Preliminary Geotechnical Investigation and Pavement Assessment

I-90 – Taft West

Mineral County, Montana

Yeh Project No.: 219-371
UPN: 9487000

December 22, 2020

Prepared for:

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12/22/2020

Table of Contents

List of Figures

List of Tables

List of Appendices

1 PURPOSE AND SCOPE OF STUDY

This report presents the results of our Preliminary Geotechnical Investigation and Pavement Assessment for Interstate 90 (I-90) from reference post (RP) 0 to 5.7, or Lookout Pass to the Taft Area in Mineral County, Montana. This work is part of the Montana Department of Transportation (MDT) Project UPN 9487000, Taft-West. The study was performed in general accordance with Yeh and Associates' (Yeh) Scope of Work dated June 25, 2020. Our work consisted of field exploration, laboratory testing, engineering analyses, and preparation of this report.

This report includes our preliminary recommendations for the geotechnical aspects of pavement design and construction for the project. The conclusions and recommendations stated in this report are based on the conditions found at the locations of our exploratory borings at the time our investigation was performed. Our findings, conclusions, and recommendations should not be extrapolated to other areas or used for other projects without our prior review. Furthermore, if the project site has been altered, they should not be used without Yeh and Associates' prior review to determine if these recommendations remain valid.

The purpose of this investigation was to evaluate the condition of the existing pavement and the geotechnical characteristics of the subsurface soils for site development and preliminary pavement design. The scope of work included the following tasks:

- A subsurface investigation of I-90 where accessible with a core machine and truck-mounted drill rig.
- Laboratory testing of the soils encountered during field exploration to evaluate relevant physical and engineering properties of the soil.
- Preparation of this report.

2 PROPOSED CONSTRUCTION

The I-90 – Taft West project consists of reconstruction of a 5.7-mile stretch of I-90 in Mineral County, Montana. The project includes the segment of I-90 that extends from Lookout Pass on the Idaho border southeast to the Taft Area (Figure 1). The proposed work will repair I-90 to current MDT design standards and includes drainage, environmental, traffic, and safety improvements. We understand existing pavement is deteriorating and needs to be replaced with a more durable pavement section.

3 SITE CONDITIONS AND GEOLOGIC SETTING

The 5.7-mile stretch of I-90 between RP 0.0 and RP 5.7 is located near the Montana-Idaho border in Mineral County, Montana. This is a principal arterial route located in forested, rugged, mountainous terrain within Lolo National Forest. The project generally parallels a portion of the St. Regis River from RP 1.7 to RP 5.7. The segment is a four-lane road that extends from Lookout Pass (Exit 0) southeast to the Taft exit near RP 5.7. The stretch of road at the west end of the project area is at an elevation of about 4,710 feet at Lookout Pass and slopes down generally to the east to an elevation of about 3,650 feet at the Taft exit. MDT owns and maintains the road and the posted speed limit is 70 miles per hour. The roadway in the project area includes three bridges. There is a ski and recreation area with associated buildings and parking on the west side of Lookout Pass. The Dena Mora Rest Area is located at RP 4.7, approximately one mile from the east end of the project, and includes paved parking and guest facilities on the north and south sides of the road. The Taft exit provides access to the Route of the Hiawatha biking and hiking trail. Other areas adjacent to the interstate are vacant land. There are ten significant rock cut slopes within the project area with two along the westbound lanes and eight along the eastbound lanes. These slopes are discussed in more detail under our Cut Slope Evaluation Report. The existing pavement is deteriorated and MDT has proposed to repair I-90 to be a more durable roadway.

3.1 Geologic Setting

Based on the 1999 Geologic map of the Montana part of the Wallace 30' x 60' quadrangle by Lonn and McFadden, the project area is in a complex geologic setting where two major tectonic features, Montana's western thrust belt and a series of faults known as the Lewis and Clark line, intersect. An east-west trending fault line crosses the project area north of the Dena Mora rest area and at the easternmost road cuts in this study (Figure 1). Evidence is lacking for Quaternary-age, or recent, movement along the faults. However, reported nearby seismic activity is generally attributed to deep mining activity (Stickney, et al, 2000). Because of the minor faulting and folding of the formations, the rock layers are tilted, or dipping in several directions at angles of 20 to 75 degrees. Lonn and McFadden mapped the project area as Precambrian-age sedimentary rock. As shown in Figure 1, representative rock in the project area includes gray to green siltite and argillite, which are fine-grained metasedimentary rock types, and white to purple quartzite of the Revett Formation(Yr) and the lower member of the Wallace Formation (Ywl). These formations can be up to 4,100 feet thick. The St. Regis Formation (Ysr) overlies the Revett Formation and contains layers of gray-purple to green

claystone and purple quartzite. Surficial deposits are mapped in eastern half of the project area as Quaternary age glacial till, which includes clay through boulder-sized material directly deposited by glaciers. Other surficial deposits observed include talus/colluvium of gravel to boulder size angular blocks of bedrock scattered on slopes and benches and in ditches. Artificial fill typical to roadway construction was also observed.

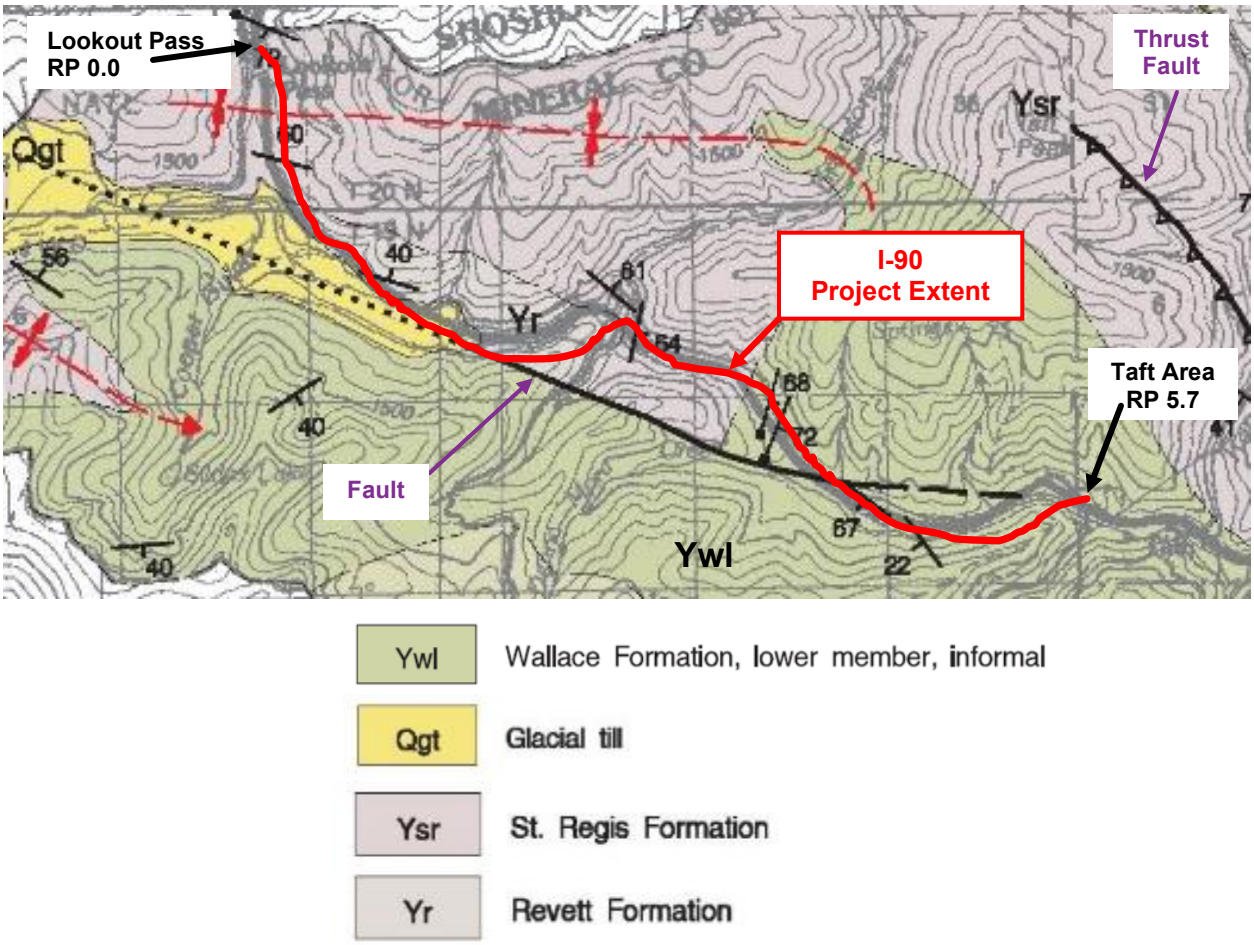

Figure 1 – Geologic map of the Montana part of the Wallace 30' x 60' quadrangle (Lonn, 1999)

4 SUBSURFACE INVESTIGATION

4.1 Field Exploration

On Wednesday July 29, 2020, Yeh completed a scoping trip to the site to identify potential boring locations and perform preliminary site reconnaissance. We returned to the site on September 2-4, 2020 to complete pavement coring and exploratory drilling and again on September 9-11, 2020 for field mapping of select cut slopes.

Yeh contracted A-Core Concrete Specialists (A-Core), to core the pavement at twenty-eight (28) locations, which included all eastbound and westbound pavement boring locations. A 6-inch diameter core barrel was used to retrieve asphalt and concrete cores. Yeh's drilling subcontractor, O'Keefe Drilling, drilled twenty-one (21) borings at most of the locations that were cored, using a truck-mounted B-61 HDX drill rig equipped with an automatic (i.e. hydraulic) hammer. The borings were advanced with 8 ¼-inch O.D., continuous-flight, hollow-stem auger on September 2-4, 2020. A representative of Yeh and Associates marked the boring locations in the field prior to drilling to indicate coring/drilling locations and was present during coring and drilling to log the subsurface conditions encountered and collect pavement cores and soil samples. The approximate boring locations were determined using a phone GPS mapping application (Locus Map) and are presented in Appendix A. Boring logs are presented in Appendix B.

We selected 4 locations to drill pairs of borings near each other to compare a relatively poor pavement condition to a relatively good condition. These pairs consisted of (1) YA-EB-4/YA-EB-5, (2) YA-EB-12/YA-EB-13, (3) YA-WB-4/YA-WB-5, and (4) YA-WB-6/YA-WB-7. We were able to retrieve the core from YA-WB-4; however drilling at this location was not possible due to its proximity to the active traffic line during our field investigation, and we could not safely use the drill rig. We cored the pavement at YA-EB-12A for additional information, but it is not included in one of the pairs.

We recorded penetration resistance measurements during drilling by driving standard split-spoon (SPT) and Modified California (MC) and samplers into subsurface materials at approximate 2 to 5-feet intervals. The SPT sampler has an O.D. of 2.0 inches and an I.D. of 1.375 inches. The SPT sampler was driven 18 inches for each sample, per ASTM D3550.The MC sampler is a 2.5-inch outer-diameter (O.D.), 2.0-inch inner-diameter (I.D.) split-barrel sampler that contains 1.95-inch inner-diameter brass liners, similar to ASTM D3550. The MC

sampler was driven 12 inches for each sample. The samplers were advanced by a calibrated, automatic, 140-pound hammer falling 30 inches. The automatic hammer had an energy transfer ratio of 82.7 percent. We also collected bulk samples of auger cuttings from each boring.

The number of blows required to drive the SPT sampler 18 inches or the MC sampler 12 inches, or fractions thereof, constitutes the penetration resistance value (N) as shown on the boring logs. The penetration resistance value is a useful index to evaluate the consistency and relative density or hardness of the subsurface materials encountered.

4.2 Subsurface Conditions

Borings YA-WB-1 through YA-WB-13 were located in the outer lane of westbound I-90 and YA-EB-1 through YA-EB-14 were located in the outer lane of eastbound I-90. Boring YA-LP-1 was drilled near the eastbound on-ramp at Lookout Pass, beyond the existing pavement area. The borings drilled within the pavement were advanced to depths of 3.75 to 10.5 feet and YA-LP-1 was advanced to a depth of 30.5 feet.

Our borings generally encountered 4.5 to 9.5 inches of asphalt and 7.75 to 9.75 inches of concrete. Six (6) borings near bridge approaches and one (1) in the shoulder had only asphalt and no concrete. The fill below the pavement generally consisted of sand and gravel. No pavement was present at YA-LP-1 that was drilled off the shoulder of the roadway. The average asphalt thickness was about 6.0 inches and the average concrete thickness was about 8.6 inches.

Soils encountered in twenty-one (21) borings advanced beneath the pavement generally consisted of 1.2 to 9.8 feet of sand and gravel fill over native sand, gravel, and clay. We do not believe we encountered bedrock in our borings but drilling conditions made it difficult to discern pulverized bedrock material from the native sand and gravel soils.

The fill generally consisted of clean to silty sand and gravel, with some isolated areas of clayey material. The fill had no to low plasticity and was medium dense to very dense based on results of field penetration resistance tests. We encountered an approximate 1.5 ft layer of clay fill that appeared to contain organics and glass in YA-WB-7 at a depth of 8 feet.

We encountered native soils below the fill in six (6) borings. The native soils were variable and consisted of clay, sand, and silt. We encountered lean clay with sand and gravel in four (4) borings below the fill. Most of the clay was very stiff, but soft to stiff, low to medium plasticity

clay was encountered in YA-WB-6. The sand and gravel were clean to clayey, had no to low plasticity, and were medium dense to very dense.

4.3 Laboratory Testing

Representative soil samples were tested to determine the classification and engineering properties of the materials encountered. The testing was conducted in general accordance with recognized test procedures, primarily those of the American Society for Testing and Materials (ASTM) and American Association of State Highway and Transportation Officials (AASHTO). Yeh's lab performed the classification testing, GROUND Engineering Consultants, Inc. (GROUND) performed the Modified Proctor, CBR (1 and 3 point), and Resilient Modulus tests, and Colorado Analytical Laboratories, Inc. conducted the resistivity, chloride, pH, and sulfate testing. The following tests were performed in general accordance with locally recognized standards:

Description and Identification of Soils (Visual-Manual Procedure)
Moisture Determination
Unit Weight
Sieve Analysis
Atterberg limits
Water Soluble Sulfates
Water Soluble Chlorides
Resistivity
pH
Modified Proctor
California Bearing Ratio (CBR)
Resilient Modulus

We performed sieve analysis tests and Atterberg limits on twenty-two (22) bulk samples obtained from the borings. Three (3) samples had an AASHTO soil classification of A-2-4 with a group index of 0, thirteen (13) samples classified as A-1-b with a group index of 0, and six (6) classified as A-1-a with a group index of 0. One (1) sample classified as GC, one (1) as GM, one (1) as GM-GC, twelve (12) as SM, two (2) as SM-SC, one (1) as SW, and four (4) as SW-SM in the USCS system.

GROUND performed three Modified Proctor tests on each of the three AASHTO soil types. The A-2-4 soil had a maximum dry density of 137.2 pcf and optimum moisture content of 6.5 percent. The A-1-b soil had a maximum dry density of 134.7 pcf and optimum moisture content of 6.7 percent. The A-1-a soil had a maximum dry density of 134.9 pcf and optimum moisture content of 6.8 percent

CBR testing (1-point and 3-point) testing was performed in accordance with ASTM D1883 on seven (7) samples. The samples were remolded to 95 percent of maximum dry density and optimum moisture content for the 1-point CBR tests, and remolded to 90, 95, and 100 percent of maximum dry density at optimum moisture content for the 3-point CBR tests. The 1-point CBR test was performed on 3 samples, yielding CBR values that ranged from 34 to 59. The 3-point CBR test was performed on 4 samples, yielding CBR values from 10 to 16 for samples remolded to 90 percent compaction, 22 to 40 for samples remolded to 95 percent compaction, and 32 to 52 for samples remolded to 100% compaction. Subgrade strength testing is discussed further in Section 6.3.

Resilient modulus testing was performed in accordance with AASHTO T-307. Combined samples were remolded to 95 percent of maximum dry density at 2 percent above optimum moisture content based on the modified Proctor tests. One resilient modulus test was performed on a representative sample of A-1-a soil and one on A-1-b soil. The A-1-a soil sample, which consisted of combined bulk samples from YA-EB-8, YA-WB-6, and YA-WB-7, had a resilient modulus of 21,791 pounds per square inch (psi). The A-1-b soil, which consisted of combined bulk samples from YA-EB-10, YA-WB-2, and YA-WB-3, had a resilient modulus of 22,701 psi.

The material descriptions and laboratory test results were used for the geotechnical engineering analyses and the development of preliminary pavement structure recommendations. Details of laboratory test results are presented in Appendix C and on the boring logs in Appendix B.

4.4 Groundwater

We encountered groundwater in one boring, YA-LP-1, during this investigation. We encountered groundwater during drilling at 6.7 feet below the surface after equilibration. We do not anticipate groundwater to affect the planned construction. Variations in groundwater conditions may occur seasonally. The magnitude of the variation will be largely dependent upon the amount of spring snowmelt, duration and intensity of precipitation, site grading changes, and the surface and subsurface drainage characteristics of the surrounding area. Perched water tables may be present but were not encountered in the borings.

4.5 Existing Pavement Thickness

We measured the thickness of the existing pavement from each pavement core. All borings were drilled through pavement except YA-LP-1 which was drilled in the shoulder near Lookout

Pass, beyond the existing pavement. Table 4-1 summarizes the pavement thickness measured from core we retrieved.

Table 4-1 – Pavement Thicknesses Measured from Pavement Cores

Boring	Asphalt Thickness (in)	Concrete Thickness (in)	Boring	Asphalt Thickness (in)	Concrete Thickness (in)
YA-EB-1	5.5	9.75	YA-WB-1	8.125	--
YA-EB-2	6.0	8.25	YA-WB-2	5.25	9.0
YA-EB-3	5.5	8.5	YA-WB-3	5.5	8.5
YA-EB-4	8.0	--	YA-WB-4	5.0	8.75
YA-EB-5	9.5	--	YA-WB-5	5.5	8.25
YA-EB-6	5.75	8.25	YA-WB-6	4.5	9.25
YA-EB-7	5.75	9.0	YA-WB-7	5.0	--
YA-EB-8	5.5	9.0	YA-WB-8	5.0	8.5
YA-EB-9	5.5	8.5	YA-WB-9	5.5	8.5
YA-EB-10	5.25	9.5	YA-WB-10	5.25	8.75
YA-EB-11	5.75	8.0	YA-WB-11	5.0	8.5
YA-EB-12	8.0	--	YA-WB-12	5.75	7.75
YA-EB-12A	8.5	--	YA-WB-13	4.75	8.25
YA-EB-13	8.25	--	YA-LP-1	None, not within pavement	
YA-EB-14	6.25	8.25			
Average Asphalt Thickness = 6.0 in			**Average Concrete Thickness = 8.6 in**		

5 PAVEMENT EVALUATION

As shown in Figure 2, this pavement has suffered extensive damage that was visible at the surface, particularly at longitudinal joint locations. We believe the damage is caused by moisture and that either compaction issues at the joints or an asphalt mix susceptible to moisture damage contributed to the extent of damage resulting in a loss of cohesion in the mix. MDT provided us representative photos of the pavement conditions taken in March 2020, prior to the most recent patching and overlay operations. Figure 2 shows representative photos of the pavement distress visible at the surface.

Figure 2 – Pavement distress visible at the surface, March 2020

It was difficult to identify older distressed areas in the field during our July and September visits due to recent patching using milling and overlay of the old pavement. We were able to distinguish the difference in asphalt mixes between the older asphalt and newer asphalt from recent mill and overlay patches by examining the pairs of pavement cores at YA-EB-4/YA-EB-5 and YA-EB-12/YA-EB-13. The other two pairs along the westbound direction did not exhibit evidence of patching/overlaying. Figure 3 shows the cores from one of the pairs, YA-EB-4/YA-EB-5, where YA-EB-4 was intended to be in an area of relatively good pavement condition, and YA-EB-5 in a relatively poor pavement condition.

The newer asphalt overlay is visible in the core from YA-EB-5 where there is a clear difference in asphalt mixes between the newer and older asphalt. For the cored areas, we believe that any distressed asphalt was removed prior to patching. Based on the thickness of new mix in the cores, we believe approximately 3+ inches of HMA were removed and replaced. This situation is also seen in the pair at YA-EB-12 and YA-EB-13, the photos of which are presented in Appendix D.

To investigate any possible damage in the lower layers of the asphalt pavement, we drilled four pairs of borings near each other to capture one in each at a location previously showing relatively poor pavement conditions and one at a location showing relatively good pavement conditions. The pavement cores we retrieved were primarily from the outer (righthand) driving lanes and none of the pairs show signs of significant damage in lower layers. Additionally, none of the cores show visible stripping damage at the interface with the old concrete.

The performance of the recent patches and continued performance of the non-patched areas will provide information to address the need for complete removal of the asphalt layer prior to any reconstruction.

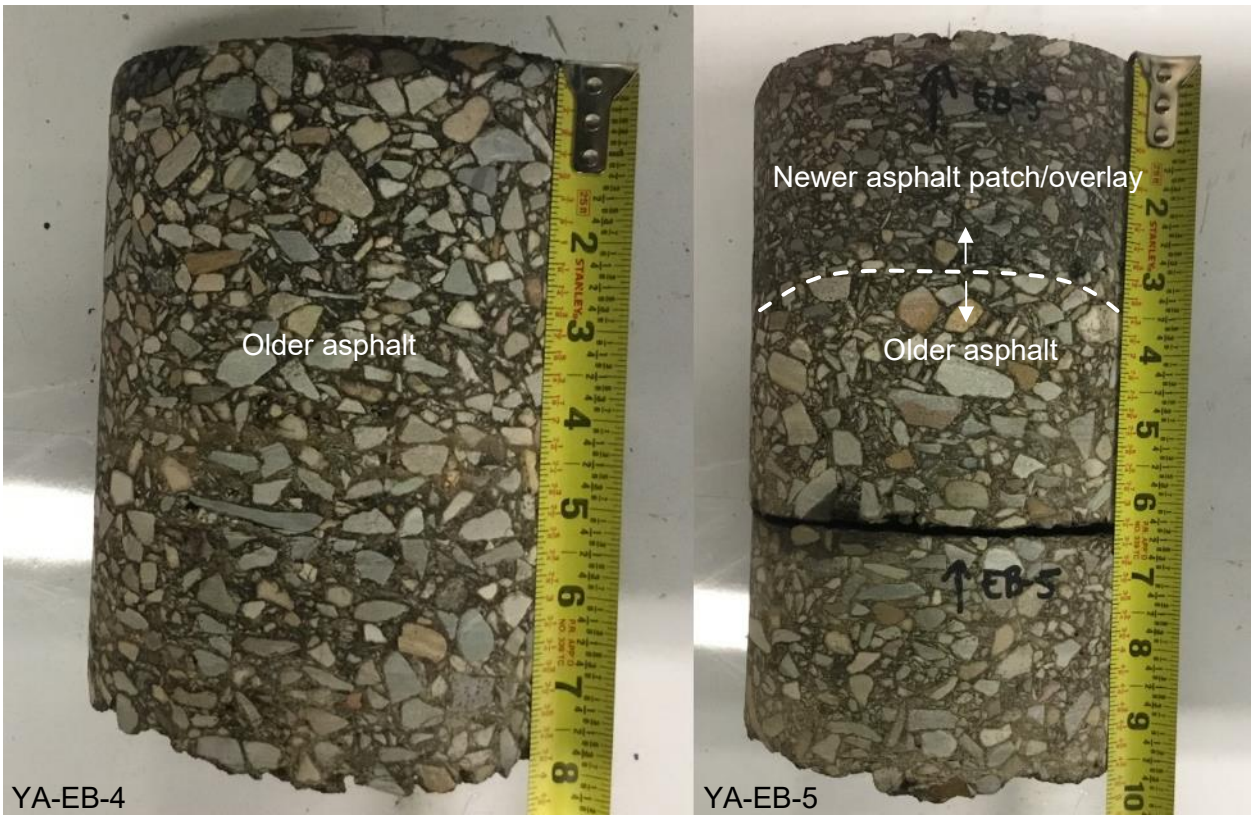

Figure 3 – Comparison of pavement cores at YA-EB-4 and YA-EB-5

6 PAVEMENT DESIGN

6.1 Pavement Repair Options

Based on our evaluation of the existing pavement and results of our subsurface investigation, we propose several options to repair the pavement. Table 6-1 presents potential pavement repair options with relative advantages, disadvantages, and costs. Relative costs are presented in Table 6-2 and are based on local experience in Colorado, which may not accurately represent costs in the project area. The costs are intended to provide estimates of each repair option relative to each other and do not reflect actual costs that may be encountered for this project.

We believe the lowest cost and fastest repair option is to remove and replace the existing asphalt by milling 3 inches of the existing asphalt and replacing it with 3 inches of new asphalt, which would likely have a design life of about 10 years, if no stripping occurs. The advantages and disadvantages presented in Table 6-1 are relative to an asphalt mill and overlay in terms of criteria such as cost, maintenance, and durability, among others.

Table 6-1 – Pavement Repair Options

Repair Option	Advantages	Disadvantages	Relevant Costs From Table 6-2
ASPHALT MILL AND OVERLAY	- Lowest cost - Fastest to construct - Shortest design life - Lowest amount of traffic control needed - Shortest length of detour/impact to traffic	- Frequent maintenance - Not as durable as concrete - Less resistance to reflection cracking from underlying concrete joints - May have stripping failures from old lower layers	- (1), (2), (3), (8)
RUBBLIZE EXISTING CONCRETE, OVERLAY WITH ASPHALT OR CONCRETE	- ↓ Maintenance (if concrete) - ↑ Design Life - ↑ Durability (if concrete) - No reflective cracking issues from underlying concrete	- ↑ Cost - ↑ Time to construct - ↑ Traffic control - ↑ Length of detour - Frequent maintenance (if asphalt) - Requires thicker overlay (by ~1-2 inches) than just a mill/overlay - Requires edge drains - Elevation rise of road profile - Removal cost for asphalt	- (1), (2), (3), (4), (5), (8), (9)
UNBONDED CONCRETE OVERLAY ON MILLED ASPHALT	- ↓ Maintenance - ↑ Design life - ↑ Durability (concrete) - No reflection cracking from underlying concrete - Existing asphalt could be used as bond breaking layer (lower cost)	- ↑ Cost - ↑ Time to construct - ↑ Traffic control - ↑ Length of detour - Elevation rise of road profile - If all the existing asphalt is removed, would need to put a new bond breaking layer - Removal cost for asphalt	- (1), (4), (8)
REMOVE AND REPLACE WITH ASPAHLT OR CONCRETE	- ↑ Durability (concrete) - ↑ Design life (concrete) - ↓ Maintenance (concrete) - No elevation rise of road profile	- ↑ Cost - ↑ Time to construct - ↑ Traffic control - ↑ Length of detour - Frequent maintenance (asphalt) - ↓ Durability (asphalt) - ↓ Design life (asphalt) - Removal cost for asphalt	- (1), (2), (3), (4), (6), (7), (8), (9)

Note:(↑) Indicates relatively higher or increased, (↓) Indicates relatively lower or decreased, compared to asphalt mill and overlay

Table 6-2 – Estimated Costs for Pavement Materials and Treatments

Material/Treatment	Estimated Cost*
(1) Removal of HMA Planing (Milling)	$2.50/yd^2
(2) HMA Unmodified	$85/ton
(3) HMA Polymer Modified	$100/ton
(4) PCCP	$5.50/yd^2-inch
(5) Concrete Pulverization	$3.50 yd^2
(6) ABC	$50/yd^2
(7) ABC	$40/ton
(8) Removal of HMA	$15/yd^2
(9) Removal of PCCP	$8.50/yd^2

Note:
Hot Mix Asphalt (HMA)
Portland Cement Concrete Pavement (PCCP)
Aggregate Base Course (ABC)

*Local Colorado costs for comparison only and not for construction.

6.2 Traffic Loading

Traffic information used for the design of pavement on this project was based on estimated current and projected volumes provided by MDT. We used the truck distribution data provided by MDT and a growth rate of 1.2 percent for loading calculations. Table 6-3 shows a summary of the projected 20-Year traffic volume and traffic loading. The traffic volumes and traffic loading provided to us by MDT are presented in Appendix E.

Table 6-3 - Design Traffic Loading

Year	Volume (AADT)	Total 20-Year Loading (ESAL) For Flexible Pavement	Total 20-Year Loading (ESAL) For Rigid Pavement
2023	7,770	9,567,682	13,768,116
2043	9,860	-	-

6.3 Subgrade Strength

CBR values ranged from 22 to 59.1, with the A-1-a soils yielding CBR values of 31 and 40, A-1-b soils yielding values from 22 to 41.5, and A-2-4 soils yielding a value of 59.1. The A-2-4 soils were encountered in 3 borings, 2 at either end of the project; we do not believe the A-2-4 soil is representative of the mainline on the project. The A-1-a soils had a resilient modulus of 21,791 psi and the A-1-b soils had a resilient modulus of 22,701 psi. We selected a resilient modulus of 22,000 psi for use in preliminary pavement design. The CBR values correlate to resilient modulus values greater than 22,000 psi.

6.4 Pavement Design

We ran preliminary pavement design analysis using the 1993 AASHTO Pavement Design Guide and the AASHTOWare Pavement ME Design software. Based on our calculations using *Equation 1.2.1* from the 1993 AASHTO Pavement Design Guide and by using AASHTOWare Pavement M-E Design software, we anticipate both rigid and flexible pavement design sections will be 9 to 10 inches for new pavement sections, or 8 to 10 inches for overlayed pavement sections. The preliminary pavement thicknesses apply to the four repair options outlined in Table 6-1. Once a repair option is selected, we will perform more detailed analysis and prepare a final pavement design.

5.4 HMA Mix and Binder Recommendations

The Long-Term Pavement Performance Program *LTPPBind* recommends using a PG 64-28 asphalt binder for the top mat, a PG 64-28 binder for the lower lift at a depth of 2 inches, and PG 58-28 binder for mixes placed at a depth of 3 inches. For the top mat, a PG 70-28 binder would meet the low temperature requirement, exceed the high temperature requirements, and may be recommended based on local experience because of large truck volume. An alternative could be to construct the top HMA lift at a thickness of 3 inches and use a PG 58-28 binder for HMA mixes for the lifts below that. The asphalt binder recommendations were produced using data from nearby weather stations in Mullan, Wallace, and Kellogg, Idaho and Thompson Falls and Haugan, Montana. A copy of the LTPPBind print-out for this project is presented in Appendix F.

7 OTHER CONSTRUCTION CONSIDERATIONS

7.1 Corrosion Potential

We submitted twelve samples to Colorado Analytical Laboratories, Inc. for chemical testing that included water-soluble sulfates and chlorides, pH, and resistivity. The samples had pH values ranging from 7.0 to 10.5. The water-soluble sulfate concentrations ranged from 0.001 to 0.012 percent and the water-soluble chloride concentrations ranged from 0.0030 to 0.0478 percent. The resistivity values were 849 to 4548 ohm-centimeters.

The concentrations of water-soluble sulfates measured on the twelve samples were all less than 0.1 percent. Sulfate concentrations less than 0.1 percent indicate negligible exposure to sulfate attack for concrete which comes into contact with the subsoils according to the American Concrete Institute (ACI). ACI indicates Type I or Type II cement can be used for concrete which comes into contact with subsoils. Superficial damage can occur to the exposed surfaces of highly permeable concrete, even though sulfate levels are less than 0.1 percent. To reduce this, the water to cement ratio should not exceed 0.52 for concrete in contact with soils which are likely to stay moist due to surface drainage or high water tables.

The corrosion potential measurements should be used to help determine the type of culvert materials or other metal to be used in contact with soils on this project. A qualified corrosion engineer should review this data to determine the appropriate level of corrosion protection.

8 LIMITATIONS

The recommendations in this preliminary report are based on our field observations, laboratory testing, and present understanding of the proposed construction. It is possible that subsurface conditions can vary beyond what we encountered in our widely-spaced borings. If the conditions found during construction differ from those described in this report, please notify us immediately so that we can review our report and provide supplemental recommendations as necessary. We should also review this report if the scope of the proposed construction changes from that described in this report.

Yeh and Associates has prepared this report for the exclusive use of Montana Department of Transportation for the proposed rehabilitation of Interstate 90 in Mineral County, Montana. This report was prepared in substantial accordance with the generally accepted standards of practice for geotechnical engineering as exist in the site area at the time of our investigation. No warranty is expressed or implied. The recommendations in this report are based on the assumption that Yeh and Associates will conduct an adequate program of construction testing and observation to evaluate compliance with our recommendations.

9 REFERENCES

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Appendix A

BORING LOCATION PLAN

Yeh and Associates, Inc.
Geotechnical · Geological · Construction Services

MDT

NO.	SHEET REVISION	BY	DATE

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CHECKED BY: SCS	DATE: 10/15/2020
DESIGNED FOR: MONTANA DEPART OF TRANSPORTATION	
PROJECT NUMBER: 219-371	
SCALE	
HORIZ: 1:2500	VERT:

I-90 TAFT WEST

BORING LOCATION PLAN

SHEET 1 OF 7

● APPROXIMATE BORING LOCATION

Yeh and Associates, Inc.
Geotechnical · Geological · Construction Services

MDT

NO.	SHEET REVISION	BY	DATE

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CHECKED BY: SCS DATE: 9/28/2020
DESIGNED FOR: MONTANA DEPART OF TRANSPORTATION
PROJECT NUMBER: 219-371
SCALE
HORIZ: 1:350 VERT:

I-90 TAFT WEST

BORING LOCATION PLAN

SHEET 2 OF 7

● APPROXIMATE BORING LOCATION

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CHECKED BY: SCS	DATE: 10/15/2020
DESIGNED FOR: MONTANA DEPART OF TRANSPORTATION	
PROJECT NUMBER: 219-371	
SCALE	
HORIZ: 1:350	VERT:

I-90 TAFT WEST

BORING LOCATION PLAN

SHEET 3 OF 7

N

● APPROXIMATE BORING LOCATION

Yeh and Associates, Inc.
Geotechnical · Geological · Construction Services

MDT

NO.	SHEET REVISION	BY	DATE

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PROJECT NUMBER: 219-371	
SCALE	
HORIZ: 1:350	VERT:

I-90 TAFT WEST

BORING LOCATION PLAN

SHEET 4 OF 7

● APPROXIMATE BORING LOCATION

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SCALE	
HORIZ: 1:350	VERT:

I-90 TAFT WEST

BORING LOCATION PLAN

SHEET 5 OF 7

● APPROXIMATE BORING LOCATION

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PROJECT NUMBER: 219-371
SCALE
HORIZ: 1:350 VERT:

I-90 TAFT WEST

BORING LOCATION PLAN

SHEET 6 OF 7

N

● APPROXIMATE BORING LOCATION

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I-90 TAFT WEST

BORING LOCATION PLAN

SHEET 7 OF 7

Appendix B

BORING LOGS

Yeh and Associates, Inc.
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Project: I-90 - Taft West

Project Number: 219-371

Legend for Symbols Used on Borehole Logs

Sample Types


Bulk Sample of auger/odex cuttings


Rock core


Modified California Sampler (2.5 inch OD, 2.0 inch ID)


Standard Penetration Test (ASTM D1586)

Drilling Methods


CORING


HOLLOW-STEM AUGER


CORING

Lithology Symbols (see Boring Logs for complete descriptions)


Asphalt


USCS Lean/Low Plasticity Clay


Concrete


Fill with Clay as major soil


Fill with Gravel as major soil


Fill with Sand as major soil


USCS Silty, Clayey Gravel


USCS Poorly-graded Gravel


Poorly-graded Gravelly Sand


USCS Low Plasticity Organic silt or clay


Low Plasticity Sandy Clay


USCS Clayey Sand


USCS Silty Sand

Lab Test Standards

Moisture Content	ASTM D2216
Dry Density	ASTM D7263
Sand/Fines Content	ASTM D421, ASTM C136, ASTM D1140
Atterberg Limits	ASTM D4318
AASHTO Class.	AASHTO M145, ASTM D3282
USCS Class.	ASTM D2487

(Fines = % Passing #200 Sieve
Sand = % Passing #4 Sieve, but not passing #200 Sieve)

Other Lab Test Abbreviations

pH	Soil pH (AASHTO T289-91)
S	Water-Soluble Sulfate Content (AASHTO T290-91, ASTM D4327)
Chl	Water-Soluble Chloride Content (AASHTO T291-91, ASTM D4327)
S/C	Swell/Collapse (ASTM D4546)
UCCS	Unconfined Compressive Strength (Soil - ASTM D2166, Rock - ASTM D7012)
R-Value	Resistance R-Value (ASTM D2844)
DS (C)	Direct Shear cohesion (ASTM D3080)
DS (phi)	Direct Shear friction angle (ASTM D3080)
Re	Electrical Resistivity (AASHTO T288-91)
PtL	Point Load Strength Index (ASTM D5731)

Notes

1. Visual classifications are in general accordance with ASTM D2488, "Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)".
2. "Penetration Resistance" on the Boring Logs refers to the uncorrected N value for SPT samples only, as per ASTM D1586. For samples obtained with a Modified California (MC) sampler, drive depth is 12 inches, and "Penetration Resistance" refers to the sum of all blows. Where blow counts were > 50 for the 3rd increment (SPT) or 2nd increment (MC), "Penetration Resistance" combines the last and 2nd-to-last blows and lengths; for other increments with > 50 blows, the blows for the last increment are reported.
3. The Modified California sampler used to obtain samples is a 2.5-inch OD, 2.0-inch ID (1.95-inch ID with liners), split-barrel sampler with internal liners, as per ASTM D3550. Sampler is driven with a 140-pound hammer, dropped 30 inches per blow.
4. "ER" for the hammer is the Reported Calibrated Energy Transfer Ratio for that specific hammer, as provided by the drilling company.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-1**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 5.0 ft
Ground Elevation:
Coordinates: Lat: 47.449885 Long: -115.693818
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
	0						**0.0 - 0.5 ft. ASPHALT** (5.5 inches).									
							0.5 - 1.3 ft. CONCRETE (9.75 inches).									
							1.3 - 2.5 ft. Silty SAND with gravel (SM) (Fill), dark gray, no to low plasticity, moist, dense.									
				40-50:3"	50:3"											pH=10.4 S=0.009% Chl=.0118% Re=2050ohm·cm
							2.5 - 5.0 ft. Silty SAND with gravel (SM), light gray, no plasticity, dry, dense to very dense.	*2.5*		*32.0*	*52.0*	*16.0*	*NV*	*NP*	*A-1-b (0) SM*	
				27-24-23	47											
	5						Bottom of Hole at 5.0 ft.									

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-2**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring
Driller: A-Core
Drill Rig:
Hammer: , ER: %

Total Depth: 1.2 ft
Ground Elevation:
Coordinates: Lat: 47.44313 Long: -115.690491
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifi-cations	Field Notes and Other Lab Tests
							0.0 - 0.5 ft. ASPHALT (6 inches).							
							0.5 - 1.2 ft. CONCRETE (8.25 inches).							

Bottom of Hole at 1.2 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-3**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 10.5 ft
Ground Elevation:
Coordinates: Lat: 47.438263 Long: -115.682598
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
	0						**0.0 - 0.5 ft. ASPHALT** (5.5 inches).									
							0.5 - 1.2 ft. CONCRETE (8.5 inches).									
							1.2 - 10.5 ft. Silty SAND with gravel (SM) (Fill), brown to light gray, no to low plasticity, moist, medium dense to very dense.									
				11-39-30	69			*4.4*		*37.0*	*44.0*	*19.0*	*NV*	*NP*	*A-1-b (0) SM*	**1.5 ft** - Slightly clayey from 1.2 to 3.0 ft pH=8.8 S=.005% Chl=.0151% Re=2064ohm·cm
	5			10-14-15	29											
				50:5"	50:5"											
	10															

Bottom of Hole at 10.5 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-4**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 10.5 ft
Ground Elevation:
Coordinates: Lat: 47.434485 Long: -115.673688
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
							0.0 - 0.7 ft. ASPHALT (8 inches).									
							0.7 - 10.5 ft. Silty, clayey SAND with gravel (SC-SM) (Fill), brown to light gray, low plasticity, dry, dense to very dense.									
				12-13-34	47			*4.4*		*30.0*	*44.0*	*26.0*	*23*	*6*	*A-2-4 (0) SC-SM*	
	5			15-15-19	34											pH=8.2 S=0.001% Chl=0.0396% Re=871ohm·cm
	10			24-33-25	58											

Bottom of Hole at 10.5 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-5**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 10.5 ft
Ground Elevation:
Coordinates: Lat: 47.434443 Long: -115.673574
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
	0						**0.0 - 0.8 ft. ASPHALT** (9.5 inches).									
							0.8 - 10.5 ft. Silty SAND with gravel (SM) (Fill), brown and light gray, no plasticity, dry, dense to very dense.									
				24-38-50:4"	88:10"			*3.5*		*35.0*	*43.0*	*22.0*	*NV*	*NP*	*A-1-b (0) SM*	
				15-29-50:4"	79:10"											
	5															
				18-18-18	36											
	10						Bottom of Hole at 10.5 ft.									

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-6**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring
Driller: A-Core
Drill Rig:
Hammer: , ER: %

Total Depth: 1.2 ft
Ground Elevation:
Coordinates: Lat: 47.434254 Long: -115.663288
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifi-cations	Field Notes and Other Lab Tests
							0.0 - 0.5 ft. ASPHALT (5.75 inches).							
							0.5 - 1.2 ft. CONCRETE (8.25 inches).							
							Bottom of Hole at 1.2 ft.							

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-7**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring
Driller: A-Core
Drill Rig:
Hammer: , ER: %

Total Depth: 1.2 ft
Ground Elevation:
Coordinates: Lat: 47.434329 Long: -115.654297
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifi-cations	Field Notes and Other Lab Tests
							0.0 - 0.5 ft. ASPHALT (5.75 inches).							
							0.5 - 1.2 ft. CONCRETE (9 inches).							

Bottom of Hole at 1.2 ft.

Yeh and Associates, Inc.
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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-8**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 5.5 ft
Ground Elevation:
Coordinates: Lat: 47.43113 Long: -115.645392
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
	0						**0.0 - 0.5 ft. ASPHALT** (5.5 inches).									
							0.5 - 1.2 ft. CONCRETE (9 inches).									
							1.2 - 5.5 ft. Well-graded SAND with silt and gravel (SW-SM) (Fill), dark brown to brown, light gray, no plasticity, dry to moist, dense.									
				10-15-37	52			*4.9*		*41.0*	*47.0*	*12.0*	*NV*	*NP*	*A-1-a (0) SW-SM*	pH=7 S=0.002% Chl=0.0369% Re=1028ohm·cm
	5			21-19-15	34											

Bottom of Hole at 5.5 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-9**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring
Driller: A-Core
Drill Rig:
Hammer: , ER: %

Total Depth: 1.2 ft
Ground Elevation:
Coordinates: Lat: 47.42615 Long: -115.638528
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifi-cations	Field Notes and Other Lab Tests
							0.0 - 0.5 ft. ASPHALT (5.5 inches).							
							0.5 - 1.2 ft. CONCRETE (1.2 inches).							

Bottom of Hole at 1.2 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-10**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 5.5 ft
Ground Elevation:
Coordinates: Lat: 47.421004 Long: -115.631165
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
	0						**0.0 - 0.4 ft. ASPHALT** (5.25 inches).									
							0.4 - 1.2 ft. CONCRETE (9.5 inches).									
							1.2 - 5.5 ft. Silty SAND with gravel (SM) (Fill), brown and light gray, no plasticity, dry, medium dense to dense.									
				16-23-18	41			*16.1*		*29.0*	*54.0*	*17.0*	*NV*	*NP*	*A-1-b (0) SM*	
				9-9-9	18											
	5															

Bottom of Hole at 5.5 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-11**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring
Driller: A-Core
Drill Rig:
Hammer: , ER: %

Total Depth: 1.2 ft
Ground Elevation:
Coordinates: Lat: 47.418189 Long: -115.621189
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
							0.0 - 0.5 ft. ASPHALT (5.75 inches).							
							0.5 - 1.2 ft. CONCRETE (8 inches).							
							Bottom of Hole at 1.2 ft.							

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-12**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 5.5 ft
Ground Elevation:
Coordinates: Lat: 47.419456 Long: -115.61604
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
	0						**0.0 - 0.7 ft. ASPHALT** (8 inches).									
							0.7 - 4.5 ft. Silty GRAVEL with sand (GM) (Fill), brown and dark brown, no plasticity, dry to moist, dense.									
				30-32-23	55			*5.0*		*42.0*	*37.0*	*21.0*	*NV*	*NP*	*A-1-b (0) GM*	pH=8.4 S=0.002% Chl=.0386% Re=1023ohm·cm
	5			34-20-18	38		**4.5 - 5.5 ft. Lean CLAY with sand (CL) and gravel**, reddish brown, low to medium plasticity, moist, very stiff.									

Bottom of Hole at 5.5 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-12A**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring
Driller: A-Core
Drill Rig:
Hammer: , ER: %

Total Depth: 0.7 ft
Ground Elevation:
Coordinates: Lat: 47.418678 Long: -115.618186
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifi-cations	Field Notes and Other Lab Tests
							0.0 - 0.7 ft. ASPHALT (8.5 inches).							

Bottom of Hole at 0.7 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-13**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 6.5 ft
Ground Elevation:
Coordinates: Lat: 47.419539 Long: -115.615794
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
							0.0 - 0.7 ft. ASPHALT (8.25 inches).									
							0.7 - 4.5 ft. Silty, clayey GRAVEL with sand (GC-GM) (Fill), brown, dark brown, light gray, reddish brown, low plasticity, dry to moist, dense.									
				8-19-19	38			*7.0*		*41.0*	*35.0*	*24.0*	*24*	*6*	*A-1-b (0) GC-GM*	
	5			11-43-50	93		**4.5 - 6.0 ft. Poorly graded SAND with gravel (SP)**, light gray, no plasticity, dry, very dense.									
							6.0 - 6.5 ft. Poorly graded GRAVEL with sand (GP), light gray, no plasticity, dry.									
							Bottom of Hole at 6.5 ft.									

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-EB-14**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Coring
Driller: A-Core
Drill Rig:
Hammer: , ER: %

Total Depth: 1.2 ft
Ground Elevation:
Coordinates: Lat: 47.420753 Long: -115.612533
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifi-cations	Field Notes and Other Lab Tests
							0.0 - 0.5 ft. ASPHALT (6.25 inches).							
							0.5 - 1.2 ft. CONCRETE (8.25 inches).							

Bottom of Hole at 1.2 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-WB-1**

Boring Began: 9/2/2020
Boring Completed: 9/2/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 10.5 ft
Ground Elevation:
Coordinates: Lat: 47.422044 Long: -115.607756
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
	0						**0.0 - 0.7 ft. ASPHALT** (8.125 inches).									
							0.7 - 10.5 ft. Silty, clayey SAND with gravel (SC-SM) (Fill), light brown and gray, low plasticity, dry, dense.									
				13-20-18	38			*5.7*		*26.0*	*48.0*	*26.0*	*24*	*6*	*A-2-4 (0) SC-SM*	
	5			18-18-15	33											pH=8.6 S=0.001% Chl=0.0030% Re=4548ohm·cm
	10			16-12-10	22											

Bottom of Hole at 10.5 ft.

Yeh and Associates, Inc.
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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-WB-2**

Boring Began: 9/2/2020
Boring Completed: 9/2/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 10.0 ft
Ground Elevation:
Coordinates: Lat: 47.419513 Long: -115.626008
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
	0						**0.0 - 0.4 ft. ASPHALT** (5.25 inches).									
							0.4 - 1.2 ft. CONCRETE (9 inches).									
							1.2 - 8.0 ft. Silty SAND with gravel (SM) (Fill), brown, light brown, gray, no plasticity, dry, medium dense to very dense.									
				32-50:5"	50:5"											
								2.6		*33.0*	*51.0*	*16.0*	*NV*	*NP*	*A-1-b (0) SM*	pH=10.5 S=0.012% Chl=0.0113% Re=1783ohm·cm
	5			14-15-13	28											
							8.0 - 10.0 ft. Poorly graded SAND with gravel (SP), brown, no to low plasticity, moist.								
	10						Bottom of Hole at 10.0 ft.									

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-WB-3**

Boring Began: 9/2/2020
Boring Completed: 9/2/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 10.5 ft
Ground Elevation:
Coordinates: Lat: 47.423469 Long: -115.634735
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:

Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
							0.0 - 0.5 ft. ASPHALT (5.5 inches).									
							0.5 - 1.2 ft. CONCRETE (8.5 inches).									
							1.2 - 6.5 ft. Silty SAND with gravel (SM) (Fill), brown, tan, light gray, white, low plasticity, dry to moist, dense to very dense, contains roots.									
				23-50	73			*3.7*		*24.0*	*59.0*	*17.0*	*NV*	*NP*	*A-1-b (0) SM*	
	5			16-20-22	42											pH=7 S=0.004% Chl=.0440% Re=1014ohm·cm
							6.5 - 8.0 ft. Lean CLAY (CL) (Fill), brown, low plasticity, moist.									
							8.0 - 10.5 ft. Poorly graded SAND with gravel (SP) (Fill), brown, gray, tan, white, no to low plasticity, moist, dense, contains bedrock chunks.									
	10			14-18-22	40											

Bottom of Hole at 10.5 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-WB-4**

Boring Began: 9/2/2020
Boring Completed: 9/2/2020
Drilling Method(s): Coring
Driller: A-Core
Drill Rig:
Hammer: , ER: %

Total Depth: 1.2 ft
Ground Elevation:
Coordinates: Lat: 47.428774 Long: -115.639513
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifi-cations	Field Notes and Other Lab Tests
							0.0 - 0.4 ft. ASPHALT (5 inches).							
							0.4 - 1.2 ft. CONCRETE (8.75 inches).							

Bottom of Hole at 1.2 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-WB-5**

Boring Began: 9/2/2020
Boring Completed: 9/2/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 10.5 ft
Ground Elevation:
Coordinates: Lat: 47.42882 Long: -115.639506
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:

Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
							0.0 - 0.5 ft. ASPHALT (5.5 inches).									
							0.5 - 1.2 ft. CONCRETE (8.25 inches).									
							1.2 - 10.5 ft. Silty SAND with gravel (SM) (Fill), brown, gray, white, rust, no plasticity, dry, dense to very dense.									
				29-33-40	73			*4.2*		*31.0*	*53.0*	*16.0*	*NV*	*NP*	*A-1-b (0) SM*	
	5			21-21-14	35											pH=7.3 S=0.005% Chl=0.0138% Re=2354ohm·cm
	10			22-32-50:5"	82:11"											

Bottom of Hole at 10.5 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-WB-6**

Boring Began: 9/2/2020
Boring Completed: 9/2/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 10.0 ft
Ground Elevation:
Coordinates: Lat: 47.43214 Long: -115.651094
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
	0						**0.0 - 0.4 ft. ASPHALT** (4.5 inches).									
							0.4 - 1.2 ft. CONCRETE (9.25 inches).									
							1.2 - 8.0 ft. Silty SAND with gravel (SM) (Fill), brown, light gray, white, no plasticity, dry, very dense.									
				23-42-50	92			*2.9*		*43.0*	*44.0*	*13.0*	*NV*	*NP*	*A-1-a (0) SM*	
				28-36-34	70											
	5															
				2-1-15	16		**8.0 - 10.0 ft. Sandy lean CLAY with gravel (CL)**, brown to reddish brown, low to medium plasticity, moist, soft to stiff.									
	10						Bottom of Hole at 10.0 ft.									

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-WB-7**

Boring Began: 9/2/2020
Boring Completed: 9/2/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 10.0 ft
Ground Elevation:
Coordinates: Lat: 47.432183 Long: -115.651197
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
	0						**0.0 - 0.4 ft. ASPHALT** (5 inches).									
							0.4 - 8.0 ft. Poorly graded SAND with silt and gravel (SP-SM) (Fill), brown, gray, light gray, no plasticity, dry to moist, very dense.									
				26-31-32	63			3.6		31.0	58.0	11.0	NV	NP	*A-1-a (0) SP-SM*	
				27-32-39	71											
	5															
							8.0 - 9.5 ft. Organic CLAY with sand (OL) (Fill), black to dark brown, low plasticity, moist, contains glass pieces.									
				5-6	11		**9.5 - 10.0 ft. Sandy lean CLAY with gravel (CL)**, reddish brown, low to medium plasticity, moist, stiff.									
	10						Bottom of Hole at 10.0 ft.									

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-WB-8**

Boring Began: 9/4/2020
Boring Completed: 9/4/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 3.8 ft
Ground Elevation:
Coordinates: Lat: 47.43604 Long: -115.658479
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, cool
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
							0.0 - 0.4 ft. ASPHALT (5 inches).									
							0.4 - 1.2 ft. CONCRETE (8.5 inches).									
				34-40-50:3"	90:9"		**1.2 - 3.8 ft. Well-graded SAND with silt and gravel (SW-SM) (Fill)**, brown, light gray, white, no plasticity, dry, very dense.	*1.7*		*39.0*	*51.0*	*10.0*	*NV*	*NP*	*A-1-a (0) SW-SM*	pH=10.4 S=0.007% Chl=0.0090% Re=2924ohm·cm
				50:3"	50:3"											

Bottom of Hole at 3.8 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-WB-9**

Boring Began: 9/4/2020
Boring Completed: 9/4/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 10.5 ft
Ground Elevation:
Coordinates: Lat: 47.433659 Long: -115.668232
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
							0.0 - 0.5 ft. ASPHALT (5.5 inches).									
							0.5 - 1.2 ft. CONCRETE (8.5 inches).									
							1.2 - 10.5 ft. Poorly graded SAND with silt and gravel (SP-SM) (Fill), brown and light gray, no plasticity, dry, dense to very dense.									
				12-18-22	40			*2.9*		*38.0*	*50.0*	*12.0*	*NV*	*NP*	*A-1-a (0) SP-SM*	
	5			10-10-24	34											
				17-50:1"	50:1"											
	10															

Bottom of Hole at 10.5 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-WB-10**

Boring Began: 9/4/2020
Boring Completed: 9/4/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 5.0 ft
Ground Elevation:
Coordinates: Lat: 47.436181 Long: -115.678237
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
	0						**0.0 - 0.4 ft. ASPHALT** (5.25 inches).									
							0.4 - 1.2 ft. CONCRETE (8.75 inches).									
							1.2 - 5.0 ft. Silty SAND with gravel (SM) (Fill), brown and gray, no plasticity, dry to moist, very dense.									
				19-37-50:3"	87:9"			*4.1*		*28.0*	*59.0*	*13.0*	*NV*	*NP*	*A-1-b (0) SM*	
				22-24-50:5.5	74:11"											
	5						Bottom of Hole at 5.0 ft.									

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-WB-11**

Boring Began: 9/4/2020
Boring Completed: 9/4/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 10.5 ft
Ground Elevation:
Coordinates: Lat: 47.440835 Long: -115.686224
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:

Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
							0.0 - 0.4 ft. ASPHALT (5 inches).									
							0.4 - 1.2 ft. CONCRETE (8.5 inches).									
							1.2 - 3.0 ft. Silty SAND with gravel (SM) (Fill), brown, gray, tan, no plasticity, dry, very dense.									
				25-50:4"	50:4"			*4.3*		*32.0*	*53.0*	*15.0*	*NV*	*NP*	*A-1-a (0) SM*	
	5			11-17-19	36		**3.0 - 10.5 ft. Clayey SAND with gravel (SC) (Fill)**, brown and gray, no to low plasticity, moist, dense to very dense.									
	10			6-45-22	51											

Bottom of Hole at 10.5 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-WB-12**

Boring Began: 9/4/2020
Boring Completed: 9/4/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 5.5 ft
Ground Elevation:
Coordinates: Lat: 47.446375 Long: -115.692639
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
							0.0 - 0.5 ft. ASPHALT (5.75 inches).									
							0.5 - 1.1 ft. CONCRETE (7.75 inches).									
							1.1 - 5.5 ft. Silty SAND with gravel (SM) (Fill), brown to light gray, no plasticity, dry, dense to very dense.									
				34-44-30	74			*3.3*		*26.0*	*58.0*	*16.0*	*NV*	*NP*	*A-1-b (0) SM*	
	5			14-19-25	44											pH=8.6 S=0.004% Chl=.0478% Re=849ohm·cm

Bottom of Hole at 5.5 ft.

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Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-WB-13**

Boring Began: 9/4/2020
Boring Completed: 9/4/2020
Drilling Method(s): Coring / Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 10.5 ft
Ground Elevation:
Coordinates: Lat: 47.452206 Long: -115.693834
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol			
Depth	-	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
	0						**0.0 - 0.4 ft. ASPHALT** (4.75 inches).									
							0.4 - 1.1 ft. CONCRETE (8.25 inches).									
							1.1 - 2.0 ft. Well-graded SAND with gravel (SW) (Fill), brown and light gray, no plasticity, dry, dense.	3.3		36.0	60.0	4.0	NV	NP	*A-1-a (0) SW*	
				13-18-22	40		**2.0 - 10.5 ft. Silty SAND with gravel (SM) (Fill)**, brown and light gray, no plasticity, dry to moist, dense.	5.1		29.0	48.0	23.0	NV	NP	*A-1-b (0) SM*	pH=8 S=0.004% Chl=.0259% Re=1414ohm·cm
	5			21-16-18	34											
	10			12-15-15	30											

Bottom of Hole at 10.5 ft.

Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services

Project Name: I-90 - Taft West

Project Number: 219-371 *Boring No.:* **YA-LP-1**

Boring Began: 9/3/2020
Boring Completed: 9/3/2020
Drilling Method(s): Hollow-Stem Auger
Driller: O'Keefe Drilling
Drill Rig: Mobile B-61 HDX
Hammer: Automatic (hydraulic), ER: 82.7%

Total Depth: 30.5 ft
Ground Elevation:
Coordinates: Lat: 47.453901 Long: -115.694738
Location:
Logged By: L. Safari
Final By: L. Safari

Weather Notes: Sunny, warm
Inclination from Horiz.: Vertical
Night Work: ☐

Groundwater Levels:			
Symbol	▽		
Depth	6.7 ft	-	-
Date	-	-	-

Elevation (feet)	Depth (feet)	Sample Type/Depth	Drilling Method	Soil Samples: Blows per 6 in	Soil Samples: Penetration Resistance	Lithology	Material Description	Moisture Content (%)	Dry Density (pcf)	Gravel Content (%)	Sand Content (%)	Fines Content (%)	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	AASHTO & USCS Classifications	Field Notes and Other Lab Tests
	0						**0.0 - 4.0 ft. Clayey GRAVEL with sand (GC) (Fill)**, brown and light gray, low plasticity, dry to moist.	*3.5*		*41.0*	*36.0*	*23.0*	*26*	*8*	*A-2-4 (0) GC*	
	5			20-37-34	71		**4.0 - 14.0 ft. Silty, clayey SAND with gravel (SC-SM)**, brown, rust, greenish-gray, gray, low plasticity, dry, medium dense to very dense.									
▽																
	10			11-12-11	23											
	15			7-9-7	16		**14.0 - 30.5 ft. Sandy lean CLAY with gravel (CL)**, brown, medium plasticity, moist to wet, very stiff.									
	20			8-15-14	29											
	25															
	30			21-17-18	35											

Bottom of Hole at 30.5 ft.

Appendix C

LABORATORY TEST RESULTS

YEH & ASSOCIATES, INC

Summary of Laboratory Test Results

Project No: 219-371 Project Name: MDOT Taft Montana Date: 9/21/2020

Sample Location			Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg			PH	Water Soluble Sulfate %	Resistivity ohm.cm	Chloride %	% Swell (+) / Consoli-dation (-)	R-Value	CLASSIFICATION	
Boring No. (final)	Depth (ft)	Sample Type			Gravel > #4 (%)	Sand (%)	Fines < #200 (%)	LL	PL	PI							AASHTO	USCS
YA-EB-1	1.33-5	Bulk	2.5	–	32	52	16	NV	NP	NP	–	–	–	–	–	–	A-1-b (0)	SM
YA-EB-1	2	SPT	–	–	–	–	–	–	–	–	10.4	0.009	2050	0.0118	–	–	–	–
YA-EB-3	1.25-5	Bulk	4.4	–	37	44	19	NV	NP	NP	–	–	–	–	–	–	A-1-b (0)	SM
YA-EB-3	2	SPT	–	–	–	–	–	–	–	–	8.8	0.005	2064	0.0151	–	–	–	–
YA-EB-4	0.66-5	Bulk	4.4	–	30	44	26	23	17	6	–	–	–	–	–	–	A-2-4 (0)	SM-SC
YA-EB-4	4	SPT	–	–	–	–	–	–	–	–	8.2	0.001	871	0.0396	–	–	–	–
YA-EB-5	0.79-5	Bulk	3.5	–	35	43	22	NV	NP	NP	–	–	–	–	–	–	A-1-b (0)	SM
YA-EB-8	1.16-5	Bulk	4.9	–	41	47	12	NV	NP	NP	–	–	–	–	–	–	A-1-a (0)	SW-SM
YA-EB-8	2	SPT	–	–	–	–	–	–	–	–	7.0	0.002	1028	0.0369	–	–	–	–
YA-EB-10	1.33-5	Bulk	3.7	–	29	54	17	NV	NP	NP	–	–	–	–	–	–	A-1-b (0)	SM
YA-EB-12	0.66-5	Bulk	5.0	–	42	37	21	NV	NP	NP	–	–	–	–	–	–	A-1-b (0)	GM
YA-EB-12	2	SPT	–	–	–	–	–	–	–	–	8.4	0.002	1023	0.0386	–	–	–	–
YA-EB-13	0.66-5	Bulk	7.0	–	41	35	24	24	18	6	–	–	–	–	–	–	A-1-b (0)	GM-GC
YA-WB-1	0.66-5	Bulk	5.7	–	26	48	26	24	18	6	–	–	–	–	–	–	A-2-4 (0)	SM-SC
YA-WB-1	4	SPT	–	–	–	–	–	–	–	–	8.6	0.001	4548	0.0030	–	–	–	–
YA-WB-2	1.16-5	Bulk	2.6	–	33	51	16	NV	NP	NP	–	–	–	–	–	–	A-1-b (0)	SM
YA-WB-2	2	SPT	–	–	–	–	–	–	–	–	10.5	0.012	1783	0.0113	–	–	–	–

YEH & ASSOCIATES, INC

Summary of Laboratory Test Results

Project No: 219-371 Project Name: MDOT Taft Montana Date: 9/21/2020

Sample Location			Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg			PH	Water Soluble Sulfate %	Resistivity ohm.cm	Chloride %	% Swell (+) / Consoli-dation (-)	R-Value	CLASSIFICATION	
Boring No. (final)	Depth (ft)	Sample Type			Gravel > #4 (%)	Sand (%)	Fines < #200 (%)	LL	PL	PI							AASHTO	USCS
YA-WB-3	1.16-5	Bulk	3.7	–	24	59	17	NV	NP	NP	–	–	–	–	–	–	A-1-b (0)	SM
YA-WB-3	4	SPT	–	–	–	–	–	–	–	–	7.0	0.004	1014	0.0440	–	–	–	–
YA-WB-5	1.16-5	Bulk	4.2	–	31	53	16	NV	NP	NP	–	–	–	–	–	–	A-1-b (0)	SM
YA-WB-5	4	SPT	–	–	–	–	–	–	–	–	7.3	0.005	2354	0.0138	–	–	–	–
YA-WB-6	1.25-5	Bulk	2.9	–	43	44	13	NV	NP	NP	–	–	–	–	–	–	A-1-a (0)	SM
YA-WB-7	0.4-5	Bulk	3.6	–	31	58	11	NV	NP	NP	–	–	–	–	–	–	A-1-a (0)	SW-SM
YA-WB-8	1.16-3.5	Bulk	1.7	–	39	51	10	NV	NP	NP	–	–	–	–	–	–	A-1-a (0)	SW-SM
YA-WB-8	2	SPT	–	–	–	–	–	–	–	–	10.4	0.007	2924	0.0090	–	–	–	–
YA-WB-9	1.16-5	Bulk	2.9	–	38	50	12	NV	NP	NP	–	–	–	–	–	–	A-1-a (0)	SW-SM
YA-WB-10	1.25-3.5	Bulk	4.1	–	28	59	13	NV	NP	NP	–	–	–	–	–	–	A-1-b (0)	SM
YA-WB-11	1.16-5	Bulk	4.3	–	32	53	15	NV	NP	NP	–	–	–	–	–	–	A-1-b (0)	SM
YA-WB-12	1.16-5	Bulk	3.3	–	26	58	16	NV	NP	NP	–	–	–	–	–	–	A-1-b (0)	SM
YA-WB-12	4	SPT	–	–	–	–	–	–	–	–	8.6	0.004	849	0.0478	–	–	–	–
YA-WB-13	1.08-2	Bulk	3.3	–	36	60	4	NV	NP	NP	–	–	–	–	–	–	A-1-a (0)	SW
YA-WB-13	2-5	Bulk	5.1	–	29	48	23	NV	NP	NP	–	–	–	–	–	–	A-1-b (0)	SM
YA-WB-13	2	SPT	–	–	–	–	–	–	–	–	8.0	0.004	1414	0.0259	–	–	–	–
YA-LP-1	0-5	Bulk	3.5	–	41	36	23	26	18	8	–	–	–	–	–	–	A-2-4 (0)	GC

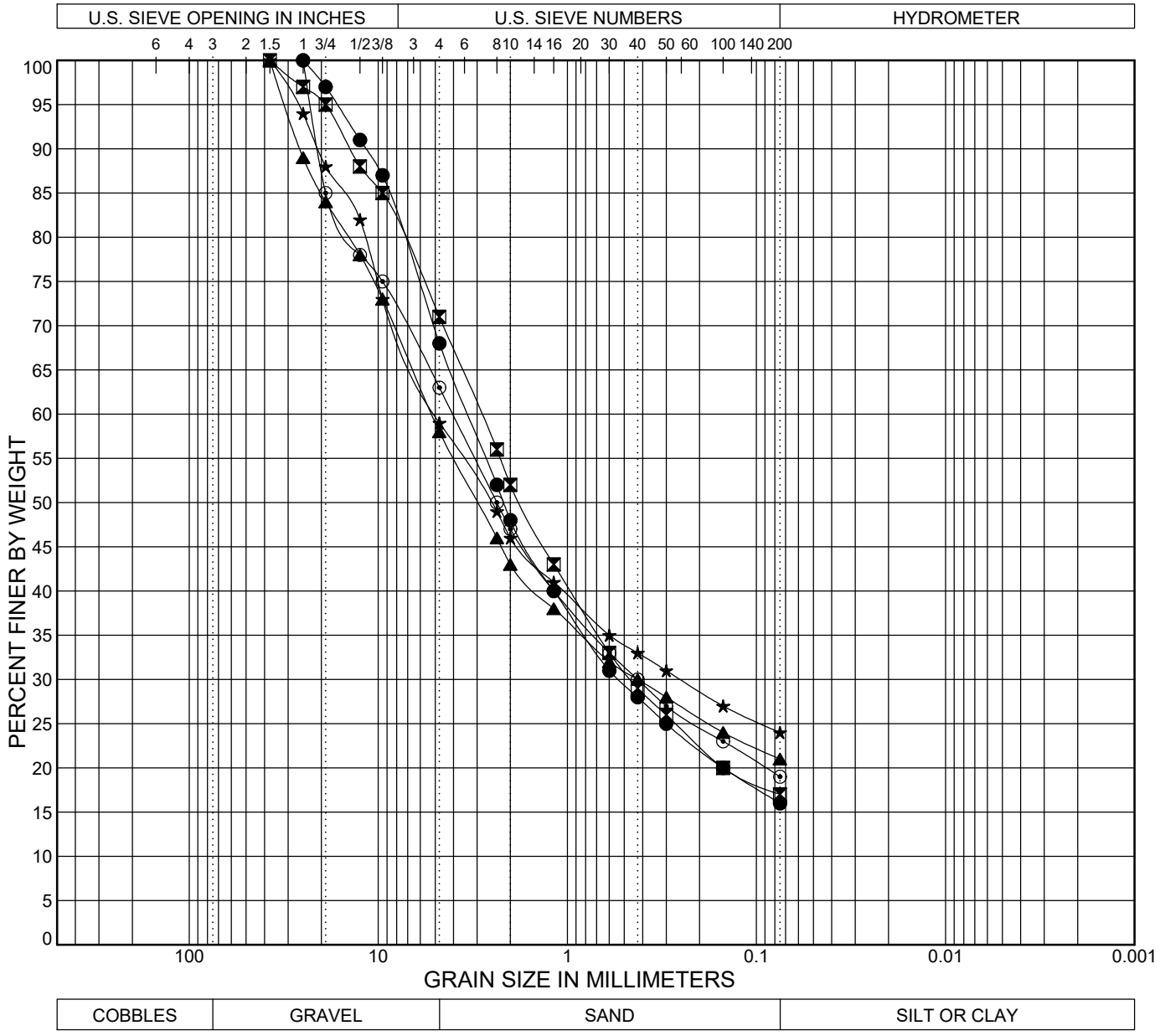
YEH & ASSOCIATES, INC

Summary of Laboratory Test Results

Project No: 219-371 Project Name: MDOT Taft Montana Date: 9/21/2020

Sample Location			Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg			Modified Proctor Max. DD (pcf)	Modified Proctor Opt. Moisture (%)	1-Point CBR* (%)	3-Point CBR* (%)	Resilient Modulus** (psi)	CLASSIFICATION	
Boring No. (final)	Depth (ft)	Sample Type			Gravel > #4 (%)	Sand (%)	Fines < #200 (%)	LL	PL	PI						AASHTO	USCS
YA-EB-8, YA-WB-6, YA-WB-7	Upper 5	Combined Bulk									134.9	6.8					
YA-EB-10, YA-WB-2, YA-WB-3	Upper 5	Combined Bulk									134.7	6.7					
YA-EB-4 YA-WB-1	Upper 5	Combined Bulk									137.2	6.5					
YA-EB-4, YA-WB-1	Upper 5	Combined Bulk											59.1				
YA-WB-5	1.16-5	Bulk											34.1				
YA-WB-11	1.16-5	Bulk											41.5				
YA-EB-1, YA-WB-13, YA-WB-12	Upper 5	Combined Bulk												22.0			
YA-EB-8, YA-WB-6, YA-WB-7	Upper 5	Combined Bulk												31.0			
YA-EB-12, YA-EB-13	Upper 5	Combined Bulk												39.0			
YA-WB-8, YA-WB-9	Upper 5	Combined Bulk												40.0			
YA-EB-8, YA-WB-6, YA-WB-7	Upper 5	Combined Bulk													21,791		
YA-EB-10, YA-WB-2, YA-WB-3	Upper 5	Combined Bulk													22,701		

*CBR Values reported were for samples compacted to 95% of maximum dry density at optimum moisture content, at 0.1 inch penetration depth
** Resilient modulus testing was performed on samples compacted to 95% of maximum dry density at 2% above optimum moisture content



BOREHOLE	DEPTH (ft)	AASHTO Classification	USCS Classification	LL	PL	PI	%Gravel	%Sand	%Fines	
									%Silt	%Clay
● YA-EB-1	3.0	A-1-b (0)	SM	NV	NP	NP	32.0	52.0	16.0	
⊠ YA-EB-10	2.0	A-1-b (0)	SM	NV	NP	NP	29.0	54.0	17.0	
▲ YA-EB-12	3.0	A-1-b (0)	GM	NV	NP	NP	42.0	37.0	21.0	
★ YA-EB-13	3.0	A-1-b (0)	GC-GM	24	18	6	41.0	35.0	24.0	
⊙ YA-EB-3	3.0	A-1-b (0)	SM	NV	NP	NP	37.0	44.0	19.0	

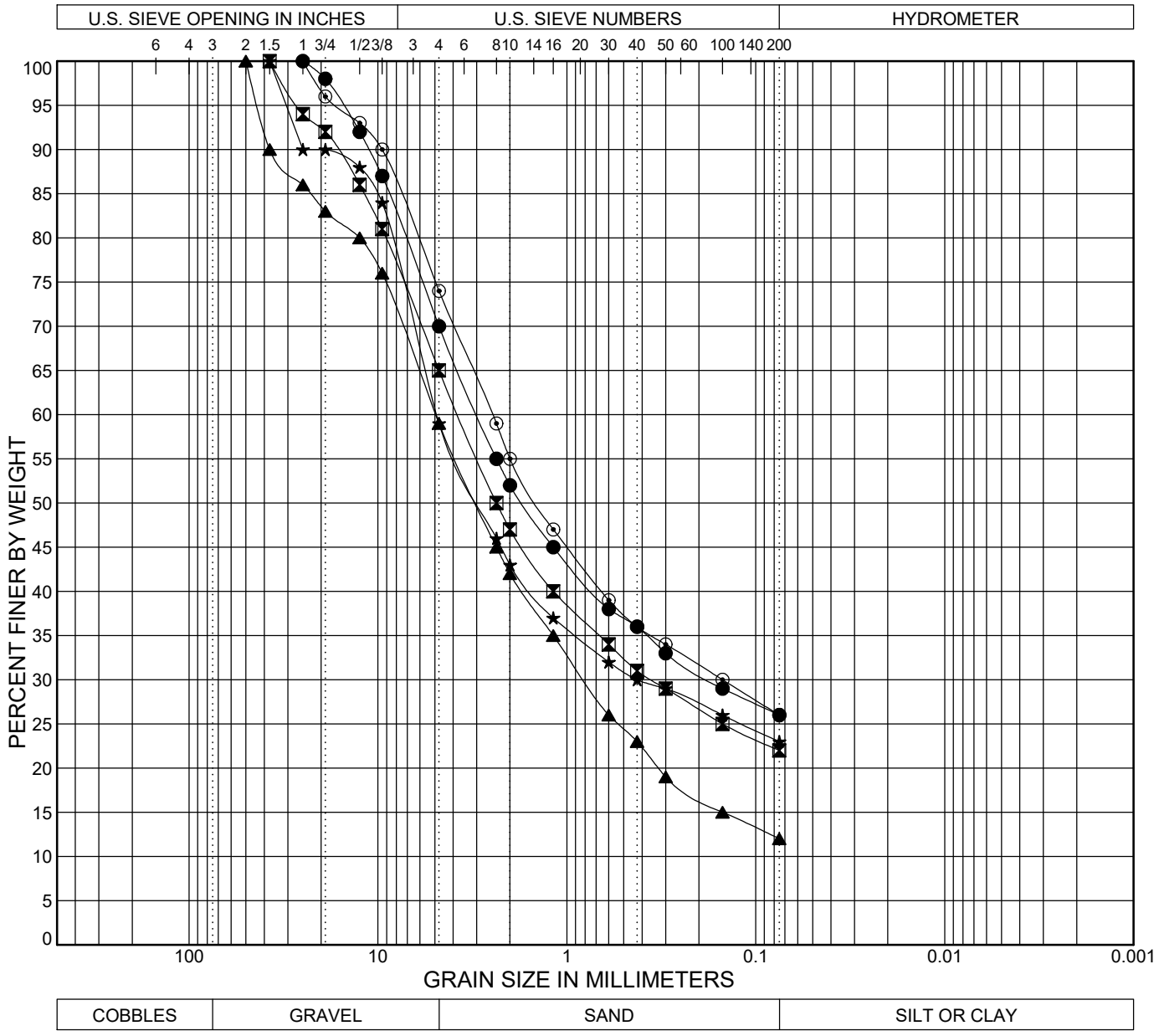
Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services

SIEVE ANALYSIS

Project No. 219-371
Report By:
Checked By:
Date: 12-08-2020
Yeh Lab: Denver

I-90 - Taft West

03 GRAIN SIZE YEH I-90 MDT TAFT.GPJ 2019 YEH COLORADO TEMPLATE.GDT 2019 YEH COLORADO LIBRARY.GLB 12/8/20



BOREHOLE		DEPTH (ft)	AASHTO Classification	USCS Classification	LL	PL	PI	%Gravel	%Sand	%Fines	
										%Silt	%Clay
●	YA-EB-4	2.0	A-2-4 (0)	SC-SM	23	17	6	30.0	44.0	26.0	
⊠	YA-EB-5	2.0	A-1-b (0)	SM	NV	NP	NP	35.0	43.0	22.0	
▲	YA-EB-8	3.0	A-1-a (0)	SW-SM	NV	NP	NP	41.0	47.0	12.0	
★	YA-LP-1	2.0	A-2-4 (0)	GC	26	18	8	41.0	36.0	23.0	
⊙	YA-WB-1	2.0	A-2-4 (0)	SC-SM	24	18	6	26.0	48.0	26.0	

Yeh and Associates, Inc.
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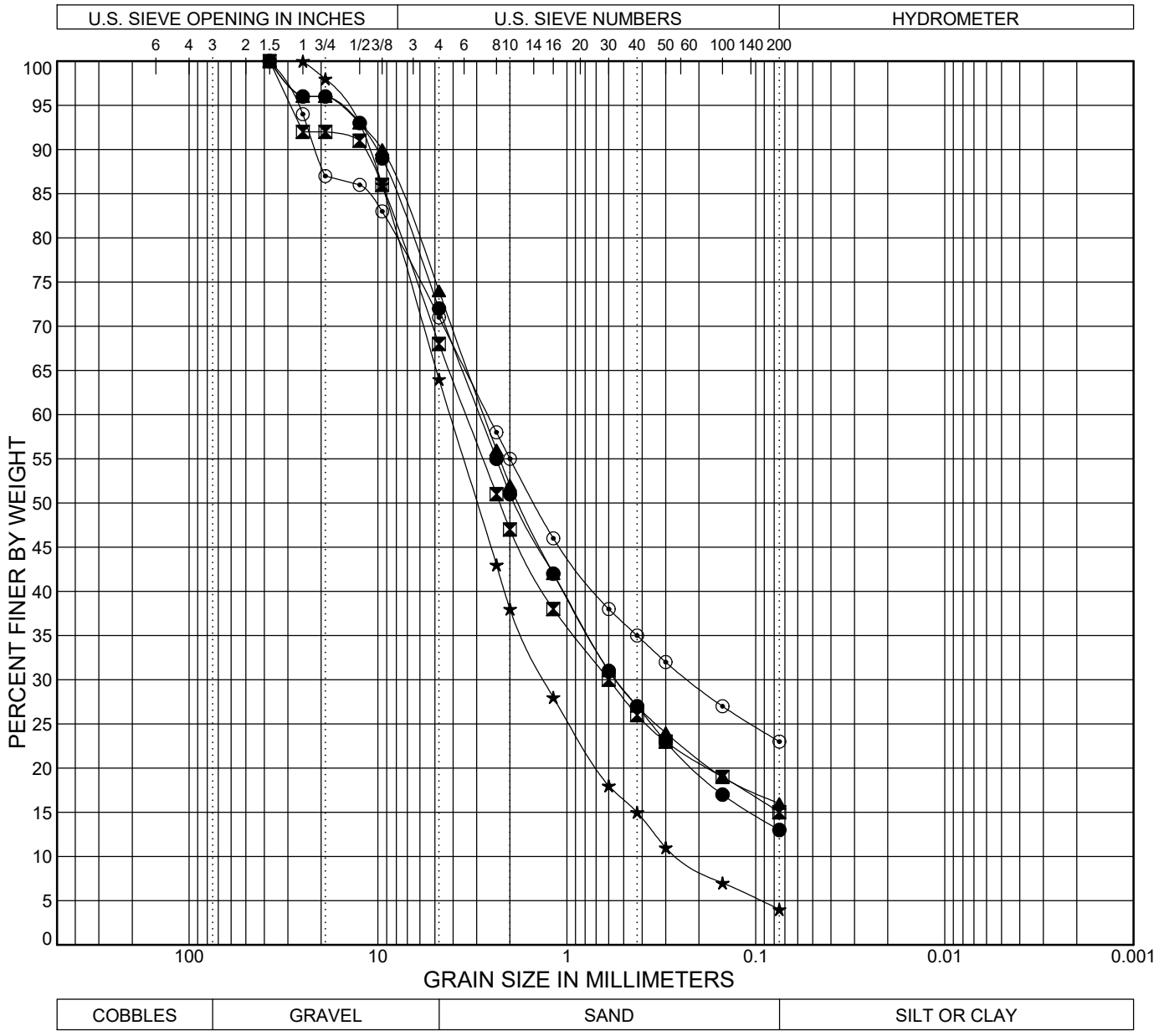
SIEVE ANALYSIS

Project No. 219-371
Report By:
Checked By:
Date: 12-08-2020
Yeh Lab: Denver

I-90 - Taft West



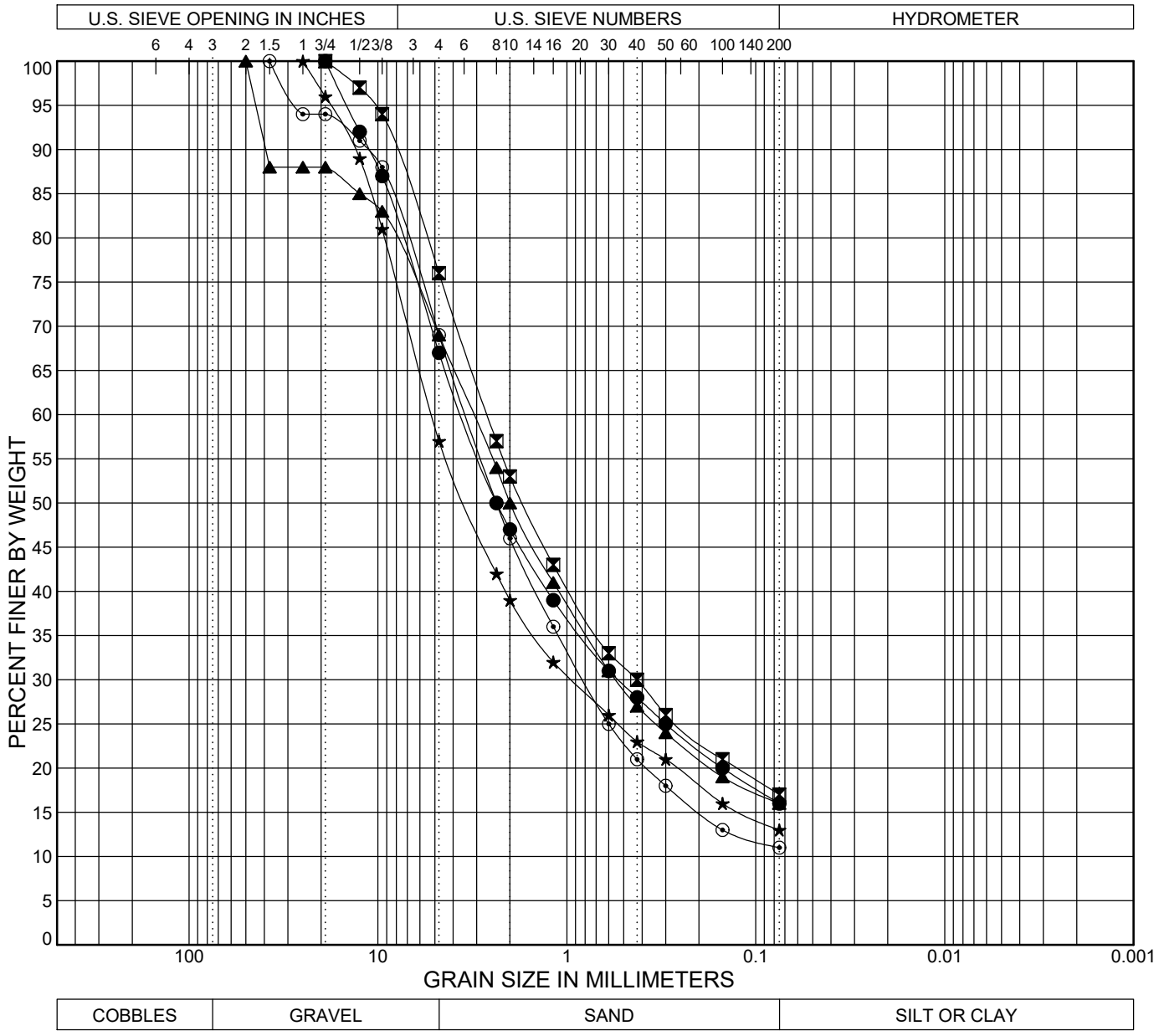
BOREHOLE		DEPTH (ft)	AASHTO Classification	USCS Classification	LL	PL	PI	%Gravel	%Sand	%Fines	
										%Silt	%Clay
●	YA-WB-10	2.0	A-1-b (0)	SM	NV	NP	NP	28.0	59.0	13.0	
⊠	YA-WB-11	2.0	A-1-a (0)	SM	NV	NP	NP	32.0	53.0	15.0	
▲	YA-WB-12	2.0	A-1-b (0)	SM	NV	NP	NP	26.0	58.0	16.0	
★	YA-WB-13	1.7	A-1-a (0)	SW	NV	NP	NP	36.0	60.0	4.0	
⊙	YA-WB-13	3.0	A-1-b (0)	SM	NV	NP	NP	29.0	48.0	23.0	

Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services

SIEVE ANALYSIS

Project No. 219-371
Report By:
Checked By:
Date: 12-08-2020
Yeh Lab: Denver

I-90 - Taft West



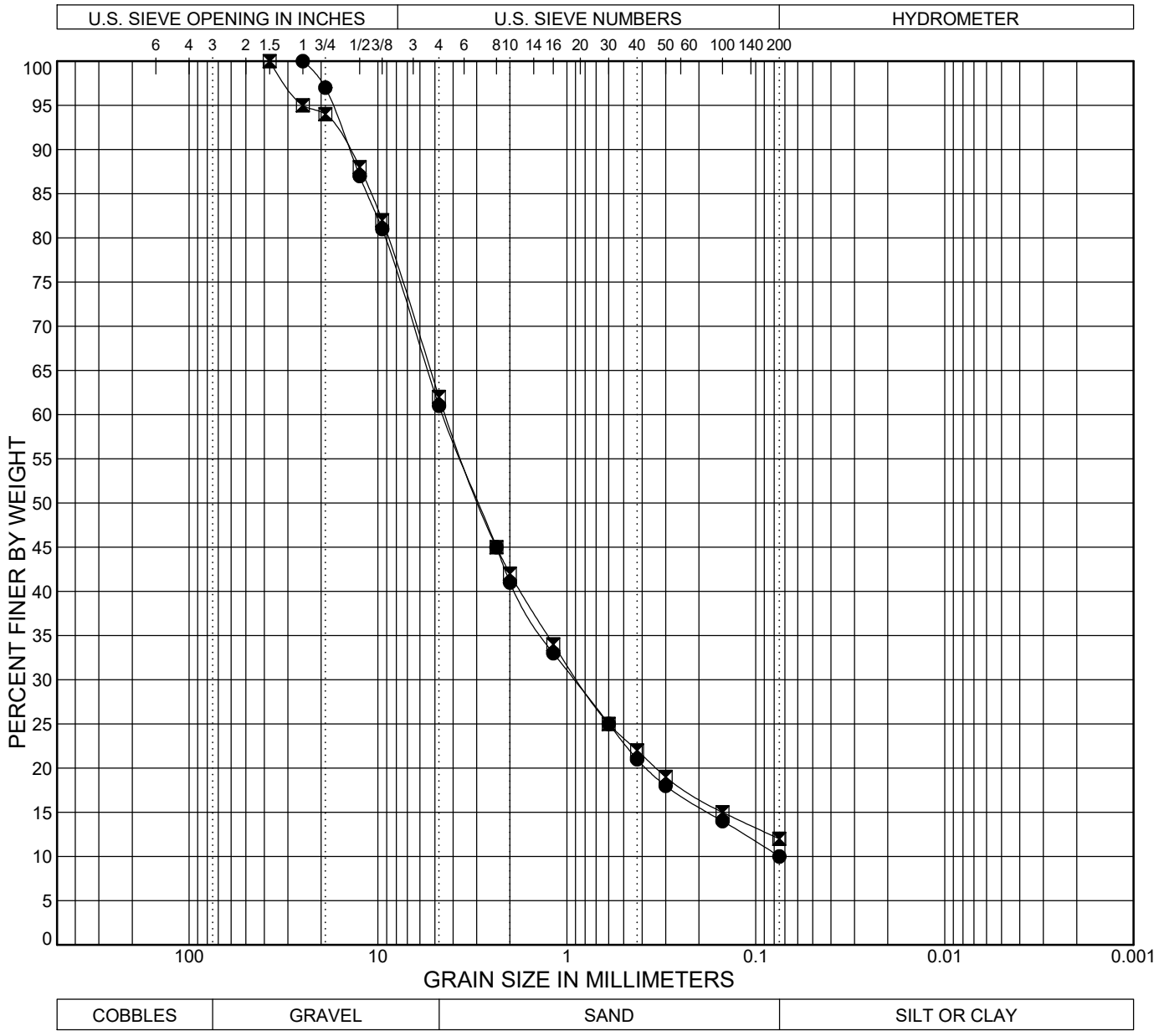
BOREHOLE	DEPTH (ft)	AASHTO Classification	USCS Classification	LL	PL	PI	%Gravel	%Sand	%Fines	
									%Silt	%Clay
● YA-WB-2	3.0	A-1-b (0)	SM	NV	NP	NP	33.0	51.0	16.0	
⊠ YA-WB-3	2.0	A-1-b (0)	SM	NV	NP	NP	24.0	59.0	17.0	
▲ YA-WB-5	2.0	A-1-b (0)	SM	NV	NP	NP	31.0	53.0	16.0	
★ YA-WB-6	2.0	A-1-a (0)	SM	NV	NP	NP	43.0	44.0	13.0	
⊙ YA-WB-7	2.0	A-1-a (0)	SP-SM	NV	NP	NP	31.0	58.0	11.0	

Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services

SIEVE ANALYSIS

Project No. 219-371 Date: 12-08-2020
Report By: Yeh Lab: Denver
Checked By:

I-90 - Taft West



BOREHOLE		DEPTH (ft)	AASHTO Classification	USCS Classification	LL	PL	PI	%Gravel	%Sand	%Fines	
										%Silt	%Clay
●	**YA-WB-8**	**3.0**	**A-1-a (0)**	**SW-SM**	**NV**	**NP**	**NP**	**39.0**	**51.0**	**10.0**	
⊠	**YA-WB-9**	**2.0**	**A-1-a (0)**	**SP-SM**	**NV**	**NP**	**NP**	**38.0**	**50.0**	**12.0**	

Yeh and Associates, Inc.
Geotechnical • Geological • Construction Services

SIEVE ANALYSIS

Project No. 219-371 Date: 12-08-2020
Report By: Yeh Lab: Denver
Checked By:

I-90 - Taft West

Client: Samantha Sherwood
Yeh and Associates
2000 N Clay St
Unit 200
Denver, CO 80211

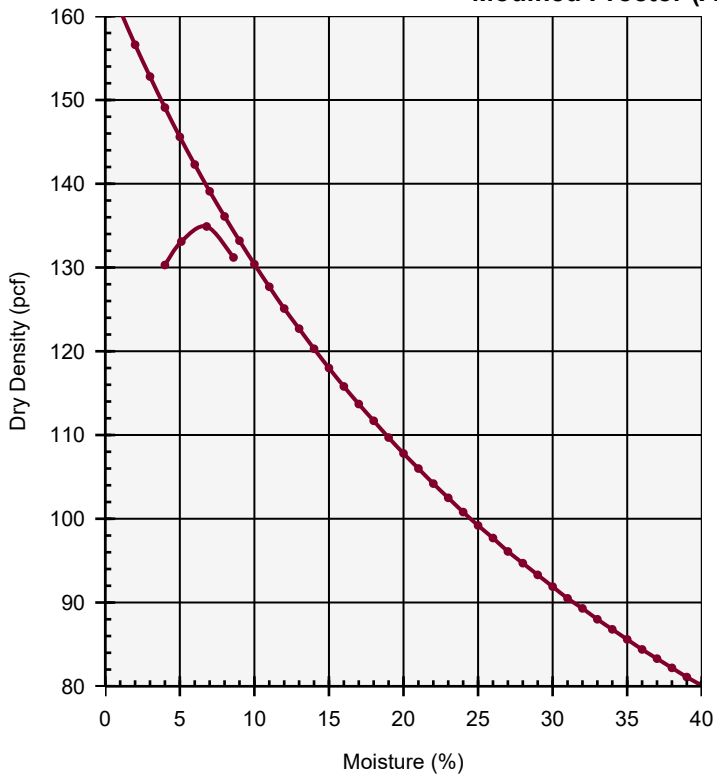
Yeh and Associates Lab Testing Services

Report Date: Oct 3, 2020
Work Order Date: Sep 22, 2020
Work Order No.: 20-1305.SoilSampling.0001; ver: 1
Reviewed by: Evan Kuhn

Soil/Aggregate Laboratory Summary

Sample No.: 1
Dropped Off By: Client *Sampling may not be in accordance with reported method.
Sampling Method: ASTM D75 / AASHTO T2 / CDOT CP30
Material Description: Light brown, silty SAND with gravel
Sample Location: Combined WB-6, WB-7, EB-8

Modified Proctor (AASHTO T180)



Method	Preparation	Hammer
Method D	Moist Preparation	Manual

Maximum Dry Density (pcf)	Optimum Moisture (%)	Oversize Corrected	
		Maximum Dry Density (pcf)	Optimum Moisture (%)
134.9	**6.8**	137.0	6.3

Oversize Sieve: 3/4 in
Coarse Fraction (%): 8
Fine Fraction (%): 92
Coarse Specific Gravity: Measured 2.64
Coarse Absorption (%): 1.22
Fine Specific Gravity: Estimated 2.65

Client: Samantha Sherwood
Yeh and Associates
2000 N Clay St
Unit 200
Denver, CO 80211

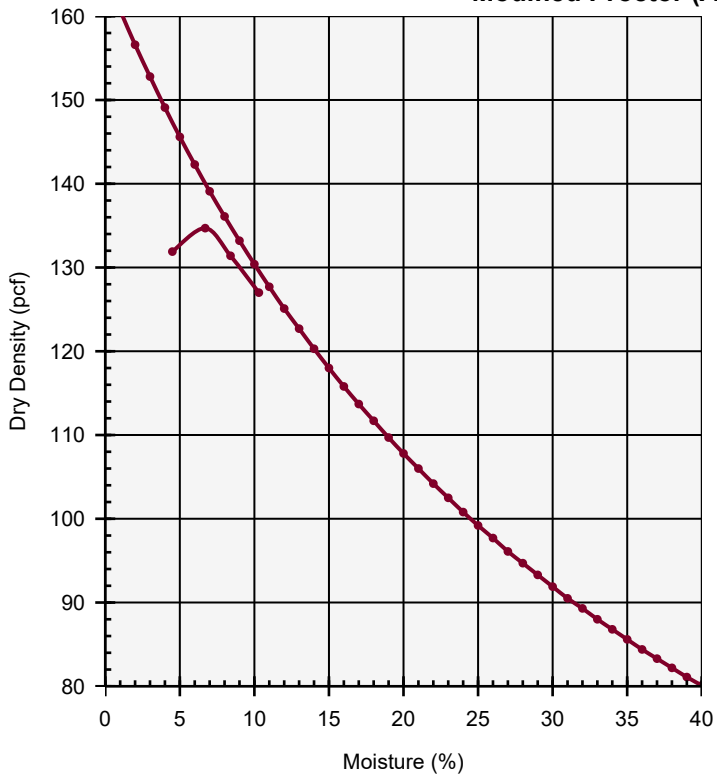
Yeh and Associates Lab Testing Services

Report Date: Oct 3, 2020
Work Order Date: Sep 22, 2020
Work Order No.: 20-1305.SoilSampling.0001; ver: 1
Reviewed by: Evan Kuhn

Soil/Aggregate Laboratory Summary

Sample No.: 2
Dropped Off By: Client *Sampling may not be in accordance with reported method.
Sampling Method: ASTM D75 / AASHTO T2 / CDOT CP30
Material Description: Light brown, silty SAND with gravel
Sample Location: Combined WB-2, WB-3, EB-10

Modified Proctor (AASHTO T180)



Method	Preparation	Hammer
Method D	Moist Preparation	Manual

Maximum Dry Density (pcf)	Optimum Moisture (%)	Oversize Corrected	
		Maximum Dry Density (pcf)	Optimum Moisture (%)
134.7	**6.7**	136.0	6.3

Oversize Sieve: 3/4 in
Coarse Fraction (%): 6
Fine Fraction (%): 94
Coarse Specific Gravity: Measured 2.67
Coarse Absorption (%): 0.86
Fine Specific Gravity: Estimated 2.65

Client: Samantha Sherwood
Yeh and Associates
2000 N Clay St
Unit 200
Denver, CO 80211

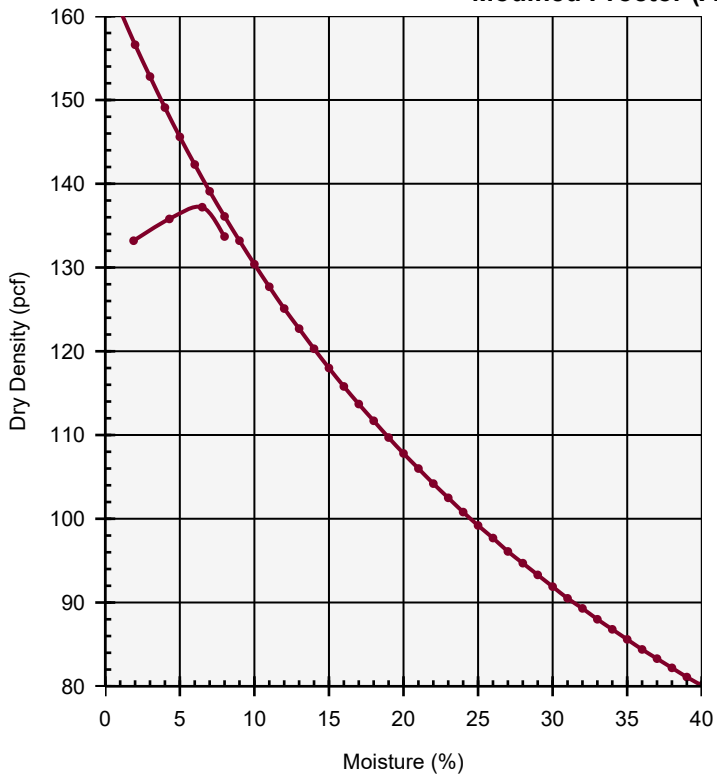
Yeh and Associates Lab Testing Services

Report Date: Oct 3, 2020
Work Order Date: Sep 22, 2020
Work Order No.: 20-1305.SoilSampling.0001; ver: 1
Reviewed by: Evan Kuhn

Soil/Aggregate Laboratory Summary

Sample No.: 3
Dropped Off By: Client *Sampling may not be in accordance with reported method.
Sampling Method: ASTM D75 / AASHTO T2 / CDOT CP30
Material Description: Pale brown, silty SAND with gravel
Sample Location: Combined EB-4 and WB-1

Modified Proctor (AASHTO T180)



Method	Preparation	Hammer
Method D	Moist Preparation	Manual

Maximum Dry Density (pcf)	Optimum Moisture (%)	Oversize Corrected	
		Maximum Dry Density (pcf)	Optimum Moisture (%)
137.2	**6.5**	139.0	6.0

Oversize Sieve: 3/4 in
Coarse Fraction (%): 10
Fine Fraction (%): 90
Coarse Specific Gravity: Measured 2.66
Coarse Absorption (%): 1.08
Fine Specific Gravity: Estimated 2.65

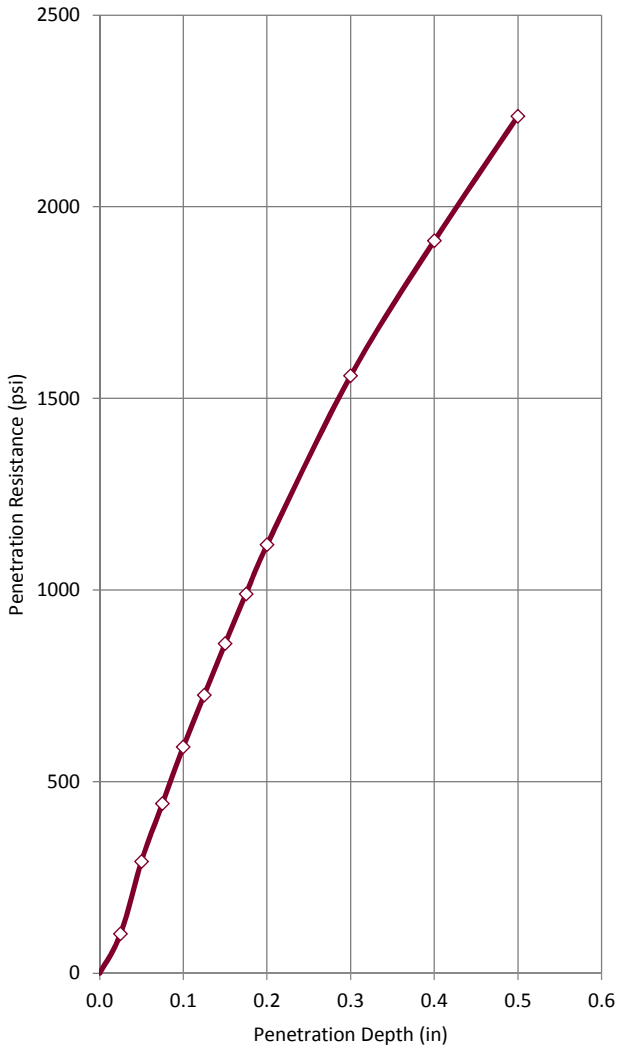
GROUND ENGINEERING

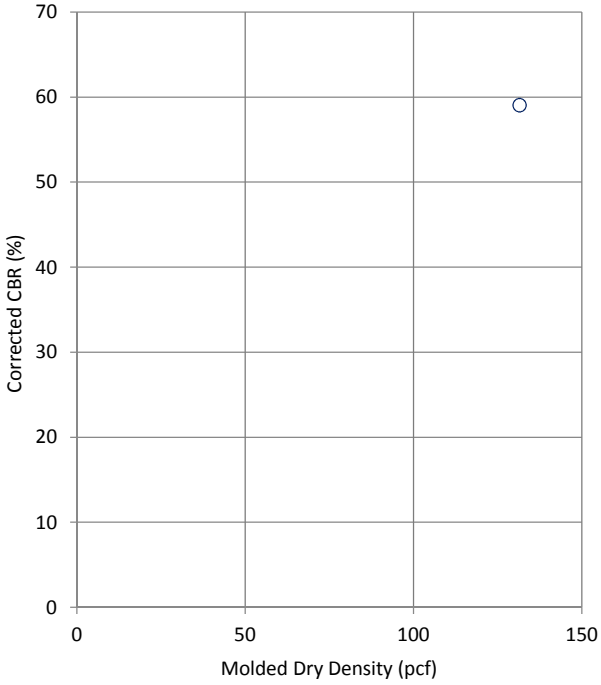
Client: Yeh and Associates, Inc

Project No.: 20-1305

Yeh and Associates
I-90 Taft West

California Bearing Ratio (Single Point)





Corrected CBR at 0.1 in from Graph		
Relative Comp. (%)	Dry Density (pcf)	CBR (%)

Proctor Method: ASTM - D1557
Max. Dry Density (pcf): 137.2
Opt. Moisture Content (%): 6.5

Specimen	Molded Properties			Soaked Properties		Surcharge (lb)	Swell (%)	Corrected CBR (%)	
	Relative Comp. (%)	Dry Density (pcf)	Moisture Content (%)	Dry Density (pcf)	Moisture Content (%)			0.1 in	0.2 in
1 ○									
2 ◊	95.9	131.6	6.7	132.5	8.1	10	0.1	59.1	74.5
3 Δ									

Sample: Combined EB-4 and WB-1
Description: Silty sand with gravel
Sample ID: Soil8894

Classification: SC-SM / A-2-4(0
Liquid Limit: 17-18
Plasticity Index: 6

< 3/4 in (%): 92-96
< No. 4 (%): 70-74
< No. 200 (%): 26.0

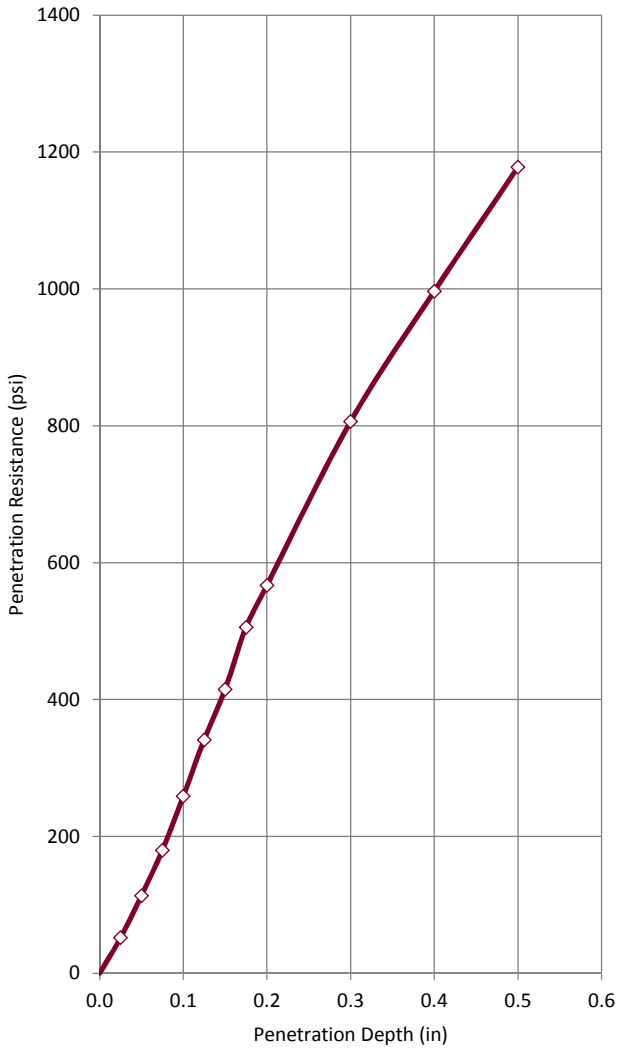
GROUND ENGINEERING

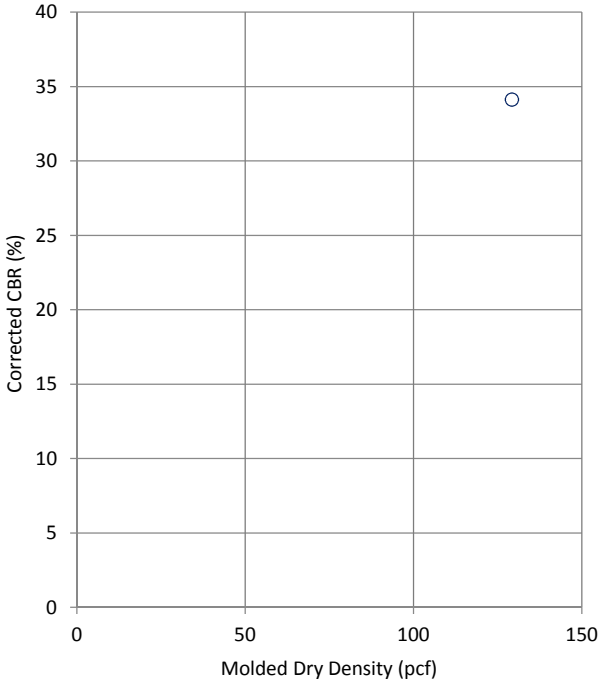
Client: Yeh and Associates, Inc

Project No.: 20-1305

Yeh and Associates
I-90 Taft West

California Bearing Ratio (Single Point)





Corrected CBR at 0.1 in from Graph		
Relative Comp. (%)	Dry Density (pcf)	CBR (%)

Proctor Method: ASTM - D1557
Max. Dry Density (pcf): 134.7
Opt. Moisture Content (%): 6.7

Specimen	Molded Properties			Soaked Properties		Surcharge (lb)	Swell (%)	Corrected CBR (%)	
	Relative Comp. (%)	Dry Density (pcf)	Moisture Content (%)	Dry Density (pcf)	Moisture Content (%)			0.1 in	0.2 in
1 ○									
2 ◊	96.0	129.3	6.6	130.3	8.2	10	-0.1	34.1	41.7
3 Δ									

Sample: WB-5
Description: Silty sand and gravel
Sample ID: Soil8898

Classification: SM / A-1-b
Liquid Limit: NV
Plasticity Index: NP

< 3/4 in (%): 96
< No. 4 (%): 69
< No. 200 (%): 16.0

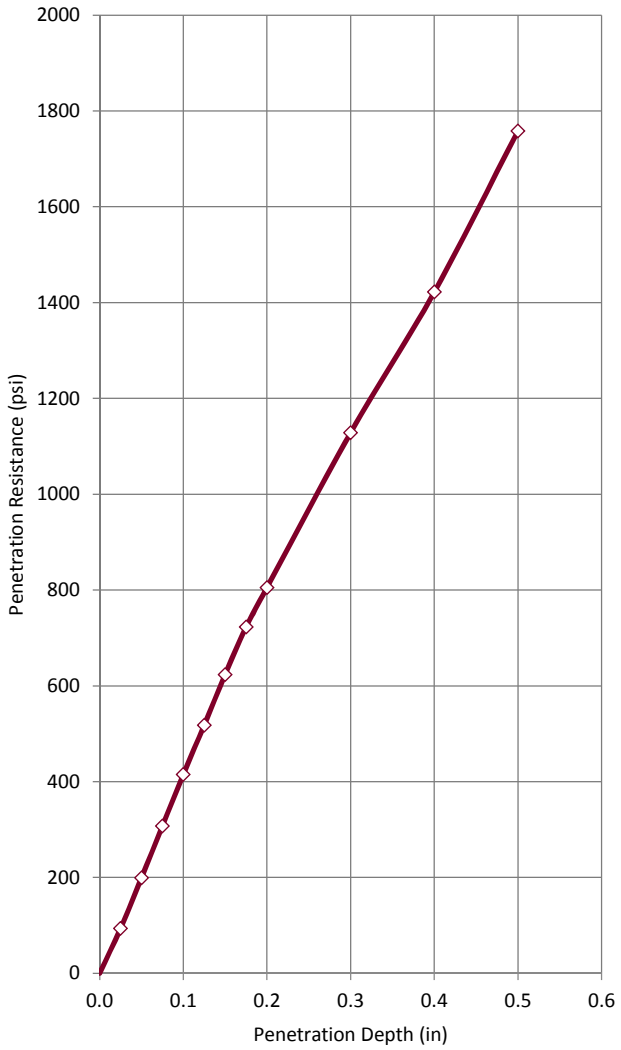
GROUND ENGINEERING

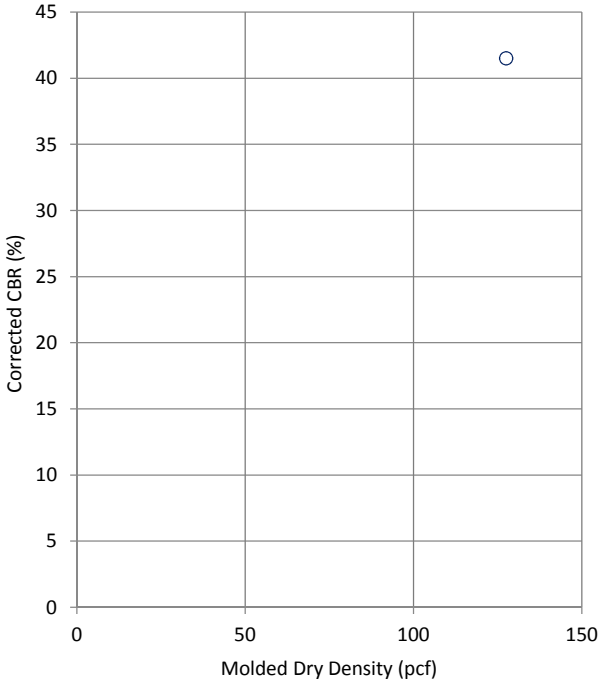
Client: Yeh and Associates, Inc

Project No.: 20-1305

Yeh and Associates
I-90 Taft West

California Bearing Ratio (Single Point)





Corrected CBR at 0.1 in from Graph		
Relative Comp. (%)	Dry Density (pcf)	CBR (%)

Proctor Method: ASTM - D1557
Max. Dry Density (pcf): 134.7
Opt. Moisture Content (%): 6.7

Specimen	Molded Properties			Soaked Properties		Surcharge (lb)	Swell (%)	Corrected CBR (%)	
	Relative Comp. (%)	Dry Density (pcf)	Moisture Content (%)	Dry Density (pcf)	Moisture Content (%)			0.1 in	0.2 in
1 ○									
2 ◊	94.7	127.6	6.5	128.5	8.6	10	0.2	41.5	53.7
3 Δ									

Sample: WB-11
Description: Silty sand and gravel
Sample ID: Soil8899

Classification: SM / A-1-b
Liquid Limit: NV
Plasticity Index: NP

< 3/4 in (%): 96
< No. 4 (%): 68
< No. 200 (%): 15.0

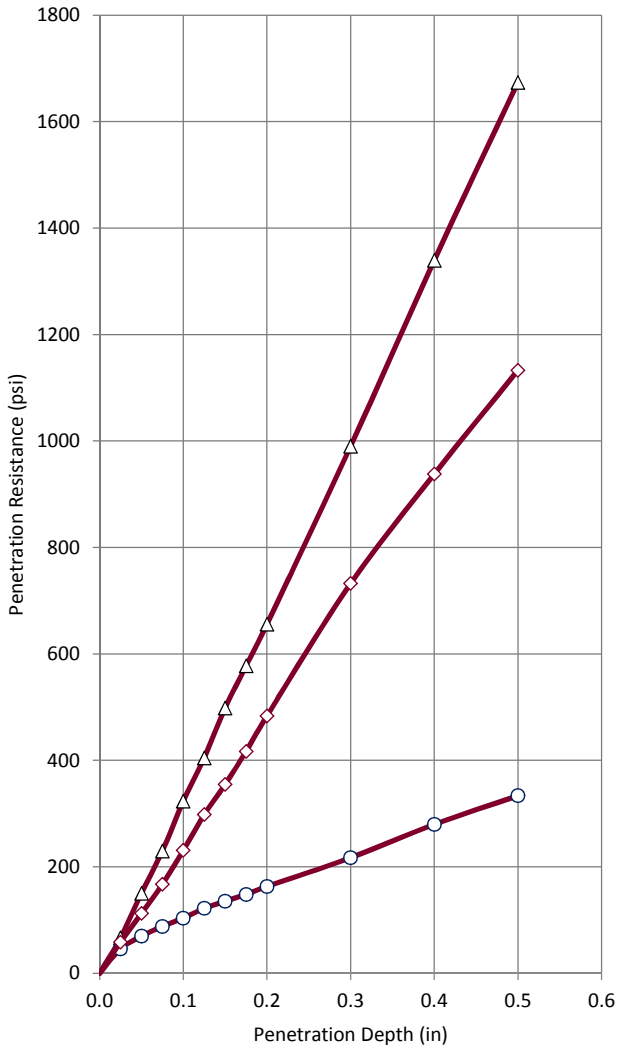
GROUND ENGINEERING

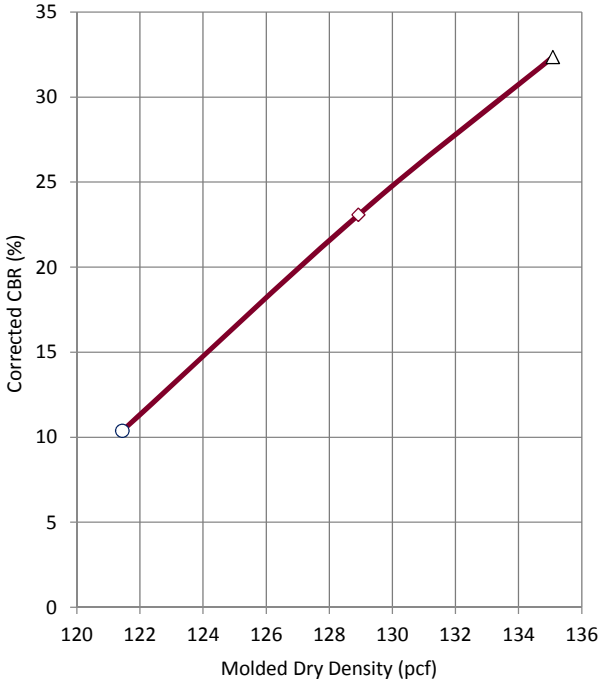
Client: Yeh and Associates, Inc

Project No.: 20-1305

Yeh and Associates
I-90 Taft West

California Bearing Ratio (ASTM D1883)





Corrected CBR at 0.1 in from Graph		
Relative Comp. (%)	**Dry Density (pcf)**	**CBR (%)**
100	134.7	32
95	128.0	22
90	121.2	10

Proctor Method: D1557
Max. Dry Density (pcf): 134.7
Opt. Moisture Content (%): 6.7

Specimen	Molded Properties			Soaked Properties		Surcharge (lb)	Swell (%)	Corrected CBR (%)	
	Relative Comp. (%)	Dry Density (pcf)	Moisture Content (%)	Dry Density (pcf)	Moisture Content (%)			0.1 in	0.2 in
1 ○	90.2	121.4	6.9	125.7	7.8	10	-0.1	10.4	10.9
2 ◊	95.7	128.9	6.9	131.2	7.2	10	0.0	23.1	32.2
3 Δ	100.3	135.1	6.9	136.1	7.2	10	-0.1	32.4	43.7

Sample: Combined EB-1, WB-13 and WB-12
Description: Silty sand
Sample ID: Soil8897

Classification: SW to SM
Liquid Limit: NV
Plasticity Index: NP

< 3/4 in (%): 43929
< No. 4 (%): 64-74
< No. 200 (%): 4-16

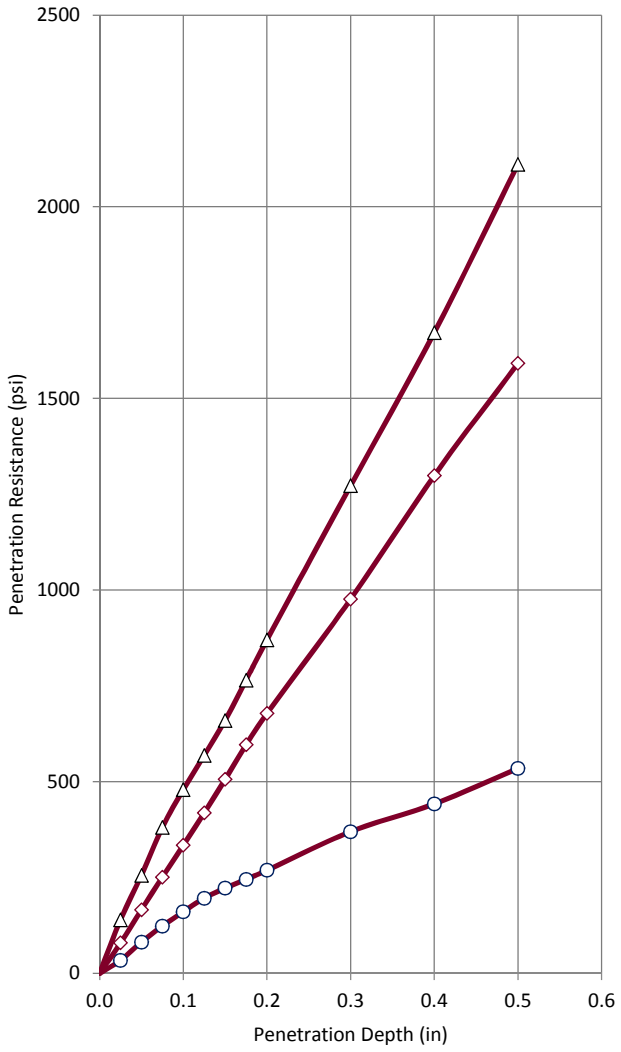
GROUND ENGINEERING

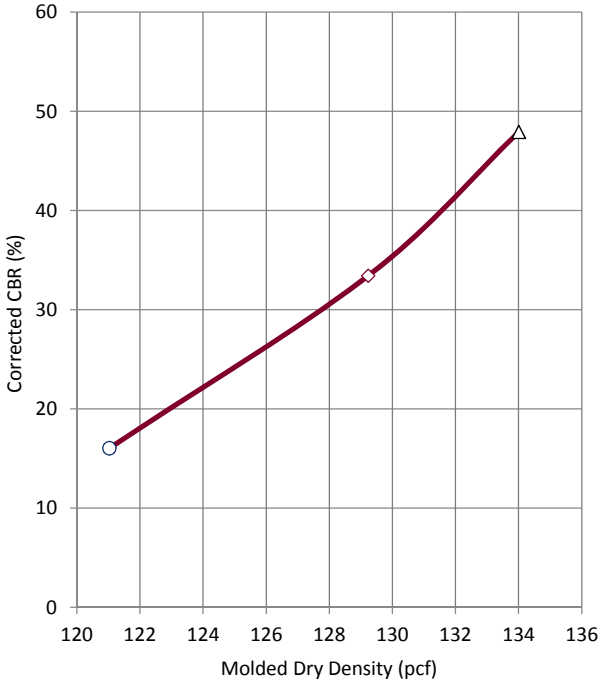
Client: Yeh and Associates, Inc

Project No.: 20-1305

Yeh and Associates
I-90 Taft West

California Bearing Ratio (ASTM D1883)





Corrected CBR at 0.1 in from Graph		
Relative Comp. (%)	Dry Density (pcf)	CBR (%)
100	134.9	51
95	128.2	31
90	121.4	17

Proctor Method: D1557
Max. Dry Density (pcf): 134.9
Opt. Moisture Content (%): 6.8

Specimen	Molded Properties			Soaked Properties		Surcharge (lb)	Swell (%)	Corrected CBR (%)	
	Relative Comp. (%)	Dry Density (pcf)	Moisture Content (%)	Dry Density (pcf)	Moisture Content (%)			0.1 in	0.2 in
1 ○	89.7	121.0	7.0	126.7	8.6	10	0.0	16.0	17.9
2 ◊	95.8	129.2	7.0	130.5	7.6	10	-0.2	33.4	45.2
3 Δ	99.3	134.0	7.0	135.3	7.3	10	-0.2	47.9	58.0

Sample: Combined WB-6, WB-7, EB-8
Description: Silty sands
Sample ID: Soil8892

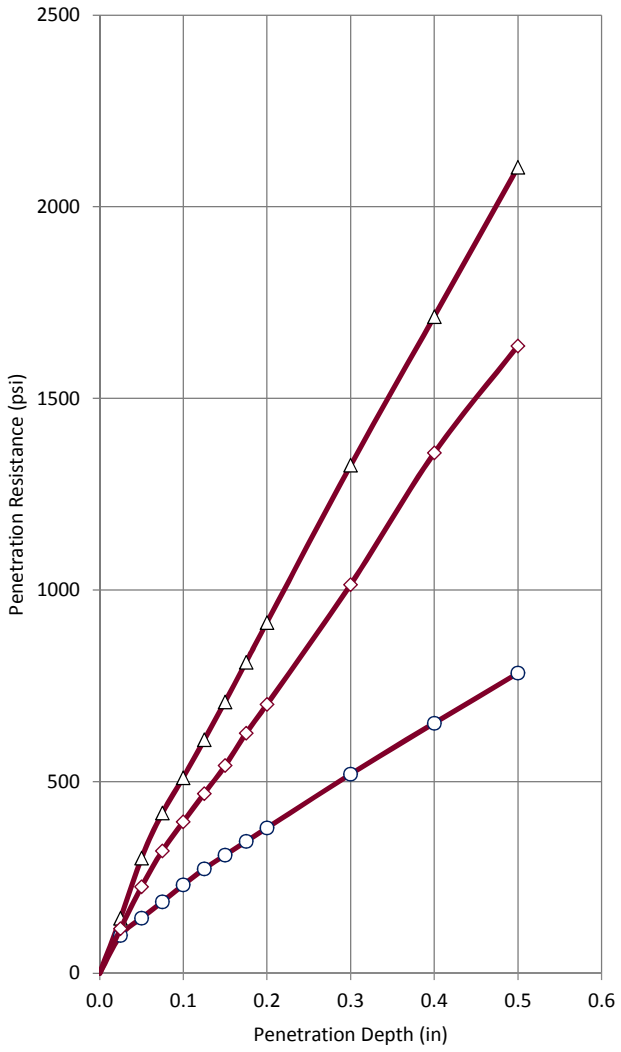
GROUND ENGINEERING

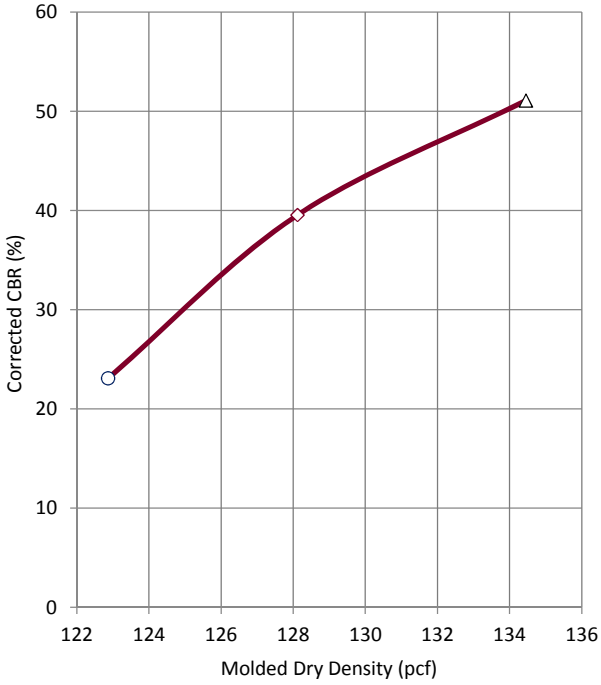
Client: Yeh and Associates Inc

Project No.: 20-1305

Yeh and Associates
I-90 Taft West

California Bearing Ratio (ASTM D1883)





Corrected CBR at 0.1 in from Graph		
Relative Comp. (%)	Dry Density (pcf)	CBR (%)
100	134.7	51
95	128.0	39
90	121.2	17

Proctor Method: D1557
Max. Dry Density (pcf): 134.7
Opt. Moisture Content (%): 6.7

Specimen	Molded Properties			Soaked Properties		Surcharge (lb)	Swell (%)	Corrected CBR (%)	
	Relative Comp. (%)	Dry Density (pcf)	Moisture Content (%)	Dry Density (pcf)	Moisture Content (%)			0.1 in	0.2 in
1 ○	91.2	122.9	6.9	125.9	9.2	10	0.0	23.1	25.3
2 ◊	95.1	128.1	6.9	130.8	8.5	10	0.3	39.5	46.8
3 Δ	99.8	134.5	6.7	138.1	7.2	10	0.0	51.1	61.0

Sample: Combined EB-12 and EB-13
Description: Silty sand
Sample ID: Soil8895

Classification: GM-GC / A-1-b *< 3/4 in (%):* 4-8
Liquid Limit: NV to 24 *< No. 4 (%):* 58-59
Plasticity Index: NP to 6 *< No. 200 (%):* 21-24

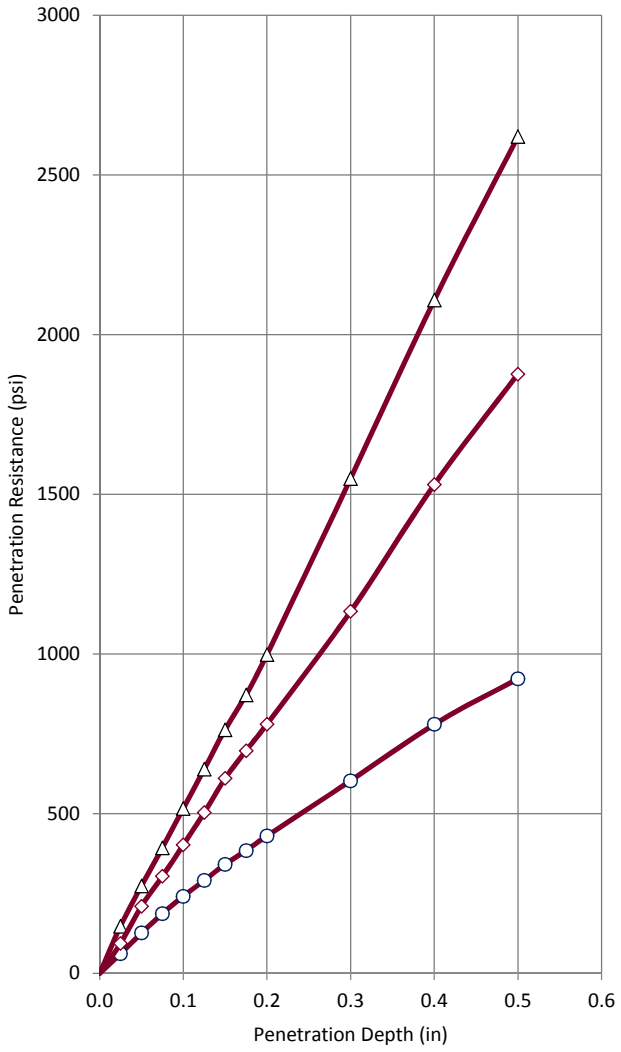
GROUND ENGINEERING

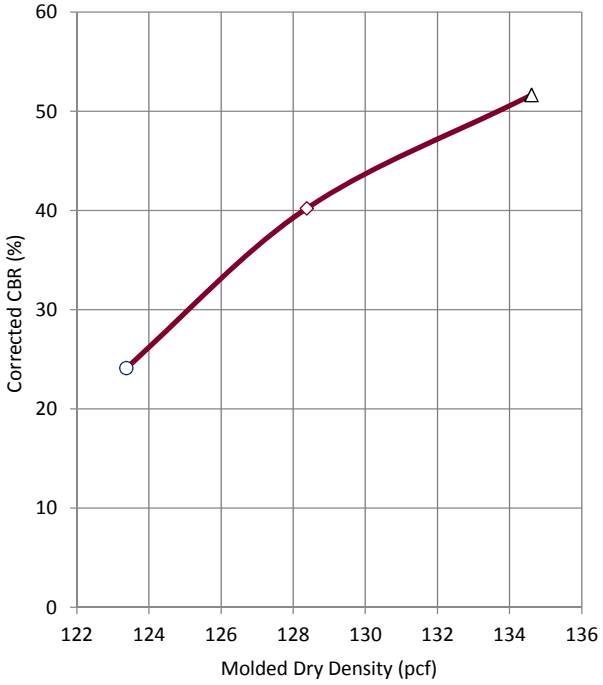
Client: Yeh and Associates Inc

Project No.: 20-1305

Yeh and Associates
I-90 Taft West

California Bearing Ratio (ASTM D1883)





Corrected CBR at 0.1 in from Graph		
Relative Comp. (%)	Dry Density (pcf)	CBR (%)
100	134.9	52
95	128.2	40
90	121.4	16

Proctor Method: D1557
Max. Dry Density (pcf): 134.9
Opt. Moisture Content (%): 6.8

Specimen	Molded Properties			Soaked Properties		Surcharge (lb)	Swell (%)	Corrected CBR (%)	
	Relative Comp. (%)	Dry Density (pcf)	Moisture Content (%)	Dry Density (pcf)	Moisture Content (%)			0.1 in	0.2 in
1 ○	91.5	123.4	6.5	125.0	7.7	10	-0.1	24.1	28.7
2 ◊	95.2	128.4	6.5	130.6	6.6	10	0.0	40.2	52.0
3 Δ	99.8	134.6	6.5	135.4	6.8	10	0.0	51.6	66.6

Sample: Combined WB-8 and WB-9
Description: Silty sand
Sample ID: Soil8896

Classification: SW-SM
Liquid Limit: NV
Plasticity Index: NP

< 3/4 in (%): 4-8
< No. 4 (%): 61-62
< No. 200 (%): 10-12

GROUND ENGINEERING

Client: Yeh and Associates, Inc

Project No.: 20-1305

Test Date: 9/25/20

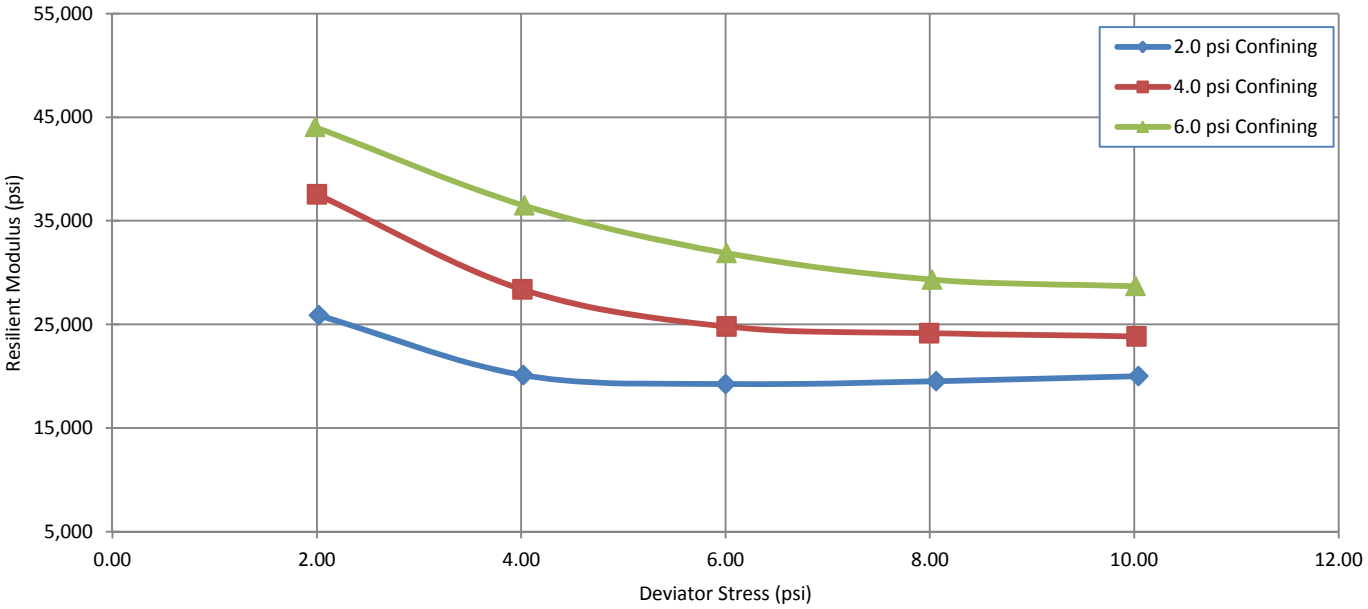
Yeh Laboratory Testing Services

Resilient Modulus of Soils and Aggregates AASHTO T-307

Sample Location:	I-90 Taft West; combined WB-2, WB-3 and EB-10	*Sample ID#:*	Soil 8893
Description:	Silty sands	*Liquid Limit:*	NV
Remold Parameters:	95% of Max Dry Density @ +2% of optimum moisture	*Plasticity Index:*	NP
Remolded Height (in):	8.085	*< No. 200 (%):*	16-17
Remolded Diameter (in):	4.002	*Classification:*	A-1-b / SM
Moisture Content at Remold (%):	8.7	*Proctor Type:*	Modified
Remolded Dry Density (pcf):	128.2	*Max Dry Density (pcf):*	134.7
Moisture Content after test (%):	8.5	*Optimum Moisture (%):*	6.7

Testing Procedure: AASHTO T 307 Subgrade Soils

Test Sequence	Confining Pressure (psi)	Maximum Deviator Stress		Applied Contact Stress (psi)	Applied Cyclic Stress (psi)	Recoverable Deformation			Measured Resilient Strain (%)	Resilient Modulus (psi)
		Specified (psi)	Applied (psi)			LVDT #1 (mils)	LVDT #2 (mils)	Average (mils)		
Conditioning	6.0	4.0	4.06	0.39	3.67	0.83	0.84	0.84	0.010	-
1	6.0	2.0	1.98	0.21	1.77	0.31	0.34	0.33	0.004	44,057
2	6.0	4.0	4.03	0.41	3.62	0.79	0.80	0.80	0.010	36,464
3	6.0	6.0	6.01	0.59	5.42	1.36	1.36	1.36	0.017	31,879
4	6.0	8.0	8.02	0.79	7.23	1.98	1.97	1.98	0.025	29,329
5	6.0	10.0	10.01	1.00	9.01	2.51	2.52	2.52	0.031	28,689
6	4.0	2.0	2.00	0.20	1.80	0.40	0.37	0.39	0.005	37,554
7	4.0	4.0	4.01	0.41	3.60	1.05	0.98	1.02	0.013	28,377
8	4.0	6.0	6.01	0.63	5.38	1.78	1.69	1.74	0.022	24,803
9	4.0	8.0	7.99	0.80	7.20	2.44	2.33	2.39	0.030	24,157
10	4.0	10.0	10.02	0.99	9.03	3.08	2.98	3.03	0.038	23,841
11	2.0	2.0	2.02	0.22	1.80	0.57	0.54	0.56	0.007	25,875
12	2.0	4.0	4.02	0.40	3.62	1.51	1.37	1.44	0.018	20,100
13	2.0	6.0	6.00	0.60	5.41	2.35	2.15	2.25	0.028	19,252
14	2.0	8.0	8.06	0.81	7.25	3.08	2.86	2.97	0.037	19,520
15	2.0	10.0	10.04	1.03	9.01	3.70	3.51	3.61	0.045	20,007
								Average of Sequences (7,8,9,12,13,14):		**22,701**



GROUND ENGINEERING

Client: Yeh and Associates, Inc

Project No.: 20-1305

Test Date: 9/25/20

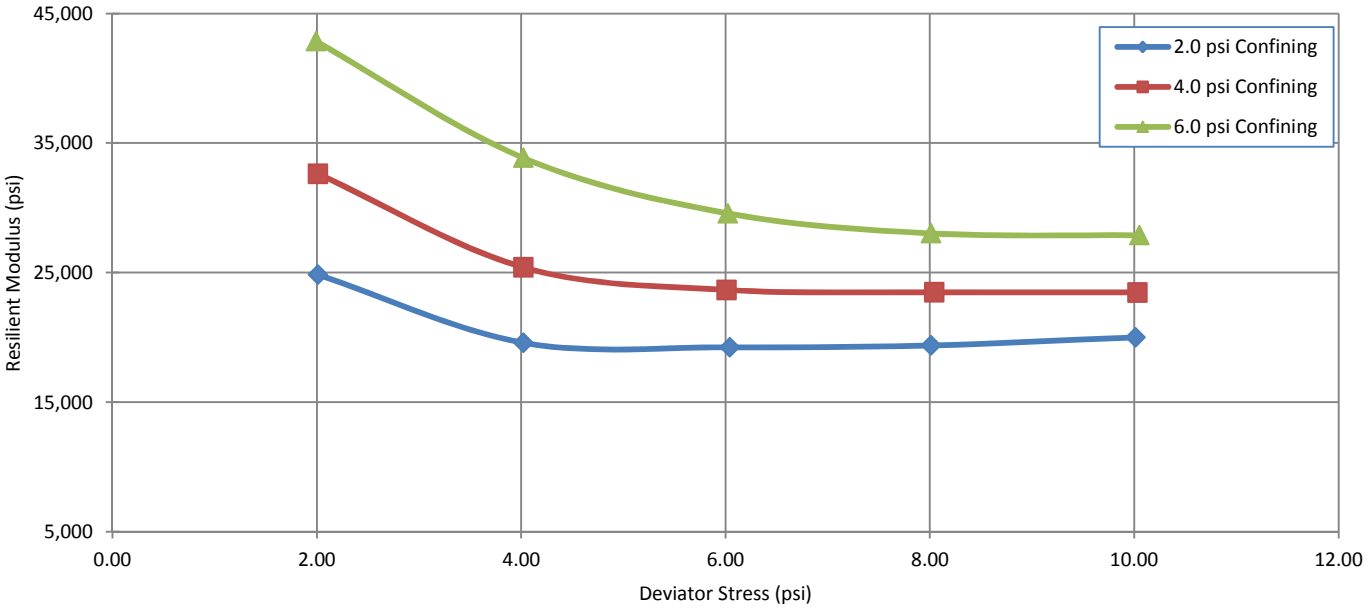
Yeh Laboratory Testing Services

Resilient Modulus of Soils and Aggregates AASHTO T-307

Sample Location:	I-90 Taft West; combined WB-6, WB-7 and EB-8	*Sample ID#:*	Soil 8892
Description:	Silty sands	*Liquid Limit:*	NV
Remold Parameters:	95% of Max Dry Density @ +2% of optimum moisture	*Plasticity Index:*	NP
Remolded Height (in):	8.090	*< No. 200 (%):*	11-13
Remolded Diameter (in):	4.001	*Classification:*	A-1-b
Moisture Content at Remold (%):	9.1	*Proctor Type:*	Modified
Remolded Dry Density (pcf):	128.2	*Max Dry Density (pcf):*	134.9
Moisture Content after test (%):	9.0	*Optimum Moisture (%):*	6.8

Testing Procedure: AASHTO T 307 Subgrade Soils

Test Sequence	Confining Pressure (psi)	Maximum Deviator Stress		Applied Contact Stress (psi)	Applied Cyclic Stress (psi)	Recoverable Deformation			Measured Resilient Strain (%)	Resilient Modulus (psi)
		Specified (psi)	Applied (psi)			LVDT #1 (mils)	LVDT #2 (mils)	Average (mils)		
Conditioning	6.0	4.0	4.08	0.39	3.69	0.89	0.92	0.91	0.011	-
1	6.0	2.0	1.99	0.19	1.81	0.33	0.34	0.34	0.004	42,863
2	6.0	4.0	4.02	0.40	3.62	0.85	0.86	0.86	0.011	33,854
3	6.0	6.0	6.02	0.62	5.40	1.44	1.48	1.46	0.018	29,571
4	6.0	8.0	8.01	0.81	7.20	2.05	2.06	2.06	0.026	28,029
5	6.0	10.0	10.05	1.00	9.04	2.58	2.61	2.60	0.032	27,880
6	4.0	2.0	2.01	0.21	1.79	0.44	0.44	0.44	0.005	32,628
7	4.0	4.0	4.02	0.41	3.61	1.14	1.14	1.14	0.014	25,406
8	4.0	6.0	6.01	0.60	5.41	1.83	1.83	1.83	0.023	23,663
9	4.0	8.0	8.04	0.79	7.25	2.49	2.46	2.48	0.031	23,481
10	4.0	10.0	10.03	1.01	9.01	3.06	3.08	3.07	0.038	23,467
11	2.0	2.0	2.01	0.21	1.80	0.60	0.57	0.59	0.007	24,848
12	2.0	4.0	4.02	0.39	3.63	1.50	1.46	1.48	0.019	19,589
13	2.0	6.0	6.04	0.60	5.44	2.28	2.24	2.26	0.028	19,228
14	2.0	8.0	8.01	0.83	7.18	2.98	2.96	2.97	0.037	19,378
15	2.0	10.0	10.01	1.03	8.98	3.58	3.61	3.60	0.045	20,002
								Average of Sequences (7,8,9,12,13,14):		**21,791**

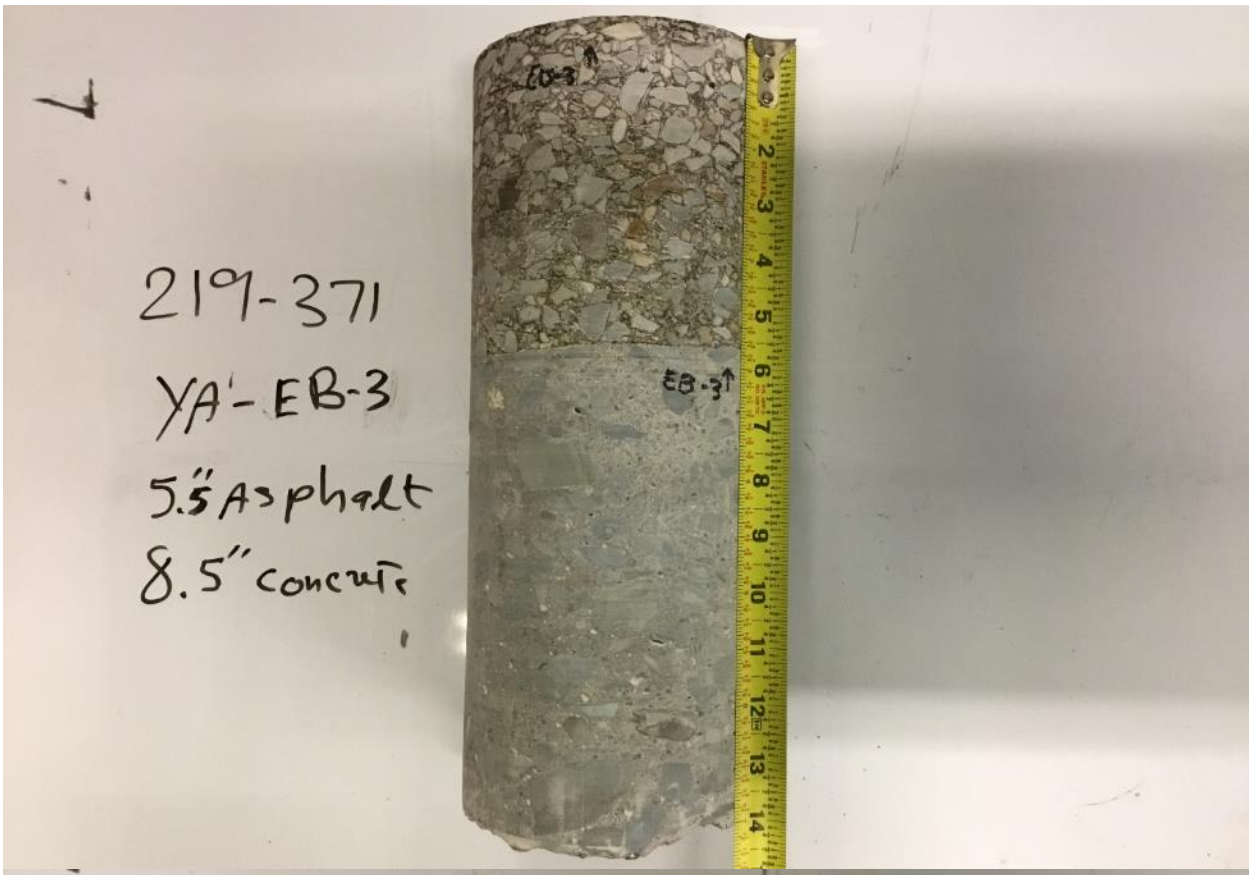


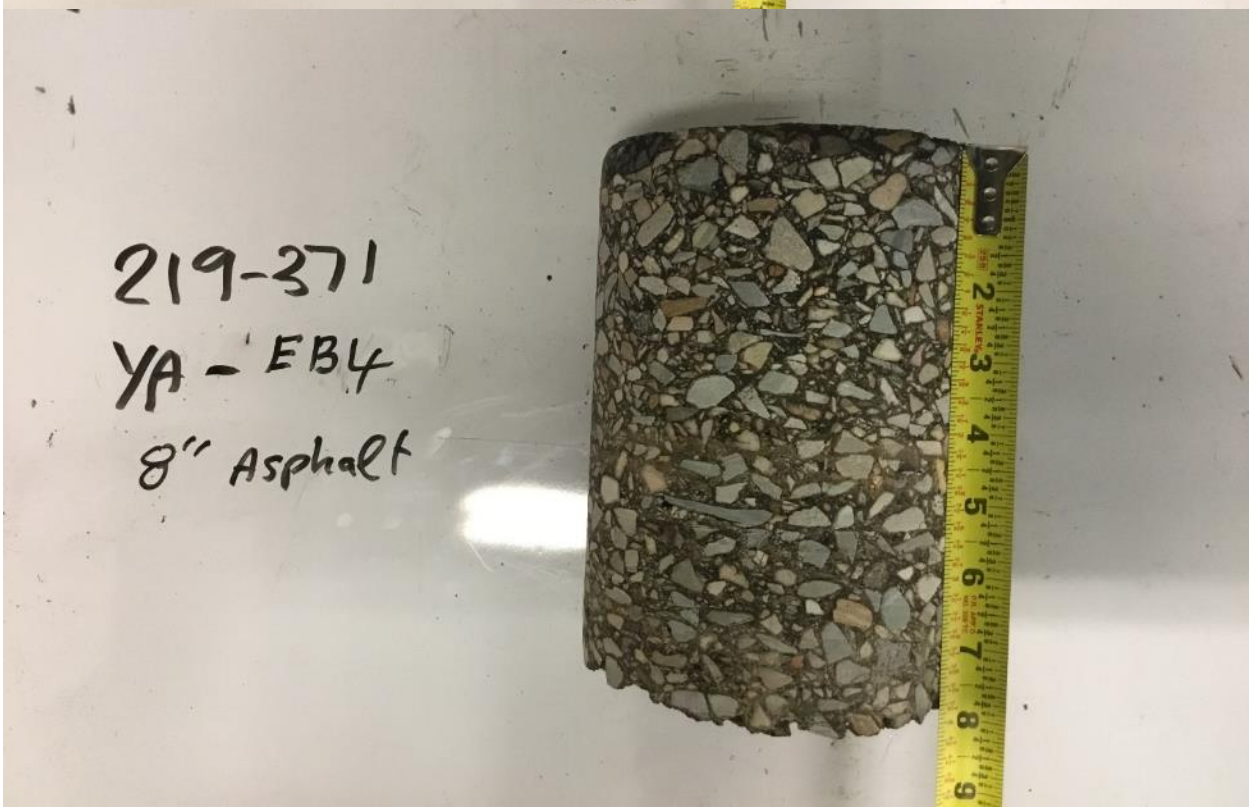
Appendix D

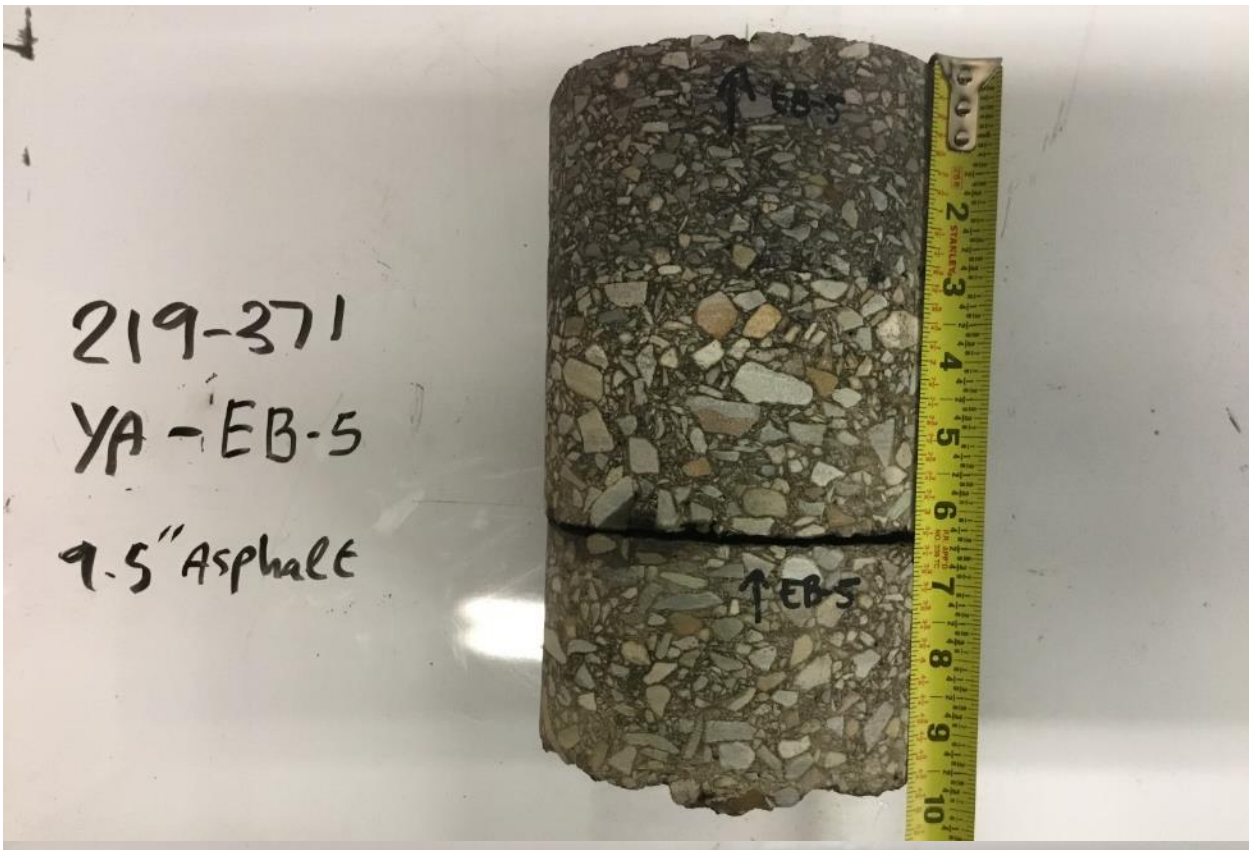
PAVEMENT CORE PHOTOS


219-371
YA-EB-1
5.5" Asphalt
9.75" Concrete
EB-1
EB-1


219-371
YA - EB2
6" Asphalt
8.85" Concrete
EB-2
EB-2


219-371
YA-EB-3
5.5" Asphalt
8.5" concrete
EB-3

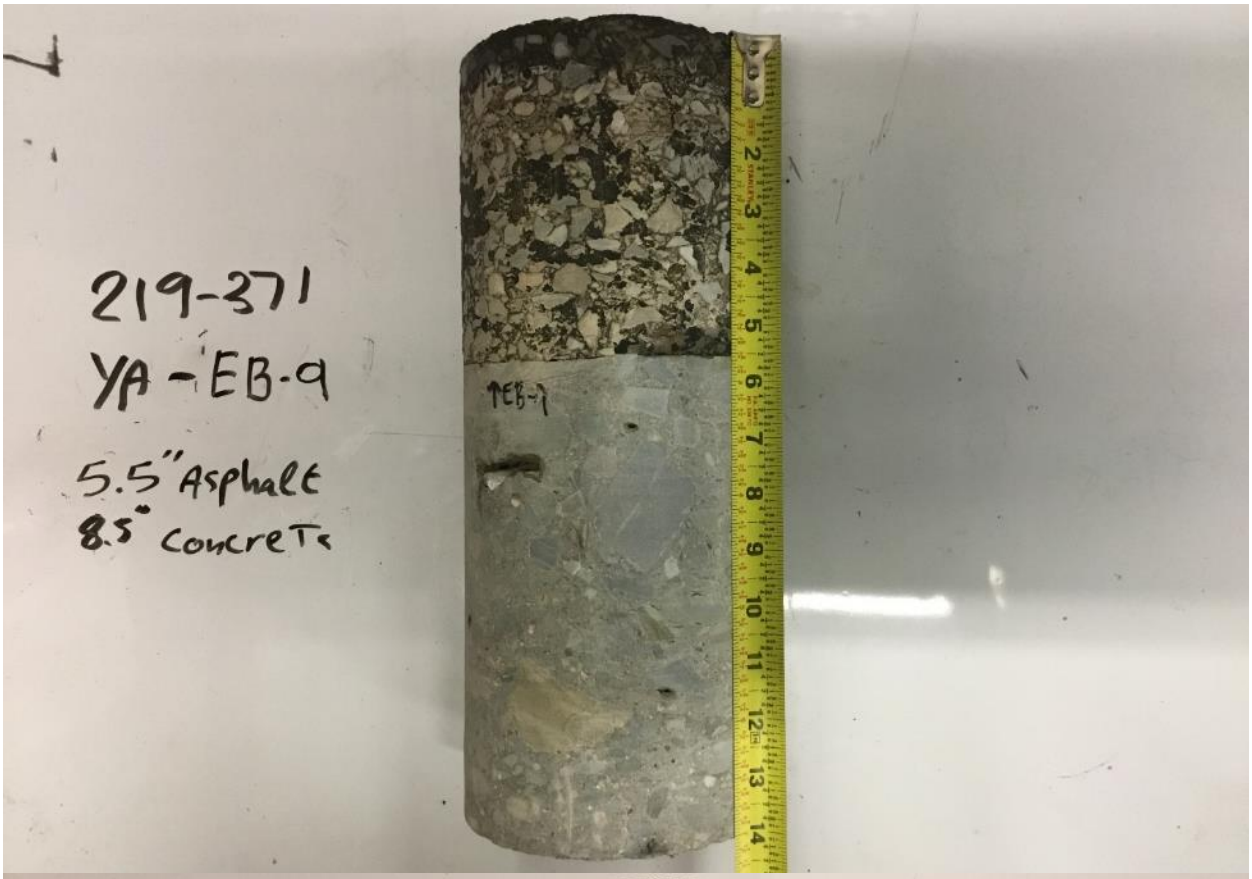

219-371
YA - EB4
8" Asphalt

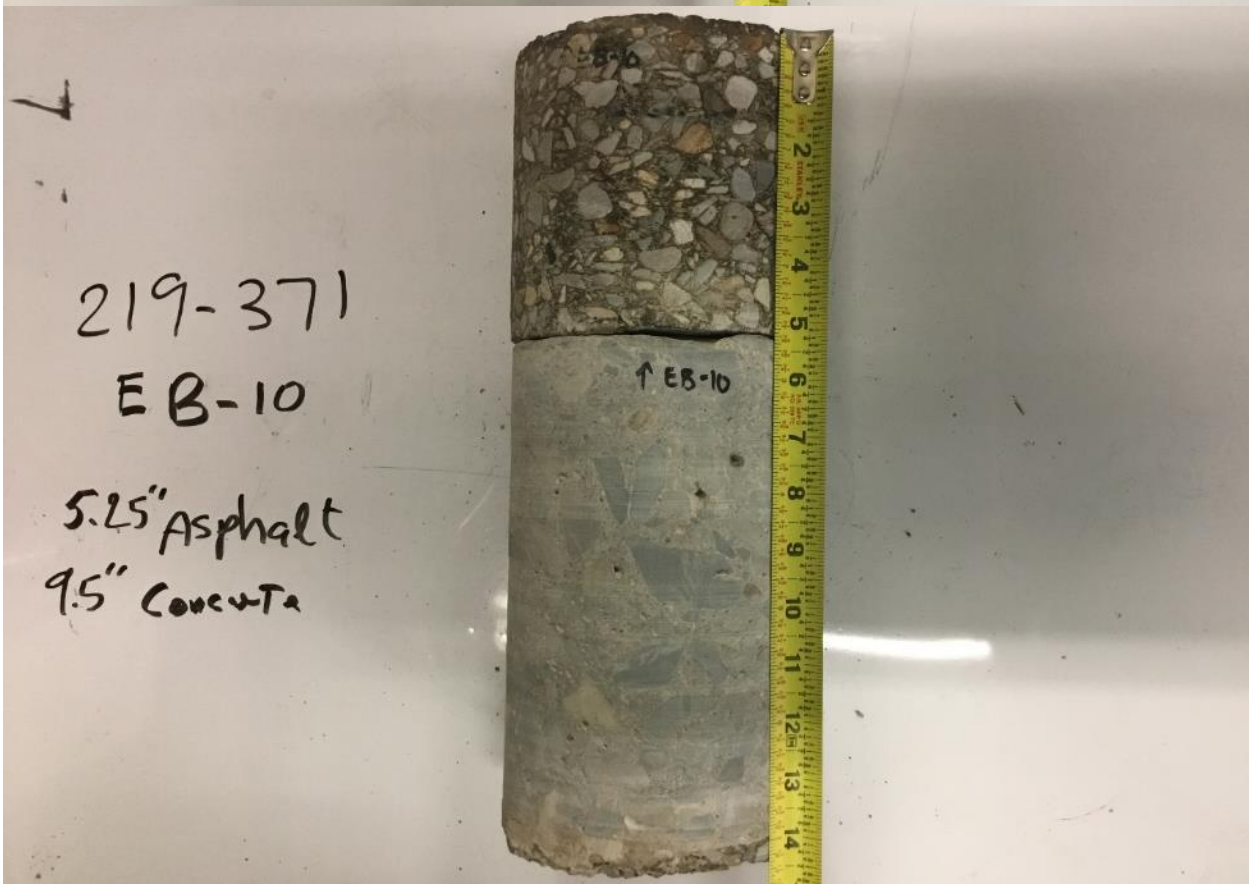

219-371
YA-EB-5
9.5" Asphalt
EB-5
EB-5


219-371
YA-WB6
5.75" Asphalt
8.85" Concrete
EB-6

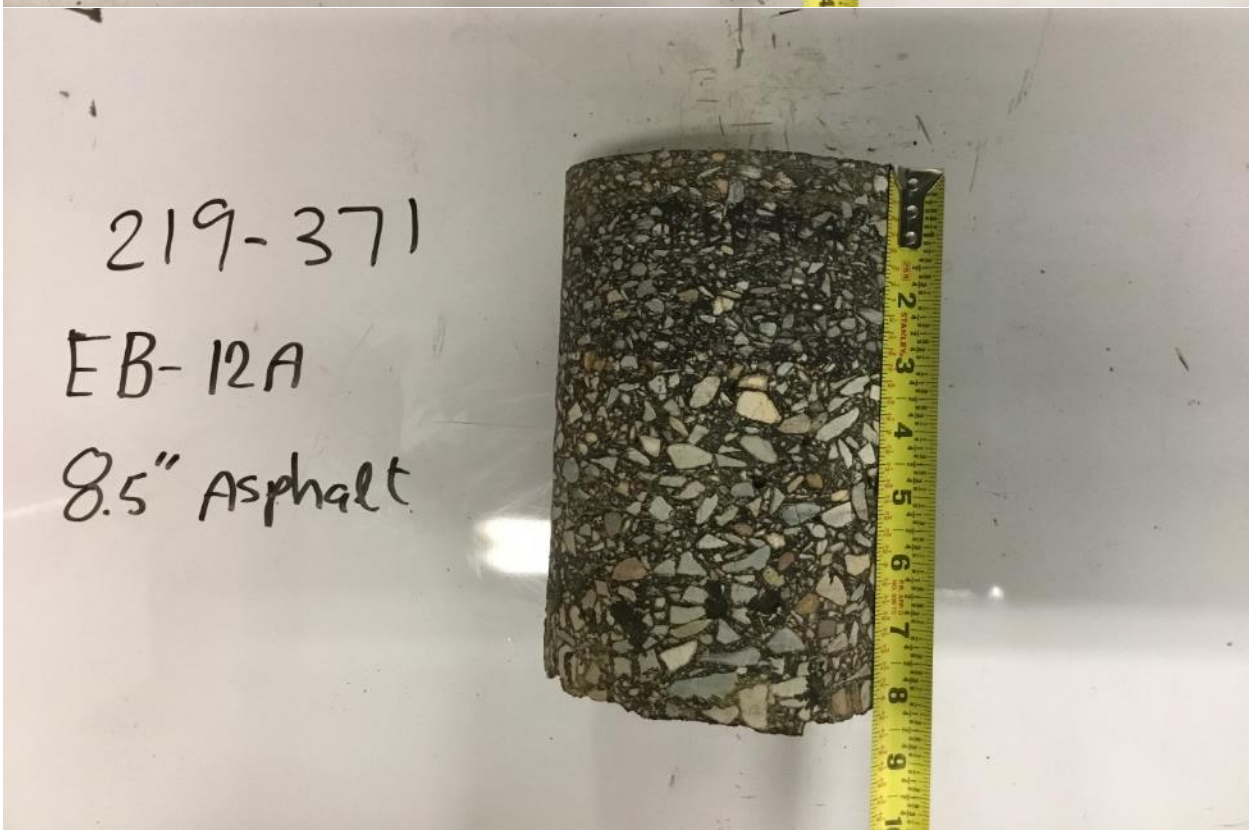

219-371
EB-7
5.75" Asphalt
9" Concrete

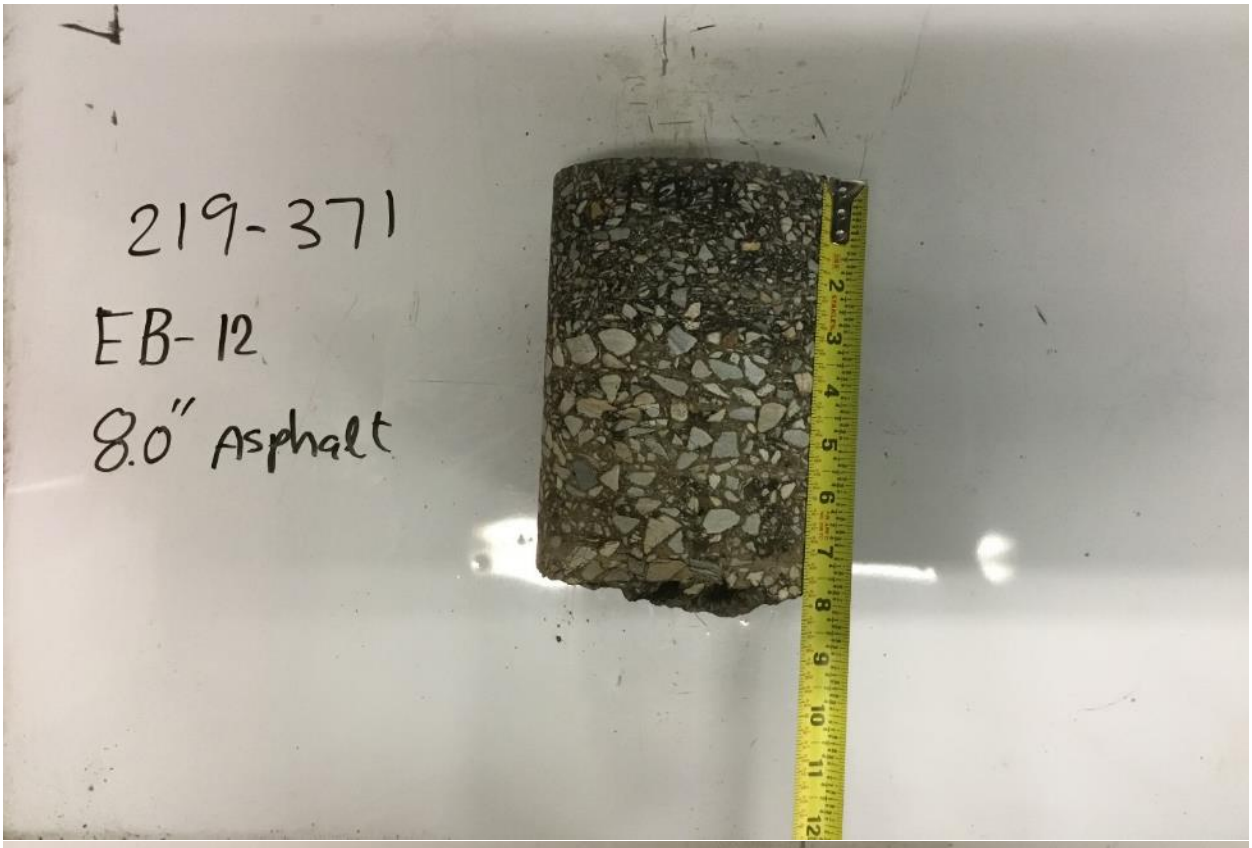

219-371
YA-EB-8
5.5" Asphalt
9" Concrete

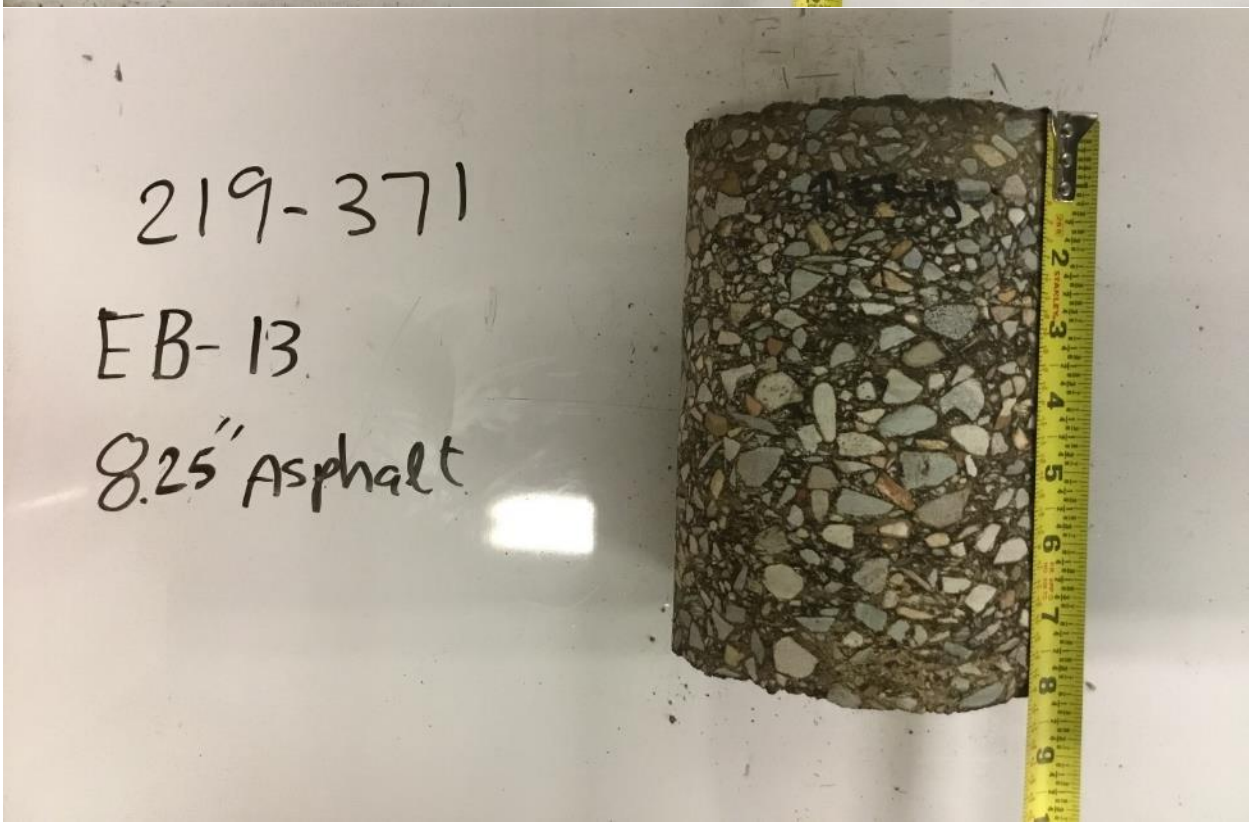

219-371
YA-EB-9
5.5" Asphalt
8.5" Concrete
↑EB-1


219-371
EB-10
5.25" Asphalt
9.5" Concrete
↑ EB-10


219-371
EB-11
5.75" Asphalt
8" Concrete
EB-11


219-371
EB-12A
8.5" Asphalt


219-371
EB-12
8.0" Asphalt


219-371
EB-13
8.25" Asphalt


219-371
YA - EB 14
6.25" Asphalt
8.25" Concrete
↑EB-14


219-371
YA-WB-1
8 1/8" Asphalt

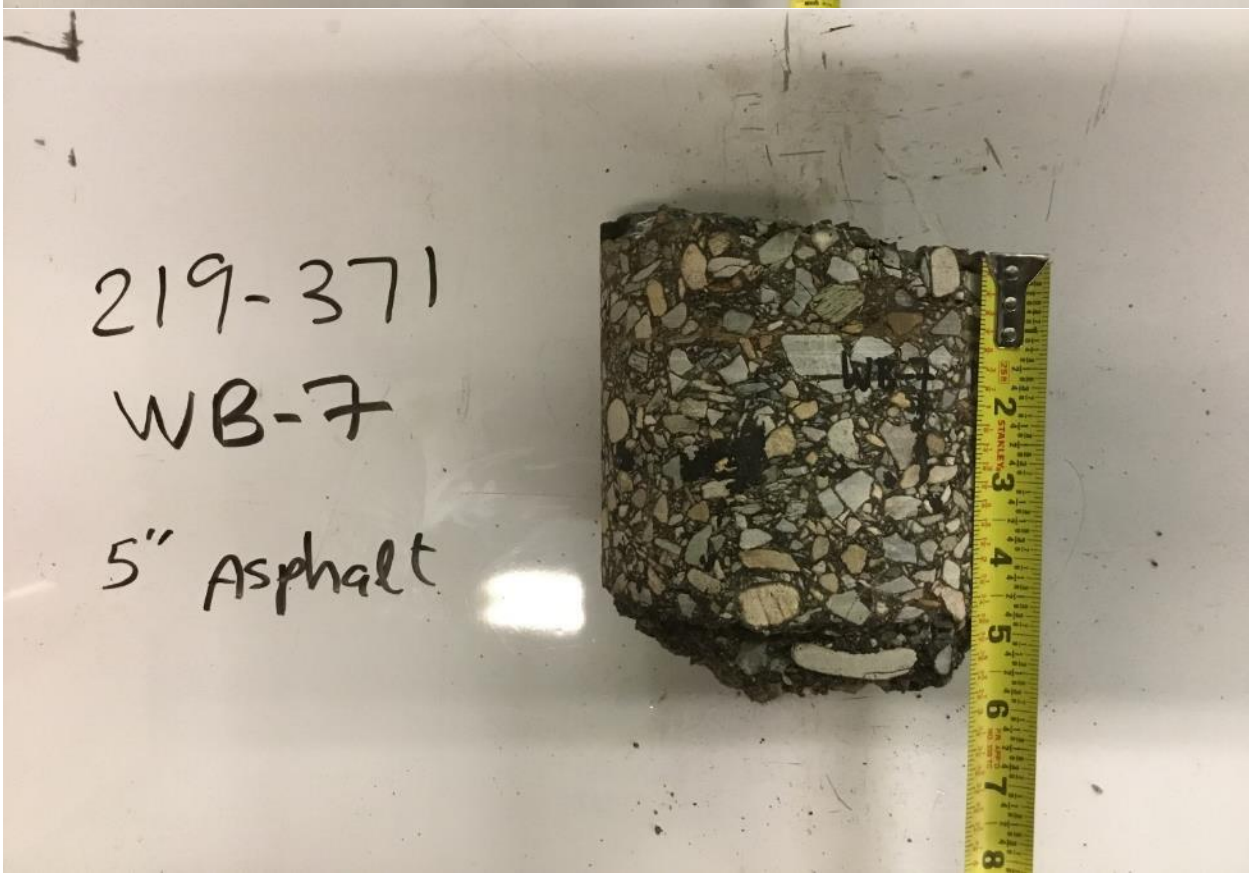

219-371
YA-WB2
5.25" Asphalt
9" Concrete
WB-2


219-371
YA-WB3
5.5" Asphalt
8.5" Concrete


219-371
YA-WB-4
5" Asphalt
8.75" Concrete


219-371
YA - WB-5
5.5" Asphalt
8.25" Concrete
↑WB-5
↑WB-5
↑WB-5


219-371
YA-WB-6
4.5" Asphalt
9.25" Concrete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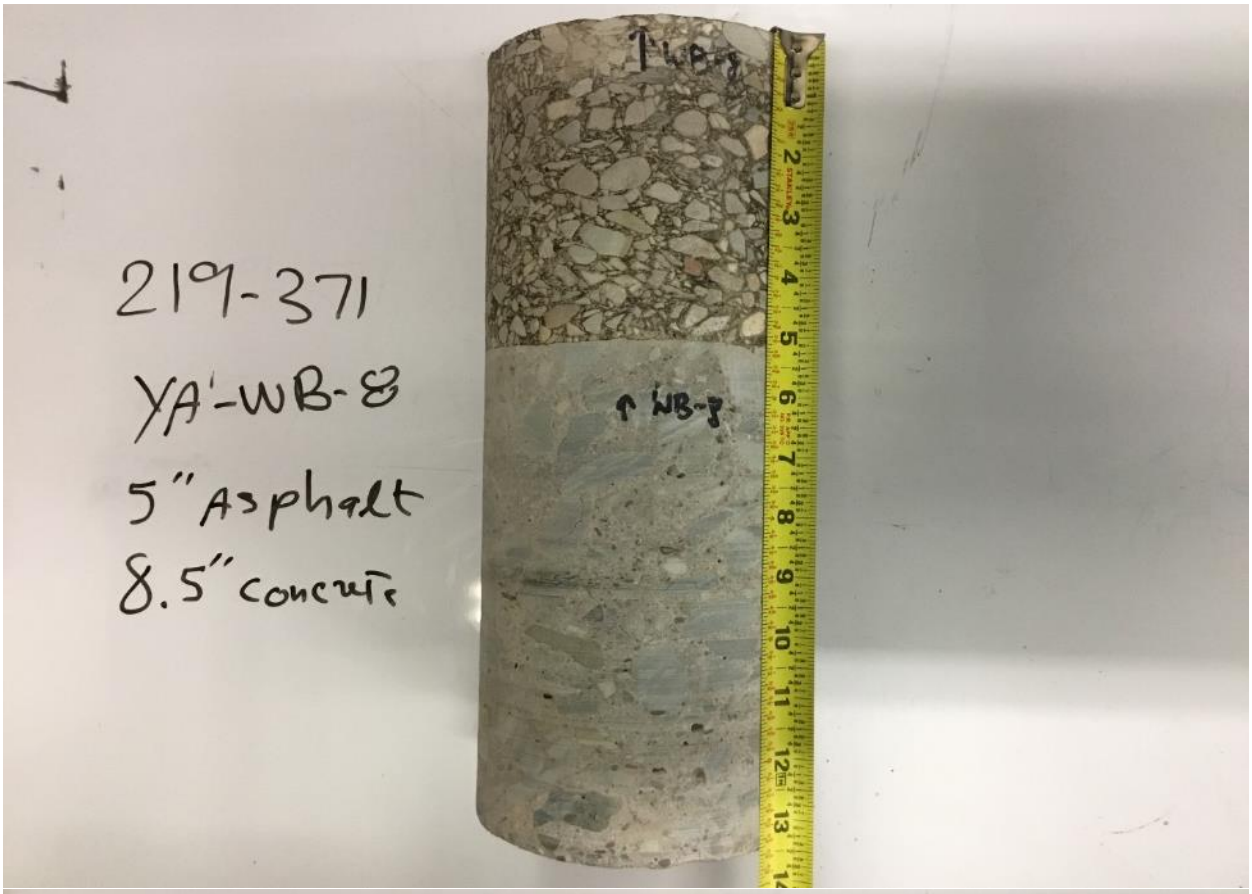
WB-7
5" Asphalt
WB-7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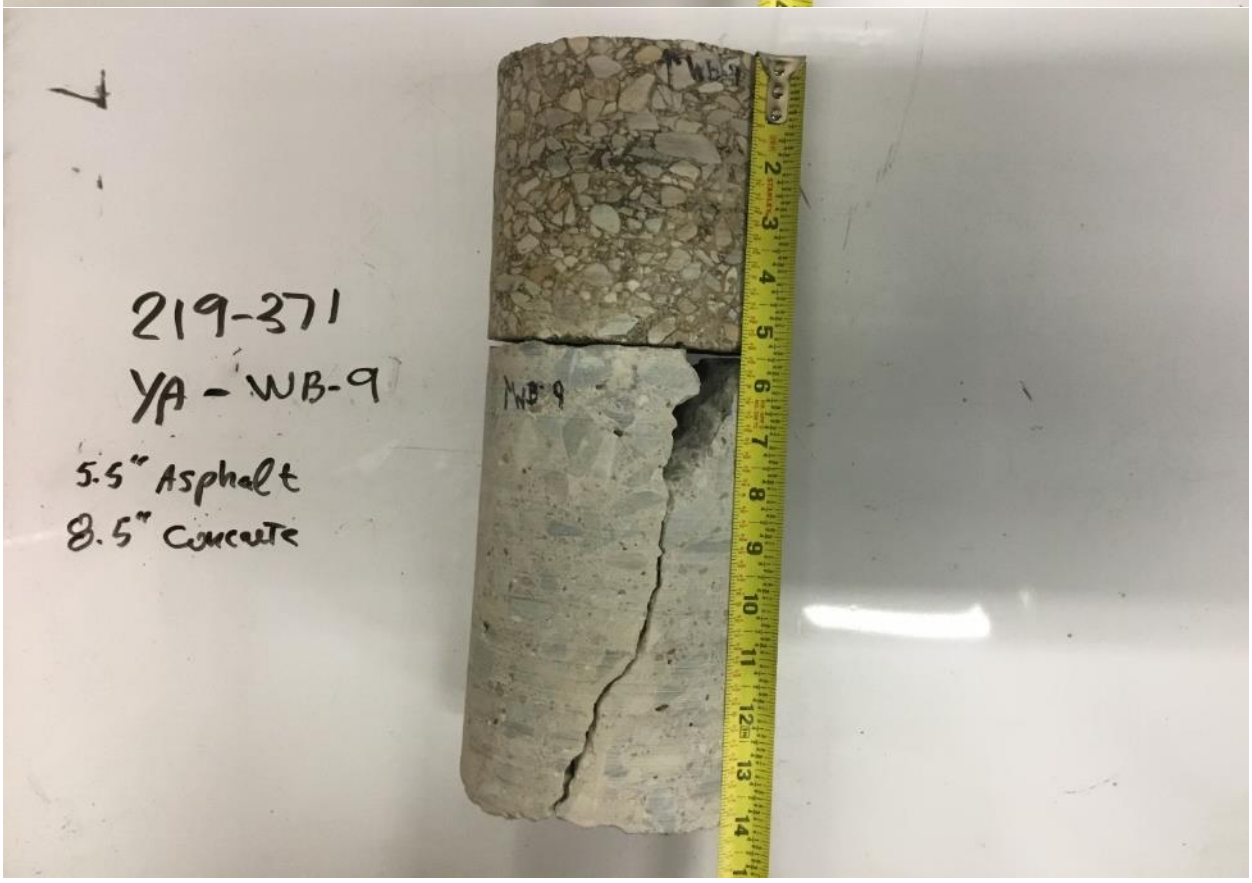
YA-WB-8
5" Asphalt
8.5" concrete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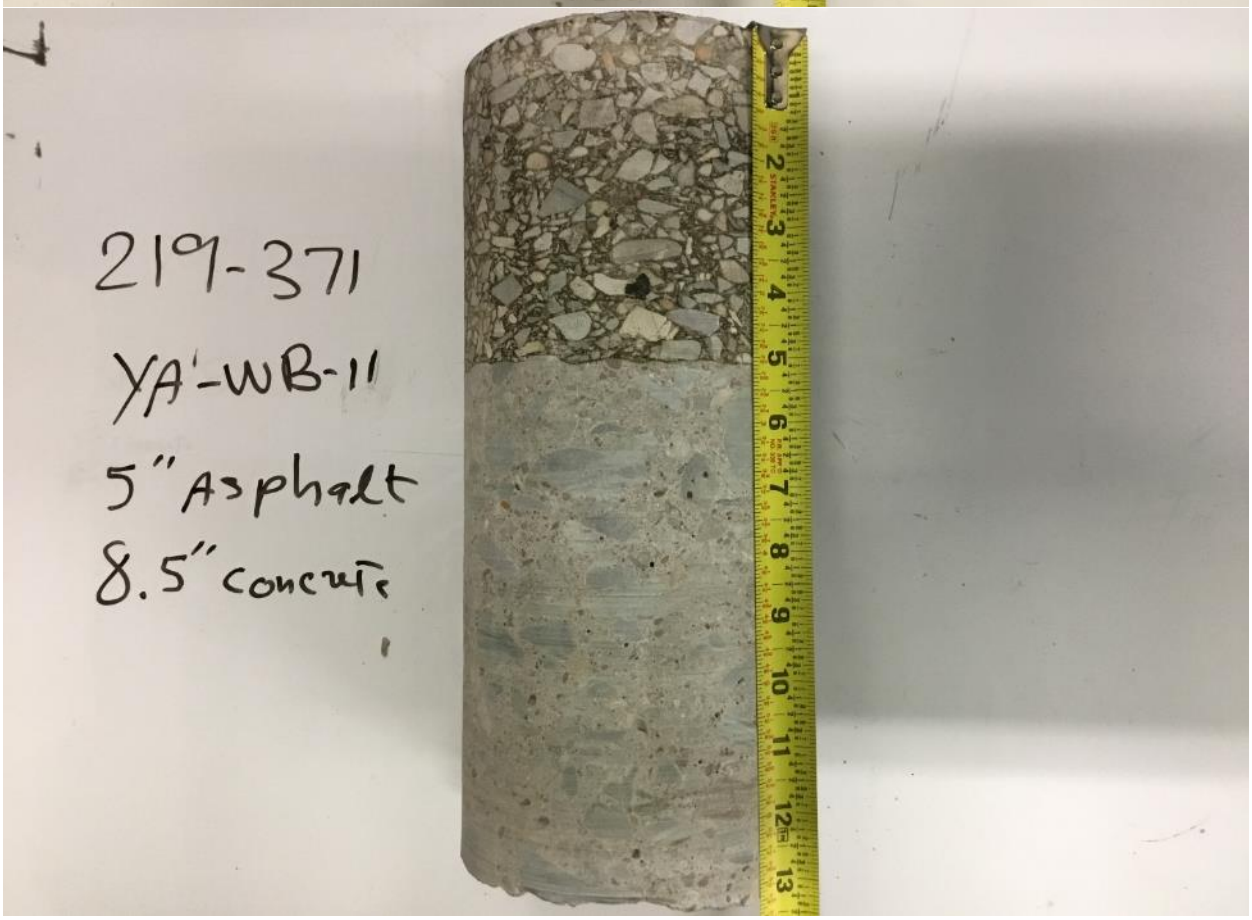
YA - WB-9
5.5" Asphalt
8.5" Concrete


219-371
YA-WB10
5.25" Asphalt
8.75" concrete


219-371
YA-WB-11
5" Asphalt
8.5" concrete

219-371
YA-WB-12
5.75" Asphalt
7.75" Concrete

219-371
YA-WB-13
4.75" Asphalt
8.25" Concrete

Appendix E

Traffic Data

RAIL TRANSIT AND PLANNING DIVISION
TRAFFIC DATA COLLECTION SECTION
Worksheet for Engineering and Planning Purposes

Project Description: Interstate Flexible

IM 90-1(227)0,IM 90-1(228)0

TAFT - WEST

UPN: 9487000

I-90: RP 000+0.000 to 005+0.700

DATE: 01-Oct-20

					*Truck Distribution**	
				5	**12.8 %**	**3.6 %**
2020	AADT=	**7,500**	PRESENT	6	**1.2 %**	**0.3 %**
				7	**0.1 %**	**0.0 %**
2023	AADT=	**7,770**	LETTING YEAR	8	**1.7 %**	**0.5 %**
2043	AADT=	**9,860**	DESIGN YEAR	9	**69.4 %**	**19.6 %**
	DHV=	**1620**		10	**7.5 %**	**2.1 %**
	D=			11	**1.1 %**	**0.3 %**
	T=	**28.3%**		12	**1.9 %**	**0.5 %**
	ESAL=	**1311**		13	**4.4 %**	**1.3 %**
	AGR=	**1.2%**				
					100.0 %	28.3 %

2019

AADT*=	7,410	
BUS=	0.8%	61
COM=	28.3%	2094
AGR=	1.2%	
K Factor=	16.40%	

* Distribution: 2019 WIM Site (W-146)

* AADTs and Growth Rate: 2019 TYC

PROJECT DESCRIPTION: Interstate Flexible
IM 90-1(227)0,IM 90-1(228)0
UPN: 9487000

DATE: 01-Oct-20

PAVEMENT: RIGID:
FLEXIBLE: X

LETTING YEAR ADT: 7,770
DESIGN YEAR ADT: 9,860

LETTING YEAR 2023
DESIGN YEAR 2043

LANE DESIGN FACTOR 95 %

VEHICLE TYPE	% OF TYPE	LETTING YEAR ADT	DESIGN YEAR ADT	MEAN YEAR ADT	DIRECTIONAL ADT	DESIGN LANE ADT	18K EQUIV RATE FAC	MEAN YEAR ADL
CLASS 1 & 2	44.5	3457.65	4387.7	3922.7	1961.3	1863.3	0.001	2.35
CLASS 3	26.4	2051.28	2603.0	2327.2	1163.6	1105.4	0.003	3.71
CLASS 4	0.8	63.96	81.2	72.6	36.3	34.5	0.59252	20.42
CLASS 5	3.6	279.96	355.3	317.6	158.8	150.9	0.13874	20.93
CLASS 6	0.3	25.25	32.0	28.6	14.3	13.6	0.50476	6.87
CLASS 7	0.0	1.10	1.4	1.2	0.6	0.6	0.87596	0.52
CLASS 8	0.5	36.89	46.8	41.8	20.9	19.9	0.38366	7.63
CLASS 9	19.6	1524.72	1934.8	1729.8	864.9	821.6	1.27780	1049.90
CLASS 10	2.1	163.80	207.9	185.8	92.9	88.3	0.96574	85.25
CLASS 11	0.3	24.37	30.9	27.7	13.8	13.1	1.37954	18.12
CLASS 12	0.5	42.16	53.5	47.8	23.9	22.7	0.79938	18.16
CLASS 13	1.3	97.27	123.4	110.4	55.2	52.4	1.46494	76.79
CLASS 14		0.00	0.0	0.0	0.0	0.0		0.00
CLASS 15		0.00	0.0	0.0	0.0	0.0		0.00
CLASS 16		0.00	0.0	0.0	0.0	0.0		0.00
	28.3	2195.51	2786.1	2490.8				
TOTAL VALUES	100.0							1310.64

AVERAGE DAILY 18 KIP EQUIVALENT AXLE LOAD: 1310.64

20 YEAR EQUIVALENT AXLE LOAD: 9,567,682

2020	AADT =	7,500
2023	AADT =	7770
2043	AADT =	9860
	DHV =	1620
	Direction =	
	Com Trks =	28.3%
	ESAL =	1310.64
	AGR =	1.200%

* Equivalency Factors: WIM Data (2015 to 2019)

RAIL TRANSIT AND PLANNING DIVISION
TRAFFIC DATA COLLECTION SECTION
Worksheet for Engineering and Planning Purposes

Project Description: Interstate Rigid

IM 90-1(227)0,IM 90-1(228)0

TAFT - WEST

UPN: 9487000

I-90: RP 000+0.000 to 005+0.700

Date: 1-Oct-20

					*Truck Distribution**	
				5	**12.8 %**	**3.6 %**
2020	AADT=	**7,500**	PRESENT	6	**1.2 %**	**0.3 %**
				7	**0.1 %**	**0.0 %**
2023	AADT=	**7,770**	LETTING YEAR	8	**1.7 %**	**0.5 %**
2043	AADT=	**9,860**	DESIGN YEAR	9	**69.4 %**	**19.6 %**
	DHV=	**1620**		10	**7.5 %**	**2.1 %**
	D=			11	**1.1 %**	**0.3 %**
	T=	**28.3%**		12	**1.9 %**	**0.5 %**
	ESAL=	**1886**		13	**4.4 %**	**1.3 %**
	AGR=	**1.2%**				
					100.0 %	28.3 %

2019

AADT*=	7,410	
BUS=	0.8%	61
COM=	28.3%	2094
AGR=	1.2%	
K Factor=	16.40%	

* Distribution: 2019 WIM (Site ID: W-146)

* AADTs and Growth Rate: 2019 TYC

PROJECT DESCRIPTION: Interstate Rigid
IM 90-1(227)0,IM 90-1(228)0
UPN: 9487000

DATE: 01-Oct-20

PAVEMENT: RIGID: X
FLEXIBLE:

LETTING YEAR AADT: 7,770 LETTING YEAR 2023 LANE DESIGN FACTOR 90 %
DESIGN YEAR AADT: 9,860 DESIGN YEAR 2043

VEHICLE TYPE	% OF TYPE	LETTING YEAR ADT	DESIGN YEAR ADT	MEAN YEAR ADT	DIRECTIONAL ADT	DESIGN LANE ADT	18K EQUIV RATE FAC	MEAN YEAR ADL
CLASS 1 & 2	44.5	3457.65	4387.7	3922.7	1961.3	1765.2	0.0012	2.12
CLASS 3	26.4	2051.28	2603.0	2327.2	1163.6	1047.2	0.003	3.14
CLASS 4	0.8	63.96	81.2	72.6	36.3	32.7	0.68842	22.48
CLASS 5	3.6	279.96	355.3	317.6	158.8	142.9	0.13810	19.74
CLASS 6	0.3	25.25	32.0	28.6	14.3	12.9	0.70868	9.14
CLASS 7	0.0	1.10	1.4	1.2	0.6	0.6	1.50502	0.84
CLASS 8	0.5	36.89	46.8	41.8	20.9	18.8	0.40848	7.69
CLASS 9	19.6	1524.72	1934.8	1729.8	864.9	778.4	1.96834	1532.16
CLASS 10	2.1	163.80	207.9	185.8	92.9	83.6	1.82322	152.47
CLASS 11	0.3	24.37	30.9	27.7	13.8	12.4	1.30086	16.19
CLASS 12	0.5	42.16	53.5	47.8	23.9	21.5	0.80780	17.39
CLASS 13	1.3	97.27	123.4	110.4	55.2	49.7	2.06810	102.70
CLASS 14		0.00	0.0	0.0	0.0	0.0		0.00
CLASS 15		0.00	0.0	0.0	0.0	0.0		0.00
CLASS 16		0.00	0.0	0.0	0.0	0.0		0.00
	28.3	2195.51	2786.1	2490.8				
TOTAL VALUES	100.0							1886.04

AVERAGE DAILY 18 KIP EQUIVALENT AXLE LOAD: 1886.04

20 YEAR EQUIVALENT AXLE LOAD: 13,768,116

2020	AADT =	7,500
2023	AADT =	7770
2043	AADT =	9,860
	DHV =	1620
	Direction =	
	Com Trks =	28.3%
	ESAL =	1886.04
	AGR =	1.200%

* Equivalency Factors: WIM Data (2015 to 2019)

Appendix F

LTPPBIND OUTPUT

Five Closest Weather Stations For Latitude/Longitude= 47.489/115.654

General	A=10 km	B=16 km	C=23 km	D=25 km	E=32 km
Station ID	✓ID6230	✓ID9498	✓MT8211	✓MT3984	✓ID4831
County/District	shoshone	shoshone	sanders	mineral	shoshone
Weather Station	mullan	wallace woodla	thompson falls	haugan	kellogg
Elevation, m	939	832	674	878	657
Latitude, Longitude	47.47 ,115.8	47.5 ,115.88	47.6 ,115.37	47.38 ,115.35	47.53 ,116.12
Last Year Data Available	1994	1997	1997	1989	1997

Air Temperature	Mean (Std, N)	Mean (Std, N)	Mean (Std, N)	Mean (Std, N)	Mean (Std, N)
High Temperature	31.4 (15,20)	32.8 (19,35)	36.1 (16,35)	34 (13,25)	35.1 (18,34)
Low Temperature	-22.5 (45,19)	-23.5 (51,35)	-22.4 (51,35)	-30.9 (53,27)	-21.3 (54,33)
Low Temperature Drop	22.7 (34,19)	24.3 (34,35)	24.8 (39,35)	28.9 (33,27)	23.9 (28,33)
Degree-Days > 10C	2093 (221,20)	2104 (183,35)	2792 (224,35)	2420 (174,25)	2534 (219,34)

PG	High Low Rel.	High Low Rel.	High Low Rel.	High Low Rel.	High Low Rel.
Pavement Temperature, C	48.3 -18.0	48.4 -18.8	54.8 -18.0	51.5 -24.0	52.5 -17.2
50% Reliability PG	52-22 (97,85)	52-22 (96,78)	58-22 (92,83)	52-28 (61,82)	58-22 (98,86)
>50% Reliability PG	52-28 (97,98)	52-28 (96,98)	58-28 (92,98)	58-28 (98,82)	58-28 (98,98)
=	58-28 (98,98)	58-28 (98,98)	64-28 (98,98)	58-34 (98,98)	
=					
=					
=					

? PG Chart Save Cancel

PG Binder Selection

Parameter	A=10 km	B=16 km	C=23 km	D=25 km	E=32 km
Station ID	✓ID6230	✓ID9498	✓MT8211	✓MT3984	✓ID4831
Elevation, m	3081	2731	2211	2880	2155
Degree-Days >10 C	2093	2104	2792	2420	2534
Low Air Temperature, C	-22.5	-23.5	-22.4	-30.9	-21.3
Low Air Temp. Std Dev	4.5	5.1	5.1	5.3	5.4

Input Data

Latitude, Degree: 47.49
Lowest Yearly Air Temperature, C: -24.1
Yearly Degree-Days>10 Deg.C: 2389
Low Air Temp. Standard Dev., Deg C: 5.1

Temperature Adjustments

Base HT PG: 52
Desired Reliability, %: 98
Depth of Layer, mm: 0

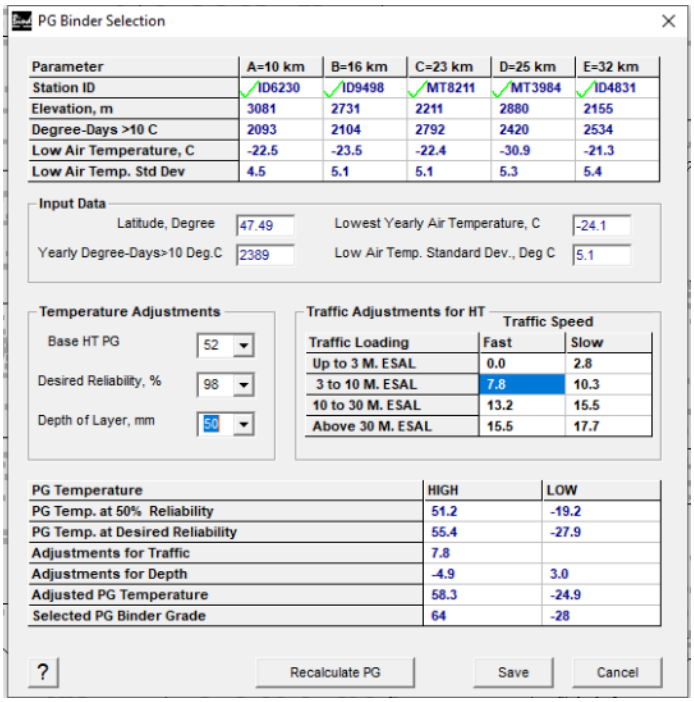
Traffic Adjustments for HT

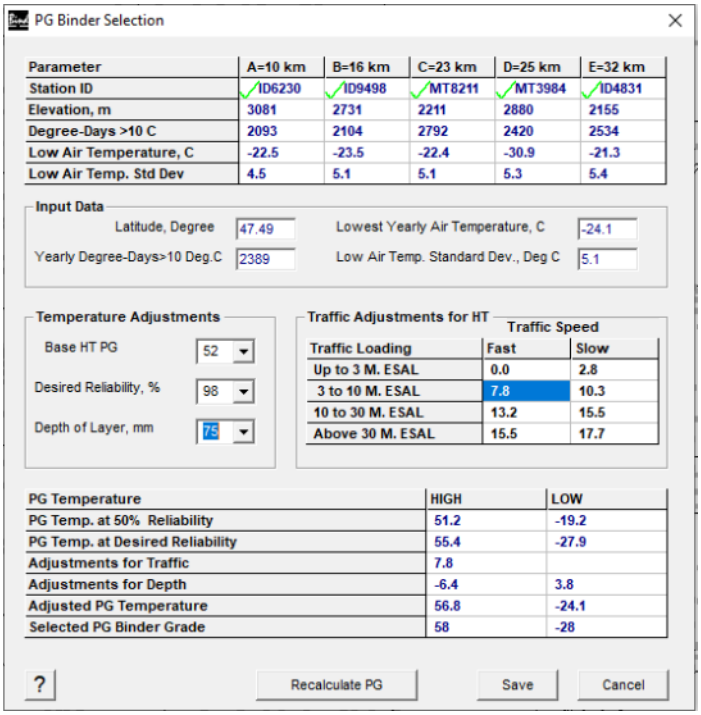
Traffic Loading	Traffic Speed: Fast	Slow
Up to 3 M. ESAL	0.0	2.8
3 to 10 M. ESAL	7.8	10.3
10 to 30 M. ESAL	13.2	15.5
Above 30 M. ESAL	15.5	17.7

PG Temperature	HIGH	LOW
PG Temp. at 50% Reliability	51.2	-19.2
PG Temp. at Desired Reliability	55.4	-27.9
Adjustments for Traffic	7.8	
Adjustments for Depth	0.0	0.0
Adjusted PG Temperature	63.2	-27.9
Selected PG Binder Grade	64	-28

? Recalculate PG Save Cancel

For the top mat, PG 64-28 is the recommended asphalt binder.
PG 70-28 would meet the low temperature requirements and exceed the high temperature requirements and may be recommended based on local experience because of large truck volume.





For the lower lifts of HMA, The LTPPBind Program recommends PG 64-28 at a depth of two inches and PG 58-28 for mixes placed at a depth of 3 inches.

May want to consider constructing the top HMA lift at a thickness of three inches and using PG 58-28 for HMA mixes the lifts below.