July 2013 version

ENVIRONMENTAL ASSESSMENT WORKSHEET

This Environmental Assessment Worksheet (EAW) form and EAW Guidelines are available at the Environmental Quality Board's website at:
http://www.eqb.state.mn.us/EnvRevGuidanceDocuments.htm. The EAW form provides information about a project that may have the potential for significant environmental effects. The EAW Guidelines provide additional detail and resources for completing the EAW form.
Cumulative potential effects can either be addressed under each applicable EAW Item or can be addresses collectively under EAW Item 19.
Note to reviewers: Comments must be submitted to the RGU during the 30-day comment period following notice of the EAW in the *EQB Monitor*. Comments should address the accuracy and completeness of information, potential impacts that warrant further investigation and the need for an EIS.

1. **Project title:** Afton Alps Trout Brook Stream Restoration – Phase III

2. **Proposer:** South Washington Watershed District
Contact person: Matt Moore
Title: Administrator
Address: 2302 Tower Drive
City, State, ZIP: Woodbury, MN 55125
Phone: 651-714-3729
Fax: 651-714-3721
Email: matt.moore@woodburymn.gov

3. **RGU:** South Washington Watershed District
Contact person: Matt Moore
Title: Administrator
Address: 2302 Tower Drive
City, State, ZIP: Woodbury, MN 55125
Phone: 651-714-3729
Fax: 651-714-3721
Email: matt.moore@woodburymn.gov

4. **Reason for EAW Preparation:** (check one)

Required:	Discretionary:
☐ EIS Scoping	☐ Citizen petition
☑ Mandatory EAW	☐ RGU discretion
	☐ Proposer initiated

If EAW or EIS is mandatory give EQB rule category subpart number(s) and name(s):

Minn.R.4410.4300, Subpart 26 Stream Diversion:
For a diversion, realignment, or channelization of any designated trout stream, or affecting greater than 500 feet of natural watercourse with a total drainage area of ten or more square miles unless exempted by part 4410.4600, subpart 14, item E, or 17, the DNR or local governmental unit is the RGU.

5. **Project Location:**

County: Washington County

City/Township: Denmark

PLS Location (¼, ¼, Section, Township, Range): NE and NW ¼ of Section 3 and NW ¼ of Section 2, Township 27N, Range 20W

Watershed (81 major watershed scale): DNR major watershed 37, Lower St. Croix River (USGS HUC08 ID: 07030005)

GPS Coordinates: Approx. midpoint: 44.858, -92.788

Tax Parcel Number:

Parcel ID	Section	Township	Range	Owner Name
0302720240002	03	27	20	AFTON STATE PARK
0302720210001	03	27	20	AFTON STATE PARK
0302720140001	03	27	20	VR US HOLDINGS
0302720130001	03	27	20	VR US HOLDINGS
0302720110001	03	27	20	AFTON STATE PARK
0202720320002	02	27	20	AFTON STATE PARK
0202720230002	02	27	20	VR US HOLDINGS

At a minimum attach each of the following to the EAW:

- **County map showing the general location of the project;**
- **U.S. Geological Survey 7.5 minute, 1:24,000 scale map indicating project boundaries (photocopy acceptable); and**
- **Site plans showing all significant project and natural features. Pre-construction site plan and post-construction site plan.**

TABLES

EXHIBITS

APPENDICES

6. **Project Description:**

a. **Provide the brief project summary to be published in the *EQB Monitor*, (approximately 50 words).**

The South Washington Watershed District (SWWD) proposes to continue the ecological and hydraulic restoration of Trout Brook through Afton Alps Ski Area and Afton State Park in cooperation with Great River Greening (GRG), the Minnesota Department of Natural Resources (DNR), and Vail Resorts Management Company (Vail). The Phase III Trout Brook Stream Restoration Project will include remeandering portions of the channel, reconnecting the stream with its natural floodplain, and installing rock and woody riffles to enhance trout habitat and reduce incision, erosion, and sedimentation. One culvert will be replaced to allow for longitudinal connectivity.

b. **Give a complete description of the proposed project and related new construction, including infrastructure needs. If the project is an expansion include a description of the existing facility. Emphasize: 1) construction, operation methods and features that will cause physical manipulation of the environment or will produce wastes, 2) modifications to existing equipment or industrial processes, 3) significant demolition, removal or remodeling of existing structures, and 4) timing and duration of construction activities.**

Phase III of the Afton Alps Trout Brook Stream Restoration (Project; **Exhibits 1 and 2**) will contribute to restoring the stream nearer to natural geomorphological conditions, which would return trout habitat by reducing sedimentation and providing conditions to allow for trout passage within the channel. Restoring trout to Trout Brook will improve the aesthetic of the stream through Afton Alps and increase recreational capacity for Afton State Park and Afton Alps during the latter's off-season. Phase III will improve approximately 1 mile of stream with expanded floodplain, remeandering, rock and woody riffles, and culvert replacement.

Trout Brook was channelized through Afton Alps in the 1960s when local landowners formed the ski area (Hong, A., 2019). Since then, sediment accumulation is a regular occurrence in the current channel alignment and ongoing maintenance is required. This sedimentation buries channel riffles and pools, limiting habitat diversity and conditions conducive to trout. In 2012, an effort began to restore the stream through Afton Alps and Afton State Park. At that time the SWWD conducted a geomorphic and feasibility reconnaissance examining channel stability, sediment sources and sinks, and potential restoration solutions for the lower segment of Trout Brook (South Washington Watershed District, 2012) (Great River Greening, 2017). Since that time, the DNR has conducted both geomorphic and fisheries investigations to support restoration at the site, including the survey of similar locations in both Trout Brook and Brown's Creek that served as references for Phase I and subsequent design (Great River Greening, 2017).

As part of this effort, a portion of the stream east of Alps Village was meandered and rerouted to the south of the parking lot, a culvert was replaced, and rock riffles and two pedestrian crossings were added. Construction was completed on Phase II in 2019.

The Project consists of four separate reaches. (**Exhibit 3**). The project boundary includes the area surrounding all project features, including spoils sites, in addition to a slight buffer. Major project features include culvert replacement and associated roadway modifications, floodplain excavation, channel remeandering, grading, sod mats, and rock and woody riffles (**Appendix A**). The total area of in-channel and floodplain disturbance is 2.43 acres.

Reach 1 will transition from the confined channel adjacent to the maintenance road to a type $B4_c$ with floodplain connectivity. The channel will be remeandered with an excavated floodplain bench to increase floodplain connectivity and storage. Pools will be constructed on outside bends of channel curves to provide hydraulic diversity and aquatic habitat. It is anticipated that toe-wood benches will be utilized to protect the banks in the Afton State Park reach where the old channel is plugged, and water is diverted to the meandered channel. The channel remeander in Reach 1 will be constructed offline so that vegetation can establish for one growing cycle prior to allowing discharges to be introduced. Rock and woody riffles will be installed in reaches 1, 2, and 3 to increase local turbulence, oxygenation, and habitat.

Reaches 2 and 3 are generally very confined, with the channel directed between the Afton Alps access road and a steep bluff. Improvements for these reaches consist of widening the floodplain (as feasible) and adding riffles. Construction in these reaches will occur under wet conditions using pumps and coffer dams to create dry conditions where construction is imminently occurring. Due to the construction conditions, it is desired to limit disturbance of vegetation. Since the low flow channel is similar to the calculated stable dimensions, grading was limited to intermittent floodplain excavation. In-channel structures such as rootwads and riffles are proposed to create a more diverse habitat.

The downstream end of Reach 3 includes a culvert replacement, with associated riprap and roadway modifications. This crossing is located to the west of the Alps Village and provides connectivity to this facility for the public and staff. The objective of the replacement is to improve channel conditions at the stream crossing and create a more efficient waterway opening. The improved waterway opening will match the channel bankfull width, reduce stream velocity to enhance conditions for fish passage, and reduce the likelihood of overtopping. Two existing 54” corrugated metal pipe (CMP) culverts at this location will be replaced with a precast concrete box culvert, which was chosen after consultation with stakeholders. The impact area for the culvert is estimated to be approximately 0.19 acres and 130 linear feet within the channel.

Reach 4 consists of two sites whose channels will be excavated to create floodplain benches. This expanded floodplain will contribute to the reduction of stream velocities and shear stress during large events, reducing sediment scour and providing more habitat. Sediment deposition will therefore likely be reduced in the downstream, rehabilitated reaches. Dewatering and other water management measures will not be required in this reach as it does not include in-stream features.

Two spoil sites will be used to temporarily store material from floodplain excavation while the remeandered stream is offline. This material will be used to fill the existing channel once vegetation has been established in the restored channel. A local spoil site adjacent to the floodplain will be used in Reach 4. An additional spoil site located near the Afton State Park entrance will be utilized for Reaches 1-3. Some material will be transported offsite by the selected contractor.

Construction is anticipated to start in the summer of 2022 and conclude in 2023. Initial earthwork will occur in 2022, with channel and floodplain excavation. Vegetation in the restored channel will be allowed to establish for one growing season before the existing channel is filled and the restored channel is moved online. If phased construction is required, some features may be constructed in 2023.

c. **Project magnitude:**

Total Project Acreage	18.01 acres
Linear project length	Approx. 0.77 miles (4,066 feet)
Number and type of residential units	0
Commercial building area (in square feet)	0
Industrial building area (in square feet)	0
Institutional building area (in square feet)	0
Other uses – specify (in square feet)	N/A
Structure height(s)	N/A

d. **Explain the project purpose; if the project will be carried out by a governmental unit, explain the need for the project and identify its beneficiaries.**

The project purpose aligns with the goals established by stakeholders early in the planning process:

- Increase longitudinal connectivity from the mouth to the crossing at St. Croix Trail South
- Improve water quality and increase floodplain connectivity in Trout Brook
- Increase in-stream habitat to improve biological communities in Trout Brook, mainly in pools
- Increase recreational and long-term educational opportunities for State Park users and the public in general
- Improvement both stream and ski functions
- Increase native terrestrial habitat to improve biological communities

The need for this Project is to address the many issues that are occurring that were mentioned above.

The beneficiaries to the Project include both aquatic and terrestrial ecological systems involving animal and plant populations in Trout Brook and the St. Croix River, upstream and downstream residents, visitors to Afton State Park and Afton Alps, and recreation as it pertains to potential trout fishing.

e. **Are future stages of this development including development on any other property planned or likely to happen? ☐ Yes ☑ No**
If yes, briefly describe future stages, relationship to present project, timeline and plans for environmental review.

f. **Is this project a subsequent stage of an earlier project? ☑ Yes ☐ No**
If yes, briefly describe the past development, timeline and any past environmental review.

The Project is Phase III of the Afton Alps Trout Brook Stream Restoration. Initial project planning began in 2012 and construction on Phase II was completed in 2019, as described above. An EAW was completed in 2017 prior to the Phase II restoration, sponsored by GRG and SWWD.

7. **Cover types:**
   Estimate the acreage of the site with each of the following cover types before and after development:

	Before	**After**		**Before**	**After**
Wetlands	1.84	1.83	Lawn/landscaping	0	0
Deep water/streams	1.35	1.42	Impervious surface	1.78	1.78
Wooded/forest	8.95	8.89	Stormwater Pond	0.02	0.02
Brush/Grassland	4.07	4.07	Other (describe)	0	0
Cropland	0	0			
			TOTAL	**18.01**	**18.01**

Approximately 0.01 acres of wetland will be converted from wetland to stream in the remeandering of Reach 1. 0.06 acres will transition from forest to stream with channel excavation in that same reach. Areas of disturbance adjacent to the stream will be restored to wooded/forest area after project completion but seeded with native vegetation before bringing the remeandered stream online.

8. Permits and approvals required:
List all known local, state and federal permits, approvals, certifications and financial assistance for the project. Include modifications of any existing permits, governmental review of plans and all direct and indirect forms of public financial assistance including bond guarantees, Tax Increment Financing and infrastructure. ***All of these final decisions are prohibited until all appropriate environmental review has been completed. See Minnesota Rules, Chapter 4410.3100.***

Unit of Government	Type of Application	Status
Federal		
US Army Corps of Engineers	Clean Water Act - Section 404 (Discharge of fill into waters of U.S.)	To be submitted
State (Minnesota)		
Minnesota Department of Natural Resources	Public Waters Work Permit (Change the course, current, or cross section of public waters)	To be submitted
	Water Appropriations Permit – Dewatering (if necessary)	To be submitted
Minnesota Pollution Control Agency	Clean Water Act - Section 401: Water Quality Standards	To be submitted
	National Pollution Discharge Elimination System (NPDES) permit (including Stormwater Pollution Prevention Plan (SWPPP))	To be submitted
Local		
Washington County	Grading and Filling Shoreland Alteration Permit	To be submitted
	Conditional Use Permit	To be submitted
South Washington Watershed District	Wetland Conservation Act	To be submitted

Cumulative potential effects may be considered and addressed in response to individual EAW Item Nos. 9-18, or the RGU can address all cumulative potential effects in response to EAW Item No. 19. If addressing cumulative effect under individual items, make sure to include information requested in EAW Item No. 19

9. Land use:

a. Describe:

i. Existing land use of the site as well as areas adjacent to and near the site, including parks, trails, prime or unique farmlands.

Most of the project area lies at the southern base of the Afton Alps ski and golf resort, a recreational facility in the northeast corner of Denmark Township. Afton State Park surrounds Afton Alps and the Project, with 1700 acres of native prairie, hardwoods, and blufflands. This park is popular for hiking, camping, wildlife viewing, cross-country skiing, swimming, and other aquatic recreation.

The general area includes of a mix of vegetation types including forest, prairie, and wetland plant communities. Pre-settlement vegetation was dominated by oak and aspen savanna, as well as tallgrass prairie to a lesser extent. Now much of the area upstream of Afton State Park is either developed with single-family housing and suburban land uses or farmed. Recreation is also significant along the St. Croix River. The current local land use of the project area includes ski recreation, forest, and hiking trails.

The entirety of the Project will be constructed on state park and resort property. Four acres of prime farmland based on soil type could be affected at the spoil site near the park entrance, though this area is on state park property and is not farmed.

ii. Plans. Describe planned land use as identified in comprehensive plan (if available) and any other applicable plan for land use, water, or resources management by a local, regional, state, or federal agency.

Trout Brook Management Plan: 2009

The *Trout Brook Management Plan* characterizes the stream and assesses its future needs (EOR, 2009). The plan identifies sites in or near the project area as channelized, entrenched, unstable, and with poor pool-riffle definition and habitat. The plan recommends improving the reach of Trout Brook through Afton Alps to improve the resource as a whole. This Project will accomplish that goal.

Denmark Township 2040 Comprehensive Plan: 2019

According to the *Denmark Township 2040 Comprehensive Plan*, the Metropolitan Council designates Denmark Township as Diversified Rural (Focus Engineering, Inc., 2019). This designation limits average densities to no more than one housing unit per ten acres. Denmark Township seeks to maintain the permanent rural character of the township by adhering to this policy. The Afton State Park portion of the project area is within the parks and open space zoning designation as part of the future land use plan. Afton Alps is zoned as rural residential. The rural residential designation allows the provision of opportunities

for new residential and commercial development consistent with the goals of the comprehensive plan. The Project is consistent with the goals of this plan as it enhances park and recreation areas of the Township and promotes the non-degradation of surface waters.

Washington County 2040 Comprehensive Plan: 2019

The *Washington County 2040 Comprehensive Plan* outlines goals and a vision for the county, with several sub-plans that are relevant to the Project. This plan iterates that land use authority is maintained by the township except for, as relevant to this project, shorelands and floodplains. The Project is compatible with Washington County's Comprehensive Plan by making progress toward several goals:

- Land Use Goal 1: Utilize land and related natural, cultural, and water resources in the shoreland and riverways so they are conserved for future generations
- Water Resources Goal 1: Manage the quality and quantity of water resources to protect human health and ensure sufficient supplies of clean water to support human uses and natural ecosystems for current and future generations
- Parks, Trails, and Open Space Goal 2: Protect, enhance, and provide access to precious public resources – our land, water, and open space – through conservation and stewardship
- Parks, Trails, and Open Space Goal 3: Provide opportunities for all people to connect to the outdoors by cultivating a welcoming environment, providing robust programming, and building partnerships
- Economic Competitiveness Goal 1: Promote and market the quality of life, rich diversity, and assets of the county

Lower St. Croix Comprehensive Watershed Management Plan (CWMP): 2020

The Lower St. Croix CWMP is a joint effort between four counties, five Soil and Water Conservation Districts (SWCD), two watershed management organizations (WMO), and four watershed districts (WD) to formulate a comprehensive watershed plan addressing water management within and beyond the South Washington Watershed District (Lower St. Croix Watershed Partnership, 2020). This multi-year planning effort strategizes solutions for water quality, quantity, and land use issues for the next 10 years and replaces local county water management plans. Trout Brook is listed as a Regionally Significant Stream and attributed specific actions such as those that reduce phosphorus and sediment. Trout Brook is specifically targeted as a trout stream in need of restoration and bank stabilization. This Project will contribute directly to these goals for Trout Brook as listed in the CWMP.

iii. Zoning, including special districts or overlays such as shoreland, floodplain, wild and scenic rivers, critical area, agricultural preserves, etc.

The project area is designated as a Shoreland Management District by Denmark Township and Washington County. Trout Brook is subject to the Washington County Development Code Chapter 6: Shoreland Management Regulations as a Tributary Stream. The portion of the project in Afton State Park is in land designated as a Conservancy use.

Most of the project is within 100-Year Floodplain (Zone A) on FEMA Flood Insurance Rate Map Number 2716C0431E, effective 2/3/2010 (**Exhibit 6**). Therefore, the project is subject to Washington County Development Code Chapter 9.

b. Discuss the project's compatibility with nearby land uses, zoning, and plans listed in Item 9a above, concentrating on implications for environmental effects.

The Project is compatible with nearby land uses, zoning, and plans as described in Item 9.a, and is specifically recommended by several of the plans. The Project will provide a net benefit to the environment by restoring the channel and adjacent riparian land (helping to meet water quality goals of local plans) and improving trout habitat.

c. Identify measures incorporated into the proposed project to mitigate any potential incompatibility as discussed in Item 9b above.

There are no mitigation measures proposed as this is a natural resource enhancement project that is compatible with local land uses, zoning, and plans.

10. Geology, soils and topography/landforms:

a. **Geology - Describe the geology underlying the project area and identify and map any susceptible geologic features such as sinkholes, shallow limestone formations, unconfined/shallow aquifers, or karst conditions. Discuss any limitations of these features for the project and any effects the project could have on these features. Identify any project designs or mitigation measures to address effects to geologic features.**

Within the project area, elevations range between approximately 680 and 760 feet above sea level. The project area is located in the Eastern Broadleaf Forest Ecological Province, St. Paul-Baldwin Plains and Moraines Subsection (DNR, n.d.). This region consists of a Superior lobe end moraine complex. The underlying bedrock of the of Trout Brook is covered by approximately 0 to 100 feet of glacial deposits. Sediments are generally gravelly sand deposited by glacial River St. Croix, with some calcareous till and loamy sand upstream (Minnesota Geological Survey, 1982) (Stanley, 2016).

The Project is located within the karstic region of Minnesota. Formations underneath, and sometimes at the surface of, the project area include Jordan Sandstone, St. Lawrence Formation, and Tunnel City Group. Karst-prone areas occur between 0 and 800 feet from the project boundary, surrounding the floodplain of Trout Brook, with some karst-prone area overlapping the northeastern boundary. These areas are comprised of Oneota Dolomite and Shakopee Formation of the Prairie du Chien Group, overlain by carbonate or sandstone bedrock with less than 50 feet of sediment cover (DNR, 2020b). Identified karstic features lie at least one mile from the project area (DNR, 2020a).

The Project is not anticipated to impact karst-prone features and surficial deposits are compatible with the requirements of the project.

b. **Soils and topography - Describe the soils on the site, giving NRCS (SCS) classifications and descriptions, including limitations of soils. Describe topography, any special site conditions relating to erosion potential, soil stability or other soils limitations, such as steep slopes, highly permeable soils. Provide estimated volume and acreage of soil excavation and/or grading. Discuss impacts from project activities (distinguish between construction and operational activities) related to soils and topography. Identify measures during and after project construction to address soil limitations including stabilization, soil corrections or other measures. Erosion/sedimentation control related to stormwater runoff should be addressed in response to Item 11.b.ii.**

The Project is situated on the northern edge of the Western Corn Belt Plains EPA Level III ecoregion and the Lower St. Croix and Vermillion Valleys Level IV ecoregion, bordering the North Central Hardwood Forests. The topography is generally rolling with steep slopes defining portions of the channel banks. The project area is composed of soil types with slopes ranging between zero and sixty percent. Chaska silt loam, the primary soil type, has a slope of 0-2 percent, is poorly drained, and is prone to flooding. Both rock outcrop complexes are moderately to well-drained.

Soil units within project boundaries as defined by the United States Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) Web Soil Survey are shown in **Table 1** and **Exhibit 7.** This soil data includes soil hydrologic groups that communicate soil runoff

potential. Runoff potential is based on the rate of water infiltration of soils that are unvegetated, wet, and receive precipitation during long duration storm events. The hydrologic groups include A, B, C, or D in which 'A' represents low runoff potential and 'D' represents highest runoff potential. The soils within the Trout Brook corridor are largely characterized by moderate to high runoff potential. The soil textures within the project area consist mainly of silt loam.

Table 1: Trout Brook Restoration Soil Units and Farmland Classifications with Hydrologic Soil Grouping

Map Unit Symbol	Map Unit Name	Prime Farmland Classification	Hydrologic Soil Group	Acres	Percent of Project Area
329	Chaska silt loam	Not prime farmland	B/D	10.94	60.8 %
1819F	Dorerton-Rock outcrop complex, 25 to 65 percent slopes	Not prime farmland	B	2.81	15.6 %
2B	Ostrander silt loam, 2 to 6 percent slopes	All areas are prime farmland	B	2.09	11.6 %
340C	Whalan silt loam, 6 to 12 percent slopes	Farmland of statewide importance	C	1.98	11.0 %
1820F	Mahtomedi variant-Rock outcrop complex, 25 to 65 percent slopes	Not prime farmland	A	0.18	1.4 %
488F	Brodale flaggy loam, 20 to 50 percent slopes	Not prime farmland	B	0.002	0.01 %

Soil Impacts and Mitigation Measures

The Project will not result in significant adverse effects to soil resources within the project area. Cut and fill activities would occur along all reaches of the Project, which would disrupt the soil horizons. The project estimates 8,500 cubic yards of soil excavation and/or grading for the channel modifications and the culvert replacement. However, this disturbance is anticipated to be temporary as the soils and topography will be rehabilitated to that of the original historical condition with associated environmental benefits. The primary concern regarding soils and the Project will be when the soils are exposed to the elements and weathering during and just after construction. The potential for runoff and erosion will be mitigated by installing and maintaining sediment and erosion control measures.

The proposed project will help mitigate the generally moderate to high erosion potential of the soils within the project area over the long term. The Project will not have permanent operational impacts.

Soil excavated from the proposed channel will be stockpiled at the spoil site (**Exhibit 3**) for one growing season to allow the newly constructed channel to vegetate. The stockpile will be seeded with temporary cover vegetation and be contained by silt fence. In the next growing season, the soil will be used to fill the existing channel, as the newly constructed channel is brought online. Approximately 6,800 CY of material may be removed from the site and disposed of by the contractor in accordance with the National Pollutant Discharge Elimination System (NPDES) Stormwater Pollution Prevention Plan (SWPPP), as described in Item 11.b.ii.

NOTE: For silica sand projects, the EAW must include a hydrogeologic investigation assessing the potential groundwater and surface water effects and geologic conditions that could create an increased risk of potentially significant effects on groundwater and surface water. Descriptions of water resources and potential effects from the project in EAW Item 11 must be consistent with the geology, soils and topography/landforms and potential effects described in EAW Item 10.

11. Water resources:

a. **Describe surface water and groundwater features on or near the site in a.i. and a.ii. below.**

i. Surface water - lakes, streams, wetlands, intermittent channels, and county/judicial ditches. Include any special designations such as public waters, trout stream/lake, wildlife lakes, migratory waterfowl feeding/resting lake, and outstanding resource value water. Include water quality impairments or special designations listed on the current MPCA 303d Impaired Waters List that are within 1 mile of the project. Include DNR Public Waters Inventory number(s), if any.

A wetland survey was conducted in October 2021 (**Appendix C**). Results of the field delineations indicate there is one wetland area (1.84 acres) and one linear watercourse (approximately 3,362 linear feet) within the 11.24-acre survey area (**Exhibit 9**). The aquatic resource classifications include Type 1 seasonally flooded floodplain wetland (PFO1A) which is a forested floodplain to the St. Croix River, and the intermittent trout stream and Minnesota Public Water (PWI ID 82028a), Trout Brook, respectively. The wetland appears to have a surface connection to the St. Croix River, the nearest traditional navigable water or water body, as well as Trout Brook, which flows into the St. Croix. Also identified as part of the wetland delineation was a small stormwater feature that appears to collect runoff from the ski slopes prior to discharging into Trout Brook.

Trout Brook is an approximately 6-mile-long designated trout stream (Minnesota Rules 6264.0050) that begins on farmland as an intermittent stream, north of 50th Street South in Afton (**Exhibit 8**). The stream drains into the St. Croix River within Afton State Park, approx. 900 feet downstream from the easternmost project boundary. The total Trout Brook drainage area is approximately 4890 acres (EOR, 2009). Groundwater flows out of the bedrock and into Trout Brook. The stream has a slightly meandering course in some places, has been straightened as it flows through the Afton Alps property, and crosses through floodplain wetlands as it flows to the east, eventually reaching the St. Croix River.

Trout Brook is impaired for aquatic recreation due to *Escherichia coli (E. coli)*. In addition, the Lake St. Croix Nutrient Total Maximum Daily Load (TMDL) report identifies Trout Brook as a contributing stream to help meet the phosphorus reduction goal for the St. Croix River (Lower St. Croix Watershed Partnership, 2020) (MPCA, 2012).

A DNR watershed geomorphic study estimated in-channel sources of sediment and extrapolated those estimates to the perennial flowing portion of Trout Brook. Streambank erosion can be a significant contribution to the sediment load. The two segments of the project area located upstream of Afton Alps are considered *moderately unstable* but very close to *stable*. The highest erosion rate in the watershed is in the lower Afton State Park reach, estimated at 0.03 tons/yr/ft. This reach is classified as *moderately unstable*, though it is close to *unstable*. Direct input from streambank erosion is relatively low in the upper State

Park and Afton Alps reaches. Trout Brook lacks in-channel habitat that will support a wide range of aquatic life. The primary problem is sand bedload burying the riffles that provide gravel habitat and deep pools.

ii. Groundwater – aquifers, springs, seeps. Include: 1) depth to groundwater; 2) if project is within a MDH wellhead protection area; 3) identification of any onsite and/or nearby wells, including unique numbers and well logs if available. If there are no wells known on site or nearby, explain the methodology used to determine this.

Groundwater is at or near the surface in much of the project area. According to a 2002 water resource evaluation conducted for Washington County, seeps occur predominantly along the perennial sections of Trout Brook, especially in the lower reaches and the historic stream channel (Washington Conservation District, 2002). There are several springs mapped by this study within the lower reach of Trout Brook at the base of Afton Alps, likely within project boundaries (Washington Conservation District, 2002).

Bedrock aquifers underlying the project sites include the Prairie du Chien-Jordan Aquifer and the Franconia-Ironton-Galesville Aquifer. Surficial aquifers occur less than a mile but greater than 100 feet to the northeast and south of the Project.

There are 139 wells listed in the MDH Well Index (2021) within a one-mile buffer of the project site (**Exhibit 8**). The eleven nearest wells, those between 200 and 1000 feet outside the project boundary, largely belong to Afton Alps or Afton State Park, with three USGS monitoring wells. One private, residential well occurs southwest of the Project, approximately 800 feet from project boundaries. These wells include numbers 00216161, 00216162, 00216163, 00235365, 00249840, 00249848, 00618207, 00698186, 00761628, 00761629, and 00795481. The Project does not occur near an MDH wellhead protection area.

b. Describe effects from project activities on water resources and measures to minimize or mitigate the effects in Item b.i. through Item b.iv. below.

i. **Wastewater - For each of the following, describe the sources, quantities and composition of all sanitary, municipal/domestic and industrial wastewater produced or treated at the site.**

No sanitary, municipal/domestic, or industrial wastewater will be produced or treated at the project site.

1) If the wastewater discharge is to a publicly owned treatment facility, identify any pretreatment measures and the ability of the facility to handle the added water and waste loadings, including any effects on, or required expansion of, municipal wastewater infrastructure.

Not applicable.

2) If the wastewater discharge is to a subsurface sewage treatment system (SSTS), describe the system used, the design flow, and suitability of site conditions for such a system.

Not applicable.

3) **If the wastewater discharge is to surface water, identify the wastewater treatment methods and identify discharge points and proposed effluent limitations to mitigate impacts. Discuss any effects to surface or groundwater from wastewater discharges.**

Not applicable.

ii. **Stormwater - Describe the quantity and quality of stormwater runoff at the site prior to and post construction. Include the routes and receiving water bodies for runoff from the site (major downstream water bodies as well as the immediate receiving waters). Discuss any environmental effects from stormwater discharges. Describe stormwater pollution prevention plans including temporary and permanent runoff controls and potential BMP site locations to manage or treat stormwater runoff. Identify specific erosion control, sedimentation control or stabilization measures to address soil limitations during and after project construction.**

All stormwater at the project site is received by Trout Brook, which flows to the nearby St. Croix River. A large majority of the surrounding area is pervious land, though much of the contributing area from the ski resort consists of manicured turfgrass which can increase runoff from historical vegetative conditions. The additional snowmelt from this area also extends and expands spring run-off beyond typical conditions for the region during this season (EOR, 2009). The effects of this phenomenon have not been studied but will be considered in project design as it impacts streamflow into the channel.

Erosion control measures will be employed during the remeandering of the stream to prevent unwanted erosion. The floodplain reconnections and remeandering of the stream will reduce sedimentation and the need for frequent maintenance to remove sediment from Trout Brook within the Afton Alps property. During the preparation of construction plans and specifications, a SWPPP will be prepared in accordance with the current NPDES General Permit for Storm Water Discharges Associated with Construction Activities. The SWPPP will include erosion and sediment control measures which will be applied. Because these soils are susceptible to erosion, best management practices (BMP) for controlling sediment will be utilized during the construction phase.

During construction, BMPs for erosion and sedimentation control will include, but are not limited to, sediment control logs, silt curtains, filter berms, bale barriers, ditch checks, erosion control blankets, and silt fences. Erosion and sedimentation controls will be utilized to avoid impacts to adjacent land and impacts to wetland areas. Following construction, restoration of impacted areas will include grading/leveling and replanting with native vegetation. Disposal of all excess materials and debris from construction will occur in accordance with state and county regulations.

iii. **Water appropriation - Describe if the project proposes to appropriate surface or groundwater (including dewatering). Describe the source, quantity, duration, use**

and purpose of the water use and if a DNR water appropriation permit is required. Describe any well abandonment. If connecting to an existing municipal water supply, identify the wells to be used as a water source and any effects on, or required expansion of, municipal water infrastructure. Discuss environmental effects from water appropriation, including an assessment of the water resources available for appropriation. Identify any measures to avoid, minimize, or mitigate environmental effects from the water appropriation.

The project does not anticipate appropriation of surface or groundwater. Dewatering may be necessary for reaches 1, 2, and 3. If dewatering is required, it is anticipated to be under the permit threshold of withdrawing more than 10,000 gallons of water per day or one million gallons per year and would not require a water use appropriation permit. If required, the dewatering would comply with the Minnesota Pollution Control Agency (MPCA) SWPPP and discharged in a manner that does not create nuisance conditions or adversely affect the receiving water or downstream properties.

iv. **Surface Waters**

a) Wetlands - Describe any anticipated physical effects or alterations to wetland features such as draining, filling, permanent inundation, dredging and vegetative removal. Discuss direct and indirect environmental effects from physical modification of wetlands, including the anticipated effects that any proposed wetland alterations may have to the host watershed. Identify measures to avoid (e.g., available alternatives that were considered), minimize, or mitigate environmental effects to wetlands. Discuss whether any required compensatory wetland mitigation for unavoidable wetland impacts will occur in the same minor or major watershed and identify those probable locations.

Approximately 0.01 acres of wetland will be converted from wetland to stream. However, wetland within the floodplain may establish adjacent to the new channel area. These impacts are considered to be of overall benefit to the stream, its floodplain, and associated wetlands, as habitat will improve throughout the project area.

b) Other surface waters- Describe any anticipated physical effects or alterations to surface water features (lakes, streams, ponds, intermittent channels, county/judicial ditches) such as draining, filling, permanent inundation, dredging, diking, stream diversion, impoundment, aquatic plant removal and riparian alteration. Discuss direct and indirect environmental effects from physical modification of water features. Identify measures to avoid, minimize, or mitigate environmental effects to surface water features, including in-water Best Management Practices that are proposed to avoid or minimize turbidity/sedimentation while physically altering the water features. Discuss how the project will change the number or type of watercraft on any water body, including current and projected watercraft usage.

The purpose of the project is to alter Trout Brook from a degraded straightened channel to a more naturalized meandered system. Water quality will be enhanced by reducing sediment and nutrient loading to the creek, improving natural waterway

drainage and wildlife habitat along the stream corridor, and reducing sediment loading downstream. Some expansion of riparian buffers is anticipated to decrease turbidity within the stream. The riparian habitat will be enhanced by stabilizing the banks which will help with the loss of habitat over time due to erosion. The return of flow to the historic channel with existing wetlands and riparian buffer areas also establishes natural habitat areas for a variety of plant and animal species. The proposed action aims to improve water quality, resulting in improved aquatic habitat for trout, other native fish, and macroinvertebrate species. The current straightened channel is ineffective in maintaining sediment transport continuity through the Afton Alps site, resulting in deposition on gravel substrate and the need for frequent channel maintenance. The proposed channel has been analyzed and modeled so that the design is anticipated to provide sediment continuity through the site, maintaining the geomorphology as intended and eliminating maintenance needs. Finally, the proposed project will improve fish habitat, installing and utilizing pools, riffles, and large wood to support healthy trout populations.

Sediment/erosion control will be a requirement of any construction contract awarded for this project. BMPs for erosion and sedimentation control during construction will include, but are not limited to, sediment control logs, erosion control blankets, and silt fences. Erosion and sedimentation controls will be utilized to avoid impacts to adjacent land and impacts to wetland areas. Limiting the duration and extent of exposed soils will also limit erosion potential.

Trout Brook is not typically used for recreational watercraft.

12. Contamination/Hazardous Materials/Wastes:

a. **Pre-project site conditions - Describe existing contamination or potential environmental hazards on or in close proximity to the project site such as soil or ground water contamination, abandoned dumps, closed landfills, existing or abandoned storage tanks, and hazardous liquid or gas pipelines. Discuss any potential environmental effects from pre-project site conditions that would be caused or exacerbated by project construction and operation. Identify measures to avoid, minimize or mitigate adverse effects from existing contamination or potential environmental hazards. Include development of a Contingency Plan or Response Action Plan.**

The MPCA's *What's in My Neighborhood* online database identifies potentially contaminated sites and environmental hazards within Minnesota. According to this database, there are nine permits or potentially contaminated sites within a one-mile radius of the project site. These sites include five active stormwater permits, two petroleum remediation sites, and one site with multiple activities. Five sites occur on or near Afton Alps or State Park property, with one located near project boundaries. The latter is the construction stormwater permit for Phase II of the Trout Brook Stream Restoration Project, which will be completed prior to construction of Phase III. There are no active cleanup sites and all previous sites have received site closure letters from MPCA (See **Exhibit 10**).

b. **Project related generation/storage of solid wastes - Describe solid wastes generated/stored during construction and/or operation of the project. Indicate method of disposal. Discuss potential environmental effects from solid waste handling, storage and disposal. Identify measures to avoid, minimize or mitigate adverse effects from the generation/storage of solid waste including source reduction and recycling.**

Safe handling, storage, and disposal of solid waste would be a requirement of any construction contract awarded for this project. Some excavated soils will need to be disposed of offsite, with the location to be determined by the contractor in accordance with the SWPPP. Any waste for project materials such as erosion control materials or plant packaging will be disposed of through existing trash hauling companies as a responsibility of the contractor.

c. **Project related use/storage of hazardous materials - Describe chemicals/hazardous materials used/stored during construction and/or operation of the project including method of storage. Indicate the number, location and size of any above or below ground tanks to store petroleum or other materials. Discuss potential environmental effects from accidental spill or release of hazardous materials. Identify measures to avoid, minimize or mitigate adverse effects from the use/storage of chemicals/hazardous materials including source reduction and recycling. Include development of a spill prevention plan.**

Fuel and lubricants necessary for the use of construction equipment will be the only toxic or hazardous materials present on the project site. No above- or below-ground storage tanks are planned for permanent use in conjunction with the Project. Temporary storage tanks for petroleum products may be located in the project area for refueling equipment during construction. Refueling will occur away from surface waters. A spill kit will be kept near any storage tanks. Safe handling, storage, and disposal of hazardous materials will be a requirement of any construction contract awarded for this project. Immediate action will be taken in accordance with MPCA and guidelines if a spill were to occur during construction, as prepared in

the contractor's Spill Prevention and Response Plan. Spills will be reported to the Project Engineer, Minnesota Duty Officer, MPCA, and Washington County.

d. **Project related generation/storage of hazardous wastes - Describe hazardous wastes generated/stored during construction and/or operation of the project. Indicate method of disposal. Discuss potential environmental effects from hazardous waste handling, storage, and disposal. Identify measures to avoid, minimize or mitigate adverse effects from the generation/storage of hazardous waste including source reduction and recycling.**

The project is largely a channel restoration and is not expected to generate any hazardous wastes.

13. Fish, wildlife, plant communities, and sensitive ecological resources (rare features):

a. Describe fish and wildlife resources as well as habitats and vegetation on or in near the site.

Afton State Park is set in rolling glacial moraine and bluffland, with oak savanna and remnant prairie (DNR, 2021a). Most of the Afton Alps property within the project area is mowed or otherwise maintained for ski resort purposes. Plant communities in the project area include upland forest and floodplain forest wetlands (**Appendix C)**. The tree species are *Salix nigra* (black willow), *Fraxinus pennsylvanica* (green ash), and *Acer saccharinum* (sugar maple). Shrubs include *Frangula alnus*, (glossy buckthorn), and *Phalaris arundinacea (*reed canarygrass) in the herbaceous layer. Habitat in the floodplain creation areas is typical of the woodland community within Afton State Park. Common wildlife includes deer, fox, badgers, thirteen-lined ground squirrel, turkeys, gray and fox squirrels.

Instream habitat within the Afton Alps property has been negatively impacted by channelization of the stream. Sedimentation, scouring, and high stream velocity during storm event results from this more pipe-like stream than a natural stream with pools, connections to floodplains, natural substrates such as overhanging vegetation and wood, and sediment flow. Additionally, existing culverts within the property act as fish barriers since the stream has eroded down from where the stream substrate was when the culverts were installed. The stream degradation reduces the number of microhabitats suitable for trout and other aquatic wildlife.

DNR Fisheries typically sample the Trout Brook fish populations on a four-year rotation. Results have indicated a limited fish community in terms of both diversity and abundance (Houston Engineering, Inc., 2021). However, recent fish surveys have found higher numbers of brown trout and located them further upstream than in past sampling efforts. Given the small drainage area, the MPCA does not sample fish and invertebrates to determine if Trout Brook meets its aquatic life usage parameters.

A tree inventory for the Project was completed in the fall of 2021. The tree survey focused on all trees that were 10 inches DBH (diameter at breast height) or larger, including both living and dead trees. In total, 239 trees were identified, surveyed, and measured. **Table 2** below summarizes the results of the tree survey. Because we identified only species with a DBH of 10 inches or higher would be inventoried, please note that other species were observed throughout the project area, but due to their smaller size they were not captured as part of this inventory.

Table 2: Trout Brook Restoration Phase III Tree Inventory Results (2021)

Tree species	**Count**	**Range in DBH inventoried (inches)**
Green ash	10	10.00 – 14.25
Basswood	2	11.25 – 14.00
Black Cherry	1	10.00
Boxelder	12	10.00-19.00
Burr Oak	5	12.25 – 19.00
Cedar	1	12.00
Cottonwood	70	10.00 – 53.25
Dead	12	10.5 – 28.50
Elm	12	10.5 – 18.25

Locust	1	27.00
Maple	33	10.00 – 26.25
Red Oak	1	15.25
Red Cedar	3	10.75 – 15.00
Slippery Elm	1	14.00
Quaking Aspen	1	12.75
Willow	68	10.5 – 40.00

b. Describe rare features such as state-listed (endangered, threatened or special concern) species, native plant communities, Minnesota County Biological Survey Sites of Biodiversity Significance, and other sensitive ecological resources on or within close proximity to the site. Provide the license agreement number (LA-1049) and/or correspondence number (ERDB _____) from which the data were obtained and attach the Natural Heritage letter from the DNR. Indicate if any additional habitat or species survey work has been conducted within the site and describe the results.

The Project is located within the Eastern Broadleaf Forest Province, St. Paul-Baldwin Plains and Moraines Subsection according to the DNR and US Forest Service Ecological Classification System (DNR, n.d.). Afton State Park is a protected area for habitat and recreation and is home to three Minnesota Biological Survey (MBS) Sites of Biodiversity Significance and four types of native plant communities (NPC) that overlap the project area (**Exhibit 11**). These sites are largely along the riparian zones of Trout Brook and the St. Croix River and in nearby forested areas. NPCs within the project area are associated with MBS sites and overlap some rare species occurrences (DNR, n.d.). NPCs that the Project would overlap are detailed in **Table 3**.

Table 3: Native Plant Communities near the Trout Brook Restoration Project

NPC Code	NPC Description	Total Community Acres
MHc38a	White Pine - Sugar Maple - Basswood Forest (Cold Slope)	20.42
UPs13	Southern Dry Prairie	128.57
FFs68a	Silver Maple - (Virginia Creeper) Floodplain Forest	38.43
FDs37a	Oak - (Red Maple) Woodland	88.89

There are 149 Species in Greatest Conservation Need (SGCN) known or expected to occur within the St. Paul-Baldwin Plains and Moraines Subsection (DNR, 2006). Of the 149 SGCN, 74 are federally or state listed as endangered, threatened, or of special concern. Four SGCN species, the gopher snake (*Pituophis catenifer*), peregrine falcon (*Falco peregrinus*), red-shouldered hawk (*Buteo lineatus*), and rusty patched bumble bee (*Bombus affinis*), have been recorded in the DNR Natural Heritage Information System (NHIS; LA-1049) overlapping the project boundary. The NHIS database tracks sightings of rare, threatened, and endangered species of concern over time and locates these sightings within a potential habitat buffer. Twenty-five rare species in total were identified by the NHIS database within a one-mile buffer of the Project, with six species potentially overlapping the project boundary. These species, the date they were last observed, and their general location are described in **Table 4** and shown in **Exhibit 12**.

Table 4: Rare and Sensitive Species within One Mile of the Project (NHIS, 2021)

Scientific Name	Common Name	Group	General Location	Status	Last Observed
Ammodramus henslowii	Henslow's Sparrow	Bird	North End of Afton State Park	SGCN/ Federally Endangered	2001
Asplenium platyneuron	Ebony Spleenwort	Plant	Unknown, but within one mile	State Special Concern	2019
Baptisia lactea var. lactea	White Wild Indigo	Plant	Habitat possibly overlaps project boundary; sighted along the St. Croix River	State Special Concern	1976
Besseya bullii	Kitten-tails	Plant	Unknown, but within one mile	State Threatened	1987
Bombus affinis	Rusty-patched Bumble Bee	Insect	Habitat possibly overlaps project boundary	SGCN/ Federally Endangered	1993
Botrychium oneidense	Blunt-lobed Grapefern	Plant	Deer trail up a steep, east-facing bluff in sparse grasses under oaks	State Threatened	2018
Buteo lineatus	Red-shouldered Hawk	Bird	Habitat possibly overlaps project boundary, but sighting was near the St. Croix River	SGCN	1996
Crocanthemum canadense	Canada Frostweed	Plant	Unknown, but within one mile	State Special Concern	1940
Crotalaria sagittalis	Rattlebox	Plant	Unknown, but within one mile	State Special Concern	1991
Crotalus horridus	Timber Rattlesnake	Reptile	Unknown, but within one mile	SGCN	1965
Eurynia dilatata	Spike	Mussel	Unknown, but within one mile	SGCN	2003
Falco peregrinus	Peregrine Falcon	Bird	Habitat possibly overlaps project boundary	SGCN	1940
Hesperia leonardus leonardus	Leonard's Skipper	Insect	Railroad tracks near St. Croix River in Afton State Park		1974
Juglans cinerea	Butternut	Plant	On an east-facing bluff above river	State Endangered	2000
Lampsilis higginsii	Higgins Eye	Mussel	St. Croix River	SGCN/ Federally Endangered	2010
Necturus maculosus	Mudpuppy	Amphibian	St. Croix River	SGCN	2016
Paronychia fastigiata var. fastigiata	Forked Chickweed	Plant	Northeast of project area	State Endangered	1981
Pituophis catenifer	Gopher snake	Reptile	Possibly within project boundary, along hiking trail near Trout Brook	SGCN	1994
Pleurobema sintoxia	Round Pigtoe	Mussel	St. Croix River	SGCN	2013
Psathyrella cystidiosa	A Species of Fungus	Fungus	Habitat possibly overlaps project boundary		1999
Ruellia humilis	Wild Petunia	Plant	Within Afton State Park, northwest of the project area, dry-mesic grassland habitat on margin of dry-mesic woodlands	State Special Concern	2005
Sagittaria calycina var. calycina	Hooded Arrowhead	Plant	St. Croix River	State Threatened	2012
Usnea mutabilis	Bloody Beard Lichen	Lichen	Large, north-facing sandstone outcrop adjacent to Trout Brook	State Threatened	2015
Usnea rubicunda	Red Beard Lichen	Lichen	Unknown, but within one mile	State Special Concern	2014
Vireo bellii	Bell's Vireo	Bird	Unknown, but within one mile	SGCN	2014

The USFWS Information for Planning and Consultation (IPaC) system identified six additional, potential threatened and endangered (T&E) species within the project boundary, *Myotis septentrionalis* (northern long-eared bat), *Danaus plexippus* (monarch butterfly), and four mussels. There are no critical habitats in the project area. The DNR/USFWS is monitoring the northern long-eared bat throughout the state of Minnesota and regularly publishes a list of townships in Minnesota known to contain northern long-eared bat roost trees and/or hibernacula which was last updated June 7, 2021 (DNR and USFWS, 2021). Two hibernacula are located in Washington County, one in T28N R22W in the central west of the county, sharing the border with Ramsey County, and the other in T32N R19W, in the very northeast of the county near William O'Brien State Park.

Bombus affinis (rusty-patched bumble bee) was observed according to the NHIS near the project area in 1993. Rusty-patched bumble bees nest or winter in prairie remnants, Maple-Basswood Forest, Oak-Hickory Forest, and within 30 meters of these habitats, and forage in Silver Maple-Floodplain Forest (USFWS, 2019). While this species is not listed on IPaC as being prevalent in this area, the conditions are favorable for its presence.

The monarch butterfly was recently added as a candidate species to the Endangered Species Act (ESA) T&E list. Candidate species are under consideration for listing, having sufficient data to support that listing. While monarchs have a broad range and migrate annually, they require milkweed and native prairie plants for sustenance, which are in decline and may be located in the Southern Dry Prairie near the Project.

Endangered mussel habitat in this area is likely in the St. Croix River, within a mussel community at least 40 river miles upstream of Trout Brook, between Taylors Falls and Franconia (DNR, n.d.). Erosion and sedimentation due to project construction should not affect this community but instream erosion mitigation measures will be implemented to prevent temporary impacts. Restoration of Trout Brook should improve long-term potential mussel habitat due to reductions in sediment contributions to the St. Croix River.

Eight birds protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act are listed for potential presence within the project boundary, *Haliaeetus leucocephalus* (Bald Eagle), *Coccyzus erythropthalmus* (Black-billed Cuckoo), *Antrostomus vociferus* (Eastern Whip-poor-will), *Ammodramus henslowii* (Henslow's Sparrow), *Protonotaria citrea* (Prothonotary Warbler), *Dolichonyx oryzivorus* (Bobolink), *Melanerpes erythrocephalus* (Red-headed Woodpecker), and *Hylocichla mustelina* (Wood Thrush).

c. Discuss how the identified fish, wildlife, plant communities, rare features and ecosystems may be affected by the project. Include a discussion on introduction and spread of invasive species from the project construction and operation. Separately discuss effects to known threatened and endangered species.

Fish, wildlife, plant communities, rare features, and ecosystems described in the above section may be impacted locally, primarily within the project corridor, during construction of the project. However, the project is expected to improve the overall, long-term ecological integrity of the

habitats in or adjacent to the project. The project is located adjacent to a commercial recreation facility and near agricultural land that has been altered from its pre-settlement conditions.

Native plant communities and MBS sites of moderate biodiversity significance may be affected directly by project features and indirectly in areas disturbed by construction equipment. An estimated 100 trees identified in the tree survey will be impacted by project disturbances. These trees consist of cottonwoods, willow, maple, boxelder, ash, and elm. Where the drip line of trees outside the excavation area is disturbed due to excavation, trees outside but adjacent to the excavation area will be cleared. The majority of impacts will occur in the State Park reaches, 1 and 4. These effects would be temporary, as vegetation will be restored with native species after construction. Construction would avoid NLEB pup season as described below.

The goal of the Project is to improve stream function that will provide better instream, floodplain, and riparian habitat for fish and wildlife. There may be temporary instream disturbance to aquatic species and to terrestrial species within riparian forests and wetlands. Measures will be taken to avoid or minimize these temporary impacts. Project activities will avoid all species of special concern, if possible, but currently no permits are required. These species are monitored by the DNR, along with federally listed T&E species.

Project construction will include measures to prevent the introduction and spread of invasive species. The DNR has instituted a variety of policy, practices, and educational programs to reduce the spread and minimize the impact of this invasive species (DNR, 2021b). BMPs for prevention of noxious and invasive plants and animals will be a requirement of any construction contract awarded for this project. These include, but are not limited to minimizing soil disturbance, equipment cleaning, weed-free gravel, rock, and mulch, and reseeding with native species. Special precaution will be taken to prevent the spread of the identified aquatic invasive species to other waterbodies.

It is possible that the NLEB may use some of the mature trees in the project area during the summer months though there is no designated critical habitat present within the project area for this species. The USFWS 4(d) Rule determines regulatory requirements for projects conducted within NLEB habitat (USFWS, 2021). According to the USFWS 4(d) Rule, "the northern long-eared bat 4(d) rule prohibits incidental take that may occur from tree removal activities within 150 feet of a known occupied maternity roost tree during the pup season (June 1 to July 31) or within a 1/4 mile of a hibernation site, year-round" (USFWS, 2021). There are no known maternity roosts in Washington County and the two hibernacula are greater than eight miles from the Project.

The rusty-patched bumble bee is active above-ground between March 15 and October 15 and nests over winter (USFWS, 2019). Earthwork could disturb or destroy underground nests.

d. Identify measures that will be taken to avoid, minimize, or mitigate adverse effects to fish, wildlife, plant communities, and sensitive ecological resources.

The purpose of this project is to restore Trout Brook which will improve habitat instream and in the surrounding area. Construction timing will supplement efforts to minimize adverse effects to fish, wildlife, plant communities, and sensitive ecological resources. DNR Fisheries exclusion dates for working in trout streams are Sept. 1 to April 1.

No trees will be modified or removed from June 1 through July 31 to avoid NLEB pup season. Trees requiring protections will be identified and fences will be placed to protect branches, foliage, and the critical root zone.

To avoid impacts to vegetative habitat, construction staging and site access will occur in areas that require minimal clearing. The Project will avoid north-facing outcrops to prevent impacts to state-listed lichens. Graded areas will be reseeded with an approved native plant mix to provide stabilization and minimize erosion. Material removed during grading would be placed in an approved placement site. If an approved placement site is not utilized, the site will be coordinated with appropriate state and federal agencies to ensure that material placement would not result in any significant, adverse impacts.

Because excavation will largely occur largely instream and staging and access will avoid vegetation-clearing to the extent possible, impacts to the rusty-patched bumble bee would be minimized. If a threatened, endangered, rare, or sensitive species is found at the project site, construction will halt, and the proper authorities will be contacted while a plan is prepared before proceeding.

Mitigation measures to prevent the spread of invasive species will be taken as part of construction activities. Some measures that will be performed include on-site treatments such as draining water from equipment, power washing, or hot water treatment. The restoration of disturbed ground and vegetative cover would include planting of native vegetative species to encourage/enhance the vegetative cover and reduce any spread of invasive species.

14. **Historic properties:**
Describe any historic structures, archeological sites, and/or traditional cultural properties on or in close proximity to the site. Include: 1) historic designations, 2) known artifact areas, and 3) architectural features. Attach letter received from the State Historic Preservation Office (SHPO). Discuss any anticipated effects to historic properties during project construction and operation. Identify measures that will be taken to avoid, minimize, or mitigate adverse effects to historic properties.

An archaeological review will be completed winter 2021-spring 2022. If sites of significant value are found, appropriate actions for mitigation or avoidance will be taken. In the case of unanticipated and inadvertent discovery of potential archaeological or cultural resources, MN State Historic Preservation Office (SHPO) will be contacted, and construction operations will cease until conclusions have been made regarding the potential archaeological or cultural resources have been properly identified and recorded.

15. **Visual:**
Describe any scenic views or vistas on or near the project site. Describe any project related visual effects such as vapor plumes or glare from intense lights. Discuss the potential visual effects from the project. Identify any measures to avoid, minimize, or mitigate visual effects.

The project area is located at the base of long ski slopes and surrounded by state park land. The Lower Saint Croix National Scenic Riverway is approximately 2,600 feet east of (and outside) of the project area, but natural areas are contiguous to the Scenic Riverway. Scenic views and vistas are part of the draw for Afton Alps and Afton State Park. The proposed project will enhance the natural scenery of the area by improving instream and riparian habitat, geomorphology, and vegetation where a straightened, incised channel currently exists. Water quality and riparian habitat improvements will include native plantings to further enhance the area for people and wildlife.

16. **Air:**
    a. **Stationary source emissions - Describe the type, sources, quantities and compositions of any emissions from stationary sources such as boilers or exhaust stacks. Include any hazardous air pollutants, criteria pollutants, and any greenhouse gases. Discuss effects to air quality including any sensitive receptors, human health or applicable regulatory criteria. Include a discussion of any methods used assess the project's effect on air quality and the results of that assessment. Identify pollution control equipment and other measures that will be taken to avoid, minimize, or mitigate adverse effects from stationary source emissions.**

    There will be no stationary source emissions involved with this project. Any air emissions produced will be temporary and on the scale of normal construction activities.

    b. **Vehicle emissions - Describe the effect of the project's traffic generation on air emissions. Discuss the project's vehicle-related emissions effect on air quality. Identify measures (e.g. traffic operational improvements, diesel idling minimization plan) that will be taken to minimize or mitigate vehicle-related emissions.**

    Air emissions resulting from the Project are limited to temporary sources from construction vehicles. Health risks are associated with pollutants such as particulate matter, carbon monoxide, nitrogen oxides, and reactive organic gasses, emitted from diesel fuel exhaust. These effects will

be temporary and unlikely to impact neighboring residents. The effect of the project's traffic generation on air emissions will be minimal/negligible and temporary. No additional measures have been developed or are planned to minimize or mitigate vehicle-related emissions. The increase of vegetation resulting from the installation of riparian buffers downstream will serve as a carbon sink compared to existing site conditions, ultimately resulting in a net benefit.

c. Dust and odors - Describe sources, characteristics, duration, quantities, and intensity of dust and odors generated during project construction and operation. (Fugitive dust may be discussed under item 16a). Discuss the effect of dust and odors in the vicinity of the project including nearby sensitive receptors and quality of life. Identify measures that will be taken to minimize or mitigate the effects of dust and odors.

Construction activities are likely to produce noise and dust. Dust generated during construction will be minimized through standard dust control measures, such as applying water to exposed soils and limiting the extent and duration of exposed soil conditions. The project will not generate substantial odor during construction. Potential odors will include exhaust from diesel engines. Odor disturbances will be limited to the construction equipment emissions and will only occur within the immediate construction area.

17. Noise

Describe sources, characteristics, duration, quantities, and intensity of noise generated during project construction and operation. Discuss the effect of noise in the vicinity of the project including 1) existing noise levels/sources in the area, 2) nearby sensitive receptors, 3) conformance to state noise standards, and 4) quality of life. Identify measures that will be taken to minimize or mitigate the effects of noise.

The Project is located within private property owned by Vail Resorts and within Afton State Park. The Project will be constructed after ski season is complete and construction noise would occur during the daytime hours. Noise would be comparable to maintenance activity typically conducted at adjacent properties, including Afton State Park. Existing noise levels at the ski resort are likely higher in the winter months than in the summer months and would be consistent of a for-profit recreational area. Reduced vehicle traffic, snowmaking, and chair lift noise occurs in the summer, and it anticipated that the addition of construction noise in the summer would not exceed the winter ambient noise.

Nearby sensitive noise receptors are located at the ski resort's hotels and lodges as well as nearby rural residential houses. The nearest house is located approximately 1200 feet southwest of the proposed improvements. Noise generated from construction activities will be temporary to both wildlife and humans within proximity of the project sites. The completed project is not anticipated to increase noise levels above existing ambient noise levels. No impacts from noise are anticipated. Construction will be restricted to daytime hours to eliminate noise at night.

18. Transportation

a. Describe traffic-related aspects of project construction and operation. Include: 1) existing and proposed additional parking spaces, 2) estimated total average daily traffic generated, 3) estimated maximum peak hour traffic generated and time of occurrence, 4) indicate source of trip generation rates used in the estimates, and 5) availability of transit and/or other alternative transportation modes.

There are two main roads that lead to Afton Alps and Afton State Park, 70th Street South (CSAH 22) and St. Croix Trail South (CSAH 21). Estimates of annual average daily traffic (AADT) on these two roads as identified by the MNDOT Traffic Mapping Application (MnDOT, n.d.) are listed in **Table 5**. No additional traffic will be generated resulting from project completion.

Table 5: AADT Estimates near the Project Area

Roadway	Location	AADT (volume)	Year Recorded
St. Croix Trail S	North of 70th St. S	1050	2018
St. Croix Trail S	South of 70th St. S	1250	2018
70th Street S	East of St. Croix Trail S	610	2018
70th Street S	West of St. Croix Trail S	1250	2019

Project construction will increase traffic flow slightly during the construction season but will not have major impacts from current use, especially given that construction will occur during the ski resort's off-season. No project-related traffic estimates have been made. Construction will occur during typical daylight hours. During construction, there may be a slight traffic influx to the project area, which will dissipate after the project has been constructed. Construction is going to be taking place within Afton Alps and the State Park area and will have minimal impact on the surrounding roads.

b. Discuss the effect on traffic congestion on affected roads and describe any traffic improvements necessary. The analysis must discuss the project's impact on the regional transportation system.
If the peak hour traffic generated exceeds 250 vehicles or the total daily trips exceeds 2,500, a traffic impact study must be prepared as part of the EAW. **Use the format and procedures described in the Minnesota Department of Transportation's Access Management Manual, Chapter 5** ***(available at: http://www.dot.state.mn.us/accessmanagement/resources.html)*** **or a similar local guidance.**

Peak traffic flow is not expected to exceed 250 vehicles per hour or 2,500 total daily trips. There are no traffic improvements necessary to accommodate the temporary construction or operations and maintenance activities associated with the stream restoration.

c. Identify measures that will be taken to minimize or mitigate project related transportation effects.

Effects to traffic corridors would be attenuated through the appropriate signage and detour routes, if necessary. Any detour routes would be determined during more detailed construction planning, would be avoided to the extent practical, and are unlikely. These effects would be short-lived and terminate when construction is complete.

19. Cumulative potential effects:
(Preparers can leave this item blank if cumulative potential effects are addressed under the applicable EAW Items)

a. Describe the geographic scales and timeframes of the project related environmental effects that could combine with other environmental effects resulting in cumulative potential effects.

Cumulative impacts on the environment are the result of the incremental impacts of past actions, the proposed project, and reasonably foreseeable future actions. No additional cumulative effects are anticipated at the project site outside of those identified within the previous sections of the document. This Project will reverse previous effects of the channelization and restore the channel nearer to its historic biotic functionality. These benefits are not anticipated to be fully realized for five to ten years after the improvements, but sediment reductions and habitat improvement will be seen upstream and downstream of Trout Brook to the St. Croix River. Afton Alps and Afton State Park should see social and environmental benefits related to recreational appeal.

b. Describe any reasonably foreseeable future projects (for which a basis of expectation has been laid) that may interact with environmental effects of the proposed project within the geographic scales and timeframes identified above.

Afton Alps is considering parking lot improvements to the large gravel lot adjacent to the proposed remeander. Parking lot improvements would include stormwater quality improvements and mitigation for any floodplain impacts.

c. Discuss the nature of the cumulative potential effects and summarize any other available information relevant to determining whether there is potential for significant environmental effects due to these cumulative effects.

Effects of the proposed project would be minimal and mostly positive in maintaining the quality of the human environment. The proposed action will help protect and improve the biological integrity of the Trout Brook.

20. Other potential environmental effects:
If the project may cause any additional environmental effects not addressed by items 1 to 19, describe the effects here, discuss the how the environment will be affected, and identify measures that will be taken to minimize and mitigate these effects.

Not applicable.

RGU CERTIFICATION. *(The Environmental Quality Board will only accept **SIGNED** Environmental Assessment Worksheets for public notice in the EQB Monitor.)*

I hereby certify that:

- The information contained in this document is accurate and complete to the best of my knowledge.
- The EAW describes the complete project; there are no other projects, stages or components other than those described in this document, which are related to the project as connected actions or phased actions, as defined at Minnesota Rules, parts 4410.0200, subparts 9c and 60, respectively.
- Copies of this EAW are being sent to the entire EQB distribution list.

Signature 

Date February 9, 2022_____

Title Administrator_____

References

DNR. (2006). *Minnesota's Wildlife Action Plan.* Retrieved from https://files.dnr.state.mn.us/assistance/nrplanning/bigpicture/cwcs/tomorrows_habitat.pdf

DNR. (2020a). *Karst Feature Inventory Points*. Retrieved from https://gisdata.mn.gov/dataset/geos-karst-feature-inventory-pts

DNR. (2020b). *Minnesota Regions Prone to Surface Karst Feature Development*. Retrieved from https://resources.gisdata.mn.gov/pub/gdrs/data/pub/us_mn_state_dnr/geos_surface_karst_feature_devel/metadata/metadata.html#Entity_and_Attribute_Information

DNR. (2021a). *Afton State Park: Park Information.*

DNR. (2021b). *Invasive Species in Minnesota*. Retrieved from https://www.dnr.state.mn.us/invasives/index.html

DNR and USFWS. (2021). *Townships Containing Documented Northern Long-Eared Bat (NLEB) Maternity Roost Trees and/or Hibernacula Entrances in Minnesota.* Retrieved December 14, 2020, from https://files.dnr.state.mn.us/eco/ereview/minnesota_nleb_township_list_and_map.pdf

DNR. (n.d.). *Ecological Classification System*. Retrieved 2021, from https://www.dnr.state.mn.us/ecs/index.html

DNR. (n.d.). *Minnesota Biological Survey Native Plant Community and Rare Species County Maps*. Retrieved December 14, 2020, from https://www.dnr.state.mn.us/eco/mcbs/maps.html

DNR. (n.d.). *Rare Species Guide*.

DNR. (n.d.). *Red River Prairie Subsection*. Retrieved 2021, from https://www.dnr.state.mn.us/ecs/251Aa/index.html

EOR. (2009). *Trout Brook Management Plan.* Retrieved from https://www.swwdmn.org/pdf/watershedplan/Library/Trout%20Brook%20Mgmt%20Plan.pdf

Focus Engineering, Inc. (2019). *Denmark Township 2040 Comprehensive Plan.* Retrieved from https://www.denmarktownship.org/vertical/sites/%7B5B1C76D5-2975-4BD2-B0BA-7327C34C7928%7D/uploads/Denmark_Township_2040_Comp_Plan_Adopted_12-02-2019.pdf

Great River Greening. (2017). *Afton Alps Trout Brook Stream Restoration Environmental Assessment Worksheet.*

Hong, A. (2019). Lending a helping hand to Afton's Trout Brook. *St. Croix 360*. Retrieved from https://www.stcroix360.com/2019/10/lending-a-helping-hand-to-aftons-trout-brook/

Houston Engineering, Inc. (2020). *Buffalo-Red River Watershed Comprehensive Watershed Management Plan.* Wilkin County, Becker County, Otter Tail County, Clay County, Wilkin SWCD, Becker SWCD, Clay SWCD, West Otter Tail SWCD, Buffalo-Red River Watershed District.

Houston Engineering, Inc. (2021). *Trout Brook Restoration Preliminary Design Considerations DRAFT.* Unpublished.

Lower St. Croix Watershed Partnership. (2020). *Lower St. Croix River Comprehensive Watershed Management Plan.* Retrieved from https://static1.squarespace.com/static/5b0dadc59772aeb1df30d0d8/t/5f9aea83cfd1f030c1d3bb17/1603988135744/Final+Lower+St+Croix+Comp+Plan+OCT+2020.pdf

Minnesota Geological Survey. (1982). *Geologic Map- of Minnesota - Quaternary Geology (MGS Map S-1).* Retrieved from https://resources.gisdata.mn.gov/pub/gdrs/data/pub/edu_umn_mngs/geos_quaternary_geology_mn/metadata/metadata.html

MnDOT. (n.d.). *Traffic Mapping Application*. Retrieved December 18, 2020, from https://mndot.maps.arcgis.com/apps/webappviewer/index.html?id=7b3be07daed84e7fa170a91059ce63bb

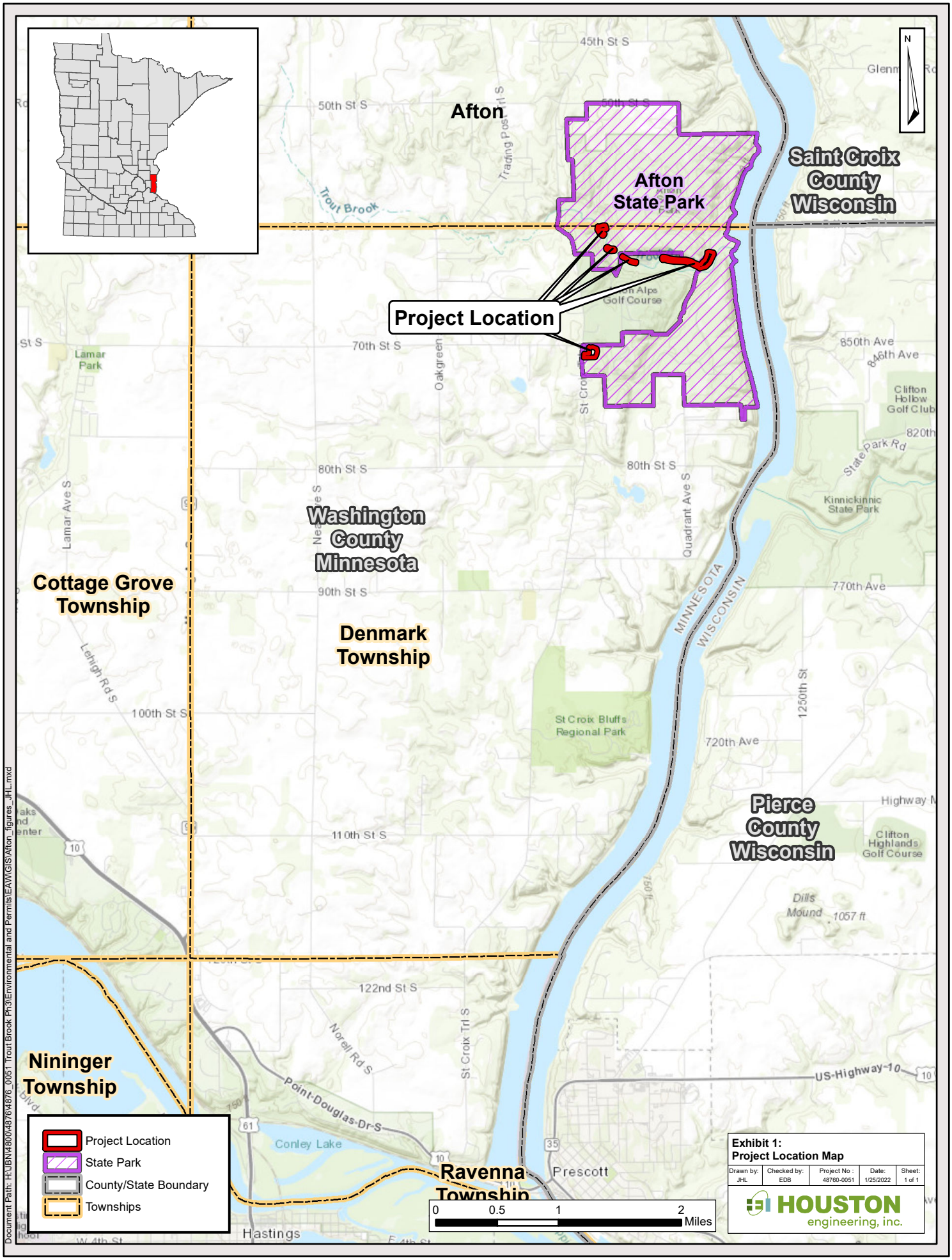
MPCA. (2012). *Lake St. Croix Nutrient Total Maximum Daily Load.* Retrieved from https://www.pca.state.mn.us/sites/default/files/wq-iw6-04e.pdf

South Washington Watershed District. (2012). *Trout Brook Watershed Improvements, Afton Alps, Afton, Minnesota.* Retrieved from https://www.swwdmn.org/wp-content/uploads/2016/03/Trout-Brook-Watershed-Improvements-Concept-Design-Report.pdf

Stanley, V. L. (2016). *Surficial Geology of Washington County* . University of Minnesota, Minnesota Geological Survey. Retrieved from https://conservancy.umn.edu/handle/11299/178852

USFWS. (2019). *Rusty Patched Bumble Bee (Bombus affinis) Endangered Species Action Section 7(a)(2) Voluntary Implementation Guidance. Version 2.1.* Retrieved from

https://www.fws.gov/midwest/endangered/insects/rpbb/pdf/Section_7_Guidance_RPBB_Ver2_1_16April2019.pdf
USFWS. (2021). *Midwest Region Endangered Species*. Retrieved from https://www.fws.gov/midwest/endangered/mammals/nleb/nhisites.html
Washington Conservation District. (2002). Denmark Township Water Resource Evaluation. *Maintaining and Enhancing Environmental Quality in Denmark Township: A Natural Resources Inventory with Stewardship Recommendations*.


Afton
Afton State Park
Saint Croix County Wisconsin
Project Location
Washington County Minnesota
Cottage Grove Township
Denmark Township
Pierce County Wisconsin
Nininger Township
Ravenna Township
Prescott
Hastings
Afton Alps Golf Course
Lamar Park
Kinnickinnic State Park
St Croix Bluffs Regional Park
Clifton Hollow Golf Club
Clifton Highlands Golf Course
Conley Lake
Dills Mound
1057 ft
45th St S
50th St S
70th St S
80th St S
90th St S
100th St S
110th St S
122nd St S
850th Ave
770th Ave
720th Ave
1250th St
Trout Brook
Trading Post Trl S
Oakgreen
Lamar Ave S
Quadrant Ave S
Lehigh Rd S
Norell Rd S
St Croix Trl S
Point-Douglas-Dr-S
US-Highway-10
State Park Rd
MINNESOTA
WISCONSIN
N
Project Location
State Park
County/State Boundary
Townships
0 0.5 1 2 Miles
Exhibit 1:
Project Location Map
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/25/2022
Sheet: 1 of 1
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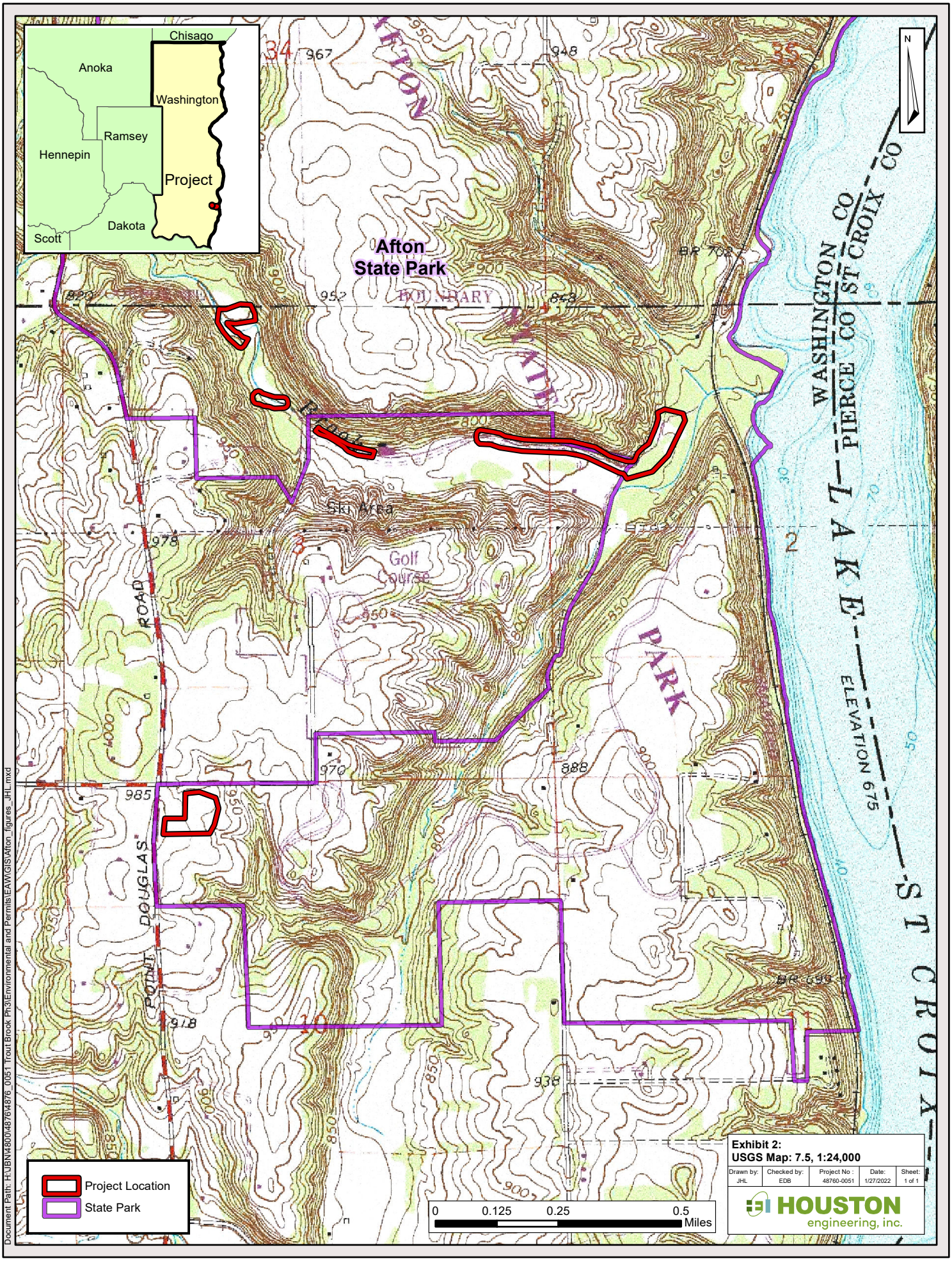
Chisago
Anoka
Washington
Ramsey
Hennepin
Project
Dakota
Scott
Afton
State Park
Ski Area
Golf Course
PARK
ROAD
DOUGLAS
POINT
WASHINGTON CO
PIERCE CO
ST CROIX CO
ELEVATION 675
ST CROIX
N
Project Location
State Park
0
0.125
0.25
0.5
Miles
Exhibit 2:
USGS Map: 7.5, 1:24,000
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/27/2022
Sheet: 1 of 1
HOUSTON
engineering, inc.
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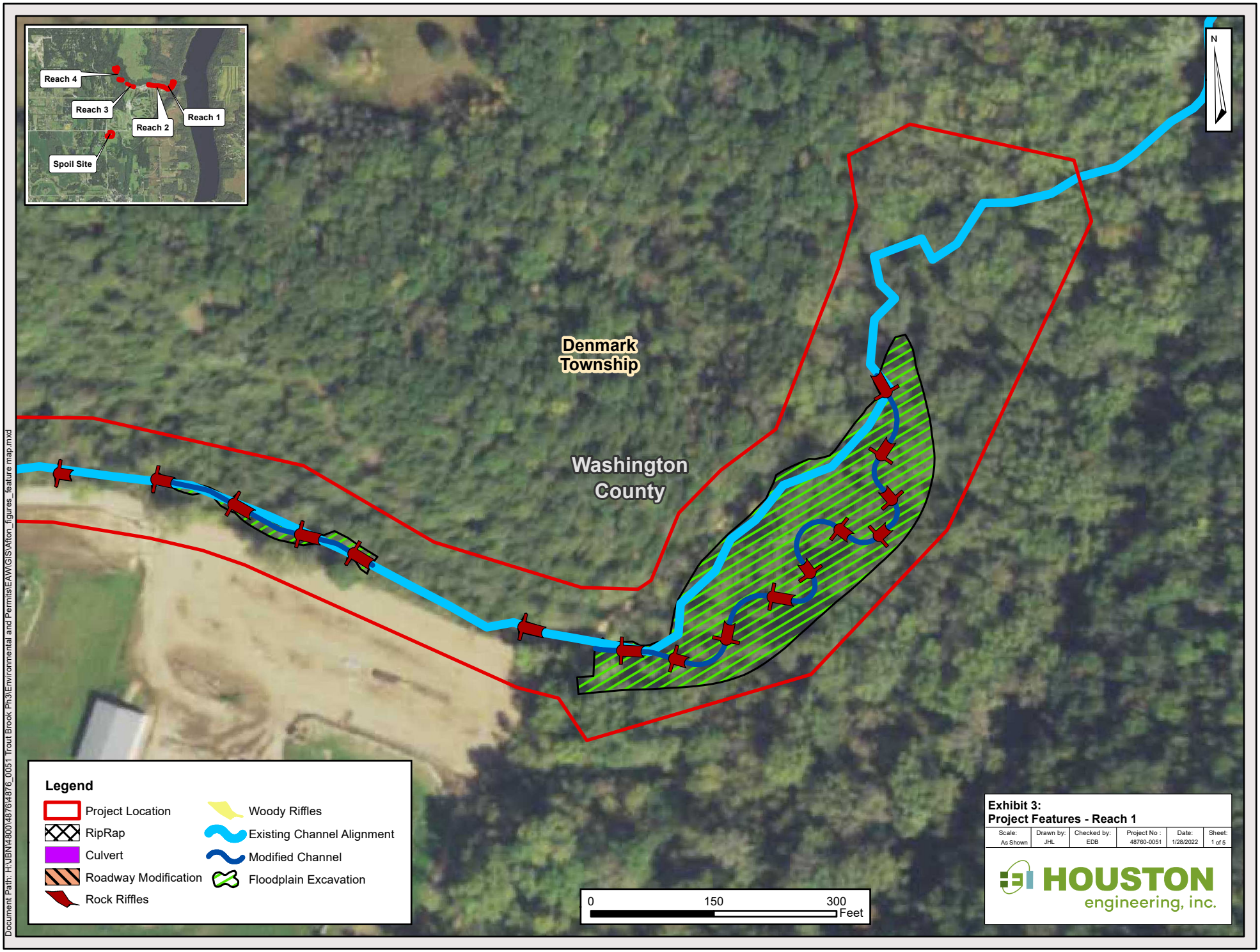
Reach 4
Reach 3
Reach 2
Reach 1
Spoil Site
Denmark Township
Washington County
N
Legend
Project Location
RipRap
Culvert
Roadway Modification
Rock Riffles
Woody Riffles
Existing Channel Alignment
Modified Channel
Floodplain Excavation
0
150
300
Feet
Exhibit 3:
Project Features - Reach 1
Scale: As Shown
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/28/2022
Sheet: 1 of 5
HOUSTON engineering, inc.
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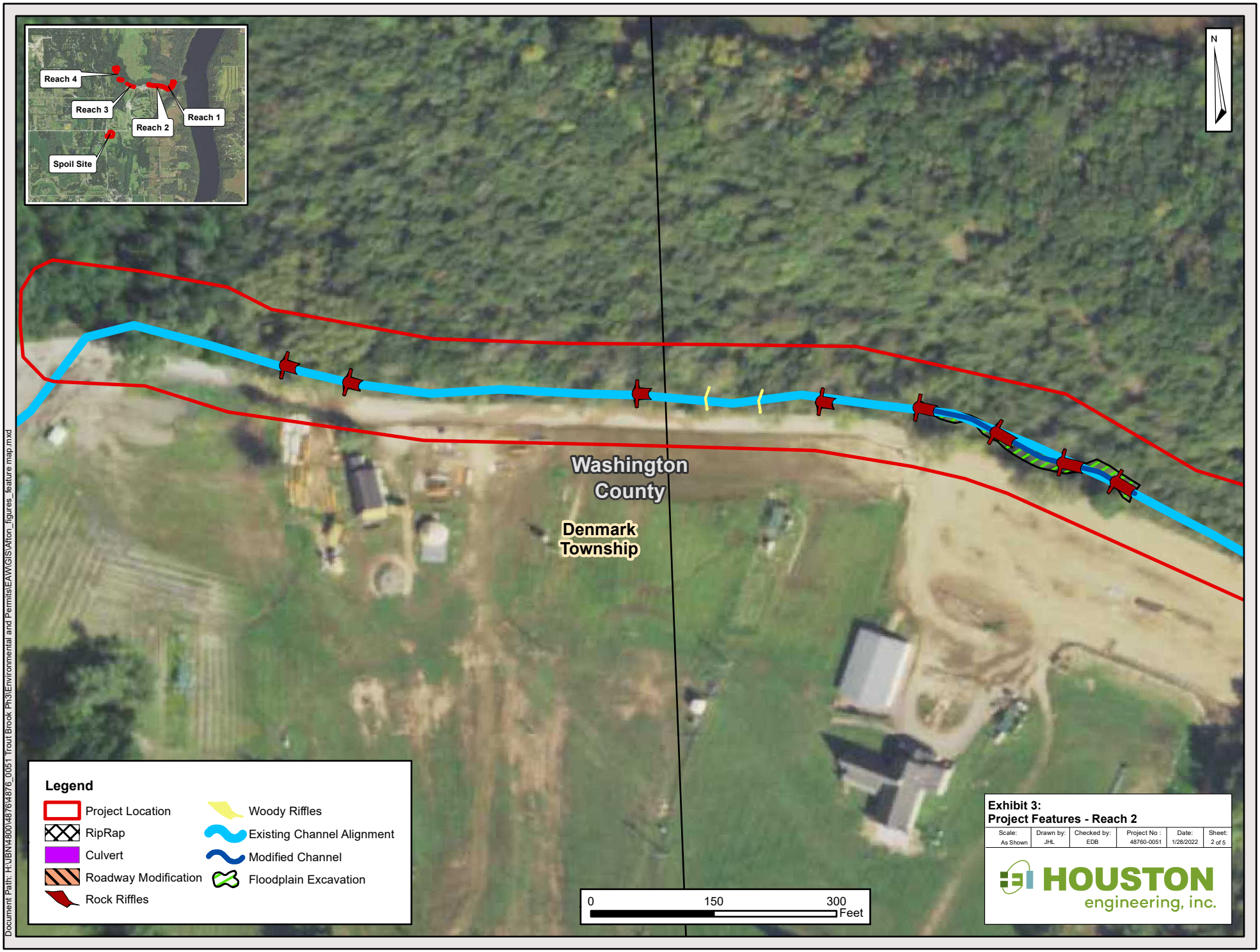
Reach 4
Reach 3
Reach 2
Reach 1
Spoil Site
N
Washington County
Denmark Township
Legend
Project Location
RipRap
Culvert
Roadway Modification
Rock Riffles
Woody Riffles
Existing Channel Alignment
Modified Channel
Floodplain Excavation
0
150
300
Feet
Exhibit 3:
Project Features - Reach 2
Scale: As Shown
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/28/2022
Sheet: 2 of 5
HOUSTON engineering, inc.
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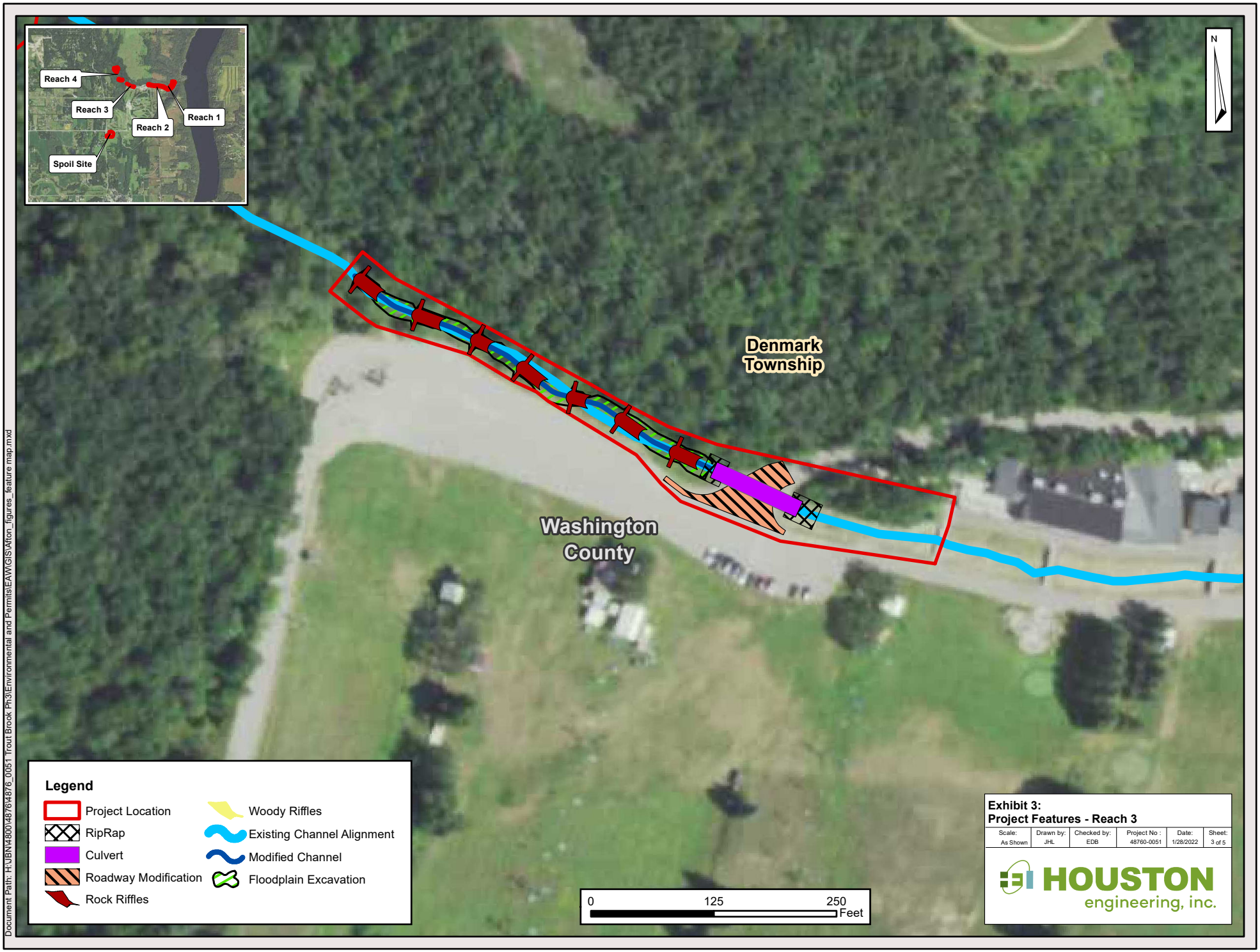
Reach 4
Reach 3
Reach 2
Reach 1
Spoil Site
N
Denmark Township
Washington County
Legend
Project Location
RipRap
Culvert
Roadway Modification
Rock Riffles
Woody Riffles
Existing Channel Alignment
Modified Channel
Floodplain Excavation
0
125
250
Feet
Exhibit 3:
Project Features - Reach 3
Scale: As Shown
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/28/2022
Sheet: 3 of 5
HOUSTON engineering, inc.
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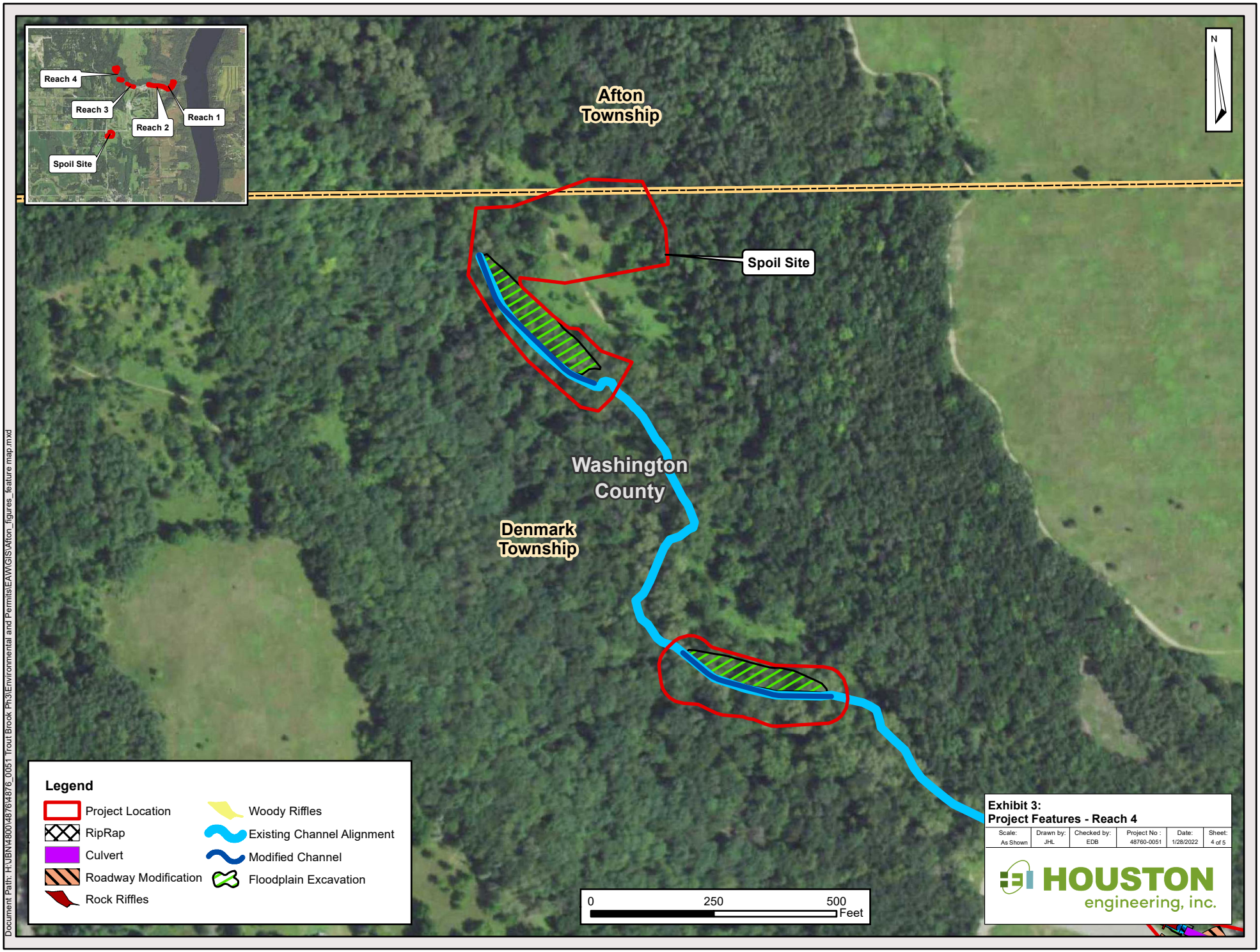
Reach 4
Reach 3
Reach 2
Reach 1
Spoil Site
Afton Township
Spoil Site
Washington County
Denmark Township
N
Legend
Project Location
RipRap
Culvert
Roadway Modification
Rock Riffles
Woody Riffles
Existing Channel Alignment
Modified Channel
Floodplain Excavation
0
250
500
Feet
Exhibit 3:
Project Features - Reach 4
Scale: As Shown
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/28/2022
Sheet: 4 of 5
HOUSTON engineering, inc.
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Reach 4
Reach 3
Reach 2
Reach 1
Spoil Site
69th St S
COUNTY 20 ROAD
Denmark Township
Washington County
COUNTY 21 ROAD
Spoil Site
STATE PARK RD 12
STATE PARK RD 12
STATE PARK RD 12
STATE PARK RD 12
N
Legend
Project Location
RipRap
Culvert
Roadway Modification
Rock Riffles
Woody Riffles
Existing Channel Alignment
Modified Channel
Floodplain Excavation
0
250
500
Feet
Exhibit 3:
Project Features - Spoil Site
Scale: As Shown
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/28/2022
Sheet: 5 of 5
HOUSTON engineering, inc.
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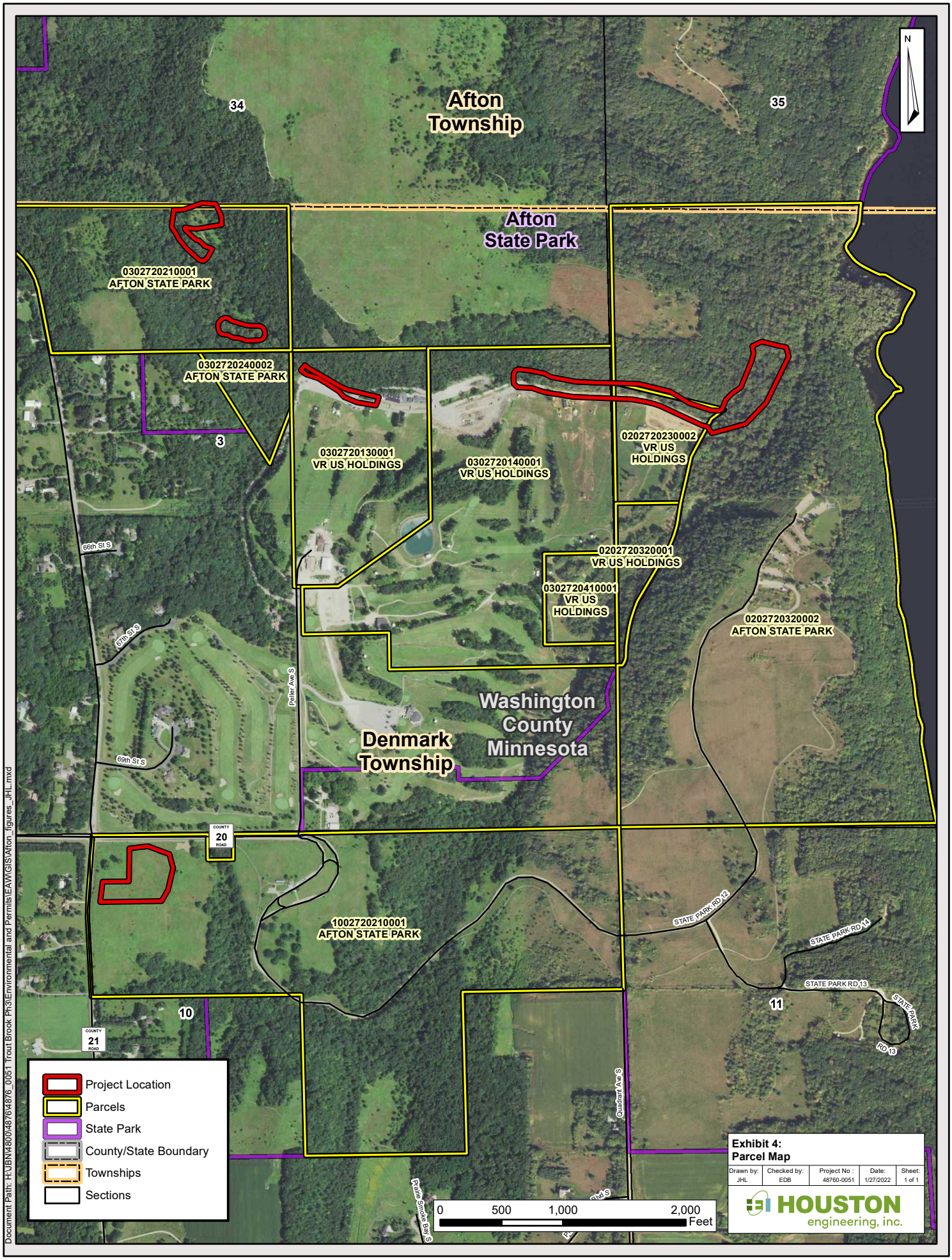
Afton Township
34
35
Afton State Park
0302720210001 AFTON STATE PARK
0302720240002 AFTON STATE PARK
3
0302720130001 VR US HOLDINGS
0302720140001 VR US HOLDINGS
0202720230002 VR US HOLDINGS
0202720320001 VR US HOLDINGS
0302720410001 VR US HOLDINGS
0202720320002 AFTON STATE PARK
66th St S
67th St S
69th St S
Peller Ave S
Washington County Minnesota
Denmark Township
COUNTY 20 ROAD
1002720210001 AFTON STATE PARK
STATE PARK RD 12
STATE PARK RD 14
STATE PARK RD 13
STATE PARK RD 13
10
11
COUNTY 21 ROAD
Quadrant Ave S
Prairie Smoke Bay S
N
Project Location
Parcels
State Park
County/State Boundary
Townships
Sections
0 500 1,000 2,000 Feet
Exhibit 4:
Parcel Map
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/27/2022
Sheet: 1 of 1
HOUSTON engineering, inc.
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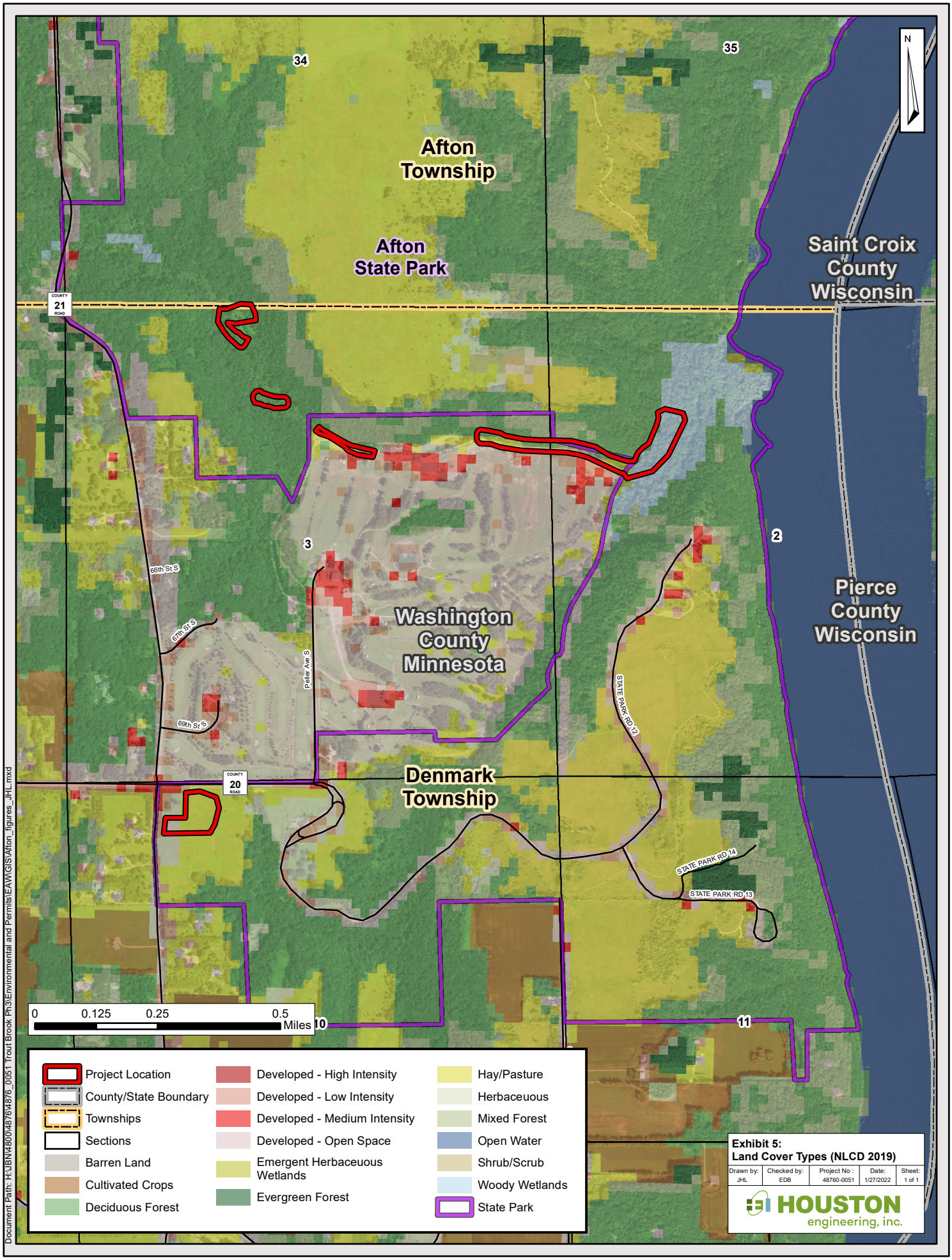
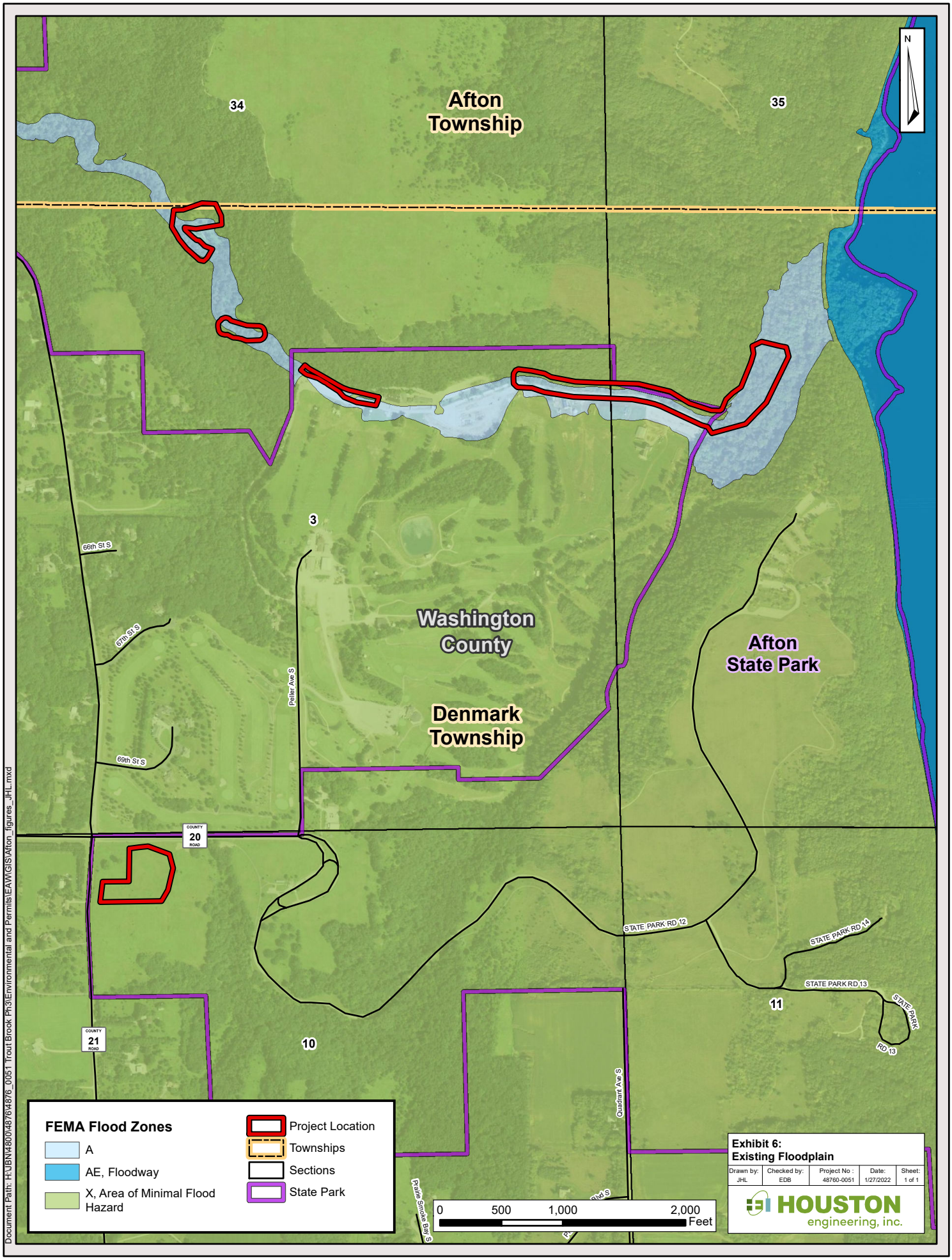

Afton Township
Afton State Park
Saint Croix County Wisconsin
Washington County Minnesota
Pierce County Wisconsin
Denmark Township
34
35
3
2
10
11
66th St S
67th St S
69th St S
Peller Ave S
STATE PARK RD 12
STATE PARK RD 14
STATE PARK RD 13
COUNTY 21 ROAD
COUNTY 20 ROAD
N
0 0.125 0.25 0.5 Miles
Project Location
County/State Boundary
Townships
Sections
Barren Land
Cultivated Crops
Deciduous Forest
Developed - High Intensity
Developed - Low Intensity
Developed - Medium Intensity
Developed - Open Space
Emergent Herbaceuous Wetlands
Evergreen Forest
Hay/Pasture
Herbaceuous
Mixed Forest
Open Water
Shrub/Scrub
Woody Wetlands
State Park
Exhibit 5:
Land Cover Types (NLCD 2019)
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/27/2022
Sheet: 1 of 1
HOUSTON engineering, inc.
Document Path: H:\JBN\48000\48764876_0051 Trout Brook Ph3\Environmental and Permits\EA\WGIS\Afton_figures_JHL.mxd


Afton Township
34
35
3
10
11
Washington County
Denmark Township
Afton State Park
66th St S
67th St S
69th St S
Peller Ave S
Quadrant Ave S
Prairie Smoke Bay S
COUNTY 20 ROAD
COUNTY 21 ROAD
STATE PARK RD 12
STATE PARK RD 14
STATE PARK RD 13
STATE PARK RD 13
N
FEMA Flood Zones
A
AE, Floodway
X, Area of Minimal Flood Hazard
Project Location
Townships
Sections
State Park
0
500
1,000
2,000
Feet
Exhibit 6:
Existing Floodplain
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/27/2022
Sheet: 1 of 1
HOUSTON engineering, inc.
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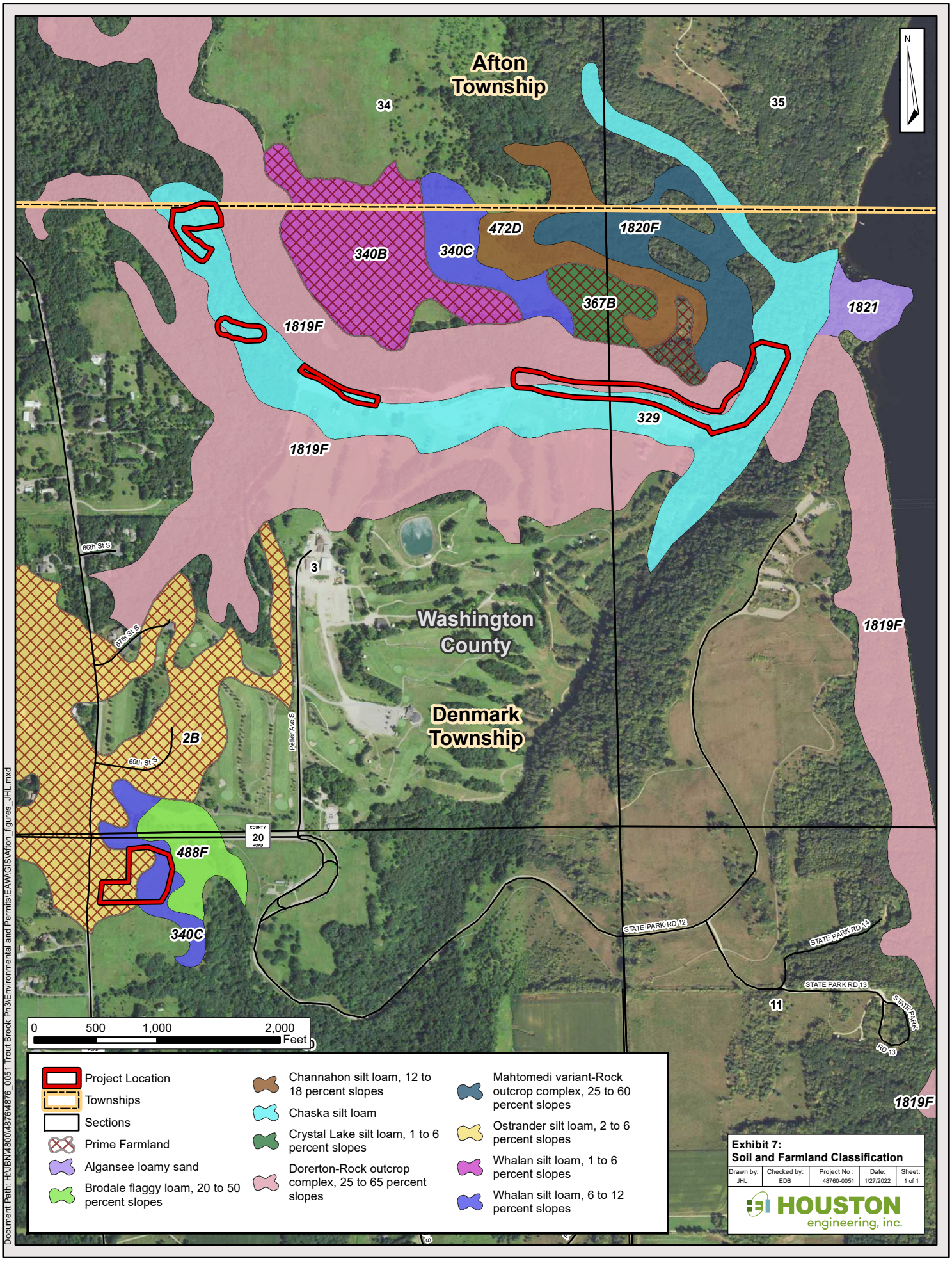
Afton Township
Washington County
Denmark Township
34
35
3
11
340B
340C
472D
1820F
367B
1821
1819F
329
488F
2B
66th St S
67th St S
69th St S
Peller Ave S
COUNTY 20 ROAD
STATE PARK RD 12
STATE PARK RD 14
STATE PARK RD 13
STATE PARK RD 13
N
0 500 1,000 2,000 Feet
Project Location
Townships
Sections
Prime Farmland
Algansee loamy sand
Brodale flaggy loam, 20 to 50 percent slopes
Channahon silt loam, 12 to 18 percent slopes
Chaska silt loam
Crystal Lake silt loam, 1 to 6 percent slopes
Dorerton-Rock outcrop complex, 25 to 65 percent slopes
Mahtomedi variant-Rock outcrop complex, 25 to 60 percent slopes
Ostrander silt loam, 2 to 6 percent slopes
Whalan silt loam, 1 to 6 percent slopes
Whalan silt loam, 6 to 12 percent slopes
Exhibit 7:
Soil and Farmland Classification
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/27/2022
Sheet: 1 of 1
HOUSTON engineering, inc.
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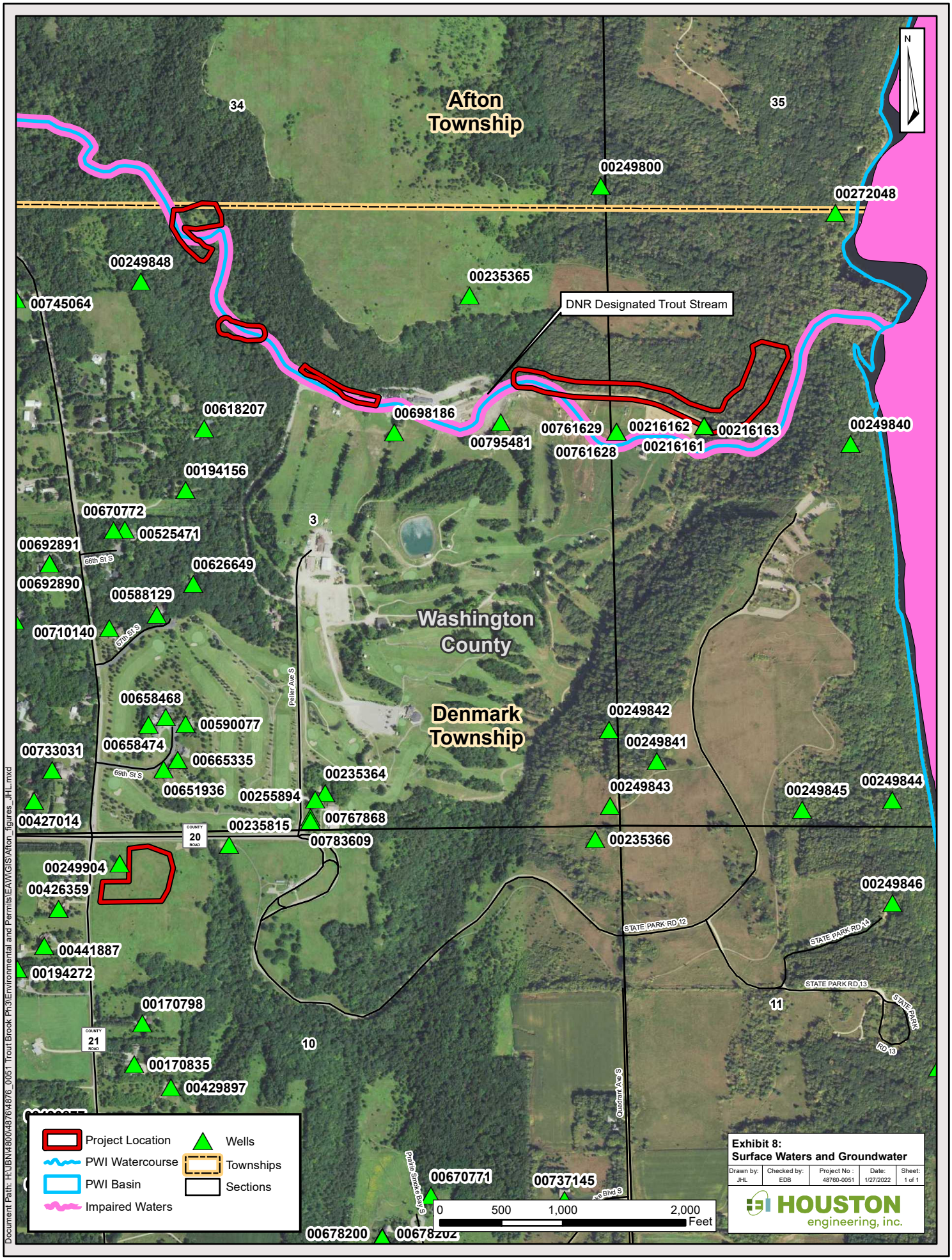
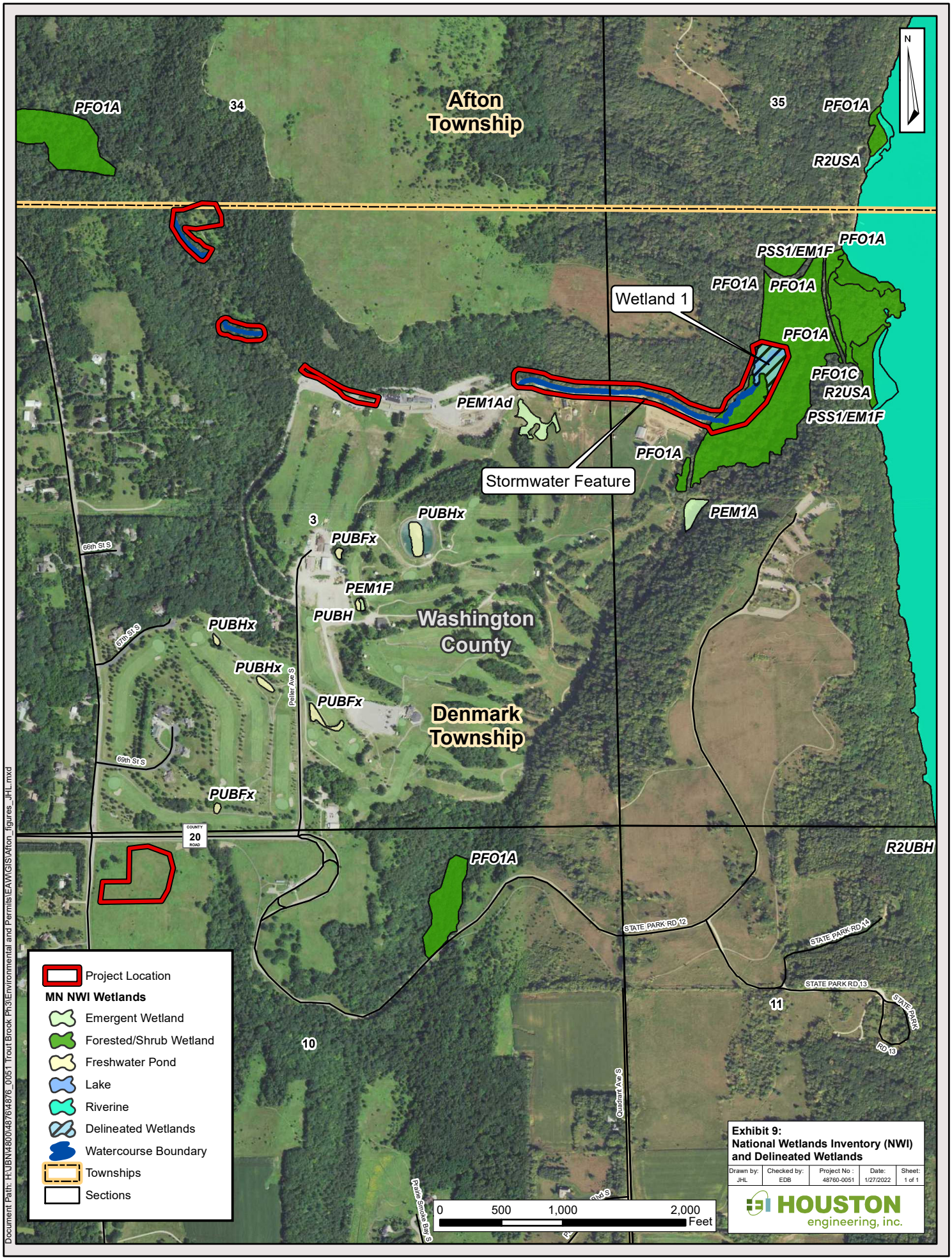

Afton Township
Washington County
Denmark Township
34
35
3
10
11
DNR Designated Trout Stream
00249800
00272048
00249848
00745064
00235365
00618207
00698186
00795481
00761629
00761628
00216162
00216161
00216163
00249840
00194156
00670772
00525471
00692891
00692890
66th St S
00626649
00588129
00710140
67th St S
Peller Ave S
00658468
00590077
00658474
00733031
69th St S
00665335
00651936
00255894
00235364
00767868
00427014
00235815
00783609
00249842
00249841
00249843
00249845
00249844
00235366
00249904
00426359
00249846
00441887
00194272
STATE PARK RD 12
STATE PARK RD 14
STATE PARK RD 13
STATE PARK RD 13
00170798
00170835
00429897
COUNTY 20 ROAD
COUNTY 21 ROAD
Quadrant Ave S
Prairie Smoke Bay S
00670771
00737145
00678200
00678202
0
500
1,000
2,000
Feet
N
Project Location
PWI Watercourse
PWI Basin
Impaired Waters
Wells
Townships
Sections
Exhibit 8:
Surface Waters and Groundwater
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/27/2022
Sheet: 1 of 1
HOUSTON engineering, inc.
Document Path: H:\JBN\4800\48764876_0051 Trout Brook Ph3\Environmental and Permits\EAW\GIS\Afton_figures_JHL.mxd


Afton Township
Washington County
Denmark Township
Wetland 1
Stormwater Feature
PFO1A
PFO1C
PSS1/EM1F
PEM1Ad
PEM1A
PEM1F
PUBHx
PUBFx
PUBH
R2USA
R2UBH
34
35
3
10
11
66th St S
67th St S
69th St S
Peller Ave S
COUNTY 20 ROAD
STATE PARK RD 12
STATE PARK RD 14
STATE PARK RD 13
Quadrant Ave S
Prairie Smoke Bay S
N
0 500 1,000 2,000 Feet
Project Location
MN NWI Wetlands
Emergent Wetland
Forested/Shrub Wetland
Freshwater Pond
Lake
Riverine
Delineated Wetlands
Watercourse Boundary
Townships
Sections
Exhibit 9:
National Wetlands Inventory (NWI) and Delineated Wetlands
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/27/2022
Sheet: 1 of 1
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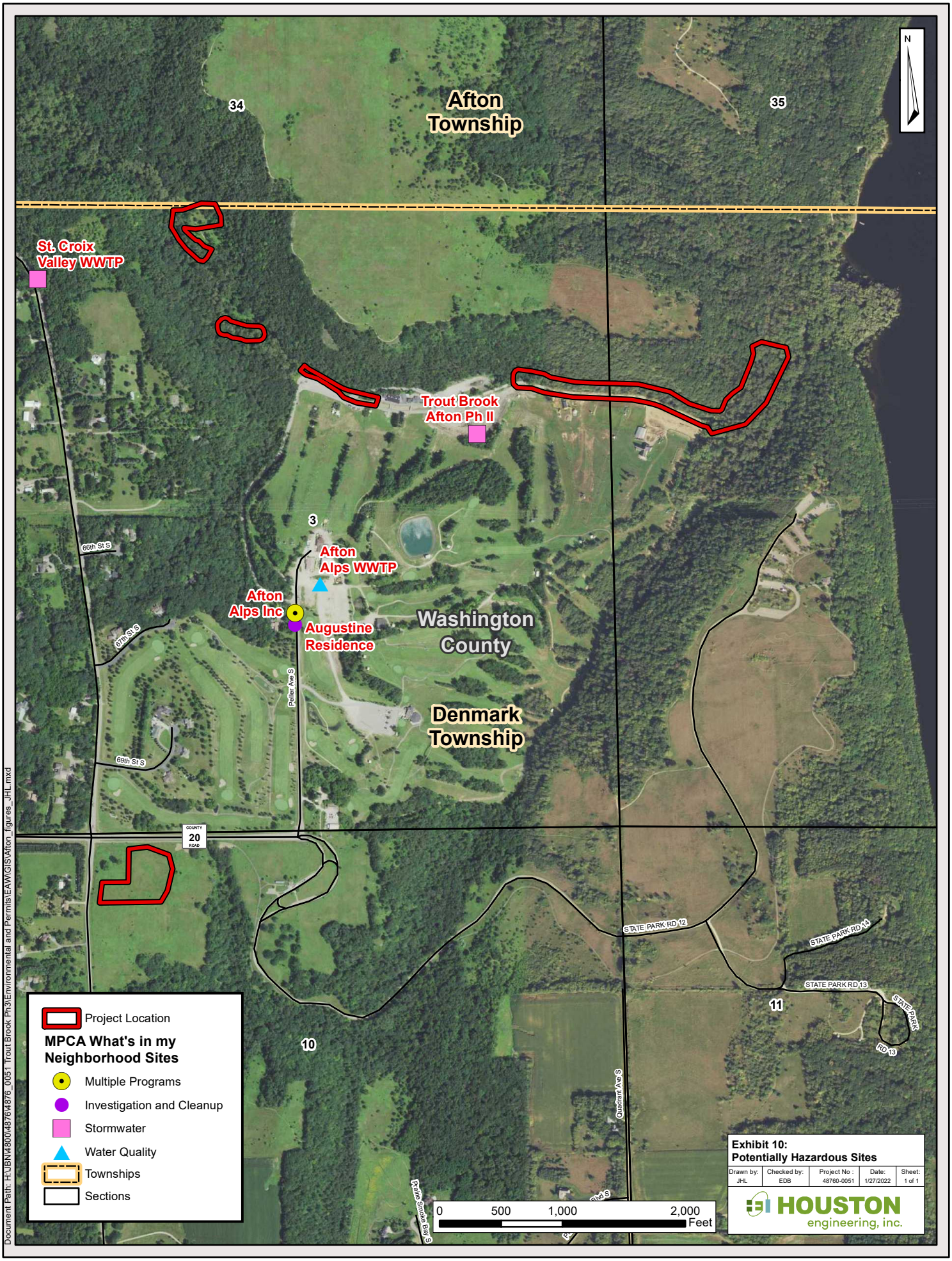
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34
35
St. Croix Valley WWTP
Trout Brook Afton Ph II
3
Afton Alps WWTP
Afton Alps Inc
Augustine Residence
Washington County
Denmark Township
66th St S
67th St S
69th St S
Peller Ave S
COUNTY 20 ROAD
STATE PARK RD 12
STATE PARK RD 14
STATE PARK RD 13
STATE PARK RD 13
11
10
Quadrant Ave S
Prairie Smoke Bay S
N
Project Location
MPCA What's in my Neighborhood Sites
Multiple Programs
Investigation and Cleanup
Stormwater
Water Quality
Townships
Sections
0 500 1,000 2,000 Feet
Exhibit 10:
Potentially Hazardous Sites
Drawn by: JHL
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Project No : 48760-0051
Date: 1/27/2022
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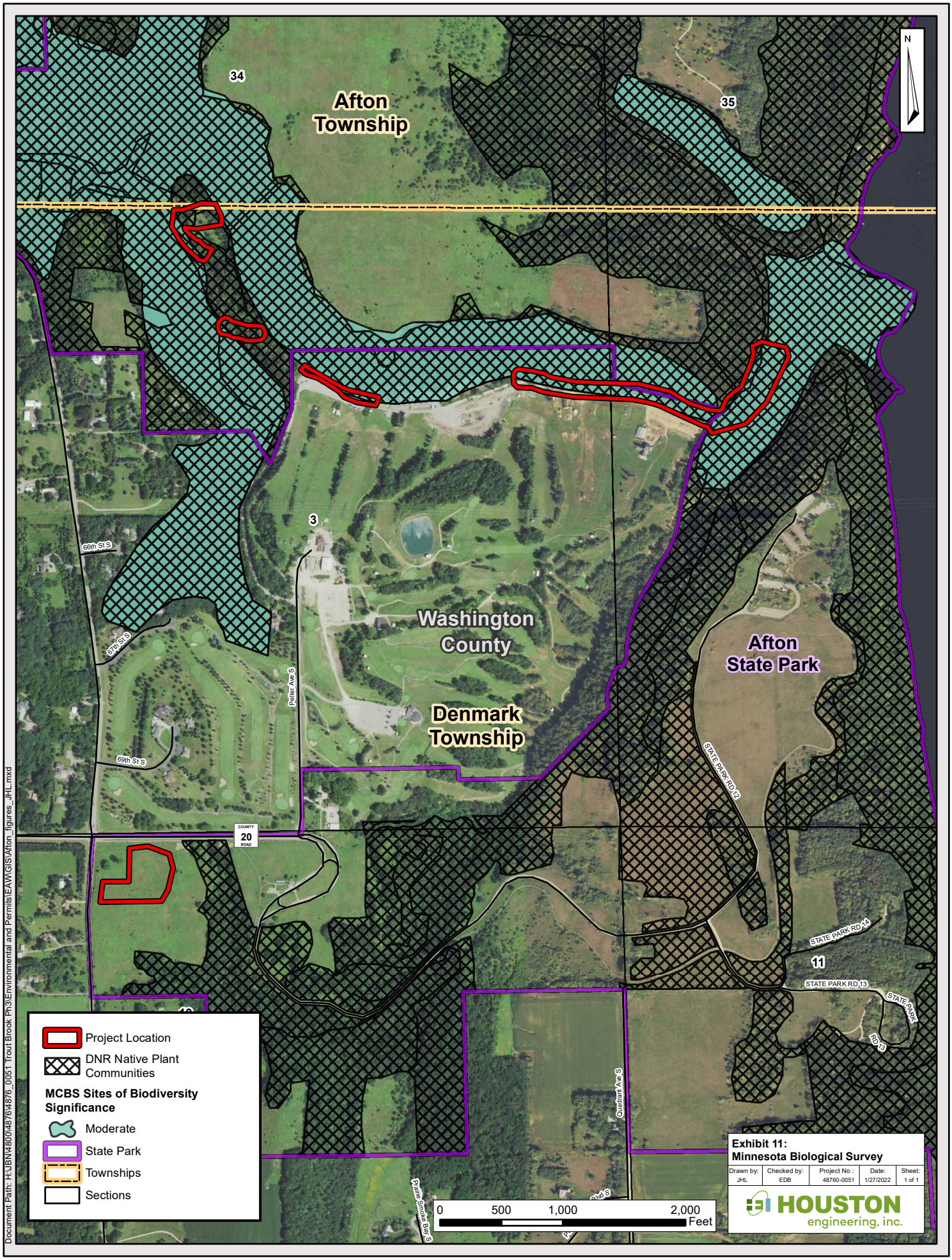
Afton Township
Washington County
Denmark Township
Afton State Park
34
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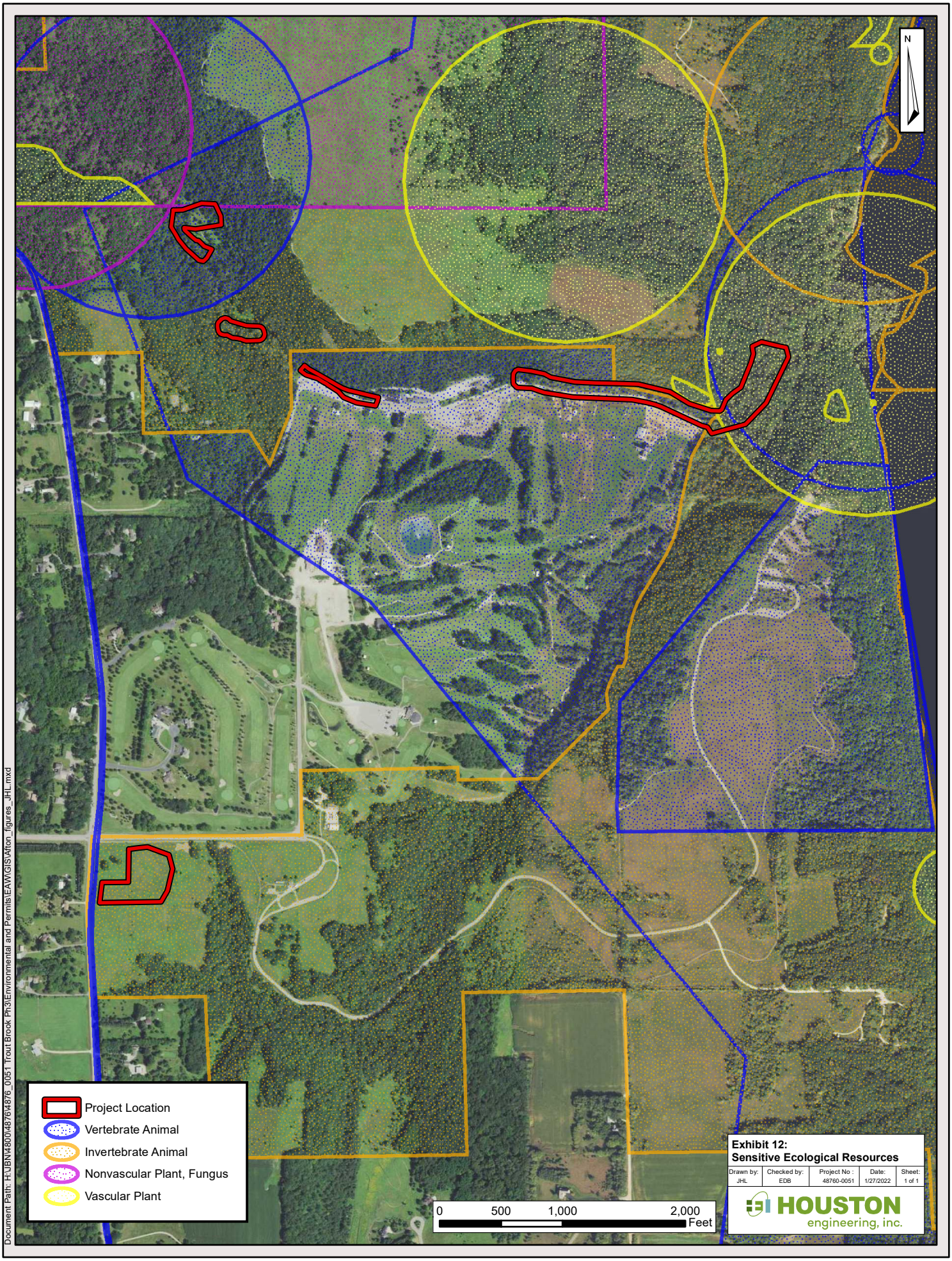
66th St S
67th St S
69th St S
Peller Ave S
Quadrant Ave S
Prairie Smoke Bay S
STATE PARK RD 12
STATE PARK RD 14
STATE PARK RD 13
STATE PARK RD 13
COUNTY 20 ROAD
N
Project Location
DNR Native Plant Communities
MCBS Sites of Biodiversity Significance
Moderate
State Park
Townships
Sections
0 500 1,000 2,000 Feet
Exhibit 11:
Minnesota Biological Survey
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/27/2022
Sheet: 1 of 1
HOUSTON engineering, inc.
Document Path: H:\JBN\48004876\4876_0051 Trout Brook Ph3\Environmental and Permits\EAW\GIS\Afton_figures_JHL.mxd


N
Project Location
Vertebrate Animal
Invertebrate Animal
Nonvascular Plant, Fungus
Vascular Plant
0
500
1,000
2,000
Feet
Exhibit 12:
Sensitive Ecological Resources
Drawn by: JHL
Checked by: EDB
Project No : 48760-0051
Date: 1/27/2022
Sheet: 1 of 1
HOUSTON engineering, inc.
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Appendix A: Trout Brook Phase III 30 % Design Report

HOUSTON engineering, inc.

Maple Grove, MN | HEI No. 004876_0051
January 28, 2022

TROUT BROOK PHASE III

30% Design Report - DRAFT

SOUTH WASHINGTON WATERSHED DISTRICT

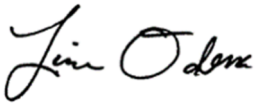
TROUT BROOK PHASE III

30% Design Report

January 28, 2022

Houston Engineering, Inc.
7550 Meridian Cir N, Suite 120
Maple Grove, MN 55369
Phone # 763.493.4522

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision, and that I am a duly Licensed Engineer under the laws of the State of Minnesota.



Lisa D Odens
Reg. No. 51685

1-28-2022
Date

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TABLES

FIGURES

1 PROJECT BACKGROUND

The purpose of this report is to provide project stakeholders with the data and methodologies used to develop the Trout Brook Phase III 30% Design. This report contains description of the project background, goals, geomorphology review, hydrology and hydraulics, concept description, and opinion of probable construction costs. Project stakeholders are anticipated to provide feedback on the design which will be incorporated into the 60% design.

South Washington Watershed District is partnered with Great River Greening (GRG), the Minnesota DNR, and Vail Properties to restore Trout Brook through areas of the Afton Alps Ski Area and Afton State Park. Houston Engineering was contracted to provide engineering services to the project.

1.1 PROJECT LOCATION

The project site is located on Vail properties at the Afton Alps Ski Area and on Mn DNR property (Afton State Park), in Sections 2 and 3 of Denmark Township (T27N-R20W), approximately 3 miles south of the City of Afton in Washington County. Trout Brook outlets to the St. Croix River. The proposed project extents include project areas 1, 2, 3 and 4 and are shown in **Figure 1**.

1.2 PROJECT GOALS

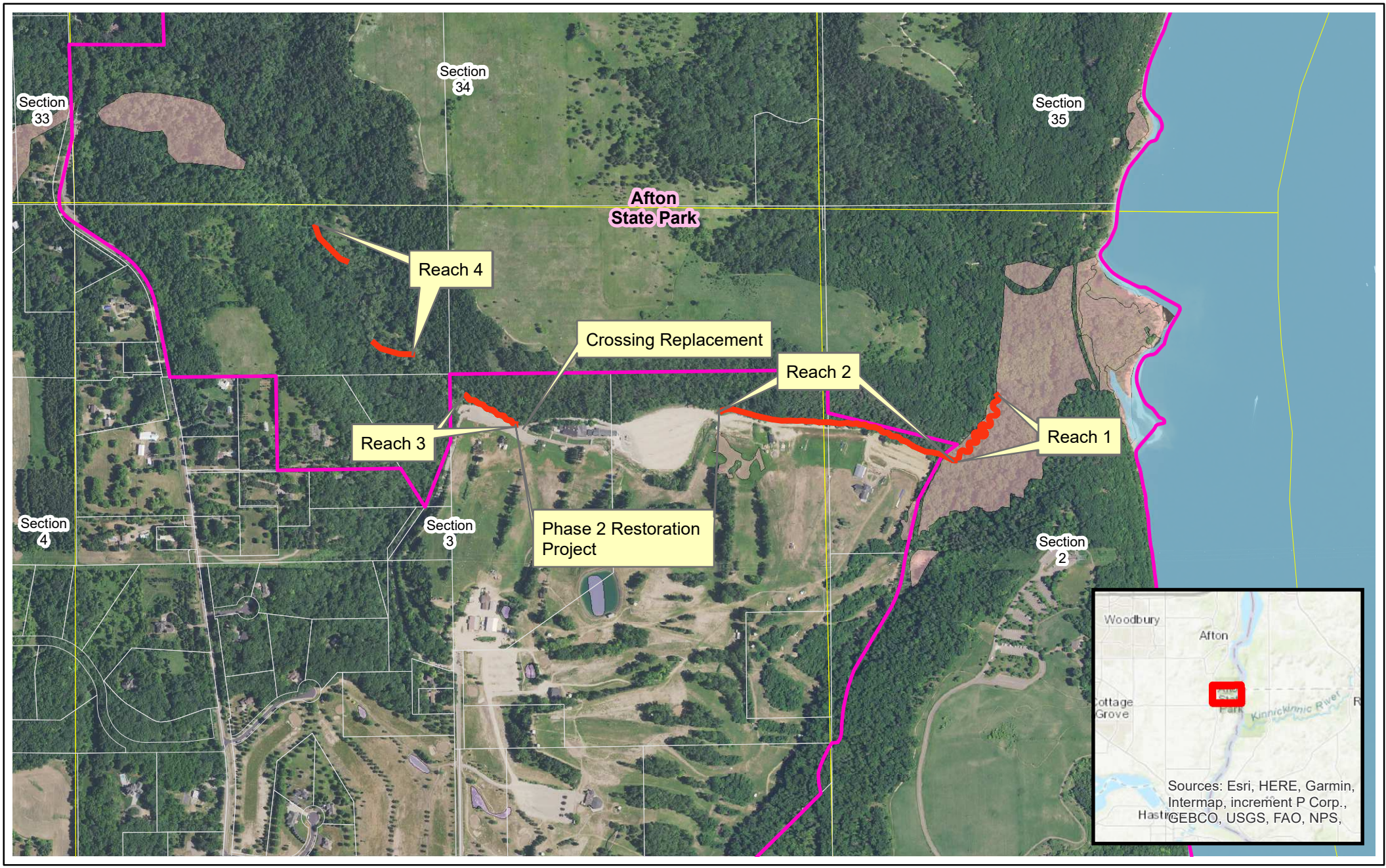
Project goals were established during previous project phases and during the Phase III project stakeholder kick-off. The project goals include:

- Increase longitudinal connectivity from the mouth to the crossing at St. Croix Trail South.
- Improve water quality and increase floodplain connectivity in Trout Brook.
- Increase in-stream habitat to improve biological communities in Trout Brook, mainly in pools.
- Increase recreational and long-term educational opportunities for State Park users and the public in general.
- Improvement both stream and ski functions.
- Increase in native terrestrial habitat to improve biological communities.

1.3 HISTORY

Study and restoration of Trout Brook has been on-going for the last decade. The most noted issue is sedimentation within the channel which buries channel riffles and pools, limiting diversity of habitat. Previous studies include:

- Trout Brook Watershed Improvements, Concept Design Report, August 9, 2012
- Trout Brook Enhancement at Afton Alps Ski Area, 30% Design Submittal, February 2015
- Wetland Delineation Report, Afton Alps Trout Brook Restoration, September 1, 2017
- Geotechnical Evaluation Report, Trout Brook Phase II Re-Meander, September 22, 2017
- Trout Brook Phase II, Re-meander Design-Bid-Build, 100% Design Submittal, May 2018



Legend

- Project Location
- Afton State Park Boundary
- Parcels
- Sections
- Public Waters Basins
- Type 1, 2, 6, 7, and 8 Wetlands
- Type 3, 4, and 5 Wetlands

0 300 600 1,200 Feet

N W E S

South Washington Watershed District

South Washington Watershed District
Trout Brook Phase 3
Location Map

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Houston Engineering Inc.
Maple Grove
P: 763.493.4522
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Design plans were prepared for Phase 2 of Trout Brook restoration by Inter-fluve in May of 2018. Construction of a majority of features shown in the design plans was completed in 2019. This construction project included:

- *Relocation of a portion of the channel downstream of the chalet area, including a two-stage channel with meandering bankfull channel within a confined floodplain area.*
- *Addition of a riffle downstream of the upstream road crossing to allow fish passage.*
- *Construction of a wet crossing for vehicles at approximately Station 24+50 (proposed alignment) for off-road maintenance vehicles.*
- *Installation of several pedestrian crossings and one 14-foot-wide by 10-foot-high reinforced concrete box culvert.*

2 EXISTING CONDITIONS

2.1 SURVEY

Survey data was collected in October and November of 2021 to identify the existing condition of the site. Additional survey information was provided by the MnDNR and from previous project phases. All survey data collected by HEI utilizes the Washington County Coordinate System and North American Vertical Datum 1988 (NAVD88). (Note: Unless otherwise noted, all elevations provided herein are based on NAVD88 vertical datum).

2.2 WETLANDS

A wetland survey was conducted in October 2021. Results of the field delineations indicate there is one wetland area (1.84 acres) and one linear watercourse (approximately 3,362 linear feet) within the 11.24-acre survey area. The aquatic resource classifications include Type 1 seasonally flooded floodplain wetland (PFO1A) which is a forested floodplain to the St. Croix River, and the intermittent trout stream and Minnesota Public Water (PWI ID 82028a), Trout Brook, respectively. The wetland appears to have a surface connection to the St. Croix River, the nearest traditional navigable water or water body, as well as Trout Brook, which flows into the St. Croix. The wetland delineation is shown in **Appendix A – Wetland Delineation**.

2.3 HYDROLOGY

Flow frequency statistics are necessary to size project features. Results from several methodologies were compared to determine design discharges for Trout Brook. The recommended discharges are based on USGS Regression Equations (StreamStats). The bankfull discharge was calculated by the MnDNR using reference reach data. **Appendix B - Hydrology** describes the methods used to define the design discharges. **Table 1** shows the recommended discharge frequency curves throughout the site.

Table 1: Recommended Discharges (cfs)

Recurrence Interval (year)	At Site Culvert and upstream	Adjacent to Maintenance Road	Through Afton State Park
Bankfull	68.3	68.3	68.3
1.5	68.3	69.9	78.6
2	98.7	101	113
5	196	200	223
10	281	287	319

Recurrence Interval (year)	At Site Culvert and upstream	Adjacent to Maintenance Road	Through Afton State Park
25	406	415	460
50	510	521	576
100	631	643	710

2.4 HYDRAULICS

A HEC-RAS model (version 6.0.0) was developed to determine the water surface profiles for the site. The HEC-RAS model was originally created by Inter-fluve with version 5.0.5 in 2018 for design of the Phase II project features. The model was updated to extend and realign the main Trout Brook channel, extend existing cross sections, add additional cross sections, and to update various other hydraulic parameters.

Topography for the HEC-RAS model came from a combination of field surveyed cross sections, surface data provided by Inter-fluve and LiDAR (LiDAR obtained from MnDNR). The additional cross sections added to the model were based on this combined survey and LiDAR topography. **Figure 2** shows a schematic of the HEC-RAS model.

Field survey elevations were collected referencing vertical datum NAVD88. The Washington County LiDAR references vertical datum NAVD88. Thus, no datum conversions were needed.

The roughness coefficients used for this study were estimated based on consistency with modeling completed during previous phases, field reconnaissance, photos taken by surveyors, consistency through similar reaches, calibration, and tables within the HEC-RAS manual [6]. **Table 2** shows the Manning's "n" values used for the channel and overbank for each reach.

The starting water surfaces elevations for the Trout Brook model were calculated using normal depth with a slope of 0.008. Backwater elevations from the downstream St. Croix River were not utilized, since normal depth will result in more conservative velocity calculations.

Figure 2: HEC-RAS Model Schematic

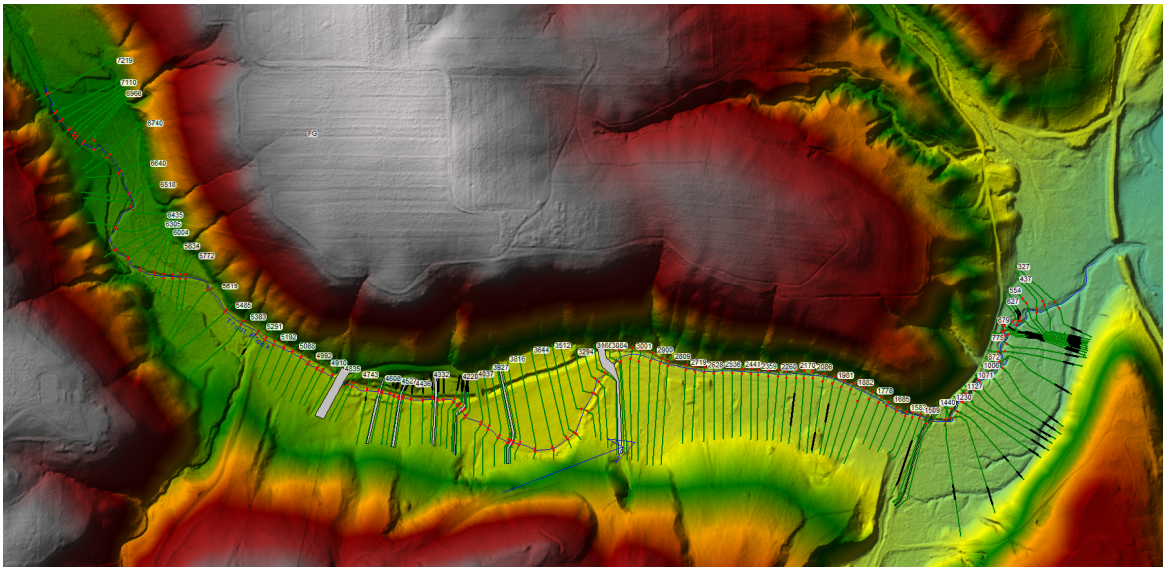


Table 2: Roughness Factors ("Manning's "n")

Location	Channel	Overbanks	
		Left	Right
Stations 7219 – 5291	0.045	0.1	0.1
Stations 5240 - 4665	0.035	0.1	0.035
Stations 4608 - 3387	0.03	0.05	0.04
Stations 3294 - 1548	0.035	0.1	0.04
Stations 1509 - 327	0.05	0.1	0.1

3 PROJECT DESIGN

3.1 CHANNEL AND FLOODPLAIN GEOMETRY

Previous design documents provide detailed narrative on the history of the site geomorphology.

The MnDNR surveyed several reference reach sites and provided an initial geomorphic assessment. Reference reach data was collected by the MnDNR during design of Phase II of the project and following construction. The DNR also collected data to record the response of the newly constructed Phase II site. The existing site is generally a G stream type, while the proposed stream type is B4c. Riffles and pools are often filled with sediment and not functioning to provide habitat.

Stream components were largely designed using Rosgen methodology in alignment with the concept design from the MnDNR. Stream dimensions were roughly modeled in HEC-RAS to calculate velocities and shear stress throughout the reaches. The design will be further refined with additional modeling moving into the 60% design.

The MnDNR calculated concept design parameters such as cross section and profile data, as well as minimum, average, and maximum values for cross section, profile, and pattern variables. This data was reviewed by HEI for concurrence. The MnDNR also provided an initial alignment and profile through Afton State Park (Reach 1). **Table 3** below shows how the resultant stream dimensions compared with the concept design and the Phase II constructed design.

The alignment provided by the MnDNR through reach 1 was refined to facilitate off-line construction. This will allow vegetation to be established prior to discharges being introduced to the reach. This reach will transition from the confined channel adjacent to the maintenance road to a type $B4_c$ with floodplain connectivity. The channel will be re-meandered with an excavated floodplain bench to increase floodplain connectivity and storage.

Reaches 2 and 3 are generally very confined. They will be constructed under wet conditions, though it is anticipated the contractor will utilize pumps and coffer dams to create dry conditions where construction is imminently occurring. Due to the construction conditions, it is desired to limit disturbance of vegetation. Since the low flow channel is similar to the calculated stable dimensions, grading was limited to intermittent floodplain excavation. In-channel structures such as rootwads and riffles are proposed to create a more diverse habitat. The downstream end of reach 3 will include a culvert replacement, which will be discussed more in Section 3.5 below.

Reach 4 consists of excavation of a floodplain bench. The benefits of this channel improvement compared to cost and land disturbance should be further considered by stakeholders.

The resultant alignment, profile, and cross sections are shown in more detail in **Appendix C – 30% Design Plans**.

Table 3: Stream Dimensions

		MnDNR Concept Design	Reach 1 (Afton State Park)	Reach 2 (Afton Alps Adjacent to Maintenance Road)	Phase II	Reach 3 (Upstream Chalet Crossing)
Riffle Width, ft (Wbkf)	Mean:	13.5	13.5	13.5	15	13.5
	Min:	12.6	13.5	13.5		13.5
	Max:	14.3	13.5	13.5		13.5
Riffle Mean Depth, ft (dbkf)	Mean:	1.06	1.11	1.11	1.3	1.11
	Min:	1.00	1.11	1.11		1.11
	Max:	1.13	1.11	1.11		1.11
Riffle Width/Depth Ratio (Wbkf/dbkf)	Mean:	12.8	12.2	12.2	11.5	12.2
	Min:	11.1	12.2	12.2		12.2
	Max:	14.4	12.2	12.2		12.2
Riffle Cross-Sectional Area, ft^2 (Abkf)	Mean:	14.3	15.0	15.0	19.5	15.0
	Min:		15.0	15.0		15.0
	Max:		15.0	15.0		15.0
Pool Mean Depth, ft (dbkfp)	Mean:	1.43	1.25	1.25		1.25
	Min:	1.13	1.25	1.25		1.25
	Max:	1.69	1.25	1.25		1.25
Stream Meander Length, ft (Lm)	Mean:	262.1	160	75	129	58
	Min:	187.6	130	75	86	50
	Max:	392.2	180	75	192	65
Stream Meander Length Ratio (Lm/Wbkf)	Mean:	19.4	11.9	5.6	8.6	4.3
	Min:	13.9	9.6	5.6	5.7	3.7
	Max:	29.0	13.3	5.6	12.8	4.8
Belt Width, ft (Wblt)	Mean:	129.2	69	31	40	31
	Min:	53.7	54	25		26
	Max:	188.5	82	35		32
Meander Width Ratio (Wblt/Wbkf)	Mean:	9.55	5.11	2.30	2.67	2.30
	Min:	3.98	4.00	1.85		1.93
	Max:	13.95	6.07	2.59		2.37
Radius of Curvature, ft (Rc)	Mean:	29.2	31.7	40.0	54	30.0
	Min:	18.9	20.0	30.0	35	25.0
	Max:	45.3	45.0	45.0	76	45.0
Radius of Curvature to Riffle Width (Rc/Wbkf)	Mean:	2.16	2.35	2.96	3.6	2.22
	Min:	1.40	1.48	2.22	2.3	1.85
	Max:	3.35	3.33	3.33	5.1	3.33
Riffle Length (Lr), ft	Mean:	26.3	24.0	25.0	23	27.1
	Min:	18.3	20.0	20.0	14	20.0

		MnDNR Concept Design	Reach 1 (Afton State Park)	Reach 2 (Afton Alps Adjacent to Maintenance Road)	Phase II	Reach 3 (Upstream Chalet Crossing)
Individual Pool Length, ft (Lp)	Max:	35.5	30.0	30.0	39	30.0
	Mean:	32.4	40.9	49.1	15	29.3
	Min:	18.3	28.0	35.0	9	28.6
Pool-to-Pool Spacing, ft (Ps)	Max:	45.1	61.0	65.5	39	32.5
	Mean:	54.7	75.6	87.0	56	60.3
	Min:	35.8	55.0	78.5	40	52.5
	Max:	68.8	93.5	95.5	81	66.5
Sinuosity (k)		1.20	1.26	1.02	1.10	1.01

3.2 HYDRAULICS

The proposed condition was modeled in HEC-RAS version 6.0. More detail will be added to the CAD drawings to show riffles and pools during the 60% design; thus the 30% model is based on only riffle cross sections to estimate a conservative water surface elevation throughout the reach. Due to the excavation of a downstream floodplain bench, and the increase in culvert size at the chalet crossing, there are no increases in water surface elevation for 100-year profiles. Smaller events have isolated locations of water surface elevation increase on the Afton State Park property at the downstream tie-in location.

It is anticipated that more detailed modeling will occur during development of the 60% and 90% design to facilitate placement of channel structures and vegetation practices in locations with high velocities or shear stress.

3.3 SEDIMENT TRANSPORT AND RIPRAP SIZING

The MnDNR provided calculations indicating the largest moveable particle during bankfull shear stress is 3.33 inches in diameter, however at key grade control locations it is necessary to consider larger rock sizes, both for stability and diversity.

Rock sizing at riffles was alternatively sized using two methods, 1) Lanes equation, which utilizes mean depth and water surface slope, and 2) the USACE unit discharge method, which utilizes channel slope, design discharge, and bottom width. Depth and width information was pulled from each cross section using HEC-RAS. For a conservative calculation, a slope of 1.8% (max riffle grade) was used for the channel slope and water surface slope at all cross sections. The cross sections were split by design segment to distinguish between locations with floodplain connectivity and sections that remain constricted. The results of this analysis are shown in **Table 4.**

The results indicate that generally riffles can be designed with a D50 of 3.5 inches based on the bankfull D50 calculation, this will allow riffles and pools to migrate over time, similar to natural streams. However riffles that perform a grade control function should be designed with larger D50 sizes, in line with Class III MnDOT sizing. Of note is that these calculations are based on angular rock, if rounded rock is preferred, sizes may be upsized 25-50%. It is anticipated that further detail will be added to the riffle design during 60% and 90% design.

Table 4: Rock Sizing Calculations (inches)

Segment	Event	Lanes Method D50 (Average)	Lanes Method D50 (Max)	USACE Unit Discharge Method D50 (Average)	USACE Unit Discharge Method D50 (Max)
Reach 1 (Afton State Park)	Bankfull	0.7	2.9	0.9	3.0
	2-year	0.6	3.2	0.9	3.8
	10-year	0.7	1.5	1.1	2.5
	50-year	0.9	1.8	1.4	2.0
	100-year	1.1	2.1	1.5	1.9
Reach 2 (Afton Alps Adjacent to Maintenance Road)	Bankfull	3.0	4.2	2.8	3.5
	2-year	3.5	4.4	3.3	4.2
	10-year	4.8	6.5	4.9	6.8
	50-year	4.5	7.9	4.7	9.0
	100-year	3.9	8.3	4.0	9.0
Reach 3 (Upstream Chalet Crossing)	Bankfull	2.4	3.5	2.3	3.0
	2-year	2.8	3.9	2.7	3.6
	10-year	3.8	5.3	3.9	5.1
	50-year	4.0	6.6	4.2	6.5
	100-year	3.9	5.2	3.9	6.5

3.4 ECOLOGY

More detailed placement of stream habitat features and plantings will be explored during the 60% and 90% design. It is anticipated that toe-wood benches will be utilized to protect the banks in the Afton State Park reach where the old channel is plugged and water is diverted to the meandered channel. Tree clearing will occur to construct the floodplain bench. Where the drip line of trees outside the excavation area is disturbed due to excavation, trees outside but adjacent to the excavation area will be cleared. Woody debris from cleared trees is anticipated to be utilized for rootwads and woody debris riffles.

It is anticipated that all areas will be seeded with native seed mixes, specified based on inundation likelihood. Shrubs and tree plantings will be utilized in areas with increased shear stress or velocities. The DNR has requested that bare root specimens be utilized. Additionally, Great River Greening has provided notes on planting specs from Phase II, to be revised during phase III. These notes will be incorporated during specification development (90% plans)

3.5 STREAM CROSSING AT CHALET

One portion of the Trout Brook Phase III project consists of removing and replacing two existing 54" corrugated metal pipe (CMP) culverts located to the west of the Alps Village. The crossing provides connectivity to the Afton Alps facility for the public and staff. The objective of the replacement is to improve channel conditions at the stream crossing and create a more efficient waterway opening. The improved waterway opening of the proposed structure will match the channel bankfull width, reduce stream velocity to enhance conditions for fish passage, and reduce the likelihood of overtopping.

During concept design, HEI prepared a structure type memo which compared 4 crossing alternatives. Structure alternatives were selected to maintain a similar channel profile, meet minimum cover requirements (2' min.) and minimize impacts to the existing roadway profile and alignment as well as the

adjacent parking lot. This memo is provided in **Appendix D – Structure Type Design Memo**. The memo was presented to stakeholders during the concept design stakeholder meeting. The precast concrete box culvert option was selected based on cost, maintenance, and ability to install fill and boulders inside without damaging the structure.

The crossing is shown in more detail in **Appendix C – 30% Design Plans**.

3.5.1 HYDRAULICS

Below is a description of the hydraulic analysis regarding the proposed crossing. **Table 5** shows existing crossings upstream and downstream of the site.

Table 5: Existing Crossings

Location	Description	Waterway Area (sq.ft.)
CSAH 21 (0.99 miles upstream)		275
Trail Bridge (0.04 miles downstream)	Truss Bridge Connecting to Main Chalet	90
Trail Bridge (0.06 miles downstream)	Truss Bridge Connecting to Main Chalet	90
Maintenance Road (0.10 miles downstream)	Truss Bridge Connecting to Main Chalet	140
Pedestrian Bridge (0.13 miles downstream)	Truss Bridge Connecting to East Parking	110
Pedestrian Bridge (0.18 miles downstream)	Truss Bridge Connecting to East Parking	140
Gravel Maintenance Crossing (0.32 miles downstream)	Box Culvert under Maintenance Road	140
Trail Crossing (0.64 miles downstream)	Concrete Beam Bridge (area estimated)	80

Because the goals of the project include fish passage and habitat, the proposed structure was designed with the MESBOAC approach:

- Match Culvert width to bankfull stream width: The proposed culvert width is 16-feet which is based on the bankful width provided by the MnDNR of 12.6-14.3 feet (average 13.5).
- Extend Culvert Length through the side slope toe of the road: The culvert is extended through the side slope of the road and will utilize end sections to transition from the culvert into the channel.
- Set culvert slope the same as the stream slope: The channel slope through this reach is generally 1%, however slopes on riffles range from 1.5 to 1.8%. The slope of the culvert is set nearly flat. The proposed box culvert will be filled in with material to match the adjacent channel bottom thus matching slope.
- Bury the Culvert: The culvert is anticipated to be buried 1 foot on the bottom, with sporadic larger boulders placed, and thus modeled assuming a fill depth of 1.5 feet.
- Offset multiple culverts: Due to the low overtopping elevation in the adjacent parking lot, floodplain culverts are not necessary to relieve shear stress and velocities for larger events.
- Align the culvert with the stream channel: The stream channel has been generally altered to straighten the reach. The proposed restoration project will add meanders where feasible and the culvert alignment will fit the proposed stream alignment.
- Consider head cuts and cutoffs: Both the upstream and downstream channel segments are stabilized with designed riffles.

The proposed crossing was analyzed in the previously described HEC-RAS model. Table 6 below describes the site hydraulic data.

Table 6: Chalet Crossing Hydraulic Data

		No Crossing	Existing	Proposed
General Data	Crossing Description	NA	2 – 54x70" CMP Culverts	1 - 16'x7' Box culvert
	Waterway Area (sq.ft.)	NA	41	112
	Flowline Elevation	717.5	717.7	715.6
	Overtopping Elevation	NA	722.6	722.6
Bankfull Event	Culvert Discharge (cfs)	68.3	68.3	68.3
	Overflow Discharge (cfs)	NA	0	0
	Headwater Elevation (ft)	720.7	720.9	720.0
	Mean Velocity through culvert (ft/sec)	NA	3.3	1.5
	Mean Velocity in Downstream Channel (ft/sec)	3.0	3.0	3.0
2-year Event	Culvert Discharge (cfs)	98.7	98.7	98.7
	Overflow Discharge (cfs)	NA	0	0
	Headwater Elevation (ft)	721.1	721.2	720.3
	Mean Velocity through culvert (ft/sec)	NA	4.1	2.0
	Mean Velocity in Downstream Channel (ft/sec)	3.3	3.3	3.3
10-year Event	Culvert Discharge (cfs)	281	281	281
	Overflow Discharge (cfs)	NA	0	0
	Headwater Elevation (ft)	722.5	723.3	721. 7
	Mean Velocity through culvert (ft/sec)	NA	7.8	4.4
	Mean Velocity in Downstream Channel (ft/sec)	3.9	3.9	3.9
25-year Event	Culvert Discharge (cfs)	406	379.7	406
	Overflow Discharge (cfs)	NA	26.3	0
	Headwater Elevation (ft)	723.2	725.2	722.4
	Mean Velocity through culvert (ft/sec)	NA	9.8	5.8
	Mean Velocity in Downstream Channel (ft/sec)	4.5	4.5	4.5
50-year Event	Culvert Discharge (cfs)	510	390.8	510
	Overflow Discharge (cfs)	NA	119.2	0
	Headwater Elevation (ft)	723.7	725.5	723.1
	Mean Velocity through culvert (ft/sec)	NA	9.9	6.9
	Mean Velocity in Downstream Channel (ft/sec)	4.8	4.8	4.8
100-year Event	Culvert Discharge (cfs)	631	398.2	631
	Overflow Discharge (cfs)	NA	232.8	0
	Headwater Elevation (ft)	724.2	725.7	723.8
	Mean Velocity through culvert (ft/sec)	NA	9.9	8.0
	Mean Velocity in Downstream Channel (ft/sec)	5.2	5.2	5.2

The existing crossing overtops during a 10-year. Following the MESBOAC approach resulted in a significantly larger waterway area which significantly reduced the frequency of flooding in the parking lot. The proposed crossing overtops during an event greater than the 100-year..

In addition to the MESBOAC approach, the DNR was consulted on appropriate culvert velocities given the species of fish in the channel and likely burst speeds. Assuming an approximate culvert length of 70 feet and DNR guidance materials resulted in a maximum 2-year velocity of 2.3 ft/sec. The proposed crossing has a 2-year velocity of 1.95 ft/sec, which is within the constraints.

4 OPINION OF PROBABLE COSTS

The estimated construction project costs for the project described in this report are as follows:

Table 7 – Opinion of Probable Construction Costs

Stream Cost*	Crossing Costs*	Other Costs**	Total Cost
$623,700	$270,700	$382,200	$1,276,600

*Includes 20% construction contingency.

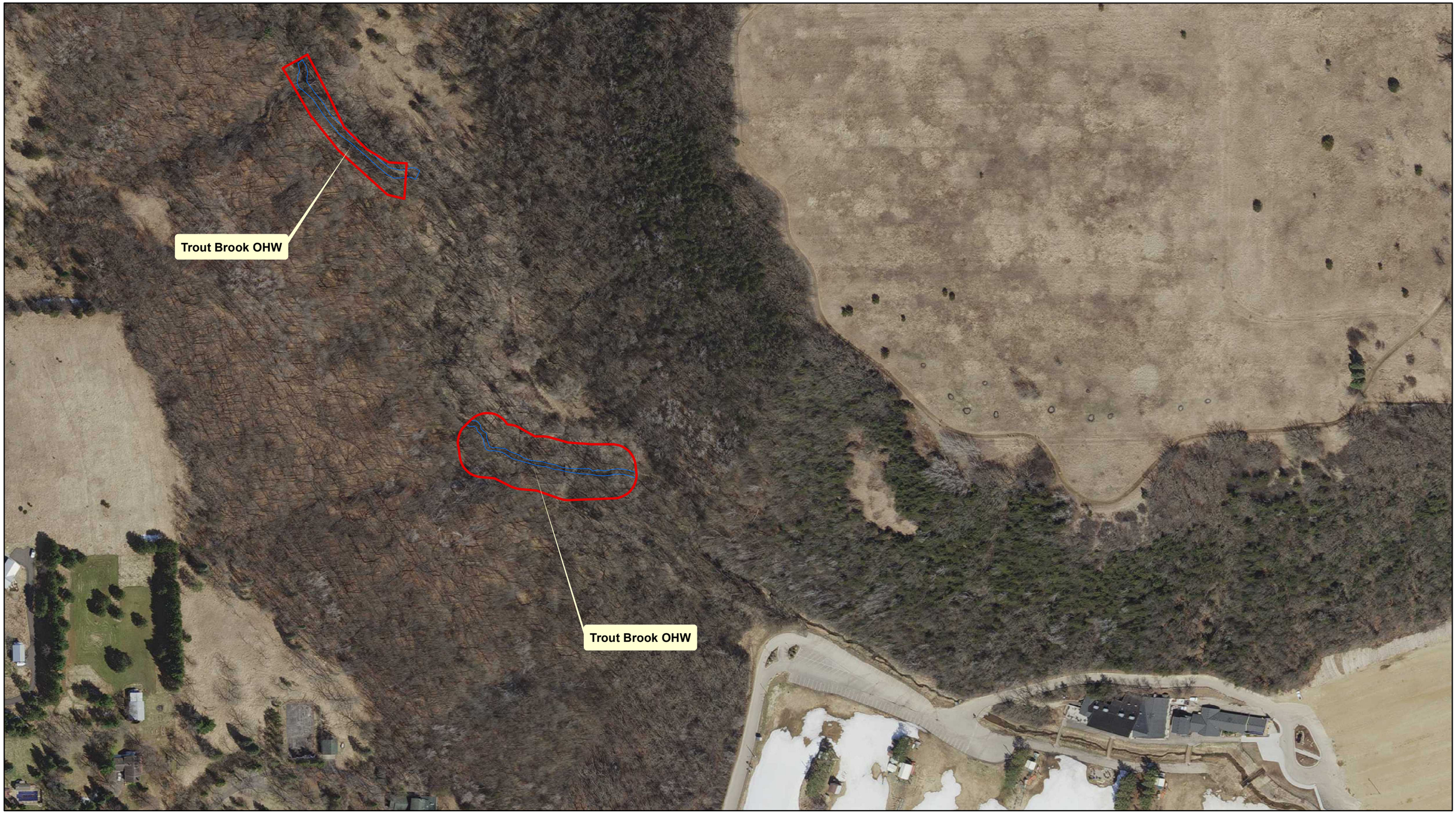
**Other costs include: engineering, legal, and other administrative costs.

A detailed breakdown of the project costs is included as **Exhibit E** to this report, Project Itemized Cost Estimate.

5 RECOMMENDATION AND NEXT STEPS

Following stakeholder review of the 30% Plans and Design Report, comments and revisions will be incorporated to create the 60% plan set. The 60% plan set will be used for permitting submittals. Any necessary revisions that arise during regulatory review will be incorporated prior to construction.

APPENDIX A – WETLAND DELINEATION



Trout Brook Restoration
Wetland / Watercourse Delineation

Created By: ebaskerville Date Created: 10/27/21 Date Exported: 11/3/2021 Image: MnGEO 2020 7-County Elevation Data: NA
Horizontal Datum: NAD 1983 UTM Zone 15N Vertical Datum: North American 1983
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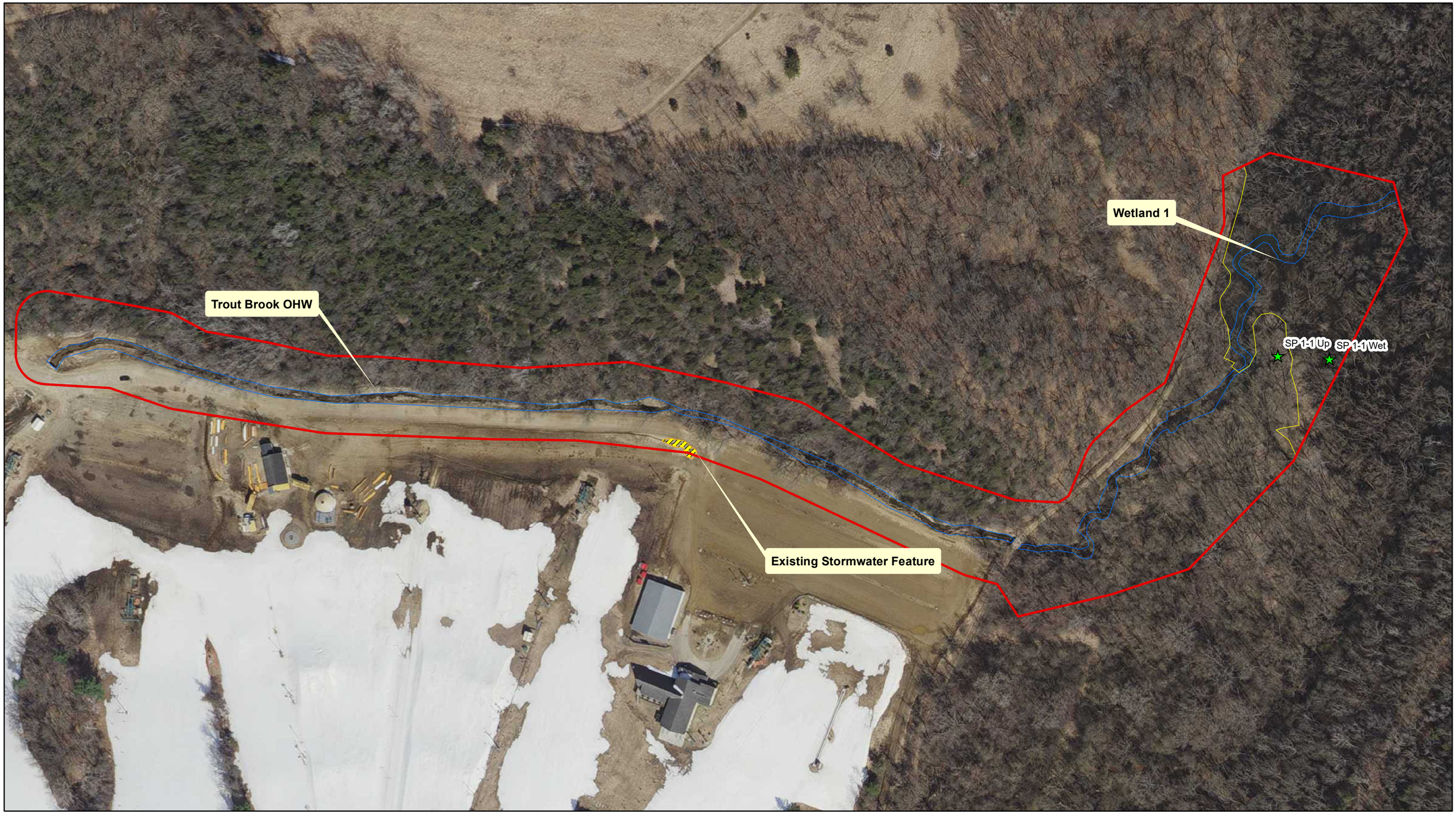
N W E S

0 190 380
Feet

1 inch = 187 feet

HOUSTON engineering, inc.



Trout Brook Restoration
Wetland / Watercourse Delineation

Created By: ebaskerville Date Created: 10/27/21 Date Exported: 1/28/2022 Image: MnGEO 2020 7-County Elevation Data: NA
Horizontal Datum: NAD 1983 UTM Zone 15N Vertical Datum: North American 1983
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Project Area Delineation
Watercourse Boundary
Stormwater Feature
Sample Points
Wetland

N
W E
S

0 140 280
Feet

1 inch = 141 feet

HOUSTON engineering, inc.

APPENDIX B - HYDROLOGY

Flow frequency statistics are necessary to size project features. Results from several methodologies were compared to determine design discharges for Trout Brook. Unless otherwise referenced all discharges are calculated at the footbridge near the Afton Alps – MnDNR property line.

USGS REGRESSION EQUATIONS

The project site is located miles from the Wisconsin border; thus discharges were calculated using both SIR 2009-5250 (Minnesota Regression Equations), and WRIR 03-4250 (Wisconsin Regression Equations). The site is in Minnesota Region B, however geographically close to regions D and F. For comparison, discharges were calculating using all three regional equations. The watershed characteristics were calculated using StreamStats v4.6.2. The resultant discharges are shown in **Table 8** below.

Table 8: USGS Regression Equations Resultant Discharges (cfs)

Event	Stream Stats (USGS Regression Equations) MN Region B	Stream Stats (USGS Regression Equations) MN Region D	Stream Stats (USGS Regression Equations) MN Region F	Stream Stats (USGS Regression Equations) WI Region 2
1.5 yr	70	86	267	
2 yr	101	123	364	318
5 yr	200	245	648	584
10 yr	286	349	873	781
25 yr	414	505	1192	1069
50 yr	520	640	1449	1291
100 yr	643	796	1727	1522

EXISTING DATA STUDIES

CSAH 21 (St. Croix Trail South) has a waterway study and risk assessment on record that was completed by a contractor for Washington County. This study was completed in 1999 and used a Hydrocad model. A drainage area transfer equation was used to transfer the calculated discharges to the project site. An exponent of 0.65 was used.

Table 9: CSAH 21 MnDOT Risk Assessment Discharges

Location/ Drainage Area/ Event	**Discharge at CR 21**	**Discharge at Parcel Boundary Foot Bridge (gage)**
	5.92 Square Miles	**6.85 Square Miles**
2yr	310	341
5yr	663	729
10yr	973	1070
25yr	1460	1605
50yr	1880	2067
100yr	2370	2606

HYDROCAD MODELING (SCS)

To compare results, a HydroCAD model (v10.10-4b) was developed. The SCS curve number method was utilized along with Atlas 14 rainfall depths. The model included 9 subcatchments, 3 storage areas, and 8 reaches. The main catchment was originally gathered from Streamstats and refined via county LiDAR data. Subcatchments range in area between 60 – 2,000 acres with the time of concentration for each subcatchment estimated using the velocity method. Reaches were split into sections ranging from 500 - 5,000 feet using the Muskingum-Cunge method with representative cross sections for each reach cut from LiDAR data. Storage curves were developed based on county LiDAR.

Table 10: HydroCAD Model Results (cfs)

Event	HydroCAD (Developed November 2021)
1.5 yr	148
2 yr	176
5 yr	310
10 yr	473
25 yr	768
50 yr	1062
100 yr	1426

DRAINAGE AREA RATIO FROM USGS GAGING STATIONS ON SIMILAR STREAMS

Due to the variation in calculated discharges via varied methodologies, an analysis was done using drainage area transfer from nearby USGS gages for comparison. Gages near the site, but on different streams with similar watershed characteristics were used. The flow frequency curves in SIR 2009-5250 were used at each gage. The results of the drainage area transfer and comparison is shown in **Table 11** and **Table 12.**

Table 11: Nearby Gage Watershed Characteristics

	Site	USGS Gage 053450000	USGS Gage 053455150
Location	Parcel Boundary Foot Bridge	Vermillion River near Empire, MN	Pine River Near Cannon Falls, MN
Years of Data in Discharge-Frequency Analysis	NA	33 years of data; 1943, 1974-2005	21 years of data; 1960-1980
Drainage area (DAREA) (mi2)	6.85	129	20.6
Main-channel slope (SLOPE) (ft/mi)	50.2	8.37	11.8
Lake area (LAKE) (percent)	0	0.88	0
Storage area (STOR) (percent)	1.87	10.8	0.81
Soil hydrologic group A (SOILA) (percent)	0	8.95	12.9
Soil hydrologic group D (SOILD) (percent)	0	0.63	4.72
Generalized mean annual runoff (ROFF) (in/yr)	6.68	6.04	6.37

Table 12: Nearby Gage Drainage Area Transfer Resultant Discharges (cfs)

Event	At USGS Gage 053450000	USGS Gage 053450000 to Site	USGS Gage 053455150	USGS Gage 053455150 to Site
1.5 yr	488	50	99	50
2 yr	703	70	155	78
5 yr	1450	141	347	172
10 yr	2140	205	515	255
25 yr	3260	310	767	378
50 yr	4280	405	981	483
100 yr	5490	518	1210	595

GAGE DATA

Gage data was provided by South Washington Watershed District for Trout Brook. Gage data has been collected during the summer from 2004-2007, and 2011-2020. The largest events on record were 2015, 2005, and 2019.

Unfortunately, in 2015, the gage malfunctioned and the peak was not collected, however the nearby gage at Afton showed 6.5 inches of rain in a 24-hr period, which is just greater than a 50-year event (using Atlas 14 precipitation depths). Site photos of the event show that water was just breaking out into the nearby parking lot and below the top of culvert at the crossing. The hydraulic modeling indicates that this was likely an approximately 150-200 cfs event. This event was ranked 1st.

The event in 2005 was recorded by the gage with no issues noted. Nearby gages indicate 4.0 to 5.5 inches fell within 24 hours. This would correspond to an approximately 7 to 30-year event. This event was ranked 2nd.

The event in 2019 was a spring snowmelt and rainfall event. The gage was not yet recording discharge data when the event occurred. This event was ranked 3rd.

HEC-SSP statistical software was used to perform a Bulletin 17C analysis. Station skew was used and the events in 2015 and 2019 were incorporated as historical events. Missing years were not considered since local knowledge indicates they did not have large events. **Table 13** and **Table 14** show the results of this analysis.

Table 13: Gage Data

Year	Rank	Discharge at Gage (cfs)	% Chance Annual Exceedance	Recurrence Interval (year)
2015	1	150-200 (estimated)	6.7%	14.9
2005	2	150	13.3%	7.5
2019	3	NA	20.0%	5.0
2020	4	142	26.7%	3.7
2007	5	103	33.3%	3.0
2013	6	100	40.0%	2.5
2014	7	81	46.7%	2.1
2017	8	56	53.3%	1.9

Year	Rank	Discharge at Gage (cfs)	% Chance Annual Exceedance	Recurrence Interval (year)
2012	9	35	60.0%	1.7
2006	10	34	66.7%	1.5
2018	11	33	73.3%	1.4
2004	12	29	80.0%	1.3
2016	13	16	86.7%	1.2
2011	14	16	93.3%	1.1

Table 14: Bulletin 17C Flow Frequency Analysis

Characteristic	Bulletin 17C Discharge Frequency Analysis at Gage	Bulletin 17C Discharge Frequency Analysis (95% Confidence Limit) at Gage
1.5 yr	43	66
2 yr	63	95
5 yr	122	191
10 yr	168	313
25 yr	232	553
50 yr	282	790
100 yr	335	1102
500 yr	389	1520

RECOMMENDED DESIGN DISCHARGES

Table 15, **Figure 3**, and **Figure 4** show the results of all the various hydrologic calculation methods.

Gage data is typically the best available data for calculating flow frequency relationships; however, with only 14 years of data, there is high potential variability in plotting positions. There appears to be a jump in the graphical plot near the 1.5 to 3-year event. This may be due to upstream storage or other factors. As a result of the limited period of record and jump, the 90% confidence limits for the 1.5-year and 2-year events are 26-66 cfs and 41-95 cfs respectively.

The design discharges to be utilized are those based on USGS Regression equations in Region B. This methodology is recommended for the following reasons:

1. The discharges for all events calculated using USGS regression equations fit between the Bulletin 17C discharge and the 95% confidence limit.
2. There is a steep jump on the plotted gaged discharges near the 1.5-2-year discharge. This indicates that a log-Pearson Type III curve may not be a good fit near the reoccurrence interval of concern.
3. This is consistent with the methodology used during previous phases.
4. Generally, Minnesota has seen increases in intense rainfall events in the last several decades, therefore a conservative discharge will increase the resiliency of the project.
5. While local knowledge indicates that 2019 was the only snowmelt event, its possible the gage is missing spring runoff peaks which is skewing the Bulletin 17C analysis to lower discharges during smaller events. It is feasible that spring snowmelt events in the 1.5 to 2-year frequency range are overlooked by local observers.
6. The USGS regression equations are based flow frequency of numerous gages with longer periods of record.

Table 15: Summary of Discharge Calculations

Recurrence Interval (year)	USGS Regression Equations MN Region B	USGS Regression Equations MN Region D	USGS Regression Equations MN Region F	USGS Regression Equations WI Region 2	MnDOT Upstream Bridge Hydraulic Report	Drainage Area Transfer USGS Gage 05345000	Drainage Area Transfer USGS Gage 05355150	HydroCAD (Developed November 2021)	Bulletin 17C	Bulletin 17C 95 % Confidence
1.5	**78**	70	86	267			50		43	95
2	**112**	101	123	364	318	341	70	176	63	191
5	**222**	200	245	648	584	729	141	310	122	313
10	**317**	286	349	873	781	1070	205	473	168	553
25	**457**	414	505	1192	1069	1605	310	767	232	790
50	**572**	520	640	1449	1291	2067	405	1062	282	1102
100	**705**	643	796	1727	1522	2606	518	1426	335	1520

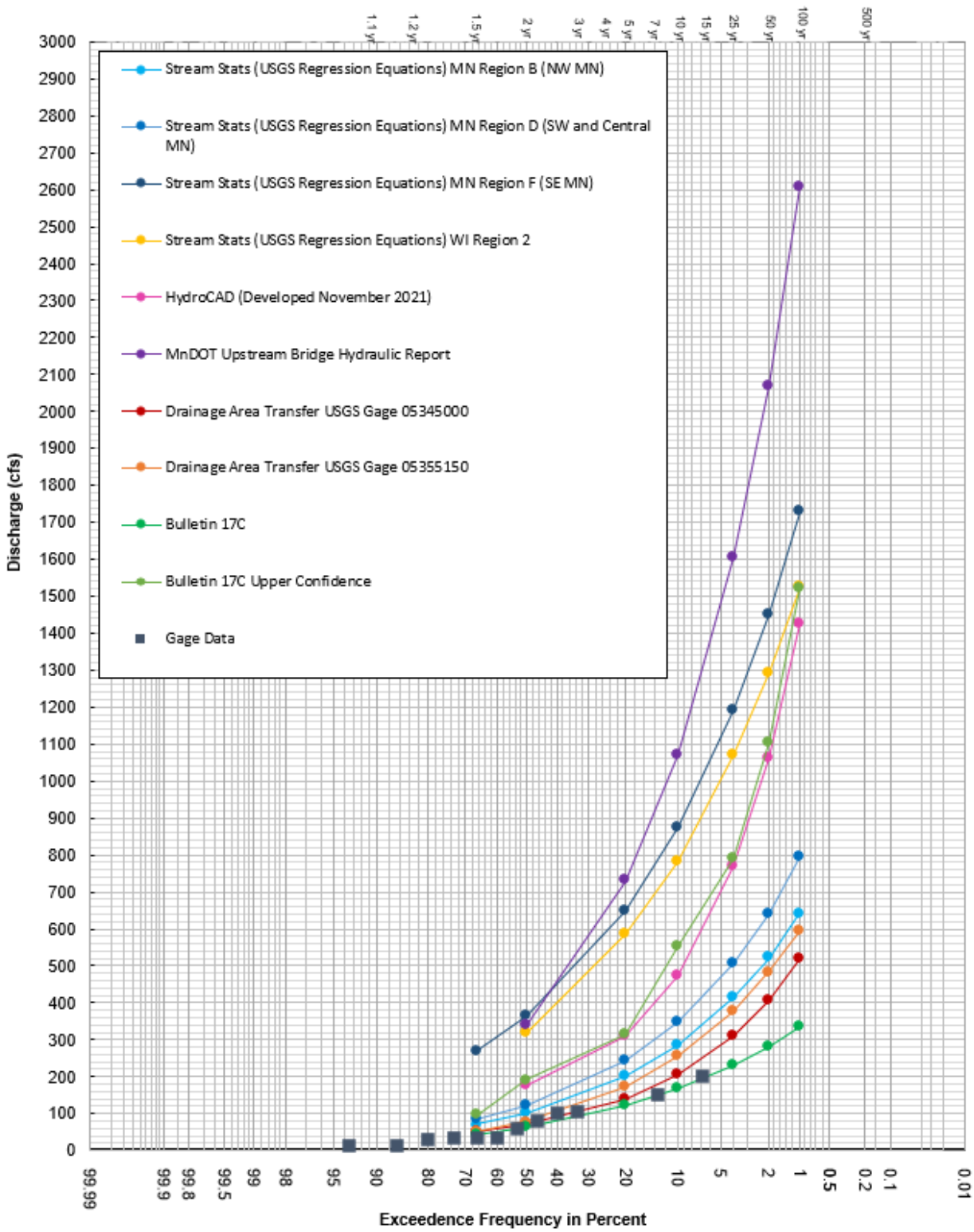


Figure 3: Discharge Frequency Plots of all Calculated Methods

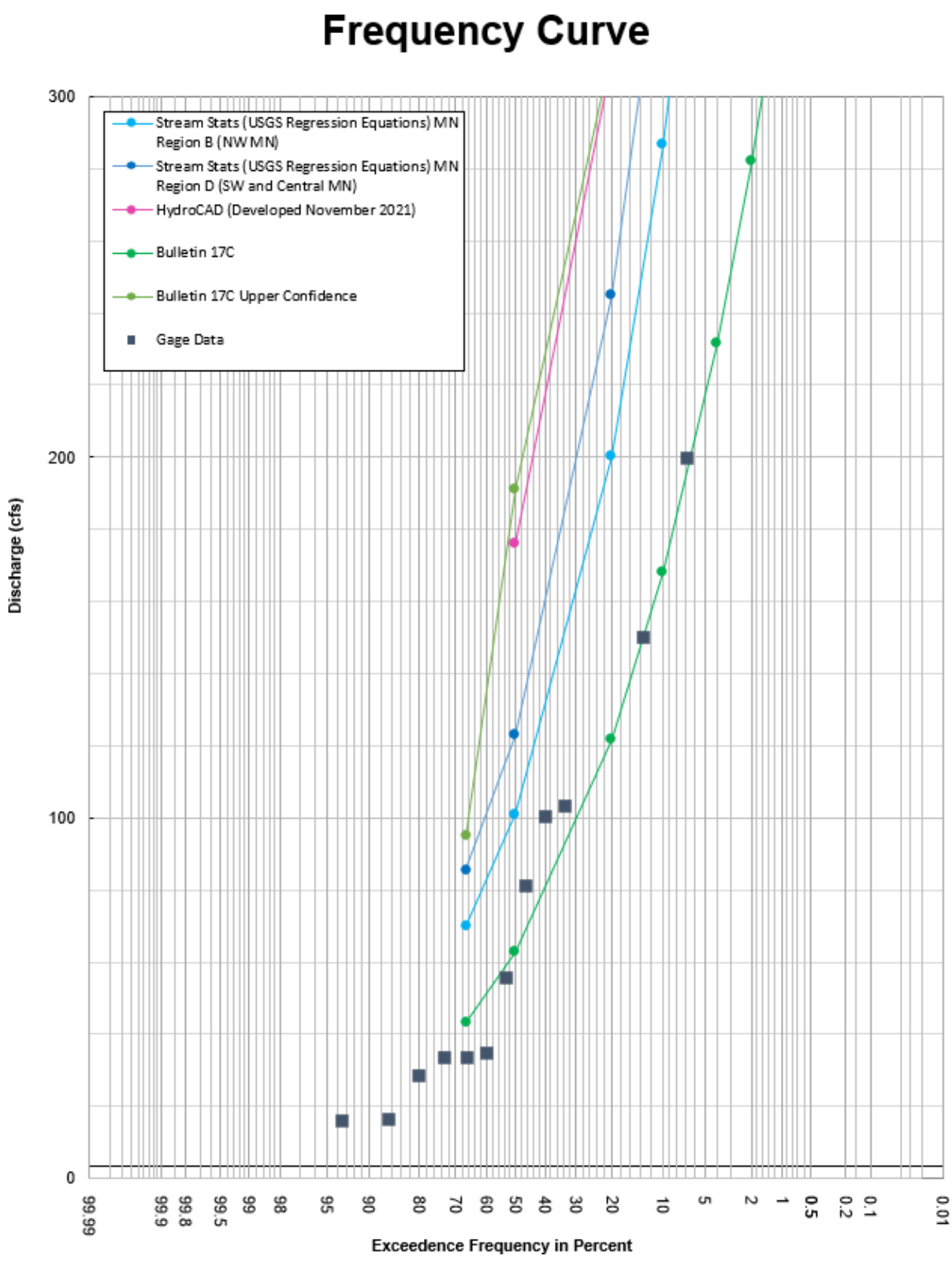


Figure 4: Discharge Frequency Plots of all Calculated Methods (low flow scale)

APPENDIX C – 30% DESIGN PLANS

CONSTRUCTION PLANS FOR

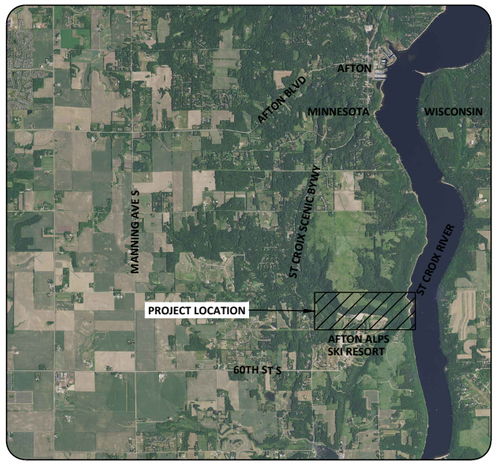
SOUTH WASHINGTON WATERSHED DISTRICT
TROUT BROOK RESTORATION PHASE 3

AFTON ALPS, MN

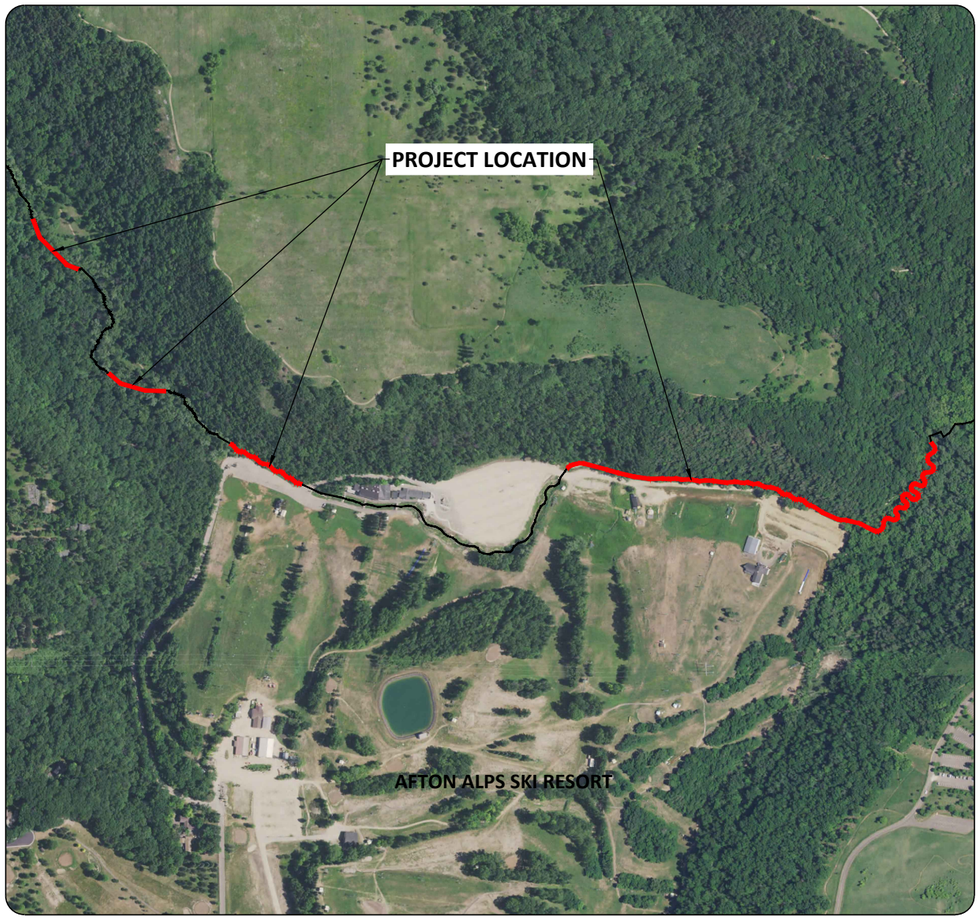
JANUARY, 2022

HOUSTON engineering, inc.
7550 MERIDIAN CIR N
SUITE 120
MAPLE GROVE, MN 55369
P: 763.493.4522
T: 1.866.319.2040
www.houstoneng.com

SHEET INDEX



VICINITY MAP



LOCATION MAP

VERTICAL DATUM: NAVD 1988
HORIZONTAL DATUM: NAD 1983

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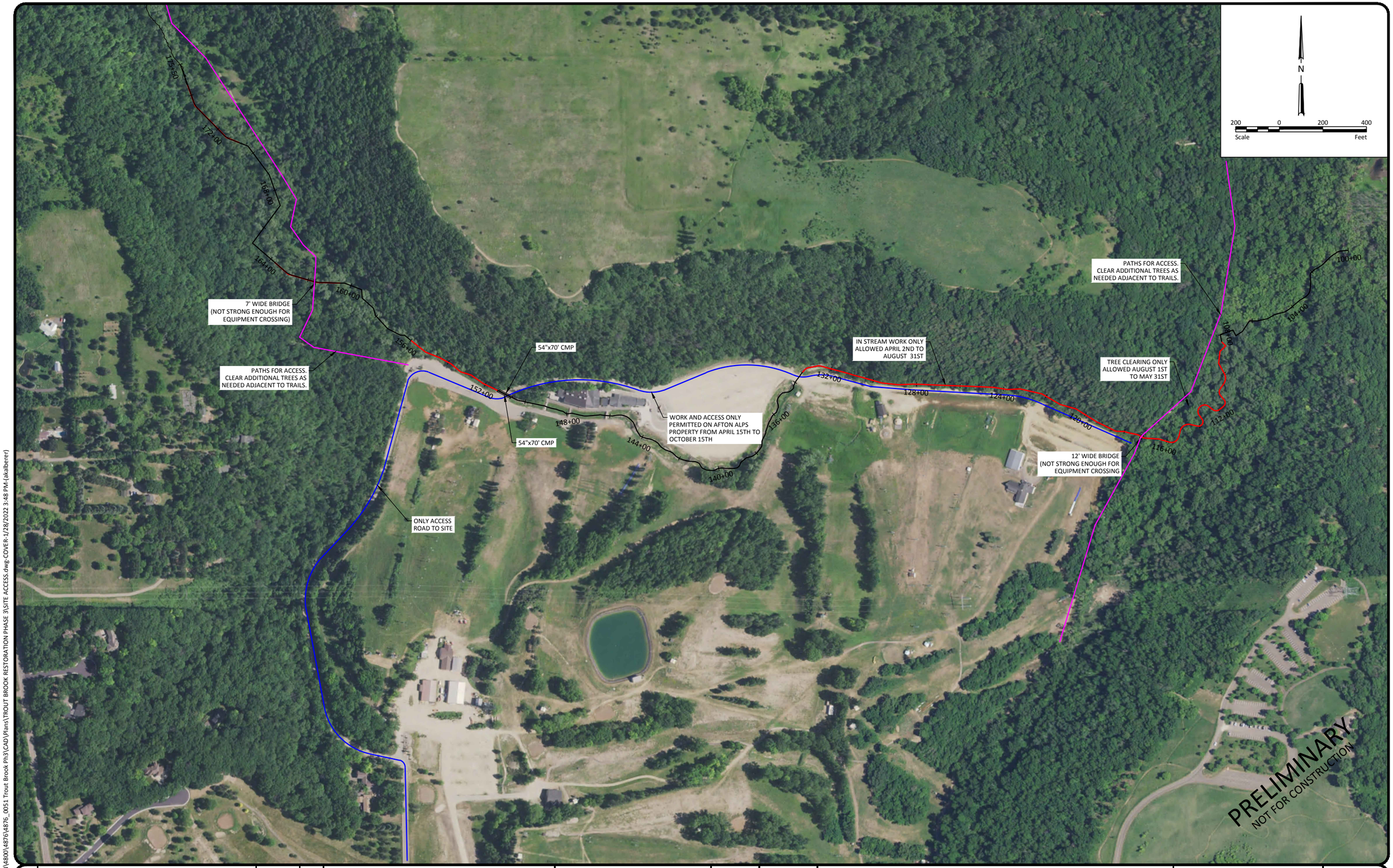
Project No. 4876-0051



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TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

SITE ACCESS AND STAGING
PROJECT NO. 4876-0051

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HEI NO. 4876-0051

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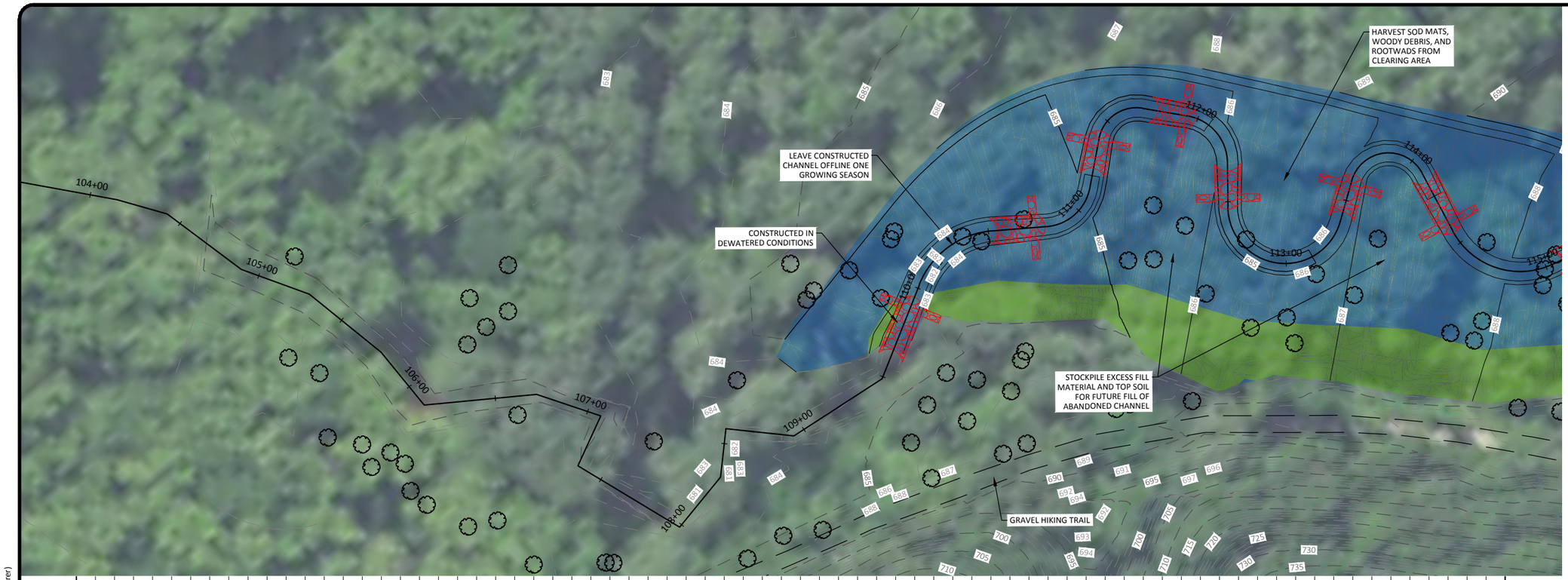

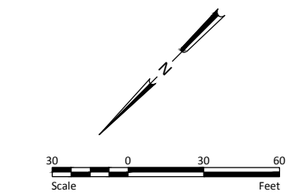

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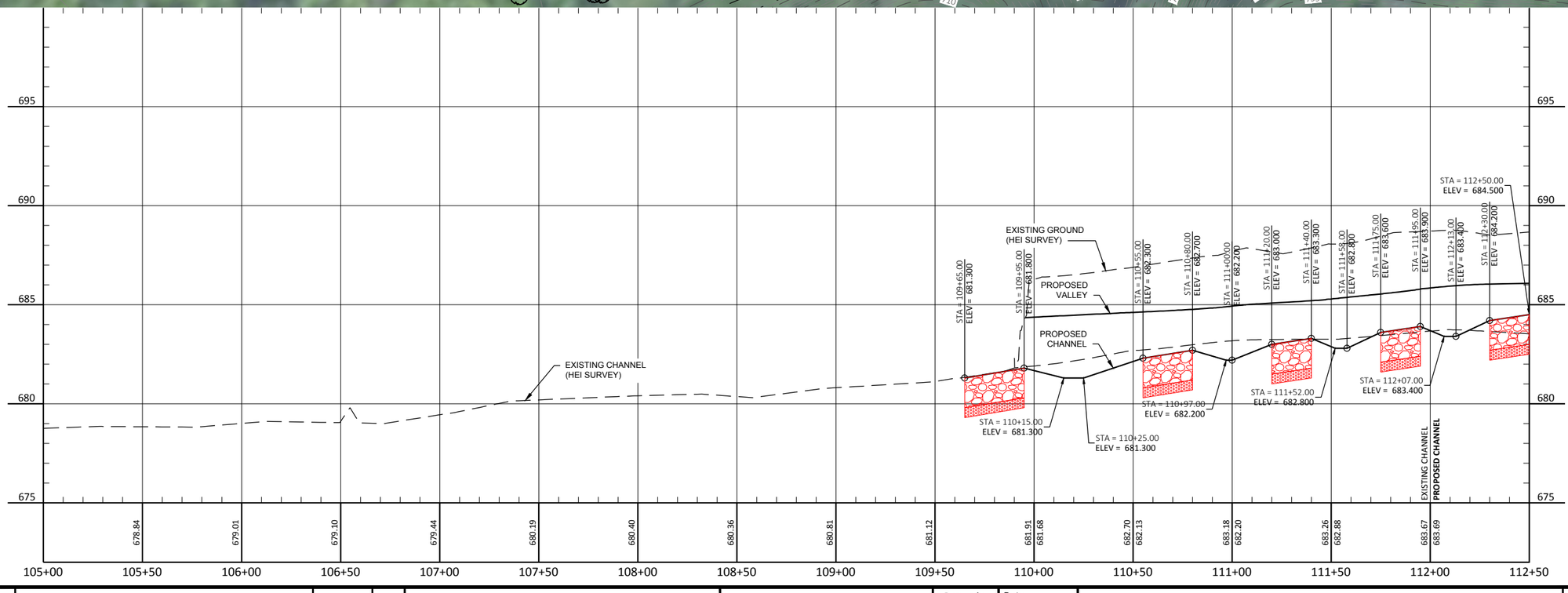

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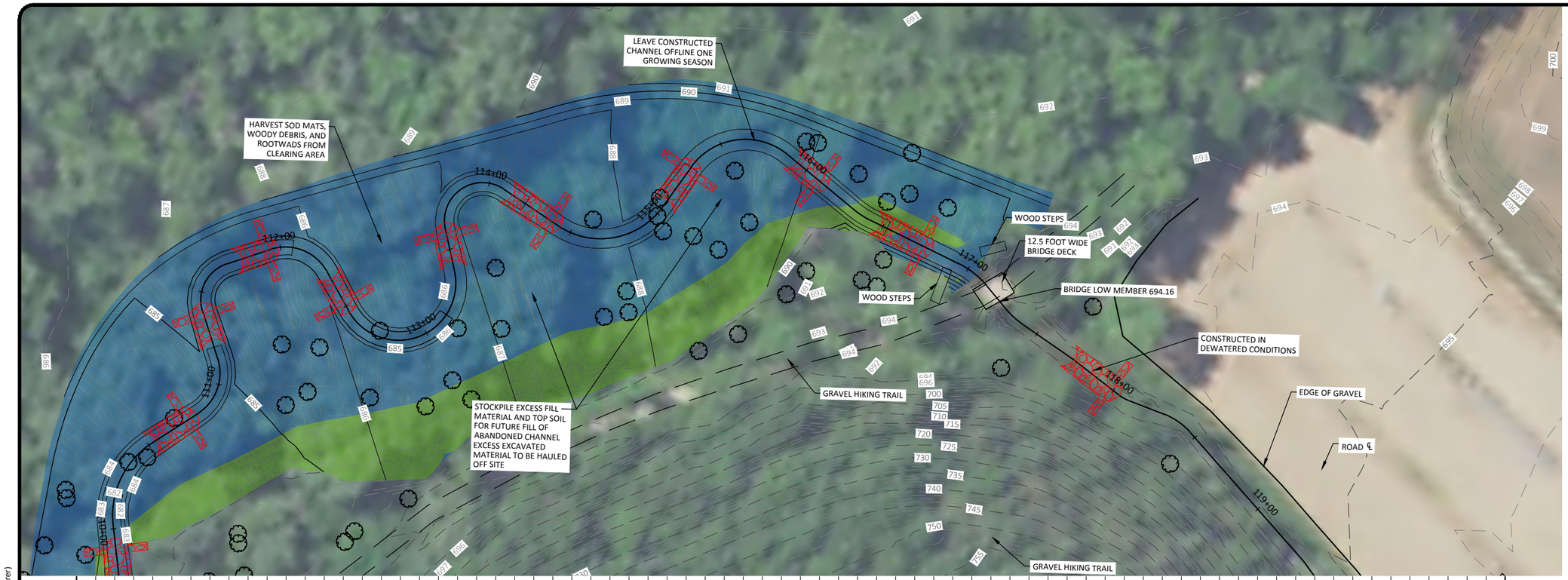
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

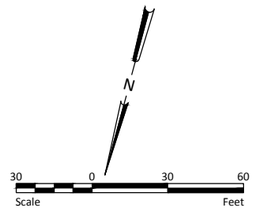
PLAN AND PROFILE

PROJECT NO. 4876-0051

SHEET 3

HEI NO. 4876-0051





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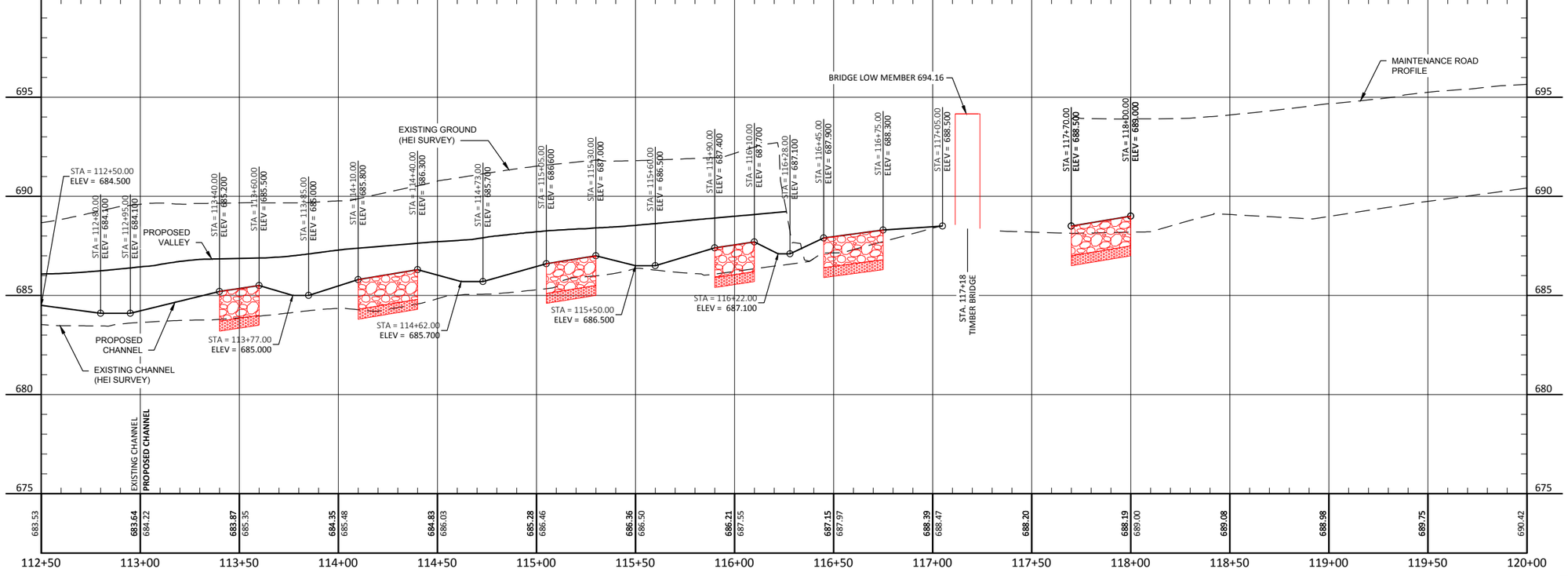

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AFTON, MN

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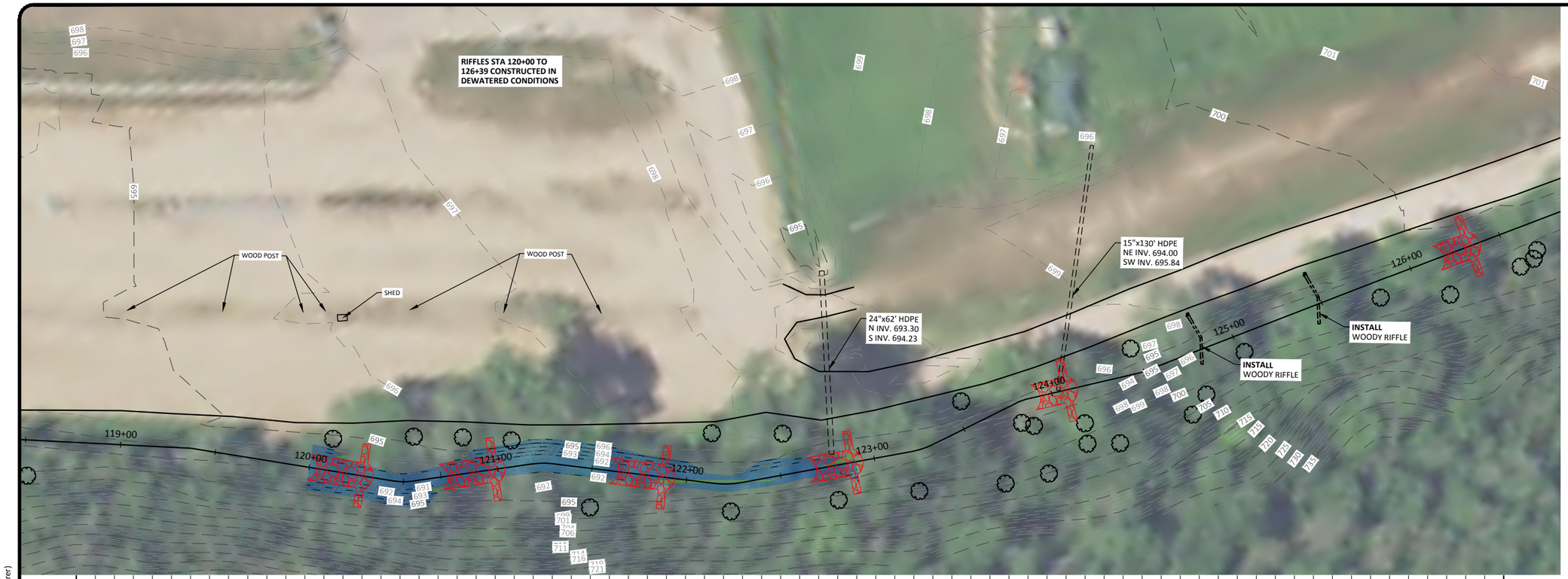

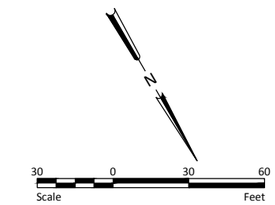

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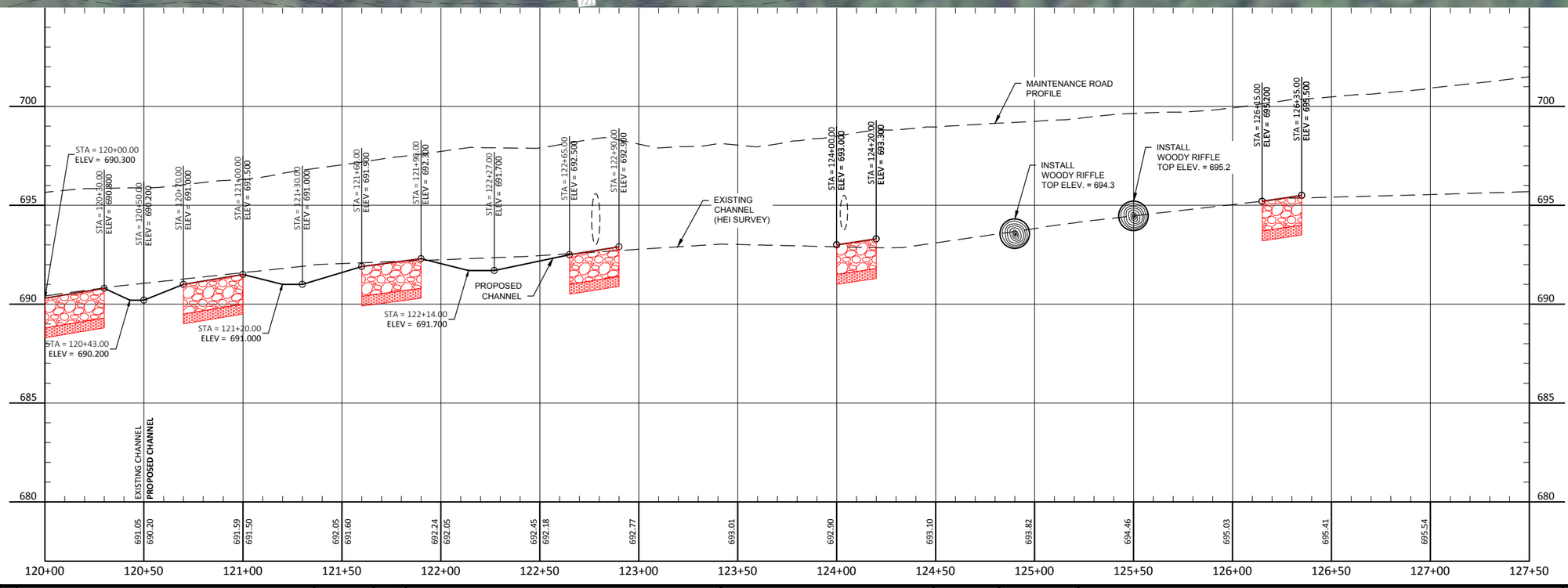

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TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

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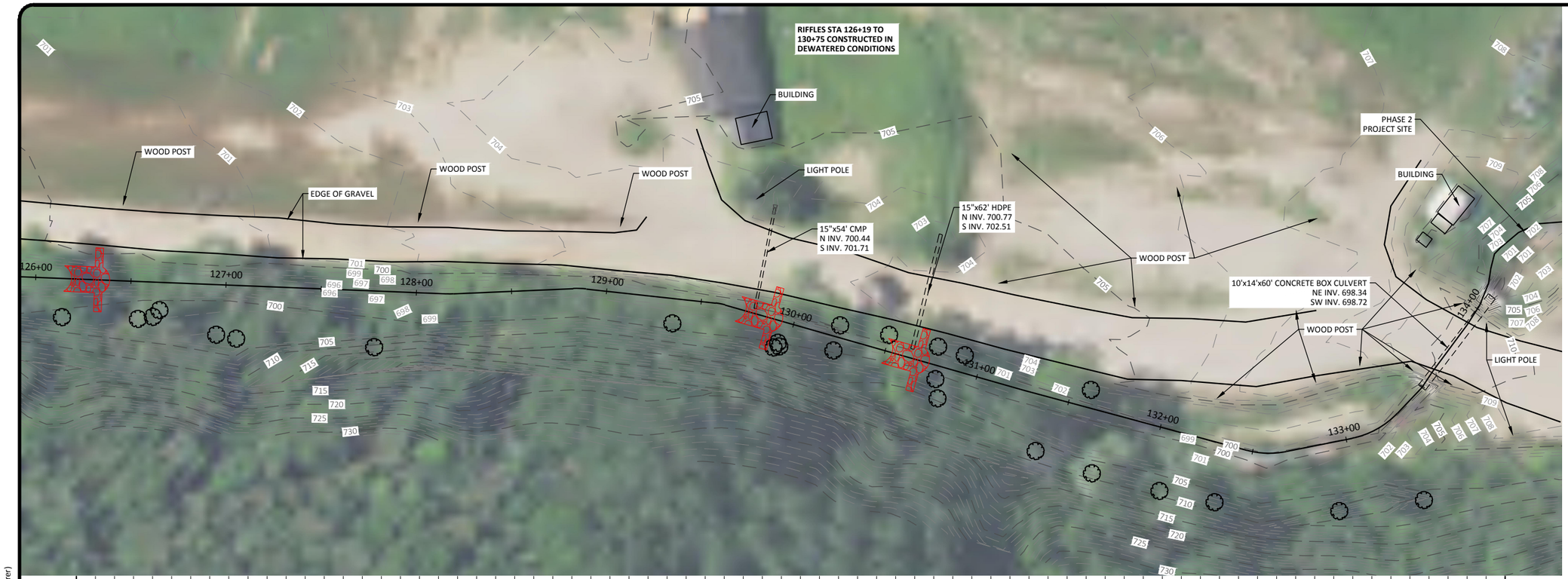

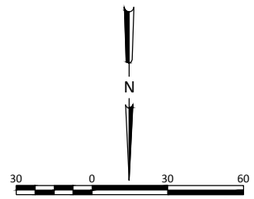

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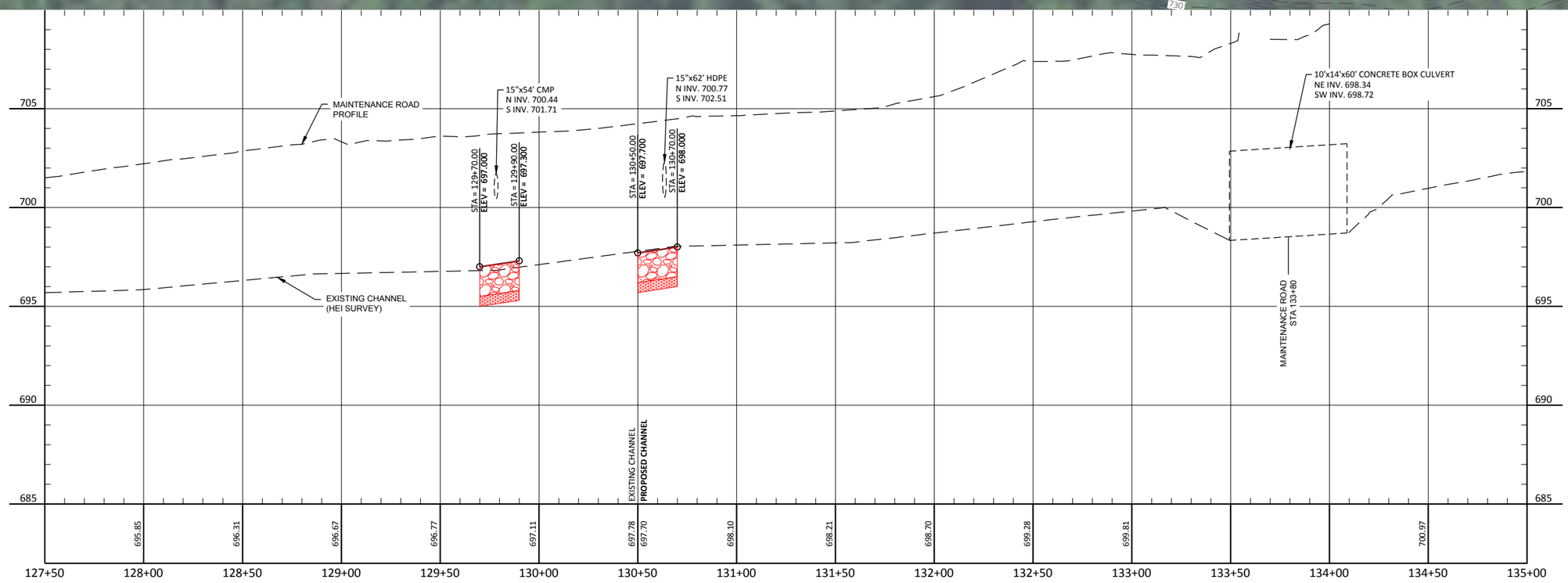

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TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

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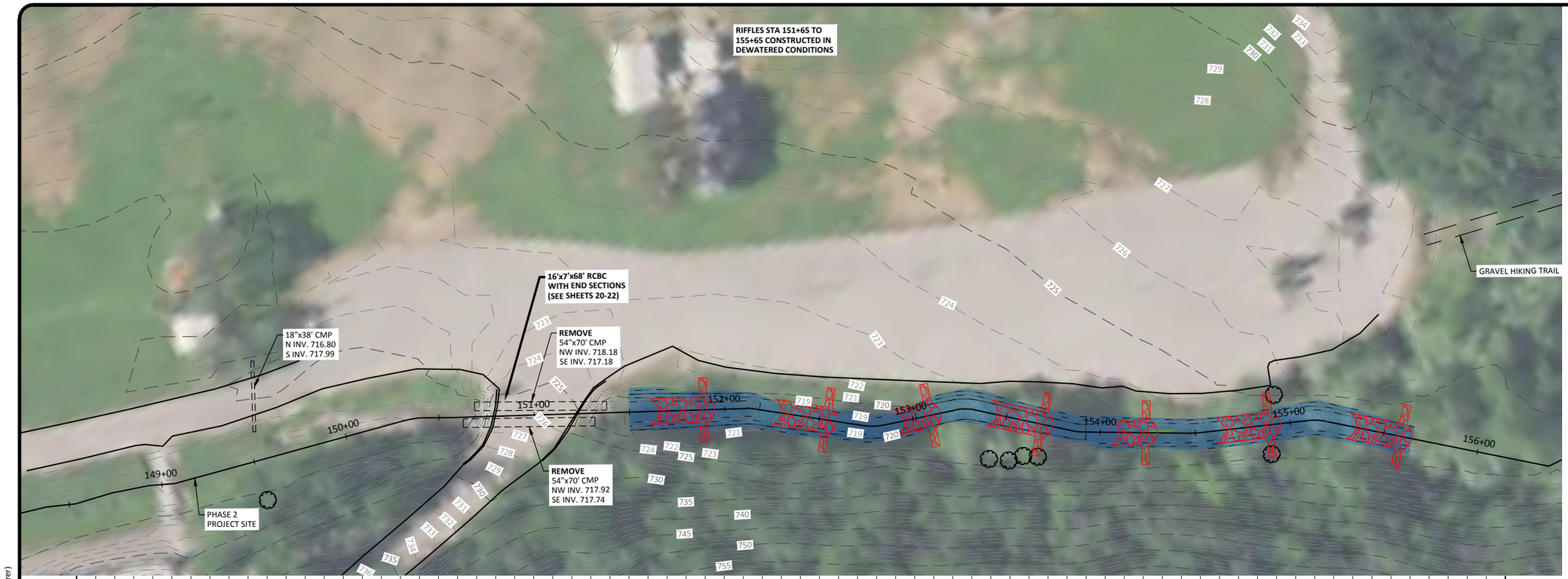

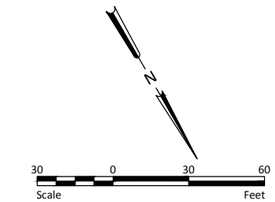

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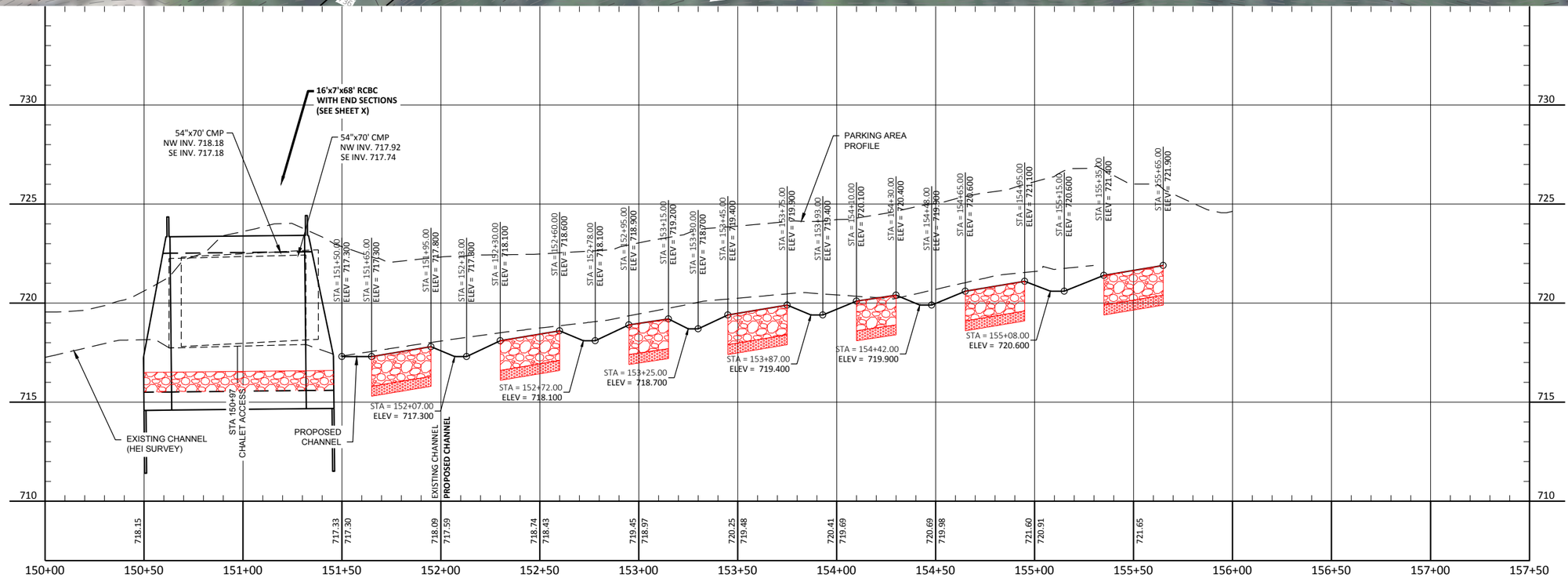

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AFTON, MN

PLAN AND PROFILE

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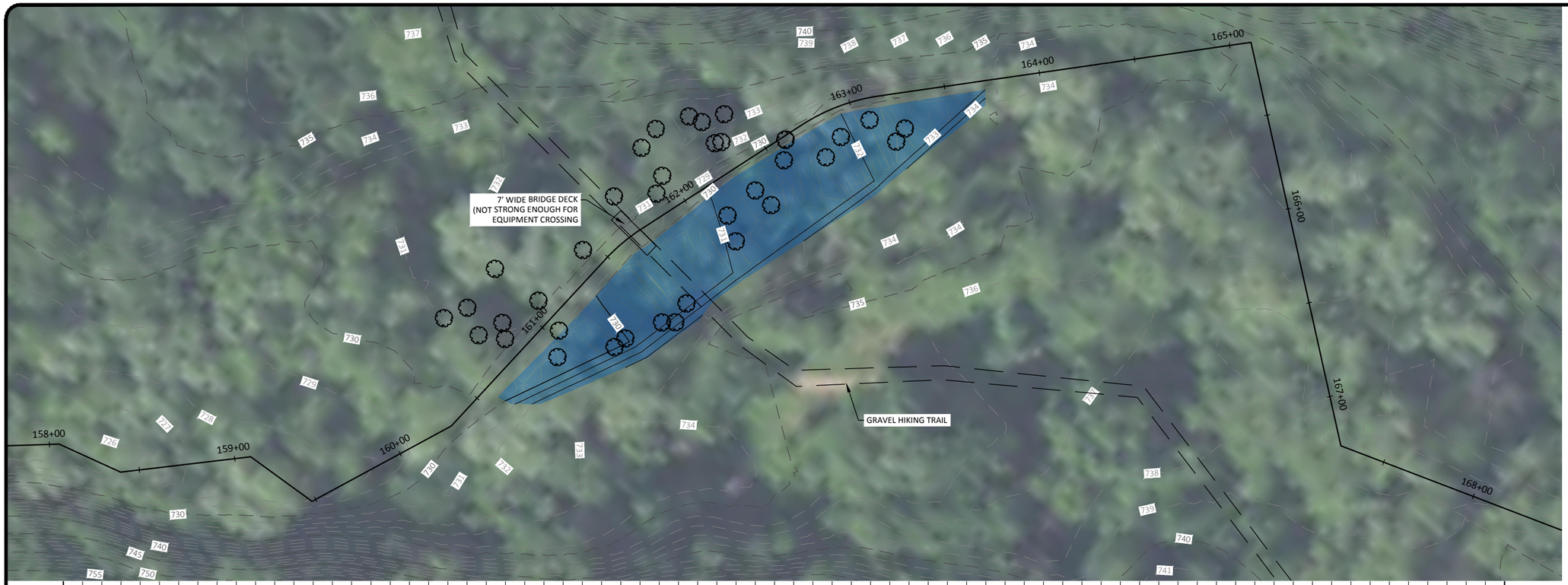

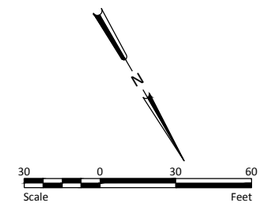

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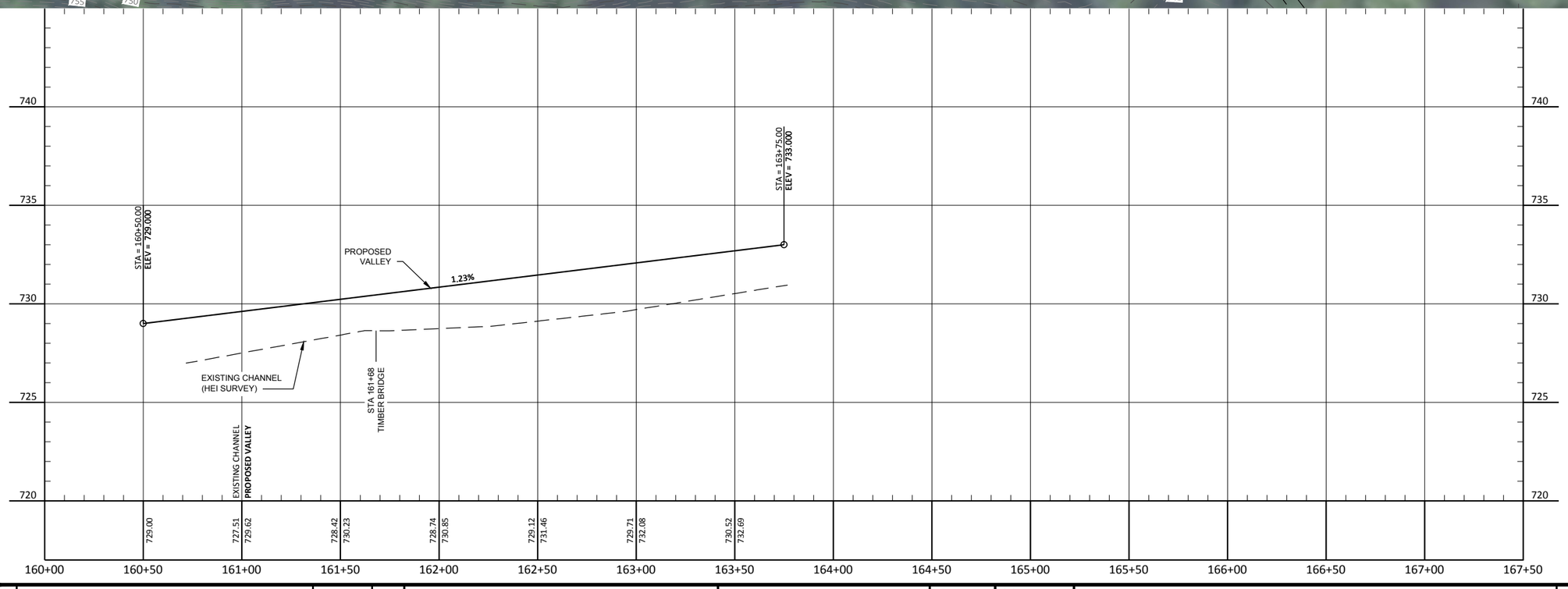
- RIFFLE
- FILL/CLEARING AREA
- EXCAVATION/CLEARING AREA



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TROUT BROOK RESTORATION PHASE 3
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PLAN AND PROFILE

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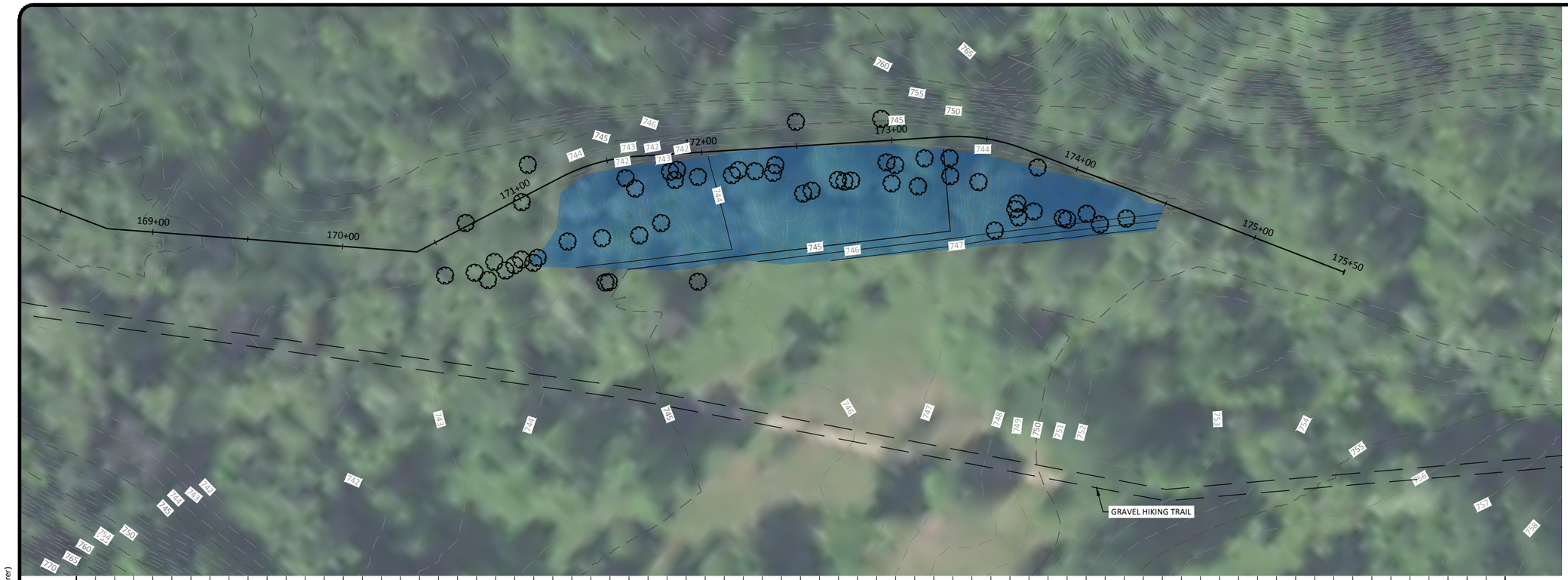

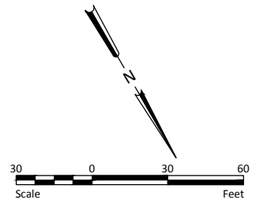

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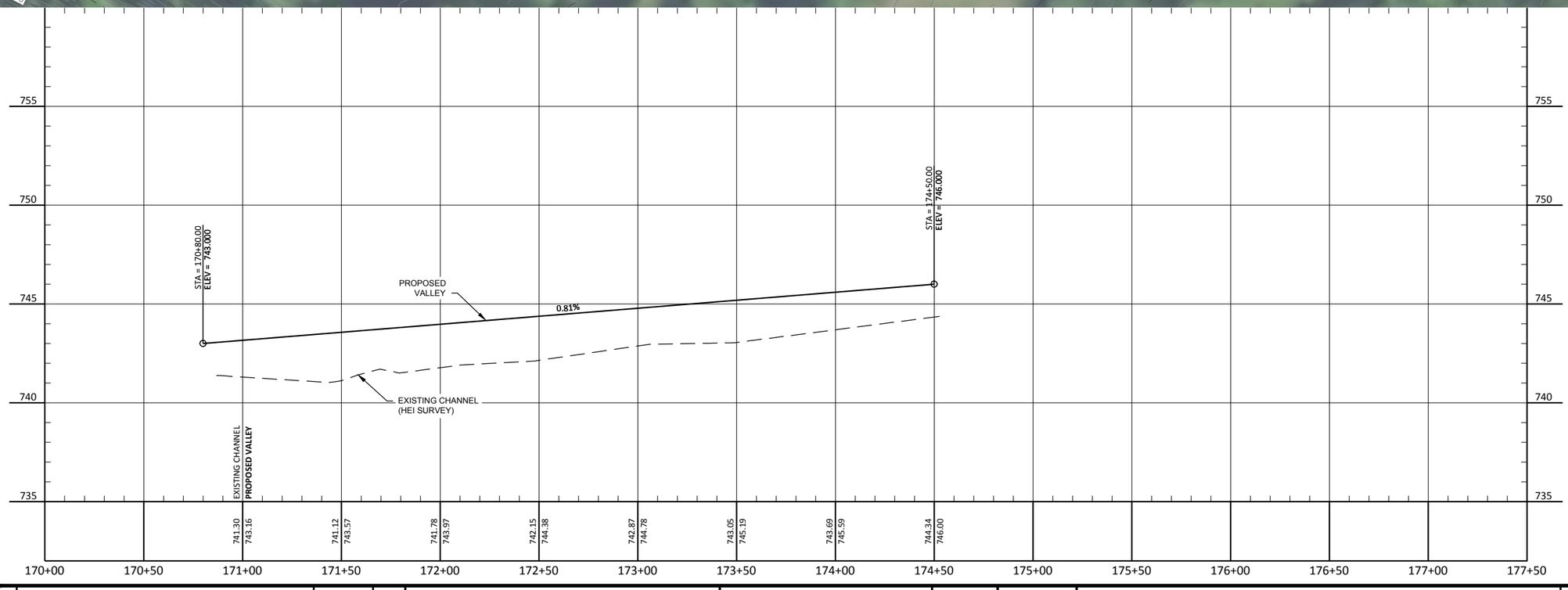
- RIFFLE
- FILL/CLEARING AREA
- EXCAVATION/CLEARING AREA



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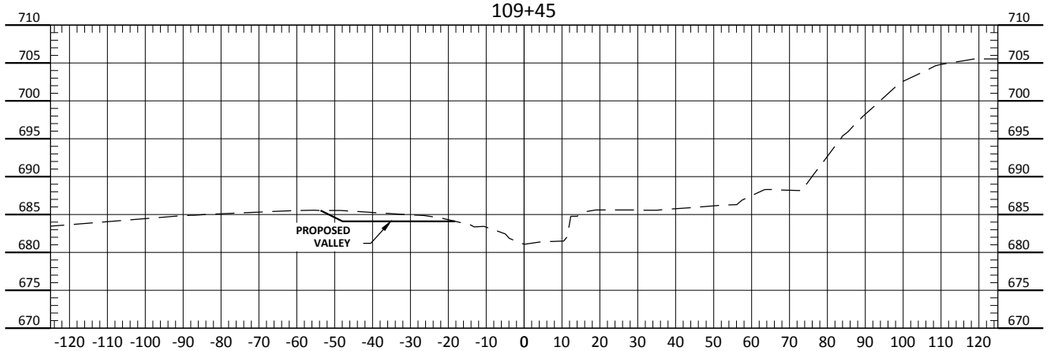
109+45



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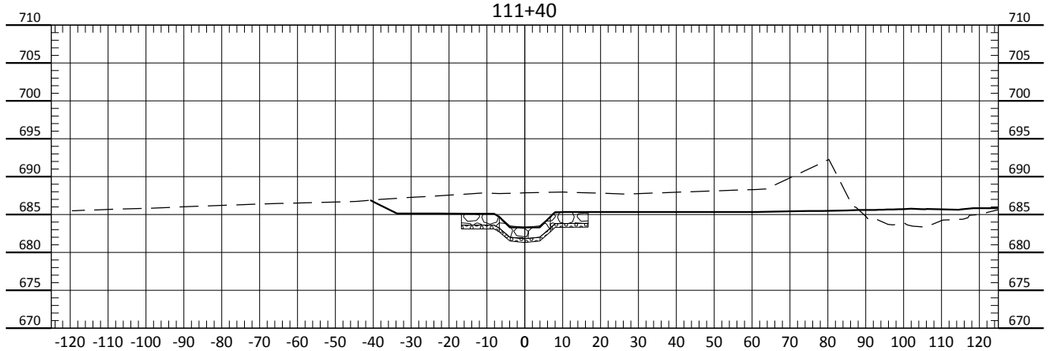

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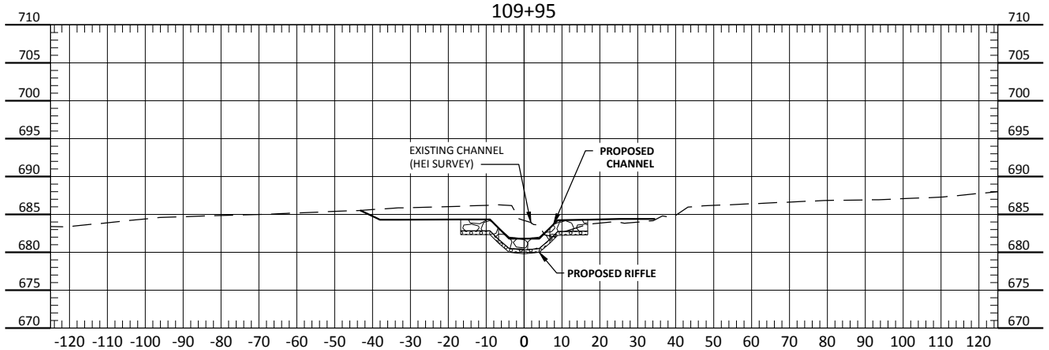

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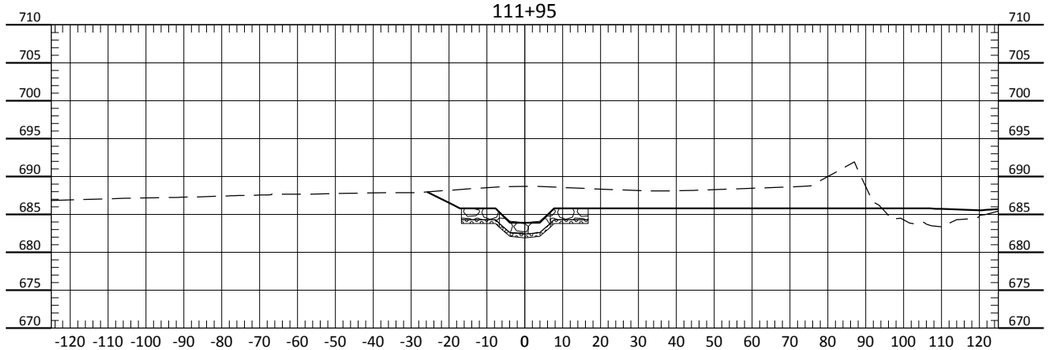

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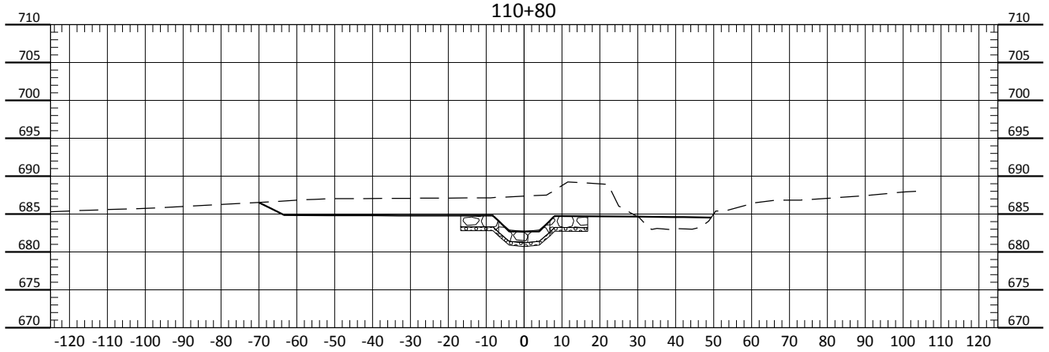
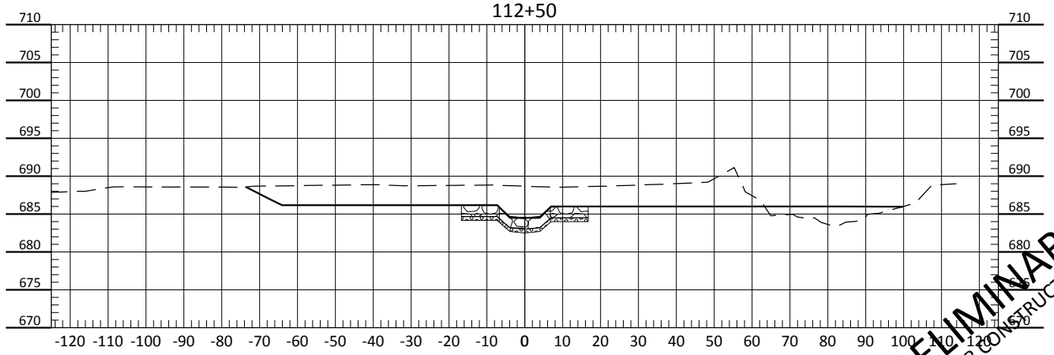


112+50



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SOUTH WASHINGTON WATERSHED DISTRICT
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CROSS SECTIONS

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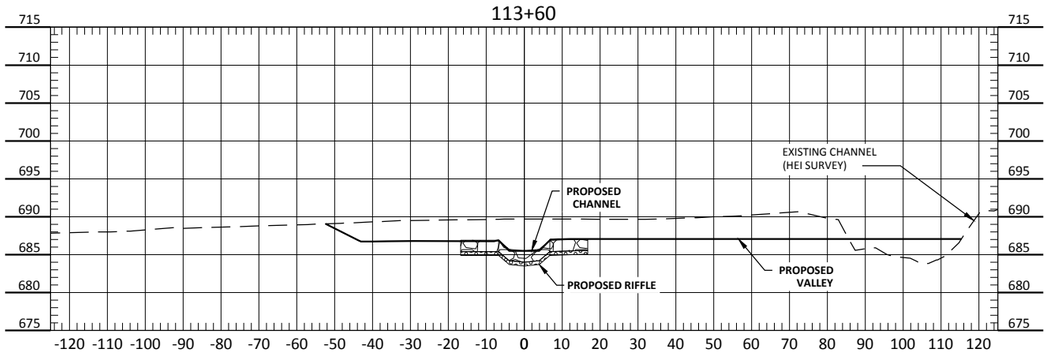

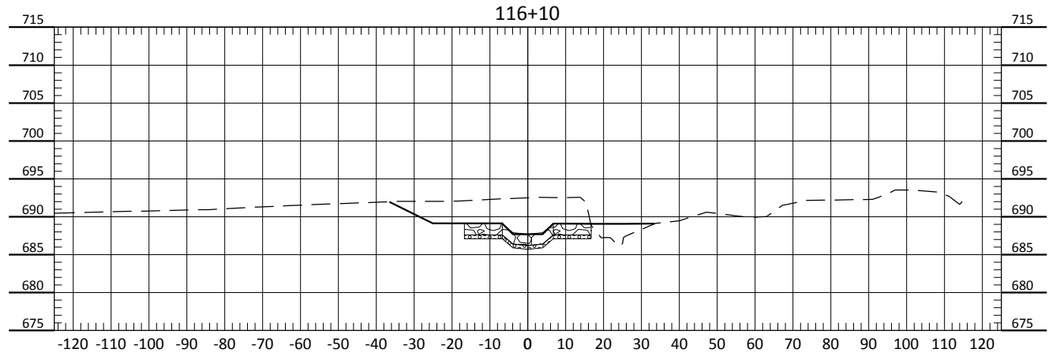

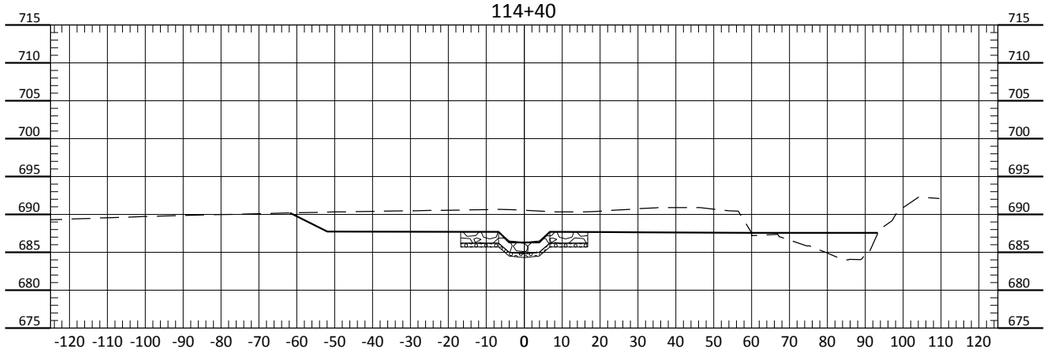

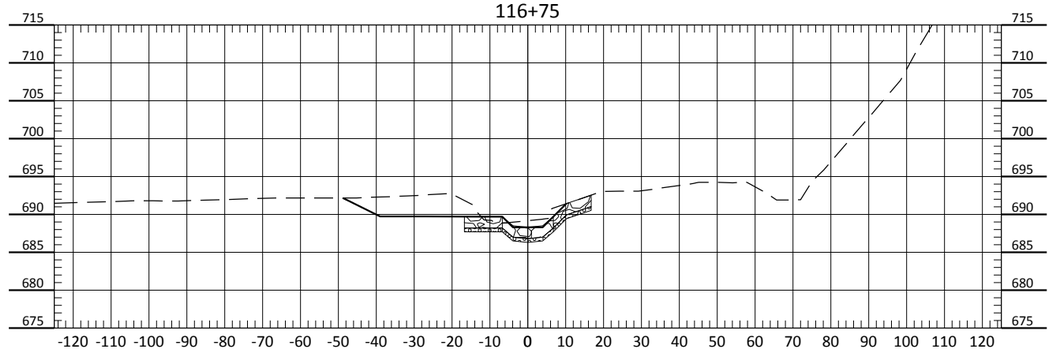

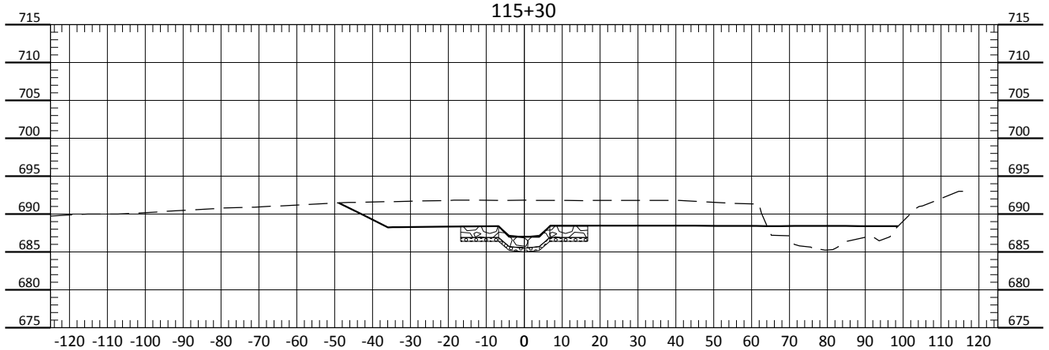

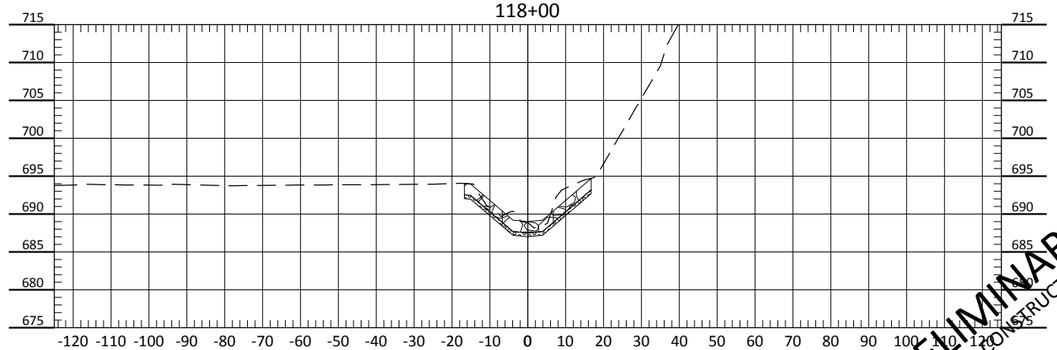

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TROUT BROOK RESTORATION PHASE 3
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AFTON, MN

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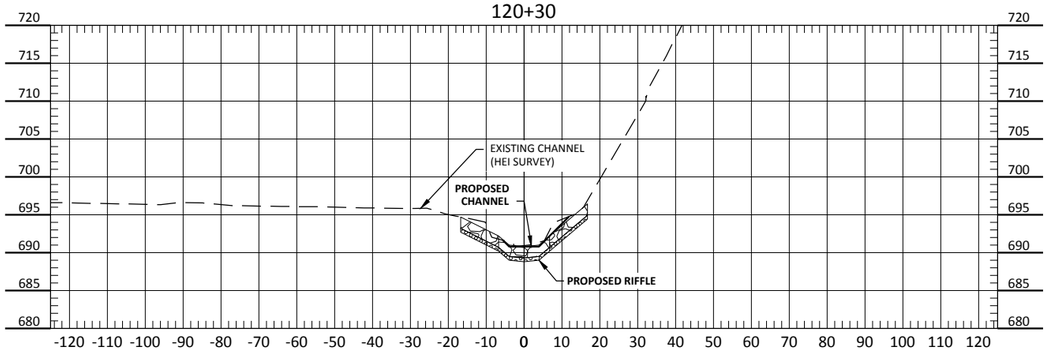

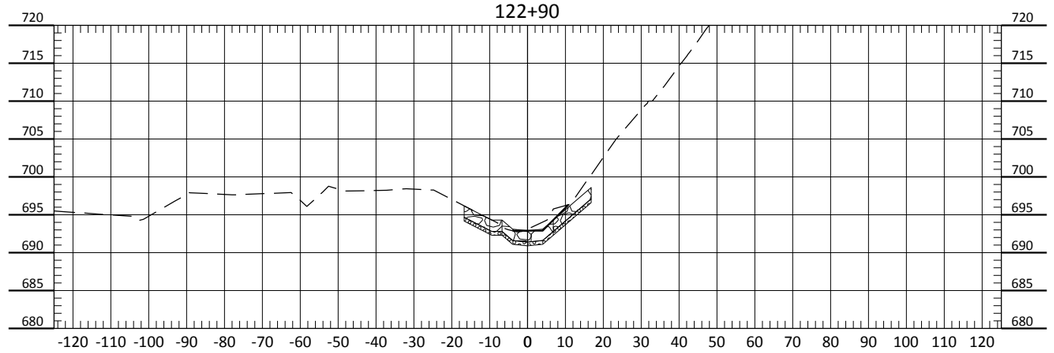

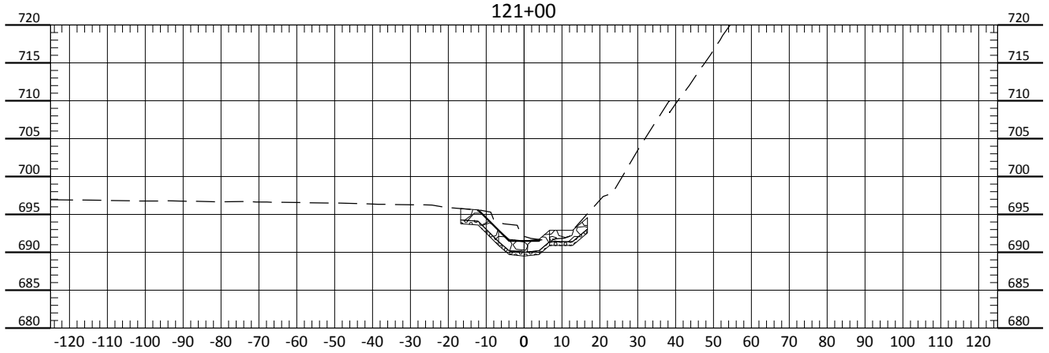

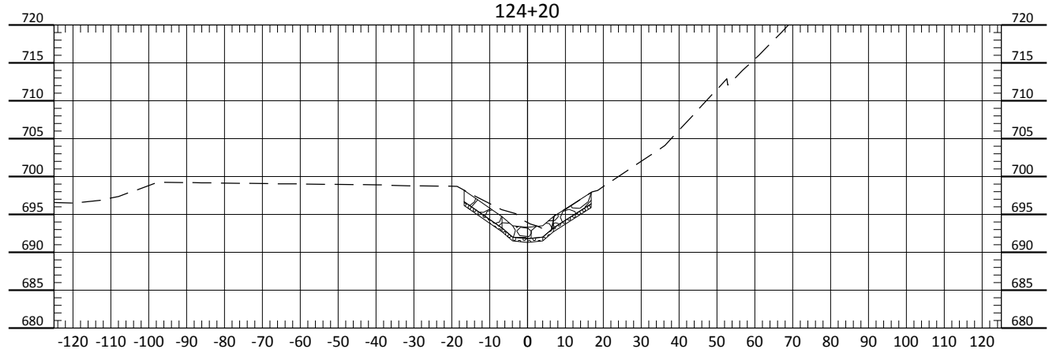

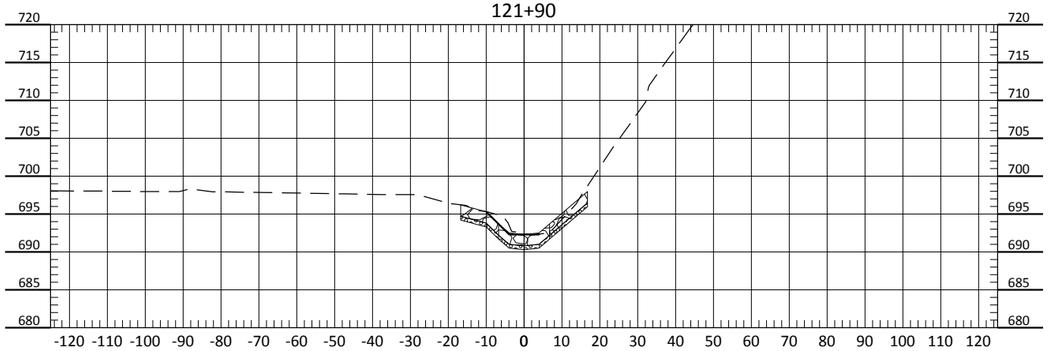

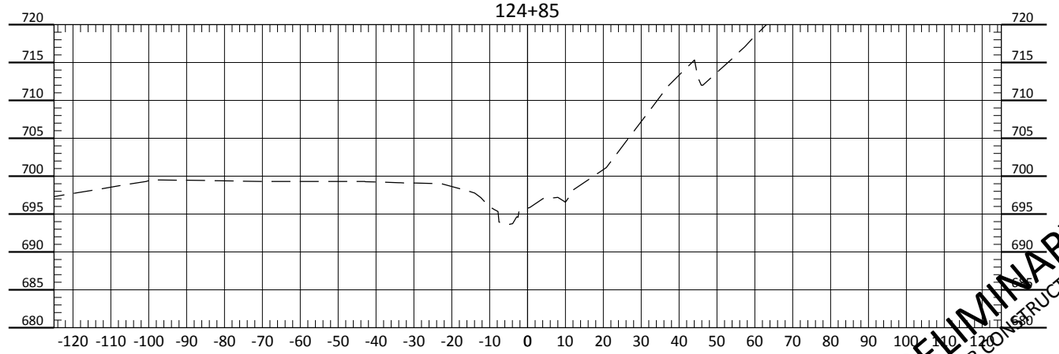

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TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
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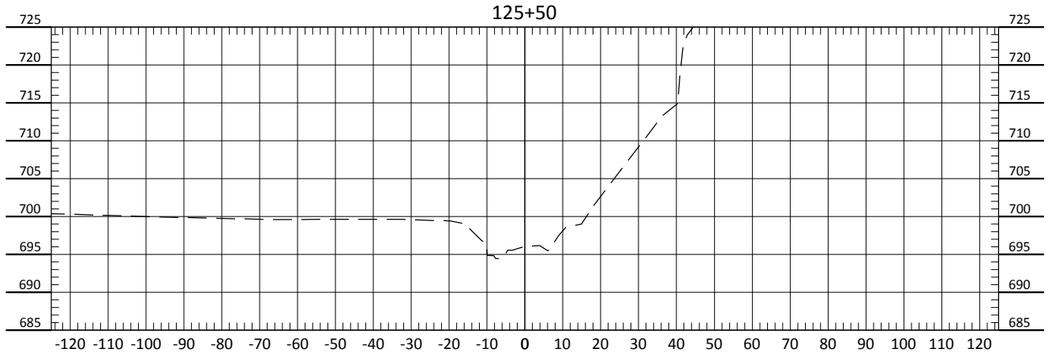

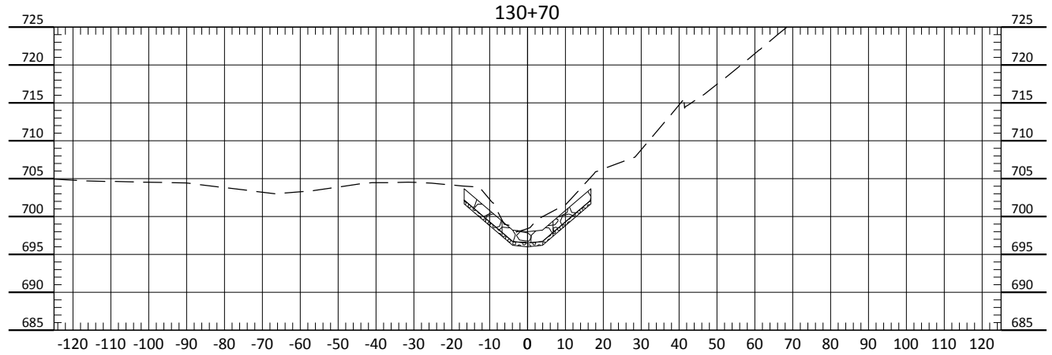

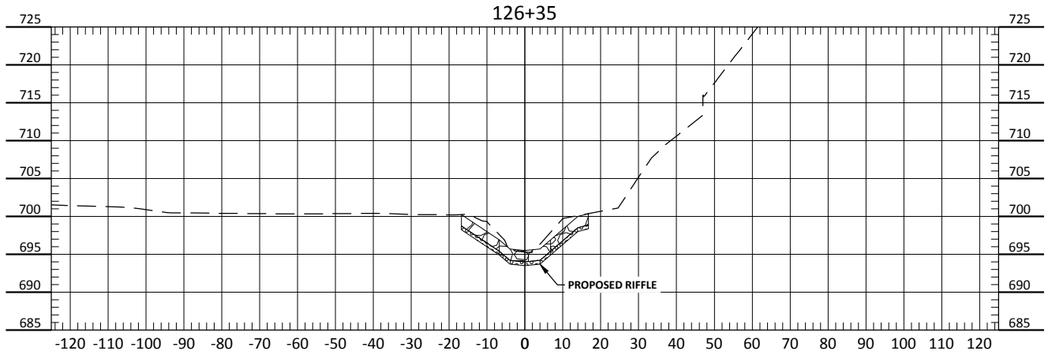

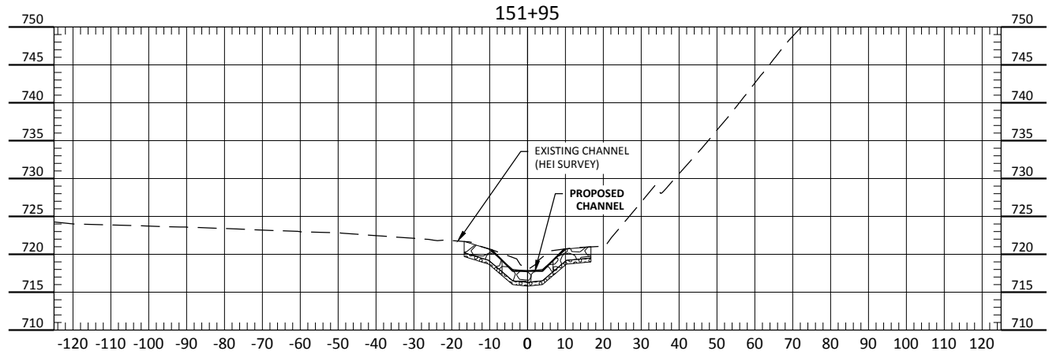

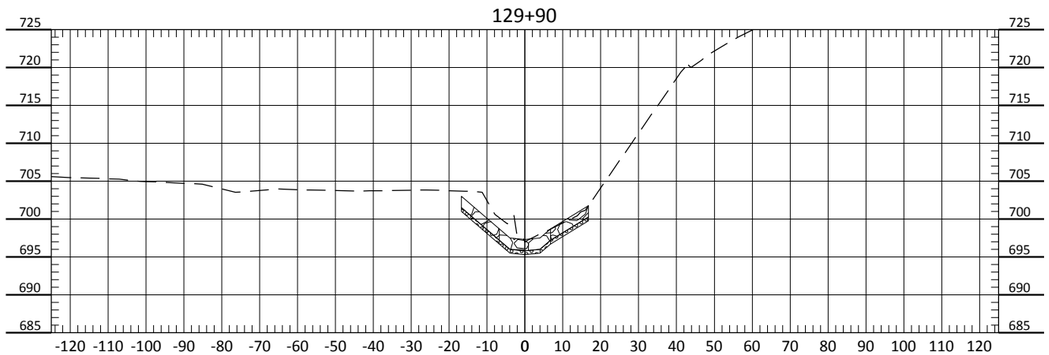

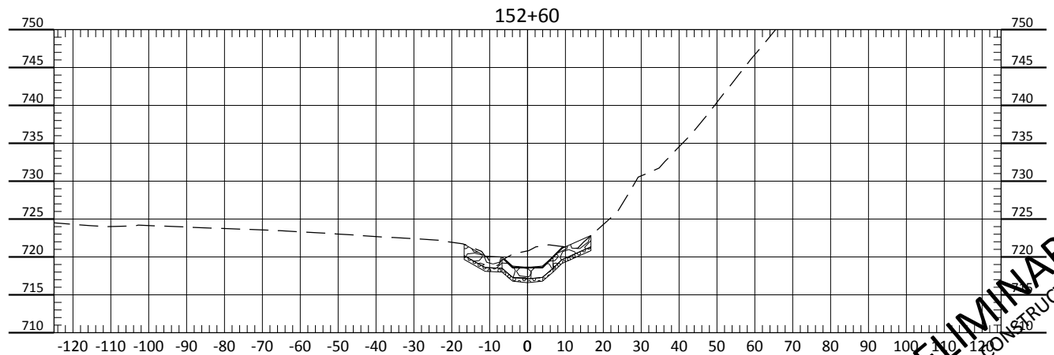

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AFTON, MN

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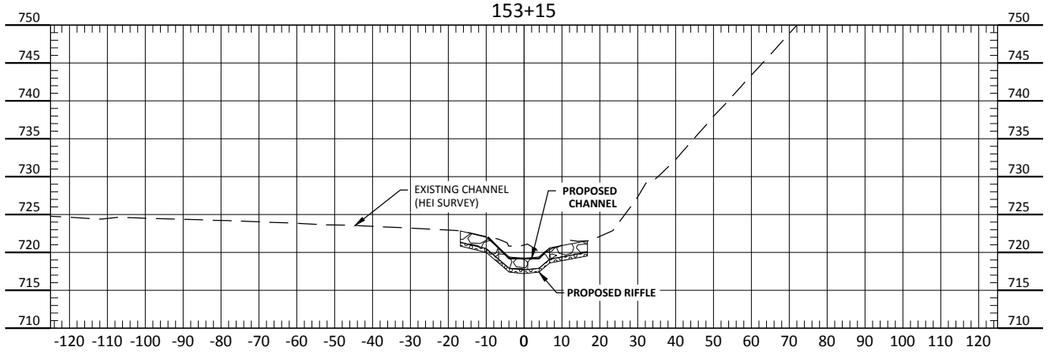
153+15



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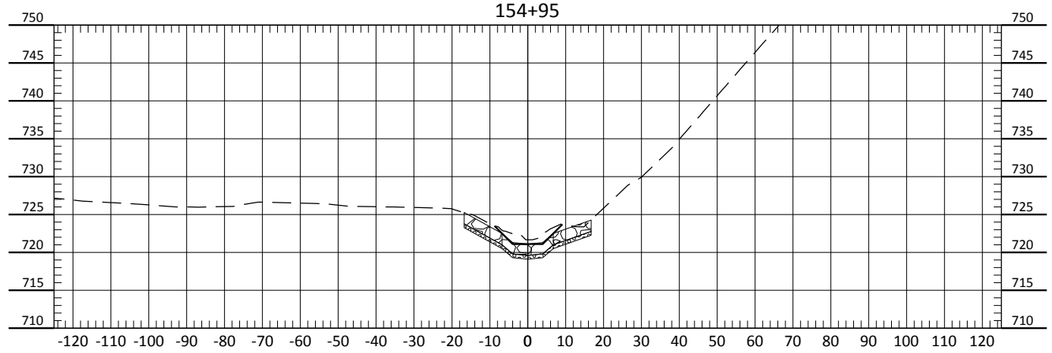

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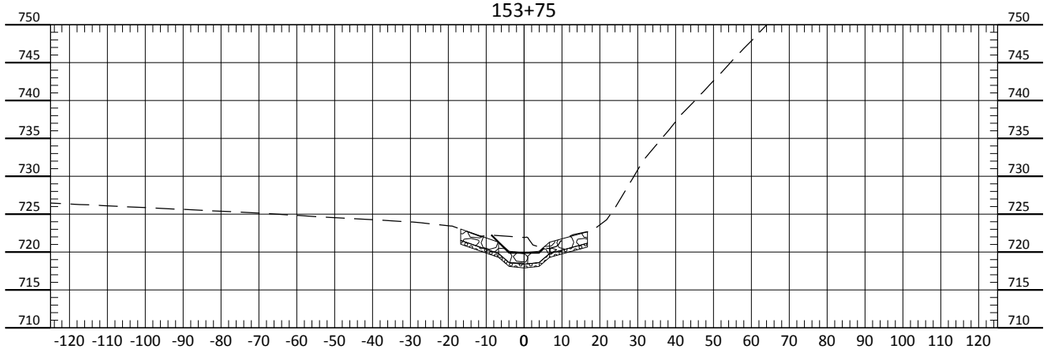

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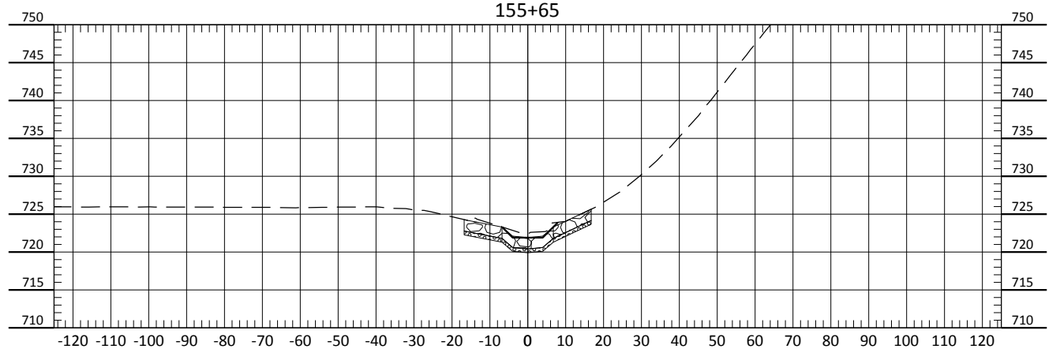

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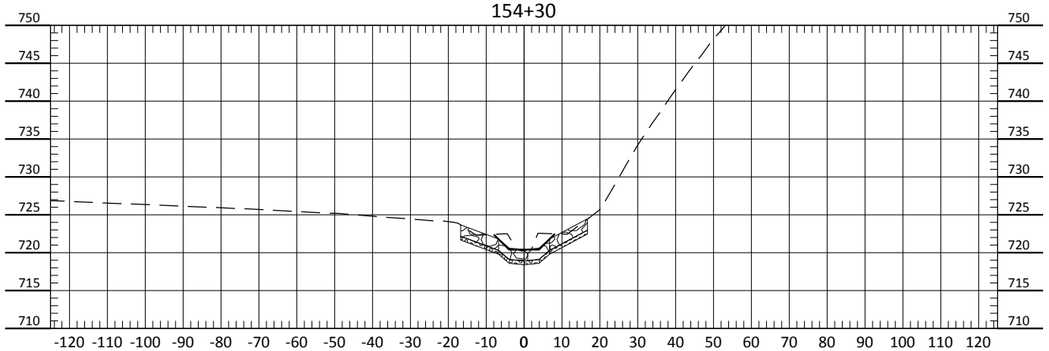
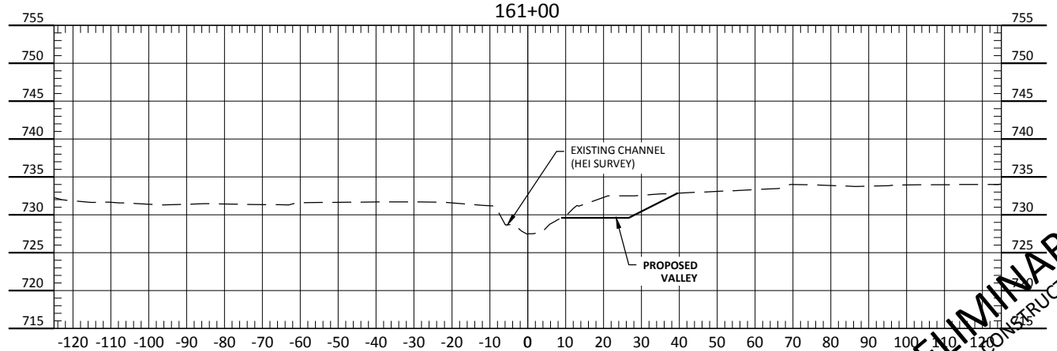


161+00



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CROSS SECTIONS

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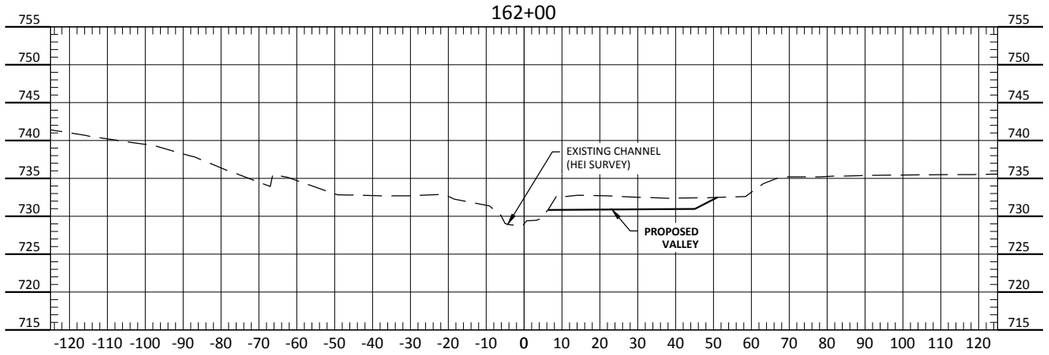

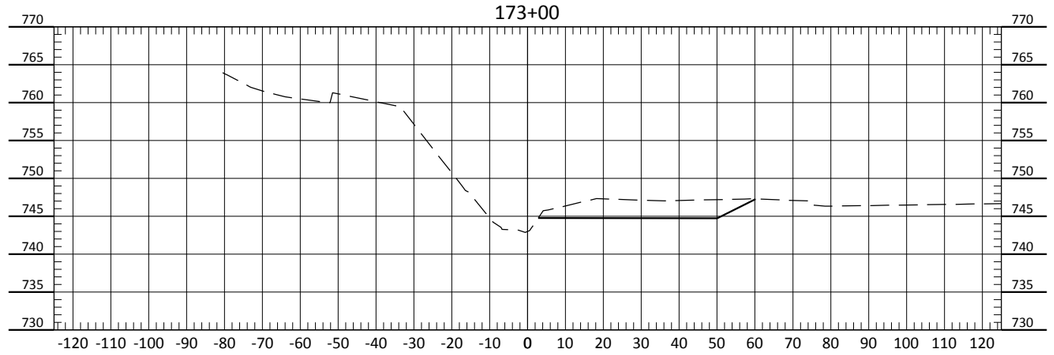

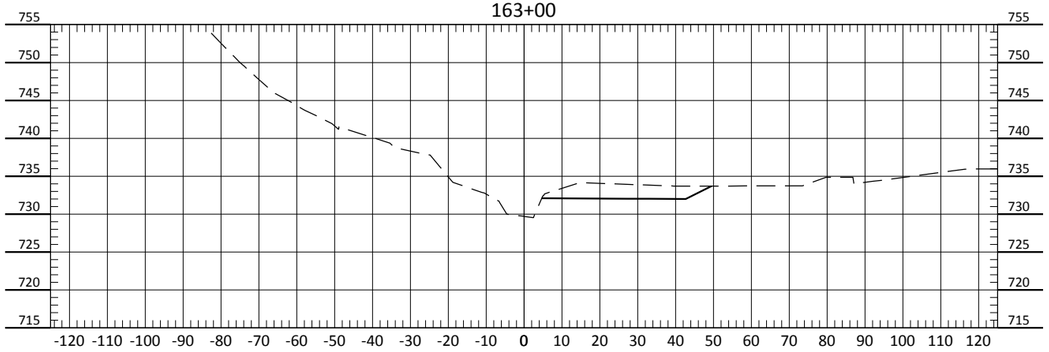

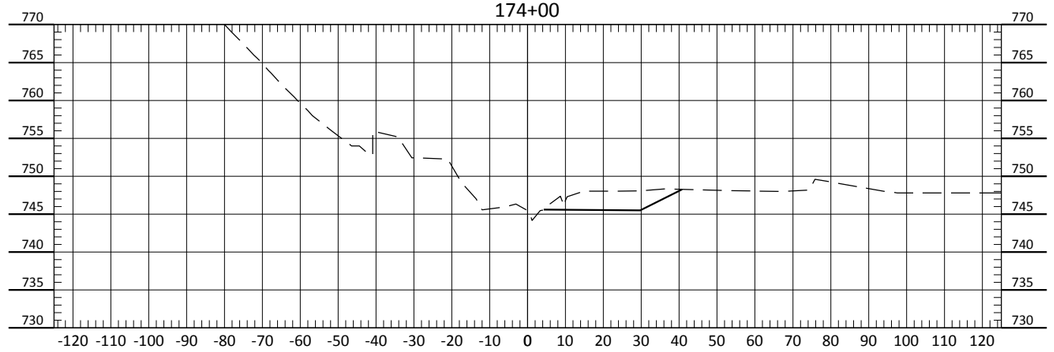

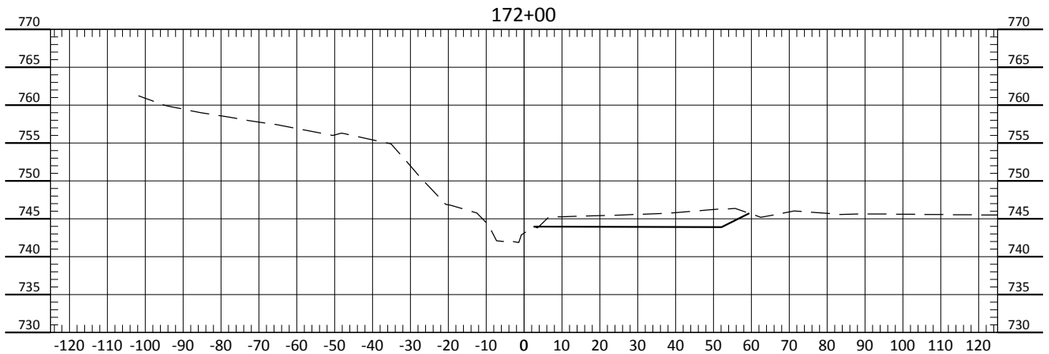

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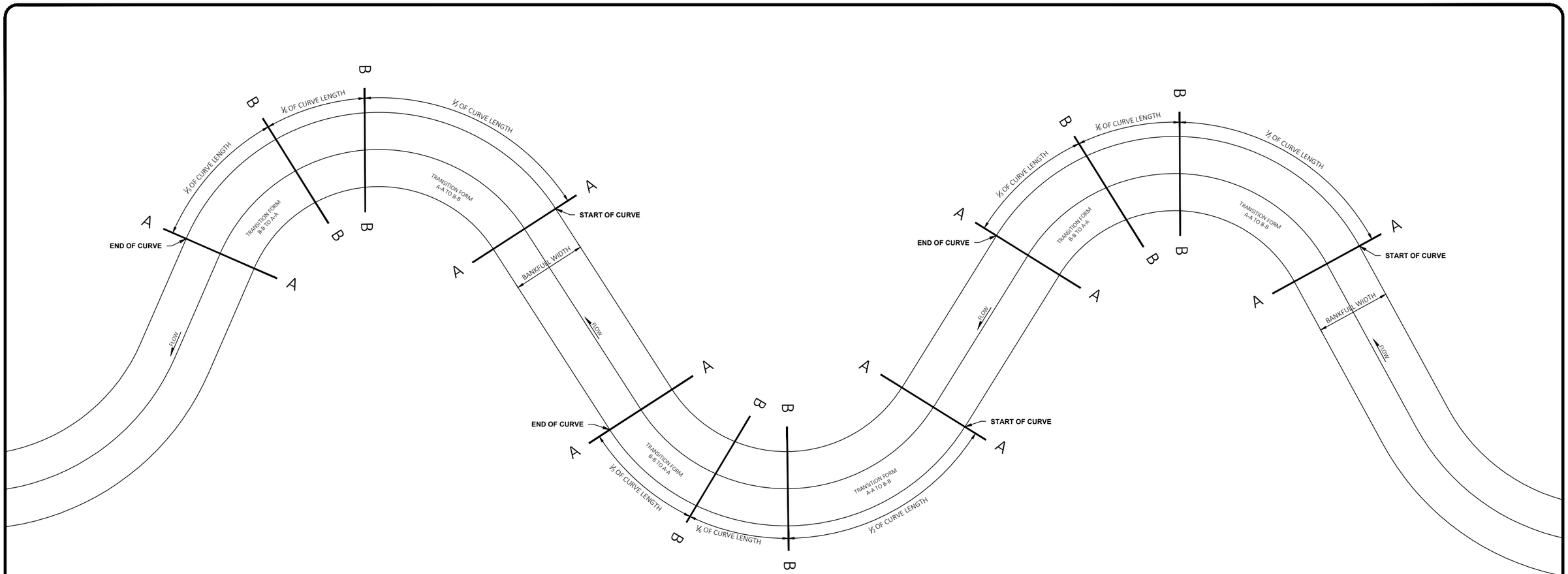
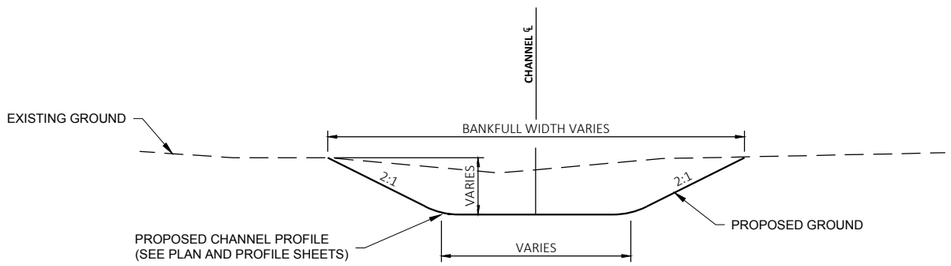
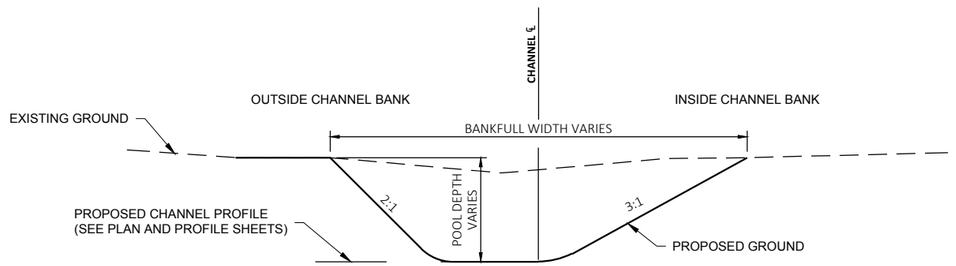




A-A TYPICAL CHANNEL SECTION

NOT TO SCALE



B-B TYPICAL CHANNEL SECTION

NOT TO SCALE

NOTE:
1. POOLS ARE TO BE CONSTRUCTED ON THE OUTSIDE BENDS ON ALL CHANNEL CURVES AS SHOWN ON THE TYPICAL CHANNEL PLAN VIEW.
2. SEE DETAILS FOR CHANNEL GEOMETRY

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TYPICAL CHANNEL PLAN VIEW

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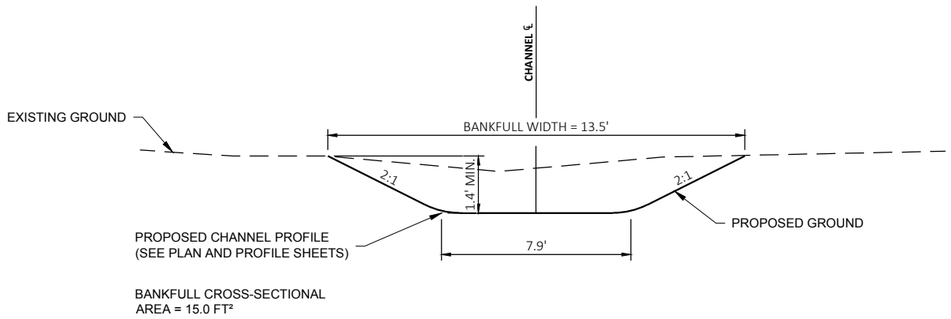
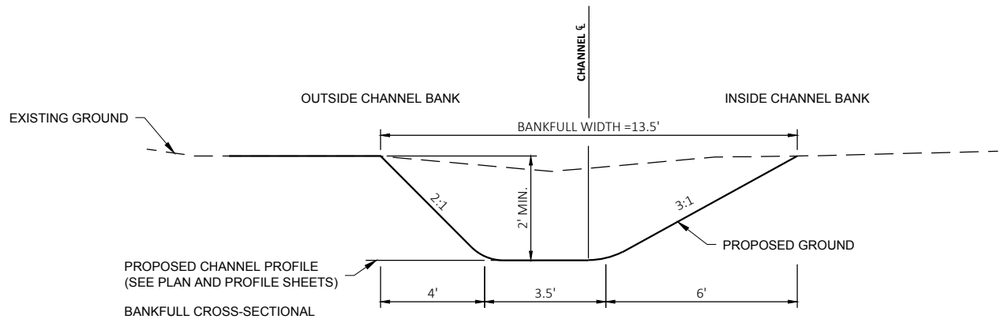


STA. 109+65 TO 117+05
STA. 120+00 TO 122+90
STA. 151+50 TO 155+65

A-A TYPICAL CHANNEL SECTION

NOT TO SCALE



STA. 109+65 TO 117+05
STA. 120+00 TO 122+90
STA. 151+50 TO 155+65

B-B TYPICAL CHANNEL SECTION

NOT TO SCALE

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CROSS SECTION DETAILS
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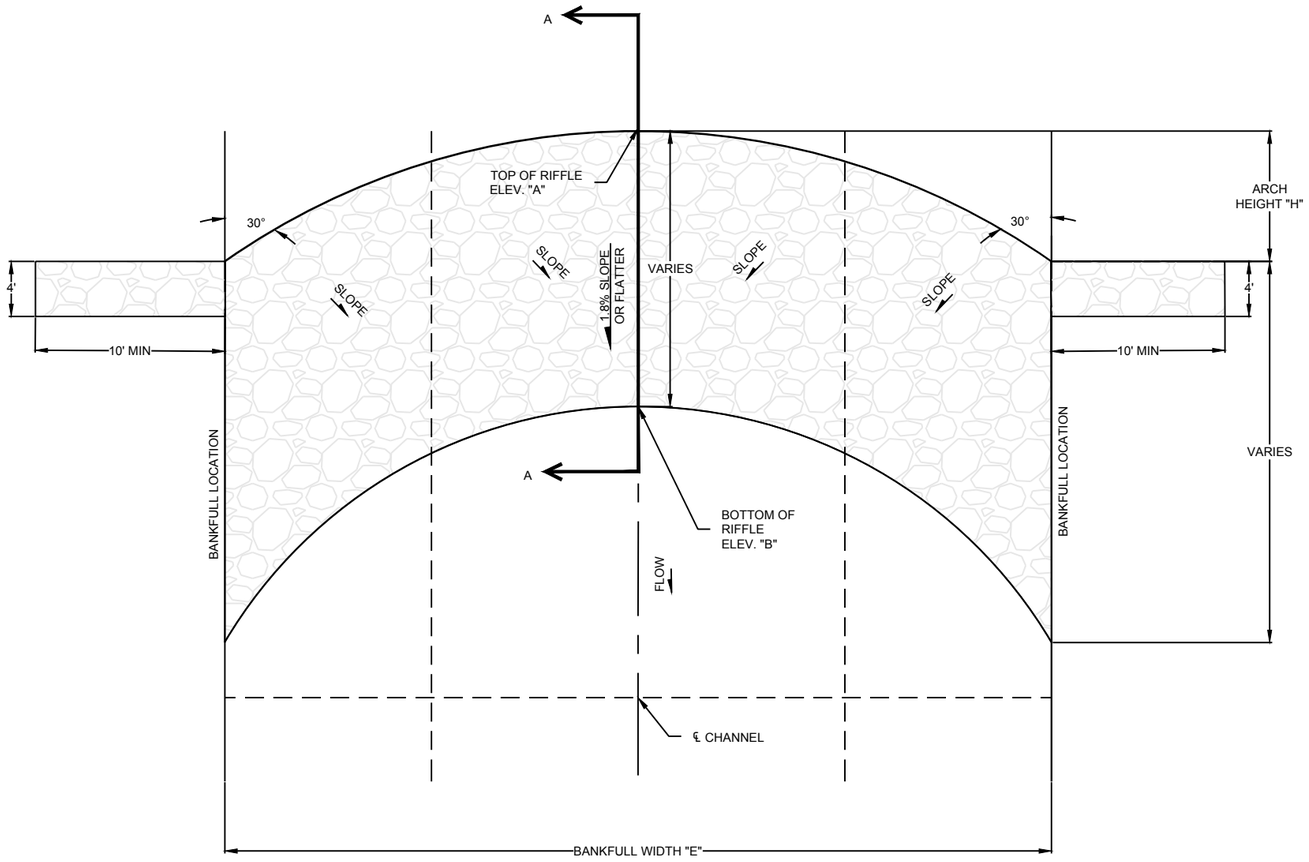
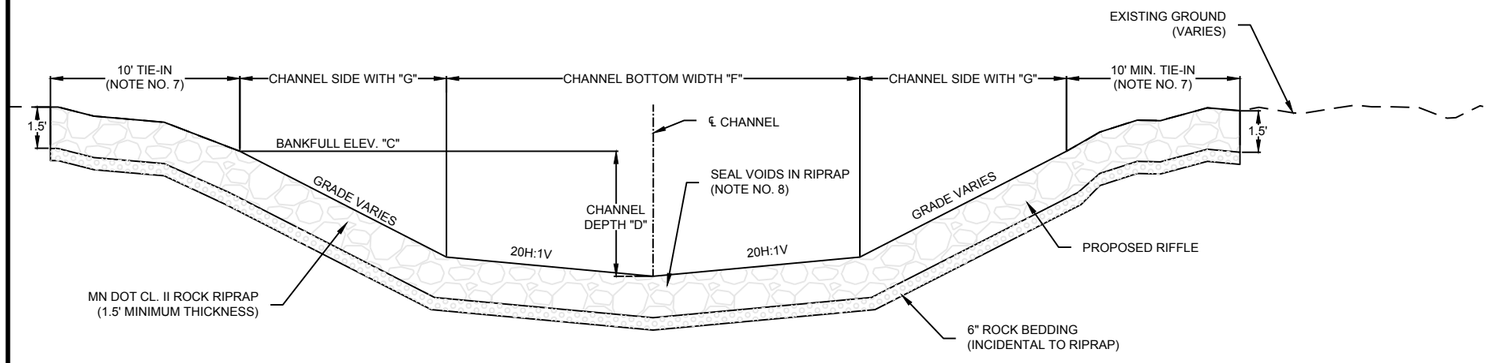




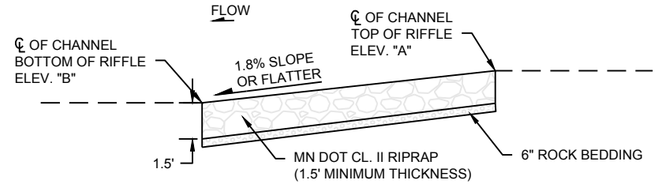
TROUT BROOK RIFFLE DETAIL
NOT TO SCALE

DETAIL TABLE

RIFFLE NO.	TOP OF RIFFLE STATION	BOTTOM OF RIFFLE STATION	TOP OF RIFFLE ELEV. "A"	BOTTOM OF RIFFLE ELEV."B"	BANKFULL ELEV. "C"	CHANNEL DEPTH "D"	BANKFULL WIDTH "E"	CHANNEL BOTTOM WIDTH "F"	CHANNEL SIDE WIDTH "G"	ARC HEIGHT "H"	CLASS II RIPRAP (CY)	ROCK BEDDING (CY)
1	109+95	109+65	681.8	681.3	683.2						27	9
2	110+80	110+55	682.7	682.3	684.1						23	8
3	111+40	111+20	683.3	683.0	684.7						19	6
4	111+95	111+75	683.9	683.6	685.3						19	6
5	112+50	112+30	684.5	684.2	685.9						19	6
6	113+60	113+40	685.5	685.2	686.9						19	6
7	114+40	114+10	686.3	685.8	687.7						27	9
8	115+30	115+05	687.0	686.6	688.4						23	8
9	116+10	115+90	687.7	687.4	689.1						19	6
10	116+75	116+45	688.3	687.9	689.7						27	9
11	118+00	117+70	689.0	688.5	690.4						27	9
12	120+30	120+00	690.8	690.3	692.2						27	9
13	121+00	120+70	691.5	691.0	692.9						27	9
14	121+90	121+60	692.3	691.9	693.7	1.4 FT	13.5 FT	7.9 FT	2.8 FT	4.0 FT	27	9
15	122+90	122+65	692.9	692.5	694.3						23	8
16	124+20	124+00	693.3	693.0	694.7						19	6
17	126+35	126+15	695.5	695.2	696.9						19	6
18	129+90	129+70	697.3	697.0	698.7						19	6
19	130+70	130+50	698.0	697.7	699.4						19	6
20	151+95	151+65	717.8	717.3	717.8						27	9
21	152+60	152+30	718.6	718.1	718.6						27	9
22	153+15	152+95	719.2	718.9	719.2						19	6
23	153+75	153+45	719.9	719.4	719.9						27	9
24	154+30	154+10	720.4	720.1	720.4						19	6
25	154+95	154+65	721.1	720.6	721.1						27	9
26	155+65	155+35	721.9	721.4	721.9						27	9
										TOTAL	602	198

NOTE:

1. CHANNEL EXCAVATION REQUIRED TO PLACE MN DOT CL. II RIPRAP AND ROCK BEDDING SHALL NOT BE MEASURED FOR SEPARATE PAYMENT BUT SHALL BE CONSIDERED SUBSIDIARY TO OTHER BID ITEMS.
2. A 6" THICK LAYER OF ROCK BEDDING WILL BE USED AS A FOUNDATION FOR MN DOT CL. II RIPRAP. 90% OF ROCK BEDDING SHALL CONSIST OF 1" TO 3" STONES. ROCK BEDDING WILL BE PAID ON A PER CUBIC YARD BASIS UNDER THE ROCK BEDDING BID ITEM.
3. MN DOT CL. II RIPRAP AT THE DOWNSTREAM END OF RIFFLE MUST BE SUBCUT INTO THE CHANNEL TO A DEPTH OF 1.5 FT. MN DOT CL. II RIPRAP WILL BE PAID ON A PER CUBIC YARD BASIS UNDER THE MN DOT CL. II RIPRAP BID ITEM.
4. WHERE FEASIBLE, RIFFLES SHALL BE CONSTRUCTED PRIOR TO DIVERTING RIVER FLOWS INTO THE NEW CHANNEL.
5. ANY DISTURBED VEGETATED AREAS ARE REQUIRED TO BE SEEDED.
6. CLEARING AND GRUBBING WILL ONLY BE CONDUCTED AS NECESSARY TO CONSTRUCT THE RIFFLES. CLEARING AND GRUBBING IS SUBSIDIARY TO THE TREE AND BRUSH REMOVAL BID ITEM.
7. TIE-IN TO BE CONSTRUCTED 10 FEET HORIZONTALLY INTO THE EXISTING BANK AND SHOULD NOT PROTRUDE ABOVE ADJACENT GROUND. DISTURBED AREAS ALONG THE EXISTING BANK ARE TO BE RESTORED TO THE EXISTING CONDITION. ALL WORK ASSOCIATED WITH RESTORING THE EXISTING BANK WILL NOT BE MEASURED FOR SEPARATE PAYMENT BUT SHALL BE CONSIDERED SUBSIDIARY TO OTHER BID ITEMS.
8. VOIDS IN THE PLACED RIPRAP SHALL BE FILLED WITH A WELL GRADED MIX OF AGGREGATE VARYING FROM THE NO. 40 SIEVE UP TO 3 INCH STONES. THE MIX OF AGGREGATE SHOULD BE SUCH THAT IT IS NOT BLOWN OUT OF THE RIPRAP BY THE RIVERS CURRENT BUT INSTEAD FORCES FLOW OVER THE RIPRAP. THE AGGREGATE AND PLACEMENT OF THE AGGREGATE SHALL NOT BE MEASURED FOR SEPARATE PAYMENT BUT SHALL BE CONSIDERED SUBSIDIARY TO OTHER BID ITEMS.



SECTION A - A
NOT TO SCALE

No.	Revision	Date	By

HOUSTON engineering, inc.

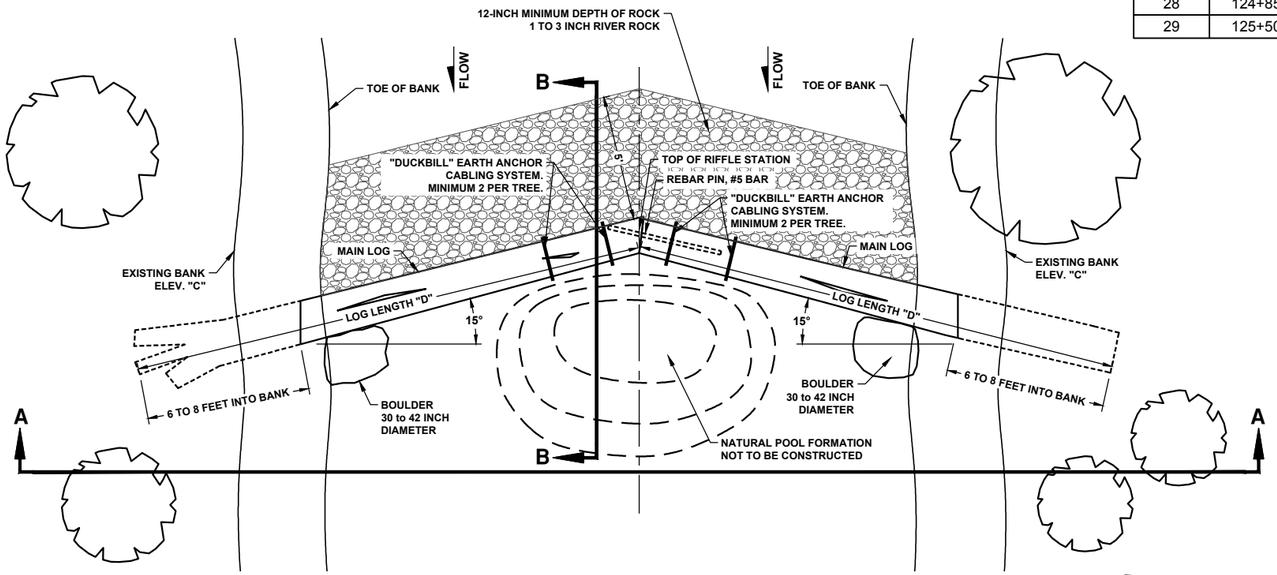
Drawn by	Date
TDR	1-26-22
Checked by	Scale
TDR	AS SHOWN

TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

RIFFLE DETAILS

PROJECT NO. 4876-0051

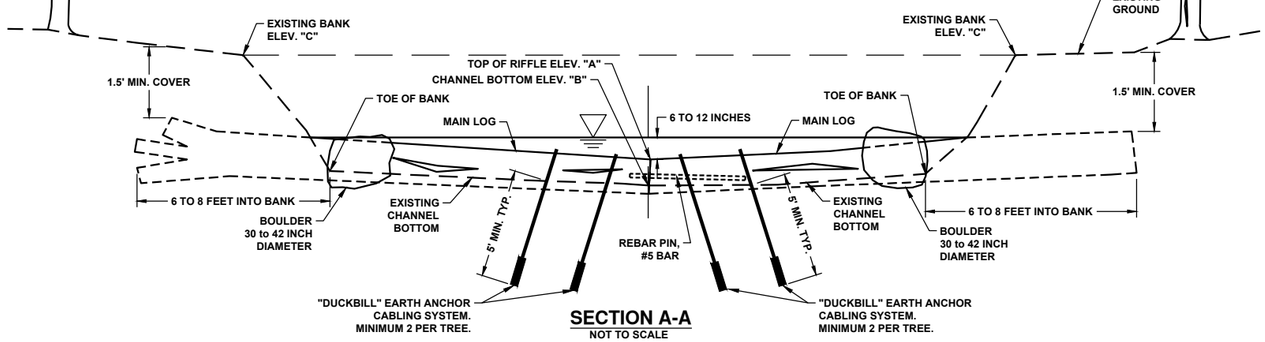
SHEET 18



PLAN VIEW
NOT TO SCALE

NOTES:

1. MINIMUM LOG DIAMETER 18 INCHES.
2. MAXIMUM RISE ABOVE CHANNEL BOTTOM = 9 INCHES
3. IT IS ANTICIPATED CONTRACTOR WILL SELECT AND HARVEST LOG FROM PROJECT AREA AS DIRECTED BY ENGINEER.



SECTION A-A
NOT TO SCALE

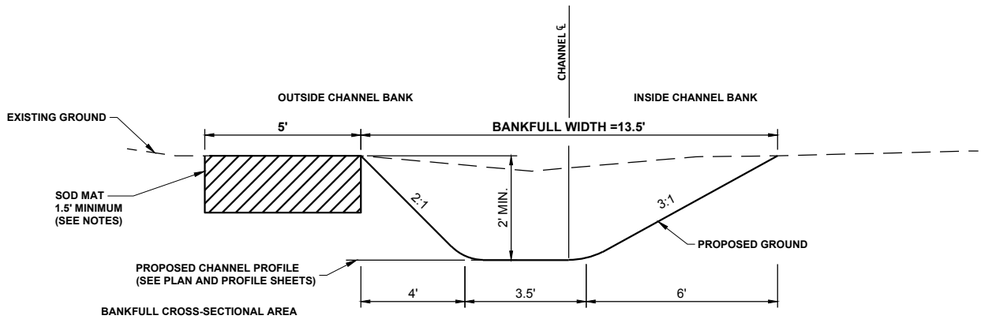
WOODY DEBRIS RIFFLE DETAIL
NOT TO SCALE

DETAIL TABLE

RIFFLE NO.	WOODY RIFFLE STATION	TOP OF RIFFLE ELEV. "A"	CHANNEL BOTTOM ELEV."B"	EXISTING BANK ELEV. "C"	LOG LENGTH [2 x "D"]
28	124+85	694.3	693.7	699.2	28 FT
29	125+50	695.2	694.5	699.6	28 FT
				TOTAL	56 FT

NOTES:

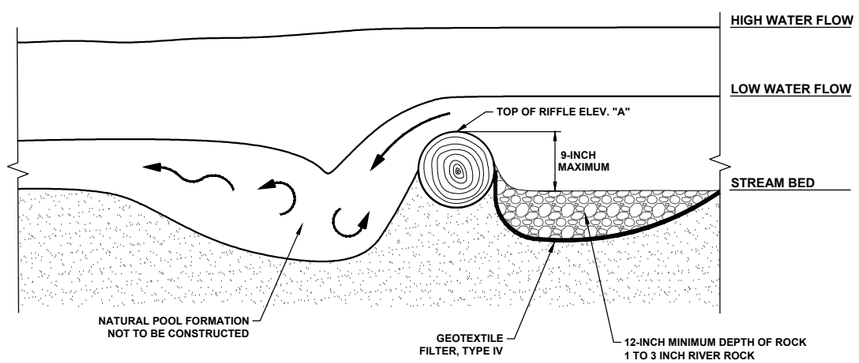
1. SOD MATERIAL SHALL CONSIST OF SUFFICIENT PLANDTO BIND THE SOD MAT TOGETHER. SOD MATS CONTAINING WILLOWS AND/OR DENSE STANDS OF GRASSES ARE CONIDERED IDEAL. ACCEPTABLE SOD MATERIAL SHALL BE DETERMINED BY THE ENGINEER OR FIELD REPRESENTATIVE. IN LOCATIONS WHERE SOD MATERIAL IS NOT AVAILABLE, THE CONTRACTOR SHALL INSTALL BIODEGRADABLE EROSION BLANKETS THAT ARE 5' IN WIDTH AND ARE PLACED AT THE VALLEY ELEVATION.
2. THE CONTRACTOR SHALL FILL ABANDONED CHANNEL TH THE VALLEY ELEVATION OR MATCH THE ADJACENT GROUND ELEVATION, WHICHEVER IS LOWER.
3. CONTRACTOR SHOULD SALVAGE EXISTING TOPSOIL FOR LATER REUSE ON SITE IN EXCAVATION AREA S WELL AS IN AREAS WHERE THE EXISTING CHANNEL IS TO BE FILLED.
4. THE DRAINAGE SHALL BE MAINTAINED ON THE OUTSIDE OF THE SPOIL PILE. AREAS OUTSIDE OF THE STOCKPILE LOCATIONS SHALL BE GRADED TO DRAIN.
5. MINIMUM OF 6" TOPSOIL SHALL BE SPREAD BELOW THE PROPOSED CHANNEL CROSS SECTION.



SOD MAT DETAIL
NOT TO SCALE

NOTES:

1. SOD MATERIAL SHALL CONSIST OF SUFFICIENT PLANT GROWTH TO BIND THE SOD MAT TOGETHER. SOD MATS CONTAINING WILLOWS AND/OR DENSE STANDS OF GRASSES ARE CONSIDERED IDEAL. ACCEPTABLE SOD MATERIAL SHALL BE DETERMINED BY THE ENGINEER OR FIELD REPRESENTATIVE. IN LOCATIONS WHERE SOD MATERIAL IS NOT AVAILABLE, THE CONTRACTOR SHALL INSTALL BIODEGRADABLE EROSION BLANKETS THAT ARE 5' IN WIDTH AND ARE PLACED AT THE VALLEY ELEVATION.
2. THE CONTRACTOR MAY NOT PLACE SPOIL IN WETLAND LOCATIONS.
3. THE CONTRACTOR SHALL FILL ABANDONED CHANNEL TO THE VALLEY ELEVATION OR MATCH THE ADJACENT GROUND ELEVATION, WHICHEVER IS LOWER.
4. CONTRACTOR SHOULD SALVAGE EXISTING TOPSOIL FOR LATER REUSE ON SITE IN EXCAVATION AREA AS WELL AS IN AREAS WHERE THE EXISTING CHANNEL IS TO BE FILLED.
5. DRAINAGE SHALL BE MAINTAINED ON THE OUTSIDE OF THE SPOIL PILE. AREAS OUTSIDE OF THE STOCKPILE LOCATIONS SHALL BE GRADED TO DRAIN.
6. MINIMUM OF 6" TOPSOIL SHALL BE SPREAD BELOW THE PROPOSED CHANNEL CROSS SECTION.



SECTION B-B
NOT TO SCALE

No.	Revision	Date	By

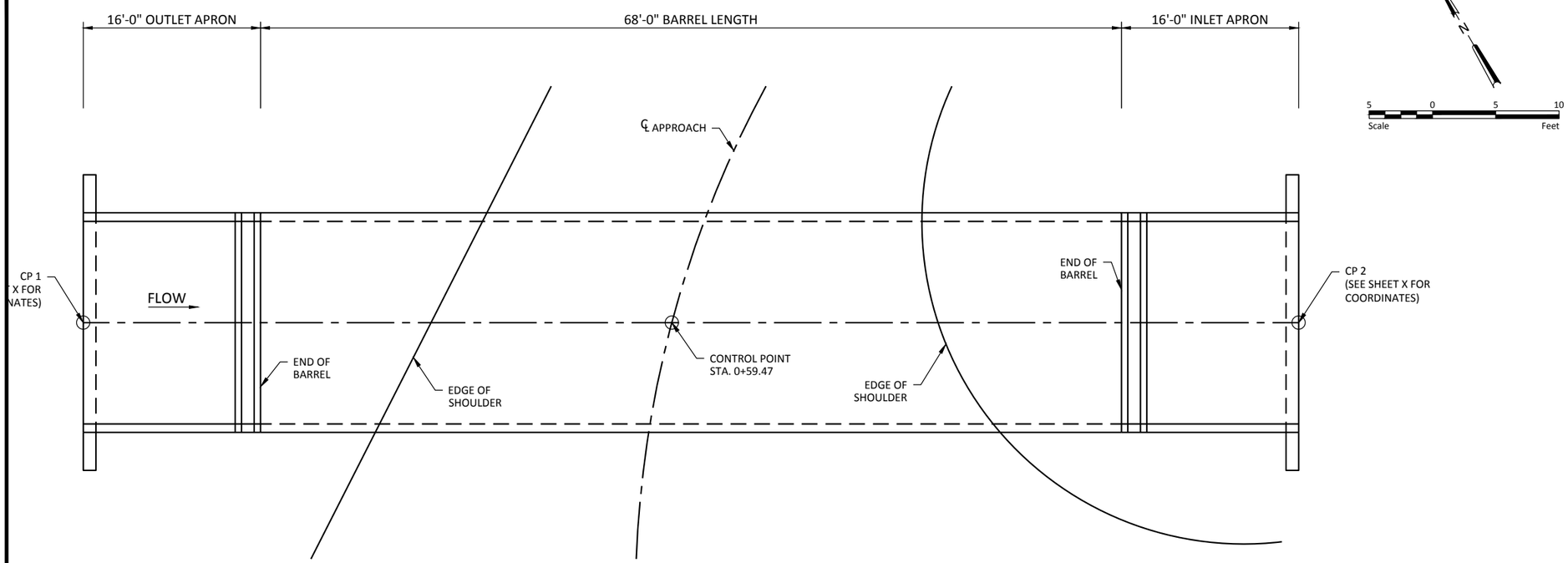
HOUSTON engineering, inc.

Drawn by	Date
TDR	1-26-22
Checked by	Scale
TDR	AS SHOWN

TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

RIFFLE AND SOD MAT DETAILS
PROJECT NO. 4876-0051

SHEET 19



PLAN VIEW

DESIGN DATA

DESIGNED IN ACCORDANCE WITH 2017 AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS AND MnDOT BRIDGE DESIGN MANUAL.

HL-93 LIVE LOAD
BARREL SPAN = 16'-0"
BARREL RISE = 7'-0"
BARREL LENGTH = 68'-0"
EST. MIN. FILL DEPTH Ⓐ = 2.00'
EST. MAX. FILL DEPTH Ⓑ = 2.00'
SKEW ANGLE = 0°00'00"

DESIGN SPEED = N/A MPH
CURRENT ADT (2019) = <50
PROJECTED ADT (2039) = <50

HL-93 LRFR
BRIDGE OPERATING RATING FACTOR RF = 1.3

CONSTRUCTION NOTES:

THE 2020 EDITION OF THE MINNESOTA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION" SHALL GOVERN.

ALL EXPOSED CONCRETE EDGES SHALL BE FORMED WITH A 1/2" OR 3/4" CHAMFER UNLESS OTHERWISE NOTED.

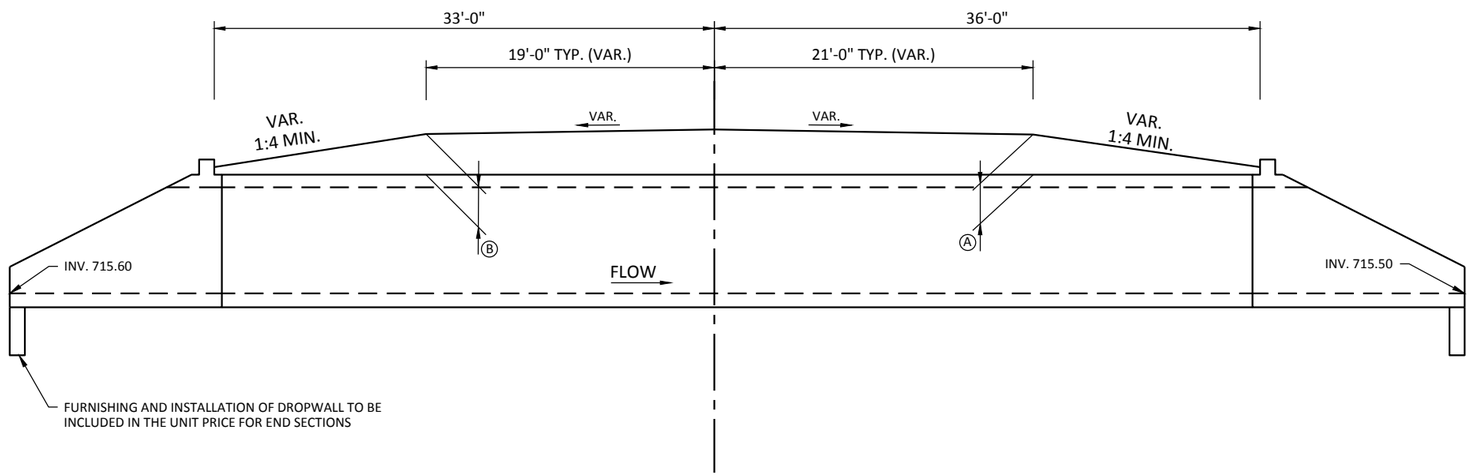
CONSTRUCTION SHALL BE IN ACCORDANCE WITH SPEC. 2411 AND 2412, EXCEPT AS NOTED.

REFER TO SHEET FOR EXCAVATION AND BACKFILL. SPEC. 2451.

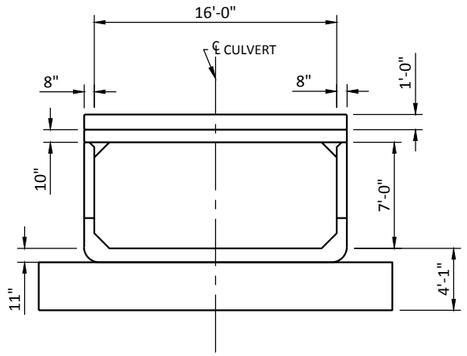
THE BAR SIZES SHOWN IN THIS PLAN ARE IN U.S. CUSTOMARY DESIGNATIONS.

REFER TO SHEET 6 OF THE PLANS FOR SUBSURFACE UTILITY INFORMATION.

REFER TO SHEET 6 OF THE PLANS FOR CONTROL POINT (CP) COORDINATES



ELEVATION VIEW



END ELEVATION

BRIDGE NO. 04J17

LOCATION: OTTO WAY NE OVER SHOTLEY BROOK
0.5 MILES NORTH AND 0.3 MILES EAST OF THE INTERSECTION OF CSAH 23 & ROGERS RD NE

MAIN TWO LINES OF 16' x 8' MNDOT STD. PRECAST CONCRETE CULVERT

IDENTIFICATION NO. 513

GENERAL PLAN AND ELEVATION

SEC. 10 T 153 N R 31 W

SHOTLEY TOWNSHIP BELTRAMI COUNTY

No.	Revision	Date	By

PRELIMINARY

HOUSTON engineering, inc.

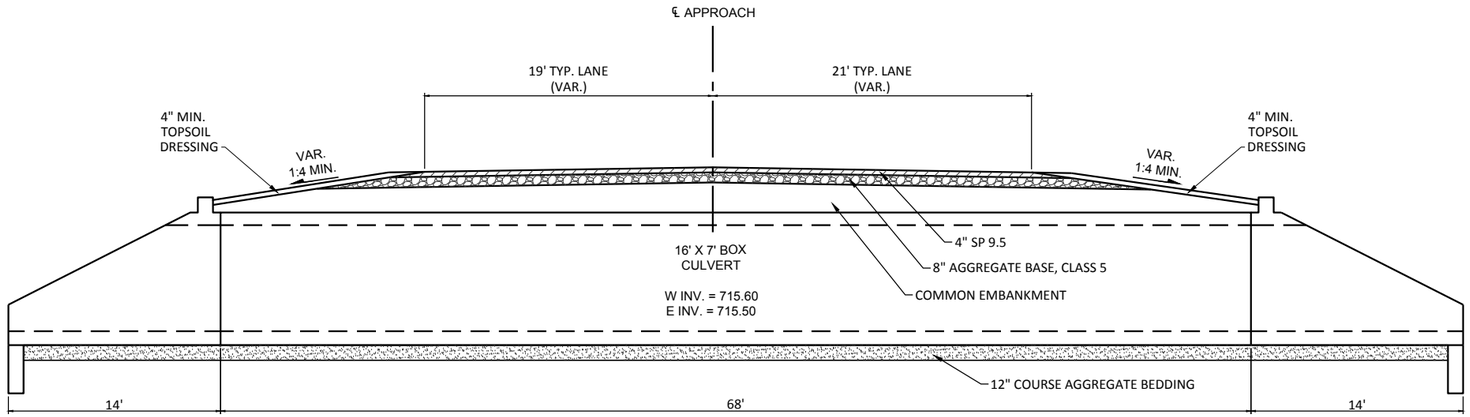
Drawn by	Date
DJK	1-26-22
Checked by	Scale
WJK	AS SHOWN

TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

BOX CULVERT
GENERAL PLAN
PROJECT NO. 4876-0051

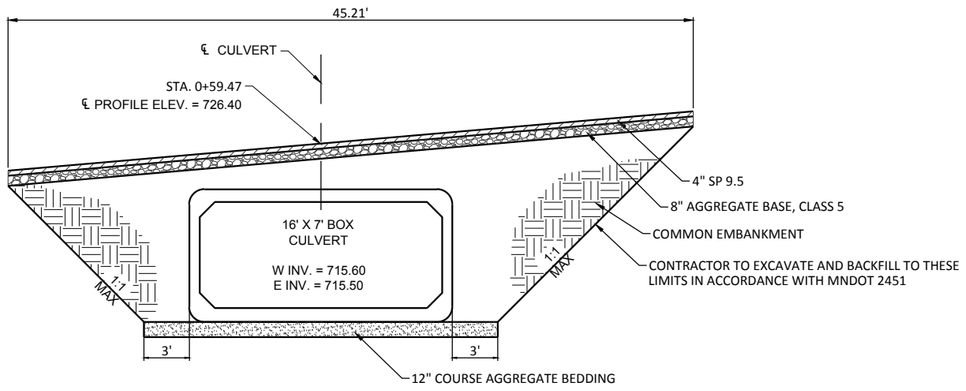
SHEET
20

HEI NO. 4876-0051



TYPICAL SECTION APPROACH

NOT TO SCALE



SPECIAL DETAIL TO BOX CULVERT

NOT TO SCALE

No.	Revision	Date	By

PRELIMINARY

HOUSTON engineering, inc.

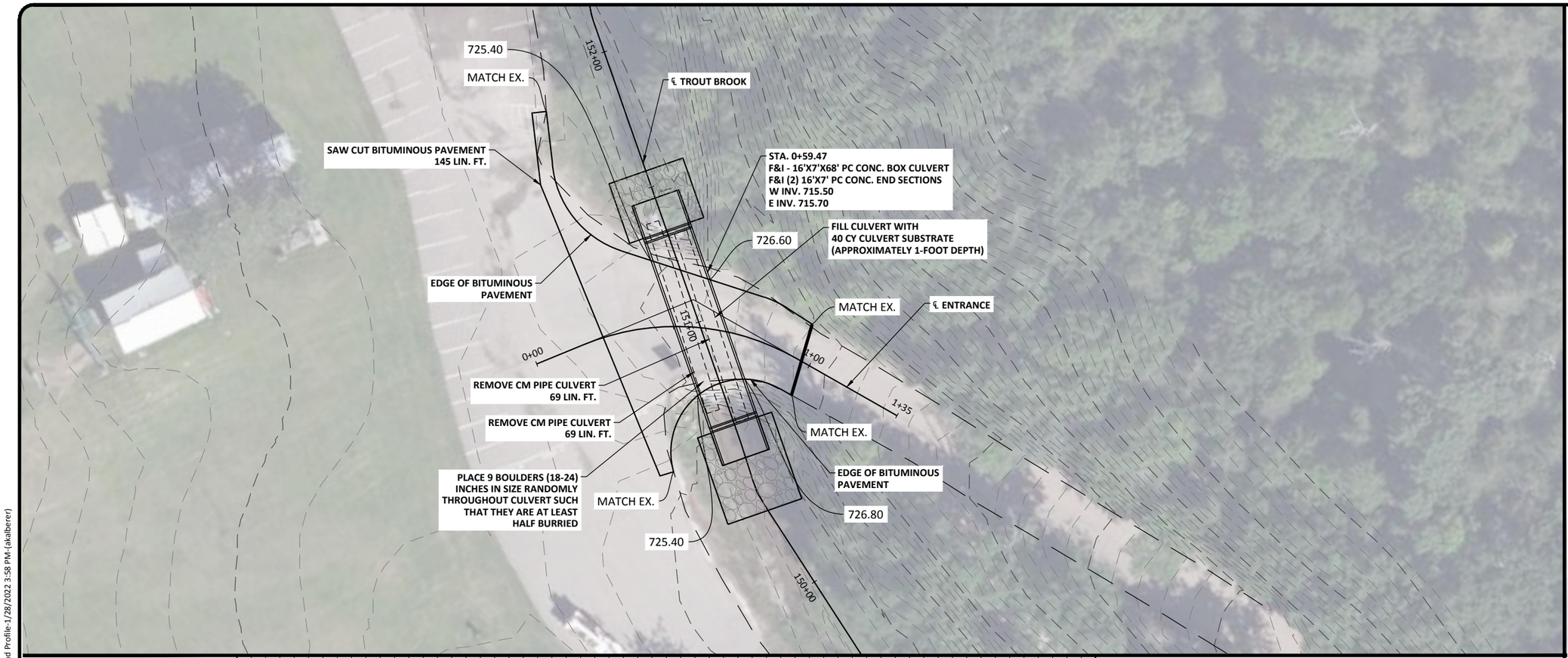
Drawn by	Date
DJK	1-26-22
Checked by	Scale
WJK	AS SHOWN

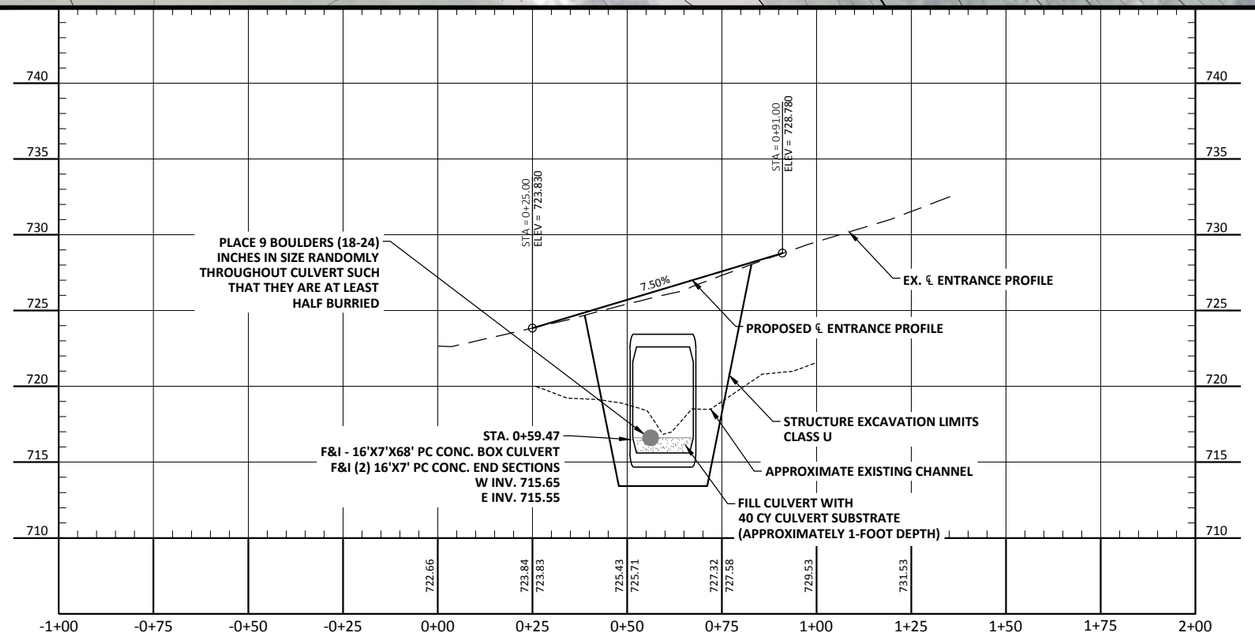
TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

BOX CULVERT
TYPICAL SECTION
PROJECT NO. 4876-0051

SHEET
21

HEI NO. 4876-0051





No.	Revision	Date	By

PRELIMINARY

HOUSTON engineering, inc.

Drawn by	Date
DJK	1-26-22
Checked by	Scale
WJK	AS SHOWN

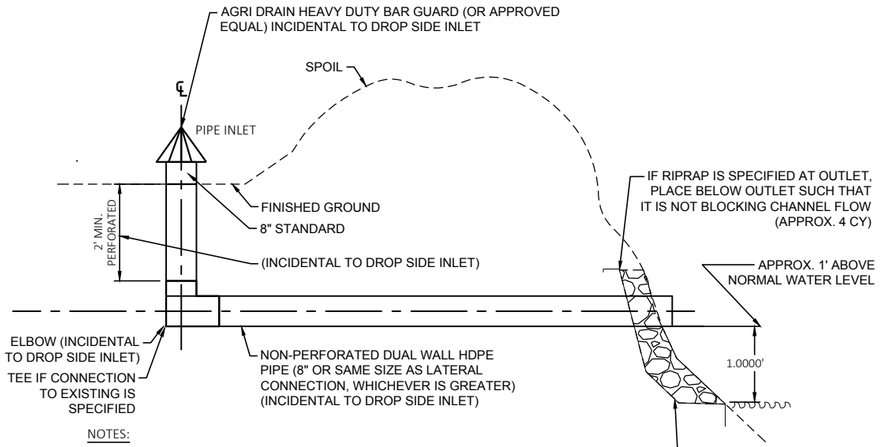
TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

BOX CULVERT
PLAN & PROFILE
PROJECT NO. 4876-0051

SHEET
22

HEI NO. 4876-0051

\\houston\hei\BN\4800\4876\4876_0051 Trout Brook Ph3\CAD\Plans\TROUT BROOK RESTORATION PHASE 3\Box Culvert Plan & Profile.dwg-Plan and Profile-1/28/2022 3:58 PM-(akalberer)

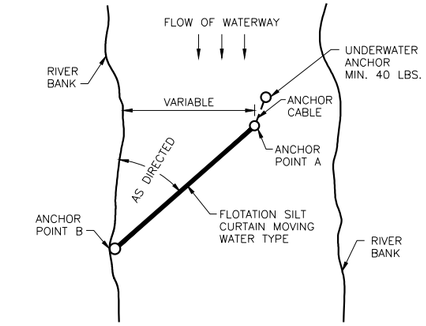


NOTES:

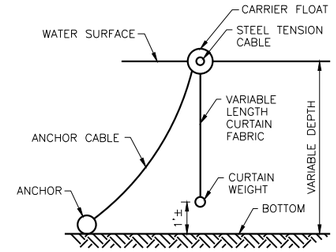
1. THE CONNECTION SHALL UTILIZE STANDARD MANUFACTURED FITTINGS.
2. THE PERFORATED SECTION OF THE INLET SHALL HAVE 6 ROWS OF HOLES SPACED AT 2 INCHES, CENTER TO CENTER, AND HAVE A 1 INCH DIAMETER.
3. INLET COMPONENT LENGTHS MAY BE SHORTENED OR LENGTHENED, TO OBTAIN THE REQUIRED HEIGHT OR DEPTH.

DROP SIDE INLET DETAIL

NOT TO SCALE



PLAN VIEW-MOVING WATER



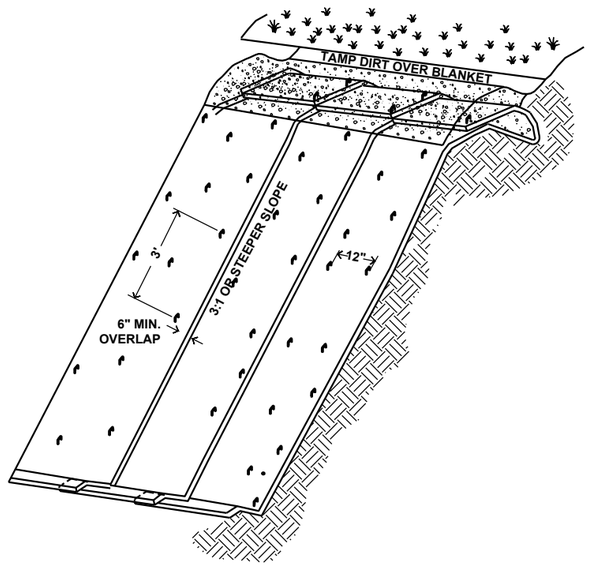
PROFILE VIEW

NOTES:

1. FLOATING SILT CURTAIN SHALL CONFORM TO SDDOT 3887-1 AND PROJECT SPECIAL PROVSIONS AND BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS OR AS DIRECTED BY THE ENGINEER.
2. DESIGN CRITERIA:
   MAXIMUM WATER DEPTH: 10'
   MAXIMUM WATER VELOCITY: 5 FT./SEC.

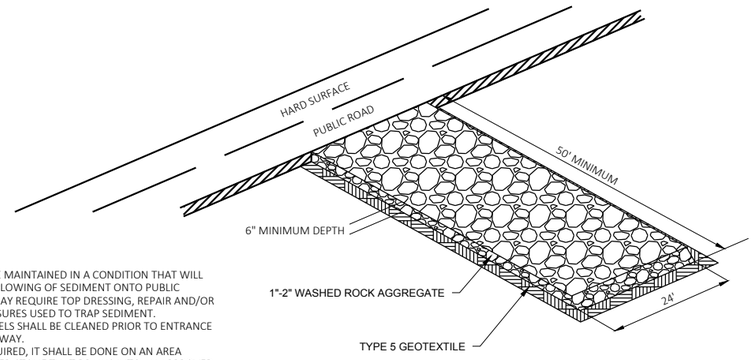
FLOATING SILT CURTAIN TYPE MOVING WATER

NOT TO SCALE



EROSION CONTROL BLANKET FOR BANK REPAIR

NOT TO SCALE



NOTES:

1. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. THIS MAY REQUIRE TOP DRESSING, REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.
2. WHEN NECESSARY, WHEELS SHALL BE CLEANED PRIOR TO ENTRANCE ONTO PUBLIC RIGHT-OF-WAY.
3. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABILIZED WITH CRUSHED STONE THAT DRAINS INTO AN APPROVED SEDIMENT TRAP OR SEDIMENT BASIN.

TEMPORARY ROCK OR WOOD CHIP

CONSTRUCTION ENTRANCE

NOT TO SCALE

No.	Revision	Date	By

HOUSTON engineering, inc.

Drawn by	Date
TDR	1-26-22
Checked by	Scale
TDR	AS SHOWN

TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

EROSION CONTROL DETAILS

PROJECT NO. 4876-0051

SHEET 23

STORM WATER POLLUTION PREVENTION NARRATIVE

PROJECT DESCRIPTION / LOCATION

THE TROUT BROOK RESTORATION PROJECT IS LOCATED AT AFTON ALPS SKI RESORT WITHIN DENMARK TOWNSHIP OF WASHINGTON COUNTY, MINNESOTA. THE PROPOSED PROJECT PROPOSES TO RESTORE APPROXIMATELY 1,450 FT OF STREAM WHICH INCLUDES 26 ROCK RIFFLES, 2 WOODY DEBRIS RIFFLES, AN EXCAVATING ADDITIONAL FLOODPLAIN IN TWO LOCATIONS ALONG A COMBINED 700 FT OF STREAM. THE PROJECT ALSO PROPOSES TO REPLACE TWO LINES OF 54'' CMP WITH A 16'X7' RCB WITH END SECTIONS.

SITE MAPS

MAPS OF THE RESTORATION CONCEPT PLAN, LAND USE, SOIL TYPE, AND AQUATIC RESOURCES CAN BE FOUND IN THE EXHIBITS OF THE ENVIRONMENTAL ASSESSMENT WORKSHEET (EAW).

ENVIRONMENTALLY SENSITIVE AREAS

THERE ARE WETLANDS ADJACENT TO THE PROJECT WORK CORRIDOR, NONE OF WHICH ARE LISTED AS A PUBLIC WATER WETLAND. MINIMAL WORK WILL BE PERFORMED IN THE WETLANDS AND WORK SHALL BE PERFORMED TO MINIMIZE FILL PLACED IN WETLANDS.

OUTSTANDING RESOURCE VALUE WATERS (ORVWs)

THERE ARE NO OUTSTANDING RESOURCE VALUE WATERS WITHIN THE PROJECT LIMITS.

CALCAREOUS FENS

THERE ARE NO CALCAREOUS FENS WITHIN THE PROJECT LIMITS.

IMPAIRED WATERS

TROUT BROOK IS A DNR DESIGNATED PUBLIC WATERS FOR THE ENTIRE LENGTH OF THE PROJECT. TROUT BROOK IS A WATERWAY LISTED BY THE MPCA AS AN IMPAIRED FOR E. COLI.

LAND FEATURE CHANGES

TOTAL PROJECT AREA DISTURBED	2.44 ACRES
TOTAL EXISTING IMPERVIOUS SURFACE AREA	0.0 ACRES
TOTAL EXISTING PERVIOUS SURFACE AREA	2.44 ACRES
TOTAL PROPOSED IMPERVIOUS SURFACE AREA	0.0 ACRES
TOTAL PROPOSED PERVIOUS SURFACE AREA	2.44 ACRES

DRAINAGE COMPUTATIONS

NO DRAINAGE COMPUTATIONS WERE REQUIRED AS PART OF THE STORM WATER POLLUTION PREVENTION PLAN FOR THIS PROJECT. SHOULD CONDITIONS IN THE FIELD WARRANT CHANGES, THE HYDRAULICS ENGINEER SHOULD BE CONSULTED AND THE CONDITIONS NOTED IN THE CONTRACTOR'S CONSTRUCTION LOG.

PROJECT CONTACTS

GREG BOWLES, PROJECT ENGINEER (763-493-6670) OR JOHN LOOMIS, PROJECT OWNER (651-714-3714) AND THE CONTRACTOR ARE RESPONSIBLE FOR IMPLEMENTATION OF THE SWPPP AND PLACEMENT, INSPECTION AND MAINTENANCE OF THE EROSION AND SEDIMENT CONTROL BMP'S BEFORE AND DURING CONSTRUCTION.

MPCA 24 HOUR EMERGENCY NOTIFICATION: 651-649-5451 OR 800-422-0798

TIMING OF BMP INSTALLATION

THE EROSION PREVENTION AND SEDIMENT CONTROL BMP's SHALL BE PLACED PRIOR TO START OF CONSTRUCTION, AS NECESSARY TO MINIMIZE EROSION FROM DISTURBED SURFACES AND CAPTURE SEDIMENT ON SITE, AND SHALL MEET THE NPDES PERMIT PART IV CONSTRUCTION ACTIVITY REQUIREMENTS.

ONCE CONSTRUCTION ACTIVITY CEASES FOR 14 DAYS OR MORE IN AN AREA, THAT AREA WILL BE STABILIZED WITH TEMPORARY OR PERMANENT BMP's.

RECEIVING WATERS

THE RECEIVING WATER FOR THE PROJECT IS TROUT BROOK. STORM WATER RUNOFF DURING CONSTRUCTION WILL BE MANAGED WITH BMP'S FOR INLET PROTECTION, AND OTHER BMP'S FOR MANAGING SEDIMENT LADEN RUNOFF. STORM WATER RUNOFF UPON COMPLETION OF THE PROJECT WILL BE MANAGED WITH GRASSY DITCHES AND SWALES. REFER TO THE EROSION CONTROL AND TURF ESTABLISHMENT SHEETS OF THE PLAN FOR DETAILS AND LOCATIONS OF TEMPORARY AND PERMANENT BMP'S.

SPECIAL CONDITIONS

THE CONTRACTOR SHALL PROVIDE SITE PLANS FOR CRITICAL AREAS IDENTIFIED IN THE EROSION CONTROL PLANS DETAILING HIS INTENDED CONSTRUCTION, EROSION CONTROL AND FINAL STABILIZATION METHODS PRIOR TO CONSTRUCTION COMMENCING. ALL WORK SPECIFICALLY NOT NOTED AS BEING PAID FOR SEPERATELY SHALL BE CONSIDERED INCIDENTAL WORK.

STORM WATER POLLUTION PREVENTION PLAN (SWPPP) NOTES

1) THE CONTRACTOR WILL WORK WITH THE PROJECT ENGINEER TO OVERSEE THE IMPLEMENTATION OF THE SWPPP, AND PLACEMENT, INSPECTION, AND MAINTENANCE OF THE EROSION PREVENTION AND SEDIMENT CONTROL BMP'S BEFORE AND DURING CONSTRUCTION.

2) THE CONTRACTOR SHALL DEVELOP A CHAIN OF RESPONSIBILITY WITH ALL OPERATORS ON THE SITE TO ENSURE THAT THE SWPPP WILL BE IMPLEMENTED AND STAY IN EFFECT UNTIL THE CONSTRUCTION PROJECT IS COMPLETE, THE ENTIRE SITE HAS UNDERGONE FINAL STABILIZATION, AND A NOTICE OF TERMINATION HAS BEEN SUBMITTED TO THE MPCA.

3) THE CONTRACTOR SHALL PROVIDE AND SUBMIT A WRITTEN, NOT ORAL, WEEKLY SCHEDULE OF PROPOSED EROSION CONTROL ACTIVITIES FOR THE PROJECT ENGINEER'S APPROVAL AS PER MN/DOT SPEC. 1803.

4) THE CONTRACTOR SHALL PREPARE AND SUBMIT A SITE PLAN FOR THE PROJECT ENGINEER'S APPROVAL AS PER MN/DOT SPEC. 1803 FOR PIPE AND STRUCTURE PLACEMENT, DEWATERING, AND AREAS SHOWN IN THE PLANS OR SPECIFIED BY THE PROJECT ENGINEER.

5) THE NORMAL WETTED PERIMETER OF ANY TEMPORARY OR PERMANENT DRAINAGE DITCH THAT DRAINS WATER FROM A CONSTRUCTION SITE, OR DIVERTS WATER AROUND A SITE, MUST BE STABILIZED WITHIN 200 LINEAL FEET FROM THE PROPERTY EDGE, OR FROM THE POINT OF DISCHARGE TO ANY SURFACE WATER. RAPID STABILIZATION MUST BE COMPLETED IMMEDIATELY AFTER CHANNEL EXCAVATION, WHERE SOD MATS OR EROSION CONTROL BLANKETS SHOULD BE PLACED IN ACCORDANCE WITH THE PLANS. THESE AREAS MUST BE KEPT STABILIZED AT ALL TIMES.

6) PIPE OUTLETS MUST BE PROVIDED WITH TEMPORARY OR PERMANENT ENERGY DISSIPATION WITHIN 24 HOURS OF CONNECTION TO A SURFACE WATER.

7) DEWATERING AND CONCRETE TRUCK WASHING RELATED TO THE CONSTRUCTION ACTIVITY THAT MAY HAVE TURBID OR SEDIMENT LADEN DISCHARGE WATER MUST BE DISCHARGED TO A TEMPORARY SEDIMENTATION BASIN ON THE PROJECT SITE. IF WATER CANNOT BE DISCHARGED TO A SEDIMENTATION BASIN PRIOR TO ENTERING THE SURFACE WATER, IT MUST BE TREATED WITH THE APPROPRIATE BMP'S, SUCH THAT THE DISCHARGE DOES NOT ADVERSELY AFFECT THE RECEIVING WATER DOWNSTREAM LANDOWNERS. THE CONTRACTOR MUST ENSURE THAT DISCHARGE POINTS ARE ADEQUATELY PROTECTED FROM EROSION AND SCOUR. THE DISCHARGE MUST BE DISPERSED OVER NATURAL ROCK RIRRAP, SAND BAGS, PLASTIC SHEETING OR OTHER ENERGY DISSIPATION MEASURES APPROVED BY THE PROJECT ENGINEER. ADEQUATE SEDIMENTATION CONTROL MEASURES ARE REQUIRED FOR DISCHARGE WATER THAT CONTAINS SUSPENDED SOLIDS.

8) ANY FUEL OR CHEMICAL TANK STORED ON THE PROJECT AREA MUST BE PROTECTED BY A SOIL BERM OR HAVE A NEGATIVE GRADIENT TO ANY WATER RESOURCE AREA, AS PER COE404. A CONTINGENCY PLAN MUST BE CREATED BY THE CONTRACTOR IN EVENT OF A SPILL OR LEAK OF ANY CHEMICAL, INCLUDING PETROCHEMICALS, DEEMED HARMFUL TO THE ENVIRONMENT, AND HAVE ON HAND THE MATERIALS NECESSARY TO CAPTURE AND CONTAIN SAID CHEMICALS.

9) A WATER APPROPRIATION PERMIT WILL BE REQUIRED FROM THE MN DNR FOR CONSTRUCTION IF DEWATERING EXCEEDS 10,000 GALLONS PER DAY.

10) ALL ERODIBLE STOCKPILES SHALL HAVE SEDIMENT CONTROL AND BE PLACED IN AREAS AWAY FROM SURFACE WATER.

11) CONTRACTOR SHALL BE RESPONSIBLE FOR CONTROLLING EROSION AS PER THE PLAN, PROJECT PROVISIONS, AND MN/DOT SPECIFICATIONS 1701, 1702, 1717, 2572, 2573, 2575.

12) TEMPORARY SEDIMENT REQUIREMENTS IS SATISFIED WITH POOLS IN OUTSIDE BENDS. CONTRACTOR MAY NEED TO COME BACK AND REMOVE ANY SEDIMENT WASHING INTO POOLS AT PROJECT COMPLETION.

13) EROSION CONTROL WILL BE ADDRESSED THROUGH SOD MATS, ECB ON OUTSIDE BENDS, AND SEEDING AND MULCHING WITHIN 14 DAYS OF CONSTRUCTION IN AN AREA.

LOCATION OF SWPPP REQUIREMENTS IN PROJECT PLAN

DESCRIPTION	TITLE	LOCATION
SUMMARY OF PERVIOUS AND IMPERVIOUS AREAS	SWPPP SHEET	SHEET 24
EROSION CONTROL SHEETS	EROSION CONTROL DETAILS SHEET	SHEET 23
EROSION CONTROL DETAILS	DETAIL SHEETS	MNDOT
FINAL STABILIZATION	ESTIMATED QUANTITIES	SEE SPECIFICATIONS

No.	Revision	Date	By

HOUSTON engineering, inc.

Drawn by	Date
TDR	1-26-22
Checked by	Scale
TDR	AS SHOWN

TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

SWPPP NOTES

PROJECT NO. 4876-0051

SHEET 24

APPENDIX D – STRUCTURE TYPE DESIGN MEMO

Technical Memorandum

To: John Loomis, Water Resource Manager
South Washington Watershed District

From: Wesley J Keller, PE
Houston Engineering, Inc.

Subject: Structure Concept Study

Date: January 4, 2022

Project: Trout Brook Phase lll

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am duly Licensed Professional Engineer under the laws of the State of Minnesota.

1/4/2022

Wesley J. Keller Date:
Reg. No. 57437

OVERVIEW

The Trout Brook Phase III Restoration Project site is located on Vail properties at the Afton Alps Ski Area and on Mn DNR property (Afton State Park), in Sections 2 and 3 of Denmark Township (T27N-R20W), approximately 3 miles south of the City of Afton in Washington County. Trout Brook outlets to the St. Croix River.

One portion of the Trout Brook Phase lll project consists of removing and replacing two existing 54" corrugated metal pipe (CMP) culverts located to the west of the Alps Village. The crossing provides connectivity to the Afton Alps facility for the public and staff. The objective of the replacement is to improve channel conditions at the stream crossing and create a more efficient waterway opening. The improved waterway opening of the proposed structure will match the channel bankfull width, reduce stream velocity to enhance conditions for fish passage, and reduce the likelihood of overtopping. Structure alternatives have been selected to maintain a similar channel profile, meet minimum cover requirements (2' min.) and minimize impacts to the existing roadway profile and alignment as well as the adjacent parking lot.

PURPOSE AND SCOPE

The purpose of this structure concept study is to investigate several potential structure types to be utilized at the proposed crossing and provide a brief description of the structure, pros/cons, and anticipated construction costs associated with constructing each alternative. Each structure size has been selected to best fit the site area, meet bankfull width and hydraulic requirements of the proposed channel, reduce overtopping frequency, and provide an economical structure that will best serve the area for years to come. All structures are designed to meet site needs and are in full compliance with AASHTO bridge design and loading standards for highway use. A concept structure layout sheet has been provided for each structure alternative to best estimate the required length of each structure and provide a conceptual exhibit showing type, size, and location of each structure.

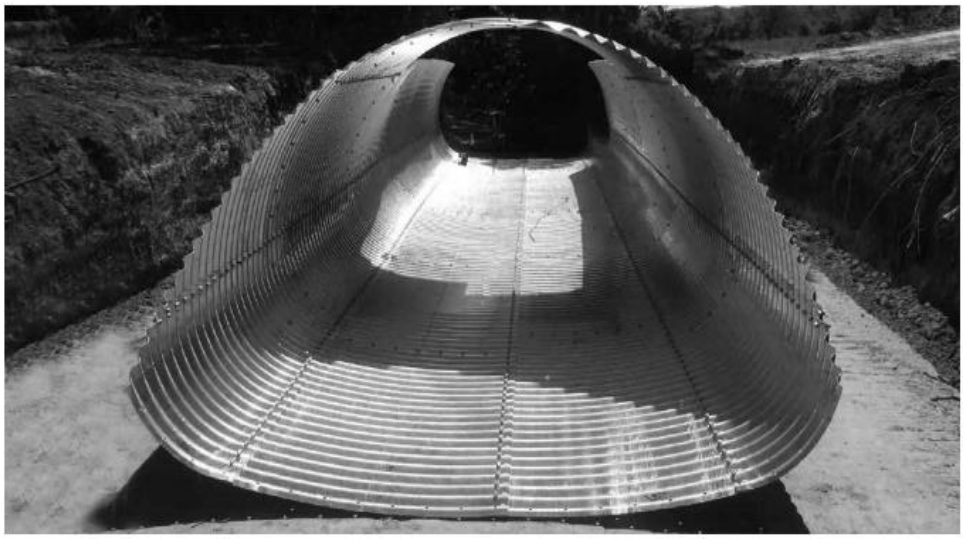
The following are objectives of this document:

- Summarize structure alternatives considered to be constructed within Trout Brook channel at the upstream crossing west of the Alps Village.
- Evaluate the structure impacts to the crossing location associated with each structure type.
- Provide conceptual layout sheets for each structure alternative.
- Provide preliminary anticipated construction costs associated with each structure type.

ALTERNATIVES

Aluminum Plate Arch Pipe

Approximate Size: 14'-10" x 9'-1"
Approximate Length: 70'-0"



Aluminum structural plate arch pipes are light-weight, easy to install, and cost friendly solutions for providing drainage at stream crossings. The aluminum alloys in aluminum structural plates have proven to be excellent in corrosion resistance. Although aluminum structures were only first introduced in the 1960's, it is anticipated that up to 75 years of service life can be expected. Aluminum structural plates are corrugated, curved, and bolt-hole punched at the plant. They are typically delivered to the site un-assembled. The plates and ribs are easily bolted together during placement to form the pipe arch shape. This low-rise arch pipe shape provides greater flow where headroom is limited along with improved hydraulic capacity during low flows. With a minimum design cover of only 2'-0", arch pipes are a great alternative when existing road profiles need to be maintained. Arch pipes are great options with relatively low installation costs and light weight construction. As seen in the attached exhibit, the invert of the arch pipe has been set below the proposed channel bottom to allow for the placement of natural channel material through the structure. The estimated structure length is 70' long with standard beveled end treatments on each end.
The estimated cost range for the aluminum plate arch pipe alternative is approximately **$195,000-$220,000**. See the attached cost summary for more information.

Pros:

- Lightweight – installation will not require special lifting equipment
- Does not require headwall or special end section.
- Low Cost

Cons:

- Structure Invert - Requires placing material over invert to maintain natural channel bottom. Special care during placement will be required to ensure the lightweight aluminum plates are not damaged.
- Assembly Required – It is estimated that an aluminum structural plate arch pipe of this size would require approximately 3-5 days and a 4–5-man crew to construct.
- Serviceability – Although the anticipated service life of up to 75 years, the high number of joints/connections increases the potential for maintenance and serviceability issues.
- Backfill Requirements – Because of the lightweight nature of plate structures, they rely on the surrounding backfill material for support and require specific material and backfill requirements during installation.
- Aesthetics

Precast Concrete Arch

Approximate Size: 18'-0" x 5'-10"
Approximate Length: 74'-0"

Precast concrete arch structures come in many shapes and sizes and are fully engineered, modular systems complete with precast concrete arch sections, headwalls, and wingwalls for rapid installation on top of precast or cast-in-place concrete foundation. It is a clear span, three-sided structure that provides a natural bottom for environmental applications providing profile continuity of the stream. When considering design life, precast concrete material typically has a longer service life than that of galvanized steel and is estimated to have a service life of 75 years. The precast concrete arch section selected for the Trout Brook site spans 18' and has approximately a 6' rise. The structure consists of a precast headwall and flared wingwall sections at each end of the arch to retain the above fill and potentially reduce the required length of the structure. Because the arch is

bottomless, the structure is typically supported by a precast or cast-in-place concrete footing at each end to distribute the loads. This often requires a geotechnical investigation of the existing site conditions and recommendations for allowable bearing capacity to ensure the structure is supported properly. As seen in the attached exhibit the estimated structure length is 70' long with concrete headwalls and flared wingwalls at each end.

The estimated cost range for the precast concrete arch alternative is approximately **$310,000-$335,000**. See the attached cost summary for more information.

Pros:

- Natural Channel Bottom
- Aesthetically Appealing – Provides appealing structure shape with ability to add aesthetic features to headwalls and wingwalls (architectural concrete texture and finishes, railing, etc.)
- Serviceability – 75-year service life with low maintenance costs. Precast concrete is manufactured in plant for high-quality and durability.

Cons:

- Structure Weight – Requires specialized lifting equipment for placement.
- Increased construction time due to concrete foundation.
- Increased Engineering Costs - Additional Geotechnical and Foundation Design Required
- High Structure Cost

Aluminum Plate Box Culvert

Approximate Size: 16'-8" x 7'x6"
Approximate Length: 74'-0"

Aluminum structural plate box culverts are practical and cost-efficient solutions for small bridge replacement projects. They provide flexibility in layout options to fit within the channel and meet vertical and horizontal clearance requirements. They are a similar shape as the precast concrete arch but can be constructed with a

full invert to eliminate the need for a separate footing to support the structure. Like the aluminum plate arch pipe, they are light-weight and easy to install. They provided excellent corrosion resistance and anticipated service life of up to 75 years. They are typically delivered to the site un-assembled. The plates and ribs are easily bolted together during placement to form the box shape. The proposed aluminum plate box culvert is approximately 74' long with aluminum headwalls and flared wingwalls on each end. The proposed invert of the box culvert will be placed below the channel bottom to allow for the placement of natural channel material through the length of the structure.

The estimated cost range for the aluminum plate box culvert alternative is approximately **$250,000-$275,000**. See the attached cost summary for more information.

Pros:

- Lightweight – installation is not anticipated to require special lifting equipment.
- Aesthetically Appealing – Provides appealing structure shape.
- No additional foundation required.

Cons:

- Structure Invert - Requires placing material over invert to maintain natural channel bottom. Special care during placement will be required to ensure the lightweight aluminum plates are not damaged.
- Serviceability – Although the anticipated service life of up to 75 years, the high number of joints/connections increases the potential for maintenance and serviceability issues
- High Structure Cost

Precast Concrete Box Culvert

Approximate Size: 16' x 7'
Approximate Length: 68'-0"

Precast reinforced concrete box culverts can provide a long-lasting solution in terms of strength and durability when it comes to roadways crossing stream beds. Not only is concrete design life greater than that of steel, but the resiliency to resist washouts during flood events is much greater as well. With minimal installation time and little to no long-term maintenance, a precast concrete box culvert is a viable structural alternative to consider for

a crossing. Precast concrete box culvert end sections are available in standard straight sections or flared wingwall style end sections to better fit the site. The proposed box culvert size for the site is a 16' span and 7' rise box culvert that is approximately 68' long. The proposed invert of the box culvert will be placed below the channel bottom to allow for the placement of natural channel material through the length of the structure.

The estimated cost range for the precast concrete box culvert alternative is approximately **$210,000-$235,000**. See the attached cost summary for more information.

Pros:

- Serviceability – 75-year service life with low maintenance costs. Precast concrete is manufactured in plant for high-quality and durability.
- Matches downstream structure type.
- Provides hydraulic efficiency that matches the bankfull width that is maintained for entire height of waterway opening
- Low Cost
- Short Installation Time

Cons:

- Structure Weight – Requires specialized lifting equipment for placement.
- Structure Invert - Requires placing material over invert to maintain natural channel bottom.

CONCLUSION

All the structure alternatives discussed in this study provide structurally sound and hydraulically efficient structures for the existing location. As shown in the cost summary, the aluminum plate arch pipe and precast concrete box provide the most economical structure alternatives. Although aluminum plate arch pipe is estimated at a slightly lower cost than the precast concrete box, the arch pipe presents a greater potential for damage during placement and serviceability and maintenance issues over the life of the structure. Therefore, the precast concrete box culvert appears to provide the most economical, durable, and least risk of potential maintenance over the service life while still maintaining all site and hydraulic requirements.

ESTIMATED COST SUMMARY

Conceptual structure related costs were compiled to determine the approximate price range of each structure type. All costs below are approximate and are subject to change as design progresses. A 15% contingency has been included to all structure alternatives.

Aluminum Plate Arch Pipe

Aluminum Plate Arch Pipe				
Items	**Unit**	**Quantity**	**Unit Price**	**Total Price**
Mobilization	LS	1	$ 15,000.00	$ 15,000.00
Dewatering	LS	1	$ 10,000.00	$ 10,000.00
Structure Excavation/Backfill	CY	815	$ 30.00	$ 24,450.00
Channel Excavation/Slope Preparation	CY	100	$ 24.00	$ 2,400.00
Aluminum Arch Pipe 14'-10" x 9'-1" (w/End Sections)	LF	70	$ 1,600	$ 112,000.00
Random Riprap	CY	65	$ 85.00	$ 5,525.00
Bituminous Pavement (4" Depth)	TON	60	$ 90.00	$ 5,400.00
Aggregate Base (8" Depth)	TON	105	$ 25.00	$ 2,625.00
			Subtotal =	**$ 177,400.00**
			Contingency (15%) =	**$ 26,610.00**
			Estimated Total =	**$ 204,010.00**
			Estimated Range	**$195,000-$220,000**

Precast Concrete Arch Pipe

Precast Concrete Arch (Con/Span O-Series)				
Items	**Unit**	**Quantity**	**Unit Price**	**Total Price**
Mobilization	LS	1	$ 35,000.00	$ 35,000.00
Dewatering	LS	1	$ 10,000.00	$ 10,000.00
Structure Excavation/Backfill	CY	820	$ 30.00	$ 24,600.00
Channel Excavation/Slope Preparation	CY	100	$ 24.00	$ 2,400.00
Precast Concrete Arch 18'-0" x 5'-10" (w/End Sections)	LF	74	$ 2,000.00	$ 148,000.00
Concrete Foundation Footing	CY	66	$ 650.00	$ 42,755.56
Random Riprap	CY	65	$ 85.00	$ 5,525.00
Bituminous Pavement (4" Depth)	TON	60	$ 90.00	$ 5,400.00
Aggregate Base (8" Depth)	TON	105	$ 25.00	$ 2,625.00
			Subtotal =	**$ 276,305.56**
			Additional Geotech & Foundation Eng. =	**$ 20,000.00**
			Contingency (15%) =	**$ 44,445.83**
			Estimated Total =	**$ 320,751.39**
			Estimated Range	**$310,000-$335,000**

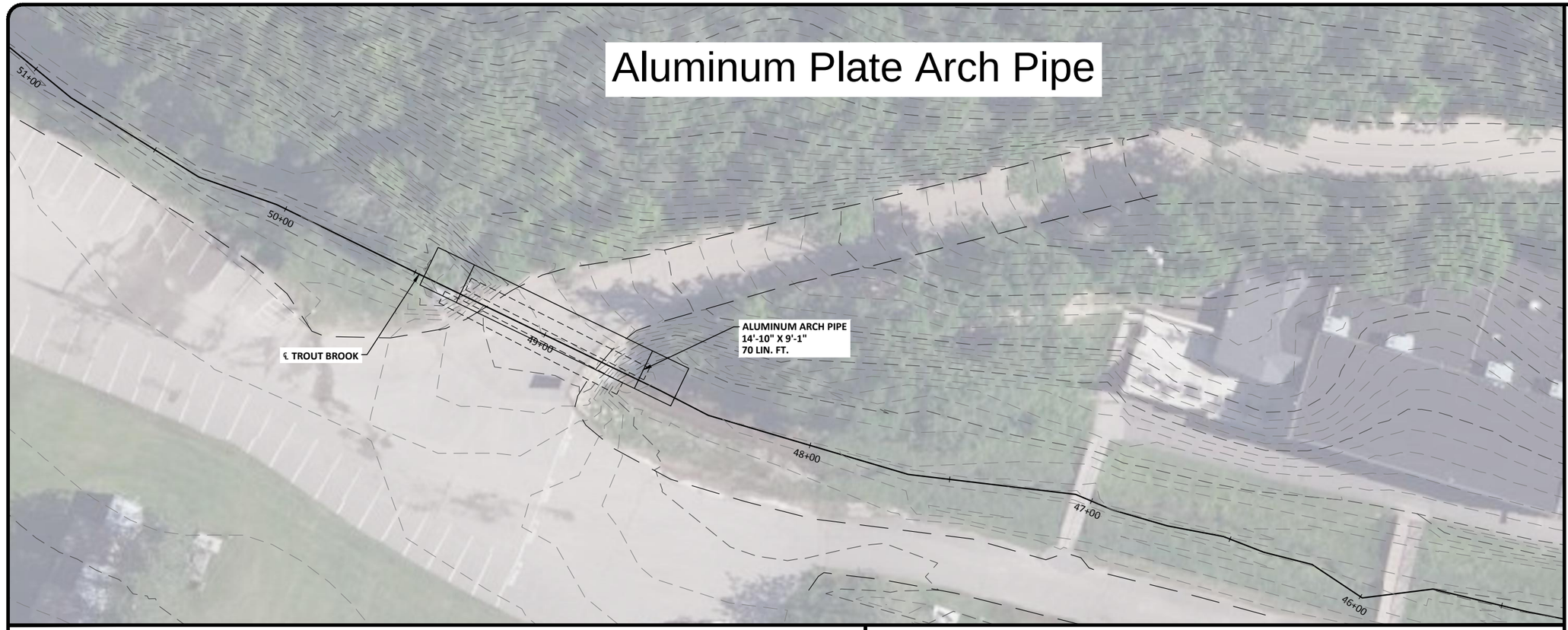
Aluminum Plate Box Culvert

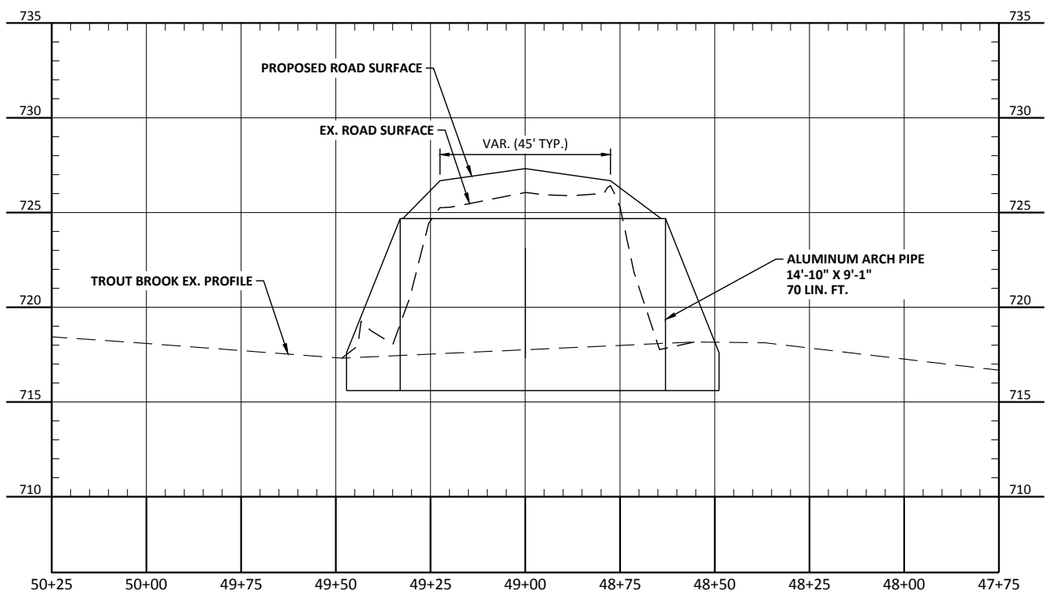
Aluminum Plate Box Culvert				
Items	**Unit**	**Quantity**	**Unit Price**	**Total Price**
Mobilization	LS	1	$ 20,000.00	$ 20,000.00
Dewatering	LS	1	$ 10,000.00	$ 10,000.00
Structure Excavation/Backfill	CY	990	$ 30.00	$ 29,700.00
Channel Excavation/Slope Preparation	CY	100	$ 24.00	$ 2,400.00
Aluminum Box Culvert 16'-8" x 7'-6" (w/End Sections)	LF	74	$ 2,000.00	$ 148,000.00
Random Riprap	CY	65	$ 85.00	$ 5,525.00
Bituminous Pavement (4" Depth)	TON	60	$ 90.00	$ 5,400.00
Aggregate Base (8" Depth)	TON	105	$ 25.00	$ 2,625.00
			Subtotal =	**$ 223,650.00**
			Contingency (15%) =	**$ 33,547.50**
			Estimated Total =	**$ 257,197.50**
			Estimated Range	**$250,000-$275,000**

Precast Concrete Box Culvert

Precast Concrete Box Culvert				
Items	**Unit**	**Quantity**	**Unit Price**	**Total Price**
Mobilization	LS	1	$ 20,000.00	$ 20,000.00
Dewatering	LS	1	$ 10,000.00	$ 10,000.00
Structure Excavation/Backfill	CY	925	$ 20.00	$ 18,499.65
Channel Excavation/Slope Preparation	CY	100	$ 24.00	$ 2,400.00
Precast Concrete Box Culvert 16' x 7'	LF	68	$ 1,400.00	$ 95,200.00
Precast Concrete Box Culvert End Sections	EA	2	$ 18,000.00	$ 36,000.00
Random Riprap	CY	65	$ 85.00	$ 5,525.00
Bituminous Pavement (4" Depth)	TON	60	$ 90.00	$ 5,400.00
Aggregate Base (8" Depth)	TON	105	$ 25.00	$ 2,625.00
			Subtotal =	**$ 195,649.65**
			Contingency (15%) =	**$ 29,347.45**
			Estimated Total =	**$ 224,997.10**
			Estimated Range	**$210,000-$235,000**

Aluminum Plate Arch Pipe





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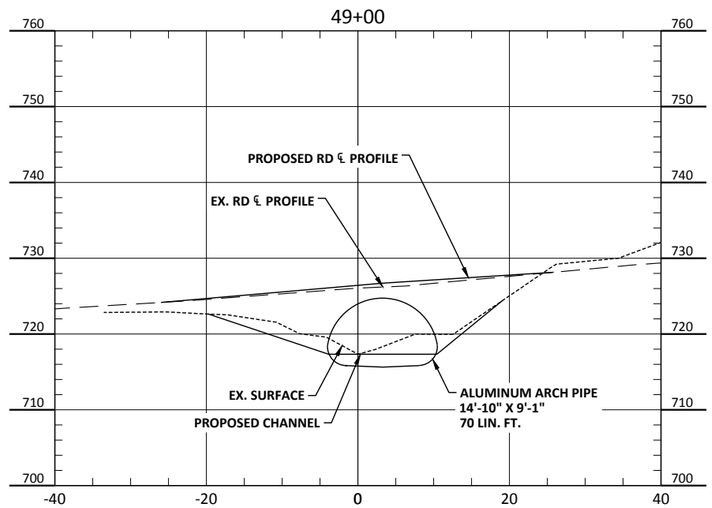

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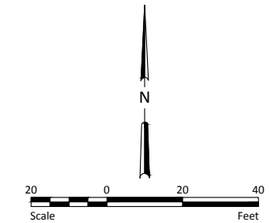

PRELIMINARY
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No.	Revision	Date	By

HOUSTON engineering, inc.

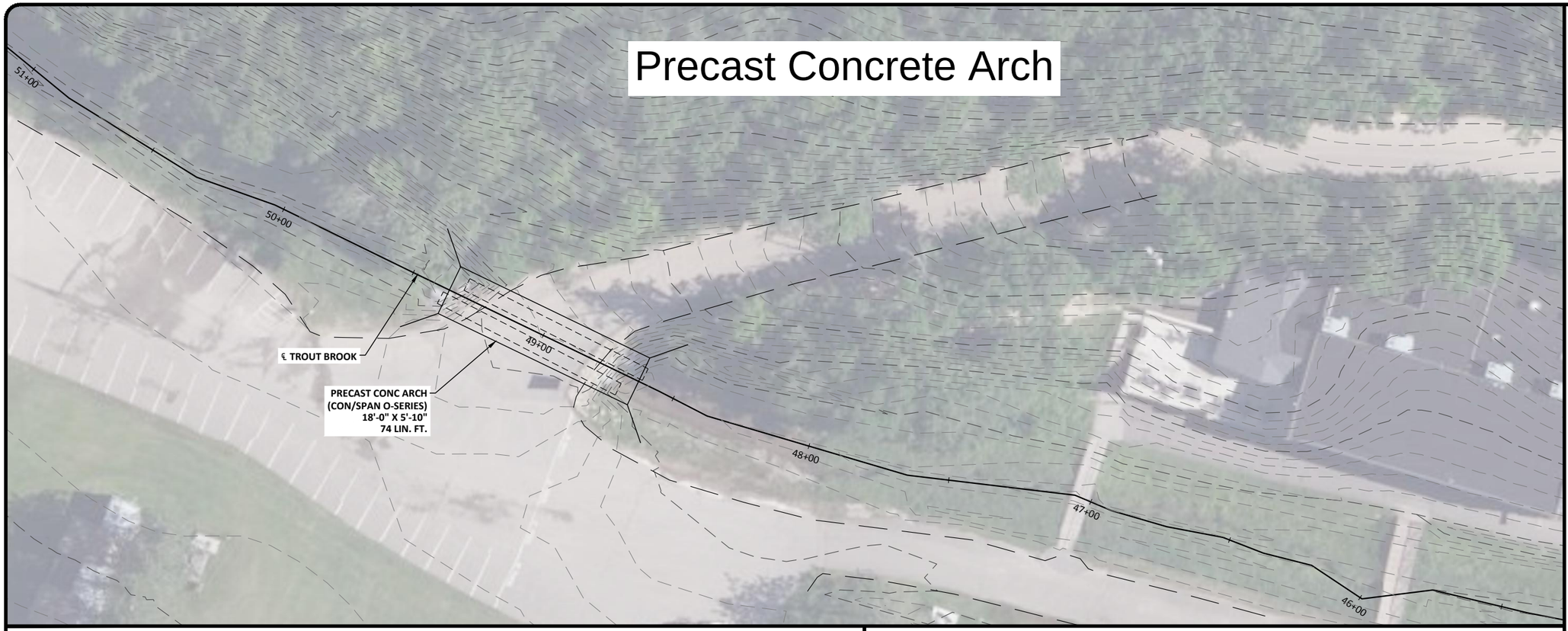
Drawn by	Date
DJK	1-3-2022
Checked by	Scale
WJK	AS SHOWN

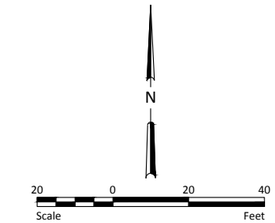
TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

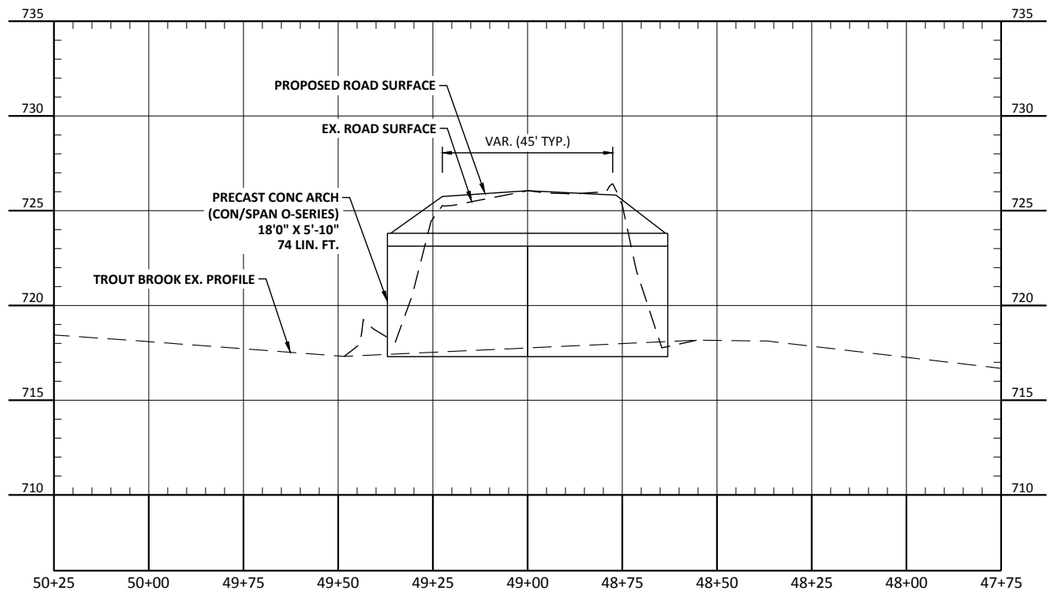
ALUMINUM ARCH PIPE
14'-10" X 9'-1"

SHEET
1

Precast Concrete Arch







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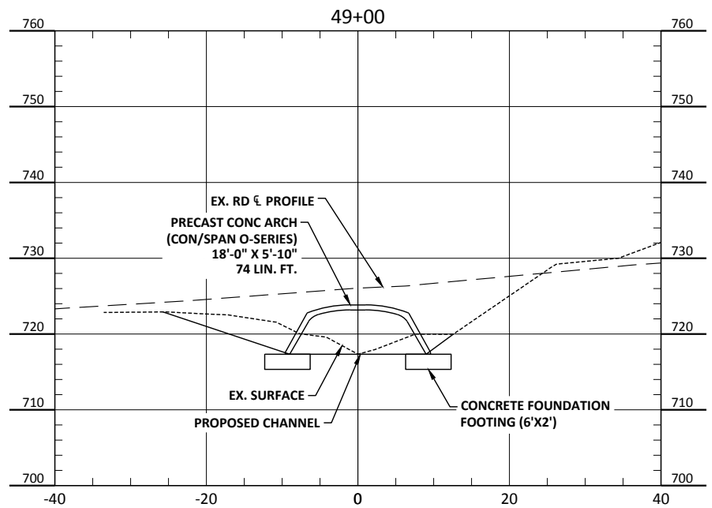

CHANNEL SECTION

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NOT FOR CONSTRUCTION

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WJK	AS SHOWN

TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

PRECAST CONC ARCH
(CON/SPAN O-SERIES)
18'-0" X 5'-10"

SHEET
1

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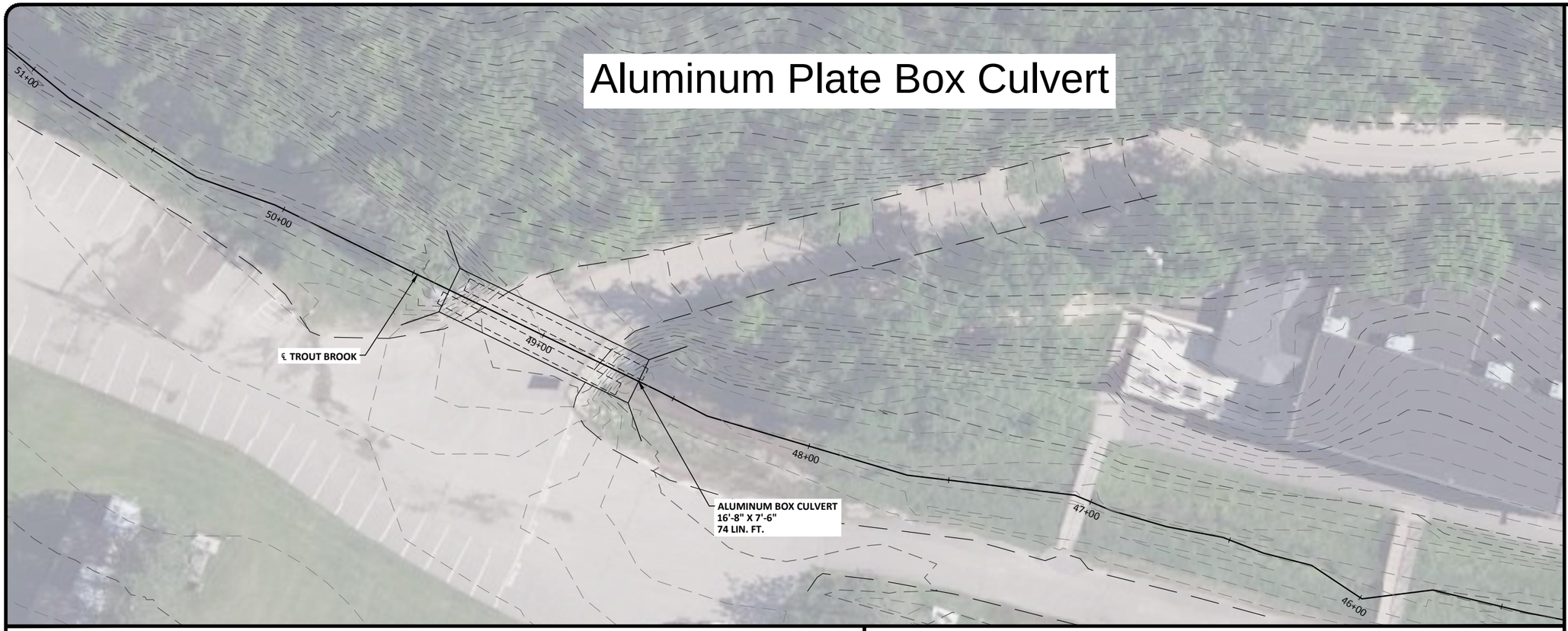
Aluminum Plate Box Culvert



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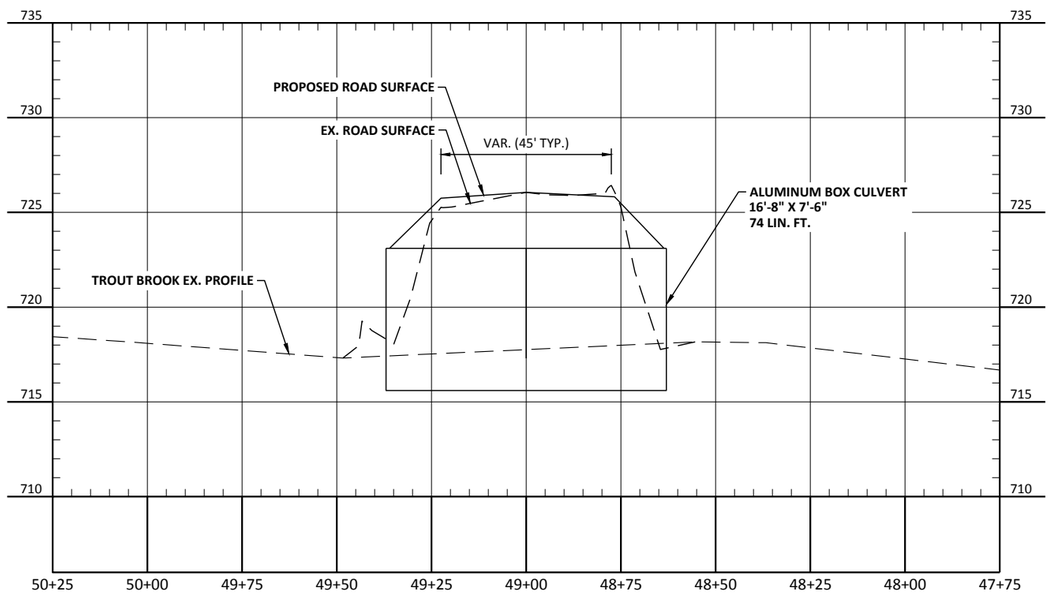

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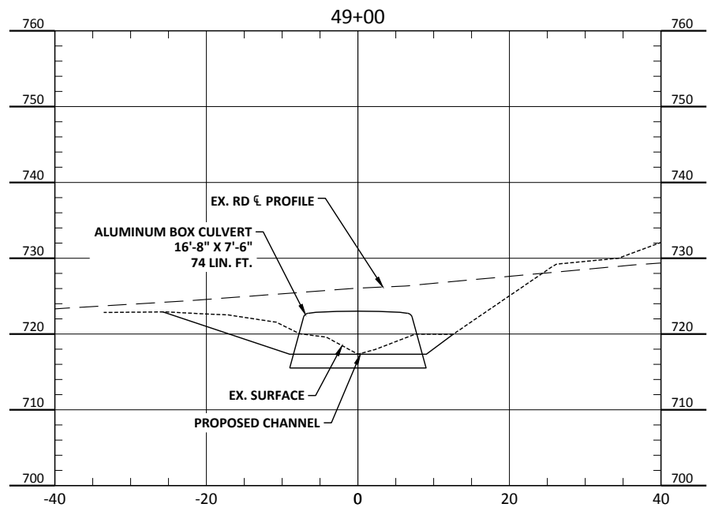

CHANNEL SECTION

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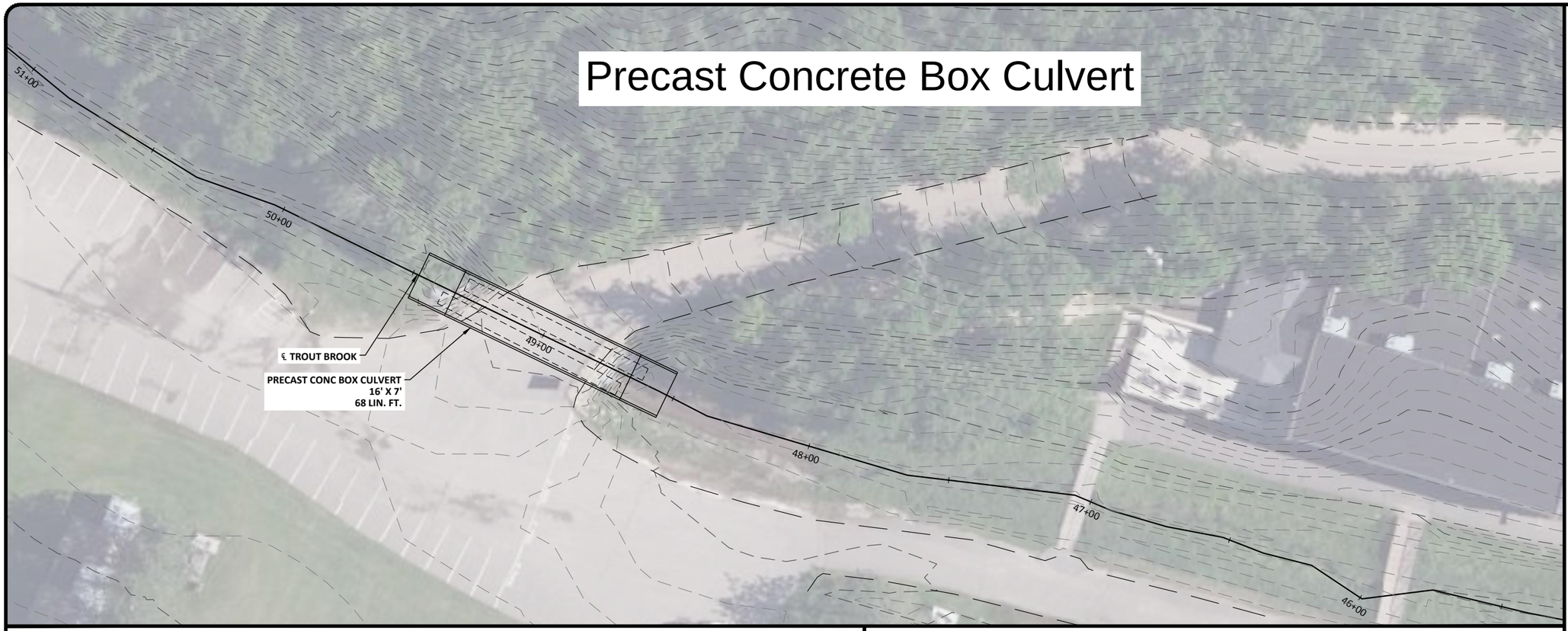
TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

ALUMINUM BOX CULVERT
16'-8" X 7'-6"

SHEET
1

Precast Concrete Box Culvert



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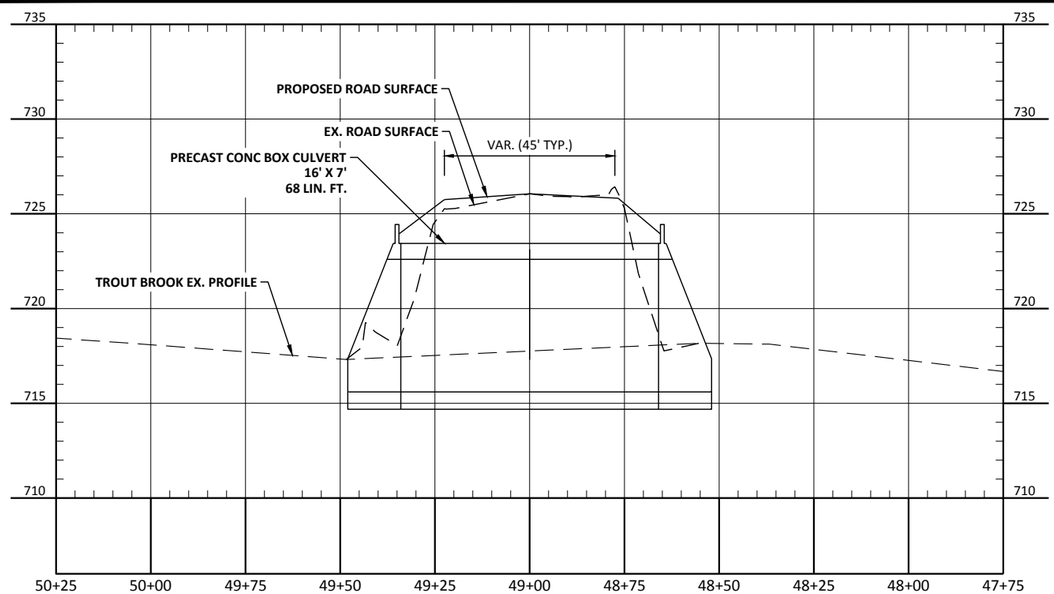

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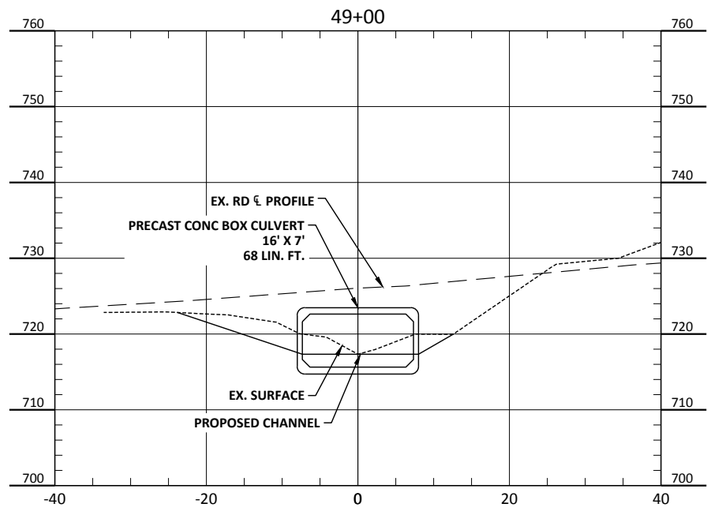

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TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

PRECAST CONCRETE
BOX CULVERT
16' X 7'

SHEET
1

APPENDIX E – PRELIMINARY OPINION OF PROBABLE CONSTRUCTION COST

TROUT BROOK PHASE III - 30% DESIGN

SOUTH WASHINGTON WATERSHED DISTRICT

No.	Item	Unit	Quantity	Unit Price	Total Costs
1	Mobilization	LS	1	$ 75,000.00	$ 75,000.00
2	Control of Water	LS	1	$ 35,000.00	$ 35,000.00
3	Clearing, Grubbing, and Brush Removal	Acre	1.95	$ 12,000.00	$ 23,400.00
4	Common Embankment (CV)	CY	685	$ 8.00	$ 5,480.00
5	Common Excavation (CV)	CY	7,535	$ 8.00	$ 60,280.00
6	Haul Off site	CY	6,850	$ 18.00	$ 123,300.00
7	Topsoil stripping, stockpiling, and respread	CY	1,573	$ 6.00	$ 9,438.00
8	Boulders (18-30 inches)	CY	20.00	$ 175.00	$ 3,500.00
9	Rock Bedding	CY	198	$ 85.00	$ 16,830.00
10	Cobble	CY	151	$ 125.00	$ 18,812.50
11	Random Riprap Class II	CY	602	$ 100.00	$ 60,200.00
12	perforated pipe drain	LF	80.00	$ 30.00	$ 2,400.00
13	Sod Mat	SY	40	$ 10.00	$ 400.00
14	Woody Debris Riffle	Each	2.00	$ 2,800.00	$ 5,600.00
15	Large wood (rootwad) on site, install only	Each	55.00	$ 470.00	$ 25,850.00
16	Large wood (log) on site install only	Each	5.00	$ 350.00	$ 1,750.00
17	Large wood (pile) on site, install only	Each	5.00	$ 838.00	$ 4,190.00
18	Seeding and Mulching "Cover Crop Seed Mix"	Acre	1.95	$ 550.00	$ 1,072.50
19	Seeding and Mulching "Riparian Seed Mix"	Acre	0.95	$ 1,600.00	$ 1,520.00
20	Seeding and Mulching "Mesic Prairie Seed Mix"	Acre	1.00	$ 1,600.00	$ 1,600.00
21	Trees	Each	52.00	$ 400.00	$ 20,800.00
22	Planting - shrub	Each	540.00	$ 60.00	$ 32,400.00
23	Erosion control blanket, category 3N	SY	900.00	$ 3.00	$ 2,700.00
24	Hydraulic Matrix, Fiber Bonded Hydro-mulch	SY	2,050.00	$ 3.00	$ 6,150.00
25	Machine sliced silt fence	LF	1,200.00	$ 2.50	$ 3,000.00
26	Ditch check	Each	2.00	$ 1,400.00	$ 2,800.00
27	Bioroll	LF	750	$ 5.00	$ 3,750.00
28	Structure Excavation / Backfill	CY	950	$ 35.00	$ 33,250.00
29	Coarse Aggregate Bedding (CV)	CY	175	$ 55.00	$ 9,625.00
30	Precast Concrete Box Culvert (16'x 7')	CL	68	$ 1,400.00	$ 95,200.00
31	Precast Concrete Box Culvert End Sections	Each	2	$ 18,000.00	$ 36,000.00
32	Random Riprap	CY	90	$ 120.00	$ 10,800.00
33	Bituminous Pavement (4" Depth)	Ton	100	$ 90.00	$ 9,000.00
34	Aggregate Base	Ton	170	$ 25.00	$ 4,250.00
	Stream Construction Costs				$ 519,723.00
	Structure Construction Costs				$ 225,625.00
PROJECT CONSTRUCTION COSTS					**$ 745,348.00**
	Contingency (20%)				$ 149,069.60
TOTAL PROJECT CONSTRUCTION COSTS with Contingency (~20%)					**$ 894,400.00**
	Engineering and Construction Management				$ 337,500.00
	Legal and Administrative Costs (5%)				$ 44,700.00
TOTAL PROJECT COSTS					**$ 1,276,600.00**

Appendix B: Construction Plans for SWWD, Trout Brook Restoration Phase 3

CONSTRUCTION PLANS FOR

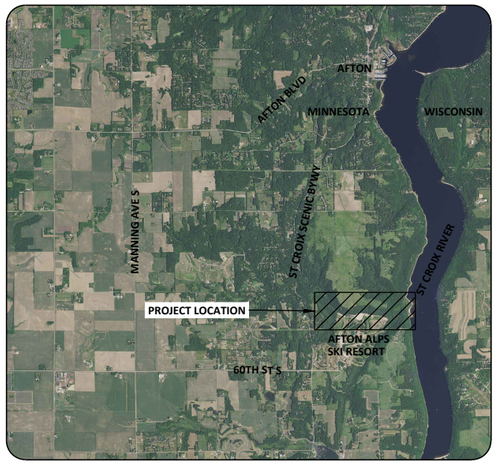
SOUTH WASHINGTON WATERSHED DISTRICT
TROUT BROOK RESTORATION PHASE 3

AFTON ALPS, MN

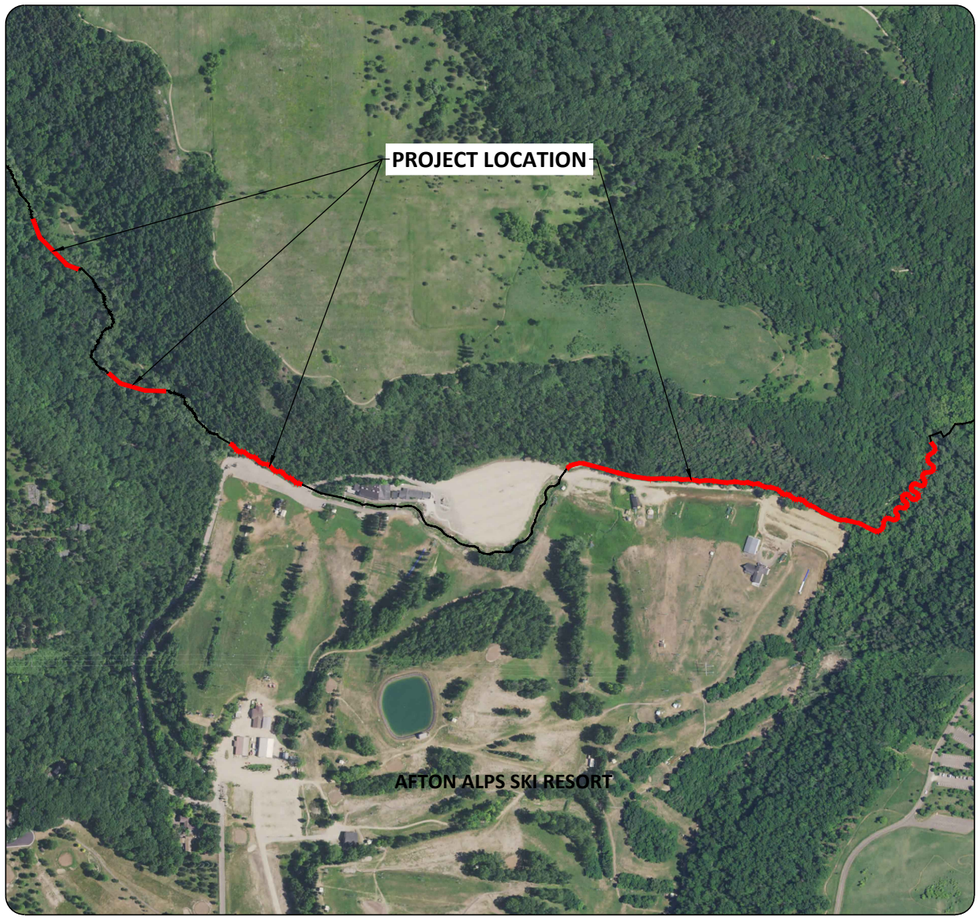
JANUARY, 2022

HOUSTON engineering, inc.
7550 MERIDIAN CIR N
SUITE 120
MAPLE GROVE, MN 55369
P: 763.493.4522
T: 1.866.319.2040
www.houstoneng.com

SHEET INDEX



VICINITY MAP

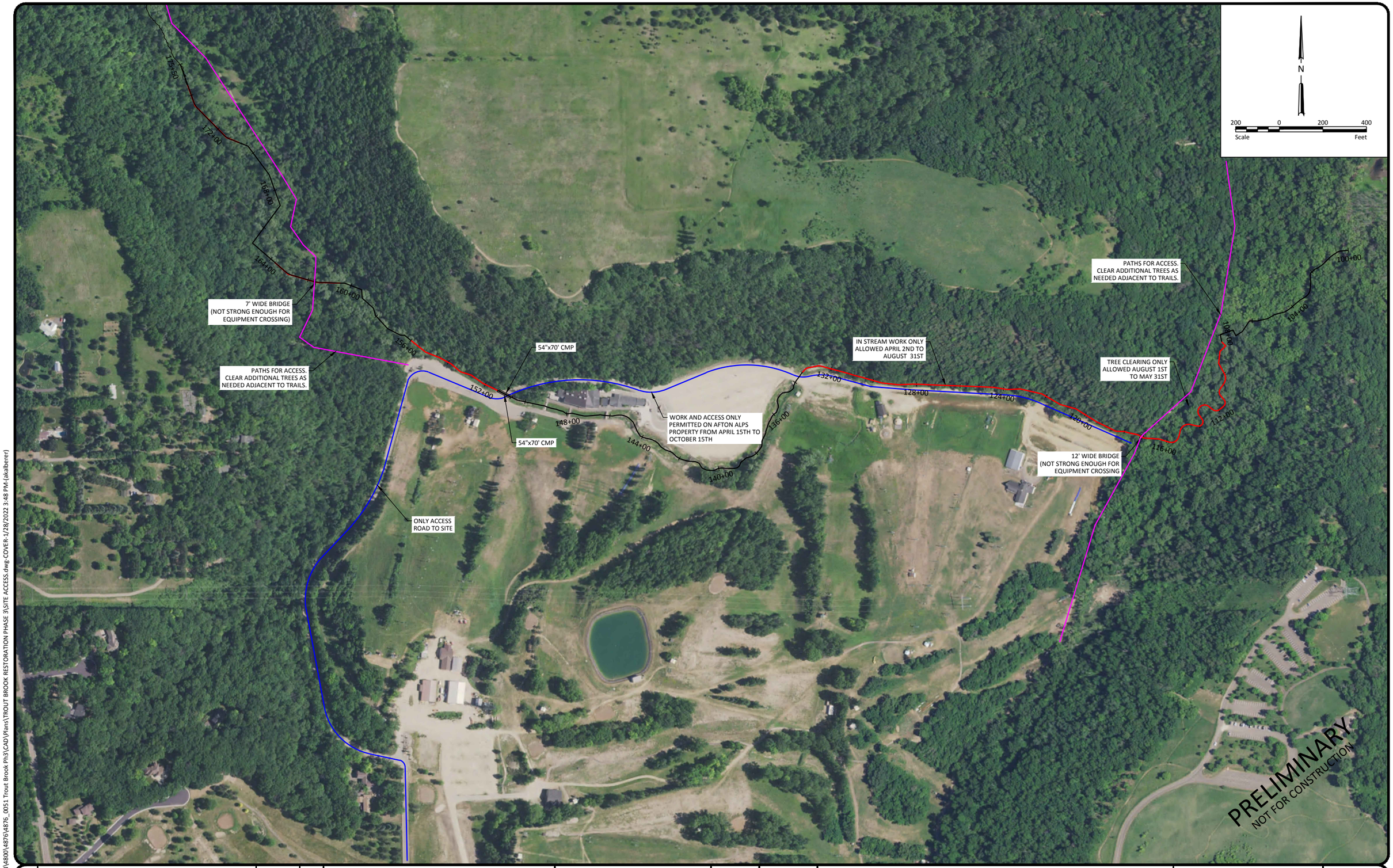


LOCATION MAP

VERTICAL DATUM: NAVD 1988
HORIZONTAL DATUM: NAD 1983

PRELIMINARY
NOT FOR CONSTRUCTION

Project No. 4876-0051



No.	Revision	Date	By

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Checked by	TDR	Scale	AS SHOWN

TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

SITE ACCESS AND STAGING
PROJECT NO. 4876-0051

SHEET 2

HEI NO. 4876-0051

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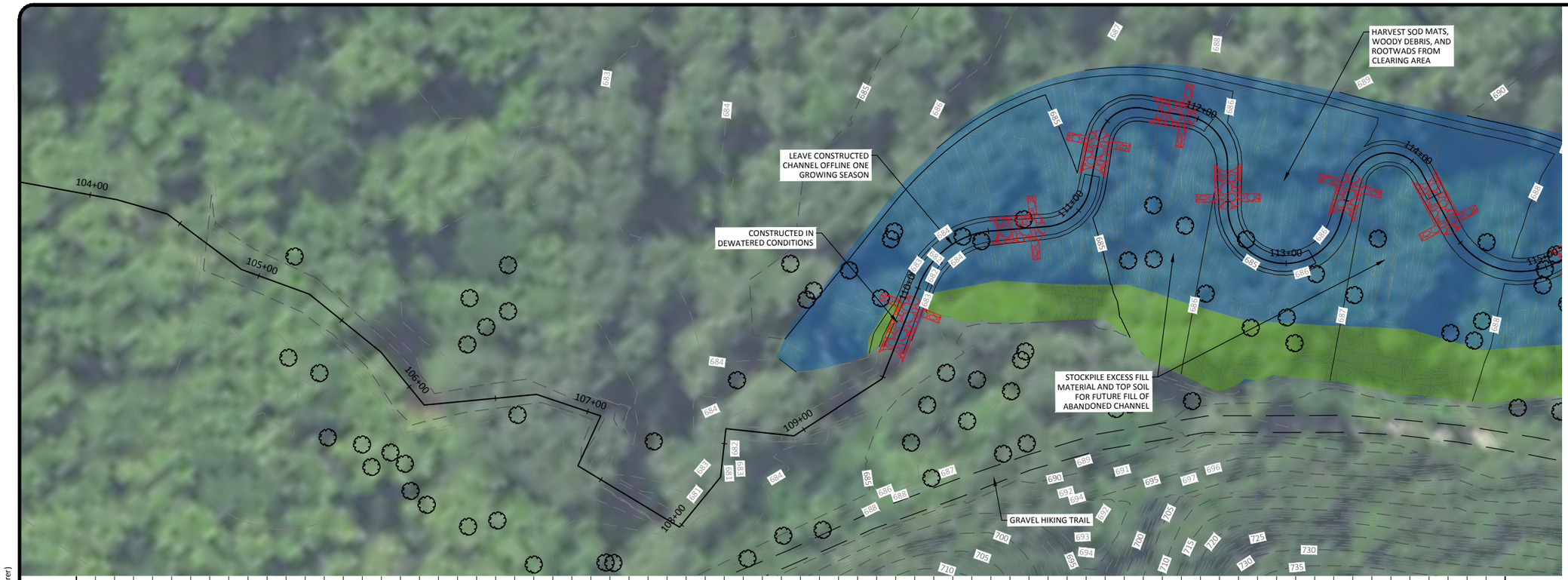

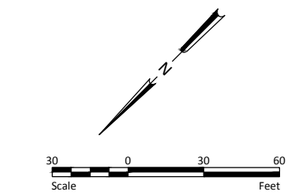

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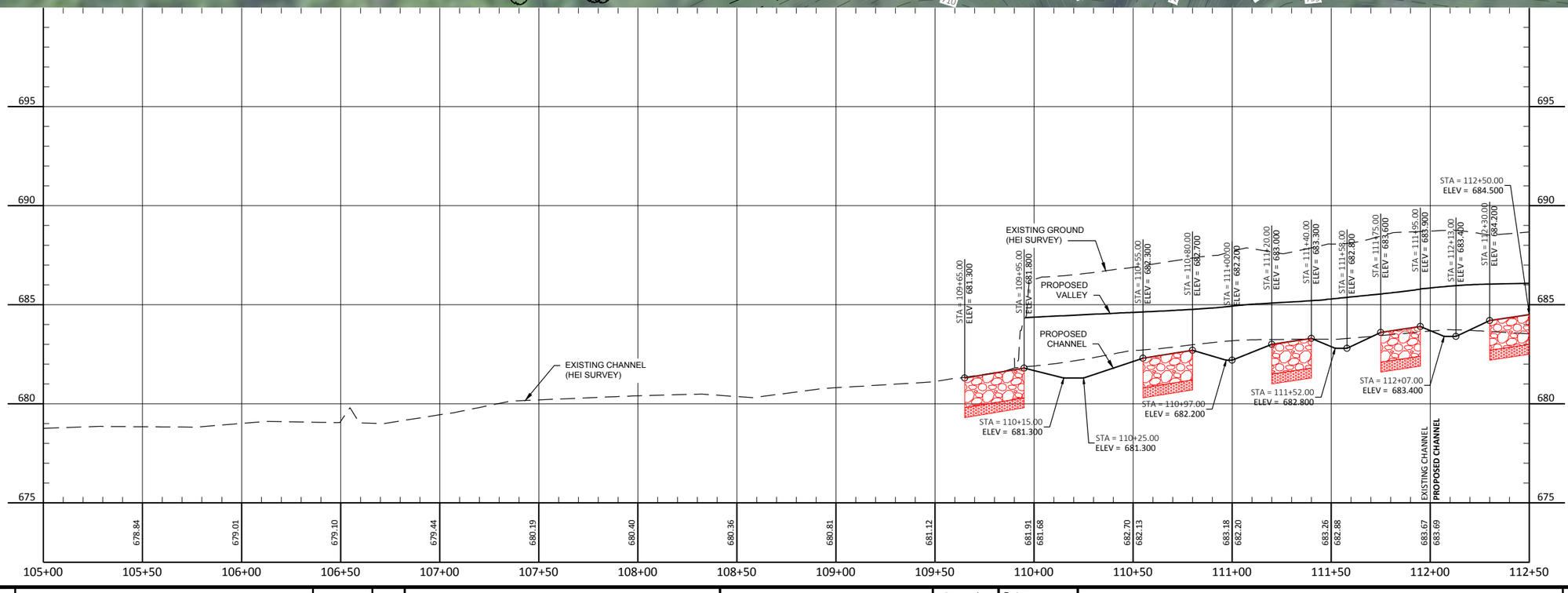
- EXCAVATION/CLEARING AREA



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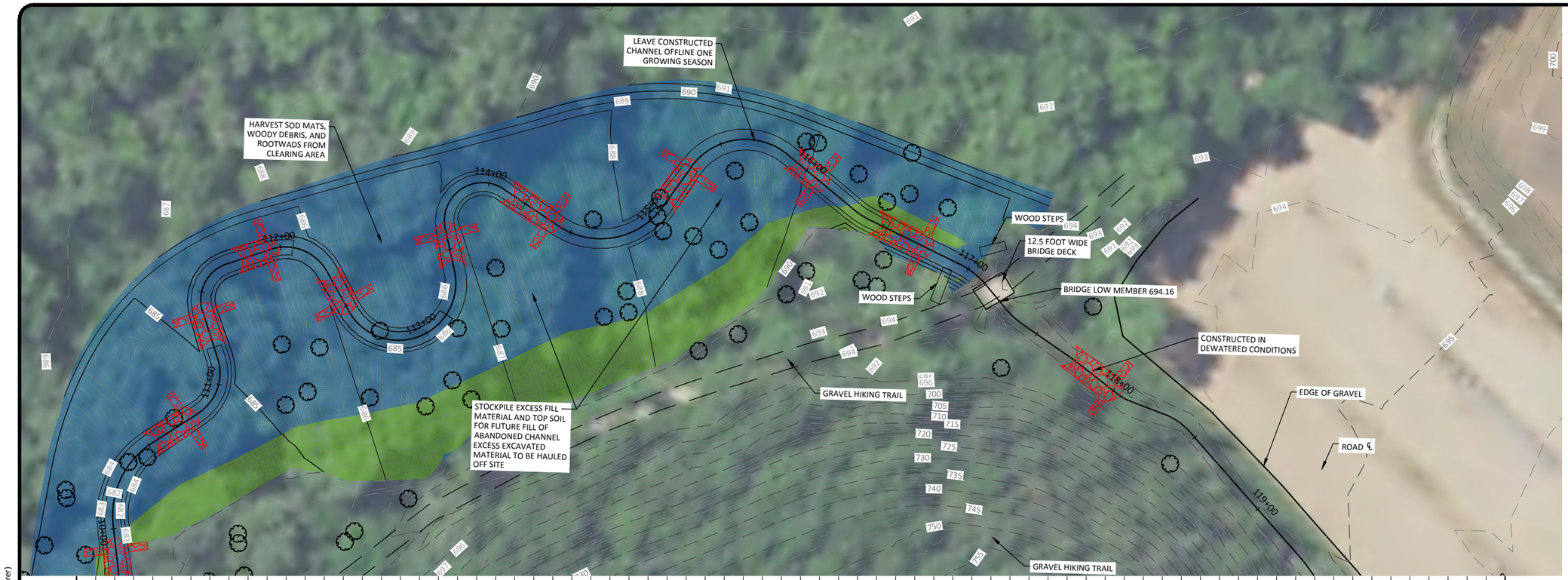
TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

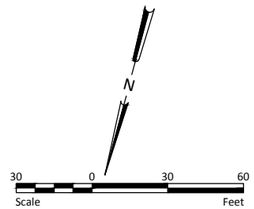
PLAN AND PROFILE

PROJECT NO. 4876-0051

SHEET 3

HEI NO. 4876-0051





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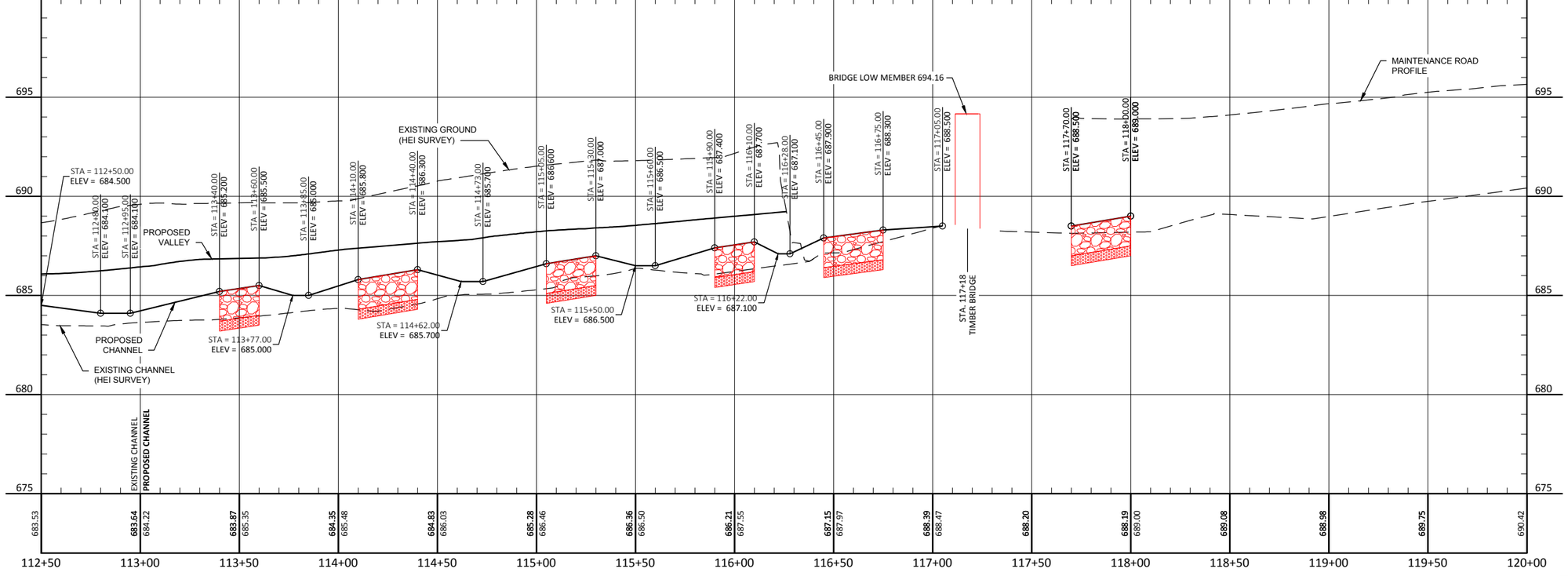

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TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

PLAN AND PROFILE

PROJECT NO. 4876-0051

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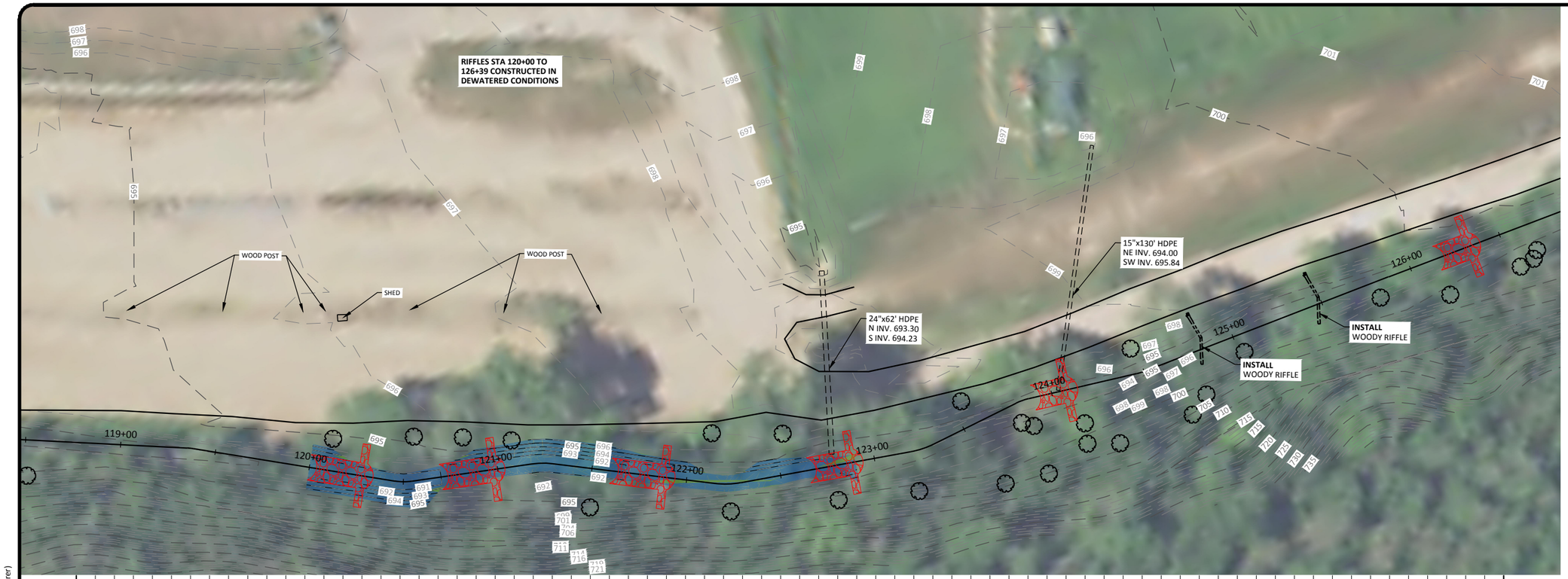

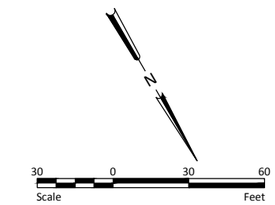

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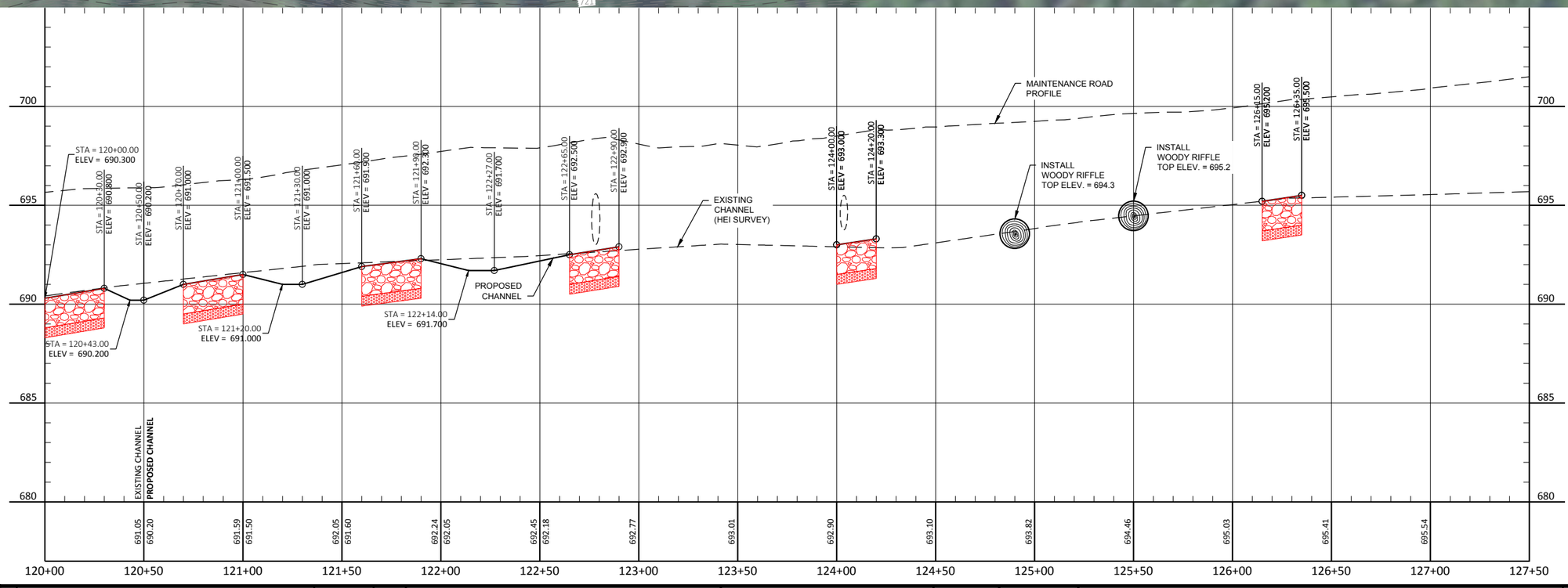

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TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

PLAN AND PROFILE

PROJECT NO. 4876-0051

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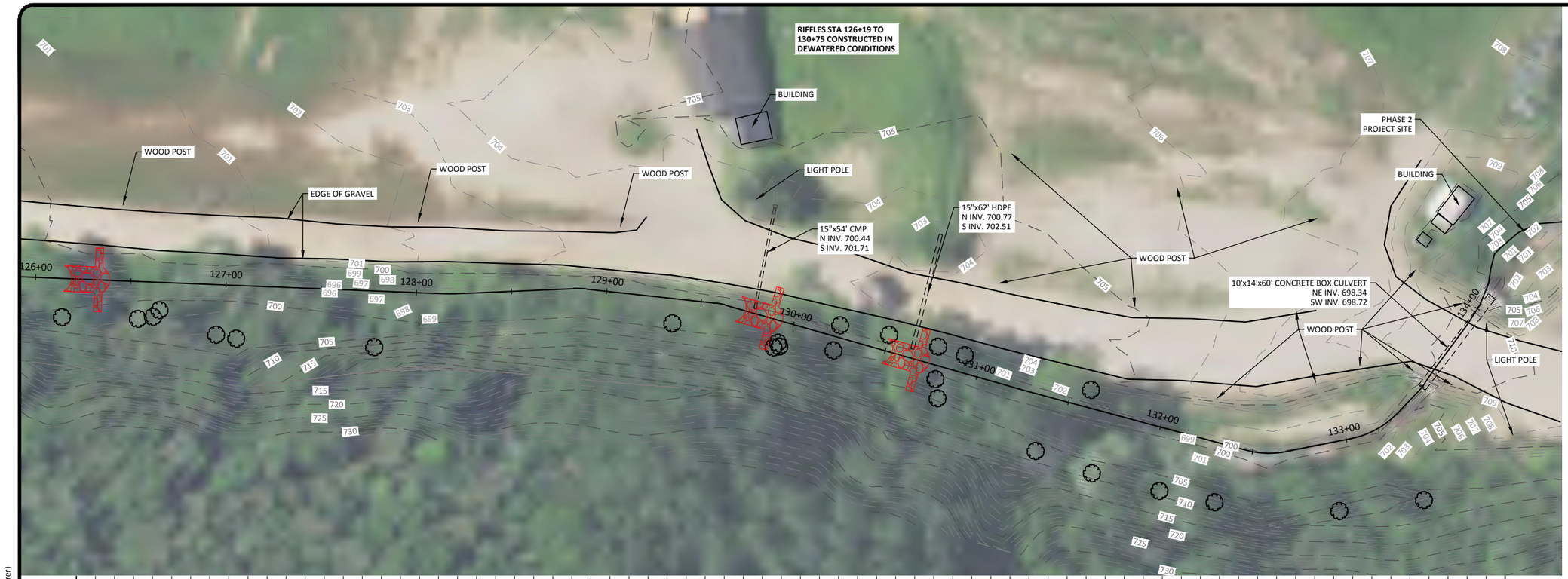

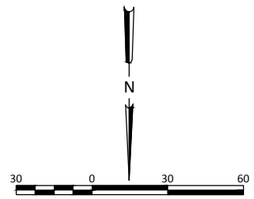

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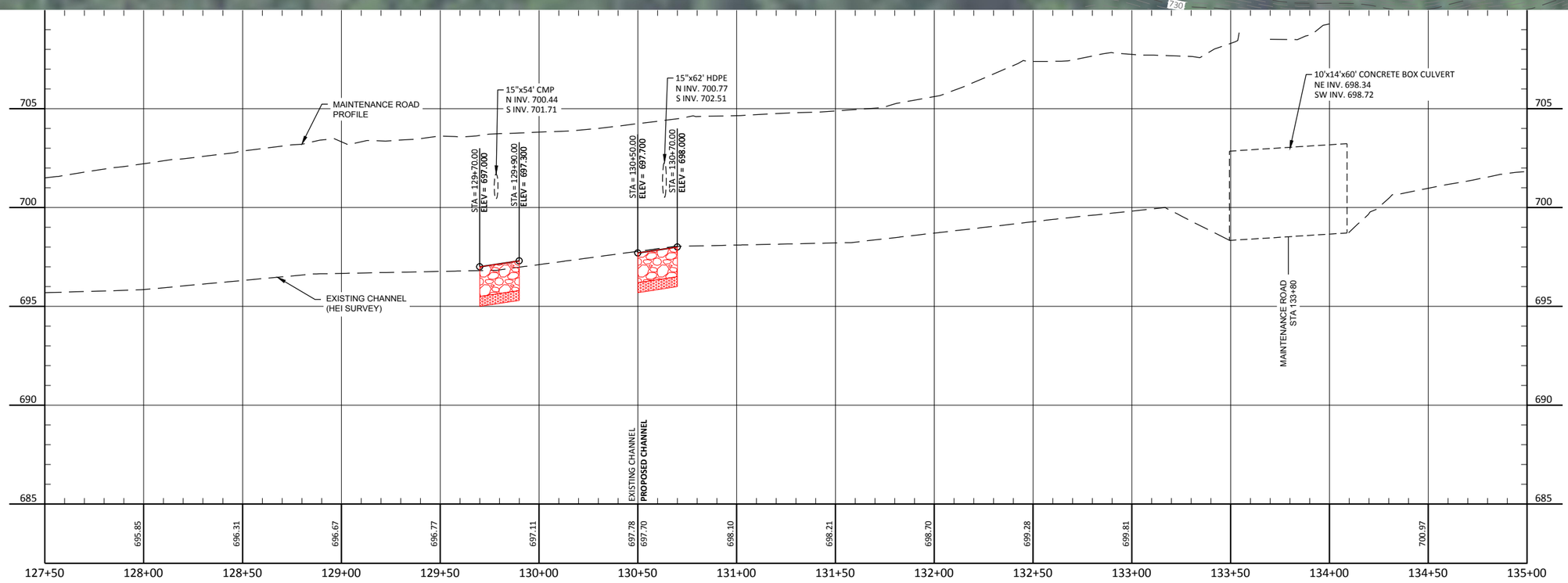

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TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

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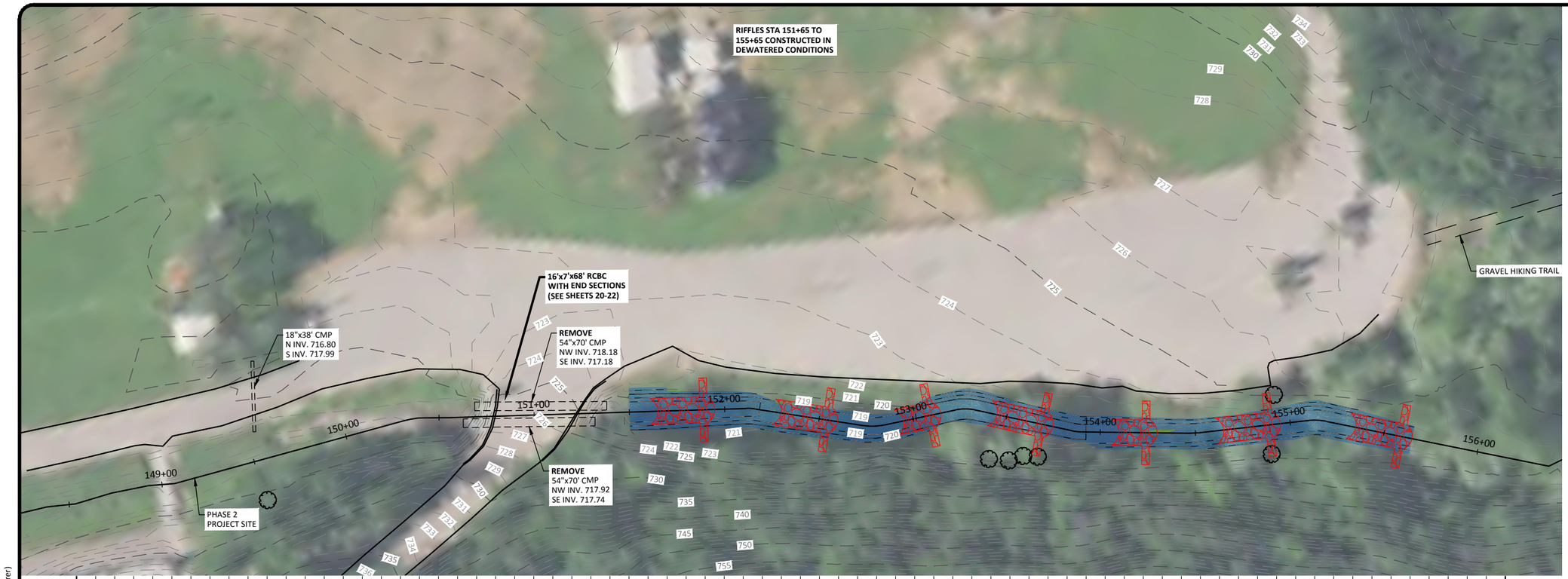

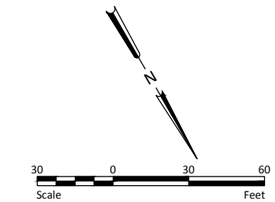

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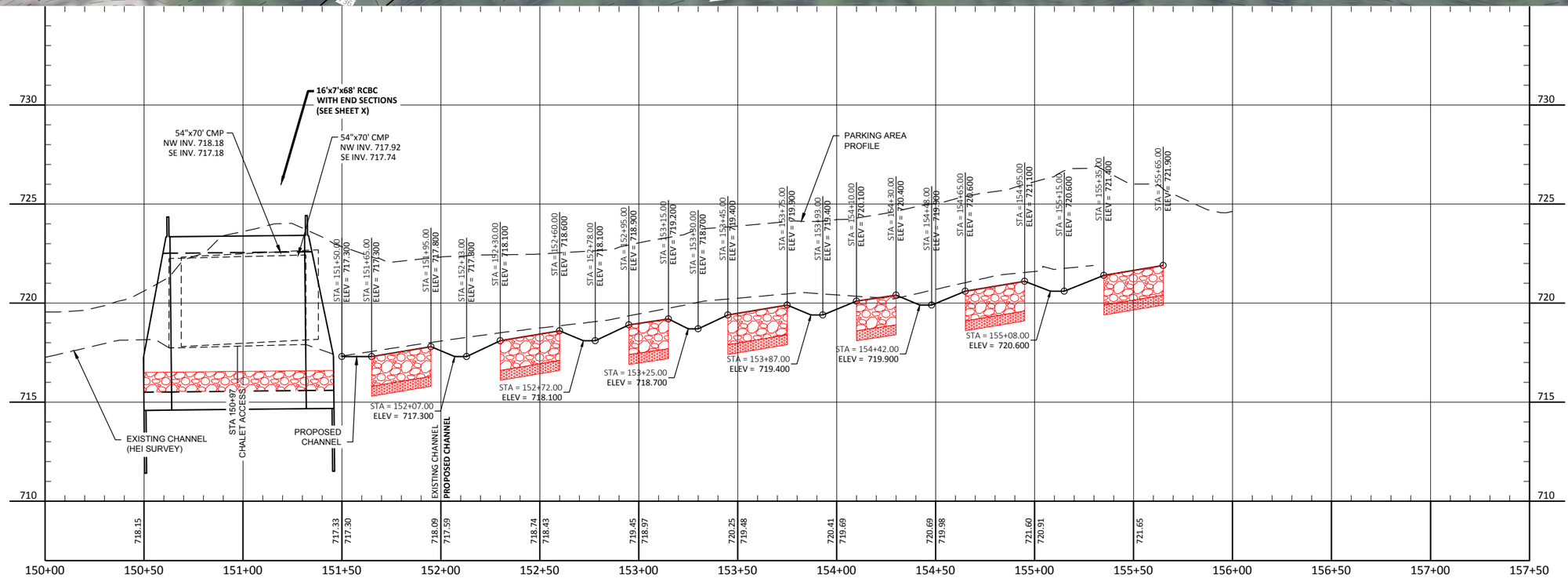

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TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

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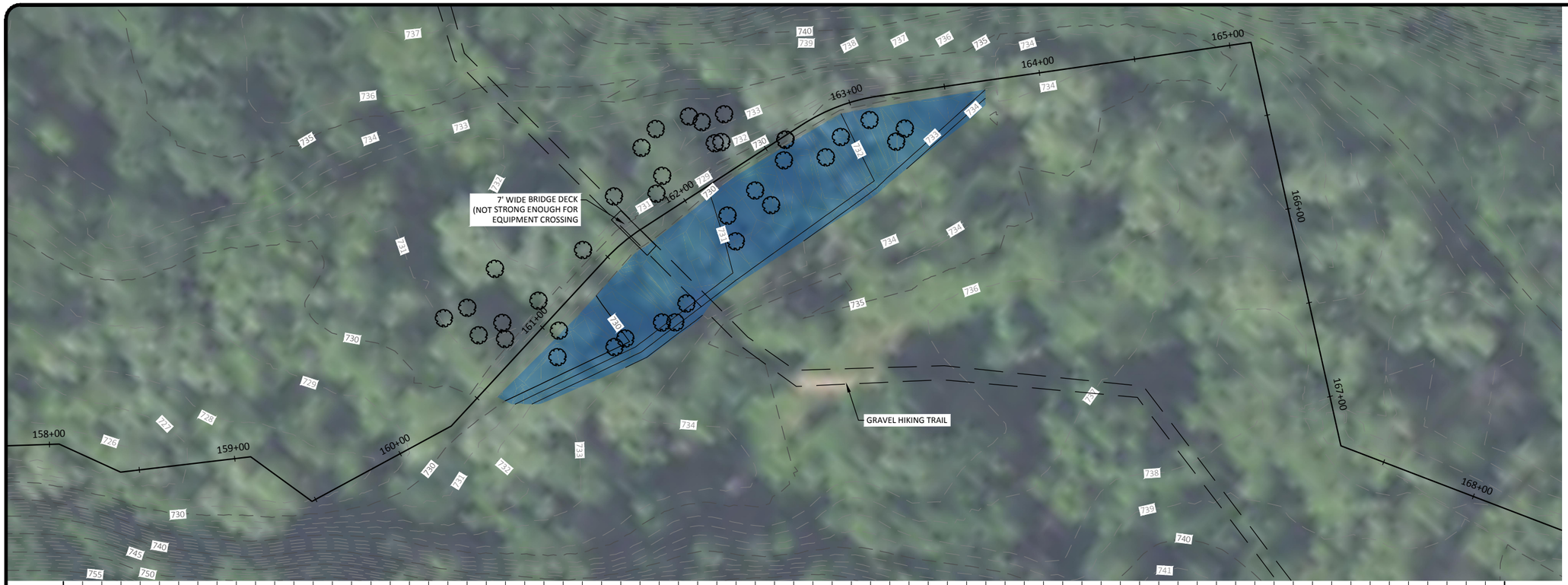

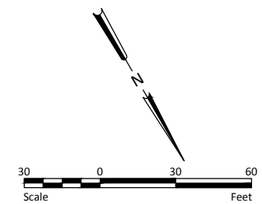

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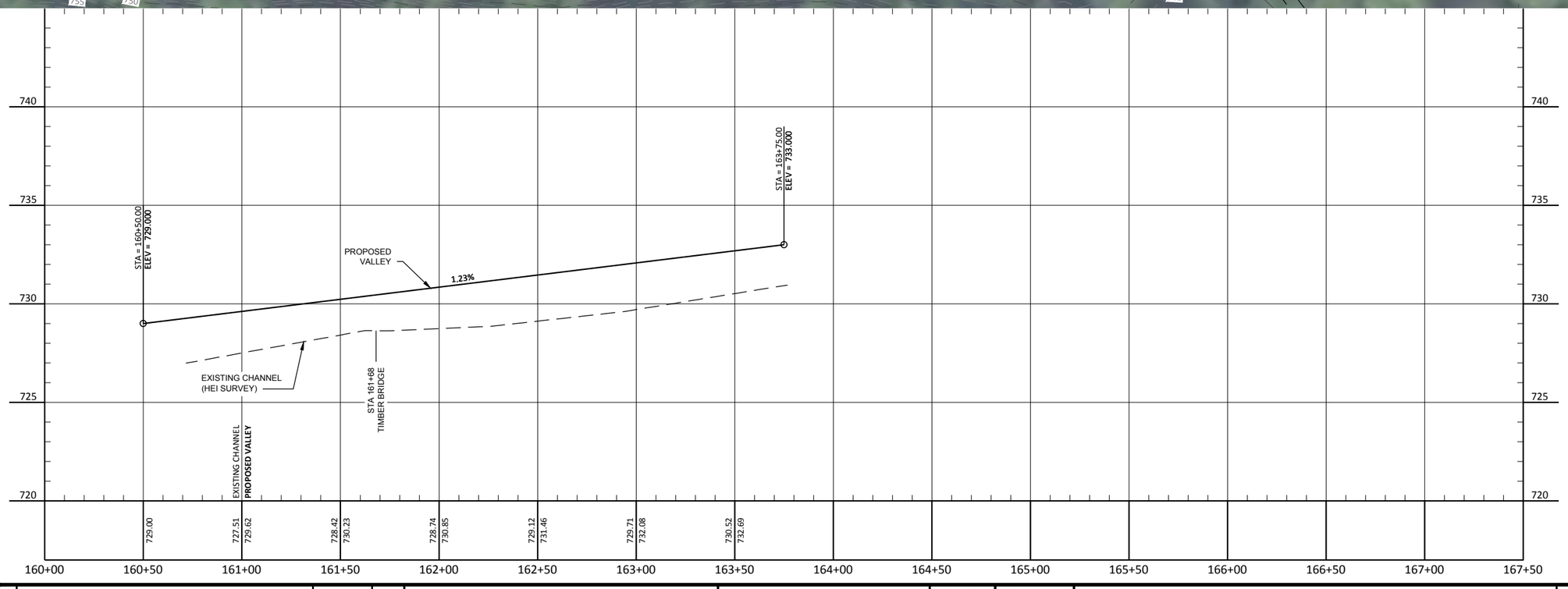

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TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

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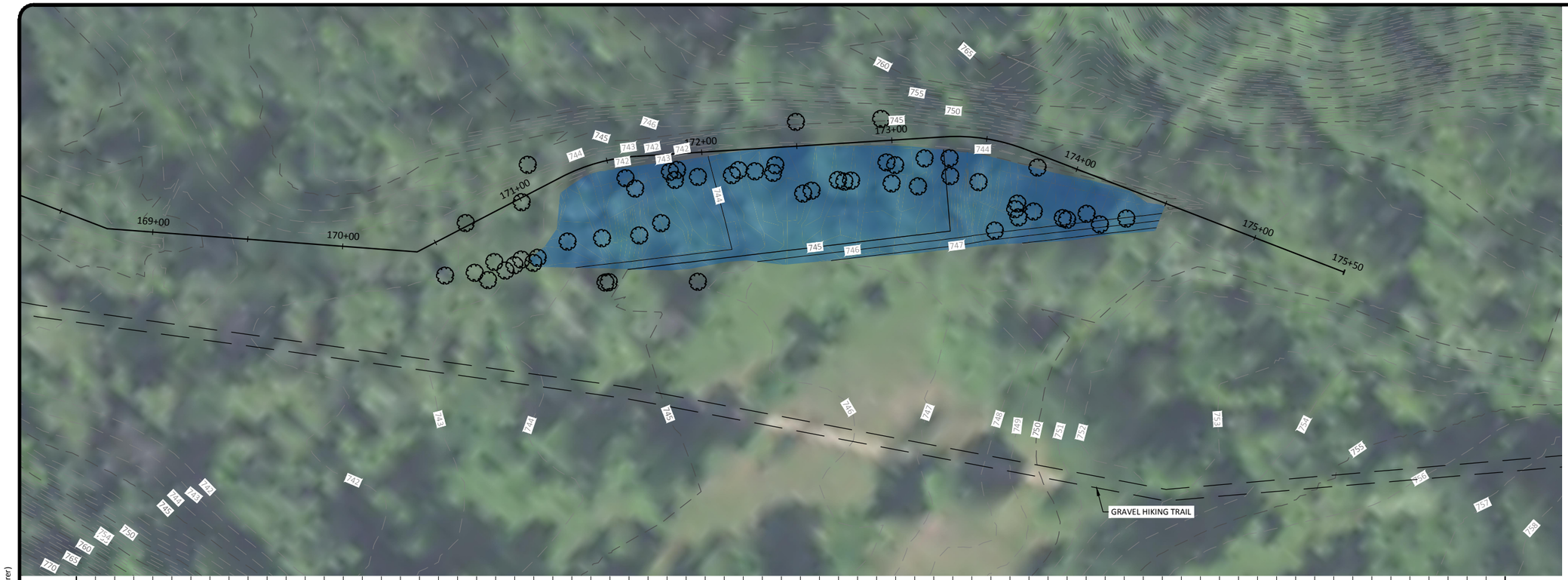

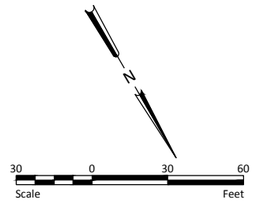

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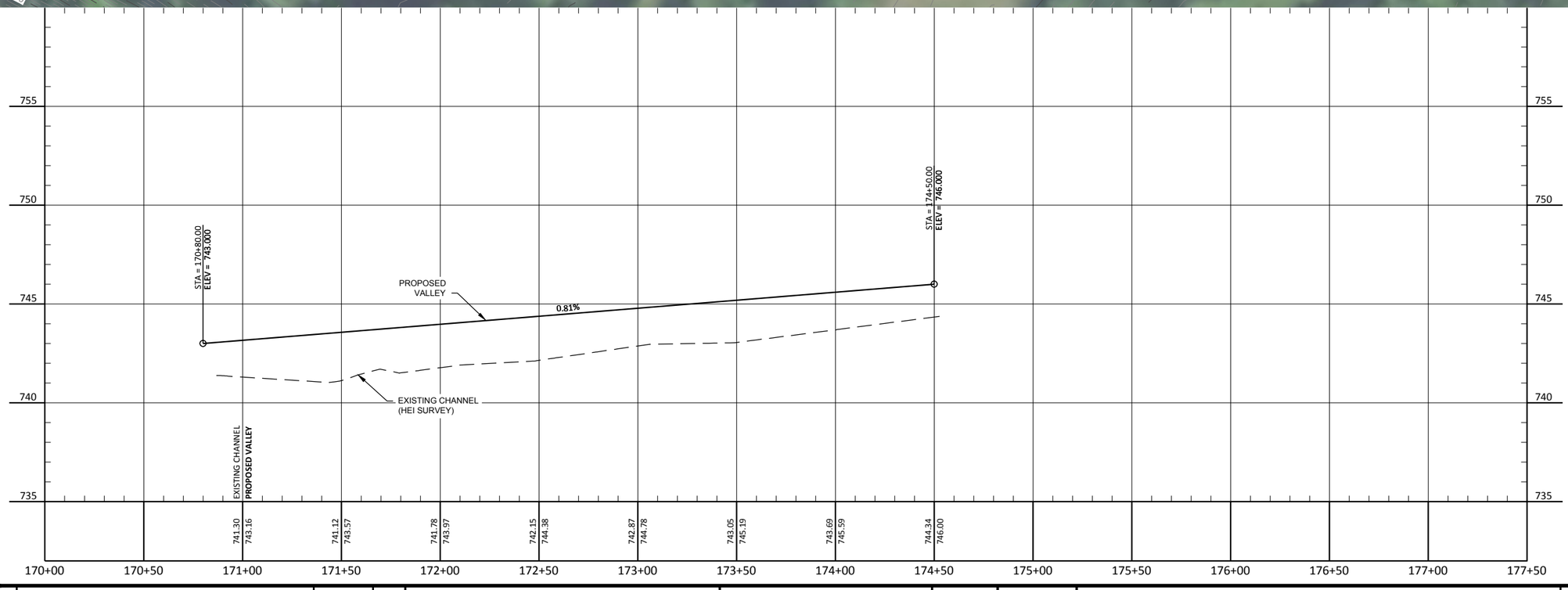

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TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

PLAN AND PROFILE

PROJECT NO. 4876-0051

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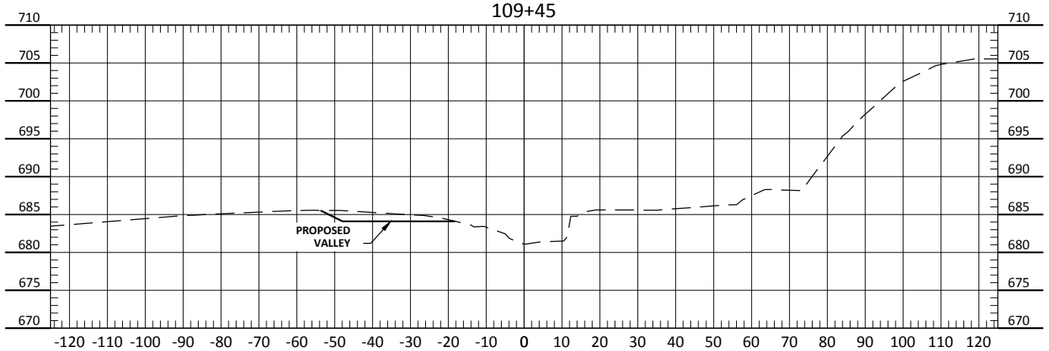

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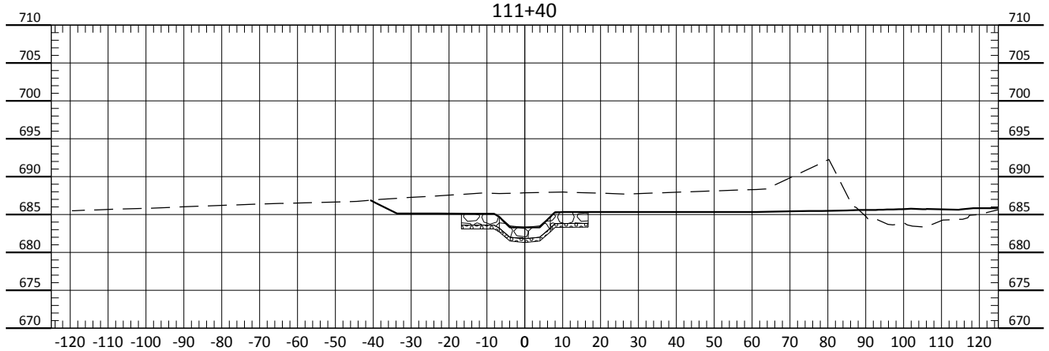

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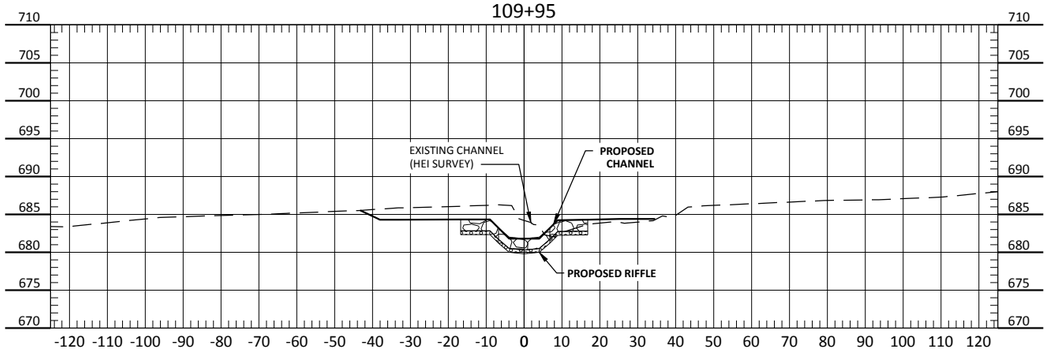

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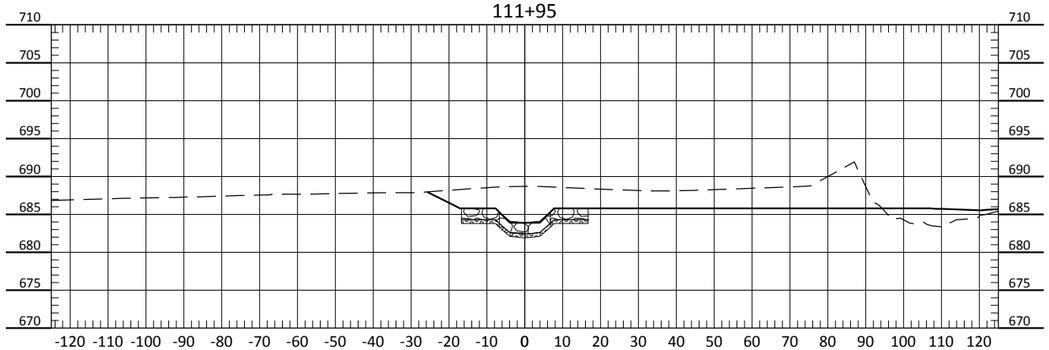

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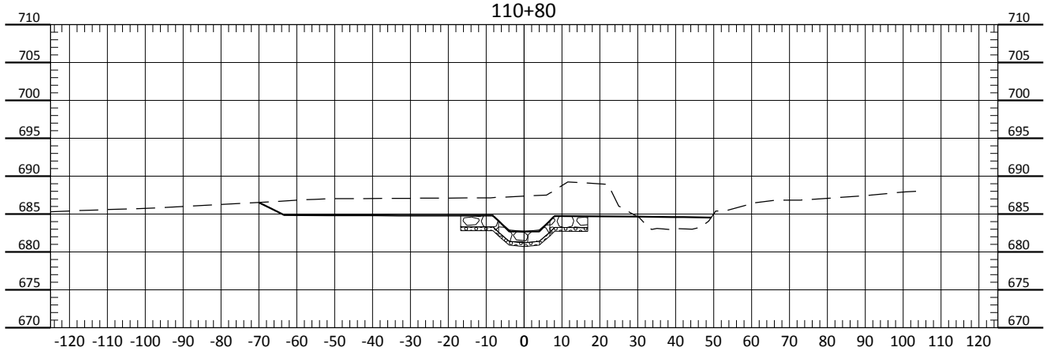

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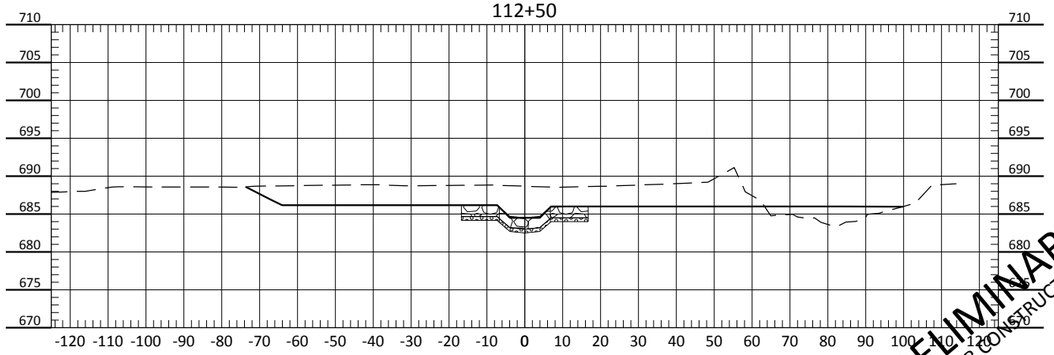

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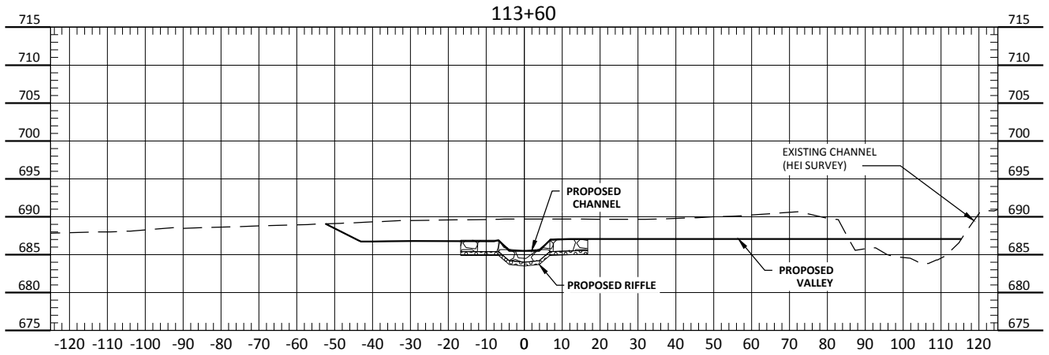
TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

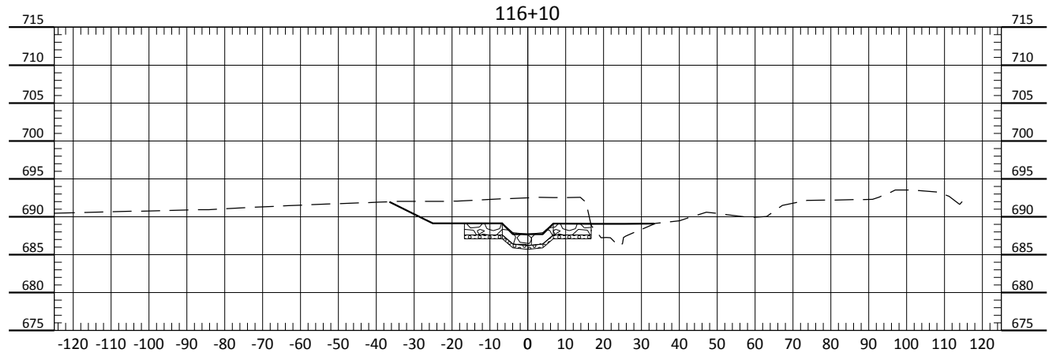
CROSS SECTIONS

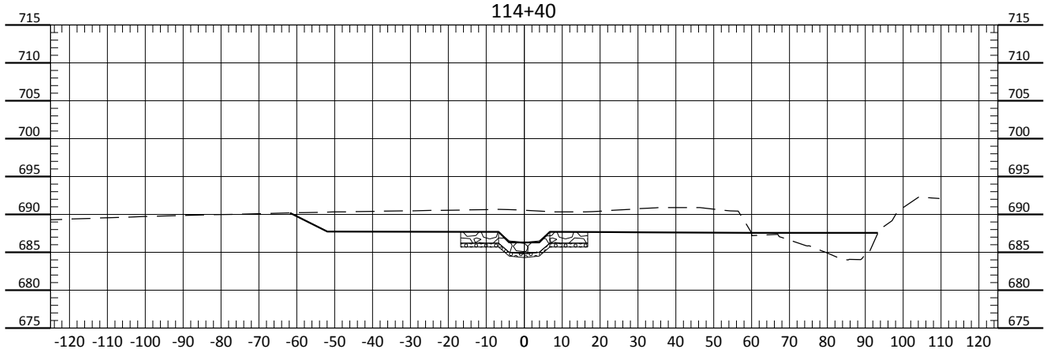
PROJECT NO. 4876-0051

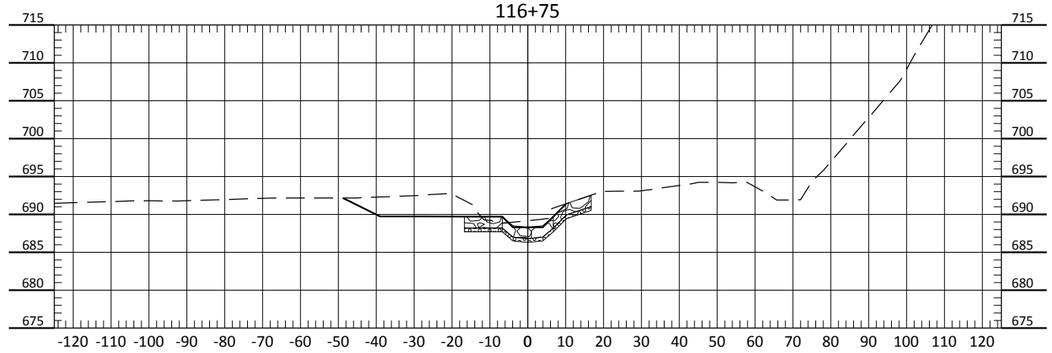
SHEET 10

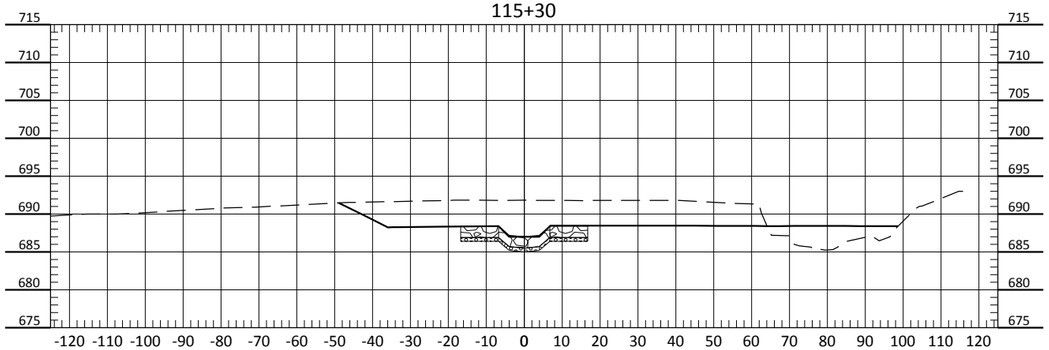
HEI NO. 4876-0051

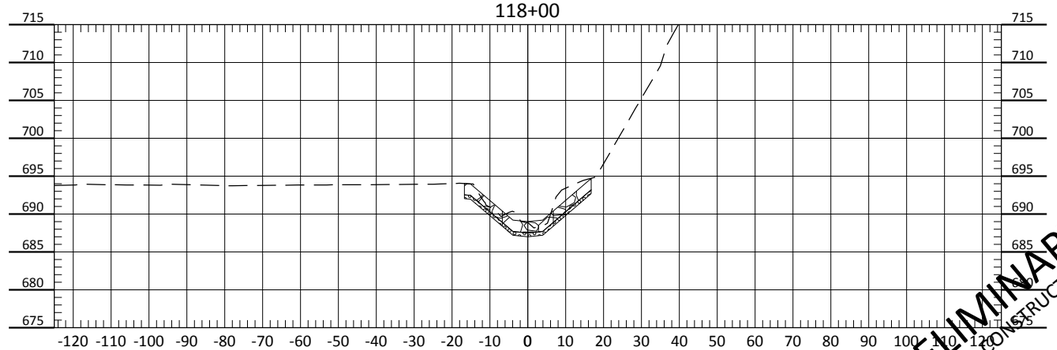












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TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

CROSS SECTIONS

PROJECT NO. 4876-0051

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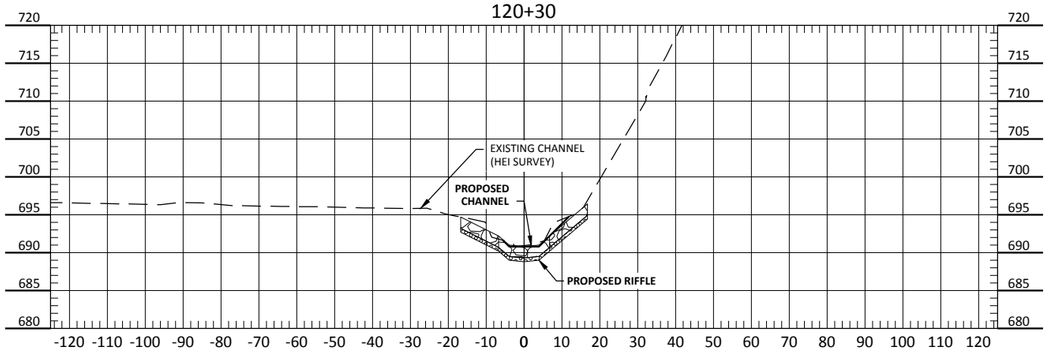

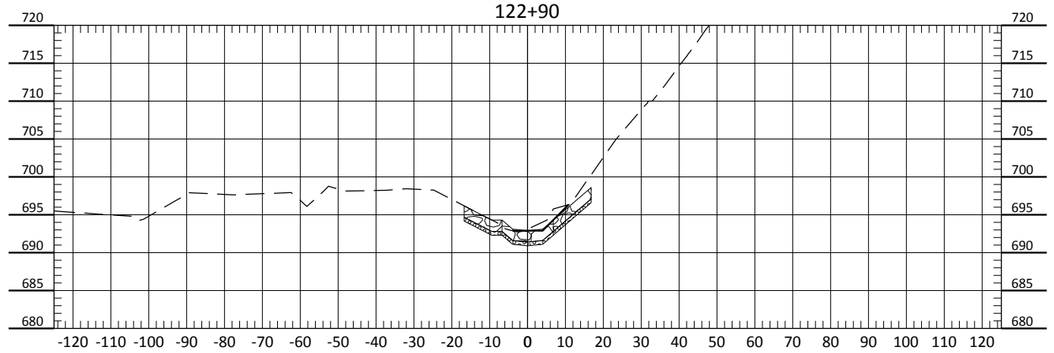

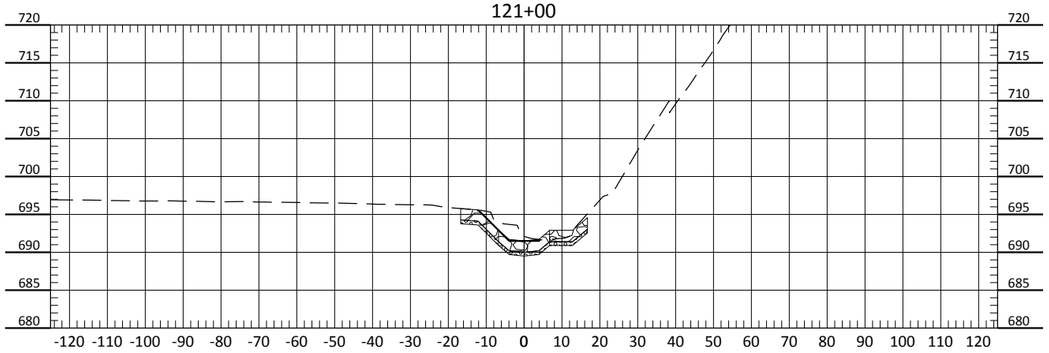

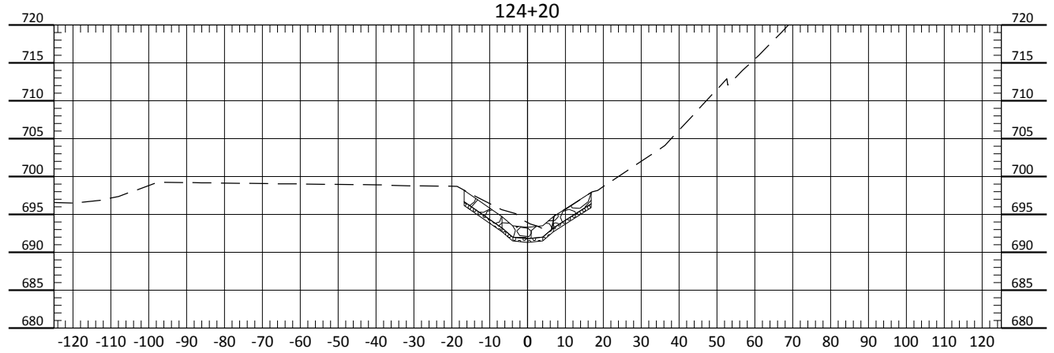

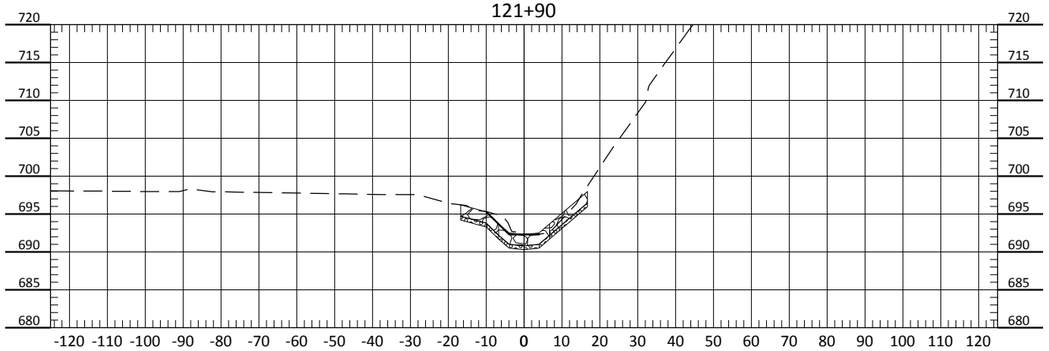

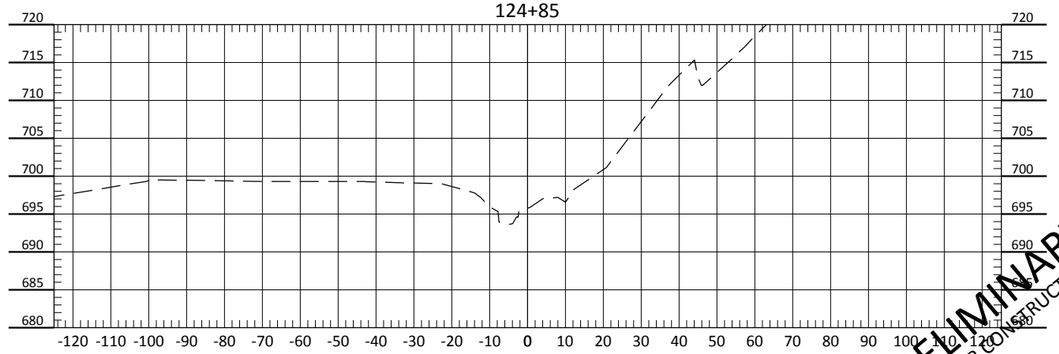

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No.	Revision	Date	By

HOUSTON engineering, inc.

Drawn by	Date
TDR	1-26-22
Checked by	Scale
TDR	AS SHOWN

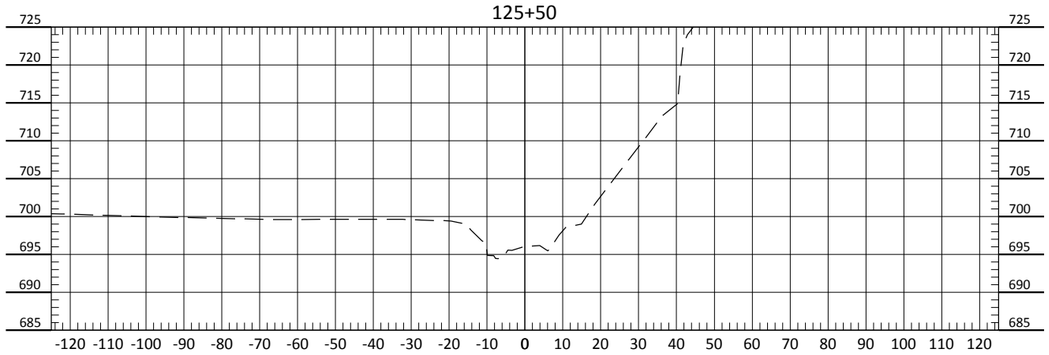
TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

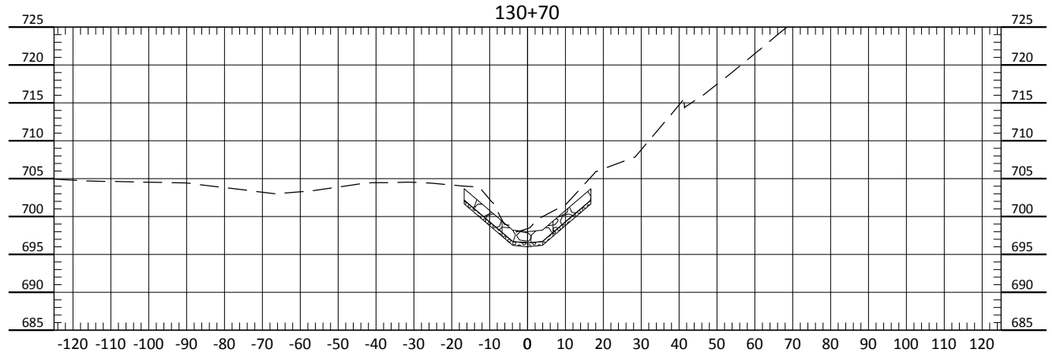
CROSS SECTIONS

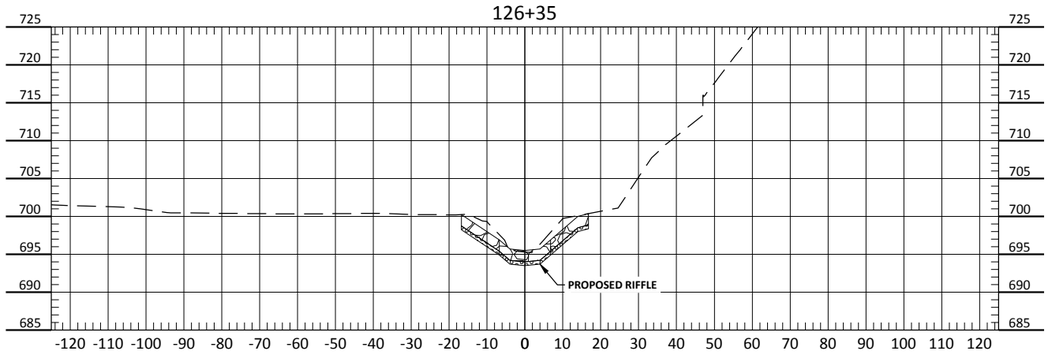
PROJECT NO. 4876-0051

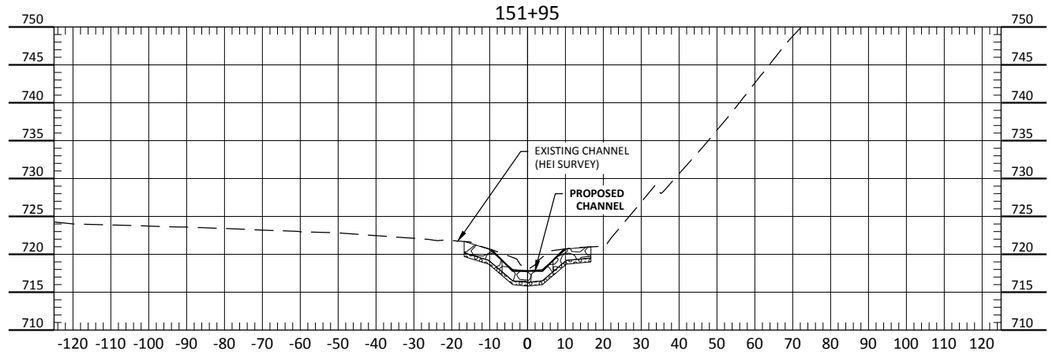
SHEET 12

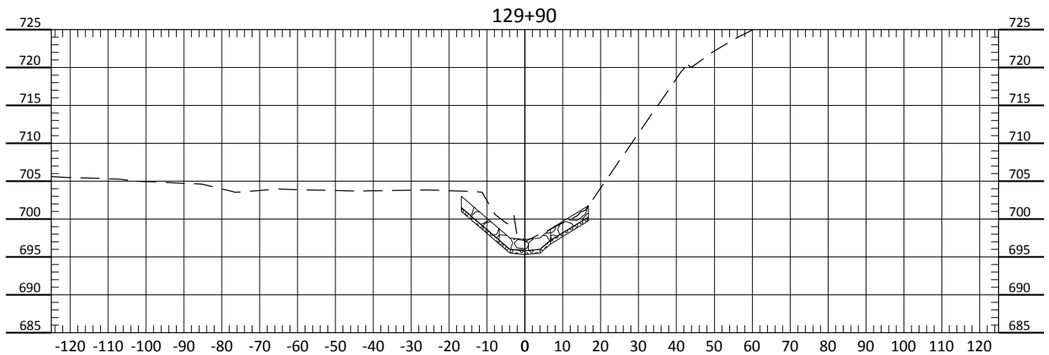
HEI NO. 4876-0051

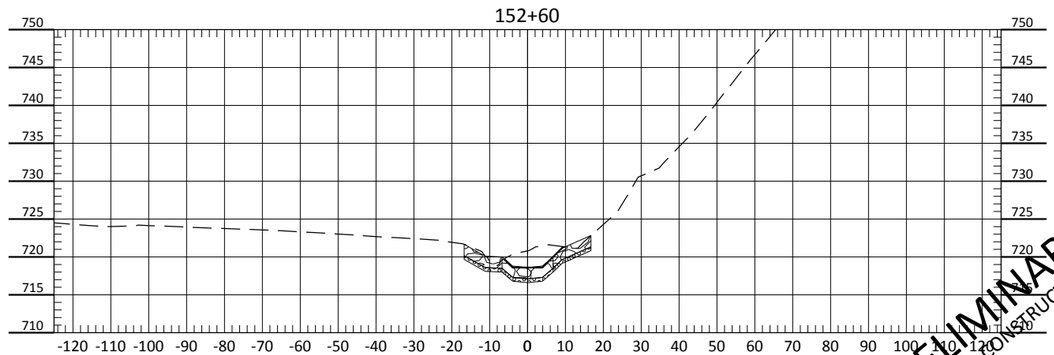












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TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

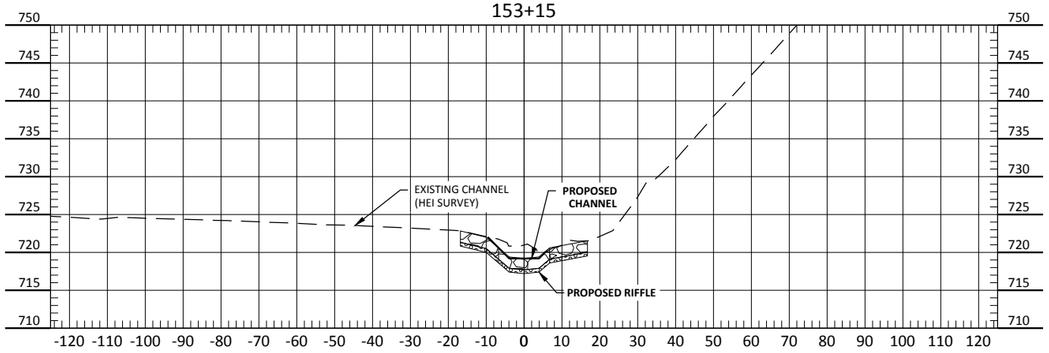
CROSS SECTIONS

PROJECT NO. 4876-0051

SHEET 13

HEI NO. 4876-0051

153+15



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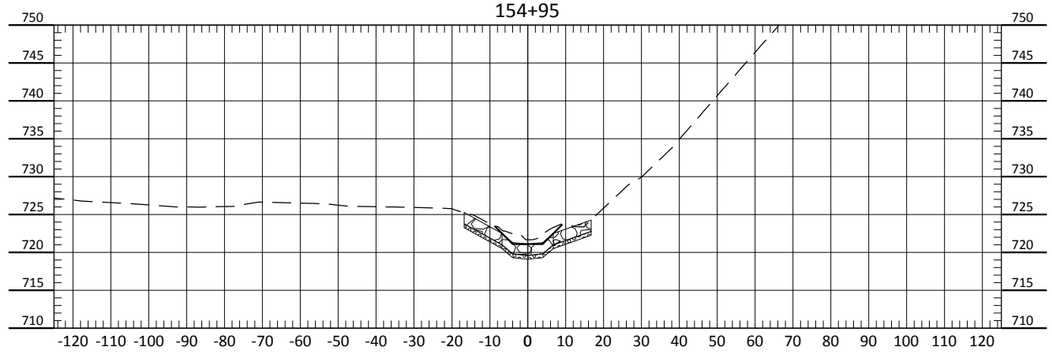

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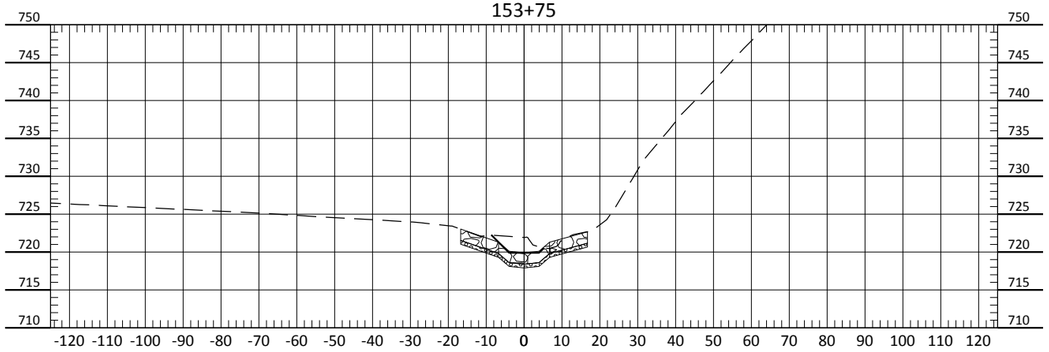

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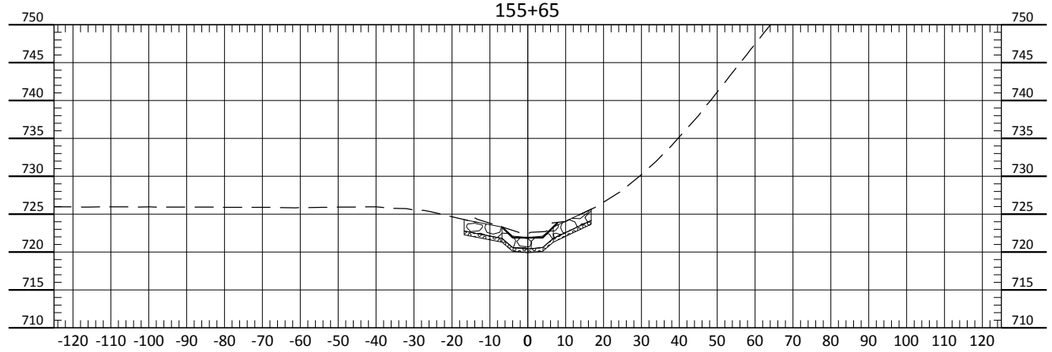

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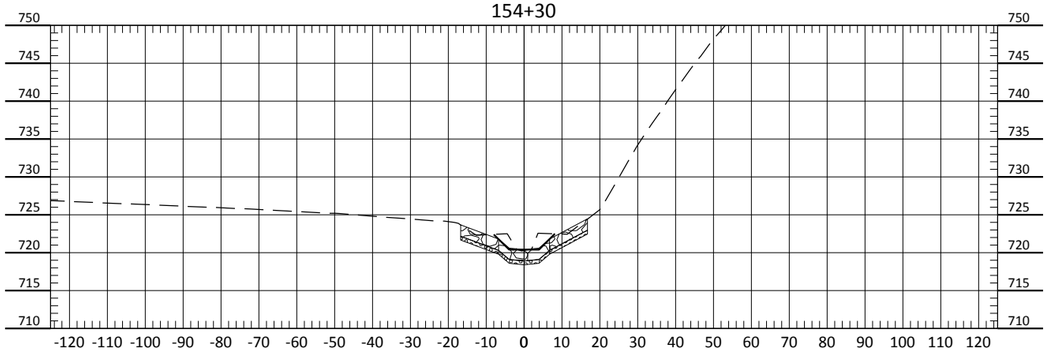

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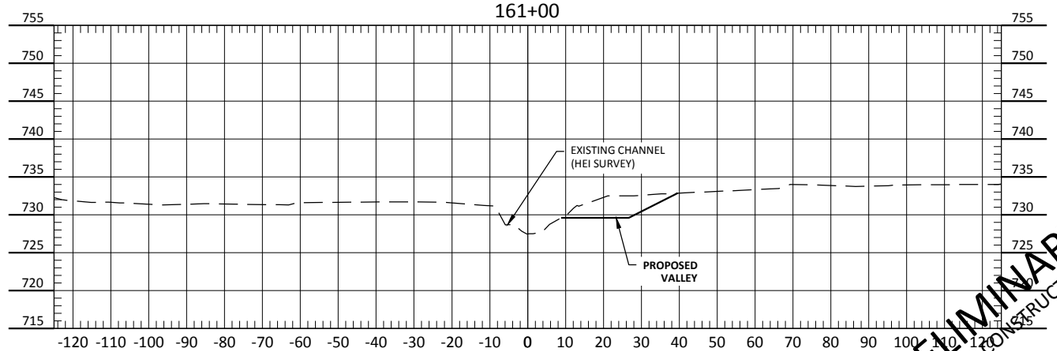

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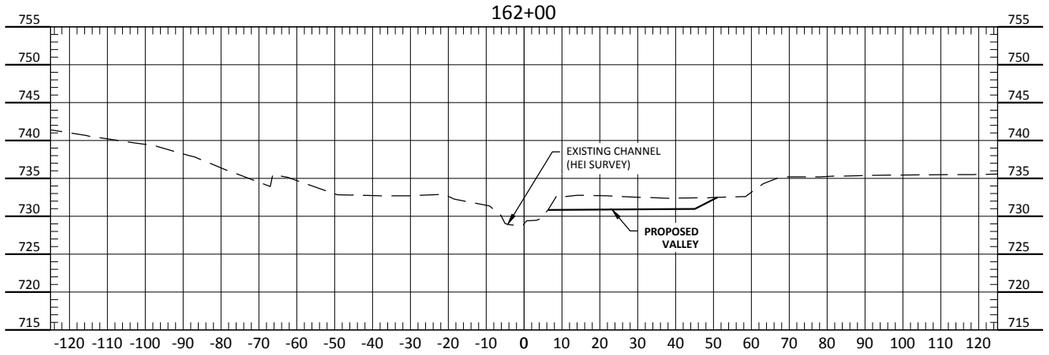
TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

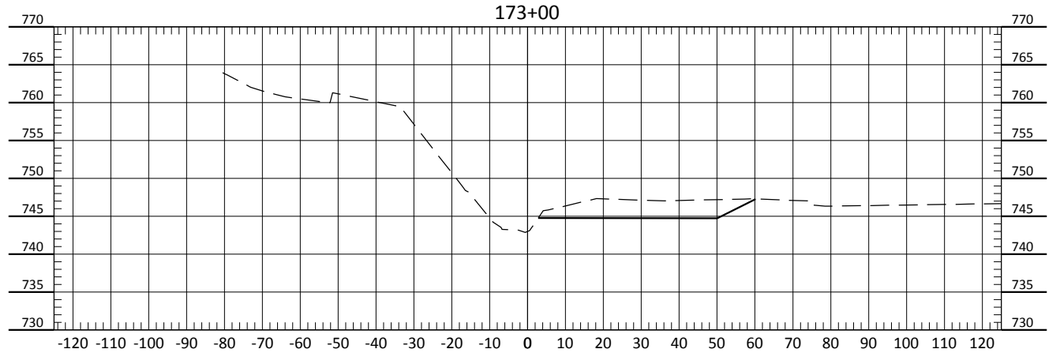
CROSS SECTIONS

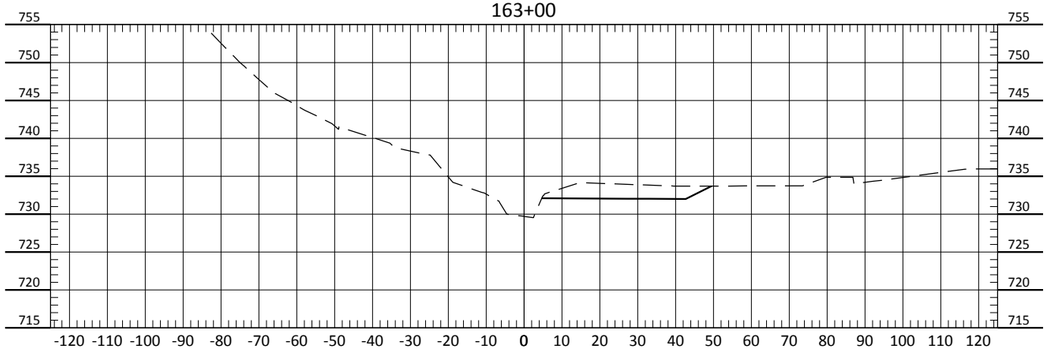
PROJECT NO. 4876-0051

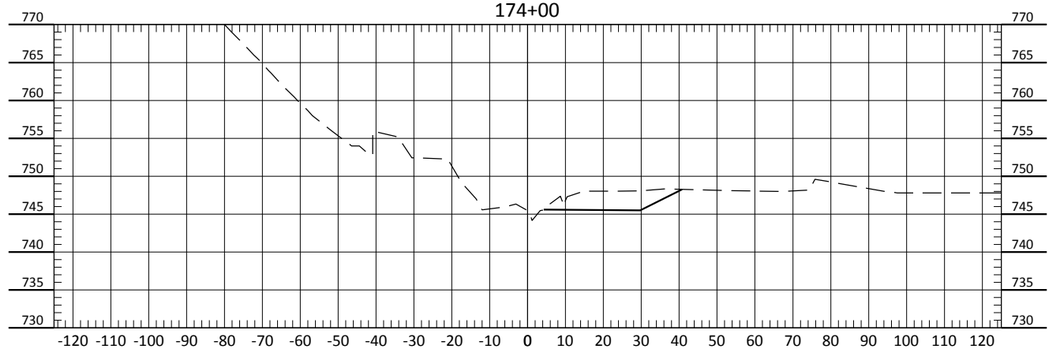
SHEET 14

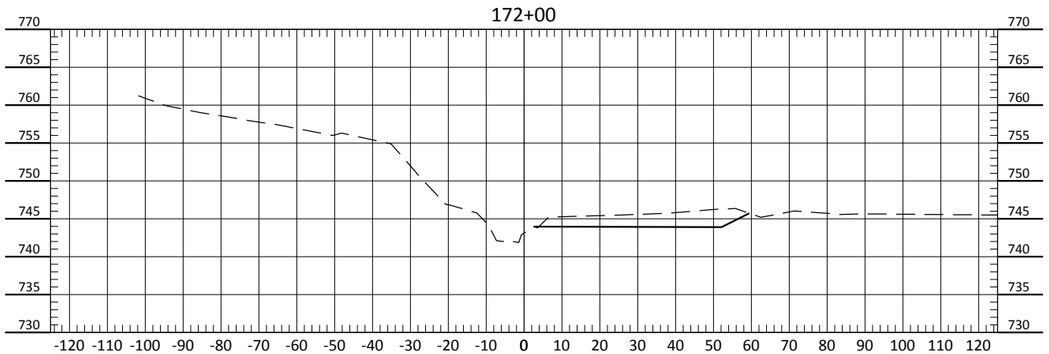
HEI NO. 4876-0051











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NOT FOR CONSTRUCTION

No.	Revision	Date	By

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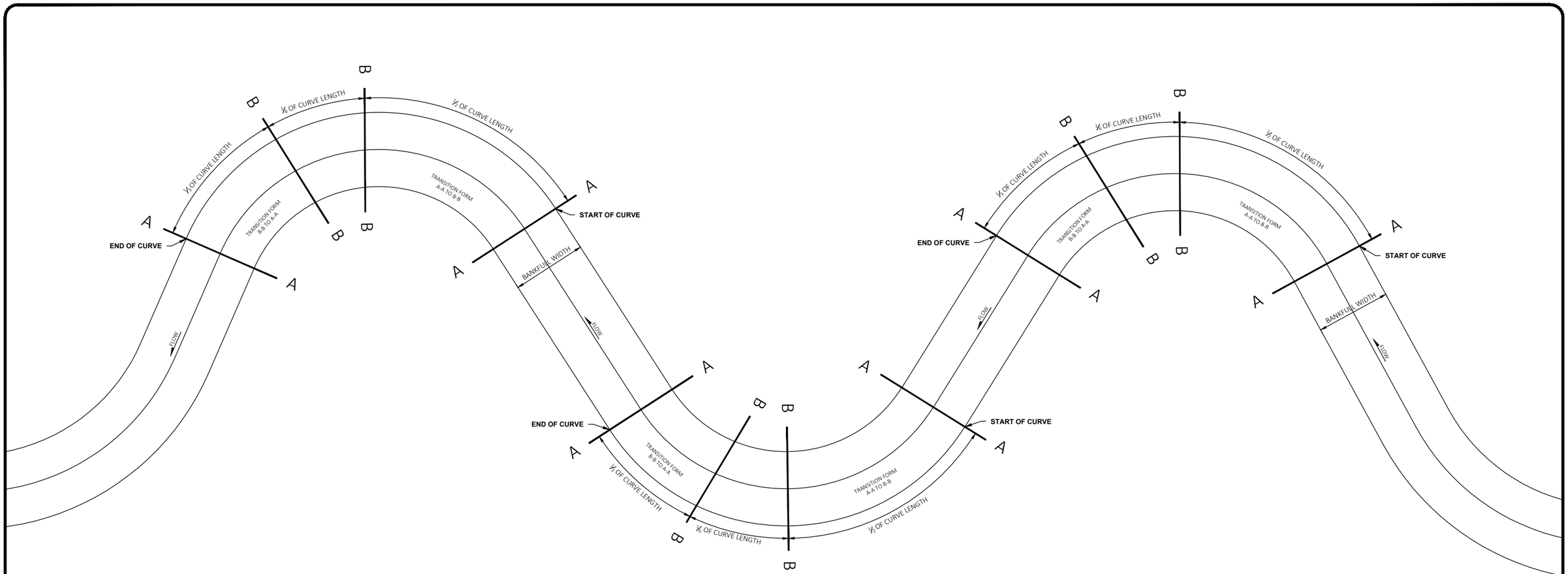
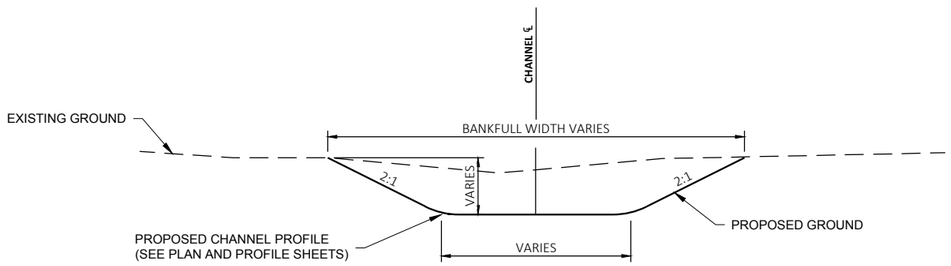
TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

CROSS SECTIONS

PROJECT NO. 4876-0051

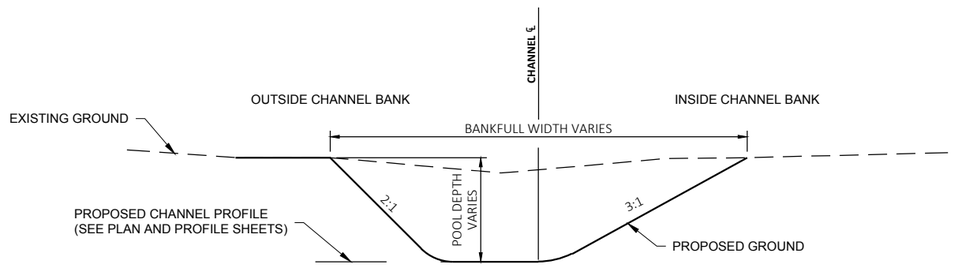
SHEET 15





A-A TYPICAL CHANNEL SECTION

NOT TO SCALE



B-B TYPICAL CHANNEL SECTION

NOT TO SCALE

NOTE:
1. POOLS ARE TO BE CONSTRUCTED ON THE OUTSIDE BENDS ON ALL CHANNEL CURVES AS SHOWN ON THE TYPICAL CHANNEL PLAN VIEW.
2. SEE DETAILS FOR CHANNEL GEOMETRY

No.	Revision	Date	By

HOUSTON engineering, inc.

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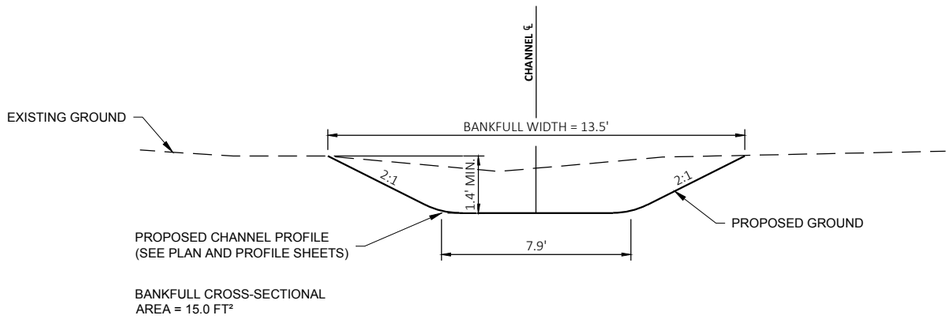
TDR	AS SHOWN

TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

TYPICAL CHANNEL PLAN VIEW

PROJECT NO. 4876-0051

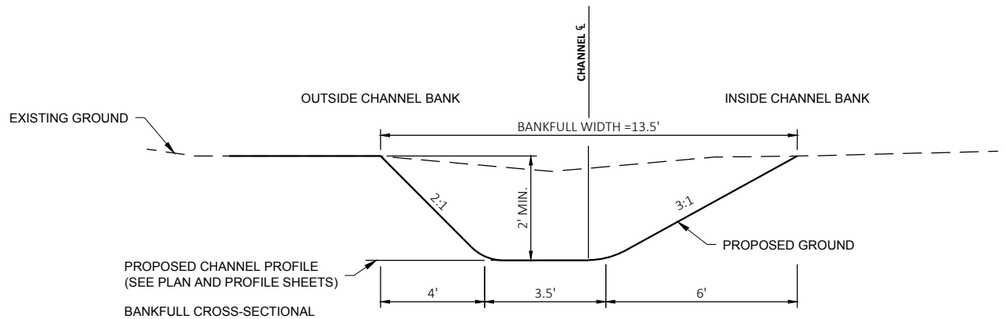
SHEET 16



STA. 109+65 TO 117+05
STA. 120+00 TO 122+90
STA. 151+50 TO 155+65

A-A TYPICAL CHANNEL SECTION

NOT TO SCALE



STA. 109+65 TO 117+05
STA. 120+00 TO 122+90
STA. 151+50 TO 155+65

B-B TYPICAL CHANNEL SECTION

NOT TO SCALE

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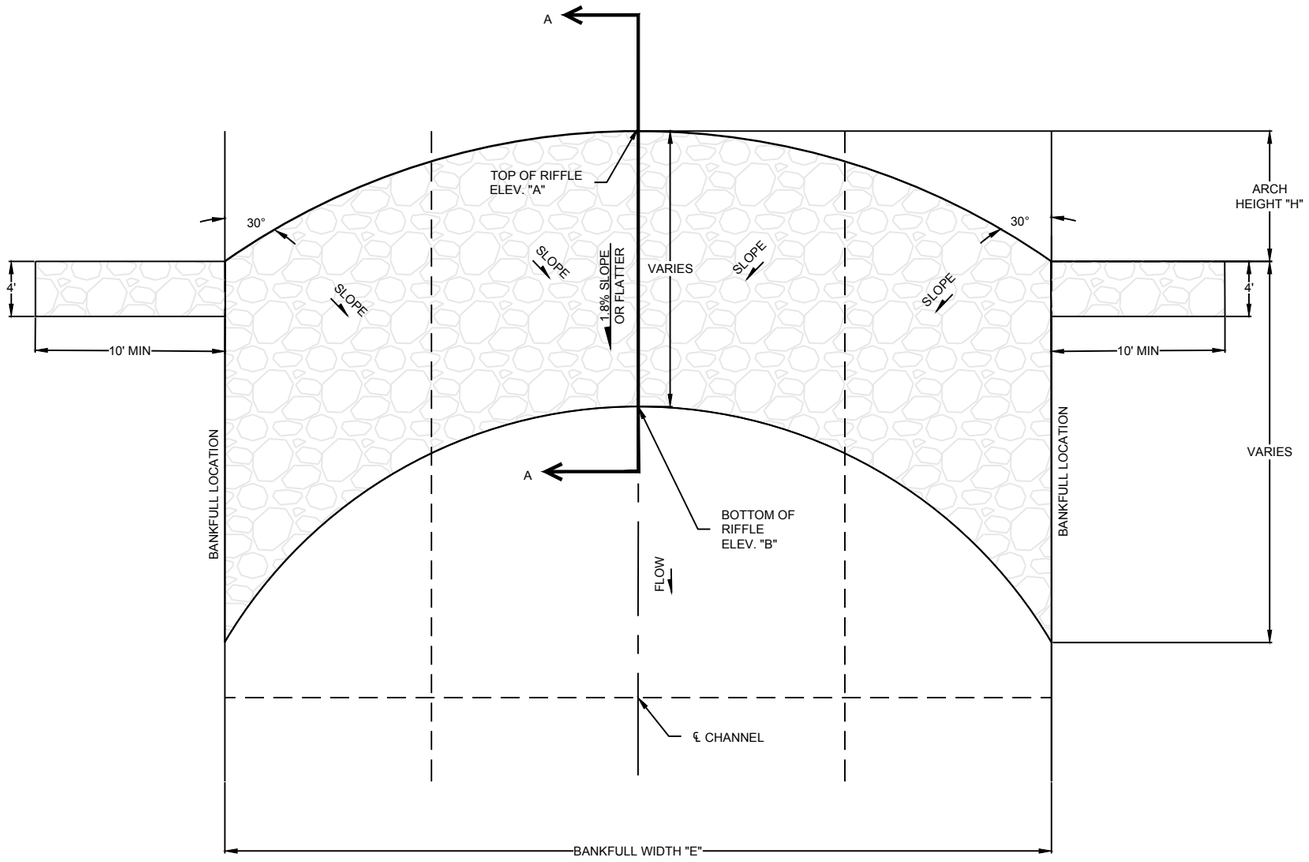
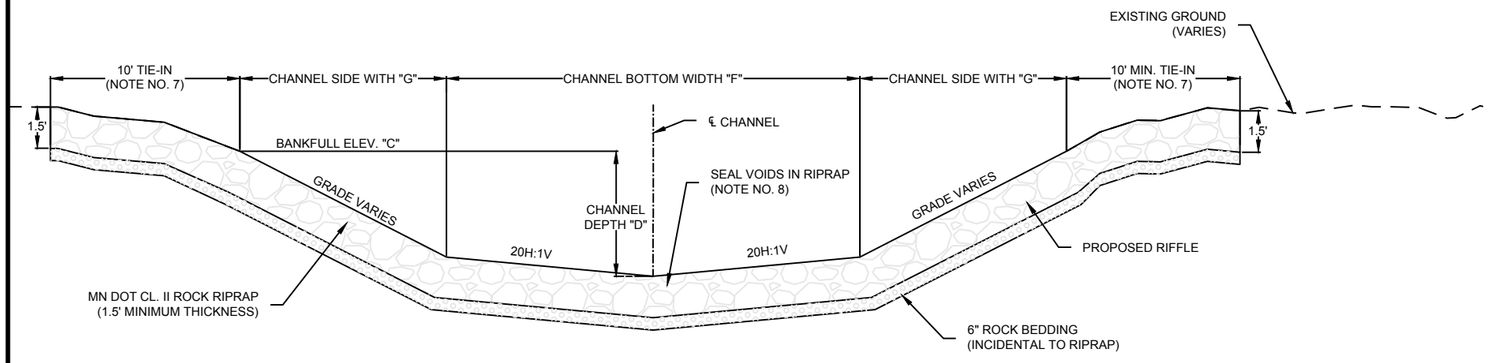
TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

CROSS SECTION DETAILS
PROJECT NO. 4876-0051

SHEET 17





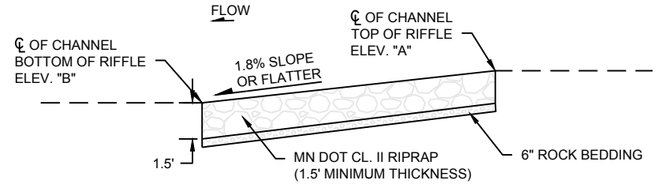
TROUT BROOK RIFFLE DETAIL
NOT TO SCALE

DETAIL TABLE

RIFFLE NO.	TOP OF RIFFLE STATION	BOTTOM OF RIFFLE STATION	TOP OF RIFFLE ELEV. "A"	BOTTOM OF RIFFLE ELEV."B"	BANKFULL ELEV. "C"	CHANNEL DEPTH "D"	BANKFULL WIDTH "E"	CHANNEL BOTTOM WIDTH "F"	CHANNEL SIDE WIDTH "G"	ARC HEIGHT "H"	CLASS II RIPRAP (CY)	ROCK BEDDING (CY)
1	109+95	109+65	681.8	681.3	683.2						27	9
2	110+80	110+55	682.7	682.3	684.1						23	8
3	111+40	111+20	683.3	683.0	684.7						19	6
4	111+95	111+75	683.9	683.6	685.3						19	6
5	112+50	112+30	684.5	684.2	685.9						19	6
6	113+60	113+40	685.5	685.2	686.9						19	6
7	114+40	114+10	686.3	685.8	687.7						27	9
8	115+30	115+05	687.0	686.6	688.4						23	8
9	116+10	115+90	687.7	687.4	689.1						19	6
10	116+75	116+45	688.3	687.9	689.7						27	9
11	118+00	117+70	689.0	688.5	690.4						27	9
12	120+30	120+00	690.8	690.3	692.2						27	9
13	121+00	120+70	691.5	691.0	692.9						27	9
14	121+90	121+60	692.3	691.9	693.7	1.4 FT	13.5 FT	7.9 FT	2.8 FT	4.0 FT	27	9
15	122+90	122+65	692.9	692.5	694.3						23	8
16	124+20	124+00	693.3	693.0	694.7						19	6
17	126+35	126+15	695.5	695.2	696.9						19	6
18	129+90	129+70	697.3	697.0	698.7						19	6
19	130+70	130+50	698.0	697.7	699.4						19	6
20	151+95	151+65	717.8	717.3	717.8						27	9
21	152+60	152+30	718.6	718.1	718.6						27	9
22	153+15	152+95	719.2	718.9	719.2						19	6
23	153+75	153+45	719.9	719.4	719.9						27	9
24	154+30	154+10	720.4	720.1	720.4						19	6
25	154+95	154+65	721.1	720.6	721.1						27	9
26	155+65	155+35	721.9	721.4	721.9						27	9
										TOTAL	602	198

NOTE:

1. CHANNEL EXCAVATION REQUIRED TO PLACE MN DOT CL. II RIPRAP AND ROCK BEDDING SHALL NOT BE MEASURED FOR SEPARATE PAYMENT BUT SHALL BE CONSIDERED SUBSIDIARY TO OTHER BID ITEMS.
2. A 6" THICK LAYER OF ROCK BEDDING WILL BE USED AS A FOUNDATION FOR MN DOT CL. II RIPRAP. 90% OF ROCK BEDDING SHALL CONSIST OF 1" TO 3" STONES. ROCK BEDDING WILL BE PAID ON A PER CUBIC YARD BASIS UNDER THE ROCK BEDDING BID ITEM.
3. MN DOT CL. II RIPRAP AT THE DOWNSTREAM END OF RIFFLE MUST BE SUBCUT INTO THE CHANNEL TO A DEPTH OF 1.5 FT. MN DOT CL. II RIPRAP WILL BE PAID ON A PER CUBIC YARD BASIS UNDER THE MN DOT CL. II RIPRAP BID ITEM.
4. WHERE FEASIBLE, RIFFLES SHALL BE CONSTRUCTED PRIOR TO DIVERTING RIVER FLOWS INTO THE NEW CHANNEL.
5. ANY DISTURBED VEGETATED AREAS ARE REQUIRED TO BE SEEDED.
6. CLEARING AND GRUBBING WILL ONLY BE CONDUCTED AS NECESSARY TO CONSTRUCT THE RIFFLES. CLEARING AND GRUBBING IS SUBSIDIARY TO THE TREE AND BRUSH REMOVAL BID ITEM.
7. TIE-IN TO BE CONSTRUCTED 10 FEET HORIZONTALLY INTO THE EXISTING BANK AND SHOULD NOT PROTRUDE ABOVE ADJACENT GROUND. DISTURBED AREAS ALONG THE EXISTING BANK ARE TO BE RESTORED TO THE EXISTING CONDITION. ALL WORK ASSOCIATED WITH RESTORING THE EXISTING BANK WILL NOT BE MEASURED FOR SEPARATE PAYMENT BUT SHALL BE CONSIDERED SUBSIDIARY TO OTHER BID ITEMS.
8. VOIDS IN THE PLACED RIPRAP SHALL BE FILLED WITH A WELL GRADED MIX OF AGGREGATE VARYING FROM THE NO. 40 SIEVE UP TO 3 INCH STONES. THE MIX OF AGGREGATE SHOULD BE SUCH THAT IT IS NOT BLOWN OUT OF THE RIPRAP BY THE RIVERS CURRENT BUT INSTEAD FORCES FLOW OVER THE RIPRAP. THE AGGREGATE AND PLACEMENT OF THE AGGREGATE SHALL NOT BE MEASURED FOR SEPARATE PAYMENT BUT SHALL BE CONSIDERED SUBSIDIARY TO OTHER BID ITEMS.



SECTION A - A
NOT TO SCALE

No.	Revision	Date	By

HOUSTON engineering, inc.

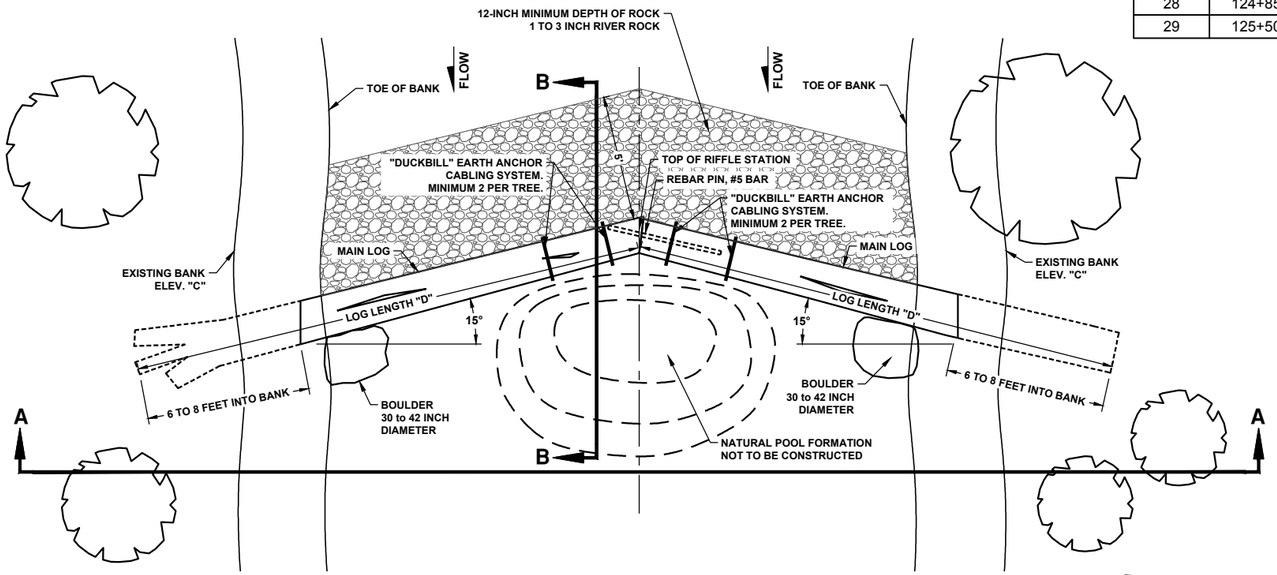
Drawn by	Date
TDR	1-26-22
Checked by	Scale
TDR	AS SHOWN

TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

RIFFLE DETAILS

PROJECT NO. 4876-0051

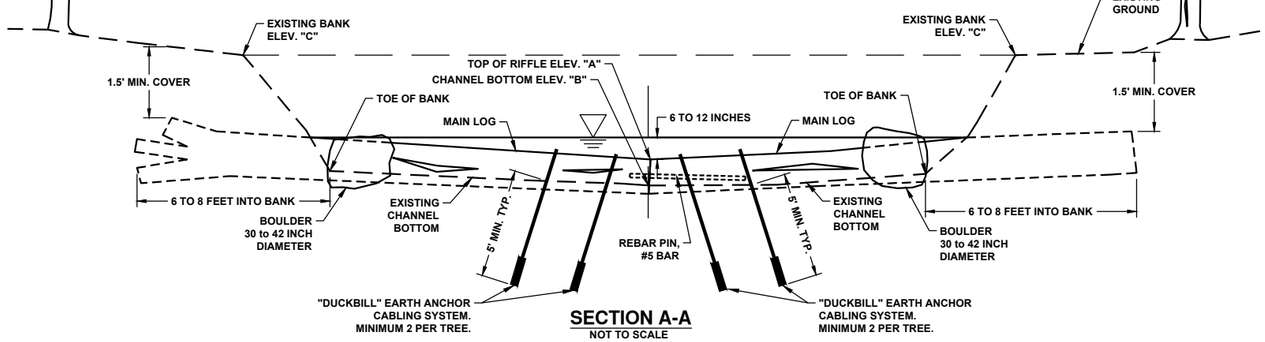
SHEET 18



PLAN VIEW
NOT TO SCALE

NOTES:

1. MINIMUM LOG DIAMETER 18 INCHES.
2. MAXIMUM RISE ABOVE CHANNEL BOTTOM = 9 INCHES
3. IT IS ANTICIPATED CONTRACTOR WILL SELECT AND HARVEST LOG FROM PROJECT AREA AS DIRECTED BY ENGINEER.



SECTION A-A
NOT TO SCALE

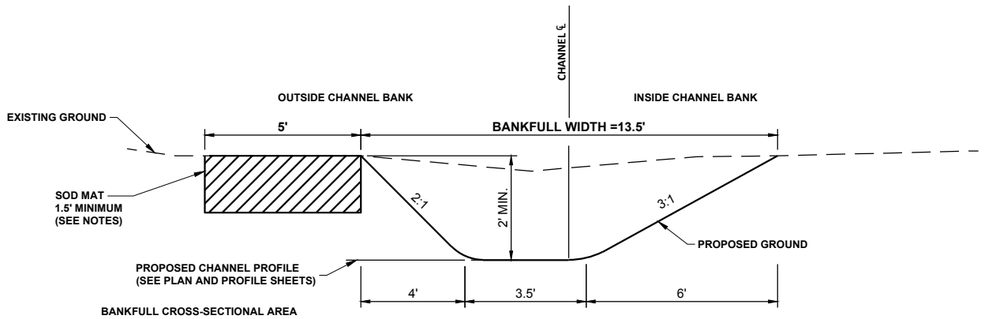
WOODY DEBRIS RIFFLE DETAIL
NOT TO SCALE

DETAIL TABLE

RIFFLE NO.	WOODY RIFFLE STATION	TOP OF RIFFLE ELEV. "A"	CHANNEL BOTTOM ELEV."B"	EXISTING BANK ELEV. "C"	LOG LENGTH [2 x "D"]
28	124+85	694.3	693.7	699.2	28 FT
29	125+50	695.2	694.5	699.6	28 FT
				TOTAL	56 FT

NOTES:

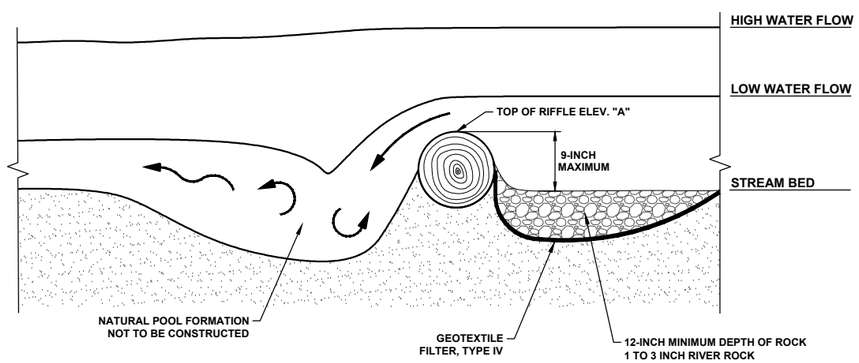
1. SOD MATERIAL SHALL CONSIST OF SUFFICIENT PLANDTO BIND THE SOD MAT TOGETHER. SOD MATS CONTAINING WILLOWS AND/OR DENSE STANDS OF GRASSES ARE CONIDERED IDEAL. ACCEPTABLE SOD MATERIAL SHALL BE DETERMINED BY THE ENGINEER OR FIELD REPRESENTATIVE. IN LOCATIONS WHERE SOD MATERIAL IS NOT AVAILABLE, THE CONTRACTOR SHALL INSTALL BIODEGRADABLE EROSION BLANKETS THAT ARE 5' IN WIDTH AND ARE PLACED AT THE VALLEY ELEVATION.
2. THE CONTRACTOR SHALL FILL ABANDONED CHANNEL TH THE VALLEY ELEVATION OR MATCH THE ADJACENT GROUND ELEVATION, WHICHEVER IS LOWER.
3. CONTRACTOR SHOULD SALVAGE EXISTING TOPSOIL FOR LATER REUSE ON SITE IN EXCAVATION AREA S WELL AS IN AREAS WHERE THE EXISTING CHANNEL IS TO BE FILLED.
4. THE DRAINAGE SHALL BE MAINTAINED ON THE OUTSIDE OF THE SPOIL PILE. AREAS OUTSIDE OF THE STOCKPILE LOCATIONS SHALL BE GRADED TO DRAIN.
5. MINIMUM OF 6" TOPSOIL SHALL BE SPREAD BELOW THE PROPOSED CHANNEL CROSS SECTION.



SOD MAT DETAIL
NOT TO SCALE

NOTES:

1. SOD MATERIAL SHALL CONSIST OF SUFFICIENT PLANT GROWTH TO BIND THE SOD MAT TOGETHER. SOD MATS CONTAINING WILLOWS AND/OR DENSE STANDS OF GRASSES ARE CONSIDERED IDEAL. ACCEPTABLE SOD MATERIAL SHALL BE DETERMINED BY THE ENGINEER OR FIELD REPRESENTATIVE. IN LOCATIONS WHERE SOD MATERIAL IS NOT AVAILABLE, THE CONTRACTOR SHALL INSTALL BIODEGRADABLE EROSION BLANKETS THAT ARE 5' IN WIDTH AND ARE PLACED AT THE VALLEY ELEVATION.
2. THE CONTRACTOR MAY NOT PLACE SPOIL IN WETLAND LOCATIONS.
3. THE CONTRACTOR SHALL FILL ABANDONED CHANNEL TO THE VALLEY ELEVATION OR MATCH THE ADJACENT GROUND ELEVATION, WHICHEVER IS LOWER.
4. CONTRACTOR SHOULD SALVAGE EXISTING TOPSOIL FOR LATER REUSE ON SITE IN EXCAVATION AREA AS WELL AS IN AREAS WHERE THE EXISTING CHANNEL IS TO BE FILLED.
5. DRAINAGE SHALL BE MAINTAINED ON THE OUTSIDE OF THE SPOIL PILE. AREAS OUTSIDE OF THE STOCKPILE LOCATIONS SHALL BE GRADED TO DRAIN.
6. MINIMUM OF 6" TOPSOIL SHALL BE SPREAD BELOW THE PROPOSED CHANNEL CROSS SECTION.



SECTION B-B
NOT TO SCALE

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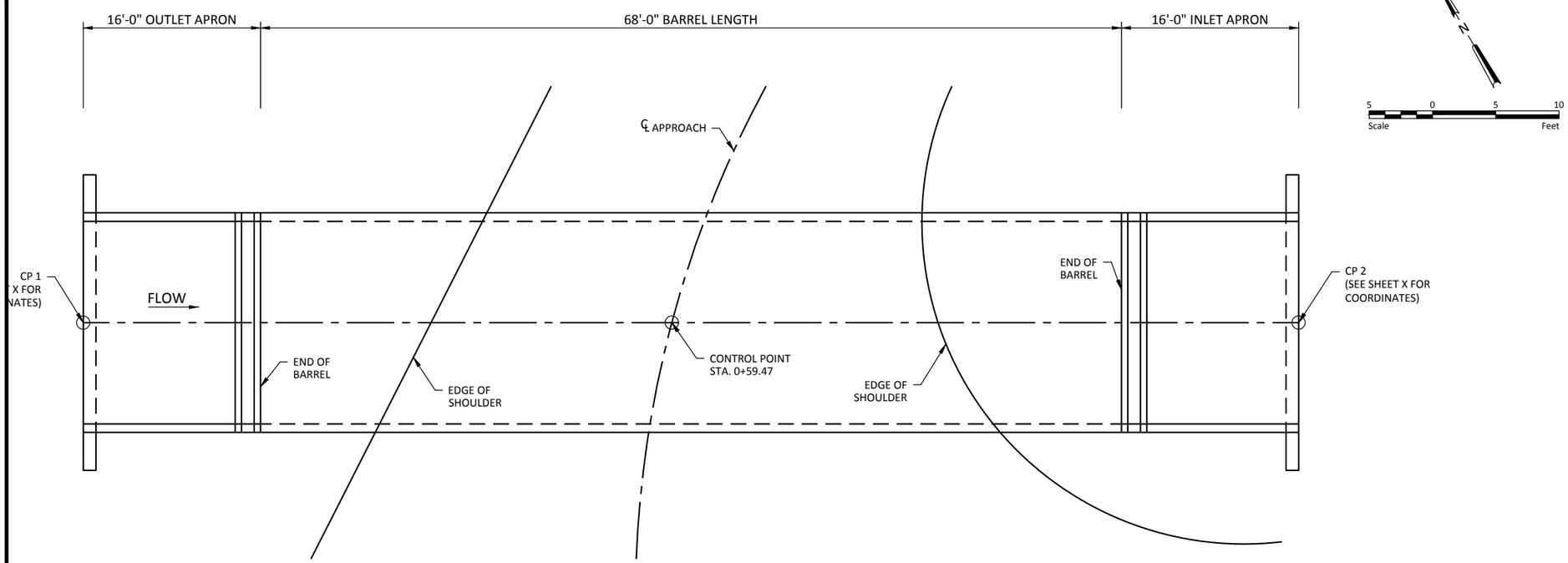
TDR	AS SHOWN

TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

RIFFLE AND SOD MAT DETAILS
PROJECT NO. 4876-0051

SHEET 19



PLAN VIEW

DESIGN DATA

DESIGNED IN ACCORDANCE WITH 2017 AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS AND MnDOT BRIDGE DESIGN MANUAL.

HL-93 LIVE LOAD
BARREL SPAN = 16'-0"
BARREL RISE = 7'-0"
BARREL LENGTH = 68'-0"
EST. MIN. FILL DEPTH Ⓐ = 2.00'
EST. MAX. FILL DEPTH Ⓑ = 2.00'
SKEW ANGLE = 0°00'00"

DESIGN SPEED = N/A MPH
CURRENT ADT (2019) = <50
PROJECTED ADT (2039) = <50

HL-93 LRFR
BRIDGE OPERATING RATING FACTOR RF = 1.3

CONSTRUCTION NOTES:

THE 2020 EDITION OF THE MINNESOTA DEPARTMENT OF TRANSPORTATION "STANDARD SPECIFICATIONS FOR CONSTRUCTION" SHALL GOVERN.

ALL EXPOSED CONCRETE EDGES SHALL BE FORMED WITH A 1/2" OR 3/4" CHAMFER UNLESS OTHERWISE NOTED.

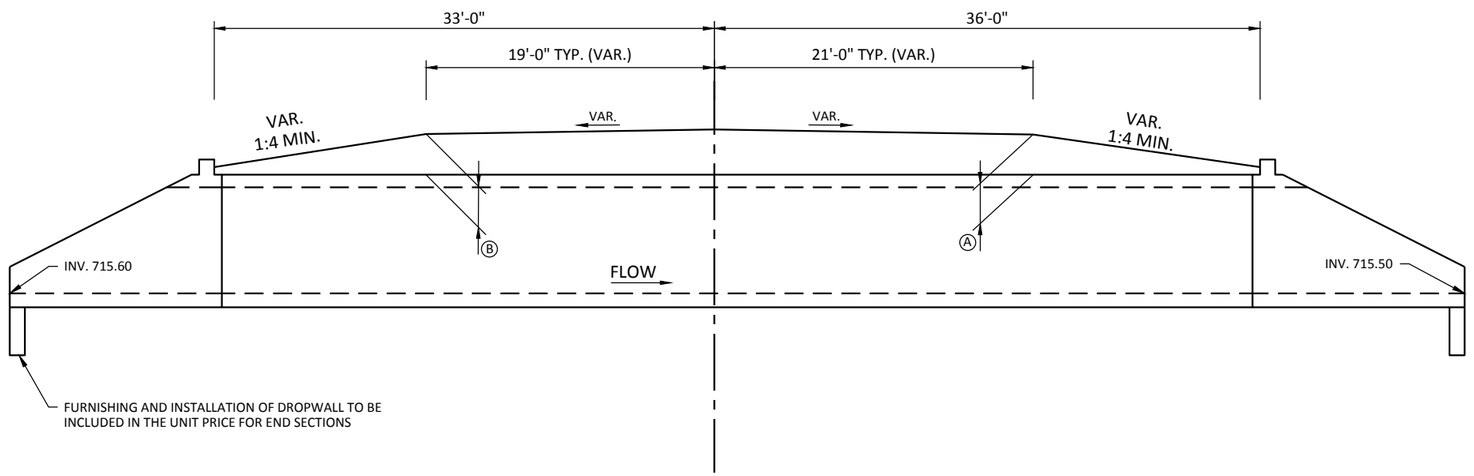
CONSTRUCTION SHALL BE IN ACCORDANCE WITH SPEC. 2411 AND 2412, EXCEPT AS NOTED.

REFER TO SHEET FOR EXCAVATION AND BACKFILL. SPEC. 2451.

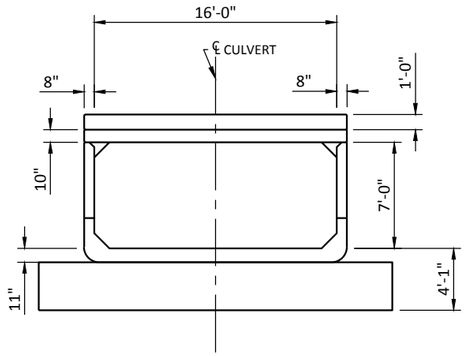
THE BAR SIZES SHOWN IN THIS PLAN ARE IN U.S. CUSTOMARY DESIGNATIONS.

REFER TO SHEET 6 OF THE PLANS FOR SUBSURFACE UTILITY INFORMATION.

REFER TO SHEET 6 OF THE PLANS FOR CONTROL POINT (CP) COORDINATES



ELEVATION VIEW



END ELEVATION

BRIDGE NO. 04J17

LOCATION: OTTO WAY NE OVER SHOTLEY BROOK
0.5 MILES NORTH AND 0.3 MILES EAST OF THE INTERSECTION OF CSAH 23 & ROGERS RD NE

MAIN TWO LINES OF 16' x 8' MNDOT STD. PRECAST CONCRETE CULVERT

IDENTIFICATION NO. 513

GENERAL PLAN AND ELEVATION

SEC. 10 T 153 N R 31 W

SHOTLEY TOWNSHIP BELTRAMI COUNTY

No.	Revision	Date	By

PRELIMINARY

HOUSTON engineering, inc.

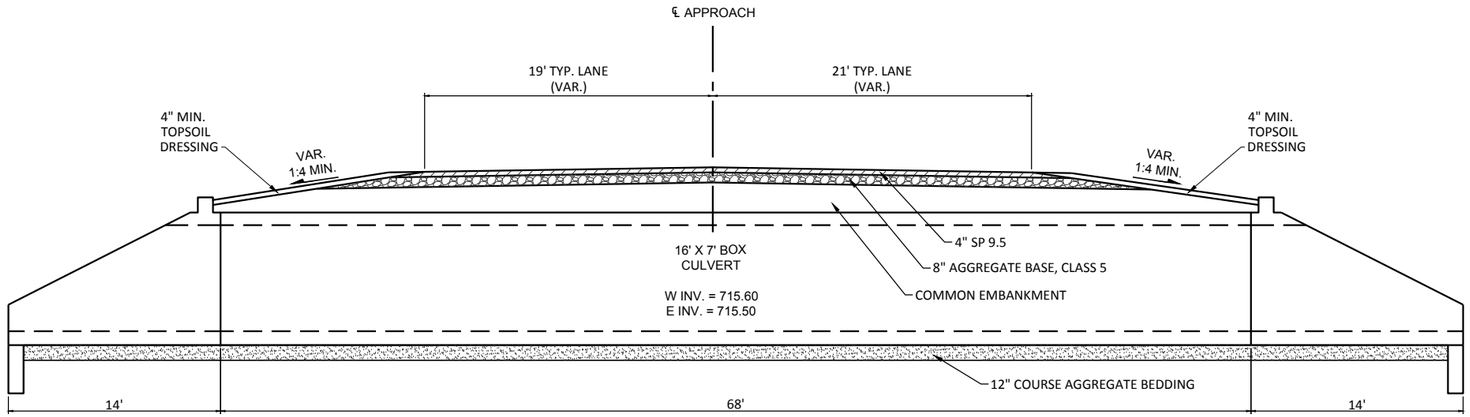
Drawn by	Date
DJK	1-26-22
Checked by	Scale
WJK	AS SHOWN

TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

BOX CULVERT
GENERAL PLAN
PROJECT NO. 4876-0051

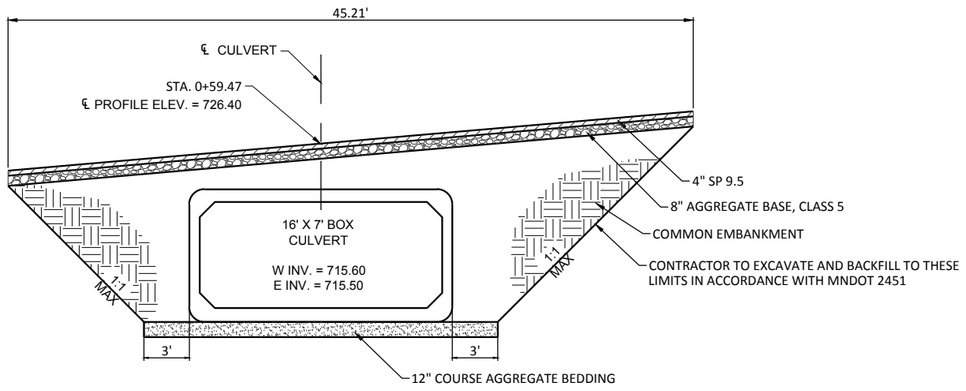
SHEET
20

HEI NO. 4876-0051



TYPICAL SECTION APPROACH

NOT TO SCALE



SPECIAL DETAIL TO BOX CULVERT

NOT TO SCALE

No.	Revision	Date	By

PRELIMINARY

HOUSTON engineering, inc.

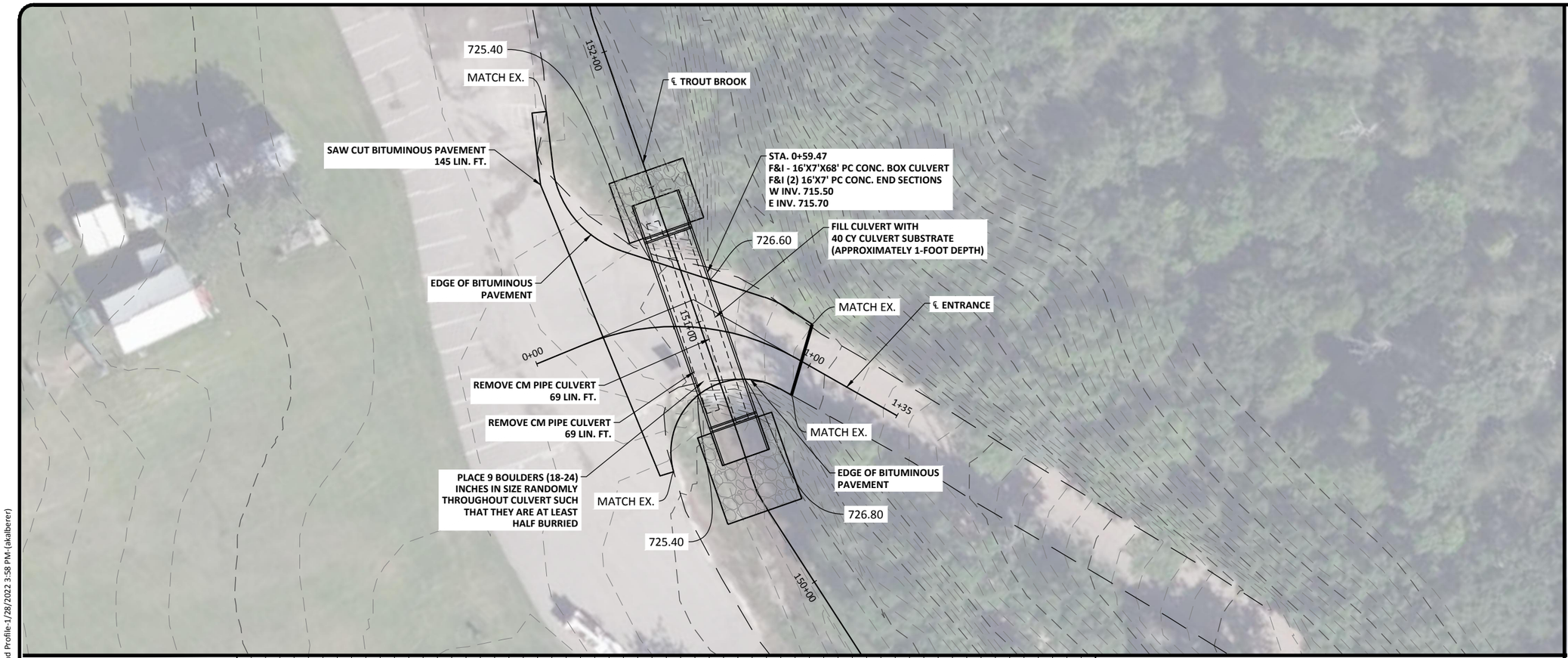
Drawn by	Date
DJK	1-26-22
Checked by	Scale
WJK	AS SHOWN

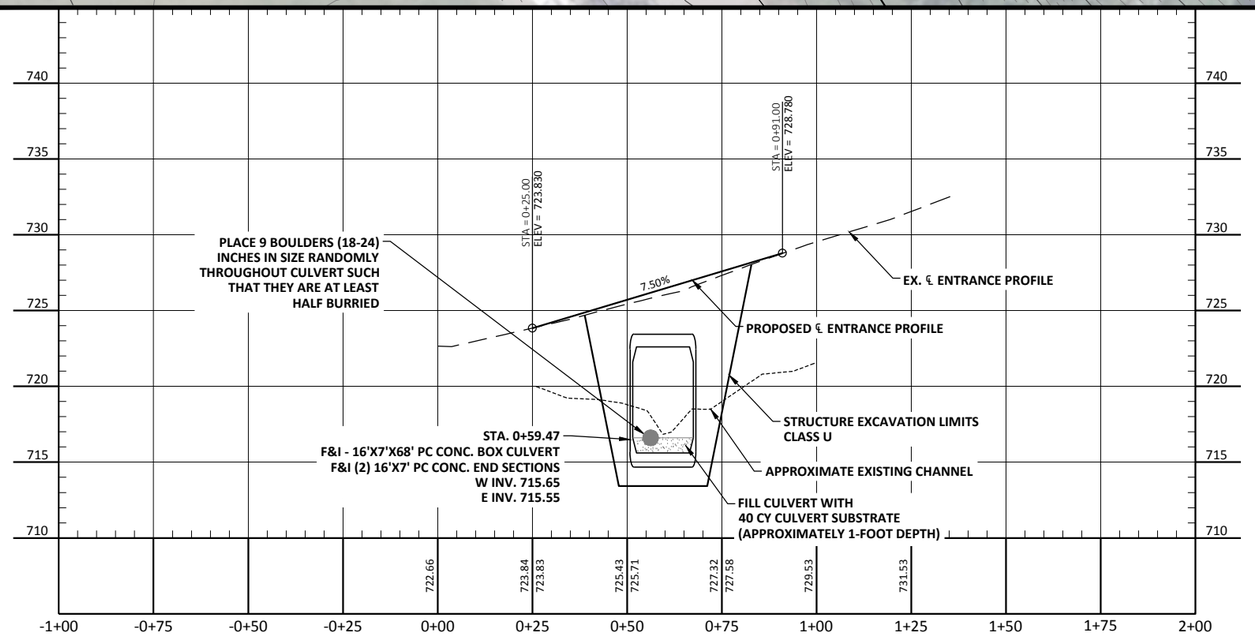
TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

BOX CULVERT
TYPICAL SECTION
PROJECT NO. 4876-0051

SHEET
21

HEI NO. 4876-0051





No.	Revision	Date	By

PRELIMINARY

HOUSTON engineering, inc.

Drawn by	Date
DJK	1-26-22
Checked by	Scale
WJK	AS SHOWN

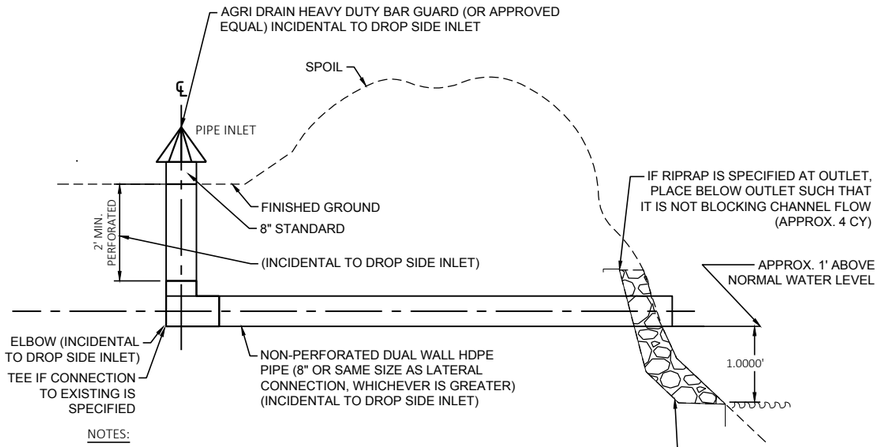
TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

BOX CULVERT
PLAN & PROFILE
PROJECT NO. 4876-0051

SHEET
22

HEI NO. 4876-0051

\\houston\hei\BN\4800\4876\4876_0051 Trout Brook Ph3\CAD\Plans\TROUT BROOK RESTORATION PHASE 3\Box Culvert Plan & Profile.dwg-Plan and Profile-1/28/2022 3:58 PM-(akalberer)

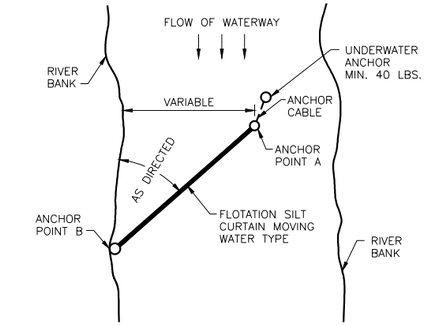


NOTES:

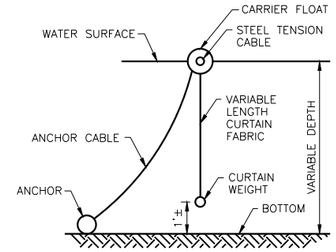
1. THE CONNECTION SHALL UTILIZE STANDARD MANUFACTURED FITTINGS.
2. THE PERFORATED SECTION OF THE INLET SHALL HAVE 6 ROWS OF HOLES SPACED AT 2 INCHES, CENTER TO CENTER, AND HAVE A 1 INCH DIAMETER.
3. INLET COMPONENT LENGTHS MAY BE SHORTENED OR LENGTHENED, TO OBTAIN THE REQUIRED HEIGHT OR DEPTH.

DROP SIDE INLET DETAIL

NOT TO SCALE



PLAN VIEW-MOVING WATER



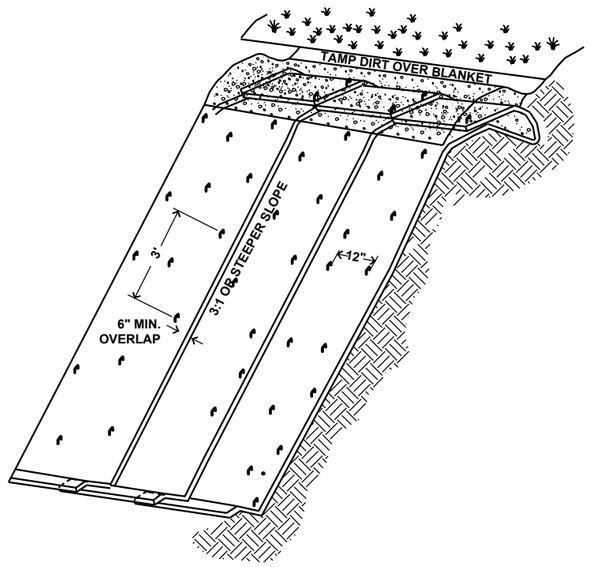
PROFILE VIEW

NOTES:

1. FLOATING SILT CURTAIN SHALL CONFORM TO SDDOT 3887-1 AND PROJECT SPECIAL PROVSIONS AND BE INSTALLED PER MANUFACTURER'S RECOMMENDATIONS OR AS DIRECTED BY THE ENGINEER.
2. DESIGN CRITERIA:
   MAXIMUM WATER DEPTH: 10'
   MAXIMUM WATER VELOCITY: 5 FT./SEC.

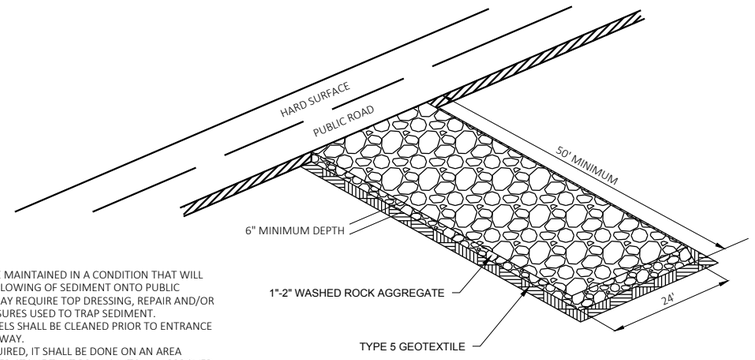
FLOATING SILT CURTAIN TYPE MOVING WATER

NOT TO SCALE



EROSION CONTROL BLANKET FOR BANK REPAIR

NOT TO SCALE



NOTES:

1. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHTS-OF-WAY. THIS MAY REQUIRE TOP DRESSING, REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.
2. WHEN NECESSARY, WHEELS SHALL BE CLEANED PRIOR TO ENTRANCE ONTO PUBLIC RIGHT-OF-WAY.
3. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABILIZED WITH CRUSHED STONE THAT DRAINS INTO AN APPROVED SEDIMENT TRAP OR SEDIMENT BASIN.

TEMPORARY ROCK OR WOOD CHIP

CONSTRUCTION ENTRANCE

NOT TO SCALE

No.	Revision	Date	By

HOUSTON engineering, inc.

Drawn by	Date
TDR	1-26-22
Checked by	Scale
TDR	AS SHOWN

TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

EROSION CONTROL DETAILS

PROJECT NO. 4876-0051

SHEET 23

STORM WATER POLLUTION PREVENTION NARRATIVE

PROJECT DESCRIPTION / LOCATION

THE TROUT BROOK RESTORATION PROJECT IS LOCATED AT AFTON ALPS SKI RESORT WITHIN DENMARK TOWNSHIP OF WASHINGTON COUNTY, MINNESOTA. THE PROPOSED PROJECT PROPOSES TO RESTORE APPROXIMATELY 1,450 FT OF STREAM WHICH INCLUDES 26 ROCK RIFFLES, 2 WOODY DEBRIS RIFFLES, AN EXCAVATING ADDITIONAL FLOODPLAIN IN TWO LOCATIONS ALONG A COMBINED 700 FT OF STREAM. THE PROJECT ALSO PROPOSES TO REPLACE TWO LINES OF 54'' CMP WITH A 16'X7' RCB WITH END SECTIONS.

SITE MAPS

MAPS OF THE RESTORATION CONCEPT PLAN, LAND USE, SOIL TYPE, AND AQUATIC RESOURCES CAN BE FOUND IN THE EXHIBITS OF THE ENVIRONMENTAL ASSESSMENT WORKSHEET (EAW).

ENVIRONMENTALLY SENSITIVE AREAS

THERE ARE WETLANDS ADJACENT TO THE PROJECT WORK CORRIDOR, NONE OF WHICH ARE LISTED AS A PUBLIC WATER WETLAND. MINIMAL WORK WILL BE PERFORMED IN THE WETLANDS AND WORK SHALL BE PERFORMED TO MINIMIZE FILL PLACED IN WETLANDS.

OUTSTANDING RESOURCE VALUE WATERS (ORVWs)

THERE ARE NO OUTSTANDING RESOURCE VALUE WATERS WITHIN THE PROJECT LIMITS.

CALCAREOUS FENS

THERE ARE NO CALCAREOUS FENS WITHIN THE PROJECT LIMITS.

IMPAIRED WATERS

TROUT BROOK IS A DNR DESIGNATED PUBLIC WATERS FOR THE ENTIRE LENGTH OF THE PROJECT. TROUT BROOK IS A WATERWAY LISTED BY THE MPCA AS AN IMPAIRED FOR E. COLI.

LAND FEATURE CHANGES

TOTAL PROJECT AREA DISTURBED	2.44 ACRES
TOTAL EXISTING IMPERVIOUS SURFACE AREA	0.0 ACRES
TOTAL EXISTING PERVIOUS SURFACE AREA	2.44 ACRES
TOTAL PROPOSED IMPERVIOUS SURFACE AREA	0.0 ACRES
TOTAL PROPOSED PERVIOUS SURFACE AREA	2.44 ACRES

DRAINAGE COMPUTATIONS

NO DRAINAGE COMPUTATIONS WERE REQUIRED AS PART OF THE STORM WATER POLLUTION PREVENTION PLAN FOR THIS PROJECT. SHOULD CONDITIONS IN THE FIELD WARRANT CHANGES, THE HYDRAULICS ENGINEER SHOULD BE CONSULTED AND THE CONDITIONS NOTED IN THE CONTRACTOR'S CONSTRUCTION LOG.

PROJECT CONTACTS

GREG BOWLES, PROJECT ENGINEER (763-493-6670) OR JOHN LOOMIS, PROJECT OWNER (651-714-3714) AND THE CONTRACTOR ARE RESPONSIBLE FOR IMPLEMENTATION OF THE SWPPP AND PLACEMENT, INSPECTION AND MAINTENANCE OF THE EROSION AND SEDIMENT CONTROL BMP'S BEFORE AND DURING CONSTRUCTION.

MPCA 24 HOUR EMERGENCY NOTIFICATION: 651-649-5451 OR 800-422-0798

TIMING OF BMP INSTALLATION

THE EROSION PREVENTION AND SEDIMENT CONTROL BMP's SHALL BE PLACED PRIOR TO START OF CONSTRUCTION, AS NECESSARY TO MINIMIZE EROSION FROM DISTURBED SURFACES AND CAPTURE SEDIMENT ON SITE, AND SHALL MEET THE NPDES PERMIT PART IV CONSTRUCTION ACTIVITY REQUIREMENTS.

ONCE CONSTRUCTION ACTIVITY CEASES FOR 14 DAYS OR MORE IN AN AREA, THAT AREA WILL BE STABILIZED WITH TEMPORARY OR PERMANENT BMP's.

RECEIVING WATERS

THE RECEIVING WATER FOR THE PROJECT IS TROUT BROOK. STORM WATER RUNOFF DURING CONSTRUCTION WILL BE MANAGED WITH BMP'S FOR INLET PROTECTION, AND OTHER BMP'S FOR MANAGING SEDIMENT LADEN RUNOFF. STORM WATER RUNOFF UPON COMPLETION OF THE PROJECT WILL BE MANAGED WITH GRASSY DITCHES AND SWALES. REFER TO THE EROSION CONTROL AND TURF ESTABLISHMENT SHEETS OF THE PLAN FOR DETAILS AND LOCATIONS OF TEMPORARY AND PERMANENT BMP'S.

SPECIAL CONDITIONS

THE CONTRACTOR SHALL PROVIDE SITE PLANS FOR CRITICAL AREAS IDENTIFIED IN THE EROSION CONTROL PLANS DETAILING HIS INTENDED CONSTRUCTION, EROSION CONTROL AND FINAL STABILIZATION METHODS PRIOR TO CONSTRUCTION COMMENCING. ALL WORK SPECIFICALLY NOT NOTED AS BEING PAID FOR SEPERATELY SHALL BE CONSIDERED INCIDENTAL WORK.

STORM WATER POLLUTION PREVENTION PLAN (SWPPP) NOTES

1) THE CONTRACTOR WILL WORK WITH THE PROJECT ENGINEER TO OVERSEE THE IMPLEMENTATION OF THE SWPPP, AND PLACEMENT, INSPECTION, AND MAINTENANCE OF THE EROSION PREVENTION AND SEDIMENT CONTROL BMP'S BEFORE AND DURING CONSTRUCTION.

2) THE CONTRACTOR SHALL DEVELOP A CHAIN OF RESPONSIBILITY WITH ALL OPERATORS ON THE SITE TO ENSURE THAT THE SWPPP WILL BE IMPLEMENTED AND STAY IN EFFECT UNTIL THE CONSTRUCTION PROJECT IS COMPLETE, THE ENTIRE SITE HAS UNDERGONE FINAL STABILIZATION, AND A NOTICE OF TERMINATION HAS BEEN SUBMITTED TO THE MPCA.

3) THE CONTRACTOR SHALL PROVIDE AND SUBMIT A WRITTEN, NOT ORAL, WEEKLY SCHEDULE OF PROPOSED EROSION CONTROL ACTIVITIES FOR THE PROJECT ENGINEER'S APPROVAL AS PER MN/DOT SPEC. 1803.

4) THE CONTRACTOR SHALL PREPARE AND SUBMIT A SITE PLAN FOR THE PROJECT ENGINEER'S APPROVAL AS PER MN/DOT SPEC. 1803 FOR PIPE AND STRUCTURE PLACEMENT, DEWATERING, AND AREAS SHOWN IN THE PLANS OR SPECIFIED BY THE PROJECT ENGINEER.

5) THE NORMAL WETTED PERIMETER OF ANY TEMPORARY OR PERMANENT DRAINAGE DITCH THAT DRAINS WATER FROM A CONSTRUCTION SITE, OR DIVERTS WATER AROUND A SITE, MUST BE STABILIZED WITHIN 200 LINEAL FEET FROM THE PROPERTY EDGE, OR FROM THE POINT OF DISCHARGE TO ANY SURFACE WATER. RAPID STABILIZATION MUST BE COMPLETED IMMEDIATELY AFTER CHANNEL EXCAVATION, WHERE SOD MATS OR EROSION CONTROL BLANKETS SHOULD BE PLACED IN ACCORDANCE WITH THE PLANS. THESE AREAS MUST BE KEPT STABILIZED AT ALL TIMES.

6) PIPE OUTLETS MUST BE PROVIDED WITH TEMPORARY OR PERMANENT ENERGY DISSIPATION WITHIN 24 HOURS OF CONNECTION TO A SURFACE WATER.

7) DEWATERING AND CONCRETE TRUCK WASHING RELATED TO THE CONSTRUCTION ACTIVITY THAT MAY HAVE TURBID OR SEDIMENT LADEN DISCHARGE WATER MUST BE DISCHARGED TO A TEMPORARY SEDIMENTATION BASIN ON THE PROJECT SITE. IF WATER CANNOT BE DISCHARGED TO A SEDIMENTATION BASIN PRIOR TO ENTERING THE SURFACE WATER, IT MUST BE TREATED WITH THE APPROPRIATE BMP'S, SUCH THAT THE DISCHARGE DOES NOT ADVERSELY AFFECT THE RECEIVING WATER DOWNSTREAM LANDOWNERS. THE CONTRACTOR MUST ENSURE THAT DISCHARGE POINTS ARE ADEQUATELY PROTECTED FROM EROSION AND SCOUR. THE DISCHARGE MUST BE DISPERSED OVER NATURAL ROCK RIRRAP, SAND BAGS, PLASTIC SHEETING OR OTHER ENERGY DISSIPATION MEASURES APPROVED BY THE PROJECT ENGINEER. ADEQUATE SEDIMENTATION CONTROL MEASURES ARE REQUIRED FOR DISCHARGE WATER THAT CONTAINS SUSPENDED SOLIDS.

8) ANY FUEL OR CHEMICAL TANK STORED ON THE PROJECT AREA MUST BE PROTECTED BY A SOIL BERM OR HAVE A NEGATIVE GRADIENT TO ANY WATER RESOURCE AREA, AS PER COE404. A CONTINGENCY PLAN MUST BE CREATED BY THE CONTRACTOR IN EVENT OF A SPILL OR LEAK OF ANY CHEMICAL, INCLUDING PETROCHEMICALS, DEEMED HARMFUL TO THE ENVIRONMENT, AND HAVE ON HAND THE MATERIALS NECESSARY TO CAPTURE AND CONTAIN SAID CHEMICALS.

9) A WATER APPROPRIATION PERMIT WILL BE REQUIRED FROM THE MN DNR FOR CONSTRUCTION IF DEWATERING EXCEEDS 10,000 GALLONS PER DAY.

10) ALL ERODIBLE STOCKPILES SHALL HAVE SEDIMENT CONTROL AND BE PLACED IN AREAS AWAY FROM SURFACE WATER.

11) CONTRACTOR SHALL BE RESPONSIBLE FOR CONTROLLING EROSION AS PER THE PLAN, PROJECT PROVISIONS, AND MN/DOT SPECIFICATIONS 1701, 1702, 1717, 2572, 2573, 2575.

12) TEMPORARY SEDIMENT REQUIREMENTS IS SATISFIED WITH POOLS IN OUTSIDE BENDS. CONTRACTOR MAY NEED TO COME BACK AND REMOVE ANY SEDIMENT WASHING INTO POOLS AT PROJECT COMPLETION.

13) EROSION CONTROL WILL BE ADDRESSED THROUGH SOD MATS, ECB ON OUTSIDE BENDS, AND SEEDING AND MULCHING WITHIN 14 DAYS OF CONSTRUCTION IN AN AREA.

LOCATION OF SWPPP REQUIREMENTS IN PROJECT PLAN

DESCRIPTION	TITLE	LOCATION
SUMMARY OF PERVIOUS AND IMPERVIOUS AREAS	SWPPP SHEET	SHEET 24
EROSION CONTROL SHEETS	EROSION CONTROL DETAILS SHEET	SHEET 23
EROSION CONTROL DETAILS	DETAIL SHEETS	MNDOT
FINAL STABILIZATION	ESTIMATED QUANTITIES	SEE SPECIFICATIONS

No.	Revision	Date	By

HOUSTON engineering, inc.

Drawn by	Date
TDR	1-26-22
Checked by	Scale
TDR	AS SHOWN

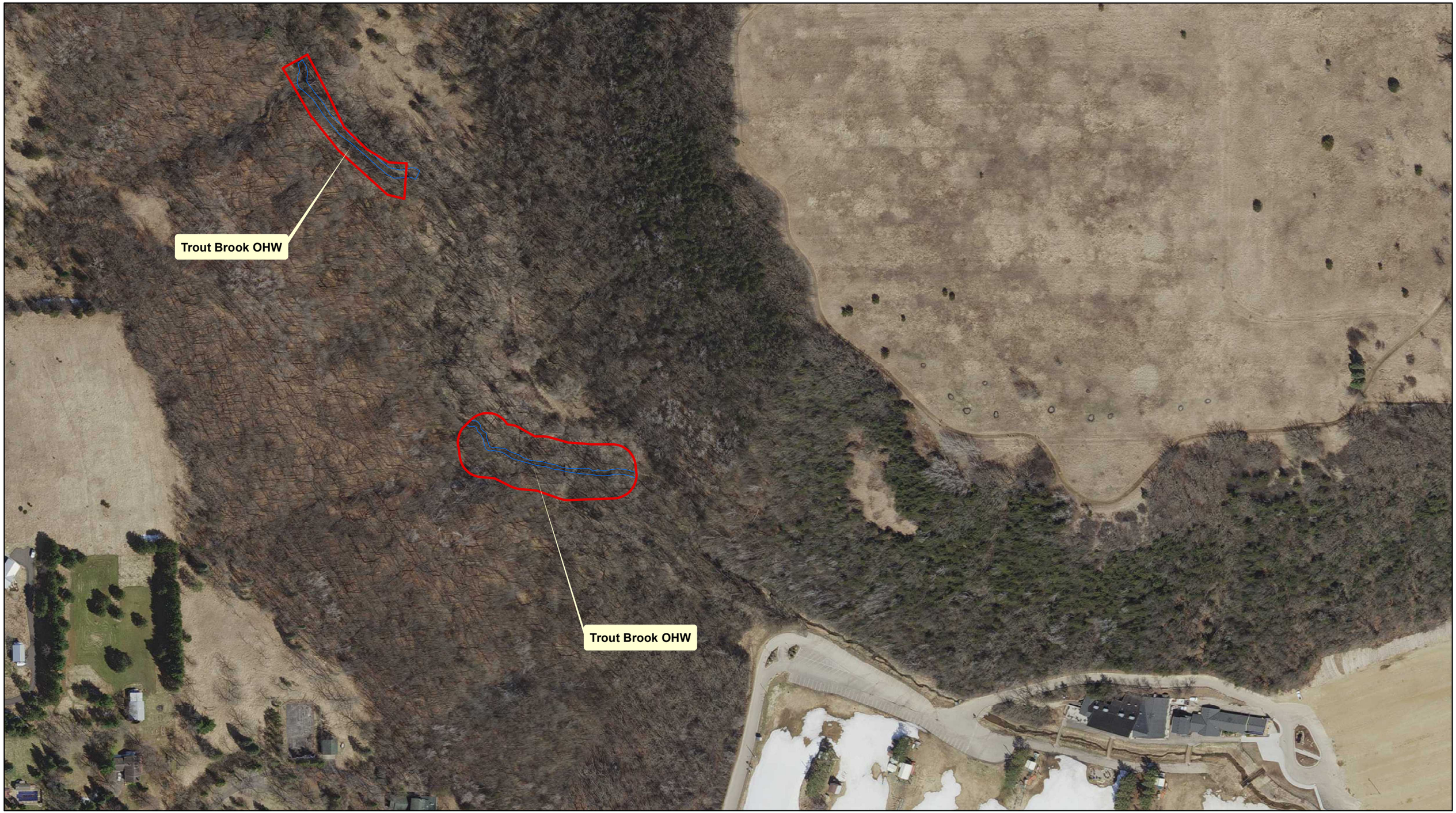
TROUT BROOK RESTORATION PHASE 3
SOUTH WASHINGTON WATERSHED DISTRICT
AFTON, MN

SWPPP NOTES

PROJECT NO. 4876-0051

SHEET 24

Appendix C: Trout Brook Aquatic Resources Delineation



Trout Brook Restoration
Wetland / Watercourse Delineation

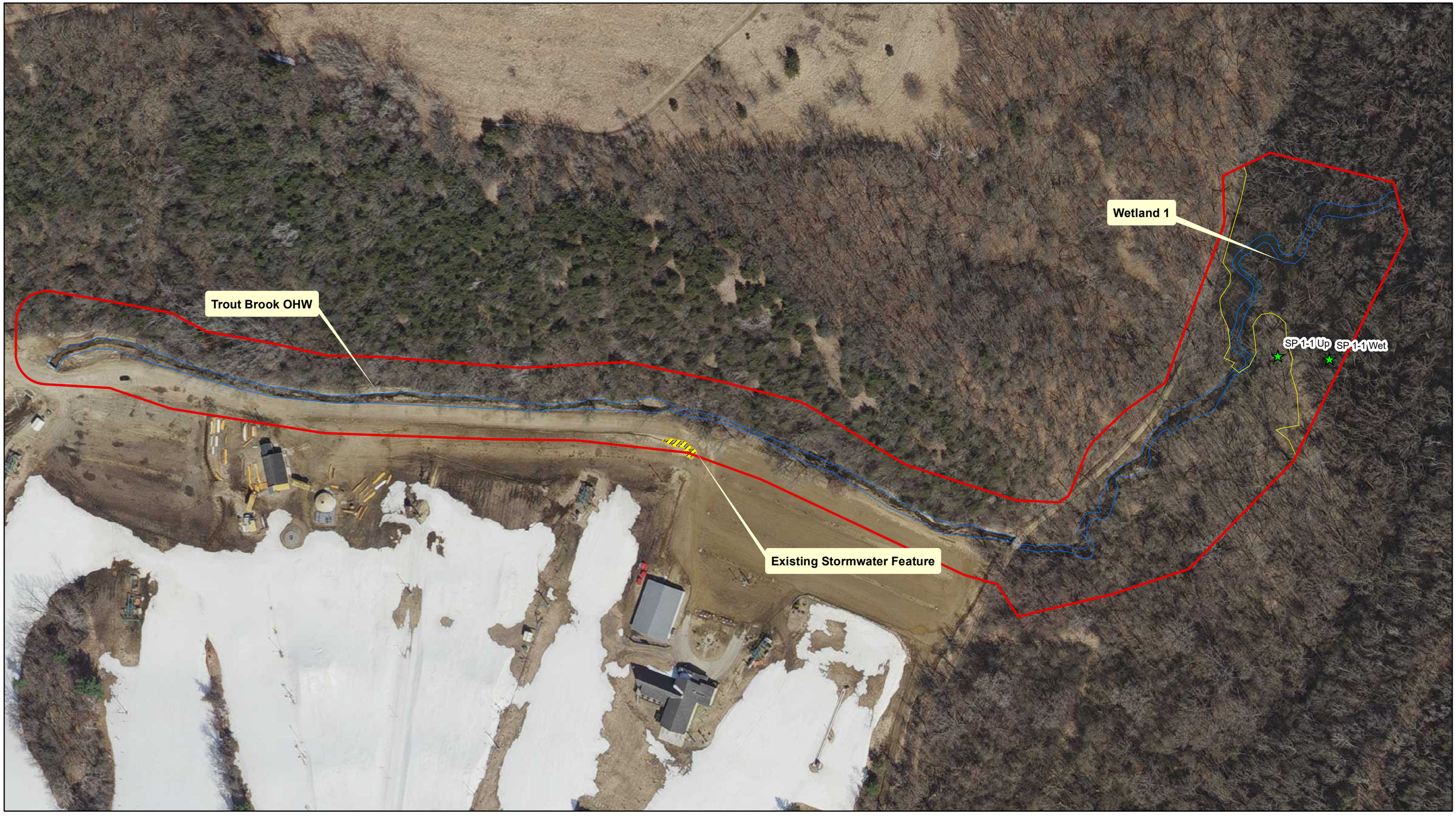
Created By: ebaskerville Date Created: 10/27/21 Date Exported: 11/3/2021 Image: MnGEO 2020 7-County Elevation Data: NA
Horizontal Datum: NAD 1983 UTM Zone 15N Vertical Datum: North American 1983
H:\Maple Grove\JBN\4800\4876\4876_0051 Trout Brook Ph3\GIS\Maps\trout_brook_emmy_WEST.mxd

N W E S

0 190 380
Feet

1 inch = 187 feet

HOUSTON engineering, inc.



Trout Brook Restoration
Wetland / Watercourse Delineation

Created By: ebaskerville Date Created: 10/27/21 Date Exported: 1/28/2022 Image: MnGEO 2020 7-County Elevation Data: NA
Horizontal Datum: NAD 1983 UTM Zone 15N Vertical Datum: North American 1983
H:\JBN\4800\4876\4876_0051 Trout Brook Ph3\GIS\Maps\trout_brook_emmy_EAST.mxd

Project Area Delineation
Watercourse Boundary
Stormwater Feature
Sample Points
Wetland

N
W E
S

0 140 280
Feet

1 inch = 141 feet

HOUSTON engineering, inc.