





Design Report

Daniels Sand Wash Fines Pond Embankment Dam Raise

Colorado Springs, Colorado

Submitted to:

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Submitted by:

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- Appendix B Hydrology Report
- Appendix C Slope Stability Analysis
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1. Purpose and Project Description

The operating Daniels Sand wash fines pond has a current capacity of 375 acre-feet. The pond is nearly full; therefore, a raise in the embankment dam is required to allow for additional storage. The site is located in Colorado Springs, Colorado as shown in Figures 1 and 2. This report presents the subsurface conditions, embankment dam design, construction recommendations and specifications.

The proposed expanded silt fines pond will have an increase in capacity of 484 acre-feet after completing the 22.5-foot raise contemplated by this report.

2. Subsurface Conditions

2.1. Previous Site Work

2.1.1. Field and Laboratory Investigation

Brierley Associates conducted a geotechnical investigation in 2016 within the pond footprint as shown in Figure 3. Eolian deposits, coarse alluvium, bedrock, and groundwater were encountered. Boring logs and laboratory testing results are presented in Appendix A.

2.1.2. Initial Construction

The existing embankment dam was constructed in 2017 with a top width of 15 feet and final slopes of 2.5H:1V. Borrow for the embankment dam was obtained from the existing mine floor within the footprint of the pond. The borrow material was on-site eolian sand (silty sand, clayey sand, lean clay). The embankment dam was keyed-in to the mine floor and had a depth of approximately ten feet and a width of 12 feet. The embankment dam is approximately 22.5 feet high at present.

The Fountian Mutual Ditch is located above and to the north of the wash fines pond. A buttress was installed in 2022 to flatten the existing steep mine slope below the ditch to 3H:1V. The buttress footprint extended into the wash fines pond. Recycled concrete (12-inch minus) was pushed into the pond along the toe of the mine slope until it daylighted above the water level. The upper 18 inches (in contact with the geotextile) was 6-inch minus recycled concrete. A needle punched nonwoven geotextile (Winfab 450n) was installed over the recycled concrete with adjacent panels overlapping approximately two feet. On-site sand was placed in 12-inch-thick horizontal loose lifts. Bi-annual monitoring of the buttress slope is currently occurring as required by DRMS.

2.2. Geologic Setting

The project site is situated in the southern Front Range located on the western-most flank of the Colorado Piedmont section of the Great Plains Physiographic Province. The Colorado Piedmont is defined as a north/south trending, asymmetrical basin that formed during the uplift of the Rocky Mountains to the west and was later incised by streams and rivers. The area is generally lower than the Great Plains Province to the east and characterized by broad alluvial and pediment deposits over dipping and flat lying bedrock. The subject site is mapped at a 1:24,000 scale in the Geologic Map of the Colorado Springs Quadrangle (Carroll and Crawford, 2000). Eolian sands (Unit Qes) are mapped as the surficial deposits across the site and are described as "silt sand to coarse-grained sand deposited by wind". The eolian deposits overly the Pierre Shale (Unit Kp) described as "gray shale that includes numerous bentonite beds; weathers to an olive-green clay, with curvilinear fractures filled with sulfate salts; particularly susceptible to slope instability in steep areas".

2.3. Geologic Hazards

In Colorado, the following are recognized geologic hazards: abandoned mines, avalanches, collapsible soils, debris flows, seismic induced hazards, erosion, fires, floods, heaving bedrock, expansive soils, landslides, mudslides, rockfall, and subsidence. Geologic hazards for the project area are discussed below. In general, the Project site has low potential for geologic hazards.

2.3.1. General Site Hazards

According to the Colorado Division of Reclamation, Mining and Safety's AUGER Map, the Project location is geographically close to mines, though only sand and gravel sources similar to the current operations are listed, and no abandoned coal mines. The Project site is outside of the avalanche ratings according to the Colorado Avalanche Information Center. According to the USGS National Landslide Hazards Map, the Project site has low landslide susceptibility. The Colorado Geological Survey Landslide inventory has not mapped landslide deposits at the site, and the closest mapped deposits are 1.5 miles to the southwest. The project site has a low wildfire intensity risk intensity according to the Colorado Wildfire Risk Assessment Portal. The Project site is outside of FEMA's FIRM mapping limits indicating the location has no special flood hazard areas. The Colorado Geological Survey does not have any reported rockfall events in the site vicinity. Mudslides are debris flows that are triggered by storms in the mountains and therefore can be dismissed due to the location of the project site.

2.4. Collapsible Soils

Collapsible soils are relatively low-density materials that shrink in volume when they become wet, and/or are subjected to increased overburden pressure such as from a building or road fill. The process of collapse with the addition of water is also known as hydrocompaction. Large ground displacements caused by collapsing soils can damage structures and alter surface drainage. According to geologic maps, the Project site is located within a zone of collapsible soils composed of windblown eolian deposits. The depositional process resulted in a soil structure with low density, high porosity, and a meta-stable open skeletal fabric. Because most of the eolian soils in the vicinity of the embankment dam was removed by mining, the risk of collapsible soils at the Project is low.

2.4.1. Expansive Soils and Bedrock

Swelling soil and bedrock is widespread throughout the Front Range of Colorado and in some mountain valleys. The phenomenon occurs when certain types of clay minerals undergo a change in moisture content. Historically, structures and other infrastructure underlain by dipping and expansive bedrock have experienced differential movement due to the geologic mechanism known as heaving bedrock (Colorado Geological Survey, 1997). Heaving bedrock is the result of steeply-dipping bedrock with hydration-induced expansion properties, confined by non-expansive bedrock. The result of heaving bedrock is heterogeneous, differential movement. Conversely, expansive soils are typically horizontal beds that exhibit relatively homogeneous swelling behavior. The project site is outside of the areas mapped as susceptible to differential heave.

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2.4.2. Seismic Induced Hazards

Earthquakes cause ground motions that can cause structures to fail either through structural collapse or loss of ground support. The nearest active fault to the property according to the US Geological Survey Earthquake Hazards Program is the Ute Pass fault approximately 5.23 miles southwest of the project site. The Ute Pass fault has a slip rate of less than 0.2 mm/year. We anticipate a minimal seismic risk potential for the embankment dam.

2.4.2.1. Liquefaction Evaluation

Loose saturated granular soils such as wind deposited (eolian) sand, silty sand or clayey sand, and nonplastic silts within 50 feet of the surface and below the water table can be susceptible to liquefaction during cyclic loading such as exhibited during seismic events. The average blow count for the embankment dam foundation is 23 blows per foot which indicates a medium dense material. Based on medium dense blow counts and the material classifications in the foundation there is a minimal risk of liquefaction for in-place undisturbed materials at the site.

Each lift in the existing embankment dam and proposed embankment dam raise was/will be compacted to at least 95 percent relative compaction. The borrow material consists of the eolian sands with USCS classifications of SM, SC, or CL. Laboratory test results for the percent gravel, percent sand, percent fines, and Atterberg Limits were evaluated based on several literature criteria to characterize the liquefaction susceptibility. The analysis indicated a low potential for liquefaction for the embankment dam.

3. Design Recommendations

The embankment dam should have a design top width of 15 feet. The haul road and embankment dam grading plans are shown on Figures 4 and 5, respectively. Embankment dam sections, benching details, and toe drain details are presented on Figure 6. After removal of any vegetation and debris on the face of the existing mine highwalls, haul road sidewalls and Fountain Mutal Ditch buttress which will form the abutments of the embankment dam, all new fills should be benched into place by cutting steps into the existing slope. The pond slope reclamation plan is shown on Figure 7. We recommend borrow for the embankment dam construction be obtained from the onsite mined eolian soils with the USCS classifications of SM, SC, or CL. The coarse alluvium encountered beneath the eolian deposits should not be utilized.

A hydrology study was conducted for two potential embankment dam height increases and is presented in Appendix B. The purpose of the evaluation was to estimate the flood stage of the settling pond due to runoff generated from the 100-year and 200-year storm and the one-half probable maximum precipitation (PMP) events, assuming no outflow during the storm event. It was determined that if a minimum freeboard of 3 feet was maintained for the proposed increase, none of the four storm events are expected to overtop the embankment dam. Accordingly, we recommend that the level of wash fines/supernatant accumulation in the pond be limited to an elevation of 5,833 feet corresponding to a minimum of three feet below the crest of the proposed embankment dam. We understand that Holcim intends to maintain this minimum freeboard by decanting the supernatant after fines have settled out. This is consistent with Holcim's current operations.

As shown on the design drawings, a blanket drain is required to meet the required slope stability factor of safety. To prevent internal erosion or piping within the blanket drain, filter material gradation requirements were determined using the procedures outlined in the USDA National Engineering Handbook Part 633 Chapter 26 as shown in the following graph. Based on the grain size distributions presented in the graph, filter material meeting the requirements of CDOT Class C filter material will be sufficient to meet USDA requirements. Gradation requirements for CDOT Class C filter material are included in Specification Section 31 00 00 Earthwork provided in Appendix D.



Filter Compatibility - Embankment Fill to CDOT Class C Filter Sand

4. Slope Stability Analysis

GEI conducted a slope stability analysis on the Daniels Sand wash fines engineered embankment dam. Slope stability was analyzed using the computer program SLOPE/W, developed by GEO-SLOPE International (GeoStudio). SLOPE/W utilizes limit equilibrium principles to analyze potential failure surfaces within a user defined two-dimensional geometry. Slip surface ranges can be defined using a variety of methods. Scenarios analyzed in this report defined failure surface locations over a range of entry and exit points. The Morgenstern-Price Method was used to calculate critical slip surfaces and associated safety factors. Using this methodology the factor of safety for a given geometry is determined by calculating the ratio of resisting forces to driving forces on a particular trial failure surface. The slip surface with the lowest factor of safety against sliding is described as the minimum factor of safety for the defined conditions.

Two stability cases were analyzed for the embankment dam: 1) Long-Term Steady-State, and 2) Long-Term Pseudo-static. Long Term Steady State considers the extended term stability of the embankment dam at the design elevation (full wash fines pond and steady state seepage condition) and the soil strength is characterized by the effective stress parameters in drained conditions. Pseudo-static introduces seismic loading to the long-term steady state model. Pseudo-static loading approximates a typical earthquake load by applying a user defined horizontal load to the model, approximating the equivalent peak ground acceleration from the design earthquake. Per the State guidelines, for a significant hazard dam, the dam shall be designed for a 2% chance of exceedance in 50 years (approximately 2,500-year return frequency). Using the USGS unified hazard tool, the peak ground acceleration for the required return period was determined to be 0.107g. Using the peak ground acceleration, a horizontal seismic coefficient (k_h) of 0.053 was chosen for use in the pseudo-static analysis in accordance with State requirements and work by Hynes-Griffin and Franklin concluding that earth dams with pseudo-static factors of safety greater than 1.0 using $k_h=0.5a_{max}/g$ would not develop dangerously large deformations.

For the slope stability analysis, the phreatic surface was generated using SEEP/W. The analysis considered the maximum reservoir pool. The embankment dam and foundation soil properties are based on conditions encountered during Brierley's subsurface investigation and laboratory results. Mohr-Coulomb strength criterion framework was utilized to define soil strengths and bedrock strengths were defined using undrained strength parameters (ϕ =0). Mohr-Coulomb assumes an inherent cohesion in over-consolidated fine-grained or cemented soils and bedrock. The strength properties used in each analysis are based on available soil classification laboratory test results and engineering judgement and experience.

Colorado DRMS requires specific minimum safety factors for slope stability of embankment dams. Slope stability results based on modeling of the above conditions along with the associated minimum factors of safety according to the Colorado DRMS are provided in Table 4-1 below. The modeling results are presented in Appendix C.

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Table 4-1. Slope Stability Results

Loading Condition	Colorado DRMS Minimum Recommended Factor of Safety	Computed Factor of Safety
Long Term Steady State Seepage	1.5	1.88
Pseudo-Static Seismic Loading	1.3	1.54

5. Construction Procedures and Recommendations

5.1. Site Preparation

The volume of material required to build the embankment dam raise is approximately 160,000 cubic yards. Modifications to site operations (access roads, haul road, stockpiles, Fountain Mutual Ditch buttress) will be required. The existing haul road on the south end of the embankment dam will have to be substantially removed prior to embankment dam construction. A grading plan for the haul road removal is shown in Figure 4 and the embankment dam grading plan is shown in Figure 5.

The Fountain Mutual Ditch buttress is located north of the pond. We recommend any erosion gullies be reconstructed and that vegetation only be stripped where the embankment dam ties into this slope. Only minimal earthwork is anticipated along the remainder of the buttress. However, the east and south sides of the pond should be reclaimed to 3H:1V slopes as shown on Figure 6.

Care should be exercised during the earthwork operations at the site. The earthwork should be done during a dry season. The Contractor should account for potential shrinkage and bulking of borrow material which are defined as the change in volume of the soil from its in-situ condition following excavation, moisture conditioning, placement, and compaction.

5.2. Fill Material

Individual particles up to six inches in diameter are acceptable. Fine and coarse material should be blended to achieve a homogenous fill across the embankment dam without lenses, pockets, or zones of different materials.

5.3. Compaction Testing and Inspection

We recommend that technical or engineering personnel be present to provide monitoring and geotechnical engineering services during construction. It is recommended that the engineering representative review the prepared surface to be filled and the fill material to be used prior to placing any fill. The engineering representative can also review density, moisture, and other laboratory testing results.

Field density tests should be performed on each lift as necessary to verify that adequate compaction is being achieved. Density and moisture testing should be carried out as specified in the earthwork specification provided in Appendix D.

6. Regulatory Environment

This report is intended to meet the requirements of the Colorado Division of Water Reclamation and Mining Safety (DRMS) and Mine Safety and Health Administration (MSHA). John Hunyadi from the Colorado Division of Water Resources, Dam Safety Branch answered our inquiry regarding jurisdiction by his email dated June 4, 2024. John stated, "Rule 14.4 Dams or other water impounding structures regulated by other State agencies (e.g., COGCC, CDPHE, DRMS, etc.) may be exempt from these Rules to avoid dual regulation. The State Engineer may provide technical consultation as necessary for the permitting of such structures".

7. Limitations

This study was conducted in accordance with generally accepted geotechnical engineering and engineering geologic practices and principles; no warranty, express or implied is made. The subsurface conditions described in this report were based on data obtained from others.

This report has been prepared exclusively for our client for design purposes for the subject project. GEI is not responsible for technical interpretations by others of the data presented in this report or use of this report by others for the subject project or other projects. If differing site conditions are encountered during further evaluation of the subsurface conditions by others or during construction, GEI should be notified immediately to determine if any changes to our recommendations presented in this report are warranted.

The recommendations presented in this report are only intended for the proposed design and construction as understood by GEI at the time of issuing this report. If the proposed design and construction changes, GEI should be notified immediately and given the opportunity to review the proposed changes and if necessary, modify our recommendations presented herein.

Design Report – Draft Daniels Sand Wash Fines Pond Embankment Dam Raise Colorado Springs, Colorado November 22, 2024

Figures

- Figure 1. Site Location Map
- Figure 2. Pond Topographic Overlay
- **Figure 3. Existing Site Conditions**
- Figure 4. Haul Road Grading Plan
- Figure 5. Embankment Dam Grading Plan
- Figure 6. Embankment Dam Section and Details
- Figure 7. Pond Slope Reclamation Plan



JOHANSON, ROBERT B:\Working\HOLCIM\2400434 Daniels Sand Wash Fines Pit Raise\00_CAD\Design\Working\Daniels_Sand_Construction_Drawings.dwg - 11/22/2024





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SCALE, FEET





Holcim



PLAN

November 2024

Fig. 5







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Appendix A Previous Boring Logs and Laboratory Test Results

DESCRIPTION AND CLASSIFICATION OF SUBSURFACE MATERIALS

SOIL		ROCK				
Soil description on logs of subsurface explorations are based on Standard Penetration Test results, visual-manual examination of exposed soil and soil samples, and the results of laboratory tests on selected samples. The	Rock descriptions noted exposed rock outcrops	d on logs of subsurface explorations are based on and core samples. The criteria, descriptive terms	visual-manual examin and definitions used a	ation of re as follows:		
Criteria, descriptive terms and definitions are as follows:	RQD:	Rock Quality Designation-Sum of the length of the theoretical length of rock cored	recovered core pleces	greater than or	equal to 4 Inch€	es divided by
DENSITI ON CONSISTENCT Modified CA	REC:	Recovery Ratio-length of core recovered divide	d by the theoretical ler	igth of rock core	əd.	
Density of SPT Sampler Consistency of SPT Cohesionless Solls (Blows per ft) (Blows per ft) Cohesive Soils (Blows per ft)	FIELD HARDNESS	A measure of resistance to scratching.				
Very Loose 0-4 0-4 Very Soft 0-2	Very Hard	Cannot be scratched with a knife point or sharp	plck.			
Loose 5-10 5-12 Soft 3-4 Medium 11-30 13-35 Medium 5-8 Dance 21 50 26 50 500 516	Hard	Can be scratched with a knife point or pick only	with difficulty.			
Very Dense over 50 over 60 Very Stiff 16-30	Medlum Hard	Can be grooved or gouged 1/16 In. deep by firm	n pressure on knlfe or	pick point.		
PENETRATION RESISTANCE	Soft	Can be grooved or gouged easily with a knife o	r pick point.			
6 in with a 140 b, weight falling freely through 30 in. Penetration values (N-values) are generally counted over the lower 12 in. of sampler penetration.	Very Soft	Can be carved with a knife and excavated with	a plck polnt. Can be s	cratched by fing	jerna li.	
COLOR: Basic colors and combinations: black, brown, gray, yellow-brown, etc.	WEATHERING:	The action of organic and inorganic and chemic In alteration of color, texture and composition.	al and physical proces	ses resulting		
MOISTURE CONTENT: - Absence of moisture, dusty, dry to the touch	Fresh-FR	No visible sign of alteration, except perhaps slig	t discoloration on ma	jor discontinuity	y surfaces.	
Molst Damp but no visible water Wet Visible free water usually sail is below water table	Slight-SL	Discoloration of rock material and discontinuity	surfaces.			
	Moderate-MOD	"framework" or as corestones.	sol. Fresh or discold	rea rock is pres	ent eitner as	
SUFFLEMENTAL SOLFTERMINOLOGY. FIELD GRADATION OBSERVATIONS Bed - A sedimentary layer bounded by depositional surfaces Trace 5% Desire - A sectimentary layer bounded by depositional surfaces Trace 5%	High-HIGH	More than half the rock material decomposed a Is present as discontinuous "framework" or as o	nd/or disintegrated to orestones.	30 II. Fresh or d	scolored rock	
down hto small angular lumps which resist further breakdown Little 15 TO 25% Bonded - Attached or adhering 30 TO 45%	Complete-COMP Residual Soil	All rock material disintegrated to soil, but mass All rock material converted to soil. Volume of m	still intact. ass changed, but mate	erial has not bee	en	
Fissured Broken along definite planes of fracture Mostly 50 TO 100% Follated Planar arrangement of textural or structural features	-	significantly transported.	<u>.</u>			
Frequent - More than one per 12 in of thickness Homogeneous - Same color and appearance throughout Groundwater Level Monitoring Well Details	COLOR:	Basic colors and combinations: gray, light gray,	brown, red-brown.			
Interbedded - Alternating soil layers of differing composition Lamina - 0 to 1/16 in. thick (cohesive)	TEXTURE	Size, shape and arrangements of constituents.	BEDDING:		APERTUR	<u>E:</u>
Layer - 1/2 to 12 in. thick Lens - Lentlcular deposit larger than a pocket	grained	individual grains invisible (igneous/metamorphic only).	Extremely thin	< 0.75	Tight	< 0.04
Mottled - Varlation of color ELD Occasional - One or less per 12 in. of thickness	Fine-grained	Grains barely visible to the unaided eye, up to 1/16 in. diameter.	Thin	> 2.5-8	Open	> 0.04 to 2
Parting 0 to 1/16 in. thick (granular) Pocket Small, erratic deposit less than 12 in. size	Medium-grained	Grains between 1/16 and 3/16 in. diameter	Thick	> 24	vvide	>2.0
Seam - 1/16 to 1/2 In. thick Stratified - Alternating layers of varying material or color	Very Coarse-	Grains larger than 1/4 in.				
Stratum - > 12 in. thick Varved - Annually alternating thin seams of slit and clay						
	Joint	 Natural breaks separating the intact rock mater Break of geologic origin in the continuity of a break of geologic origin. 	lal Into discrete units. dv of rock along which	there has bee	n no visible disp	acement
Deposit type - GLACIAL TILL, ALLUVIUM, FILL		A group of parallel joints is called a set and joint	t sets Intersect to form	a joint system.	Joints frequent	y
The natural solls are identified by criteria of Unified Soli Classification System (USCS), with appropriate group symbol in parenthesis for each soli description. Fill materials may not be classified by USCS criteria.		and cleavage joints accordingly.	eavage and may be ter	med bedding p	iane joints, ionat	uon joints
	Shear	Discontinuity in which differential movement ha produce slickensides (i.e. striations and polishir	s taken place parallel t iq). Shear discontinuiti	o the discontinu es may be acco	uity surface, suff ompanied by a z	clent to one of
U.S. Standard Serles Sleve Clear Square Sleve OpenIngs 12" 3" 3/4" 4 10 40 200		fractured rock up to a few Inches wide.		,		
Boulders Cobbles Gravel Sand Silts and Clays	ORIENTATION:	Relative to the horizontal	SPACING:	Distance be	tween discontini	uities
305 mm 76 mm 19 mm 4.75 mm 2.00 mm 0.43 mm 0.074 mm	Horizontal	0-5	Extremely close	Less than 3/	/4	
	Moderately dipping	35-35 55-55	Close	2-1/2 to 8		
GENERAL NOTES	High Angle Vertical	55-85 85-90	Moderate Wilde Very Wilde	8-24 24-80 > 80		
1. Logs of subsurface explorations depict soil, rock and groundwater conditions only at the locations specified on the dates indicated. Subsur	rface conditions may vary	at other locations and at other times.				
 The stratification lines designating the interface between soil types on the logs of borings and on the subsurface profile represent approxima Water levels noted on the logs were measured at the times and under the conditions indicated. During test borings, these water levels could be a subsurface profile representation of the logs were measured at the times and under the conditions indicated. During test borings, these water levels could be a subsurface profile representation of the logs were measured at the times and under the conditions indicated. During test borings, these water levels could be a subsurface profile representation of the logs were measured at the times and under the conditions indicated. 	ate boundaries. The trans Id have been affected by t	sition between material may be gradual. the Introduction of water into the				
borehole, extraction of tools or other procedures and thus may not reflect actual groundwater level at the test boring location. Groundwater level precipitation, temperature, season, adjacent construction activities and pumping of water supply wells and construction dewatering systems	vel fluctuations may also o	ccur as a result of variations in				
 Solid lines represent change in geologic unit, dashed lines represents change in USCS classification within same geologic unit. 						
5. BK in the USUS dassification column indicates bedrock.		BRIERI EY				
		ACCOCIATES	÷			-~
		ASSUCIALES	11	-21 BO	RING KE	= Y

Width(in) < 0.04 > 0.04 to 0.4 > 0.4 to 2.0

Creating Space Underground

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Creating Spa	Broa	rground		Dri	ent: Ilina (Contracto	Iran or: Vine	sit Mix Laboratori	es. Inc.			F	Start: Finish	:	06 06	/09/20 /09/20	016 016		
Suite 2 Denver	22 r, Col	lorado 80)209	Ca	asing	Samp	oler	Barrel	Drilling Equipment and Proc	edures			Driller BA Re	: эр.:	Ale D.	ex, Re Kwie	enee, tnews	Juan ki	
Туре				ł	ISA	SS, C	A		Rig Make & Model: CME 750 Buggy	Rig		E	Eleva	tion:					
Inside [Diam	eter (in.)		4	1.25"	1 3/8"	2"		Hoist/Hammer: Automatic Drill Method: Hollow Stem Auger			┢	ocat	ion [.]					
Hamme	er We	eight (lb.)					_		Bit Type: Cutting Head			N	North :	side o	f the h	naul ro	bad, n	orth c	of BA-
Hamme	er Fa	ll (in.)		Vato		Data			Casing: Hollow Stem Auger						N	otoc			
Water)ate	V	Flar		Bottom	Bottom	Depth to	Sample Identification	1		+				oles			
Level	mm	/dd/yy	ime	Ti	ne	of Casing	of Hole	Water	C California Barrel										
Ţ	06/	09/16		No	one	10'	10'	7.5'	CS Continuous Sampler R Co	re									
± <u> </u> ▼									S Split Spoon B Bu	lk									
Ŧ						Vie	uəl-Mər	l Jual Idan	G Geoprobe T Thi	n Wall T	ube		Labo	rator	v Res	sults			
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(f.)	(ft.)	ft.) /ROI		sel	hy													(%) e	e (ks
pth (1	ation	ID pth (1 %)	ws/6	er Le	tigra	Soil: Do	ensity/cons e, odor, mo	sistency, colo bisture,optior	or, GROUP NAME, max. particle size, al descriptions, geologic interpretation	ram	(%)	(lapse	ssure
De	Elev	De	B B	Wat	Stra	R	ock: Hardn j	ess, weather oint spacing,	ing, color, LITHOLOGY, texture, drilling rate (min./ft.)	Diag	ture (el (%	(%)	(%) \$	(9	((ksf)	I/Col	l Pre
		S PC (Vell	∕lois	Grav	Sand	lines	%) T	%) Ic	JCS	Swell	Swel
0			·	_						-	~	<u> </u>	- ⁰	-	_		_	0,	
-																			
-																			
-																			
		S-1	6			Mediur	n dense, m	nedium brow	n, SILTY SAND (SM), trace gravel,			0.3	69.9	29.8					
5-		4.0-5.5 17"	8			mostly	sand, som	e siit, some	brange iron-oxide staining, moist.										
-						-EOLIA			4.5 ft.										
-				-				LT-GRADE	4.75 ft.										
									0.4										
10		S-2 9.0-10.5	1			Mediur	n stiff, brov	vn, sandy, S	ILTY CLAY (CL-ML), some clay, some										
		17"	3				e sano, mo	JISI.											
-						-EOLIA	NN-												
						H													
		S-3	4		Y/Y	1			14 ft.										
15 -		14.0-15. 16"	5 17 19			Top 8"	dense, br silt.	own, SILTY :	SAND (SM), mostly fine sand with										
		10				Bottom	8": dense	, orange-bro	wn, POORLY- GRADED SAND (SP),										
-						mostly	coarse sa	nd, wet.											
-						-EOLIA	N-												
		S-4	5			Mediur	n dense, o	range-brown	, POORLY-GRADED SAND (SP),										
20 -		19.0-20. 12"	7			Bottom	d": brown	NO.											
-						mostly	fine sand	with some sil	t, wet, discolored.										
						-EOLIA	N-												
25		S-5 24.0-25.	10 5 14			Dense	brown wit	h red brown,	WELL-GRADED SAND (SW), less										
		12"	14			varying	color and	gradations of	f sand.										
						-COAR	SE ALLU	/IUM-											
Mavim	m	narticlo	si70	is do	termi	ed by di	rect obso	rvation with	in the limitations of the sampler										
NOTE	: So	il and ro	ock id	entifi	catior	n based o	n visual-	manual me	thods of the USCS as practiced by	Brierle	ey As	soci	ates.	⊢в	oring	No:	BA-1	_	

							TES	T BO	RING REPORT	Γ			5	Bor Sheet	ing No.	No 2 of 2	. B	\-1		
ASSC	RIER	LEY TES		Pro	ject:		Dan	iels Sand V	Vash Fines Pit				F	File N	0.	51	6051·	-000		
Creating Sp 990 S	ace Unde	rground dwav		Dril	ent: Iling C	contracto	or: Vine	Eaboratori	ies, Inc.				F	-inish	:	06	6/09/20 6/09/20	016		
Suite 2 Denve	222 er, Co	lorado 80	209	Ca	asing	Sam	oler	Barrel	Drilling Equipment and	l Proce	dures	5		Driller BA Re	: ep.:	Ale D.	ex, Re Kwie	enee, tnews	Juan ki	
Туре				F	ISA	SS, C	A		Rig Make & Model: CME 750	Buggy I	Rig		E	Eleva	tion:					
Inside	Diam	eter (in.)		4	1.25"	1 3/8"	, 2"		Drill Method: Hollow Stem Aug	ger				ocat	ion:					
Hamm	ner We	eight (lb.)							Bit Type: Cutting Head					North s	side o	f the h	naul ro	oad, r	orth o	of BA-
Hamm	ier Fa	li (in.)	V	/ater	Leve	l Data			Sample Identifi	cation			+			N	otes			
Water	r C	Date T	ime	Elap	osed	Bottom	Bottom	Depth to	•											
Level	mm	/dd/yy		Tir	ne	of Casing	of Hole	Water	C California Barrel											
Ē	06/	09/16		No	one	10'	10'	7.5	CS Continuous Sampler	R Cor	e									
Ē									S Split Spoon	B Bulk	(Wall	Tube								
						Vis	on	i wan	Tube		Labo	rator	y Res	sults						
	~	ND(%															(9	sf)		
(ft.)	n (ft.	(ft.))/RC	6 in.	evel	aphy	Soil: D	sizo	~								se (%	re (k			
epth	/atio	epth or %	/SWC	ater L	atigra	structur	e, odor, m	oisture,optior	nal descriptions, geologic interpre	etation	gran	(%)	(%					(J	ollaps	essu
	Шe	(in.	Ē	Ň	St		JCK. Halu	joint spacing,	drilling rate (min./ft.)		I Dia	sture	vel (°	%) p	ss (%	(%	(%	S (ks	II/Co	II Pr
		Rec									Wel	Moi	Gra	San	Fine	L(Ъ	ő	Swe	Swe
╞─┧		S-6	7			Mediur	n dense	prown POOR	NY-GRADED SAND (SP) few o	-29 ft. ravel			6.5	89.9	3.6					
30 -		29.0-30.5 12"	12			mostly	sand, tra	ce fines, wet.		lavol,										
						-COAF	SE ALLU	VIUM-												
										33.5 ft										
25		C-7 34.0-35	23 50/6			Very s	oft, slightl	sible bedrock / weathered,	dark-gray, CLAYSTONE (BR), m	ostly										
35 -		12"					ry, some :	-	top of the sampler.											
						-PIERI	KE SHALI	-												
-																				
		C-8	50/5	,"		As abo	ve, excep	t fresh.												
40 -		39.0-40 5"				<u> </u>	-,			9.42 ft										
-																				
-																				
-																				
45 -																				
50 -																				
50																				
55 -																				

						TES	T BOI	RING REPORT			l	Bor Sheet	ing t No.	No . 1 of 2	. B A	۹-2		
BR	IERLEY		Pro	ject:		Dani	els Sand V	Vash Fines Pit			F	File N	0.	51	6051-	000		
Creating Space	e Underground		Clie	ent: Iling (ontracto	Tran	sit Mix Laboratori	es Inc				Start: Finish		06	/09/20 /09/20	016 016		
Suite 2	Broadway 22 Colorodo (0000		ining C			Laboratori					Driller	:	Ale	əx, Re	enee,	Juan	
Denver	, Colorado e	10209	Ca	asing	Samp	oler	Barrel	Drilling Equipment and Proc	edures		E	BA R	ep.:	D.	Kwie	tnews	ki	
Туре			+	ISA	SS			Rig Make & Model: CME 750 Buggy Hoist/Hammer: Automatic	Rig		E	Eleva	tion:					
Inside D	Diameter (in.)	4	4.25"	1 3/8"			Drill Method: Hollow Stem Auger			Ţ	ocat	ion:	6 4h - h				
Hamme Hamme	er Weight (lb er Fall (in.)	.)						Bit Type: Cutting Head Casing: Hollow Stem Auger				North : B.	side o	r the r	aui ro	bad, n	onn o	T BA-
		١	Vater	r Leve	l Data			Sample Identification	1					Ν	otes			
Water	Date mm/dd/vv	Time	Elap	osed	Bottom of Casing	Bottom of Hole	Depth to Water	C California Parrol										
	06/09/16		No	one	20'	20'	19'	CS Continuous Sampler R Co	re									
<u> </u>					-			S Split Spoon B Bu	k									
Ţ								G Geoprobe T Thi	n Wall	Tube								
		(%)			Vis	ual-Ma	nual Iden	tification and Description				Labo	rator	y Res	sults			
			~	~													(%	ksf)
(ft.)	(#) (#) (#)	%)/K	Leve	raph	Soil: D	ensity/con	sistency, colo	or, GROUP NAME, max. particle size,	ε) əsc	ure (
Dept	evation Depth		ater	ratig	structur	e, odor, m ock: Hardr	bisture, option less, weather	al descriptions, geologic interpretation ing, color, LITHOLOGY, texture,	agra	e (%	(%)	()	(%			sf)	ollap	ress
			5	۵.		j	oint spacing,	drilling rate (min./ft.)	ji Di	istur	avel	6) pu	es ((%)	(%)	S (k	ell/C	ell P
	6	۳ ۲							N.	M	ũ	Sa	Ъ	Ц	Ē	Ŋ	Š	Ś
0				1111431 1111431 1111431	Pit san	d/Lt. Vege	tation.											
					1. U 1													
				C 6 8 1 1 200 100 3 3 400 100 1 8 400	с 1. Г													
	61			661336 221722 661336		brown D(
5 -	4.0-5.			100 30.500 100 1 4000 100 1 5 900	fine to	medium sa	and, some sil	t, moist.										
	18"				-EOLIA	N-												
-																		
-				666344436 06531940 16631940														
	S-2	7		////	Stiff b	own to ar		of color sandy LEAN CLAY (CL)										
10 -	9.0-10. 18"	5 4 5			mostly	clay, mois	t, approximat	tely 40% fines.										
-					-EOLIA	N-												
-																		
	S-3	5 2		HH	Mediur	n stiff, bro	wn, SILTY Cl	14 ft. _AY with sand (CL-ML), moist.										
15 -	18"	4			-EOLIA	N-												
					7													
				W							50	00 F	07.0					
20 -	19.0-20	.5 3	Ē		Loose, sand, s	tan-browr	to brown, SI	LTY SAND (SM), few gravel, mostly de staining, wet.			5.6	00.5	27.9					
					-EOLIA	N-												
-																		
	S-5	2		WW	Top 0	stiff brow	In sandy CII	24 ft.										
25 –	24.0-25 17"	.5 7			Bottom	8". mediu	m dense tan	24.75 ft.										
					-FOUA	N-												
-																		
Maxim	um particle	e size	is de	termi	ned by di	rect obse	rvation with	in the limitations of the sampler.					В	oring	No:	BA-2		
NOTE	: Soil and r	ock id	entifi	catior	n based o	on visual-	manual me	thods of the USCS as practiced by	Brierle	ey A	ssoci	iates.		mg		2		

							TES	T BO	RING REPORT			5	Bor Sheet	ing No.	No 2 of 2	. B /	۹-2		
ASSO	RIER	LEY TES		Pro	ject:		Dar	iels Sand V	Vash Fines Pit			F	ile N	0.	51	6051	-000		
Creating Spo 990 S	Broa	rground dwav		Dril	ent: Iina C	ontracto	Irai or: Vine	isit Mix e Laboratori	es. Inc.			F	Start: Finish	1:	06	5/09/20 5/09/20	016 016		
Suite 2 Denve	222 r, Co	lorado 80	209	Ca	asing	Samp	oler	Barrel	Drilling Equipment and Proc	edures	\$		Driller BA Re	: эр.:	AI D.	ex, Re Kwie	enee, tnews	Juan ki	
Туре				F	ISA	SS			Rig Make & Model: CME 750 Buggy	Rig		E	Eleva	tion:					
Inside	Diam	eter (in.)		4	.25"	1 3/8"			Drill Method: Hollow Stem Auger				ocat	ion:					
Hamm	er We	eight (lb.)							Bit Type: Cutting Head			N 3	lorth : 3.	side o	f the I	haul ro	oad, r	orth c	of BA-
namm	erra	II (IN.)	v	Vater	Leve	l Data			Sample Identification	1		+			N	lotes			
Water	C	Date T	ime	Elap	sed	Bottom	Bottom	Depth to	•										
Level	mm	/dd/yy		Tir	ne	of Casing	of Hole	Water	C California Barrel										
i ■ ■	06/	09/16		NC	one	20	20	19	CS Continuous Sampler R Co	re									
									G Geoprobe T Th	n Wall '	Tube								
		(9		Visual-Manual Identification and Description									Labo	rator	y Re	sults			
		2D(%																()	(sf)
(,	n (ft.	(ft.))/RC	6 in.	명 같 Soil: Density/consistency, color, GROUP NAME, max. particle size, E														se (%	re (k
epth	vatio	ID epth or %	/swo	Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture,optional descriptions, geologic interpretation													f)	ollaps	essu
	Ele	(in.	Ē	Ň	Str		JUK. HAIU	joint spacing,	drilling rate (min./ft.)	I Dia	sture	vel (%) p	%) se	(%	(%	S (ks	II/Co	ll Pr
		Rec								Wel	Moi	Gra	San	Fine	Ē	ы	ő	Swe	Swe
		S-6 29.0-30.5	4		Sér	Mediur	n dense,	an-brown, W	29 ft. ELL-GRADED GRAVEL (GW), mostly										
30 -		10"	12			gravel,	less than	5% fines, we	t, sampler stuck/heaving sands.										
						-COAR	SE ALLU	VIUM-											
	1	S-7	3						34 ft.	-		4 1	90.9	5					
35 -		34.0-35.5 17"	8			Mediur mostly	n dense, sand, fev	orown, POOR / fines, wet.	LY-GRADED SAND (SP), trace gravel					Ŭ					
						-COAR	SE ALLU	VIUM-											
-						Heavin	g sands/ł	ard to get cer	nter bit back into position. Pulled back										
-						approx	imately 5	and redrilled.	. Keeping HSA charged with water. 37.5 ft.										
		C-8	50/5			Dimer		- -	TUCK at 57.5.										
40 -		5"				Very se	oft, fresh,	<u>-</u> dark gray, CL	AYSTONE (BR), mostly clay, dry.										
		<u> </u>	50/2			Voryou	off froob												
45 -		44.0-45	50/3	Ë.		Very so	on, fresh,	as above.											
-		3"																	
-																			
-																			
-																			
50 -																			
-																			
-																			
55																			
-																			

							TES	T BOI	RING REPORT			E	Bor Sheet	ing t No.	No 1 of 2	. B /	۹-3		
BR	IER	LEY		Pro	ject:		Dani	els Sand V	Vash Fines Pit			F	ile N	0.	51	- 6051-	-000		
Creating Spa	ce Under	rground.		Dril	ent: lina (Contracto	ıran or: Vine	sit Mix Laboratori	es Inc				inish		06	/03/20 6/03/20	016 016		
Suite 2. Denver	22 r, Col	orado 802	209	Ca	isina	Samo	oler	Barrel	Drilling Equipment and Proc	edures			Driller BA Re	: ep.:	Ov S.	wen P Baile	otter v		
Туре					ISA	SS. C	A		Rig Make & Model: CME 750 Buggy	Rig		F	leva	tion:					
Inside [Jiam	otor (in)			25"	1 3/8"	2"		Hoist/Hammer: Automatic			H		ion:					
Hamme	er We	eight (lb.)			.20	10/0 ,	2		Bit Type: Cutting Head				local	side o	f the I	naul ro	oad.		
Hamme	er Fal	l (in.)							Casing: Hollow Stem Auger			_							
Wator		Voto	V	Flor		Data	Dettern	Dopth to	Sample Identification	1					N	otes			
Level	mm	/dd/yy	ime	Tin	ne	of Casing	of Hole	Water	C California Barrel										
Ţ	06/	03/16 9:	21	No	one	25'	25'	20'	CS Continuous Sampler R Co	re									
									S Split Spoon B Bul	k									
<u> </u>				<u> </u>					G Geoprobe T Thi	n Wall ⁻ I	Tube		Labo	rator		culte			
		(%)				VIS	uai-iviai	nual Iden	tification and Description						y r.e.	Suits			
£	(#:)	r:) ROD	.e	vel	hy													(%)	e (ksf
ath (f	tion	8)/(%)//	vs/6	sr Le	Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture,optional descriptions, geologic interpretation Rock: Hardness, weathering, color, LITHOLOGY, texture,													apse	sure
Dep	leva	n. or	Blov	Wate	B Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture,optional descriptions, geologic interpretation Rock: Hardness, weathering, color, LITHOLOGY, texture, joint spacing, drilling rate (min./ft.) E (*) Image: Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture,optional descriptions, geologic interpretation repretation repretation repretation representation representati												(ksf)	Colli	Pres
	"	ec.(i					loist	rave	and	ines	%) -	(%)	CS (well/	well				
		2		_	joint spacing, drilling rate (min./ft.)											_₽_	⊃	S	S
		S-1 4.0-5.5 18" S-2 9.0-10.5 13" S-3 14.0-15.5 18" S-4 19.0-20.5 18" S-5 24.0-25.5 18"	5556 457 7810 447 347			Mediur to med -EOLIA Very st fine sau -EOLIA Mediur Mediur Mediur	n dense, b ium sand, IN- iff, gray/or nd, no odo IN- n dense, b fine to me se sand au IN- n dense, b own/gray, n sand, no	rown, SILTY some silt and ange, sandy r, moist, med dium sand, s nd gravel, slig rown, no coa	CLAYEY SAND (SC-SM), mostly fine d clay, no odor, moist. 9 ft. EAN CLAY (CL), mostly clay, little tium plasticity, iron-oxide staining. 14 ft. SILTY CLAYEY SAND (SC-SM), ome silt and clay, no odor, moist, trace ght iron-oxide staining. 14 ft. 24 ft. 24 ft. vith sand (CH), mostly clay, little fine to ighly plastic, trace of coarse sand.					71.1	32	15			
						1													
				<u> </u>		1													
Maxim		particle :	size i sk ide	s det	termir	hed by di	rect obse	rvation with	nin the limitations of the sampler.	Rrierl		ssoci	ates	┥⋴	oring	No:	BA-3		
LINGIE	. 00		un iu	o nulli	Juniol	. 50360 0	ni visual•				-y A		u.03.						

							TES	T BOI	RING REPORT			E	Bor i Sheet	ing t No.	No 2 of 2	. B /	۹-3		
BR	IER	LEY		Pro	ject:		Dani	els Sand V	Vash Fines Pit			F	ile N	0.	51	- 6051-	-000		
Creating Span	ce Undei Broa	rground dwav		Dril	ina C	Contracto	or: Vine	Laboratori	es. Inc.			F	inish	n:	06	6/03/20	016		
Suite 2. Denver	22 r, Col	orado 80.	209	Ca	asina	Samr		Barrel	Drilling Equipment and Proc	edure				: =n ·	0\ S	wen P Baile	otter		
Туре					494	SS C	Δ	Darrer	Rig Make & Model: CME 750 Bugg	/ Rig	3			tion:	0.	Dalle	y		
Incido [otor (in)			105	1 2/0"	ົ		Hoist/Hammer: Automatic			H							
Hamme	er We	eight (lb.)		4	1.20	13/8	, 2		Bit Type: Cutting Head				locati	ion: side o	f the h	naul ro	oad.		
Hamme	er Fa	ll (in.)		• .					Casing: Hollow Stem Auger										
Water				/ater	Leve	el Data	Detter	Depth to	Sample Identificatio	n		_			N	otes			
Level	mm	/dd/yy	ime	Tir	ne	of Casing	of Hole	Water	C California Barrel										
—	06/	03/16 9:	21	No	one	25'	25'	20'	CS Continuous Sampler R Co	ore									
									S Split Spoon B B	ılk									
÷						Vie	ual-Mar	 	G Geoprobe T Th	in Wall	Tube		Labo	rator	v Res	sults			
		(%)c)			_	f)
(;	(#:)	ft.) /RQI	. <u>c</u>	Svel	hy									(%) e	e (ks				
bth (ation	⊆ û û	ws/6	ter Le	ttigra	Soil: D	(%)							lapse	ssur				
De	Elev	(in. c	B	Wat	Stra	R	ock: Hardn j	ture	el (%	(%)	(%) \$	(9		(ksf	I/Col	l Pre			
		Rec.								Vell	Mois	Grav	Sand	Fines	LL (%	Ы (%	ncs	Swel	Swel
		S-6	0		5555				29 ft			_					_		
30 -		29.0-30.5 6"	0			Very lo mostly	ose, brown fine to me	n, WELL-GR. dium sand, li	ADED SAND with CLAY (SW-SC), ttle coarse sand, little clay, no odor,										
		-				wet.													
-						-COAR	SE ALLU	/IUM-											
-						2													
		S-7	7		<u></u>	Dense	, tan, WEL	L-GRADED	34 fi SAND (SW), mostly fine to medium	.1									
35 –		18"	18			sand, l fines, r	ittle to som 10 odor, we	ie coarse sar et.	nd, trace to few fine gravel, trace of										
-						-COAR	SE ALLU	/IUM-											
		C 0	-			Top 6"													
40 -		39.0-40.5	, 11 15			Bottom	. as above.	oft highly we											
		13				(BR), b	locky, mos	stly clay, no c	odor, dry, highly plastic, iron-oxide										
-							9. Reshaie	_											
-																			
		C-9	50/4			Very se	oft, fresh, c	lark-gray, as	above.										
45 -		44.0-45 5"																	
-																			
50 -		C-10 49.0-50	50/3	"		As abo	ve.												
50		4"																	
_																			
-																			
-																			
55 -																			
						1													

							TES	T BOI	RING REPORT			E	Bor i Sheet	ing t No.	No 1 of 2	. B /	۹-4		
BR	IERI	LEY		Pro	ject:		Dani	els Sand V	Vash Fines Pit			F	ile N	0.	51	6051	-000		
Creating Spa	ce Under	ground dwav		Dril	ent: Ilina C	ontracto	Tran pr: Vine	sit Mix Laboratori	es. Inc.			F	Start: Finish	1:	06 06	/09/20 ;/09/20	016 016		
Suite 2. Denver	22 r, Col	orado 80	209	Ca	asina	Sam	oler	Barrel	Drilling Equipment and Proc	edures			Driller BA Re	: en.:	Ale D.	ex, Re Kwie	enee, tnews	Juan ki	
Туре				F	HSA	SS. C	A	24.101	Rig Make & Model: CME 750 Buggy	Rig			leva	tion:					
Inside [Diame	eter (in)			1.25"	1.3/8"	2"		Hoist/Hammer: Automatic			H		ion:					
Hamme	er We	eight (lb.)					_		Bit Type: Cutting Head			S	South	side c	of the	haul r	oad.		
Hamme	er Fal	l (in.)	V	Vater	· Level	Data			Casing: Hollow Stem Auger Sample Identification						N	otes			
Water	D	ate -	imo	Elap	sed	Bottom	Bottom	Depth to	Campio Idonalio							0100			
Level	mm	/dd/yy	ine	Tir	ne (of Casing	of Hole	Water	C California Barrel										
i ↓ ↓	06/0	09/16		No	one	20'	20'	18'	CS Continuous Sampler R Co	re									
Ē									S Split Spoon B Bu	lk in Wall ⁻	Tuhe								
						Vis	ual-Mar	nual Iden	tification and Description		Tube		Labo	rator	y Res	sults			
		D(%																()	(sf)
(#.)	n (ft.	(ft.)	6 in.	Level	Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture, optional descriptions, geologic interpretation													se (%	ure (k
lepth	vatic	or %	/S/NO	ater	Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture,optional descriptions, geologic interpretation Rock: Hardness, weathering, color, LITHOLOGY, texture, joint spacing, drilling rate (min./ft.) E (%)												sf)	ollap	essi.
	E			×	t.		vel (%) pi	6) se	(%)	(%	S (k	ell/C	ell Pr					
		В В							Mo	G	Sar	ц	Ē	Ы(nc	Š	Š		
		S-1 4.0-5.5 18" 9.0-10.5 18" S-3 14.0-15.5 17" C-4 19.0-20 12" S-5 24.0-25.5 18"	5 5 6 7 1 4 4 4 6 5 4 4 6 7			Mediur fine to -EOLIA Mediur clay wi -EOLIA Stiff, m clay wi -EOLIA Stiff, m clay wi	n dense, li medium sa N- n stiff, orar th some fir N- n stiff, brow ightly plas N- oddled bro th some fir oddled bro th some fir	ght-brown, P and, with less nge brown, sa he sand and s wn and orang tic, moist.	OORLY-GRADED SAND (SP), mostly than 5% of fines. 9 ft. andy SILTY CLAY (CL-ML), mostly silt, moist. 					69.8	28	12			
Mavim		narticle	 sizo	is do	tormin	ed by di	ract aboa	invation with	in the limitations of the complet										
NOTE	: Soi	il and ro	size ck id	entifi	cation	based c	n visual-	manual me	thods of the USCS as practiced by	/ Brierle	ey A	ssoci	ates.	В	oring	No:	BA-4		

							TES	ат во	RING REPORT			9	Bor Sheet	ing t No.	No 2 of 2	. B /	۹-4		
BR	IER	LEY TES		Pro	ject:		Dar	iels Sand V	Vash Fines Pit			F	File N	lo.	51	6051·	-000		
Creating Space	ce Unde Broa	rground dwav		Dril	ent: Iling (Contracto	or: Vine	Exaborator	ies, Inc.			F	-inish	n:	06	/09/20 5/09/20	016		
Suite 2 Denver	22 r, Col	lorado 80	209	Ca	asina	Sam	oler	Barrel	Drilling Equipment and Proc	edures	\$		Drillei BA Ri	r: ep.:	Al D.	ex, Re Kwie	enee, tnews	Juan ki	
Туре				 +	HSA	SS. C	A	24.10	Rig Make & Model: CME 750 Buggy	Rig			=leva	tion:					
Inside D	Diam	eter (in.)		4	1.25"	1 3/8"	. 2"		Hoist/Hammer: Automatic Drill Method: Hollow Stem Auger			H	ocat	ion [.]					
Hamme	er We	eight (lb.)					,		Bit Type: Cutting Head			5	South	side o	of the	haul r	oad.		
Hamme	er Fa	ll (in.)	v	/ater	·leve	l Data			Casing: Hollow Stem Auger Sample Identification	<u>וווווווווווווווווווווווווווווווווווו</u>		_			N	otes			
Water	C	Date T	ime	Elap	sed	Bottom	Bottom	Depth to		<u> </u>									
Level	mm	/dd/yy ·		Tir	ne	of Casing	of Hole	Water	C California Barrel	r0									
	00/	09/10		INC		20	20	10	S Split Spoon B Bu	lk									
Ţ				_		-			G Geoprobe T Th	in Wall	Tube								
		(%				Vis	ual-Ma	nual Iden	tification and Description			r –	Labo I	orator	y Re: I	sults			
	ft.)) DD(ē	Þ													(%)	(ksf)
th (ft.	ion (1	D th (ft. %)/R	s/6 ir	r Lev	Soil: Density/consistency, color, GROUP NAME, max. particle size, structure, odor, moisture,optional descriptions, geologic interpretation) əsdi	sure
Dep	ilevat	Dep n. or	Blow	Nate	Strati	R	e, odor, n ock: Hard	Diagra	re (9	(%)	(%)	(%)	_		ksf)	Colla	Pres		
	ш	tec.(i						Joint Spacing		Vell D	loistu	irave	and (ines	r (%	l (%)	ICS (well/	well
		S-6	0	-			2	1.8	68.0	LL 20.3		<u> </u>		0)	05				
30 -		29.0-30.5 18"	11 7			Mediur sand, t	m dense, race grav	orange-browr el, some silt.	h, SILTY SAND (SM), mostly coarse			1.0	00.3	23.5					
		10				-COAF	RSE ALLU	IVIUM-											
-																			
25		S-7 34.0-35.5	5 9			Mediu	m dense,	brown to orar				5.9	86	8.1					
35 7		14"	13				LI (5P-5	wi), iew grave	a, mostry sand, lew silt, wet.										
-						-COAP													
-					1991-1998 1991-1998 1991-1998														
		S-8	8			Dense	, POORL	Y-GRADED S	39 ft. AND (SP), mostly fine sand from 39-	-									
40 -		39.0-40.5 19"	22			39.75',	mostly m	edium to coa	rse sand from 39.75-40.5'.										
						-COAF	RSE ALLU	IVIUM-											
		C-9	32				6 P I I		44 ft.	-									
45 -		44.0-45 8"	50/4	"		clay.	oft, slighti	y weathered,	dark-gray, CLAYSTONE (BR), mostly										
-						-PIERI	RE SHALI	≣-											
			50/0				- 4 4 1-												
50 -			50/2			very s	oft, fresh,	as above.		-									
-																			
55 -																			



Checked By: K. Runner



Checked By: K. Runner



Checked By: K. Runner


Design Report – Draft Daniels Sand Wash Fines Pond Embankment Dam Raise Colorado Springs, Colorado November 22, 2024

Appendix B Hydrology Report

		Client	Holcim			Page	1 of 2
(\bigcirc)		Project	Daniels Sand Wa	sh Fines l	Rev.	0	
GEI Project No. By Date 2301310		Ву	KDS Chk. CEF			Арр.	
		Date	8/15/2024	Date	8/16/2024	Date	
		301310	Document No.	N/A			
Subject Stormwater Calculations for DSWFP							

Purpose:

The purpose of this calculation is to estimate the flood stage of the settling pond due to runoff generated from the 100-year and 200-year storm and the one-half Probable Maximum Precipitation (PMP) events, (both HMR 55A and CO-NM REPS) assuming no outflow via an emergency overflow spillway or return water pumping system. The tailings basin was assumed to store all runoff from these large storm events until it can be safely discharged through the return water pumping system.

Design Criteria and Assumptions:

- 1. The contributing watershed is approximately 29 acres (0.5 square miles) and is limited to the area of the fines pit and side slopes. The land uses are as follows:
 - a. A settling pond of approximately 22 acres.
 - b. Approximately 7 acres of sloped wall.
- 2. The maximum normal operating settling pond elevation was assumed to be approximately +5,818 feet for a dam elevation of +5,821 feet for the 2 year buildout plan.
- 3. The maximum normal operating settling pond elevation was assumed to be approximately +5,833 feet for a dam elevation of +5,836 feet for the 7 year buildout plan.
- 4. HydroCAD 10.10 was used to model the stormwater at Daniels Sand Wash Fines Pit.
- 5. The storm events include: (calculations are included in an attached calc package)
 - a. 100-Year Storm: 5.15 inches of rainfall, 24-hour duration
 - b. 200-Year Storm: 6.01 inches of rainfall, 24-hour duration
 - c. One-Half PMP (HMR 55A): 17.5 inches of rainfall, 24-hour duration
 - d. One-Half PMP (CO-NM REPS): 14.9 inches of rainfall, 24-hour duration
- Reservoir Elevation-Storage Relationship: The stage-storage relationships are based upon estimated topographical information for the planned tailings beach contours. Figures 1 and 2 illustrate the estimated surface elevations that were used to determine the available storage volume of the basin.
- 7. Wind induced wave estimates included in attached calculation package.

		Client	Holcim			Page	2 of 2
		Project	Daniels Sand Wash Fines Pit			Rev.	0
	/	Ву	KDS Chk. CEF		App.		
	nts	Date	8/15/2024	Date	8/16/2024	Date	
GEI Project No.		301310	Document No.	N/A			
Subject	Sto	ormwater C	alculations for DS	WFP			

Results:

The attached HydroCAD report includes input and output for the stormwater model developed for the Daniels Sand Wash Fines Pit. The table below is a summary of the waves and pond rise due to the analyzed storm events. Based on the anticipated tailings contours and HydroCAD modeling, it is anticipated that if the ½ PMP (HMR 55A) is realized and wave run up is considered, the containment dam may overtop under the current 2-Year planned buildout. A minimum freeboard of 3.0 feet will contain the ½ PMP (CO-NM REPS), 100-Year, and 200-Year storm events. If the minimum freeboard of 3.0 feet is maintained after the 7-Year buildout, all four storm events are not expected to overtop the dam.

2-Year Buildout Storm Events Water Elevations

	(A)	(B)	(C)	(D)	(E)	(F)	(G)
Storm Event	Pond Starting Elevation* (feet)	Wave Run-up (feet)	Wind Set-up (feet)	Approximate Rise of Pond Due to Storm (feet)	Maximum Water Surface Elevation (A+B+C+D) (feet)	Minimum Crest of Water Retention Dam (feet)	Available Freeboard (F-E) (feet)
100 Year	5818.00	0.72	0.35	0.62	5819.69	5821.00	1.31
200-Year	5818.00	0.72	0.35	0.73	5819.80	5821.00	1.20
1/2PMP (CO-NM REPS)	5818.00	0.72	0.35	1.85	5820.92	5821.00	0.08
1/2 PMP (HMR55A)	5818.00	0.72	0.35	2.16	5821.23	5821.00	-0.23

*Assumes a maximum pond elevation of +5,818 feet for a Water Retention Dam elevation of +5,821 feet.

7-Year Buildout Storm Events Water Elevations

	(A)	(B)	(C)	(D)	(E)	(F)	(G)
Storm Event	Pond Starting Elevation* (feet)	Wave Run-up (feet)	Wind Set-up (feet)	Approximate Rise of Pond Due to Storm (feet)	Maximum Water Surface Elevation (A+B+C+D) (feet)	Minimum Crest of Water Retention Dam (feet)	Available Freeboard (F-E) (feet)
100 Year	5833.00	0.72	0.35	0.52	5834.59	5836.00	1.41
200-Year	5833.00	0.72	0.35	0.62	5834.69	5836.00	1.31
1/2PMP (CO-NM REPS)	5833.00	0.72	0.35	1.61	5835.68	5836.00	0.32
1/2 PMP (HMR55A)	5833.00	0.72	0.35	1.89	5835.96	5836.00	0.04

*Assumes a maximum pond elevation of +5,833 feet for a dam elevation of +5,836 feet.

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		Project	Daniels Sand Wash Fines Pit			Rev.	
GEI Project No.		Ву	KDS	CEF	App.		
		Date	8/15/2024	Date	8/16/2024	Date	
		2400434 Document No.		N/A			
Subject Stormwater (Calculations for DS	WFP			

Attachments:

- HydroCAD Summary Report
- Precipitation Calculations
- Wind Induced Wave Calculations

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		Project	Daniels Sand Wash Fines Pit			Rev.	
	/	Ву	KDS	Chk.	CEF	App.	
	nts	Date	8/15/2024	Date	8/16/2024	Date	
GEI Project No.		2400434 Document No.		N/A			
Subject Design Precipitation Estimates for Daniels Sand Wash Fines						Pit	

Purpose:

The purpose of this analysis is to estimate the precipitation quantity for selected storm events which will be utilized in other calculations to estimate that Daniels Sand Wash Fines Pit can safely store runoff associated with the analyzed storm events. The analyzed storm events include the 100/200-year, 24-hour, and the ½ PMP, 24-hour probable maximum precipitation (PMP) events.

Procedure:

100/200-year, 24-hour Storm Event:

The rainfall depth estimation for the 100/200-year, 24-hour event follows the procedures outlined in Precipitation-Frequency (PF) Atlas of the United States (Atlas 14, Volume 8, Version 2: Colorado). As instructed in Atlas 14, the user is referred to the NOAA Precipitation Frequency Data Server (PFDS) http://hdsc.nws.noaa.gov/hdsc/pfds/index.html. The approximate center of Daniels Sand Wash Fines Pit was input into the PFDS and the PF estimates were returned.

Daniels Sand Wash Fines Pit Coordinates



38.7739°, -104.7507°

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	ノ	Ву	KDS	Chk.	CEF	Арр.	
	ints	Date	8/15/2024	Date	8/16/2024	Date	
GEI Project No.		2400434 Document No.		N/A			
Subject	Des	Design Precipitation Estimates for Daniels Sand Wash Fines Pit					

Tabular Output from the PFDS:

		PDS-based	precipitation	n frequency	estimates w	vith 90% cor	fidence inte	ervals (in inc	ches) ¹	
					Average recurren	ce interval (years)				
Duration	1	2	5	10	25	50	100	200	500	1000
5-min	0.244	0.293	0.380	0.459	0.575	0.671	0.774	0.884	1.04	1.16
	(0.201-0.298)	(0.242-0.359)	(0.312-0.468)	(0.374-0.567)	(0.455-0.748)	(0.517-0.884)	(0.573-1.05)	(0.625-1.23)	(0.703-1.49)	(0.762-1.69)
10-min	0.357 (0.295-0.437)	0.429 (0.354-0.526)	0.557 (0.458-0.685)	0.672 (0.548-0.830)	0.842 (0.667-1.10)	0.983 (0.757-1.30)	1.13 (0.839-1.53)	1.29 (0.914-1.80)	1.52 (1.03-2.19)	1.70 (1.12-2.48)
15-min	0.435 (0.359-0.533)	0.524 (0.432-0.642)	0.679 (0.558-0.835)	0.819 (0.668-1.01)	1.03 (0.813-1.34)	1.20 (0.923-1.58)	1.38 (1.02-1.87)	1.58 (1.12-2.20)	1.86 (1.26-2.67)	2.08 (1.36-3.02)
30-min	0.648	0.779	1.01	1.22	1.53	1.78	2.06	2.35	2.77	3.10
	(0.535-0.794)	(0.643-0.956)	(0.830-1.24)	(0.994-1.51)	(1.21-1.99)	(1.37-2.35)	(1.52-2.79)	(1.66-3.28)	(1.87-3.98)	(2.03-4.51)
60-min	0.848 (0.700-1.04)	0.996 (0.821-1.22)	1.27 (1.05-1.57)	1.54 (1.26-1.90)	1.95 (1.56-2.56)	2.31 (1.78-3.06)	2.70 (2.00-3.68)	3.13 (2.22-4.39)	3.75 (2.54-5.42)	4.26 (2.79-6.20)
2-hr	1.05	1.21	1.54	1.86	2.37	2.83	3.34	3.90	4.74	5.43
	(0.870-1.27)	(1.01-1.48)	(1.27-1.88)	(1.53-2.28)	(1.91-3.12)	(2.21-3.75)	(2.50-4.53)	(2.80-5.46)	(3.24-6.81)	(3.58-7.84)
3-hr	1.15	1.31	1.64	1.98	2.56	3.08	3.66	4.33	5.32	6.15
	(0.957-1.39)	(1.09-1.59)	(1.36-2.00)	(1.64-2.43)	(2.08-3.37)	(2.42-4.08)	(2.77-4.98)	(3.12-6.06)	(3.67-7.65)	(4.08-8.85)
6-hr	1.31	1.48	1.84	2.23	2.89	3.50	4.19	4.99	6.18	7.18
	(1.10-1.58)	(1.24-1.78)	(1.54-2.22)	(1.85-2.71)	(2.38-3.80)	(2.77-4.62)	(3.20-5.68)	(3.63-6.94)	(4.30-8.83)	(4.80-10.3)
12-hr	1.46	1.67	2.10	2.54	3.27	3.93	4.68	5.52	6.78	7.82
	(1.23-1.75)	(1.41-2.00)	(1.76-2.52)	(2.12-3.07)	(2.70-4.25)	(3.14-5.14)	(3.59-6.28)	(4.04-7.62)	(4.74-9.61)	(5.28-11.1)
24-hr	1.63	1.90	2.41	2.90	3.69	4.39	5.15	6.01	7.25	8.28
	(1.39-1.94)	(1.61-2.26)	(2.04-2.88)	(2.44-3.48)	(3.05-4.72)	(3.51-5.66)	(3.97-6.83)	(4.42-8.20)	(5.11-10.2)	(5.63-11.7)
2-day	1.86	2.18	2.77	3.32	4.17	4.90	5.70	6.57	7.82	8.84
	(1.60-2.20)	(1.87-2.58)	(2.36-3.29)	(2.82-3.96)	(3.46-5.27)	(3.94-6.26)	(4.41-7.47)	(4.86-8.87)	(5.54-10.9)	(6.06-12.4)
3-day	2.04	2.39	3.04	3.63	4.53	5.30	6.12	7.02	8.30	9.35
	(1.75-2.40)	(2.06-2.82)	(2.60-3.59)	(3.09-4.31)	(3.76-5.68)	(4.27-6.72)	(4.76-7.98)	(5.22-9.43)	(5.91-11.5)	(6.44-13.0)
4-day	2.19	2.56	3.24	3.87	4.81	5.60	6.45	7.37	8.68	9.75
	(1.89-2.57)	(2.21-3.01)	(2.79-3.82)	(3.30-4.58)	(4.00-6.00)	(4.53-7.07)	(5.02-8.37)	(5.49-9.86)	(6.20-12.0)	(6.74-13.6)
7-day	2.57	2.97	3.70	4.36	5.35	6.19	7.08	8.05	9.43	10.5
	(2.23-3.00)	(2.58-3.47)	(3.20-4.33)	(3.74-5.13)	(4.48-6.63)	(5.03-7.77)	(5.55-9.14)	(6.04-10.7)	(6.78-12.9)	(7.34-14.6)
10-day	2.89	3.32	4.09	4.78	5.82	6.68	7.60	8.60	10.0	11.1
	(2.52-3.36)	(2.89-3.87)	(3.54-4.77)	(4.12-5.61)	(4.88-7.17)	(5.45-8.34)	(5.98-9.76)	(6.47-11.4)	(7.22-13.6)	(7.79-15.4)
20-day	3.77	4.32	5.26	6.08	7.26	8.21	9.20	10.2	11.7	12.8
	(3.31-4.36)	(3.79-5.00)	(4.60-6.10)	(5.28-7.09)	(6.10-8.82)	(6.73-10.1)	(7.27-11.7)	(7.75-13.4)	(8.48-15.8)	(9.03-17.5)
30-day	4.51	5.18	6.29	7.22	8.53	9.55	10.6	11.7	13.1	14.2
	(3.97-5.18)	(4.55-5.96)	(5.51-7.26)	(6.29-8.38)	(7.18-10.3)	(7.85-11.7)	(8.40-13.3)	(8.85-15.1)	(9.54-17.6)	(10.1-19.4)
45-day	5.45	6.28	7.61	8.70	10.2	11.3	12.4	13.5	14.9	16.0
	(4.82-6.25)	(5.55-7.20)	(6.70-8.76)	(7.62-10.1)	(8.58-12.1)	(9.30-13.7)	(9.85-15.5)	(10.3-17.4)	(10.9-19.9)	(11.4-21.7)
60-day	6.28	7.24	8.76	9.98	11.6	12.8	14.0	15.1	16.5	17.5
	(5.57-7.17)	(6.41-8.28)	(7.74-10.0)	(8.76-11.5)	(9.79-13.8)	(10.6-15.5)	(11.1-17.3)	(11.5-19.3)	(12.1-21.9)	(12.5-23.8)

¹ Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.



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	nts	Date	8/15/2024	Date	8/16/2024	Date	
GEI Project No.		400434	Document No.	N/A			
Subject	De	sign Precip	tation Estimates for Daniels Sand Wash Fines Pit				

One-half Probable Maximum Precipitation (PMP) event:

There are serveral references that were used to estimate the precipiaton depth for the PMP event at Daniels Sand Wash Fines Pit. Historically, Hydrometerological Report No. 55A (NOAA HMR 55A 1988) was most commonly used to determine the depths for the PMP event. Alternatively, in 2018 the Colorado Department of Water Resources, along with Applied Weather Associates (AWA) and the New Mexico Dam Safety Bureau, performed a study for Colorado and New Mexico that refined the PMP event and reduced the precipitation depths from HMR 55A by up to 15%. The PMP results gathered from the study performed by AWA have been accepted and used by numerous organizations, including Colorado and New Mexico dam safety groups.

The one-half PMP from HMR 55A was taken from an all-season PMP for 24-hour 10 square mile plate and then halved (see figure below).







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Climate Change Considerations:

When determining the ½ PMP depth, GEI considered the effect of climate change. The correlation between climate change and rainfall events is not clear. An atmosphere that is subject to warmer weather may be more susceptible to an increase in atmospheric moisture; however, the relationship between a warming climate and the dynamics of a storm is not known. An increase in temperature may affect the frequency or intensity of a storm, but the evidence that has been gathered does not show a significant trend in data in regards to PMP depth. Climate change should not be considered when estimating the rainfall depths for PMP events (WMO 2009, Section 1.1.1). Similar climate change conclusions were recently discussed in the report "*Site-Specific Probable Maximum Precipitation Study For Tittabawasse River Basin, Michigan Final Report*" by Applied Weather Associates (AWA).

Results:

The 100-yr and 200-yr, 24-hour storms are 5.15 inches and 6.01 inches, respectively, for the Daniels Sand Wash Fine Pit, with the ½ PMP storm event being 17.5 inches from HMR 55A and 14.9 inches from CO-NM REPS (2018), as summarized in the table below. These values will be utilized in the stormwater model (under a separate calculation package).

Frequency	Depth	Reference
100-year, 24-Hour	5.15 inches	NOAA Atlas 14
200-yr, 24-Hour	6.01 inches	NOAA Atlas 14
½ PMP, 24-Hour	17.5 inches	HMR 55A (NOAA 1988)
½ PMP, 24-Hour	14.9 inches	CO-NM REPS (2018)

Table 1: Design Precipitation Events

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		Project	Daniels Sand Wash Fines Pit			Rev.		
GEI Project No. By Data Set Project No. By Data		Ву	KDS	Chk.	CEF	Арр.		
		Date	8/15/2024	Date	8/16/2024	Date		
		400434	Document No.	N/A				
Subject	De	sign Precip	cipitation Estimates for Daniels Sand Wash Fines Pit					

References:

- Applied Weather Associates (AWA). (2021). (rep.). Site-Specific Probable Maximum Precipitation Study For Tittabawasse River Basin, Michigan Final Report (pp. 1–57). Monument , CO.
- Applied Weather Associates (AWA). (2018). (rep.). Colorado New Mexico Regional Extreme Precipitation Study, Summary Report Volume II, Monument, CO.
- NOAA (National Oceanic and Atmospheric Administration). 1988. Probable Maximum Precipitation Estimates, United States Between the Continental Divide and the 103^{rh} Meridian, Hydrometeorological Report 55A (HMR55A). Silver Spring, MD.
- NOAA. 2013. National Weather Service Atlas 14, Volume 8, Version 2.0: Midwestern States. Precipitation Frequency Atlas of the United States.
- NOAA, Precipitation Frequency Data Server (PFDS). <u>https://hdsc.nws.noaa.gov/hdsc/pfds/</u>. Accessed 2/28/23.
- World Meteorological Organization, 2009: Manual for Estimation of Probable Maximum Precipitation, Operational Hydrology Report No 1045, WMO, Geneva, 259 pp.

Project By Date 4 un Up Calcu ine the maximu procedures as Technical Mem Dams, U.S. D See Attached Trees Cos 5 0.8 5 0.8 5 0.8 5 0.8 5 0.8 5 0.9 5 0.9	Daniels Sand KDS 8/15/2024 Document N ulation 2-yr um water surface described in ACE horandum No. 2, Department of Inte Site Plan, Figure 319 79 366 94 306 98 340 100 366 94 366 94 366 94 366 94 366 94 366 94 366 94 366 94 366 94 366 94 366 94 366 94 366 94 364 100	I Wash Fi Ch Da No. N/J e elevation of ER Technic: Freeboard (erior Bureau 0.2 0.2 0.4 140	ines Pit k. C te 8 A due to wind criteria and u of Reclam <u>Xi (miles)</u> 0.15 0.18 0.19 0.20	EF 2/16/2024 induced waves indum No. 2 (US Guidelines for nation, 1981. Xi * Cos(α) 0.123 0.154 0.168	Pg. Rev. App. Date	ETL 1110-2-221)
By Date 4 un Up Calcu ine the maximu procedures as Fechnical Mem b Dams, U.S. D See Attached rees Cos 5 0.8 5 0.8 5 0.8 5 0.8 5 0.8 5 0.9 5 0.9	KDS 8/15/2024 Document N ulation 2-yr um water surface described in ACE norandum No. 2, Department of Inte Site Plan, Figure 366 94 306 98 340 10 365 111 366 111 366 94 366 94 366 111 366 111 366 111 366 111 366 111 366 111	Ch Da No. N// e elevation of ER Technic Freeboard 0 erior Bureau 0.2 0.2 0.4 40	k. C te 8 A due to wind cal Memorar Criteria and u of Reclam <u>Xi (miles)</u> 0.15 0.18 0.19 0.20	EF 3/16/2024 induced waves ndum No. 2 (US Guidelines for nation, 1981. Xi * Cos(α) 0.123 0.154 0.168	App. Date	ETL 1110-2-221)
Date Date In Up Calculation ine the maximum procedures as Technical Memme Dams, U.S. D See Attached Image Dams, U.S. D See One See One <td>8/15/2024 Document N ulation 2-yr um water surface described in ACE norandum No. 2, Department of Inte Site Plan, Figure (α) Xi (1 319 79 366 94 306 98 340 10 366 111 366 11</td> <td>Da No. N// e elevation of E E elevation of E</td> <td>te 8 A due to wind cal Memorar Criteria and u of Reclam <u>Xi (miles)</u> 0.15 0.18 0.19 0.20</td> <td>3/16/2024 induced waves ndum No. 2 (US Guidelines for nation, 1981. Xi * Cos(α) 0.123 0.154 0.168</td> <td>Date Date</td> <td>ETL 1110-2-221) ard Allowances for</td>	8/15/2024 Document N ulation 2-yr um water surface described in ACE norandum No. 2, Department of Inte Site Plan, Figure (α) Xi (1 319 79 366 94 306 98 340 10 366 111 366 11	Da No. N// e elevation of E E elevation of E	te 8 A due to wind cal Memorar Criteria and u of Reclam <u>Xi (miles)</u> 0.15 0.18 0.19 0.20	3/16/2024 induced waves ndum No. 2 (US Guidelines for nation, 1981. Xi * Cos(α) 0.123 0.154 0.168	Date Date	ETL 1110-2-221) ard Allowances for
4 un Up Calcu- ine the maximu- procedures as Technical Mem Dams, U.S. D See Attached rees Cos 5 0.8 5 0.8	Document N ulation 2-yr um water surface described in ACE norandum No. 2, Department of Inte Site Plan, Figure Site Plan, Figure 366 94 306 98 340 10 366 111 366 94 366 94 366 94 366 94 366 94 366 94 366 94 366 94 366 111 366 111	e elevation of ER Technic Freeboard (erior Bureau e 3.) feet) 0.2 0.2 0.4 140	A due to wind cal Memorar Criteria and u of Reclam <u>Xi (miles)</u> 0.15 0.18 0.19 0.20	induced waves ndum No. 2 (US Guidelines for nation, 1981. <u>Xi * Cos(α)</u> 0.123 0.154 0.168	BR 1981, based on Computing Freeboa	ETL 1110-2-221) ard Allowances for
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ine the maximu procedures as Technical Mem Dams, U.S. D See Attached Trees Cos 5 0.8 5 0.8 5 0.8 5 0.8 5 0.8 5 0.9 5 0.8 5 0.9 5 0.0 5 0.0 5 0.0 5 0.0	um water surface described in ACE norandum No. 2, Department of Inte Site Plan, Figur Site	e elevation (ER Technic Freeboard (erior Burea) e 3.) feet) 0.2 0.2 0.4 140	due to wind cal Memorar Criteria and u of Reclam Xi (miles) 0.15 0.18 0.19 0.20	induced waves ndum No. 2 (US Guidelines for nation, 1981. Xi * Cos(α) 0.123 0.154 0.168	BR 1981, based on Computing Freeboa	ETL 1110-2-221)
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See Attached prees Cos 5 0.8 5 0.8 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9	Site Plan, Figur s (α) Xi (1) 319 79 366 94 906 98 940 10 966 111 965 102	e 3.) feet) 0.2 0.2 0.4 40	Xi (miles) 0.15 0.18 0.19 0.20	Xi * Cos(α) 0.123 0.154 0.168		
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rees Cos 5 0.8 5 0.9 6 0.9	s (α) Xi (1) 319 79 366 94 906 98 940 10 966 111 966 111 966 111	feet) 0.2 0.2 0.4 \u00e40	Xi (miles) 0.15 0.18 0.19 0.20	Xi * Cos(α) 0.123 0.154 0.168		
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0 0.8 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 5 0.9 6 0.9 6 0.9	366 94 906 98 940 10 966 111 985 120	0.2	0.18	0.154 0.168		
5 0.9 0 0.9 5 0.9 5 0.9 0 0.9 0 0.9 0 0.9 0 0.9	906 98 940 10 966 111 985 120	0.4	0.19	0.168		
0.9 0.9 5 0.9 5 0.9 0 0.9 0 0.9 0 0.9	940 10 966 111	040	0.20			
0.9		1 1 1	0.20	0.185		
0.9	10.1	11.2	0.21	0.203		
	996 130	07.6	0.25	0.247		
1.0	000 14	46	0.27	0.274		
0.9	996 127	77.8	0.24	0.241		
0.9	985 120)1.4	0.23	0.224		
5 0.9	966 116	6.65	0.22	0.213		
0.9		33.1	0.21	0.202		
		73	0.20	0.182		
5 0.8	319 91	7.8	0.10	0.100		
0.7	766 87	1.7	0.17	0.126		
5 0.7	707 80	8.8	0.15	0.108		
Sum = 15.4	429		Sum =	= 3.18		
$\sum (Xi\cos(a))$	$(\alpha))/\sum \cos(\alpha)$	Effec	ctive Fetch =	= 0.21	miles	
		Foff -	0.2	miles		
	Wind V	/elocity =	60	mph		
	D	uration =	5.1	mins	(Figure 9 USBR 198	81)
design wave		Hs =	13	ft		
) wave period		T =	1.95	sec		
Lo = 5.12	2(T) ²	Lo =	19.5	ft		
= 1.67(Hs)	-	Hmax =	2.2	ft		
de) \) =	esign wave wave period Lo = 5.1; : 1.67(Hs)	Wind V Wind V Besign wave wave period $Lo = 5.12(T)^2$ = 1.67(Hs)	Feff = Wind Velocity = Duration = esign wave Hs = wave period T = Lo = $5.12(T)^2$ Lo = = 1.67(Hs) Hmax =	$Feff = 0.2 \\ Wind Velocity = 60 \\ Duration = 5.1 \\ esign wave Hs = 1.3 \\ wave period T = 1.95 \\ Lo = 5.12(T)^2 Lo = 19.5 \\ = 1.67(Hs) Hmax = 2.2 \\ Hmax = 2.2 \\$	$Feff = 0.2 \text{ miles}$ $Wind \text{ Velocity} = 60 \text{ mph}$ $Duration = 5.1 \text{ mins}$ esign wave $Hs = 1.3 \text{ ft}$ wave period $T = 1.95 \text{ sec}$ $Lo = 5.12(T)^2 \qquad Lo = 19.5 \text{ ft}$ $1.67(Hs) \qquad Hmax = 2.2 \text{ ft}$	$Feff = 0.2 \text{ miles}$ $Wind \text{ Velocity} = 60 \text{ mph}$ $Duration = 5.1 \text{ mins} \text{ (Figure 9 USBR 19)}$ esign wave $Hs = 1.3 \text{ ft}$ wave period $T = 1.95 \text{ sec}$ $Lo = 5.12(T)^2 \text{ Lo} = 19.5 \text{ ft}$ $1.67(Hs) \text{ Hmax} = 2.2 \text{ ft}$

		Client	Holcin	n			Page		
	\bigcirc	Project	Danie	ls Sand Was	sh Fines Pit		Pg. Re	ev.	
GEI	Ľ	Ву	KDS		Chk.	CEF	App.		
	sultants	Date	8/15/2	2024	Date	8/16/2024	Date		
Project No.	240043	34	Docu	ment No.	N/A				
Subject	Wave F	Run Up Ca	alculation	n 2-yr					
Wind Setup	* Assu	me a uniforr	n depth =	4	ft				
	Wind S	Setup Z	$Z_S = \frac{V_{WI}}{14}$	$\frac{nd^{2} * F}{00 * d}$					
			Vwind =	60	mph				
			Feff =	0.21	miles				
		F	= 2*Feff =	0.41	miles				
			d =	3	ft				
			Zs =	0.35	ft				
Wind Runup	* East	Dams have Design V I Design [2H:1V slop Vave, Hs = Period, T = Depth, ds =	es with riprap I 1.3 1.95 3	ining ft sec ft	(depth at toe	of impoundmen)	
			ds/Hs =	2.31					
	Hs = H	'o F	$1'o/(g^{*}T^{2}) =$	0.011					
	From F	igure 11 (U	SBR 1981) R/H'o = R =	0.55 0.72	ft				
Summary:	- -						(F)		
Storm Event	(/ Pond S Eleva	a) Starting Ition* Wa	(В) ve Run-up	(C) Wind Set-up	(D) Approxima Rise of Po Due to Sto	(E) Maximum ate Water nd Surface rm Elevation (A+B+C+D)	(F) Minimum Crest of Water Retention Dam	(G) Available Freeboard	
	(fe	et)	(feet)	(feet)	(feet)	(feet)	(feet)	(F-E) (feet)	

1.31 1.20

0.08

	(feet)	(feet)	(feet)	(feet)	(feet)	(feet)
100 Year	5818.00	0.72	0.35	0.62	5819.69	5821.00
200-Year	5818.00	0.72	0.35	0.73	5819.80	5821.00
1/2PMP (CO-NM REPS)	5818.00	0.72	0.35	1.85	5820.92	5821.00
1/2 PMP (HMR55A)	5818.00	0.72	0.35	2.16	5821.23	5821.00

*Assumes a maximum pond elevation of +5,818 feet for a Water Retention Dam elevation of +5,821 feet.

Attachments:

Figure 3. USBR Referenced Figures

		Client	Holcim			Page	
))	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GEI	$\underline{\mathbb{S}}$	Ву	KDS	Chk.	CEF	Арр.	
	sultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	34	Document No.	N/A			
Subject	Wave R	Run Up Cal	culation 2-yr				
	Our ror	ort					
· · · · · · · · · · · · · · · · · · ·	zyriep	on					
		28			39	\mathbf{s}	
				^			
				\land	V _		
	P	ond SI	opes 🖊	1P	Rainfall Eve	ent (Area	ı)
				• • • •			
			Daniels	Sand \	Nash		
			FI	nes Pit			
			^				
	Subcat	Reach	Pond Link	Ro	uting Diagram for HydroC	ad Calcs KDS	
				HydroCAD® 10.	00-25 s/n 11294 © 2019 Hydro	CAD Software Solution	is LLC

Γ		1	1				
	\bigcirc	Client	Holcim			Page	
	\bigcirc	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GEL	S	Ву	KDS	Chk.	CEF	App.	
	nsultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	34	Document No.	N/A			
Subject	Wave F	Run Up Cal	culation 2-yr				
Hy Pre <u>Hyc</u>	droCad epared by droCAD® 10	Calcs KDS GEI Consul ^{0.00-25} s/n 11	tants I294 © 2019 HydroCAD	Software Solu	utions LLC	2-Yi Printed 8/	ear Plan 13/2024 <u>Page 2</u>
			Area Lis	sting (all no	des)		
	Δr	ea CN	Description	- •			
	(acre	es)	(subcatchment-number	rs)			
	7.0 21 7	00 77 00 98	Fallow, bare soil, HSG Water Surface, HSG A	A (2S) (3S)			
	28.7	00 93	TOTAL AREA	(00)			

		Client	Holcim			Page	
	$\bigcirc)$	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GEI	$\underline{\mathcal{D}}$	Ву	KDS	Chk.	CEF	App.	
	nsultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	34	Document No.	N/A			
Subject	Wave F	Run Up Cal	culation 2-yr				
Hy Pre Hyd	droCad pared by roCAD® 10	Calcs KDS GEI Consult 0.00-25 s/n 11	ants 294 © 2019 HydroCAD	Software Solu	itions LLC	2-Y	ear Plan 13/2024 <u>Page 3</u>
			Soil Lis	ting (all noo	des)		
	Ar (acre 28.7 0.0 0.0 0.0	ea Soil es) Group 00 HSG A 00 HSG B 00 HSG C 00 HSG D	Subcatchment Numbers 2S, 3S				
	0.0 28.7	00 Other 00	TOTAL AREA				
l .							

		Client	Holcim		Page		
	\bigcirc	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GEI	I solution	Ву	KDS	Chk.	CEF	App.	
	sultants	Date	8/16/2024	Date			
Project No.	240043	4	Document No.	N/A			
Subject	Wave R	lun Up Cal	culation 2-yr				
Hyo						2-Y	′ear Plan
Hyd	pared by oCAD® 10	GEI Consul GEI Consul 0.00-25 s/n 11	tants 294 © 2019 HydroCAD Ground C	Software Solu	tions LLC odes)	Printed 8	/13/2024 Page 4
He Hyd	HSG-A (acres)	GEI Consuli J.00-25 s/n 11 HSG-B (acres)	tants <u>294 © 2019 HydroCAD</u> Ground C HSG-C HSG-D (acres) (acres)	Software Solu Covers (all n Other (acres)	tions LLC odes) Total Ground (acres) Cover	Printed 8 Subcatch Numbers	/13/2024 Page 4 ment

	Client	Holcim			Page	
	Project	Daniels Sand Wa	it	Pg. Rev.		
GEI	Ву	KDS	Chk.	CEF	Арр.	
VLI Consultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No. 24004	34	Document No.	N/A			
Subject Wave	Run Up Ca	Iculation 2-yr				
HydroCad Prepared b HydroCAD®	l Caics KDS y GEI Consu 10.00-25 s/n 1 Reach rout	tants 1294 © 2019 HydroCAD Time span=0.00-72.0 Runoff by SCS TR-20 r ing by Stor-Ind+Trans r	ype II 24-hr <u>Software Sol</u> 0 hrs, dt=0.0 nethod, UH= method - Pc	1/2 PMP (HMR 57 utions LLC 5 hrs, 1441 points SCS, Weighted-CN ond routing by Stor-Ir	2-Ye 1), 24 hr Rainfalı Printed 8/ nd method	ear Plan =17.50″ I3/2024 <u>Page 5</u>
Subcatchm	ent2S: Pond F	Slopes Run low Length=140' Slope=	noff Area=7.00 =0.3330 '/' To	00 ac 0.00% Impervio =0.7 min CN=77 Ri	ous Runoff Depth unoff=183.70 cfs 8	=14.36" 3.379 af
Subcatchm	ent3S: Rainfa	all Event (Area) Runoff	Area=21.700 Tc=	ac 100.00% Impervio =0.0 min CN=98 Ru	ous Runoff Depth noff=610.14 cfs 3	=17.26" I.207 af
Pond 1P: Da	aniels Sand W	/ash Fines Pit Peak Ele	v=5,820.16' S	Storage=39.586 af Int	flow=792.99 cfs 39 Outflow=0.00 cfs	9.586 af 0.000 af

		Client	Holcim			Page	
	\bigcirc	Project	Daniels Sand Wa	ash Fines Pi	t	Pg. Rev.	
GEI	Y	Ву	KDS	Chk.	CEF	App.	
	nsultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	34	Document No.	N/A			
Subject	Wave F	Run Up Cal	culation 2-yr				
Hy Pre <u>Hyc</u> Rui Rui	droCad (epared by lroCAD® 1(noff =	Calcs KDS GEI Consult 0.00-25 s/n 11 \$ 183.70 cfs S TR-20 meth	7 tants <u>294 © 2019 HydroCAE</u> Summary for Subo s @ 11.89 hrs, Volur nod, UH=SCS, Weight	<i>Type II 24-hr</i> <u>) Software Solu</u> catchment me= 8 ted-CN, Time	<i>1/2 PMP (HMR 51),</i> <u>utions LLC</u> 2S: Pond Slopes 3.379 af, Depth=14.36 Span= 0.00-72.00 hrs	2-Y 24 hr Rainfa Printed 8 " , dt= 0.05 hrs	∕ear Plan /II=17.50″ /13/2024 Page 6
Тур	e II 24-hr	1/2 PMP (HN	/IR 51), 24 hr Rainfall=	=17.50"			
	Area (ac) 7.000	CN Desc 77 Fallo	cription w, bare soil, HSG A				
	7.000	100.	00% Pervious Area				
(Tc Leng min) (fe	gth Slope eet) (ft/ft)	Velocity Capacity (ft/sec) (cfs)	Description			
	0.7 1	140 0.3330	3.49	Sheet Flow, Smooth surfa	Slopes	1 90"	
			Subcatchm	ent 2S: Por	nd Slopes	1.00	
			Hydrog	graph			
Elow (deb)		183.70 cfs	16 18 20 22 24 26 28 30 32 3 Tim	Ru 4 36 38 40 42 44 ie (hours)	Type II 1/2 PMP (HM 24 hr Rainfall=1 Runoff Area=7.0 noff Volume=8.3 Runoff Depth=1 Flow Length Slope=0.3 Tc=0. C	24-hr IR 51) 7.50" 00 ac 379 af 4 36" =140' 330 '/' 7 min N=77 4 66 68 70 72	- Runoff

		Client	Holcim			Page	
	\sum	Pg. Rev.					
	Y	Ву	KDS	Chk.	CEF	Арр.	
	sultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	4	Document No.	N/A			
Subject	Wave R	un Up Cal	culation 2-yr				
Subject NO. Subject Hyd Prep Hydro Runc Type At	$\frac{ \mathbf{roCad} }{ \mathbf{roCad} } \\ \mathbf{roCad} \\ $	4 Iun Up Cali Calcs KDS GEI Consult .00-25 s/n 11 Sum 610.14 cfs S TR-20 meth 1/2 PMP (HN 98 Wate 100.1	Ty tants 294 © 2019 HydroCAD mary for Subcatch mary for Subcatch a @ 11.89 hrs, Volum nod, UH=SCS, Weighte AR 51), 24 hr Rainfall= cription er Surface, HSG A 00% Impervious Area Subcatchment 3 Hydrog	ype II 24-hr Software Solu ment 3S: I ne= 31 ed-CN, Time 17.50" S: Rainfall raph S: Rainfall raph S: Rainfall raph S: Rainfall raph S: Rainfall raph S: Rainfall raph S: Rainfall raph S: Rainfall raph S: Rainfall raph S: Rainfall S: S: S	1/2 PMP (HMR 51), tions LLC Rainfall Event (Are .207 af, Depth=17.26 Span= 0.00-72.00 hrs I Event (Area) I Event (Area) I Z PMP (HMI 4 hr Rainfall=1 noff Area=21.7(ff Volume=31.2 unoff Depth=1 Tc=0.0 C	2-Y 24 hr Rainfa Printed 8 ea) , dt= 0.05 hrs 24-hr R 51) 7.50" 00-ac 07-af 7.26" 00-ac 07-af 7.26" 0 min N=98	'ear Plan i/I=17.50" /13/2024 _Page 7

			Client	Holcim			Page	
		\bigcirc	Project	Daniels Sand V	Vash Fines P	it	Pg. Rev.	
GEL		Ľ	Ву	KDS	Chk.	CEF	App.	
	Con	sultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No		240043	4	Document No	o. N/A			
Subject		Wave R	tun Up Calo	culation 2-yr				
	Hyd Pre <u>Hydr</u> Inflc	droCad (pared by roCAD® 10 w Area =	Calcs KDS GEI Consult 0.00-25 s/n 11 Sum 28.700 a	tants <u>294 © 2019 HydroC</u> 1mary for Pond ac, 75.61% Impervi	Type II 24-hr AD Software Soli 1P: Daniels S ious, Inflow Der	1/2 PMP (HMR 51 utions LLC Sand Wash Fines oth = 16.55" for 1/2	2-Y), 24 hr Rainfa Printed 8, s Pit 2 PMP (HMR 51	ear Plan //=17.50" /13/2024 Page 8), 24 hr event
	Inflo Out	ilow =	792.99 cfs 0.00 cfs	s @ 11.89 hrs, Vo s @ 0.00 hrs, Vo	olume= 39	9.586 af 0.000 af, Atten= 100	%, Lag= 0.0 mi	n
	Rou Pea Pluc	ung by Sto k Elev= 5, g-Flow det	ention time=	a, Time Span= 0.00 1.10 hrs Surf.Area= (not calculated: initi	= 72.00 hrs, dt= = 20.557 ac St al storage exce	บ.บว ทrs orage= 39.586 af eds outflow)		
	Cen	ter-of-Mas	ss det. time=	(not calculated: no	outflow)	,		
	<u>Volu</u> #	<u>ime</u> 1 5,8	Invert Ava 18.00'	ail.Storage Storag 57.250 af Custo	e Description m Stage Data (Prismatic)Listed belo	ow	
	Ele	vation (feet)	Surf.Area	Inc.Store	Cum.Store			
	5,8 5,8 5,8 5,8	18.00 19.00 20.00 21.00	15.960 18.080 20.340 21.700	0.000 17.020 19.210 21.020	0.000 17.020 36.230 57.250			
				Pond 1P: Dar	niels Sand W	ash Fines Pit		
	Flow (cfs)	850 - - - 800 - - - 750 - - - 650 - - - 500 - - - 400 - - - 300 - - - 200 - - - 100 - - - 0 2 4	792.99 cfs		2 34 36 38 40 42 44 Time (hours)	w Area=28.7 eak Elev=5,8 Storage=39. 46 48 50 52 54 56 58 60 6	20.16 586 af 2 64 66 68 70 72	- Inflow

	Client	Holcim			Page	
	Project	Daniels Sand Wa	it	Pg. Rev.		
GEI	Ву	KDS	Chk.	CEF	Арр.	
Consultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No. 24004	34	Document No.	N/A			
Subject Wave	Run Up Cal	culation 2-yr				
HydroCac Prepared b <u>HydroCAD®</u>	I Caics KDS y GEI Consul 10.00-25 s/n 1 F Reach rout	<i>Type</i> Itants 1294 © 2019 HydroCAD Time span=0.00-72.00 Runoff by SCS TR-20 n ing by Stor-Ind+Trans r	<i>II 24-hr 1/2</i> Software Soli O hrs, dt=0.0 nethod, UH= nethod - Pc	<i>PMP CO-NMREP</i> utions LLC 5 hrs, 1441 points SCS, Weighted-CN ond routing by Stor-In	2-Ye S, 24 hr Rainfal Printed 8/ d method	ear Plan I=14.90″ 13/2024 Page 9
Subcatchm	ent2S: Pond S	Slopes Rur low Length=140' Slope=	noff Area=7.00 0.3330 '/' To	00 ac 0.00% Impervio ≔0.7 min CN=77 Ru	us Runoff Depth noff=153.39 cfs 6	=11.83" 5.902 af
Subcatchm	ent3S: Rainfa	all Event (Area) Runoff	Area=21.700 Tc=	ac 100.00% Impervio =0.0 min CN=98 Rur	us Runoff Depth noff=519.41 cfs 26	=14.66" 5.506 af
Pond 1P: Da	aniels Sand W	/ash Fines Pit Peak Ele	v=5,819.85' S	Storage=33.408 af Infl (ow=672.03 cfs 33 Dutflow=0.00 cfs	3.408 af 0.000 af

			Client	Holcim			Page
		\bigcirc	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.
GEL		$\underline{\mathcal{S}}$	Ву	KDS	Chk.	CEF	App.
	Cor	isultants	Date	8/15/2024	Date	8/16/2024	Date
roject No.		240043	34	Document No.	N/A		· · · ·
ubject		Wave F	Run Up Cal	culation 2-yr			
	Hy o Pre Hyd	droCad pared by roCAD® 10	Calcs KDS GEI Consul 0.00-25 s/n 11	<i>Type</i> tants 1294 © 2019 HydroCAD Summary for Subc	II 24-hr 1/2 Software Solu	PMP CO-NMREPS Itions LLC 2S: Pond Slopes	2-Year Plan , 24 hr Rainfall=14.90" Printed 8/13/2024 Page 10
	Run	off =	153.39 cfs	s @ 11.90 hrs, Volun	ne= 6	.902 af, Depth=11.83	3"
	Run Typ	off by SC e II 24-hr	S TR-20 metl 1/2 PMP CO	hod, UH=SCS, Weight -NMREPS, 24 hr Rain	ed-CN, Time fall=14.90"	Span= 0.00-72.00 hr	s, dt= 0.05 hrs
		Area (ac)	CN Des				
		7.000	<u>//</u> Fallo 100.	ow, bare soil, HSG A 00% Pervious Area			
	(r	Tc Len nin)_ (fe	gth Slope eet) (ft/ft)	Velocity Capacity (ft/sec) (cfs)	Description		
		0.7 1	140 0.3330	3.49	Sheet Flow, Smooth surfa	Slopes aces n= 0.011 P2=	1.90"
				Subcatchme	ent 2S. Por	nd Slopes	
				Hydrog	raph		
	Flow (cfs)		153.39 cfs	le 18 20 22 24 26 28 30 32 3. Tim		Type I 1/2 PMP CO-NM 24 hr Rainfall= Runoff Area=7. noff Volume=6. Runoff Depth= Flow LengtI Slope=0.3 Tc=0	REPS 14.90" 000 ac 902 af 11.83" 1=140 3300 Y' 7 min CN=77 64 66 68 70 72

		Client	Holcim			Page	
	\bigcirc	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GEI	I solution of the solution of	Ву	KDS	Chk.	CEF	Арр.	
	sultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	4	Document No.	N/A			
Subject	Wave R	un Up Cal	culation 2-yr				
Hyc Prej <u>Hydr</u> Bun	droCad (pared by oCAD® 10	Calcs KDS GEI Consul <u>0.00-25 s/n 11</u> Sum 519 41 cf	<i>Type</i> tants <u>1294 © 2019 HydroCAD</u> mary for Subcatch s.@. 11.89 brs. Volum	II 24-hr 1/2 <u>Software Solu</u> 1ment 3S: he= 26	PMP CO-NMREPS, utions LLC Rainfall Event (Ar	2-Ye 24 hr Rainfall Printed 8/1 P ea)	ar Plan =14.90″ 3/2024 age 11
Run Type	off by SCS e II 24-hr	S TR-20 met 1/2 PMP CO	hod, UH=SCS, Weight -NMREPS, 24 hr Rain	ed-CN, Time fall=14.90"	Span= 0.00-72.00 hrs	, dt= 0.05 hrs	
A	Area (ac)	CN Des	cription				
	21.700	<u>98 Wate</u> 100.	00% Impervious Area				
			Subcatchment 3	S: Rainfal	l Event (Area)		
			Hydrog	raph			
Flow (cts)	500 - - 500 - - 450 - - 350 - - 350 - - 350 - - 350 - - 300 - - 250 - - 250 - - 150 - - 150 - - 0 - - 0 - - 0 2 4	519.41 cfs	16 18 20 22 24 26 28 30 32 3 ² Time	1/2 Runo1 Runo1 8 38 40 42 44	Type II 2 PMP CO-NMF 4 hr Rainfall=1 noff Area=21.7(ff Volume=26.5 unoff Depth=14 Tc=0.0 C	24-hr REPS 4.90" 00 ac 06 af 4.66" 0 min N=98	lunoff

			Client	Holcim			Page	
		\bigcirc	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GFI		Ľ	Ву	KDS	Chk.	CEF	App.	
	Con	sultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.		240043	4	Document No.	N/A			
Subject		Wave R	un Up Cal	culation 2-yr				
	Hyc Prej Hydr	IroCad (bared by oCAD® 10	Calcs KDS GEI Consult 0.00-25 s/n 11 Sum	<i>Type</i> ants 294 ⊚ 2019 HydroCAD mary for Pond 1 F	II 24-hr 1/2 Software Solu 2: Daniels S	PMP CO-NMREPS tions LLC and Wash Fines	2-Y 7, 24 hr Rainfa Printed 8/ Pit	ear Plan <i>II=14.90"</i> 13/2024 Page 12
	Inflo Inflo Outf Rou	w Area = w = low =	28.700 a 672.03 cfs 0.00 cfs pr-Ind method	ac, 75.61% Imperviou @ 11.89 hrs, Volur @ 0.00 hrs, Volur 1 Time Span= 0.00-72	s, Inflow Dep ne= 33 ne= 0 2 00 hrs. dt= 0	th = 13.97" for 1/2 .408 af .000 af, Atten= 100%	PMP CO-NMR %, Lag= 0.0 mi	EPS, 24 hr event n
	Peal Plug Cen	k Elev= 5, -Flow det ter-of-Mas	819.85' @ 24 ention time= s det. time=	(not calculated: initial s	0.008 ac Sto storage excee flow)	rage= 33.408 af		
	Volu #	me 1 5,8	Invert Ava 18.00'	il.Storage Storage E 57.250 af Custom S	Description Stage Data (F	Prismatic)Listed below	w	
	Ele	vation (feet)	Surf.Area (acres)	Inc.Store C (acre-feet) (a	um.Store acre-feet)			
	5,8 5,8 5,8 5,8	18.00 19.00 20.00 21.00	15.960 18.080 20.340 21.700	0.000 17.020 19.210 21.020	0.000 17.020 36.230 57.250			
				Pond 1P: Danie Hydrog	els Sand Wa _{graph}	ash Fines Pit		
	Flow (cfs)		6 8 10 12 14	16 18 20 22 24 26 28 30 32 3 Tir	4 36 38 40 42 44 e (hours)	w Area=28.7 ak Elev=5,81 Storage=33.4	00 ac 19.85'- 08 af 64 66 68 70 72	- Inflow

		Client	Holcim			Page	
		Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GEL	C	Ву	KDS	Chk.	CEF	App.	
	Consultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	34	Document No.	N/A			
Subject	Wave F	Run Up Cal	culation 2-yr				
₽ F <u>⊢</u>	HydroCad Prepared by HydroCAD® 11	Calcs KDS GEI Consul 0.00-25 s/n 1 ⁻¹ F Reach routi	tants 1294 © 2019 HydroCAD Time span=0.00-72.00 Runoff by SCS TR-20 n ng by Stor-Ind+Trans r	<u>Software Solu</u> 0 hrs, dt=0.05 hethod, UH=3 nethod - Po	<i>Type II 24-hr 100y</i> utions LLC 5 hrs, 1441 points SCS, Weighted-CN ind routing by Stor-Ind	2-Ye rr, 24hr Rainfa Printed 8/ I method	ear Plan Il=5.15" 13/2024 Page 13
s	Subcatchme	nt2S: Pond S	Slopes Ru Flow Length=140' Slope	unoff Area=7.0 =0.3330 '/' T	000 ac 0.00% Impervio c=0.7 min CN=77 Ru	us Runoff Dept noff=38.68 cfs	h=2.75" 1.604 af
s	Subcatchme	nt3S: Rainfa	III Event (Area) Runof	f Area=21.700 To) ac 100.00% Impervioi ≔0.0 min CN=98 Run	us Runoff Dept off=178.80 cfs	h=4.91" 8.884 af
F	ond 1P: Da	niels Sand W	a sh Fines Pit Peak Elev	v=5,818.62' S	torage=10.488 af Inflo Oเ	w=217.01 cfs 1 utflow=0.00 cfs	0.488 af 0.000 af
		Total Runof	f Area = 28.700 ac R	unoff Volum	e = 10.488 af Avera	ge Runoff Der	oth = 4.39"
			24.39	% Pervious	= 7.000 ac 75.61%	Impervious =	21.700 ac
1							
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		Client	Holcim			Page	
	\bigcirc	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GEIN	$\underline{\mathcal{S}}$	Ву	KDS	Chk.	CEF	App.	
	nsultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	34	Document No.	N/A			
ubject	Wave R	Run Up Cal	culation 2-yr	1			
Rur Typ 	droCad (pared by roCAD® 10 noff = noff by SC a ll 24-hr 7.000 7.000 Tc Leng <u>min) (fe</u> 0.7 1	Calcs KDS GEI Consul 0.00-25 s/n 1 ⁻¹ 38.68 cf: 38.68 cf: 38.68 cf: 5 TR-20 met 100yr, 24hr l 00yr, 24hr l 00yr, 24hr l 100. 77 Falk 100. gth Slope et) (ft/ft) 40 0.3330	tants 1294 © 2019 HydroCAD Summary for Subc s @ 11.90 hrs, Volun hod, UH=SCS, Weighte Rainfall=5.15" cription w, bare soil, HSG A 00% Pervious Area Velocity Capacity (ft/sec) (cfs) 3.49 Subcatchme Hydrog	Software Solu atchment : ne= 1 ed-CN, Time Description Sheet Flow, Smooth surfa	Type II 24-hr 100y utions LLC 2S: Pond Slopes .604 af, Depth= 2.75 Span= 0.00-72.00 hrs Slopes aces n= 0.011 P2= - nd Slopes	2-1 rr, 24hr Raint Printed 8 " s, dt= 0.05 hrs	/ear Plan fall=5.15" h/13/2024 Page 14
Flow (cfs)		33.68 cfs 38.68 cfs 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4 4	6 18 20 22 24 26 28 30 32 34 Time	Ru 36 38 40 42 44 4 (hours)	Type II 24hr Rainfall= Runoff Area=7.0 noff Volume=1.0 Runoff Depth= Flow Length Slope=0.3 Tc=0.0 C	24-hr 100yr 5.15" 100 ac 604 af 2.75" 1=140' 330 '/ 7 min N=77	- Runoff

		Client	Holcim			Page	
	\bigcirc	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GEL	I all a construction of the second se	Ву	KDS	Chk.	CEF	Арр.	
	nsultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	4	Document No.	N/A			
Subject	Wave R	un Up Cal	culation 2-yr				
Hy Pre Hyd	/droCad (epared by droCAD® 10	Calcs KDS GEI Consul 0.00-25 s/n 1/	tants I294 © 2019 HydroCAD	Software Solu	Type II 24-hr 100y	2-Y r, 24hr Rainfa Printed 8/	ear Plan all=5.15" /13/2024 Page 15
		Sum	mary for Subcatch	nment 3S:	Rainfall Event (Are	ea)	
Ru	noff =	178.80 cf	s @ 11.89 hrs, Volum	ne= 8	.884 af, Depth= 4.91		
Ru Tyj	noff by SCS pe II 24-hr	5 TR-20 met 100yr, 24hr	hod, UH=SCS, Weighte Rainfall=5.15"	ed-CN, Time	Span= 0.00-72.00 hrs	, dt= 0.05 hrs	
	Area (ac) 21.700	CN Des 98 Wat	cription er Surface. HSG A				
	21.700	100.	00% Impervious Area				
			Subcatchment 3	S: Rainfal	l Event (Area)		
	200		Hydrog	raph			
	190	178.80 cfs 	16 18 20 22 24 26 28 30 32 34 Time	Runo Runo 36 38 40 42 44	Type 11 2 1 24hr Rainfall=5 off Area=21.70 ff Volume=8.88 Sunoff Depth=4 Tc=0.0 Ch	24-hr 00yr 5.15" 00 ac 84 af 1.91" min N=98	- Runoff

		Client	Holcim			Page	
		Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GFI 🌄	9	Ву	KDS	Chk.	CEF	Арр.	
	sultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	4	Document No.	N/A			
Subject	Wave R	un Up Calo	culation 2-yr				
Hyd Prep <u>Hydro</u>	roCad (bared by boCAD® 10	Calcs KDS GEI Consult .00-25 s/n 11	ants 294 © 2019 HydroCAD	Software Solu	Type II 24-hr 100y. tions LLC	2-Y r <i>, 24hr Rainf</i> Printed 8	ear Plan all=5.15" /13/2024 Page 16
		Sum	mary for Pond 1P	: Daniels S	and Wash Fines I	Pit	
Inflov Inflov Outfle Routi	w Area = w = ow =	28.700 a 217.01 cfs 0.00 cfs	ac, 75.61% Impervious s @ 11.89 hrs, Volun s @ 0.00 hrs, Volun	s, Inflow Dep ne= 10 ne= 0	th = 4.39" for 100y .488 af .000 af, Atten= 100%	r, 24hr event , Lag= 0.0 mi	n
Peak	Elev= 5,	818.62' @ 24	1.10 hrs Surf.Area= 1	7.266 ac Sto	brage= 10.488 af		
Cente	er-of-Mas	s det. time=	(not calculated: no out	flow)	as outnow)		
<u>Volur</u> #1	<u>me</u> 5,8	Invert Ava 18.00'	ail.StorageStorage57.250 afCustom \$	escription Stage Data (F	Prismatic)Listed below	,	
Elev (5,81 5,81 5,82 5,82 5,82	vation (feet) 18.00 19.00 20.00 21.00	Surf.Area (acres) 15.960 18.080 20.340 21.700	Inc.Store Cd (acre-feet) (a 0.000 17.020 19.210 21.020	um.Store <u>icre-feet)</u> 0.000 17.020 36.230 57.250			
			Pond 1P: Danie	Is Sand Wa	ash Fines Pit		
Flow (cb)	240	6 8 10 12 14	6 18 20 22 24 26 28 30 32 3 Tim	4 36 38 40 42 44 e (hours)	w Area=28.70 ak Elev=5,81 Storage=10.48	0 ac 8.62 38 af	- Inflow

	Client	Holcim			Page	
	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
	Ву	KDS	Chk.	CEF	App.	
Consultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No. 240043	34	Document No.	N/A			
Subject Wave I	Run Up Cal	culation 2-yr				
HydroCad Prepared by <u>HydroCAD® 1</u>	Calcs KDS GEI Consul 0.00-25 s/n 1 ⁻¹ F Beach routi	tants 1294 © 2019 HydroCAD Time span=0.00-72.0 Runoff by SCS TR-20 r Runoff Stor-Ind+Trans r	Software Solu 0 hrs, dt=0.0 nethod, UH= nethod - Pc	<i>Type II 24-hr 200</i> utions LLC 5 hrs, 1441 points SCS, Weighted-CN and routing by Stor-Ing	2-Ye <i>yr, 24hr Rainfa</i> Printed 8/ [.] F	ar Plan II=6.01" 3/2024 Page 17
Subcatchme	nt2S: Pond S	Slopes Ri Flow Length=140' Slope	unoff Area=7.(=0.3330 '/' T	000 ac 0.00% Impervic C=0.7 min CN=77 Rt	ous Runoff Depti unoff=48.64 cfs 2	1=3.49" .035 af
Subcatchme	nt3S: Rainfa	III Event (Area) Runof	f Area=21.700 Tc=) ac 100.00% Impervic :0.0 min CN=98 Rune	ous Runoff Deptl off=208.91 cfs 10	n=5.77").437 af
Pond 1P: Da	niels Sand W	/ash Fines Pit Peak Ele	v=5,818.73' S	otorage=12.472 af Inflo C	ow=257.05 cfs 12 0utflow=0.00 cfs (2.472 af 0.000 af

		Client	Holcim			Page	
		Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GEL	C	Ву	KDS	Chk.	CEF	App.	
	onsultants	Date	8/15/2024	Date	8/16/2024	Date	
roject No.	240043	34	Document No.	N/A			
ubject	Wave F	Run Up Cal	culation 2-yr	•			
H P H	lydroCad repared by ydroCAD® 10	Calcs KDS GEI Consul 0.00-25 s/n 11	tants 294 © 2019 HydroCAD Summary for Subc	Software Solu atchment	Type II 24-hr 200 Itions LLC 2S: Pond Slopes	2-Year Plar yr, 24hr Rainfall=6.01 Printed 8/13/2024 Page 18)
R T	unoff = unoff by SC ype II 24-hr	48.64 cf S TR-20 met 200yr, 24hr l	s @ 11.90 hrs, Volun hod, UH=SCS, Weighte Rainfall=6.01"	ne= 2 ed-CN, Time	2.035 af, Depth= 3.4 Span= 0.00-72.00 hr	9" s, dt= 0.05 hrs	
_	Area (ac)	CN Des	cription				-
-	7.000	100.	00% Pervious Area				-
	Tc Len (min) (fe	gth Slope	Velocity Capacity (ft/sec) (cfs)	Description			
_	0.7 1	40 0.3330	3.49	Sheet Flow,	Slopes	1.00"	-
						1.90	
			Subcatchme	ent 25: Por raph	id Slopes		
	$\begin{array}{c} 52 \\ 52 \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ $	6 8 10 12 14 1	6 18 20 22 24 26 28 30 32 34 Time	Ru 36 38 40 42 44 4 (hours)	Type I 24hr Rainfall Runoff Area=7. noff Volume=2 Runoff Depth Flow Lengt Slope=0. Tc=0	<u>-Runoff</u> 200yr =6.01" 000 ac 035 af =3.49" h=140' 3330 '/' L7 min CN=77 64 66 68 70 72	

		Client	Holcim			Page	
	\bigcirc	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GEI	I solution of the solution of	Ву	KDS	Chk.	CEF	App.	
ULI Con	sultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	34 Document No. N/A					
Subject	Wave R	un Up Cal	culation 2-yr				
Hyc Prej <u>Hydr</u>	droCad (pared by roCAD® 10	Calcs KDS GEI Consuli 0.00-25 s/n 11	tants 1294 © 2019 HydroCAD	Software Solu	Type II 24-hr 200y utions LLC	2-Year Plan r, 24hr Rainfall=6.01" Printed 8/13/2024 Page 19	
_		Sum	mary for Subcatch	iment 35:		ea)	
Run	off =	208.91 cfs	s @ 11.89 hrs, Volun	ne= 10	0.437 at, Depth= 5.77		
Run Type	oπ by SCS e II 24-hr	5 TR-20 metl 200yr, 24hr f	nod, UH=SCS, Weight Rainfall=6.01"	ed-CN, Time	Span= 0.00-72.00 hrs	, ατ= 0.05 nrs	
<u> </u>	<u>Area (ac)</u> 21.700	CN Desc 98 Wate	cription er Surface, HSG A				
	21.700	100.	00% Impervious Area				
			Subcatchment 3	S: Rainfal	l Event (Area)		
	230		Hydrog	raph			
Flow (cfs)			1	Runo Runo 1 36 38 40 42 44 9 (hours)	Type II 24hr Rainfall=(noff Area=21.7(ff Volume=10.4 Runoff Depth= Tc=0.0 C	24-hr 200yr 3.01" 00 ac 37 af 5.77" 0-min N=98	

		Client	Holcim			Page	
	\bigcirc	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GEL	Y	Ву	KDS	Chk.	CEF	App.	
	nsultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	4	Document No.	N/A		·	
Subject	Wave R	tun Up Calo	culation 2-yr				
Hy Pre Hyc	droCad (epared by troCAD® 10	Caics KDS GEI Consult 0.00-25 s/n 11 Sum	ants 294 © 2019 HydroCAD I mary for Pond 1F	Software Solu	Type II 24-hr 200y tions LLC and Wash Fines	2-Y rr, 24hr Rainfa Printed 8, Pit	ear Plan all=6.01" /13/2024 Page 20
Infli Infli Out Pez	ow Area = ow = tflow = uting by Ste ak Elev= 5, a-Elow det	28.700 a 257.05 cfs 0.00 cfs or-Ind methoo 818.73' @ 24	ac, 75.61% Imperviou s@ 11.89 hrs, Volur s@ 0.00 hrs, Volur d, Time Span= 0.00-72 .10 hrs Surf.Area= 1	s, Inflow Dep ne= 12 ne= 0 2.00 hrs, dt= 0 7.514 ac Sto	th = 5.21" for 200y .472 af .000 af, Atten= 100% 0.05 hrs rage= 12.472 af	yr, 24hr event , Lag= 0.0 mi	n
Cei	nter-of-Mas	s det. time=	(not calculated: no out	flow)			
Vol #	ume ¢1 5,8	Invert Ava 18.00'	il.Storage Storage [57.250 af Custom Storage [Description Stage Data (F	Prismatic)Listed below	v	
Ele	evation	Surf.Area	Inc.Store C	um.Store			
5, 5, 5, 5,	818.00 819.00 820.00 821.00	(acres) 15.960 18.080 20.340 21.700	0.000 17.020 19.210 21.020	0.000 17.020 36.230 57.250			
			Pond 1P: Danie	els Sand Wa	ash Fines Pit		
	280 260 240 200 180 180 180 100 100 100 100 1	257.05 cfs	16 18 20 22 24 26 28 30 32 3 Tin	4 36 38 40 42 44 te (hours)	w Area=28.70 ak Elev=5,81 Storage=12.4	00 ac 8.73 72 af 64 66 68 70 72	- Inflow

		Client	Holcir	n			Page			
	$\bigcirc)$	Project	Danie	Is Sand Was	sh Fines Pi	t	Pg. Rev.			
	\mathcal{D}	By	KDS		Chk.	CEF	App.			
	sultants	Date	8/15/	2024	Date	8/16/2024	Date			
Project No.	240043	4	Docu	ment No.	N/A					
Subject	Wave R	un Up Ca	Iculatio	n 7-yr	I					
-										
Purpose:	Determ	ine the max	imum wate	er surface eleva	ation due to wi	nd induced wave	28.			
Procedure:	Follow	procedures	as describ	ed in ACER Te	chnical Memo	randum No. 2 (U	ISBR 1981, based on	ETL 1110-2-221)		
References:	ACER Storage	Technical M e Dams, U.S	emorandu 6. Departm	m No. 2, Freeb ent of Interior E	oard Criteria a Bureau of Recl	nd Guidelines fo amation, 1981.	or Computing Freeboa	ard Allowances for		
Effective Fetch Ca		See Attach		an, Figure 3.)			-			
	α Deg	grees C	:os (α) 0 819	790 2	XI (mile 0.15	s) Xι * Cos(α) 0 123				
	30	0	0.866	940.2	0.18	0.154				
	2	5	0.906	980.4	0.19	0.168				
	20	0	0.940	1040	0.20	0.185	_			
	1:	5 0	0.966	1111.2	0.21	0.203	_			
	5	5	0.965	1202.3	0.23	0.224	_			
	0)	1 000	1446	0.23	0.247	_			
	5	5	0.996	1277.8	0.24	0.241				
	1(0	0.985	1201.4	0.23	0.224				
	1:	5	0.966	1166.65	0.22	0.213				
	20	0	0.940	1133.1	0.21	0.202	_			
	2	5	0.906	1060.9	0.20	0.182				
	30	5	0.800	973	0.18	0.160	_			
	4	0	0.766	871.7	0.17	0.142	_			
	4	5	0.707	808.8	0.15	0.108				
		Sum =	15.429	•	Su	m = 3.18				
	Feff =	$=\sum (Xi\cos \theta)$	$(\alpha))/\sum c$	$os(\alpha)$	Effective Fetc	ch = 0.21	miles			
Design Wave Heig	ht			Fet	ff = 0.2	miles				
<u>Design Wave Heig</u>	<u>ht</u>			Fet Wind Velocit Duratio	ff = 0.2 y = 60 n = 5.1	miles mph mins	(Figure 9 USBR 19	31)		
Design Wave Heig * From Figure 9 (US	<u>ht</u> 6BR 1981)	design wave	9	Fei Wind Velocit Duration H	$ \begin{array}{rcl} ff = & 0.2 \\ y = & 60 \\ n = & 5.1 \\ s = & 1.3 \end{array} $	miles mph mins ft	(Figure 9 USBR 19	31)		
Design Wave Heig * From Figure 9 (US * From Figure 10 (U	<u>ht</u> 5BR 1981) SBR 1981	design wave) wave perio	e id	Fei Wind Velocit Duration H.	$\begin{array}{rrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrrr$	miles mph mins ft sec	(Figure 9 USBR 19	31)		
	Client Project			n			Page	Page		
-----------------	-------------------	-------------------------	---	---------------------------------	---------------------------------------	--	---	------------------------	--	--
	\bigcirc	Project	Danie	ls Sand Was	sh Fines Pit		Pg. Re	ev.		
GEI	Ľ	Ву	KDS		Chk.	CEF	App.			
	sultants	Date	8/15/2	2024	Date	8/16/2024	Date			
Project No.	240043	34	Docu	ment No.	N/A					
Subject	Wave F	Run Up Ca	lculation	ո 7-yr						
Wind Setup	* Assu	me a uniform	n depth =	4	ft					
	Wind S	Setup Z	$s = \frac{Vwi}{14}$	$\frac{nd^{2} * F}{00 * d}$						
			Vwind =	60	mph					
			Feff =	0.21	miles					
		F	= 2*Feff =	0.41	miles					
			d = 7s =	3 0 35	ft ft					
Wind Runup	* East	Dams have : Design W	2H:1V slop /ave, Hs = Period, T =	es with riprap I 1.3 1.95	ning ft sec			,		
		Design D	epth, ds =	3	ft	(depth at toe	of impoundment)		
	Hs = H	'o H	ds/Hs = 'o/(g*T ²) =	2.31 0.011						
	From F	Figure 11 (Us	SBR 1981) R/H'o = R =	0.55 0.72	ft					
<u>Summary:</u>			(B)	(C)	(D)	(E)	(E)	(6)		
Storm Event	Pond S Eleva	Starting ation*	ve Run-up	Wind Set-up	Approxima Rise of Po Due to Sto	(E) Maximum ate Water nd Surface rm Elevation (A+B+C+D)	رت) Minimum Crest of Water Retention Dam	Available Freeboard		
	(fe	et)	(feet)	(feet)	(feet)	(feet)	(feet)	(F-E) (feet)		

1.41 1.31

0.32

0.04

	(feet)	(feet)	(feet)	(feet)	(feet)	(feet)
100 Year	5833.00	0.72	0.35	0.52	5834.59	5836.00
200-Year	5833.00	0.72	0.35	0.62	5834.69	5836.00
1/2PMP (CO-NM REPS)	5833.00	0.72	0.35	1.61	5835.68	5836.00
1/2 PMP (HMR55A)	5833.00	0.72	0.35	1.89	5835.96	5836.00

*Assumes a maximum pond elevation of +5,833 feet for a dam elevation of +5,836 feet.

Attachments:

Figure 3. USBR Referenced Figures



		Client	Holcim						Pag	ge		
		Project	Daniels Sa	nd Wa	sh Fir	nes Pit			Pg.	Rev.		
	Y	Ву	KDS		Chk	ί.	CEF		Арр	Э.		
	nsultants	Date	8/15/2024	ļ	Date	e	8/16/20)24	Dat	e		
Project No.	240043	34	Documen	nt No.	N/A							
ubject	Wave F	Run Up Cal	culation 7-y	/r	•							
	1											
Hy Pre	droCad (Calcs KDS GEI Consul	7yr tants						Pr	inted 8/1	15/2024	
Hyd	droCAD® 10	0.20-5a_s/n 01	250 © 2023 Hy	ydroCAD	Softwa	are Soluti	ons LLC				Page 2	
			I	Rainfall	l Even	its Listi	ing					
	Event# E ^r N	vent ame		Storm 7	Гуре	Curve	Mode	Duration (hours)	B/B	Deptl (inches	h AMC	
	1 1/	2 PMP (HMR	51), 24 hr	Type II	24-hr		Default Default	24.00	1 1	17.50	02	
	∠ 1/ 3 1(oz ⊨ivie CO-Nľ 00yr, 24hr	virtero, 24 nr	Type II	∠4-nr 24-hr		Default	24.00 24.00	י 1	5.1	52	
	4 20	00yr, 24hr		Type II	24-hr		Default	24.00	1	6.0	12	

		Client	Holcim			Page	
		Project	Daniels Sand Wa	sh Fines P	it	Pa. Rev.	
		By	KDS	Chk.	CEF	App.	
GEI	Consultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	34	Document No.	N/A			
Subject	Wave F	Run Up Cal	lculation 7-yr				
	HydroCad Prepared by HydroCAD® 10	Calcs KDS GEI Consul 0.20-5a s/n 0	5 7yr Itants 1250 © 2023 HydroCAD	Software Sol	utions LLC	Printed 8/	15/2024 <u>Page 3</u>
			Area Lis	sting (all no	odes)		
	Ar (acre	ea CN es)	Description (subcatchment-number	rs)			
	6.4	00 77	Fallow, bare soil, HSG	A (2S)			
	25.0 31.4	70 98 70 94	TOTAL AREA	(33)			

		Client	Holcim			Page	
	\bigcirc	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GEI	Ľ	Ву	KDS	Chk.	CEF	App.	
	nsultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	34	Document No.	N/A			
Subject	Wave F	Run Up Cal	culation 7-yr				
Hy Pre Hyd	droCad pared by roCAD® 10	Calcs KDS GEI Consult).20-5a s/n 01	7yr tants 250 © 2023 HydroCAD Soil Lis	Software Solu	itions LLC	Printed 8	/15/2024 Page 4
	Δr	ea Soil	Subcatchment	ung (un not			
	(acre	ea Soli es) Group	Numbers				
	31.4	70 HSG A	2S, 3S				
	0.0	00 HSG C					
	0.0 0.0	00 HSG D 00 Other					
	31.4	70	TOTAL AREA				

			Client	Holcim					Page	
	(\bigcirc	Project	Daniels	Sand Wa	sh Fines P	it		- Pg. Rev.	
GEI		Y	Ву	KDS		Chk.	CEF		App.	
ULI	Cor	isultants	Date	8/15/20	024	Date	8/16/2	2024	Date	
Project No).	240043	34	Docum	nent No.	N/A				
Subject		Wave F	Run Up Cal	culation	7-yr	ı.				
	Hy Pre _{Hyd}	droCad pared by roCAD® 10	Calcs KDS GEI Consul 0.20-5a s/n 0 ⁻	7yr tants 1250 © 202	3 HydroCAD	Software So	lutions LLC		Printed 8	/15/2024 Page 5
					Ground C	overs (all	nodes)			
		HSG-A (acres)	HSG-B (acres)	HSG-C (acres)	HSG-D (acres)	Other (acres)	Total (acres)	Ground Cover	Subcatch Numbers	ment
		6.400 25.070	0.000	0.000	0.000	0.000	6.400 25.070	Fallow, bare s	oil 2S	
		31.470	0.000	0.000	0.000	0.000	31.470	TOTAL AREA	· 55	

		Client	Holcim			Page	
		Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GFU	C	Ву	KDS	Chk.	CEF	Арр.	
	Consultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	34	Document No.	N/A			
Subject	Wave I	Run Up Cal	culation 7-yr				
F E	IydroCad Prepared by IydroCAD® 1	Calcs KDS GEI Consul [:] 0.20-5a s/n 01	5 7yr 7 tants I250 © 2023 HydroCAD	ype II 24-hr Software Solu	1/2 PMP (HMR 51), utions LLC	24 hr Rainfa Printed 8	<i>II=17.50"</i> (15/2024 <u>Page 6</u>
		F Reach routi	Time span=0.00-72.00 Runoff by SCS TR-20 n ng by Stor-Ind+Trans r	0 hrs, dt=0.05 nethod, UH=9 nethod - Po	5 hrs, 1441 points SCS, Weighted-CN nd routing by Stor-Ind	method	
s	Subcatchme	nt2S: Pond S Fl	Slopes Rur ow Length=140' Slope=	noff Area=6.40 =0.3330 '/' Tc	0 ac 0.00% Impervious =2.2 min CN=77 Runo	Runoff Deptl off=157.48 cfs	n=14.36" 7.661 af
S	Subcatchme	nt3S: Rainfa	II Event (Area) Runoff	Area=25.070 a Tc=	ac 100.00% Impervious 0.0 min CN=98 Runo	Runoff Deptl ff=704.90 cfs 3	n=17.26" 66.054 af
F	ond 1P: Da	niels Sand W	a sh Fines Pit Peak Ele	v=5,834.89' S	torage=43.715 af Inflov Ou	v=855.33 cfs 4 itflow=0.00 cfs	3.715 af 0.000 af
	-	Total Runoff	Area = 31.470 ac Ru	noff Volume	e = 43.715 af Average	e Runoff Dep	th = 16.67" 25.070 ac
			20.04		- 0.400 ac 7 3.00 /8 1		20.070 ac

			Client	Holcim			Page	
		\bigcirc	Project	Daniels Sand W	ash Fines Pi	it	Pg. Rev.	
GFI		${ > }$	Ву	KDS	Chk.	CEF	App.	
	Cor	nsultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.		240043	34	Document No.	N/A			
Subject		Wave F	Run Up Cal	culation 7-yr				
	Hy o Pre <u>Hyd</u>	droCad pared by roCAD® 10	Calcs KDS GEI Consul 0.20-5a_s/n 01	5 7yr tants 250 © 2023 HydroCA	Type II 24-hr D Software Soli	1/2 PMP (HMR 51) utions LLC	, 24 hr Rainfal Printed 8/	l=17.50" 15/2024 Page 7
			5	Summary for Sub	catchment	2S: Pond Slopes		
	[49]	Hint: Tc<	2dt may requ	ire smaller dt				
	Rur F	off = Routed to	157.48 cfs Pond 1P : Da	s @ 11.92 hrs, Volu aniels Sand Wash Fin	ume= 7 lies Pit	7.661 af, Depth=14.3	6"	
	Rur Typ	off by SC e II 24-hr	S TR-20 metl 1/2 PMP (HM	hod, UH=SCS, Weigł MR 51), 24 hr Rainfall	nted-CN, Time I=17.50"	Span= 0.00-72.00 hr	s, dt= 0.05 hrs	
	/	Area (ac)	CN Des					
		6.400	<u>//</u> Fallo 100.	00% Pervious Area				
	(r	Tc Len nin) (fe	gth Slope et) (ft/ft)	Velocity Capacity (ft/sec) (cfs)	Description			
		2.2 1	40 0.3330	1.04	Sheet Flow, Fallow n= 0	Pond Slopes 0.050 P2= 1.90"		
				Subcatchr	ent 2S [.] Por	nd Slones		
				Hydro	ograph	la Slopes		
	Flow (cfs)	170 160 150 140 130 100 90 80 70 60 50 40 30 0 0				Type 1/2 PMP (Hi 24 hr Rainfall= Runoff Area=6. Sunoff Volume=7 Runoff Depth= Flow Lengt Slope=0. Tc=2	II 24-hr VR 51) 17.50" 400 ac 661 af 14.36" h=140' 3330 '/' 2 min CN=77	Runoff
		024	6 8 10 12 14 1	l6 18 20 22 24 26 28 30 32 3 Tim	14 36 38 40 42 44 40	6 48 50 52 54 56 58 60 62 64	66 68 70 72	

GEI Consultant Project No. 2400 Subject Wave HydroCate Prepared to HydroCate	Project By Date 434 Run Up Ca	Daniels Sand Wa KDS 8/15/2024 Document No.	sh Fines Pi Chk. Date	t CEF 8/16/2024	Pg. Rev. App.
GEL Consultant Project No. 2400 Subject Wave HydroCat Prepared to HydroCAD®	By Date 434 Run Up Ca	KDS 8/15/2024 Document No.	Chk. Date	CEF 8/16/2024	App.
Consultant Project No. 2400 Subject Wave HydroCat Prepared b HydroCAD®	Date 134 Run Up Ca	8/15/2024 Document No.	Date	8/16/2024	Data
Project No. 2400 Subject Wave HydroCat Prepared b HydroCAD®	434 Run Up Ca	Document No.			Dale
Subject Wave HydroCa Prepared b HydroCAD®	Run Up Ca	culation 7-yr	IN/A		
HydroCa Prepared k HydroCAD®	d Calcs KDS	iculation 7-yi			
[A0] 18-6 T	y GEI Consu 10.20-5a s/n 0	5 7yr 7 Itants 1250 © 2023 HydroCAD	ype II 24-hr Software Solu	1/2 PMP (HMR 5	1), 24 hr Rainfall=17.50" Printed 8/15/2024 Page 8
	Sun	nmary for Subcatel	nment 3S:	Rainfall Event (Area)
[46] HINT: 10	=0 (Instant ru	noff peak depends on d	lt)		
Runoff	= 704.90 c	fs @ 11.89 hrs, Volun	ne= 36 s Pit	6.054 af, Depth=17	26"
Runoff by S	CS TR-20 me	thod UH=SCS Weight	ed-CN Time	Span = 0.00.72.00	hrs. dt= 0.05 hrs
Type II 24-h	or 1/2 PMP (H	MR 51), 24 hr Rainfall=	17.50"	opun 0.00-72.00	, at 0.00 m3
Area (ac) CN Des	cription			
25.07) 100	.00% Impervious Area			
		Subcatchment 3	S: Rainfal	l Event (Area)	
650 600 550 500 90 150 100 50 0 0 2		16 18 20 22 24 26 28 30 32 34 Time	36 38 40 42 44 40 (hours)	1/2 PMP (H 24 hr Rainfall: unoff Area=25 off Volume=36 Runoff Depth: Tc=	MR 51) =17.50" 5.054 af =17.26" 0.0 min CN=98 64.66 68 70 72

			Client	Holcim			Page	
	(\bigcirc	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GFL		I I I I I I I I I I I I I I I I I I I	Ву	KDS	Chk.	CEF	App.	
	Con	sultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.		240043	34	Document No.	N/A			
Subject		Wave R	Run Up Calo	culation 7-yr				
	Hye Pre Hydr	droCad (pared by roCAD® 10	Calcs KDS GEI Consult).20-5a_s/n 01	7yr 7 tants 250 © 2023 HydroCAD	ype II 24-hr Software Solu	1/2 PMP (HMR 51), tions LLC	24 hr Rainfa Printed 8	<i>II=17.50"</i> /15/2024 9
			Sum	mary for Pond 1P	: Daniels S	and Wash Fines F	Pit	
	Inflo Inflo Out	w Area = w = flow =	31.470 a 855.33 cfs 0.00 cfs	ac, 79.66% Imperviou s@ 11.89 hrs, Volun s@ 0.00 hrs, Volun	s, Inflow Dep ne= 43 ne= 0	th = 16.67" for 1/2 P .715 af .000 af, Atten= 100%,	MP (HMR 51 Lag= 0.0 mi), 24 hr event n
	Rou Pea	k Elev= 5,	or-Ind method 834.89' @ 24	d, Time Span= 0.00-72 I.20 hrs Surf.Area= 2	2.00 hrs, dt= 0 4.083 ac Sto	0.05 hrs prage= 43.715 af		
	Plug	g-Flow det iter-of-Mas	ention time= ss det. time=	(not calculated: initial s (not calculated: no out	storage excee flow)	ds outflow)		
	Volu	ıme	Invert Ava	ail.Storage Storage D	Description			
	#	1 5,8	33.00'	70.920 af Custom \$	Stage Data (F	Prismatic)Listed below		
	Ele	vation (feet)	Surf.Area (acres)	Inc.Store C (acre-feet) (a	um.Store			
	5,8	333.00	21.830	0.000	0.000			
	5,8 5,8	334.00 335.00	23.290	22.560	46.295			
	5,8	35.00	25.070	24.625	70.920			
				Pond 1P: Danie	els Sand Wa	ash Fines Pit		
		950			+-+-+	+ - + - + - + - + -		Inflow
		900	· - - <mark>855.33 cfs</mark>		Inflo	w Δroa=31.47	0-ac	
		800			P	eak Elev=5.83	4.89'	
		700				Storage=43.71	15 af	
		600						
	w (cfs	500						
	Ę	400	·					
		300	· _!!!!!					
		200	· -¦¦¦					
		150	· -¦¦¦ ·	+ - + - + - + - + - + - + - + - + - + -	- + - + - + - + - + - + - + - + - + - +	· -¦¦¦¦¦¦¦ -		
		50 0						
		024	ა ა 10 12 14 1	0 18 20 22 24 26 28 30 32 34 Time	36 38 40 42 44 46 (hours)	9 48 50 52 54 56 58 60 62 64 6	0 870 72 XO 0	

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		\bigcirc	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
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	Cor	nsultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No	•	240043	34	Document No.	N/A			
Subject		Wave R	Run Up Cal	culation 7-yr				
	Hy o Pre <u>Hyd</u>	droCad pared by roCAD® 10	Calcs KDS GEI Consuli 0.20-5a_s/n 01	7yr <i>Type</i> tants 250 © 2023 HydroCAD	II 24-hr 1/2 Software Solu	PMP CO-NMREPS,	24 hr Rainfa Printed 8	ll=14.90" '15/2024 <u>Page 10</u>
			Reach routi	Time span=0.00-72.00 Runoff by SCS TR-20 n ng by Stor-Ind+Trans r	0 hrs, dt=0.05 nethod, UH=5 nethod - Po	5 hrs, 1441 points SCS, Weighted-CN nd routing by Stor-Ind	method	
	Sub	ocatchme	nt2S: Pond S Fl	Slopes Rur ow Length=140' Slope=	noff Area=6.40 =0.3330 '/' Tc:	0 ac 0.00% Impervious =2.2 min CN=77 Runo	Runoff Deptl off=131.45 cfs	1=11.83" 6.310 af
	Sub	ocatchme	nt3S: Rainfa	II Event (Area) Runoff	Area=25.070 a Tc=	ac 100.00% Impervious 0.0 min CN=98 Runof	Runoff Deptl f=600.07 cfs 3	1=14.66" 60.623 af
	Por	nd 1P: Dar	niels Sand W	ash Fines Pit Peak Ele	v=5,834.61' S	torage=36.933 af Inflov Ou	v=725.39 cfs 3 tflow=0.00 cfs	6.933 af 0.000 af
		т	otal Runoff	Area = 31.470 ac Ru	noff Volume	= 36.933 af Average	e Runoff Dep	th = 14.08"
				20.34	% Pervious =	= 6.400 ac 79.66% I	mpervious =	25.070 ac

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	\bigcirc	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
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	nsultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	4	Document No.	N/A			
Subject	Wave R	un Up Cal	culation 7-yr				
Hy Pre Hyd	droCad pared by IroCAD® 10	Calcs KDS GEI Consult 0.20-5a_s/n 01	7yr <i>Type</i> tants 250 © 2023 HydroCAD	II 24-hr 1/2 Software Solu	PMP CO-NMREPS,	, 24 hr Rainfa Printed 8,	<i>ll=14.90"</i> '15/2024 Page <u>11</u>
		S	Summary for Subc	atchment	2S: Pond Slopes		
[49]	Hint: Tc<	2dt may requ	ire smaller dt				
Rur	noff = Routed to	131.45 cfs Pond 1P : Da	s @ 11.92 hrs, Volun iniels Sand Wash Fine	ne= 6 s Pit	5.310 af, Depth=11.83	3"	
Rur Typ	noff by SC be II 24-hr	S TR-20 meth 1/2 PMP CO	nod, UH=SCS, Weight -NMREPS, 24 hr Rain	ed-CN, Time fall=14.90"	Span= 0.00-72.00 hrs	s, dt= 0.05 hrs	
	Area (ac) 6 400	CN Desc	cription				
	6.400	100.	00% Pervious Area				
(1	Tc Leng min) (fe	gth Slope et) (ft/ft)	Velocity Capacity	Description			
	2.2 1	40 0.3330	1.04	Sheet Flow,	Pond Slopes		
			Subcatchmo	nt 28. Por			
Etvur (ds)			Hydrog	raph	Type I 1/2 PMP CO-NM 24 hr Rainfall= Runoff Area=6. unoff Volume=6. Runoff Depth= Flow Lengtl Slope=0.3 Tc=2	L 24-hr IREPS 14.90" 400 ac 310 af - 11.83" h=140 3330 '/' .2 min CN=77 66 68 70 72	I Runoff

		\bigcirc	Client	Holcim			Page	
		\bigcirc	Project	Daniels Sand Wa	sh Fines P	it	Pg. Rev.	
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	Cor	nsultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No		240043	34	Document No.	N/A			
Subject		Wave F	Run Up Cal	culation 7-yr				
	Hy Pre <u>Hyd</u>	droCad pared by roCAD® 10	Calcs KDS GEI Consul).20-5a_s/n 0′	5 7yr <i>Type</i> tants 1250 © 2023 HydroCAD	II 24-hr 1/2 Software Sol	PMP CO-NMREF	PS, 24 hr Rainfall=14.90 Printed 8/15/2024 Page 12)″
			Sum	mary for Subcatcl	nment 3S:	Rainfall Event (Area)	
	[46]	Hint: Tc=	0 (Instant rur	off peak depends on d	lt)			
	Rur	noff = Routed to	600.07 cf Pond 1P [.] D:	s @ 11.89 hrs, Volun aniels Sand Wash Fine	ne= 30 s Pit	0.623 af, Depth=14	.66"	
	Rur Typ	noff by SC be II 24-hr	S TR-20 met 1/2 PMP CC	hod, UH=SCS, Weight -NMREPS, 24 hr Rain	ed-CN, Time fall=14.90"	Span= 0.00-72.00	hrs, dt= 0.05 hrs	
		Area (ac)	CN Des	cription				-
		25.070 25.070	<u>98</u> Wat 100.	er Surface, HSG A 00% Impervious Area				
				Subcatchment 3	BS: Rainfa	ll Event (Area)		
				Hydrog	raph			
	Elnw (refe)	600 550 500 450 350 350 200 150 100 50 0			Run	Type I/2 PMP CO-N 24 hr Rainfall unoff Area=25 off Volume=30 Runoff Depth Tc=	II 24-hr MREPS =14.90" 070 ac 0.623 af =14.66" 0.0 min CN=98	
		0 2 4	6 8 10 12 14 ⁻	l6 18 20 22 24 26 28 30 32 34 Time	36 38 40 42 44 4 (hours)	6 48 50 52 54 56 58 60 62	64 66 68 70 72	

		Client	Holcim			Page	
	\bigcirc	Project	Daniels Sand Wa	sh Fines Pi	t	Pg. Rev.	
GFI	S	Ву	KDS	Chk.	CEF	App.	
	nsultants	Date	8/15/2024	Date	8/16/2024	Date	
Project No.	240043	34	Document No.	N/A			
Subject	Wave R	Run Up Calo	culation 7-yr				
Hy Pre Hyo	droCad epared by droCAD® 10	Calcs KDS GEI Consult).20-5a_s/n 01	7yr <i>Type</i> tants 250 © 2023 HydroCAD	II 24-hr 1/2 Software Solu	PMP CO-NMREPS,	24 hr Rainfa Printed 8	<i>II=14.90"</i> /15/2024 Page <u>13</u>
l		Sum	mary for Pond 1P	: Daniels S	and Wash Fines I	Pit	
Infl Infl Ou Roi Pei	ow Area = ow = tflow = uting by Sto ak Elev= 5.	31.470 a 725.39 cfs 0.00 cfs or-Ind methoo 834.61' @ 24	ac, 79.66% Impervious s@ 11.89 hrs, Volun s@ 0.00 hrs, Volun d, Time Span= 0.00-72 J.20 hrs Surf.Area= 2	s, Inflow Dep ne= 36 ne= 0 2.00 hrs, dt= 0 3.829 ac Sto	th = 14.08" for 1/2 F .933 af .000 af, Atten= 100%, 0.05 hrs orage= 36.933 af	MP CO-NMR Lag= 0.0 mi	REPS, 24 hr event n
Plu Cei	g-Flow det nter-of-Mas	ention time= ss det. time=	(not calculated: initial s (not calculated: no out	storage excee flow)	eds outflow)		
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/r ts <u>0 © 2023 HydroCAD</u> me span=0.00-72.00 юff by SCS TR-20 n	<u>Software Solu</u>) hrs, dt=0.05 hethod, UH=5	<i>Type II 24-hr 100y</i> utions LLC 5 hrs, 1441 points SCS, Weighted-CN	vr, 24hr Rainfa Printed 8/	all=5.15" 15/2024 Page 14
by Stor-Ind+Trans n	nethod - Po	nd routing by Stor-Ind	method	
ρes Ru v Length=140' Slope	inoff Area=6.4 ≔0.3330 '/' T	.00 ac 0.00% Impervio c=2.2 min CN=77 Ru	us Runoff Dep noff=33.91 cfs	th=2.75" 1.466 af
vent (Area) Runoff	f Area=25.070 Tc=	ac 100.00% Impervio 0.0 min CN=98 Runc	us Runoff Dep off=206.57 cfs 1	th=4.91" 0.264 af
h Fines Pit Peak Elev	/=5,833.52' S	torage=11.730 af Inflo	w=237.11 cfs 1	1.730 af
	<i></i>			0.000 ai
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			5	Summary for Subo	catchment	2S: Pond Slopes		
	[49]	Hint: Tc<2	2dt may requ	ire smaller dt				
	Run F	off = Routed to I	33.91 cfs Pond 1P : Da	s @ 11.93 hrs, Volur iniels Sand Wash Fine	me= 1 es Pit	.466 af, Depth= 2.75	"	
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	A	vrea (ac)	CN Des					
		<u>6.400</u> 6.400	// Fallo 100.	ow, bare soil, HSG A 00% Pervious Area				
	(n	Tc Leng nin) (fe	gth Slope et) (ft/ft)	Velocity Capacity (ft/sec) (cfs)	Description			
		2.2 1	40 0.3330	1.04	Sheet Flow, Fallow n= 0.	Pond Slopes .050 P2= 1.90"		
				Subcatchm	ent 2S: Pon	nd Slopes		
				Hydrog	graph			
	Flow (cfs)	36 -		116 20 22 24 26 28 30 32 34 Time	36 38 40 42 44 46 (hours)	Type II 24hr Rainfall= Runoff Area=6.4 unoff Volume=1.4 Runoff Depth= Flow Length Slope=0.3 Tc=2.	24-hr 100yr =5.15" 400 ac 466 af =2.75" 1=140' 330 '/ 2 min 2 min 2 min 330 '/	I Runoff

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			Sum	mary for Subcatch	nment 3S:	Rainfall Event (Area)
	[46] Hint:	Tc=0 (I	instant run	off peak depends on d	t)		
	Runoff Routed	= d to Poi	206.57 cfs nd 1P : Da	s @ 11.89 hrs, Volun Iniels Sand Wash Fine	ne= 10 s Pit	0.264 af, Depth= 4.	91"
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		Sum	mary for Pond 1P	: Daniels S	Sand Wash Fines	Pit	
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Sul	ocatchme	nt2S: Pond S	Slopes Ru Flow Length=140' Slope	unoff Area=6.4 =0.3330 '/' T	400 ac 0.00% Impervio ⁻ c=2.2 min CN=77 Ru	us Runoff Dep inoff=41.59 cfs	th=3.49" 1.860 af
Sul	ocatchme	nt3S: Rainfa	II Event (Area) Runof	f Area=25.070 Tc=) ac 100.00% Impervio ⊧0.0 min CN=98 Runo	us Runoff Dep off=241.35 cfs 1	th=5.77" 2.058 af
Por	nd 1P: Dar	niels Sand W	a sh Fines Pit Peak Ele	v=5,833.62' S	Storage=13.919 af Inflo O	w=280.06 cfs 1 utflow=0.00 cfs	3.919 af 0.000 af
		Total Runof	f Area = 31 470 ac R	unoff Volum	ne = 13 919 af Avera	ige Runoff De	oth = 5 31"

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Subject		Wave R	Run Up Cal	culation 7-yr				
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			5	Summary for Subo	catchment	2S: Pond Slopes		
	[49]	Hint: Tc<	2dt may requ	ire smaller dt				
	Run F	off = Routed to	41.59 cfs Pond 1P : Da	s @ 11.92 hrs, Volur niels Sand Wash Fine	me= 1 es Pit	.860 af, Depth= 3.49)"	
	Run Typ	off by SC e II 24-hr	S TR-20 metl 200yr, 24hr I	hod, UH=SCS, Weigh Rainfall=6.01"	ted-CN, Time	Span= 0.00-72.00 hrs	s, dt= 0.05 hrs	
		Area (ac)	CN Dese					
		6.400	<u>//</u> ⊢allo 100.	00% Pervious Area				
	(r	Tc Leng nin) (fe	gth Slope et) (ft/ft)	Velocity Capacity (ft/sec) (cfs)	Description			
		2.2 1	40 0.3330	1.04	Sheet Flow, Fallow n= 0	Pond Slopes .050 P2= 1.90"		
				Subcatchm	ent 2S: Por	nd Slopes		
	Flow (ds)			Hydrog	raph	Type I 24hr Rainfall Runoff Area=6.4 unoff Volume=1. Runoff Depth Flow Length Slope=0.3 Tc=2	E 24-hr 200yr =6.01" 400.ac 860.af =3.49" 1=140 1=140 1=140 1=140 CN=77 CN=77 66 68 70 72	Runoff

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			Sum	mary for Subcatcl	hment 3S:	Rainfall Event (A	Area)	
	[46]	Hint: Tc=	0 (Instant rur	off peak depends on d	lt)			
	Rur I	noff = Routed to	241.35 cf Pond 1P : Da	s @ 11.89 hrs, Volun aniels Sand Wash Fine	ne= 12 s Pit	2.058 af, Depth= 5.7	77"	
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	/	Area (ac) 25.070	CN Des 98 Wat	cription er Surface, HSG A				
		25.070	100	.00% Impervious Area				
				Subcatchment 3	3S: Rainfal	l Event (Area)		
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		Sum	mary for Pond 1F	: Daniels S	and Wash Fines F	Pit	
Infl Infl Ou	ow Area = ow = tflow =	31.470 a 280.06 cfs 0.00 cfs	ac, 79.66% Imperviou s @ 11.89 hrs, Volur s @ 0.00 hrs, Volur	s, Inflow Dep ne= 13 ne= 0	th = 5.31" for 200y .919 af .000 af, Atten= 100%,	r, 24hr event Lag= 0.0 mi	n
Pea	ak Elev= 5,	833.62' @ 24	l.20 hrs Span= 0.00-72	2.00 nrs, dt= 0 2.731 ac Sto	0.05 nrs prage= 13.919 af		
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Vol	ume	Invert Ava	ail.Storage Storage [Description			
#	<i>‡</i> 1 5,8	33.00'	70.920 af Custom	Stage Data (F	Prismatic)Listed below		
Ele	evation (feet)	Surf.Area (acres)	Inc.Store C (acre-feet) (a	um.Store			
5, 5, 5, 5,	833.00 834.00 835.00 836.00	21.830 23.290 24.180 25.070	0.000 22.560 23.735 24.625	0.000 22.560 46.295 70.920			
- ,			Pond 1P: Danie	els Sand Wa	ash Fines Pit		
	300 280 260 240 220 200 180			Inflo	ow Area=31.47 eak Elev=5,833 Storage=13.91	0 ac 3.62 19 af	Inflow

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Appendix A – Figures







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		3DWK, &,



LEGEND:

Solid Lines represent significant wave heights, in feet,





-DEEP WATER CONDITIONS (FROM FIGURE 11, REF. 3)





FIGURE 11. - COMPARISON OF WAVE RUNUP ON SMOOTH SLOPES WITH RUNUP ON PERMEABLE RUBBLE SLOPES (DATA FOR d_s/H'_o > 3.0) (FROM FIGURE 7-20, REF. 6)

Design Report – Draft Daniels Sand Wash Fines Pond Embankment Dam Raise Colorado Springs, Colorado November 22, 2024

Appendix C Slope Stability Analysis

Daniels Sand Wash Fines Pond Embankment Dam Raise Slope Stability Analysis

Slope Stability Analysis Drawn By: RDJ Designed By: RDJ Checked By: SCK Date: 11/22/2024

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Total Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Graded Gravel Envelope	Mohr-Coulomb	135		0	40
	Native Coarse Alluvium	Mohr-Coulomb	135		0	35
	Native Eolian Deposits	Mohr-Coulomb	125		100	32
	New Embankment Fill	Mohr-Coulomb	130		100	35
	Old Embankment Fill	Mohr-Coulomb	130		100	35
	Pierre Shale Bedrock	Undrained (Phi=0)	135	2,000		
	Sand Drain	Mohr-Coulomb	135		0	38
	Wash Fines	Mohr-Coulomb	90		0	10





Daniels Sand Wash Fines Pond Embankment Dam Raise Slope Stability Analysis

Slope Stability Analysis Drawn By: RDJ Designed By: RDJ Checked By: SCK Date: 11/21/2024

Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Total Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Graded Gravel Envelope	Mohr-Coulomb	135		0	40
	Native Coarse Alluvium	Mohr-Coulomb	135		0	35
	Native Eolian Deposits	Mohr-Coulomb	125		100	32
	New Embankment Fill	Mohr-Coulomb	130		100	35
	Old Embankment Fill	Mohr-Coulomb	130		100	35
	Pierre Shale Bedrock	Undrained (Phi=0)	135	2,000		
	Sand Drain	Mohr-Coulomb	135		0	38
	Wash Fines	Mohr-Coulomb	90		0	10





Daniels Sand Wash Fines Pond Embankment Dam Raise Slope Stability Analysis - Pseudo-Static Drawn By: RDJ Designed By: RDJ Checked By: SCK Date: 11/21/2024



Color	Name	Slope Stability Material Model	Unit Weight (pcf)	Total Cohesion (psf)	Effective Cohesion (psf)	Effective Friction Angle (°)
	Graded Gravel Envelope	Mohr-Coulomb	135		0	40
	Native Coarse Alluvium	Mohr-Coulomb	135		0	35
	Native Eolian Deposits	Mohr-Coulomb	125		100	32
	New Embankment Fill	Mohr-Coulomb	130		100	35
	Old Embankment Fill	Mohr-Coulomb	130		100	35
	Pierre Shale Bedrock	Undrained (Phi=0)	135	2,000		
	Sand Drain	Mohr-Coulomb	135		0	38
	Wash Fines	Mohr-Coulomb	90		0	10

Horz Seismic Coef.: 0.053



Design Report – Draft Daniels Sand Wash Fines Pond Embankment Dam Raise Colorado Springs, Colorado November 22, 2024

Appendix D Specifications

SECTION 31 00 00

EARTHWORK

PART 1 SCOPE

1.01 WORK INCLUDED

A. This Section includes construction of earth embankments and placement of embankment fills to construct final slopes to the established lines and grades at the locations shown on the Contract Drawings and as directed by the Engineer.

1.02 DEFINITIONS

- A. RELATIVE COMPACTION: "Relative compaction" is defined as the ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D 698. Corrections for oversize material may be applied to either the as-compacted field dry density or the maximum dry density, as determined by the Engineer.
- B. OPTIMUM MOISTURE CONTENT: "Optimum moisture content" shall be determined by the ASTM D 698 to determine the maximum dry density for relative compaction. Field moisture content shall be determined on the basis of the fraction passing the ³/₄ inch sieve.
- C. ENGINEER: The licensed engineer in the State of Colorado designated to perform construction inspection services and administrative functions on behalf of Holcim.

1.03 SUBMITTALS

- A. All submittals, including drawings and calculations, shall be required for the sole purpose of providing Engineer sufficient details to confirm that the Contractor's planned work and work in progress is in accordance with Contract Documents. Engineer's review shall not be construed to relieve Contractor in any way of responsibilities under the Contract. Do not begin work on any item requiring a submittal until the required relevant submittals have been reviewed and approved by the Engineer. All structural designs and other engineered components shall be signed and sealed by a professional engineer licensed in the State of Colorado.
- B. Preconstruction Submittals Submit to the Engineer the following a minimum of three weeks before the scheduled start of the applicable activity:
 - 1. A work plan for the earthwork that describes equipment means and methods anticipated for this project.

1.04 TESTING

A. All testing, including field and laboratory services, will be completed by the Owner.
- 1.05 CODES, ORDINANCES AND STATUTES: The Constructor shall be familiar with, and comply with, all applicable codes, ordinances, statutes, and bear sole responsibility for the penalties imposed for noncompliance.
- 1.06 TOLERANCES: All material limits shall be constructed within a tolerance of 0.1 foot except where dimensions or grades are shown or specified as minimum. All grading shall be performed to maintain slopes as shown.

PART 2 EQUIPMENT AND MATERIALS

- 2.01 EMBANKMENT FILL: Embankment fill shall consist of on-site material free from roots, organic matter, debris, and other deleterious material. Peat and organic clay are not acceptable as embankment fill. Individual particles up to six inches in diameter are acceptable. When compacted, embankment fill shall result in a fill without visible voids between particles, and all particles larger than ¹/₄ inch shall be completely surrounded by a continuous soil matrix. Embankment fill is anticipated to come from the mining operation stockpiles.
- 2.02 BLANKET DRAIN FILTER MATERIAL: Filter Sand for the blanket drain shall consist of a free-draining sandy material meeting the requirements of a CDOT Class C Filter Material with gradation requirements presented in the following table:

Sieve Size	Mass Percent Passing Square Mesh Sieves			
3/4"	100			
No. 4	60-100			
No. 50	10-30			
No. 100	0-10			
No. 200	0-3			

2.03 TOE DRAIN MATERIAL: The material surrounding the toe drain shall consist of a free-draining coarse aggregate material meeting the requirements of a CDOT No. 4 Coarse Aggregate with gradation requirements presented in the following table:

Sieve Size	Mass Percent Passing Square Mesh Sieves
2"	100
$1 \frac{1}{2}$	90-100
1"	20-55
3/4"	0-15
3/8"	0-5

- 2.04 TOE DRAIN FILTER FABRIC: Geotextile filter fabric surrounding the toe drain material shall consist of an AASHTO M288 Class 2 non-woven geotextile filter fabric with a minimum permittivity of 0.5 sec⁻¹ and a maximum average apparent opening size of 0.43 mm.
- 2.05 COMPACTION EQUIPMENT: Provide compaction, watering, and aerating equipment of suitable type to achieve the specified compaction moisture content and relative compaction.

PART 3 EXECUTION

3.01 SUBGRADE PREPARATION

- A. The entire surface to be covered with embankment shall be grubbed and stripped of all grass, vegetation, topsoil, rubbish, or other unsuitable materials before any embankment fill is placed.
 - 1. Topsoil shall be stockpiled or placed as designated.
 - 2. Other grubbed and stripped materials shall be removed as spoil.
- B. Existing slopes shall be "benched" to prevent the development of a potential sliding surface.
- C. Stripped or excavated surfaces on which embankment fill is to be placed shall be compacted to the required density of the embankment prior to any fill being placed.
- D. Prior to placement of fill, subgrade shall be scarified with a disc or similar equipment and moisture conditioned to facilitate bonding with the new fill.
- E. Surfaces to receive fill shall not have ponded water, snow or ice, nor be desiccated or cracked.
- 3.02 FILL SURFACE PREPARATION: Immediately before embankment fill is added to the existing surface.
 - A. Surfaces to receive fill shall be free of debris, organic materials, particles larger than six inches, and other deleterious materials.
 - B. Previous fill surfaces to receive additional fill shall be compacted to the required relative density of 95 percent relative compaction (standard Proctor) with moisture content within a range of -2 to +2 percent of the optimum moisture content.
 - C. Prior to placement of subsequent lifts, previous fill surfaces shall be scarified with a disc or similar equipment and moisture conditioned to facilitate bonding with the new fill.
 - D. Surfaces to receive fill shall not have ponded water, snow or ice, nor be desiccated or cracked.

3.03 PLACEMENT AND COMPACTION

- A. Materials shall be placed in lifts not greater than 8 inches of thickness unless greater thicknesses are allowed by the Engineer upon demonstration by the Contractor that the materials and compaction efforts are adequate to obtain the required density.
- B. Material shall be placed in a uniform lift and thoroughly compacted by compaction equipment suitable for the material encountered to obtain the required density prior to the placement of succeeding lift.
 - 1. Each lift shall be tested for proper compaction before successive lifts are applied.
- C. Stone shall be defined as rock material either in its natural or broken state. Stones shall not exceed 6 inches in greatest dimension and shall be well distributed throughout the soil mass.
- D. Stones not well mixed with soil material shall not be used in earth embankments unless the stone material is sufficiently deteriorated or friable so as to be compactible to achieve minimum voids and required density.

- E. If the required density is not obtained, compaction of the embankment shall continue until specified densities are obtained, before any additional embankment is placed. Improperly compacted embankment shall be removed.
- F. Where required, the Contractor shall, at his/her expense, add sufficient water during the compaction effort to assure proper density. If, due to rain or other causes, the material exceeds the optimum moisture content for satisfactory compaction, it shall be allowed to dry, assisted by discing or harrowing, if necessary, before compaction or filling effort is resumed.
- G. Compaction or consolidation achieved by traveling trucks, machines and other equipment will not be accepted unless such procedures are approved by the Engineer and proper compaction density is achieved.
- H. Embankments shall be constructed to such elevations as to make allowance for any settlement that may occur. Prior to the construction of any structure, roadway or other ground feature and before final acceptance of the Contract, the Contractor shall regrade the embankments to conform to the established lines and grades.
- 3.04 PROTECTION OF COMPLETED LIFT AND PREPARED GROUND SURFACE: After completion of a lift or ground surface preparation, all unnecessary traffic shall be kept off. Should it be found necessary to haul over the completed lift or prepared ground surface, the Contractor shall drag and roll the traveled way as frequently as may be necessary to remove ruts, cuts, and breaks in the surface. All cuts, ruts, and breaks in the lift or surface that are not removed by the above operations shall be repaired. Winter earthwork operations are common therefore can be performed satisfactorily by adopting certain procedures and taking prudent precautions.
 - A. Generally, earthwork operations can be conducted whenever the water being used to moisture condition the fill does not freeze prior to being mixed with the fill and, after mixing, the moisture-conditioned fill does not freeze prior to compaction or prior to placing the next lift. These conditions can obviously be met when temperatures are above freezing and can even be met when temperatures are below freezing due to direct sunshine and/or due to the fill material being warmer than the ambient temperature. The exact temperature and weather limitations can be determined by the Contractor and the Engineer as winter operations progress.
 - B. At the end of each work day, the exposed active fill area should be covered with a minimum six-inch thick, loose, dry lift of soil which will serve as an insulating layer to limit freezing.
 - C. At the beginning of each work day, the loose lift form the night before should be inspected for evidence of freezing. If any frozen soil exists, it should be removed to the full depth of freezing, even if frozen soil extends beneath the loose lift and into previously compacted soil. After removing frozen soil, the exposed surface should be scarified with a disk or pulvamixer. Earthwork operations can then proceed as normal. If the loose lift does not contain any frozen soil, then it can be moisture conditioned and compacted in place without the need for removing it.
 - D. Any portion of the fill which is not being actively worked but becomes subject to freeze/thaw cycles should be scarified and re-compacted prior to placing additional fill even if it is not frozen at the time work is resumed in that area.
 - E. Also at the beginning of each work day, the borrow source should be inspected for evidence of freezing. All frozen materials should be stripped from the borrow source and not used in the fill. Pre-wetting the borrow source is not desirable for winter construction.

F. Earthwork can be conducted after snowstorms providing that the snow is removed from the borrow source and from the active fill area and providing that the other conditions outlined above are met.

3.05 FILL

- A. Obtain the Engineer's review of the surface to be filled and the fill material to be used prior to placing any fill.
- B. Do not place frozen fill, or fill mixed with snow or ice.
- C. Embankment fill shall be placed in horizontal lifts and each lift compacted to the specified relative compaction for the full width. Borrow area fill shall be blended to achieve a homogenous fill across the embankment without lenses, pockets, or zones of different materials.
- D. All embankment fill shall be moisture conditioned to the specified range.
- E. All surfaces shall be finished to provide adequate drainage. Any softening or loosening due to the collection of water shall be corrected by overexcavation and replacement. The finished surface shall be reasonably smooth, compacted, free from irregular surface changes, and comparable to the smoothness obtained by bladegrader operations.

3.06 COMPACTION REQUIREMENTS

- A. General: Compact all materials by mechanical means. Flooding or jetting will not be permitted. If compaction tests indicate that compaction or moisture content is not as specified, material placement shall be terminated and the Constructor shall take corrective action prior to continued placement. Hand tamping shall be required around buried utility lines or other subsurface features that could be damaged by mechanical compaction equipment.
- B. Fill: Place fill in loose lifts not exceeding 8 inches. Compact each lift to at least 95 percent relative compaction within moisture content of -2 to +3 percent of optimum. A kneading compactor such as a pad foot roller or equivalent is required for embankment fill compaction. Rubber tired rollers are specifically excluded. Do not attempt to compact fill material that contains excess or insufficient moisture. If the fill contains insufficient moisture, add water by sprinkling and thoroughly disking the fill. If the fill contains excess moisture, aerate the material by blading, disking, harrowing, or other methods, to accelerate the drying process.
 - 1. Compaction curves for the full range of soil materials to be used in the embankment shall be provided by the Owner.
- 3.07 FIELD DENSITY AND MOISTURE TESTING: Density and moisture testing will be carried out by the Owner as specified herein and as specified at the end of this section to determine if adequate compaction of the embankment material is being achieved.
- 3.08 SITE GRADING: Perform all earth work to the lines and grades as shown. Shape, trim, and finish slopes to conform to the lines, grades, and cross sections shown. Make slopes free of all exposed roots and stones exceeding 6-inch diameter. Finished site grading will be reviewed by

the Engineer. Blend new embankment fill into existing topography. Perform grading such that ponding or channeling of water is avoided.

3.09 MINIMUM TESTING FREQUENCY FOR MATERIAL AND QUALITY EVALUATION

	Grain Size Distribution (ASTM D 422)	Atterberg Limit (ASTM D 4318)	Proctor (ASTM D 698)	Moisture Content & Density (ASTM D 3017 & D 2922)
Minimum frequency required	One per 5,000 cubic yards	One per 5,000 cubic yards	One per 5,000 cubic yards	One per 500 cubic yards or 1 per lift placed

END OF SECTION