.665
71	212.00	164.00	385.53	200.00	249.95	417.30	256.12	1.665
72	213.05	164.00	385.53	200.00	251.04	413.16	252.04	1.665
73	218.84	164.61	386.05	200.00	258.78	388.63	227.55	1.666
74	216.74	164.00	386.05	200.00	253.98	405.02	243.88	1.666
75	212.00	164.00	385.00	200.00	248.64	421.61	260.20	1.666
76	213.05	164.00	385.00	200.00	249.72	417.48	256.12	1.666
77	215.16	164.00	386.05	200.00	252.77	409.09	247.96	1.667
78	219.37	164.79	385.00	200.00	258.27	388.99	227.55	1.667
79	216.21	164.00	385.53	200.00	252.54	409.28	247.96	1.667
80	214.63	164.00	385.53	200.00	251.34	413.35	252.04	1.667
81	219.37	164.79	386.05	200.00	260.01	384.53	223.47	1.667
82	214.63	164.00	386.58	200.00	253.09	408.96	247.96	1.667
83	216.21	164.00	386.58	200.00	254.30	404.89	243.88	1.667
84	219.89	164.96	385.00	200.00	259.50	384.90	223.47	1.667
85	213.58	164.00	386.05	200.00	251.57	413.16	252.04	1.667
86	217.79	164.26	385.53	200.00	254.99	401.16	239.80	1.668
87	214.63	164.00	385.00	200.00	250.92	413.42	252.04	1.668
88	215.68	164.00	386.05	200.00	252.87	409.16	247.96	1.668
89	217.26	164.09	385.53	200.00	253.76	405.22	243.88	1.668
90	214.11	164.00	386.05	200.00	251.67	413.23	252.04	1.668
91	212.53	164.00	386.05	200.00	250.47	417.30	256.12	1.668
92	219.89	164.96	386.05	200.00	261.24	380.42	219.39	1.668
93	218.32	164.44	385.53	200.00	256.22	397.08	235.71	1.669
94	212.00	164.00	386.05	200.00	250.37	417.23	256.12	1.669
95	217.26	164.09	386.58	200.00	255.52	400.81	239.80	1.669
96	217.79	164.26	386.58	200.00	256.75	396.74	235.71	1.669
97	220.42	165.14	385.00	200.00	260.72	380.79	219.39	1.669
98	212.53	164.00	385.00	200.00	248.74	421.67	260.20	1.670
99	220.42	165.14	386.05	200.00	262.46	376.30	215.31	1.670

Critical Failure Surface (circle 1)

Intersects: XL: 216.21 YL: 164.00 XR: 385.00 YR: 200.00
Centre: XC: 253.94 YC: 400.81 Radius: R: 239.80
Generated failure surface: (20 points)
216.21 164.00 225.41 162.72 234.66 161.79 243.93 161.22
253.22 161.01
262.51 161.17 271.79 161.68 281.04 162.55 290.25 163.78
299.40 165.36
308.49 167.30 317.50 169.59 326.41 172.23 335.21 175.21
343.88 178.52
352.43 182.17 360.82 186.15 369.06 190.46 377.12 195.07
385.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 44 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	216.21	0.04	-7.9	0.79	0.80	3	100.00	18.0	6.13	2.74	16.64	1.04
2	217.00	4.65	-7.9	4.21	4.25	3	100.00	18.0	625.65	292.74	159.76	1.04
3	221.21	13.01	-7.9	4.21	4.25	3	100.00	18.0	1746.30	819.85	430.22	1.04
4	225.41	23.53	-5.7	4.62	4.65	3	100.00	18.0	3152.29	1475.53	695.56	1.03
5	230.04	32.79	-5.7	4.62	4.65	3	100.00	18.0	4387.21	2056.47	965.59	1.03
6	234.66	41.78	-3.5	4.64	4.65	3	100.00	18.0	5582.54	2612.09	1215.57	1.01
7	239.29	50.26	-3.5	4.64	4.65	3	100.00	18.0	6706.92	3142.40	1459.63	1.01
8	243.93	58.43	-1.3	4.64	4.65	3	100.00	18.0	7785.90	3647.02	1681.71	1.00
9	248.58	66.10	-1.3	4.64	4.65	3	100.00	18.0	8795.88	4125.93	1899.67	1.00
10	253.22	73.37	0.9	4.65	4.65	3	100.00	18.0	9748.21	4578.83	2094.00	1.00
11	257.87	80.21	0.9	4.65	4.65	3	100.00	18.0	10640.58	5005.64	2285.78	1.00
12	262.51	86.50	3.2	4.64	4.65	3	100.00	18.0	11457.30	5405.97	2452.52	0.99
13	267.15	92.49	3.2	4.64	4.65	3	100.00	18.0	12229.32	5779.94	2618.04	0.99
14	271.79	97.76	5.4	4.63	4.65	3	100.00	18.0	12904.07	6127.33	2757.35	0.99
15	276.41	102.88	5.4	4.63	4.65	3	100.00	18.0	13554.09	6447.96	2896.60	0.99
16	281.04	107.09	7.6	4.60	4.65	3	100.00	18.0	14081.67	6741.75		

3008.68	0.98									
17	285.64	111.33	7.6	4.60	4.65	3	100.00	18.0	14608.69	7008.62
3121.66	0.98									
18	290.25	31.60	9.8	1.28	1.30	3	100.00	18.0	4140.52	2000.92
3175.44	0.98									
19	291.53	87.28	9.8	3.47	3.53	2	0.00	35.0	11433.87	5527.34
3172.12	0.95									
20	295.00	113.40	9.8	4.40	4.47	2	0.00	35.0	14854.95	7181.16
3251.83	0.95									
21	299.40	119.84	12.0	4.54	4.65	2	0.00	35.0	15699.40	7646.39
3304.31	0.94									
22	303.95	122.32	12.0	4.54	4.65	2	0.00	35.0	16024.04	7804.50
3372.64	0.94									
23	308.49	102.67	14.3	3.75	3.87	2	0.00	35.0	13449.81	6610.30
3398.36	0.93									
24	312.25	103.79	14.3	3.75	3.87	2	0.00	35.0	13596.05	6682.18
3435.30	0.93									
25	316.00	41.65	14.3	1.50	1.54	2	0.00	35.0	5455.74	2657.38
3459.62	0.93									
26	317.50	104.98	16.5	3.75	3.91	2	0.00	35.0	13752.84	6557.21
3442.01	0.93									
27	321.25	105.51	16.5	3.75	3.91	2	0.00	35.0	13821.89	6286.11
3450.60	0.93									
28	325.00	39.32	16.5	1.41	1.47	2	0.00	35.0	5150.51	2284.18
3429.27	0.93									
29	326.41	118.94	18.7	4.40	4.65	2	0.00	35.0	15580.99	6965.77
3282.96	0.92									
30	330.81	112.39	18.7	4.40	4.65	2	0.00	35.0	14722.48	6534.03
3100.75	0.92									
31	335.21	104.00	20.9	4.34	4.65	2	0.00	35.0	13623.42	6077.65
2882.45	0.92									
32	339.55	96.80	20.9	4.34	4.65	2	0.00	35.0	12680.53	5596.81
2681.12	0.92									
33	343.88	94.57	23.1	4.62	5.02	2	0.00	35.0	12388.94	5478.07
2438.44	0.92									
34	348.50	46.34	23.1	2.44	2.65	5	0.00	45.0	5097.74	1367.13
1762.82	0.86									
35	350.94	26.98	23.1	1.49	1.62	2	0.00	35.0	3534.76	0.00
2009.92	0.92									
36	352.43	70.66	25.4	4.20	4.65	2	0.00	35.0	9255.96	0.00
1833.62	0.92									
37	356.63	62.30	25.4	4.20	4.65	2	0.00	35.0	8161.66	0.00
1616.84	0.92									
38	360.82	47.43	27.6	3.68	4.15	2	0.00	35.0	6213.92	0.00
1379.99	0.92									
39	364.51	40.35	27.6	3.68	4.15	2	0.00	35.0	5286.48	0.00
1174.03	0.92									
40	368.19	8.53	27.6	0.87	0.98	1	150.00	22.0	1116.89	0.00
1091.80	1.00									
41	369.06	33.82	29.8	4.03	4.65	1	150.00	22.0	4430.64	0.00
917.20	1.01									
42	373.09	24.51	29.8	4.03	4.65	1	150.00	22.0	3211.37	0.00
652.15	1.01									
43	377.12	14.55	32.0	3.94	4.65	1	150.00	22.0	1906.48	0.00
369.81	1.02									
44	381.06	4.85	32.0	3.94	4.65	1	150.00	22.0	635.49	0.00
90.22	1.02									
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X-S Area:		2921.62	Path Length:		176.54		X-S Weight:		383240.12	

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DATA: Analysis 1 - Case 5-3 Rapid Drawdown - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
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Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
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Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	190.00	348.50	190.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	164.00	348.50	164.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	161.00	348.50	161.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
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351.50	200.00	450.00	200.00	
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Slope Surface (4 points)

100.00	164.00	217.00	164.00	325.00	200.00	450.00	200.00

Phreatic Surface (6 points)

100.00	164.00	217.00	164.00	316.00	197.00	348.50	197.00
351.50	178.00						
450.00	178.00						

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	217.00	YL:	164.00	XR:	390.00	YR: 200.00
Centre:	XC:	255.85	YC:	410.96	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 5-3 Rapid Drawdown - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 1.511

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 1.36

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	216.21	164.00	385.00	200.00	253.94	400.81	239.80	1.358	<-- Critical Surface
2	217.79	164.26	385.00	200.00	256.40	392.66	231.63	1.358	
3	218.32	164.44	385.00	200.00	257.63	388.57	227.55	1.358	
4	217.26	164.09	385.00	200.00	255.17	396.73	235.71	1.358	
5	219.37	164.79	385.00	200.00	260.10	380.36	219.39	1.359	
6	218.84	164.61	385.00	200.00	258.87	384.47	223.47	1.359	
7	216.74	164.00	385.00	200.00	254.04	400.88	239.80	1.360	
8	215.16	164.00	385.00	200.00	252.82	404.95	243.88	1.361	
9	212.00	164.00	385.00	200.00	250.41	413.10	252.04	1.363	
10	213.05	164.00	385.00	200.00	251.51	408.96	247.96	1.363	
11	214.63	164.00	385.00	200.00	252.72	404.89	243.88	1.364	
12	215.68	164.00	385.00	200.00	252.92	405.02	243.88	1.365	
13	216.74	164.00	385.53	200.00	254.46	400.81	239.80	1.365	
14	215.16	164.00	385.53	200.00	253.24	404.89	243.88	1.365	
15	213.58	164.00	385.53	200.00	252.04	408.96	247.96	1.366	
16	213.58	164.00	385.00	200.00	251.61	409.02	247.96	1.366	
17	216.21	164.00	385.00	200.00	253.03	405.08	243.88	1.366	
18	217.26	164.09	385.00	200.00	254.25	401.01	239.80	1.367	
19	218.32	164.44	385.00	200.00	256.72	392.87	231.63	1.367	
20	212.53	164.00	385.00	200.00	250.51	413.16	252.04	1.367	
21	218.84	164.61	385.00	200.00	257.95	388.78	227.55	1.368	
22	215.68	164.00	385.53	200.00	253.35	404.95	243.88	1.368	
23	217.79	164.26	385.00	200.00	255.48	396.94	235.71	1.368	
24	214.11	164.00	385.53	200.00	252.14	409.02	247.96	1.368	
25	219.37	164.79	385.00	200.00	259.18	384.68	223.47	1.368	
26	216.74	164.00	385.00	200.00	253.13	405.15	243.88	1.370	
27	220.42	165.14	385.00	200.00	261.64	376.46	215.31	1.370	
28	219.89	164.96	385.00	200.00	260.41	380.58	219.39	1.370	
29	220.95	165.32	385.00	200.00	262.87	372.34	211.22	1.370	
30	222.00	165.67	385.00	200.00	265.33	364.05	203.06	1.370	
31	214.11	164.00	385.00	200.00	251.71	409.09	247.96	1.370	
32	221.47	165.49	385.00	200.00	264.10	368.20	207.14	1.370	
33	217.79	164.26	385.53	200.00	255.91	396.88	235.71	1.371	
34	213.05	164.00	385.00	200.00	250.62	413.23	252.04	1.371	
35	218.32	164.44	385.53	200.00	257.14	392.79	231.63	1.371	
36	216.21	164.00	385.53	200.00	253.45	405.02	243.88	1.371	
37	212.00	164.00	385.00	200.00	249.52	417.36	256.12	1.372	
38	218.84	164.61	385.53	200.00	258.37	388.71	227.55	1.372	
39	215.68	164.00	386.05	200.00	253.77	404.89	243.88	1.372	
40	214.63	164.00	385.00	200.00	251.82	409.16	247.96	1.372	
41	214.63	164.00	385.53	200.00	252.24	409.09	247.96	1.372	
42	214.11	164.00	386.05	200.00	252.56	408.96	247.96	1.372	
43	219.37	164.79	385.53	200.00	259.60	384.61	223.47	1.373	
44	216.74	164.00	385.53	200.00	253.55	405.08	243.88	1.373	
45	217.26	164.09	385.53	200.00	254.67	400.95	239.80	1.373	
46	215.68	164.00	385.00	200.00	252.02	409.28	247.96	1.373	
47	219.89	164.96	385.53	200.00	260.82	380.50	219.39	1.373	
48	215.16	164.00	385.53	200.00	252.34	409.16	247.96	1.374	
49	220.42	165.14	385.53	200.00	262.05	376.38	215.31	1.374	
50	213.58	164.00	385.53	200.00	251.14	413.23	252.04	1.374	
51	212.53	164.00	385.53	200.00	250.94	413.10	252.04	1.374	
52	220.95	165.32	385.53	200.00	263.28	372.25	211.22	1.374	
53	216.21	164.00	386.05	200.00	253.87	404.95	243.88	1.374	
54	212.53	164.00	385.00	200.00	249.62	417.42	256.12	1.375	
55	213.58	164.00	385.00	200.00	250.72	413.29	252.04	1.375	
56	217.79	164.26	386.05	200.00	256.33	396.81	235.71	1.375	
57	214.63	164.00	386.05	200.00	252.66	409.02	247.96	1.375	
58	217.26	164.09	386.05	200.00	255.10	400.88	239.80	1.375	
59	218.32	164.44	386.05	200.00	257.56	392.72	231.63	1.376	
60	215.16	164.00	385.00	200.00	251.92	409.22	247.96	1.376	
61	213.05	164.00	386.05	200.00	251.46	413.10	252.04	1.376	
62	218.84	164.61	386.05	200.00	258.78	388.63	227.55	1.376	
63	217.26	164.09	385.00	200.00	253.34	405.28	243.88	1.376	
64	216.21	164.00	385.00	200.00	252.12	409.35	247.96	1.376	

65	217.79	164.26	385.00	200.00	254.57	401.22	239.80	1.376
66	218.32	164.44	385.00	200.00	255.80	397.15	235.71	1.377
67	219.37	164.79	386.05	200.00	260.01	384.53	223.47	1.377
68	215.68	164.00	385.53	200.00	252.44	409.22	247.96	1.377
69	218.84	164.61	385.00	200.00	257.03	393.08	231.63	1.377
70	214.11	164.00	385.53	200.00	251.24	413.29	252.04	1.377
71	219.89	164.96	386.05	200.00	261.24	380.42	219.39	1.377
72	220.42	165.14	386.05	200.00	262.46	376.30	215.31	1.378
73	216.74	164.00	386.05	200.00	253.98	405.02	243.88	1.378
74	219.37	164.79	385.00	200.00	258.27	388.99	227.55	1.378
75	214.11	164.00	385.00	200.00	250.82	413.35	252.04	1.378
76	219.89	164.96	385.00	200.00	259.50	384.90	223.47	1.379
77	216.21	164.00	386.58	200.00	254.30	404.89	243.88	1.379
78	215.16	164.00	386.05	200.00	252.77	409.09	247.96	1.379
79	213.05	164.00	385.53	200.00	251.04	413.16	252.04	1.379
80	214.63	164.00	386.58	200.00	253.09	408.96	247.96	1.379
81	217.79	164.26	386.58	200.00	256.75	396.74	235.71	1.379
82	212.00	164.00	385.53	200.00	249.95	417.30	256.12	1.379
83	216.74	164.00	385.00	200.00	252.21	409.41	247.96	1.379
84	217.26	164.09	386.58	200.00	255.52	400.81	239.80	1.380
85	220.42	165.14	385.00	200.00	260.72	380.79	219.39	1.380
86	218.32	164.44	386.58	200.00	257.97	392.65	231.63	1.380
87	217.79	164.26	385.53	200.00	254.99	401.16	239.80	1.380
88	216.21	164.00	385.53	200.00	252.54	409.28	247.96	1.380
89	218.32	164.44	385.53	200.00	256.22	397.08	235.71	1.380
90	215.68	164.00	386.05	200.00	252.87	409.16	247.96	1.380
91	218.84	164.61	386.58	200.00	259.20	388.56	227.55	1.380
92	213.58	164.00	386.05	200.00	251.57	413.16	252.04	1.380
93	214.63	164.00	385.53	200.00	251.34	413.35	252.04	1.381
94	217.26	164.09	385.53	200.00	253.76	405.22	243.88	1.381
95	214.11	164.00	386.05	200.00	251.67	413.23	252.04	1.381
96	219.37	164.79	386.58	200.00	260.42	384.46	223.47	1.381
97	213.05	164.00	385.00	200.00	249.72	417.48	256.12	1.381
98	216.74	164.00	386.58	200.00	254.40	404.95	243.88	1.381
99	212.53	164.00	386.05	200.00	250.47	417.30	256.12	1.381

Critical Failure Surface (circle 1)

Intersects: XL: 216.21 YL: 164.00 XR: 385.00 YR: 200.00
Centre: XC: 253.94 YC: 400.81 Radius: R: 239.80

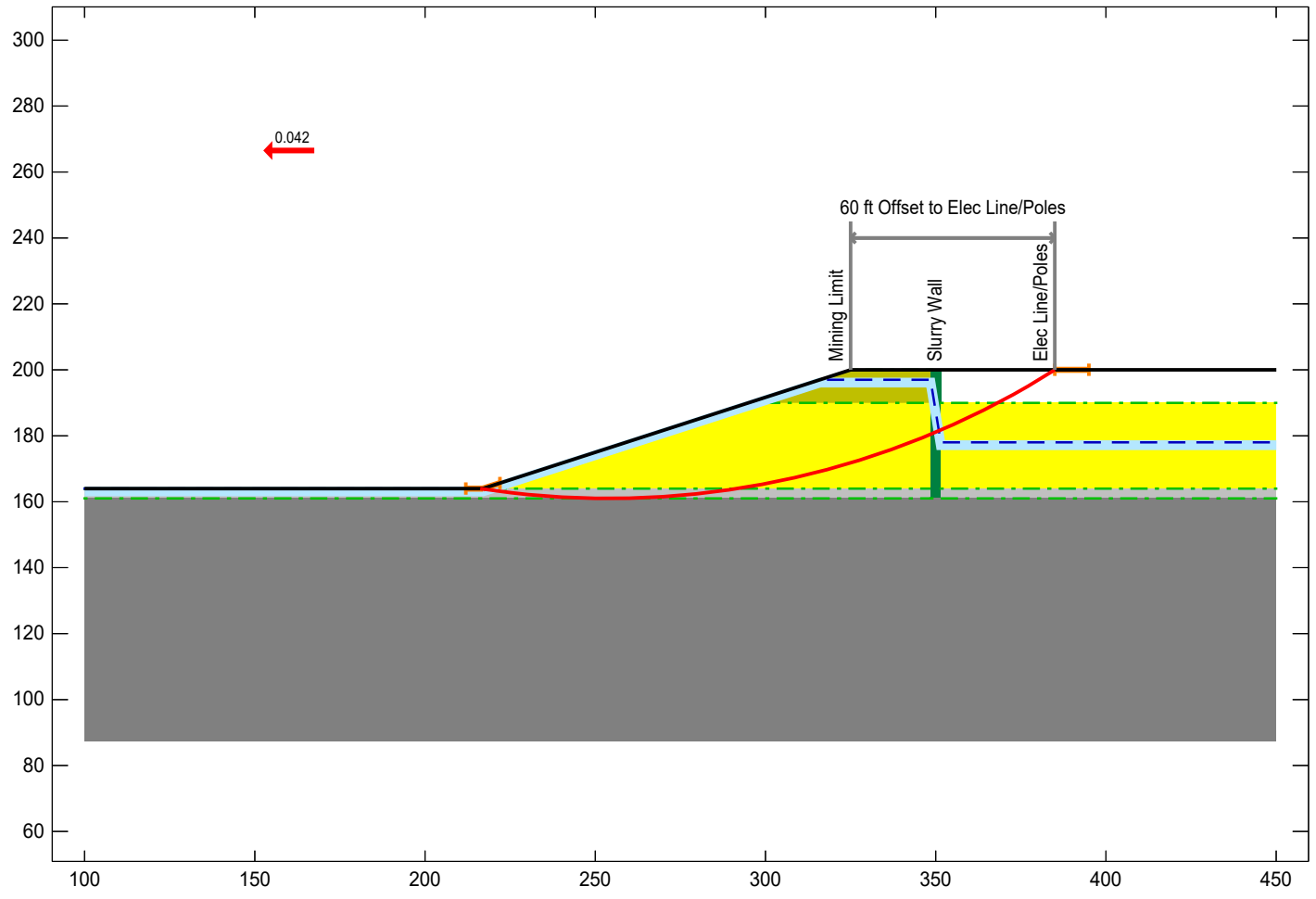
Generated failure surface: (20 points)

216.21 164.00 225.41 162.72 234.66 161.79 243.93 161.22
253.22 161.01
262.51 161.17 271.79 161.68 281.04 162.55 290.25 163.78
299.40 165.36
308.49 167.30 317.50 169.59 326.41 172.23 335.21 175.21
343.88 178.52
352.43 182.17 360.82 186.15 369.06 190.46 377.12 195.07
385.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 44 slices)

Slice	X-S	Base							PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	216.21	0.04	-7.9	0.79	0.80	3	100.00	18.0	6.13	2.74	18.54	1.04
2	217.00	4.65	-7.9	4.21	4.25	3	100.00	18.0	625.65	292.74	162.12	1.04
3	221.21	13.01	-7.9	4.21	4.25	3	100.00	18.0	1746.30	819.85	433.46	1.04
4	225.41	23.53	-5.7	4.62	4.65	3	100.00	18.0	3152.29	1475.53	698.45	1.03
5	230.04	32.79	-5.7	4.62	4.65	3	100.00	18.0	4387.21	2056.47	969.10	1.03
6	234.66	41.78	-3.5	4.64	4.65	3	100.00	18.0	5582.54	2612.09	1218.02	1.02
7	239.29	50.26	-3.5	4.64	4.65	3	100.00	18.0	6706.92	3142.40	1462.42	1.02
8	243.93	58.43	-1.3	4.64	4.65	3	100.00	18.0	7785.90	3647.02	1682.82	1.01
9	248.58	66.10	-1.3	4.64	4.65	3	100.00	18.0	8795.88	4125.93	1900.89	1.01
10	253.22	73.37	0.9	4.65	4.65	3	100.00	18.0	9748.21	4578.83	2093.05	1.00
11	257.87	80.21	0.9	4.65	4.65	3	100.00	18.0	10640.58	5005.64	2284.76	1.00
12	262.51	86.50	3.2	4.64	4.65	3	100.00	18.0	11457.30	5405.97	2448.94	0.99
13	267.15	92.49	3.2	4.64	4.65	3	100.00	18.0	12229.32	5779.94	2614.27	0.99
14	271.79	97.76	5.4	4.63	4.65	3	100.00	18.0	12904.07	6127.33		

2750.74	0.98									
15	276.41	102.88	5.4	4.63	4.65	3	100.00	18.0	13554.09	6447.96
2889.72	0.98									
16	281.04	107.09	7.6	4.60	4.65	3	100.00	18.0	14081.67	6741.75
2998.76	0.98									
17	285.64	111.33	7.6	4.60	4.65	3	100.00	18.0	14608.69	7008.62
3111.45	0.98									
18	290.25	31.60	9.8	1.28	1.30	3	100.00	18.0	4140.52	2000.92
3162.19	0.97									
19	291.53	87.28	9.8	3.47	3.53	2	0.00	35.0	11433.87	5527.34
3149.53	0.93									
20	295.00	113.40	9.8	4.40	4.47	2	0.00	35.0	14854.95	7181.16
3228.68	0.93									
21	299.40	119.84	12.0	4.54	4.65	2	0.00	35.0	15699.40	7646.39
3276.08	0.92									
22	303.95	122.32	12.0	4.54	4.65	2	0.00	35.0	16024.04	7804.50
3343.82	0.92									
23	308.49	102.67	14.3	3.75	3.87	2	0.00	35.0	13449.81	6610.30
3364.67	0.91									
24	312.25	103.79	14.3	3.75	3.87	2	0.00	35.0	13596.05	6682.18
3401.25	0.91									
25	316.00	41.65	14.3	1.50	1.54	2	0.00	35.0	5455.74	2657.38
3425.03	0.91									
26	317.50	104.98	16.5	3.75	3.91	2	0.00	35.0	13752.84	6557.21
3401.84	0.90									
27	321.25	105.51	16.5	3.75	3.91	2	0.00	35.0	13821.89	6286.11
3408.66	0.90									
28	325.00	39.32	16.5	1.41	1.47	2	0.00	35.0	5150.51	2284.18
3386.73	0.90									
29	326.41	118.94	18.7	4.40	4.65	2	0.00	35.0	15580.99	6965.77
3237.42	0.90									
30	330.81	112.39	18.7	4.40	4.65	2	0.00	35.0	14722.48	6534.03
3057.49	0.90									
31	335.21	104.00	20.9	4.34	4.65	2	0.00	35.0	13623.42	6077.65
2837.91	0.89									
32	339.55	96.80	20.9	4.34	4.65	2	0.00	35.0	12680.53	5596.81
2639.35	0.89									
33	343.88	94.57	23.1	4.62	5.02	2	0.00	35.0	12388.94	5478.07
2396.65	0.89									
34	348.50	46.34	23.1	2.44	2.65	5	0.00	45.0	5097.74	1367.13
1711.50	0.83									
35	350.94	26.98	23.1	1.49	1.62	2	0.00	35.0	3534.76	0.00
1947.56	0.89									
36	352.43	70.66	25.4	4.20	4.65	2	0.00	35.0	9255.96	0.00
1771.75	0.89									
37	356.63	62.30	25.4	4.20	4.65	2	0.00	35.0	8161.66	0.00
1562.28	0.89									
38	360.82	47.43	27.6	3.68	4.15	2	0.00	35.0	6213.92	0.00
1329.68	0.89									
39	364.51	40.35	27.6	3.68	4.15	2	0.00	35.0	5286.48	0.00
1131.22	0.89									
40	368.19	8.53	27.6	0.87	0.98	1	150.00	22.0	1116.89	0.00
1057.98	0.98									
41	369.06	33.82	29.8	4.03	4.65	1	150.00	22.0	4430.64	0.00
884.97	0.98									
42	373.09	24.51	29.8	4.03	4.65	1	150.00	22.0	3211.37	0.00
626.55	0.98									
43	377.12	14.55	32.0	3.94	4.65	1	150.00	22.0	1906.48	0.00
349.83	0.99									
44	381.06	4.85	32.0	3.94	4.65	1	150.00	22.0	635.49	0.00
77.78	0.99									
		---			---				---	
X-S Area:		2921.62	Path Length:		176.54		X-S Weight:		383240.12	



GALENA Version 7.2

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Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

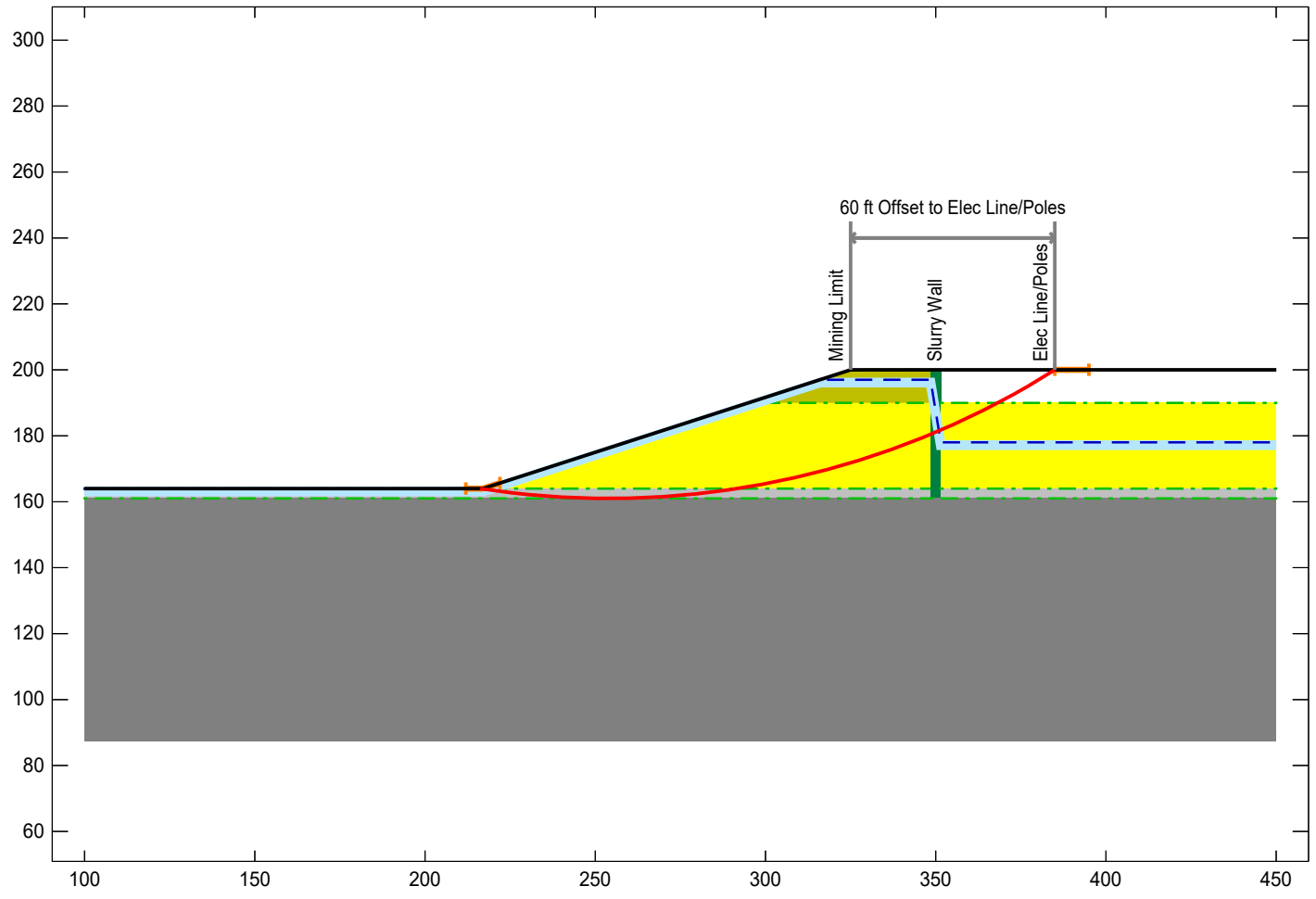
Critical Factor of Safety: 1.36

Project West Farm Pit Expansion
Case 5-3 Rapid Drawdown - Pseudostatic

File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Rapid Drawdown-EQ.gmf

Edited: 1 Apr 2021
Processed: 1 Apr 2021

J&T Consulting, Inc.



GALENA Version 7.2

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Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

Critical Factor of Safety: 1.64

Project West Farm Pit Expansion
Case 5-3 Rapid Drawdown

File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Rapid Drawdown.gmf

Edited: 1 Apr 2021
Processed: 1 Apr 2021

J&T Consulting, Inc.

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Full Reservoir.gmf
Processed: 01 Apr 2021 09:51:58

DATA: Analysis 1 - Case 5-3 Full Reservoir

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	190.00	348.50	190.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	164.00	348.50	164.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	161.00	348.50	161.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	190.00	450.00	190.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	164.00	450.00	164.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	161.00	450.00	161.00	

Slope Surface (4 points)

100.00	164.00	217.00	164.00	325.00	200.00	450.00	200.00

Phreatic Surface (4 points)

100.00	197.00	348.50	197.00	351.50	178.00	450.00	178.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	217.00	YL:	164.00	XR:	390.00	YR: 200.00
Centre:	XC:	255.85	YC:	410.96	Radius:	R:	250.00

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

- -

RESULTS: Analysis 1 - Case 5-3 Full Reservoir

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 3.272

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.96

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	216.21	164.00	385.00	200.00	253.94	400.81	239.80	2.957	<-- Critical Surface
2	217.79	164.26	385.00	200.00	256.40	392.66	231.63	2.958	
3	217.26	164.09	385.00	200.00	255.17	396.73	235.71	2.959	
4	218.32	164.44	385.00	200.00	257.63	388.57	227.55	2.959	
5	218.84	164.61	385.00	200.00	258.87	384.47	223.47	2.962	
6	219.37	164.79	385.00	200.00	260.10	380.36	219.39	2.962	
7	216.74	164.00	385.00	200.00	254.04	400.88	239.80	2.962	
8	215.16	164.00	385.00	200.00	252.82	404.95	243.88	2.963	
9	212.00	164.00	385.00	200.00	250.41	413.10	252.04	2.965	
10	215.68	164.00	385.00	200.00	252.92	405.02	243.88	2.970	
11	213.05	164.00	385.00	200.00	251.51	408.96	247.96	2.972	
12	216.74	164.00	385.53	200.00	254.46	400.81	239.80	2.972	
13	215.16	164.00	385.53	200.00	253.24	404.89	243.88	2.973	
14	216.21	164.00	385.00	200.00	253.03	405.08	243.88	2.973	
15	213.58	164.00	385.53	200.00	252.04	408.96	247.96	2.974	
16	217.26	164.09	385.00	200.00	254.25	401.01	239.80	2.974	
17	212.53	164.00	385.00	200.00	250.51	413.16	252.04	2.974	
18	218.32	164.44	385.00	200.00	256.72	392.87	231.63	2.976	
19	214.63	164.00	385.00	200.00	252.72	404.89	243.88	2.976	
20	217.79	164.26	385.00	200.00	255.48	396.94	235.71	2.977	
21	218.84	164.61	385.00	200.00	257.95	388.78	227.55	2.977	
22	215.68	164.00	385.53	200.00	253.35	404.95	243.88	2.978	
23	213.58	164.00	385.00	200.00	251.61	409.02	247.96	2.978	
24	214.11	164.00	385.53	200.00	252.14	409.02	247.96	2.978	
25	219.37	164.79	385.00	200.00	259.18	384.68	223.47	2.979	
26	216.74	164.00	385.00	200.00	253.13	405.15	243.88	2.979	
27	212.00	164.00	385.00	200.00	249.52	417.36	256.12	2.982	
28	220.42	165.14	385.00	200.00	261.64	376.46	215.31	2.983	
29	219.89	164.96	385.00	200.00	260.41	380.58	219.39	2.983	
30	217.79	164.26	385.53	200.00	255.91	396.88	235.71	2.984	
31	220.95	165.32	385.00	200.00	262.87	372.34	211.22	2.985	
32	216.21	164.00	385.53	200.00	253.45	405.02	243.88	2.985	
33	221.47	165.49	385.00	200.00	264.10	368.20	207.14	2.986	
34	215.68	164.00	385.00	200.00	252.02	409.28	247.96	2.986	
35	218.32	164.44	385.53	200.00	257.14	392.79	231.63	2.986	
36	222.00	165.67	385.00	200.00	265.33	364.05	203.06	2.986	
37	214.63	164.00	385.53	200.00	252.24	409.09	247.96	2.987	
38	213.05	164.00	385.00	200.00	250.62	413.23	252.04	2.987	
39	214.11	164.00	385.00	200.00	251.71	409.09	247.96	2.988	
40	212.53	164.00	385.00	200.00	249.62	417.42	256.12	2.988	
41	218.84	164.61	385.53	200.00	258.37	388.71	227.55	2.988	
42	215.68	164.00	386.05	200.00	253.77	404.89	243.88	2.988	
43	216.74	164.00	385.53	200.00	253.55	405.08	243.88	2.988	
44	215.16	164.00	385.53	200.00	252.34	409.16	247.96	2.988	
45	214.11	164.00	386.05	200.00	252.56	408.96	247.96	2.989	
46	213.58	164.00	385.53	200.00	251.14	413.23	252.04	2.989	
47	217.26	164.09	385.53	200.00	254.67	400.95	239.80	2.989	
48	219.37	164.79	385.53	200.00	259.60	384.61	223.47	2.990	
49	214.63	164.00	385.00	200.00	251.82	409.16	247.96	2.991	
50	219.89	164.96	385.53	200.00	260.82	380.50	219.39	2.991	
51	216.21	164.00	385.00	200.00	252.12	409.35	247.96	2.992	
52	217.26	164.09	385.00	200.00	253.34	405.28	243.88	2.992	
53	217.79	164.26	385.00	200.00	254.57	401.22	239.80	2.993	
54	216.21	164.00	386.05	200.00	253.87	404.95	243.88	2.993	
55	220.42	165.14	385.53	200.00	262.05	376.38	215.31	2.993	
56	214.63	164.00	386.05	200.00	252.66	409.02	247.96	2.993	
57	218.32	164.44	385.00	200.00	255.80	397.15	235.71	2.994	
58	213.05	164.00	386.05	200.00	251.46	413.10	252.04	2.994	
59	213.58	164.00	385.00	200.00	250.72	413.29	252.04	2.994	
60	218.84	164.61	385.00	200.00	257.03	393.08	231.63	2.994	
61	220.95	165.32	385.53	200.00	263.28	372.25	211.22	2.994	
62	215.68	164.00	385.53	200.00	252.44	409.22	247.96	2.995	
63	217.26	164.09	386.05	200.00	255.10	400.88	239.80	2.995	
64	217.79	164.26	386.05	200.00	256.33	396.81	235.71	2.995	
65	214.11	164.00	385.53	200.00	251.24	413.29	252.04	2.995	
66	218.32	164.44	386.05	200.00	257.56	392.72	231.63	2.996	
67	212.53	164.00	385.53	200.00	250.94	413.10	252.04	2.997	
68	216.74	164.00	385.00	200.00	252.21	409.41	247.96	2.997	
69	219.37	164.79	385.00	200.00	258.27	388.99	227.55	2.998	
70	218.84	164.61	386.05	200.00	258.78	388.63	227.55	2.998	

71	219.89	164.96	385.00	200.00	259.50	384.90	223.47	2.999
72	215.16	164.00	385.00	200.00	251.92	409.22	247.96	2.999
73	219.37	164.79	386.05	200.00	260.01	384.53	223.47	3.000
74	216.74	164.00	386.05	200.00	253.98	405.02	243.88	3.000
75	212.00	164.00	385.00	200.00	248.64	421.61	260.20	3.000
76	216.21	164.00	385.53	200.00	252.54	409.28	247.96	3.001
77	220.42	165.14	385.00	200.00	260.72	380.79	219.39	3.001
78	214.63	164.00	385.53	200.00	251.34	413.35	252.04	3.001
79	217.79	164.26	385.53	200.00	254.99	401.16	239.80	3.002
80	219.89	164.96	386.05	200.00	261.24	380.42	219.39	3.002
81	215.16	164.00	386.05	200.00	252.77	409.09	247.96	3.002
82	214.11	164.00	385.00	200.00	250.82	413.35	252.04	3.002
83	218.32	164.44	385.53	200.00	256.22	397.08	235.71	3.002
84	217.26	164.09	385.53	200.00	253.76	405.22	243.88	3.002
85	220.42	165.14	386.05	200.00	262.46	376.30	215.31	3.003
86	216.21	164.00	386.58	200.00	254.30	404.89	243.88	3.003
87	215.68	164.00	386.05	200.00	252.87	409.16	247.96	3.003
88	214.63	164.00	386.58	200.00	253.09	408.96	247.96	3.004
89	213.58	164.00	386.05	200.00	251.57	413.16	252.04	3.004
90	214.11	164.00	386.05	200.00	251.67	413.23	252.04	3.004
91	212.53	164.00	386.05	200.00	250.47	417.30	256.12	3.005
92	212.00	164.00	385.53	200.00	249.95	417.30	256.12	3.005
93	217.26	164.09	386.58	200.00	255.52	400.81	239.80	3.005
94	217.79	164.26	386.58	200.00	256.75	396.74	235.71	3.005
95	213.05	164.00	385.00	200.00	249.72	417.48	256.12	3.005
96	212.53	164.00	385.00	200.00	248.74	421.67	260.20	3.006
97	221.47	165.49	385.00	200.00	263.18	372.56	211.22	3.006
98	212.00	164.00	386.05	200.00	250.37	417.23	256.12	3.006
99	218.84	164.61	385.53	200.00	257.45	393.01	231.63	3.006

Critical Failure Surface (circle 1)

Intersects: XL: 216.21 YL: 164.00 XR: 385.00 YR: 200.00
Centre: XC: 253.94 YC: 400.81 Radius: R: 239.80
Generated failure surface: (20 points)

216.21 164.00 225.41 162.72 234.66 161.79 243.93 161.22 253.22 161.01
262.51 161.17 271.79 161.68 281.04 162.55 290.25 163.78 299.40 165.36
308.49 167.30 317.50 169.59 326.41 172.23 335.21 175.21 343.88 178.52
352.43 182.17 360.82 186.15 369.06 190.46 377.12 195.07 385.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 44 slices)

Slice	X-S	Base							PoreWater	
Normal	Test									
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force
Stress	Factor									
1	216.21	0.04	-7.9	0.79	0.80	3	100.00	18.0	6.13	1644.17
2071.82	1.03									
2	217.00	4.65	-7.9	4.21	4.25	3	100.00	18.0	625.65	8852.62
2170.22	1.03									
3	221.21	13.01	-7.9	4.21	4.25	3	100.00	18.0	1746.30	9008.11
2351.37	1.03									
4	225.41	23.53	-5.7	4.62	4.65	3	100.00	18.0	3152.29	10005.61
2525.56	1.02									
5	230.04	32.79	-5.7	4.62	4.65	3	100.00	18.0	4387.21	10139.90
2698.15	1.02									
6	234.66	41.78	-3.5	4.64	4.65	3	100.00	18.0	5582.54	10248.14
2854.03	1.01									
7	239.29	50.26	-3.5	4.64	4.65	3	100.00	18.0	6706.92	10330.36
3000.94	1.01									
8	243.93	58.43	-1.3	4.64	4.65	3	100.00	18.0	7785.90	10386.56
3130.04	1.00									
9	248.58	66.10	-1.3	4.64	4.65	3	100.00	18.0	8795.88	10416.67
3251.17	1.00									
10	253.22	73.37	0.9	4.65	4.65	3	100.00	18.0	9748.21	10420.81
3353.55	1.00									
11	257.87	80.21	0.9	4.65	4.65	3	100.00	18.0	10640.58	10398.78
3448.85	1.00									
12	262.51	86.50	3.2	4.64	4.65	3	100.00	18.0	11457.30	10350.50
3524.58	1.00									
13	267.15	92.49	3.2	4.64	4.65	3	100.00	18.0	12229.32	10276.21
3594.04	1.00									
14	271.79	97.76	5.4	4.63	4.65	3	100.00	18.0	12904.07	10176.05
3643.23	0.99									
15	276.41	102.88	5.4	4.63	4.65	3	100.00	18.0	13554.09	10049.72
3686.85	0.99									
16	281.04	107.09	7.6	4.60	4.65	3	100.00	18.0	14081.67	9897.59
3709.65	0.99									
17	285.64	111.33	7.6	4.60	4.65	3	100.00	18.0	14608.69	9719.49

3727.49	0.99									
18	290.25	31.60	9.8	1.28	1.30	3	100.00	18.0	4140.52	2677.97
3726.89	1.00									
19	291.53	87.28	9.8	3.47	3.53	2	0.00	35.0	11433.87	7195.01
3695.84	0.97									
20	295.00	113.40	9.8	4.40	4.47	2	0.00	35.0	14854.95	8928.54
3694.89	0.97									
21	299.40	119.84	12.0	4.54	4.65	2	0.00	35.0	15699.40	9030.59
3666.35	0.97									
22	303.95	122.32	12.0	4.54	4.65	2	0.00	35.0	16024.04	8749.67
3641.50	0.97									
23	308.49	102.67	14.3	3.75	3.87	2	0.00	35.0	13449.81	7064.16
3592.71	0.97									
24	312.25	103.79	14.3	3.75	3.87	2	0.00	35.0	13596.05	6833.46
3552.40	0.97									
25	316.00	41.65	14.3	1.50	1.54	2	0.00	35.0	5455.74	2657.38
3538.89	0.97									
26	317.50	104.98	16.5	3.75	3.91	2	0.00	35.0	13752.84	6557.21
3534.95	0.97									
27	321.25	105.51	16.5	3.75	3.91	2	0.00	35.0	13821.89	6286.11
3547.64	0.97									
28	325.00	39.32	16.5	1.41	1.47	2	0.00	35.0	5150.51	2284.18
3527.69	0.97									
29	326.41	118.94	18.7	4.40	4.65	2	0.00	35.0	15580.99	6965.77
3389.34	0.98									
30	330.81	112.39	18.7	4.40	4.65	2	0.00	35.0	14722.48	6534.03
3201.80	0.98									
31	335.21	104.00	20.9	4.34	4.65	2	0.00	35.0	13623.42	6077.65
2987.48	0.98									
32	339.55	96.80	20.9	4.34	4.65	2	0.00	35.0	12680.53	5596.81
2779.62	0.98									
33	343.88	94.57	23.1	4.62	5.02	2	0.00	35.0	12388.94	5478.07
2537.94	0.99									
34	348.50	46.34	23.1	2.44	2.65	5	0.00	45.0	5097.74	1367.13
1889.49	0.95									
35	350.94	26.98	23.1	1.49	1.62	2	0.00	35.0	3534.76	0.00
2158.39	0.99									
36	352.43	70.66	25.4	4.20	4.65	2	0.00	35.0	9255.96	0.00
1982.36	0.99									
37	356.63	62.30	25.4	4.20	4.65	2	0.00	35.0	8161.66	0.00
1747.99	0.99									
38	360.82	47.43	27.6	3.68	4.15	2	0.00	35.0	6213.92	0.00
1502.09	1.00									
39	364.51	40.35	27.6	3.68	4.15	2	0.00	35.0	5286.48	0.00
1277.90	1.00									
40	368.19	8.53	27.6	0.87	0.98	1	150.00	22.0	1116.89	0.00
1170.14	1.05									
41	369.06	33.82	29.8	4.03	4.65	1	150.00	22.0	4430.64	0.00
992.36	1.07									
42	373.09	24.51	29.8	4.03	4.65	1	150.00	22.0	3211.37	0.00
711.85	1.07									
43	377.12	14.55	32.0	3.94	4.65	1	150.00	22.0	1906.48	0.00
416.70	1.09									
44	381.06	4.85	32.0	3.94	4.65	1	150.00	22.0	635.49	0.00
119.42	1.09									
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X-S Area:		2921.62	Path Length:		176.54		X-S Weight:		383240.12	

Project: West Farm Pit Expansion
File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Full Reservoir-EQ.gmf
Processed: 01 Apr 2021 09:53:13

DATA: Analysis 1 - Case 5-3 Full Reservoir - Pseudostatic

Material Properties (5 materials)

Material: 1 (Mohr-Coulomb Isotropic) - Overburden

Cohesion	Phi	UnitWeight	Ru
150.00	22.0	131.00	Auto

Material: 2 (Mohr-Coulomb Isotropic) - Sand and Gravel

Cohesion	Phi	UnitWeight	Ru
0.00	35.0	131.00	Auto

Material: 3 (Mohr-Coulomb Isotropic) - Weathered Bedrock

Cohesion	Phi	UnitWeight	Ru
100.00	18.0	141.00	Auto

Material: 4 (Mohr-Coulomb Isotropic) - Stable Bedrock

Cohesion	Phi	UnitWeight	Ru
2000.00	20.0	141.00	Auto

Material: 5 (Mohr-Coulomb Isotropic) - Slurry Wall

Cohesion	Phi	UnitWeight	Ru
0.00	45.0	110.00	Auto

Water Properties

Unit weight of water: 62.400 Unit weight of water/medium above ground: 62.400

Material Profiles (9 profiles)

Profile: 1 (2 points)	Material beneath: 1 - Overburden			
100.00	200.00	348.50	200.00	
Profile: 2 (2 points)	Material beneath: 2 - Sand and Gravel			
100.00	190.00	348.50	190.00	
Profile: 3 (2 points)	Material beneath: 3 - Weathered Bedrock			
100.00	164.00	348.50	164.00	
Profile: 4 (2 points)	Material beneath: 4 - Stable Bedrock			
100.00	161.00	348.50	161.00	
Profile: 5 (2 points)	Material beneath: 5 - Slurry Wall			
348.50	200.00	351.50	200.00	
Profile: 6 (2 points)	Material beneath: 1 - Overburden			
351.50	200.00	450.00	200.00	
Profile: 7 (2 points)	Material beneath: 2 - Sand and Gravel			
351.50	190.00	450.00	190.00	
Profile: 8 (2 points)	Material beneath: 3 - Weathered Bedrock			
351.50	164.00	450.00	164.00	
Profile: 9 (2 points)	Material beneath: 4 - Stable Bedrock			
348.50	161.00	450.00	161.00	

Slope Surface (4 points)

100.00	164.00	217.00	164.00	325.00	200.00	450.00	200.00

Phreatic Surface (4 points)

100.00	197.00	348.50	197.00	351.50	178.00	450.00	178.00

Failure Surface

Initial circular surface for critical search defined by: XL,XR,R

Intersects:	XL:	217.00	YL:	164.00	XR:	390.00	YR: 200.00
Centre:	XC:	255.85	YC:	410.96	Radius:	R:	250.00

Earthquake Force

Pseudo-static earthquake (seismic) coefficient: 0.042

Variable Restraints

Parameter descriptor:	XL	XR	R
Range of variation:	10.00	10.00	200.00
Trial positions within range:	20	20	50

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RESULTS: Analysis 1 - Case 5-3 Full Reservoir - Pseudostatic

Bishop Simplified Method of Analysis - Circular Failure Surface

Critical Failure Surface Search using Multiple Circle Generation Techniques

Initial failure surface approximation - Factor of Safety: 2.422

Analysis Summary

There were: 20001 successful analyses from a total of 20001 trial failure surfaces

Critical (minimum) Factor of Safety: 2.20

Results Summary - Lowest 99 Factor of Safety circles

Circle	X-Left	Y-Left	X-Right	Y-Right	X-Centre	Y-Centre	Radius	FoS	
1	219.37	164.79	385.00	200.00	260.10	380.36	219.39	2.201	<-- Critical Surface
2	218.32	164.44	385.00	200.00	257.63	388.57	227.55	2.201	
3	217.79	164.26	385.00	200.00	256.40	392.66	231.63	2.201	
4	218.84	164.61	385.00	200.00	258.87	384.47	223.47	2.202	
5	216.21	164.00	385.00	200.00	253.94	400.81	239.80	2.202	
6	217.26	164.09	385.00	200.00	255.17	396.73	235.71	2.202	
7	216.74	164.00	385.00	200.00	254.04	400.88	239.80	2.206	
8	215.16	164.00	385.00	200.00	252.82	404.95	243.88	2.207	
9	212.00	164.00	385.00	200.00	250.41	413.10	252.04	2.210	
10	216.74	164.00	385.53	200.00	254.46	400.81	239.80	2.211	
11	215.68	164.00	385.00	200.00	252.92	405.02	243.88	2.212	
12	215.16	164.00	385.53	200.00	253.24	404.89	243.88	2.212	
13	213.05	164.00	385.00	200.00	251.51	408.96	247.96	2.213	
14	218.32	164.44	385.00	200.00	256.72	392.87	231.63	2.213	
15	213.58	164.00	385.53	200.00	252.04	408.96	247.96	2.214	
16	218.84	164.61	385.00	200.00	257.95	388.78	227.55	2.214	
17	222.00	165.67	385.00	200.00	265.33	364.05	203.06	2.214	
18	216.21	164.00	385.00	200.00	253.03	405.08	243.88	2.214	
19	219.37	164.79	385.00	200.00	259.18	384.68	223.47	2.214	
20	217.26	164.09	385.00	200.00	254.25	401.01	239.80	2.214	
21	221.47	165.49	385.00	200.00	264.10	368.20	207.14	2.215	
22	220.42	165.14	385.00	200.00	261.64	376.46	215.31	2.215	
23	220.95	165.32	385.00	200.00	262.87	372.34	211.22	2.215	
24	214.63	164.00	385.00	200.00	252.72	404.89	243.88	2.215	
25	217.79	164.26	385.00	200.00	255.48	396.94	235.71	2.216	
26	215.68	164.00	385.53	200.00	253.35	404.95	243.88	2.216	
27	219.89	164.96	385.00	200.00	260.41	380.58	219.39	2.216	
28	212.53	164.00	385.00	200.00	250.51	413.16	252.04	2.217	
29	214.11	164.00	385.53	200.00	252.14	409.02	247.96	2.217	
30	213.58	164.00	385.00	200.00	251.61	409.02	247.96	2.218	
31	217.79	164.26	385.53	200.00	255.91	396.88	235.71	2.219	
32	216.74	164.00	385.00	200.00	253.13	405.15	243.88	2.219	
33	218.32	164.44	385.53	200.00	257.14	392.79	231.63	2.219	
34	218.84	164.61	385.53	200.00	258.37	388.71	227.55	2.219	
35	219.37	164.79	385.53	200.00	259.60	384.61	223.47	2.220	
36	219.89	164.96	385.53	200.00	260.82	380.50	219.39	2.220	
37	220.95	165.32	385.53	200.00	263.28	372.25	211.22	2.220	
38	220.42	165.14	385.53	200.00	262.05	376.38	215.31	2.220	
39	216.21	164.00	385.53	200.00	253.45	405.02	243.88	2.221	
40	215.68	164.00	386.05	200.00	253.77	404.89	243.88	2.222	
41	214.11	164.00	386.05	200.00	252.56	408.96	247.96	2.223	
42	212.00	164.00	385.00	200.00	249.52	417.36	256.12	2.223	
43	214.63	164.00	385.53	200.00	252.24	409.09	247.96	2.223	
44	217.26	164.09	385.53	200.00	254.67	400.95	239.80	2.223	
45	216.74	164.00	385.53	200.00	253.55	405.08	243.88	2.223	
46	215.68	164.00	385.00	200.00	252.02	409.28	247.96	2.225	
47	215.16	164.00	385.53	200.00	252.34	409.16	247.96	2.225	
48	217.79	164.26	386.05	200.00	256.33	396.81	235.71	2.225	
49	214.11	164.00	385.00	200.00	251.71	409.09	247.96	2.225	
50	218.32	164.44	386.05	200.00	257.56	392.72	231.63	2.225	
51	213.05	164.00	385.00	200.00	250.62	413.23	252.04	2.225	
52	216.21	164.00	386.05	200.00	253.87	404.95	243.88	2.225	
53	218.84	164.61	386.05	200.00	258.78	388.63	227.55	2.225	
54	219.37	164.79	386.05	200.00	260.01	384.53	223.47	2.226	
55	217.26	164.09	386.05	200.00	255.10	400.88	239.80	2.226	
56	213.58	164.00	385.53	200.00	251.14	413.23	252.04	2.226	
57	219.89	164.96	386.05	200.00	261.24	380.42	219.39	2.226	
58	220.42	165.14	386.05	200.00	262.46	376.30	215.31	2.226	
59	214.63	164.00	386.05	200.00	252.66	409.02	247.96	2.226	
60	214.63	164.00	385.00	200.00	251.82	409.16	247.96	2.227	
61	218.84	164.61	385.00	200.00	257.03	393.08	231.63	2.227	
62	212.53	164.00	385.00	200.00	249.62	417.42	256.12	2.227	
63	218.32	164.44	385.00	200.00	255.80	397.15	235.71	2.228	
64	217.79	164.26	385.00	200.00	254.57	401.22	239.80	2.228	
65	213.05	164.00	386.05	200.00	251.46	413.10	252.04	2.228	
66	217.26	164.09	385.00	200.00	253.34	405.28	243.88	2.228	

67	219.89	164.96	385.00	200.00	259.50	384.90	223.47	2.228
68	219.37	164.79	385.00	200.00	258.27	388.99	227.55	2.229
69	216.21	164.00	385.00	200.00	252.12	409.35	247.96	2.229
70	215.68	164.00	385.53	200.00	252.44	409.22	247.96	2.229
71	220.42	165.14	385.00	200.00	260.72	380.79	219.39	2.229
72	212.53	164.00	385.53	200.00	250.94	413.10	252.04	2.230
73	214.11	164.00	385.53	200.00	251.24	413.29	252.04	2.230
74	217.79	164.26	386.58	200.00	256.75	396.74	235.71	2.230
75	213.58	164.00	385.00	200.00	250.72	413.29	252.04	2.231
76	218.32	164.44	386.58	200.00	257.97	392.65	231.63	2.231
77	216.74	164.00	386.05	200.00	253.98	405.02	243.88	2.231
78	218.84	164.61	386.58	200.00	259.20	388.56	227.55	2.231
79	221.47	165.49	385.00	200.00	263.18	372.56	211.22	2.231
80	216.21	164.00	386.58	200.00	254.30	404.89	243.88	2.231
81	222.00	165.67	385.00	200.00	264.41	368.42	207.14	2.231
82	219.37	164.79	386.58	200.00	260.42	384.46	223.47	2.231
83	217.26	164.09	386.58	200.00	255.52	400.81	239.80	2.231
84	218.32	164.44	385.53	200.00	256.22	397.08	235.71	2.232
85	214.63	164.00	386.58	200.00	253.09	408.96	247.96	2.232
86	217.79	164.26	385.53	200.00	254.99	401.16	239.80	2.232
87	220.95	165.32	385.00	200.00	261.95	376.68	215.31	2.233
88	215.16	164.00	386.05	200.00	252.77	409.09	247.96	2.233
89	215.16	164.00	385.00	200.00	251.92	409.22	247.96	2.233
90	216.74	164.00	385.00	200.00	252.21	409.41	247.96	2.233
91	219.37	164.79	385.53	200.00	258.68	388.92	227.55	2.233
92	216.21	164.00	385.53	200.00	252.54	409.28	247.96	2.234
93	215.68	164.00	386.05	200.00	252.87	409.16	247.96	2.234
94	218.84	164.61	385.53	200.00	257.45	393.01	231.63	2.234
95	217.26	164.09	385.53	200.00	253.76	405.22	243.88	2.234
96	219.89	164.96	385.53	200.00	259.91	384.82	223.47	2.234
97	216.74	164.00	386.58	200.00	254.40	404.95	243.88	2.234
98	214.11	164.00	386.05	200.00	251.67	413.23	252.04	2.235
99	214.63	164.00	385.53	200.00	251.34	413.35	252.04	2.235

Critical Failure Surface (circle 1)

Intersects: XL: 219.37 YL: 164.79 XR: 385.00 YR: 200.00
Centre: XC: 260.10 YC: 380.36 Radius: R: 219.39

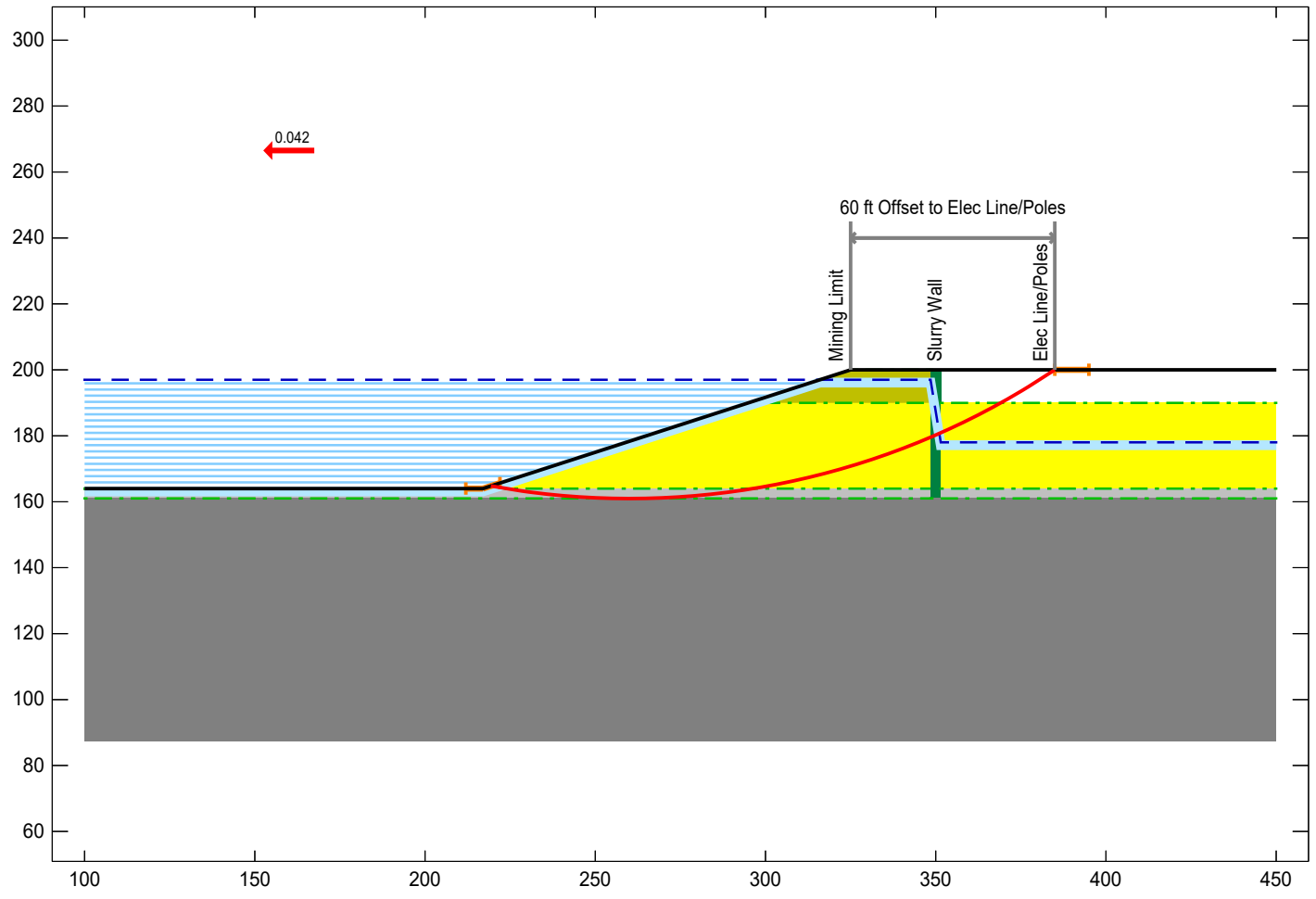
Generated failure surface: (20 points)

219.37 164.79 228.39 163.28 237.47 162.15 246.59 161.39
255.73 161.02
264.88 161.03 274.02 161.42 283.14 162.19 292.21 163.34
301.23 164.87
310.18 166.77 319.05 169.04 327.80 171.68 336.45 174.69
344.96 178.05
353.32 181.76 361.52 185.82 369.54 190.22 377.37 194.95
385.00 200.00

Slice Geometry and Properties - Critical Failure Surface (circle 1, 42 slices)

Slice	X-S	Base						PoreWater	Normal	Test
	X-Left	Area	Angle	Width	Length	Matl	Cohesion	Phi	Weight	Force	Stress	Factor
1	219.37	5.57	-9.5	4.72	4.78	2	0.00	35.0	729.28	9727.17	2120.12	1.07
2	224.08	14.82	-9.5	4.31	4.37	3	100.00	18.0	1957.00	9093.43	2335.17	1.04
3	228.39	25.23	-7.1	4.54	4.57	3	100.00	18.0	3350.96	9706.62	2526.38	1.03
4	232.93	34.67	-7.1	4.54	4.57	3	100.00	18.0	4613.38	9868.36	2712.85	1.03
5	237.47	43.89	-4.7	4.56	4.57	3	100.00	18.0	5842.28	10003.10	2879.69	1.02
6	242.03	52.53	-4.7	4.56	4.57	3	100.00	18.0	6992.17	10110.72	3038.74	1.02
7	246.59	60.91	-2.3	4.57	4.57	3	100.00	18.0	8102.81	10191.12	3176.53	1.01
8	251.16	68.73	-2.3	4.57	4.57	3	100.00	18.0	9135.26	10244.34	3308.06	1.01
9	255.73	76.17	0.1	4.57	4.57	3	100.00	18.0	10115.06	10270.38	3416.98	1.00
10	260.30	83.13	0.1	4.57	4.57	3	100.00	18.0	11026.03	10269.08	3520.96	1.00
11	264.88	89.56	2.4	4.57	4.57	3	100.00	18.0	11864.20	10240.52	3601.17	0.99
12	269.45	95.64	2.4	4.57	4.57	3	100.00	18.0	12650.72	10184.92	3677.62	0.99
13	274.02	101.00	4.8	4.56	4.57	3	100.00	18.0	13339.35	10102.19	3729.32	0.99
14	278.58	106.16	4.8	4.56	4.57	3	100.00	18.0	13998.96	9992.18	3778.30	0.99
15	283.14	110.40	7.2	4.54	4.57	3	100.00	18.0	14531.42	9855.05		

3801.75	0.99									
16	287.67	114.65	7.2	4.54	4.57	3	100.00	18.0	15062.75	9690.88
3823.36	0.99									
17	292.21	72.35	9.6	2.79	2.83	3	100.00	18.0	9489.53	5895.37
3819.89	0.99									
18	295.00	29.43	9.6	1.12	1.14	3	100.00	18.0	3856.43	2345.47
3817.46	0.99									
19	296.12	137.02	9.6	5.11	5.19	2	0.00	35.0	17949.53	10540.69
3776.17	0.96									
20	301.23	122.97	12.0	4.47	4.57	2	0.00	35.0	16109.03	9036.91
3741.30	0.96									
21	305.71	125.39	12.0	4.47	4.57	2	0.00	35.0	16425.63	8765.32
3716.66	0.96									
22	310.18	82.61	14.4	2.91	3.00	2	0.00	35.0	10822.48	5594.63
3664.60	0.95									
23	313.09	83.26	14.4	2.91	3.00	2	0.00	35.0	10907.42	5454.73
3632.19	0.95									
24	316.00	87.87	14.4	3.05	3.14	2	0.00	35.0	11510.46	5560.91
3628.29	0.95									
25	319.05	86.41	16.8	2.98	3.11	2	0.00	35.0	11319.32	5338.33
3619.06	0.95									
26	322.02	86.69	16.8	2.98	3.11	2	0.00	35.0	11356.12	5164.04
3625.47	0.95									
27	325.00	80.60	16.8	2.80	2.93	2	0.00	35.0	10558.65	4704.80
3575.81	0.95									
28	327.80	119.10	19.2	4.32	4.57	2	0.00	35.0	15602.63	7012.07
3404.03	0.95									
29	332.13	112.61	19.2	4.32	4.57	2	0.00	35.0	14752.35	6583.28
3217.51	0.95									
30	336.45	104.11	21.6	4.25	4.57	2	0.00	35.0	13638.88	6129.07
2997.35	0.96									
31	340.70	96.96	21.6	4.25	4.57	2	0.00	35.0	12701.98	5649.21
2790.02	0.96									
32	344.96	75.02	23.9	3.54	3.88	2	0.00	35.0	9827.06	4395.87
2569.34	0.96									
33	348.50	50.78	23.9	2.56	2.81	5	0.00	45.0	5585.33	1520.72
1903.80	0.91									
34	351.06	42.21	23.9	2.25	2.47	2	0.00	35.0	5530.00	0.00
2150.51	0.96									
35	353.32	70.60	26.3	4.10	4.57	2	0.00	35.0	9248.68	0.00
1948.94	0.96									
36	357.42	62.28	26.3	4.10	4.57	2	0.00	35.0	8158.59	0.00
1719.24	0.96									
37	361.52	50.03	28.7	3.81	4.34	2	0.00	35.0	6554.25	0.00
1464.86	0.97									
38	365.33	42.08	28.7	3.81	4.34	2	0.00	35.0	5511.97	0.00
1231.92	0.97									
39	369.14	36.15	30.9	4.12	4.80	1	150.00	22.0	4736.06	0.00
999.55	1.05									
40	373.25	25.92	31.1	4.12	4.81	1	150.00	22.0	3395.05	0.00
705.16	1.05									
41	377.37	14.45	33.5	3.81	4.57	1	150.00	22.0	1892.74	0.00
402.21	1.07									
42	381.19	4.82	33.5	3.81	4.57	1	150.00	22.0	630.92	0.00
107.24	1.07									
		---			---				---	
X-S Area:		2984.78	Path Length:		173.83		X-S Weight:		391382.72	



GALENA Version 7.2

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Material Keys

1: Overburden
2: Sand and Gravel
3: Weathered Bedrock
4: Stable Bedrock
5: Slurry Wall

Analysis 1

Multiple Stability Analysis
Method: Bishop Simplified
Surface: Circular

Results

Critical Factor of Safety: 2.20

Project West Farm Pit Expansion
Case 5-3 Full Reservoir - Pseudostatic

File: C:\Galena Models\Case 5-3\West Farm Expansion Case 5-3 Full Reservoir-EQ.gmf

Edited: 1 Apr 2021
Processed: 1 Apr 2021

J&T Consulting, Inc.