

EXHIBIT B
SPECIAL PROVISIONS



CITY OF FLAGSTAFF
SWITZER CANYON WATER TRANSMISSION MAIN
PHASE IV
CITY OF FLAGSTAFF PROJECT NO. PZ-21-00008 AND
WA-3427

PREPARED BY

TURNER ENGINEERING INC.
CONSULTING CIVIL ENGINEERING

528 West Aspen Avenue
Flagstaff, Arizona 86001
Ph 928 779-1814

email pturner@teiaz.com

Project Number 10219

January 11, 2023

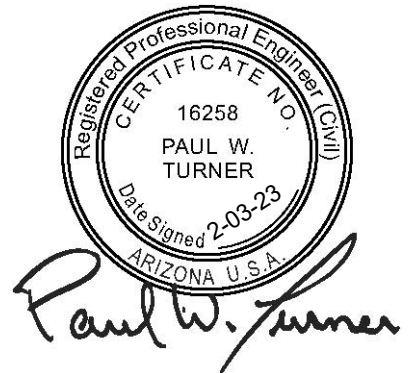




TABLE OF CONTENTS

PART 000	INTRODUCTION
PART 100	GENERAL CONDITIONS
	SECTION 103 AWARD AND EXECUTION OF CONTRACT
	SECTION 104 SCOPE OF WORK
	SECTION 105 CONTROL OF WORK
	SECTION 107 LEGAL REGULATION AND RESPONSIBILITY TO PUBLIC
	SECTION 108 COMMENCEMENT, PROSECUTION AND PROGRESS
	SECTION 109 MEASUREMENTS AND PAYMENTS
PART 300	STREETS AND RELATED WORK
	SECTION 301 SUB-GRADE PREPARATION
	SECTION 336 PAVEMENT MATCHING AND SURFACING REPLACEMENT
	SECTION 340 CONCRETE CURB, GUTTER, SIDEWALK, SIDEWALK RAMPS, DRIVEWAY AND ALLEY ENTRANCE
PART 400	RIGHT OF WAY AND TRAFFIC CONTROL
	SECTION 430 LANDSCAPING AND PLANTING
PART 600	WATER AND SEWER
	SECTION 601 TRENCH EXCAVATION, BACKFILLING AND COMPACTION
	SECTION 611 WATER, SEWER AND STORM DRAIN TESTING
	SECTION 630 TAPPING SLEEVES, VALVES AND VALVE BOXES ON WATER LINES
PART 700	MATERIALS
	SECTION 750 IRON WATER PIPE AND FITTINGS
ATTACHMENTS:	APPENDIX A: GEOTECHNIAL REPORT AND TWO ADDENDUMS
	APPENDIX B: CONTRACTORS PAY REQUEST
	APPENDIX C: SWITZER WATERMAIN RESTORATION GUIDELINES AS PROVIDED BY THE CITY OF FLAGSTAFF

NEW PART 000
INTRODUCTION

Modifications to the MAG Specifications, Arizona Department of Transportation Specifications (ADOT), and the preceding City of Flagstaff Amendments to MAG STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION (General Provisions) – Amended February 2022 EDITION (Hereinafter known as Exhibit A) are made in these Special Provisions and take precedence over aforementioned Specifications for Public Works Construction. Where there is no conflict between MAG Specifications, ADOT Specifications and Exhibit A, these Special Provisions are to be construed as being additions to the Specifications. In cases of conflict between the other Specifications and the Special Provisions, the Special Provisions are to be construed as supplanting only the conflicting portions of the other Specifications.

MAG UNIFORM STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION (LATEST EDITION) AND EXHIBIT A ARE HEREBY AMENDED TO INCLUDE THE FOLLOWING:

SECTION 103
AWARD AND EXECUTION OF CONTRACT

103.6 CONTRACTOR'S INSURANCE:

103.6.1 General: (add the following after the first sentence)

No additional payment shall be made for compliance with insurance requirements and certificates.

SECTION 104
SCOPE OF WORK

104.1: WORK TO BE DONE:

104.1.2 Maintenance of Traffic: (add the following)

The Contractor is responsible for preparing, submitting and obtaining approval of a complete traffic control plan satisfactory to the Transportation Engineer. A permit shall not be issued until approval is granted from the City of Flagstaff, Transportation Department. Detailed traffic control plans shall include provisions for access to all adjacent properties within the project area. If

absolutely necessary, and by approval of the Project Manager, the Contractor may temporarily limit vehicular and pedestrian traffic to properties through advance written notice and verbal confirmation of the affected property owner, and occupant(s). Any temporary limit to access shall be as short as possible. Traffic Control Plan & Implementation are pursuant to Exhibit A. Finalization of the traffic control plan(s) will be done prior to issuance of the Right-of-Way Permit through the City's Transportation Engineering Section.

Furthermore add: Social trail on parcel 110-02-008 shall be relocated approximately 40 feet further West at the direction of the City's Project Manager. The relocation shall include removal of vegetation and grading of the native soil for a width of approximately 3 feet. The length of the new trail will be approximately 550 feet and be suitable for bicycles. Detour signage on ground mounted steel posts will be placed at each end of the trail at the direction of the City's Project Manager. The new trail route will remain in place after the project and not be restored. This work shall be considered incidental to the overall traffic control plan.

SECTION 105 CONTROL OF WORK

105.12 MAINTENANCE DURING CONSRUCTION: (add the following)

Maintenance shall also include dust control and abatement both during working hours and off hours (weekends). This may include watering, sweeping and general cleanup. The cost of this maintenance work during the construction duration shall be per the Bid Schedule.

SECTION 107 LEGAL REGULATIONS AND RESPONSIBILITY TO PUBLIC

107.2 – PERMITS: (is modified to add the following):

The Contractor shall obtain all permits and licenses, including those required by the City of Flagstaff, State of Arizona, Coconino County, U.S. Government, or any other local or federal agency, and shall pay all charges, fees, taxes and provide all notices necessary and incidental to due and lawful prosecution of the work. The cost for the required City of Flagstaff Public Improvement Permit will be paid by the City. Construction activities shall not begin until approvals are received from all applicable permitting agencies.

107.9 PROTECTION AND RESTORATION OF PROPERTY AND LANDSCAPE: (add the following)

Survey monuments and property corners shall be identified, protected and not disturbed except as noted on the Plans. All costs associated with protecting or re-establishing disturbed survey monuments and property corners shall be the sole responsibility of the Contractor. Re-establishing all monuments and property corners shall be performed by a current Licensed Arizona Surveyor pursuant to the Arizona State Board of Technical Registration and all applicable State Statutes. Monuments and property corners shall be in place and visible prior to final acceptance of the Project.

The Contractor shall pay special attention to **SECTION 430** and Appendix C. Restoration Guidelines.

107.9.1 Coordination of Service Interruption and Hours of Operation: (add new sub section)

The work affecting adjacent properties services including emergency services, trash and recycling pick-up, bulky trash, limb pickup, wood chip access and mail delivery shall be coordinated with those property owners, occupants, renters, lessees (herein after called owners) being affected. When construction activity interferes with bulky trash pickup, Contractor shall provide vehicle access to the affected properties or relocate the bulky trash where access is acceptable. The Contractor shall notify those owners two weeks prior to any interruption in service. Service interruptions shall be coordinated with the affected owners. This may mean that the Contractor will have to do their work during the night or on a weekend or both. This effort and cost shall be included in work of those items that require service interruption.

Furthermore and notwithstanding the above, due to the fact that most of the Construction is occurring in Coconino County and the restrictions placed upon the property owners Covenants, Conditions and Restrictions the daily hours of operation are from 7:00 am to 7:00 pm M-F.

107.9.2 Coordination of Limits of Construction Duration and Days of Operation: (add another new sub section)

Due to the presence of an Osprey nest near the Construction corridor, Construction activities can not occur from April 15th to July 31st. This limit is dictated by the Migratory Bird Treaty Act and the U.S. Fish and Wildlife Service. The limits of no activity has been identified on the Construction Plans and are from Station 40+20 to Station 50+54. This amounts to approximately 1,034 linear feet of Construction corridor under this restriction. Contractor shall not remove or relocate the

osprey nest located on APN 110-12-017F. The restriction regarding construction activities may be waived by providing sound reducing methods that are acceptable to the Authority Having Jurisdiction. If the Contractor elects to proceed with providing sound reducing methods it shall be at its own sole expense.

107.9.2 Erosion and Sediment Control and SWPPP: (new subsection added)

An erosion and sediment control plan sheet is contained within the Plans. The Contractor is required to follow the instructions for obtaining authorization to discharge stormwater from construction activities under the AZPDES Construction General Permit --- AZG2020-001 or the most current revision thereto. For specific information about the program or the permit, visit their website at <http://azdeq.gov/AZPDES/CGP>. This effort will include, but not be limited to, a Notice of Intent (NOI), preparation and maintenance of the SWPPP and a Notice of Termination (NOT). The cost of this effort shall be paid Lump Sum per the Bid Schedule.

107.11 CONTRACTOR'S RESPONSIBILITY FOR UTILITY PROPERTY AND SERVICES:
(add the following)

All franchise utilities will be asked to attend the preconstruction meeting. The Contractor shall perform required utility potholes. It shall be the Contractor's responsibility to determine the exact location of the utilities prior to any construction operations and to notify the respective utility and the city's project manager per Exhibit "A"

The Contractor shall protect existing water, sewer, electric, gas, telephone, cable TV, and fiber optic lines where construction crosses lines. Main line and electric, telephone, cable TV, other components and service lines may not be shown on the plans or may not be accurately shown on the plans. It is the Contractor's responsibility to determine their location in the field. (Call Blue Stake, 1 (800) STAKE-IT). Protection or repair of existing main, service lines or any other utility damaged by the Contractor is incidental to the work causing such damage and not consider Extra Work.. Any Extra Work required as a result of an unforeseen main or service conflict will be ordered and paid for in accordance with MAG Section 104.2.3. Locations of underground utilities shown on the plans are to be regarded as approximately only. The Contractor shall perform utility potholes in advance of the trenching or excavation operations to determine the actual locations of underground utilities which may affect the proposed work as called out on the plans. The Contractor shall contact all utility companies prior to commencing any work and shall be responsible for scheduling and coordinating their work activities accordingly to avoid conflicts and

delays with utilities. Delays due to the lack of early coordination with utilities shall not warrant an increase in contract time.

(add the following as provided by COF for UniSource Energy Service (UES) Gas relocations and connections)

Relocated gas mains shall be horizontally separated by 2 feet or greater from Boundaries, but still within the Public Utility easement as recorded in Book 14, Page 72 & Docket 2180 Pg. 954 as shown on the Plans. Gas lines shall be protected and covered when not being monitored by UES. Gas services shall remain in operation before and after the new relocated gas main is placed in service and any interruptions shall be minimized. Service interruptions shall be coordinated with the affected owners/occupants. The Contractor shall notify those owners two weeks prior to any interruption in service. This may mean that the Contractor will have to work during the night or on a weekend or both. This effort and cost shall be considered incidental to the gas relocation line item. Gas line installation and connections shall be performed by Unisource Energy Services or their designee and shall be coordinated by the Contractor. The gas line relocation will be paid as shown on the bid schedule. Any costs related to gas line relocation, utility coordination, are included in the line item for Relocate Gas Main and no additional payment will be made.

Minimum horizontal clearance of gas line to water main is 12 inches.

Minimum vertical clearance of gas line to water main is 12 inches.

Minimum cover for gas mains is 36".

Minimum trench width for 2-inch diameter gas pipe is 7 inches.

For polyethylene (PE) gas line trenches, if rock ledge, hard-pan or boulders are encountered, the ditch bottom shall be undercut at least six inches (6") and the undercut refilled and compacted with a minimum of six inches (6") of "sandy type soil" meeting UES specifications, free of any rock debris.

Bedding and Backfill material shall meet Unisource Energy Services specifications. Compacted bedding material depth for gas pipe shall be 6" minimum (with 2" minimum between pipe and trench wall).

Compacted shading material depth for gas pipe shall be 6" minimum (with 2" minimum between pipe and trench wall).

107.11.1 Payment: (new subsection)

No additional payment shall be made for the utility pothole work. This cost shall be included in the price bid for the construction or installation of items to which such measures are incidental or appurtenant.

**SECTION 108
COMMENCEMENT, PROSECUTION AND PROGRESS**

108.4.1 Weekly Construction Meetings: (new subsection added)

The Contractor's Responsible Person-in-Charge shall attend weekly construction meetings and be knowledgeable about daily operations. The Contractor shall update the current schedule to include the past work and the worked planned for the next two weeks. In addition to the schedule, the Contractor shall keep a log of problems, issues, complaints, safety, traffic, bicycle or pedestrian issues, delays, material testing results, inspection results and notes, any service disruptions and duration, access disruptions and duration, field orders or changes, or any items related to Project that the Project Manager considers necessary. This log shall be updated weekly and be available for review by the Project Manager at the weekly construction meetings. The Contractor shall prepare meeting agendas and meeting minutes. Meeting agendas shall be distributed to the Project Manager two working days prior to the meeting. Minutes shall be distributed within four working days of the meeting. No separate measurement or payment shall be made for weekly construction meetings. Weekly construction meetings shall be considered incidental to the work.

108.5 LIMITATION OF OPERATIONS: (add the following)

Notwithstanding anything to contrary, the Contractor shall be prepared to perform some work during nights, weekends and/or both. This applies to connecting mains to mains and services and associated utility work. It also applies to work in and around roadway intersections. Night time work is to be considered incidental to those bid items requiring night time work and no additional compensation will be paid to the Contractor. The Contractor is hereby made aware of the additional inspection and testing cost and should include such costs in the bid items requiring night time, weekends and/or both (See Exhibit A, 108.5). Night time or weekend work shall be done at the request of the Project Manager and requires the approval of the Project Manager.

The project limits are within and near a residential neighborhood. The Contractor will take careful consideration to the residents and owners and their personal property while performing the project work. The Contractor will have a designated public relations person on staff that will speak and interact with the residents and owners when necessary. This person will conduct themselves in a professional manner and will not be compensated by the City's contract. That person shall take notes of the issues and/or complaints and the resolution. These shall be transmitted by email to the Project Manager upon resolution of each event and kept for the record. This effort will be considered incidental to the project work and included in the overall project bid amount. No separate payment will be made by the City of Flagstaff.

**SECTION 109
MEASUREMENTS AND PAYMENTS**

109.2 SCOPE OF PAYMENT: (add the following)

The form for submitting pay requests shall be NSPE form C620. The successful Bidder shall be provided this form in Excel© electronic version upon request at no cost. No additional payment will be made to the Contractor for using this form. An Adobe© copy is attached as Appendix B for reference.

**PART 300
STREETS AND RELATED WORK**

**SECTION 301
SUB-GRADE PREPARATION**

301.1 DESCRIPTION: (add the following)

Sub-grade preparation shall be, in addition to the above, per the Analysis and Recommendations to include, but not be limited to: Site preparation, earthwork factors, fill and backfill, utility installation, slabs-on-grade, corrosion protection, and permanent Cut/Fill Slope Limitations shall all be per the Geotechnical Evaluation prepared by Western Technologies, Inc. project number 2529JB126 dated October 30, 2020. The Geotechnical Evaluation and two Addendums are attached as Appendix A.

301.3 RELATIVE COMPACTION: (add the following paragraph)

Additional compaction requirements and soil treatment shall be per the Geotechnical Evaluation prepared by Western Technologies, Inc. project number 2529JB126 dated October 30, 2020. The Geotechnical Evaluation and two Addendums are attached as Appendix A.

SECTION 336 PAVEMENT MATCHING AND SURFACING REPLACEMENT

336.2 MATERIALS AND CONSTRUCTION METHODS:

336.2.3 Temporary Pavement Replacement: (Add the following paragraphs)

All pavement cuts are to be paved with temporary or final permanent pavement within two (2) working days of backfilling the excavation. Temporary surfaces shall be maintained so that a smooth surface is available at all times for all traffic and is maintained to be free from ruts, depressions, holes, mounds and loose material.

Except as otherwise provided, pavement shall be maintained in a safe and reasonably smooth condition until final pavement replacement is completed or ordered by the Project Manager. Temporary paving removed shall be hauled from the job site and disposed of legally by the Contractor at no additional cost to the project. All costs for temporary paving installation, maintenance, and removal shall be included in the contract unit prices for that respective bid item of construction, and no extra compensation will be made to the Contractor.

336.2.4 Permanent Pavement Replacement and Adjustments:

336.2.4.2 Adjustments: (add the following to the first paragraph)

In addition to adjustments in the new pavement, above, the Contractor shall adjust all other construction related components to final grade pursuant to the City of Flagstaff's applicable Engineering Standards and Details. This work shall be considered incidental to the bid item requiring the adjustment or replacement.

336.4 MEASUREMENT: (replace first sentence to read)

No measurement for pavement and surface replacement shall be made for other than that indicated within the plans. This shall include, but not be limited to, asphalt, concrete, curbs, gutters, pads, driveways, alleys, ramps or any other hard or soft permanent surface. The quantity of surface replacement in this SECTION shall be included in the bid item requiring replacement. Furthermore, delete (A), (B), (C), (D), (F) and (G).

336.5 PAYMENT: (replace first sentence to read)

No direct payment for quantity of pavement or surfacing replacement will be made for replacement over pipes, valves, blow-offs, air-relief components, services, water meters, thrust blocks or any other component of the water, sewer, or storm drain system, including irrigation systems replacement, or reconstruction except where the alignment is located in San Francisco Street. Pavement replacement has been quantified separately for that portion of the alignment within San Francisco Street and Quintana Drive. The cost for pavement or surface replacement shall be included in the bid item requiring pavement or surface replacement. Payment for replacements over other work shall be included in the cost of constructing that work, in accordance with the applicable standard details and specifications. The exception to the above is that pavement or surface replacement called out on the plans as a Bid Item.

336.5 PAYMENT: (add the following)

(replace the third sentence to read)

Since no direct payment for pavement or surface replacement will be made other than that called out on the plans as a Bid Item, the replacement cost of any existing pavement markings that have been obscured, obliterated or removed by construction activities shall be included in the bid item requiring pavement or surface replacement except as provided in the plans. This shall include obliteration or damage of pavement markings due to construction activities and construction traffic.

-Revise the Fifth sentence

Furthermore, no direct payment shall be made for pavement and surface replacement to repair or replace any existing pavement outside of the trench neat line that was damaged by the Contractor's or Subcontractor's work to install the water mains and associated appurtenances.

**SECTION 340
CONCRETE CURB, GUTTER, SIDEWALK, SIDEWALK RAMPS, DRIVEWAY AND ALLEY
ENTRANCE**

340.3 CONSTRUCTION METHODS:

(add the following paragraph)

Curb, gutter, sidewalk, FUTS, driveway aprons, driveways, and handicapped sidewalk ramps shall be constructed on 3" of A.B.C. or as shown on the plans, placed in accordance with M.A.G. Section 310. The cost for the A.B.C. and placement as specified shall be included in the respective bid item.

**PART 400
RIGHT OF WAY AND TRAFFIC CONTROL**

**SECTION 430
LANDSCAPING AND PLANTING (add the following)**

The attached Appendix C, as provided by the City of Flagstaff, to these Special Provisions are to be construed as being additions to City of Flagstaff Specifications Chapter 13-18. In cases of conflict between the other Specifications and the attached Appendix C in these Special Provisions, the attached Appendix C Specifications are to be construed as supplanting only the conflicting portions of the other Specifications.

430.8 PLANT GUARANTEE AND MAINTENANCE: (add the following)

The special warranty period shall be defined to be a minimum of 2 years after final project acceptance.

**PART 600
WATER AND SEWER**

**SECTION 601
TRENCH EXCAVATION, BACKFILLING AND COMPACTION**

601.1 DESCRIPTION: (add the following)

Storm drain pipes shall be included in this PART 600.

601.2 EXCAVATION:

601.2.3 Trench Grade: (add the following)

Elevation stakes are required for all water pipes that have grades shown on the Plans.

601.2.11 Dewatering: (add a new subsection)

Any water encountered during the operation shall be disposed of by the Contractor in a manner that will not damage public or private property or create a nuisance or health problem. The cost of furnishing pumps, pipes, disposal and equipment for dewatering shall be considered incidental

to the work and no additional payment shall be made. If water is encountered notify the Project Manager immediately.

601.6 PAVEMENT REPLACEMENT AND SURFACE RESTORATION: (add a new subsection)

601.6.5 Permanent Pavement Replacement:

Permanent pavement replacement shall be included in the cost of the items requiring pavement removal, including pavement damaged by construction as determined by the Project Manager. Except that pavement that is identified in the plans.

601.7 PAYMENT: (add the following to the first sentence after temporary pavement)

and permanent pavement. (See **336.2.4 Permanent Pavement Replacement and Adjustments** above in these Special Provisions also.)

SECTION 611 WATER, SEWER AND STORM DRAIN TESTING

611.1 HYDROSTATIC TESTING: (amend as follows)

Hydrostatic Testing: (modify (A) and (B) as follows)

(A) **Pressure Testing:** Minimum prescribed test pressure shall be at least 200 psi for ALL pipes.

(B) **Testing Allowance/Makeup Water:** Allowable leakage for ALL pipes shall be per the "Engineering Design and Construction Standards & Specifications for New Infrastructure" latest edition.

SECTION 630 TAPPING SLEEVES, VALVES AND VALVE BOXES ON WATER LINES

630.3 GATE VALVES: (amend as follows)

630.3.1 General: (replace the 4th sentence with the following)

All valves shall be class 250 or higher as necessary to withstand the required test pressure of 200 psi.

(add as follows) Valves shall be class 250, epoxy coated resilient seat and valves greater than 12" shall be installed horizontally with scraper, roller, scraper and track and bevel gear operated with no bypass.

630.4 TAPPING SLEEVES AND VALVES:

630.4.2 Tapping Sleeves: (amend as follows)

Replace the time for testing at 200 psi from 30 minutes to two hours.

(add as follows) All tapping sleeves shall be City of Flagstaff stainless steel.

**PART 700
MATERIALS**

**SECTION 750
IRON WATER PIPE AND FITTINGS**

750.2 DUCTILE IRON WATER PIPE: (add the following)

All ductile iron water pipe 6" to 12" in diameter shall be Class 350. All ductile iron water pipe larger than 12" diameter shall be Class 250. All pipe shall be Polyethylene coated or cement mortar lined and poly wrapped. Test pressure shall be 200 psi for two hours for all pipes.

APPENDIX A

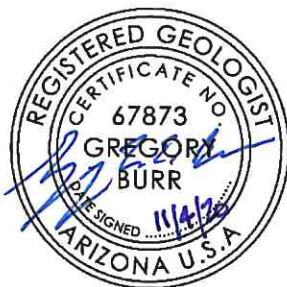
GEOTECHNICAL EVALUATION REPORT

COF SWITZER CANYON WATER TRANSMISSION MAINS – PHASE 4

West Fir Avenue to North Quintana Drive
Flagstaff, Arizona
WT Reference No. 2529JB126

PREPARED FOR:

Turner Engineering, Inc.
528 West Aspen Avenue
Flagstaff, Arizona 86001
Attn: Mr. Paul Turner, P.E., C.F.M.
Attn: Mr. Duke MacArthur
October 30, 2020



Gregory L. E. Burr, R.G.
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

October 30, 2020

Turner Engineering, Inc.
528 West Aspen Avenue
Flagstaff, Arizona 86001

Attn: Mr. Paul Turner, P.E., C.F.M.
Mr. Duke MacArthur

Re: Geotechnical Evaluation
COF Switzer Canyon Water Transmission Mains – Phase 4
West Fir Avenue to North Quintana Drive
Flagstaff, Arizona

Job No. 2529JB126

Western Technologies Inc. has completed the geotechnical evaluation for the proposed water transmission mains to be located in Flagstaff, Arizona. This study was performed in general accordance with our proposal number 2528PW210R dated August 2, 2020. 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 blue ink that reads "Gregory L. E. Burr".

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

Copies to: Addressee (emailed)

TABLE OF CONTENTS

	Page No.
1.0 PURPOSE	1
2.0 PROJECT DESCRIPTION	1
3.0 SCOPE OF SERVICES.....	2
3.1 Field Exploration	2
3.2 Laboratory Analyses.....	2
3.3 Analyses and Report	3
4.0 SITE CONDITIONS.....	3
4.1 Surface	3
4.2 Subsurface.....	3
5.0 GEOTECHNICAL PROPERTIES.....	4
5.1 Laboratory Tests.....	4
5.2 Field Tests.....	4
6.0 RECOMMENDATIONS.....	4
6.1 General.....	4
6.2 Soil Corrosivity	5
6.3 Lateral Design Criteria for Thrust Blocks.....	5
6.4 Pavement	5
6.4.1 Pavement Analyses	6
6.5 Materials	6
6.6 Placement and Compaction	6
7.0 ADDITIONAL SERVICES	7
8.0 LIMITATIONS	7
9.0 CLOSURE.....	8
 BORING LOCATION DIAGRAM	 Plate 1
 APPENDIX A	
Definition of Terminology	A-1
Method of Soil Classification	A-2
Boring Log Notes.....	A-3
Boring Logs.....	A-4 to A-13
 APPENDIX B	
Laboratory Tests	B-1 to B-8

GEOTECHNICAL EVALUATION

**COF SWITZER CANYON WATER TRANSMISSION MAINS – PHASE 4
WEST FIR AVENUE TO NORTH QUINTANA DRIVE
FLAGSTAFF, ARIZONA
JOB NO. 2529JB126**

1.0 PURPOSE

This report contains the results of our geotechnical evaluation for the proposed water transmission mains. The alignment runs generally along the eastern side of North San Francisco and Chickadee Streets from West Fir Avenue to North Quintana Drive. The purpose of these services is to evaluate the subsurface soil conditions along the alignment, and provide information and recommendations for the water transmission mains, including:

- anticipated excavation conditions
- earthwork, including backfill placement, and suitability of existing soils for backfill materials
- lateral earth pressures
- corrosivity
- on-site pavements

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

2.0 PROJECT DESCRIPTION

Based on information provided by Mr. Duke MacArthur, Phase 4 of the proposed project will consist of approximately 5,000 linear feet of 16 and 24-inch diameter water lines to be installed. We understand that the pipe inverts will be about 7 to 9 feet below the lowest existing site grades. In addition, the project will include approximately 5,000 linear feet of new pavement on San Francisco and Chickadee Streets. Borings were located in the general areas requested, adjusted for existing utilities and Site access. 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

Ten borings were drilled to depths ranging from about 11 to 16 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.

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 ASTM and Arizona methods. The following tests were performed and the results are presented in Appendix B.

- Water content
- Dry density
- Remolded expansion potential
- Compression
- Gradation
- Plasticity
- Soluble salts/sulfates/chlorides
- Corrosivity (ASTM A674)
- R-value

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

3.3 Analyses and Report

This geotechnical evaluation 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 required to satisfy the purpose previously described.

This report is for the exclusive purpose of providing geotechnical engineering and/or testing information and recommendations. The scope of services for this project does not include, either specifically or by implication, any environmental assessment of the Site or identification of contaminated or hazardous materials or conditions. If the owner is concerned 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

Along the proposed water main alignment, San Francisco Street is a narrow, asphalt paved roadway. The asphalt surface is in generally fair condition. The top of asphalt elevations are within about 1 foot of the adjacent existing grades. A concrete paved low water crossing is located near the south end of the alignment. In the southern portions of the alignment, the adjacent ground surface slopes gently to moderately down to the west. Adjacent grades are flatter in the northern portions of the alignment. Basalt gravels and cobbles are embedded in the native surface soils adjacent to the roadway. Vegetation adjacent to the roadway consisted of a moderate growth of native grasses and weeds, along with some medium sized ponderosa pine trees.

4.2 Subsurface

As presented on the boring logs, surface and subsoils extending to the full depth of exploration were found to be primarily stiff to hard, high to very high plasticity CLAYS with variable amounts of sand and gravel. It should be anticipated that random amounts of basalt cobbles and boulders will also be encountered along the alignment. The near-surface soils were of medium plasticity in the two borings located near the north end of the alignment. 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

5.1 Laboratory Tests

Laboratory test results (see Appendix B) indicate that native subsoils exhibit moderate compressibility at existing water contents. Either low additional compression occurs or moderate to high expansive pressures develop when the water content is increased.

Most of the near-surface soils are of high to very high plasticity. These soils exhibit high to extremely high expansion potentials 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 native clay soils.

5.2 Field Tests

Site soils exhibited low to moderate resistance to penetration using test method ASTM D3550. Plate A-2 in Appendix A, as well as the boring logs, describe soil consistency based on the blow counts recorded during sampling. The soil consistency and relative density give an indication of the drilling effort required to advance a hollow-stem auger through the soils, as well as providing a relative indicator of excavation effort required.

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 pipeline alignment 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.

Basalt cobbles and boulders were not encountered in the borings, but will likely be encountered during construction. These oversized materials, greater than 3 inches, could present construction difficulties for utility trenches and other excavations. Additional excavation effort and use of heavy duty equipment should be anticipated for these conditions.

6.2 Soil Corrosivity

The chemical test results indicate that the site soils are negligibly corrosive to concrete. However, in order to be consistent with standard local practice and for reasons of material availability, we recommend that Type II portland cement be used for all concrete on and below grade.

The laboratory test results indicate that the on-site soils exhibit low to moderate corrosive potential to ductile iron pipe. This information should be used as an aid in choosing the construction materials that will be in contact with these soils and corrosion protection methods. Pipe and material manufacturers' representatives should be contacted regarding the specific corrosivity resistance for their particular product.

6.3 Lateral Design Criteria for Thrust Blocks

For thrust block design, lateral loads may be resisted using a soil bearing pressure of 2000 pounds per square foot (psf). Any fill against or around thrust blocks should be compacted to densities specified herein under **Placement and Compaction**.

6.4 Pavement

We understand that a COF street classification of residential should be used for San Francisco and Chickadee Streets. Based on existing subgrade conditions, the following pavement section is recommended for San Francisco and Chickadee Streets:

Residential Streets	Asphalt Concrete (in.)	Base Course (in.)
San Francisco and Chickadee Streets	3	13

Bituminous surfacing should be constructed of dense-graded, central plant-mix, asphalt concrete. Base course and asphalt concrete should conform with City of Flagstaff specifications. The gradient of paved surfaces should ensure positive drainage. Water should not pond in areas directly adjoining paved sections. The native subgrade soils will soften and lose stability if subjected to conditions which result in an increase in water content.

6.4.1 Pavement Analyses

The recommended pavement sections are based on the following conditions. This firm should be contacted if any of these conditions change so that revised recommendations can be provided, if necessary.

- a. A design R-value of 10 for the on-site soils which corresponds to a resilient modulus of approximately 3310 pounds per square inch. Any required fills should be constructed using on-site or imported materials with subgrade support characteristics equal to or greater than the subgrade soils in the area being filled.
- b. Structural coefficients of 0.40 for asphalt concrete and 0.12 for aggregate base course material.
- c. A present serviceability index of 4.5, a terminal serviceability index of 2.5, an overall standard deviation of 0.35, a reliability factor of 85 percent, a drainage coefficient of 0.85, a seasonal variation factor of 3.5, and a design life of 20 years.
- d. A total 18-kip equivalent single axle load (ESAL) of 36,500 for the residential streets.

6.5 Materials

All trench backfill, aggregate base course and pavement materials should meet the current City of Flagstaff specifications. Frozen soils should not be used as fill or backfill.

6.6 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 placed around and below thrust blocks, where applicable, should be compacted to a minimum of 95 percent of the maximum density as determined by ASTM

D698. On-site soils should be compacted with a moisture content in the range of optimum to 4 percent above optimum. 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. 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 Section 2.0. 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, contact WT 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.

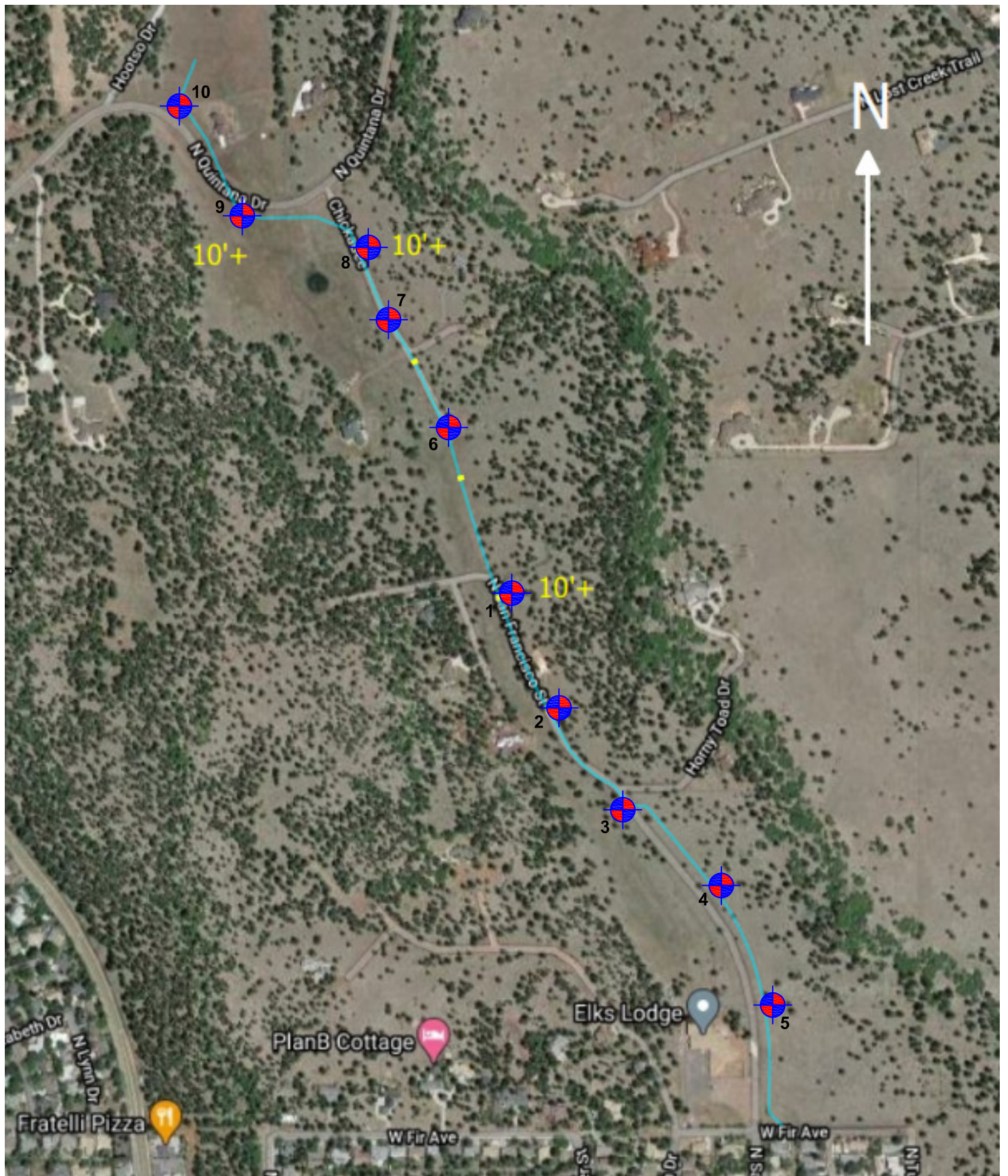
The recommendations presented are based entirely upon data derived from a limited number of samples obtained from widely spaced borings. The attached logs are indicators of subsurface conditions only at the specific locations and times noted. This report assumes the uniformity of the geology and soil structure between borings, 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 until the earlier of one year from the date of issuance, a change in circumstances, or discovered variations. After expiration, no person or entity shall have any right to 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 borings, 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 warranty, express or implied, is made.



Not to Scale



Approximate Test Boring Location

Geotechnical
Environmental
Inspections
Materials



Western Technologies Inc.
The Quality People
Since 1955

COF SWITZER CANYON WATER MAINS - PHASE 4

Boring Location Diagram

Western Technologies Inc.

Job No.: 2529JB126

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: 10-12-20
 LOCATION: See Location Diagram
 ELEVATION: Not Determined

BORING NO. 1

EQUIPMENT TYPE: CME-75
 DRILLING TYPE: 7"HSA
 FIELD ENGINEER: J. Quinlan

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
23.8	93	G		14		CH		Fat CLAY; with sand, trace gravel, black, stiff to hard, damp to moist
20.5	89	R		12	5			color change to brown
14.0		R		33	10			decrease in gravel content
24.6	93	R		30	15			
Boring Stopped at 16 Feet								
20								

- 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: COF SC WATER MAINS - PHASE 4
 PROJECT NO.: 2529JB126

BORING LOG








PLATE
A-4

DATE DRILLED: 10-12-20
 LOCATION: See Location Diagram
 ELEVATION: Not Determined

BORING NO. 2

EQUIPMENT TYPE: CME-75
 DRILLING TYPE: 7"HSA
 FIELD ENGINEER: J. Quinlan

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
10.0	90	G				CH		Fat CLAY; with sand, trace gravel, brown, very stiff, damp to moist
21.9	92	R		19				
		R			5			
		R		17				
		R						
16.5	94	R		20	10			basalt cobble in sampler shoe
Boring Stopped at 11 Feet								
					15			
					20			

- 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: COF SC WATER MAINS - PHASE 4
 PROJECT NO.: 2529JB126

BORING LOG

PLATE
A-5

DATE DRILLED: 10-12-20
 LOCATION: See Location Diagram
 ELEVATION: Not Determined

BORING NO. 3

EQUIPMENT TYPE: CME-75
 DRILLING TYPE: 7"HSA
 FIELD ENGINEER: J. Quinlan

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
5.3		G				CH		Fat CLAY; some sand, trace gravel, black, very stiff to stiff, slightly damp to wet
		R		26				
22.8	102	R		9	5			color change to brown
29.7	87	R		11	10			
Boring Stopped at 11 Feet								
					15			
					20			

- 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: COF SC WATER MAINS - PHASE 4
 PROJECT NO.: 2529JB126

BORING LOG







PLATE
A-6

DATE DRILLED: 10-12-20
 LOCATION: See Location Diagram
 ELEVATION: Not Determined

BORING NO. 4

EQUIPMENT TYPE: CME-75
 DRILLING TYPE: 7"HSA
 FIELD ENGINEER: J. Quinlan

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
6.3		G				CH		Fat CLAY; with sand, trace to some gravel, brown, hard, slightly damp to damp
10.7	106	R		51				
		R		31	5			
		R						
11.4		R		50/7"	10			basalt cobble in sampler shoe
Boring Stopped at 11 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: COF SC WATER MAINS - PHASE 4
 PROJECT NO.: 2529JB126

BORING LOG





PLATE
A-7

DATE DRILLED: 10-12-20
 LOCATION: See Location Diagram
 ELEVATION: Not Determined

BORING NO. 5

EQUIPMENT TYPE: CME-75
 DRILLING TYPE: 7"HSA
 FIELD ENGINEER: J. Quinlan

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
18.3	90	G		17		CH		Fat CLAY; with sand, some gravel, brown, very stiff to hard, moist
22.8	97	R		22	5			
17.3	87	R		39	10			
Boring Stopped at 11 Feet								
					15			
					20			

- 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: COF SC WATER MAINS - PHASE 4
 PROJECT NO.: 2529JB126

BORING LOG

PLATE
A-8

DATE DRILLED: 10-12-20
 LOCATION: See Location Diagram
 ELEVATION: Not Determined

BORING NO. 6

EQUIPMENT TYPE: CME-75
 DRILLING TYPE: 7"HSA
 FIELD ENGINEER: J. Quinlan

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
21.9	89	G		14		CH		Fat CLAY; some sand, trace to some gravel, brown, stiff to hard, moist
26.3	95	R		15	5			
27.8	83	R		45	10			
Boring Stopped at 11 Feet								
					15			
					20			

- 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: COF SC WATER MAINS - PHASE 4
 PROJECT NO.: 2529JB126

BORING LOG





PLATE
A-9

DATE DRILLED: 10-12-20
 LOCATION: See Location Diagram
 ELEVATION: Not Determined

BORING NO. 7

EQUIPMENT TYPE: CME-75
 DRILLING TYPE: 7"HSA
 FIELD ENGINEER: J. Quinlan

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
24.9	78	G		11		CH		Fat CLAY; some sand, trace gravel, brown, stiff to very stiff, moist to wet
34.4	89	R		11	5			
29.6	92	R		22	10			
Boring Stopped at 11 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: COF SC WATER MAINS - PHASE 4
 PROJECT NO.: 2529JB126

BORING LOG






PLATE
A-10

DATE DRILLED: 10-12-20
 LOCATION: See Location Diagram
 ELEVATION: Not Determined

BORING NO. 8

EQUIPMENT TYPE: CME-75
 DRILLING TYPE: 7"HSA
 FIELD ENGINEER: J. Quinlan

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
31.8	79	G		11		CH		Fat CLAY; some sand, trace to some gravel, brown, stiff to hard, moist to wet
34.3	85	R		10	5			
23.4	87	R		37	10			
22.9	96	R		10	15			
Boring Stopped at 16 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: COF SC WATER MAINS - PHASE 4
 PROJECT NO.: 2529JB126

BORING LOG







PLATE
A-11

DATE DRILLED: 10-12-20
 LOCATION: See Location Diagram
 ELEVATION: Not Determined

BORING NO. 9

EQUIPMENT TYPE: CME-75
 DRILLING TYPE: 7"HSA
 FIELD ENGINEER: J. Quinlan

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	94	G		14		CL		Sandy Lean CLAY; some gravel, brown, stiff, slightly damp
16.0	102	R		9	5	CH		Fat CLAY; some sand, trace to some gravel, brown, stiff to hard, moist to damp
25.9	99	R		49	10			
13.5	105	R		16	15			
Boring Stopped at 16 Feet								
20								

- 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: COF SC WATER MAINS - PHASE 4
 PROJECT NO.: 2529JB126

BORING LOG

PLATE
A-12

DATE DRILLED: 10-12-20
 LOCATION: See Location Diagram
 ELEVATION: Not Determined

BORING NO. 10

EQUIPMENT TYPE: CME-75
 DRILLING TYPE: 7"HSA
 FIELD ENGINEER: J. Quinlan

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
8.5	89	G		17		CL		Sandy Lean CLAY; trace gravel, brown, very stiff to stiff, slightly damp to wet
		R						
7.4	91	R		10	5			
34.4		R		13	10			
Boring Stopped at 11 Feet								
					15			
					20			

- 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: COF SC WATER MAINS - PHASE 4
 PROJECT NO.: 2529JB126

BORING LOG

PLATE
A-13


Boring No.	Depth (ft)	USCS Class.	Particle Size Distribution (%) Passing by Weight						Atterberg Limits		Laboratory Compaction Characteristics			R-Value	Remarks
			3"	¾"	#4	#10	#40	#200	LL	PI	Dry Density (pcf)	Optimum Moisture (%)	Method		
1	0-5	CH		100	98	94	87	77.9	54	34					2
3	0-5	CH	100	99	97	96	93	86.0	74	54				8	2,4
5	0-5	CH	100	98	94	92	88	79.5	61	36					2
7	0-5	CH		100	99	99	96	90.0	73	59					2
9	0-5	CL		100	92	84	74	60.1	32	10				11	2,4

NOTE: NP = Non-plastic

REMARKS

Classification / Particle Size / Moisture-Density Relationship

1. Visual
2. Laboratory Tested
3. Minus #200 Only
4. Testing in Progress – to be reported in addendum
5. Test Method ASTM D1557/AASHTO T180
6. From the ADOT Family of Curves

 <p><i>Geotechnical Environmental Inspections Materials</i> Western Technologies Inc. The Quality People Since 1955 wt-us.com</p>	PROJECT: COF SWITZER CANYON WATER MAINS – PHASE 4 JOB NO.: 2529JB126	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	CH	104.1	16.9				0.1	12.3						1,2
3	0-5	CH	99.5	19.2				0.1	24.7						1,2
5	0-5	CH	97.3	20.3				0.1	16.4						1,2
7	0-5	CH	101.7	18.1				0.1	20.6						1,2
9	0-5	CL	108.9	14.6				0.1	1.9						1,2

Notes: 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. Sulfate testing performed by an approved vendor (test reports attached).

*Geotechnical
Environmental
Inspections
Materials*

Western Technologies Inc.
 The Quality People
 Since 1955
 wt-us.com

PROJECT: COF SWITZER CANYON WATER MAINS – PHASE 4
JOB NO.: 2529JB126

PLATE
B-2

SOIL PROPERTIES

CORROSIVITY TEST RESULTS

The procedures for soil survey tests and observations can be found in Appendix X1.1 of ASTM A674-10 and includes five soil properties: earth resistivity • pH • redox potential • sulfides • moisture.

Boring 1(0-5):

<u>Analysis</u>	<u>Results</u>	<u>Points</u>
Resistivity (ohm-cm)	3,250	0
pH	7.90	0
Redox Potential (mV)	+1.2	4
Sulfides	trace	2
Moisture	fair	1
Total Points		7

Boring 5(0-5):

<u>Analysis</u>	<u>Results</u>	<u>Points</u>
Resistivity (ohm-cm)	500	10
pH	7.95	0
Redox Potential (mV)	+2.2	4
Sulfides	trace	2
Moisture	fair	1
Total Points		17

The test procedure states that if the sum of the points is greater than 10, the soil is considered corrosive to ductile iron pipe and special protection against exterior corrosion is necessary. This conclusion is limited to soil corrosion and does not include consideration of stray direct current.

CORROSIVITY TEST RESULTS

The procedures for soil survey tests and observations can be found in Appendix X1.1 of ASTM A674-10 and includes five soil properties: earth resistivity • pH • redox potential • sulfides • moisture.

Boring 9(0-5):

<u>Analysis</u>	<u>Results</u>	<u>Points</u>
Resistivity (ohm-cm)	3,400	0
pH	7.13	3
Redox Potential (mV)	+16	4
Sulfides	trace	2
Moisture	fair	1
Total Points		10

The test procedure states that if the sum of the points is greater than 10, the soil is considered corrosive to ductile iron pipe and special protection against exterior corrosion is necessary. This conclusion is limited to soil corrosion and does not include consideration of stray direct current.



Laboratory Analysis Report

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

Project: 2520P028
 Date Received: 10/28/2020
 Date Reported: 10/31/2020
 PO Number: 2520P028

Lab Number: 934358-12
 Sample ID: 1 (0-5)
 Description: 2529JB126

Test Parameter

Test	Method	Result	Units	Levels
Soluble Salts	ARIZ 237b	349	ppm	
Sulfate	ARIZ 733b	< 3	ppm	
Chloride	ARIZ 736b	< 3	ppm	

Lab Number: 934358-13
 Sample ID: 5 (0-5)
 Description: 2529JB126

Test Parameter

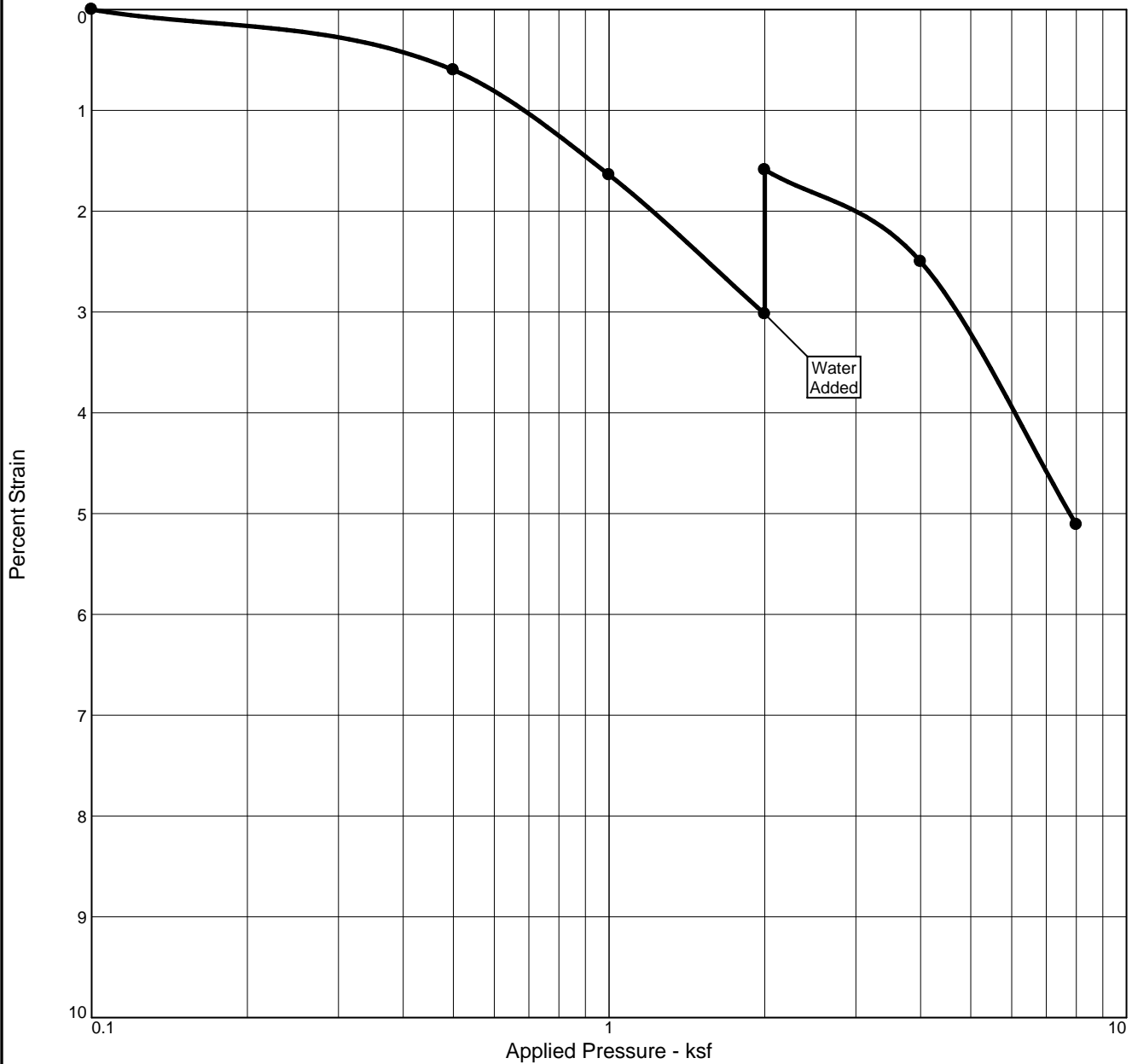
Test	Method	Result	Units	Levels
Soluble Salts	ARIZ 237b	498	ppm	
Sulfate	ARIZ 733b	< 3	ppm	
Chloride	ARIZ 736b	64	ppm	

Lab Number: 934358-14
 Sample ID: 9 (0-5)
 Description: 2529JB126

Test Parameter

Test	Method	Result	Units	Levels
Soluble Salts	ARIZ 237b	310	ppm	
Sulfate	ARIZ 733b	20	ppm	
Chloride	ARIZ 736b	< 3	ppm	

COMPRESSION TEST REPORT

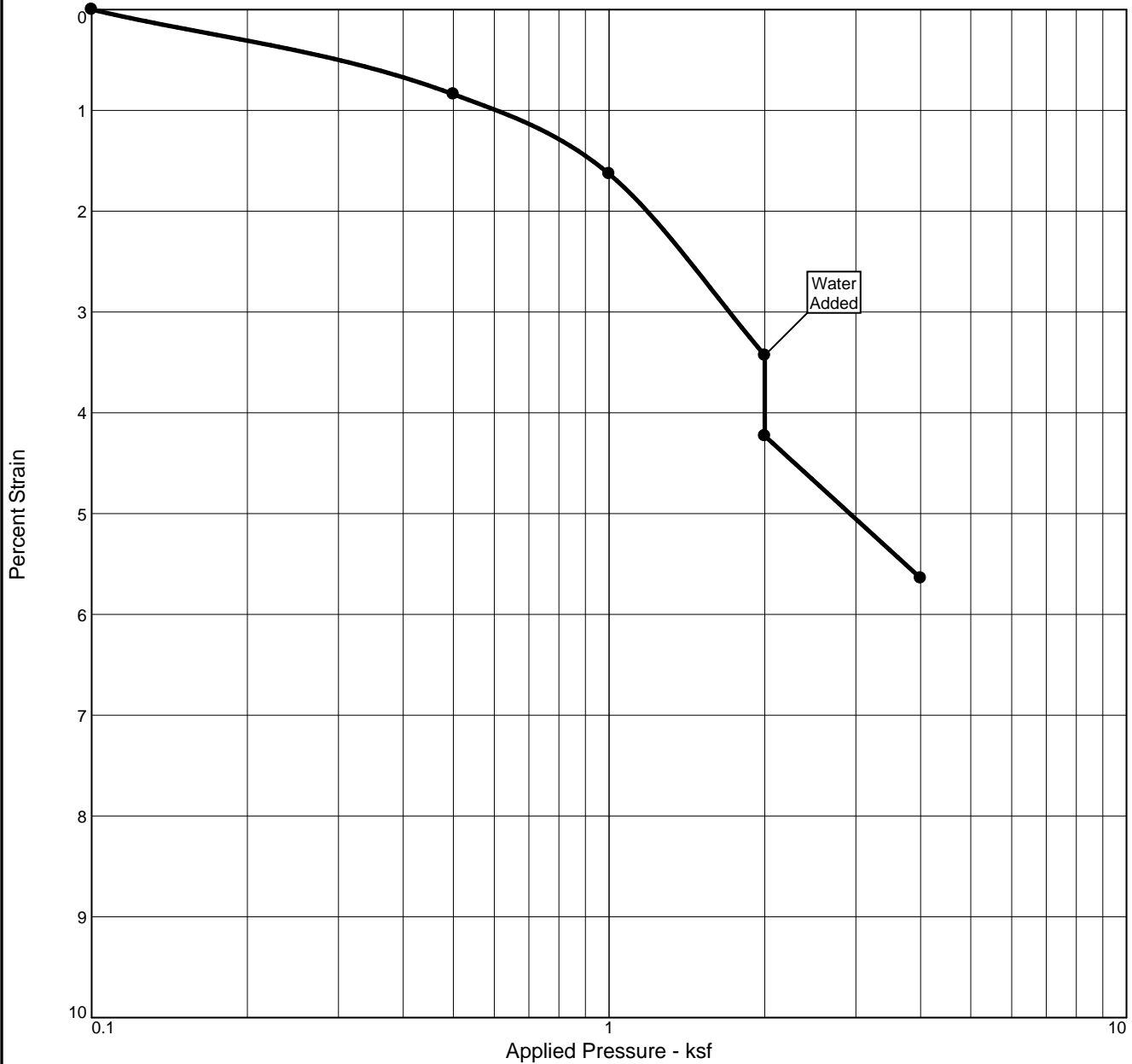


Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	e _o	Swell Press. (ksf)	Swell %	C _r
Sat.	Moist.									
87.2 %	29.7 %	87.0			2.65		0.901	2.7	1.4	

MATERIAL DESCRIPTION								USCS	AASHTO
FAT CLAY								CH	

<p>Project No. 2529JB126 Client: TURNER ENGINEERING, INC.</p> <p>Project: COF SWITZER CANYON WATER MAINS - PHASE 4</p> <p>Source: RING SAMPLE Depth: 10-11 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-6</p>
--	--

COMPRESSION TEST REPORT

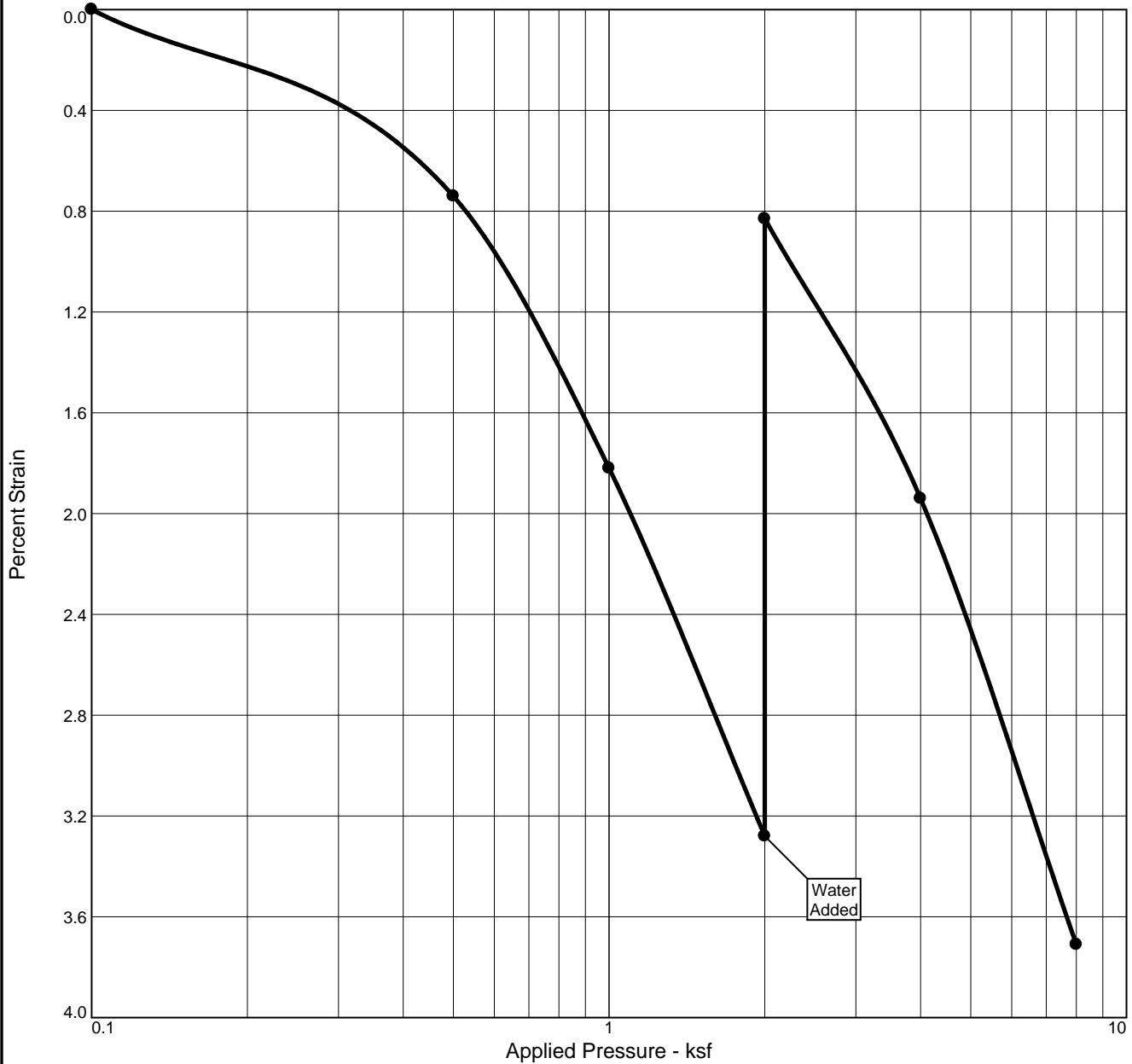


Natural		Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	e _o	Swell Press. (ksf)	C _{ip} se. %	C _r
Sat.	Moist.									
50.9 %	17.3 %	87.1			2.65		0.900		0.8	

MATERIAL DESCRIPTION								USCS	AASHTO
FAT CLAY WITH SAND								CH	

<p>Project No. 2529JB126 Client: TURNER ENGINEERING, INC.</p> <p>Project: COF SWITZER CANYON WATER MAINS - PHASE 4</p> <p>Source: RING SAMPLE Depth: 10-11 FEET Sample No.: BORING 5</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>
--	--

COMPRESSION TEST REPORT



Natural Sat.	Moist.	Dry Dens. (pcf)	LL	PI	Sp. Gr.	Overburden (ksf)	e ₀	Swell Press. (ksf)	Swell %	C _r
82.9 %	22.9 %	95.5			2.65		0.733	4.8	2.5	

MATERIAL DESCRIPTION	USCS	AASHTO
FAT CLAY	CH	

<p>Project No. 2529JB126 Client: TURNER ENGINEERING, INC.</p> <p>Project: COF SWITZER CANYON WATER MAINS - PHASE 4</p> <p>Source: RING SAMPLE Depth: 15-16 FEET Sample No.: BORING 8</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-8</p>
--	--



November 5, 2020

Turner Engineering, Inc.
528 West Aspen Avenue
Flagstaff, Arizona 86001

Attn: Mr. Paul Turner, P.E., C.F.M.
Attn: Mr. Duke MacArthur

Re: COF Switzer Canyon Water Transmission Mains – Phase 4
West Fir Avenue to North Quintana Drive
Flagstaff, Arizona

Job No. 2529JB126
Addendum No. 1

In accordance with the request of Mr. Duke MacArthur, we have reviewed our geotechnical evaluation report for the above referenced project. The purpose of the review was to provide some additional recommendations for pavement section thickness design.

Based on our review and on the existing subgrade conditions, the following pavement sections are recommended for the areas indicated:

Traffic Area	Asphalt Concrete (in.)	Aggregate Base Course with Triaxial Geogrid* (in.)	Aggregate Base Course without Triaxial Geogrid (in.)
San Francisco and Chickadee Streets	3	7	--
San Francisco and Chickadee Streets	4	--	9

* Calculated based on Tensar TX5 triaxial geogrid placed at the bottom of the aggregate base course layer.

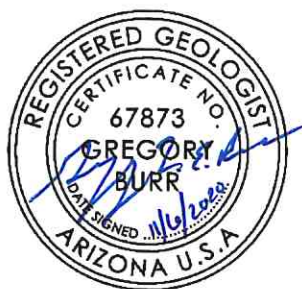
Bituminous surfacing should be constructed of dense-graded, central plant-mix, asphalt concrete. Base course and asphalt concrete should conform with City of Flagstaff specifications. The gradient of paved surfaces should ensure positive drainage. Water should not pond in areas directly adjoining paved sections. The native subgrade soils will soften and lose stability if subjected to conditions which result in an increase in water content.

The recommended pavement sections are based on the following conditions. This firm should be contacted if any of these conditions change so that revised recommendations can be provided, if necessary.

- a. A design R-value of 10 for the on-site soils which corresponds to a resilient modulus of approximately 3310 pounds per square inch. Any required fills should be constructed using on-site or imported materials with subgrade support characteristics equal to or greater than the subgrade soils in the area being filled.
- b. Structural coefficients of 0.40 for asphalt concrete, 0.12 for aggregate base course material and 0.221 for geogrid reinforced aggregate base course material.
- c. A present serviceability index of 4.5, a terminal serviceability index of 2.5, an overall standard deviation of 0.35, a reliability factor of 85 percent, a drainage coefficient of 0.85, a seasonal variation factor of 3.5, and a design life of 20 years.
- d. A total 18-kip equivalent single axle load (ESAL) of 36,500 for the residential streets.

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, design, observation, or testing services, please contact us.

Sincerely,
WESTERN TECHNOLOGIES INC.
Geotechnical Engineering Services



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



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

Copies to: Addressee (emailed)



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

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

November 18, 2020

Turner Engineering, Inc.
528 West Aspen Avenue
Flagstaff, Arizona 86001

Attn: Mr. Paul Turner, P.E., C.F.M.
Attn: Mr. Duke MacArthur

Re: COF Switzer Canyon Water Transmission Mains – Phase 4
West Fir Avenue to North Quintana Drive
Flagstaff, Arizona

Job No. 2529JB126
Addendum No. 2

In accordance with the request of Mr. Duke MacArthur, we have reviewed our geotechnical evaluation report for the above referenced project. The purpose of the review was to provide some alternative recommendations for unbound aggregate surfacing of Chickadee Trail.

For unpaved sections, we recommend an initial minimum thickness of 6 inches of granular cover material. 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.

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, design, observation, or testing services, please contact us.

Sincerely,
WESTERN TECHNOLOGIES INC.
Geotechnical Engineering Services



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



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

Copies to: Addressee (emailed)

APPENDIX B

Contractor's Application for Payment

Owner: <u>City of Flagstaff</u>	Owner's Project No.: _____
Engineer: <u>Turner Engineering, Inc.</u>	Engineer's Project No.: <u>10219</u>
Contractor: _____	Contractor's Project No.: _____
Project: <u>SWITZER CANYON WATER TRANSMISSION MAINS PHASE IV</u>	
Contract: _____	
Application No.: _____	Application Date: _____
Application Period: From _____ to _____	

1. Original Contract Price	\$	-
2. Net change by Change Orders	\$	-
3. Current Contract Price (Line 1 + Line 2)	\$	-
4. Total Work completed and materials stored to date (Sum of Column G Lump Sum Total and Column J Unit Price Total)	\$	-
5. Retainage		
a. _____ X \$ - Work Completed	\$	-
b. _____ X \$ - Stored Materials	\$	-
c. Total Retainage (Line 5.a + Line 5.b)	\$	-
6. Amount eligible to date (Line 4 - Line 5.c)	\$	-
7. Less previous payments (Line 6 from prior application)		
8. Amount due this application	\$	-
9. Balance to finish, including retainage (Line 3 - Line 4)	\$	-

Contractor's Certification

The undersigned Contractor certifies, to the best of its knowledge, the following:

(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;

(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such liens, security interest, or encumbrances); and

(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.

Contractor: _____

Signature: _____ **Date:** _____

Recommended by Engineer	Approved by Owner
By: _____	By: _____
Title: _____	Title: _____
Date: _____	Date: _____
Approved by Funding Agency	
By: _____	By: _____
Title: _____	Title: _____
Date: _____	Date: _____

Progress Estimate - Unit Price Work

Contractor's Application for Payment

Owner: <u>City of Flagstaff</u>	Owner's Project No.: _____
Engineer: <u>Turner Engineering, Inc.</u>	Engineer's Project No.: <u>10619</u>
Contractor: _____	Contractor's Project No.: _____
Project: <u>KIT CARSON TO KAIBAB LANE SEWER MAIN</u>	
Contract: _____	

Application No.: _____ **Application Period:** From _____ to _____ **Application Date:** _____

A	B	C	D	E	F	G	H	I	J	K	L	
Bid Item No.	Description	Contract Information				Work Completed		Materials Currently Stored (not in G) (\$)	Work Completed and Materials Stored to Date (H + I) (\$)	% of Value of Item (J / F) (%)	Balance to Finish (F - J) (\$)	
		Item Quantity	Units	Unit Price (\$)	Value of Bid Item (C X E) (\$)	Estimated Quantity Incorporated in the Work	Value of Work Completed to Date (E X G) (\$)					
					-		-		-		-	
					-		-		-		-	
					-		-		-		-	
					-		-		-		-	
Change Order Totals					\$	-	\$	-	\$	-	\$	-
Original Contract and Change Orders												
Project Totals					\$	-	\$	-	\$	-	\$	-

APPENDIX C

Switzer Watermain Restoration Guidelines Phase IV

Drafted in partnership with The Arboretum of Flagstaff, the Museum of Northern Arizona, and the City of Flagstaff, Open Space Program.

Project Description Area

This project encompasses site rehabilitation, invasive plant treatment, and reseeding with native vegetation for Switzer Watermain Project, Phase IV.

Introduction

Revegetation and final stabilization are essential components of any project that involves significant ground disturbances. Final stabilization is necessary to prevent on-going erosion from areas that have been disturbed and to discourage invasive noxious weed development. Flagstaff's climate, the prevalence of introduced weeds, and difficult soil conditions can make revegetation challenging and requires proper planning, installation, and maintenance to be successful. Services of a revegetation specialist are required for the restoration steps of this project including maintenance and monitoring. It is highly recommended that a revegetation specialist (i.e., ecologist, botanist, vegetation specialist) who is experienced in restoration ecology and local native plant communities be included in the contractor's team to assist with project planning, direction, construction observation, monitoring, and long-term maintenance supervision for the revegetation aspects of the project.

Homeowner Representative

The Homeowner Representative has the capacity and specialized knowledge to consult on the project. The Homeowner Representative can be relied on for consultation on all phases of restoration.

Contact Information

Barbara Phillips
1603 N SUNSET DR
Flagstaff, Arizona 86001
Ph. (928) 853-3355
Email: bagphillips@yahoo.com

Site Preparation Phase

Site preparation involves assessing vegetation, managing weeds, preserving topsoil, preparing the soil for planting, and preventing impact. Erosion control shall be put in place including the installation of stormwater control measures (i.e., rock trackout pad, sediment wattles, silt fence, etc.) where appropriate.

Weed & Vegetation Condition Evaluation

Prior to excavation a plant survey shall be conducted at the project site to inventory native and invasive non-native plant species (scientific and common names) within the entire proposed construction area. Areas with invasive species (species listed on the Arizona State Noxious Weed List, [Official-2020-Arizona-State-Noxious-Weed-List.pdf \(aznps.com\)](#)) and non-native annual brome grasses (*B. japonica* and *B. tectorum*) need to be identified and marked. An inventory of native plants shall be used to develop the proper seed mix. Information provided by the Homeowner Representative may be relied on to complete the baseline inventory and plant survey.

Weed Control

While construction activities are underway, maintain weed control over the entire site including on the topsoil stockpile to reduce weed density once the topsoil is replaced and revegetation commences. Invasive plant infestations shall be controlled to allow the establishment of the desired native vegetation. If a site has invasive weed growth, weed management before revegetation is crucial for minimizing weeds and weed

seed to allow for native species establishment. Implement weed control practices during construction to reduce the level of effort required for weed control later as new vegetation is becoming established.

If project timing does not allow for weed control to precede construction, it may be implemented as the site is being prepared for revegetation. Weed control may still be necessary even if it is initiated prior to construction. Spring and fall are good times for spot herbicide treatment of invasive weeds, especially common regional weeds including thistle and knapweed.

There are different techniques for weed control including mowing, herbicide treatment, and mechanical removal. A revegetation specialist shall be consulted to provide site-specific recommendations for weed control.

- For light mild weed infestations, manual removal with shovels is the most effective. Plants shall be removed prior to setting seed. If seed heads have already developed, flowers and seeds shall be bagged and disposed of preferably at an incinerator to prevent spread.
- Moderate infestations are better controlled with a broad-spectrum herbicide treatment. An appropriate herbicide shall be used to allow for the necessary time between herbicide treatments and revegetating the site (seeding) to reduce the residual impact of the chemicals.
- If the site has heavy annual weed growth, some topsoil may need to be removed or buried. Since some topsoil is lost with this method, recommendations shall be sought from a revegetation specialist.
- Biennial and perennial weeds shall be spot treated with approved herbicides by mid-summer or when the seeded grasses have three to four leaves. A boom sprayer shall **NOT** be used during the first summer after seeding. Weed control of established seeded areas during the second growing season may involve a combination of techniques including spot spraying weedy areas. Herbicide applications shall be chosen carefully to consider herbicide type, method of application, times, and rates based on the types and amounts of weeds present.

Topsoil Preservation

During construction activities topsoil shall be stripped and stockpiled separately from other soils. Topsoil from areas marked with invasive weeds (Listed on the Arizona State Noxious Weed List, [Official-2020-Arizona-State-Noxious-Weed-List.pdf \(aznps.com\)](#)) and non-native annual brome grasses (*B. japonica* and *B. tectorum*) will not be reapplied. All other topsoil shall be stockpiled in a weed-free area and kept available for restoration. Information provided by the Homeowner Representative can be relied on to identify known areas where storing topsoil should not occur. With a revegetation specialist recommendation, topsoil not available for reapplying may be buried to prevent weed-infested soil from germination. Topsoil contaminated with invasive weeds shall be buried to a depth of one foot or greater. This method may be possible if the project entails trenching. If burying contaminated topsoil is not an option, it shall be removed from the site.

To preserve soil microbes, limit topsoil stockpiles to a height of 10 feet. Once stockpiled, the topsoil may be seeded with a native seed mix. This is recommended if the topsoil will be sitting undisturbed through a growing season to assist in stabilizing the topsoil, reducing erosion, and minimizing weed infestations. Once construction is complete the topsoil can be spread before seeding and planting.

Impact Prevention

Protection of the project site is an important aspect of site preparation and shall occur at the beginning of the construction phase. Appropriate measures include:

- Provide tree resource protection. Work conducted shall include preventing physical injury to trunk and crown, root cutting, soil compaction, and smothering roots by adding soil.
- Temporary snow fencing shall be placed around each tree within the corridor and within 10 feet of the work area. Snow fencing shall be set approximately 6 inches from the trunk for each inch of trunk

diameter. Snow-fenced areas around trees shall be kept clear of building material, waste, and excess soil. No digging, trenching, or other disturbance shall occur in the snow-fenced zones.

- During project implementation ensure exclusion of weed seed from entering the site on vehicles, infill, tools, personnel, etc. Vehicles and equipment shall be power washed before entering the location after every departure from the project area to any other off-highway site.
- Materials and equipment shall be stored at a weed-free staging area to prevent noxious weed seed migration. If on-site, this staging area shall be restored.
- All materials and soil brought on-site shall be noxious weed-free (weed-free pit inspection).
- Avoid operating vehicles on wet soils.
- Notify the City immediately of any changes or plans that could affect City property including the Open Space Program (Robert.wallace@flagstaffaz.gov).

Seedbed Preparation Phase

Seedbed preparation (tilling) is required before reseeding and generally consists of decompaction of the soil, adding soil amendment (if needed), and gently firming the soil surface prior to seeding. Do not compact the soil.

Decompaction shall occur in three steps with special attention given to staging areas, roads, and other high-traffic areas that are severely compacted:

1. Before the topsoil is replaced the sub-soil shall be ripped to a depth of 6 to 12 inches via disking, ripping, plowing, and rototilling. On steeper slopes other methods may need to be used to decompact soil to the proper depth. Slopes shall only be ripped along the contour of the slope. During topsoil replacement the ground shall be contoured to restore the site to approximately the original contour.
2. Once the sub-soil is ripped the topsoil shall be replaced uniformly over all the disturbed area. Spreading shall not be done when the ground or topsoil is frozen or wet. The soil shall be tilled to 6 inches leaving no clod over 3 inches in diameter.
3. Once the final tilling is complete, gently firming of the seedbed soil shall be performed prior to seeding if determined necessary by a vegetation specialist. If soils are sandy and contain a small amount of moisture, a cultipacker may be used to firm the seedbed soil. Soils that are wet or silt loam to clay loam shall not be cultipacked.

Plant Material Selection Phase

Appropriate plant selection is crucial in the successful revegetation of sites. A site plan shall be created by a revegetation specialist. The revegetation specialist shall base plant selection on the native plant assessment conducted before the project. Seeds shall be obtained from a nursery that locally sources their seed (grown locally). Regardless of the plant material selected, several general principles shall be followed:

- Plant material that originates in proximity to the revegetation project shall be chosen due to its adaptability to the local environment, resistance to pests, and more robust growth over the long term.
- Plant species shall be chosen to closely match the environmental conditions at the project site.
- Restoration seed mixes for a site shall be developed by a qualified revegetation specialist. Table 1 provides a recommended restoration seed mix for the project location (Switzer Watermain Project, Phase IV).
- All seed mixtures shall be certified free of noxious weeds and shall not contain any of the species listed on the most recent 2020 Arizona State Noxious Weed List ([Official-2020-Arizona-State-Noxious-Weed-List.pdf \(aznps.com\)](#)). Seed shall be tested and the viability testing of seed shall be done in accordance

with State law(s) and within three months prior to purchase. Commercial seed shall be either certified or registered seed. The seed mixture container shall be tagged in accordance with State law(s).

- All seed substitutions must be requested and approved by the City of Flagstaff Open Space Program in consultation with a revegetation specialist.

Seeding Phase

After the soil has been decompacted, the seedbed has been adequately prepared, and the plant material has been selected, the site is ready for seed application. The timing of seeding is an important aspect of the revegetation process. The best times of year to seed for the Flagstaff area are just before the monsoon season (~ late June) or Fall (late October – early November). Fall is the preferred time for seeding. Late summer seedbed preparation followed by installation of the seed in the fall allows winter months for additional firming of the seedbed before spring and germination. Fall seeding benefits from winter and spring moisture and usually assures maximum soil moisture availability for establishment. Seeding shall **NOT** be conducted if the soil is frozen, snow-covered, or wet (muddy).

Hydroseeding shall only be conducted with the written recommendation and approval of a revegetation specialist.

Broadcast seeding, which consists of spreading the seed onto the surface of the soil by hand or with a hand spreader (also known as a belly grinder) or a mechanized rotary or cyclone seeder is the most viable option for the Flagstaff area. Broadcast seeding is necessary in areas that are inaccessible such as rocky slopes and steeper terrain.

Broadcast seeding is best completed after the ground has been raked or harrowed. Broadcast seeding is less reliable than drill seeding so it is necessary to increase the seeding rate to double or even triple the recommended rates. The seed mixture(s) shall be planted in the amounts specified Table 1. After seeding is complete, the seed shall be raked or harrowed in to provide better seed to soil contact and to cover the seed with soil. Seed shall be buried to a depth of ¼ to ½ inch.

After the seed has germinated spot-seed areas that did not establish. Inaccessible, small, steep, or soft seedbed areas may be broadcast seeded and harrowed or raked to cover the seed. In areas that pose challenges for revegetation, seeding rates may be up to 50 to 60 pounds per acre to assure faster establishment or to provide erosion protection.

Table 1. Recommended Restoration Seed Mix for Switzer Mesa Watermain Project, Phase IV.

<u>Common Name</u>	<u>Species Name</u>	<u>lbs PLS/acre</u>
Blue Grama	<i>Bouteloua gracilis</i>	1.2
Little Bluestem	<i>Schizachyrium scoparium</i>	1.8
Bottlebrush Squirreltail	<i>Elymus elymoides</i>	2
Arizona Fescue	<i>Festuca arizonica</i>	1.8
Slender Wheatgrass	<i>Elymus trachycaulus</i> <i>ssp. trachycaulus</i>	2.4
Muttongrass	<i>Poa fendleriana</i>	0.6
Spike Muhly	<i>Muhlenbergia wrightii</i>	0.9
TOTAL		10.7

Mulching Phase

Mulching is the practice of applying a protective layer of material onto the soil surface of individually planted trees and shrubs or a seeded area. Mulching shall be achieved through straw or rolled erosion control product (RECP) installation. The type of mulch shall meet one of the following requirements:

- Crimped straw: Straw mulch is cost-effective, readily available, and conveniently packaged in bales. Straw mulch may be spread and crimped on slopes of 4:1 or less. Steeper slopes require a different type of mulch. Straw shall be certified free of noxious weeds or other objectionable material. Long straw is appropriate for straw mulching, fragmented straw shall **NOT** be used. At least 50% of the straw mulch shall be a minimum of 10 inches long for stability once crimped. The straw mulch may be applied by hand in small areas or by a chopper/spreader or blower in larger areas. When mulching over a seeded area, mulch to a density where some soil is visible beneath the straw.

Straw mulch is susceptible to blowing away so it must be anchored or crimped. The straw shall be crimped into the soil to a depth of 2 to 3 inches with a crimping tool. Disks and chisels shall not be used to crimp because they will cut the straw allowing it to blow free. Mulching with hay with non-native grass species shall **NOT** be used. Alternatively, native grass species of hay may be purchased.

- Rolled erosion control products: rolled erosion control products (RECPs) include a variety of manufactured products designed to control erosion and enhance vegetation establishment particularly on slopes and in channels. Products such as netting, open weave textiles, and a variety of erosion control blankets (ECBs) made of natural and biodegradable materials (e.g. straw, jute, coconut) may be used. Products shall be certified free from noxious weeds or other objectionable material. All used products shall be all-natural biodegradable and safe for sensitive areas (no plastic components). RECPs are the best approach for facilitating revegetation on steep slopes (3:1 or steeper). For purposes of revegetation, it is best to avoid thick straw or excelsior blankets because they can impede grass establishment. RECPs must be installed correctly to be effective, and installation must be completed according to manufacturer directions.

Maintenance & Monitoring

To achieve successful revegetation a warranty period shall be required of the contractor for two years. Permits shall not be terminated until the site has reached final stabilization. During the warranty period an integrated weed management plan shall be developed for the site to include the following activities:

- Weed control and long-term management.
- Replanting dead trees and shrubs.
- Reseeding bare areas where grasses did not establish.
- Repairing ECB or other erosion control fabrics, if applicable.
- Stabilizing eroded areas, particularly following large storm events.
- Installing protection from animal damage.
- Debris removal.
- Installing and repairing temporary fencing to control foot traffic, particularly in heavily used areas.

Weed Management

Any weeds on the Arizona State Noxious Weed List shall be promptly and aggressively treated. Special attention shall be given to Scotch Thistle, Jointed Goatgrass, Musk Thistle, Bull Thistle, Yellow Star Thistle, Diffuse Knapweed, Cheatgrass, and Japanese Brome.

Integrated weed management is defined as using a variety of techniques to control weeds. Techniques that may be used include mowing, herbicide application, and hand-removal or cutting. The integrated weed management plan shall evaluate the weed species found at the site and determine the best combination of control strategies for each species. Newly seeded plants are especially vulnerable to all herbicides; therefore, herbicides shall **NOT** be applied to newly seeded areas until the plants are well established. Following the initial intensive management period, a long-term commitment for spot-spraying of re-sprouting weeds shall be a part of the control plan.

Annual weed seeds are abundant in most topsoil and germinate readily. Annual weeds must be mowed when they are in flower before they produce seeds. Two or three mowing operations in the first year of growth may address most of the annual weeds on a site. A seeded area may be mowed during the first year of establishment as an early weed control method if shrubs are avoided. Weedy areas shall be mowed 6 to 8 inches when they exceed 12 inches in height or just begin to produce seed. The mowing height for established grasses shall be no less than 6 inches. Biennial and perennial weeds shall be spot treated with approved herbicides by mid-summer or when the seeded grasses have three to four leaves. A boom sprayer shall not be used during the first summer after seeding. Weed control of established seeded areas during the second growing season may involve a combination of techniques including spot spraying weedy areas. Herbicide applications shall be chosen carefully to consider herbicide type, method of application, times, and rates based on the types and amounts of weeds present.

Post-Construction Assignments

- After the completion of reseeded, remove all temporary snow fencing placed around trees within the corridor and around the work area.
- Temporary sediment control will be left in place until vegetation infill is successful. Once native plant cover has been established, remove all non-natural stormwater control measures (i.e., rock trackout pad, sediment wattles, silt fence, etc.).
- Rake out tracks/signs of construction to reduce visibility at all points.
- Provide invasive plant mitigation for two years with two treatments per year at the appropriate time of year to prevent seed dispersal of plants listed on the Arizona State Noxious Weed List ([Official-2020-Arizona-State-Noxious-Weed-List.pdf \(aznps.com\)](https://www.aznps.com/Official-2020-Arizona-State-Noxious-Weed-List.pdf)). A revegetation specialist shall determine the treatment type to ensure appropriateness for the site. Particular attention shall be given to Scotch Thistle, Musk Thistle, Bull Thistle, Yellow Star Thistle, Diffuse Knapweed, Bromus tectorum, and Bromus japonicus.
- A revegetation specialist shall be utilized to determine seedling/revegetation establishment and success metrics.
- Evaluate growth following the growing season after the seeding for two years. Assessment work must be completed by a revegetation specialist.
- Seeding shall be repeated if establishment and success metrics are not met as determined by a revegetation specialist.
- If prior seeding was ineffective, the City may require the addition of soil amendments with the second round of seeding.
- A revegetation specialist shall be contracted to provide an integrated weed management plan that identifies how weeds will be controlled, how revegetation success will be determined, and associated mitigation steps.
- Provide an annual report of the findings to the City Open Space Program.

Post-Construction Restoration Schedule

Year 1:

1. Integrated weed management plan.
 - Develop monitoring, maintenance, and metric criteria.
2. Seedbed preparation
 - Prepare seedbed for the identified area.
 - Rake out tracks/signs of construction to reduce visibility at all points.
3. Seeding
 - Sow seed.
4. Mulching
 - Apply mulch to seeded area.
5. Weed management
 - Treat weeds identified on the Arizona State Noxious Weed List and annual bromes (*B. tectorum* and *B. japonicus*).
6. Annual Assessment
 - Complete annual monitoring report.

Year 2:

1. Seeding
 - Repeat the seeding to obtain a satisfactory stand if directed by the revegetation specialist monitoring report.
2. Weed management
 - Treat weeds identified on the Arizona State Noxious Weed List and annual bromes (*B. tectorum* and *B. japonicus*).
3. Annual Assessment
 - Complete annual monitoring report.