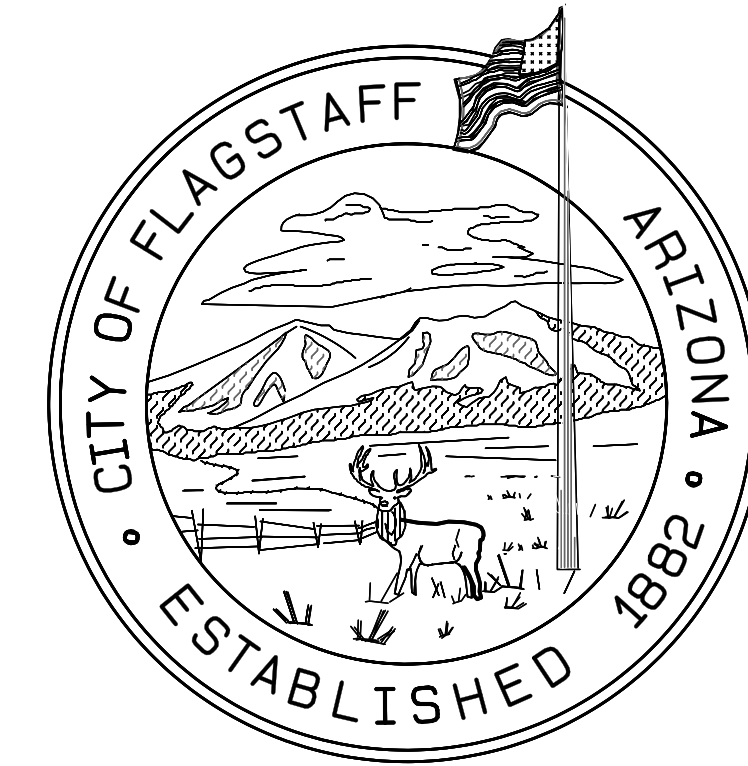


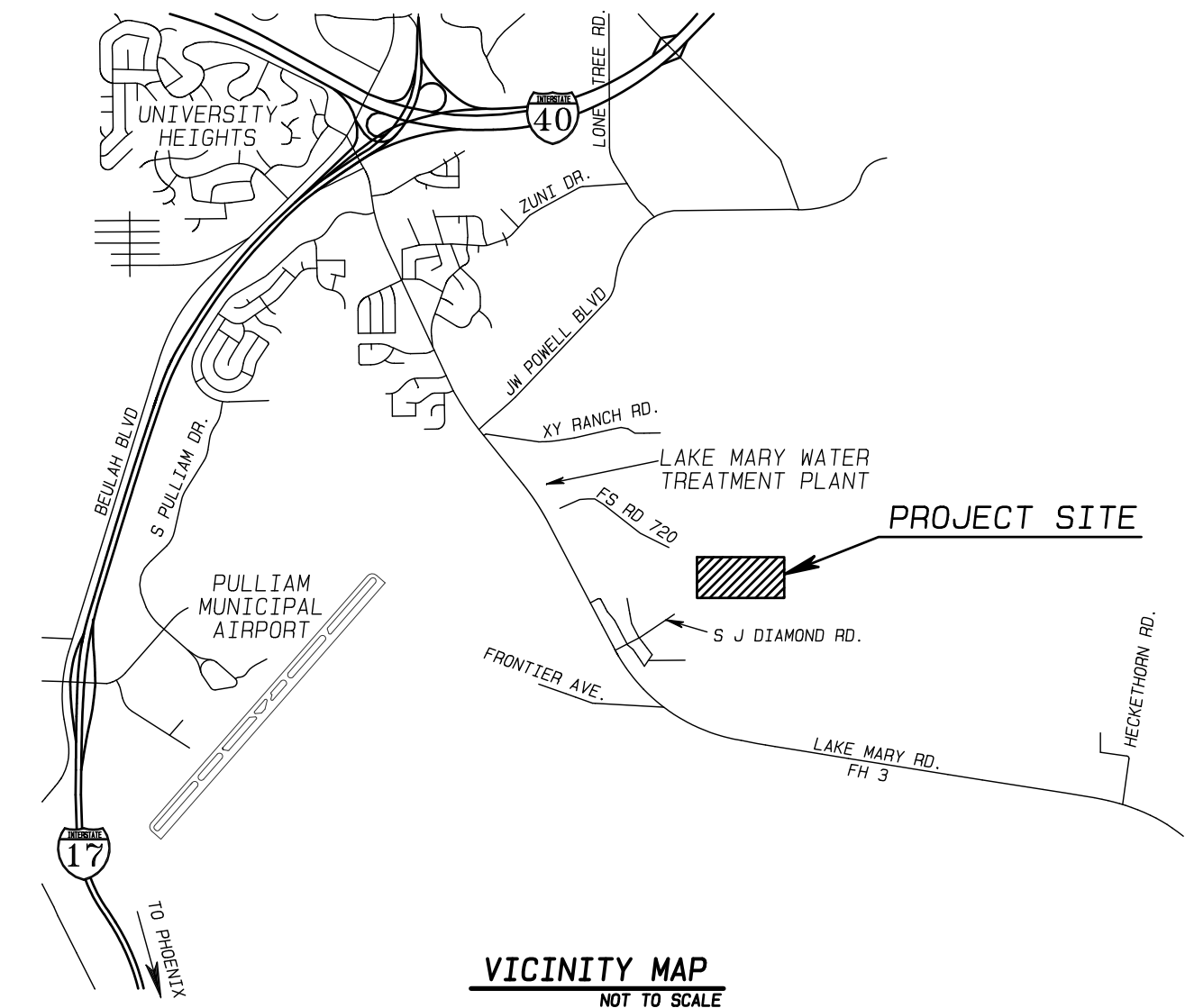
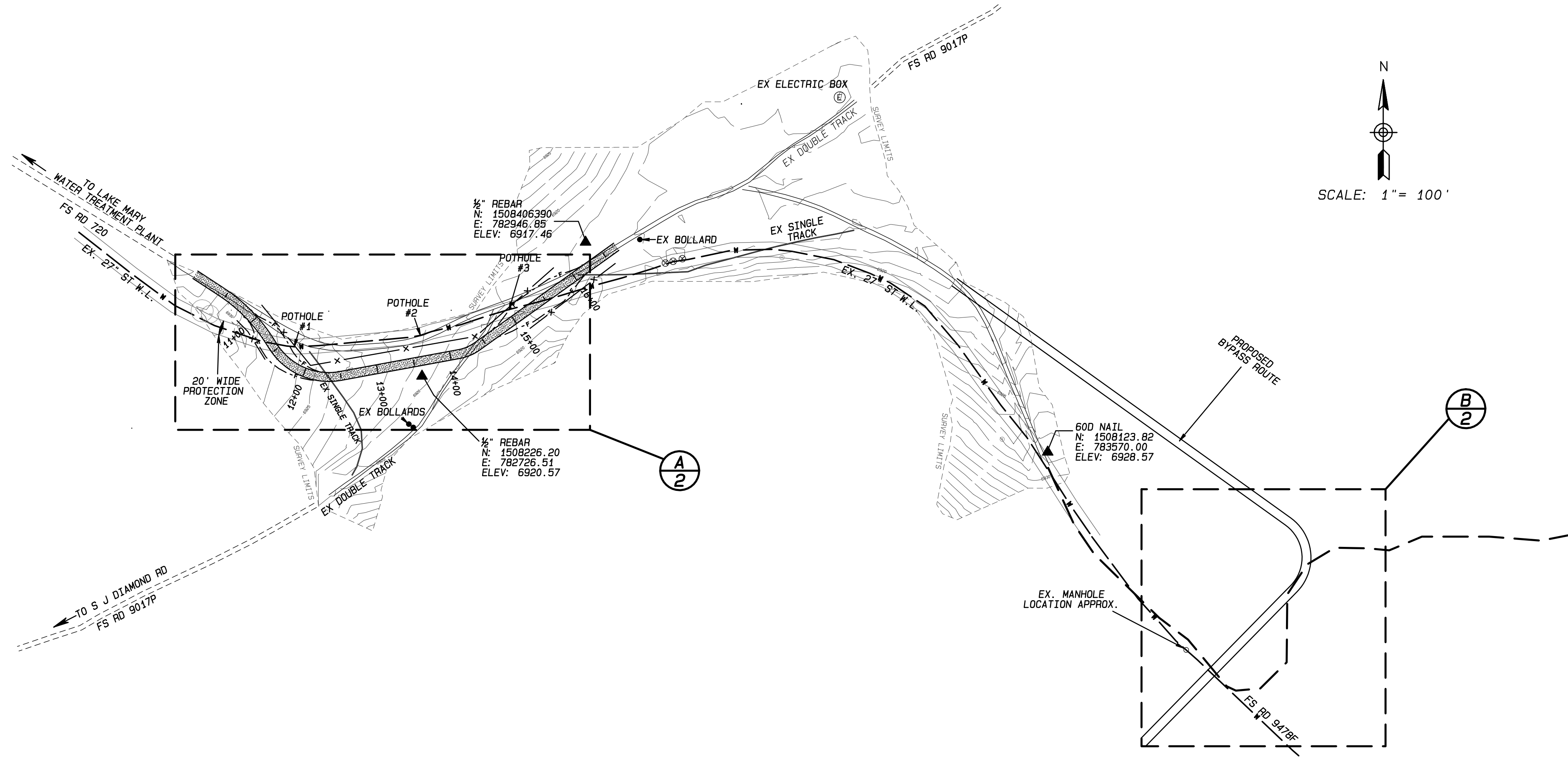
CITY OF FLAGSTAFF 27" WATERLINE PROTECTION

DIAMOND RD ○ FLAGSTAFF, ARIZONA 86001



TURNER ENGINEERING INC.
558 N. ASPEN AVE., FLAGSTAFF, ARIZONA 86001
(928) 779-1814

TEL PROJ. NO.: 10421 SCALE: 1"=100'
DESIGN: MW CHECKED: PT HORIZ:
DRAWN: MW DATE: 9/20/2021 VERT:



**USFS LAKE MARY SERVICE ROAD
LAKE MARY 27" WATERLINE**

LAKE MARY USFS TRUCK ROUTE SITE OVERVIEW

TRUCK ROUTE ROAD COORDINATE TABLE

| PT# | DESCRIPTION BEARING/CURVE DATA | STATION DISTANCE | NORTHING | EASTING | PT# | DESCRIPTION BEARING/CURVE DATA | STATION DISTANCE | NORTHING | EASTING | | |
|-----|-----------------------------------|---------------------|--------------|-------------|-----------|-----------------------------------|---------------------|----------------|--------------|-------------|-----------|
| 101 | START | 10+00.0000 | 1508360.9303 | 782420.7590 | 6932.7790 | 105 | PT | 12+49.8004 | 1508224.5422 | 782616.7591 | 6923.7300 |
| 102 | PC | 10+41.6159 | 1508338.1337 | 782455.5755 | 6930.9646 | 106 | PC | 14+12.3600 | 1508254.0525 | 782776.6177 | 6919.2217 |
| | RADIUS POINT: | 18529 | 1508154.0834 | 782335.0658 | | | RADIUS POINT: | 18530 | 1508313.0555 | 782765.7256 | |
| | RADIUS: | 219.8933ft | | | | | RADIUS: | 60.0000ft | | | |
| | DELTA: | 24 25 41" RIGHT | | | | | DELTA: | 25 09 34" LEFT | | | |
| | ARC LENGTH: | 93.7944ft | | | | | ARC LENGTH: | 26.3469ft | | | |
| 103 | PT | 11+35.4103 | 1508271.8207 | 782520.9018 | 6927.2769 | 107 | PT | 14+38.7069 | 1508264.2808 | 782800.6688 | 6918.6102 |
| 104 | PC | 11+44.2728 | 1508264.3342 | 782525.6449 | 6927.1830 | 108 | END | 16+69.4983 | 1508398.6907 | 782988.2818 | 6917.4010 |
| | RADIUS POINT: | 18529 | 1508311.8491 | 782600.6421 | | | | 230.7914ft | SD230.7945ft | | |
| | RADIUS: | 88.7820ft | | | | | | 16+69.4983 | 1508398.6907 | | |
| | DELTA: | 68 06 10" LEFT | | | | | | | | | |
| | ARC LENGTH: | 105.5277ft | | | | | | | | | |

ABC COORDINATE TABLE

| Pt # | NORTHING | EASTING | ELEVATION | DESCRIPTION |
|------|------------|-----------|-----------|-------------|
| 109 | 1508309.33 | 782490.93 | 6928.62 | START ABC |
| 110 | 1508223.51 | 782591.76 | 6924.51 | STOP ABC |
| 111 | 1508282.27 | 782825.78 | 6918.44 | START ABC |
| 112 | 1508368.64 | 782946.34 | 6917.70 | STOP ABC |

SURVEY NOTES

SURVEY PERFORMED BY THE MLB GROUP, FLAGSTAFF, ARIZONA. ALL SURVEY REFERENCES MADE HEREON ARE RELATIVE TO THAT SURVEY BY MLB ENTITLED "TOPOGRAPHIC SURVEY FOR CITY OF FLAGSTAFF 27" WATERLINE LYING WITHIN S03 T20N R7E, GILA & SALT RIVER MERIDIAN, IN THE CITY OF FLAGSTAFF, COCONINO COUNTY, ARIZONA" PROJECT No. 321008a001, DATED 07/02/21.

BASIS OF SURVEY:
THE SURVEY IS BASED ON A GPS, ONE POINT CALIBRATION USING A FOUND NGS ALUMINUM CAP NEAR THE INTERSECTION OF LAKE MARY ROAD AND THE LOWER LAKE MARY PICNIC AREA TURNOFF, STAMPED "COCONINO COUNTY PUBLIC WORKS 2009 KNOTT"

N: 1496749.37
E: 798524.09
(NGVD88)
6813.20 FEET

BASIS OF ELEVATION:
A FOUND NGS ALUMINUM CAP NEAR INTERSECTION OF LAKE MARY ROAD AND THE LOWER LAKE MARY PICNIC AREA TURNOFF, STAMPED "COCONINO COUNTY PUBLIC WORKS 2009 KNOTT"
SAID ELEVATION BEING: 6813.20 (NAVDB8)

INDEX TO SHEETS

- 1 SITE OVERVIEW
 - 2 PROTECTION DETAILS
- SURVEY ATTACHED

PROJECT LEGEND

| LINETYPES | SYMBOLS |
|--|----------------------|
| --- EX. SURVEY LIMITS | ● EX. BOLLARD |
| --- EX. 27" WATERLINE | ⊙ EX. WATER VALVES |
| --- EX. DIRT TRACKS | ⊙ EX. ELECTRICAL BOX |
| --- APPROXIMATE CONTINUATION OF FOREST ROAD NOT SURVEYED | ▲ EX. CONTROL |
| --- APPROXIMATE LOCATIONS OF FS ROADS NOT SURVEYED | ⊙ NEW INDICATOR POLE |
| --- PROPOSED BYPASS | |
| --- NEW PROTECTIVE FENCE | |
| --- FILL LIMITS | |

ESTIMATED QUANTITIES

| | |
|---|---------|
| AGGREGATE BASE COURSE UNIFORM THICKNESS | |
| AT CROSSING #1 & #2 (SURVEYED) | 572 CY |
| AT CROSSING #3 (ESTIMATED NOT SURVEYED) | 110 CY |
| INDICATOR POLES | 12 EA |
| PROTECTIVE FENCE | 755 LF |
| GEOTEXTILE FABRIC | 1080 SY |

ADOT 1014-4.03

1014-4.03 High Survivability Fabric:
High survivability fabric shall additionally meet the following requirements:

| High Survivability Fabric Requirements | | |
|--|--------------------------------|-------------|
| Property | Non-Woven | Test Method |
| | Elongation ≥50% (Note 1) | |
| Grab strength: lb. | 202 | ASTM D4632 |
| Tear strength: lb. | 79 | ASTM D4533 |
| Puncture strength: lb. | 433 | ASTM D6241 |
| Ultraviolet stability (retained strength): | ≥ 50% after 500 hours exposure | ASTM D4355 |

Notes:
(1) As measured in accordance with ASTM D4632.

GEOTECHNICAL NOTES:

A GEOTECHNICAL EVALUATION REPORT WAS PREPARED FOR THIS PROJECT BY WESTERN TECHNOLOGIES, INC. (WTI), REFERENCE No. 2521W159, DATED 08/25/21. THE FOCUS OF THE INVESTIGATION WAS TO PROVIDE TRUCK TRAFFIC PROTECTION RECOMMENDATIONS TO PROTECT THE EXISTING 27" WIRE WRAPPED PIPE.

ADDENDUM No. 1-REVISED ROADWAY SUBGRADE PREPARATION RECOMMENDATIONS DATED 9/17/21. DO NOT SCARIFY B!!

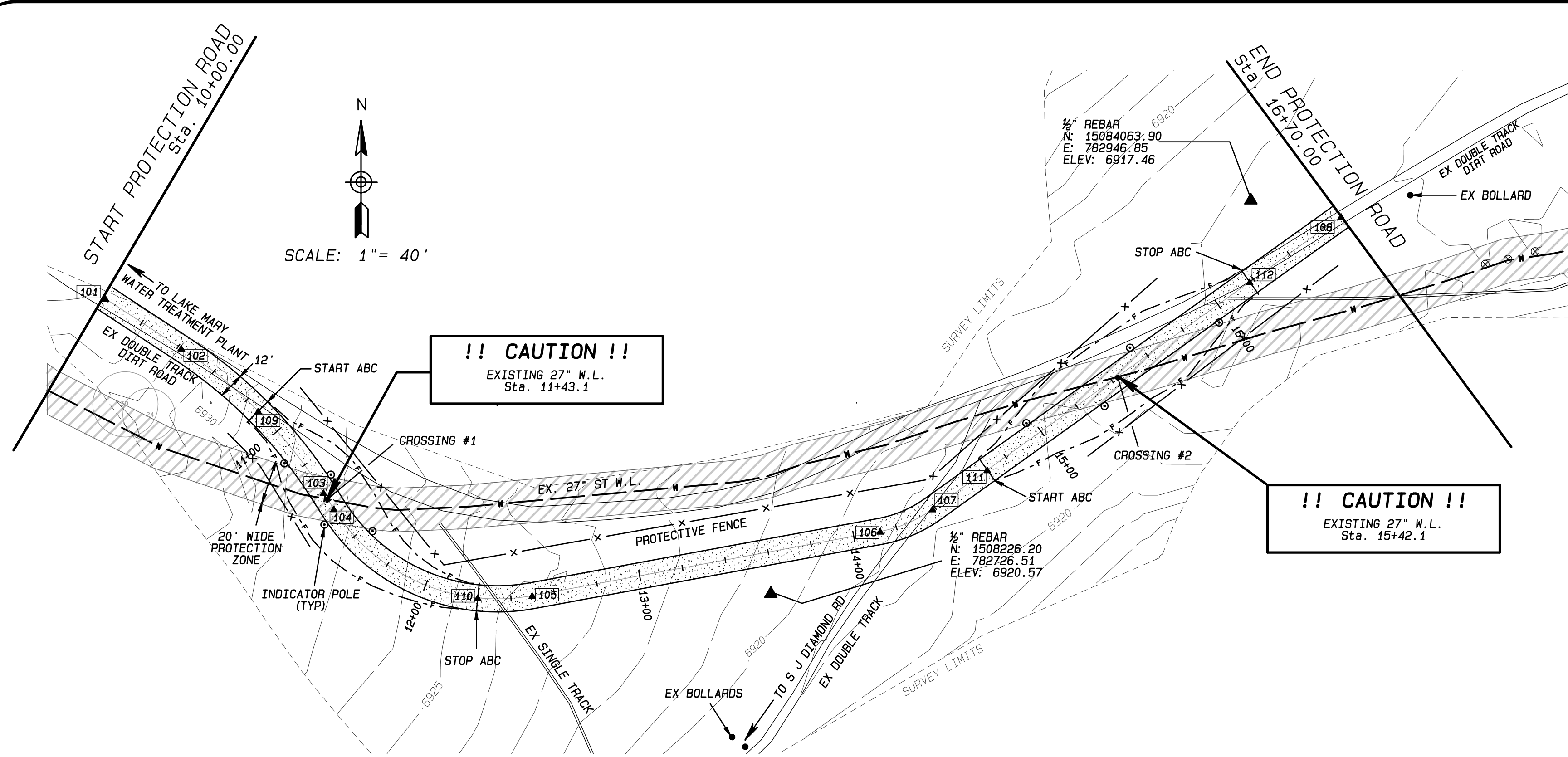
THE RESULTS OF WTI'S STUDY INCLUDE A BORING/TEST PIT LOCATION DIAGRAM, LABORATORY RESULTS, BORING AND TEST PIT LOGS AND GEOTECHNICAL RECOMMENDATIONS.

ADAM'S TRENCHING, INC.

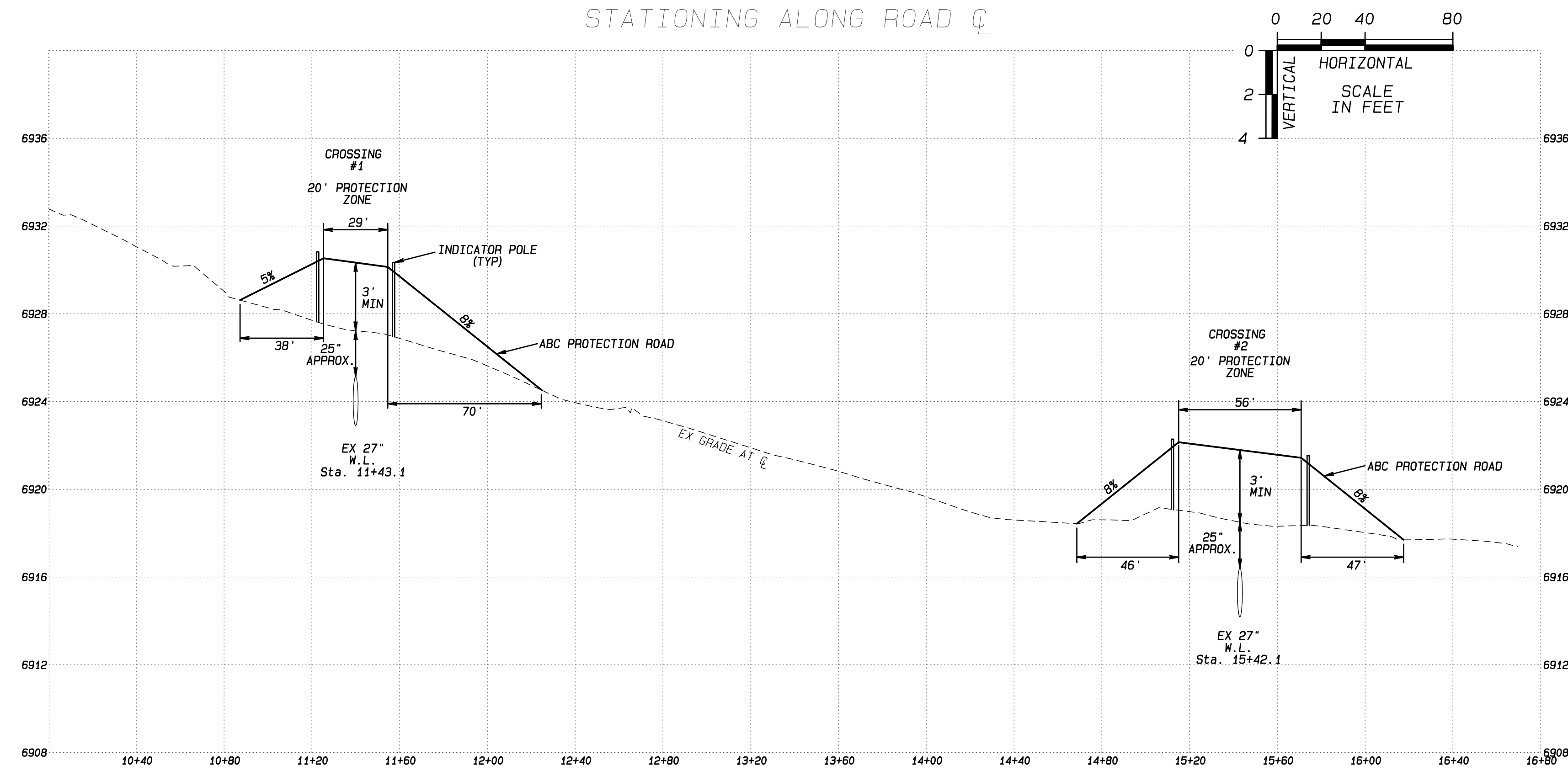
POTHOLE INVESTIGATION ATTACHED



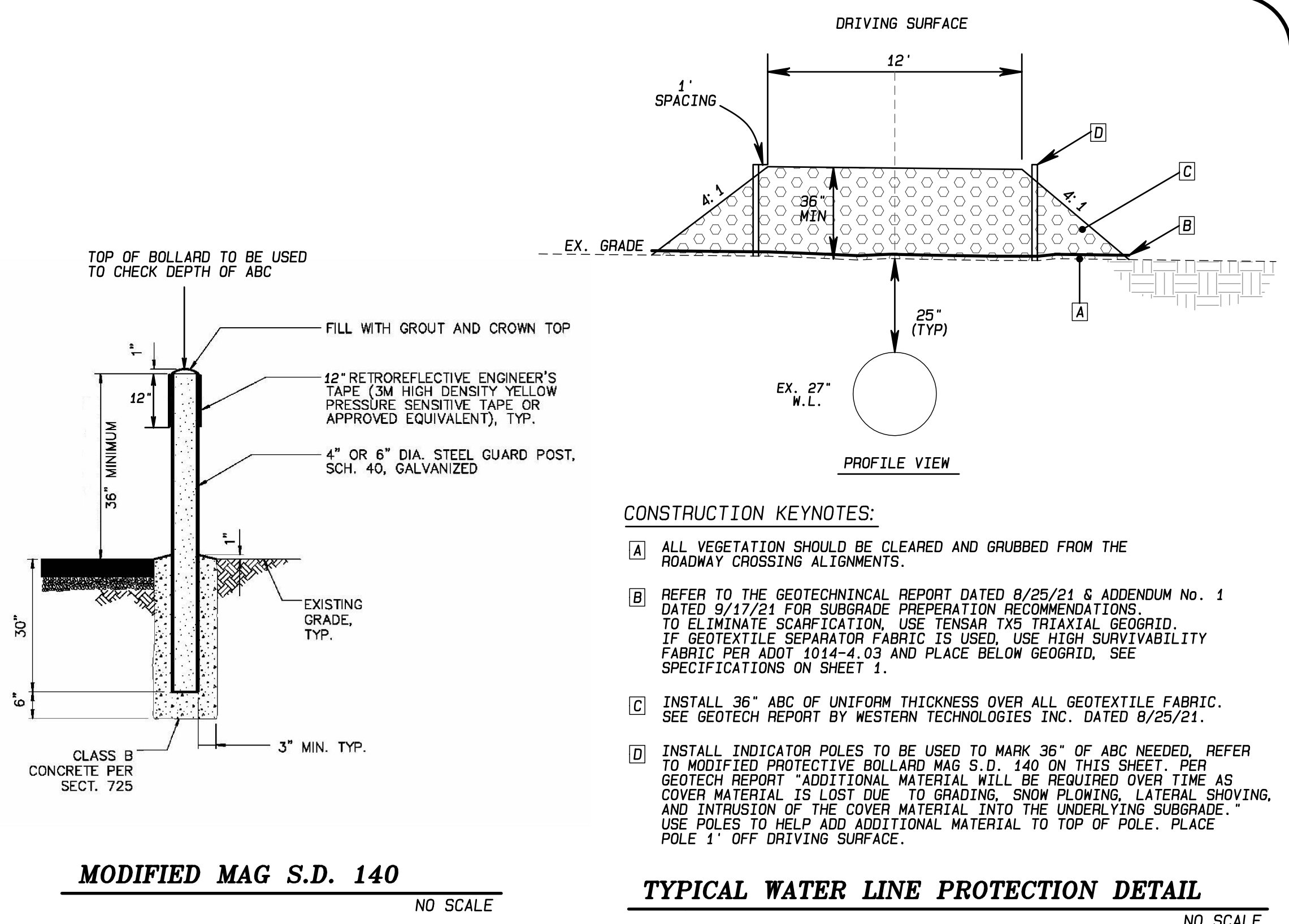
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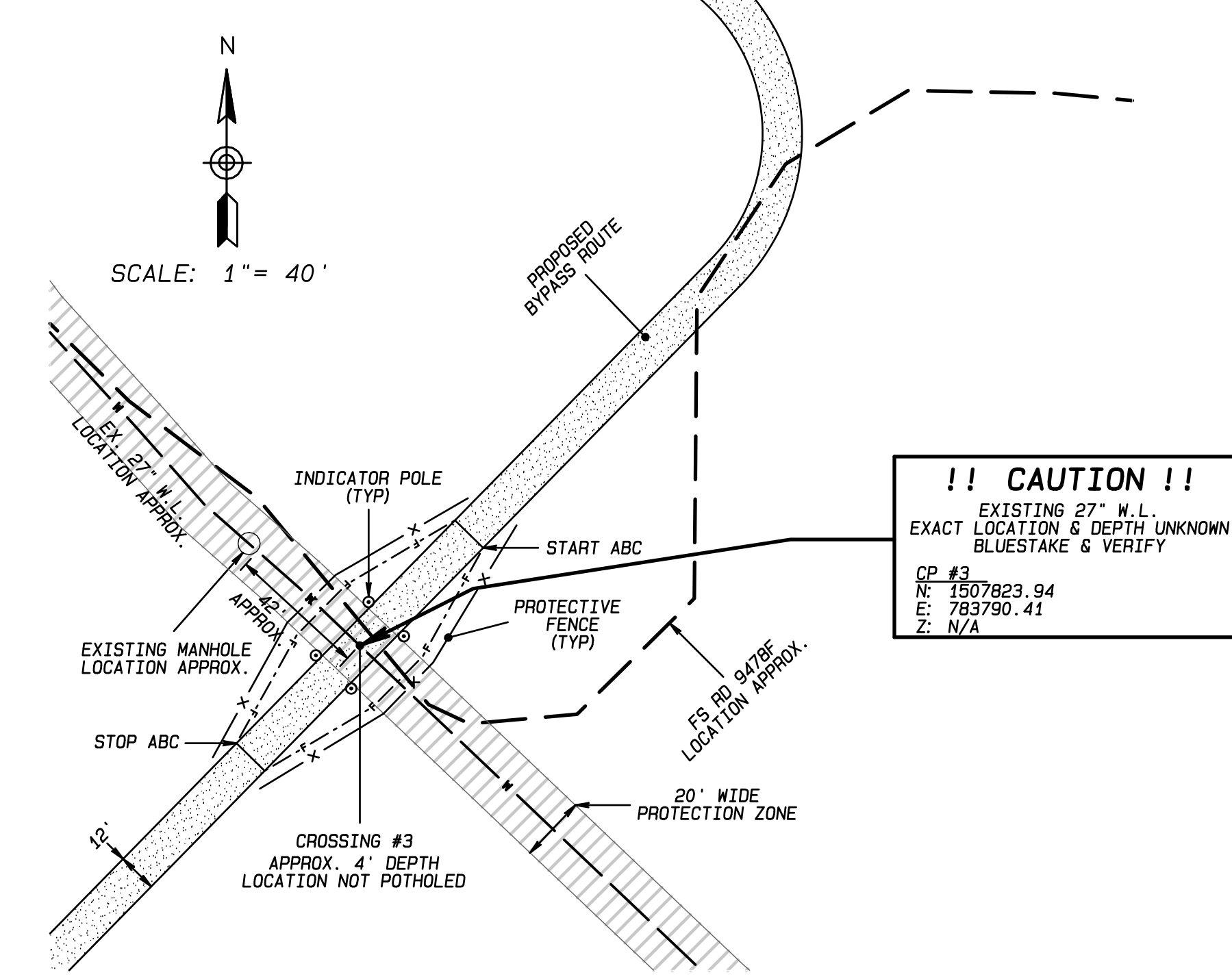
PLAN & PROFILE
Sta. 10+00.00 TO Sta. 16+70.00
STATIONING ALONG ROAD Q



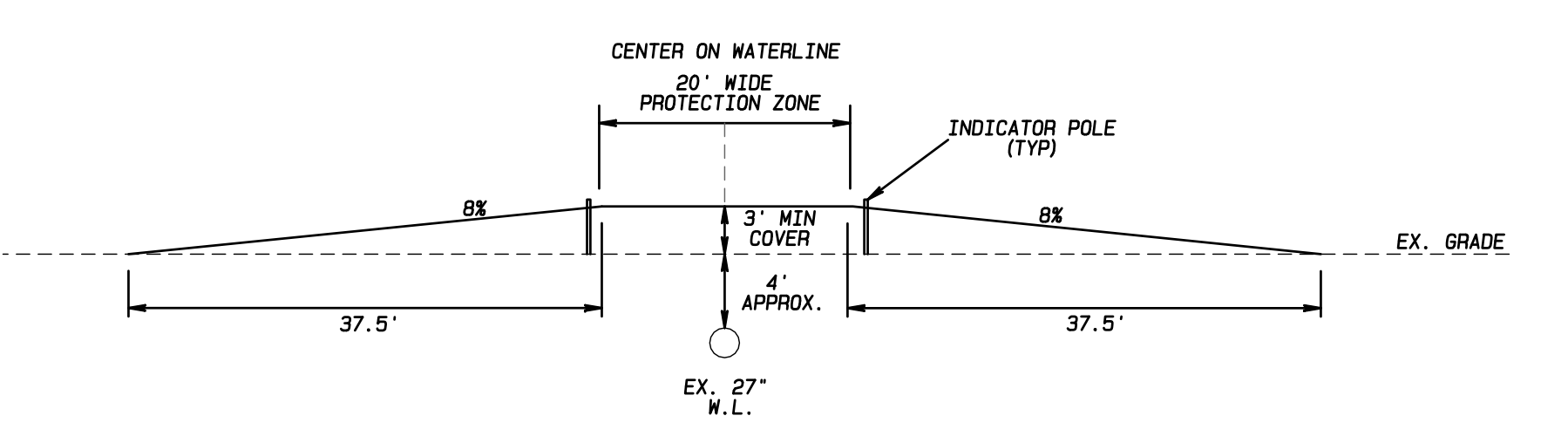
A
2 PROTECTION ROAD PLAN & PROFILE
1"=40'



- CONSTRUCTION KEYNOTES:
- A ALL VEGETATION SHOULD BE CLEARED AND GRUBBED FROM THE ROADWAY CROSSING ALIGNMENTS.
 - B REFER TO THE GEOTECHNICAL REPORT DATED 8/25/21 & ADDENDUM No. 1 DATED 9/17/21 FOR SUBGRADE PREPARATION RECOMMENDATIONS. TO ELIMINATE SCARIFICATION, USE TENSAR TX5 TRIAXIAL GEOGRID. IF GEOTEXTILE SEPARATOR FABRIC IS USED, USE HIGH SURVIVABILITY FABRIC PER ADOT 1014-4.03 AND PLACE BELOW GEOGRID. SEE SPECIFICATIONS ON SHEET 1.
 - C INSTALL 36" ABC OF UNIFORM THICKNESS OVER ALL GEOTEXTILE FABRIC. SEE GEOTECH REPORT BY WESTERN TECHNOLOGIES INC. DATED 8/25/21.
 - D INSTALL INDICATOR POLES TO BE USED TO MARK 36" OF ABC NEEDED. REFER TO MODIFIED PROTECTIVE BOLLARD MAG S.D. 140 ON THIS SHEET. PER GEOTECH REPORT "ADDITIONAL MATERIAL WILL BE REQUIRED OVER TIME AS COVER MATERIAL IS LOST DUE TO GRADING, SNOW FLOWING, LATERAL SHOVING, AND INTRUSION OF THE COVER MATERIAL INTO THE UNDERLYING SUBGRADE. USE POLES TO HELP ADD ADDITIONAL MATERIAL TO TOP OF POLE. PLACE POLE 1" OFF DRIVING SURFACE.

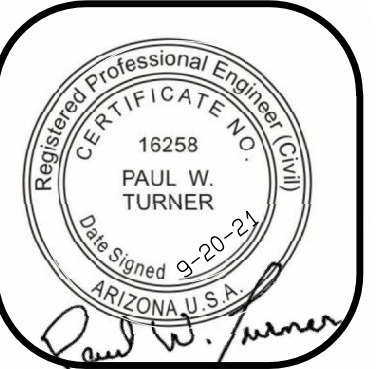


B
2 WATERLINE PROTECTION PLAN CROSSING #3
NOTE: THIS AREA IS OUTSIDE OF THE SURVEY LIMITS ALL LOCATIONS ARE APPROXIMATE.
1"=40'



B
2 WATERLINE PROTECTION PROFILE CROSSING #3
NOTE: THIS AREA IS OUTSIDE OF THE SURVEY LIMITS ALL LOCATIONS ARE APPROXIMATE.
NO SCALE

| | | |
|---|-----------------|---------------|
| TURNER ENGINEERING INC. 558 N. ASPEN AVE., FLAGSTAFF, ARIZONA 86001 (928) 779-1814 | | SCALE: 1"=40' |
| TELEPHONE NO.: 10421 | CHECKED: PT | HORIZ: 1"=40' |
| DESIGN: MW | DATE: 9/20/2021 | VERT: 1"=4' |
| DRAWN: MW | | |



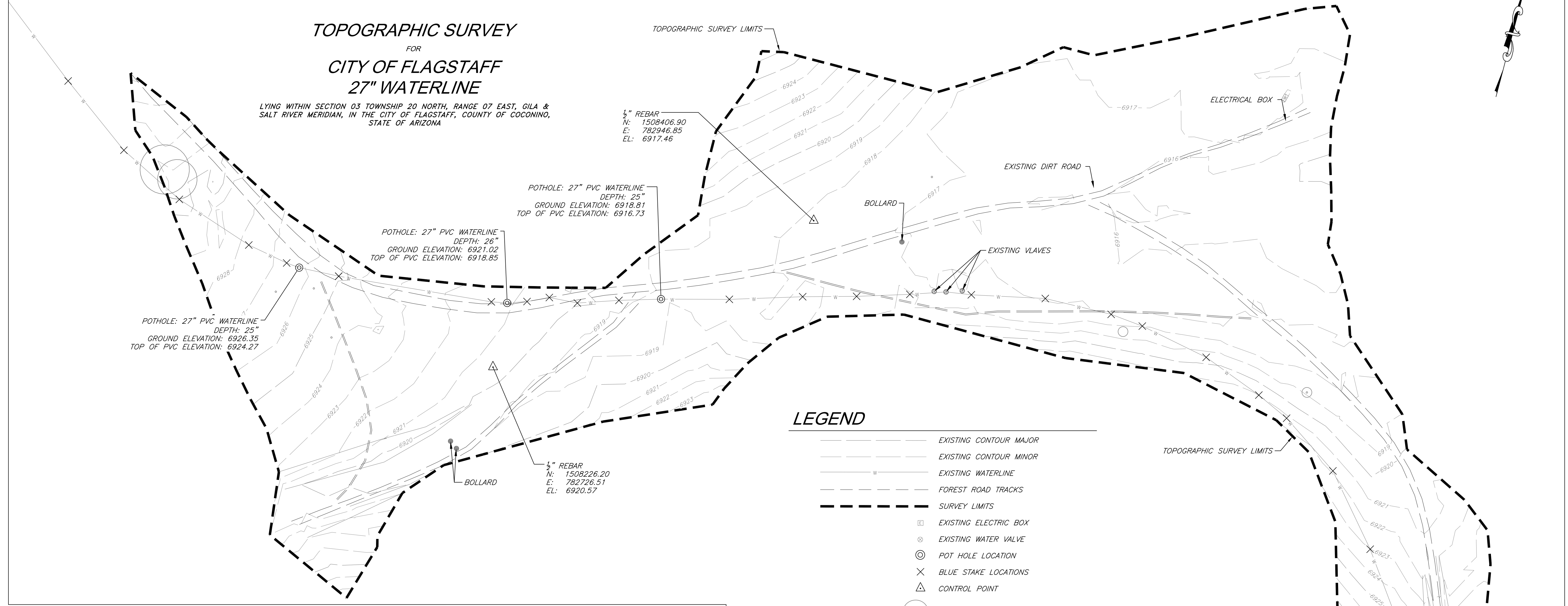
USFS LAKE MARY SERVICE ROAD
LAKE MARY 27" WATERLINE

PROTECTION DETAILS



TOPOGRAPHIC SURVEY
FOR
CITY OF FLAGSTAFF
27" WATERLINE

LYING WITHIN SECTION 03 TOWNSHIP 20 NORTH, RANGE 07 EAST, GILA & SALT RIVER MERIDIAN, IN THE CITY OF FLAGSTAFF, COUNTY OF COCONINO, STATE OF ARIZONA



LEGEND

- EXISTING CONTOUR MAJOR
- EXISTING CONTOUR MINOR
- - - - - EXISTING WATERLINE
- - - - - FOREST ROAD TRACKS
- - - - - SURVEY LIMITS
- EXISTING ELECTRIC BOX
- ⊗ EXISTING WATER VALVE
- ⊙ POT HOLE LOCATION
- × BLUE STAKE LOCATIONS
- △ CONTROL POINT
- EXISTING TREE

BASIS OF SURVEY

THE SURVEY IS BASED ON A GPS, ONE POINT CALIBRATION USING A FOUND NGS ALUMINUM CAP NEAR THE INTERSECTION OF LAKE MARY ROAD AND THE LOWER LAKE MARY PICNIC AREA TURNOFF. STAMPED "COCONINO COUNTY PUBLIC WORKS 2009 KNOTT"

N: 1496749.37
E: 798524.09

(NGVD88)
6813.20 FEET

BASIS OF ELEVATION

A FOUND NGS ALUMINUM CAP NEAR THE INTERSECTION OF LAKE MARY ROAD AND THE LOWER LAKE MARY PICNIC AREA TURNOFF. STAMPED "COCONINO COUNTY PUBLIC WORKS 2009 KNOTT"

SAID ELEVATION BEING: 6813.20 (NAVD88)

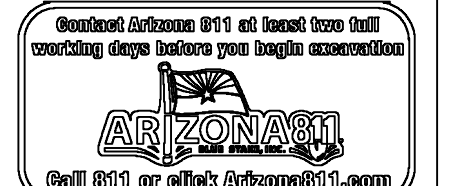
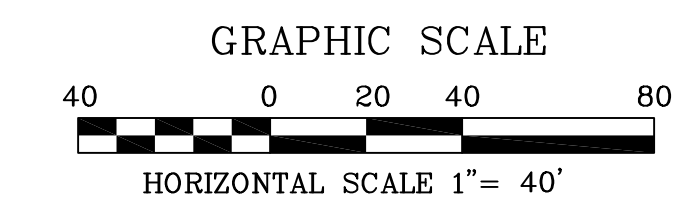
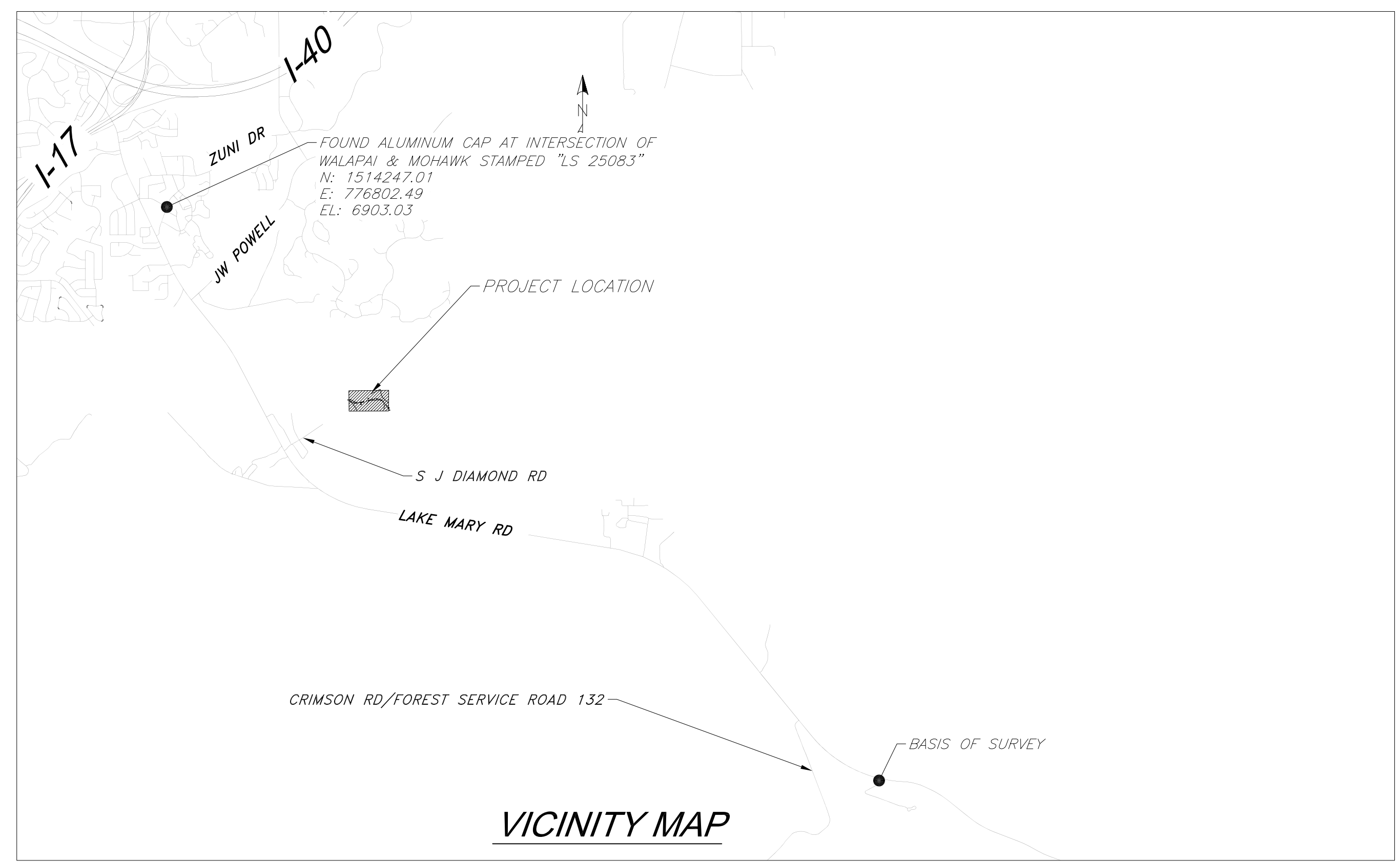
NOTES

THE FIELD SURVEY WAS COMPLETED ON MAY 21, 2021.

THIS SURVEY WAS PERFORMED UNDER MY DIRECT SUPERVISION.

Peter D. Cote

PETER D. COTE, RLS 44121
EMAIL ADDRESS: pcote@wlbgroup.com



| | | |
|-----|------|-----------|
| NO. | DATE | REVISIONS |
| | | |
| | | |
| | | |

The **WLB** Group, Inc.
 Surveying • Planning • Urban Design
 Engineering • Architecture • Civil
 Flagstaff, AZ • Las Vegas, NV
 500 N. Beaver Street, Flagstaff, AZ 86001
 PH: (928) 779-1500

TOPOGRAPHIC SURVEY
EXISTING CONDITIONS



| | |
|--------------|-----------|
| DESIGNED BY: | KK |
| DRAWN BY: | BL/PC |
| CHECK BY: | JULY 2021 |
| DATE: | BY: |
| | |

| | |
|-------------|------------|
| PROJECT NO. | 321008A001 |
| SHEET | OF |
| 1 | 1 |

GEOTECHNICAL EVALUATION REPORT

LAKE MARY WATERLINE PROTECTION

35.145167 N, -111.640417 W

Flagstaff, Arizona

WT Reference No. 2521JW159

PREPARED FOR:

City of Flagstaff

4500 Lake Mary Road

Flagstaff, Arizona 86005

Attn: Mr. Mr. Paul Turner, P.E.

Attn: Mr. Brian Huntzinger, Water Production Manger

August 25, 2021



Gregory L. E. Burr, R.G., E.I.T.
Geotechnical Project Manager



Craig P. Wiedeman, P.E.
Senior Geotechnical Engineer





**Western
Technologies Inc.**
The Quality People
Since 1955

2400 East Huntington Drive
Flagstaff, Arizona 86004-8934
(928) 774-8700 • fax 774-6469

August 25, 2020

City of Flagstaff
4500 Lake Mary Road
Flagstaff, Arizona 86005

Attn: Mr. Paul Turner, P.E., C.F.M.
Mr. Brian Huntzinger, Water Production Manager

Re: Geotechnical Evaluation
Lake Mary Waterline Protection
35.145167 N; -111.640417 W
Flagstaff, Arizona

Job No. 2521JW159

Western Technologies Inc. has completed the geotechnical evaluation for the proposed waterline protection to be located in Flagstaff, Arizona. This study was performed in general accordance with our proposal number 2520PW274R dated July 14, 2021. The results of our study, including the boring location diagram, laboratory test results, boring logs, and the geotechnical recommendations are attached.

We have appreciated being of service to you in the geotechnical engineering phase of this project and are prepared to assist you during the construction phases as well. If design conditions change, or if you have any questions concerning this report or any of our testing, inspection, design and consulting services, please do not hesitate to contact us. We look forward to working with you on future projects.

Sincerely,
WESTERN TECHNOLOGIES, INC.
Geotechnical Engineering Services

A handwritten signature in black ink, appearing to read 'G. L. E. Burr'.

Gregory L. E. Burr, R.G.
Geotechnical Project Manager

Copies to: Addressee (emailed)

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 5.2 Field Tests 4

6.0 RECOMMENDATIONS 4

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BORING LOCATION DIAGRAM Plate 1

APPENDIX A

 Definition of Terminology A-1

 Method of Classification A-2

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APPENDIX B

 Laboratory Tests..... B-1 to B-7

**GEOTECHNICAL EVALUATION
LAKE MARY WATERLINE PROTECTION
35.145167 N; -111.640417 W
FLAGSTAFF, ARIZONA
JOB NO. 2521JW159**

1.0 PURPOSE

This report contains the results of our geotechnical evaluation for the proposed waterline protection project. The purpose of these services is to evaluate the subsurface soil conditions along a portion of the waterline alignment, and provide information and recommendations for truck traffic protection of the water transmission main, including:

- options for waterline protection
- anticipated excavation conditions
- earthwork, including backfill placement, and suitability of existing soils for backfill materials
- corrosivity to concrete

Results of the field exploration, field tests, and laboratory testing program are presented in the Appendices.

2.0 PROJECT DESCRIPTION

Based on the information provided by Mr. Paul Turner, P.E., the proposed project consists of an evaluation of the need for protection of an existing 27-inch diameter waterline to be subjected to heavy log truck loadings. Two crossing areas about 30 and 60 feet long, and one perpendicular crossing are considered. Based on recent potholing by others, the top of the existing waterline is located about 27 inches to 4 feet below the existing unpaved roadway crossing grades. The pipe is suspected to be about 57 years old. Log truck traffic loading will consist of 80 total kips transmitted over 18 tires on 5 axles. The total number of trips and years of service are undetermined at this time. We understand that it will be possible to raise the roadway crossing grades some amount. Should any of our information or assumptions not be correct, we request that the Client notify WT immediately.

3.0 SCOPE OF SERVICES

3.1 Field Exploration

Three borings were drilled to depths of about 6 to 10 feet below existing site grades at the approximate locations shown on the attached boring location diagram. Logs of the borings are presented in Appendix A. Subsoils encountered during drilling were examined visually and sampled at selected depth intervals. A field log was prepared for each boring. These logs contain visual classifications of the materials encountered during drilling as well as interpolation of the subsurface conditions between samples. Final logs, included in Appendix A, represent our interpretation of the field logs and include modifications based on laboratory observations and tests of the field samples. The final logs describe the materials encountered, their thicknesses, and the locations where samples were obtained. The Unified Soil Classification System was used to classify soils. The soil classification symbols appear on the boring logs and are briefly described in Appendix A. Local and regional geologic characteristics were used to estimate the seismic design criteria and liquefaction potential.

3.2 Laboratory Analyses

Laboratory analyses were performed on representative soil samples to aid in material classification and to estimate pertinent engineering properties of the on-site soils for preparation of this report. Testing was performed in general accordance with applicable standard test methods. The following tests were performed and the results are presented in Appendix B.

- Water content
- Dry density
- Remolded expansion potential
- Compression
- Shear strength
- Gradation
- Expansion
- Plasticity
- Soluble salts/sulfates/chlorides

Test results were utilized in the development of the recommendations contained in this report.

3.3 Analyses and Report

This geotechnical engineering report includes a description of the project, a discussion of the field and laboratory testing programs, a discussion of the subsurface conditions, and design recommendations as appropriate to the purpose. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the site, discovery of underground storage tanks or other underground structures, or identification of contaminated or hazardous materials or conditions. If there is concern about the potential for such contamination, other studies should be undertaken. We are available to discuss the scope of such studies with you.

4.0 SITE CONDITIONS

4.1 Surface

Located along the existing waterline alignment, adjacent to the proposed logging road crossings, was undeveloped land with vegetation that consisted of a sparse to heavy growth of native ponderosa pine trees, grasses and weeds. Existing roads in this area are basically narrow, two-track, unpaved roads with occasional areas of thin cinder surfacing.

4.2 Subsurface

As presented on the boring logs, surface and subsoils extending to the full depth of exploration, in all but Boring 2, were found to be stiff, non-plastic Sandy SILTS and medium dense to dense, non-plastic Silty SANDS, both with variable amounts of gravel. Surface soils in Boring 2 were underlain by stiff, medium plasticity Sandy Lean CLAYS with variable amounts of gravel that extended from about 5 feet to the full depth of exploration in that boring. Refusal to auger penetration occurred in Boring 1 at a depth of about 6 feet on LIMESTONE. Groundwater was not encountered in any boring at the time of exploration. The logs in Appendix A show details of the subsurface conditions encountered during the field exploration.

The boring logs included in this report are indicators of subsurface conditions only at the specific location and date noted. Variations from the field conditions represented by the borings may become evident during construction. If variations appear, we should be contacted to re-evaluate our recommendations.

5.0 GEOTECHNICAL PROPERTIES AND ANALYSIS

5.1 Laboratory Tests

Laboratory test results (see Appendix B) indicate that the site soils exhibit low compressibility at existing water contents. Either low additional compression occurs or low expansive pressure develops when the water content is increased.

Near-surface soils are non-plastic. These soils exhibit no expansion potential when recompacted, confined by loads approximating floor loads and saturated in accordance with standard Arizona test methods. Densification of the soil by the passage of construction equipment will increase the expansion potential of the soil.

5.2 Field Tests

On-site native soils exhibited generally moderate resistance to penetration using test method ASTM D3550. The penetration resistances also exhibited variability between test locations and with depth.

6.0 RECOMMENDATIONS

6.1 General

Recommendations contained in this report are based on our understanding of the project criteria described in Section 2.0, **PROJECT DESCRIPTION**, and the assumption that the soil and subsurface conditions are those disclosed by the explorations. Others may change the plans, final elevations, and roadway crossing alignments during design or construction. Substantially different subsurface conditions from those described herein may be encountered or become known between our explorations. Any changes in the project criteria or subsurface conditions shall be brought to our attention in writing.

6.2 Design Considerations

The existing waterline that will require protection is assumed to be a 27-inch diameter, cast iron, wire wrapped, brittle pipe that is thought to have embedment depths to the top of pipe of 27 to 48 inches, based on several widely spaced pothole test pits

excavated by others. Log trucks that have 5 axles, 18 tires, and total weights of 80 kips will be crossing the line at three locations producing 5 to 13 kip dynamic loads. To protect the waterline, two alternates are provided; one using aggregate surfacing to provide the needed support, and one using a structural slab to provide support.

To model aggregate protection over the waterline, the Schmertmann Method was used with a maximum load of 13 kips. Per AASHTO *Standard Specification for Highway Bridges*, the tire contact area was taken as 20 inches wide and 10 inches long, with the load imposed at the surface. Elastic moduli were correlated from soil types based on tables contained in *Foundation Analysis and Design* (Bowles 1977). The elastic modulus for the native Silty Sands and Sandy Silts was taken as 432 kips per square foot (ksf), and the properly compacted aggregate that will produce most of the waterline protection, was modeled as a well-graded aggregate base course with an elastic modulus of 1,008 ksf. Recommendations based on this model are provided in the following Aggregate Surfacing Protection section.

A structurally reinforced slab capable of supporting the vehicle weights that will be crossing the waterline should be designed by a structural engineer. Recommendations are provided in the following Slab-on-Grade Support section for geotechnical design parameters. A minimum perimeter slab turn-down depth of 2.5 feet is recommended.

6.3 Aggregate Surfacing Protection

We recommend an initial minimum thickness of 3 feet of granular cover material using aggregate base course material conforming to City of Flagstaff specifications. As with any unbound vehicular section, additional material will be required over time as cover material is lost due to grading, snow plowing, lateral shoving, and intrusion of the cover material into the underlying subgrade soils. To help reduce intrusion, consideration should be given to the use of a geotextile separator fabric placed at the cover material/subgrade soil interface.

6.4 Slab-on-Grade Support

Structural slabs-on-grade can be supported on properly placed and compacted imported fill or approved, properly recompacted, low expansive potential native soils. For design of structural slabs-on-grade, we recommend using a modulus of subgrade reaction (k) of 90 pounds per cubic inch (pci) for the on-site soils and 225 pci for imported fill material,

based on a 30-inch diameter plate. The slab subgrade should be prepared by the procedures outlined in this report.

6.5 Waterline Protection Preparation

Prior to placement of the cover material and a geotextile separator fabric, scarify, moisten or dry as required, and compact all subgrade soils to a minimum depth of 8 inches. The subgrade preparation should be accomplished in a manner that will result in uniform water contents and densities after compaction.

6.6 Materials

All aggregate base course should meet the current City of Flagstaff specifications. Frozen soils should not be used as fill or backfill. A geotextile separator fabric should conform to Section 1014-4.03 of the 2021 ADOT *Standard Specifications for Road and Bridge Construction* for a high survivability fabric.

6.7 Placement and Compaction

All trench backfill should be placed and compacted in accordance with the current City of Flagstaff specifications for trench backfill. Fill soils should not be placed over frozen ground. All fill soils and aggregate base materials placed should be compacted to a minimum of 100 percent of the maximum density as determined by ASTM D698. On-site and imported soils with low expansive potential and aggregate base course materials should be compacted with a moisture content in the range of 3 percent below to 3 percent above optimum.

7.0 ADDITIONAL SERVICES

The recommendations provided in this report are based on the assumption that a sufficient schedule of tests and observations will be performed during construction to verify compliance. At a minimum, these tests and observations should be comprised of the following:

- Observations and testing during site preparation and earthwork,
- Observation of foundation excavations, and
- Consultation as may be required during construction.

Retaining the geotechnical engineer who developed your report to provide construction observation is the best way to verify compliance and to help you manage the risks associated with unanticipated conditions.

8.0 LIMITATIONS

This report has been prepared assuming the project criteria described in **2.0 PROJECT DESCRIPTION**. If changes in the project criteria occur, or if different subsurface conditions are encountered or become known, the conclusions and recommendations presented herein shall become invalid. In any such event, WT should be contacted in order to assess the effect that such variations may have on our conclusions and recommendations. If WT is not retained for the construction observation and testing services to determine compliance with this report, our professional responsibility is accordingly limited.

The recommendations presented are based entirely upon data derived from a limited number of samples obtained from widely spaced explorations. The attached logs are indicators of subsurface conditions only at the specific locations and times noted. This report assumes the uniformity of the geology and soil structure between explorations, however variations can and often do exist. Whenever any deviation, difference, or change is encountered or becomes known, WT should be contacted.

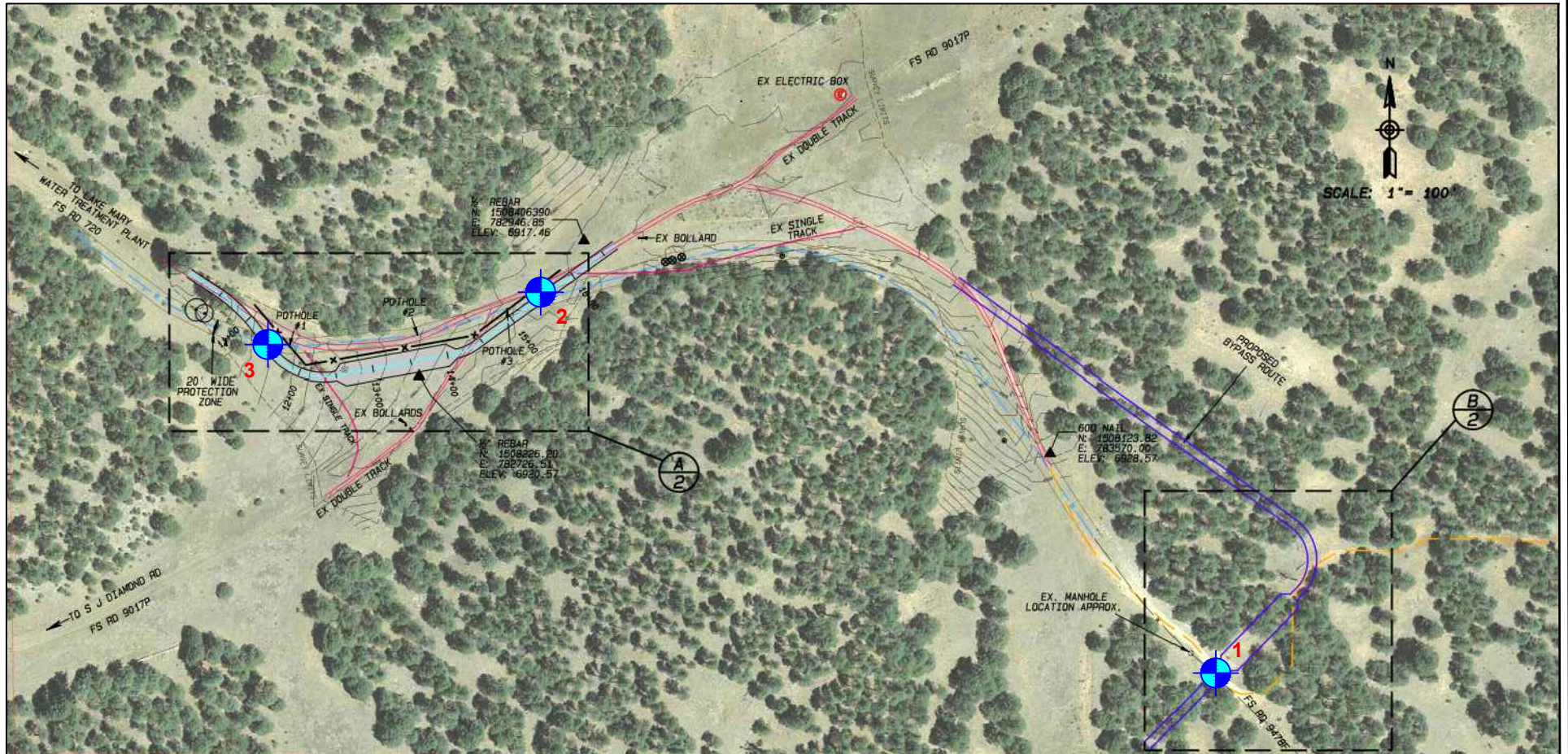
This report is for the exclusive benefit of our client alone. There are no intended third-party beneficiaries of our contract with the client or this report, and nothing contained in the contract or this report shall create any express or implied contractual or any other relationship with, or claim or cause of action for, any third party against WT.

This report is valid for the earlier of one year from the date of issuance, a change in circumstances, or discovered variations. After expiration, no person or entity shall rely on this report without the express written authorization of WT.


9.0 CLOSURE


We prepared this report as an aid to the designers of the proposed project. The comments, statements, recommendations and conclusions set forth in this report reflect the opinions of the authors. These opinions are based upon data obtained at the location of the explorations,

and from laboratory tests. Work on your project was performed in accordance with generally accepted standards and practices utilized by professionals providing similar services in this locality. No other warranty, express or implied, is made.



N
 SCALE: 1" = 100'

 Not to Scale

 Approximate Test Boring Location

*Geotechnical
 Environmental
 Inspections
 Materials*  **Western
 Technologies Inc.**
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 Since 1955

| | |
|-----------------------------------|----------|
| LAKE MARY WATER LINE PROTECTION | |
| Boring Location Diagram | |
| Western Technologies, Inc. | |
| Job No. 2521JW159 | Plate: 1 |

| | |
|--|--|
| Allowable Soil Bearing Capacity | The recommended maximum contact stress developed at the interface of the foundation element and the supporting material. |
| Backfill | A specified material placed and compacted in a confined area. |
| Base Course | A layer of specified aggregate material placed on a subgrade or subbase. |
| Base Course Grade | Top of base course. |
| Bench | A horizontal surface in a sloped deposit. |
| Caisson/Drilled Shaft | A concrete foundation element cast in a circular excavation which may have an enlarged base (or belled caisson). |
| Concrete Slabs-On-Grade | A concrete surface layer cast directly upon base course, subbase or subgrade. |
| Crushed Rock Base Course | A base course composed of crushed rock of a specified gradation. |
| Differential Settlement | Unequal settlement between or within foundation elements of a structure. |
| Engineered Fill | Specified soil or aggregate material placed and compacted to specified density and/or moisture conditions under observations of a representative of a soil engineer. |
| Existing Fill | Materials deposited through the action of man prior to exploration of the site. |
| Existing Grade | The ground surface at the time of field exploration. |
| Expansive Potential | The potential of a soil to expand (increase in volume) due to absorption of moisture. |
| Fill | Materials deposited by the actions of man. |
| Finished Grade | The final grade created as a part of the project. |
| Gravel Base Course | A base course composed of naturally occurring gravel with a specified gradation. |
| Heave | Upward movement. |
| Native Grade | The naturally occurring ground surface. |
| Native Soil | Naturally occurring on-site soil. |
| Rock | A natural aggregate of mineral grains connected by strong and permanent cohesive forces. Usually requires drilling, wedging, blasting or other methods of extraordinary force for excavation. |
| Sand and Gravel Base Course | A base course of sand and gravel of a specified gradation. |
| Sand Base Course | A base course composed primarily of sand of a specified gradation. |
| Scarify | To mechanically loosen soil or break down existing soil structure. |
| Settlement | Downward movement. |
| Soil | Any unconsolidated material composed of discrete solid particles, derived from the physical and/or chemical disintegration of vegetable or mineral matter, which can be separated by gentle mechanical means such as agitation in water. |
| Strip | To remove from present location. |
| Subbase | A layer of specified material placed to form a layer between the subgrade and base course. |
| Subbase Grade | Top of subbase. |
| Subgrade | Prepared native soil surface. |



COARSE-GRAINED SOILS
LESS THAN 50% FINES

| GROUP SYMBOLS | DESCRIPTION | MAJOR DIVISIONS |
|---------------|--|--|
| GW | WELL-GRADED GRAVEL OR WELL-GRADED GRAVEL WITH SAND, LESS THAN 5% FINES | GRAVELS MORE THAN HALF OF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE |
| GP | POORLY-GRADED GRAVEL OR POORLY-GRADED GRAVEL WITH SAND, LESS THAN 5% FINES | |
| GM | SILTY GRAVEL OR SILTY GRAVEL WITH SAND, MORE THAN 12% FINES | |
| GC | CLAYEY GRAVEL OR CLAYEY GRAVEL WITH SAND, MORE THAN 12% FINES | |
| SW | WELL-GRADED SAND OR WELL-GRADED SAND WITH GRAVEL, LESS THAN 5% FINES | SANDS MORE THAN HALF OF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE |
| SP | POORLY-GRADED SAND OR POORLY-GRADED SAND WITH GRAVEL, LESS THAN 5% FINES | |
| SM | SILTY SAND OR SILTY SAND WITH GRAVEL, MORE THAN 12% FINES | |
| SC | CLAYEY SAND OR CLAYEY SAND WITH GRAVEL, MORE THAN 12% FINES | |

NOTE: Coarse-grained soils receive dual symbols if they contain 5% to 12% fines (e.g., SW-SM, GP-GC).

FINE-GRAINED SOILS
MORE THAN 50% FINES

| GROUP SYMBOLS | DESCRIPTION | MAJOR DIVISIONS |
|---------------|---|--|
| ML | SILT, SILT WITH SAND OR GRAVEL, SANDY SILT, OR GRAVELLY SILT | SILTS AND CLAYS LIQUID LIMIT LESS THAN 50 |
| CL | LEAN CLAY OF LOW TO MEDIUM PLASTICITY, SANDY CLAY, OR GRAVELLY CLAY | |
| OL | ORGANIC SILT OR ORGANIC CLAY OF LOW TO MEDIUM PLASTICITY | |
| MH | ELASTIC SILT, SANDY ELASTIC SILT, OR GRAVELLY ELASTIC SILT | SILTS AND CLAYS LIQUID LIMIT MORE THAN 50 |
| CH | FAT CLAY OF HIGH PLASTICITY, SANDY FAT CLAY, OR GRAVELLY FAT CLAY | |
| OH | ORGANIC SILT OR ORGANIC CLAY OF HIGH PLASTICITY | |
| PT | PEAT AND OTHER HIGHLY ORGANIC SOILS | HIGHLY ORGANIC SOILS |

NOTE: Fine-grained soils may receive dual classification based upon plasticity characteristics (e.g. CL-ML).

SOIL SIZES

| COMPONENT | SIZE RANGE |
|----------------------|------------------|
| BOULDERS | Above 12 in. |
| COBBLES | 3 in. – 12 in. |
| GRAVEL | No. 4 – 3 in. |
| Coarse | ¾ in. – 3 in. |
| Fine | No. 4 – ¾ in. |
| SAND | No. 200 – No. 4 |
| Coarse | No. 10 – No. 4 |
| Medium | No. 40 – No. 10 |
| Fine | No. 200 – No. 40 |
| Fines (Silt or Clay) | Below No. 200 |

NOTE: Only sizes smaller than three inches are used to classify soils

CONSISTENCY

| CLAYS & SILTS | BLOWS PER FOOT |
|---------------|----------------|
| VERY SOFT | 0 – 2 |
| SOFT | 3 – 4 |
| FIRM | 5 – 8 |
| STIFF | 9 – 15 |
| VERY STIFF | 16 – 30 |
| HARD | OVER 30 |

RELATIVE DENSITY

| SANDS & GRAVELS | BLOWS PER FOOT |
|-----------------|----------------|
| VERY LOOSE | 0 – 4 |
| LOOSE | 5 – 10 |
| MEDIUM DENSE | 11 – 30 |
| DENSE | 31 – 50 |
| VERY DENSE | OVER 50 |

NOTE: Number of blows using 140-pound hammer falling 30 inches to drive a 2-inch-OD (1½-inch ID) split-barrel sampler (ASTM D1586).

PLASTICITY OF FINE GRAINED SOILS

| PLASTICITY INDEX | TERM |
|------------------|-------------|
| 0 | NON-PLASTIC |
| 1 – 7 | LOW |
| 8 – 20 | MEDIUM |
| Over 20 | HIGH |

DEFINITION OF WATER CONTENT

| |
|---------------|
| DRY |
| SLIGHTLY DAMP |
| DAMP |
| MOIST |
| WET |
| SATURATED |



The number shown in "**BORING NO.**" refers to the approximate location of the same number indicated on the "Boring Location Diagram" as positioned in the field by pacing or measurement from property lines and/or existing features.

"**DRILLING TYPE**" refers to the exploratory equipment used in the boring wherein **HSA = hollow stem auger**, and the dimension presented is the outside diameter of the HSA used.

"**R**" in "**BLOW COUNTS**" refers to a 3-inch outside diameter ring-lined split barrel sampler driven into the ground with a 140 pound drop-hammer dropped 30 inches repeatedly until a penetration of 12 inches is achieved or until refusal. The number of blows required to advance the sampler 12 inches is defined as the "**R**" blow count. The "**R**" blow count requires an engineered conversion to an equivalent SPT N-Value. Refusal to penetration is considered more than 50 blows per foot. A double vertical line within the symbol indicates no sample recovery. A circle within the symbol indicates sample disturbance.

"**SAMPLE TYPE**" refers to the form of sample recovery, in which **R** = Ring-lined sample and **G** = Grab sample.

"**DRY DENSITY (LBS/CU FT)**" refers to the laboratory-determined dry density in pounds per cubic foot.


"**WATER (MOISTURE) CONTENT**" (% of Dry Wt.) refers to the laboratory-determined water content in percent using the standard test method ASTM D2216.

"**USCS**" refers to the "Unified Soil Classification System" Group Symbol for the soil type as defined by ASTM D2487 and D2488. The soils were classified visually in the field, and where appropriate, classifications were modified by visual examination of samples in the laboratory and/or by appropriate tests.

These notes and boring logs are intended for use in conjunction with the purposes of our services defined in the text. Boring log data should not be construed as part of the construction plans nor as defining construction conditions.

Boring logs depict our interpretations of subsurface conditions at the locations and on the date(s) noted. Variations in subsurface conditions and characteristics may occur between borings. Groundwater levels may fluctuate due to seasonal variations and other factors.

The stratification lines shown on the boring logs represent our interpretation of the approximate boundary between soil or rock types based upon visual field classification at the boring location. The transition between materials is approximate and may be more or less gradual than indicated.

| | | |
|---|--------------------------------|-----------------------------|
| <p><i>Geotechnical Environmental Inspections Materials</i></p>  <p>Western Technologies Inc. The <u>Quality</u> People Since 1955 wt-us.com</p> | <p>BORING LOG NOTES</p> | <p>PLATE A-3</p> |
|---|--------------------------------|-----------------------------|

DATE DRILLED: 8-4-21
 LOCATION: See Location Diagram
 ELEVATION: Not Determined

BORING NO. 1

EQUIPMENT TYPE: CME-75
 DRILLING TYPE: 7"HSA
 FIELD ENGINEER: C. Senior

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

| MOISTURE CONTENT (% OF DRY WT) | DRY DENSITY (LBS/CU FT) | SAMPLE TYPE | SAMPLE | BLOWS/FT. | DEPTH (FEET) | USCS | GRAPHIC | SOIL DESCRIPTION |
|--------------------------------------|-------------------------|-------------|-----------------|-----------|--------------|------|------------------|--|
| 26.9 | 73 | R | [Patterned Box] | 15 | | SM | [Vertical Lines] | Silty SAND; some gravel, brown, medium dense to dense, moist |
| 19.9 | 90 | R | [Patterned Box] | 40 | 5 | | | |
| Auger Refusal at 6 Feet on LIMESTONE | | | | | | | | |
| 10 | | | | | | | | |

- N- STANDARD PENETRATION TEST
- R- RING SAMPLE
- CA- CALIFORNIA MODIFIED SAMPLER
- G- GRAB SAMPLE
- B- BUCKET SAMPLE

NOTES: Groundwater Not Encountered



WESTERN TECHNOLOGIES INC.
 2400 Huntington Drive
 Flagstaff, AZ 86004-8934

PROJECT: LAKE MARY WATERLINE PROTEC.
 PROJECT NO.: 2521JW159

BORING LOG


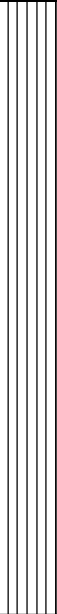





PLATE
A-4

DATE DRILLED: 8-4-21
 LOCATION: See Location Diagram
 ELEVATION: Not Determined

BORING NO. 2

EQUIPMENT TYPE: CME-75
 DRILLING TYPE: 7"HSA
 FIELD ENGINEER: C. Senior

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

| MOISTURE CONTENT (% OF DRY WT) | DRY DENSITY (LBS/CU FT) | SAMPLE TYPE | SAMPLE | BLOWS/FT. | DEPTH (FEET) | USCS | GRAPHIC | SOIL DESCRIPTION |
|----------------------------------|-------------------------|-------------|---|-----------|--------------|------|--|---|
| 7.1 | 85 | G |  | | | ML |  | Sandy SILT; trace gravel, brown, stiff, slightly damp |
| | | R |  | 13 | | | | |
| 15.5 | 103 | R |  | 16 | 5 | CL |  | Sandy Lean CLAY; trace gravel, brown, stiff, damp |
| | | G |  | | | | | |
| 18.1 | 106 | R |  | 14 | | | | |
| | | | | | 10 | | | |
| Boring Stopped at 10 Feet | | | | | | | | |

N- STANDARD PENETRATION TEST
 R- RING SAMPLE
 CA- CALIFORNIA MODIFIED SAMPLER
 G- GRAB SAMPLE
 B- BUCKET SAMPLE

NOTES: Groundwater Not Encountered



WESTERN TECHNOLOGIES INC.
 2400 Huntington Drive
 Flagstaff, AZ 86004-8934

PROJECT: LAKE MARY WATERLINE PROTEC.
 PROJECT NO.: 2521JW159

BORING LOG







PLATE
A-5

DATE DRILLED: 8-4-21
 LOCATION: See Location Diagram
 ELEVATION: Not Determined

BORING NO. 3

EQUIPMENT TYPE: CME-75
 DRILLING TYPE: 7"HSA
 FIELD ENGINEER: C. Senior

THIS SUMMARY APPLIES ONLY AT THIS LOCATION AND AT THE TIME OF LOGGING. CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH TIME. DATA PRESENTED IS A SIMPLIFICATION.

| MOISTURE CONTENT (% OF DRY WT) | DRY DENSITY (LBS/CU FT) | SAMPLE TYPE | SAMPLE | BLOWS/FT. | DEPTH (FEET) | USCS | GRAPHIC | SOIL DESCRIPTION |
|--------------------------------|-------------------------|-------------|---|-----------|--------------|------|--|--|
| 8.9 | 107 | G |  | | | SM |  | Silty SAND; some gravel, dark brown, medium dense, slightly damp to damp |
| | | R |  | 19 | | | | |
| | | R |  | 17 | 5 | | | |
| | | G |  | | | | | |
| 19.1 | 95 | R |  | 13 | | | | |
| | | | | | 10 | | | Boring Stopped at 10 Feet |

- N- STANDARD PENETRATION TEST
- R- RING SAMPLE
- CA- CALIFORNIA MODIFIED SAMPLER
- G- GRAB SAMPLE
- B- BUCKET SAMPLE

NOTES: Groundwater Not Encountered



WESTERN TECHNOLOGIES INC.
 2400 Huntington Drive
 Flagstaff, AZ 86004-8934

PROJECT: LAKE MARY WATERLINE PROTEC.
 PROJECT NO.: 2521JW159

BORING LOG

PLATE
A-6


| Boring No. | Depth (ft) | USCS Class. | Particle Size Distribution (%) Passing by Weight | | | | | | | Atterberg Limits | | Laboratory Compaction Characteristics | | | Remarks |
|------------|------------|-------------|---|-----|----|-----|-----|------|----|------------------|----|---------------------------------------|----------------------|--------|---------|
| | | | 3" | ¾" | #4 | #10 | #40 | #200 | 2μ | LL | PI | Dry Density (pcf) | Optimum Moisture (%) | Method | |
| 1 | 0-5 | SM | 100 | 96 | 87 | 85 | 84 | 39.0 | | | NP | | | | 2 |
| 2 | 0-5 | ML | | 100 | 99 | 98 | 96 | 53.3 | | | NP | | | | 2 |
| 3 | 0-5 | SM | 100 | 98 | 93 | 89 | 83 | 45.5 | | | NP | | | | 2 |

NOTE: NP = Non-plastic
μ = microns (2μ = 0.002mm)

REMARKS

Classification / Particle Size / Moisture-Density Relationship

1. Visual
2. Laboratory Tested
3. Minus #200 Only
4. Test Method ASTM D698/AASHTO T99
5. Test Method ASTM D1557/AASHTO T180
6. From the ADOT Family of Curves

| | | |
|---|---|-------------------------|
|  <p><i>Geotechnical Environmental Inspections Materials</i></p> <p>Western Technologies Inc. The Quality People Since 1955</p> <p>wt-us.com</p> | PROJECT: LAKE MARY WATERLINE PROTECTION JOB NO.: 2521JW159 | PLATE B-1 |
| | SOIL PROPERTIES | |

| Boring No. | Depth (ft.) | USCS Class. | Initial Dry Density (pcf) | Initial Water Content (%) | Compression Properties | | | Expansion Properties | | Plasticity | | Percent Passing #200 | Soluble | | Remarks |
|------------|-------------|-------------|---------------------------|---------------------------|------------------------|-----------------------|------------------|----------------------|---------------|------------|----|----------------------|-------------|---------------|---------|
| | | | | | Surcharge (ksf) | Total Compression (%) | | Surcharge (ksf) | Expansion (%) | LL | PI | | Salts (ppm) | Sulfate (ppm) | |
| | | | | | | In-Situ | After Saturation | | | | | | | | |
| 1 | 0-5 | SM | 108.9 | 14.6 | | | | 0.1 | 0 | | | | | | 1,2 |
| 2 | 0-5 | ML | 115.7 | 11.9 | | | | 0.1 | 0 | | | | | | 1,2 |
| 3 | 0-5 | SM | 118.0 | 11.2 | | | | 0.1 | 0 | | | | | | 1,2 |

Notes: Initial Dry Density and Initial Water Content are remolded.

Remarks

1. Compacted density (approx. 95% of ASTM D698 max. density at moisture content slightly below optimum.)
2. Submerged to approximate saturation.

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PROJECT: LAKE MARY WATERLINE PROTECTION
 JOB NO.: 2521JW159

PLATE
B-2

SOIL PROPERTIES

| Boring No. | Depth (ft.) | USCS Class. | Initial Dry Density (pcf) | Initial Water Content (%) | Compression Properties | | | Direct Shear | | Plasticity | | Percent Passing #200 | Soluble Salts (ppm) | Remarks |
|------------|-------------|-------------|---------------------------|---------------------------|------------------------|-----------------------|------------------|----------------|----------------|--------------|------------------|----------------------|---------------------|---------|
| | | | | | Surcharge (ksf) | Total Compression (%) | | Cohesion (ksf) | Φ Angle (deg.) | Liquid Limit | Plasticity Index | | | |
| | | | | | | In-Situ | After Saturation | | | | | | | |
| 2 | 5-6 | CL | 103.3 | 15.5 | | | | 0.15 | 32.9 | | | | | 2 |

Note: Initial Dry Density and Initial Water Content are in-situ values unless otherwise noted.
NP = Non-Plastic

Remarks

1. Compacted density (approx. 95% of ASTM D698 max. density at moisture content slightly below optimum.)
2. Submerged to approximate saturation.
3. Slight rebound after saturation.
4. Sample disturbance observed.
5. ASTM D3080 Procedure

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PROJECT: LAKE MARY WATERLINE PROTECTION
JOB NO.: 2521JW159

PLATE
B-3

SOIL PROPERTIES



Laboratory Analysis Report

Western Technologies - Flagstaff
Gregory L. E. Burr
2400 East Huntington
Flagstaff, AZ 86004-8934

Project: 2521JW159
Date Received: 8/13/2021
Date Reported: 8/17/2021
PO Number: 2521PO31

| | |
|-----------------------------|-----------------|
| Lab Number: 938287-1 | 1 (0-5') |
|-----------------------------|-----------------|

| <i>Test Parameter</i> | Method | Result | Units | Levels |
|-----------------------|-----------|--------|-------|--------|
| Soluble Salts | ARIZ 237b | 175 | ppm | |
| Sulfate | ARIZ 733b | 15 | ppm | |
| Chloride | ARIZ 736b | < 3 | ppm | |

COMPRESSION TEST REPORT

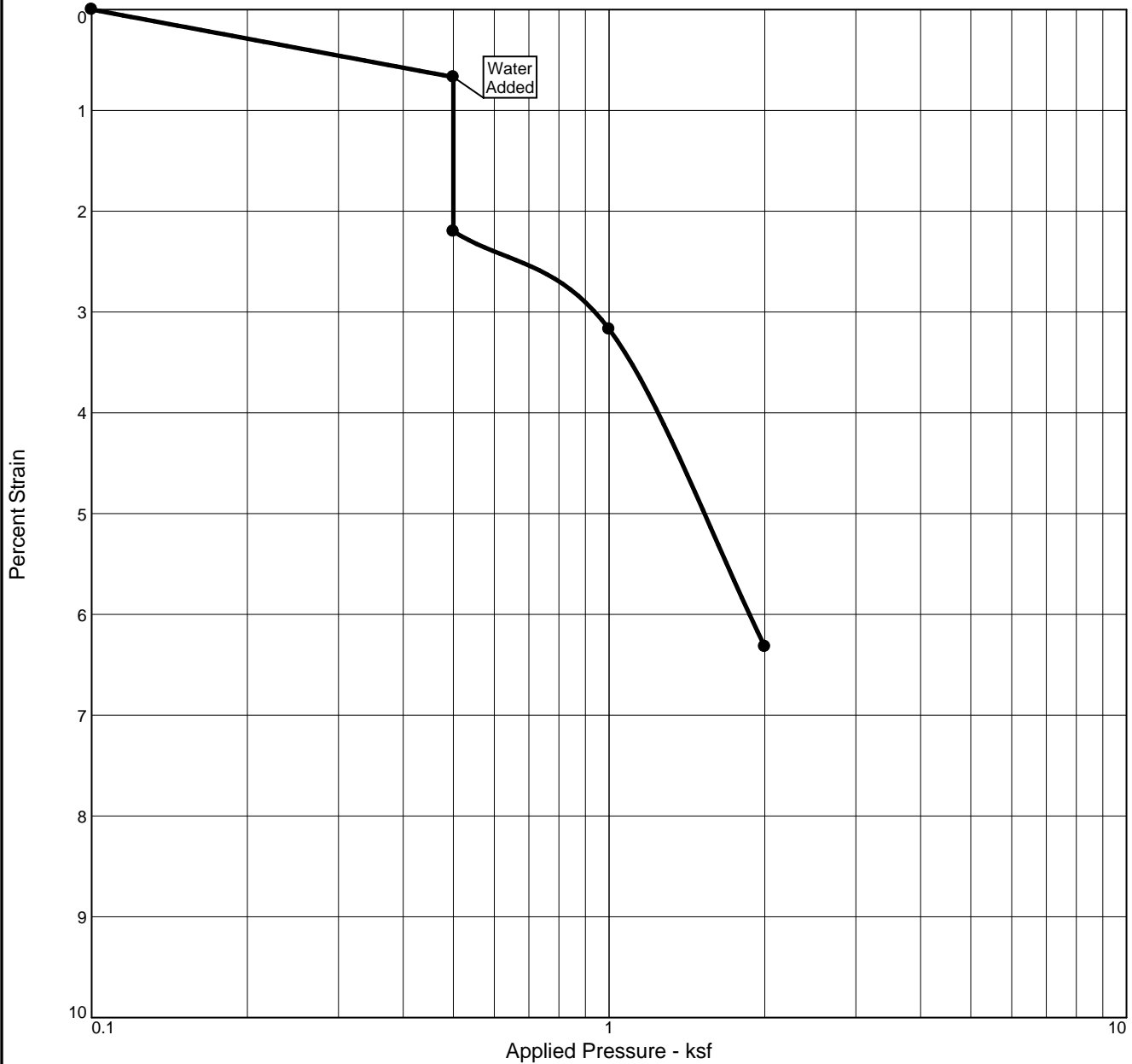


| Natural | | Dry Dens. (pcf) | LL | PI | Sp. Gr. | Overburden (ksf) | e _o | Swell Press. (ksf) | Swell % | C _r |
|---------|--------|-----------------|----|----|---------|------------------|----------------|--------------------|---------|----------------|
| Sat. | Moist. | | | | | | | | | |
| 55.9 % | 26.9 % | 72.7 | | | 2.65 | | 1.275 | 0.1 | 0.6 | |

| MATERIAL DESCRIPTION | | | | | | | | USCS | AASHTO |
|----------------------|--|--|--|--|--|--|--|------|--------|
| SILTY SAND | | | | | | | | SM | |

| | |
|--|--|
| <p>Project No. 2521JW159 Client: CITY OF FLAGSTAFF</p> <p>Project: LAKE MARY WATERLINE PROTECTION</p> <p>Source: RING SAMPLE Depth: 2-3 FEET Sample No.: BORING 1</p> <p style="text-align: center;">Western Technologies, Inc.</p> <p style="text-align: center;">Flagstaff, AZ</p> | <p>Remarks:</p> <p style="text-align: right;">Plate B-5</p> |
|--|--|

COMPRESSION TEST REPORT

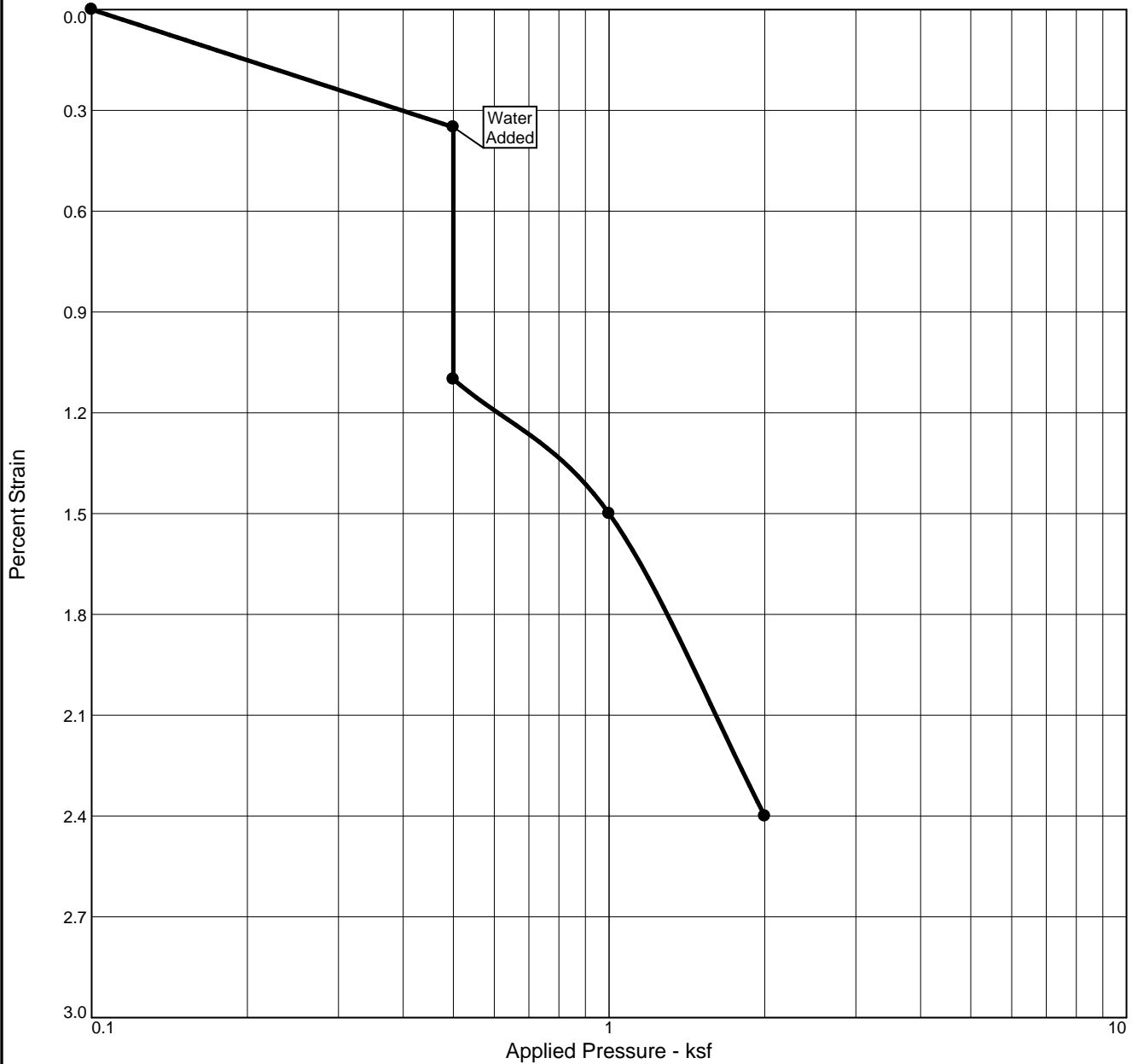


| Natural | | Dry Dens. (pcf) | LL | PI | Sp. Gr. | Overburden (ksf) | e_o | Swell Press. (ksf) | Cpse. % | C_r |
|---------|--------|-----------------|----|----|---------|------------------|-------|--------------------|---------|-------|
| Sat. | Moist. | | | | | | | | | |
| 20.0 % | 7.1 % | 85.1 | | | 2.65 | | 0.943 | | 1.5 | |

| MATERIAL DESCRIPTION | | USCS | AASHTO |
|----------------------|--|------|--------|
| SANDY SILT | | ML | |

| | |
|--|--|
| <p>Project No. 2521JW159 Client: CITY OF FLAGSTAFF</p> <p>Project: LAKE MARY WATERLINE PROTECTION</p> <p>Source: RING SAMPLE Depth: 2-3 FEET Sample No.: BORING 2</p> <p style="text-align: center;">Western Technologies, Inc.</p> <p style="text-align: center;">Flagstaff, AZ</p> | <p>Remarks:</p> <p style="text-align: right;">Plate B-6</p> |
|--|--|

COMPRESSION TEST REPORT



| Natural | | Dry Dens. (pcf) | LL | PI | Sp. Gr. | Overburden (ksf) | e _o | Swell Press. (ksf) | C _{ip} se. % | C _r |
|---------|--------|--------------------|----|----|---------|---------------------|----------------|-----------------------|--------------------------|----------------|
| Sat. | Moist. | | | | | | | | | |
| 42.5 % | 8.9 % | 106.5 | | | 2.65 | | 0.553 | | 0.8 | |

| MATERIAL DESCRIPTION | | | | | | | | USCS | AASHTO |
|----------------------|--|--|--|--|--|--|--|------|--------|
| SILTY SAND | | | | | | | | SM | |

| | |
|--|--|
| <p>Project No. 2521JW159 Client: CITY OF FLAGSTAFF</p> <p>Project: LAKE MARY WATERLINE PROTECTION</p> <p>Source: RING SAMPLE Depth: 2-3 FEET Sample No.: BORING 3</p> <p style="text-align: center;">Western Technologies, Inc.</p> <p style="text-align: center;">Flagstaff, AZ</p> | <p>Remarks:</p> <p style="text-align: right;">Plate B-7</p> |
|--|--|



**Western
Technologies Inc.**
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Since 1955

2400 East Huntington Drive
Flagstaff, Arizona 86004-8934
(928) 774-8700 • fax 774-6469

September 17, 2021

City of Flagstaff
4500 Lake Mary Road
Flagstaff, Arizona 86005

Attn: Mr. Paul Turner, P.E., C.F.M.
Mr. Brian Huntzinger, Water Production Manager

Re: Geotechnical Evaluation
Lake Mary Waterline Protection
35.145167 N; -111.640417 W
Flagstaff, Arizona

Job No. 2521JW159
Addendum No. 1

In accordance with your request, we have reviewed our geotechnical evaluation report for the above referenced project. The purpose of the review was to provide some additional recommendations for roadway subgrade preparation. The following recommendations are presented:

- All vegetation should be cleared and grubbed from the roadway crossing alignments.
- To eliminate the recommendation for scarification and recompaction of the existing subgrade soils in the waterline crossing areas, we recommend the use of Tensar TX5 triaxial geogrid placed at the bottom of the granular cover material at the interface with the existing subgrade soils. A specification sheet for the recommended geogrid is attached.
- If a geotextile separator fabric is used, it should conform to Section 1014-4.03 of the 2021 ADOT *Standard Specifications for Road and Bridge Construction* for a high survivability fabric. The separator fabric should be placed below the geogrid.
- As an alternative, Tensar provides a product where the geogrid and the separator fabric are combined. See the following link:
<https://www.tensarcorp.com/solutions/geogrids/filtergrid-solutions>
The FG90 product is recommended.

All of the recommendations contained in the original report remain applicable. This addendum should be attached to and become part of the original report. If you have any questions concerning this information, or require additional consultation, observation, or testing services, please contact us.

Sincerely,
WESTERN TECHNOLOGIES INC.
Geotechnical Engineering Services

Craig P. Wiedeman

Craig P. Wiedeman, P.E.
Senior Geotechnical Engineer



Copies to: Addressee (emailed)

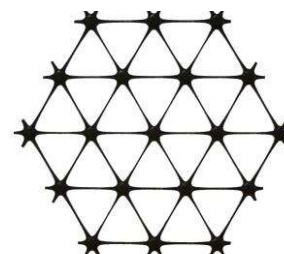
Product Specification - TriAx® TX5 Geogrid

Tensor International Corporation reserves the right to change its product specifications at any time. It is the responsibility of the person specifying the use of this product and of the purchaser to ensure that product specifications relied upon for design or procurement purposes are current and that the product is suitable for its intended use in each instance.

General

1. The geogrid is manufactured from a punched polypropylene sheet, which is then oriented in three substantially equilateral directions so that the resulting ribs shall have a high degree of molecular orientation, which continues at least in part through the mass of the integral node.
2. The properties contributing to the performance of a mechanically stabilized layer include the following:

Tensor TriAx® Geogrid



| Index Properties ¹ | Longitudinal/ Transverse | Diagonal | General |
|--|-----------------------------|------------|-------------|
| ▪ Rib pitch ⁽²⁾ , mm (in) | 40 (1.60) | 40 (1.60) | |
| ▪ Mid-rib depth ⁽²⁾ , mm (in) | 1.2 (0.05) | 1.3 (0.05) | |
| ▪ Mid-rib width ⁽²⁾ , mm (in) | 1.2 (0.05) | 0.9 (0.04) | |
| ▪ Rib shape | | | Rectangular |
| ▪ Aperture shape | | | Triangular |

Dimensions and Delivery

The TX geogrid shall be delivered to the jobsite in roll form with each roll individually identified. Rolls are shipped with nominal measurements: Equal to 4.0 meters (13.1feet) in width by 75 meters (246 feet) in length or 4.87 meters (16 feet) in width by 100 meters (328 feet) in length.

Notes

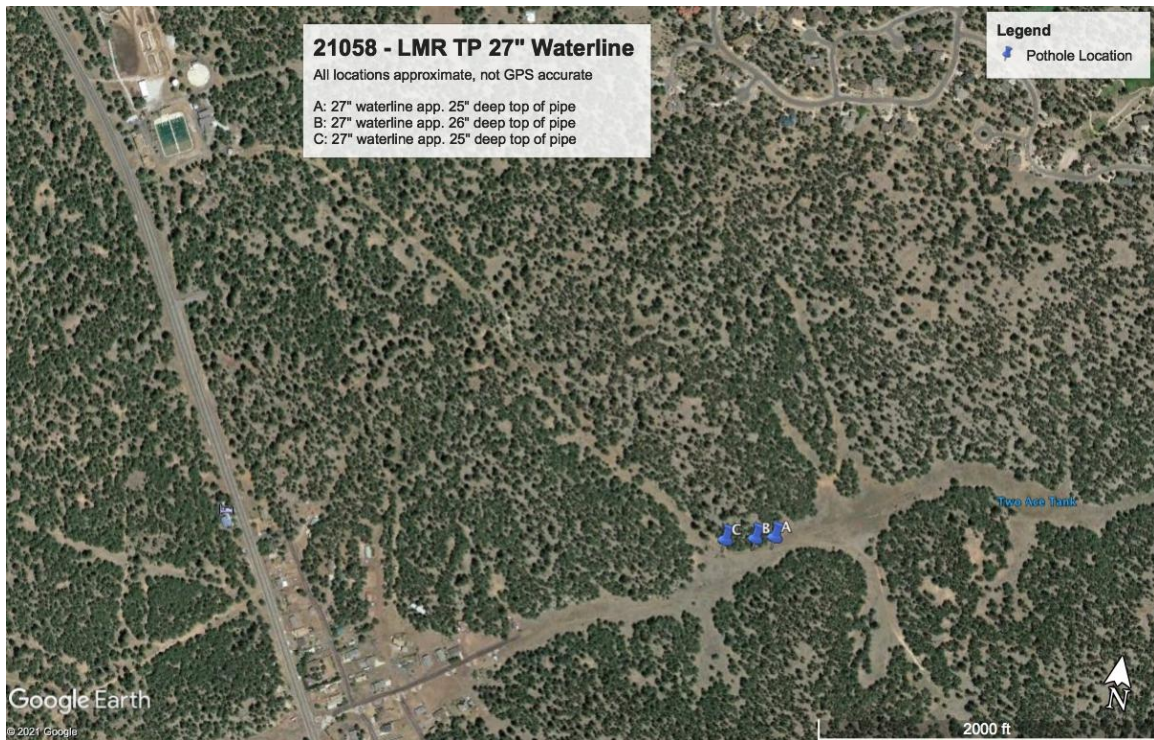
1. Unless indicated otherwise, values shown are minimum average roll values determined in accordance with ASTM D4759-02. Brief descriptions of test procedures are given in the following notes.
2. Nominal dimensions.

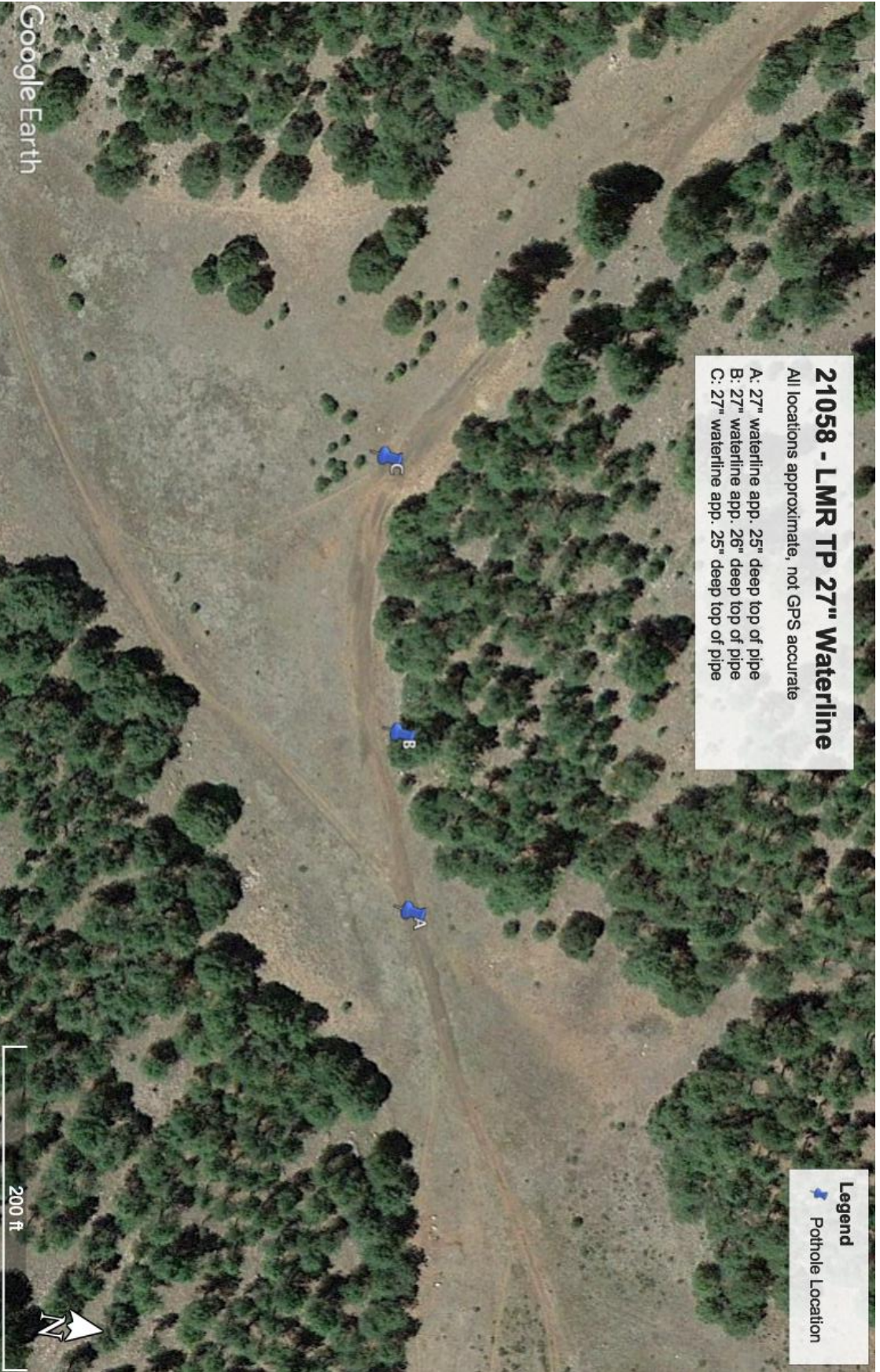
21058 LMR TP 27" Waterline

Pothole Excavation Field Notes

4.16.21

Adams Trenching, INC
809 W. Riordan Rd.
Suite 100-371
Flagstaff, AZ 86001-0859
AZ ROC A General Engineering #121998
AZ ROC B-4 General Engineering #126006
For questions contact Alan Adams:
928-607-2312
adamstrenching@gmail.com






21058 - LMR TP 27" Waterline

All locations approximate, not GPS accurate

- A: 27" waterline app. 25" deep top of pipe
- B: 27" waterline app. 26" deep top of pipe
- C: 27" waterline app. 25" deep top of pipe

Legend

 Pothole Location

200 ft



Google Earth



| Station # | PH # | Notes | Photo |
|-----------|------|--|------------------------------|
| | A | Found app. 27" waterline app.25" deep top of pipe | 6359 6360 6361 6362 |



| Station # | PH # | Notes | Photo |
|-----------|------|---|----------------------|
| | B | Found app. 27" waterline app. 26" deep top of pipe | 6367 6368 6369 |



| Station # | PH # | Notes | Photo |
|-----------|------|---|----------------------|
| | C | Found app. 27" waterline App. 25" deep top of pipe | 6370 6371 6372 |



| Station # | PH # | Notes | Photo |
|-----------|------|---|---|
| | NA | <p data-bbox="808 894 992 930">Special Note:</p> <p data-bbox="574 968 1227 1077">Potholes A, B and C all showed electronic locator depths of app. 3' on average, yet actual depth top of pipe was found at app. 25".</p> <p data-bbox="574 1081 1227 1150">Shallowest electronic locator depths as pictured was found at app. 22".</p> <p data-bbox="659 1155 1143 1188">Not potholed as requested by client</p> | <p data-bbox="1281 894 1357 930">6363</p> <p data-bbox="1281 934 1357 970">6364</p> |