



September 28, 2017
Project No. EC595

Mr. Victor Garcia
The Holt Group
1601 N. Imperial Ave.
El Centro, California 92243

SUBJECT: GEOTECHNICAL INVESTIGATION ADDENDUM
Pavement Improvements for Imperial Avenue, Wake Avenue, and Danenberg Drive, El Centro, California

REFERENCE: *Geotechnical Investigation for Pavement Improvements, Imperial Avenue, Wade Avenue, and Danenberg Avenue, El Centro, California, Project No. EC461, November 25, 2015.*

Dear Mr. Garcia:

The following report is an addendum to our previous geotechnical investigation referenced above. The intent of this addendum is to supplement the findings and recommendations of the initial report to include the extension of Imperial Avenue from Interstate 8 to Wake Avenue and Wake Avenue east of Imperial Avenue.

1.0 SCOPE OF WORK

The scope of services provided during this investigation was generally as described in our proposal No. EC15-013, dated March 13, 2015. Our scope of work included the following items:

- A visual reconnaissance of the site to review the current exposed conditions that may affect geotechnical aspects of site development.
- One exploration boring was made using an 8-inch diameter, hollow-stem auger drill rig. The boring was extended to approximately 20 feet below existing grade. This boring was intended to supplement information from boring made in the previous investigation. Selected soil samples were collected for laboratory testing. Logs of the explorations are presented in Appendix A.

- Laboratory testing of selected samples collected during the subsurface exploration. Testing was intended to assist in characterizing and assessing pertinent engineering properties of the on-site soils. Laboratory test results are presented in Appendix B.
- Engineering analysis of field and laboratory data to make recommendations regarding pavement sections, site preparation, earthwork, and trench backfill.
- Preparation of this report summarizing our findings, conclusions and recommendations.

2.0 SITE DESCRIPTION

The site topography is generally flat with a ground surface elevation of approximately minus 30 feet (\pm 5 feet) Mean Sea Level (MSL). Agricultural fields and residential subdivisions surround the roadways. Irrigation canals associated with the agricultural fields are aligned with many area roadways. The site vicinity is shown in Figure 1.

3.0 PROPOSED DEVELOPMENT

The planned improvements include South Imperial Avenue between Highway 8 and West McCabe Road, and will include the currently unpaved portions of Wake Avenue and Danenberg Drive to the east. It is our understanding that the improvements will include the regrading of the existing roadways and pavement with asphalt concrete and aggregate base sections. It is anticipated that grading may involve various cuts and fills to provide the Imperial Avenue to Wake Avenue interchange and the approach of Imperial Avenue toward Interstate 8.

4.0 GEOLOGY AND SUBSURFACE CONDITIONS

The general geology and soil conditions were described in detail in the November 15, 2015 report. The supplemental boring performed for this addendum revealed soil conditions similar to those described previously. These consisted of lacustrine deposits that are primarily lean clay (Unified Soil Classification CL), and low plasticity silty clay (ML-CL). The soils are moderate yellowish brown, dry to moist, and stiff.

4.1 Groundwater

Free groundwater was observed in the boring at approximately 15 feet below existing surface grade. The groundwater elevation is likely controlled by the adjacent Date Drain and it has been our experience that groundwater levels may fluctuate over time due to changes in irrigation activity.

5.0 CONCLUSIONS

Our additional investigation indicated conditions consistent with the findings of our initial investigation and in our opinion, the conclusions previously presented remain valid. It is our opinion that the proposed improvements are feasible from a geotechnical standpoint provided that the following recommendations and appropriate construction practices are followed. Based on the results of our field investigation, laboratory testing and engineering analyses, we have developed the following conclusions regarding the pertinent geotechnical conditions at the site.

- Free groundwater encountered at approximately 15 feet in this supplemental investigation and was not present in borings in the initial investigation. Based on our experience and soil moisture contents from testing, it should be anticipated to encounter zones of soil that are within the range at which the soils will show plastic behavior resulting in pumping conditions when worked with equipment. The high moisture will also result in over optimum moisture conditions (relative to the compaction curves) and would require drying back before placing as compacted fill. The high moisture areas appear in random areas and are likely the result of perched water conditions. Recommendations for subgrade stabilization are provided in this report.
- The unpaved shoulders are likely to be underlain by shallow undocumented fill overlying lacustrine deposits.
- The subgrade soils for the proposed pavement section will consist lean clay and clayey silt. Laboratory testing indicates an R-Value of 5 would be appropriate for the subgrade conditions.
- Excavations should be achievable using standard heavy equipment. Excavations may generate wet soil that will need to be dried prior to placement as compacted fill.

6.0 RECOMMENDATIONS

The remainder of this report presents recommendations regarding earthwork construction and the geotechnical aspects of the pavement improvements. These recommendations are based on empirical and analytical methods typical of the standard of practice in southern California. If these recommendations do not appear to cover a specific feature of the project, please contact our office for amendments.

6.1 Excavation and Grading Observation

Sierra Materials Testing and Inspection should observe pavement construction, site grading and trench excavations and backfill. Sierra Materials Testing and Inspection should provide observation and testing services continuously during pavement construction, grading and backfill operations. Such observations are considered essential to identify field conditions that differ from those anticipated by the preliminary investigation, to adjust designs to actual field conditions, and to determine that the earthwork is accomplished in general accordance with the recommendations provided in this report. Recommendations presented in this report are contingent upon Sierra Materials Testing and Inspection performing such services. Our personnel should perform sufficient testing of pavement construction, fill and trench backfill to support our professional opinion as to compliance with the compaction recommendations.

6.2 Earthwork

Pavement construction, grading and earthwork should be conducted in accordance with the applicable local grading ordinance, Caltrans, and the most recent edition of the *Standard Specifications for Public Works Construction* "Greenbook". The following recommendations are provided regarding specific aspects of the proposed earthwork construction. These recommendations should be considered subject to revision based on field conditions observed by the geotechnical consultant.

6.2.1 General: General site preparation should include the removal of deleterious materials from the proposed improvement areas. Deleterious materials include vegetation, trees and roots, trash, construction or demolition debris (such as asphalt concrete pavements or Portland cement concrete improvements, and rocks

with greatest dimensions in excess of 6 inches. Deleterious materials are not considered suitable for use in trench backfill, and should be removed from the site.

Surficial loose fill may be present at existing road shoulders and other areas. Any loose fill not removed during the planned roadway cuts should be removed to exposed firm native soil. This should be evaluated by the geotechnical consultant during grading. The design grade may then be achieved by filling with uniformly compacted soil.

6.2.2 Fill Compaction: All fill and trench backfill to be placed in association with the proposed improvements should be accomplished at slightly over optimum moisture conditions using equipment that is capable of producing a uniformly compacted product. The minimum relative compaction recommended for fill is 90 percent of the maximum dry density based on ASTM D1557. Sierra Materials Testing and Inspection should perform sufficient observation and testing of fill and backfill so that an opinion can be rendered as to the compaction achieved.

6.2.3 Temporary Excavations: Excavations should conform to Cal-OSHA guidelines. Temporary trench excavations should be observed by Sierra Materials Testing and Inspection in order to identify potentially adverse geologic conditions. Excavations deeper than 3 feet should be shored or laid back to a 1:1 gradient for heights up to 10 feet. Excavations that expose seepage or adverse geologic conditions should be evaluated by our firm for additional recommendations. Excavations that will be subjected to vehicle or equipment loads within a 1:1 plane from the bottom of the trench should be engineered by the contractors registered professional engineer in accordance with OSHA guidelines.

6.2.4 Construction Dewatering: Based on conditions observed during this investigation, the need for construction dewatering is not anticipated.

6.2.5 Subgrade Stabilization: The bottom of all excavations should be firm and unyielding prior to placing compacted fill. In areas of saturated and yielding (or “pumping”) subgrade conditions, the yielding area may be stabilized by placing a layer of geogrid (such as Tensar BX1200 or approved similar) directly on the excavation bottom. The geogrid should be installed in accordance with the product manufacturer’s recommendations. The geogrid should then be covered with

between 12 and 24 inches of minus ¾-inch crushed rock. The thickness of rock needed to stabilize the excavation bottom may be determined in the field by trial and error. Our experience suggests that 1 to 2 feet of rock should generally be sufficient to stabilize most conditions.

6.3 Pavements

Pavement section thickness is based in part on the traffic index (TI) assigned to the roadway, based on the anticipated vehicle volume and loading. Sections for various traffic indices are provided below. The appropriate traffic index should be determined by the City’s Department of Public Works.

Testing performed on the subgrade soil collected from our investigation indicated an R-value of 5. The pavement structural sections were determined using the design criteria of Caltrans Topic 608.4. The pavement design is summarized below:

<u>Traffic Index</u>	<u>Asphalt Concrete inches</u>	<u>Class 2 Aggregate Base, inches</u>	<u>Class 2 Aggregate Base, inches With Geogrid Enhancement</u>
5	3	10	8
6	3	14	11
7	4	16	12
8	5	18	14
9	6	20	15
10	6	24	18

The option of using a mechanically stabilized layer through the use of a biaxial geogrid is provided in the last column, which shows the resulting decreased aggregate base thickness. The geogrid should be placed at the contact between the subgrade and the aggregate base and overlapped in accordance with manufacturer’s specifications. Biaxial geogrid should be punched and drawn polypropylene and meet the requirements of Caltrans Standard Specification 88-1.02P.

Subgrade preparation should be conducted immediately prior to the placement of the pavement section. For conventional asphalt concrete and base, the upper 12 inches of pavement subgrade should be scarified, brought to about optimum moisture content and compacted to at least 95 percent of maximum dry density based on ASTM D1557

guidelines. For mechanically stabilized pavements using geogrid, the upper 30 inches of subgrade should be compacted to at least 95 percent relative compaction, based on Caltrans guidelines. Asphalt concrete should be compacted to at least 95 percent based on the Hveem unit weight.

Asphalt concrete should conform to Section 26 of the Caltrans Standard Specifications or Section 400-4 of the *SSPWC*. Aggregate base should conform to the specifications for Class 2 aggregate base as defined in Section 26-1.02A of the Caltrans Standard Specifications or to crushed aggregate, crushed miscellaneous base, or processed miscellaneous base as defined in Section 200-2 of the "Greenbook".

Lime Treated Subgrade Alternative

As an option, the subgrade soils may be treated with lime to reduce the structural section. During our geotechnical investigation for the IV Commons South, laboratory testing of the soils treated with 6 percent quicklime by weight and mellowed as recommended in this report indicate R-Values of at least 44. Final pavement design should be based on R-value test results of the finish pavement subgrade soils.

Based on the indicated Traffic Indexes and using a lime treated design R-value of 44, the following pavement sections are recommended in accordance with the Caltrans design method. Please note that we do not recommend aggregate base be placed on lime treated sub-grade because it provides a potential avenue of water to the sub-grade.

<u>Traffic Index</u>	<u>Asphalt Concrete</u> <u>inches</u>	<u>Lime Treated Subgrade</u> <u>inches</u>
5	3	11
6	4	13
7	5	15
8	6	17
9	7	20
10	8	22

7.0 LIMITATIONS

This investigation was performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable geotechnical consultants practicing in this or similar localities. No warranty, express or implied, is made as to the conclusions and professional opinions included in this report. The samples taken and used for testing, and the observations made are believed representative of the project site. However, soil and geologic conditions can vary significantly between borings. If this occurs, the changed conditions must be evaluated by the geotechnical consultant and additional recommendations made, if warranted.

The findings of this report are valid as of the present date. However, changes in the condition of a property can occur with the passage of time, whether due to natural processes or the work of man on this or adjacent properties. In addition, changes in applicable or appropriate standards of practice may occur from legislation or the broadening of knowledge. Accordingly, the findings of this report may be invalidated wholly or partially by changes outside our control. Therefore, this report is subject to review and should not be relied upon after a period of three years.

Sincerely,

SIERRA Material Testing & Inspection, Inc.



Alex Rojas
Office Manager



Roberto Martinez, PE
Project Engineer

APPENDIX A

SUBSURFACE EXPLORATION

Field exploration consisted of a visual reconnaissance of the site, and the drilling of one exploratory boring on September 8, 2017. The exploratory borings were drilled using an 8-inch diameter, continuous flight, hollow stem, and drill rig. Bulk samples were collected for laboratory testing. The maximum depth of exploration was 20 feet. The approximate location of the boring is shown on the Exploration Plan, Figure 2. Logs describing the subsurface conditions encountered are presented in Figure A-1.

The borings were located by visually estimating and pacing distances from landmarks shown on the Exploration Plan. The locations should not be considered more accurate than is implied by the method of measurement used and the scale of the map. The lines designating the interface between different soils on the logs may be abrupt or gradational. Further, soil conditions at locations between the borings may be substantially different from those at the specific locations explored. It should be recognized that the passage of time could result in changes in the soil conditions reported in our logs.

APPENDIX B LABORATORY TESTING

Laboratory testing was conducted in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing under similar conditions and in the same locality. No warranty, express or implied, is made as to the correctness or serviceability of the test results, or the conclusions derived from these tests. Where a specific laboratory test method has been referenced, such as ASTM, Caltrans, or AASHTO, the reference applies only to the specified laboratory test method and not to associated referenced test method(s) or practices. The referenced test method referenced has been used only as a guidance document for the general performance of the test and not as a "Test Standard." A brief description of the tests performed follows:

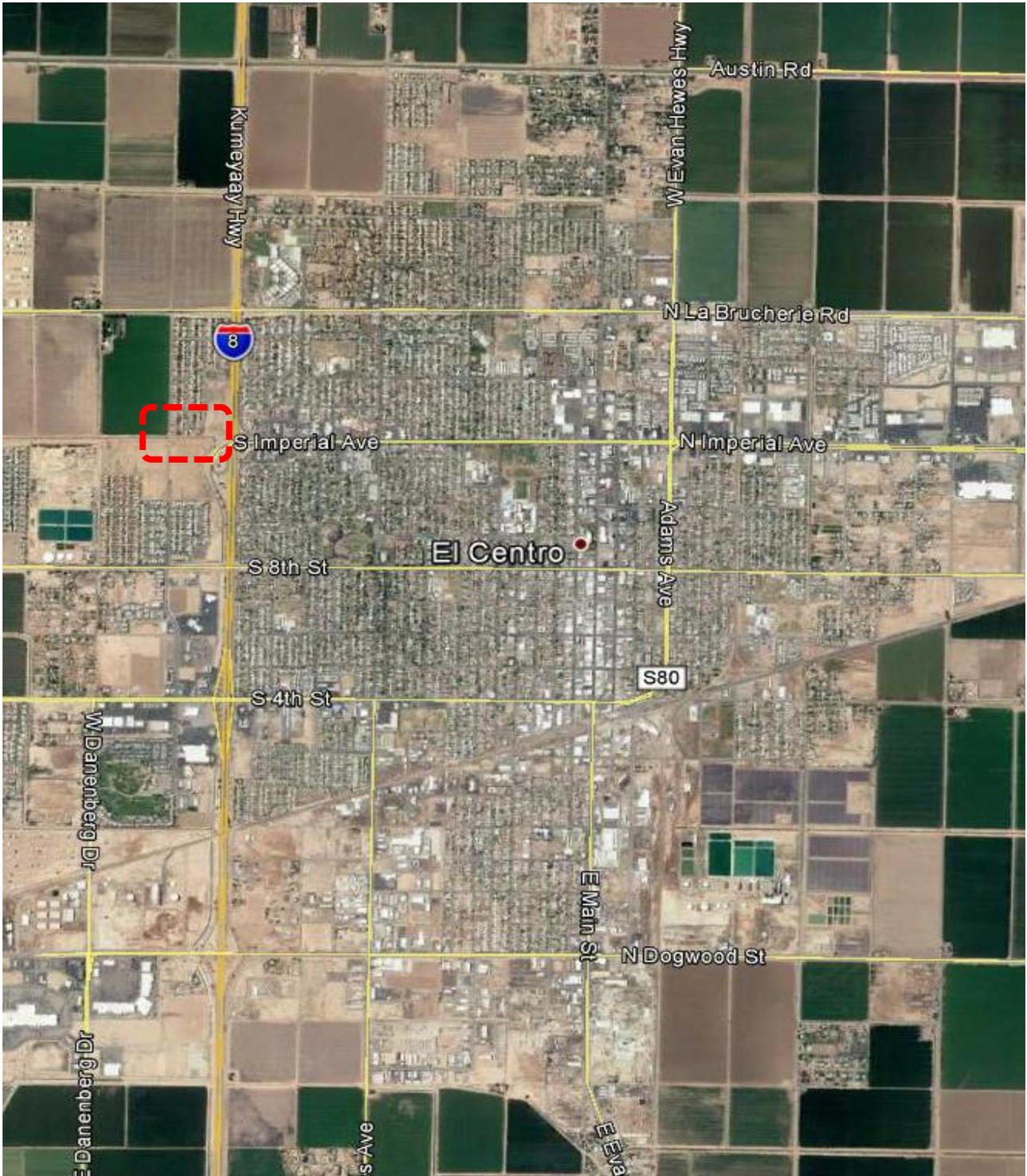
Classification: Soils were classified visually according to the Unified Soil Classification System as established by the American Society of Civil Engineers. Visual classification was supplemented by laboratory testing of selected soil samples and classification in general accordance with the laboratory soil classification tests outlined in ASTM test method D2487. The resultant soil classifications are shown on the boring logs in Appendix A.

In-Situ Moisture/Density: The in-place moisture content of selected soil samples were determined using bulk samples. The moisture contents are shown on the Boring Logs in Appendix A.

Maximum Density/Optimum Moisture: The maximum dry density and optimum moisture content of selected soil samples were estimated in general accordance with the laboratory procedures outlined in ASTM D1557, modified Proctor.

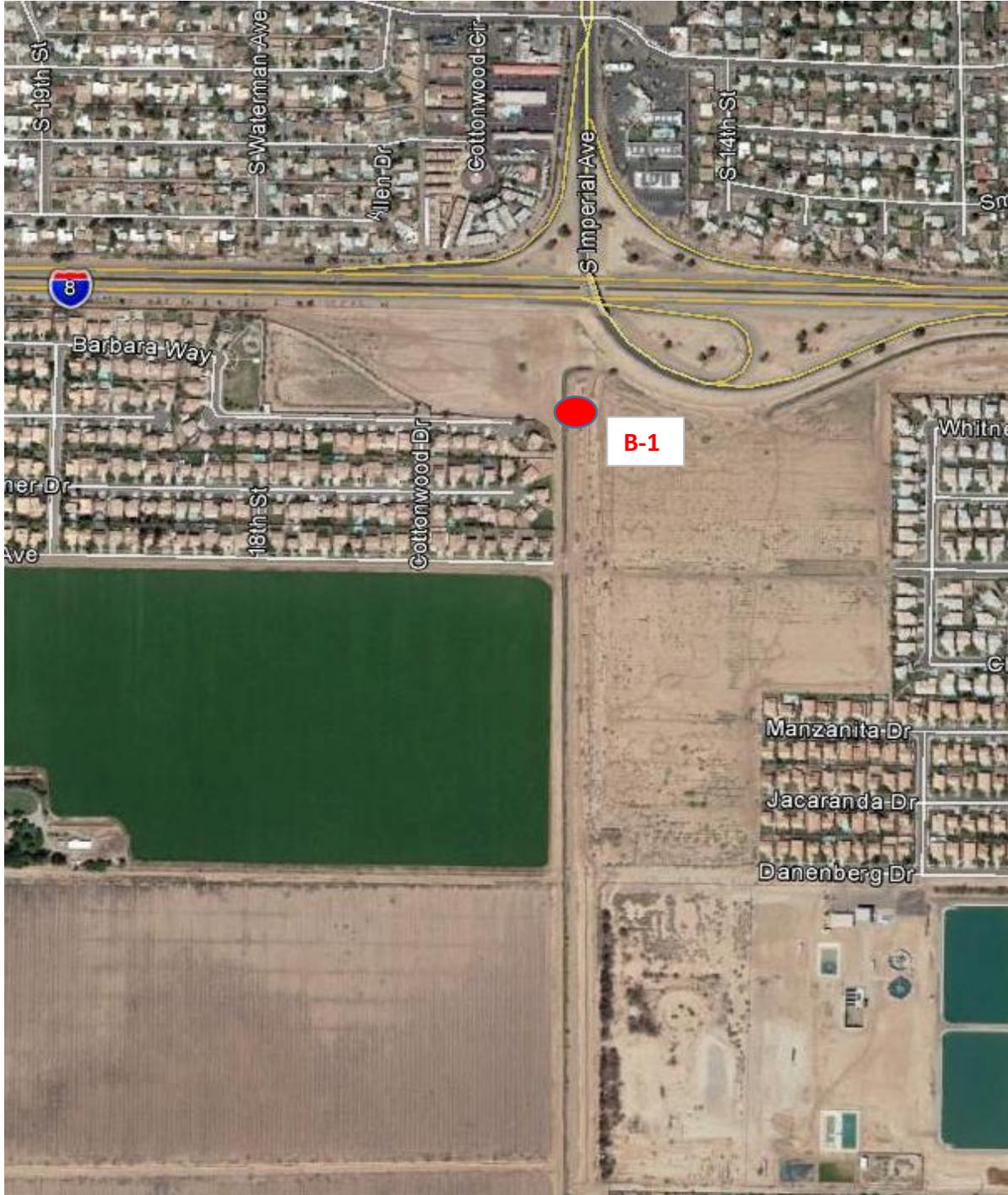
Atterberg Limits: The liquid limit, plastic limit, and plasticity index of selected fine-grained soil samples were estimated in general accordance with the laboratory procedures outlined in ASTM test method D4318.

Particle Size Analysis: Particle size analysis was performed in general accordance with ASTM D422.



Approximate Location of Project

SIERRA MATERIAL TESTING & INSPECTION 		PROJECT NO.
		EC-461
PROJECT NAME: Imperial Avenue Extension Investigation		DOCUMENT No.
		FIGURE No. 1
LOCATION PLAN		



 B Approximate location of boring

SIERRA MATERIAL TESTING & INSPECTION		PROJECT NO.
		EC-461
		DOCUMENT No.
		FIGURE No.
PROJECT NAME: Imperial Avenue Extension Investigation		2
BORING LOCATION PLAN		

Project: Imperial Ave Investigation		Project Number: EC595		Client: IID		Boring No 1			
Logged By: IHR		Started: 9/8/2017		Diameter: 8"					
Site Location: El Centro		Date	Completed: 9/8/2017		Total Depth of Boring: 20'				
			Backfilled: 9/8/2017						
Drilling Method: Auger Drilling		Groundwater Depth: 14.7' after drilling (09/08/2017)		Elevation: - 30 Ft					
Depth (feet)	Sample Type	Sample Number	Blow Counts (blows/foot)	Graphic Log	Lithology		Liquid Limit	Plasticity Index	Additional Test
					Soil Group Name: modifier, color, moisture, density/consistency, grain size, other descriptors Rock Description: modifier color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions.				
5		S1			Lacustrine deposits, Clayey Silt, (CL-ML) Moderate yellowish brown, dry weak cementation		43.0	22	Sieve analysis, Atterberg limits.
10					Lacustrine deposits, Silty Clay, (CL-ML) Moderate brown, moist moderate cementation				Boring terminated at 20 ft. Groundwater was encountered at 14.7ft after drilling on 09/08/2017, no groundwater was found during drilling. One 15 ft. piezometer was installed
15									
20									
<input checked="" type="checkbox"/> Standard Penetration Slit Spoon Sampler (SPT) <input checked="" type="checkbox"/> Stabilized Ground water <input checked="" type="checkbox"/> Groundwater At time of Drilling <input checked="" type="checkbox"/> California Sampler <input checked="" type="checkbox"/> CPP Sampler <input checked="" type="checkbox"/> Shelby Tube <input checked="" type="checkbox"/> Bulk/ Bag Sample					Sierra MTI Project No. EC595 Imperial Ave Investigation El Centro, CA 				



**STANDARD TEST METHOD FOR
ATTERBERG LIMITS (ASTM D4318)**

REV 9-2-15

PROJECT: Imperial Ave Investigation

SAMPLE ID: B1

PROJECT NO.: EC 595

DATE: 8-Sep-17

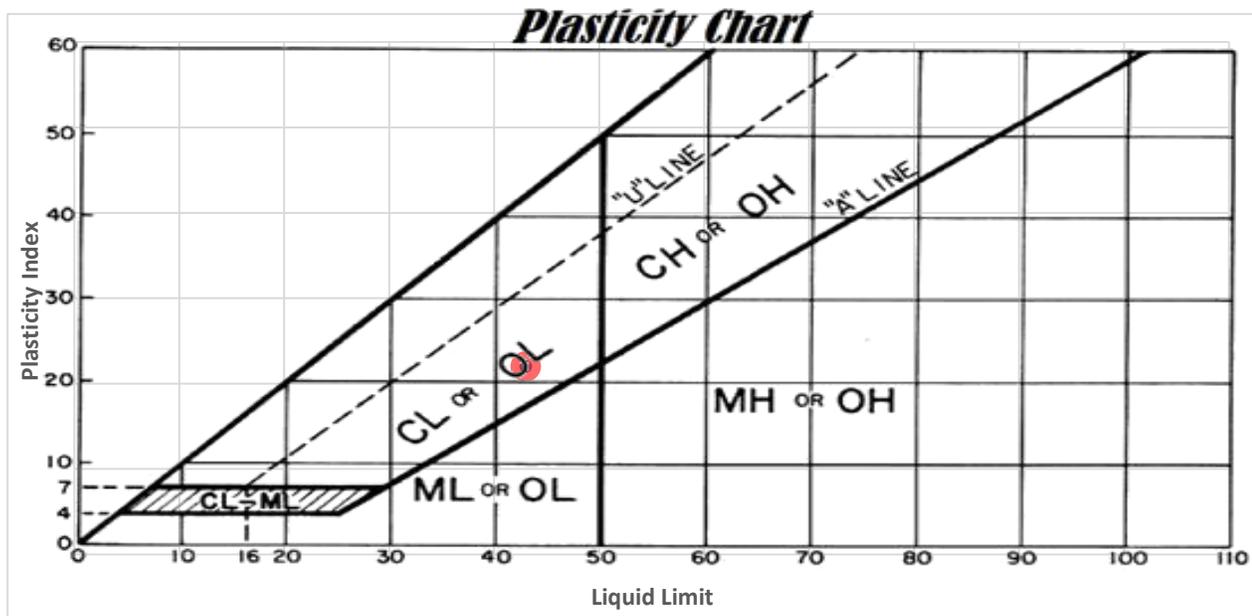
TESTED BY: Mario Muro

CHECKED BY: IH

LIQUID LIMIT

TRIAL NO.

	NO. 1	NO. 2	NO. 3	NO.4
A) TARE WEIGHT (g)	16.41	16.4	16.56	
B) WEIGHT OF WET SOIL AND TARE (g)	25.15	25.78	26.1	
C) WEIGHT OF DRY SOIL AND TARE(g)	22.6	22.94	23.06	
D) WEIGHT OF DRY SOIL (C - A) (g)	6.19	6.54	6.5	
E) WEIGHT OF MOISTURE (B - C) (g)	2.55	2.84	3.04	
F) MOISTURE CONTENT (E / D * 100) (%)	41.20	43.43	46.77	
G) NUMBER OF BLOWS	34	25	16	



LIQUID LIMIT 43

PLASTIC LIMIT

TRIAL NO.

	NO.1	NO.2
H) TARE WEIGHT (g)	15.94	15.66
I) WEIGHT OF WET SOIL AND TARE (g)	23.80	25.40
J) WEIGHT OF DRY SOIL AND TARE (g)	22.42	23.72
K) WEIGHT OF DRY SOIL (J - H) (g)	6.48	8.06
L) WEIGHT OF MOISTURE (I - J) (g)	1.38	1.68
M) MOISTURE CONTENT (L / K * 100) %	21.30	20.84

AVERAGE P.L. 21

PLASTICITY INDEX

PLASTICITY INDEX (LIQUID LIMIT - PLASTIC LIMIT) %

22

FIGURE 4