STATE OF COLORADO

Ebert - DNR, Jared <jared.ebert@state.co.us>

Tucson South Resource, M-2004-044, AM01, Adequacy Review No. 3

Christine FELZ <christine.felz@lafargeholcim.com> Thu, Nov 14, 2019 at 12:25 PM
To: "Ebert - DNR, Jared" <jared.ebert@state.co.us>
Cc: Barb Brunk <barbb@dgmllc.com>, "Hora, Pam" <Pam.Hora@tetratech.com>, "Hesemann, Thomas" <Thomas.Hesemann@tetratech.com>, "Butson, Jeff" <Jeff.Butson@tetratech.com>

Hi Jared,

1) The San Martin Caballero well that was identified in Exhibit G as being potentially impacted is an illegal well due to the no diversion notice the DWR placed on the well in 2018.
This is well permit # 12379 R-R. If you recall, we discussed that the Division will not require AI to sign a well agreement for an illegal well. I can send the email again for reference as well as the pictures of the no diversion notice for the well if needed.

2) We revised Exhibit D. I'm not quite sure how it didn't get included, but please see attached.

3) The slope stability memo was only updated to remove one reference to the old phasing, nothing else changed. In fact, the only change was on the mine plan figure that was included in the memo. Please see the attached redline version showing the exact area where the change was made to make it easier for your review. The Phase 1 reference on the figure is highlighted to indicate it was deleted. Hopefully that makes your review quicker and easier.

Let me know if you have any other questions. If needed, I can request an extension to the decision date for Monday.
Thanks.

On Thu, Nov 14, 2019 at 10:52 AM Ebert - DNR, Jared <jared.ebert@state.co.us> wrote:

> Hello Christine,
>
> I have done a brief run through on your adequacy response submittal. I have a couple of quick requests to hopefully speed this along.
>
> 1.) AI included copies of the agreements obtained from the Bloom and Baker wells. Please submit an executed agreement from San Martin Caballero, LLC/Donald Stogh well.
>
> 2.) A revised Exhibit D - Mining Plan was not included in the Adequacy #3 response. As we discussed this exhibit needs to be updated to reflect the new mine phasing.
>
> 3.) I was not expecting a complete revised stability memo, this will take a significant amount of time to review. Given the decision date is tomorrow, the Division will not have time to review this revised exhibit and request that AI request an extension. Please keep in mind the Division may deny the application if we are not allowed sufficient time to review the revised material. Is there a reason this was revised and submitted?
>
> More issues may arise as I dig into this submittal further.
>
> Thanks,
>
> Jared
>
> On Fri, Nov 8, 2019 at 1:11 PM Ebert - DNR, Jared <jared.ebert@state.co.us> wrote:
>
>> Hello Christine,
>>
>> I will be looking for the hard copy and will do everything I can to get to it on Tuesday as I have three hearings on Wednesday.
>>
>> Thanks and have a good weekend.

Jared

On Fri, Nov 8, 2019 at 11:07 AM Christine FELZ <christine.felz@lafargeholcim.com> wrote:

Hi Jared,

Please see the attached letter in response to Adequacy Review No. 3. All of the associated files are in a Dropbox folder which I have shared with you. You should see an email from Dropbox soon.

Please let me know if you have any issues accessing the folder. We are printing up all the documents today with FedEx delivery for Tuesday since it is Veterans Day on Monday. There will be a USB included in the package.

Let me know if you have any questions. Thanks.

On Tue, Sep 24, 2019 at 1:42 PM Ebert - DNR, Jared <jared.ebert@state.co.us> wrote:

Hello Christine,

We have reviewed AI's adequacy response, attached is our third adequacy review letter.

Please let me know if you have any questions or concerns.

Thank you,

Jared

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Jared Ebert

Environmental Protection Specialist III

COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

P 303.866.3567 ext. 8120 | F 303.832.8106 |

1313 Sherman St., Room 215, Denver, CO 80203

jared.ebert@state.co.us | mining.state.co.us

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Christine Felz | Land and Environment Manager| Colorado, Arizona
LafargeHolcim| Aggregate Industries
Address: 1687 Cole Blvd Suite 300 Golden, CO 80401
Office & Mobile: (303) 809-7231
Email: Christine.Felz@lafargeholcim.com

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Jared Ebert

Senior Environmental Protection Specialist

COLORADO
Division of Reclamation, Mining and Safety
Department of Natural Resources

P 303.866.3567 ext. 8120 | F 303.832.8106 |

1313 Sherman St., Room 215, Denver, CO 80203

jared.ebert@state.co.us | mining.state.co.us

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Christine Felz | Land and Environment Manager| Colorado, Arizona
LafargeHolcim| Aggregate Industries
Address: 1687 Cole Blvd Suite 300 Golden, CO 80401
Office & Mobile: (303) 809-7231
Email: Christine.Felz@lafargeholcim.com

2 attachments

Attachment 7 - Stability memo update 09162019 - Phase Change Highlights.pdf
6107K

Exhibit D MINING PLAN 11 8 2019.pdf
88K

EXHIBIT D

MINING PLAN

Revised 11/8/2019

EXHIBIT D

Mining Plan

The proposed amended Mined Land Reclamation Board (MLRB) Tucson South Resource permit area is approximately 1.5 miles south of the Aggregate Industries Wattenberg Lakes Mine (M-2004-051), which supplies aggregate construction materials to much of southern Weld and western Adams counties. The amended Tucson South Resource Permit Boundary contains substantiated aggregate resources to continue the supply in this region of Colorado. Supplementing resources at the Wattenberg operation, new supplies from the amended Tucson South Resource will continue to provide construction materials to meet the Front Range Colorado demand.

Introduction and Overview

The amended Tucson South Resource permit area is currently owned by Aggregate Industries-WCR Inc. and the City of Aurora and consists of dryland agriculture, a small, partially reclaimed gravel resource and a former greenhouse growing operation and water utility infrastructure including an above ground tank and auxiliary building. The property is located both north and south of Colorado Highway 7, bisected by Tucson Street.

Mining of the Tucson South Resource is proposed to happen in three phases. The South Area (Phase 3) is located south of Colorado Highway 7, the West Area (Phase 1) is located north of Colorado Highway 7 and west of Tucson Street, and the East Area (Phase 2) is located north of Colorado Highway 7 and east of Tucson Street.

In general, drainage on the site flows toward the South Platte River to the north and east of the property. The South Area located south of Colorado State Highway 7 generally drains north toward Highway 7 where it is then conveyed east to the river. The drainage pattern in the West Area either flows to local low spots on the property, is conveyed off-site to the north, or is conveyed via an irrigation return ditch to the East Area. The East cell generally drains north and east to the river via overland flow or through existing channels and ditches left by historic disturbance.

With this project the Permit Boundary and the Affected Lands are different areas, as explained below.

Permit Boundary Area

The proposed Permit Boundary contains the following areas as shown on Exhibit C-1 and Exhibit F-1:

- Tracts of land owned by Aggregate Industries-WCR, Inc. referred to on our mapping as Tracts A, B, D, E, F, H, I and M.
- Tracts of land owned by the City of Aurora referred to on our mapping as Tracts C, G and K.
- Tucson Street right-of-way referred to on our maps as Tract L.
- Land owned by the City of Thornton referred to on our maps as Tract J. The applicant is working with the landowner to obtain a right-of-way easement for a conveyor on this tract. The goal is to reduce truck traffic and transport the material to the existing Wattenberg Lakes Mine (M-2004-051) via conveyor.

Affected Land

The Affected Land includes all Tracts described in the Permit Boundary except Tract K, which is owned by the City of Aurora. This area is located west of and including the Brighton Ditch and will not be disturbed by the mining activities and reclamation operations. Therefore, it was excluded from the Affected Land.

Existing Land Uses

The proposed Tucson South Resource mine currently consists of dryland agriculture, one house and a former greenhouse growing operation. The former greenhouse growing operation is currently being demolished by the City if Aurora in preparation of mining. Aggregate Industries is currently renting the existing house and they have given the renters notice to vacate the property by March 31, 2019. The Todd Creek water well and associated United Power overhead electric line on the west side of the West area will also be removed. Aggregate Industries purchased the Todd Creek water well parcel and entered into an agreement to relocate the well to an area adjacent to the river. The relocated well is shown on Exhibit C-3. The applicant has contacted United Power regarding removal of the existing electric service and will forward the documentation regarding removal of the service line upon receipt. There is one rural residential property located adjacent to property on Tucson Street, several rural residential properties south of Tract H and Highway 7 and east of Tract I, and there is a developing residential subdivision located west of Track K. The South Platte River corridor receives recreational use and the City of Brighton operates a parks and wildlife recreational area north of Highway 7 and east of Tract H along the west side of the South Platte River.

Improvements owned by the applicant or property owners that are located within the Permit Boundary Area such as un-improved roads, fences, alluvial water wells and associated pumps, houses and outbuildings, irrigation ditches and laterals, may be removed or relocated during mining and reclamation. There are two established oil and gas wells and associated facilities located on the property. The operator of the well has notified Aggregate Industries that the wells will be capped and abandoned in 2019. No mining will take place within 75' of the existing oil and gas wells until the wells are plugged and abandoned per Colorado Oil and Gas Conservation Commission standards. Structures, easements, or rights-of-ways not owned by the applicant or property owner will not be disturbed without prior permission (see Exhibit C Pre-Mining Maps). None of the easements, rights-of-ways, or associated structures are expected to be negatively affected by mining or reclamation operations.

<u>Nature of Deposit to be Mined</u>

Test borings indicate a layer of topsoil and overburden ranging from 1 to 11 feet in depth with a typical overburden depth of 5 feet. The typical depth of topsoil to be removed is 6". In the western part of the site, the topsoil has been tilled until recently and likely contains a significant amount of organics. The overburden is underlain by an aggregate layer with a thickness ranging from 0 to 46 feet with a typical thickness of 25 feet. In some parts of the sites, the aggregate layer contains a 2- to 9-foot thick mud lens. The total depth to bedrock from the surface grade ranges from 5 feet in the west to approximately 50 feet in an apparent paleochannel in the eastern part of the site. The typical depth to bedrock is approximately 27 feet over most of the mine area. The aggregate layer overlies sedimentary bedrock of the Denver Basin.

A complete soils report is attached in Exhibit I herein for reference.

Mine Phasing

Aggregate Industries anticipates mining and reclaiming the proposed Tucson South Resource site in approximately 5 to 10 years. The rate of mining and overall life of the mine is dependent on several factors including product demand and operational needs. Test pits have verified that commercial deposits of sand and gravel exist up to 50 feet below the surface of the ground. In addition to the commercial sand and gravel materials, clay, silt, and other non-marketable materials excavated from the proposed permit area will be used on-site for reclamation.

The mining plan currently includes mining in three phases. Mining will occur simultaneously in more than one phase. The actual sequence may change depending on market conditions, operational needs, or site conditions:

- West Area (Phase 1), is located north of Highway 7 and west of Tucson Street and included Tracts A, B and C
- East Area (Phase 2) is north of Highway 7 and east of Tucson Street and includes Tracts D, E, F, G and H
- South Area (Phase 3), is located south of State Highway 7, and included Tract I

Tract J will contain the conveyor to carry product off-site to the processing facility at the Wattenberg Lakes Site and will be used during all mining phases.

Mining will begin in the West Area (Phase 1, 88.6 acres) will be mined from south to north. The East Area (Phase 2 - 139.6 acres) will be mined from south to north. All necessary permits will be obtained, and any required special construction techniques will be used prior to disturbance in any jurisdictional Waters of the U.S. A summary of mining phases is presented in the table below.

The West Area (Phase 1, 67 acres) and mined from the east to the west utilizing a dry mining technique (i.e. dewatering). Material will be transported across Highway 7 to the West Area for conveyance to the Wattenberg Lakes Mine (M-2004-051). Processing and sale of the material will occur on the Platte Valley site (M-1989-120). When mining in the South Area is complete, overburden from the West and East Areas will be trucked across Highway 7 and used to back fill the South Area to create an upland meadow.

A slurry wall will be constructed around the East and West Areas prior to exposure of the water table. The final design of the slurry wall is pending and will be provided to the DRMS prior to exposing the water table.

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Mine Phasing Summary

Mine Phase	Total Acreage To be mined (acres)	Duration (years)
South	13.6	2
West	67.0	4
East	79.8	4
Total	163.2	10

Mining Methods

There will be two methods of mining used within the permit boundary:

- Phase 3 will be mined using excavators, transport trucks, and active dewatering during mining. Topsoil will be stripped and stockpiled in locations shown on the Exhibit C Mining Maps. Material will be excavated and transferred to transport vehicles and placed in the designated areas within the East Area, north of Highway 7 to await transfer via conveyor or truck to the processing area at the Wattenberg Mine.

- The slurry wall liner for the West and East Areas will likely be installed prior to exposure of ground water in the site. Once the slurry wall is installed the West and East Areas will be dewatered. The deposit will be dry mined using dewatering trenches and pumps within the slurry lined area. Prior to excavation of each mining phase, trenches will be cut along the perimeter of the excavation to begin dewatering the sand and gravel material. The trenches will extend through the overburden and alluvium to bedrock. Pumps will be used to remove the groundwater that drains from the deposit within the lined excavation. If necessary, water from the trenches will be circulated through a settling pond prior to being discharged to adjacent drainage ditches and/or the South Platte River (see Exhibit C Mining Maps). As excavation begins, the mining cell and dewatering trenches on the floor will continue to collect any water entering the lined Areas, keeping the deposit material relatively dry. The collected water will be directed to settling ponds within the Areas or near the final discharge point to South Platte River. It is anticipated that dewatering will be completed within the slurry wall lined mining area within 12 months and dewatering throughout the life of the mine will be limited to precipitation, stormwater runoff that drains into the mining area, and minor amounts of groundwater.

Earth Moving

Setbacks from the top of slope of each area to the proposed permit boundary or man-made structures not owned by the applicant or by agreement with the structure owner will generally be 30 feet or greater. Specific setbacks from Highway 7 and Tucson Street also account for future expansion of the roadways. The perimeter setbacks from the structures are shown on Exhibit C - Mining Maps.

These setbacks were determined in combination with Adams County regulations and the Slope Stability Analysis prepared by Tetra Tech provided herein in the Geotechnical Stability Exhibit. The setbacks reflect the Factors of Safety in the Proposed Slope Stability/Geotechnical Analysis Policy in the DRMS memorandum dated May 16, 2018.

Areas to be mined will be prepared by removal of topsoil and overburden. Each preparation area may be as much as 100 feet wide along the anticipated mining face. Usually, only enough area is stripped and prepared to provide the estimated needs for the next 10 to 14 months of mining. Surface topsoil material will be stripped separate from the underlying, deeper subsoil or overburden material. This topsoil layer contains most of the soils organic matter and will be stockpiled separately for use in reclamation. Once the topsoil has been removed, the rest of the overburden will be stripped and stockpiled separate from the topsoil.

When the alluvial material is exposed and sufficiently dewatered, the aggregate material will be recovered using equipment typical for sand and gravel mining operations. In the South, West and East Areas, the aggregates will be mined using conventional dry mining methods. Earth moving equipment may include, but is not limited to, dozers, loaders, scrapers, and excavators as mining progresses to a depth of 20 to 50 feet below the surface. The alluvial material is an unconsolidated deposit and, therefore, no blasting is required. The aggregate material from the Areas will be temporarily stockpiled within the various Areas, conveyed to the staging area, or immediately transported off-site for processing. During mining and reclamation activities, watering trucks for dust control will be used as needed.

The active mining face will extend no more than 1,500 feet in length. During mining in the South Area, the mine walls will be at or near the angle of repose, approximately 2H:1V. During mining and prior to reclamation in the West and

East Areas, the mine walls will be a nearly vertical to ½H:1V slope (see Exhibit C, Mining Maps). Mining will progress down to the depth of quality aggregate material. Backfilling and/or grading of side slopes may follow behind the mining activities before mining in the Area is complete. Concurrent reclamation will be practiced when the highwall reaches the mine limit. During the flood season April 1 through September 30 and when the highwall is within 400 feet or less of the river the highwall will be no steeper then 3H:1V.

As mining progresses, topsoil, overburden, and non-marketable materials will be removed and stockpiled for use in reclamation activities. In the South Area, topsoil and overburden will first be stockpiled along the west and north sides of the South Area, or, used for screening during the South Area mining activities. Once mining in the South Area is complete, overburden from the West Area may be transported across Highway 7 to backfill the South Area. During mining in the West and East Areas, topsoil will be segregated and stockpiled in the locations shown on Exhibit C Mining Maps, i.e. outside of the Floodway. As mining progresses, overburden will be taken directly to mined out slopes for use in reclamation. Topsoil and overburden stockpiles will be configured to have side-slopes no steeper than 3H:1V. If the stockpiles are inactive for more than one growing season, such as the stockpiles used for screening, they will be seeded with the fast-growing grass seed mixture below.

Stockpile Grass Seed Mixture

Grass Species	Rate (#PLS/acre)
Luna Pubescent Wheatgrass	15.0
Amur Intermediate Wheatgrass	15.0
Rates are for broadcast seeding.	

Other than those used for screening, long-term stockpiles are not anticipated. Temporary stockpile materials will continually be used for reclamation and the stockpiles will likely be disturbed on a frequent basis and seeding the stockpiles may not be practical during the operation. If stockpile seeding is not used, surface roughening will be maintained to limit wind and water erosion.

Most of the proposed Tucson South Resource Permit Boundary Area is within the regulatory floodplain of South Platte River. Because of floodplain regulatory restrictions, stockpiling will occur within a mining Area whenever possible with the top of stockpile elevation lower than the pre-project grade. Stockpiles within the modeled floodplain above the existing ground surface will generally be created parallel to potential South Platte River flood flows. The stockpiles will be no longer than 300 feet, with minimum spacing of 100 feet between stockpiles for flood flows to pass (see Exhibit C, Mining Maps). The screening stockpiles along Highway 7 as indicated by modeling, are located in areas where placement is not expected to impact floodplain water surface elevations. Consequently, there is no restriction on length or orientation. The impacts of stockpiles on floodplain water surface elevations is presented in the *Floodplain Use Permit* application submitted to Adams County in support of the County Special Use Permit application.

Additional mining and reclamation procedures will be used within the regulatory floodplain to mitigate impacts from potential flood flows. Flood season is considered to be April 1 through September 30. The southern and eastern slopes of each area will either be maintained at 3H:1V during the flood season during mining or concurrently reclaimed at 3H:1V with reclamation backfill. This restriction only applies for areas within 400 feet of the South Platte River in accordance with DRMS policy. If flood waters reach the mining Areas prior to complete reclamation, the

3H:1V slopes will allow controlled flow into the Areas while reducing the potential for head cutting and capture of the South Platte River.

A Floodplain Use Application is being prepared and will be submitted to Adams County for this project. Adams County is the regulating authority on the flood permit; however, Adams County may request review and comment from Urban Drainage and Flood Control District (UD&FCD). Comments and revisions from the County or the UDFCD will be incorporated into the final Floodplain Use Permit.

Each aspect of the mining operation is listed in the following table with associated disturbed area. The table illustrates a point in time when the mining disturbance could be at its maximum. At the proposed Tucson South Resource site, it is assumed that the mining disturbance will be at its greatest when the East Area mining is nearly complete. That will be a time when the slurry wall is installed and, topsoil replacement and initial seeding will be completed for the West Area.

Mine Operation Aspects and Disturbance Areas

Aspect	Mining Operation	Disturbed Area (acres)
A	*Active Mining Area*: South Cell and 2300 linear feet of the east cell 1. Backfill remaining East Cell mining face and side slopes (2,300 feet in length averaging 27 feet deep requiring backfill and rough grading to 3H:1V slopes.) 2. Rough Grade remaining disturbed areas of the east cell 3. Replace topsoil on backfilled area of East cell above the HWL of the reservoir (61.5 acres) 4. Final Grade East Cell 5. Backfill South Cell 6. Replace Topsoil South Cell (15 Acres) 7.	88
B	*Miscellaneous Disturbed Areas (Stockpiles, Haul Roads, Conveyor route)* 1. Replace topsoil on internal haul roads and main site entrance (3 acres x 0.5') 2. Replace topsoil on conveyor route (3.3 acres X.5') 3. Replace topsoil on stockpile area (5 acres x 0.5') 4. Scarify internal haul roads and conveyor route areas 5. Final grade all miscellaneous areas (8.3 acres x 0.5') *6.* Reseed 20% of all areas in the area of disturbance above the HWL of the reservoirs.	8.3 15
D	*Final Reclamation*: 1. Seeding – entire South Cell and East Area above the highwater line of the reservoir plus internal haul route and the conveyor route. 2. Weed management and re-seeding (20% of the Affected Lands located above the highwater line of the reservoirs)	88 15
Total Disturbed Area		103

Diversions and Impoundments

Roads and irrigation ditches will effectively minimize stormwater surface run-on to the mining site, so run-on diversion structures are not anticipated. During the initial mining activities, stockpiling of topsoil and overburden on the surface is anticipated. Diversionary channels, as shown on Exhibit C, will be used divert surface runoff from leaving each of the Areas or entering the wetlands areas. Surface diversion channels will convey runoff to settling ponds, prior to discharging to the South Platte River. As mining progresses and the excavation increases in size, diversionary channels will convey less runoff because more runoff will enter the mine excavations. Runoff that collects in the excavations will be conveyed by the dewatering trenches to a common point, where it will be pumped to the river after sediment settling has occurred, if necessary.

Material Processing and Associated Facilities

Pit run material will be hauled or conveyed off-site to the Wattenberg Lakes site (M-2004-051) to be conveyed for processing at the Platte Valley site (M-1989-120).

<u>Commodities to be Mined and Intended Use</u>

Sand and gravel for use as construction materials will be the primary products produced from the proposed Tucson South Resource. Test pits have verified that commercial deposits of sand and gravel exist up to 50 feet below the surface of the ground. In addition to the commercial sand and gravel materials, topsoil and overburden materials will be used on-site for reclamation.

<u>Use of Explosives</u>

The material is unconsolidated deposits, no explosives or blasting are required.

Wetlands

Tetra Tech also prepared the *Tucson South Sand and Gravel Mine Project—Adams County, Colorado Wetland Delineation Report dated February 2019*. A copy of the report is included in Exhibit J.

A buffer zone has been added to the Exhibit C maps around all the delineated features within the mining excavation limits. The buffer width is proportional to the planned depth of mining surrounding the delineated features. Note 16 has been added to Exhibit C-1 to state that wetlands buffer shall not be disturbed until USACE authorization has been obtained

TETRA TECH

MEMO

To:	Christine Felz, Aggregate Industries, Inc.
cc:	Joel Bolduc, Aggregate Industries, Inc.
From:	Derek Foster, PE, Tetra Tech July 3, 2019
Updated:	Jacob Jansen, EI, Tetra Tech September 16, 2019
Subject:	Slope Stability and Setback Updates, July 3, 2019; Tetra Tech Job No. 200-23514-18004

The memo describes the updated analysis performed to evaluate the minimum setback distance between the proposed mine limit and identified critical manmade structures near the site as required per the Mine Land Reclamation Board (MLRB) Construction Materials Rules 6.3.12(b) and 6.4.19(b) and the memorandum from the DRMS dated May 16, 2018[1]. This slope stability analysis was not performed to evaluated the stability of highwalls, proposed mine slopes, proposed reclamation slopes, or infrastructure owned by Aggregate Industries. The setbacks reported in this memo represent the minimum setback based on the physical and geotechnical input parameters for each model. The required setback may be greater based on regulatory requirements.

1.0 SITE LAYOUT

The Tucson South Mine is comprised of approximately 250 acres, located a half-mile west of the City of Brighton, Colorado. The site lies within the south half of Section 1 and the northwest quarter of Section 12 in Township 1 South, Range 67, West of the 6th Principal Meridian. Land use around the site is aggregate mining, residential, and agricultural. Tucson Street, a paved north-south road, bisects the proposed East and West Pits of the mine. Colorado Highway 7 (E 160th Avenue) separates the proposed East and West Pits from the proposed Southwest Pit. The South Platte River forms the eastern border for the proposed mine and the Brighton Ditch forms the western border of the proposed mine.

2.0 GEOLOGY

The site is in the alluvial valley of the South Platte River. Geologic mapping indicates that the mine is located on an alluvial terrace corresponding with the Piney Creek and Post Piney Creek alluvium[2]. The bedrock underlying the alluvium may be the Arapahoe Formation, which consists of claystone and sandstones.

A total of 130 boreholes have been drilled on the site. Drilling logs indicate the general subsurface profile consists of an average of three feet (one to ten feet) of silty sand overburden, overlying an average of 23 feet (five to 46 feet) of sand and gravel, overlying the bedrock. A mud lens was found in the area, mainly in the West and Southwest Pits of the proposed mine. Groundwater was encountered while drilling in 2004 at depths between eight and 12 feet below the ground surface. Monitoring well readings from December 2003 to August 2004 have water levels between four and 16 feet below ground surface.

[1] Cazier, T. (2018, May 16). Re: Factors of Safety for Slope Stability/Geotechnical Analyses Associated with Mining Operations. Denver, CO: Division of Reclamation, Mining and Safety Minerals Program.
[2] Trimble, E. D., & Machette, N. M. (1979). Geologic Map of the Greater Denver Area, Front Range Urban Corridor, Colorado. USGS Map I-856-H, Version 1.1.

3.0 PREVIOUS EVALUATIONS

A slope stability evaluation was performed by Tetra Tech for the Tucson South mine in November 2004[3]. The evaluation used the (previously required) required minimum factor of safety value of 1.0 and analyzed sections for a total of 14 critical structures surrounding the Tucson South mine. A seismic analysis was not required by the DRMS as part of the slope stability analysis in 2004. The 2004 evaluation was used as the basis for an updated slope stability analysis performed by Tetra Tech in 2018.

In preparation of an amendment to the Tucson South permit application in 2018 Tetra Tech performed an updated slope stability analysis. Critical structures within 200 feet of the mine in 2018 were reevaluated and seven manmade structures were identified as requiring slope stability analysis. A memorandum dated November 9, 2018[4] describes the results of the analysis that was prepared and submitted to Aggregate Industries for their use.

A slope stability analysis preformed in February of 2019 to determine required minimum setbacks from permanent manmade structures around the Tucson South Mine if mine highwalls were excavated at a slope of 0.5H:1V and not reclamation slopes were not constructed concurrently.

4.0 STABILITY ANALYSIS JUNE 2019

This updated stability analysis was performed using GeoStudio 2018 (*Slope/W Define)* computer software[5]. The software is capable of computing factors of safety for a range of materials using finite element analysis. Spencer's method of slices[6] was used to calculate the safety factor for the individual failure surfaces.

Several assumptions were made for the models including:

- Surficial geology was modeled based on stability models and borehole data from 2004.
- Geologic layers are generally horizontal in the subsurface.
- The highwall will be concurrently reclaimed, or mined only at 3H:1V slopes
- The West and East pits will be mined after the slurry wall is installed and will be dewatered as needed.
- The slurry wall (designed by others) will be keyed into bedrock.
- No excess pore pressure build up will occur within the soil strata.
- No slurry wall will be constructed around the South pit.
- The South pit will be wet mined.
- The slurry wall is setback a minimum of 20 feet from the crest of the mine slope/reclamation slope.
- The slurry wall will be constructed a minimum of 15 feet from any structure or easement.

Both a reclamation slope and a mine slope were considered during this stability analysis for each section analyzed in February 2018. A reclamation slope is a slope built of fill material, typically overburden found at the site, used to stabilize the mine highwall. A mine slope is a slope cut at a stable grade leaving the native material in place. The grade modeled for both the reclamation slope and the mine slope was a 3H:1V. The highwall, from the February study, is assumed to be 0.5H:1V.

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[3] Goss, C. (2004, November 22). RE: Revised Tucson South Proposed Gravel Mine Slope Stability Analysis; Tetra Tech RMC Job No. 19-3919.019.00. (T. M. Refer, Ed.) Longmont, CO: Tetra Tech.
[4] Franke, M. (2018, November 9). RE: Updated Tucson South Proposed Gravel Mine Slope Stability Analysis; Tetra Tech Job No. 200-23514-18004. (Bolduc, J, Ed.) Longmont, CO: Tetra Tech.
[5] GEO-SLOPE International, Ltd. (2014). SLOPE/W 2012. December 2014 Release.
[6] Spencer, E., 1967. *A Method of Analysis of the Stability of Embankments Assuming Parallel Inter-Slice Forces."* Geotechnique, Vol. XVII, No. 1, pp. 11-26.

4.1 ANALYZED SECTIONS

Critical manmade structures within 200 feet of proposed mining were modeled during this evaluation. A critical structure is defined by the DRMS as a manmade structure that poses a potential human safety risk, major environmental impact, and major repair cost if the slope were to fail[1]. A mud lens was modeled in sections evaluated where a mud lens was present at the site based on borehole information prepared for the 2004 evaluation. The cross sections and profiles were created using Figures 1 to 6. These figures show the proposed site layout and locations to critical structures, easements, and the topography in the area. Sections were created at each of the critical structures in the vicinity, and the estimated depth to bedrock from the subsurface study was used to create the profile for the slope stability analysis. The eleven (11) critical manmade structures were identified within 200 feet of the proposed Tucson South, East, and West Pit mine boundaries were:

- Tucson St.
- Colorado Highway 7 (E 160th Avenue)
- Power poles to the west of the proposed West Pit boundary
- South Platte River
- Gas well to the west of the proposed West Pit boundary
- Todd Creek waterline north of the proposed mine boundary
- Brighton Ditch
- Brighton Return Ditch
- A gravel road and building to the west of the South pit
- Challenger Pit to the north of the West pit
- City of Aurora waterline

A total of fifteen (15) slope stability models were prepared to evaluate the risk of damage to critical manmade structures for this evaluation as shown on Figure 1. Below is a description of the 15 model sections:

Section A – Tucson St. Setback from the West Mine Pit
Section A, (static analysis Figures A-1; seismic analysis Figures A-2) evaluated the proposed setback from the Tucson St. easement from the West Pit boundary. A 500 psf load was applied to the road to represent live traffic loads. A mud lens was present and modeled based on previous studies in the area. The area is modeled with high water table assuming wet season. The model includes the transmission lines adjacent to the road as the critical structure.

Section B – Tucson St. Setback from the East Mine Pit
Section B (static analysis Figures B-1; seismic analysis Figures B-2) evaluated the proposed setback from the Tucson St. easement from the East Pit boundary. A 500 psf load was applied to the road to represent live traffic loads. No mud lens was modeled based on previous studies in the area[7]. The model uses the edge of the Right of Way as the critical location.

Section C – South Platte River
Section C (static analysis Figures C-1; seismic analysis Figures C-2) evaluated the proposed setback for the South Platte River from the East Pit boundary. The section is modeled where the South Platte River comes closest to the proposed mine boundary. A mud lens is not modeled based on the information available from previous studies in the area[7]. The proposed slurry wall is modeled 20 feet from the river bank. This alignment should be verified by the slurry wall designer. Offset regulations may dictate a greater minimum setback. The model uses the edge of the riverbank as the critical structure.

Section D – Pipeline (North Side of East Cell)
Section D (static analysis Figures D-1; seismic analysis Figures D-2) evaluated the proposed setback for the Todd Creek waterline (pipeline) north of the proposed East and West Pit boundaries. A mud lens is not modeled based on the information available from previous studies in the area[7]. The proposed slurry wall alignment is modeled 15 feet inside of the existing easement. The model identifies the pipeline as the critical structure with the setback measured from the edge of the easement. An agreement with the Todd Creek Metropolitan Water District included in the DRMS application allows for a lesser setback than estimated in the models.

Section E – Gas Well West of the Proposed West Pit Boundary
Section E (static analysis Figures E-1; seismic analysis Figures E-2) evaluated the proposed setback for an existing gas well to the west of the proposed West Pit boundary. A mud lens is modeled based on previous studies in the area[7]. The aggregate layer is noticeably thinner in this area. The weight of a tank in the area is simulated by a 3,000 psf load. The proposed slurry wall is modeled 15 feet from the edge of a gravel apron for the well. The water table on the west side of the slurry wall was modeled at approximately seven feet below ground surface. The water table was not modeled above the mud lens on the east side of the slurry wall since the pit is assumed to be dewatered. The gravel apron was the critical location in the model.

Section F – Power Poles to the West of the Proposed West Pit Boundary
Section F (static analysis Figures F-1; seismic analysis Figures F-2) evaluated the proposed setback for the power poles to the west of the proposed West Pit boundary. The closest power pole to the proposed mine boundary was modeled. A mud lens was present and modeled based on previous studies in the area[7]. The proposed slurry wall is modeled. The overburden is assumed to be approximately constant in thickness. The existing grade at the location would prevent the cutting of a mine slope, only a reclamation slope was considered for this cross section.

Section G – Brighton Ditch
Section G (static analysis Figures G-1; seismic analysis Figures G-2) evaluated the proposed setback for the Brighton Ditch to the west of the proposed West Pit boundary. The section of the ditch closest to the proposed mine boundary was modeled. The proposed slurry wall is modeled 15 feet inside of the affected land boundary. The overburden is assumed to be approximately constant in thickness. The existing grade at the location would prevent the cutting of a mine slope, only a reclamation slope was considered for this cross section. A mud lens is not modeled based on previous studies in the area[7]. The setback presented is measured from the affected land boundary.

Section H – Highway 7 from North Cell (East)
Section H (static analysis Figures H-1; seismic analysis Figures H-2) evaluated the proposed setback for Highway 7 to the south of the proposed East pit boundary. A mud lens is not modeled based on previous studies in the area[7]. The proposed slurry wall is modeled. A 500 psf load was modeled to simulate traffic on Highway 7. A power pole adjacent to Highway 7 is used as the critical structure for the setback. Right-of-way requirements may increase the required offset for this section.

Section I – Highway 7 from South Cell
Section I (static analysis Figures I-1; seismic analysis Figures I-2) evaluated the proposed setback for Highway 7 and a power line to the north of the proposed South pit boundary. A mud lens was present and modeled based on previous studies in the area[7].A slurry wall will not be constructed around the cell and is not modeled. A steady state phreatic surface was modeled along the top of the mud seam, and daylights along the cut slope to model open pit dewatering. A 2H:1V mine slope was modeled to increase yield from the pit, the reclamation slope remained at 3H:1V. A 500 psf load was modeled to simulate traffic on the Highway 7. A 200 psf load was modeled to simulate the weight of a screening berm on the north side of the South Cell.

Section J – Brighton Return Ditch
Section J (static analysis Figures J-1; seismic analysis Figures J-2) evaluated the proposed setback for the Brighton Return Ditch to the southwest of the proposed South pit boundary. A mud lens was present and modeled based on previous studies in the area[7]. A slurry wall will not be constructed around the cell and is not modeled. A steady state phreatic surface was modeled along the top of the mud seam, and daylights along the cut slope to model open pit dewatering. A 2H:1V mine slope was modeled to increase yield from the pit, the reclamation slope remained at 3H:1V. In order to comply with regulatory stability requirements, without increasing mine setback limits, the phreatic surface must be dewatered as to not seep down the face of the mine slope. The ditch was modeled with approximately five feet of water.

Section K – Gravel Road and Waterline
Section K (static analysis Figures K-1; seismic analysis Figures K-2) evaluated the proposed setback for a building and gravel road and waterline to the west of the proposed South pit boundary. A mud lens was present and modeled based on previous studies in the area[7].A slurry wall will not be constructed around the cell and is not modeled. A steady state phreatic surface was modeled along the top of the mud seam, and daylights along the cut slope to model open pit dewatering. A 2H:1V mine slope was modeled to increase yield from the pit, the reclamation slope remained at 3H:1V. The waterline adjacent to the gravel road is the critical structure. A 3000

psf load is modeled to simulate the weight of the building. The setback presented is measured from the edge of the water utility easement.

Section L – Challenger Pit
Section L (static analysis Figures L-1; seismic analysis Figures L-2) evaluated the proposed setback for the Challenger Pit to the north of the proposed West pit boundary. A mud lens was present and modeled based on previous studies in the area[7]. A slurry wall is modeled for the proposed Tucson South pit and the existing Challenger Pit. The water table is modeled 13 feet below ground surface. The setbacks presented are measured from the edge of the utility easements. Offset regulations may dictate a different minimum setback.

Section M – Pipeline (East Side of East Cell)
Section M (static analysis Figures M-1; seismic analysis Figures M-2) evaluated the proposed setback for the Todd Creek waterline (pipeline) to the east of the proposed East pit boundary. The pipeline comes closer to the property in this area. A mud lens is not modeled based on previous studies in the area[7]. The proposed slurry wall is modeled. The presented setbacks are measured from the edge of the utility easement. An agreement with the Todd Creek Metropolitan Water District included in the DRMS application allows for a lesser setback than estimated in the models

Section N – Highway 7 from North Cell (West)
Section N (static analysis Figures N-1; seismic analysis Figures N-2) evaluated the proposed setback for Highway 7 to the south of the proposed West pit boundary. A mud lens was present and modeled based on previous studies in the area[7].The proposed slurry wall is modeled. A 500 psf load was modeled to simulate traffic on the Highway 7. A transmission line adjacent to Highway 7 is the critical structure which the setback presented is measured from. The model assumes a screening berm is located between the road and the mine and the slurry wall is not constructed under the berm.

Section O – City of Aurora Water Line
Section O (static analysis Figures O-1; seismic analysis Figures O-2) evaluated the proposed setback for the Aurora waterline to the south of the proposed West pit boundary. A mud lens was present and modeled based on previous studies in the area[7]. The proposed slurry wall is modeled. A 200 psf load was modeled to simulate the weight of a screening berm on the south side of the West Cell. The model assumes that the slurry wall is not constructed under the screening berm. The waterline is the critical structure and where the setback is measured from.

4.2 INPUT PARAMETERS

Each section was modeled to resemble the existing site topography based on the site survey referenced on the Tucson South Resource Pre-Mining and Mining Plan Maps. Material thicknesses were modeled based on a geotechnical investigation perforemed at the site in 2004. In general, the sand and gravel were thinner on the west side of the site. The materials were generally assumed to be horizontal in the subsurface. A three-foot thick weathered claystone bedrock layer was modeled based on a letter from Allen Sorenson to Kate Pickford dated March 6, 2003[7]. The sections modeled should not be used as an estimation of the aggregate resource.

The input parameters for each of the materials used were those required for the 2004 analysis and are based on a memo from Allen Sorenson to Larry Oehler, dated August 29, 2004[8]. A reclamation slope fill material was added for this revised analysis. The material properties are presented in Table 1. All materials were modeled using the Mohr/Coulomb framework.

[7] Sorenson, A. (2003, March 6). RE: Pit Wall Stability Analysis, Irwin Corporation, Bernhardt Resource Gravel Pie, Permit No. M-2002-120. Denver, CO.
[8] Sorenson, A. (2004, August 29). RE: Reclamation Cost Estimate and Pit Wall Stability Analysis, Aggregate Industries, Tucson South Resource Gravel Pit, File No. M-2004-044.

Table 1: Material parameters used in the slope stability models[8].

Material Parameters				
Material	**Moist Unit Weight (pcf)**	**Saturated Unit Weight (pcf)**	**Effective Cohesion c' (psf)**	**Effective Friction Angle ϕ' (degrees)**
Overburden	114	126	50	28
Sand & Gravel	130	137	0	35
Weathered Claystone Bedrock (residual strength)	124	134	0	14
Claystone Bedrock (peak strength)	124	134	100	28
Mud Lens	114	126	50	28
Slurry Wall	110	122	0	0
Reclamation Slope Fill	119	126	25	26

**pcf= pounds per cubic foot; psf= pounds per square foot*

A seismic analysis was also performed for each of the sections described above as required by the DRMS. The seismic analysis accounts for the effects of horizontal acceleration experienced during an earthquake. The horizontal acceleration used was 0.067 g. The value was obtained from a U.S. Seismic Design map of the area[9]. The U.S. Seismic Design Maps program considers the soil classification and location of the site. For the Tucson South site, Site Class D – Stiff Soil was used.

Other applicable DRMS requirements that were used are as follows:

- The minimum factor of safety for the static analysis is 1.5.
- The minimum factor of safety for the seismic analysis is 1.3.

The scenarios were modeled with entry/exit geometry for currently proposed setbacks. The setbacks were adjusted as needed to reach the minimum required factor of safety in each case.

4.3 MODEL RESULTS

The model results are given in Table 2. Detailed model results and a comparison with previous slope stability modeling is included in Appendix A. The setbacks listed are the minimum setbacks required. Resulting sections from the model are presented in Figures. It should be noted that the setback requirement for model J is dependent on the reduced phreatic surface in the soils behind the mine cut, care should be given to the dewatering process chosen in the South Pit.

[9] U.S. Geological Survey. (2017, July 27). U.S. Seismic Design Maps. U.S. Geological Survey.

Model	Mine Slope			Reclamation Slope			Highwall			Object measured from
	Factor of Safety		Setback (ft)	Factor of Safety		Setback (ft)	Factor of Safety		Setback (ft)	
	Static (1.5 min)	Seismic (1.3 min)		Static (1.5 min)	Seismic (1.3 min)		Static (1.5 min)	Seismic (1.3 min)		
A-Tucson St. West Power Pole	1.68	1.31	35	1.64	1.34	44	1.76	1.30	110	Power Pole
B-Tucson St. East	2.17	1.67	35	1.91	1.49	35	1.71	1.41	65	Edge of ROW
C-South Platte River	2.13	1.63	44	1.89	1.46	44	1.87	1.32	120	Edge of Riverbank
D-Pipeline	2.09	1.65	35	1.73	1.37	35	1.86	1.33	175	Pipeline easement
E-Fence near gas well	2.08	1.49	56	2.10	1.52	56	1.72	1.31	65	Gas Well
F-Power Pole	(1)'			1.89	1.41	68	1.75	1.39	100	Power Pole
G-Brighton Ditch	(1)'			1.93	1.53	35	1.69	1.38	90	Affected Land Boundary
H-Highway 7 North	2.00	1.56	35	1.77	1.38	35	1.81	1.32	105	Power Pole
I-Highway 7 South	2.31	1.67	86	2.72	1.86	86	1.63	1.33	90	Power Pole (assume 20' offset from toe of berm) *2:1 mine slope with dewatered pit
J-Brighton Return Ditch	1.58	1.32	51	1.81	1.35	51	1.68	1.32	105	Brighton Ditch Easement Boundary *2:1 mine slope with lowered phreatic surface
K-South Cell Gravel Road	2.19	1.53	30	2.59	1.75	30	1.67	1.32	75	Edge of Waterline Easement *2:1 mine slope with dewatered pit
L-Challenger Pit	2.24	1.75	45	1.97	1.52	45	1.81	1.34	185	Edge of utility easements
M-East Cell Pipeline	2.37	1.76	52	2.22	1.66	52	2.08	1.53	120	Todd Creek Pipeline easement
N-Highway 7 northwest	3.13	2.19	106	3.07	2.16	106	1.93	1.37	110	Power Pole (assume screening berm between mine and pole)
O-City of Aurora Pipeline	2.76	1.88	72	2.61	1.79	72	1.90	1.37	80	City water line (assume screening berm between mine and waterline)

(1)- Existing geometry prevents a mine slope from being cut at a 3H:1V

5.0 LIMITATIONS

The findings presented in this memorandum are based on information from previous geotechnical investigations at the site and strength parameters of the modeled materials provided by the Colorado Division of Minerals and Geology in 2004. Tetra Tech should be contacted if the mining plans change or if the subsurface conditions vary from the descriptions here as reevaluation may be necessary to the investigate potential effects of the changes on the factors of safety for the critical structures determined in this evaluation. Factors of safety for this evaluation were limited to effects at the critical manmade structures and were not an evaluation of the mining highwall and/or reclamation slopes.

Please do not hesitate to contact us with any questions or comments.

Sincerely,

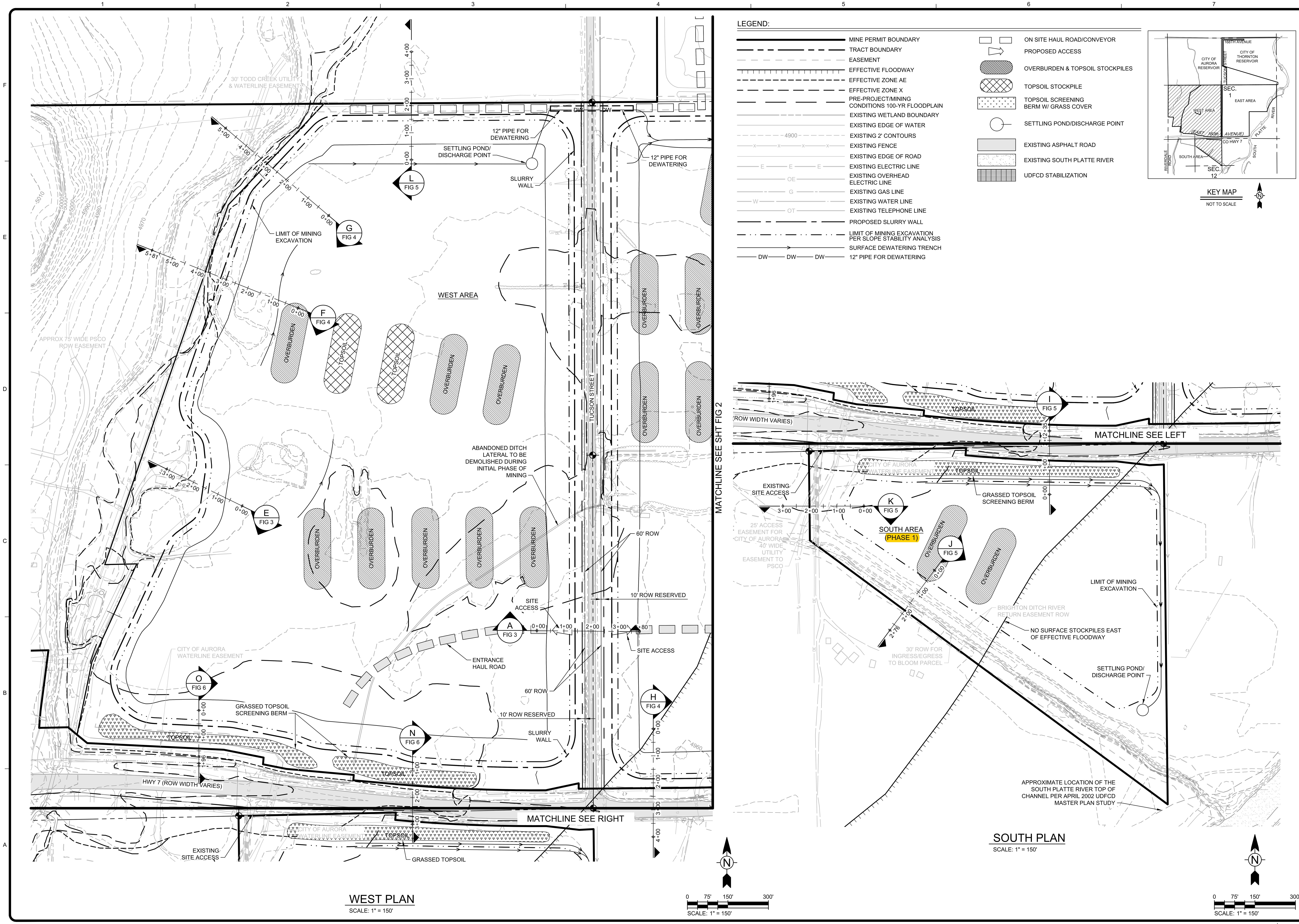
Jacob Jansen, EI
Geotechnical Engineer
Tetra Tech
1560 Broadway, Suite 1400
Denver, CO 80202
720-931-9363
Jacob.jansen@tetratech.com

REVISION HISTORY

9/16/2019

- Revised offset table
- Revised CAD cross section exhibits to add more detail
- Revised Slope/W cross section exhibit to add more detailed dimensions
    - Computer analysis changed for Section M only
    - Computer analysis not changed for all other cross sections

FIGURES



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TUCSON SOUTH RESOURCE

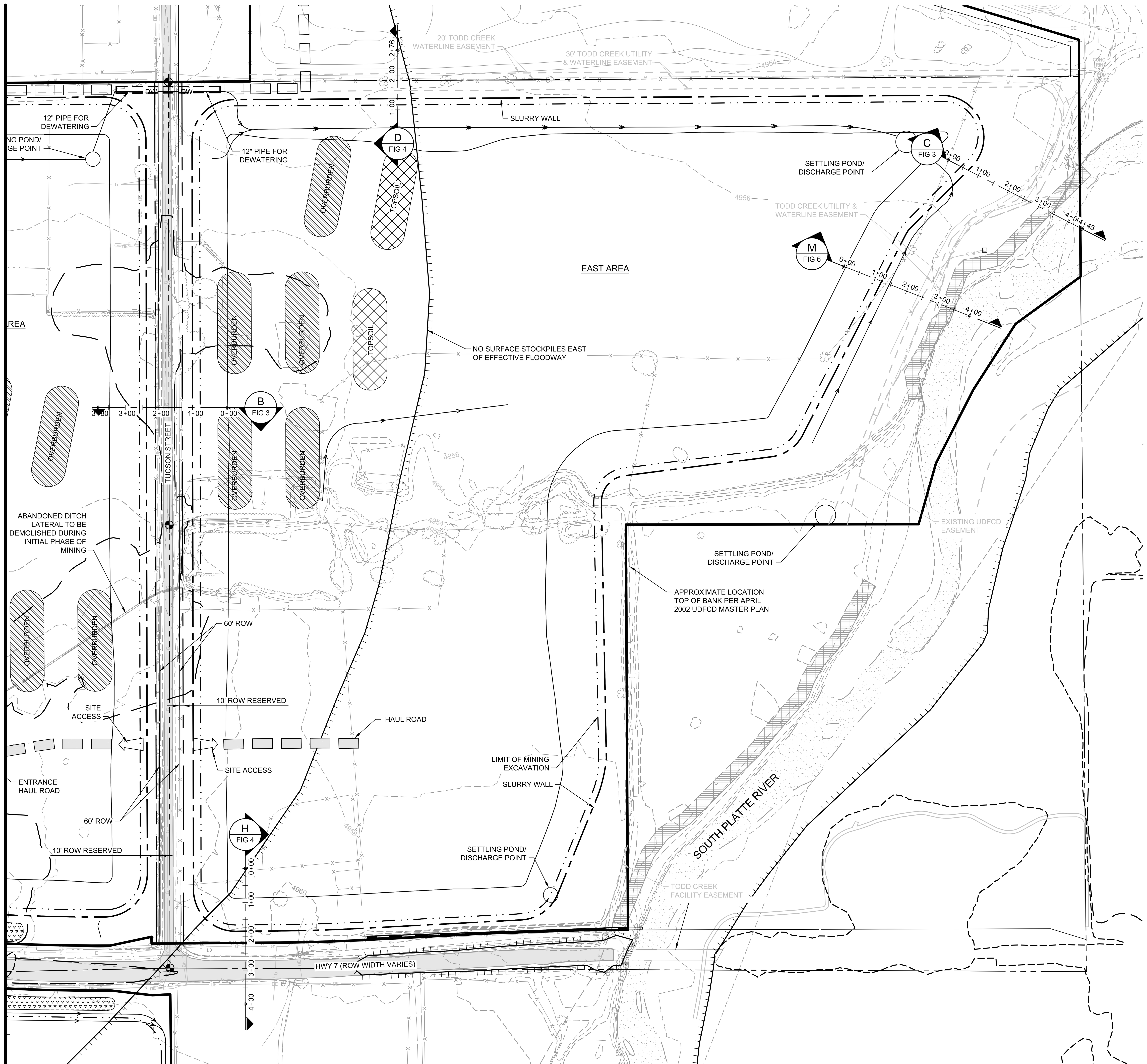
STABILITY ANALYSIS PLAN

Project No.:	200-23514-18004
Designed By:	DF
Drawn By:	CFW
Checked By:	PH

FIG 1
EXHIBIT

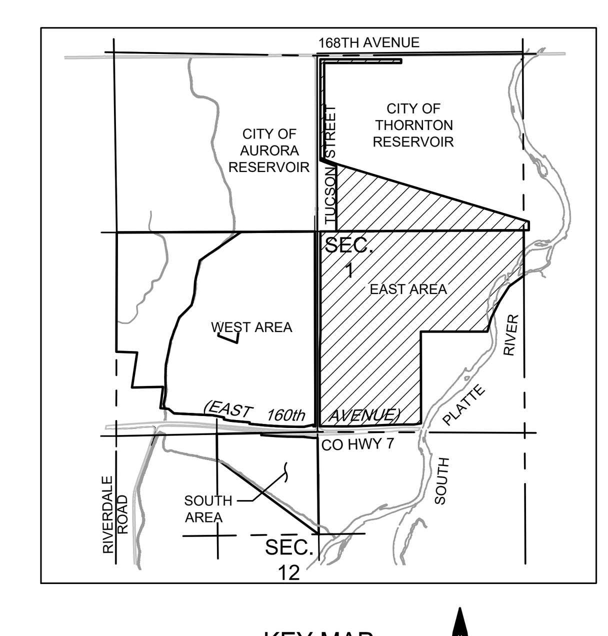
Bar Measures 1 inch

9/13/2019 3:06:39 PM - P:\23514\133-23514-17005\CAD\SHEETFILES\SLOPE STABILITY ANALYSIS\FIG 1 STABILITY ANALYSIS CROSS SECTIONS.DWG - WEATHERL, LAURA



LEGEND:

- MINE PERMIT BOUNDARY
- TRACT BOUNDARY
- EASEMENT
- EFFECTIVE FLOODWAY
- EFFECTIVE ZONE AE
- EFFECTIVE ZONE X
- PRE-PROJECT/MINING CONDITIONS 100-YR FLOODPLAIN
- EXISTING WETLAND BOUNDARY
- EXISTING EDGE OF WATER
- EXISTING 2' CONTOURS
- EXISTING FENCE
- EXISTING EDGE OF ROAD
- EXISTING ELECTRIC LINE
- EXISTING OVERHEAD ELECTRIC LINE
- EXISTING GAS LINE
- EXISTING WATER LINE
- EXISTING TELEPHONE LINE
- PROPOSED SLURRY WALL
- LIMIT OF MINING EXCAVATION PER SLOPE STABILITY ANALYSIS
- SURFACE DEWATERING TRENCH
- 12" PIPE FOR DEWATERING
- ON SITE HAUL ROAD/CONVEYOR
- PROPOSED ACCESS
- OVERBURDEN & TOPSOIL STOCKPILES
- TOPSOIL STOCKPILE
- TOPSOIL SCREENING BERM W/ GRASS COVER
- SETTLING POND/DISCHARGE POINT
- EXISTING ASPHALT ROAD
- EXISTING SOUTH PLATTE RIVER
- UDFCD STABILIZATION



KEY MAP
NOT TO SCALE

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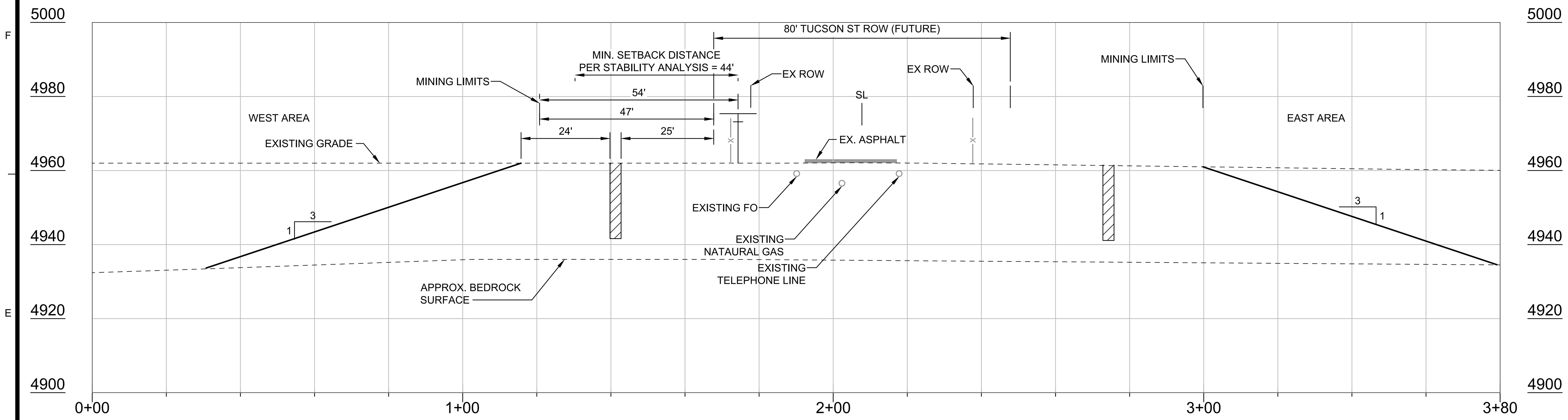
FIG 2
EXHIBIT

Bar Measures 1 inch

9/13/2019 12:36:00 PM - P:\23514\133-23514-17005\CAD\SHEETFILES\SLOPE STABILITY ANALYSIS\FIG 1 STABILITY ANALYSIS CROSS SECTIONS.DWG - WEATHERL, LAURA



PROFILE CROSS SECTION A TUCSON ST
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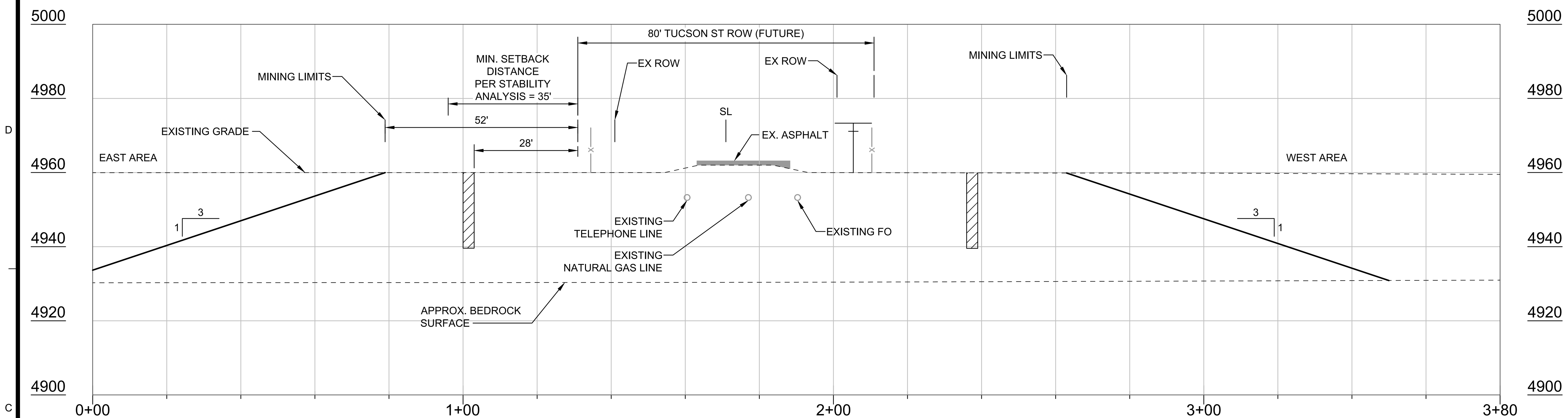

PROFILE CROSS SECTION B TUCSON ST
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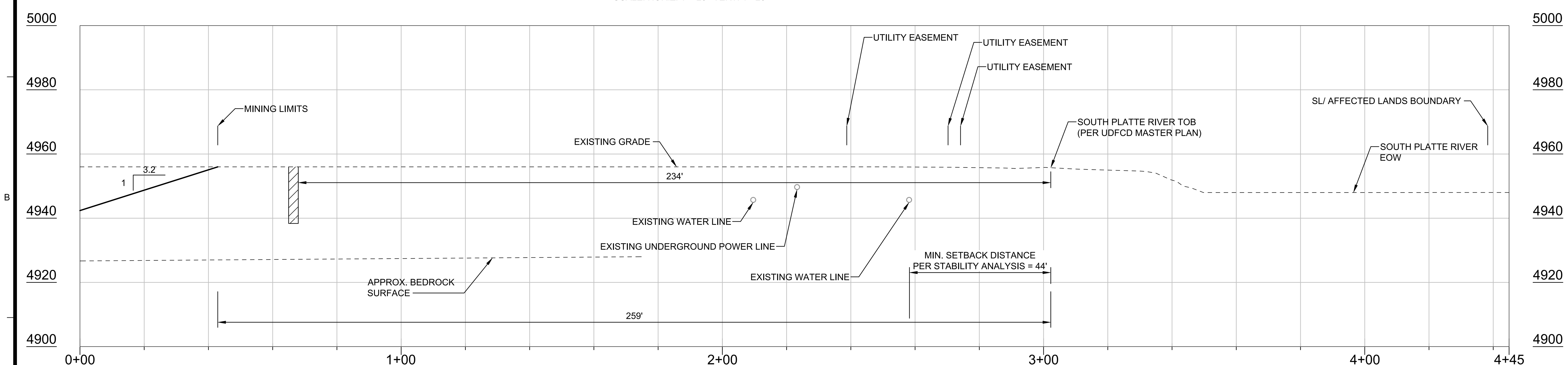

PROFILE CROSS SECTION C SOUTH PLATTE RIVER
SCALE: HORIZ: 1"= 20' VERT: 1"=20'

0 10' 20' 40'
SCALE: 1" = 20'

LEGEND

- EXISTING GRAVEL ROAD
- EXISTING PAVED ROAD
- OVERHEAD POWERLINE
- EXISTING FENCE
- EXISTING GAS WELL
- SL SECTION LINE

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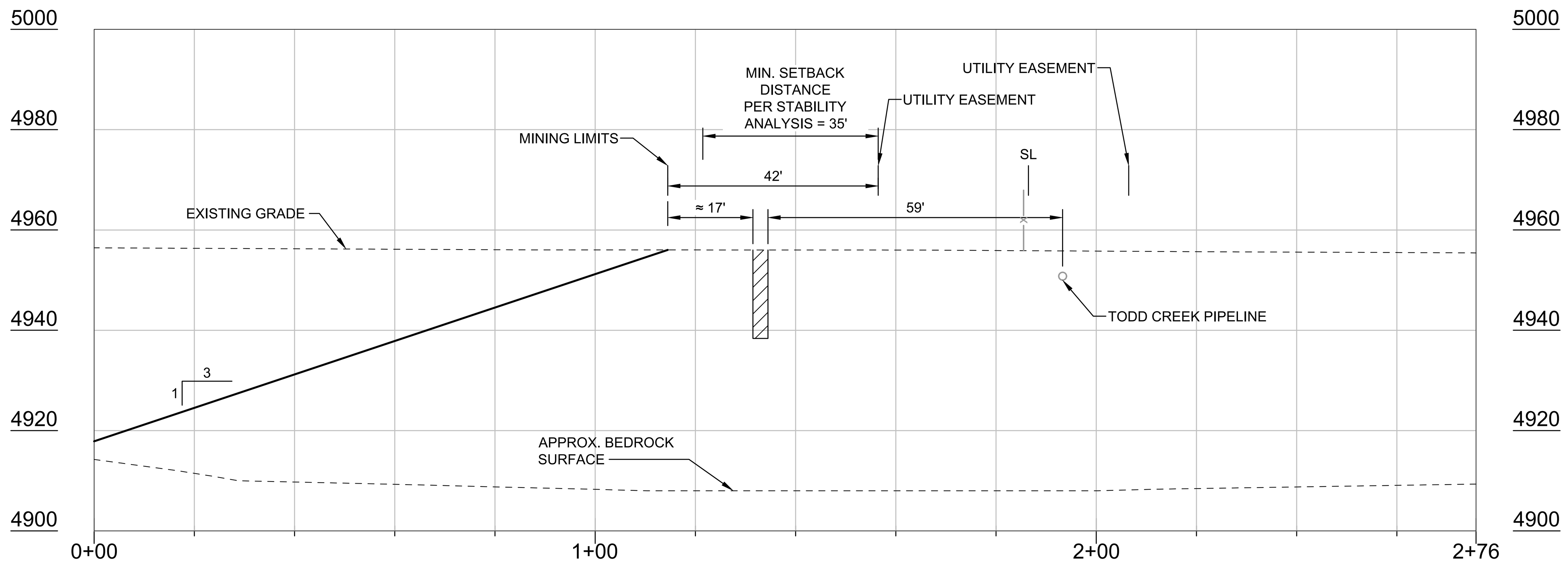
FIG 3
EXHIBIT

Bar Measures 1 inch



PROFILE CROSS SECTION D TODD CREEK PLIPELINE

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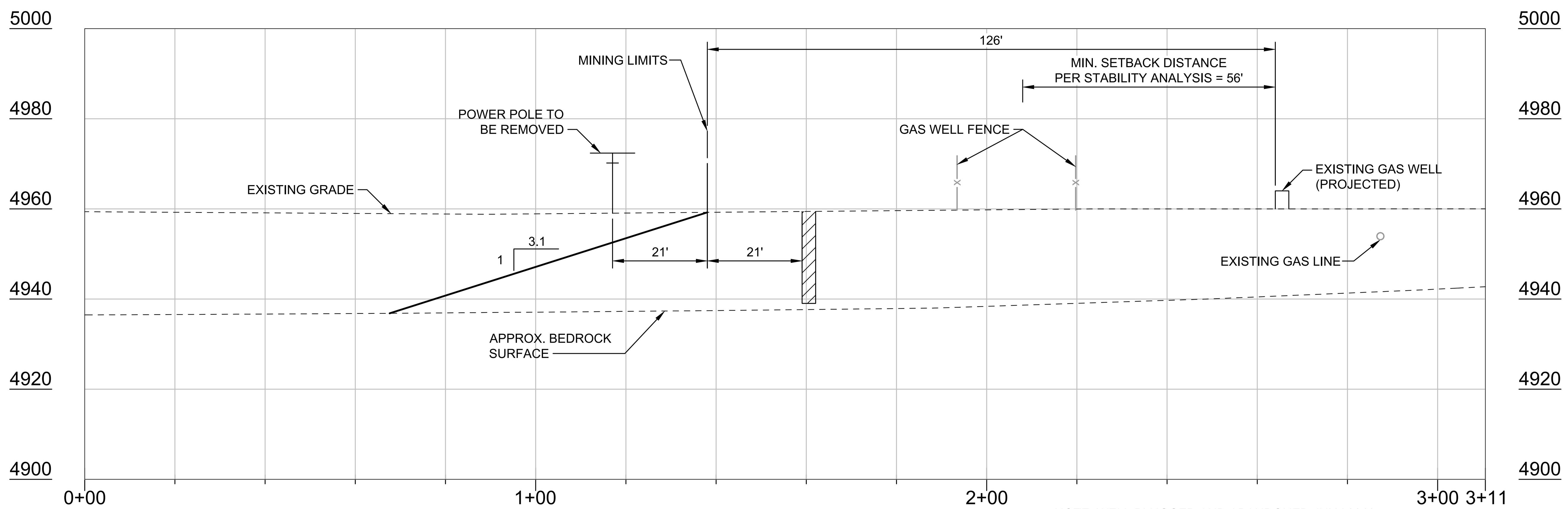
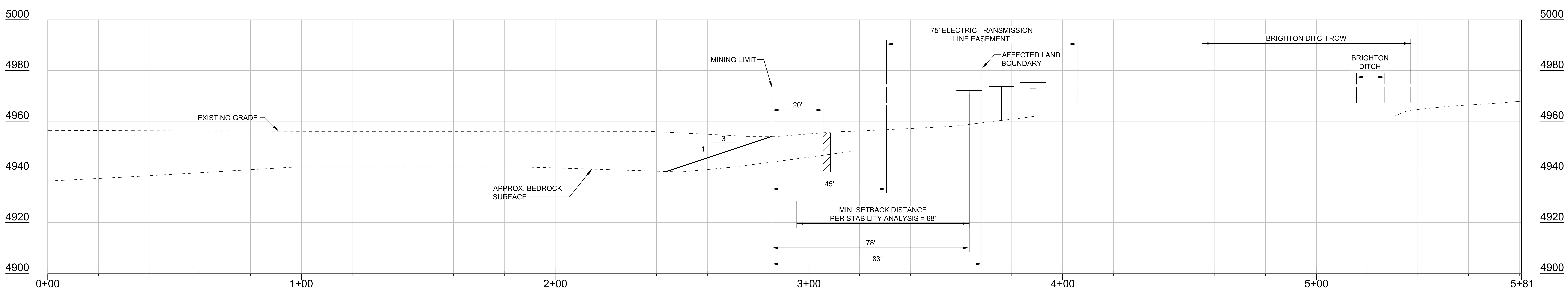


NOTE: WELL PLUGGED AND ABANDONED JULY 2019

PROFILE CROSS SECTION E GAS WELL

SCALE: HORIZ: 1"= 20' VERT: 1"=20'



PROFILE CROSS SECTION F POWER POLE

SCALE: HORIZ: 1"= 20' VERT: 1"=20'

LEGEND

- EXISTING GRAVEL ROAD
- EXISTING PAVED ROAD
- OVERHEAD POWERLINE
- EXISTING FENCE
- EXISTING GAS WELL
- SL — SECTION LINE

0 10' 20' 40'
SCALE: 1" = 20'

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FIG 4

EXHIBIT

Bar Measures 1 inch

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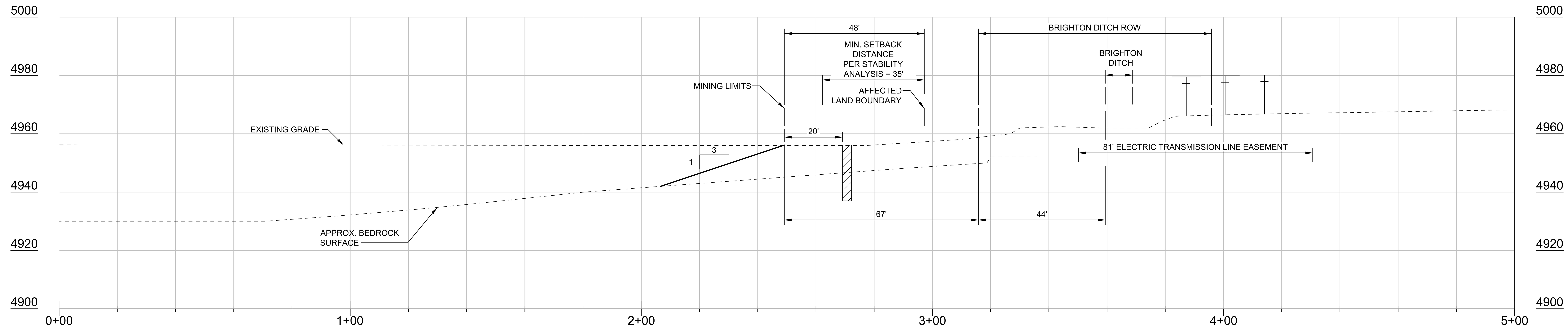

PROFILE CROSS SECTION G BRIGHTON DITCH

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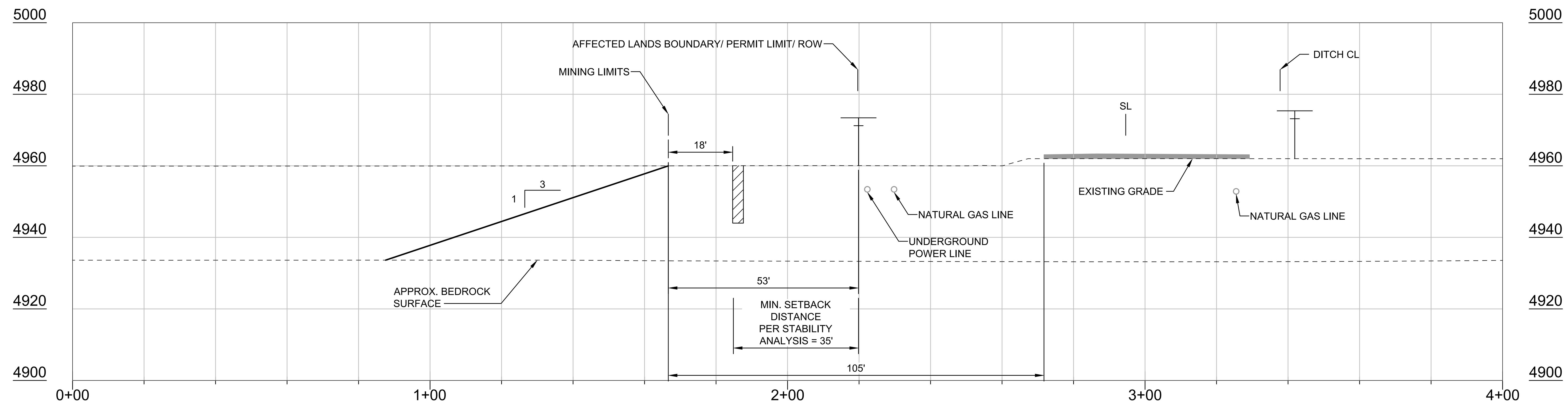

PROFILE CROSS SECTION H HIGHWAY 7 NORTH

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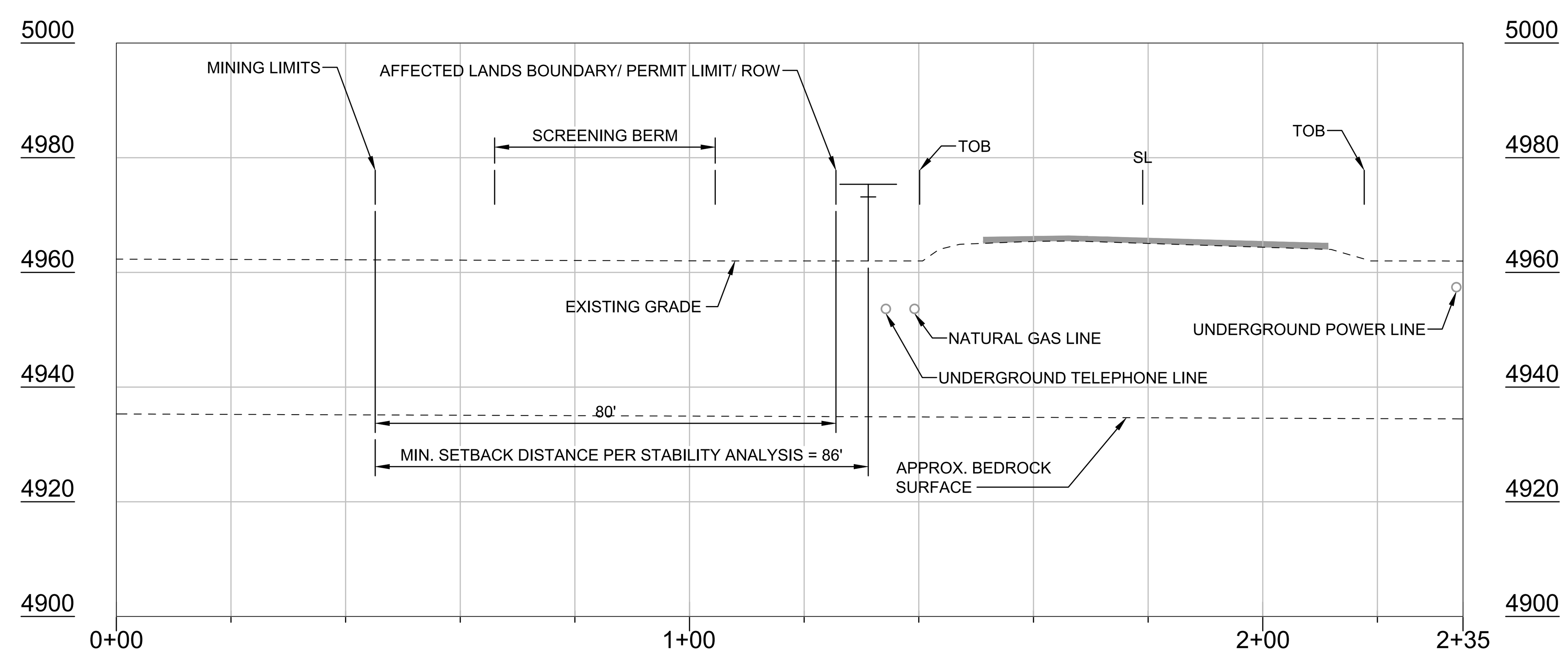

PROFILE CROSS SECTION I HIGHWAY 7 SOUTH

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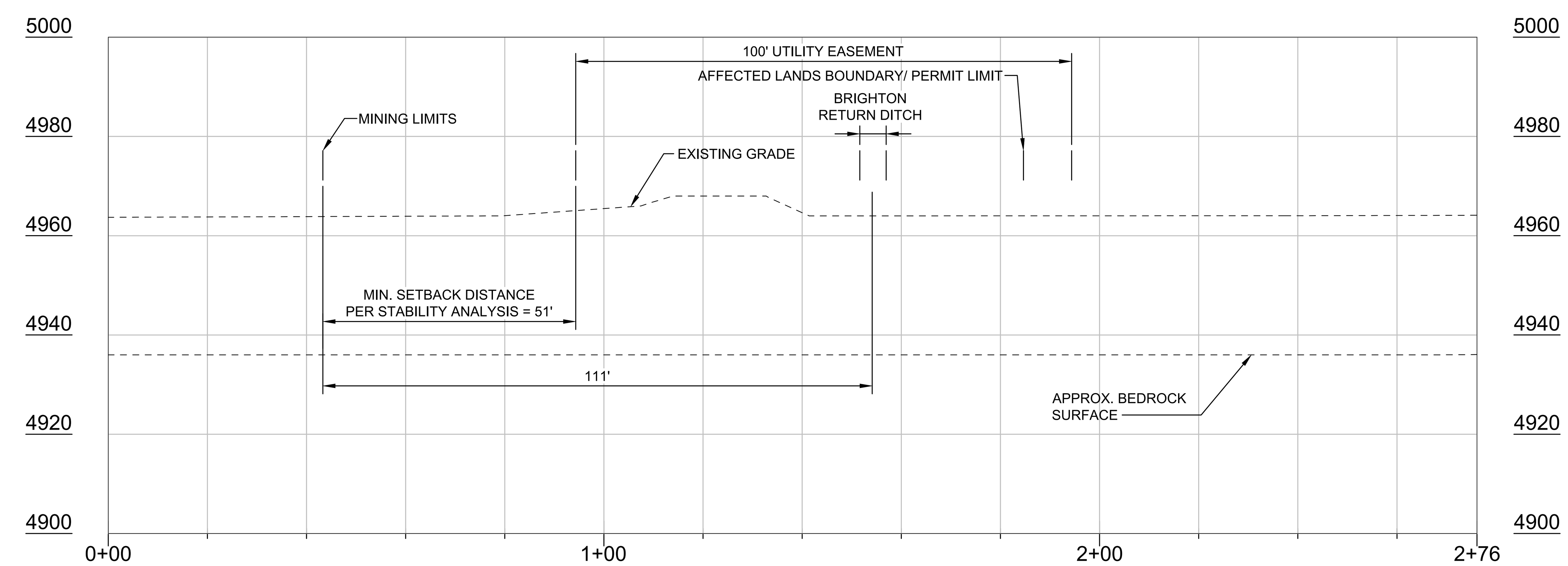

PROFILE CROSS SECTION J BRIGHTON RETURN DITCH

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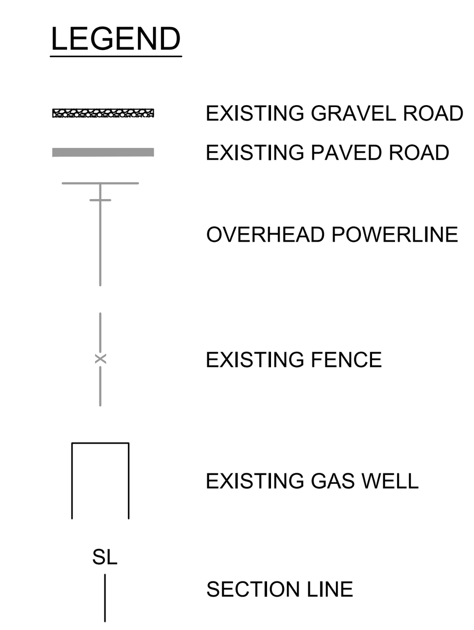

0 10' 20' 40'
SCALE: 1" = 20'

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FIG 5

EXHIBIT

Bar Measures 1 inch

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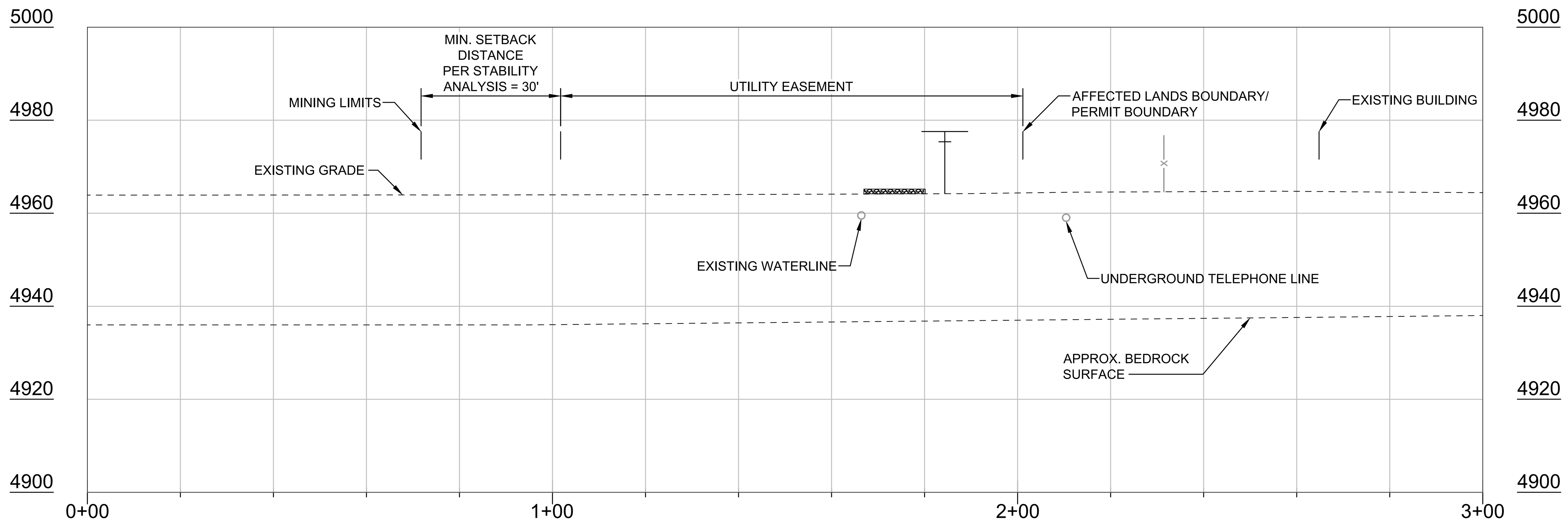
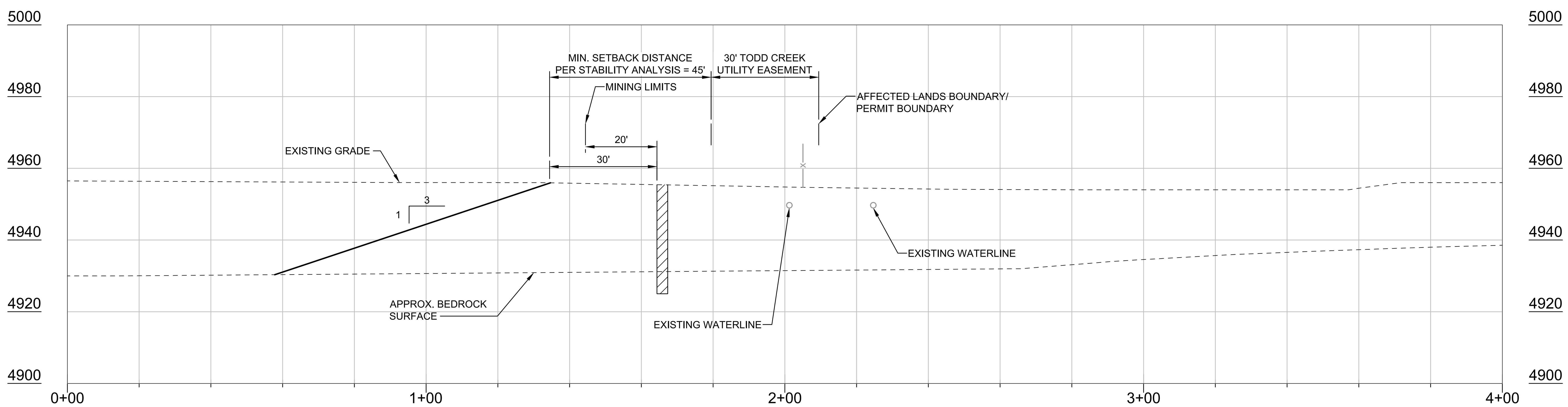


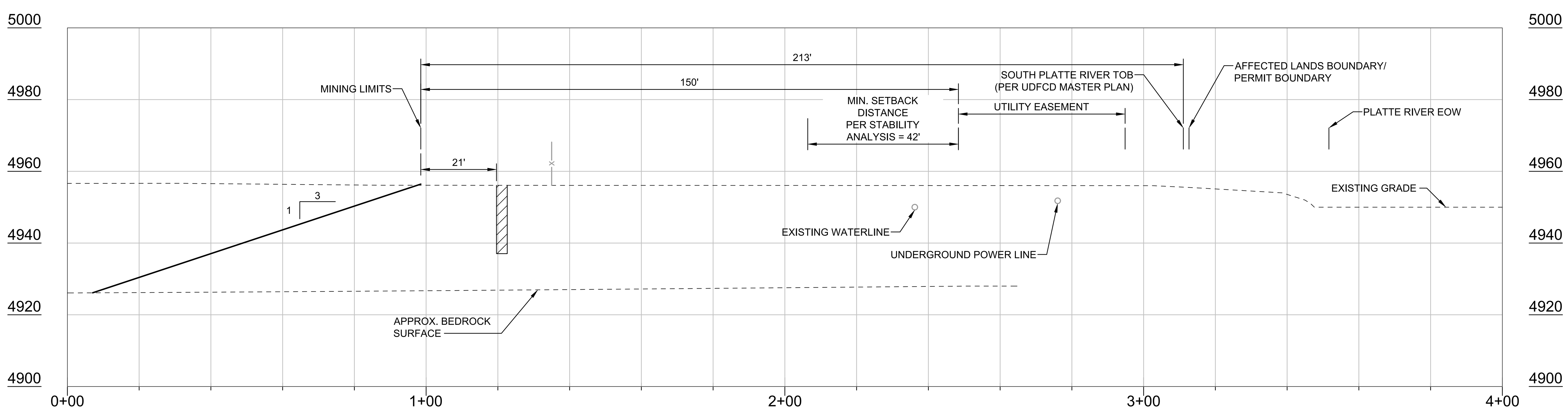
PROFILE CROSS SECTION K POWER POLE & GRAVEL ROAD

SCALE: HORIZ: 1"= 20' VERT: 1"=20'



PROFILE CROSS SECTION L CHALLENGER PIT

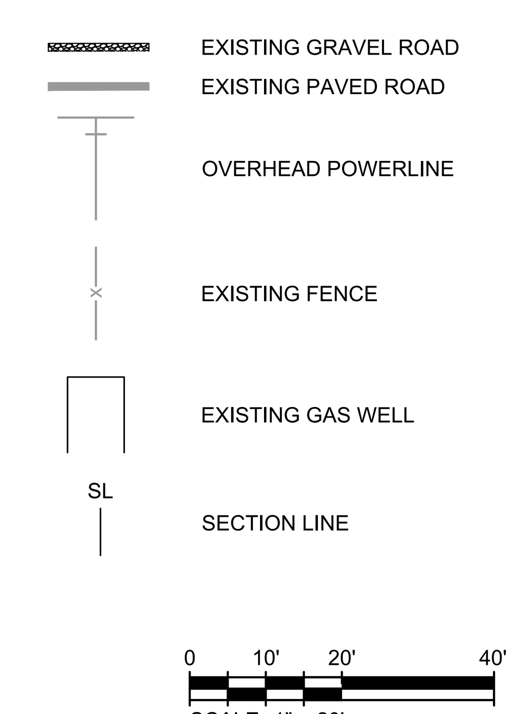
SCALE: HORIZ: 1"= 20' VERT: 1"=20'



PROFILE CROSS SECTION M TODD CREEK PIPELINE

SCALE: HORIZ: 1"= 20' VERT: 1"=20'

LEGEND



TETRA TECH

www.tetratech.com
1900 S. Sunset St., Ste. 1-E
Longmont, CO 80501
Phone: (303) 772-5282

MARK	DATE	DESCRIPTION	BY
1	7/8/19	FIRST ADEQUACY REVEW RESPONSE	TH

AGGREGATE INDUSTRIES - WCR, INC.

TUCSON SOUTH RESOURCE

STABILITY ANALYSIS CROSS SECTIONS

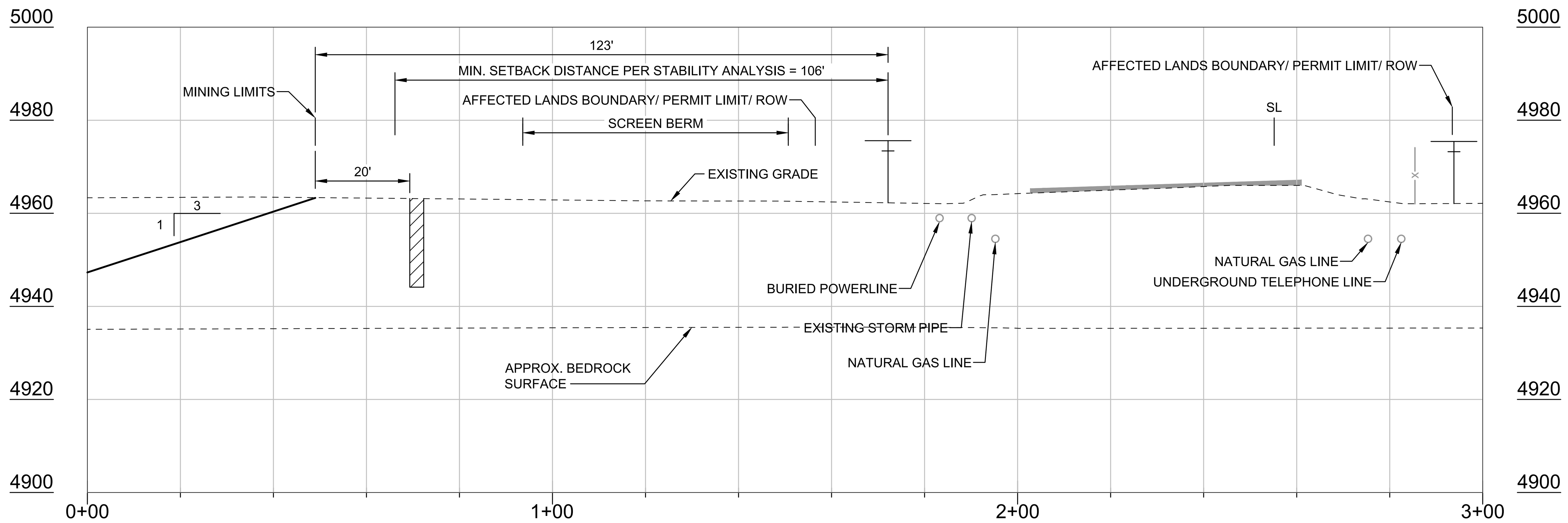
Project No.:	200-23514-18004
Designed By:	DF
Drawn By:	CFW
Checked By:	PH

FIG 6

EXHIBIT

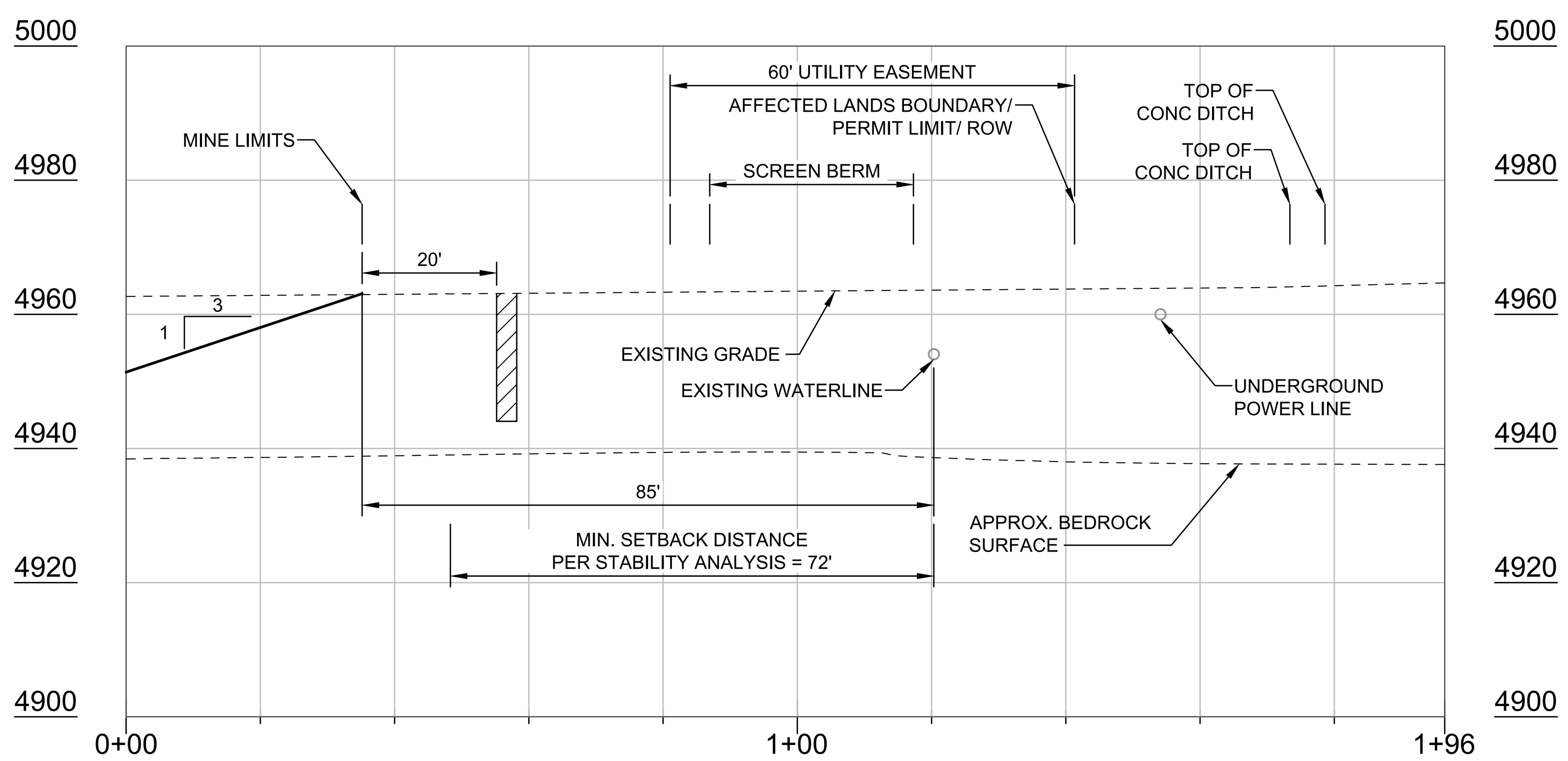
Bar Measures 1 inch

9/13/2019 12:40:22 PM - P:\23514\133-23514-17005\CAD\SHEETFILES\SLOPE STABILITY ANALYSIS\FIG 1 STABILITY ANALYSIS CROSS SECTIONS.DWG - WEATHERL, LAURA



PROFILE CROSS SECTION N HIGHWAY 7 NORTHWEST

SCALE: HORIZ: 1"= 20' VERT: 1"=20'



PROFILE CROSS SECTION O

SCALE: HORIZ: 1"= 20' VERT: 1"=20'

LEGEND

- EXISTING GRAVEL ROAD
- EXISTING PAVED ROAD
- OVERHEAD POWERLINE
- EXISTING FENCE
- EXISTING GAS WELL
- SL SECTION LINE

0 10' 20' 40'
SCALE: 1" = 20'

TETRA TECH
www.tetratech.com
1900 S. Sunset St., Ste. 1-E
Longmont, CO 80501
Phone: (303) 772-5282

MARK	DATE	DESCRIPTION	BY
1	7/8/19	FIRST ADEQUACY REVEW RESPONSE	TH

AGGREGATE INDUSTRIES - WCR, INC.

TUCSON SOUTH RESOURCE

STABILITY ANALYSIS CROSS SECTIONS

Project No.:	200-23514-18004
Designed By:	DF
Drawn By:	CFW
Checked By:	PH

FIG 7

EXHIBIT

Bar Measures 1 inch

9/13/2019 12:41:00 PM - P:\23514\133-23514-17005\CAD\SHEETFILES\SLOPE STABILITY ANALYSIS\FIG 1 STABILITY ANALYSIS CROSS SECTIONS.DWG - WEATHERL, LAURA

APPENDIX A

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - WEST SIDE TUCSON STREET

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28	1
	Mud Lens	Mohr-Coulomb	126	50	28	1
	Overburden	Mohr-Coulomb	126	50	28	1
	Sand and Gravel	Mohr-Coulomb	137	0	35	1
	Slurry Wall	Mohr-Coulomb	122	0	0	1
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14	1

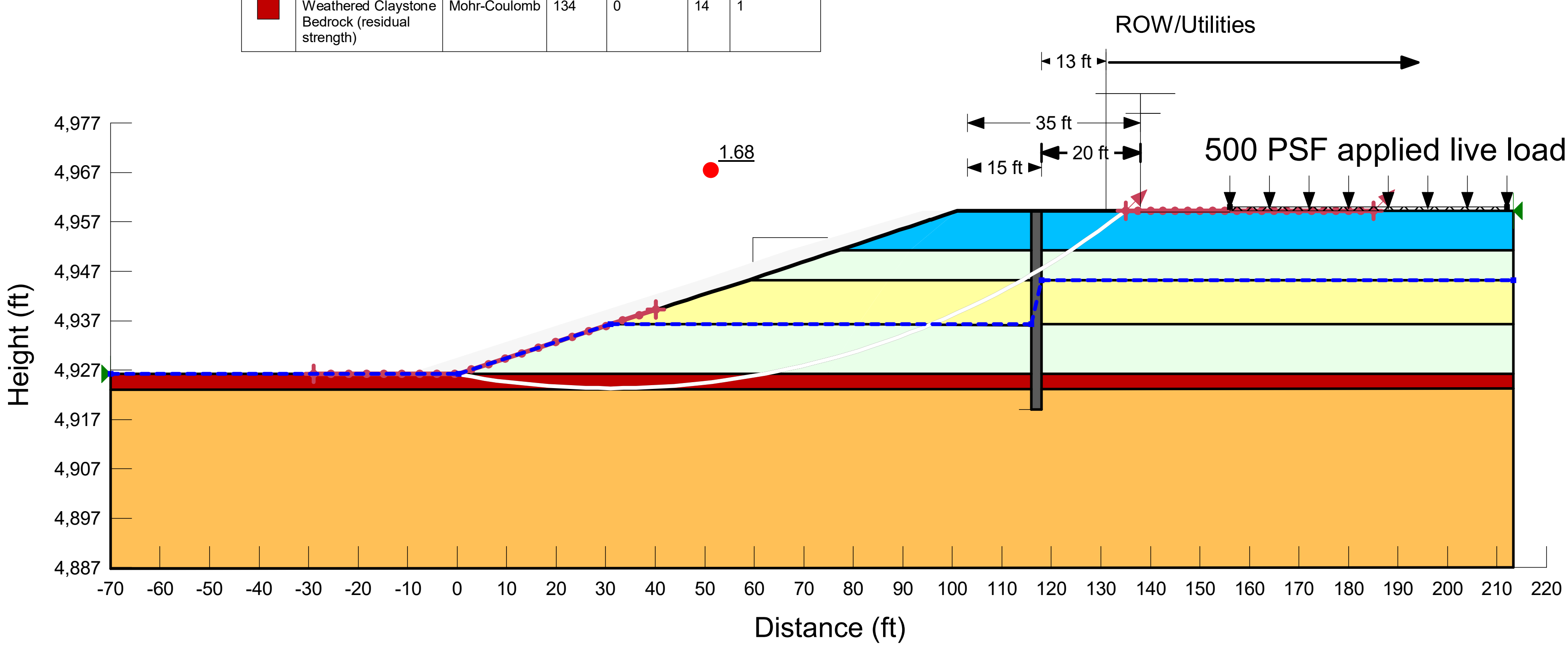


Figure A-1 - Static Analysis with Low Phreatic Surface

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - WEST SIDE TUCSON STREET

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line
Orange	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28	1
Purple	Fill	Mohr-Coulomb	126	25	26	1
Yellow	Mud Lens	Mohr-Coulomb	126	50	28	1
Blue	Overburden	Mohr-Coulomb	126	50	28	1
Pale green	Sand and Gravel	Mohr-Coulomb	137	0	35	1
Dark grey	Slurry Wall	Mohr-Coulomb	122	0	0	1
Red	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14	1

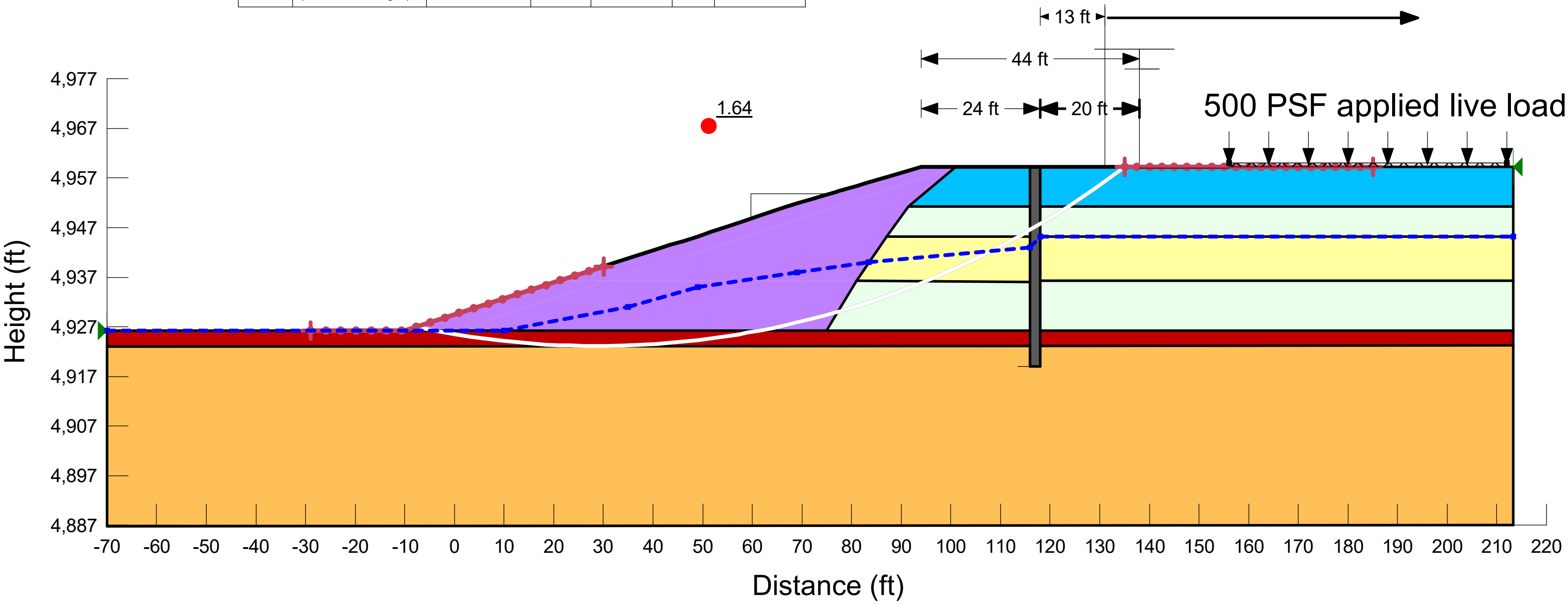


Figure A-1 - Static Analysis with Low Phreatic Surface

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - WEST SIDE TUCSON STREET

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28	1
	Mud Lens	Mohr-Coulomb	126	50	28	1
	Overburden	Mohr-Coulomb	126	50	28	1
	Sand and Gravel	Mohr-Coulomb	137	0	35	1
	Slurry Wall	Mohr-Coulomb	122	0	0	1
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14	1

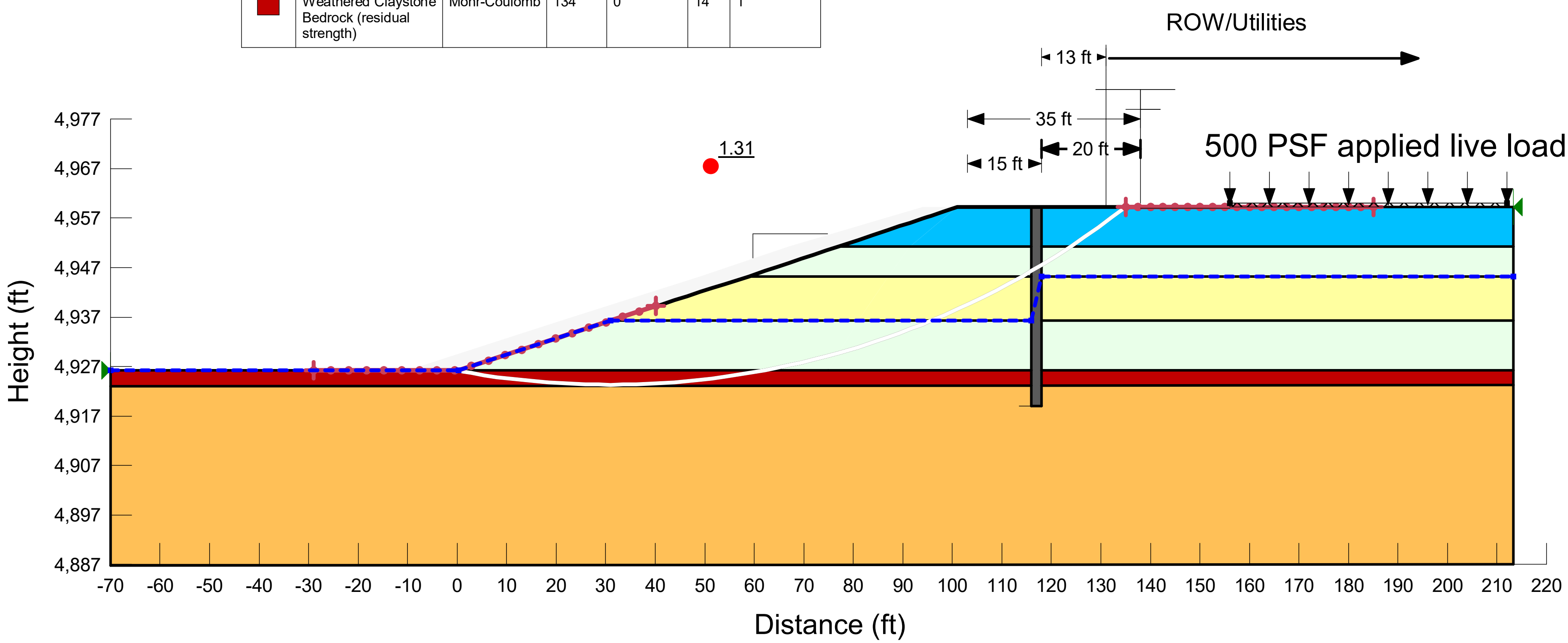


Figure A-2 - Pseudostatic Analysis with Low Phreatic Surface

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - WEST SIDE TUCSON STREET

Color	Name	Model	Unit Weight (pcf)	Cohesion' (psf)	Phi' (°)	Piezometric Line
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28	1
	Fill	Mohr-Coulomb	126	25	26	1
	Mud Lens	Mohr-Coulomb	126	50	28	1
	Overburden	Mohr-Coulomb	126	50	28	1
	Sand and Gravel	Mohr-Coulomb	137	0	35	1
	Slurry Wall	Mohr-Coulomb	122	0	0	1
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14	1

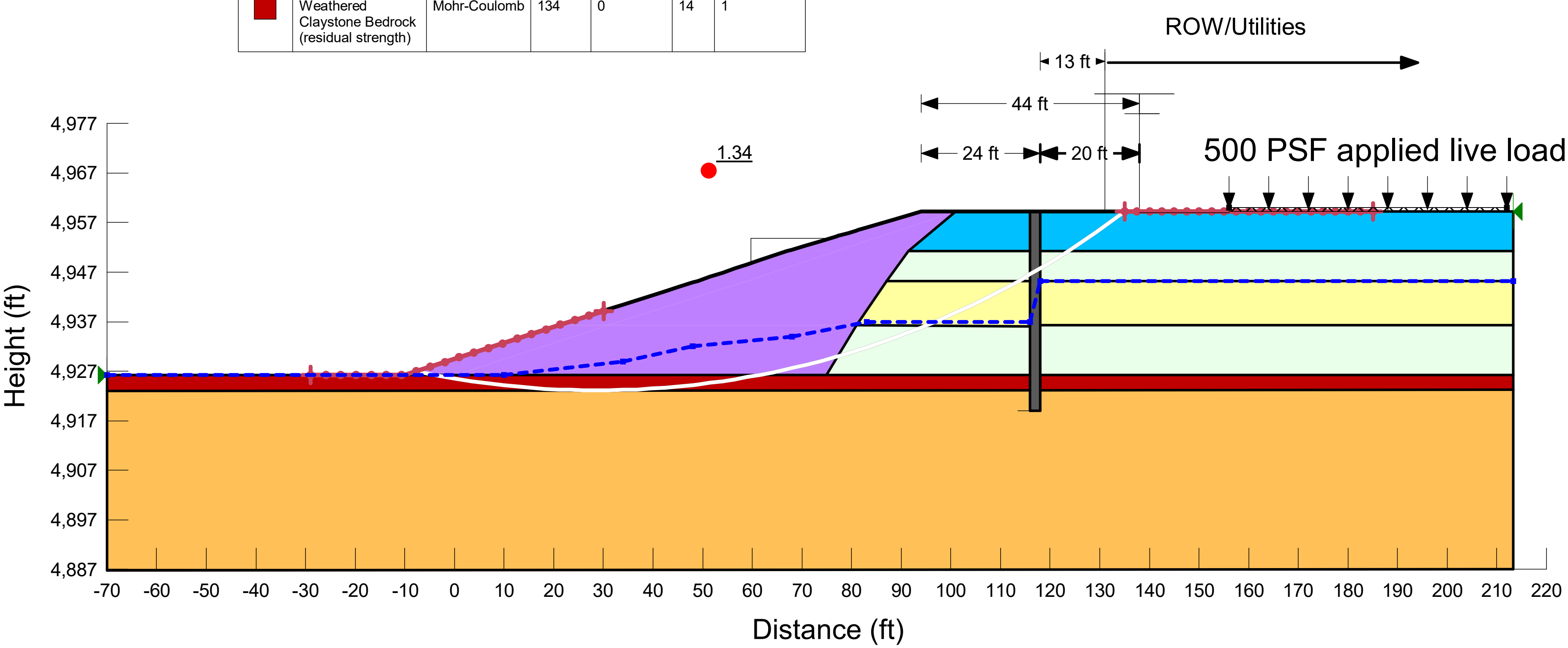


Figure A-2 - Pseudostatic Analysis with Low Phreatic Surface

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - EAST SIDE TUCSON STREET

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

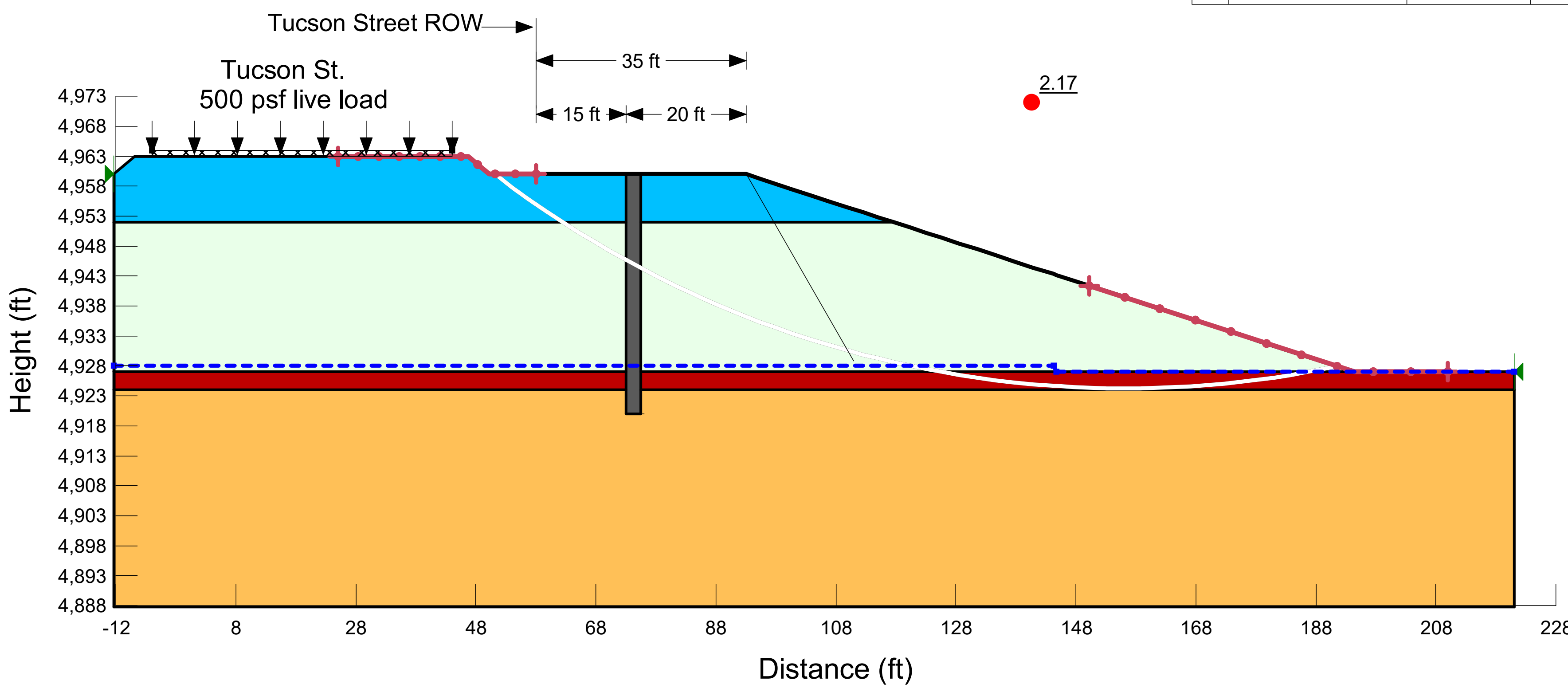


Figure B-1 -Static Analysis

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - EAST SIDE TUCSON STREET

TETRA TECH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

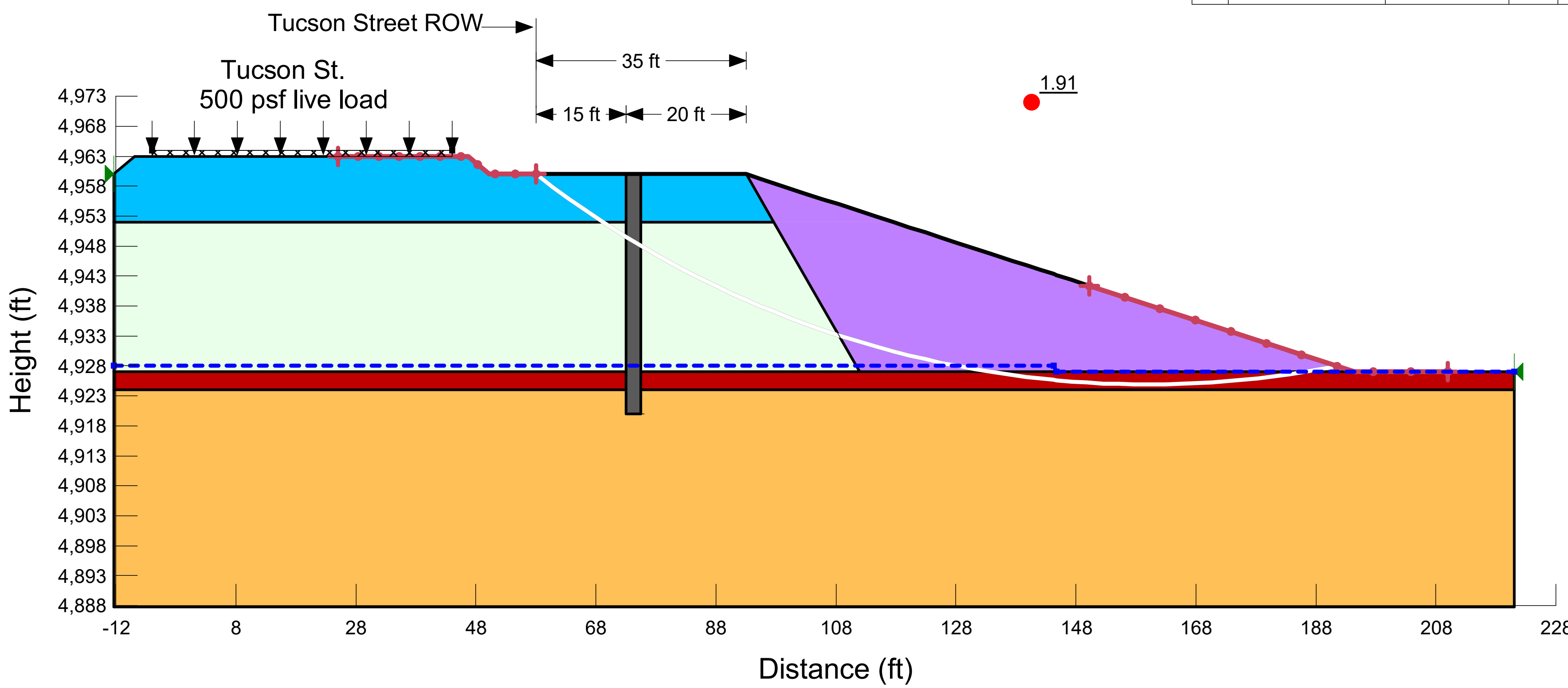


Figure B-1 -Static Analysis

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - EAST SIDE TUCSON STREET

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

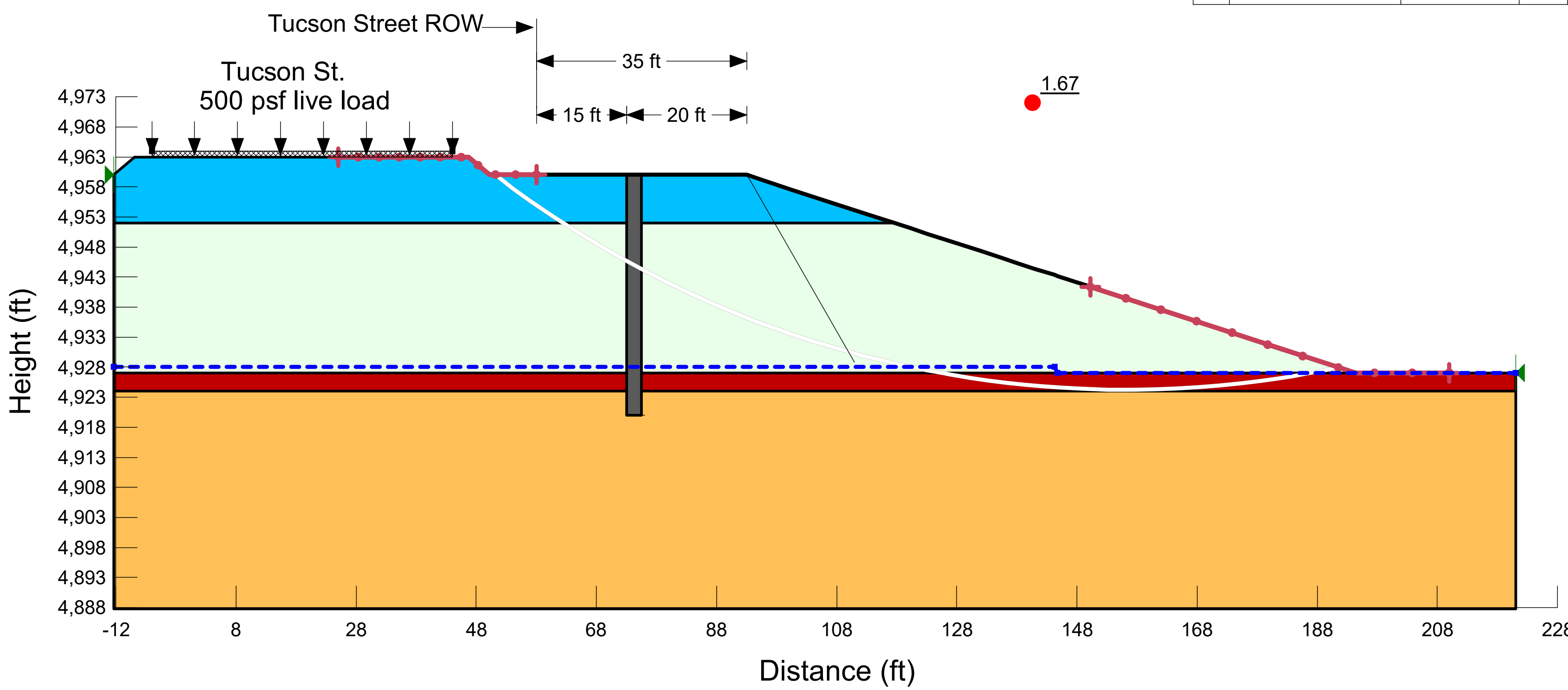


Figure B-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - EAST SIDE TUCSON STREET

TETRA TECH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

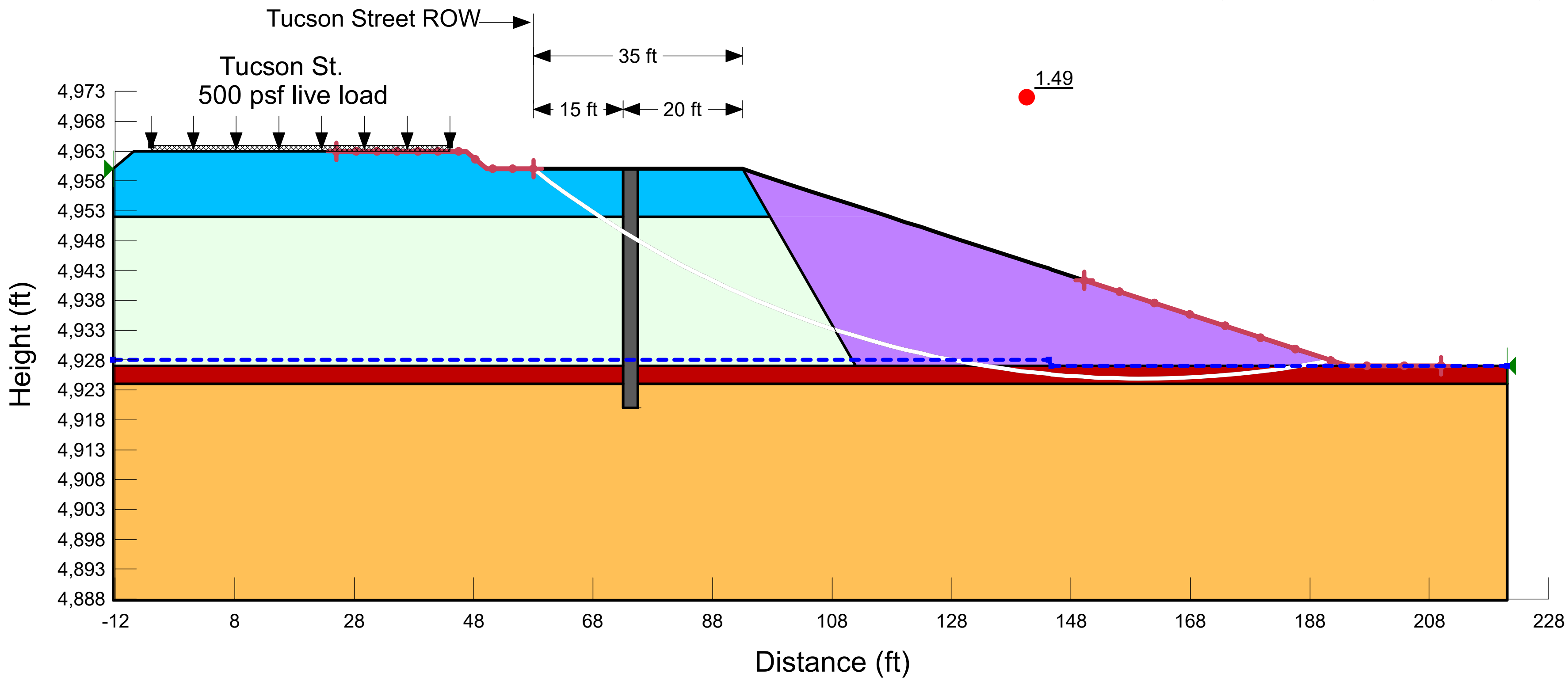


Figure B-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - SOUTH PLATTE RIVER

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

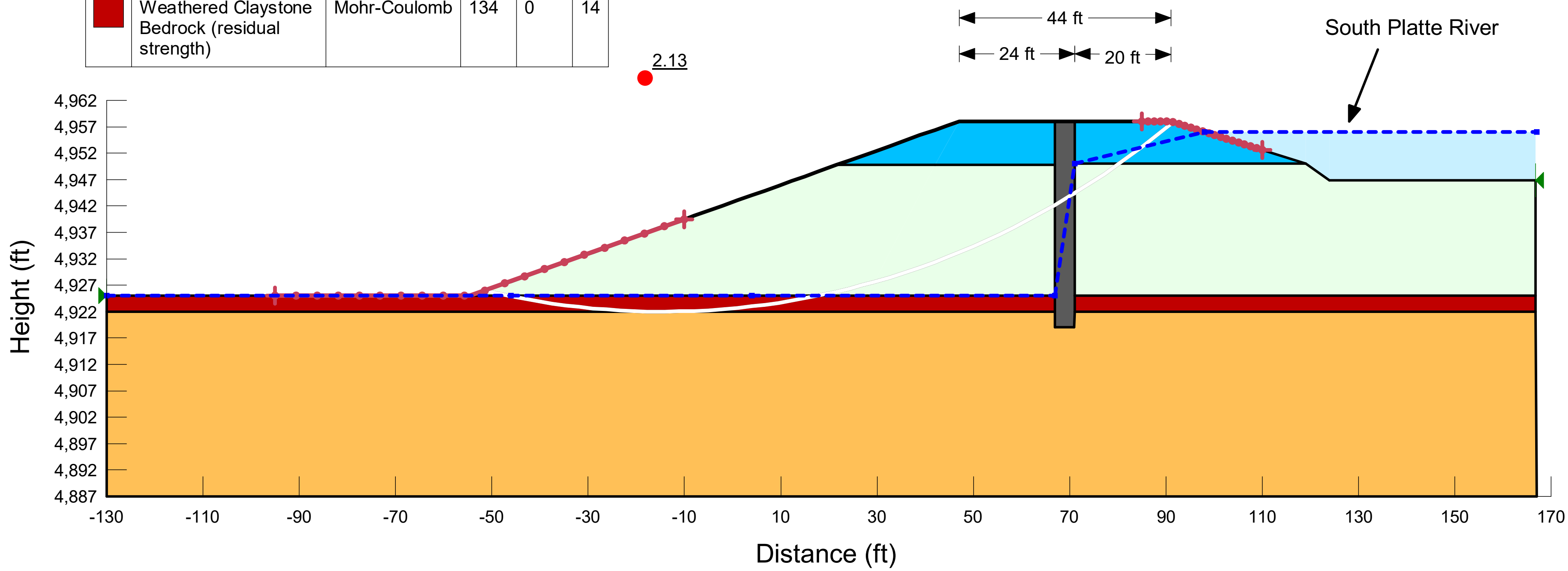


Figure C-1 - Static Analysis

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - SOUTH PLATTE RIVER

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

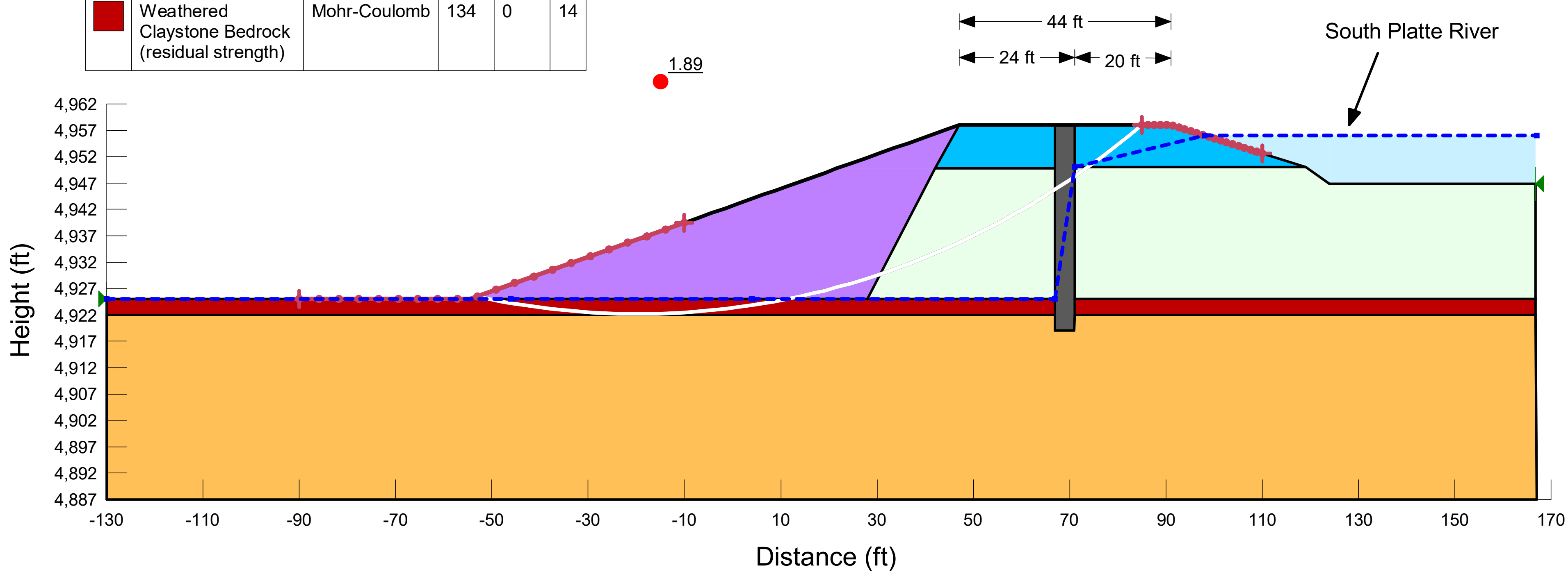


Figure C-1 - Static Analysis

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - SOUTH PLATTE RIVER

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

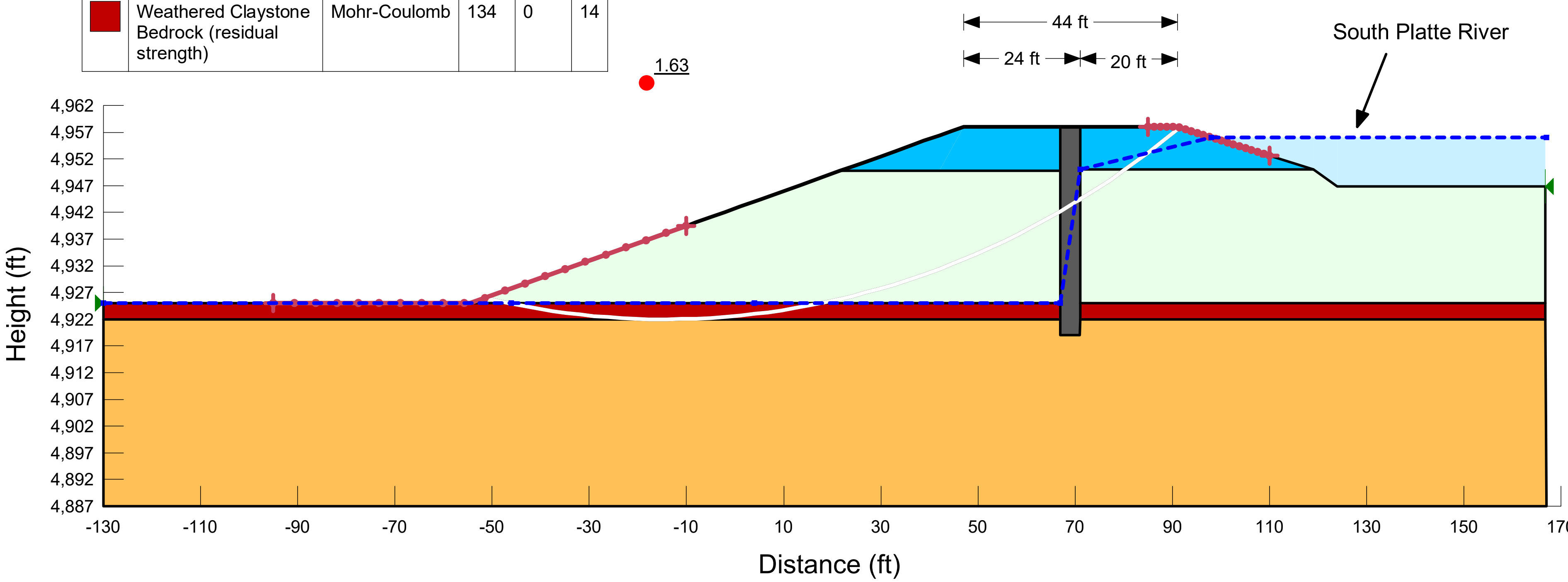


Figure C-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - SOUTH PLATTE RIVER

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

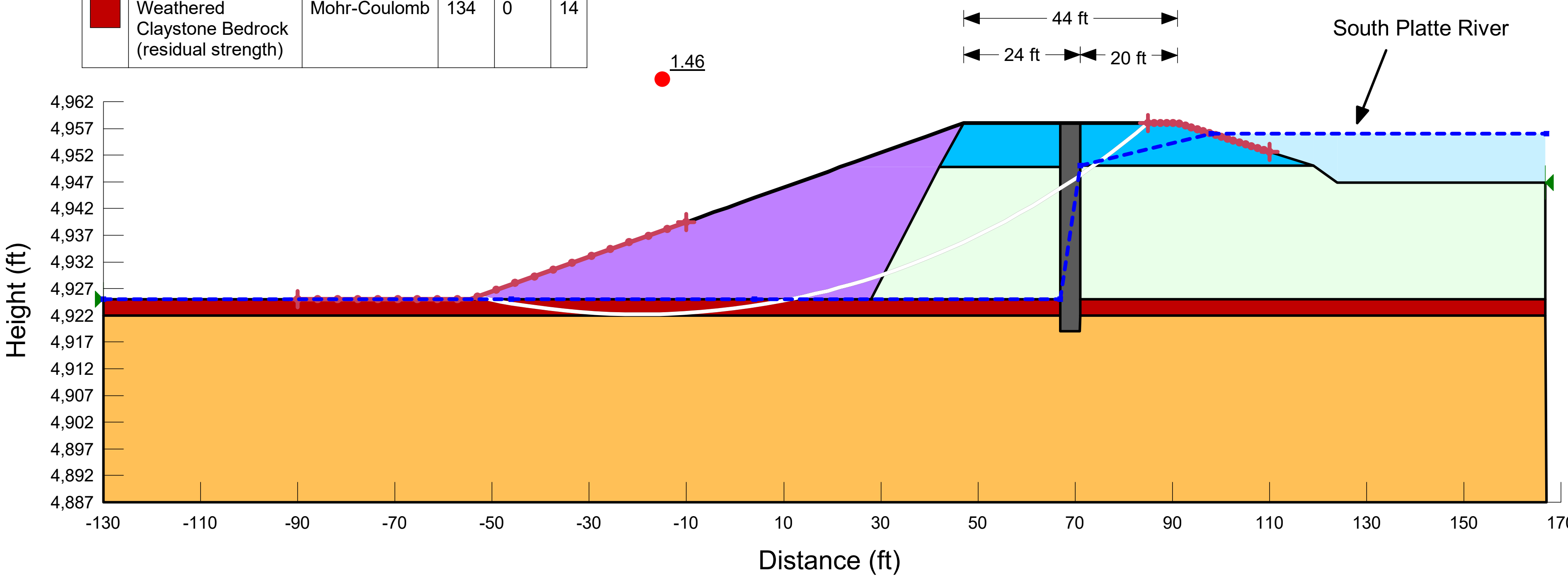


Figure C-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - PIPELINE (NORTH SIDE OF EAST CELL)

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

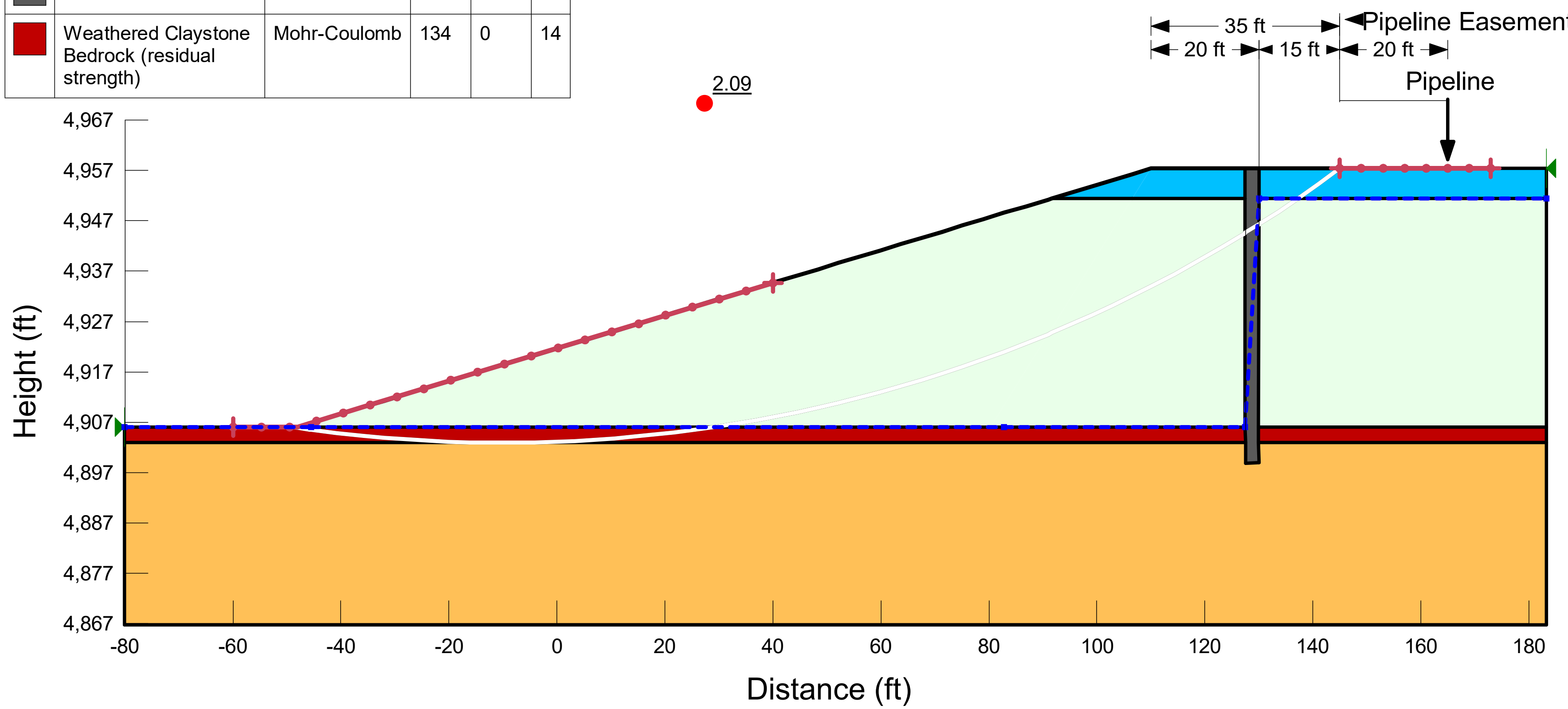


Figure D-1 - Static Analysis

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - PIPELINE (NORTH SIDE OF EAST CELL)

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

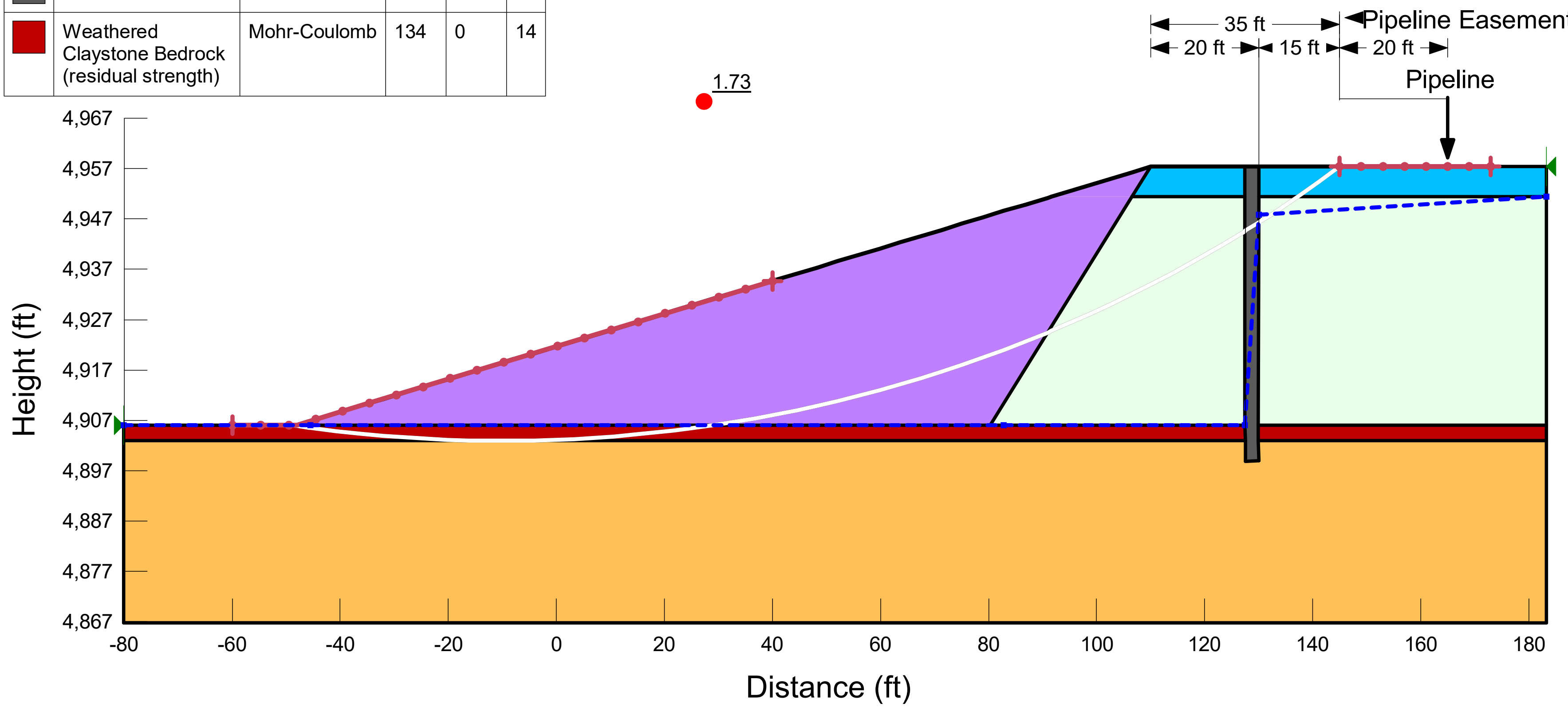


Figure D-1 - Static Analysis

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - PIPELINE (NORTH SIDE OF EAST CELL)

TETRA TECH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

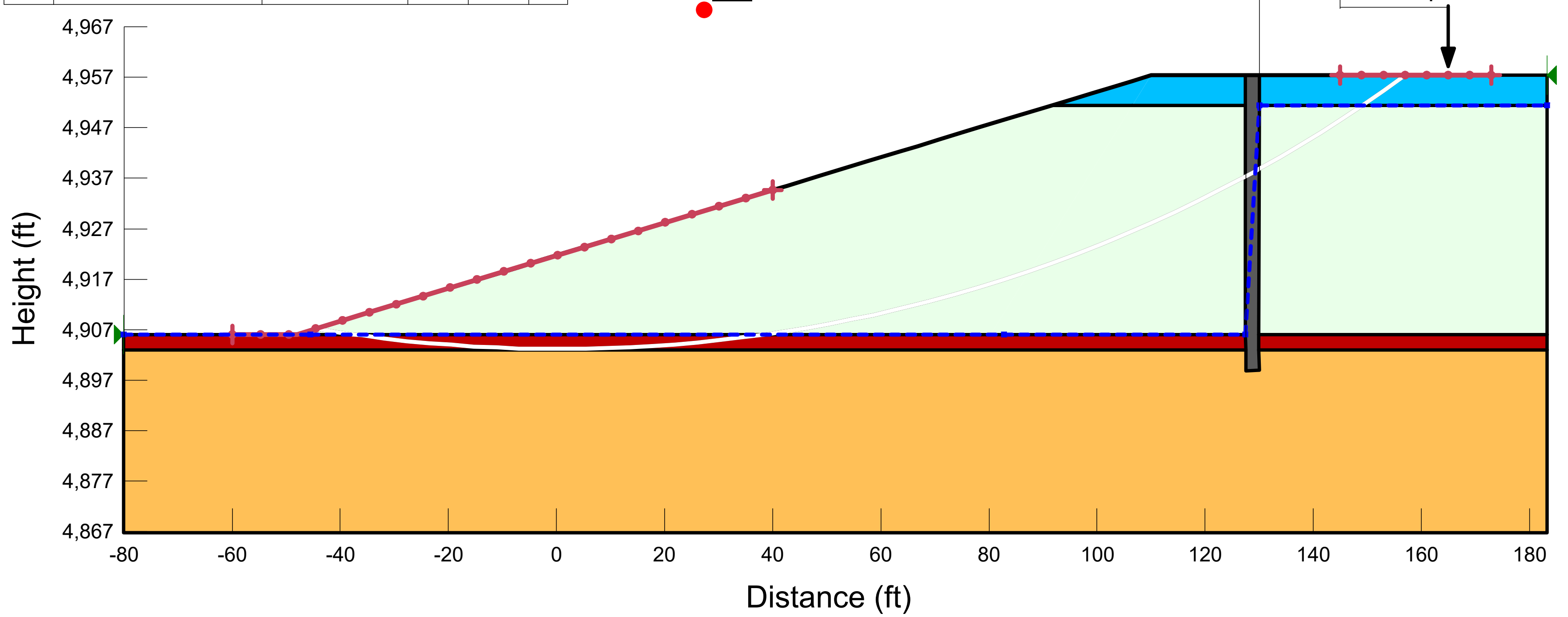


Figure D-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - PIPELINE (NORTH SIDE OF EAST CELL)

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

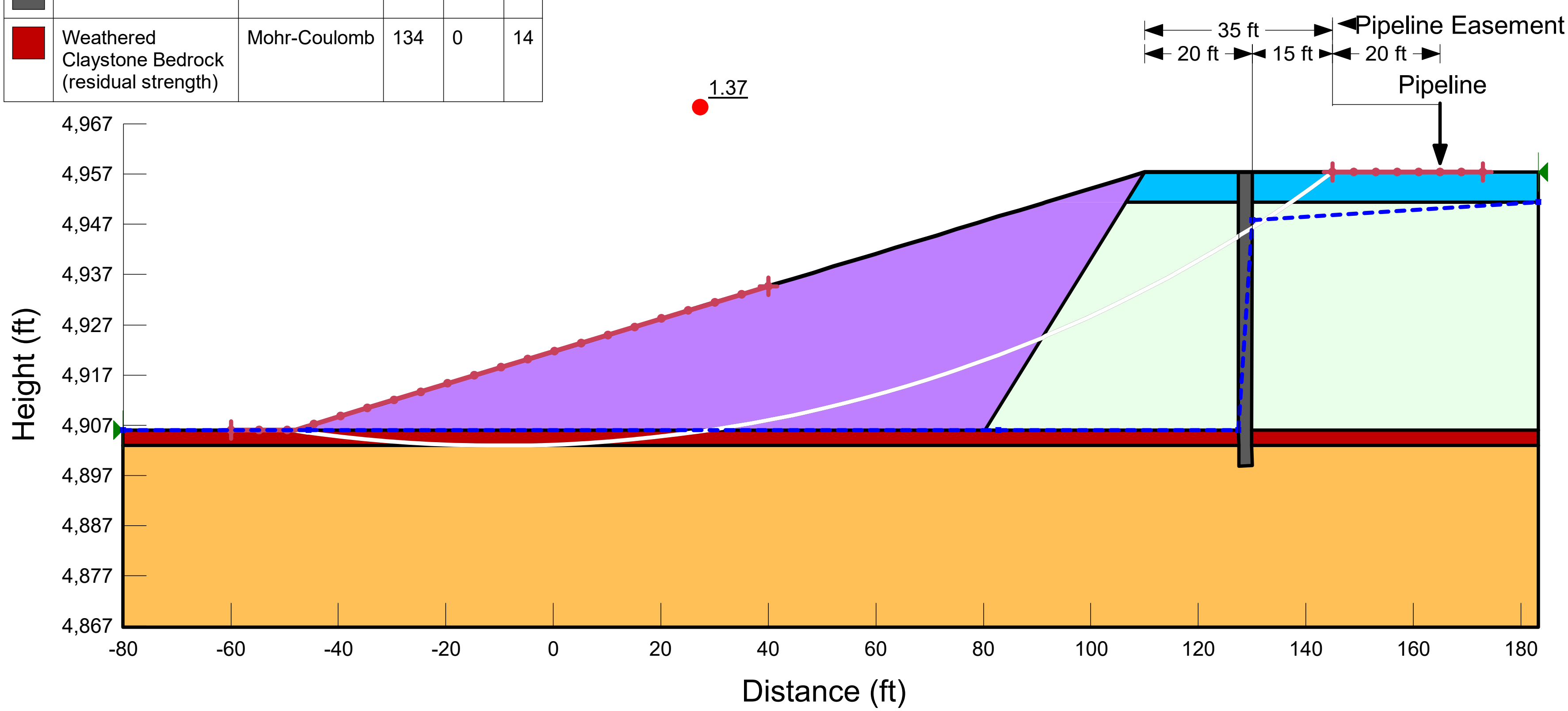


Figure D-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - GAS WELL/FENCE

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

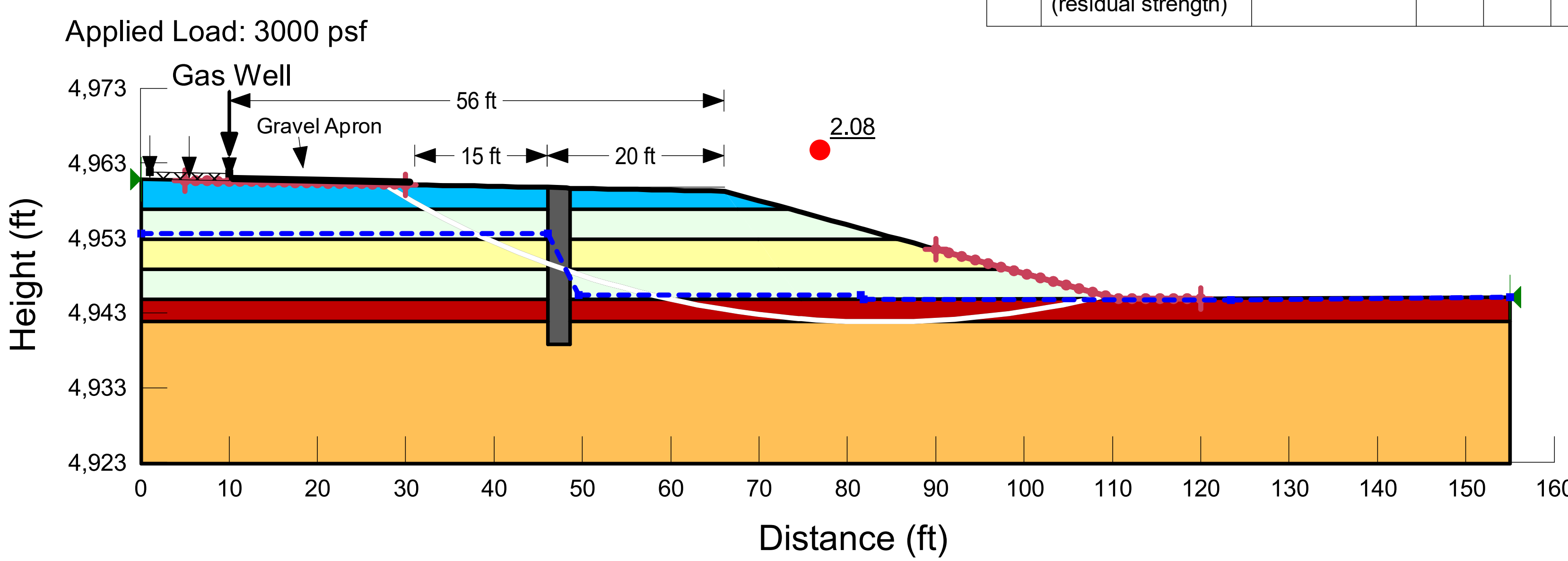


Figure E-1 - Static Analysis

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - GAS WELL/FENCE

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

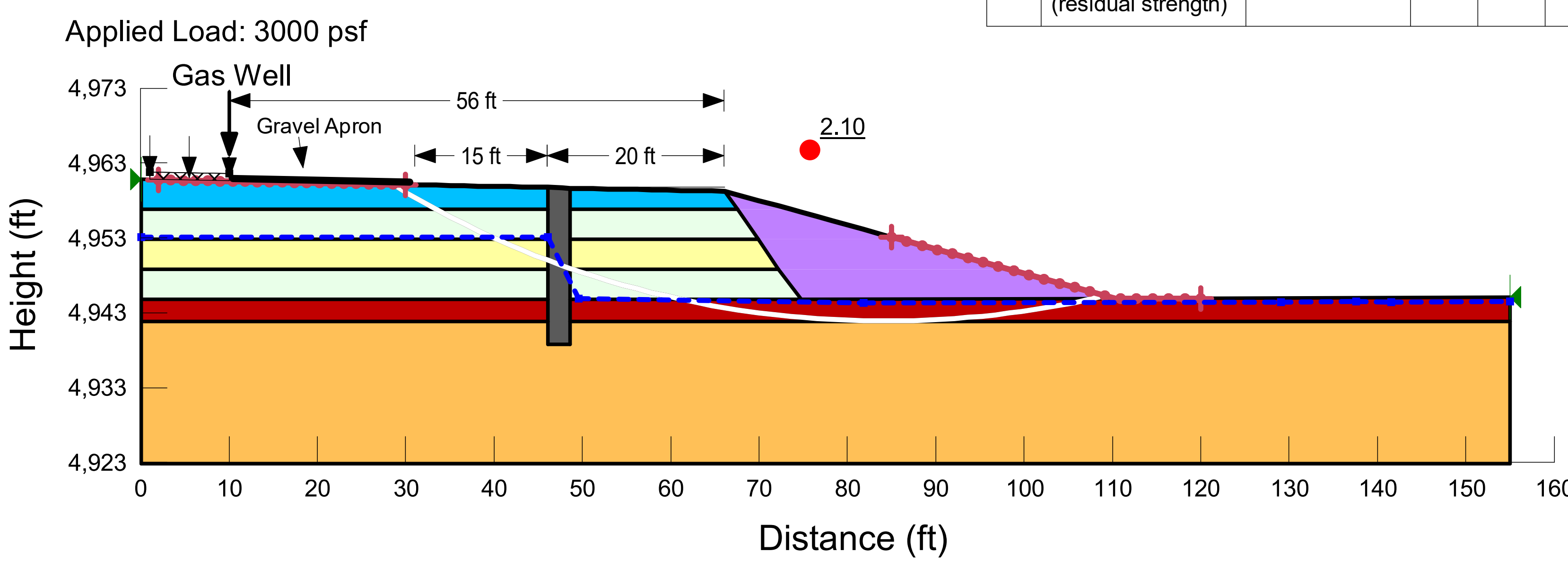


Figure E-1 - Static Analysis

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - GAS WELL/FENCE

TETRA TECH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

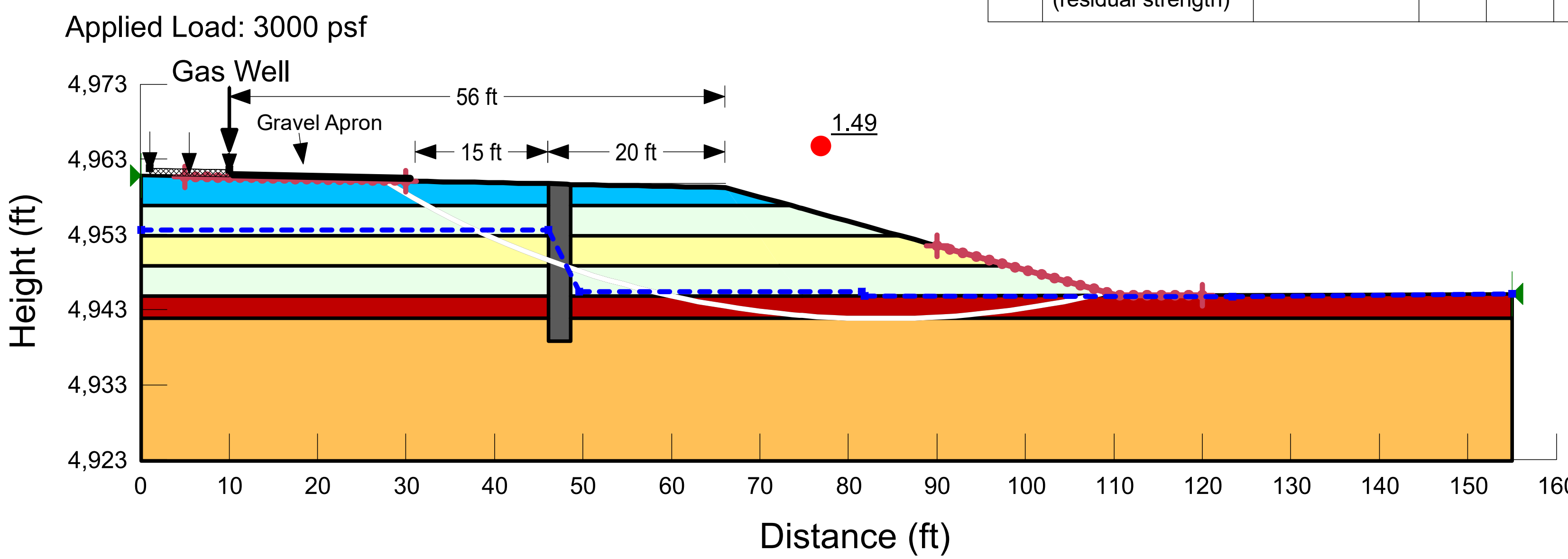


Figure E-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - GAS WELL/FENCE

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

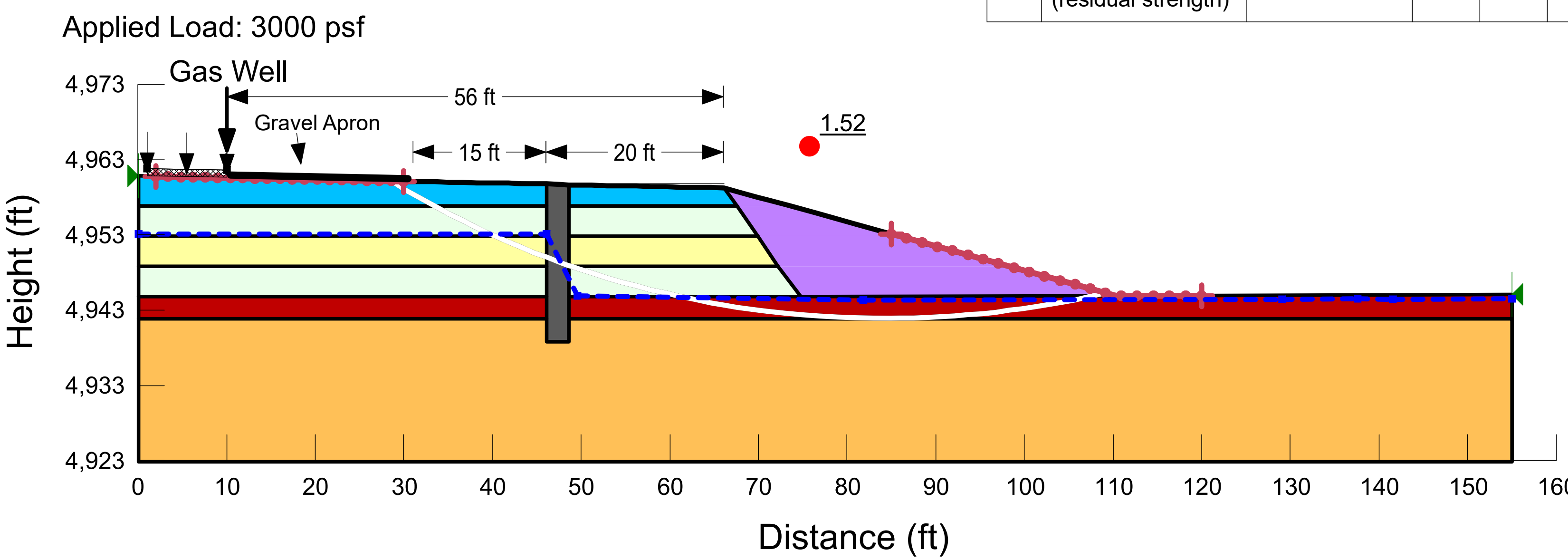


Figure E-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - POWER POLES

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

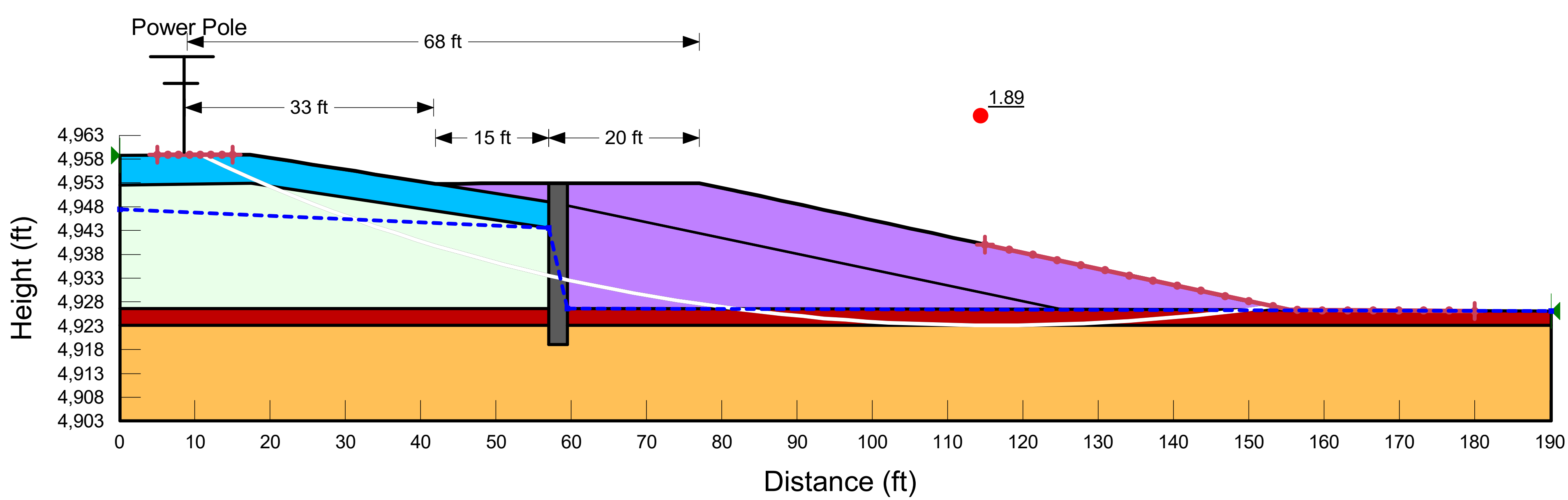


Figure F-1- Static Analysis

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - POWER POLES

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

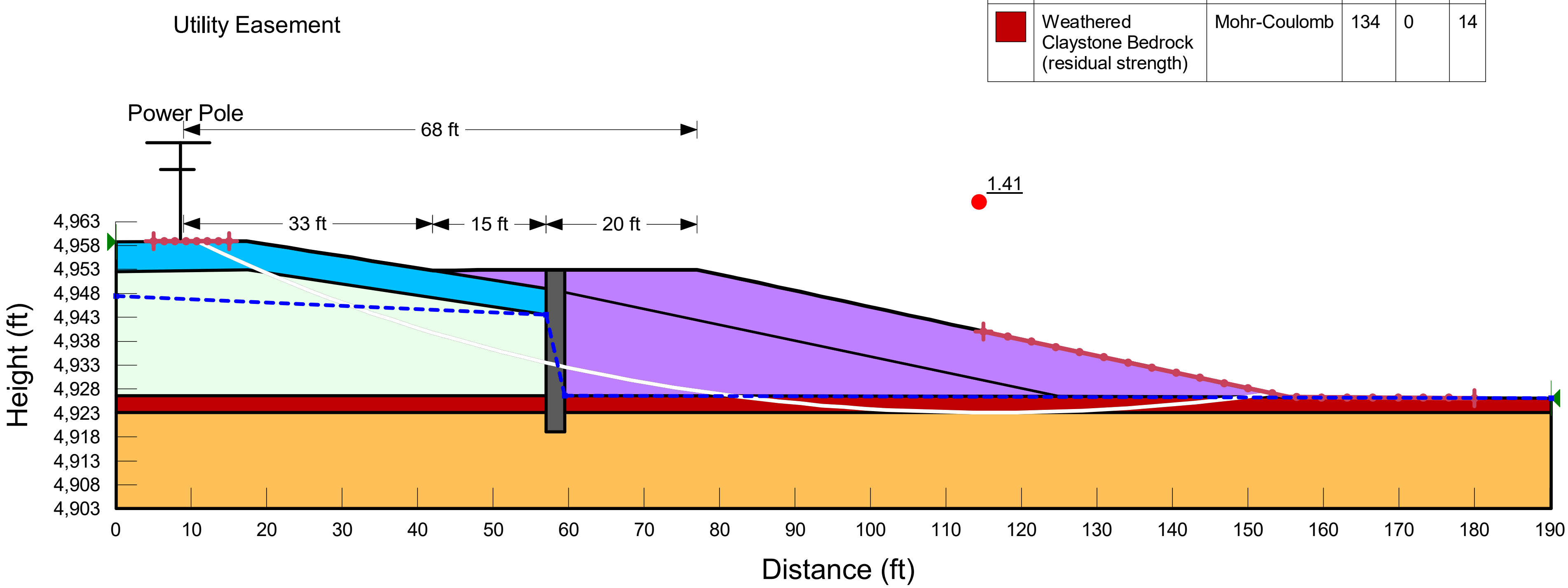


Figure F-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - BRIGHTON DITCH

TETRA TECH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

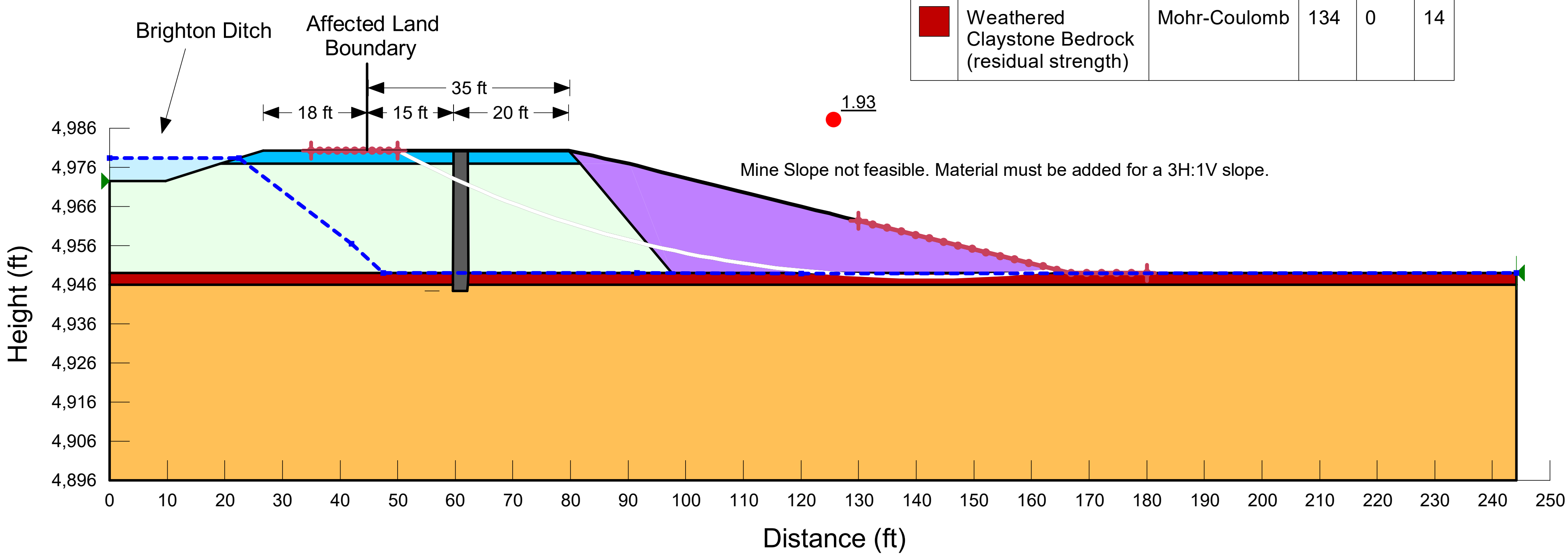


Figure G-1 - Static Analysis

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - BRIGHTON DITCH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

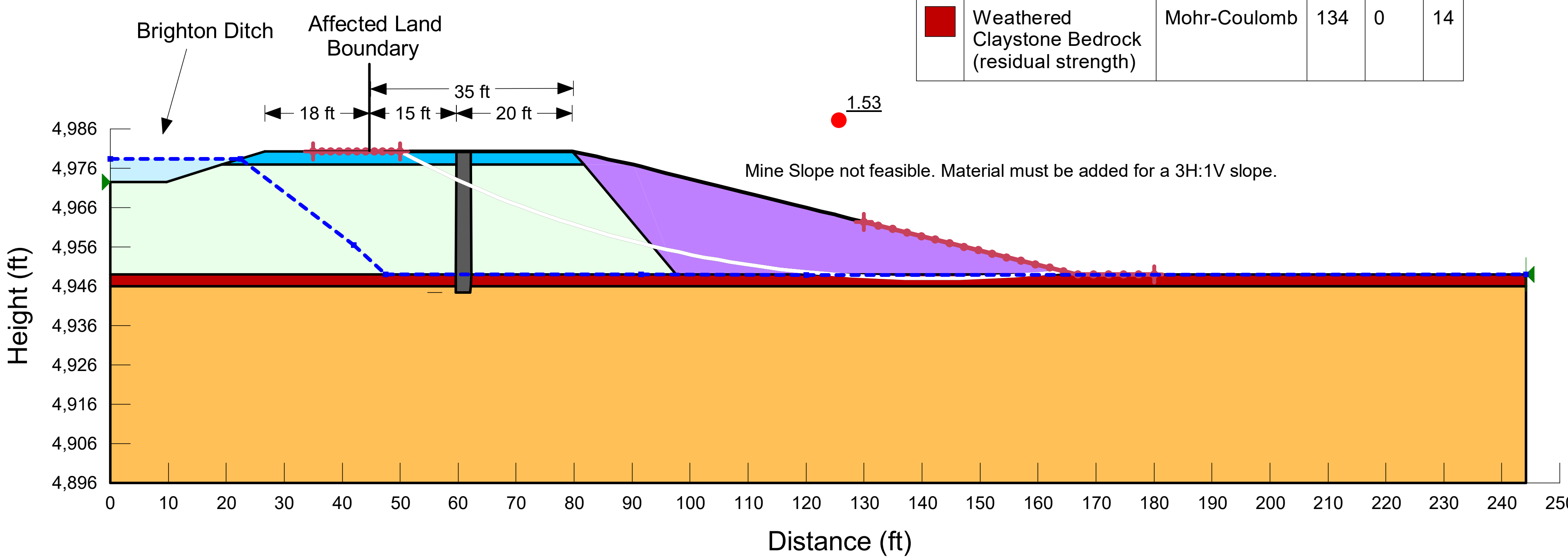


Figure G-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - HIGHWAY 7 FROM NORTH CELL (EAST)

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

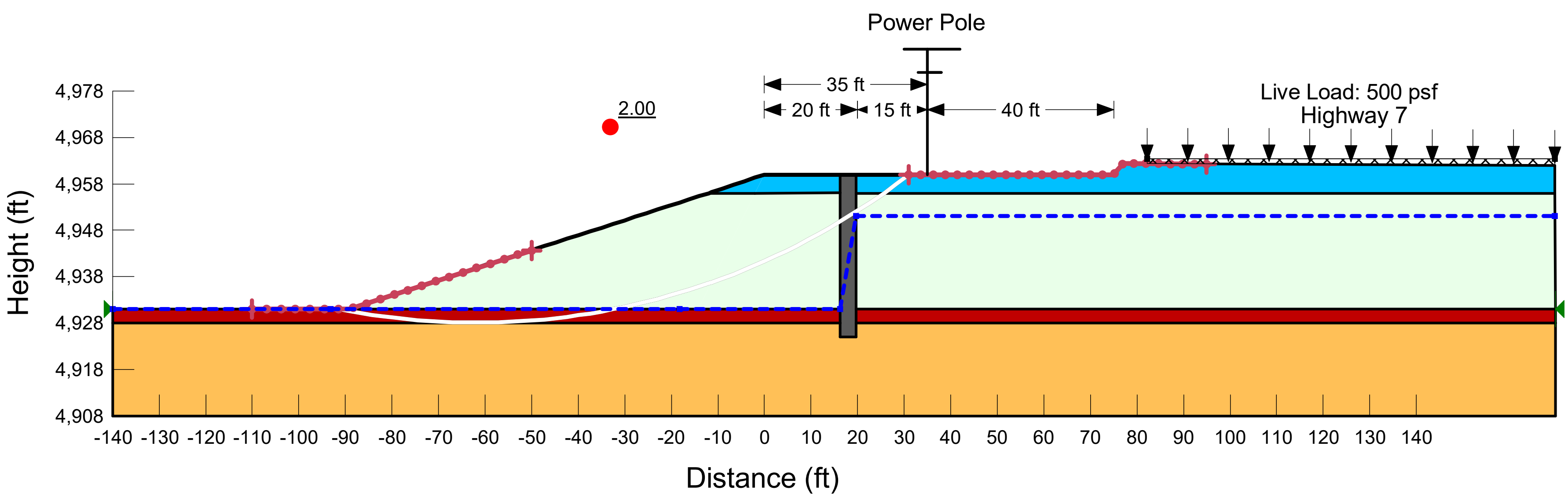


Figure H-1 - Static Analysis

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - HIGHWAY 7 FROM NORTH CELL (EAST)

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

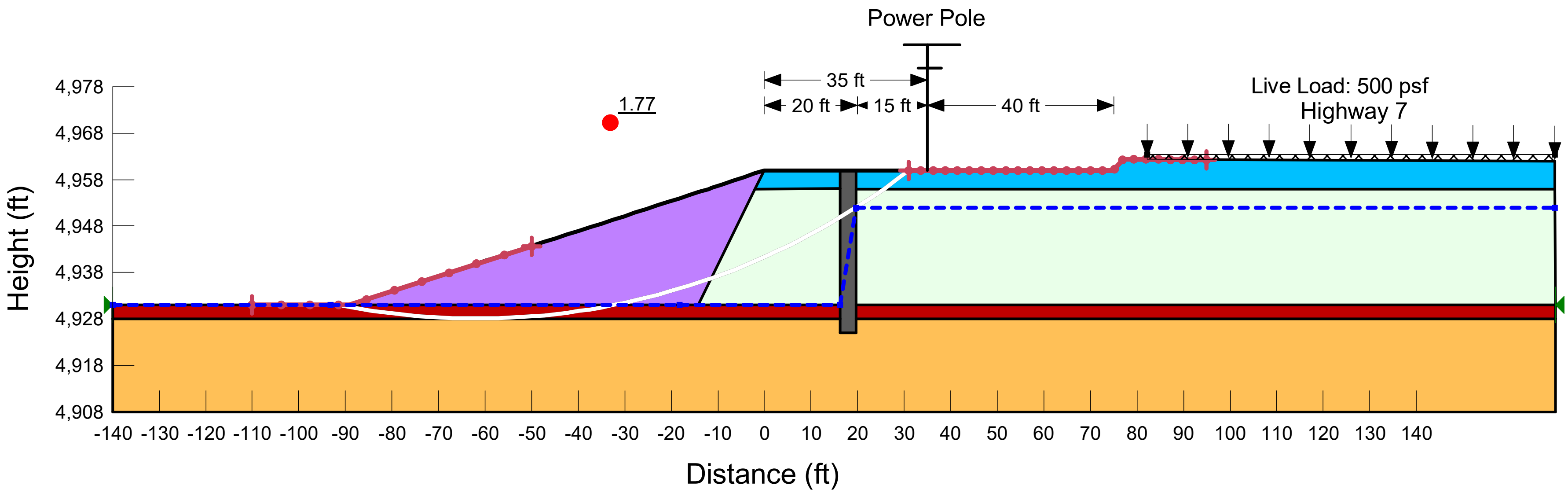


Figure H-1 - Static Analysis

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - HIGHWAY 7 FROM NORTH CELL (EAST)

TETRA TECH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

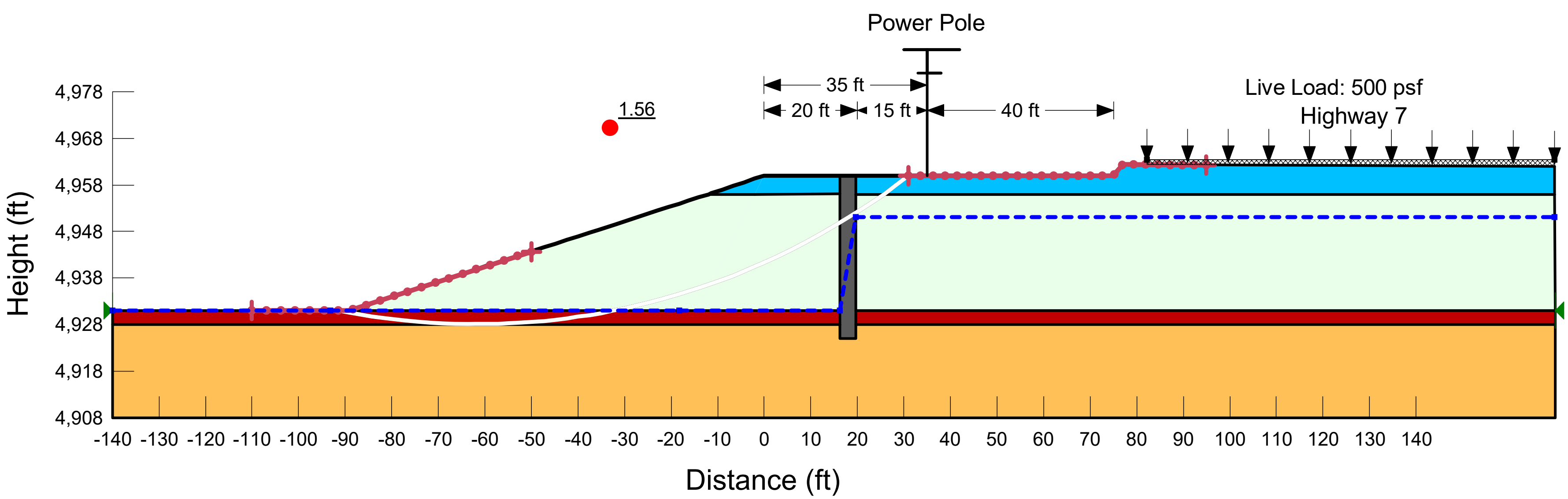


Figure H-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - HIGHWAY 7 FROM NORTH CELL (EAST)

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

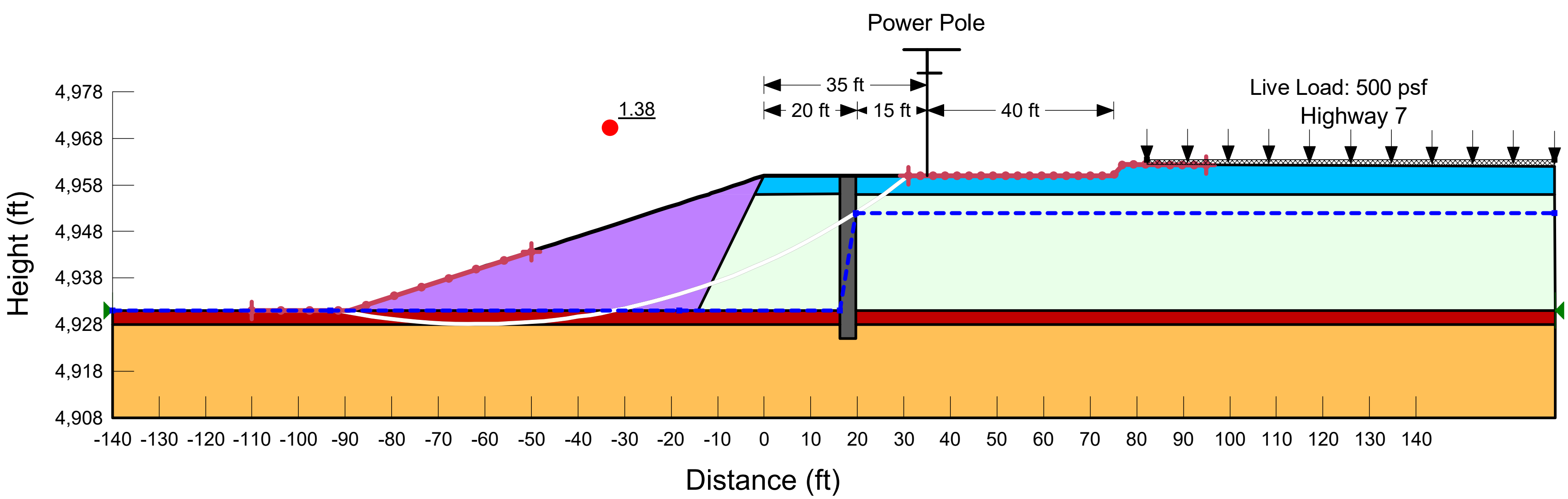


Figure H-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - HIGHWAY 7 FROM SOUTH CELL

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

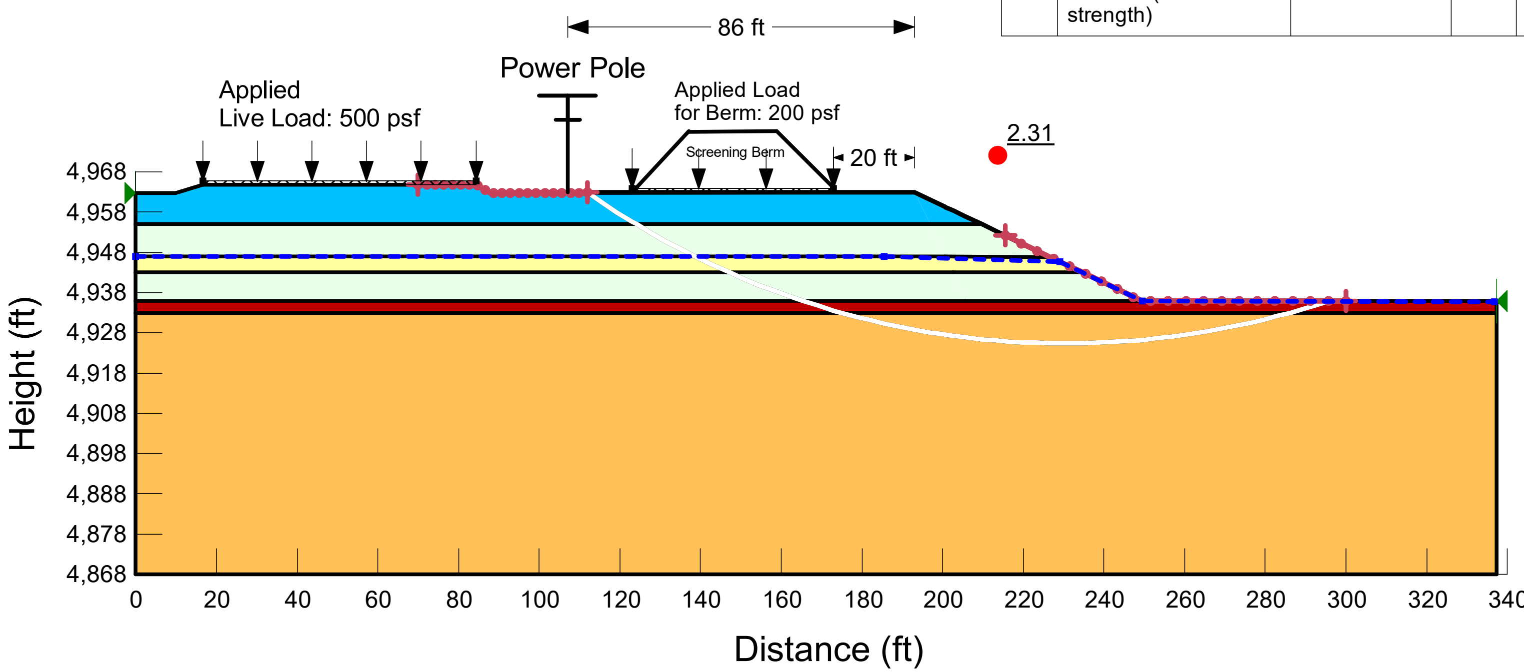


Figure I-1 - Static Analysis with High Phreatic Surface

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - HIGHWAY 7 FROM SOUTH CELL

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

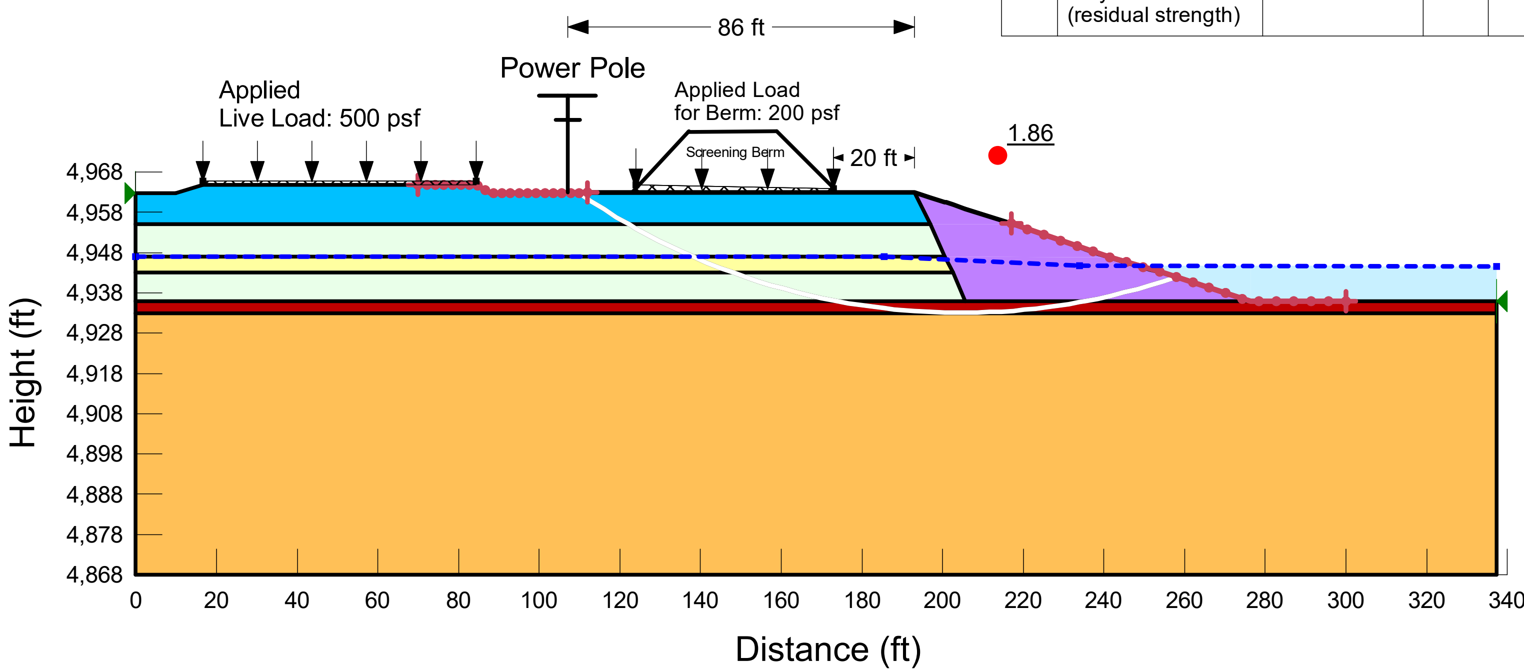


Figure I-2 - Pseudostatic Analysis with High Phreatic Surface

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - HIGHWAY 7 FROM SOUTH CELL

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

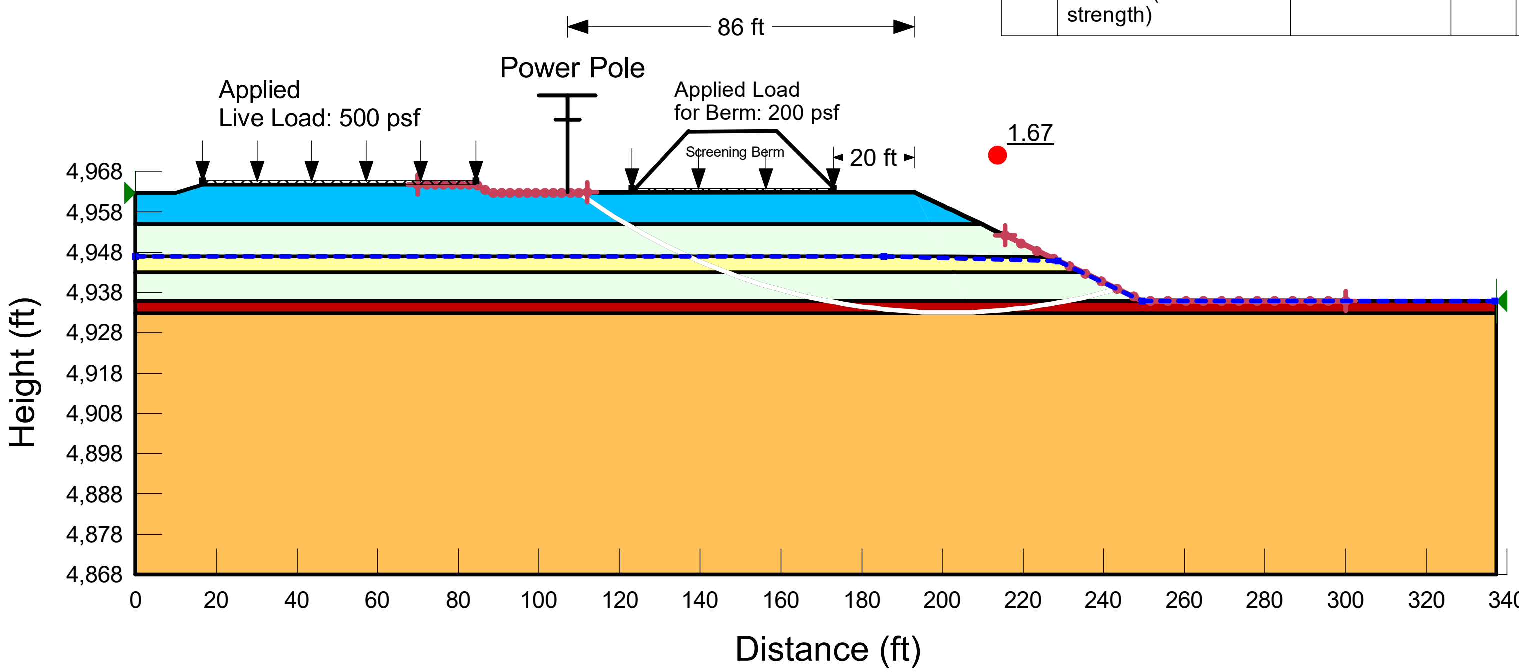


Figure I-2 - Pseudostatic Analysis with High Phreatic Surface

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - HIGHWAY 7 FROM SOUTH CELL

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

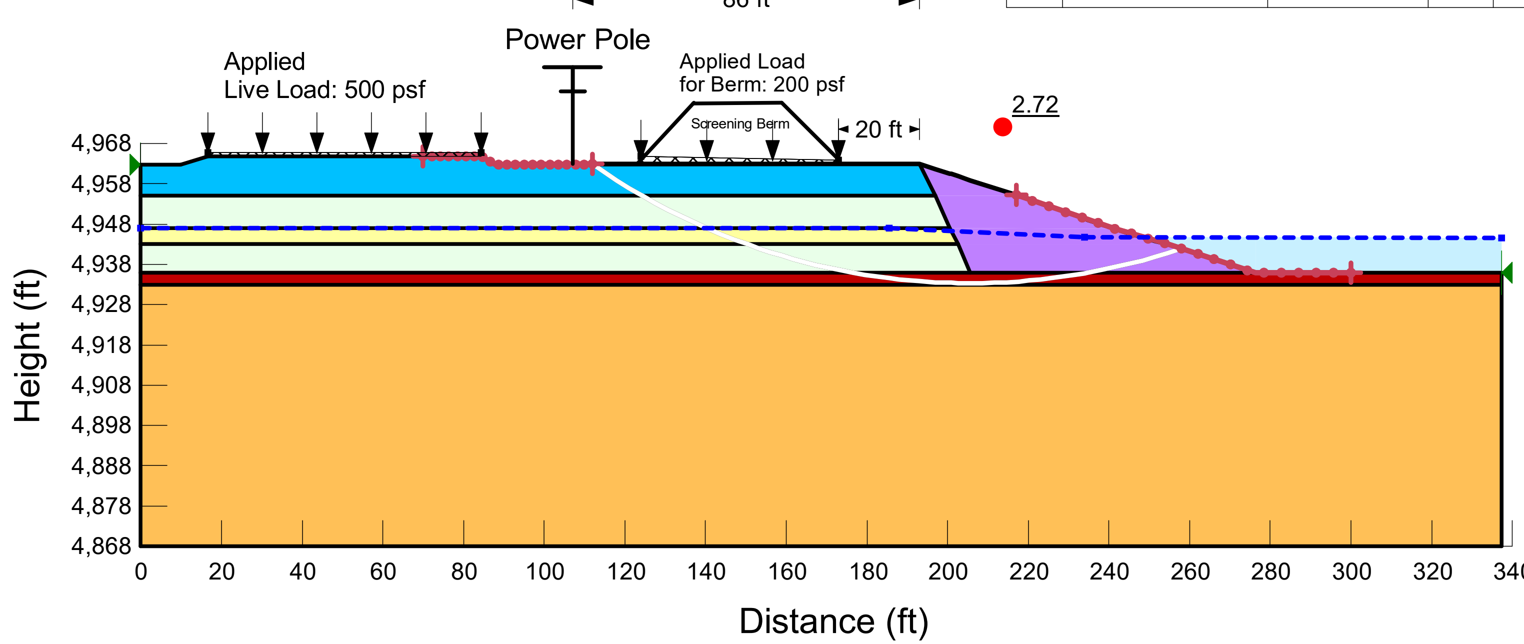


Figure I-1 - Static Analysis with High Phreatic Surface

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - BRIGHTON RETURN DITCH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

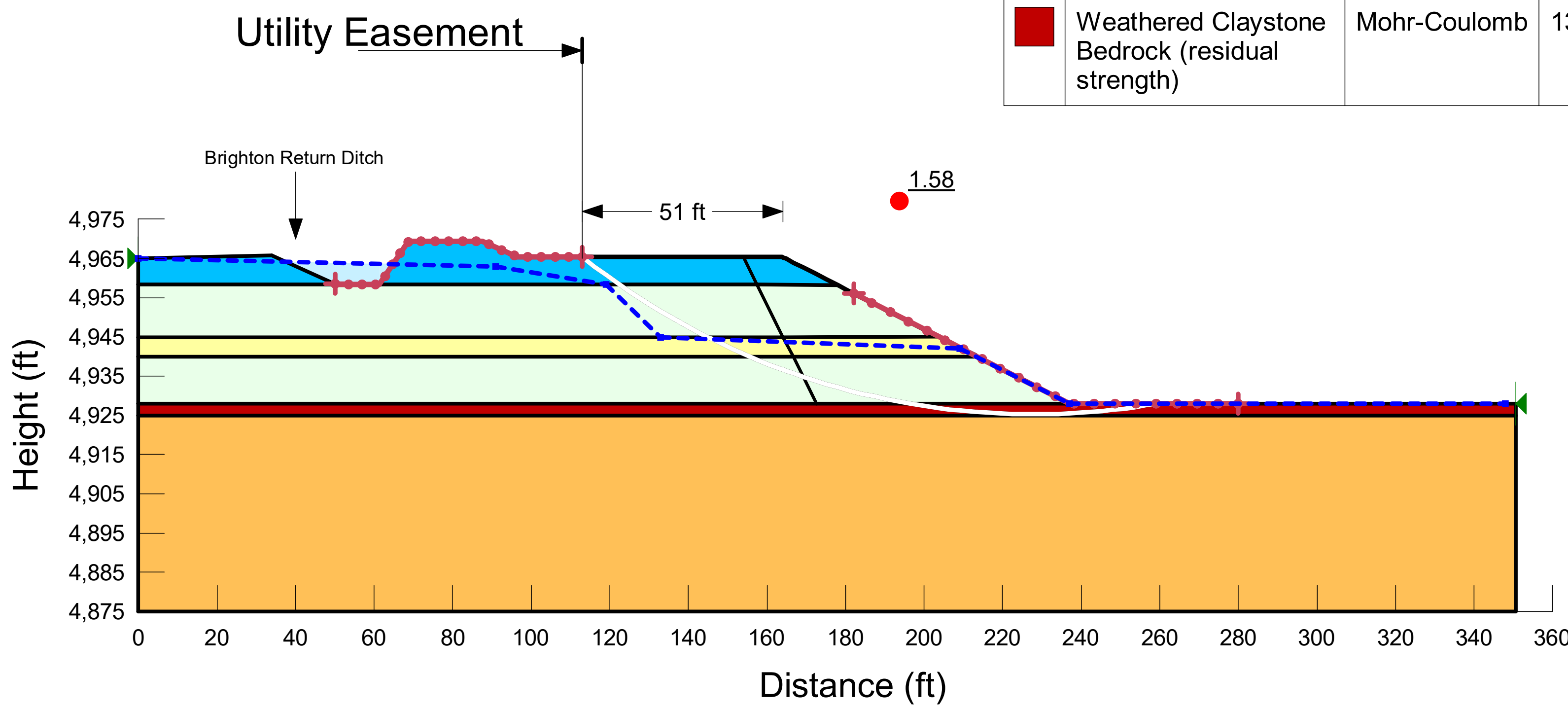


Figure J-1 - Static Analysis

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - BRIGHTON RETURN DITCH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

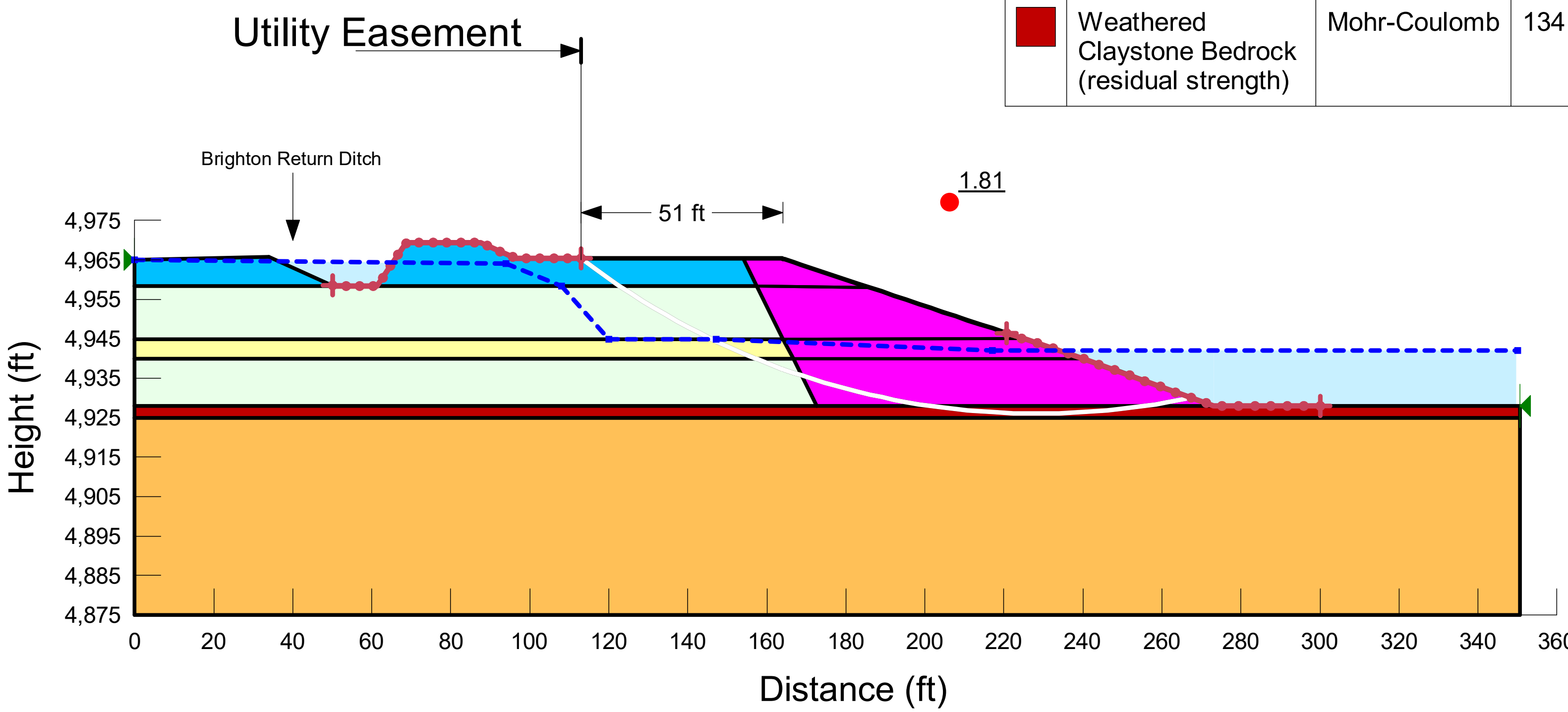


Figure J-1 - Static Analysis

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - BRIGHTON RETURN DITCH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

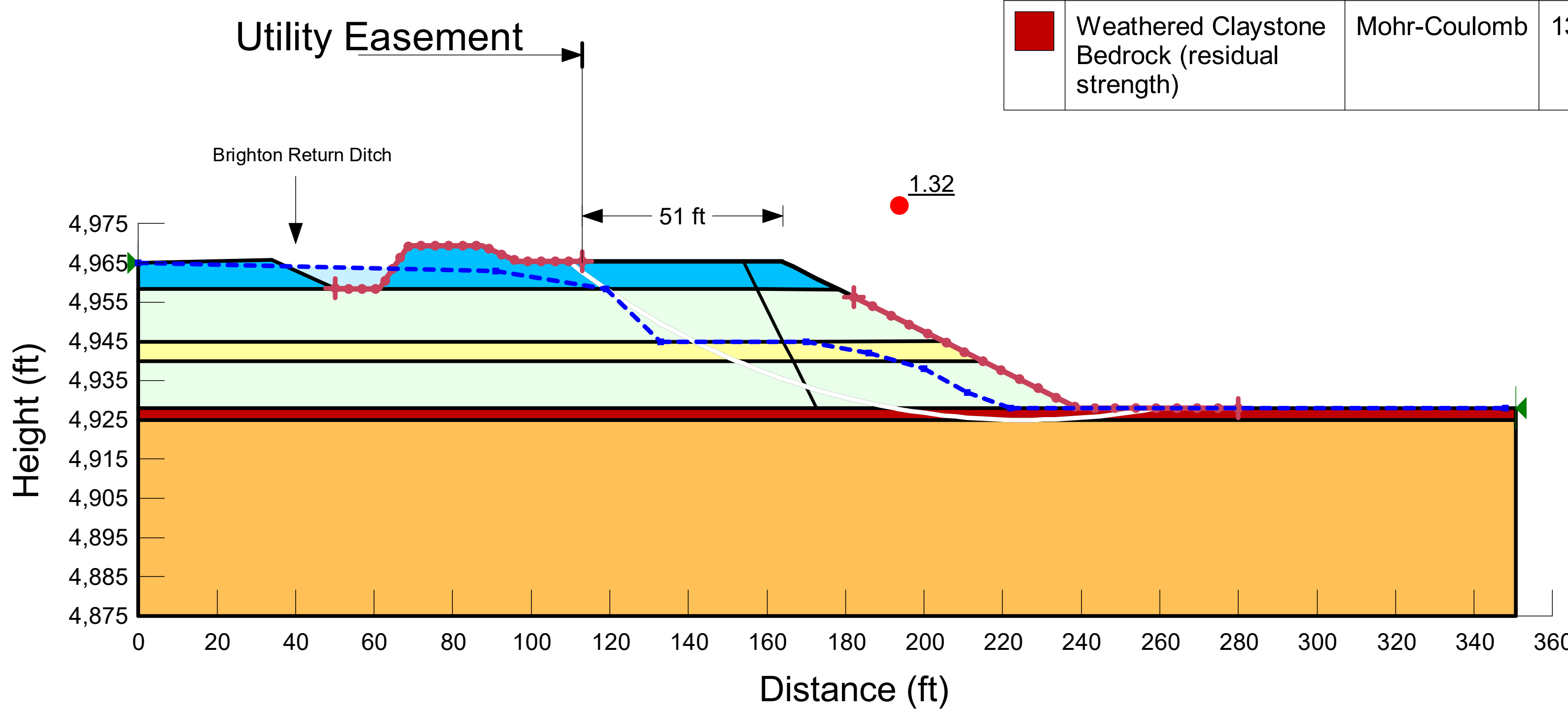


Figure J-2 - Pseudostatic Analysis with Mine Slope- Lowered Phreatic Surface

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - BRIGHTON RETURN DITCH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

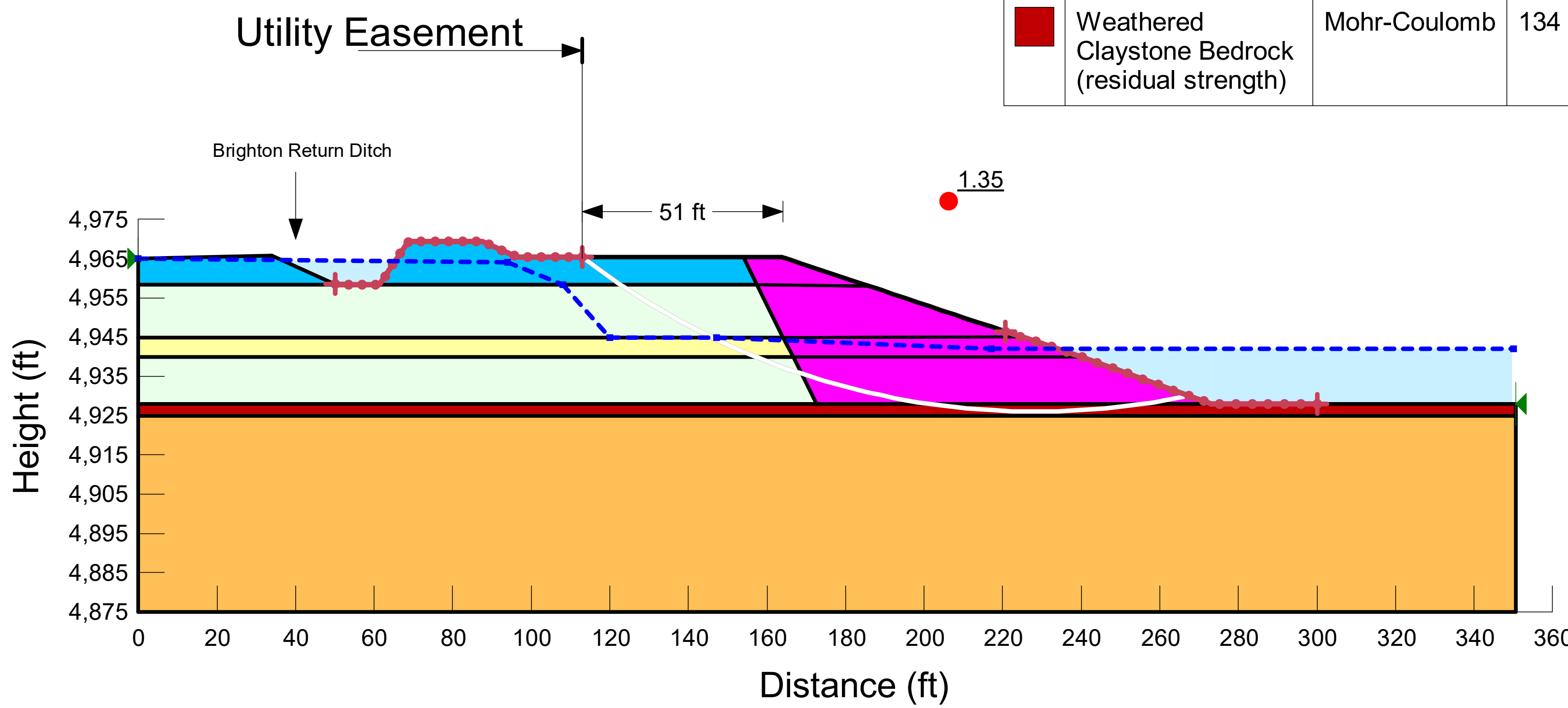


Figure J-2 - Pseudostatic Analysis with Mine Slope- Lowered Phreatic Surface

Horizontal Acceleration Coefficient: 0.067g

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - GRAVEL ROAD/BUILDING

TETRA TECH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

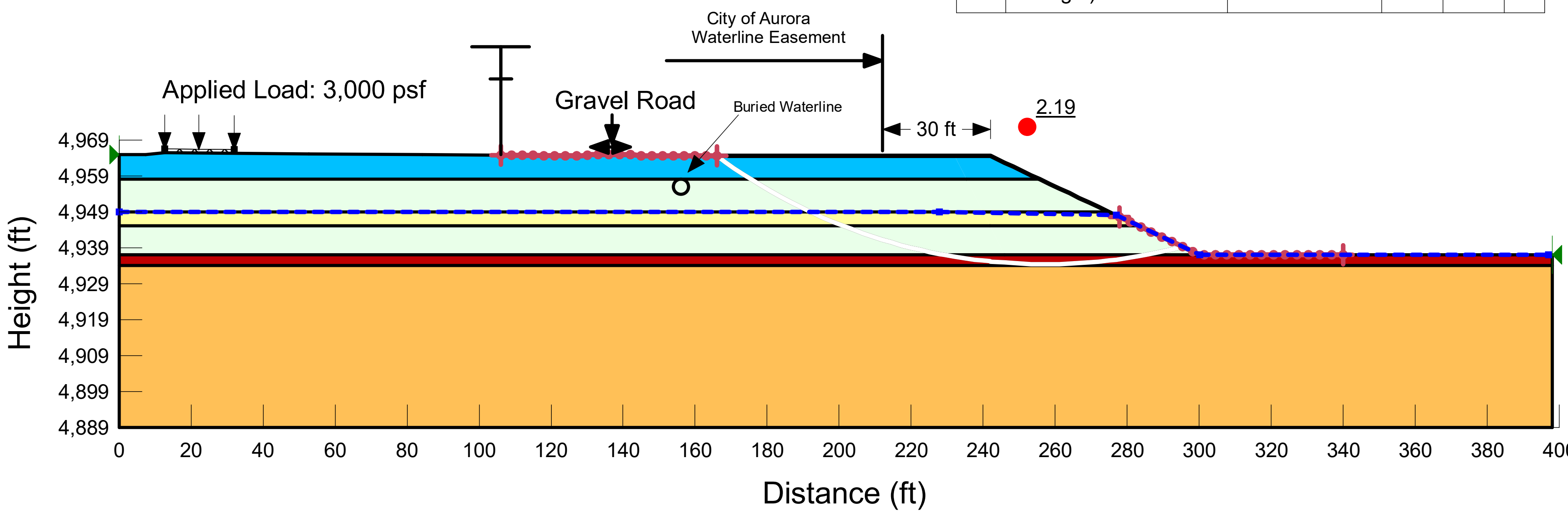


Figure K-1 - Static Analysis with High Phreatic Surface

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - GRAVEL ROAD/BUILDING

TETRA TECH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

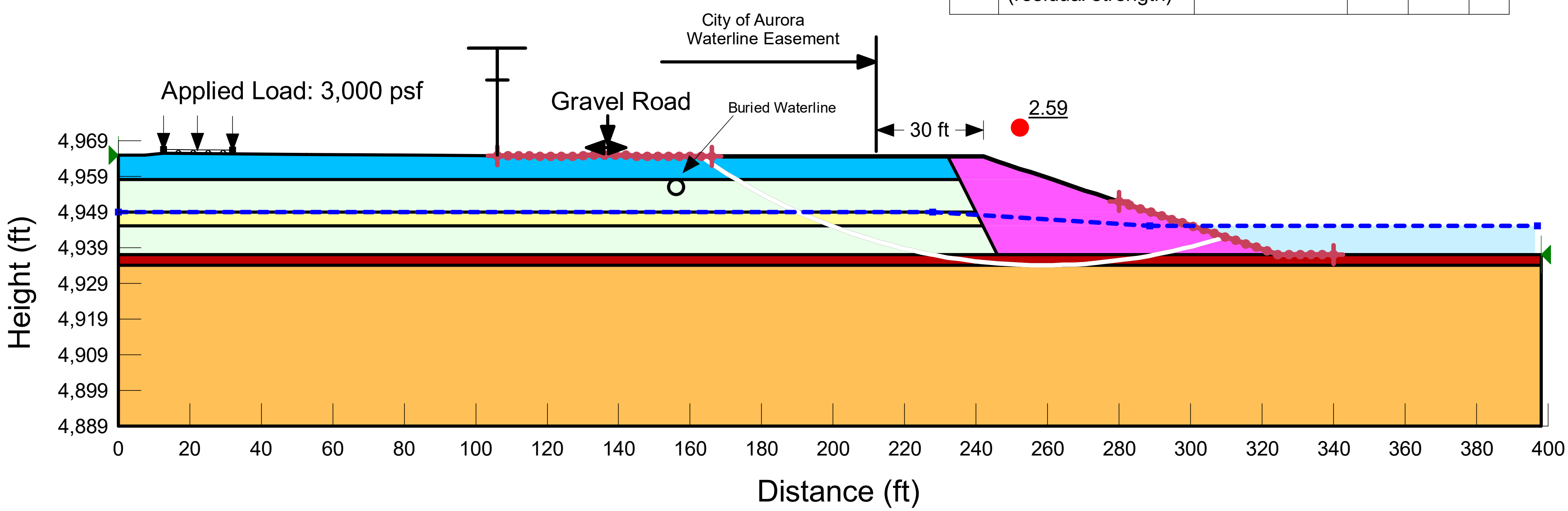


Figure K-1 - Static Analysis with High Phreatic Surface

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - GRAVEL ROAD/BUILDING

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

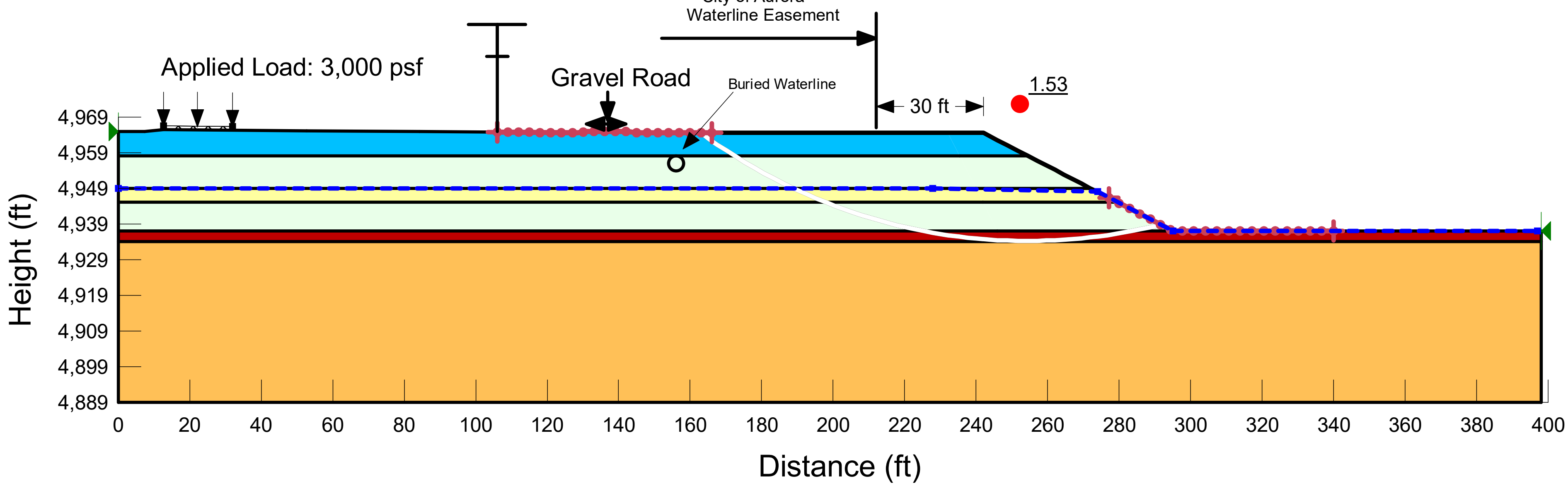


Figure K-2 - Pseudostatic Analysis with High Phreatic Surface

Horizontal Acceleration Coefficient: 0.067g

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - GRAVEL ROAD/BUILDING

TETRA TECH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

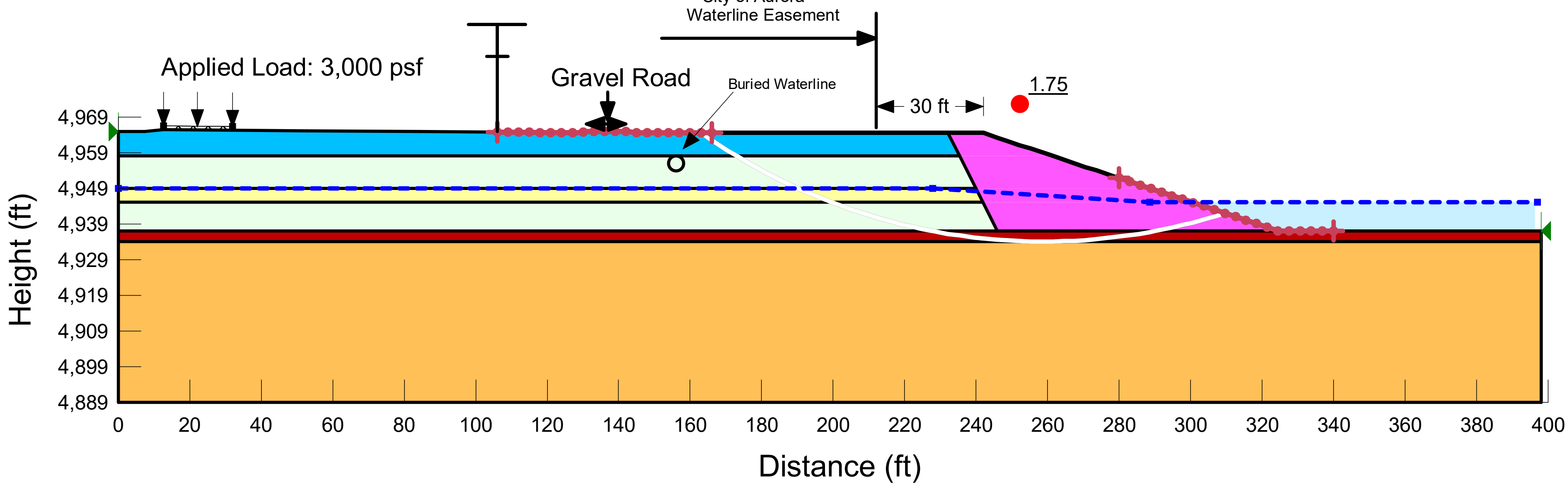


Figure K-2 - Pseudostatic Analysis with High Phreatic Surface

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - CHALLENGER PIT

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Reclamation Slope Fill	Mohr-Coulomb	126	25	26
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

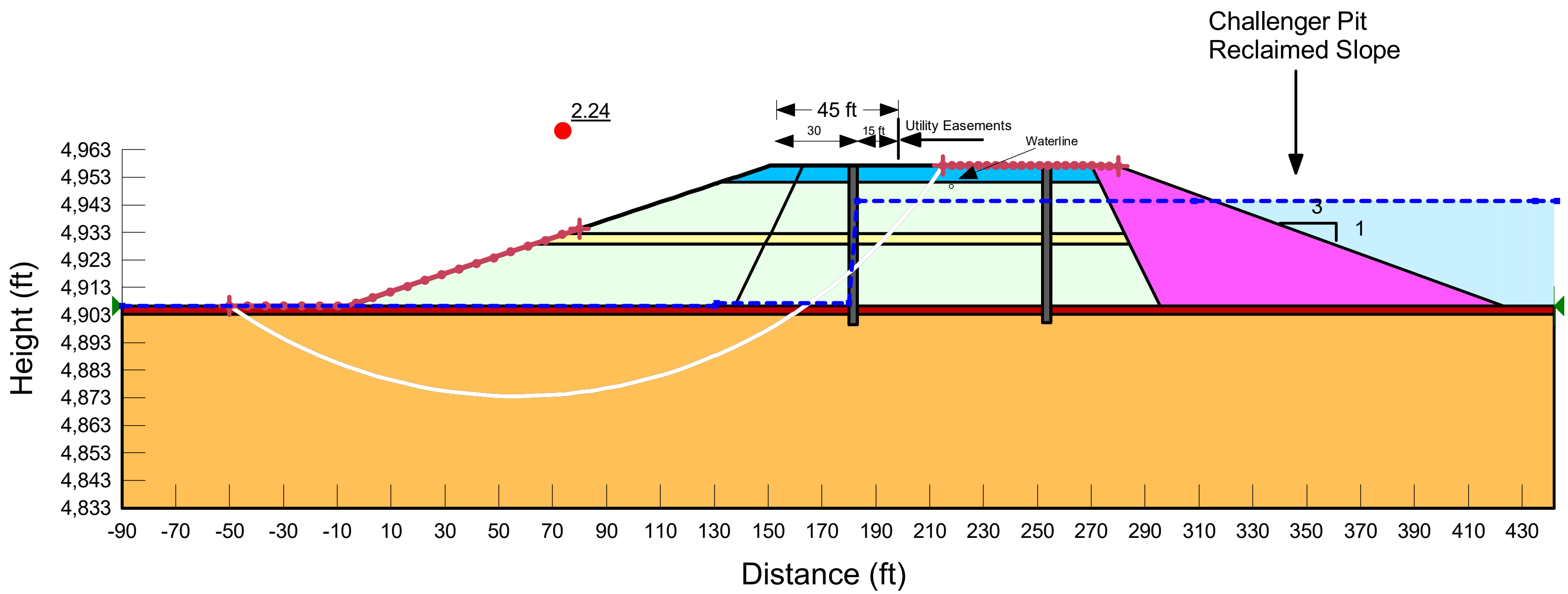


Figure L-1 - Static Analysis

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - CHALLENGER PIT

TETRA TECH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Reclamation Slope Fill	Mohr-Coulomb	126	25	26
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

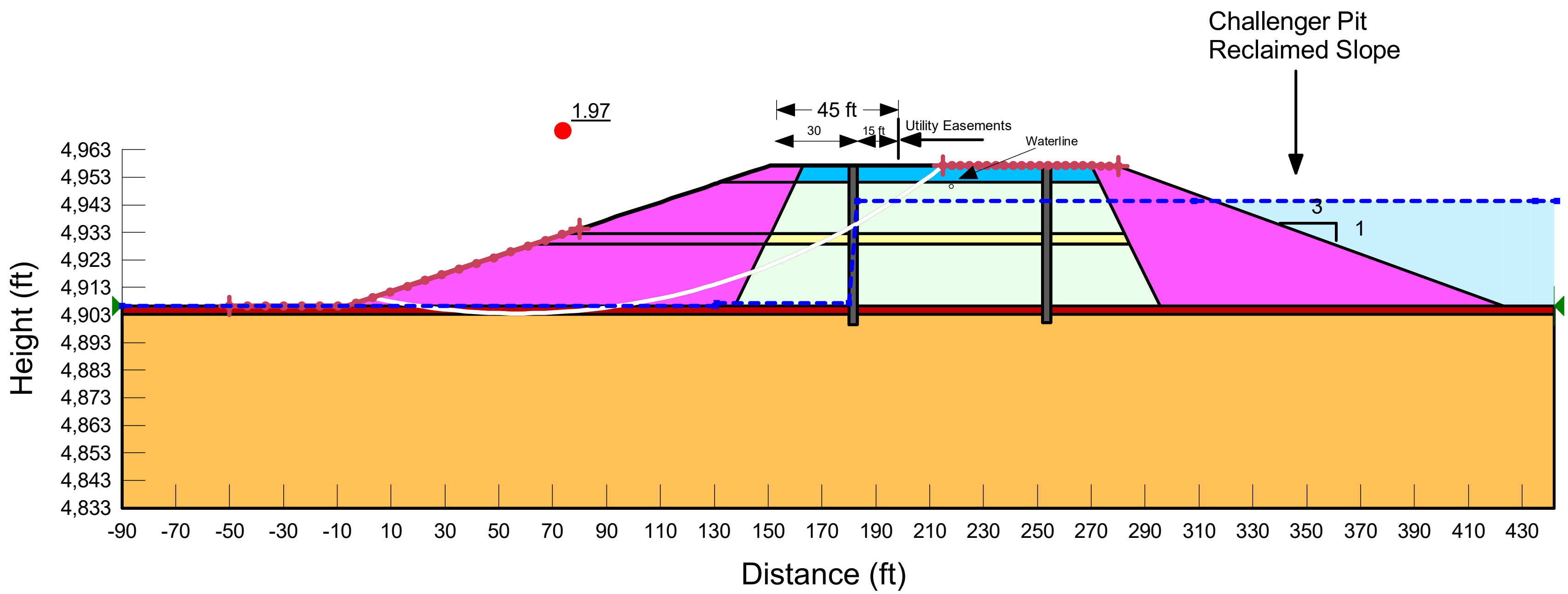


Figure L-1 - Static Analysis

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - CHALLENGER PIT

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Reclamation Slope Fill	Mohr-Coulomb	126	25	26
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

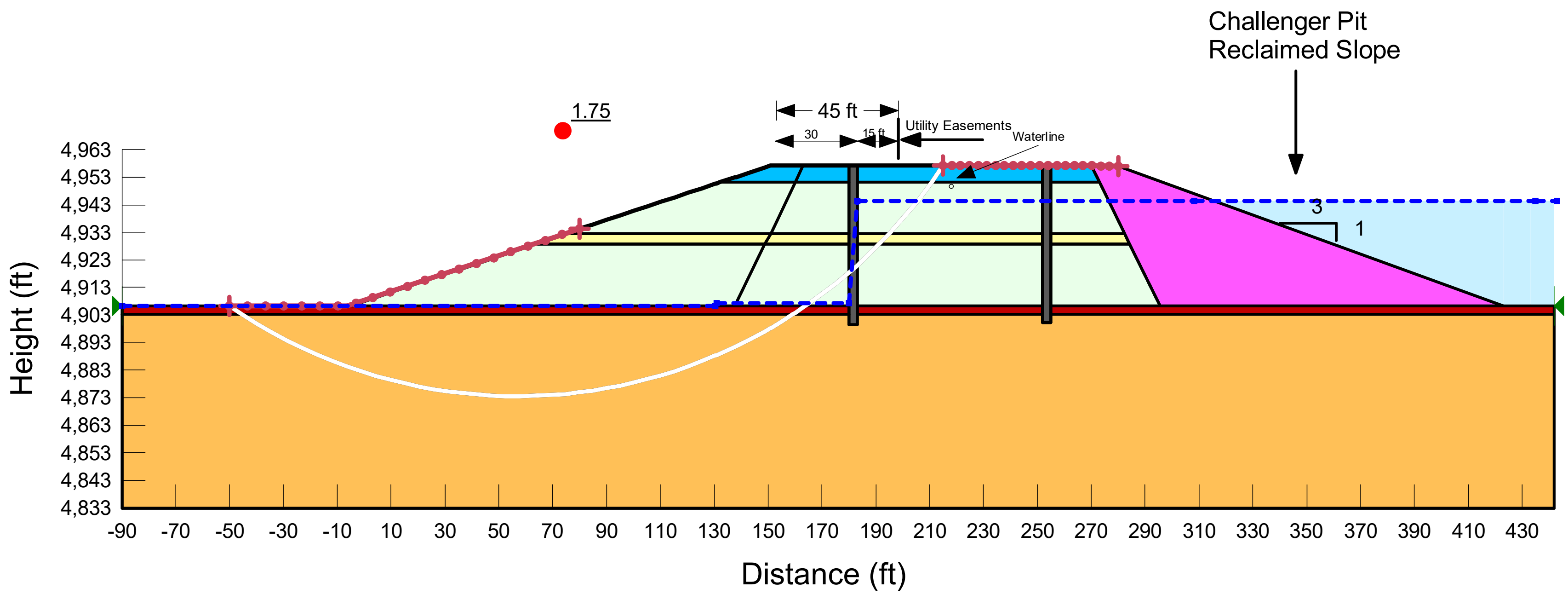


Figure L2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - CHALLENGER PIT

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Reclamation Slope Fill	Mohr-Coulomb	126	25	26
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

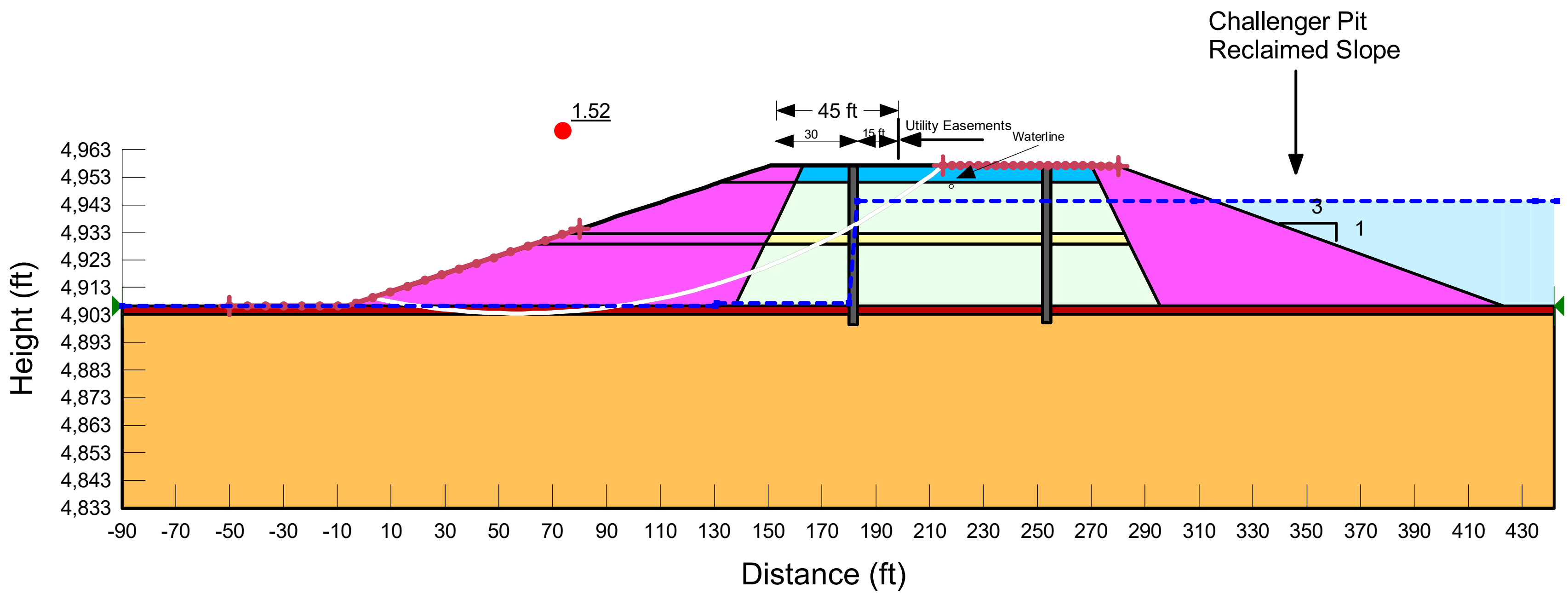


Figure L2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - PIPELINE (EAST SIDE OF EAST CELL)

TETRA TECH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

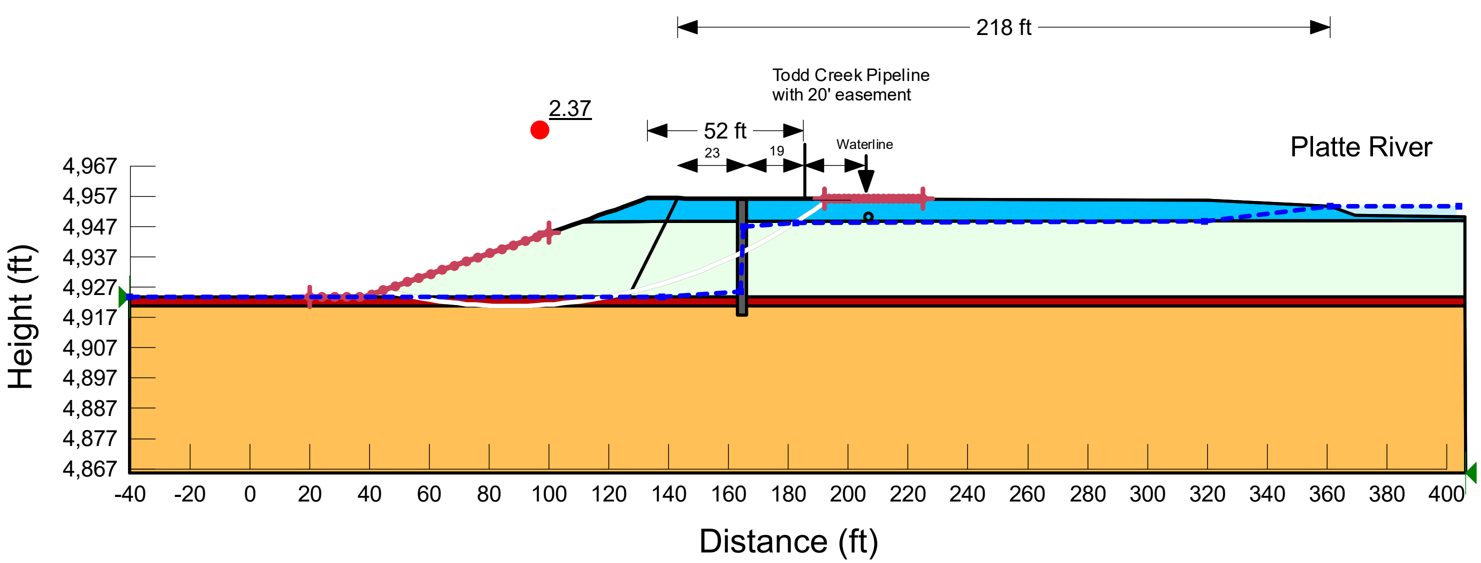


Figure M-1- Static Analysis

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - PIPELINE (EAST SIDE OF EAST CELL)

TETRA TECH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Overburden	Mohr-Coulomb	126	50	28
	Reclamation Slope Fill	Mohr-Coulomb	126	25	26
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

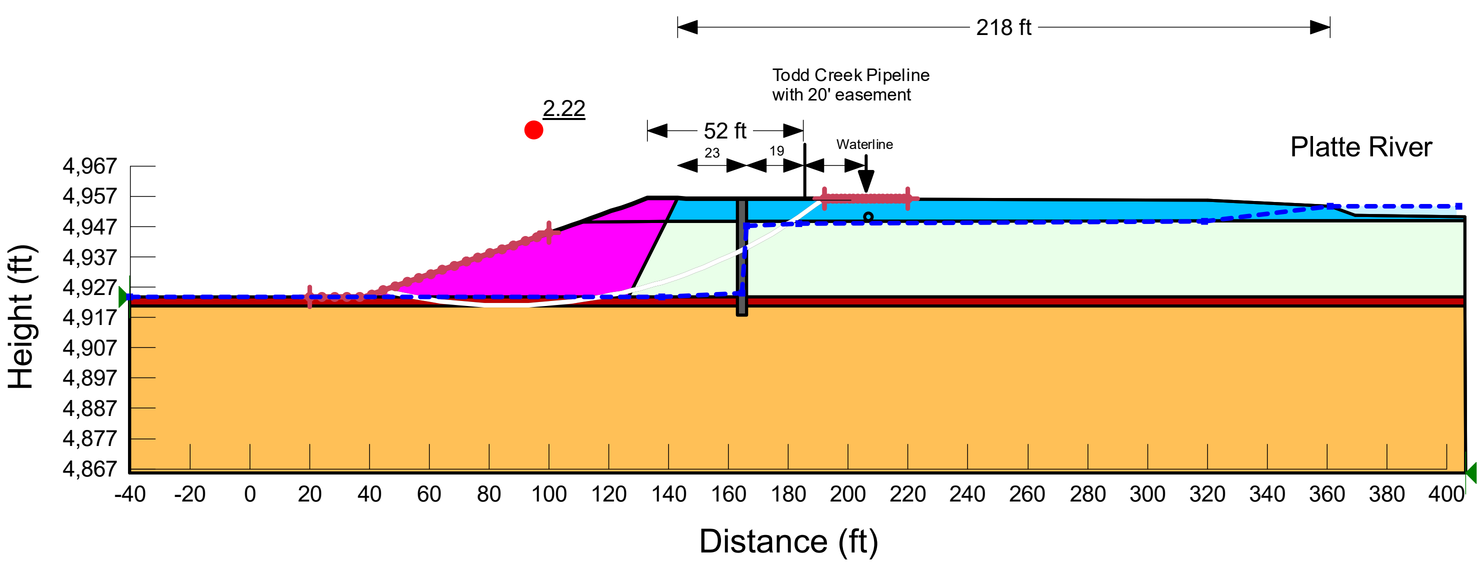


Figure M-1- Static Analysis

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - PIPELINE (EAST SIDE OF EAST CELL)

TETRA TECH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

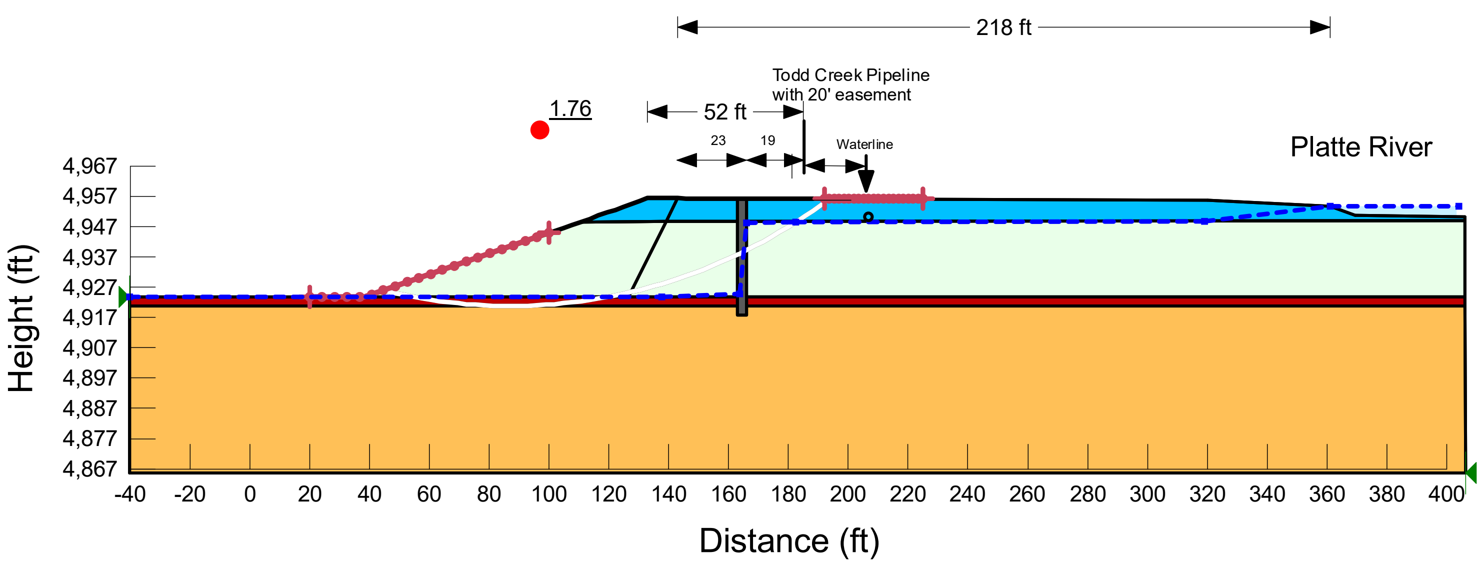


Figure M-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - PIPELINE (EAST SIDE OF EAST CELL)

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Overburden	Mohr-Coulomb	126	50	28
	Reclamation Slope Fill	Mohr-Coulomb	126	25	26
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

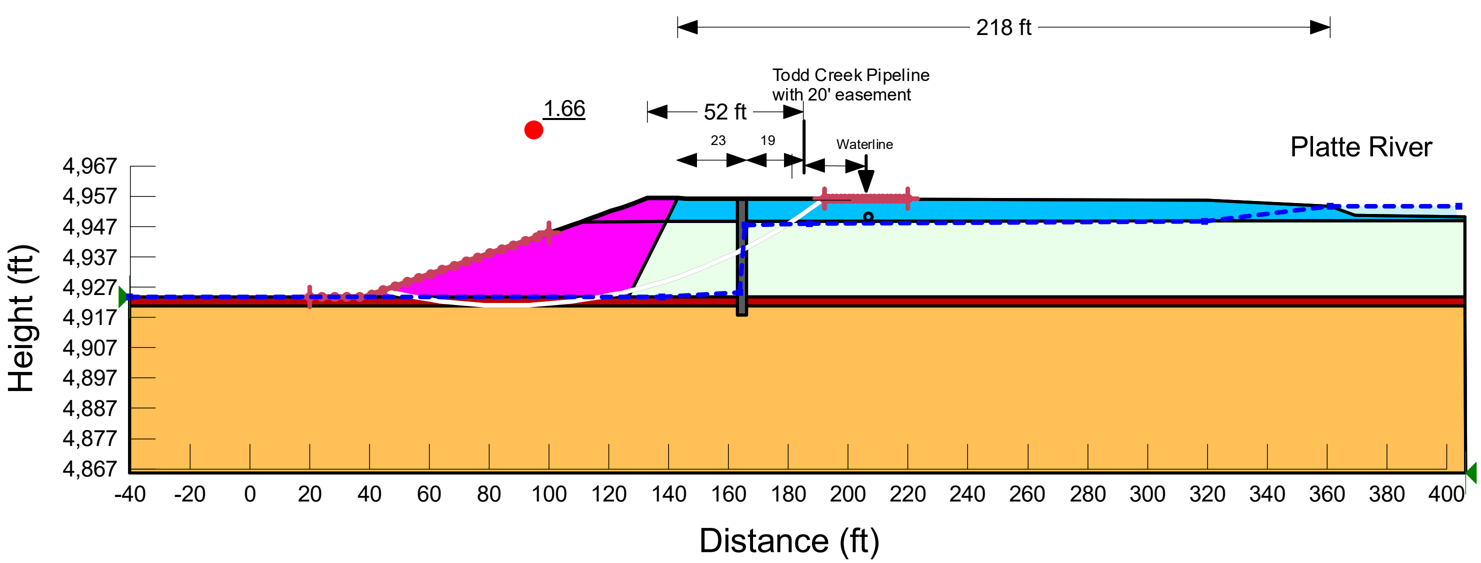


Figure M-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - HIGHWAY 7 FROM NORTH CELLS - WEST

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

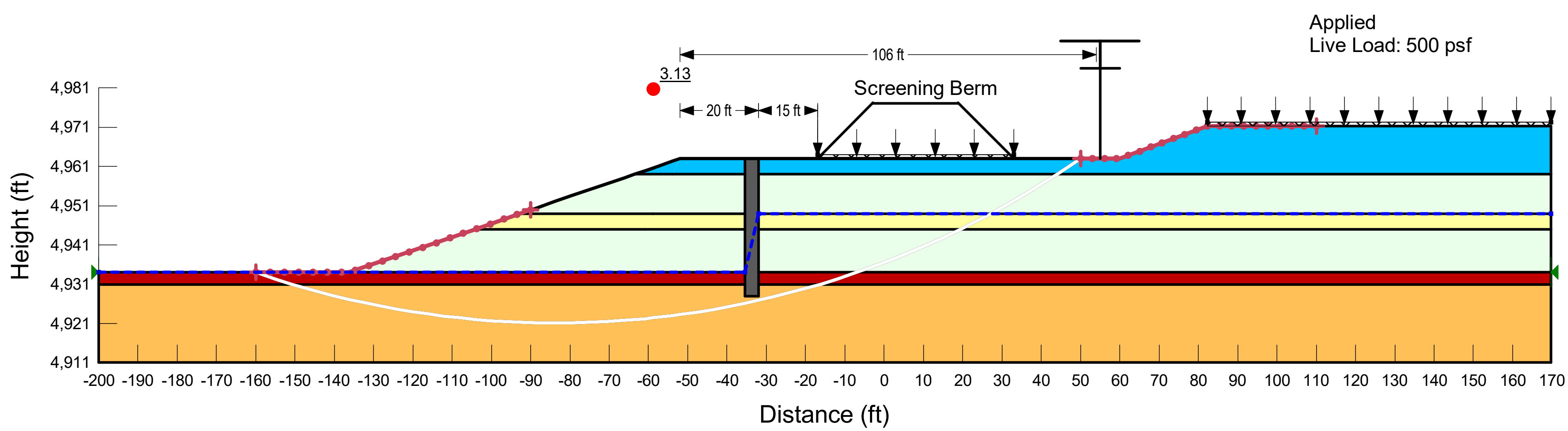


Figure N-1- Static Analysis

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - HIGHWAY 7 FROM NORTH CELLS - WEST

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

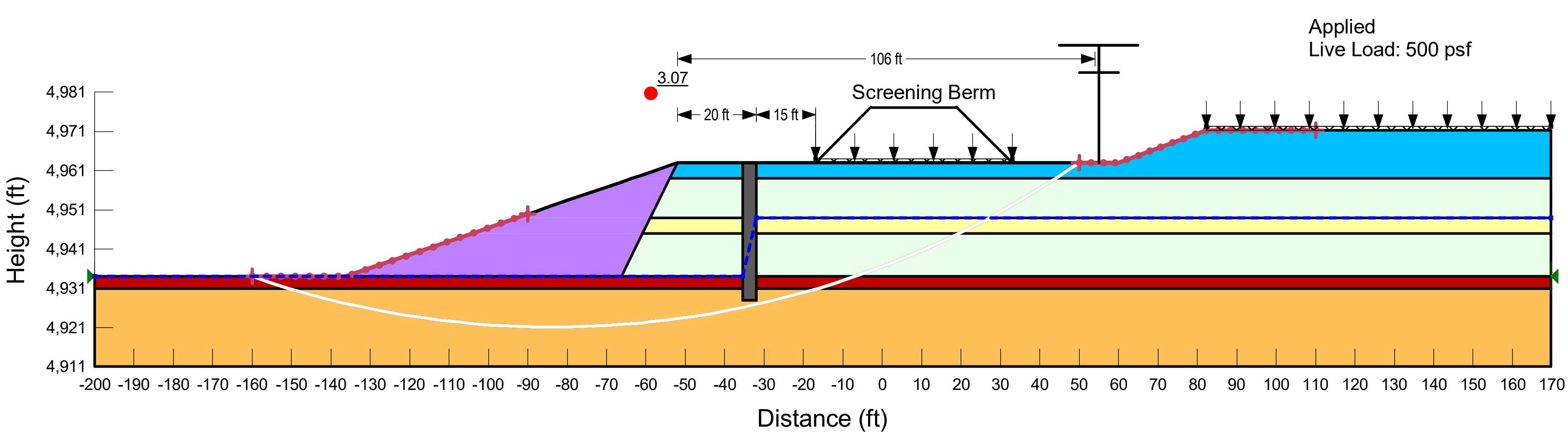


Figure N-1- Static Analysis

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - HIGHWAY 7 FROM NORTH CELLS - WEST

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

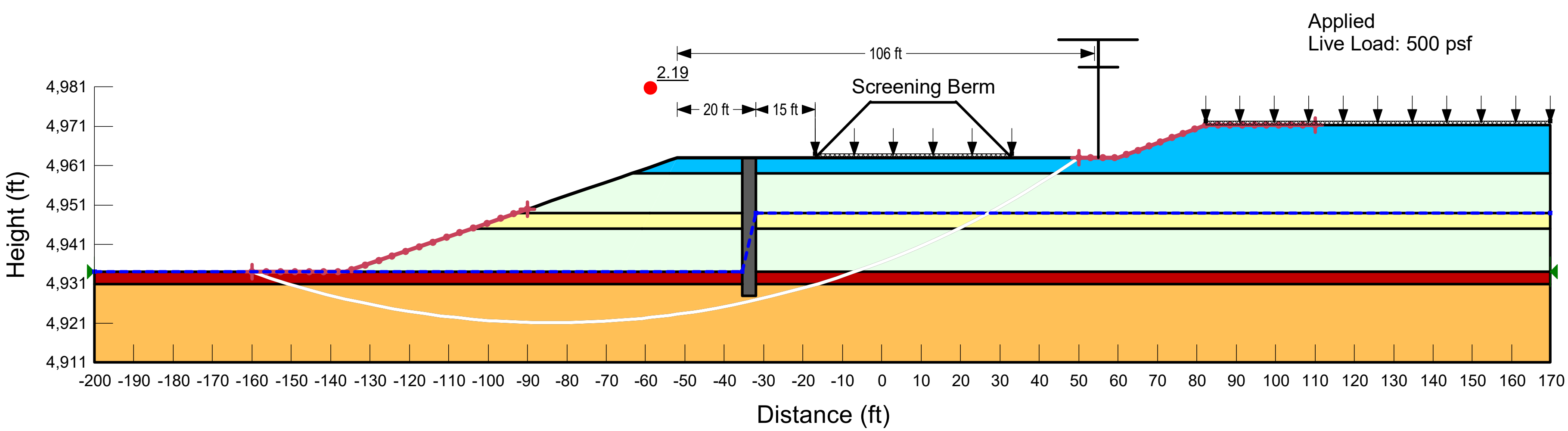


Figure N-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - HIGHWAY 7 FROM NORTH CELLS - WEST

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

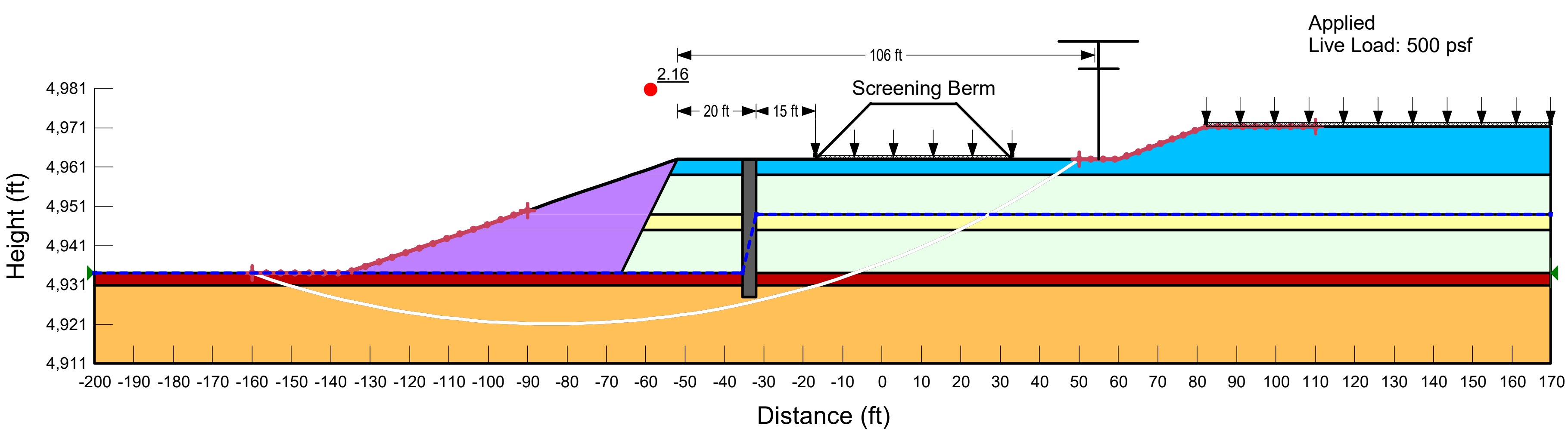


Figure N-2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - CITY OF AURORA WATERLINE

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

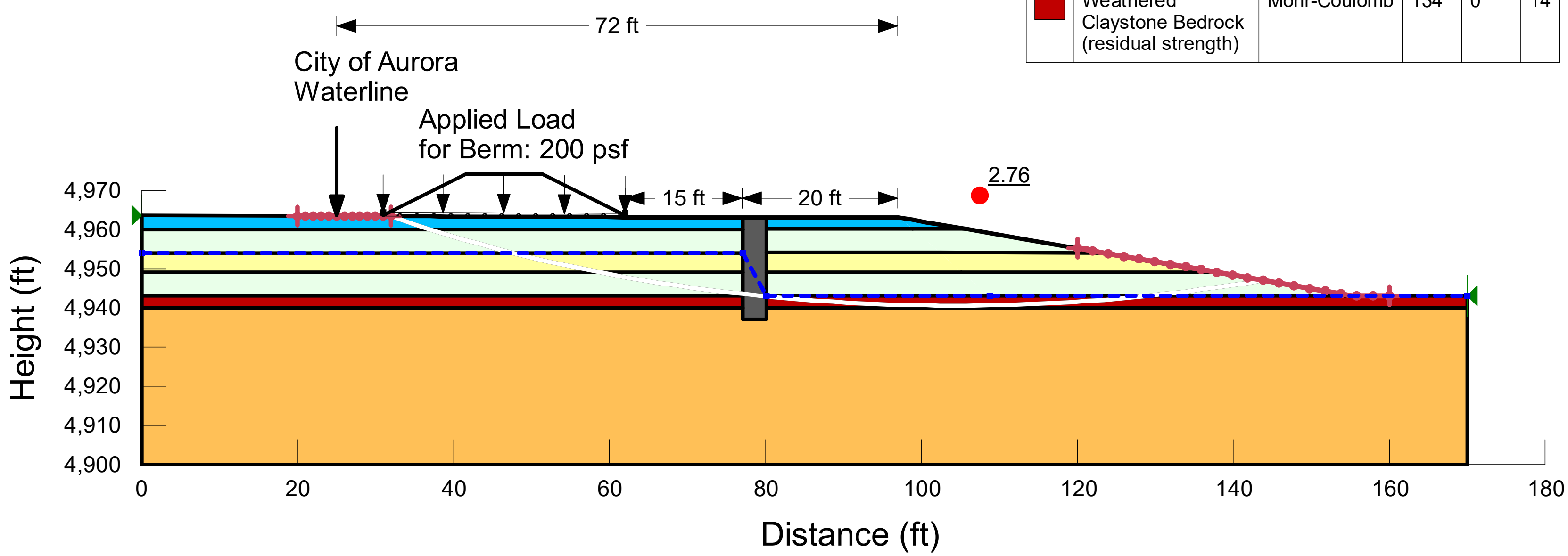


Figure O-1 - Static Analysis

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - CITY OF AURORA WATERLINE

TETRA TECH

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

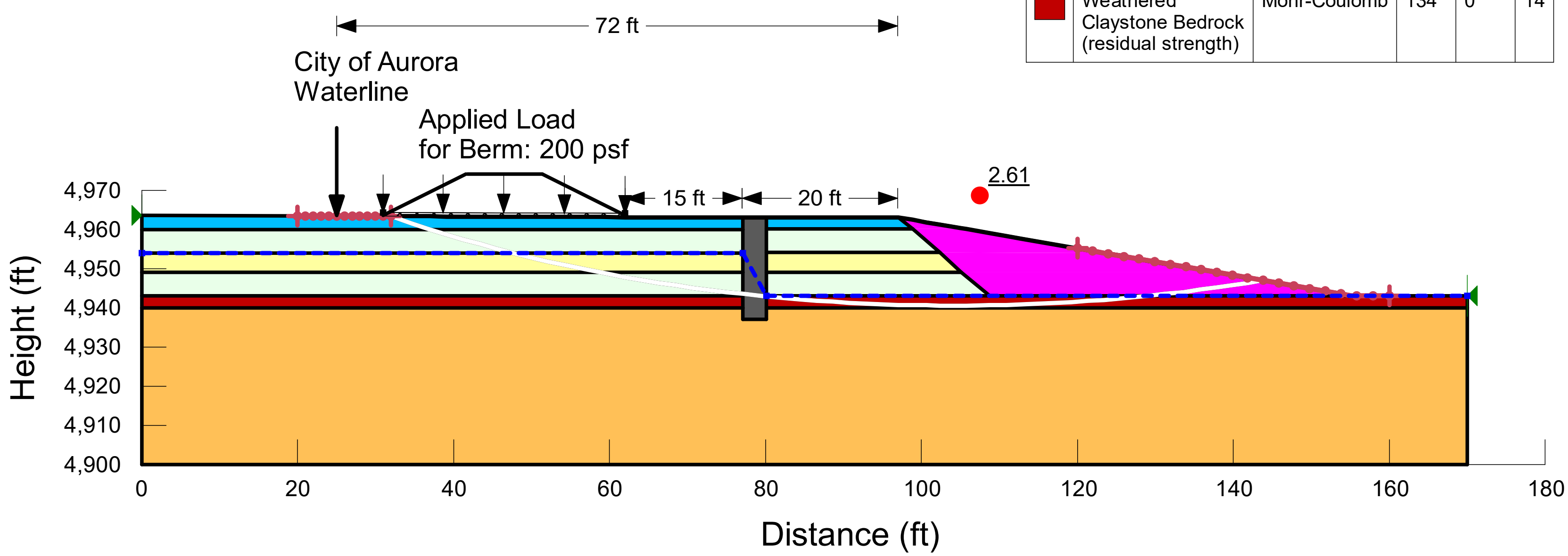


Figure O-1 - Static Analysis

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - CITY OF AURORA WATERLINE

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

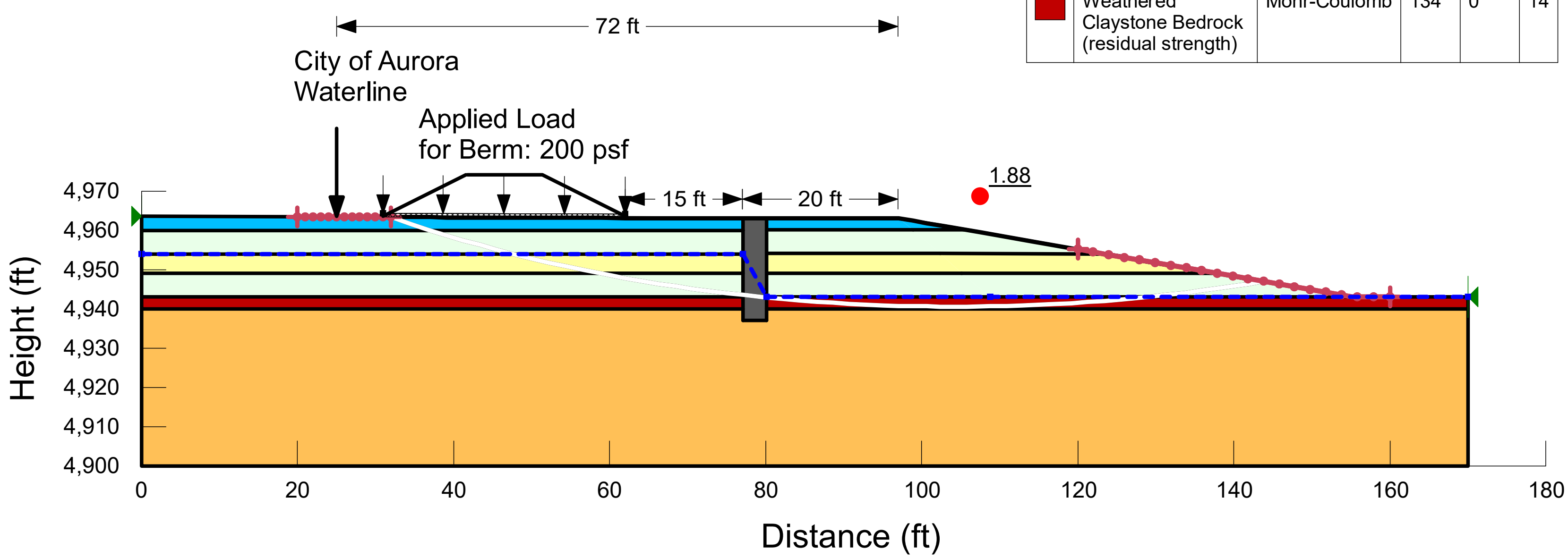


Figure O2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g

TETRA TECH

TUCSON SOUTH PROPOSED GRAVEL MINE STABILITY ANALYSIS
SLOPE STABILITY ANALYSIS - CITY OF AURORA WATERLINE

			(pcf)	(psf)	(°)
	Claystone Bedrock (peak strength)	Mohr-Coulomb	134	100	28
	Fill	Mohr-Coulomb	126	25	26
	Mud Lens	Mohr-Coulomb	126	50	28
	Overburden	Mohr-Coulomb	126	50	28
	Sand and Gravel	Mohr-Coulomb	137	0	35
	Slurry Wall	Mohr-Coulomb	122	0	0
	Weathered Claystone Bedrock (residual strength)	Mohr-Coulomb	134	0	14

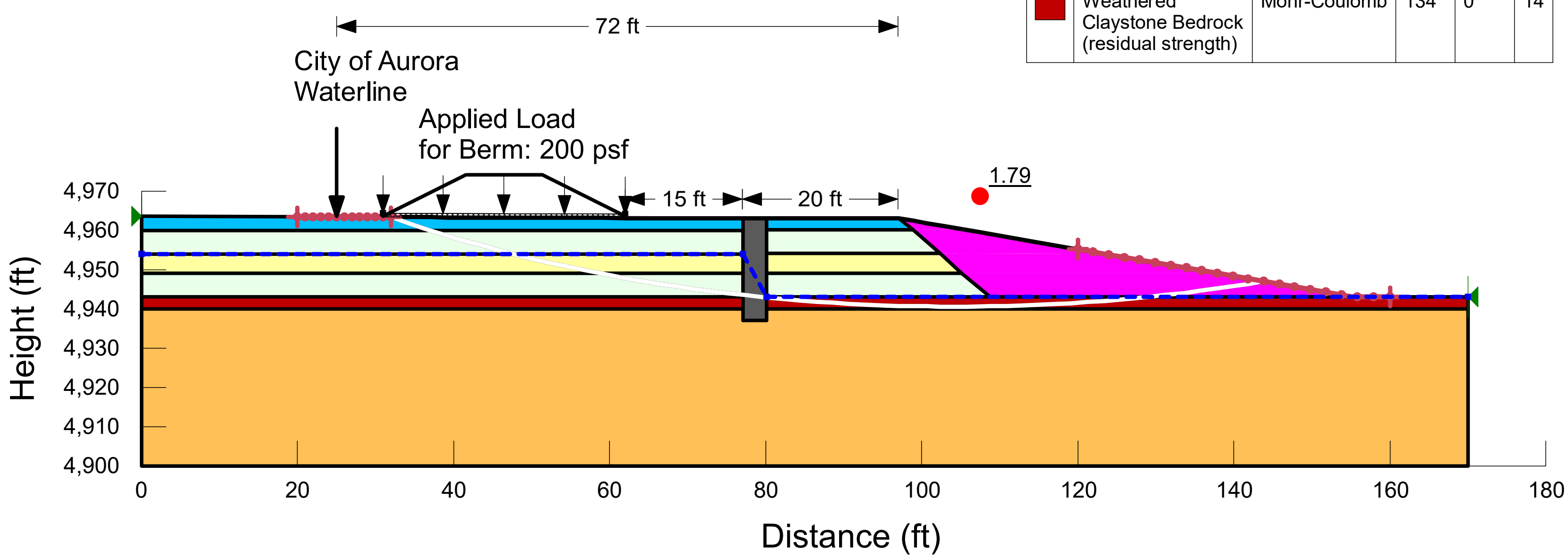


Figure O2 - Pseudostatic Analysis

Horizontal Acceleration Coefficient: 0.067g