Waukesha Water Utility
SERVING WAUKESHA SINCE 1886

115 DELAFIELD STREET
WAUKESHA, WI 53188-3615

Telephone: (262) 521-5272 • Fax: (262) 521-5265 • E-mail: contactus@waukesha-water.com

MEMORANDUM

Date: September 10, 2021

To: Dan Duchniak, P.E.

From: Chris Walter, P.E.

Re: Request for Approval of CP 5 - Change Order No. 003

On August 6, 2021, Change Order Request No. 003 was submitted by S.J. Louis, regarding horizontal directional drill (HDD) work on Contract Package 5. This request was evaluated in detail by the Construction Management Team and discussed with me at length. I concur with the recommendation by Black & Veatch to approve the proposed revisions to the HDD on Les Paul Parkway adjacent to Sunset Drive.

The contractor is requesting an additional HDD length of 287 feet, which results in a net contract price increase of $186,112.56. They are also requesting an associated contract time increase of 4 days. The request is being recommended for approval for the following primary reasons:

- Increased angles will allow depth to be achieved sooner and provide greater protection of the existing roadway and utilities.
- Insufficient room for pipe laydown on the original exit side of the HDD.
- Added length and depth to mitigate incidental return risks.

Detailed supporting documentation with a description and engineered design for this HDD Crossing is enclosed with this memo. Along with our Construction Management team, I have reviewed and recommend approval of this Change Order. Please note that five other HDD crossings that were part of CO No. 003 were evaluated and denied. With this approval, the contractor takes full responsibility for the design and method of installation for this HDD crossing.

Recommended Motion: Move to approve of the noted portion of Change Order No. 003 for Contract Package 5 for a total of $186,112.56 and 4 additional days of contract time.

Great Water Alliance
115 Delafield Street

Waukesha, WI,53187
P: (262) 521-5272 F: (262) 521-5265

Waukesha Water Utility
Great Lakes Water Supply Program
CP5 - Return Flow Pipeline
S.J. Louis Construction, Inc.
1351 Broadway Street W PO Box 459
Rockville MN
USA 56369

Project No.: 199990-CP5
File No.: 80.1633

Submittal Item

Submittal Item No.:	D-330522-002-011 Rev.: 0
Submittal Set No.:	330522-009 Rev.: 0
Description:	CROSSING PLAN 2 (DWG C123-C127) - SIGNED/SEALED CERTIFICATE OF PLAN AND CALCULATIONS
Expedited Review:	No
Review Disposition:	Acknowledged
Status:	Approved

Specification Section/CSI Code: 33 05 22 - Horizontal Directional Drilling

Section Reference:

Drawing Reference:

Sub-Contractor:

Supplier:

Manufacturer:

Critical Path Item: ☐ Yes ☑ No

Deviation from Contract Requirements: ☐ None / ☐ Yes

Notes:

Workflow Status: Approved

Actioned By: Collin Kruse

Sample Received:

Sample Received Date:

Sample Delivery Method:

Review Due Date:	Actual Review Duration:	Days Overdue:
August 18, 2021	12	9

Review Comments:

This submittal item was marked as approved via the workflow approval of the linked submittal set on 8/9/2021 12:35 PM

Submittal Set No. 330522-009 – HDD Crossing Plan 2

Submittal Item D-330522-002-011– Signed Certificate – Acknowledged

Notes regarding D-330522-002-011 are as follows:

1. The calculations submitted were not reviewed.

Subject to Excessive Review Clause: ☑ No / ☐ Yes

Engineer's review of submittals covers only general conformity to the Drawings and Specifications, external connections, and dimensions that affect the layout; it does not indicate a thorough review of all dimensions, quantities, and details of the material, equipment, device, or item covered. Engineer's review shall not relieve Contractor of sole responsibility for errors, omissions, or deviations in the drawings and data, nor of Contractor's sole responsibility for compliance with the Contract Documents.

Attached: D-330522-002-011 - Certs and Calcs

Workflow Log

	07/28/2021	Submit	Trevor Scaife(TScaife)
CM - Submittal Coordinator 02	07/28/2021	Approve	Collin Kruse(CKruse)
PM - Submittal Coordinator 02	08/09/2021	Approve	Karissa Brunette(KBrunette)
CM - Submittal Coordinator 02	08/09/2021	Approve	Collin Kruse(CKruse)
CM - Submittal Coordinator 02	08/09/2021	Approve	Collin Kruse(CKruse)
	08/09/2021		Collin Kruse(CKruse)
	08/09/2021		Collin Kruse(CKruse)
	08/09/2021		Collin Kruse(CKruse)

S.J. Louis Construction, Inc.
1351 Broadway Street W.
Rockville, MN 56369
S.J. LOUIS CONSTRUCTION, INC. Office (320) 253-9291

LETTER OF TRANSMITTAL

Date:	July 28, 2021
Attention:	**Jeff A. Champion**
Regarding:	Great Lakes Water Supply Program Contract Package 5 - Return Flow Line
Job No.'s:	SJL # 52007-10

To: Black and Veatch
225 E Mason Street, Suite 801
Milwaukee, WI 53202

WE ARE SENDING YOU:

[X] ATTACHED [ ] UNDER SEPARATE COVER VIA _____ THE FOLLOWING ITEMS:

[ ] SHOP DRAWINGS [ ] PRINTS [ ] CHANGE ORDER [ ] SAMPLES

[ ] COPY OF LETTER [ ] PLANS [ ] SPECIFICATIONS [X] OTHER (See Below)

COPIES	SPEC SECT	NO.	DESCRIPTION
1	33 05 22	D-330522-002-011	Crossing Plan 2 - Signed/Sealed Certificate of Plan and Calculations

THESE ARE TRANSMITTED AS CHECKED BELOW:

[X] FOR APPROVAL [ ] APPROVED AS SUBMITTED [ ] RESUBMIT _____ COPIES FOR APPROVAL

[ ] FOR YOUR USE [ ] APPROVED AS NOTED [ ] SUBMIT _____ COPIES FOR DISTRIBUTION

[ ] AS REQUESTED [ ] RETURN FOR CORRECTIONS [ ] RETURN _____ CORRECTED PRINTS

[X] FOR REVIEW AND COMMENT [ ] [ ] RETURN _____ EXECUTED COPY

[ ] FOR BIDS DUE

REMARKS:

COPIED: File SIGNED: Trevor Scaife

S.J. Louis Construction
1351 Broadway Street W.
Rockville, MN 56369

__X__ Approved and Certified to comply with the Contract Documents.

_____ Approved and Certified to comply with the Contract Documents, except for variations specifically noted on the Transmittal Form and the associated documents.

PRINTED NAME: Trevor Scaife

TITLE: Project Engineer

SIGNATURE: Trevor Scaife

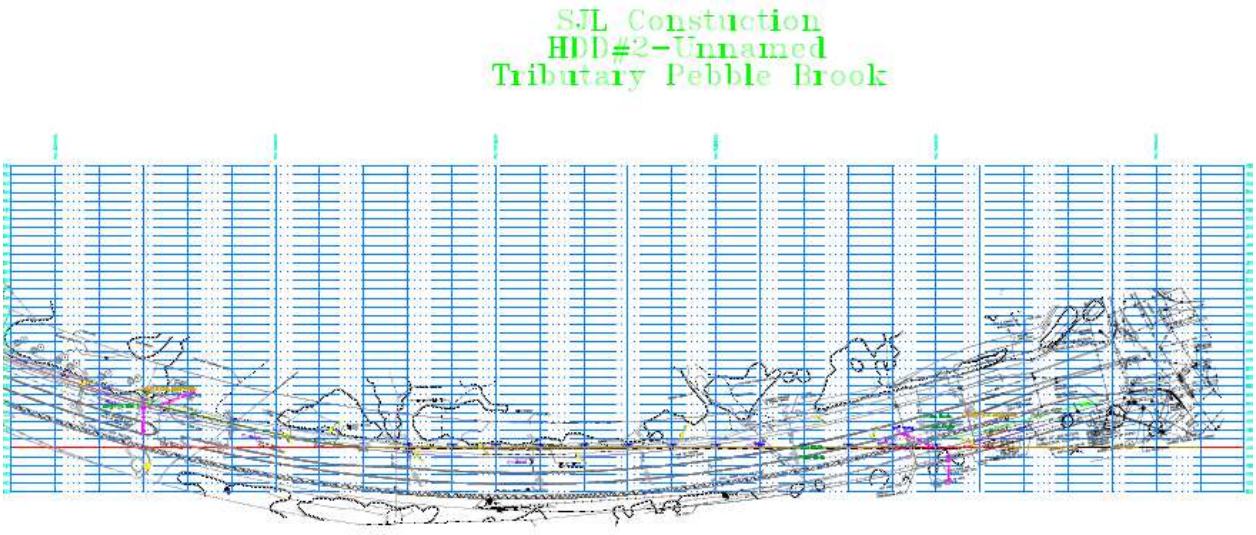
Digitally signed by Trevor Scaife
DN: C=US, E=TrevorS@SJLouis.com, O=S.J. Louis, CN=Trevor Scaife
Reason: I am the author of this document
Date: 2021.07.28 07:25:55-05'00'

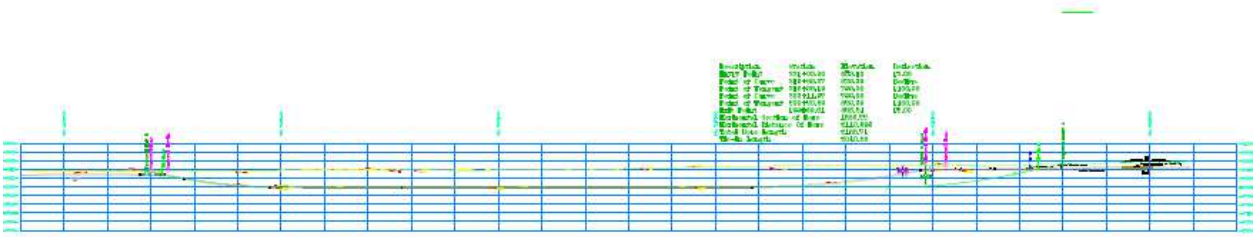
DATE:

Project: Waukesha Water Utility - Great Lakes Water Supply Program - Contract Package 5
Location: Waukesha, WI
Client : S.J. Louis Construction, Inc. (SJL Construction)
SJL Engineers Project No.: 1-20-106 (estimate of pulling force for Crossing #2 - UNT to Pebble Brook)

By: SJL
Checked: KAL

Statement:
Estimate the pulling force for the referenced crossing. Based on information, SJL Construction plans to utilize a horizontal directional drilling technique to install a 36-in. return flow pipeline. Refer to the plan and profile below and attached information regarding the crossing and anticipated ground conditions.





S.J. Ludlow Consulting Engineers, Inc.
450 E. 96th St., Suite 500
Indianapolis, IN 46240
317-371-5539 | *www.sjlengineers.com*

Project: Waukesha Water Utility - Great Lakes Water Supply Program - Contract Package 5
Location: Waukesha, WI
Client : S.J. Louis Construction, Inc. (SJL Construction)
SJL Engineers Project No.: 1-20-106 (estimate of pulling force for Crossing #2 - UNT to Pebble Brook)

By: SJL
Checked: KAL

Assumptions and Rationale:

Within the limits of the bore (i.e., approximately 2,139 lin ft), SJL Construction plans to utilize a continuous borehole method that generally includes sequential activities of: a 10 5/8-in. pilot hole (with 12-deg entry/exit angles); ream passes with 30- to 54-in. openers/reamers (rock tooling); a mud pass using a 42 to 48-in. diameter ball; and pullback of the 36-in. carrier pipe (i.e., water filled). A bentonite slurry is planned as a lubricant and aid in borehole stability, and ground surface elevations for the borehole entry and exit points are relatively the same except as shown. Based on information in the Contract Documents, ground conditions along the alignment are anticipated to consist of medium dense silty sand and silt and dolomite rock.

References:

SJL Construction submittal for CP5 - 2 HDD Plan D-330522-002-009
AASHTO LRFD Bridge Design Specifications, 8th ed.
Buried Flexible Steel Pipe: Design and Structural Analysis, Engineering Practice No. 119
ASTM F1962-11, Standard Guide for Use of Maxi-Horizontal Directional Drilling for Placement of Polyethylene Pipe or Conduit Under Obstacles, Including River Crossings (per license agreement).

Estimate Pulling Force:

For the configuration shown above, estimate the pulling force based on ASTM F1962 reference. Below is an illustration of a crossing which identifies variables for this analysis, namely length and points of interest along the bore path.

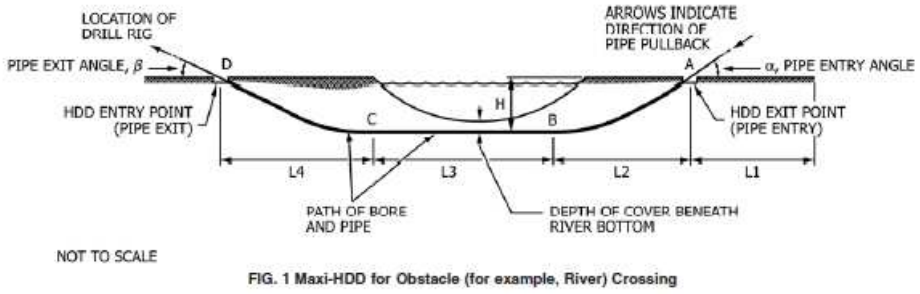


FIG. 1 Maxi-HDD for Obstacle (for example, River) Crossing

$v_a := 0.1$: coefficient of friction applicable at the surface before the pipe enters borehole; pipe on rollers

$v_b := 0.3$: coefficient of friction applicable w/in lubricated borehole

$L_1 := 50\ ft$: additional pipe length required for handling and thermal effects, assumed

$L_2 := 322\ ft$: approximate horizontal distance to achieve desired depth

$L_3 := 1386\ ft$: approximate distance traversed at desired depth

$L_4 := 402\ ft$: approximate horizontal distance to rise to surface

$\alpha := 12\ deg$: borehole angle of pipe entry

$\beta := 12\ deg$: borehole angle of pipe exit

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Estimate Pulling Force cont'd:

$H := 50\ ft$: Approximate depth of borehole from ground surface

$OD_{pipe} := 38.3\ in$: Outside diameter of pipe

$ID_{pipe} := 30.919\ in$: Inside diameter of pipe

$t_{wall} := \frac{OD_{pipe} - ID_{pipe}}{2} = 3.69\ in$: Wall thickness of pipe

$DR := \frac{OD_{pipe}}{t_{wall}} = 10.4$: Dimension ratio

$\gamma_a := 0.955$: Specific gravity of pipe

$\gamma_b := 1.5$: Specific gravity of lubricant, bentonite

$\gamma_c := 1.0$: Specific gravity of ballast, water

$\rho_w := 62.4\ \frac{lbf}{ft^3}$: Density of water

$w_a := \pi \cdot OD_{pipe}^{\ 2}\ \frac{(DR-1)}{DR^2}\ \rho_w \cdot \gamma_a = 166.1\ \frac{lbf}{ft}$: Weight of empty pipe

$w_{b\_empty} := \pi \cdot \frac{OD_{pipe}^{\ 2}}{4} \cdot \rho_w \cdot \left(\gamma_b - \frac{4 \cdot \gamma_a \cdot (DR-1)}{DR^2}\right) = 582.8\ \frac{lbf}{ft}$: Net (upward) buoyant force on empty pipe

$w_b := \pi \cdot \frac{OD_{pipe}^{\ 2}}{4} \cdot \rho_w \cdot \left(\gamma_b - \gamma_c \cdot \left(1 - \frac{2}{DR}\right)^2\right) - w_a = 257.4\ \frac{lbf}{ft}$: Net (upward) buoyant force on pipe filled with ballast

$w_{ballast} := \pi \cdot \frac{ID_{pipe}^{\ 2}}{4} \cdot \rho_w \cdot \gamma_c = 325\ \frac{lbf}{ft}$: Weight of ballast, check

$T_A := \exp(v_a \cdot \alpha) \cdot (v_a \cdot w_a \cdot (L_1 + L_2 + L_3 + L_4)) = 36627.3\ lbf$: Pulling force on pipe at point A

$T_B := \exp(v_b \cdot \alpha) \cdot (T_A + v_b \cdot |w_b| \cdot L_2 + w_b \cdot H - v_a \cdot w_a \cdot L_2 \cdot \exp(v_a \cdot \alpha)) = 73377.1\ lbf$

: Pulling force on pipe at point B

$T_C := T_B + v_b \cdot |w_b| \cdot L_3 - \exp(v_b \cdot \alpha) \cdot (v_a \cdot w_a \cdot L_3 \cdot \exp(v_a \cdot \alpha)) = 155396\ lbf$

: Pulling force on pipe at point C

$T_D := \exp(v_b \cdot \beta) \cdot (T_C + v_b \cdot |w_b| \cdot L_4 - w_b \cdot H - \exp(v_b \cdot \alpha)\ (v_a \cdot w_a \cdot L_4 \cdot \exp(v_a \cdot \alpha))) = 177097.8\ lbf$

: Pulling force on pipe at point D

These forces are considered to be a minimum requirement for assessing equipment.

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Project: Waukesha Water Utility - Great Lakes Water Supply Program - Contract Package 5
Location: Waukesha, WI
Client : S.J. Louis Construction, Inc. (SJL Construction)
SJL Engineers Project No.: 1-20-106 (estimate of pulling force for Crossing #2 - UNT to Pebble Brook)

By: SJL
Checked: KAL

Check stresses in pipe:

Estimate pulling force due to hydrokinetic pressure:

$\Delta P := 10\ psi$: Hydrokinetic pressure, estimated

$D_{hole} := 52\ in$: Backreamed hole diameter

$\Delta T := \Delta P \cdot \frac{\pi}{8}\left({D_{hole}}^2 - {OD_{pipe}}^2\right) = 4858.1\ lbf$: Pulling force from hydrokinetic pressure

Maximum axial tensile stress:

$$\sigma_{max} := \left(\max\left(T_A, T_B, T_C, T_D\right) + \Delta T\right)\left(\frac{1}{\pi \cdot {OD_{pipe}}^2}\right) \cdot \left(\frac{DR^2}{DR-1}\right) = 453.5\ psi$$

Average axial tensile stress at respective locations:

$$\sigma_A := \left(\left(T_A + \Delta T\right)\left(\frac{1}{\pi \cdot {OD_{pipe}}^2}\right)\right) \cdot \left(\frac{DR^2}{DR-1}\right) = 103.4\ psi$$

$$\sigma_B := \left(\left(T_B + \Delta T\right)\left(\frac{1}{\pi \cdot {OD_{pipe}}^2}\right)\right) \cdot \left(\frac{DR^2}{DR-1}\right) = 195\ psi$$

$$\sigma_C := \left(\left(T_C + \Delta T\right)\left(\frac{1}{\pi \cdot {OD_{pipe}}^2}\right)\right) \cdot \left(\frac{DR^2}{DR-1}\right) = 399.4\ psi$$

$$\sigma_D := \left(\left(T_D + \Delta T\right)\left(\frac{1}{\pi \cdot {OD_{pipe}}^2}\right)\right) \cdot \left(\frac{DR^2}{DR-1}\right) = 453.5\ psi$$

Axial bending stress (per ASTM F1962):

$R_1 := 1000\ ft$: Local radius of curvature, pipe entry

$R_2 := 2000\ ft$: Local radius of curvature, pipe exit

$E_a := 110\ ksi$: Apparent Modulus of Elasticity

$\varepsilon_{a1} := \frac{OD_{pipe}}{2 \cdot R_1} = 0.002$ $\quad \varepsilon_{a2} := \frac{OD_{pipe}}{2 \cdot R_2} = 0.001$: Peak axial strain

$\sigma_{a1} := E_a \cdot \varepsilon_{a1} = 175.5\ psi$ $\quad \sigma_{a2} := E_a \cdot \varepsilon_{a2} = 87.8\ psi$: Peak axial stress

Peak tensile stress at respective locations (per ASTM F1962):

$\sigma_{pA} := \sigma_A + \sigma_{a1} = 278.9\ psi$

$\sigma_{pB} := \sigma_B + \sigma_{a1} = 370.5\ psi$

$\sigma_{pC} := \sigma_C + \sigma_{a2} = 487.1\ psi$

$\sigma_{pD} := \sigma_D + \sigma_{a2} = 541.2\ psi$

$SPS := 1100\ psi$: Safe pull tensile stress, Table X1.1

$\sigma_{pi} < SPS$: OK

$ATL := SPS \cdot \pi \cdot {OD_{pipe}}^2 \left(\frac{1}{DR} - \frac{1}{DR^2}\right) = 220.7\ tonf$: Allowable tensile load (safe pull tensile load)

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450 E. 96th St., Suite 500
Indianapolis, IN 46240
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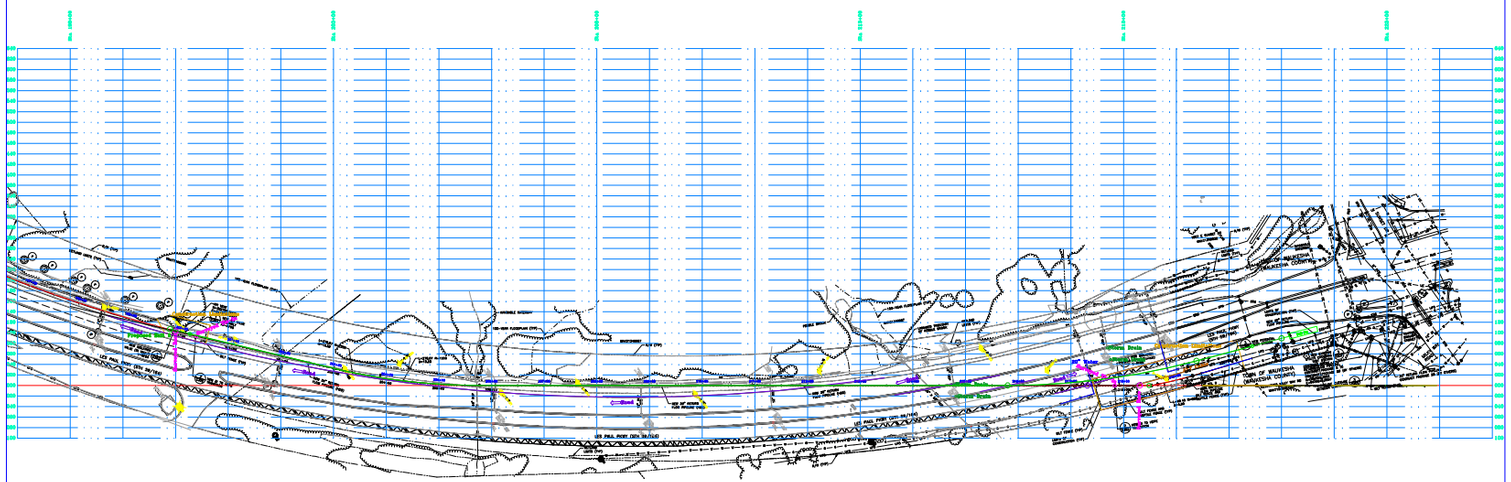
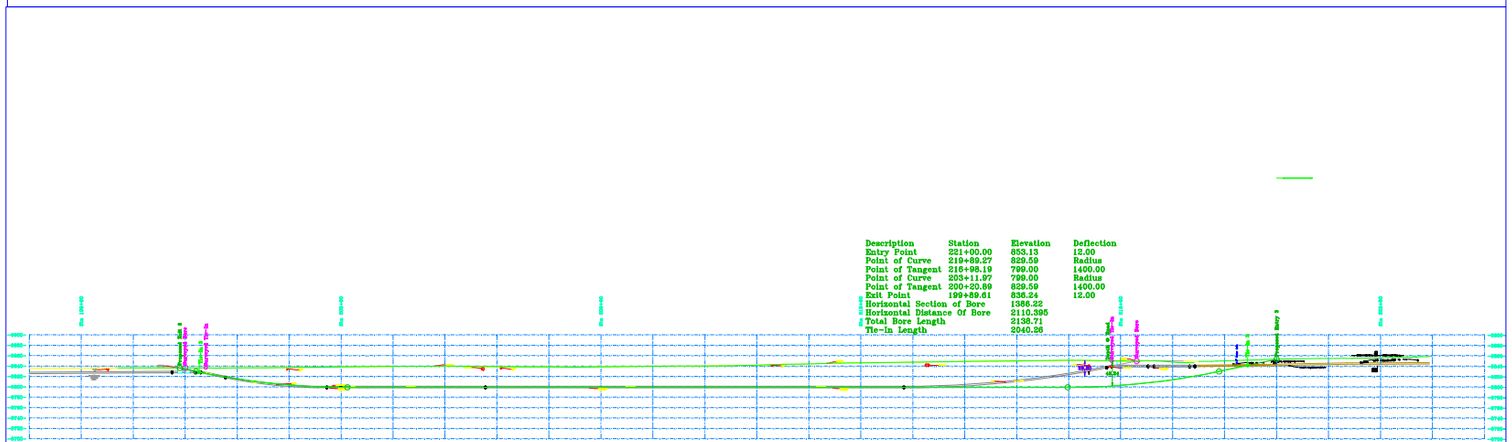
SJL Constuction
HDD#2-Unnamed
Tributary Pebble Brook





Description	Station	Elevation	Deflection
Entry Point	221+00.00	853.13	12.00
Point of Curve	219+80.27	829.59	Radius
Point of Tangent	216+98.19	799.00	1400.00
Point of Curve	203+11.97	799.00	Radius
Point of Tangent	200+20.89	829.59	1400.00
Exit Point	199+89.61	836.24	12.00
Horizontal Section of Bore		1386.22	
Horizontal Distance Of Bore		2110.395	
Total Bore Length		2136.71	
Tie-In Length		2040.26	

General Notes

Date	Revision	Drawn By
9/10/20	1	SL
10.16.20	2	GL
04.07.21	3	GL
04.16.21	4	GL

S.J. LOUIS
CONSTRUCTION, INC.

Project
42081-30

Date
04.16.2021

Sheet
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