MARCH 9, 2015

GEOTECHNICAL INVESTIGATION REPORT
WASHINGTON STREET ALIGNMENT
PHILLIPS STREET TO ROOP STREET
CARSON CITY, NEVADA

Prepared For:

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March 6, 2015

Mr. Ken Anderson, PE
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Carson City, NV 89706

SUBJECT: ***East/West Water Transmission Main Project, Phase 2B***
Washington Street Alignment
Carson City, Nevada
Geotechnical Investigation Report

Dear Mr. Anderson:

In accordance with your request, we are submitting our Geotechnical Investigation Report for the East/West Water Transmission Main Project, Washington St. Alignment, to be located between Phillips St. to Roop St. in Carson City, Nevada. Our work is intended for the sole and exclusive use of Manhard Consulting, Ltd., Carson City Community Development, their agents, or designated consultants.

In our opinion there are no significant geotechnical constraints, which would preclude the proposed construction of the water line provided the recommendations of this report are incorporated by design into the construction of the project.

We appreciate the opportunity to work with you on this project. Should you have questions concerning the contents of this report, or if we may be of further service, please contact the undersigned at your convenience.

Respectfully submitted,

RESOURCE CONCEPTS, INC.

PROFESSIONAL ENGINEER - STATE OF NEVADA
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TABLE OF CONTENTS

MAPS AND ILLUSTRATIONS

1.0 INTRODUCTION

This report presents the findings and conclusions of our geotechnical investigation for the proposed East/West Water Transmission Main Project, Phase 2B located within Carson City, Nevada. This phase extends from Phillips St. (westerly project limit) along Washington St. to Roop St. (easterly project limit), totaling approximately 3,150 lineal feet.

The water line is likely to be located in the center of the street due to potential conflicts with existing water, sewer, storm drain and gas. On the portion of the alignment east of Stewart St., multiple fiber optic lines are located in the eastbound lane. At each of these intersections, Washington St. consists of one lane in each direction, and a middle turn lane facility.

2.0 SCOPE OF SERVICES

Our scope of services for our preliminary geotechnical investigation for the subject project included:

- Review of published geologic maps, aerial photographs, and other literature pertaining to the site to aid in evaluating geologic conditions and hazards that may be present.
- Review and analysis of the *Geotechnical Report for Roop St. Widening, Washington St. to Winnie Lane, Carson City, Nevada* dated April 15, 2003, prepared by Black Eagle Consulting, Inc.
- Review and analysis of the *Geotechnical Investigation Report for the Robinson Transmission Main Project,* dated October 2010, by Geocon Consultants Inc.
- Performed 8 pavement cores through the existing asphalt surface and base section to examine the prevailing soil conditions. The cores were advanced both with a portable drill and also by using a twelve-inch diameter asphalt cutting head attachment on the truck mounted drilling rig.
- Performed laboratory tests on representative near surface soil samples to determine their engineering characteristics for pavement support.
- Performed research on the Nevada Department of Transportation (NDOT) website to obtain applicable traffic count information for Washington St.
- Prepared this report presenting our findings, conclusions and recommendations regarding the geotechnical aspects of constructing the proposed project including pavement section design and rehabilitation options, slab on grade construction, grading and utility recommendations.

3.0 PROJECT DESCRIPTION

3.1 Project Overview

The East/West Transmission Main Project, Phase 2B as currently proposed includes approximately 3,150 linear feet of new 24-inch diameter water line. The approximate project limits are illustrated on the attached Vicinity Map (Figure 1). This portion of Washington St. contains one-lane in each direction, and a middle turn lane facility between Stewart St. and Carson St. Washington St. is a two-lane local collector street that crosses two four-lane arterial streets, Carson St. and Stewart St. Washington St. also crosses

four local collector streets west of Carson St. consisting of N. Curry St., N. Nevada St., N. Division St. and N. Minnesota St.. Local street crossings consist of N. Phillips St., N. Plaza St., N. Valley St., Anderson St., and N. Walsh St. While N. Plaza St. is considered a local street, it is used as the central staging area for Jump around Carson (JAC) bus service. Total relief along the Washington St. alignment is approximately 13 feet, from elevation 4667 feet at E. Washington to elevation 4654 feet at Roop St. The average gradient of the street is less than 1% to the east.

This project builds upon efforts implemented by Carson City Engineering to upgrade the Carson City water system as part of the overall Douglas County Intertie project. The primary purpose of the overall intertie project is to allow for blending of Carson City water to lower arsenic levels and allow an arsenic treatment system to be avoided as well as expanding the overall capacity of the Carson City system.

The scope of construction anticipated to be performed for this project consists of (but may not be limited to) the following:

- Demolition of existing pavement and some concrete improvements including curb and gutter, gutter pans, sidewalk, and valley gutters.
- Grading of roadway areas.
- Installation of concrete curb, gutter and sidewalk.
- Removal and reconstruction of some utilities (such as storm drain) where in conflict with the transmission main improvements.
- Limited removal and installation of landscaping.
- Either full reconstruction or rehabilitation of existing pavement surfaces via cold-milling and overlay methods.
- Constructing new pavement asphalt concrete over aggregate base sections for the new street sections.

The purpose of our work is to describe the existing pavement surface and subsurface conditions within the project area, provide recommendations for underground utility installations and to recommend pavement sections for the street reconstruction areas, and to provide specific construction recommendations based on our analysis.

The recommendations presented herein are based on the analyses of the data obtained from exploratory cores, laboratory tests, engineering analyses, and our local experience with similar soil and geologic conditions. The logs of our exploratory excavations and laboratory test results are presented as Appendices A and B. Also presented in Appendix C is calculations for pavement surfaces. The approximate locations of the exploratory cores are presented on the Site Map, Figure 2.

3.2 Regional Geology

The geology of the site is referenced from *Carson City Folio Geologic Map* (Trexler, 1977, Figure 3). The Eagle Valley area in Carson City is a large fault bounded valley typical of the western edge of the Great Basin geomorphic province. The geologic map indicates the project site is predominantly underlain by Quaternary alluvial plain deposits of Eagle Valley. These deposits are described by Trexler (1977) as yellowish brown to gray, unbedded to poorly bedded, poorly to moderately sorted fine silty sand, sandy

silt, granular muddy coarse sand, and minor sandy gravel. The alluvial plain deposits are on the order of 2,000 feet deep in the Eagle Valley basin based on geophysical data.

3.3 Geologic Hazards

Review of *Carson City Folio Geologic Map* (1977), *Carson City Quadrangle Earthquake Hazards Map* (1979), and the *Quaternary Fault and Fold Database* (accessed February 19, 2015) indicate that a series of Holocene to late Pleistocene (approximately 500 to 35,000 years since last displacement) northeasterly-trending faults have been mapped near the site. A single potentially active fault is shown on the mapping across Washington St. closely following N. Minnesota St. (See Fault Map, Figure 4).

The *Carson City Quadrangle Earthquake Hazards Map* indicates that this subject portion of Washington St. is located within areas potentially subject to a moderate to high severity of shaking and/or liquefaction during a seismic event. A liquefaction investigation was not performed as part of our study since the risk of liquefaction is not considered for utility projects such as proposed.

Review of the *Carson City Quadrangle Flood and Related Debris Flow Hazards Map* (1981) indicates that Roop St. south of U.S. Highway 50 (Williams St.) may be subject to light to moderate debris movement of fine-grained sediment during moderate flooding from debris flows emanating from Kings Canyon.

3.4 Soils

According to the Soil Survey of Carson City Area, Nevada, (US Department of Agriculture, 1979), the site soil is classified as Urban Land (Unit 71), which includes areas that are so altered or obscured by urban improvements that identification of the soils is not feasible. Figure 5 presents the soil map for the site.

Based on our findings from the exploratory cores, the near surface soils within the limits of the project generally consist predominantly of silty very fine to coarse-grained sand (SM) with lesser amounts of sandy silt (ML) with minor clay, and less common clayey silt (ML). The majority of soils encountered were observed to be in a damp to moist and medium dense or firm condition. The silt-rich soils in the westerly portion of the alignment are generally very dark brown in color, while the sand-rich soils were observed to be dark yellowish to light brown.

3.5 Groundwater and Surface Water

Based on the *Carson City Quadrangle Generalized Groundwater Map*, the depth to groundwater in the project area ranges from 20 feet below the ground surface (bgs) near Roop St. and E. Washington St. to less than 10 feet bgs near the intersection of Washington St. and Phillips St. (Katzer 1980). The groundwater flow is generally towards the southeast. Groundwater was not encountered within the shallow drill hole excavations advanced for this investigation although soil mottling was encountered at depth of six to seven feet bgs in borings BH-1, BH-3 and BH-4. Carson City has been experiencing draught conditions for approximately five years and the current depth of groundwater may be attributed to the climatic impact to recharge of the groundwater. Groundwater was not encountered with the borings performed by Black Eagle Consulting, Inc. (north of E. Washington St.) in 2002 which were advanced to a maximum depth of 11.5 feet.

No natural water courses cross the limits of project limits. Surface flows are directed to storm drain improvements. The potential for flooding is not addressed herein however, the flood map for the project vicinity is included as Figure 6.

3.6 Existing Pavement Surface Conditions

On January 5, 2015, representatives of RCI performed a site reconnaissance visit to observe the surface condition of the pavement along the alignment for the purpose of identifying significant signs of distress. The primary distress patterns observed in the alignment consist of joint cracking (between adjoining paving courses, roughly parallel to centerline) and transverse (shrinkage) cracking, spaced at 20 to 50 feet on-center, roughly perpendicular to the street's alignment. Transverse cracking is prevalent in the pavement along the entire length of the alignment. These forms of cracking are common in older pavements and attributed to volumetric changes (age-related shrinkage) in the asphalt in response to the seasonal temperature changes. Some of these cracks may be reflective, having propagated from the original asphalt section into newer overlays. "Alligator" Cracking was observed along the alignment and was most pronounced west of N. Carson St. Rutting, transverse cracking as well as alligator cracking was observed to be elevated in intensity within the approaches and intersection of Washington St. and N. Division St. Deflection of pavement was also noted under heavier vehicle loads at this location.

Crack sealing maintenance measures had been performed for most of the larger cracks, along with the sealing of separations between the asphalt section and concrete curb and gutter.

Numerous utility patches were observed throughout the alignment, and are primarily associated with the water and gas lines (south-bound lane) and where laterals have been installed for new building construction. The majority of patches appear be performing satisfactorily. Site photographs taken along the alignment that illustrate representative sections of pavement are attached as Figures 6 through 11.

3.7 Existing Utilities

Numerous underground and overhead utilities are present in the street throughout the project length. Underground utilities include at a minimum water, gas, fiber optic cable, cable TV, electric, storm drain, and sewer. Traffic light loops are located at the intersections with Stewart and Carson St. It is important to note the there are multiple fiber optic lines in the east bound lane of Washington between Stewart and Roop St. The distribution of utilities is shown on the Site Plan, Figure 2.

4.0 Field Exploration

4.1 Subsurface Exploration

A total of four exploratory auger holes were advanced with a CME 55 drilling rig. In addition six asphalt cores were recovered by the use of a portable coring machine as part of our investigation. The logs of these excavations are provided in Appendix A. The cores obtained with the portable equipment were 4-inches in diameter while the cores recovered with the drill rig were 12-inches in diameter. Cold patch was placed to match or exceed the existing asphalt section.

Table 4.1 summarizes our exploration locations and includes four cores by Geocon, Inc. that were advanced in 2009.

TABLE 4.1 SUMMARY OF EXPLORATION LOCATIONS

Exploratory Core No.	Core/Boring Location			
	Location Description	Approx. Station No.	Offset from Existing Centerline	Approx. Surface Elevation (feet)
BH-1	Approx. 50 ft. West of Anderson St.	33+20	CL	4674.5
BH-2	Approx. 100 ft. West of Stewart St.	28+30	1'L	4681.0
BH-3	Approx. 80 ft. West of N. Nevada St.	15+55	9'L	4694.5
BH-4	Approx. 60 ft. West of N. Division St.	13+40	11'L	4695.5
CR-1	Approx. 60 ft. East of N. Walsh St.	37+45	6'R	4671.0
CR-2	Approx. 70 ft. West of N. Walsh St.	35+40	12'L	4672.5
CR-3	Approx. 70 ft. West of N. Walsh St.	35+40	10'R	4672.5
CR-4	Approx. 30 ft. East of N. Valley St.	32+25	10'L	4676.0
CR-5	Approx. 60 ft. West of N. Valley St.	31+00	11'R	4678.0
CR-6	Approx. 100 ft. West of N. Curry St.	18+20	15'L	4691.5
CR-7	Approx. 100 ft. West of N. Curry St.	18+20	16"R	4691.5
CH-1	Approx. 60 ft. East of N. Phillips St.	10+60	11'L	4703.0
CH-2	Approx. 30 ft. East of N. Minnesota St.	12+75	12'L	4696.5
CH-3	Approx. 40 ft. West of N. Division St.	13+75	14'R	4695.0
CH-4	Approx. 40 ft. West of N. Nevada St.	16+30	10'L	4694.0

Note – BH is RCI boring, CR# denotes RCI core location and CH# denotes a Geocon core location
Note – Stationing and Elevations based on Manhard Consulting plans dated January 2015 (Horiz. +- 2.5' Vertical +- 1.0 feet)

4.2 Existing Pavement and Base Sections

The following table summarizes the asphalt and base or sub-base material thicknesses encountered in the exploratory cores, in addition to the soil type immediately underlying the pavement section.

TABLE 4.2 PAVEMENT SECTION DATA

Core Number	Asphalt Thickness (inches)	AB Thickness (inches)	Subgrade Soil Type (USCS)	AC Description
BH-1	5.50	NA	SM	Appears to be Type 3 AC overlaid with 2" of Type 2 and a ¼ chip seal
BH-2	5.50	NA	SM	Appears to be Type 2 AC overlaid with 2.5" of Type 2 and a ¼ chip seal
BH-3	4.00	NA	SM	Appears to be Type 3 AC overlaid with 1" of Type 2 and a ¼ chip seal
BH-4	4.25	NA	SM W/Fine Gravel	AC Measured at 4.25 inches with approximately the bottom 1 inch showing stripping. (No Sample)
CR-1	4.25	NA	SM	Appears to be a Type 2 AC patch
CR-2	5.00	NA	SM	Appears to be Type 3 AC overlaid with 1.5" of Type 3
CR-3	5.75	NA	SM	Appears to be two lifts of Type 3 AC overlaid with 1.75" of Type 2
CR-4	5.75	NA	SM	Appears to be two lifts of Type 3 AC overlaid with 1.75" of Type 2
CR-5	5.00	NA	SM	Appears to be Type 2 AC overlaid with 1" of Type 2
CR-6	3.75	NA	SM	Appears to be Type 2 AC Patch overlaid with 0.5 3/8 Chip Seal
CR-7	3.75	NA	SM	Appears to be Type 2 AC Patch overlaid with 0.5 3/8 Chip Seal
C-1	3.25*	NA	SM W/Fine Gravel	Appears to be Type 2 AC overlaid with 1" of Type 3
C-2	4.00	NA	SM W/Fine Gravel	Appears to be Type 2 AC overlaid with 1" of Type 3
C-3	4.25	NA	SM W/Fine Gravel	Appears to be Type 2 AC overlaid with 1" of Type 3
C-4	3.50*	NA	SM W/Fine Gravel	Appears to be Type 2 AC overlaid with 1" of Type 3

As indicated in the logs, multiple generations of asphalt (overlays) were noted in the cores which explains the notable thickness, particularly at the crown (as evident in C1, C7, C9, and C12). The approximate thicknesses and layers of overlay are noted on the enclosed logs presented in Appendix A. In the case of C3 and C6, the original pavement surface consisted of an oiled or asphaltic sand horizon. The findings from

C3A indicate that asphalt patches likely match the adjacent asphalt pavement section. Photographs of the cores are presented in Figures 12-15.

5.0 LABORATORY TESTING

Laboratory tests were performed in accordance with American Association of State Highway and Transportation Officials (AASHTO) Test Methods or generally accepted test methods of the American Society for Testing and Materials (ASTM). Near surface soil samples were tested for R-value to support pavement section design. The types of tests performed are listed below:

- Gradation Analysis AASHTO T88, ASTM D 422
- Moisture Content AASHTO T65, ASTM D 2937
- Atterberg Limits ASTM D 4318
- #200 Wash ASTM D 1140
- R-value ASTM D 2844

Test results and descriptions of tests performed are provided in Appendix B. The following table summarizes the R-value test results obtained by our office. Specific locations are shown on Figure 2.

TABLE 5.0 R-VALUE TEST RESULTS

EXCAVATION	LOCATION	R-VALUE
BH-1	Between Anderson St and Stewart St.	73
BH-2	Between Stewart and Plaza St.	75
BH-3	Between Curry St. and Nevada St.	45

The laboratory reports for this testing is provided in Appendix B.

6.0 CORROSION EVALUATION AND CONCRETE CONSIDERATIONS

Based on our experience in this part of Carson City and the NRCS data, we do not anticipate any significant levels of chlorides or sulfate in the native soils. Cathodic protection of uncoated steel should be incorporated by design. Due to negligible concentrations of soluble sulfate we recommend that Type II cement, with a maximum water-cementious material ratio of 0.45, be used for all flatwork or thrust blocks if needed. All exterior concrete should be air entrained with from 4.5% to 7.0% air content. The water cement ratio for all exterior concrete should be 0.45 or less. The use of mid-range plasticizer is recommended to facilitate the finishing process while maintaining the desired water cement ratio. Exterior concrete should be placed and finished in accordance with American Concrete Institute (ACI) recommendations for concrete placed in areas subject to freeze-thaw environments.

Recommendations presented herein are intended to reduce the potential for cracking of slabs as a result of differential movement. However, even with the incorporation of the recommendations presented herein, slabs-on-grade will still exhibit some cracking. The occurrence of concrete shrinkage cracks is independent of the soil supporting characteristics. Their occurrence may be reduced and/or controlled by limiting the slump of concrete, the use of crack control joints and proper concrete placing and curing. Adherence to ACI and Portland Concrete Association (PCA) recommendations including those for adverse conditions such as low humidity and wind, if applicable, should be incorporated into project construction practices.

7.0 Pavement Section Design and Recommendations

7.1 Pavement Reconstruction

Should full reconstruction be considered along the alignment the following pavement sections are provided. Pavement design calculations were performed using the AASHTO methodology and checked with the Asphalt Institute Method. The Nevada Department of Transportation Traffic Information Access (TRINA) website was utilized to procure traffic information for Washington St. as shown in Table 7.1.1.

Table 7.1 NDOT Traffic Data

NDOT AVERAGE ANNUAL DAILY TRAFFIC			
YEAR	AADT	YEAR	AADT
2000	4250	2007	3400
2001	3800	2008	3300
2002	3900	2009	3000
2003	3650	2010	2200
2004	3900	2011	3000
2005	3650	2012	2900
2006	3700	2013	2600

Washington St. is designated as a Minor Urban Collector by NDOT. The latest Annual Average Daily Traffic Count (AADT) is 2,600 from 2013. The traffic counts since 2000 have been within the range of 2,200 to 4,250 as indicated in the website output above. For the purpose of pavement design, an AADT of 3,000 for 2011 was utilized in our analysis. The vehicle distribution assumed for Washington St. is based on the Minor Urban Collector distribution published in 2007 by NDOT.

A growth rate of 2% per year and a 20 year design life were assumed. We consider the 2% growth rate appropriate due to: (1) the lack of growth observed in the NDOT traffic counts from 2009 which corresponds with the completion of the U.S. 395 Freeway improvements south to Fairview Drive. The calculated pavement sections are also based on the following assumptions:

- The subgrade soil has an R-Value of 45 or higher for the area west of Carson St. and an R-value of 45 for the area from Carson St. to Roop St. R-value testing performed for these respective portions

- The subgrade soil has an R-Value of 45 or higher for the area west of Carson St. and an R-value of 45 for the area from Carson St. to Roop St. R-value testing performed for these respective portions were a single test on the west side of Carson St. of 45 and two tests to the east of 73 and 75. The maximum R-value of 45 reflects recommendations utilized by NDOT limiting sub-grade R-values.
- The recycled asphalt concrete aggregate base (may be placed in lowermost 4 inches of base section) and overlying Type 2, Class B aggregate base have minimum R-Values of 70 and meets the requirements of the Standard Specifications for Public Works Construction.
- The aggregate base materials are compacted to 95% or higher relative compaction at or near optimum moisture content.
- Soil subgrade has been prepared as previously recommended.
- Asphalt concrete should conform Section 320.02 of the Standard Specifications for Public Works Construction ("Orange Book"). We recommend that the asphalt consist of polymerized oil type PG64-28NV.
- The asphalt concrete should consist of Type II of Section 200.02.02 of the Standard Specifications for Public Works Construction ("Orange Book") per Table 12-8 of Division 12 of the Carson City Development Standards.
- We recommend that the pavement section consist of two inches of Type 2 asphalt concrete overlain by two inches of Type 3 asphalt concrete.

The design pavement section presented below is recommended for use on this project for new and reconstructed sections of Washington St. and exceeds the minimum calculated sections that were less than the Carson City minimum sections for arterial streets, as presented in Table 12.8 of Division 12 of the Carson City Development Standards.

TABLE 7.2 RECOMMENDED PAVEMENT SECTION

	AC Thickness (inches)	Aggregate Base Thickness (inches)
W. Washington St.	4.0	8.0
E. Washington St.	4.0	8.0

7.2 Mill and Overlay Considerations

As part of our investigation we performed a Pavement Surface Evaluation and Rating (PASER) survey of the alignment which is presented in Appendix A. The results of the PASER survey combined with our subsurface investigation form the basis for our considerations for mill and overlay recommendations. The significant thickness of asphalt encountered along the easterly portion of the alignment (Roop to Carson St.) creates an opportunity for the use of overlays. However, the final location in the street of the new utility trench and width may limit the desirability of this approach. We recommend a value engineering analysis of the combined effort to patch, grind an overlay vs. complete reconstruction be conducted to determine the cost benefits to overlays vs full reconstruction. We have performed additional pavement design calculations to assess the structural adequacy of the existing sections should the use of overlays be considered in the project design. As long as a minimum of four inches of finish surface is maintained,

the section would meet the structural number calculated if the lack of existing aggregate base is allowable to Carson City Engineering.

The existing pavement east of Carson St. is suitable for a grind and overlay approach recognizing that spot patching and possible reconstruction of approaches to intersections are recommended. The overlay thicknesses should be a minimum of 1.5 inches and a separation fabric should be provided between cold-milled surface and overlay to aid in the reduction of reflective cracking. Complete reconstruction is recommended for the areas west of Carson St. with the possible exception of the single block between Carson St. and N. Nevada St.

8.0 Conclusions and Recommendations for Construction

8.1 General

8.1.1 Based on the results of our investigation, there are no significant adverse conditions on the project site from a geotechnical perspective, provided the recommendations presented herein are implemented in the design and construction of the project.

8.1.2 Our field investigation and the previous geotechnical work indicates the site soil is generally characterized by silty sands and sandy silts (SM, ML) with very minor amounts of clayey sand (SC), clayey silt (ML), and sand (SP) to at least feet 15 bgs.

8.1.3 Groundwater was not encountered in any of the exploration excavations advanced for this study. Groundwater is not anticipated to adversely impact grading, utility construction or street improvements. Areas of wet soils or elevated moisture may be encountered seasonally adjacent to heavily irrigated lawns or other landscape areas adjacent to the street.

8.1.4 A potentially active fault crosses the alignment near North Minnesota St. However, major mitigations for faulting are not recommended for the transmission main such as flexible pipes that would allow for the accommodation of displacement of approximately three feet. The only mitigation we would recommend be considered by design is the strategic placement of values that would allow for the isolation of the section of line that crosses the fault. This would probably involve a closer spacing than might otherwise be considered.

8.1.5 Soil Conservation Service data, our site specific testing, and our local experience indicate that site soils are not aggressive for either Type II or Type IP concrete. However, site soils are moderately aggressive (corrosive) to very aggressive for uncoated steel. The project engineer should consider the use of coatings or other cathodic protection where uncoated steel may be in contact with native site soils.

8.2 Soil Handling, Pavement Reconstruction and Grind and Overlay Preparation

8.2.1 In our opinion, demolition of pavement, grading, and excavations may be accomplished with light to moderate effort with conventional medium-duty grading/excavation equipment. Excavations in native soils are not anticipated to generate significant quantities oversized material (greater than six inches in dimension) that would require special handling or exporting from the site.

8.2.2 Care should be taken during the demolition of the existing pavement surfaces to minimize the entrainment of aggregate base or soils, assuming that the asphalt may be recycled for use as recycled asphalt concrete base.

8.2.3 Where import structural fill material is required, it should meet the Section 304.03 of the *Standard Specifications for Public Works Construction*. Structural fill is defined herein as all fill placed beneath pavement sections, beneath slab on grade construction, or other structural loading areas. Imported structural fill material should be sampled and approved by RCI prior to its transportation to the site.

8.2.4 In areas slated for grinding and overlay, saw cutting, and patching of excessive alligator cracking or rutted pavement should be performed. It is also recommended that the trench area be paved with the geometry of the final roadway considered, so that any milling results in the minimum structural section being maintained.

8.2.5 Key cutting along curb and gutter should also be conducted prior to placing any new curb and gutter.

8.2.6 Excavated soils generated from cut operations at the site are anticipated to generally be suitable for use as structural fill. The minor amounts of silt or clayey sands identified should be avoided for use as structural fill unless blended with coarser soils

8.3 Grading – General, Site Preparation

8.3.1 Earthwork operations should be observed and compacted fill tested by our representative.

8.3.2 All references to relative compaction and optimum moisture content in this report are based on the ASTM D1557-07 Test Procedure.

8.3.3 A preconstruction conference should be held at the site prior to the beginning of grading operations with the owner, contractor, city inspectors, civil engineer, and geotechnical engineer in attendance. Demolition, utility, excavation, materials testing, soil handling, and grading requirements can be discussed at that time. In addition, the depth to groundwater should be checked by the contractor and if necessary any special mitigation requirements and procedures discussed and agreed upon.

8.3.4 Site preparation should begin with the removal of any curb and gutter, sidewalk, signage, and vegetation as specified in the drawings. The depth of removal should be such that material exposed in the cut areas or soils to be used as fill is relatively free of organic matter. This will likely result in removal depths (outside of areas of existing pavement or flatwork) ranging from approximately 1 to 4 inches, depending on location. In the case of tree root balls, additional removal depths will be necessary as directed by the Engineer. Material generated during stripping is not suitable for use in structural areas but may be placed in landscaped or other non-structural areas if deemed suitable by the Engineer for the specific application.

8.3.5 During or immediately following wet weather, the near-surface soil may deflect or pump under heavy equipment loads. Yielding soil conditions can typically be stabilized using one of the methods listed below. Time considerations may preclude the use of the methods requiring drying of the affected soils. However, soil conditions and utility depths should be reviewed by the

Engineer for the affected area. The Engineer should recommend or approve of any proposed mitigation methods. Typical options recommended in this area of Nevada are as follows:

- **Option 1.** Deeply scarify (10 to 12 inches) allow to air dry to near optimum moisture content and re-compact.
- **Option 2**. Remove unstable (wet) soils to a firm base and allow the wet subgrade soil to dry to near optimum moisture content and re-compact. Replace the removed soils with drier soil meeting the structural fill specifications.
- **Option 3.** Adjust the subgrade elevation at least 18 inches below plan elevation to allow for the placement of stabilization cobble rock. Compact native subgrade to 85% at 2 to 3% over optimum and cover with a stabilizing geotextile fabric (Mirafi 500X or equal). The fabric should be covered with at least 18 inches of 6 to 12-inch angular cobble rock. If angular cobble rock is used, a filter fabric (such as Mirafi 140N) should be placed between the rock and overlying soil material. The purpose of the filter fabric will be to reduce the migration of fines from the soil into the stabilizing cobble rock. Test sections are recommended if areas are larger than a few tens of square yards to ensure the effectiveness of the method. Proof rolling of the rock should be conducted under the direction of the Engineers representative prior to covering with filter fabric to ensure effectiveness.

  Other stabilization alternatives may be appropriate depending on the situation. Consultation with us is crucial for expedient and appropriate mitigation.

8.4 Grading – Pavement and Flatwork Areas

8.4.1 The subgrade for pavements should be finished to a compacted smooth unyielding surface. We recommend proof-rolling the subgrade with a loaded water truck (or similar equipment) to verify the stability of the subgrade prior to placing aggregate base.

8.4.2 New pavement and flatwork subgrade areas should be scarified to a depth of 8 to 10 inches and then moisture conditioned to near optimum moisture content. The soil should then be compacted to a minimum of 90% relative compaction.

8.4.3 Existing pavements may be pulverized or ground for use as recycled aggregate base or structural fill in accordance with the Standard Specifications for Public Works Construction. If used as recycled asphalt concrete base, the asphalt pavement should be pulverized by rotomilling per Section 308.02. At a minimum, every 500 cubic yards (or 400 lineal feet of roadway, whichever is lesser) of recycled asphalt concrete base should be tested for compliance with R-value and gradation requirements for Type 2 (recycled on-site) asphalt concrete aggregate base per Section 200.01.04 of the Standard Specifications for Public Works Construction.

8.4.4 Contractors should perform test sections of recycled asphalt concrete base for the purpose of verifying conformance of recycled asphalt materials with the aforementioned specifications. It should be noted that the aggregate content and size is variable, and may result in variations in the product produced. No warranty is provided that the pulverized asphalt will meet the requirements of Section 200.01.04 of the Standard Specifications for Public Works Construction.

8.4.5 The recycled bituminous materials should be used as a uniform 4 inch thick layer at the bottom of the aggregate base section. A clean Type 2 Class B aggregate base should then be placed to complete the structural section thickness. Testing of the bituminous materials will require use of

laboratory determinations of in-situ moisture contents. Alternatively moisture content can be determined by use of a "speedy moisture" device pursuant to NAQTC criteria.

8.4.6 Recycled asphalt concrete base produced from the on-site asphalt should be placed in accordance with Section 308 of the *Standard Specifications for Public Works Construction*. Base materials should be compacted to at least 95% relative compaction.

8.5 Utility Bedding and Backfill

8.5.1 Site soils will not be suitable for utility trench pipe bedding since they do not meet the *Standard Specifications for Public Works Construction* criteria for Class A backfill. Site soils Importation of bedding materials should be planned for accordingly. Bedding and pipe zone backfill should extend from the bottom of the trench excavation to a minimum of 6 inches above the crown of the pipe. Pipe bedding material should consist of Class A Backfill material as defined by the *Standard Specifications for Public Works Construction* (Orange Book). Bedding and pipe zone material should be compacted in 6-inch maximum lifts.

8.5.2 Following the placement and compaction of the bedding materials, underground utility trenches should be backfilled with properly compacted native silty sand (SM) or Class E imported soils. The native silty sands generally contain 60-80% by weight passing the No. 40 sieve, which exceeds the Class E backfill specification of 10-50% by weight. Some of the silty sand soils also contain in excess of 35% by weight passing the #200 sieve. Provided the native silty sand materials are properly moisture conditioned and compacted, we anticipate such soils to perform satisfactorily as backfill. Moreover, the re-use of the native silty sand soils as backfill would avoid significant costs associated with their exportation and the importation of Class E soils.

8.5.3 Trench backfill should be placed in loose lifts not exceeding eight inches. The lifts should be compacted to a minimum of 90% relative compaction at or near optimum moisture content.

8.6 Erosion Control and Drainage Considerations

8.6.1 Adequate drainage is critical to reduce the potential for differential soil movement, erosion and subsurface ponding. The site should be graded and maintained such that surface drainage is directed towards gutters, swales or other controlled drainage devices. Pavement flows should be directed into conduits to carry runoff to natural drainages.

8.6.2 It is the contractor's responsibility to protect work from stormwater runoff and to obtain necessary Storm Water Pollution Plan Permits (SWPPP) and implement the required Best Management Practices (BMP's).

9.0 Limitations and Uniformity of Conditions

The recommendations of this report pertain only to the sites investigated and are based upon the assumption that soil and bedrock conditions do not deviate from those disclosed in the investigation. If any variations or undesirable conditions are encountered during construction, or if the proposed construction will differ from that anticipated herein, Resource Concepts Inc. should be notified immediately so that supplemental recommendations can be given if necessary. The evaluation or

identification of the potential presence of hazardous or corrosive materials was not part of the scope of services provided by RCI.

This report is issued with the understanding that it is the responsibility of the owner or his representative to ensure that the information and recommendations contained herein are brought to the attention of the architect and engineer for the project and incorporated into the plans, and that the necessary steps are taken to see that the contractor and subcontractors carry out such recommendations in the field.

The findings of this report are valid as of the present date. However, changes in the conditions of a project site can occur with the passage of time, whether due to natural processes or the works of man on this or adjacent properties. In addition, changes in applicable or appropriate standards may occur, whether they result 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.

10.0 REFERENCES

1. *Black Eagle Consulting, Inc.(2003), Geotechnical Investigation, Roop Street Widening, Washington Street to Winnie Lane, Carson City, Nevada, Project No. 0522-01-1, dated April 15, 2003*
2. *Geotechnical Investigation Report for the Robinson Transmission Main Project, dated October 2010, by Geocon Consultants Inc.*
3. *Katzer, T. (1980). Carson City Quadrangle, General Groundwater Map, Nevada Bureau of Mines and Geology, Scale 1:24,000*
4. *Katzer, T. and Schroer, C.V (1981), Carson City Quadrangle, Flood and Related Debris Flow Hazards Map, Nevada Bureau of Mines and Geology, Scale 1:24,000*
5. *Natural Resources Conservation Service Website, Soil Survey of Carson City Area, Nevada, (http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm).*
6. *Nevada Department of Transportation website, Traffic Information Access (TRINA), www.ndot.gov*
7. *Soil Survey of Carson City Area, Nevada, U.S. Department of Agriculture,*
8. *Standard Specifications for Public Works Construction (2012), Regional Transportation Commission of Washoe County, Washoe County, City of Sparks, City of Reno, Carson City, City of Yerington*
9. *Trexler, D.T. (1977), Carson City Folio Geologic Map, Nevada Bureau of Mines and Geology, Carson City 7.5' Minute Quadrangle, Nevada, Scale 1:24,000*
10. *Trexler, D.T. and Bell, J.W., (1979), Carson City Quadrangle, Earthquake Hazards Map, Nevada Bureau of Mines and Geology, Scale 1:24,000*

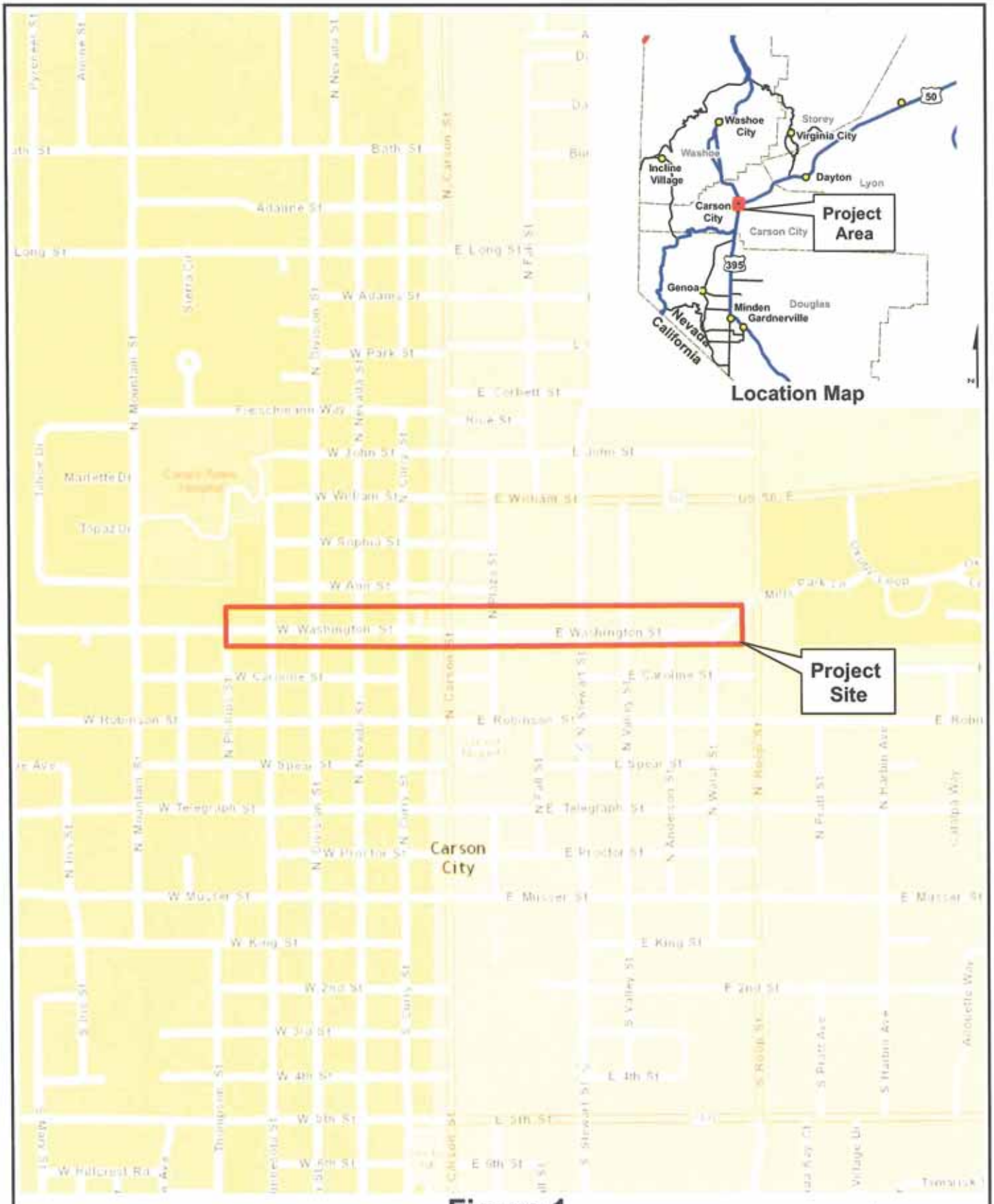

Figure 1
Vicinity Map
East West Waterline

Date: 3/5/2015

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Document Path: R:\projects\Manhard\14_298_1\MXDs\Location_Map.mxd

LEGEND

- AC Core Hole Locations - GEOCON
- AC Core Hole Locations - RCI
- Boring Location - RCI
- Boring Location - GEOCON

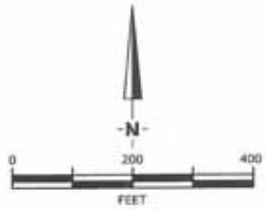

Figure 2 - Site Plan
East/West Waterline
Washington St. Alignment
Carson City, Nevada

Prepared: 2/27/15
Proj. No.: 14-296.1

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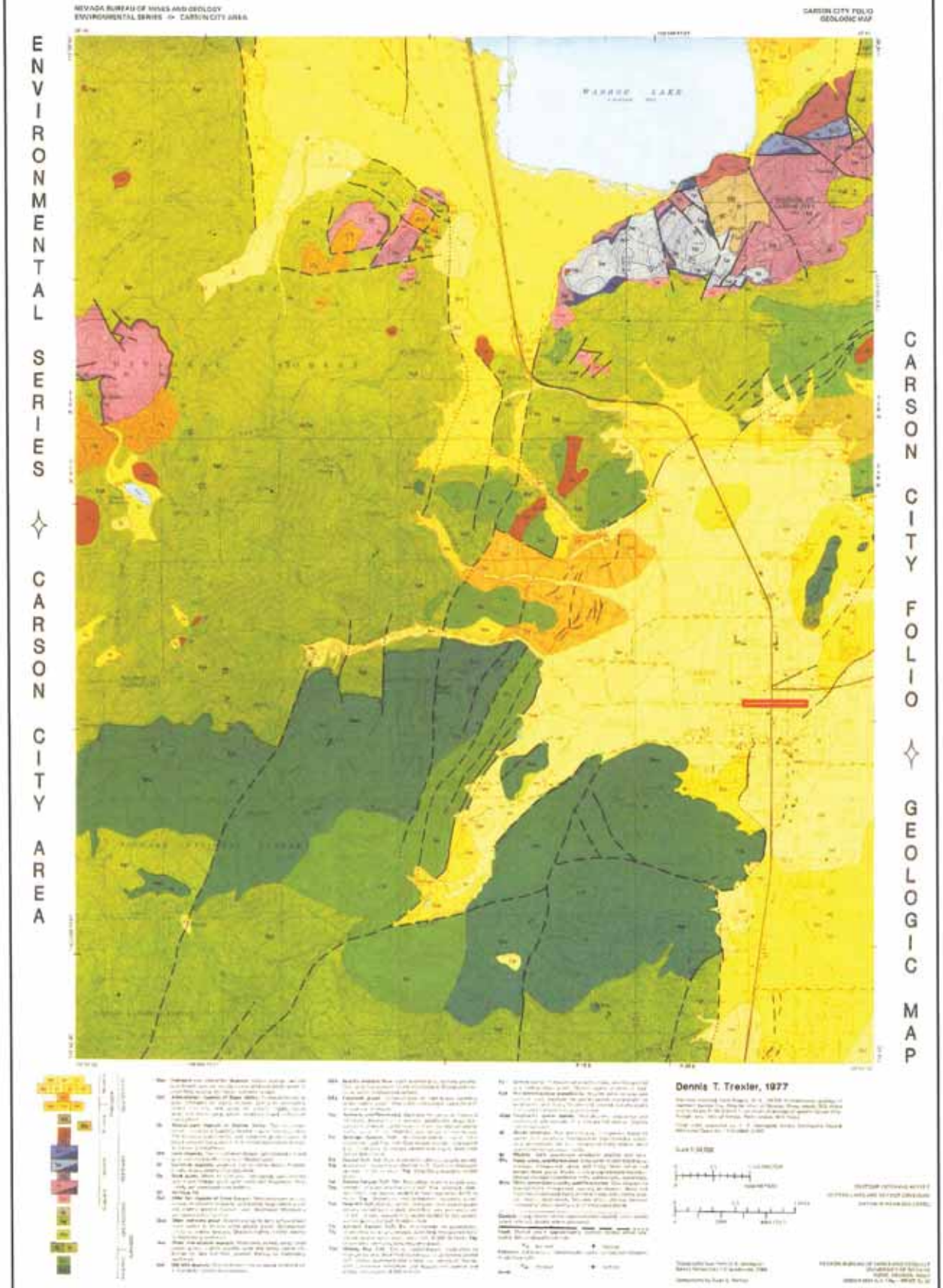

Legend

Project Area

0 1 2 Miles

Figure 3
Geologic Map
East West Waterline

Date: 3/6/2015

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Figure 4
Fault Map
East West Waterline

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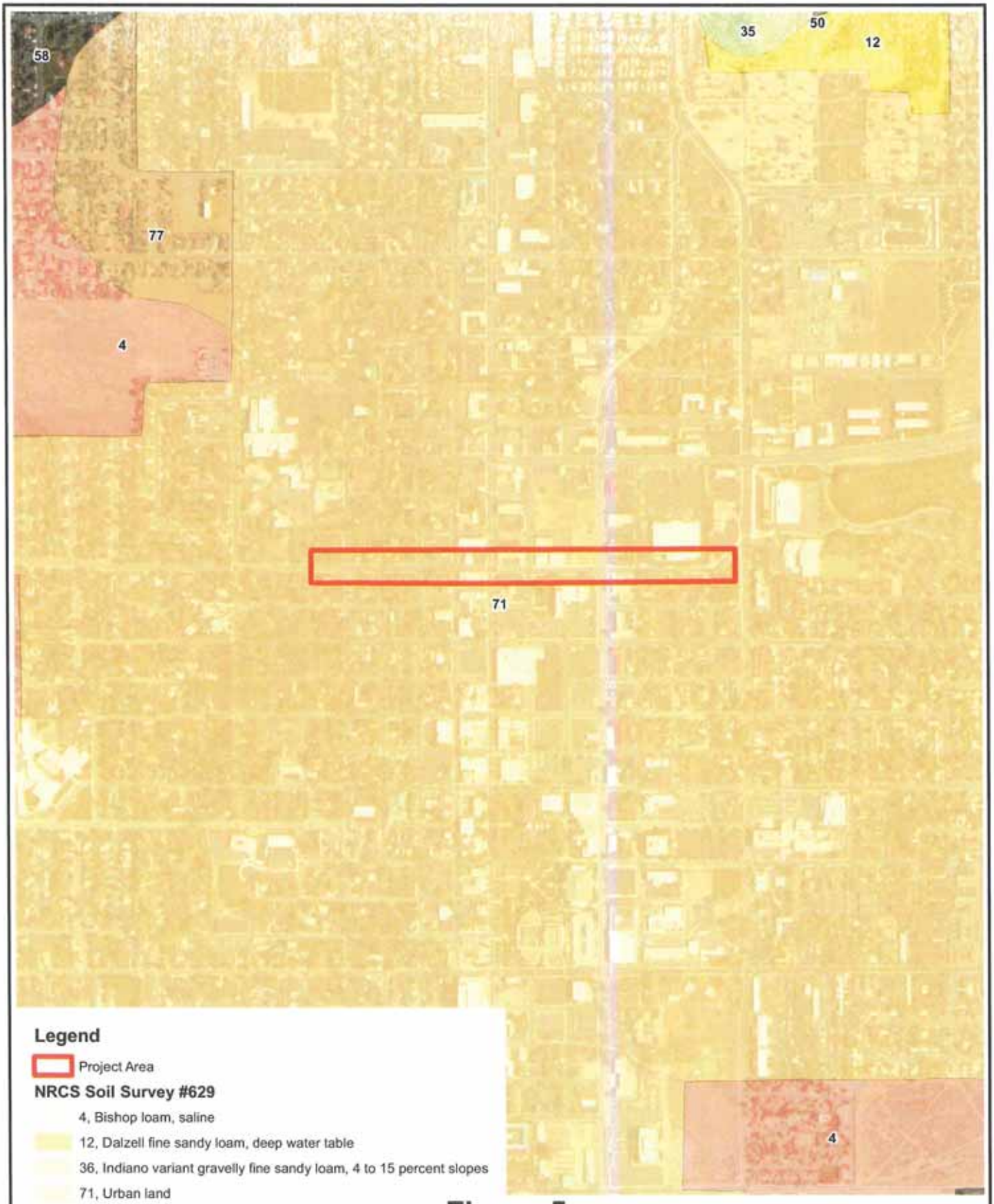

Figure 5
Soils Map
East West Waterline

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Figure 6
Flood Zone Map
East West Waterline

Date: 3/5/2015

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Document Path: R:\projects\Manhard\14_296_1\MXDs\FEMA_Map.mxd

APPENDIX A

FIELD INVESTIGATION

The approximate locations of all excavations are illustrated on the Site Plan, Figure 2. The soil conditions encountered in the exploratory excavations were visually examined, classified, and logged in general accordance with the Unified Soil Classification System.

Site Photographs are also included that depict the existing field conditions at the time of our investigation.

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Location of Test Pit: Washington Street

Project No: 14-296.1	Project Name: E/W Trans. Main	Location: Washington Street, Carson City
Boring No: BH-1	Coordinates:	Started Time: 8:43 am Date: 1-7-2015
Elevation: Total Depth: 14.0'	GWL: NA Depth:	Completed Time: 9:35 am Date: 1-7-2015
Engineer/Geologist: G. Luce	Date/Time:	Backfilled Time: 9:50 am Date: 1-7-2015
Drill Rig Type: CME 55	Drilling Contractor: Andresen	Driller: Jose

SAMPLE DEPTH	SAMPLE TYPE	DRILLING RATE	LL/PI	DD/%M	-200	ATTERBERG LIMITS	DEPTH	SAMPLE	GRAPHIC LOG	BLOWS	N	RECOVERY	DESCRIPTION	USCS
													0.0-0.4 AC 5.5 Inches	SM
				/2.6	10.0								0.4-5.9 Dense, Moist, Brown, SILTY SAND (SM)	
							1							
							2							
							3							
							4							
							5				22		5.9-14.0-Medium Dense to Dense	SC
													Moist, Olive Brown to Dark Brown	
				/7.3	24.4		6						SILTY CLAYEY SAND (SC)	
													FeOx Mottling 6.4 feet bgs	
							7						Dark Reddish Brown staining	
											21			
							8							
							9							
							10				35		10.0-11.5 Mottling, less than above,	
													slight gleyed color	
							11							
							12						12.5-14.0 Mottling and with fine gravel	
											35			
							13							
							14							
							15							
							16							
							17							
							18							
							19							
							20							

Notes: High groundwater inferred to be as little as 6.4 feet, may reflect pre Carson City development level.

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Location of Test Pit: Washington Street

Project No: 14-296.1	Project Name: E/W Trans. Main	Location: Washington Street, Carson City
Boring No: BH-2	Coordinates:	Started Time: 10.05 am Date: 1-7-2015
Elevation: Total Depth: 1.6'	GWL: NA Depth:	Completed Time: 11:20 am Date: 1-7-2015
Engineer/Geologist: G. Luce	Date/Time:	Backfilled Time: Date:
Drill Rig Type: CME 55	Drilling Contractor: Andresen	Driller: Jose

SAMPLE DEPTH	SAMPLE TYPE	DRILLING RATE	LL/PI	DD/%M	-200	ATTERBERG LIMITS	DEPTH	SAMPLE	GRAPHIC LOG	BLOWS	N	RECOVERY	DESCRIPTION	USCS
													0.0-0.4 AC 5.5 inches (1.0 inch stripped)	SM
				/6.4	17.7		1						04- 1.5 Medium Dense, Moist, Dark Grayish Brown SILTY SAND (SM)	
							2						1.6 REFUSAL - Dark Greenish Gray, Metamorphosed ANDESITE COBBLE ROCK FILL	
							3							
							4							
							5							
							6							
							7							
							8							
							9							
							10							
							11							
							12							
							13							
							14							
							15							
							16							
							17							
							18							
							19							
							20							

Notes: Three attempts were made to advance boring (5 foot spacing).
All boring attempts met refuals on cobble rock fill.

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Location of Test Pit: Washington Street

Project No: 14-296.1	Project Name: E/W Trans. Main	Location: Washington Street, Carson City
Boring No: BH-3	Coordinates:	Started Time: 1:32 pm Date: 1-7-2015
Elevation: Total Depth: 14.0'	GWL: NA Depth:	Completed Time: 2:30 pm Date: 1-7-2015
Engineer/Geologist: G. Luce	Date/Time:	Backfilled Time: Date:
Drill Rig Type: CME 55	Drilling Contractor: Andresen	Driller: Jose

SAMPLE DEPTH	SAMPLE TYPE	DRILLING RATE	LL/PI	DD/%M	-200	ATTERBERG LIMITS	DEPTH	SAMPLE	GRAPHIC LOG	BLOWS	N	RECOVERY	DESCRIPTION	USCS
													0.0-0.3 AC 4.0 Inches	SM
				/10.3	30.5		1						0.3- 6.0 Dense, Moist, V. Dark Gray	
													SILTY SAND (SM) with Fine Gravel	
							2							
				/10.0	35.5									
							3				9			
													CLAYEY SAND (SC) lens @ 3.8-4.0	SC
							4							
							5							
				/13.1	46.5						12		5.9-9.0- Medium Dense to Dense,	SM
							6						Moist, Grayish Brn. To Dark Brn.	
													SILTY SAND (SM)	
							7							
							8				24			
													FeOx Mottling 8.5-9.0	
							9						9.0-14.0 Medium Dense, Moist, Dark Yellowish	SC SM
							10						Brown CLAYEY SAND TO SILTY SAND (SC-SM)	
											20			
							11							
							12							
							13				22			
							14							
							15							
							16							
							17							
							18							
							19							
							20							

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Location of Test Pit: Washington Street

Project No: 14-296.1	Project Name: E/W Trans. Main	Location: Washington Street, Carson City
Boring No: BH-4	Coordinates:	Started Time: 3:10 pm Date: 1-7-2015
Elevation: Total Depth: 14.0'	GWL: NA Depth:	Completed Time: 4:15 pm Date: 1-7-2015
Engineer/Geologist: G. Luce	Date/Time:	Backfilled Time: Date:
Drill Rig Type: CME 55	Drilling Contractor: Andresen	Driller: Jose

SAMPLE DEPTH	SAMPLE TYPE	DRILLING RATE	LL/PI	DD/%M	-200	ATTERBERG LIMITS	DEPTH	SAMPLE	GRAPHIC LOG	BLOWS	N	RECOVERY	DESCRIPTION	USCS
													0.0-0.3 AC 3.5 Inches (Striping noted)	SM
							1						0.3- 6.0 Dense, Moist, Very Dark Grayish Brown	
													SILTY SAND (SM) with Gravel	
							2							
				/7.1	16.7									
							3				4			
							4							
							5							
				/9.6	21.1						6			
							6						6.0-12.8 Loose to Medium Dense, Moist	SM SC
													Dark Yellowish Brown, SILTY SAND TO	
							7						CLAYEY SAND (SM-SC)	
							8				15			
							9							
							10							
			23/1	/15.6	47.5						17			
							11							
							12							
													12.8-14.0 Dense, Moist, Reddish Brown	SM
							13				46		SILTY SAND (SM) with gravel	
													Moderate FeOx Mottling	
							14							
							15							
							16							
							17							
							18							
							19							
							20							

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UNIFIED SOIL CLASSIFICATION ANS SYMBOL CHART

COARSE-GRAINED SOILS

(more than 50% of material is larger than No. 200 sieve size.)

GRAVELS More than 50% of coarse fraction larger than No. 4 sieve size	Clean Gravels (Less than 5% fines)	**GW**	**Well-graded gravels, gravel-sand mixtures, little or no fines**
		GP	**Poorly-graded gravels, gravel-sand mixtures, little or no fines**
	Gravels with fines (More than 12% fines)	**GM**	**Silty gravels, gravel-sand-silt mistures**
		GC	**Clayey gravels, gravel-sand-clay mixtures**
SANDS 50% or more of coarse fraction smaller than No. 4 sieve size	Clean Gravels (Less than 5% fines)	**SW**	**Well-graded gravels, gravel-sand mixtures, little or no fines**
		SP	**Poorly-graded gravels, gravel-sand mixtures, little or no fines**
	Sands with fines (More than 12% fines)	**SM**	**Silty gravels, gravel-sand-silt mistures**
		SC	**Clayey gravels, gravel-sand-clay mixtures**

FINE-GRAINED SOILS

(50% or more of material is smaller than No. 200 sieve size.)

SILTS AND CLAYS Liquid limit less than 50%	**ML**	Inorganic silts and very fine sands, rock flour, silty of 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 silts and organic silty clays of low plasticity
SILTS AND CLAYS Liquid limit 50% or greater	**MH**	Inorganic silts, micaceous or diatomaceous 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

☒ Bulk / Bag Sample

▼ Stabilized Ground water

14-296 Manhard Consulting
East West Waterline – Washington Street
Pavement Condition Review- K. Garcia, PE Senior Engineer

Phillips to Nevada (PASER rating 3-4)

Severe deterioration in travel way

- Wheelpath failures
- Alligator cracking
- Base failure areas
- Moderate flushing
- Moderate rutting

Significantly better condition at shoulders, however, there is patching. Structural failure of travelways warrants reconstruction. Depending on alignment and width of trench at surface, may be able to salvage shoulder paving with mill and overlay.

Nevada to Carson (Paser Rating 4)

Overall appearance better than segment to West. Appears to have been overlaid approximately 4-5 years ago. Alligator cracking reflecting through indicating base failure in the wheelpaths. Same recommendation as above.

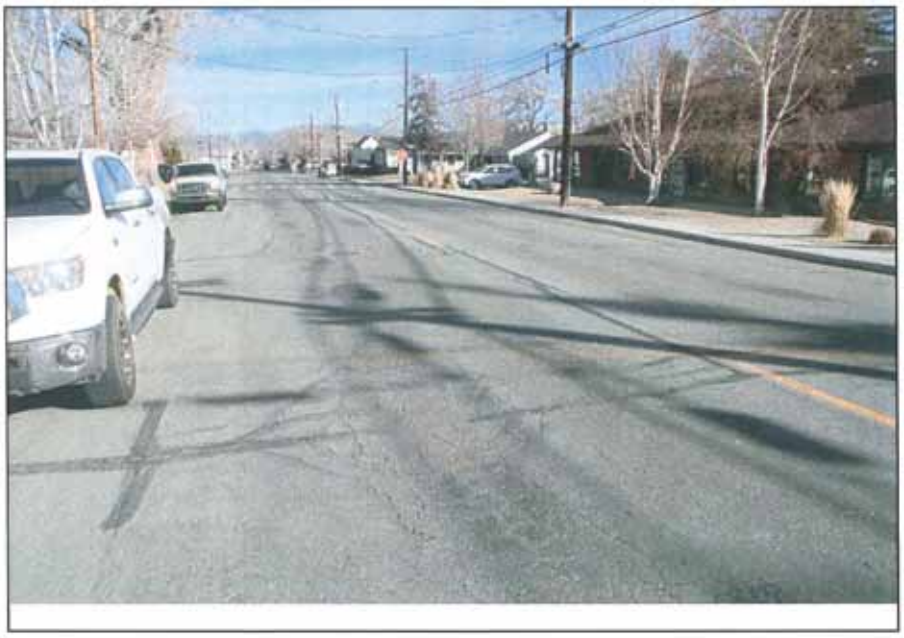
Carson to Stewart (Paser Rating 5)

Block cracking and trenchlines have been sealed. Rutting, alligator cracking or wheelpath failures not observed with exception of WB lane west of Plaza. Cracking at intersection with Stewart appears to be primarily related to loop detector installation. Recommend mill and overlay with dig-outs and patching at isolated locations, depends on trench alignment.

Stewart to Roop (Paser Rating 6)

Block cracking and trenchlines have been sealed. WB lane from Roop to Walsh in very good condition. Some longitudinal cracking behind Smith's (beginning of wheelpath failure from truck traffic?) and alligator cracking at intersection with Stewart. Recommend mill and overlay with dig-outs and patching at isolated locations, depends on trench alignment.

Photograph #1
View facing west from Minnesota St. to Phillips St. Alligator cracking in foreground.



Photograph #2
View looking east from northeast corner of Minnesota and Washington toward Division.

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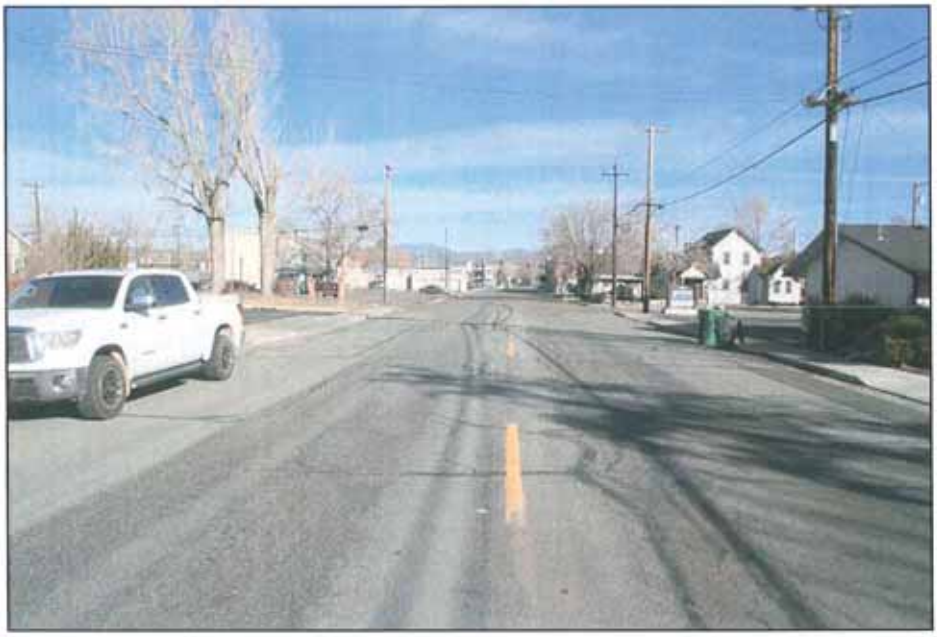
SITE PHOTOGRAPHS 1 and 2

EAST/WEST WATER
TRANSMISSION MAIN
CARSON CITY, NEVADA

PROJECT NO. 14-296.1



Photograph #3
View facing east from Division St. towards N. Nevada St. Alligator cracking in foreground.

Photograph #4
View looking east of rutting in east bound lane at N. Division St..

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SITE PHOTOGRAPHS 3 and 4

EAST/WEST WATER
TRANSMISSION MAIN
CARSON CITY, NEVADA

PROJECT NO. 14-296.1

Photograph #5
View facing east from Division St. towards N. Nevada St. north side of street.

Photograph #6
View looking west of patching and cracking in west bound lane at N. Curry St. looking towards N. Division St.

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SITE PHOTOGRAPHS 5 and 6

EAST/WEST WATER
TRANSMISSION MAIN
CARSON CITY, NEVADA

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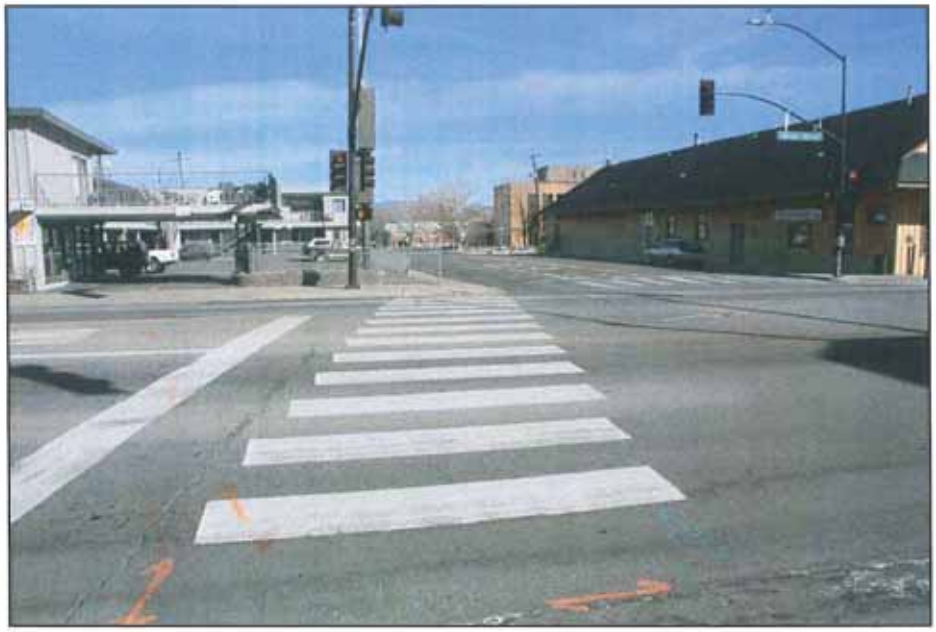
Photograph #7
View facing east from SE corner of N. Curry St. towards Carson St. showing rutting in east bound lane.



Photograph #8
View facing east from NE corner of Carson Street and Washington St.

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SITE PHOTOGRAPHS 7 and 8

EAST/WEST WATER
TRANSMISSION MAIN
CARSON CITY, NEVADA

PROJECT NO. 14-296.1

Photograph #9
View facing west from NW corner of N. Curry St. towards N. Nevada St. showing chip seal surface and existing transverse and longitudinal cracking w/ alligator cracking as well.

Photograph #10
View facing east from NE corner of Carson Street and Washington St.

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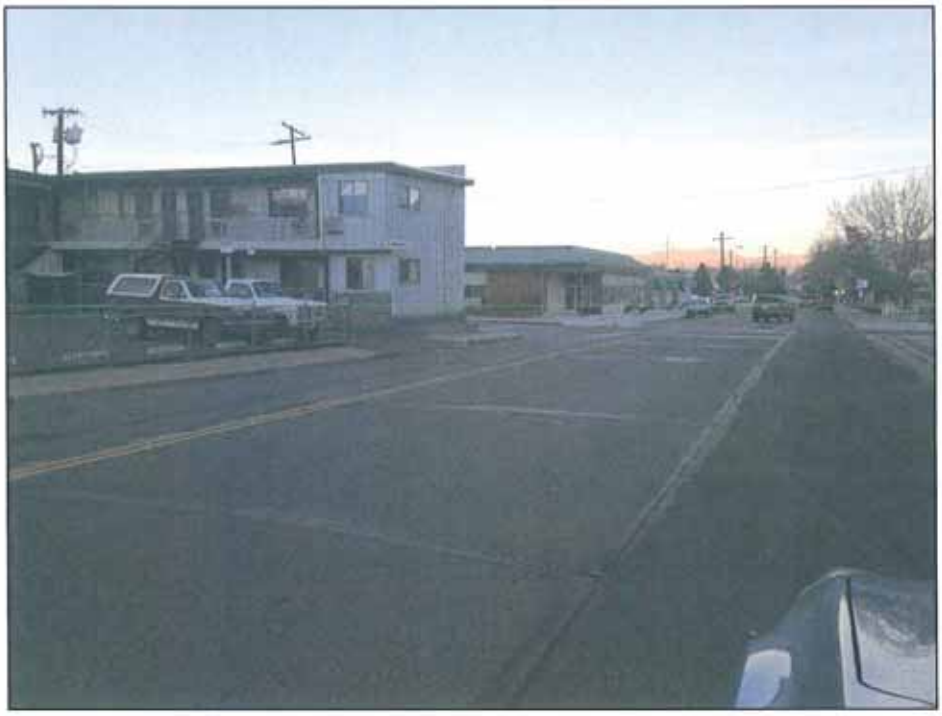
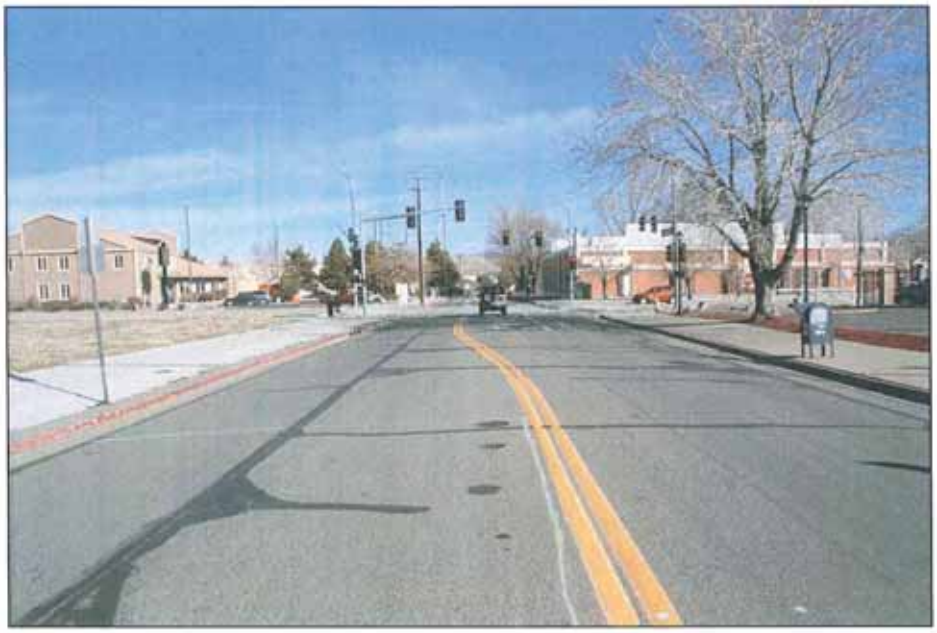
SITE PHOTOGRAPHS 9 and 10

EAST/WEST WATER
TRANSMISSION MAIN
CARSON CITY, NEVADA

PROJECT NO. 14-296.1



Photograph #11
View facing east from Carson Street towards Plaza St. showing cracking and patching.



Photograph #12
View looking east from Plaza Street to Stewart Street. Area where cobble rock fill was encountered.

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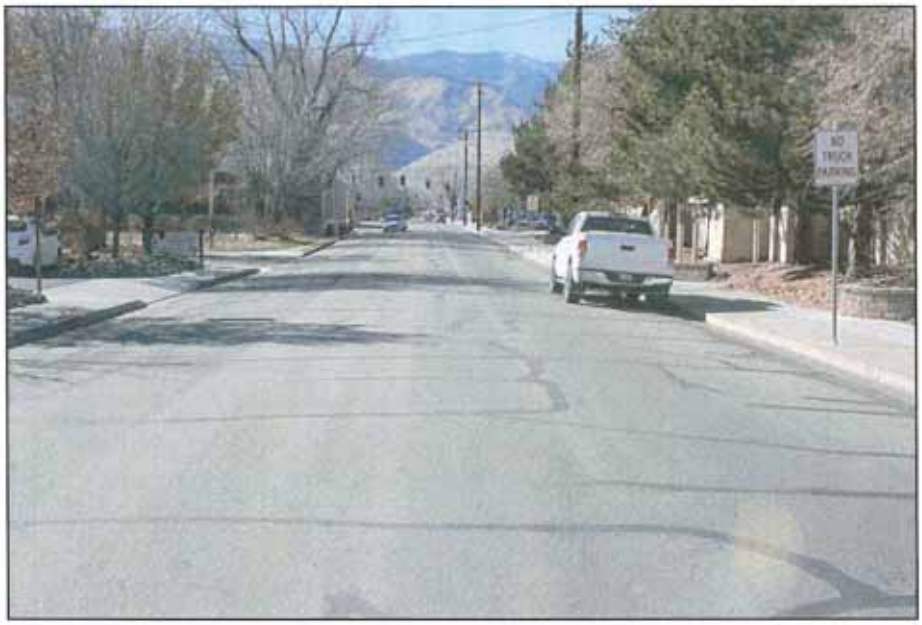
SITE PHOTOGRAPHS 11 and 12

EAST/WEST WATER
TRANSMISSION MAIN
CARSON CITY, NEVADA

PROJECT NO. 14-296.1



Photograph #13
View facing west from W. Walsh Street towards Anderson St. showing cracking and utility patching.

Photograph #14
View looking east from W. Walsh St. towards Roop St. with fiber optic trench patch in eastbound lane near centerline.

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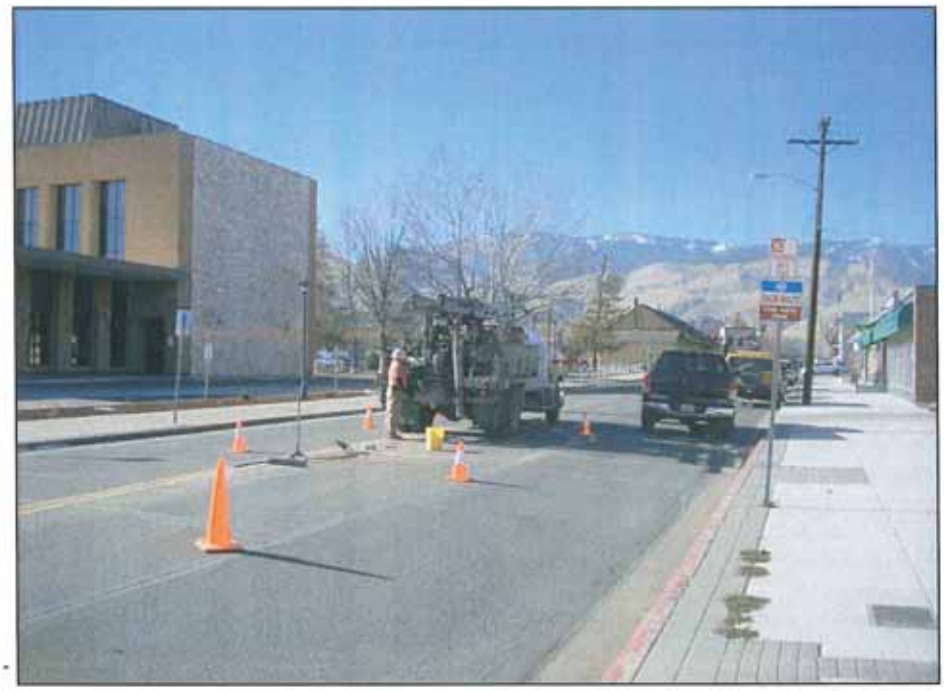
SITE PHOTOGRAPHS 13 and 14

EAST/WEST WATER
TRANSMISSION MAIN
CARSON CITY, NEVADA

PROJECT NO. 14-296.1

Photograph #15



Photograph #16

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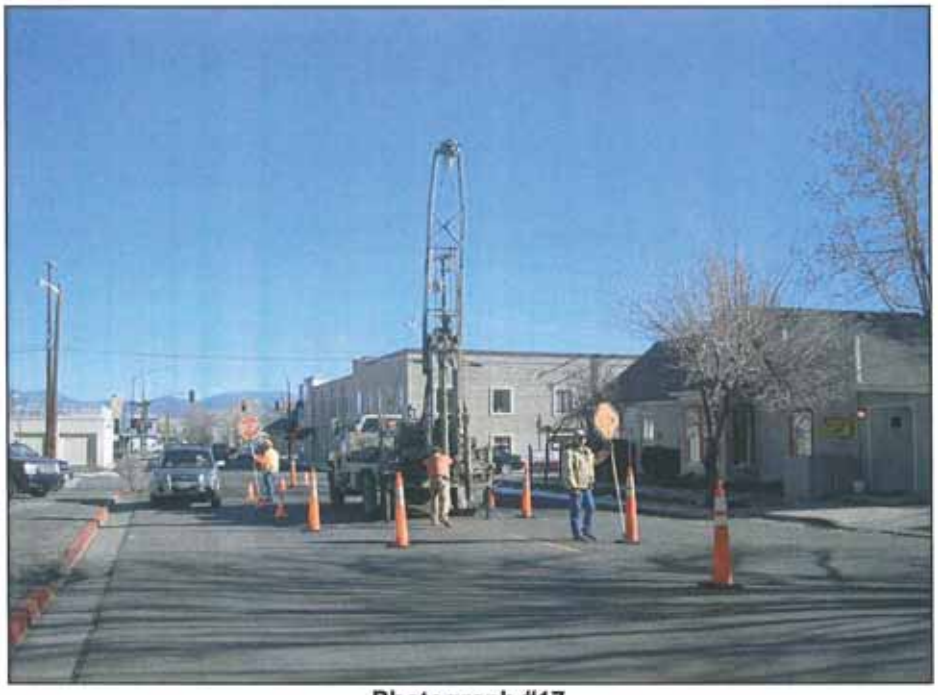
SITE PHOTOGRAPHS 15 and 16

EAST/WEST WATER
TRANSMISSION MAIN
CARSON CITY, NEVADA

PROJECT NO. 14-296.1



Photograph #17

Photograph #18

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SITE PHOTOGRAPHS 17 and 18

EAST/WEST WATER
TRANSMISSION MAIN
CARSON CITY, NEVADA

PROJECT NO. 14-296.1

APPENDIX B

LABORATORY TESTING

Laboratory tests were performed in accordance with generally accepted test methods of the American Society for Testing and Materials (ASTM) or other suggested procedures. Selected soil samples were tested for their moisture content, grain-size distribution and pavement support characteristics (R-Value).

The remaining soil samples are stored in our laboratory for future reference and analysis if needed. Unless notified to the contrary, all samples will be disposed of 60 days from the date of this report.

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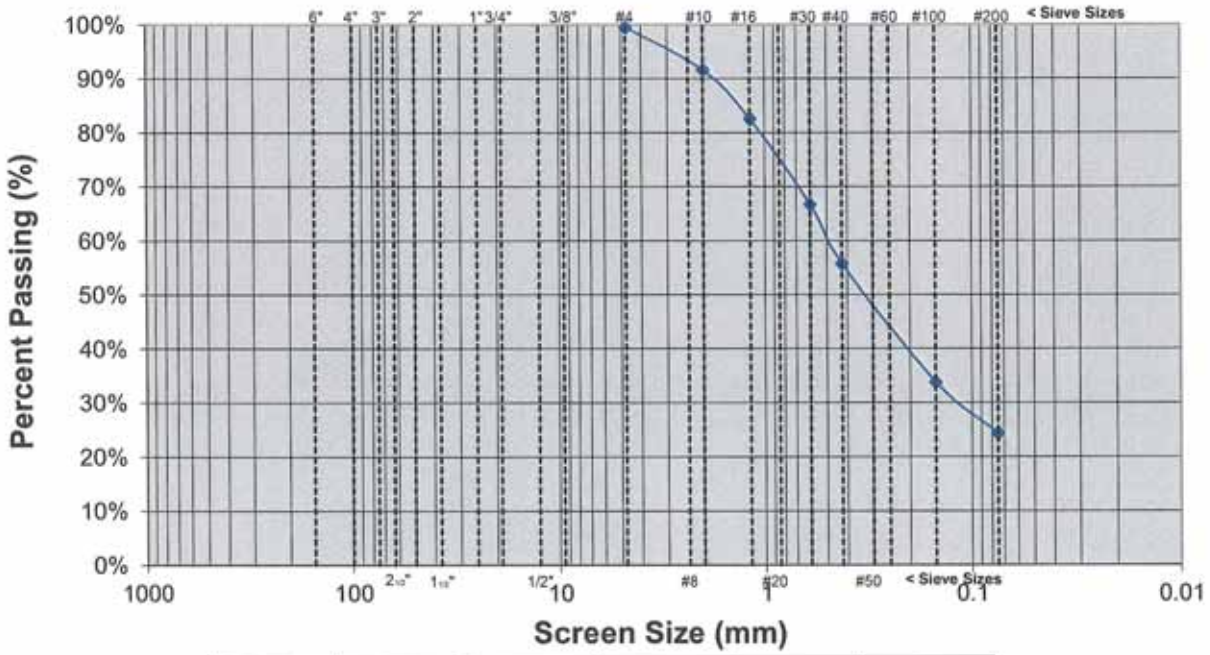
4010 Technology, Unit Dcarson City, NV
775-888-9900 ofc/775/888-9904 fax

Project:	East West Water Line
Project No:	14-296.1
Lab No:	CC084
Date Sampled:	1/7/2015
Date Tested:	1/21/2015
Sample No:	BH-01 @ 5.9-6.5
Material Desc:	Clayey Sand (SC)
	2.5Y 4/3 Olive Brown

Sieve Analysis-ASTM C136/AASHTO T27

Soil Gradation



Tr & Wt Samp:	522.2
Tr & Dry Samp:	501.9
Water Loss:	20.3
Tare Weight:	222.6
Dry Weight:	279.3
% Moisture:	7.3%

Sieve Size	Percent Passing	Specification	
6"			GRAVEL %
4"			
3"			
2 1/2"			
2"			
1 1/2"			
1"			
3/4"			
1/2"			
3/8"	100%		
#4	100%		
#8			SAND %
#10	92%		
#16	83%		
#20			
#30	67%		
#40	56%		
#50			
#60			
#100	33.8%		
#200	24.4%		
			FINES %

Resource Concepts Inc
4010 Technology, Unit Dcarson City, NV
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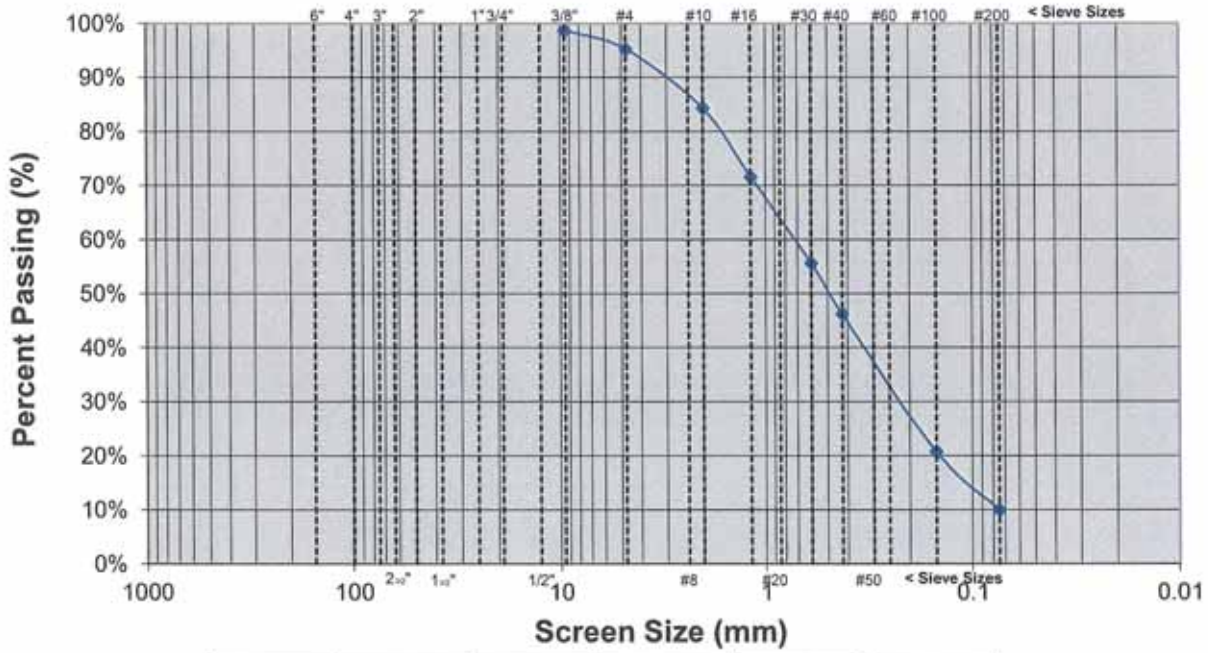
Project:	East West Water Line
Project No:	14-296.1
Lab No:	CC084
Date Sampled:	1/7/2015
Date Tested:	1/21/2015
Sample No:	BH-01 @ 0.5-1.0
Material Desc:	Silty Sand (SM)
	10YR 4/3 Brown

Sieve Analysis-ASTM C136/AASHTO T27

Soil Gradation



Tr & Wt Samp:	543.6
Tr & Dry Samp:	536
Water Loss:	7.6
Tare Weight:	244
Dry Weight:	292
% Moisture:	2.6%

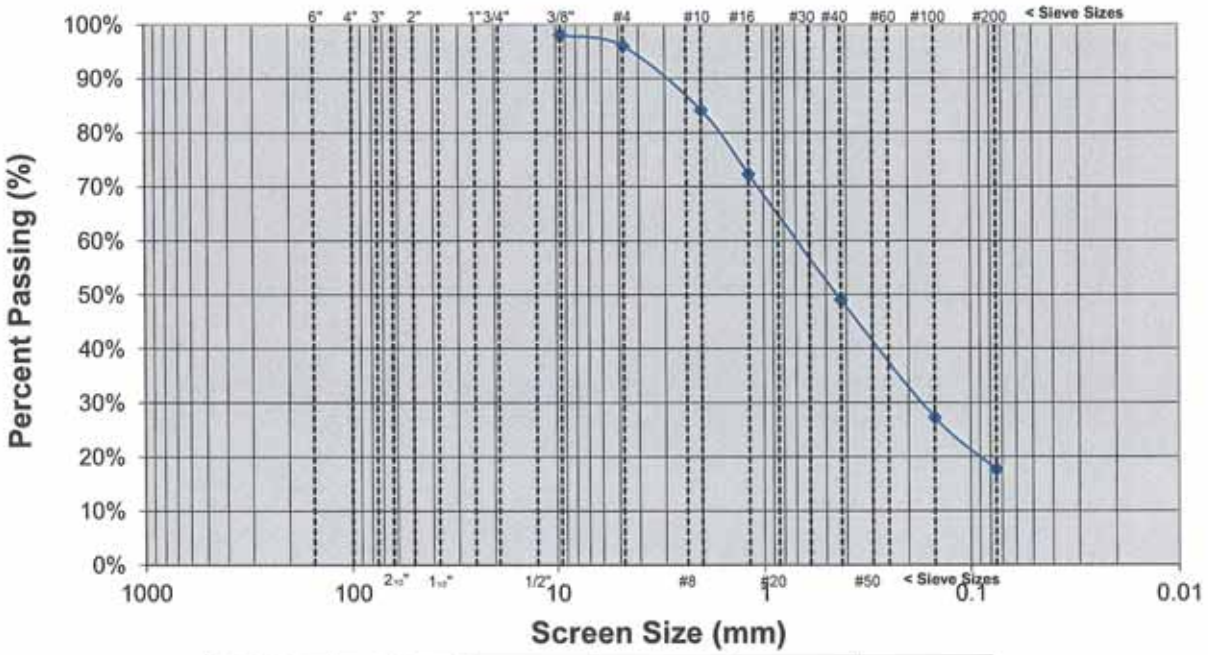
Sieve Size	Percent Passing	Specification	
6"			GRAVEL %
4"			
3"			
2 1/2"			
2"			
1 1/2"			
1"			
3/4"			
1/2"			
3/8"	99%		
#4	95%		
#8			SAND %
#10	84%		
#16	72%		
#20			
#30	56%		
#40	46%		
#50			
#60			
#100	20.8%		
#200	10.0%		
			FINES %

Resource Concepts Inc
4010 Technology, Unit Dcarson City, NV
775-888-9900 ofc/775/888-9904 fax

Project:	East West Water Line
Project No:	14-296.1
Lab No:	CC084
Date Sampled:	1/7/2015
Date Tested:	1/21/2015
Sample No:	BH-02 @ 0.5-1.5
Material Desc:	Silty Sand (SM)
	10YR 3/1 Dark Brown

Sieve Analysis-ASTM C136/AASHTO T27

Soil Gradation



Tr & Wt Samp:	529.3
Tr & Dry Samp:	511.3
Water Loss:	18
Tare Weight:	230.8
Dry Weight:	280.5
% Moisture:	6.4%

Sieve Size	Percent Passing	Specification	
6"			GRAVEL %
4"			
3"			
2 1/2"			
2"			
1 1/2"			
1"			
3/4"			
1/2"			
3/8"	98%		
#4	96%		
#8			SAND %
#10	84%		
#16	72%		
#20			
#30	58%		
#40	49%		
#50			
#60			
#100	27.3%		
#200	17.7%		
			FINES %

Resource Concepts Inc
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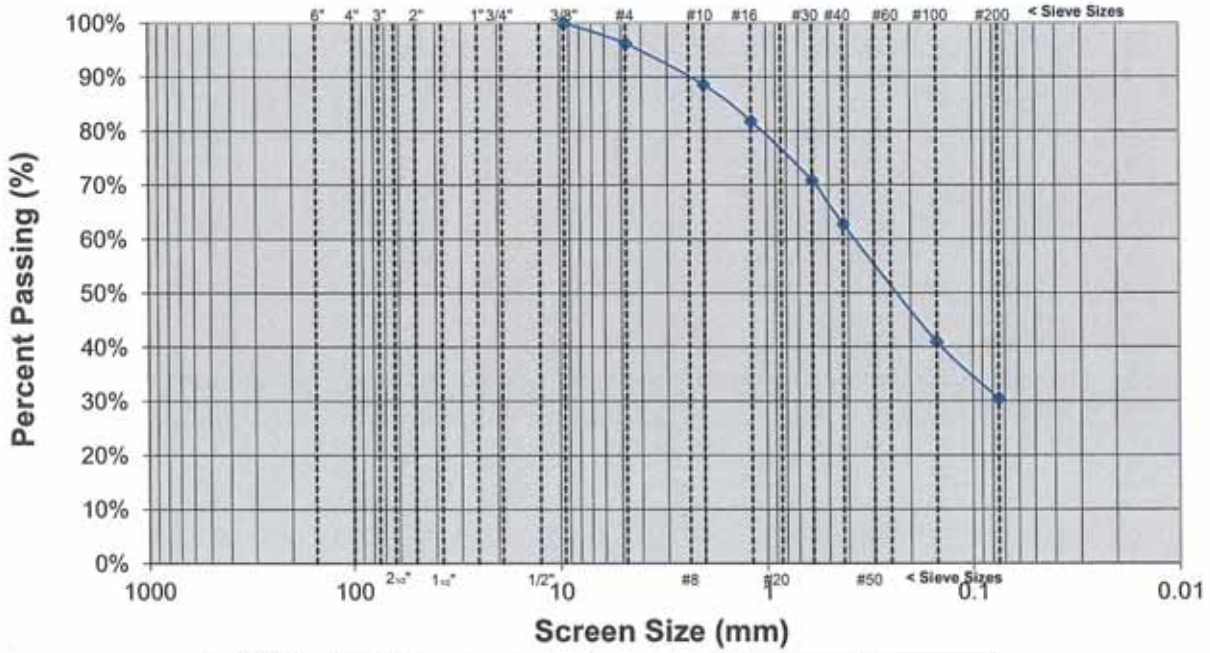
775-888-9900 ofc/775/888-9904 fax

Project:	East West Water Line
Project No:	14-296.1
Lab No:	CC084
Date Sampled:	1/7/2015
Date Tested:	1/21/2015
Sample No:	BH-03 @ 0.4-1.5
Material Desc:	Silty Sand (SM)
	7.5YR 2.5/1 Very Dark Brown

Sieve Analysis-ASTM C136/AASHTO T27

Soil Gradation



Tr & Wt Samp:	533.8
Tr & Dry Samp:	505.9
Water Loss:	27.9
Tare Weight:	234.4
Dry Weight:	271.5
% Moisture:	10.3%

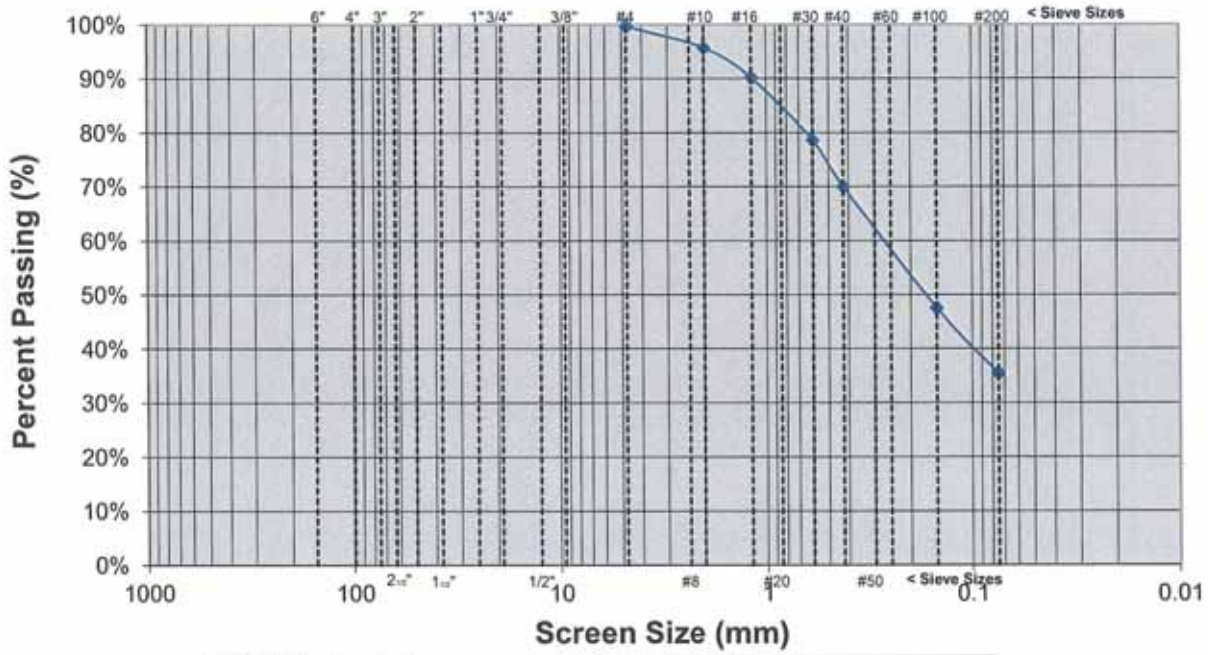
Sieve Size	Percent Passing	Specification	
6"			GRAVEL %
4"			
3"			
2 1/2"			
2"			
1 1/2"			
1"			
3/4"			
1/2"			
3/8"	100%		
#4	96%		
#8			SAND %
#10	89%		
#16	82%		
#20			
#30	71%		
#40	63%		
#50			
#60			
#100	41.0%		
#200	30.5%		
			FINES %

Resource Concepts Inc
4010 Technology, Unit Dcarson City, NV
775-888-9900 ofc/775/888-9904 fax

Project:	East West Water Line
Project No:	14-296.1
Lab No:	CC084
Date Sampled:	1/7/2015
Date Tested:	1/21/2015
Sample No:	BH-03 @ 2.5-3.7
Material Desc:	Silty Sand (SM)
	7.5YR 3/1 Very Dark Gray

Sieve Analysis-ASTM C136/AASHTO T27

Soil Gradation



Tr & Wt Samp:	569.5
Tr & Dry Samp:	542.2
Water Loss:	27.3
Tare Weight:	269.7
Dry Weight:	272.5
% Moisture:	10.0%

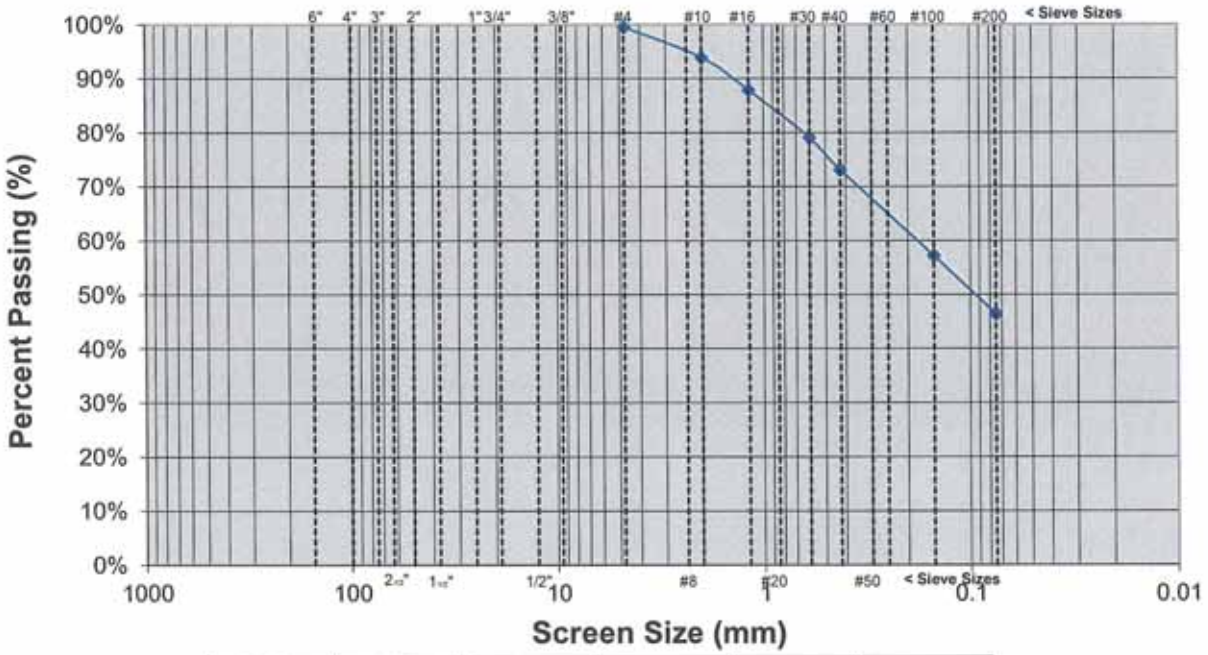
Sieve Size	Percent Passing	Specification	
6"			GRAVEL %
4"			
3"			
2 1/2"			
2"			
1 1/2"			
1"			
3/4"			
1/2"			
3/8"	100%		
#4	100%		
#8			SAND %
#10	96%		
#16	90%		
#20			
#30	79%		
#40	70%		
#50			
#60			
#100	47.6%		
#200	35.5%		
			FINES %

Resource Concepts Inc
4010 Technology, Unit Dcarson City, NV
775-888-9900 ofc/775/888-9904 fax

Project:	East West Water Line
Project No:	14-296.1
Lab No:	CC084
Date Sampled:	1/7/2015
Date Tested:	1/21/2015
Sample No:	BH-03 @ 5.0-6.0
Material Desc:	Clayey Sand (SC)
	7.5YR 3/2 Dark Brown

Sieve Analysis-ASTM C136/AASHTO T27

Soil Gradation



Tr & Wt Samp:	526.1
Tr & Dry Samp:	491.2
Water Loss:	34.9
Tare Weight:	225.8
Dry Weight:	265.4
% Moisture:	13.1%

Sieve Size	Percent Passing	Specification	
6"			GRAVEL %
4"			
3"			
2 1/2"			
2"			
1 1/2"			
1"			
3/4"			
1/2"			
3/8"	100%		
#4	100%		
#8			SAND %
#10	94%		
#16	88%		
#20			
#30	79%		
#40	73%		
#50			
#60			
#100	57.2%		
#200	46.5%		
			FINES %

Resource Concepts Inc
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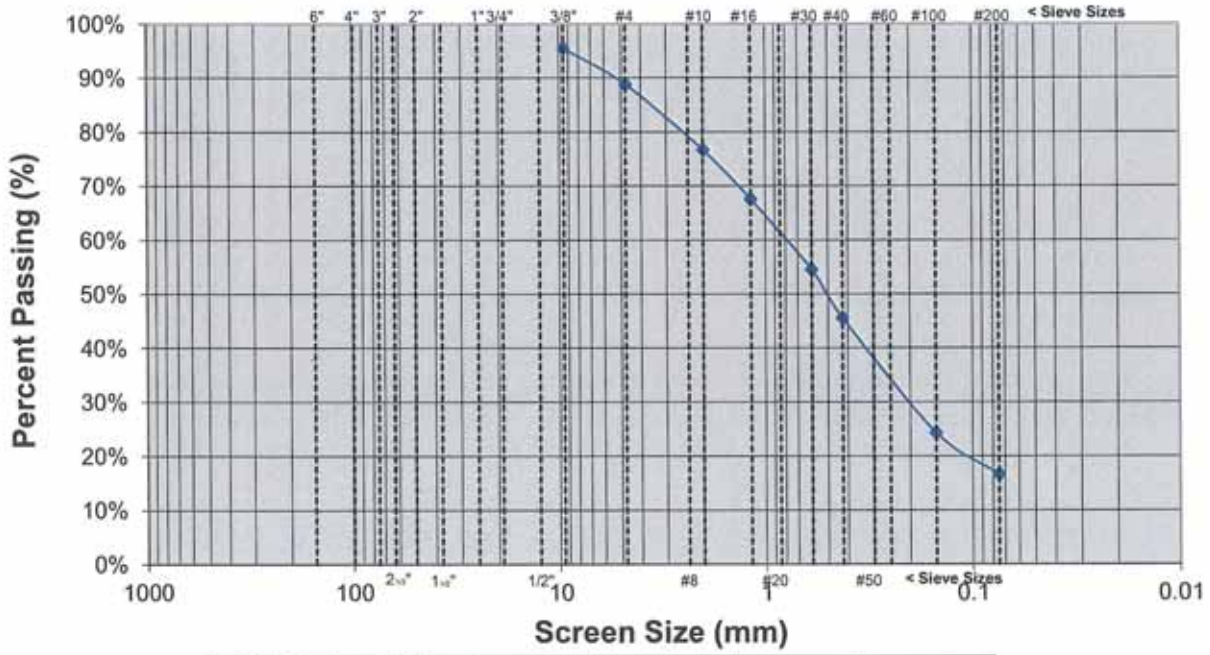
775-888-9900 ofc/775/888-9904 fax

Project:	East West Water Line
Project No:	14-296.1
Lab No:	CC084
Date Sampled:	1/7/2015
Date Tested:	1/21/2015
Sample No:	BH-04 @ 2.5-3.7
Material Desc:	Silty Sand (SM)
	10YR 3/2 Very Dark Grayish Brown

Sieve Analysis-ASTM C136/AASHTO T27

Soil Gradation



Tr & Wt Samp:	523.8
Tr & Dry Samp:	503.8
Water Loss:	20
Tare Weight:	223.7
Dry Weight:	280.1
% Moisture:	7.1%

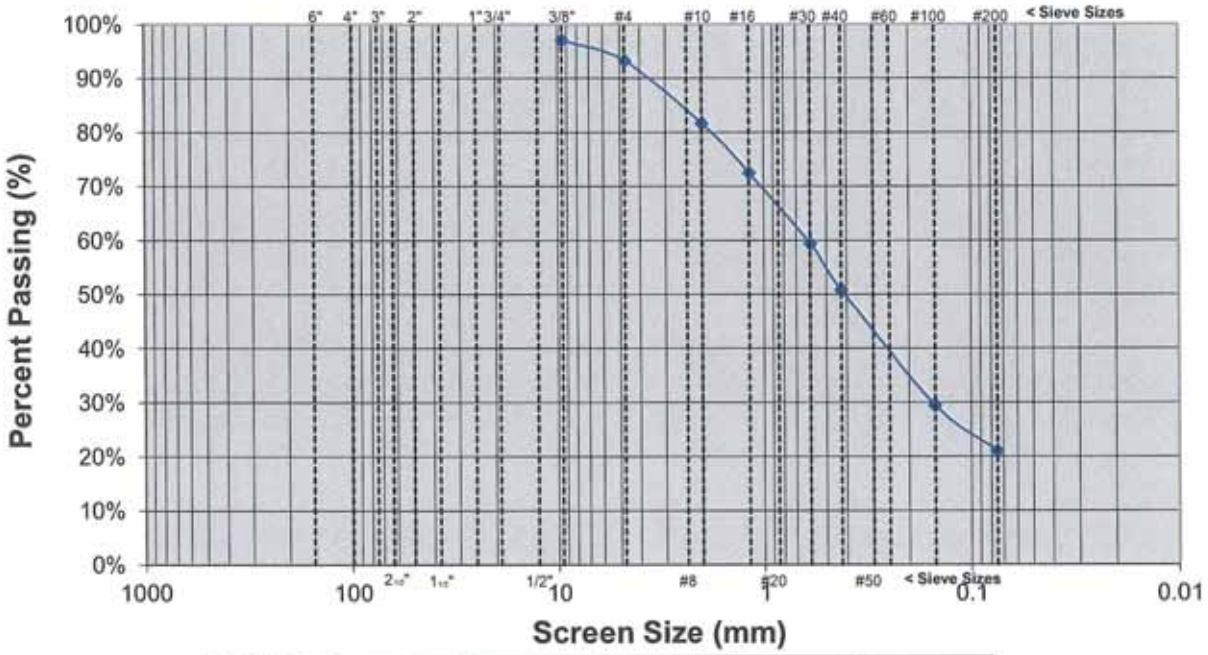
Sieve Size	Percent Passing	Specification	
6"			GRAVEL %
4"			
3"			
2 1/2"			
2"			
1 1/2"			
1"			
3/4"			
1/2"			
3/8"	96%		
#4	89%		
#8			SAND %
#10	77%		
#16	68%		
#20			
#30	55%		
#40	46%		
#50			
#60			
#100	24.3%		
#200	16.7%		
			FINES %

Resource Concepts Inc
4010 Technology, Unit Dcarson City, NV
775-888-9900 ofc/775/888-9904 fax

Project:	East West Water Line
Project No:	14-296.1
Lab No:	CC084
Date Sampled:	1/7/2015
Date Tested:	1/21/2015
Sample No:	BH-04 @ 5.0-5.6
Material Desc:	Silty Sand (SM)
	2.5Y 3/2 Very Dark Grayish Brown

Sieve Analysis-ASTM C136/AASHTO T27

Soil Gradation



Tr & Wt Samp:	571
Tr & Dry Samp:	544.6
Water Loss:	26.4
Tare Weight:	270.7
Dry Weight:	273.9
% Moisture:	9.6%

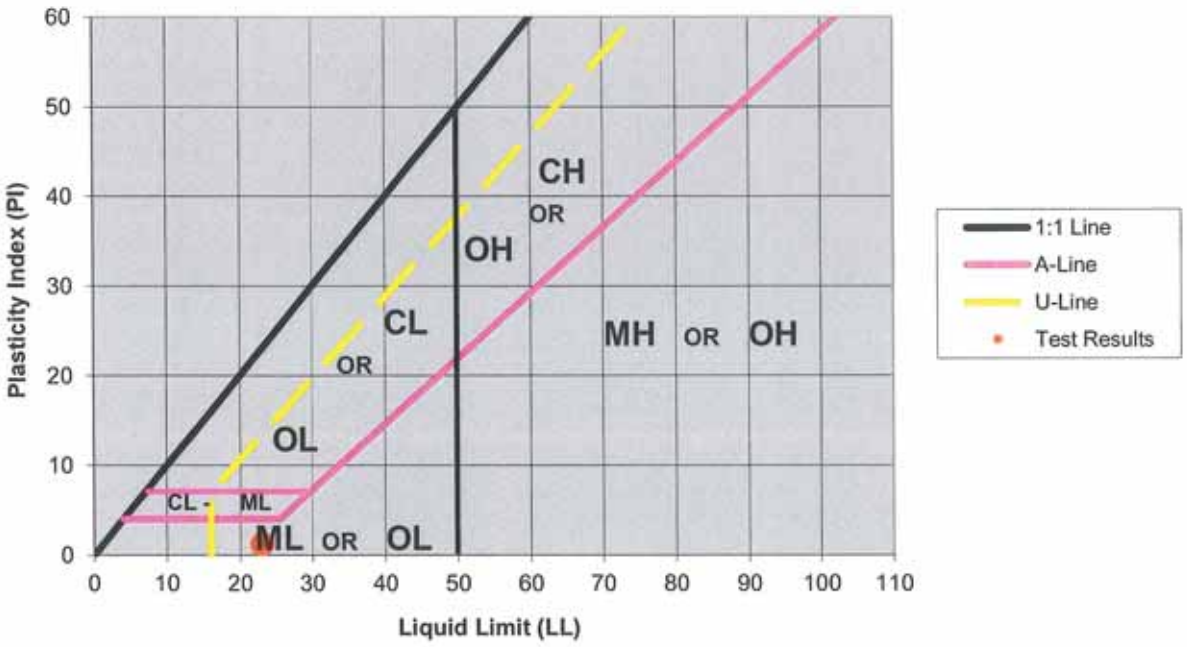
Sieve Size	Percent Passing	Specification	
6"			GRAVEL %
4"			
3"			
2 1/2"			
2"			
1 1/2"			
1"			
3/4"			
1/2"			
3/8"	97%		
#4	93%		
#8			SAND %
#10	82%		
#16	72%		
#20			
#30	59%		
#40	51%		
#50			
#60			
#100	29.5%		
#200	21.1%		
			FINES %

RESOURCE CONCEPTS INC

PLASTICITY INDEX

Project Name:		East West Water Line	
Project Number:		14-296.1	
Sample Number:		BH-4 10.4'-11.5'	
Date:	1/27/2015	By:	DE

Plasticity Chart (ASTM D2487)



LIQUID LIMIT	23
PLASTIC LIMIT	22
PLASTICITY INDEX	1

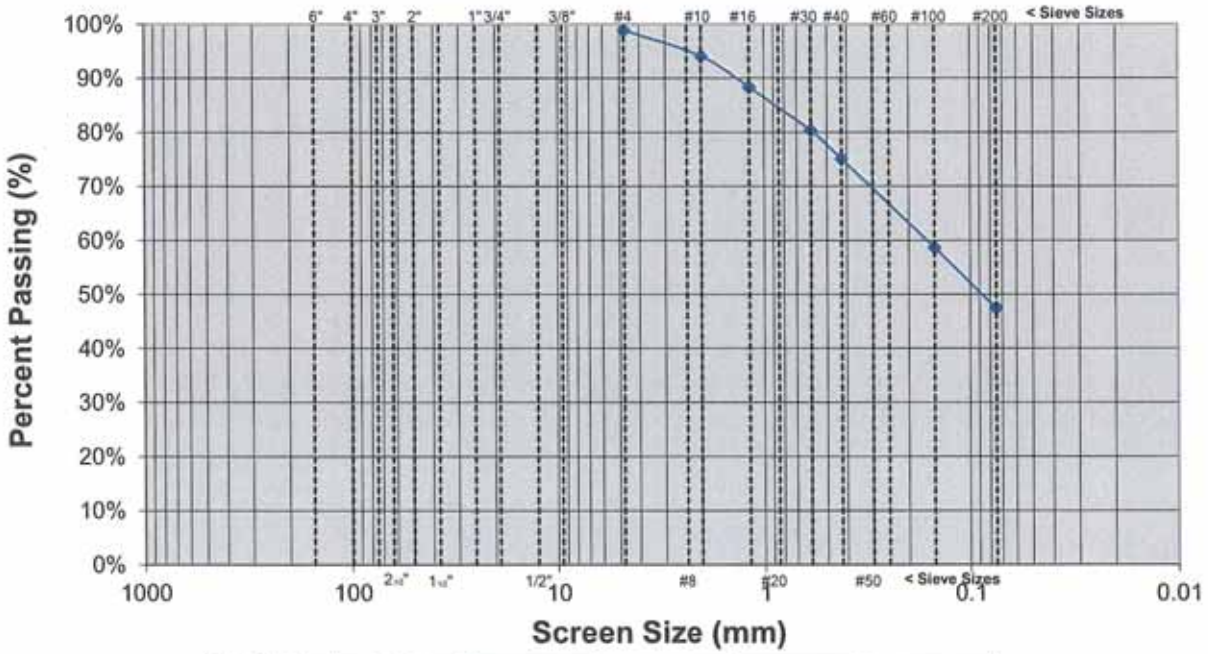
USCS Classification:
SM-SILTY SAND

Resource Concepts Inc
4010 Technology, Unit Dcarson City, NV
775-888-9900 ofc/775/888-9904 fax

Project:	East West Water Line
Project No:	14-296.1
Lab No:	CC084
Date Sampled:	1/7/2015
Date Tested:	1/21/2015
Sample No:	BH-04 @ 10.4-11.5
Material Desc:	Silty Sand (SM)
	2.5Y 4/2 Dark Grayish Brown

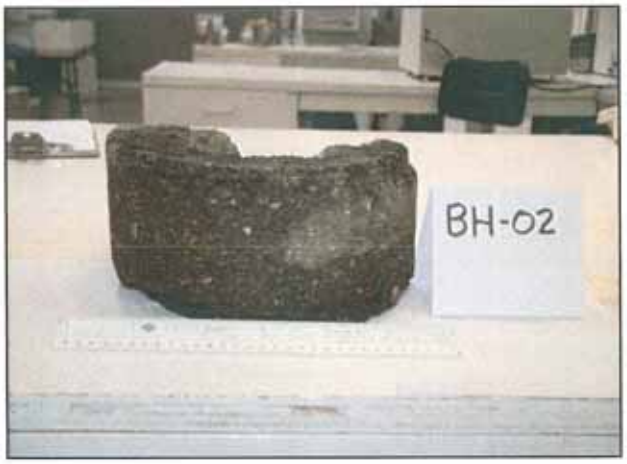
Sieve Analysis-ASTM C136/AASHTO T27

Soil Gradation



Tr & Wt Samp:	531.5
Tr & Dry Samp:	491
Water Loss:	40.5
Tare Weight:	231.6
Dry Weight:	259.4
% Moisture:	15.6%

Sieve Size	Percent Passing	Specification	
6"			GRAVEL %
4"			
3"			
2 1/2"			
2"			
1 1/2"			
1"			
3/4"			
1/2"			
3/8"	100%		
#4	99%		
#8			SAND %
#10	94%		
#16	88%		
#20			
#30	80%		
#40	75%		
#50			
#60			
#100	58.7%		
#200	47.5%		
			FINES %



Resource Concepts Inc
340 N. MINNESOTA ST. CARSON CITY, NV 89703
775 883-1600

GCL

PHOTOGRAPHS OF ASPHALT CORES

EAST/WEST WATER
TRANSMISSION MAIN
CARSON CITY, NEVADA

PROJECT NO. 14-296.1

Project:

East-West Water Line

Roop St. to Phillips St.

Core Sample: C1

Project:

East-West Water Line

Roop St. to Phillips St.

Core Sample: C2

Project:

East-West Water Line

Roop St. to Phillips St.

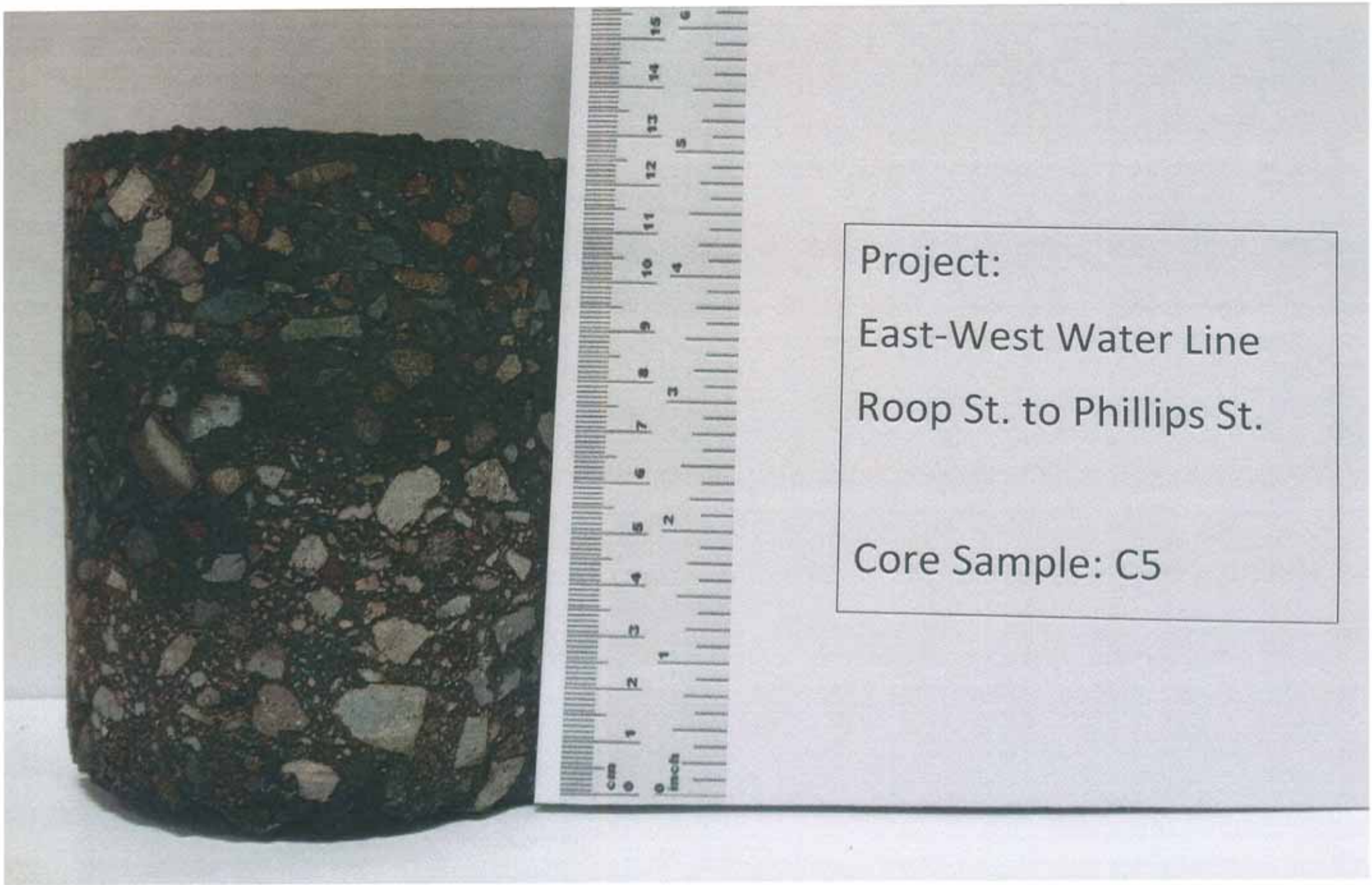
Core Sample: C3

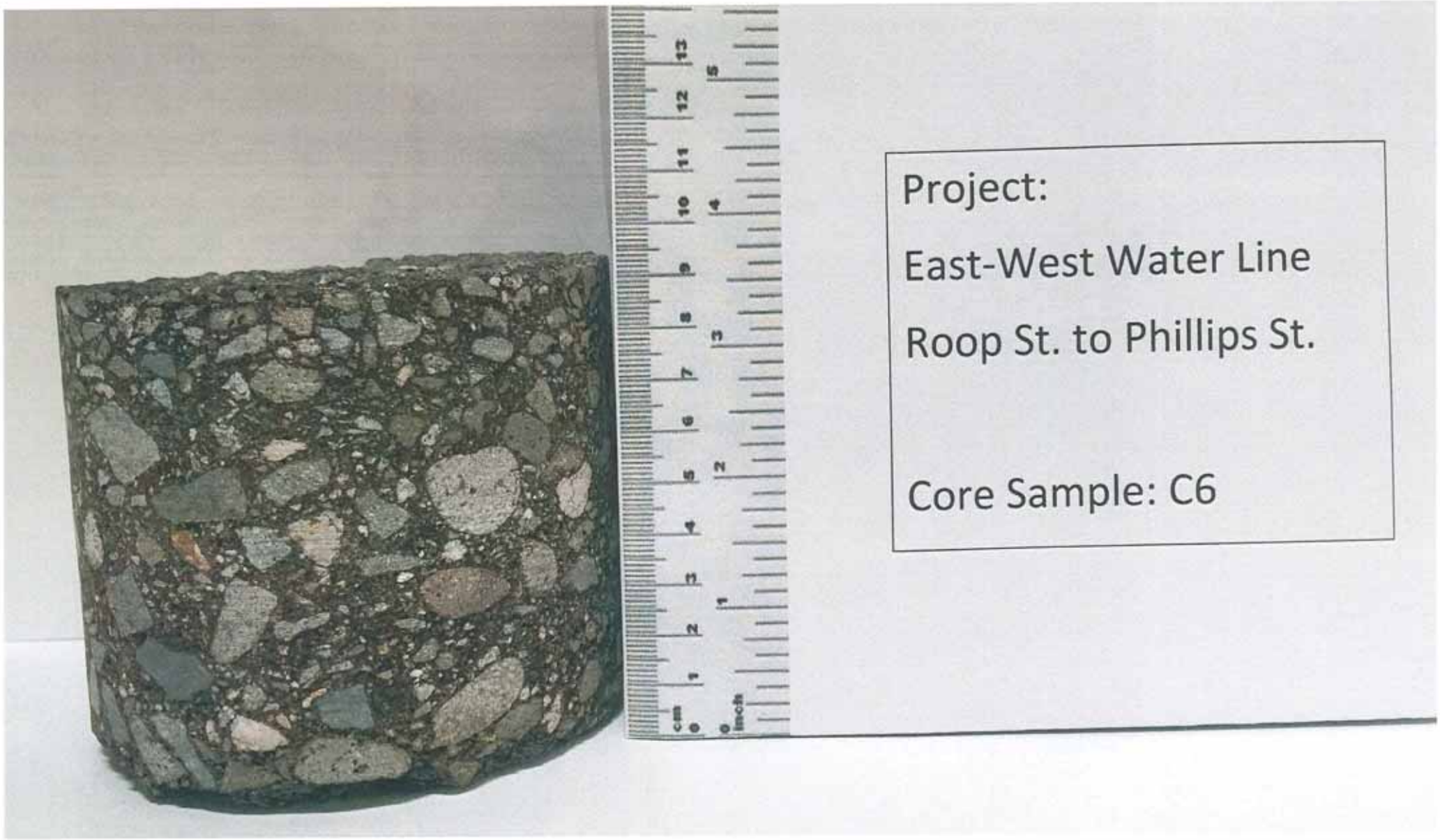
Project:

East-West Water Line

Roop St. to Phillips St.

Core Sample: C4


Project:
East-West Water Line
Roop St. to Phillips St.
Core Sample: C5

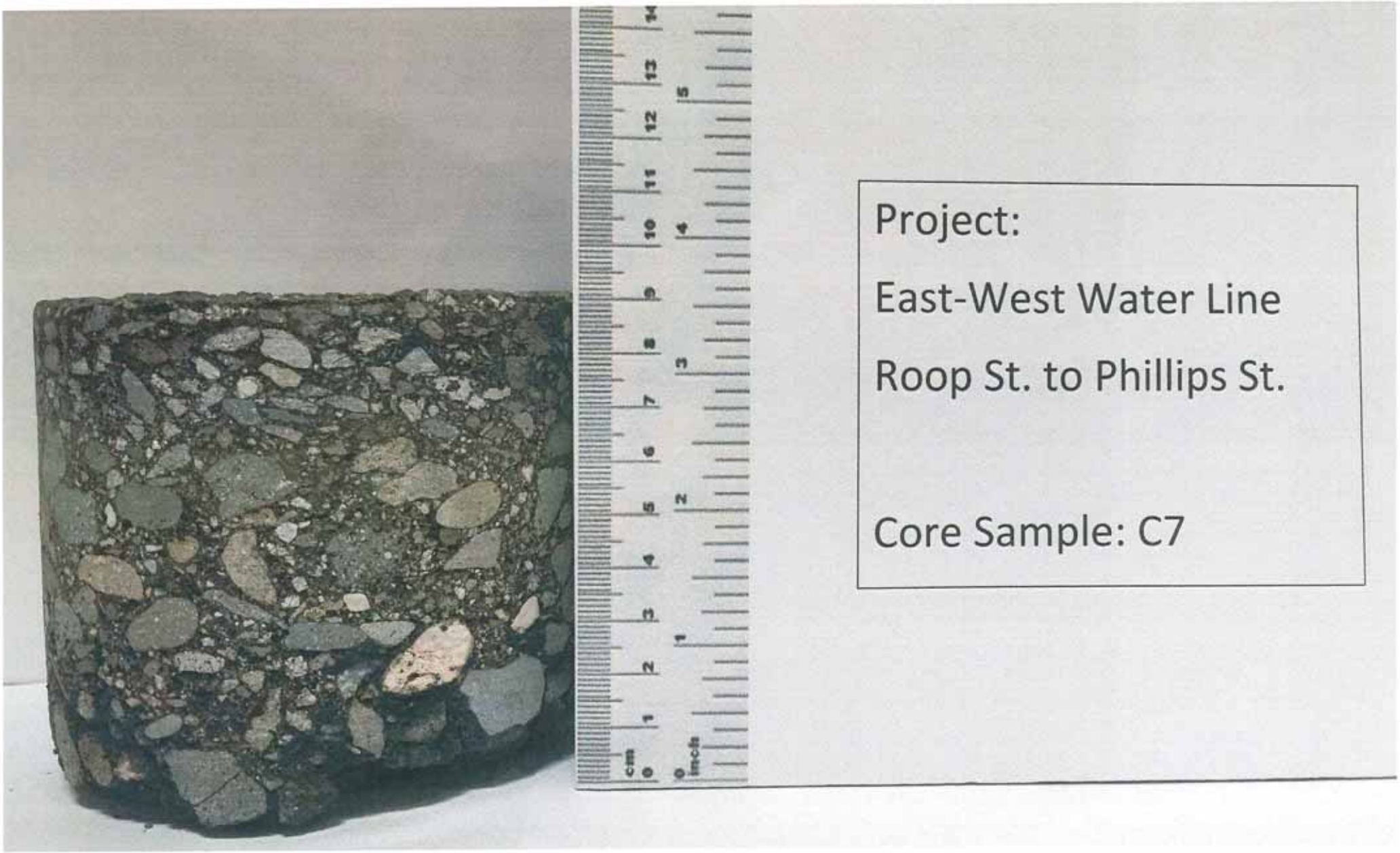


Project:

East-West Water Line

Roop St. to Phillips St.

Core Sample: C6



Project:

East-West Water Line

Roop St. to Phillips St.

Core Sample: C7

APPENDIX C

ENGINEERING ANALYSES

Design calculations were performed using the AASHTO method. Assumptions included in the calculation are discussed on page 14 of this report. The calculations are provided in this Appendix.

DETERMINATION OF EQUIVALENT AXLE LOAD
AND STRUCTURAL NUMBER

PROJECT: Washington Street DATE: Mar-15
JOB #:

LOCATION	East Washington St
2015 ADT	3,000
GROWTH RATE (%)	4.00
DESIGN LIFE (YRS)	20
GROWTH FACTOR	29.778
TOTAL VEHICLES (DESIGN LIFE)	3.26E+07
PER CENT TRUCKS	100
DIRECTIONAL SPLIT (%)	50
DESIGN LANE (%)	100
TRUCKS IN DESIGN LANE	16303498

DETERMINE EQUIVALENT SINGLE AXLE LOAD (ESAL's)

	%	TRUCK FACTOR	EASL
2-AXLE 4-TIRE	97.98	0.0004	6390
BUSES	0.51	0.8665	72048
2-AXLE 6-TIRE	1.19	0.2214	42954
3-AXLE SINGLE UNIT	0.12	0.7513	14699
4-AXLE SEMI-TRUCK	0.1	0.6317	10299
5-AXLE SEMI-TRUCK	0.07	1.0239	11685
6-AXLE SEMI-TRUCK	0	1.1451	0
5-AXLE MULTIPLE TRLR	0.01	1.6830	2744
6-AXLE MULTIPLE TRLR	0.01	0.9041	1474
7 AXLE MULTIPLE TRLR	0.01	2.1666	3532
	100		162292
.---> DESIGN ESAL (1,000,000)			0.16

. DETERMINE STRUCTURAL NUMBER

RELIABILITY:	0.85
STD DEVIATE(4.1):	-1.037
STD DEVIATION(So):	0.45
TERM SERVICEABILITY:	2.0
CBR	
Rvalue	45
Subgrade Modulus,Mr	26130
----> REQUIRED Structural Number, SN	1.5
.---> CALCULATED ESAL (1,000,000)	0.17

PAVEMENT TYPICAL SECTION:

MATERIAL	COEF.	DEPTH	SN
Asphalt	0.35	4.0	1.4
Aggregate Base	0.10	8.0	0.8
Sub-base	0.07		0.0
_____			0.0
------> CALCULATED Struc Number,SN			2.20

DETERMINATION OF EQUIVALENT AXLE LOAD
AND STRUCTURAL NUMBER

PROJECT: Washington Street DATE: Mar-15
JOB #:

	LOCATION	West Washington St
	2015 ADT	3,000
	GROWTH RATE (%)	4.00
	DESIGN LIFE (YRS)	20
	GROWTH FACTOR	29.778
	TOTAL VEHICLES (DESIGN LIFE)	3.26E+07
	PER CENT TRUCKS	100
	DIRECTIONAL SPLIT (%)	50
	DESIGN LANE (%)	100
	TRUCKS IN DESIGN LANE	16303498

DETERMINE EQUIVALENT SINGLE AXLE LOAD (ESAL's)

		%	TRUCK FACTOR	EASL
	2-AXLE 4-TIRE	97.98	0.0004	6390
	BUSES	0.51	0.8665	72048
	2-AXLE 6-TIRE	1.19	0.2214	42954
	3-AXLE SINGLE UNIT	0.12	0.7513	14699
	4-AXLE SEMI-TRUCK	0.1	0.6317	10299
	5-AXLE SEMI-TRUCK	0.07	1.0239	11685
	6-AXLE SEMI-TRUCK	0	1.1451	0
	5-AXLE MULTIPLE TRLR	0.01	1.6830	2744
	6-AXLE MULTIPLE TRLR	0.01	0.9041	1474
	7 AXLE MULTIPLE TRLR	0.01	2.1666	3532
		100		162292
.--->	DESIGN ESAL (1,000,000)			0.16

. DETERMINE STRUCTURAL NUMBER

.	RELIABILITY:	0.85	
.	STD DEVIATE(4.1):	-1.037	
.	STD DEVIATION(So):	0.45	
.	TERM SERVICEABILITY:	2.0	
.	CBR		
.	Rvalue		45
.	Subgrade Modulus,Mr		26130
---->	REQUIRED Structural Number, SN		1.5
.--->	CALCULATED ESAL (1,000,000)		0.17

PAVEMENT TYPICAL SECTION:

MATERIAL	COEF.	DEPTH	SN
Asphalt	0.35	4.0	1.4
Aggregate Base	0.10	8.0	0.8
Sub-base	0.07		0.0
			0.0
CALCULATED Struc Number,SN			2.20