SUPPLEMENT TO GEOTECHNICAL ENGINEERING INVESTIGATION

NEW ROADWAYS
TURLOCK WASTEWATER TREATMENT PLANT
901 SOUTH WALNUT ROAD
TURLOCK, CALIFORNIA 95380

BSK PROJECT G18-113-11F

PREPARED FOR:

AECOM
1360 E. SPRUCE AVENUE, SUITE 101
FRESNO, CALIFORNIA 93720

DECEMBER 6, 2018

UPDATE TO GEOTECHNICAL ENGINEERING INVESTIGATION
NEW ROADWAYS
TURLOCK WASTEWATER TREATMENT PLANT
901 SOUTH WALNUT ROAD
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Prepared for:

AECOM
1360 E. Spruce Avenue, Suite 101
Fresno, California 93720

BSK Project: G18-113-11F

December 6, 2018

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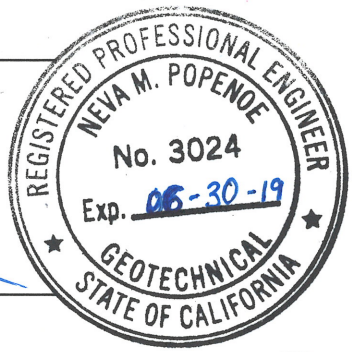

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1 INTRODUCTION

1.1 General

This report presents the results of a supplemental geotechnical engineering investigation conducted by BSK Associates (BSK) for new or improved roadways at the Turlock Wastewater Treatment Plant (WWTP). BSK previously prepared a Geotechnical Engineering Investigation Report for the Turlock WWTP Laydown Area (BSK Project G18-113-11F, dated August 6, 2018). This report provides supplemental/updated recommendations for the proposed new roadways.

The geotechnical engineering investigation was conducted in general accordance with the scope of services outlined in BSK Proposal GF18-16700A, dated July 31, 2018.

1.2 Project Description

BSK understands that the project will include new or improved roadways in conjunction with the referenced project. Pavement reconstruction associated with pipeline installation may consist of widening existing pavement, replacement, or new pavement. Site improvements will also include an aggregate base haul road and vactor trucks wash down area.

If the project description differs significantly from that anticipated above, we should be notified so that we can review our scope of work for applicability.

1.3 Purpose and Scope of Services

The purpose of the geotechnical investigation is to assess soil conditions at the improvement areas and to provide supplemental geotechnical engineering recommendation for use by the project designers during preparation of the project plans and specifications. The scope of the investigation included a field exploration, laboratory testing, engineering analysis, and preparation of this report. Previous field and laboratory test data were utilized in conjunction with current field and laboratory test data to develop supplemental recommendations. The proposed improvements and exploratory boring locations are shown on Figure 2, Boring Location Map.

2 FIELD INVESTIGATION AND LABORATORY TESTING

2.1 Field Investigation

The field exploration, conducted on November 12, 2018 consisted of a site reconnaissance and augering six (6) test borings to a maximum depth of approximately 4 feet below ground surface (bgs). Test boring were drilled with manually-operated hand auger equipment and a six (6) inch diamond core barrel. Details of the field exploration and the boring logs are provided in Appendix A.

2.2 Laboratory Testing

Laboratory testing of selected samples were performed to evaluate their physical and engineering characteristics and properties. The testing program included in-situ moisture and dry density, R-value and sulfate content.

The in-situ moisture and dry density test results are presented on the boring logs in Appendix A. Descriptions of the laboratory test methods and test results are provided in Appendix B.

3 SITE CONDITIONS

3.1 Site Description

The new road or improved roadways are planned in areas that are currently occupied by or adjacent to existing roadways. At the time of the field investigation the project site was within the Turlock WWTP developed with paved roads east of the dechlorination facilities and surrounding the equalization basins and along the western edge of the holding ponds. An unpaved road extends east from Kilroy Road between the unlined basins and north to the dechlorination facility. WGS84 GPS coordinates for the center of the site are 37.482949 degrees North latitude and 120.873942 degrees West longitude. The proposed sludge drying/laydown area contains debris and soil piles, with little to no seasonal weeds and vegetation.

3.2 Subsurface Description

Unpaved roadways contained silty gravel fill with sporadic debris, trash, concrete, and glass, which was up to 1 to 6 inches in diameter. The fill was underlain by native soil. Paved roadways were underlain by silty aggregate base and native soils. The native near surface soils encountered within the test boring consisted of fine to medium grained silty sand in upper 3 feet underlain by sandy clay, poorly graded sand, and silty sands to the maximum depth of exploration, 4 feet bgs. The boring logs in Appendix A provide a more detailed description of the soils encountered, including the applicable Unified Soil Classification System symbols.

Borings were drilled through existing pavement at three locations. The pavement section thickness was measured and is presented in Table 1. R-value testing was completed for a near surface (0 to 4 feet bgs) sample and the result is presented in Table 1. The estimated equivalent 18-kip single axle load (ESAL) for each core location was calculated. The results are also presented in Table 1.

Table 1: Coring Summary				
Boring	**AC Thickness (inches)**	**AB Thickness (inches)**	**R-Value**	**Estimated ESAL**
C-1	4 ¾	5	64	51,890
C-2	2	3 ½	-	328
C-3	2	6	-	6,010

Notes:
AC: Asphalt concrete
AB: Aggregate Base (Minimum R-Value = 78)
ESAL: Equivalent 18-kip single axle load

The estimated ESAL presented in Table 1 is based on the measured asphalt and aggregate base sections, an assumed gravel factor of 1.4 for the asphalt concrete, and R-values of 50 and 78 for soil subgrade and aggregate base, respectively.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 General

Based upon the data collected during this investigation and from a geotechnical engineering standpoint, it is our opinion that there are no soil conditions that would preclude the construction of the proposed improvements. The soils at the subject site are essentially similar to the previous site investigation, therefore, the recommendation presented in the referenced report are applicable to the proposed improvements/site provided the following recommendations are incorporated into the report.

4.2 Site Preparation and Earthwork Construction

The following procedures must be implemented during site preparation for the proposed improvements. It should be noted that references to maximum dry density, optimum moisture content, and relative compaction are based on ASTM D1557 (latest test revision) laboratory test procedures.

1. Prior to any site grading, all miscellaneous surface obstructions must be removed from the improvement area. Near surface soils containing vegetation, roots, organics, glass, or other objectionable material must be stripped to a depth of at least 3-inches to expose a clean soil surface. Roots larger than ½-inch in diameter must be removed. Surface strippings must not be incorporated into engineered fill unless the organic content is less than 3 percent by weight (ASTM D2974).
2. Within the area of the planned improvements, remove existing underground utilities and debris to expose a clean soil surface free of deleterious material.

3. Soil disturbed as a result of construction, undocumented fill deemed to possess inadequate compaction or uniformity, debris, or abandoned underground structures, must be excavated to expose undisturbed native soil or suitable fill.

4. Following the required demolition, stripping, and/or removal of underground structures, the exposed soil surface in proposed improvement areas or areas to receive fill must be proof-rolled under the observation of a BSK field representative to detect soft or pliant areas. Soft or pliant areas must be over-excavated to firm native soil. The exposed surface must be scarified a minimum of 12 inches, uniformly moisture conditioned to at or above optimum moisture, and compacted to 95 percent relative compaction.

5. Excavated soils, free of deleterious substances (organic matter, demolition debris, tree roots, etc.) and with less than 3 percent organic content by weight, may be returned to the excavations as engineered fill. Consideration can be made to reuse of excavated asphalt and hardscape as base material for pavement areas, provided it is pulverized and sufficiently blended to meet Caltrans Class 2 aggregate-base standards.

6. All engineered fill should be placed in uniform layers not exceeding 8 inches in loose thickness, moisture conditioned to at or above optimum moisture content. Engineered fill to support structures should compacted to at least 95 percent. Engineered fill in other areas should be compacted to at least 90 percent, with material beneath roadways or pavement compacted to at least 95 percent in the upper 1-foot. Acceptance of engineered fill placement must be based on both moisture content at time of compaction and relative compaction.

7. Imported fill materials must be free of deleterious substances and have less than 3 percent organic content by weight. The project specifications must require the contractor to contact BSK for review of the proposed import fill materials for conformance with these recommendations at least two weeks prior to importing to the site, whether from on-site or off-site borrow areas. Imported fill soils must be non-hazardous and be derived from a single, consistent soil type source conforming to the following criteria:

Maximum Particle Size:	3-inches
Percent Passing #4 Sieve:	65 – 100
Percent Passing #200 Sieve:	20 – 45
Plasticity Index:	less than 12
Expansion Index:	< 20
Low Corrosion Potential:	
Soluble Sulfates:	< 1,500 mg/kg
Soluble Chlorides:	< 300 mg/kg
Soil Resistivity:	> 2,000 ohm-cm

Grading operations must be scheduled as to avoid working during periods of inclement weather. Should these operations be performed during or shortly following periods of inclement weather, unstable soil conditions may result in the soils exhibiting a "pumping" condition. This condition is caused by excess moisture, in combination with compaction, resulting in saturation and near zero air voids in the soils. If

this condition occurs, the affected soils must be over-excavated to the depth at which stable soils are encountered and replaced with suitable soils compacted as engineered fill. Alternatively, the Contractor may proceed with grading operations after utilizing a method to stabilize the soil subgrade, which must be subject to review by BSK prior to implementation.

4.3 Conventional Pavement Section Recommendations

4.3.1 Flexible Pavement

Pavement sections from the reference report are still valid and are presented in Table 2 for clarity. Options include with or without aggregate base (AB), and gravel roadway (no HMA). If a fill material used in roadways has a measured R-value less than the design R-value of 50, BSK can update the pavement design.

TABLE 2
Recommended Minimum Pavement Sections (Conventional)
(R-Value = 50, 20-yr design life)

Traffic Index	Option 1		Option 2	Option 3
	HMA (inches)	AB (inches)	HMA (inches)	AB (inches)
5.0	2.5	4	5.0	9
5.5	3.0	4	5.5	10
6.0	3.5	4	6.0	10.5
6.5	3.5	4.5	7.0	11.5
7.0	4.0	4.5	7.5	12

Notes:HMA: Hot Mix Asphalt
AB: Caltrans Class 2 Aggregate Base (Minimum R-Value = 78)

Hot mix asphalt and Class 2 aggregate base should conform to and be placed in accordance with the latest revision of Caltrans Standard Specifications. It is recommended soil subgrade be scarified to a depth of 8 inches, moisture conditioned and compacted to at least 95 percent maximum density, based on ASTM D1557 prior to placing new aggregate base section.

If geogrid is used, the pavement sections shown in Table 2 can be used with the aggregate base section reduce by 30 percent. The geogrid should be integrally-formed bi-axial or tri-axial polypropylene. Aperture size for bi-axial materials should be approximately 1" x 1.3". The geogrid should be rated for tensile strength in accordance with ASTM D6637. Minimum average Roll Value of strength should be rated at 5% strain. Placement of geogrid should be longitudinally along the roadway alignment and performed in accordance to the manufacturer's specifications.

Prior to placement of geogrid, the subgrade should be in firm and unyielding condition. The subgrade must also be relatively flat and cleaned of loose soil to allow the geogrid to develop tension upon initial loading. No compaction is required on the subgrade soil. The aggregate base placed over the geogrid

should be compacted to 95 percent of ASTM D1557. Equipment used to compact the aggregate base must be non-vibratory equipment, should be light enough not to cause unstable soil subgrade condition, and either a smooth wheeled roller or rubber tire roller. Sheepsfoot or other non-smooth roller should not be used. Where over-lapping of geogrid is necessary, the geogrid must overlap a minimum of 12 inches or to the manufacturer's specifications, whichever is greater.

4.3.2 Rigid Pavement

A range of pavement sections have been provided based on annual average daily truck traffic (AADT). The project design consultant may select the pavement section corresponding to the appropriate truck traffic. The following table presents portland cement concrete pavement (PCCP) design sections based upon standards developed the American Concrete Institute. The 28-day compressive strength of pavement concrete used for the analyses was 4,000 psi.

TABLE 3
Recommended Minimum Pavement Section (PCCP)
(R-Value: 50 minimum)

Truck Usage	Average Daily Truck Traffic (ADTT)	Portland Cement Concrete (inch)	Aggregate Base Class 2 (inch)
Heavy Duty	6-7	5	6

Reinforcement of the concrete pavement should be determined by structural, curing, thermal considerations and should be designed by the civil or structural designer. Concrete pavement edges must be thickened by no less than 6 inches over the design pavement thickness and must taper to the thickness of the pavement section over a minimum distance of 36 inches. Pavement areas must be sloped at a gradient of two percent or greater to allow for positive surface drainage. Both the proper surface slope and uniform compaction are necessary for satisfactory pavement performance.

4.4 Soil-Cement Treated Subgrade – Pavement Section Recommendations

Soil-cement pavement sections from the reference report are still valid and are presented in Table 4 for clarity.

TABLE 4
Recommended Minimum Pavement Sections (Soil-Cement Subgrade)
(Cement Content = 6%, Unconfined Compressive Strength = 250 psi, R-Value = 50, 25-yr design life)

Traffic Index	Soil-Cement Section	
	HMA (inches)	Soil-Cement Thickness (inches)
5.0	2.5	12
5.5	3.0	12
6.0	3.5	12
6.5	3.5	12
7.0	4.0	12

Notes:
HMA: Hot Mix Asphalt
Soil-Cement Treat Subgrade with 6% cement to a depth of 12 inches.

BSK recommends after initial site grading, uniformly mix remaining material with 6 percent cement, moisture condition to 4 percent above optimum moisture content, and compact it to 95 percent relative compaction by ASTM D1557. Specifications can be provided for use in construction, if desired.

Hot mix asphalt should conform to and be placed in accordance with the latest revision of Caltrans Standard Specifications.

If unstable soil conditions occur during construction, BSK recommends replacing unstable material with a minimum of two feet of Class 2 aggregate base or 18 inches of soil cement. The aggregate base should be compacted to 95 percent relative compaction, and soil cement should follow recommendations above.

4.5 Excavation Stability

Soils encountered within the depth explored are generally classified as Type C soils in accordance with OSHA (Occupational Safety and Health Administration). The slopes surrounding or along temporary excavations should be no steeper than 1.5H:1V for excavations that are less than five feet deep and exhibit no indication of potential caving. Temporary excavations for the project construction should be left open for as short a time as possible and should be protected from water runoff. In addition, equipment and/or soil stockpiles must be maintained at least 10 feet away from the top of the excavations. Because of variability in soils, BSK must be afforded the opportunity to observe and document sloping and shoring conditions at the time of construction. Slope height, slope inclination, and excavation depths (including utility trench excavations) must in no case exceed those specified in

local, state, or federal safety regulations, (e.g., OSHA Health and Safety Standards for Excavations, 29 CFR Part 1926, or successor regulations).

4.6 Temporary Shoring

Where there is insufficient space to layback slopes, temporary shoring will be necessary. Lateral earth pressures for cantilevered or braced shoring supporting level ground are presented in Table 5.

TABLE 5
Lateral Earth Pressures for Temporary Shoring

Parameter	Pressure
Active Pressure	35 psf/ft
Braced Pressure	23H psf
Allowable Passive Pressure	
Solid Sheeting	270 psf/ft
Isolated Soldier Pile	610 psf/ft

Notes: 1. H is shored height in feet
2. Values for isolated soldier piles already include an increase for arching, no further consideration should be applied.

Traffic and equipment should not encroach within 10 feet of shoring. Shoring, bracing or underpinning required for the project (if any), should be designed by a professional engineer registered in the State of California.

4.7 Trench Backfill and Compaction

Processed on-site soils comprising of silty sand and sand, which are free of organic material, are suitable for use as general trench backfill above the pipe envelope. The backfill must be placed in thin layers, not exceeding 12-inches in loose thickness, scarified (if necessary) to achieve a smooth and consistent texture, moisture conditioned to within one to three percent above optimum moisture content, and compacted to at least 90 percent of the maximum dry density as determined by ASTM D1557. The uppermost 12-inches of trench backfill below pavement must be compacted to at least 95 percent of the maximum dry density as determined by ASTM: D1557 within proposed pavement areas, or as per City of Turlock Standards. Mechanical compaction methods are recommended, ponding or jetting should not be used. Moisture content within two percent of optimum moisture content must be maintained while compacting the upper 24-inch zone. Test validation must include moisture content compliance at the time of compaction.

Field density testing must conform to ASTM Test Methods D1556, and/or D6938. We recommend that field density tests be performed in the utility trench bedding, envelope and backfill for every vertical lift,

at an approximate longitudinal spacing of not greater than 250-feet. Backfill that does not conform to the criteria represented by the failing test must be removed or reworked as applicable over the trench length represented by the failing tests so as to conform to BSK recommendations.

4.8 Pipe Subgrade Preparation

Excavations to pipe subgrade elevation and setting of final grade is expected to produce soil disturbance, particularly in the sandier zones. Disturbed zones but not less than six (6) inches below final subgrade elevation must be compacted to a minimum of 90 percent. Moisture conditions during compaction must be not less than optimum but not greater than 3 percent above optimum.

4.9 Pipe Bedding and Envelope

A minimum thickness of six inches of bedding material or the thickness equivalent to 1/4 the pipe outside diameter whichever is the greater, is recommended for pipe installation. The bedding thickness may be adjusted to achieve the desired bedding angle and corresponding bedding constant. Bedding material must consist of sand with not more than 5 percent passing the #200 sieve and with 100 percent passing the 3/8-inch sieve. We recommend that the pipe zone up to the spring line also be backfilled with the bedding materials described above.

The remaining pipe zone up to 12-inches above the top of the pipe must consist of friable granular backfill. Silty sand deposits with 35 percent or less passing the #200 sieve are suitable for backfill. Bedding and pipe zone backfill must be placed in loose thickness not exceeding 8-inches and compacted to not less than 90 percent of the maximum dry density as determined by ASTM Test Method D1557. Backfill moisture content during compaction must be maintained at or above optimum. Sand-cement slurry may be used for envelope backfill (50-200 psi at 28 days).

4.10 Modulus of Soil Reaction E´

Modulus of Soil Reaction E´ values for use in the Iowa Formula for estimating the deflection of buried flexible pipes are provided in Table 6. The materials include undisturbed native soils (trench sidewalls), compacted native soil backfill, Class 2 base rock conforming to Caltrans Section 26 of Standard Specifications and sand-cement slurry (50 psi at 7 days).

TABLE 6
Modulus of Soil Reaction (E´)

Material Designation	Modulus of Soil Reaction (E´), psi	Degree of Compaction of Bedding & Envelope (ASTM: D1557)
Trench Sidewalls: (SM)(SP)*	1000	-
Compacted Native Soil Backfill	1350	90 percent
Class 2 Base Rock:	3400	95 percent
Sand-Cement Slurry	4000	--

Note: * SM: Silty Sand, SP: Sand

The Modulus of Soil Reaction is applicable to the determination of initial deflection only. For long-term deflection, a deflection lag factor of 1.25 is recommended for design purposes.

4.11 Horizontal Bearing Capacity-Thrust Blocks

We recommend that thrust blocks size determinations, in cases when force mains stabilization is required at pipe direction changes, be based on the bearing values for shallow and deep thrust blocks presented in Table 7. Shallow thrust blocks have a height greater than 70% of depth to center of pipeline. Deep thrust blocks have a height less than 70% of the depth to the pipe center.

TABLE 7
Horizontal Bearing Capacity

Loading	Thrust Block	Design Horizontal Bearing Capacity
Sustained	Shallow	260 psf/ft of depth
	Deep	2700H psf
Test	Shallow	345 psf/ft of depth
	Deep	4050H psf

Note: H is block height in feet

The thrust blocks must be cast between the pipe and undisturbed soil at the trench sidewalls. The horizontal deformation associated with the available capacity of shallow thrust blocks is 0.005D for test and sustained loading, where D is the depth to the bottom of the thrust block. It is anticipated the lateral movement associated with the available lateral bearing of deep thrust blocks under sustained or test loading is about 0.1 inch per 1000 psf of horizontal loading.

4.12 Pipe Loading Design Factors

Pipe loading design factors listed in Table 8 are provided for bedding material consisting of:

1) Native and imported sand or silty sand soil with less than 35 percent passing the #200 sieve and 100 percent passing the 3/8-inch sieve (SP/SM);
2) Class 2 crushed base rock conforming to Caltrans Section 26 of standard specifications;
3) Sand-cement slurry with 28-day compressive strength of 50-200 psi.

TABLE 8
Pipe Loading Design Factors

Materials Classification	Angle of Internal Friction, Degrees	Kμ (Marston's Formula)	Degree of Compaction ASTM: D1557
(1) SM	34	0.19	90
(2) Class 2 Aggregate Base	45	0.17	95
(3) Cement/Sand Slurry (CLSM)	55	0.14	--

A bulk unit weight of 125 pcf is recommended for compacted soil backfill within the pipe bedding and envelope. For Class 2 aggregate base, a unit weight of 140 pcf is recommended.

In the determination of the load coefficient, Kμ, "K" is Rankine's lateral earth pressure ratio and μ is equal to the coefficient of friction.

4.13 Permanent Slope Stability

Permanent fill slopes are anticipated to be constructed using onsite soil material for fill. As such, the proposed fill slopes are anticipated to be stable to slopes of 2.5H:1V or flatter, to a maximum height of 10 feet, with a factor of safety of 1.5. Preparation of soils to receive fill and fill placement must follow the guidelines provided in Section 4.2. Slope faces steeper than 4:1 (H:V) should utilize an erosion blanket, hydro-seed, or other measure to prevent erosion.

4.14 Surface Drainage Control

Final grading around site improvements must provide for positive and enduring drainage. Ponding of water must not be allowed on or near the proposed structures. Saturation of the soils immediately adjacent to or below structures must not be allowed. Although landscaping is not anticipated, irrigation water must be applied in amounts not exceeding those required to offset evaporation, sustain plant life, and maintain a relatively uniform moisture profile around and below, site improvements. Fill elevations are anticipated to be less than 10 feet above natural grade to achieve positive site drainage.

5 PLANS AND SPECIFICATIONS REVIEW

BSK recommends that it be retained to review the draft plans and specifications for the project, with regard to foundations and earthwork, prior to their being finalized and issued for construction bidding.

6 CONSTRUCTION TESTING AND OBSERVATIONS

Geotechnical testing and observation during construction is a vital extension of this geotechnical investigation. BSK recommends that it be retained for those services. Field review during site preparation and grading allows for evaluation of the exposed soil conditions and confirmation or revision of the assumptions and extrapolations made in formulating the design parameters and recommendations. BSK's observations must be supplemented with periodic compaction tests to establish substantial conformance with these recommendations. BSK must also be called to the site to observe foundation excavations, prior to placement of reinforcing steel or concrete, in order to assess whether the actual bearing conditions are compatible with the conditions anticipated during the preparation of this report. BSK must also be called to the site to observe placement of foundation and slab concrete.

If a firm other than BSK is retained for these services during construction, that firm must notify the owner, project designers, governmental building officials, and BSK that the firm has assumed the responsibility for all phases (i.e., both design and construction) of the project within the purview of the geotechnical engineer. Notification must indicate that the firm has reviewed this report and any subsequent addenda, and that it either agrees with BSK's conclusions and recommendations, or that it will provide independent recommendations

7 LIMITATIONS

The analyses and recommendations submitted in this report are based upon the data obtained from the test borings performed at the locations shown on Figure 2. The report does not reflect variations which may occur between or beyond the borings. The nature and extent of such variations may not become evident until additional exploration and testing is performed or construction is initiated. If variations then appear, a re-evaluation of the recommendations of this report will be necessary after performing on-site observations during the excavation period and noting the characteristics of the variations.

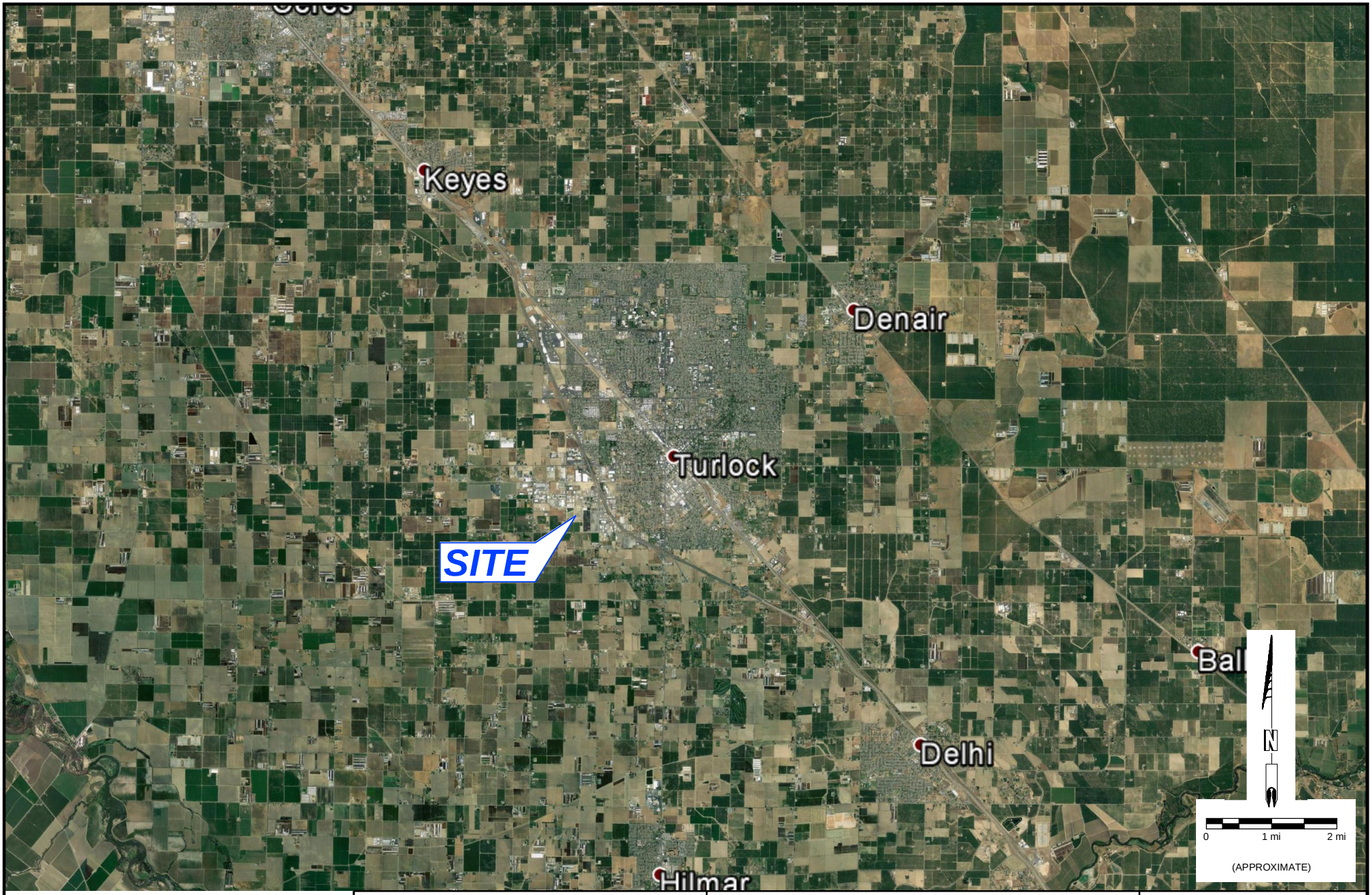
The validity of the recommendations contained in this report is also dependent upon an adequate testing and observation program during the construction phase. BSK assumes no responsibility for construction compliance with the design concepts or recommendations unless it has been retained to perform the testing and observation services during construction as described above.

The findings of this report are valid as of the present. However, changes in the conditions of the site can occur with the passage of time, whether caused by natural processes or the work of man, on this property or adjacent property. In addition, changes in applicable or appropriate standards may occur, whether they result from legislation, governmental policy or the broadening of knowledge.

BSK has prepared this report for the exclusive use of the Client and members of the project design team. The report has been prepared in accordance with generally accepted geotechnical engineering practices

which existed in Stanislaus County at the time the report was written. No other warranties either express or implied are made as to the professional advice provided under the terms of BSK's agreement with Client and included in this report.

FIGURES



P:\FRS\Active\G18113311F - Turlock WWTP Solids Laydown Area TONo.1\Graphics\Phase 002\G18-113-11F.dwg User:jschallberger Plotted:Nov 26, 2018 - 2:22pm Last Save:May 11, 2018 - 4:49pm

REFERENCE IMAGE: Google Earth

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SITE VICINITY MAP

Turlock WWTP Laydown Area Roadways
901 S. Walnut Road
Turlock, California 95380

FIGURE 1

JOB NO. G18-113-11F
DATE November 26, 2018
DR. BY JS
CH. BY NP
SCALE AS SHOWN
SHEET NO. 1 OF 1 SHEETS

LEGEND:

B-8 APPROXIMATE BORING LOCATIONS

C-3 APPROXIMATE CORING LOCATIONS

B-5 PREVOIUS BORING LOCATIONS (G18-113-11F, AUGUST 6, 2018)

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BORING LOCATION MAP

Turlock WWTP Laydown Area Roadways
901 S. Walnut Road
Turlock, California 95380

FIGURE 2

JOB NO. G18-113-11F
DATE November 26, 2018
DR. BY JS
CH. BY NP
SCALE AS SHOWN
SHEET NO. 1
OF 1 SHEETS

APPENDIX A
FIELD EXPLORATION

APPENDIX A
Field Exploration

The field exploration was conducted on November 12, 2018, under the oversight of a BSK staff engineer. Six (6) test borings were excavated to a maximum depth of 4 feet below existing ground surface (bgs) within the vicinity of the building area. The boring was excavated with a manually-operated hand auger and a six (6) inch diamond core barrel. The approximate location of the test boring is presented on Figure 2, boring location map.

The soil materials encountered in the test borings were visually classified in the field and logs were recorded during the excavation and sampling operations. Visual classification of the materials encountered in the test borings were made in general accordance with the Unified Soil Classification System (ASTM: D2487). A soil classification chart is presented herein. Boring logs are presented herein and should be consulted for more details concerning subsurface conditions. Stratification lines were approximated by the field staff on the basis of observations made at the time of excavation while the actual boundaries between different soil types may be gradual and soil conditions may vary at other locations.

Subsurface samples were obtained at the successive depths shown on the boring log by driving a sampler which consisted of a 2.5-inch inside diameter (I.D.) with a slide hammer. The relatively undisturbed soil samples were capped at both ends to preserve the samples at their natural moisture content. At the completion of the field exploration, the test boring was backfilled with the soil cuttings and capped with cold patch, where necessary, as set forth in BSK's proposal.

MAJOR DIVISIONS				TYPICAL NAMES
COARSE GRAINED SOILS More than Half > #200 sieve	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES
			GP	POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES
		GRAVELS WITH OVER 15% FINES	GM	SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL GRADED SANDS, GRAVELLY SANDS
			SP	POORLY GRADED SANDS, GRAVELLY SANDS
		SANDS WITH OVER 15% FINES	SM	SILTY SANDS, POOORLY GRADED SAND-SILT MIXTURES
			SC	CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES
FINE GRAINED SOILS More than Half < #200 sieve	SILTS AND CLAYS LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACIOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS			Pt	PEAT AND OTHER HIGHLY ORGANIC SOILS

■	Modified California	RV	R-Value
⧓	Standard Penetration Test (SPT)	SA	Sieve Analysis
☒	Split Spoon	SW	Swell Test
◪	Pushed Shelby Tube	TC	Cyclic Triaxial
	Auger Cuttings	TX	Unconsolidated Undrained Triaxial
	Grab Sample	TV	Torvane Shear
⧄	Sample Attempt with No Recovery	UC	Unconfined Compression
CA	Chemical Analysis	(1.2)	(Shear Strength, ksf)
CN	Consolidation	WA	Wash Analysis
CP	Compaction	(20)	(with % Passing No. 200 Sieve)
DS	Direct Shear	▽	Water Level at Time of Drilling
PM	Permeability	▼	Water Level after Drilling(with date measured)
PP	Pocket Penetrometer		

SOIL CLASSIFICATION CHART AND LOG KEY

BSK ASSOCIATES

BSK Associates
550 W Locust
93650
Telephone: 559-497-2880
Fax: 559-497-2886

Project: Turlock WWTP New Roadways

Location: 901 S. Walnut Road Turlock, CA 95380

Project No.: G18-113-11F

Logged By: J. Schallberger

Checked By: N. Popenoe

Boring: **C-1**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
0									**Asphalt Concrete** - 4.75"	partial sample recovered
								GM	**Silty Aggregate Base** - 5", brown, moist, loose, fine to coarse gravel	
1								SM	**Silty SAND** - brown, moist, fine to medium grained	
2				110.0	11.6					
								CL	**Sandy CLAY** - brown, moist, fine grained sand	
3								SM	**Silty SAND** - brown, moist, fine to medium grained	
4									Boring terminated at approximately 4 feet bgs. No groundwater encountered. Boring backfilled with soil cuttings and capped with cold patch.	
5										
6										
7										
8										
9										

Drilling Contractor: BSK Associates
Drilling Method: Hand Auger
Drilling Equipment: 6" diamond bit core barrel
Date Started: 11/12/18
Date Completed: 11/12/18

Surface Elevation:
Sample Method: 2.5-inch I.D. drive tube
Groundwater Depth: Not Encountered
Completion Depth: 4 Feet
Borehole Diameter: 4"

* See key sheet for symbols and abbreviations used above.

GEO G18-113-11F.GPJ BSK.GDT 12/6/18

BSK Associates
550 W Locust
93650
Telephone: 559-497-2880
Fax: 559-497-2886

Project: Turlock WWTP New Roadways

Location: 901 S. Walnut Road Turlock, CA 95380

Project No.: G18-113-11F

Logged By: J. Schallberger

Checked By: N. Popenoe

Boring: **C-2**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
0								GM	**Asphalt Concrete** - 4.75"	
									Silty Aggregate Base - 3.5", brown, moist, loose, fine to coarse gravel	
1								SM	**Silty SAND** - brown, moist, fine to medium grained sand	
2				116.3	7.6					
3									... gray	
									Boring terminated at approximately 3 feet bgs. No groundwater encountered. Boring backfilled with soil cuttings and capped with cold patch.	
4										
5										
6										
7										
8										
9										

Drilling Contractor: BSK Associates
Drilling Method: Hand Auger
Drilling Equipment: 6" diamond bit core barrel
Date Started: 11/12/18
Date Completed: 11/12/18

Surface Elevation:
Sample Method: 2.5-inch I.D. drive tube
Groundwater Depth: Not Encountered
Completion Depth: 3 Feet
Borehole Diameter: 4"

* See key sheet for symbols and abbreviations used above.

GEO G18-113-11F.GPJ BSK.GDT 12/6/18

BSK Associates
550 W Locust
93650
Telephone: 559-497-2880
Fax: 559-497-2886

Project: Turlock WWTP New Roadways

Location: 901 S. Walnut Road Turlock, CA 95380

Project No.: G18-113-11F

Logged By: J. Schallberger

Checked By: N. Popenoe

Boring: **C-3**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
1								GM	**Asphalt Concrete** - 2" **Silty Aggregate Base** - 6", brown, moist, loose, fine to coarse gravel	
2								SM	**Silty SAND** - brown, moist, fine to medium grained	
3				118.3	6.7				... gray Boring terminated at approximately 3 feet bgs. No groundwater encountered. Boring backfilled with soil cuttings and capped with cold patch.	
4										
5										
6										
7										
8										
9										

Drilling Contractor: BSK Associates
Drilling Method: Hand Auger
Drilling Equipment: 6" diamond bit core barrel
Date Started: 11/12/18
Date Completed: 11/12/18

Surface Elevation:
Sample Method: 2.5-inch I.D. drive tube
Groundwater Depth: Not Encountered
Completion Depth: 3 Feet
Borehole Diameter: 4"

* See key sheet for symbols and abbreviations used above.

GEO G18-113-11F.GPJ BSK.GDT 12/6/18

BSK Associates
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Telephone: 559-497-2880
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Project: Turlock WWTP New Roadways

Location: 901 S. Walnut Road Turlock, CA 95380

Project No.: G18-113-11F

Logged By: J. Schallberger

Checked By: N. Popenoe

Boring: **B-6**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
1								GM	**Silty GRAVEL** - brown, moist, fine grained gravel (FILL)	Broken glass and concrete chunks found 1" diameter encountered throughout
2									Boring terminated at approximately 1.5 feet bgs. No groundwater encountered. Boring backfilled with soil cuttings.	
3										
4										
5										
6										
7										
8										
9										

Drilling Contractor: BSK Associates
Drilling Method: Hand Auger
Drilling Equipment: N/A
Date Started: 11/12/18
Date Completed: 11/12/18

Surface Elevation:
Sample Method: 2.5-inch I.D. drive tube
Groundwater Depth: Not Encountered
Completion Depth: 1.5 Feet
Borehole Diameter: 4"

* See key sheet for symbols and abbreviations used above.

GEO G18-113-11F.GPJ BSK.GDT 12/6/18

BSK Associates
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Project: Turlock WWTP New Roadways

Location: 901 S. Walnut Road Turlock, CA 95380

Project No.: G18-113-11F

Logged By: J. Schallberger

Checked By: N. Popenoe

Boring: **B-7**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
0								GM	**Silty GRAVEL** - brown, moist, loose, fine to coarse gravel (FILL)	Broken glass and concrete chunks found
1								SM	**Silty SAND** - brown, moist, fine to medium grained (NATIVE)	
2										
3				109.0	1.7			SP	**Poorly Graded SAND** - light brown, moist, fine to medium grained	
4									Boring terminated at approximately 3 feet bgs. No groundwater encountered. Boring backfilled with soil cuttings.	
5										
6										
7										
8										
9										

Drilling Contractor: BSK Associates
Drilling Method: Hand Auger
Drilling Equipment: N/A
Date Started: 11/12/18
Date Completed: 11/12/18

Surface Elevation:
Sample Method: 2.5-inch I.D. drive tube
Groundwater Depth: Not Encountered
Completion Depth: 3 Feet
Borehole Diameter: 4"

* See key sheet for symbols and abbreviations used above.

GEO G18-113-11F.GPJ BSK.GDT 12/6/18

BSK Associates
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93650
Telephone: 559-497-2880
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Project: Turlock WWTP New Roadways

Location: 901 S. Walnut Road Turlock, CA 95380

Project No.: G18-113-11F

Logged By: J. Schallberger

Checked By: N. Popenoe

Boring: **B-8**

Depth (Feet)	Samples	Bulk Samples	Penetration Blows / Foot	In-Situ Dry Density (pcf)	In-Situ Moisture Content (%)	% Passing No. 200 Sieve	Graphic Log	USCS	MATERIAL DESCRIPTION	REMARKS
0								GM	**Silty GRAVEL** - light brown, moist, fine to coarse gravel (FILL)	glass and string found
1								SM	**Silty SAND** - brown, moist, fine to medium grained	
2				96.3	3.5					
3										dark black debris/wood found at bottom of hole
4									Boring terminated at approximately 3 feet bgs. No groundwater encountered. Boring backfilled with soil cuttings.	
5										
6										
7										
8										
9										

Drilling Contractor: BSK Associates
Drilling Method: Hand Auger
Drilling Equipment: N/A
Date Started: 11/12/18
Date Completed: 11/12/18

Surface Elevation:
Sample Method: 2.5-inch I.D. drive tube
Groundwater Depth: Not Encountered
Completion Depth: 3 Feet
Borehole Diameter: 4"

* See key sheet for symbols and abbreviations used above.

GEO G18-113-11F.GPJ BSK.GDT 12/6/18

APPENDIX B
LABORATORY TESTING

APPENDIX B
Laboratory Testing

The results of laboratory testing performed in conjunction with this project are contained in this Appendix. The following laboratory tests were performed on soil samples in general conformance with applicable standards.

In-Situ Moisture and Density

The field moisture content and in-place dry density determinations were performed on relatively undisturbed samples obtained from the test borings. The field moisture content, as a percentage of dry weight of the soils, was determined by weighing the samples before and after oven drying in accordance with ASTM D2216 test procedures. Dry densities, in pounds per cubic foot, were also determined for undisturbed core samples in accordance with ASTM D2937 test procedures. Test results are presented on the boring logs in Appendix A.

R-Value Test

The Resistance-Value result of one (1) sample of the surficial soil was obtained in accordance with California Department of Transportation's Test Method CA 301. The result of the R-Value test is presented on Figure B-1.

Soil Corrosivity

One (1) Corrosivity Evaluations was performed on a bulk soil sample obtained at the time of drilling in the area of planned construction. The soil was evaluated for sulfate ion concentration (CT 417). The test results are presented in Table B-1.

Table B-1: Summary of Corrosion Test Results

Sample Location	Sulfate, ppm
C-1 @ 0-4 feet bgs	11

R-Value Test

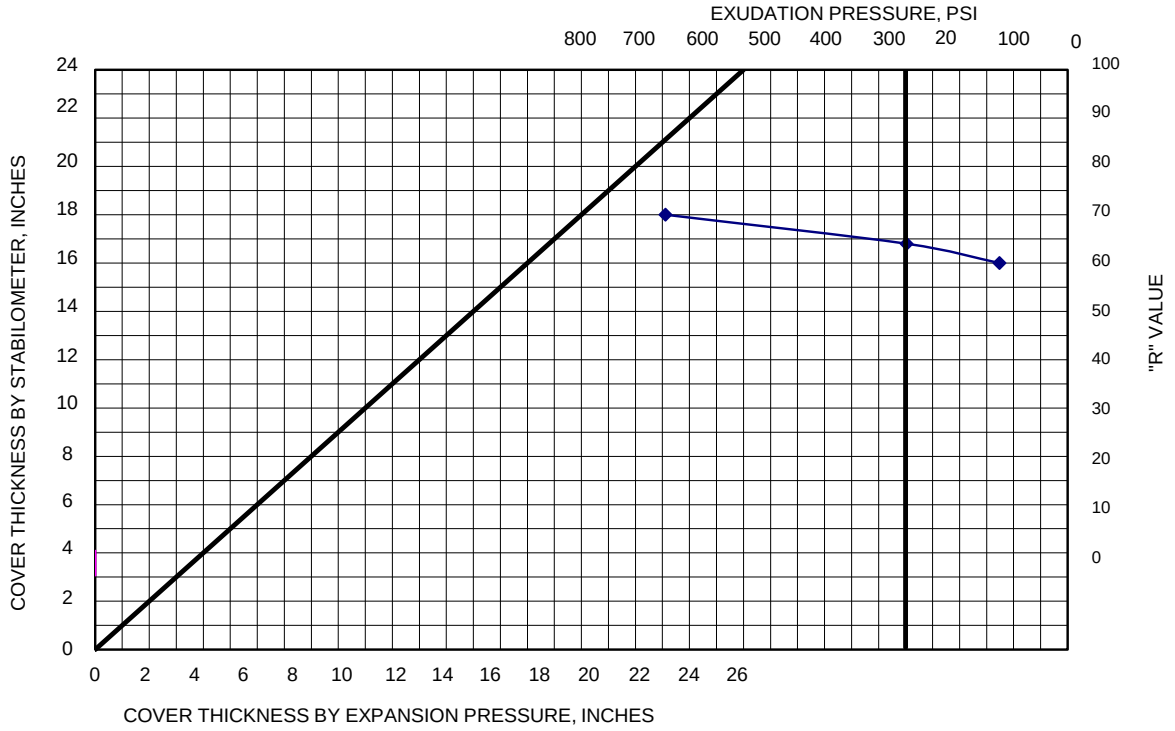
Caltrans Test Method 301

Figure B-1

700 22nd St.
Bakersfield, CA 93301
Ph: (661) 327-0670
Fax: (661) 324-4217

Project Name: Turlock WWTP New Roadways
Project Number: G18-113-11F
Lab Tracking ID: B-18-422
Sample Location: C-1 @ 0.0-4.0 feet bgs

Sample Date: 11/12/2018
Test Date: 11/19/2018
Report Date: 11/20/2018
Tested By: ILT Remotigue



Sample Description: SM/SP: SILTY SAND/SAND; brown; fine to Coarse; some gravel; moist.

SPECIMEN	A	B	C
EXUDATION PRESSURE, LOAD (lb)	9349.5	3743.6	1586.1
EXUDATION PRESSURE, PSI	744	298	126
EXPANSION, * 0.0001 IN	-0.001	-0.0042	-0.0012
EXPANSION PRESSURE, PSF	0	0	0
STABILOMETER PH AT 2000 LBS	32	40	47
DISPLACEMENT	4.29	4.23	3.99
RESISTANCE VALUE "R"	70	64	60
"R" VALUE CORRECTED FOR HEIGHT	70	64	60
% MOISTURE AT TEST	9.7	10.7	11.7
DRY DENSITY AT TEST, PCF	124.2	122.8	120.7
"R" VALUE AT 300 PSI EXUDATION PRESSURE	**64**		
"R" VALUE BY EXPANSION PRESSURE TI = 4.0, GF=1.50	**N/A**		

Reviewed By: *Ian Leo T. Remotigue*