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September 24, 2010
File: 113079.01

Carollo Engineers
1265 East Fort Union Blvd. #200
Midvale, Utah 84047

Attention: Mr. John Richardson, P.E.

**SUBJECT: Geotechnical Investigation Update Letter
Proposed Wastewater Reclamation Plant Improvements
Carson City, Nevada**

Dear Mr. Richardson:

The purpose of this letter is to provide an update to both our geotechnical report dated November 16, 2006 and our Geotechnical Investigation Update Letter dated April 8, 2009 for the Proposed Wastewater Reclamation Plant Improvements at the Carson City Wastewater Reclamation Plant in Carson City, Nevada. This letter addresses only the 5th Street Influent Structure, North Meter Lift Vault, the North Lift Screening Structure located adjacent the existing North Lift Pump Station, the associated 24-inch ductile iron pipeline between these structures, and the short section of 42-inch fiberglass reinforced mortar pipe from the 5th Street Influent Box to the Headworks.

Based on our work to date, no severe soil or groundwater constraints were observed in the course of our study, which would preclude project development. In general it appears the subsurface conditions encountered during this investigation are consistent with the conditions encountered during the previous investigations. Our conclusions and recommendations, along with restrictions and limitations, are discussed below.

PROJECT DESCRIPTION

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Information regarding the proposed construction was obtained based on our conversations, a review of our previous work experience at the site, and the provided site plan. It is our understanding that this phase of the project will consist of the construction of the following:

- The 5th Street Influent Structure – This structure will consist of a 13.5-foot deep cast-in-place concrete box approximately 7 feet by 7 feet. Long-term structural loads provided to us were approximately 43 kips across the footprint of the structure.

- The North Lift Meter Vault – This structure will consist of either a cast-in-place concrete or precast box approximately 13 feet deep and approximately 10 feet by 14 feet in plan. Long-term structural loads provided to us across the footprint of the proposed structure were approximately 114 kips.

- The North Lift Screen Structure – This structure will be constructed adjacent the North Lift Pump Station and will be of cast-in-place concrete construction approximately 23 feet deep and 23 feet by 11 feet in plan. Construction will include overexcavation to 23.5 feet and replacement with lean concrete or CLSM to 16 feet. Long-term structural loads across the footprint of the structure were provided to us, and are approximately 538 kips.

- A 24-inch diameter pipeline – The pipeline will connect the 5th Street Influent Structure with the Screening Structure and the North Lift Meter Vault. We have assumed the pipeline will not exceed seven feet in depth.

- A 42-inch diameter pipeline – The pipeline will connect the 5th Street Influent Box to the Headworks. We have assumed the pipeline will not exceed seven feet in depth.

Should final design details vary significantly from those outlined above, this firm should be notified to review and possibly revise the recommendations contained within this letter report.

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Access to the project site is provided by a driveway leading off of 5th Street near the intersection of Butti Way. The Carson City Wastewater Reclamation Plant is bordered by 5th Street to the south, Butti Way to the west, Fairview Drive to the east, and the Carson City Parking Enforcement Facility to the north. The project location is shown on the attached Vicinity Map, Plate 1. Existing improvements at the site consist of a wastewater treatment facility consisting of pump stations, secondary clarifiers, a concrete-lined aerated pond, among various other structures. The proposed improvements are generally along the western boundary of the wastewater treatment plan and the existing conditions consisted of landscaping and asphalt concrete pavements. The site is relatively flat and a total relief of less than 5 feet was estimated between the proposed improvements.

PREVIOUS FIELD EXPLORATION

Previous site investigations have included numerous subsurface explorations. The locations of the explorations can be seen on the attached Site Plan, Plate 2. The 2009 Update Letter included drilling 2 soil borings for the currently proposed structures. The soil boring logs for these 2 soil borings have been included as Plates 3 and 4. A description of the Unified Soil Classification System used to identify the site soils and a boring log legend are presented on Plates 5 and 6.

LABORATORY TESTING

Laboratory testing is useful for evaluating both index and engineering properties of soils. Typical index tests evaluate soil moisture content, unit weight, soil particle gradation, and plasticity characteristics. Tests for engineering properties can assess soil strength, compressibility, swell potential, and potential steel corrosion or adverse reactivity with Portland Cement Concrete. Previously, laboratory testing was performed on selected soil samples to assess the following:

- Soil Classification (ASTM D422 and D4318)
- Unit Weight and Moisture Content (ASTM D2937 and D2216)
- Consolidation (ASTM D2435)
- Direct Shear Strength (ASTM D3080)

In addition, the following analytical tests were performed by Western Environmental Testing (WET) Laboratory:

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- Soluble Sulfate Content
- Resistivity and pH

Individual laboratory test results performed for the 2009 Update Letter can be found on the field exploration logs and on Plates 7 through 10 at the end of this letter report. Laboratory tests performed as part of our previous investigations at the project site were used to the extent possible (Kleinfelder 2006).

SUBSURFACE CONDITIONS

The subsurface conditions encountered during the 2009 investigation were similar to the conditions encountered during the previous investigations. We generally encountered 5½ to 7½ feet of fill material consisting of non- to low-plastic silty sands underlain by silty sands, poorly graded sands, and sandy silts to the maximum depth explored of 21 feet below ground surface. A layer of high plasticity fat clay was encountered in soil boring B-2 at a depth of 3 to 5½ feet below ground surface.

Our previous investigations encountered fill material extending to depths of 5 to 10 feet below ground surface. It should be noted that soil boring B-9 of our 2006 investigation, located in the vicinity of the 5th Street Influent Structure, did not encounter fill material.

Groundwater was initially encountered in soil boring B-1 at a depth of approximately 9 feet below ground surface. After allowing the groundwater level in the soil boring to stabilize, the groundwater level rose to a depth of approximately 5 feet below ground surface. Groundwater was encountered in soil boring B-2 at a depth of 6 feet below ground surface. During our previous investigations at the project site, groundwater was initially encountered at approximate depths of 6 to 9 feet below ground surface, with the groundwater level rising to a depth of approximately 4 feet below ground surface after being allowed to stabilize within the soil borings. Fluctuations in the level of the groundwater and soil moisture conditions as noted in this report may occur due to variations in precipitation, snow melt, land use, irrigation, and other factors.

CONCLUSIONS AND RECOMMENDATIONS

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It is our opinion that the geotechnical recommendations provided within our November 16, 2006 geotechnical investigation report are applicable for the proposed 5th Street Influent Structure, the North Lift Meter Vault, the North Lift Screening Structure, the associated 24-inch diameter pipeline, and the 42-inch diameter pipeline from the 5th Street Influent Box to the Headworks, with the exceptions below. Our November 16, 2006 geotechnical investigation report should be read fully and in conjunction with this update letter report. Several of the sections provided in our November 16, 2006 geotechnical investigation report have also been reiterated below. Where previous sections of the referenced 2006 Geotechnical Report referred to the 2003 International Building Code (IBC) the 2006 IBC should now be referenced.

Remedial Earthwork

During our previous field investigations, we generally encountered a near surface layer of fill material generally consisting of non- to low-plastic silty sands. The depth of the fill material varied from 4 to 8 feet below ground surface.

The existing fill should be considered non-engineered fill, unless construction documentation can be provided. Construction on non-engineered fills without remedial earthwork could potentially result in excessive differential settlement beneath proposed improvements. The majority of the fill should be suitable for reuse as structural fill provided it is overexcavated, processed (removal of any oversize material, high plasticity clays, organics, and debris); moisture conditioned to a minimum of 2% above optimum, and recompacted in accordance with the recommendations for structural fill provided in our November 16, 2006 geotechnical investigation report.

Based on the information provided to us, we understand the proposed structures will be founded at a depth below the encountered undocumented fill material. Proposed structures should not be founded on undocumented fill. If undocumented fill is encountered beneath any proposed structures it should be overexcavated to native material and replaced with structural fill material in accordance with the recommendations of our original geotechnical investigation report.

Temporary Unconfined Excavations

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We understand that deep cuts of up to approximately 23 feet below ground surface are proposed to construct the 5th Street Influent Structure, the North Lift Meter Vault, and the North Lift Screenings Structure. The use of steepened, temporary cut slopes will be needed to construct below grade structures. Excavations should comply with current OSHA safety requirements for Type B soils, with a maximum inclination of 1:1 (horizontal to vertical) constructed as a simple slope or as a multiple bench layout. This inclination could possibly be increased at the time of construction by the project geotechnical engineer based on subsurface and groundwater conditions. The above layback assumes complete dewatering of the soils and is a suggested guideline, which may require modification in the field after the start of construction. The excavated slope may not be stable if diligent dewatering has not been performed. Any nearby structures (within 15 feet of the top of excavation) should be monitored for settlement, movement and any signs of instability.

The Contractor is ultimately responsible for the safety of workers and should strictly observe federal and local OSHA requirements for excavation shoring and safety. Due to the granular nature of the surface soils, some raveling of temporary cut slopes should be anticipated. During wet weather, runoff water should be prevented from entering excavations.

In areas where a sloped excavation is not possible, shoring will be required. Design and construction of a shoring system should be provided by a specialty contractor.

Temporary Trench Excavation and Backfill

The recommendations provided in the referenced 2006 Geotechnical Report should be used for Trench Excavation and Backfill.

Construction Dewatering

Significant construction dewatering will be required for the construction of the proposed structures; the contractor should be alerted to the need for dewatering. The recommendations provided in the referenced 2006 Geotechnical Report should be used for dewatering. Ultimately, the Contractor is responsible for dewatering.

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Foundations

The proposed structures may be supported by conventional spread footings and/or mat foundations bearing on non-expansive native soil or compacted structural fill as provided in our November 16, 2006 geotechnical investigation report. Any loose soil in the bottom of footing excavations should be recompacted to at least 90% relative compaction or removed to expose firm, unyielding material. Since the soils at the base of deep excavations are likely to be wet of optimum and difficult to compact, a minimum of 12 inches of subgrade stabilization may be used in lieu of achieving the required compaction criteria. Foundations designed and constructed in accordance with the recommendations of this letter report may be designed for an allowable soil bearing pressure of 2,000 pounds per square foot for dead loads plus long-term live loads.

The allowable bearing capacities may be increased by one-third for total loading conditions, including wind and seismic forces. The allowable bearing pressures are net values; therefore, the weight of the foundation and backfill may be neglected when computing dead loads. Since the proposed structures are founded 10 to 15 feet below grade, the net bearing pressure should consider the applied structural load minus the displaced soil volume over the structure footprint. The foundation loads for the buried structures are generally less than or equal to the soil overburden at the same depth.

We estimate that total post-construction settlement of foundations designed and constructed in accordance with our recommendations will be less than 1 inch, with approximate differential settlement on the order of ½ inch over the entire structure.

For all foundation types, resistance to foundation lateral loads may be calculated using an allowable passive equivalent fluid unit weight of 350 pounds per cubic foot or an allowable coefficient of friction of 0.40 applied to vertical dead loads. For foundations within 2 feet of the existing groundwater level, the passive pressure should be reduced to 175 pounds per cubic foot. Both passive and frictional resistances may be assumed to act concurrently.

Consideration should be given to establishing permanent dewatering wells, which can be used to temporarily lower groundwater levels, decreasing the buoyancy (uplift) force, beneath the proposed subsurface structures when the structures are drained for periodic maintenance. Alternatively, structures could be designed to resist buoyant forces using their weight and soil resistance. In addition, the structures should be anchored to their foundations and foundations widened to allow overburden pressures from fill soils to resist uplift. Buoyant pressures can be found by multiplying the unit weight of water (62.4 pounds per cubic foot) by the depth below the groundwater table. For example, if the bottom of the concrete box was 10 feet below the design groundwater surface, a pressure of 624 pounds per square foot would be applied across the bottom of the box. A soil unit weight of 55 pcf below the ground water and 115 pcf above the groundwater level should be used for computing the overburden pressures. Based on the measured groundwater depths, a design groundwater depth of five feet is appropriate.

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Additional foundation recommendations are included in the referenced 2006 Geotechnical Report.

Seismic Site Class

The site is located in the Carson City, which has adopted the *2006 International Building Code (IBC)* as the building design standard. If seismic loadings are evaluated using the 2006 *International Building Code* (IBC) method, we recommend using the following

- Site Class: D (Applicable to stiff soil profile with an average shear wave velocity of 600 to 1,200 feet/second) (Table 1613.5.2))
- Mapped Spectral Response Acceleration at Short Periods (S_S): 1.60g (Figure 1613.5(3))
- Mapped Spectral Response Acceleration at 1-Second Period (S_1): 0.60g (Figure 1613.5(4))

Spectral response accelerations were determined based on information from the USGS *Seismic Design Values for Buildings,* Java Ground Motion Parameter Calculator-Version 5.09 for the location of 39.162° Latitude and -119.733° Longitude.

Retaining Structures

Lateral earth pressures will be imposed on all subterranean structures. Design pressures, recommended factors of safety, general recommendations are provided in the referenced 2006 Geotechnical Report.

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Steel and Concrete Reactivity

Analytical testing of a selected soil sample was performed to assess the potential for adverse reactivity with concrete and corrosivity with steel. Soluble sulfate tests were performed to evaluate potential sulfate attack against Portland cement concrete. According to data furnished by WET Laboratory, the soluble sulfate content of the selected soil sample tested was observed to 79 ppm. Based on the requirements of the *2006 International Building Code* (*IBC)* conventional Type II cement may be used for site concrete. However, it should be noted that during our 2006 investigation, a selected soil sample (soil boring B-5) was observed to have a severe reaction (2,900 ppm) to soluble sulfates.

Resistivity testing indicates the subgrade soils have a low corrosion potential when in contact with buried ferrous metal. The resistivity value for the selected soil samples was observed to vary between 32,000 ohm-cm. Resistivity testing performed as part of our 2006 investigation indicated a high corrosion potential when in contact with buried ferrous metal. Due to the variability of the site soils, a corrosion engineer should review resistivity and pH testing results to determine if additional corrosion testing or protection for buried, ferrous metal elements is required. Additional testing as directed by the corrosion engineer may be necessary.

LIMITATIONS

All limitations and liability requirements presented in our original investigation report (November 26, 2006) are applicable and in force for these update recommendations. This letter should be read in conjunction with the referenced soils report.

CLOSURE

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We appreciate this opportunity to be of service to you and look forward to future endeavors. If you have any questions about this report or need additional information, please contact either of the undersigned in our Reno office.

Sincerely,

KLEINFELDER WEST, INC.

PROFESSIONAL ENGINEER - STATE OF NEVADA
JONATHAN PEASE
Exp: 12-2011
CIVIL
No. 16209

9-24-10

Don Adams, P.E.
Project Engineer

Jonathan Pease, P.E.
Senior Geotechnical Engineer

Enclosures: Plates

Plate 1 – Vicinity Map
Plate 2 – Site Plan
Plate 3 through Plate 4 – Boring Logs
Plate 5 – Key to Soil Classification and Terms
Plate 6 – Key to Boring Logs
Plate 7 – Grain Size Analysis
Plate 8 – Atterberg Limits Results
Plate 9 – Steel Corrosion Potential of Soil
Plate 10 – Potential Reactivity

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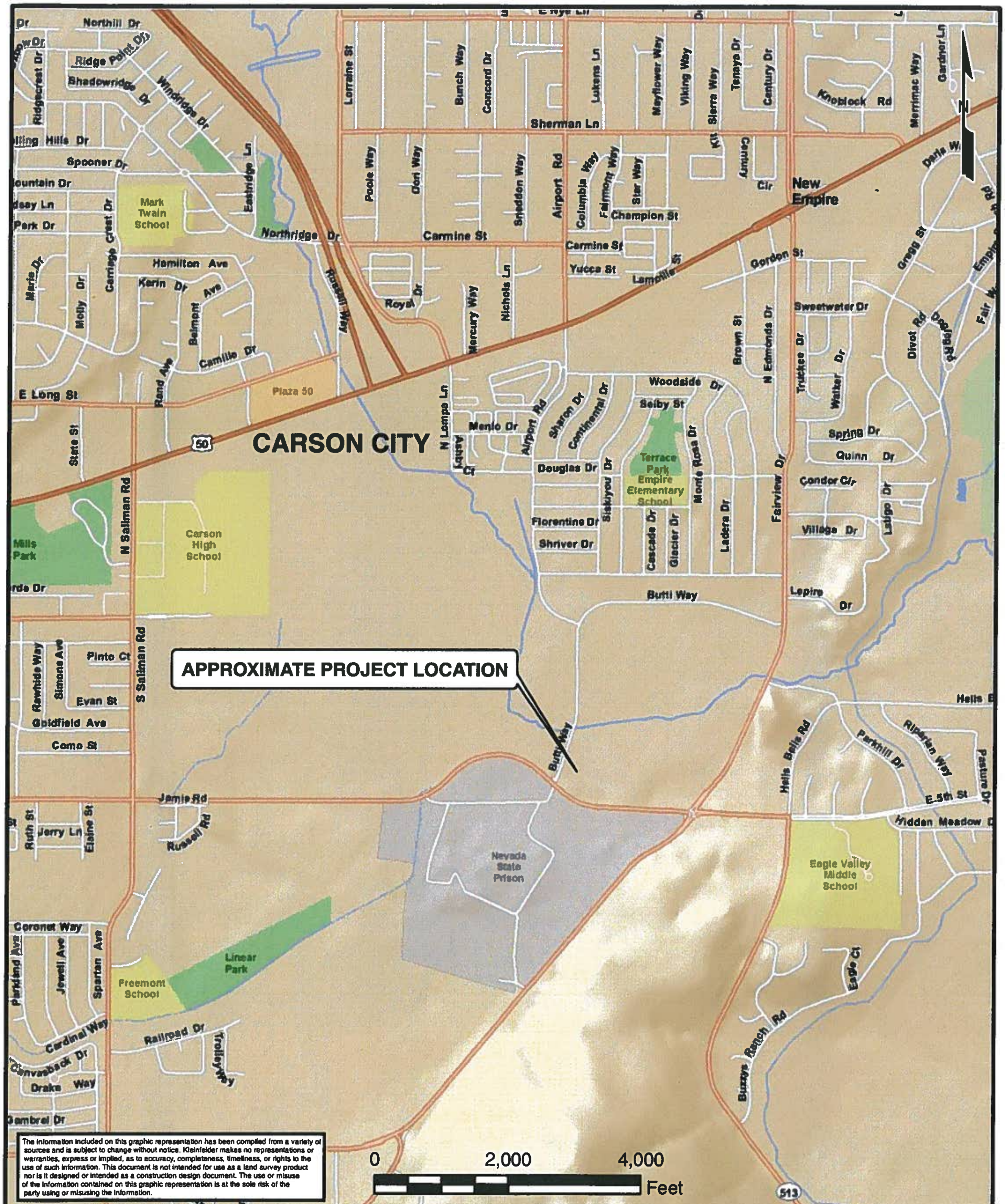
REFERENCES

Geotechnical Investigation Report, Wastewater Reclamation, Plant Phase 1A Improvements, Carson City, Nevada. Kleinfelder, Project No 35846.01. November 16, 2006.

Geotechnical Investigation Update Letter, Proposed Wastewater Reclamation, Carson City, Nevada. Kleinfelder, Project No 102776.01. April 8, 2009.

United States Geological Survey (USGS), *Seismic Design Values for Buildings,* Java Ground Motion Parameter Calculator-Version 5.09, accessed April 1, 2009, from USGS website: http://earthquake.usgs.gov/research/hazmaps/design.

PLATES



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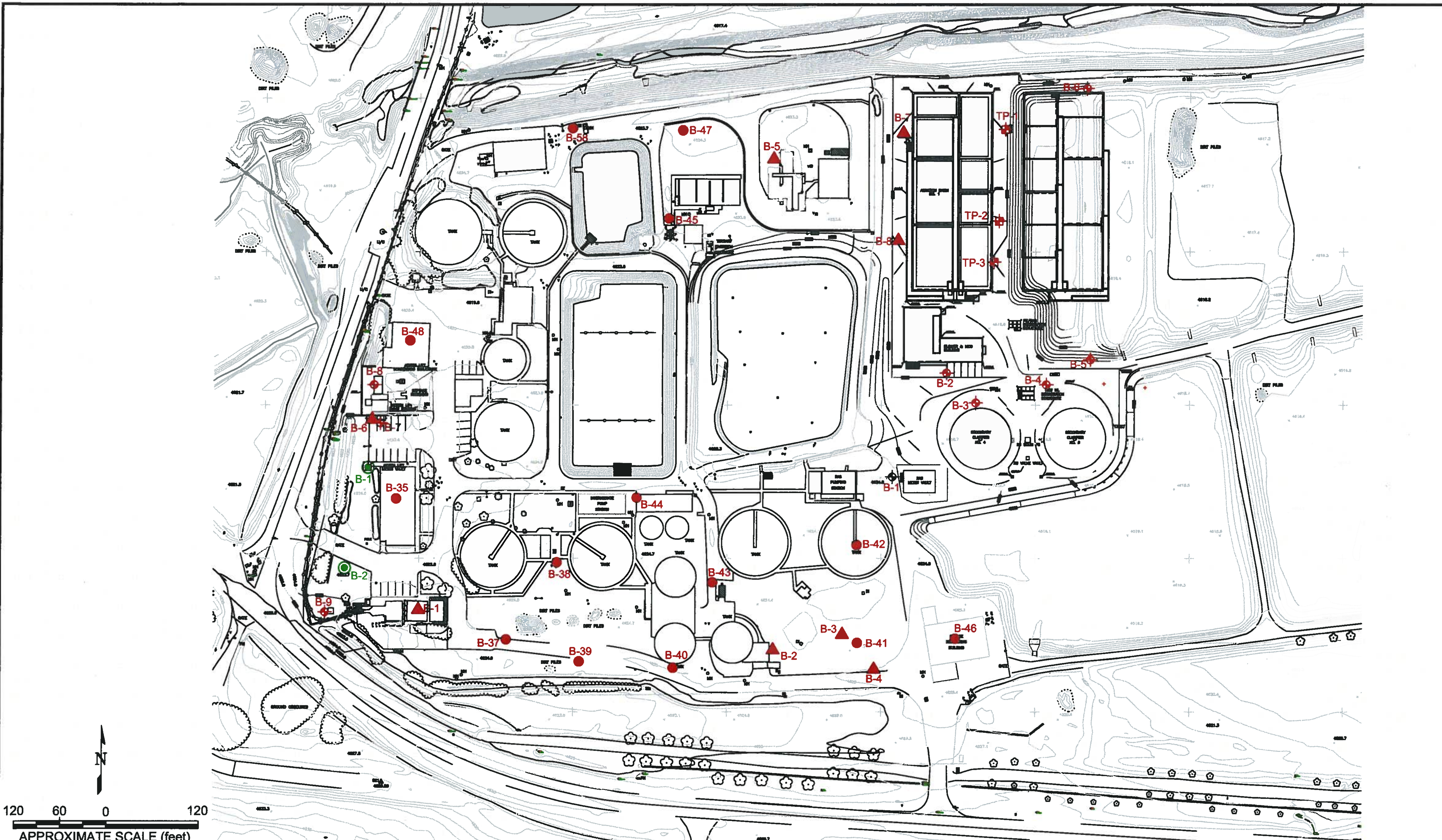
VICINITY MAP

GEOTECHNICAL INVESTIGATION UPDATE LETTER
CARSON CITY WASTEWATER TREATMENT PLANT
CARSON CITY, NEVADA

PLATE
1

ATTACHMENT D



LEGEND

B-1	◉	APPROXIMATE SOIL BORING LOCATION (2009 INVESTIGATION)
B-1	⊕	APPROXIMATE SOIL BORING LOCATION (2006 INVESTIGATION)
TP-1	⊕	APPROXIMATE TEST PIT LOCATION (2003 INVESTIGATION)
B-1	▲	APPROXIMATE SOIL BORING LOCATION (2003 INVESTIGATION)
B-38	●	APPROXIMATE SOIL BORING LOCATION (1982 INVESTIGATION)

ATTACHED IMAGES:
ATTACHED XREFS: XRef: NEW YARD-PIPING: XRef: PAVING & GRADING: XRef: X-YARD-PIPES: XRef: 50base: XRef: SITESCHEMATIC: XRef: AREAS
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SITE PLAN

GEOTECHNICAL INVESTIGATION UPDATE LETTER
CARSON CITY WASTEWATER RECLAMATION PLANT
CARSON CITY, NEVADA

PLATE
2

ATTACHMENT D

Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	GRAPHIC LOG	SOIL DESCRIPTION
		23				FILL: **OLIVE SILTY SAND (SM)** moist, low plastic fines, fine to coarse sand, trace fine gravel, some organics.
		17	29			FILL: **DARK BROWN SILTY SAND (SM)** moist, non-plastic fines, fine to coarse sand, trace fine to coarse gravel, trace organics.
	▼ ▽	12				Very moist
66	▽51.3	4				**GRAY BROWN SILTY SAND (SM)** very moist to wet, very loose, low plastic fines, fine to medium sand, trace organics. Wet
		39				**GRAY BROWN POORLY GRADED SAND (SP)** wet, dense, non-plastic fines, fine to coarse sand, some fine to coarse gravel.
99	24.9	50/5"	53			**GRAY TO GRAY GREEN SANDY SILT (ML)** wet, hard, low plastic fines, fine to medium sand. pp > 4.5 tsf (pocket penetrometer)
		50/3"				Lense of poorly graded sand at 20.5 feet

DEPTH IN FEET: 0, 2, 4, 6, 8, 10, 12, 14, 16, 18, 20, 22

DATE: 3-23-09
TOTAL DEPTH: 21.0 feet
LOGGED BY: D. ADAMS
EQUIPMENT: CME 55 HOLLOW STEM AUGER

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DRAFTED BY: K. Carter PROJECT NO. 113079.01

LOG OF B-1

GEOTECHNICAL INVESTIGATION UPDATE LETTER
CARSON CITY WASTEWATER RECLAMATION PLANT
CARSON CITY, NEVADA

PLATE **3**

Depth (ft)	Dry Density lb/ft3	Moisture Content %	Blows/ Ft.	Percent Passing #200	Sample	GRAPHIC LOG	SOIL DESCRIPTION
0			14				FILL: **OLIVE SILTY SAND (SM)** moist, low plastic fines, fine to coarse sand, trace fine to coarse gravel, organics.
2.5			36				FILL: **DARK BROWN SILTY SAND (SM)** moist, low plastic fines, fine to coarse sand.
3							**RED GRAY FAT CLAY (CH)** moist, stiff, high plastic fines. pp > 4.5 tsf (pocket penetrometer)
5			23				pp = 3.5 tsf (pocket penetrometer)
5.5		∇ (approx. 6 ft)					**GRAY POORLY GRADED SAND (SP)** wet, medium dense, non-plastic fines, fine to medium sand.
7			22				
7.5	97	26.2		4			

DEPTH IN FEET: 0 – 22

DATE: 3-23-09
TOTAL DEPTH: 8.5 feet
LOGGED BY: D. ADAMS
EQUIPMENT: CME 55 HOLLOW STEM AUGER

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LOG OF B-2

GEOTECHNICAL INVESTIGATION UPDATE LETTER
CARSON CITY WASTEWATER RECLAMATION PLANT
CARSON CITY, NEVADA

PLATE **4**

DRAFTED BY: K. Carter PROJECT NO. 113079.01

THE UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAINED SOIL More than 50% of the material is LARGER than the No. 200 sieve.	GRAVELS More than 50% of coarse part is LARGER than the No. 4 Sieve.	CLEAN GRAVELS Less than 5% finer than No. 200 Sieve.	GW	Well graded gravels, gravel - sand mixtures, little or no fines, Cu>4 & 1<Cc>3
			GP	Poorly graded gravels or gravel - sand mixtures, little or no fines Cu<4 or 1>Cc<3
		GRAVEL More than 12% finer than No. 200 Sieve.	GM	Silty gravels, gravel - sand - silt mixtures
			GC	Clayey gravels, gravel - sand - clay mixtures
	SANDS More than 50% of coarse part is SMALLER than the No. 4 Sieve.	CLEAN SANDS Less than 5% finer than No. 200 Sieve.	SW	Well graded sands, gravelly sands, little or no or no fines, Cu>6 & 1<Cc>3
			SP	Poorly graded sands or gravelly sands, little or no fines Cu<6 or 1>Cc<3
		SAND More than 12% finer than No. 200 Sieve.	SM	Silty sands, sand - silt mixtures
			SC	Clayey sands, sand - clay mixtures
FINE GRAINED SOIL More than 50% of the material is SMALLER than the No. 200 sieve.	SILTS AND CLAYS Liquid limit LESS than 50	PI-Below A-Line	ML	Inorganic silts, rock flour, or clayey silts of low plasticity
		PI-Above A-Line	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
			OL	Organic silts & organic clays of low plasticity
	SILTS AND CLAYS Liquid limit GREATER than 50	PI-Below A-Line	MH	Inorganic silts, clayey silts, or silts of high plasticity
		PI-Above A-Line	CH	Inorganic clays of high plasticity, fat clays
			OH	Organic clays of medium to high plasticity, organic silts
HIGHLY ORGANIC SOILS			PT	Peat & other highly organic soils

BOUNDARY CLASSIFICATIONS: Soils possessing characteristics of two groups are designated by combinations of group symbols.

PARTICLE SIZE LIMITS

BOULDERS	COBBLES	GRAVEL		SAND			SILT	CLAY
		Coarse	Fine	Coarse	Medium	Fine		
12"	3"	3/4"	#4	#10	#40	#200	0.002 mm	

DESCRIPTIVE TERMS USED WITH SOILS

CONSISTENCY & APPARENT DENSITY	SILTS & CLAYS	SANDS & GRAVELS
Strongest	Hard	Very Dense
	Very Stiff	Dense
	Stiff	Medium Dense
	Medium Stiff	Loose
Weakest	Soft	Very Loose
	Very Soft	

MOISTURE CONTENT	
Wettest	Wet
	Very Moist
	Moist
	Slightly Moist
Driest	Dry

▽ - Water Level Observed During Exploration

▼ - Water Level Observed After Exploration

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KEY TO SOIL CLASSIFICATION AND TERMS

GEOTECHNICAL INVESTIGATION UPDATE LETTER
CARSON CITY WASTEWATER RECLAMATION PLANT
CARSON CITY, NEVADA

PLATE 5

SYMBOLS

Symbol	Description
☒	Disturbed Bag or Bulk Sample
◩	Standard Penetration Sample (1.4 inch I.D., 2.0 inch O.D.)
■	Modified California (Porter) Sample (2.0 inch I.D., 2.56 inch O.D.)
*	No Sample Recovery
▽	Water Level Observed During Drilling
▼	Water Level Observed After Allowed to Stabilize
▽ (half-filled)	Water Level Observed Shortly After Drilling

COMMENTS

NOTE: Blow count represents the number of blows required to drive a sampler through the last 12 inches of an 18 inch penetration. A standard 140 pound hammer with a 30.4 inch free fall is used to drive the sampler.

NOTE: The lines separating strata on the logs represent approximate boundaries only. The actual transition may be gradual. No warranty is provided as to the continuity of soil strata between borings.

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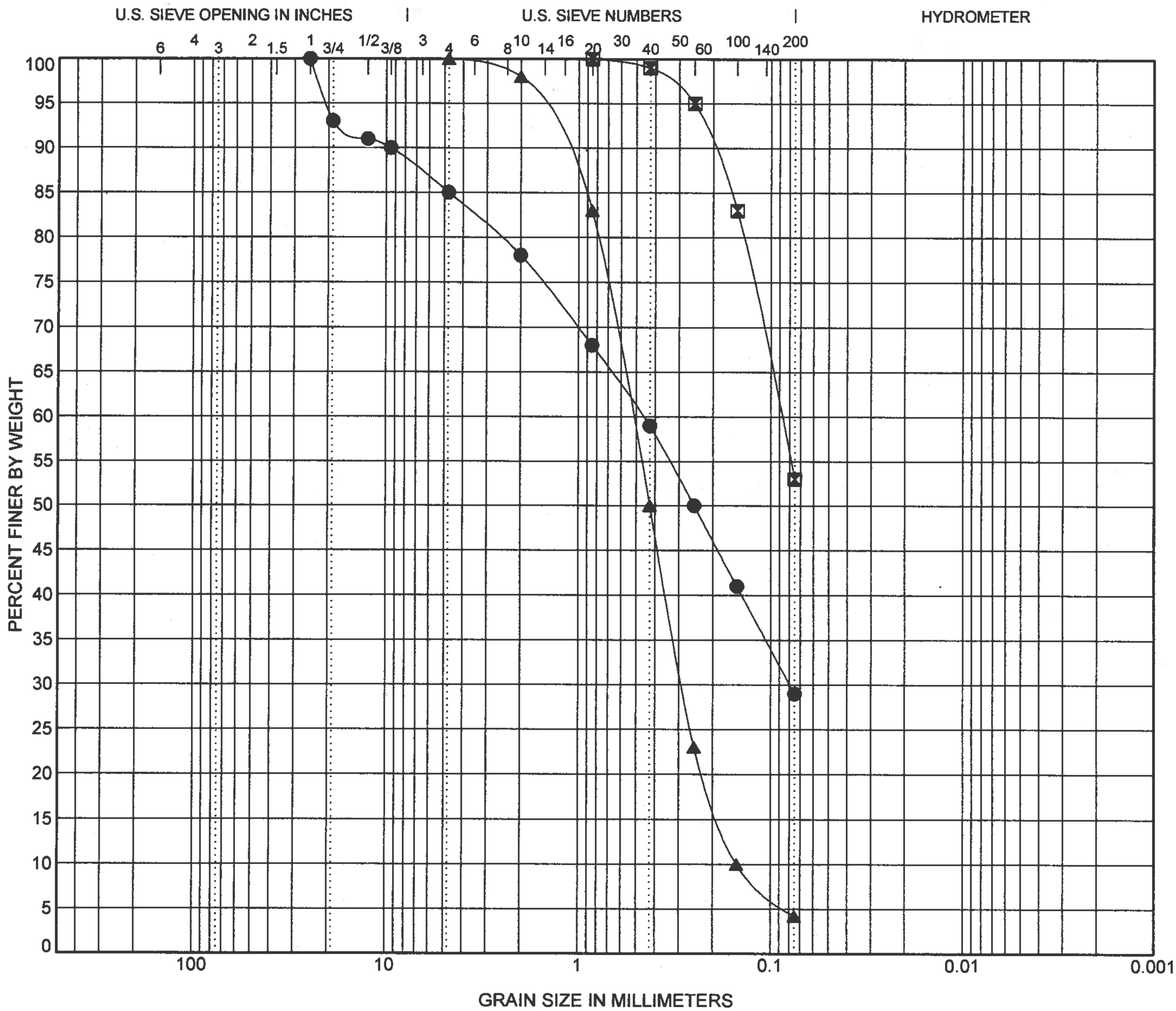
KEY TO BORING LOGS

GEOTECHNICAL INVESTIGATION UPDATE LETTER
CARSON CITY WASTEWATER RECLAMATION PLANT
CARSON CITY, NEVADA

PLATE
6



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Boring	Depth (ft.)	Description - ASTM Classification	LL	PL	PI	Cc	Cu
●	B-1	3.5	FILL: DARK BROWN SILTY SAND (SM)	NP	NP	NP		
⊠	B-1	15.5	GRAY TO GRAY GREEN SANDY SILT (ML)					
▲	B-2	7.5	GRAY POORLY GRADED SAND (SP)				1.05	3.50

	Boring	Depth (ft.)	D100	D60	D30	D10	% Gravel	% Sand	% Silt	% Clay
●	B-1	3.5	25	0.459	0.079		15.0	56.0	29.0	
⊠	B-1	15.5	0.85	0.088			0.0	47.0	53.0	
▲	B-2	7.5	4.75	0.524	0.287	0.15	0.0	95.8	4.2	

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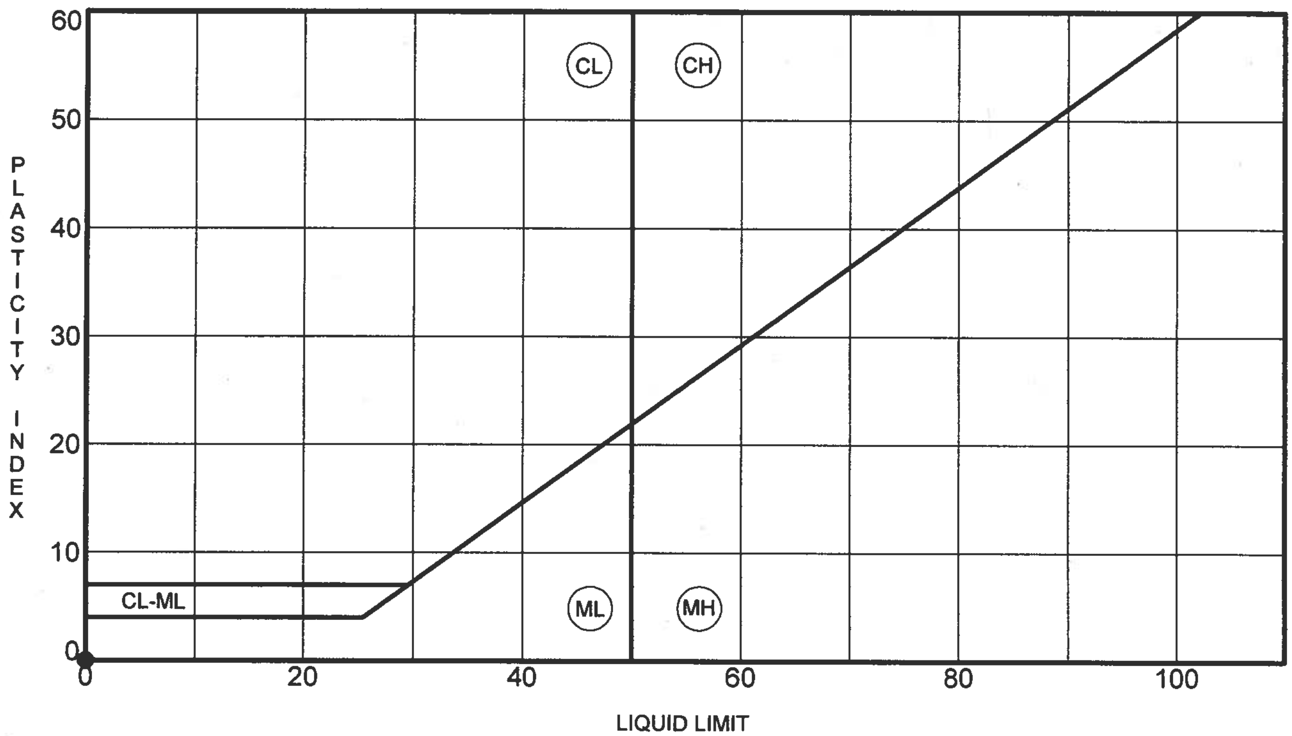
GEOTECHNICAL INVESTIGATION UPDATE LETTER
CARSON CITY WASTEWATER RECLAMATION PLANT
CARSON CITY, NEVADA

PLATE

7

DRAFTED BY: K. CARTER PROJECT NUMBER: 113079.01

GRAIN SIZE ANALYSES



	Specimen Identification		LL	PL	PI	Fines	Classification
●	B-1	3.5	NP	NP	NP	29	FILL: DARK BROWN SILTY SAND (SM)

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PLASTICITY INDEX

STEEL CORROSION POTENTIAL OF SOIL*

	Resistivity (ohm-cm)
Excellent	6,000 to 10,000
Good	4,500 to 6,000
Fair	2,000 to 4,500
Bad	0 to 2,000

LABORATORY TEST RESULTS

Soil Type	Source	Resistivity (ohm-cm)	pH**
GRAY TO GRAY GREEN SANDY SILT (ML)	B-1 TUBE @ 15-15.5 FT	32,000	9.06

* Reference: "Accelerated Corrosion Tests for Buried Metal Structures," by Paul Lieberman, Ph.D., in Pipeline and Gas Journal, October, 1996, Pg. 51.

** Note: Corrosion potential of soils generally increases as pH decreases below 7.

*** Note: Corrosion testing performed by Western Environmental Testing (WET) Laboratory.

PLOTTED: 31 Aug 2010, 9:58am, kcarter

CAD FILE: L:\2010\Project\113079\Drafting\ LAYOUT: CORROSION

Images: color_kf_logo.jpg Images: color_kf_logo_transparent.png

ATTACHED IMAGES:
ATTACHED XREFS:
RENO, NV

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DRAWN:	AUGUST 31, 2010
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CHECKED BY:	D. ADAMS
FILE NAME:	LABS.dwg

STEEL CORROSION POTENTIAL OF SOIL

GEOTECHNICAL INVESTIGATION UPDATE LETTER
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CARSON CITY, NEVADA

PLATE 9

POTENTIAL REACTIVITY OF SOLUBLE SULFATES IN SOIL OR GROUNDWATER WITH PORTLAND CEMENT CONCRETE

REQUIREMENTS FOR CONCRETE EXPOSED TO SULFATE-CONTAINING SOLUTIONS

SULFATE EXPOSURE	WATER-SOLUBLE SULFATE (SO4) IN SOIL, PERCENTAGE BY WEIGHT	SULFATE (SO4) IN WATER, ppm	CEMENT TYPE	MAXIMUM WATER-CEMENTITIOUS MATERIALS RATIO, BY WEIGHT, NORMAL-WEIGHT AGGREGATE CONCRETE (1)	MINIMUM NORMAL-WEIGHT AND LIGHTWEIGHT AGGREGATE CONCRETE, psi x 0.00689 for MP
Negligible	0.00-0.10	0-150	(Negligible..........	..........Sulfate..........	..........Reaction)
Moderate (2)	0.10-0.20	150-1,500	II, IP (MS), IS (MS)	0.50	4,000
Severe	0.20-2.00	1,500-10,000	V	0.45	4,500
Very Severe	Over 2.00	Over 10,000	V plus pozzolan (3)	0.45	4,500

Reference: 2003 International Building Code

(1) A lower water-cementitious materials ratio or higher strength may be required for low permeability or for protection against corrosion of embedded items or freezing and thawing.

(2) Seawater.

(3) Pozzolan that has been determined by test or service record to improve sulfate resistance when used in concrete containing Type V cement.

*Note: Corrosion testing performed by Western Environmental Testing (WET) Laboratory.

SAMPLE IDENTIFICATION	B-1 TUBE @ 15-15.5 FT		
SAMPLE DESCRIPTION	GRAY TO GRAY GREEN SANDY SILT (ML)		
SOLUBLE SULFATE (ppm)	79		
COMMENTS	NEGLIGIBLE SULFATE REACTION		

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PROJECT NO. 113079.01	POTENTIAL REACTIVITY	PLATE
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FILE NAME: LABS.dwg		

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CAD FILE: L:\2010\Project\113079\Drafting\ LAYOUT: REACTIVITY
Images: color_kf_logo.jpg Images: color_kf_logo_transparent.png
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