SUMMIT COUNTY
COLORADO

OPEN SPACE & TRAILS DEPARTMENT

970.668.4060 ph | 970.668.4225 f
www.SummitCountyCO.gov

0037 Peak One Dr. | PO Box 5660
Frisco, CO 80443

January 8, 2020

Mr. Ben Wilson
U.S. Army Corps of Engineers
Sacramento District
400 Rood Avenue, Room 224
Grand Junction, Colorado 81501

RE: Swan River Restoration Project: Year Four Monitoring Report (SPK-2015-00780)

Dear Mr. Wilson,

Included herewith, please find the 2020 Year Four Monitoring Report for the Swan River Restoration Project (Action ID: SPK-2015-00780) permitted under Nationwide Permit Number 27 – Aquatic Habitat Restoration, Establishment, and Enhancement Activities.

Please do not hesitate to contact me should you need any additional information.

Best regards,

Jason Lederer

Jason Lederer
Senior Resource Specialist

Encl: 2020 Year Four Monitoring Report

cc: (w/ encls)
Mr. David Blauch, Ecological Resource Consultants, via email: Dave@erccolorado.net
Mr. Troy Thompson, Ecological Resource Consultants, via email: Troy@erccolorado.net
Mr. April Kroner, Summit County Planning Department, via email: April.Kroner@SummitCountyCO.gov
Mr. Brian Lorch, Summit County Open Space and Trails, via email: Brian.Lorch@SummitCountyCO.gov
Mr. Robert Jacobs, Summit County Engineer, via email: Robert.Jacobs@SummitCountyCO.gov
Mr. Jon Ewert, Colorado Parks and Wildlife, via email: Jon.Ewert@state.co.us
Mr. Chris Sturm, Colorado Water Conservation Board, via email: Chris.Sturm@state.co.us

Ecological Resource Consultants, Inc.
2820 Wilderness Place, Suite A ~ Boulder, CO 80301 ~ (303) 679-4820

Monitoring Report-Swan River Restoration Project
Summit County, Colorado
2020 Year Four Monitoring

i. Project Overview	
1. USACE Permit#	**# SPK-2015-00780**
2. Permittee:	Summit County Open Space and Trails (0037 Peak One Drive, Frisco, CO 80443) Mr. Jason Lederer, Senior Resource Specialist (Jason.lederer@SummitCountyCO.gov)
Monitoring By:	Ecological Resource Consultants Inc. (ERC)
3. Project Description	The primary purpose of the project was to relocate approximately 2,504 linear feet of channelized Swan River, resulting in the re-establishment of approximately 4,800 linear feet of stream channel. This segment of river had been highly modified and degraded from historic dredge boat mining and remaining spoils left onsite. Restoration of the natural channel form and reconnection of the stream to its floodplain and groundwater interaction, as well as large scale revegetation efforts, have enhanced riparian and wetland vegetation across the site. A new open bottom culvert bridge has eliminated a major fish barrier and now better accommodates a dynamic channel and annual peak flows. The project was specifically developed with the objectives of: 1) eliminating historic channelization, 2) reestablishing appropriate channel dimensions, pattern, and profile for the valley type, 3) restoring floodplain connectivity, 4) promoting bedform diversity, 5) restoring riparian/wetland vegetation to the floodplain.
4. Location	The project area is located in the upper Swan River drainage northeast of the Town of Breckenridge. The project area is centered at Latitude: 39.5232397° North, Longitude: -105.9662198° West in S ½ of Section 14, Township 6 South, Range 77 West, Summit County, Colorado.
5. Completion Date	Channel shaping, mass grading and seeding: November 2016; Nursery Plant (trees and shrubs) Installation: August 2017
6. Performance Standards Met	Monitoring to continue through 2022. This is Year 4 of the USACE specified 5-year monitoring requirement.
7. Corrective Actions	No corrective or remedial actions required.
8. Recommendations	No recommendations at this time.
Notes: a. This monitoring report has been completed in accordance with USACE RGL No. 08-03.	

ii. Monitoring Requirements

The USACE Permit requires submission of a brief annual monitoring report for a period of five years, beginning one year after the completion of project construction. Per permit requirements, monitoring reports shall include a narrative describing the status of both the channel restoration work and the success of the target objectives of the project.

Summary of Monitoring Protocol

In accordance with the Colorado Water Conservation Board (CWCB) Standard Operating Procedures (SOP) and US Army Corps of Engineers regional guidance, the goal and purpose of this monitoring protocol is to collect high quality, reproducible data that can be: 1) used to track and assess stream condition changes within the project site over time and 2) assess trends and assist in determination of restoration goals being met. As part of the USACE CWA 404 PCN it was clearly stated that the primary purpose of the project is restoration of aquatic resource function and services to a previously channelized section of the Swan River and valley ecosystem. The project intent was to reestablish natural channel functions and processes that originally occurred in the valley prior to the channelization and dredge mining. Restoration efforts focused on establishing a natural form of the channel, maintaining correct geomorphic parameters, reconnecting the stream to its floodplain, reestablishing groundwater interactions and developing appropriate biological characteristics as well as reclaiming the surrounding upland valley to a natural upland ecosystem.

The monitoring plan was designed to consider key elements related to the stream restoration and vegetation program. Restoration efforts included stream improvements on approximately 0.9 miles of the Swan River and over 25 acres of reclaimed land. The monitoring program is split into two categories: stream morphology and vegetation monitoring. It is intended to be used as a tool to evaluate the stability and natural evolution of the stream as it adjusts to flows and sediment loads as well as the development of riparian and upland habitats during the early stages of establishment to determine vegetation growth patterns and soil development using numerous methods of quantitative measurement.

Monitoring parameters are standards that are used to evaluate measurable aspects of the restored system. For the stream itself, four physical parameters were identified for monitoring. Five individual parameters were selected to monitor vegetation. Each element was selected based on its ability to effectively and cost efficiently measure trends of the restored system. Collection of this data on an annual basis will allow for direct comparison of the project condition and development over time. Each individual parameter, the method of data collection/measurement, and resulting data are summarized in **Tables 1 and 2** below. **Table 3** below provides a summary of the Habitat Suitability Index (HSI) methods of measurement and HSI parameter ranking for data collected for parameters *S-3. Sediment Sampling* and *S-4. Average Thalweg Depth.*

Table 1. Stream Parameters

Monitoring Parameters	Quantitative Method of Measurement	Resulting Data
S-1. Stream Profile	Profile topographic survey	Adjustments in stream profile over time
S-2. Stream Cross Sections	Cross sectional topographic survey	Information on lateral stability of channel
S-3. Sediment Sampling	Wohlman Pebble Counts	Gradation of channel substrate (HSI Score)
S-4. Average Thalweg Depth	Direct measure	Information on thalweg sustainability and indirect information on aquatic habitat quality (HSI Score)

Table 2. Vegetation Parameters

Monitoring Parameters	Quantitative Method of Measurement	Resulting Data
V-1. Upland Tree Assessment	Direct count	Percent Survival of Planted Trees, Growth and Overall Health
V-2. Upland Shrub Assessment	Direct count	Percent Survival of Planted Shrubs and Overall Health
V-3. Upland Herbaceous Vegetation Community Assessment	Plots	Herbaceous Cover and Species Composition
V-4. Riparian Shrub Community Assessment Along Outside Bends	Line intercept transect	Cover, Height and Species Composition
V-5. Soil Development	Laboratory analysis and soil profile description	Soil Nutrient/Organic Matter/Profile Development

Table 3. HSI Measurement Methods and Parameter Ranking

Parameter	Method of Measurement	HSI Parameter Ranking		
		Not Functioning (HSI Score ≤0.33)	**Functioning-at-Risk (HSI Score 0.34-0.66)**	**Functioning (HSI Score ≥0.67**
S-3. Sediment Sampling Sediment Transport and Substrate Conditions – Percent Fines in Riffle-runs (HSI V_{16})	A numeric score from 0 to 1.0 will be generated for the percent fines material (<3mm) determined from the Wohlman Pebble Count as part of each year's monitoring activities.	>47% fines in riffle-run	33-47% fines in riffle-run	<33% fines in riffle-run
S-4. Average Thalweg Depth Low Flow Channel Conditions (HSI V_4)	A numeric score from 0 to 1.0 based on average thalweg depth will be generated as part of each year's monitoring activities.	<22 cm	22-31 cm	>31 cm

iii. Summary Data

The following graphs, tables and photographs provide a summary of data collected as part of the monitoring requirements and protocol outlined above. This report is organized to follow the order of the above tables. Data forms used to collect the information in the field, detailed survey data, and photographs are provided in **Appendix A – 2020 Survey Data,** and **Appendix B – 2020 Vegetation Data**. Representative photographs of the Swan River stream channel that have been repeated from previous years are provided below in **Section iv. Visual Observation and Photo Documentation.** In addition, Summit County has established ten (10) permanent photo point locations around the project area. These photos provide a general overview and condition of the site which are generally situated at vantage points on adjacent hillsides located outside of the project disturbance area. These locations are depicted on the **Monitoring Map (Section v. Maps)** and the photos are enclosed in **Appendix C – 2020 Summit County Photo Points.**

S-1. Stream Profile

The longitudinal stream profile provides a good indication of overall channel adjustments over time. Areas of aggradation and degradation can be identified through comparison of repeated profile surveys. Longitudinal profile surveys also provide direct information on the presence and evolution of channel bedform including riffles, pools and glides.

Field Method

A continuous longitudinal profile survey was completed along the thalweg (deepest portion of the channel) through the project reach. Survey points were collected via level loop survey and a hand-held GPS receiver along the entire channel profile at key grade breaks and bed features. All surveys were completed using a relative elevation. Each annual survey is tied into existing control points that have been previously established. Generally, the same survey point locations have been used each year to maintain consistency.

Evaluating Results

The restored system is intended to be able to function as a natural stream. This means that except on the upstream and downstream ends of the restored reach and at the bridge crossing, no artificial means were included to lock the channel in place. Rather the stream was designed and constructed to allow it to evolve in response to flow and sediment load in the way that a natural channel would. With the project intended natural channel design, local adjustments to the channel profile are expected from year to year.

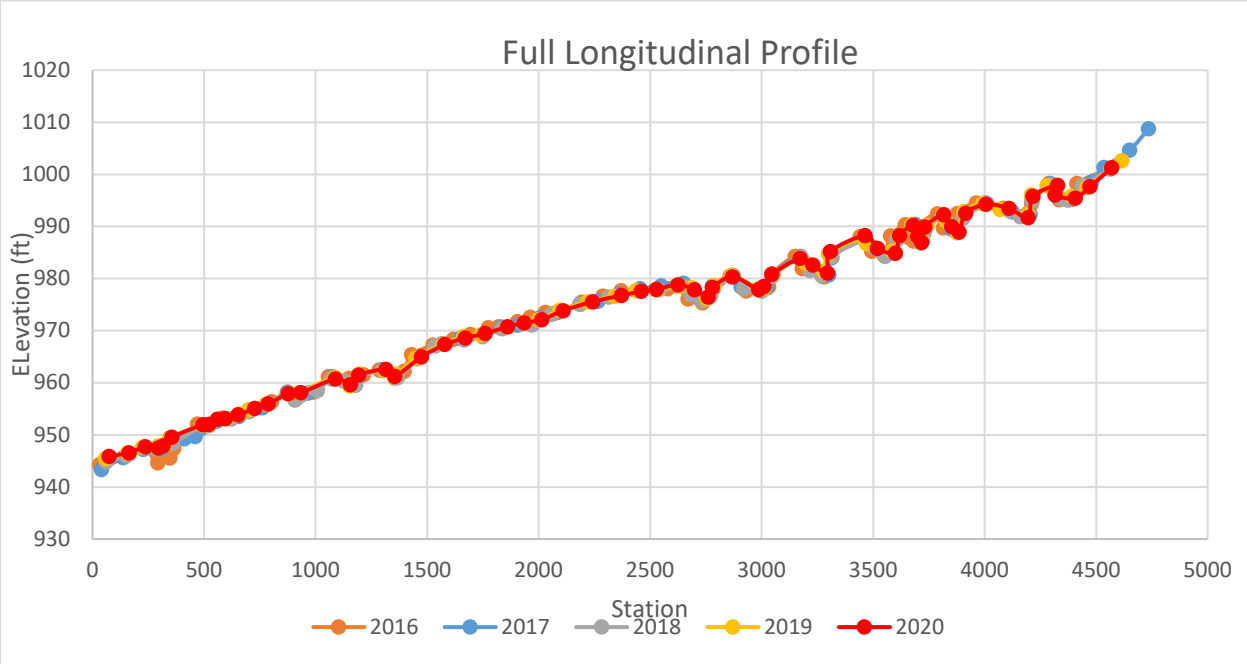
The channel profile provides a good indication of the overall channel bed stability and bed form diversity. The restoration will be viewed successful if, over time, the constructed profile remains relatively constant, exhibits no unnatural areas of aggradation or degradation and maintains bed form diversity. The Reach 1 channel profile results from 2016 (As-Built), 2017 (Year 1), 2018 (Year 2), 2019 (Year 3), and 2020 (Year 4) are presented in **Graph 1** below. **Graphs 2-4** provide more detailed data for the downstream, middle and upstream reaches of the restored river. From survey results, the following general conclusions can be drawn:

- The pool that was initially constructed around Station 3+00 filled in from 2016 to 2017 and then has remained stable from 2017 to 2020.

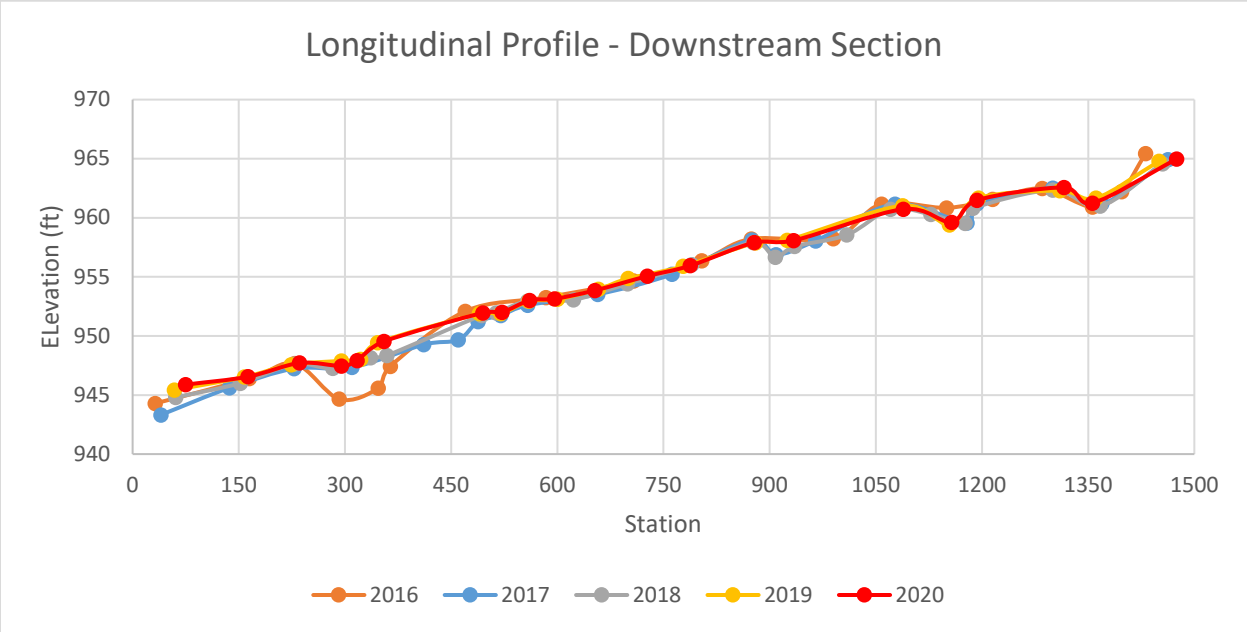
- The grade control downstream of the bridge at approximately Station 4+60 appears to have lowered a minor amount from 2016 to 2017 and then remained stable from 2017 to 2020.
- The reach upstream of the bridge from Station 5+00 to approximately Station 16+50 has remained stable from 2016 to 2020.
- The reach from Station 16+50 to 20+00 generally appears to have lowered a minor amount from 2016 to 2017, and then remained stable from 2017 to 2020.
- The reach from Station 20+00 to 26+00 has elevations that are very similar in 2020 to what they were in 2016. Some minor aggradation that was picked up in the 2017 survey from Station 24+00 to 26+00 was not evident in the 2018, 2019, or 2020 surveys.
- The glide in the vicinity of Station 27+00 showed some filling from 2016 to 2017. Those elevations have decreased slightly in 2020.
- Survey results show only negligible difference in any of the four surveys from Station 28+00 to Station 31+50.
- Surveys from Station 31+50 to the upstream end of the project show nearly identical results from 2017 to 2020. Results of the 2016 survey show nearly identical elevations of the riffles and pools in this section, however between Stations 31+50 and 39+75 the 2016 results are shifted downstream by about 35 feet. Given how similar the 2017, 2018, 2019, and 2020 results are, how closely the 2016 results match the elevations from the other two years and visual observations it is believed that the 2016 results don't accurately capture stationing in this range. It is therefore believed that the stream profile has remained very stable from Station 31+50 to the upstream end of the project.

Complete survey data including detailed tables showing stationing and relative elevations are enclosed as **Appendix A**, **Table 1.**

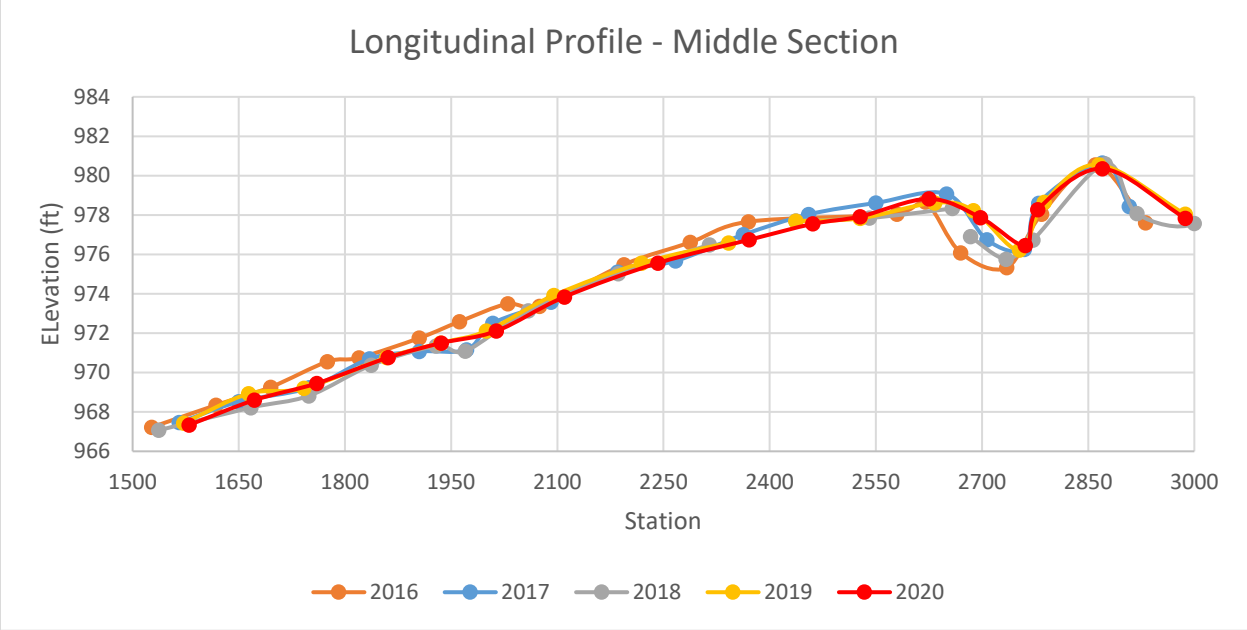
Graph 1. Longitudinal Profile of Full Restoration Reach



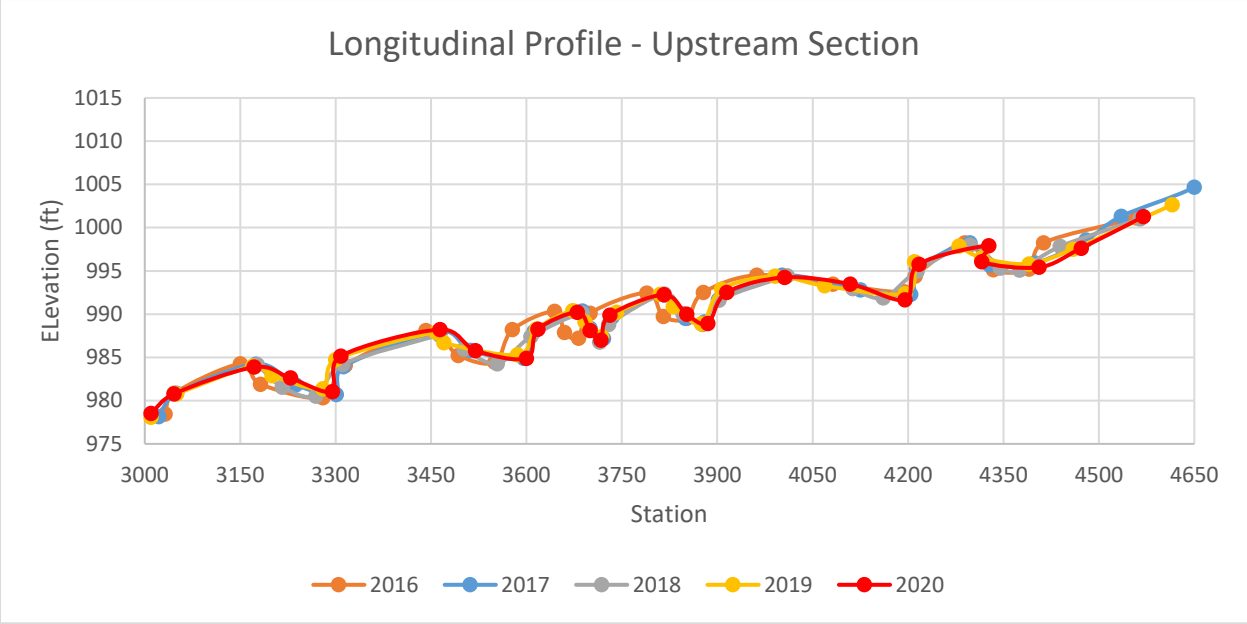
Graph 2. Longitudinal Profile of Downstream Section



Graph 3. Longitudinal Profile of Middle Section



Graph 4. Longitudinal Profile of Upstream Section



In order to better quantify changes in the longitudinal profile, elevations at distinct locations were compared from one survey to the other. Given that riffles are the channel element that is expected to be the most stable while pool and glide elevations respond to changes in sediment loads, riffles were selected as the elements that best represent actual elevation change that may be occurring. The elevation of the ten (10) constructed riffles at their upstream ends (riffle beginnings) were therefore used in the evaluation. Since formal riffles were not included between Station 5+00 and 27+00, points along the channel through this segment were also included. In the reach from Station 5+00 to 27+00 points were selected in the transition area from a left to a right bend and from a right to a left bend. These areas are most similar to a riffle and therefore they were judged to be appropriate for this comparison. **Table 4** presents the surveyed elevation at these points from the three surveys and compares results across the three survey events.

The numeric results indicate that on average there is very little change from year to year in the profile. The largest variations that have occurred from 2016 to 2020 are at Stations 16+50 (0.6-foot increase), 20+75 (0.4-foot increase), and 42+95 (0.4-foot decrease). All other points were within +/- 0.3 feet from the as-built condition. The magnitude of all changes is small, particularly given the limits of accuracy when surveying on cobble sized material. Any changes are very minor and indicate that the channel profile has remained stable.

Table 4. Tabulated Comparison of Elevations Between Surveys

ID	Approx. Station	2016	2017	2018	2019	2020	2016-2017	2017-2018	2018-2019	2019-2020	2016-2020
RB-10	225	947.7	947.2	947.6	947.6	947.7	-0.5	+0.4	0.0	+0.1	0.0
RB-9	470	952.1	951.2	951.7	951.9	952.0	-0.9	+0.5	+0.2	+0.1	-0.1
Pt Along Channel	875	958.2	958.1	957.9	957.9	957.9	-0.1	-0.2	-0.3	0.0	-0.3
Pt Along Channel	1300	962.5	962.5	962.4	962.3	962.6	0.0	-0.1	-0.1	+0.3	+0.1
Pt Along Channel	1650	968.0	968.5	968.1	968.9	968.6	+0.5	-0.4	+0.8	-0.3	+0.6
Pt Along Channel	1835	970.8	970.7	970.4	970.8	970.8	-0.1	-0.3	+0.4	0.0	0.0
Pt Along Channel	2075	973.4	973.6	973.1	973.9	973.8	+0.2	-0.5	+0.8	-0.1	+0.4
Pt Along Channel	2450	977.8	978.0	977.7	977.7	977.5	+0.2	-0.3	0.0	-0.2	-0.3
Pt Along Channel	2550	978.1	978.6	977.9	977.8	977.9	+0.5	-0.7	-0.1	-0.1	-0.2
RB-8	2860	980.5	980.7	980.6	980.6	980.4	+0.2	-0.1	0.0	-0.2	-0.1
RB-7	3160	984.2	984.2	984.2	984.0	983.9	0.0	0.0	-0.2	-0.1	+0.3
RB-6	3460	988.1	988.0	987.6	987.9	988.2	-0.1	-0.4	+0.3	+0.3	+0.1
RB-5	3690	990.3	990.4	990.1	990.4	990.2	+0.1	-0.3	+0.3	-0.2	-0.1
RB-4	3820	992.5	992.2	992.3	992.3	992.2	-0.3	+0.1	0.0	-0.1	-0.3
RB-3	4005	994.5	994.5	994.4	994.4	994.3	0.0	-0.1	0.0	-0.1	-0.2
RB-2	4295	998.3	998.2	998.0	997.9	997.9	-0.1	-0.2	-0.1	0.0	-0.4
RB-1	4555	1001.1	1001.3	1001.0	1001.0	1001.2	+0.2	-0.3	0.0	+0.2	+0.1
Average for All Points							-0.01	-0.2	0.1	-0.02	-0.02
Average for All Riffle Beginnings							-0.1	-0.04	0.05	-0.02	-0.07

S-2. Stream Cross Sections

Stability of stream cross sections provide information on the lateral stability of a stream. Widening over time is a sign of lateral instability and typically is associated with degradation while stream narrowing may be a sign of aggradation. Information on cross sections when taken in conjunction with a longitudinal profile provides a good indication of stream movement trends.

Field Method

Four permanent channel cross sectional monitoring locations were established by installing rebar set in concrete at the ground surface along the banks to denote the surveyed locations. The elevations along the cross sections were tied into a relative datum (CP-1) to allow for comparison from year to year. The elevations of the rebar locations (RB Pins and LB Pins in Appendix A) have remained consistent from year to year and any variation is due to sampling error. Cross section locations are recorded on the **Monitoring**

Map (Section v. Maps) and survey data compiled into an excel file table and graphed. Elevation control was established as part of the cross section survey. Nine (9) elevation control points were established in the field (2-per each cross-section on opposite banks and a separate control point (CP-1)) that are tied to the construction and design elevations. Control points consist of 2-foot rebar set in concrete into the ground surface. Control points are identified and labeled in the field and GPS mapped and depicted on the **Monitoring Map (Section v. Maps)**.

Evaluating Results

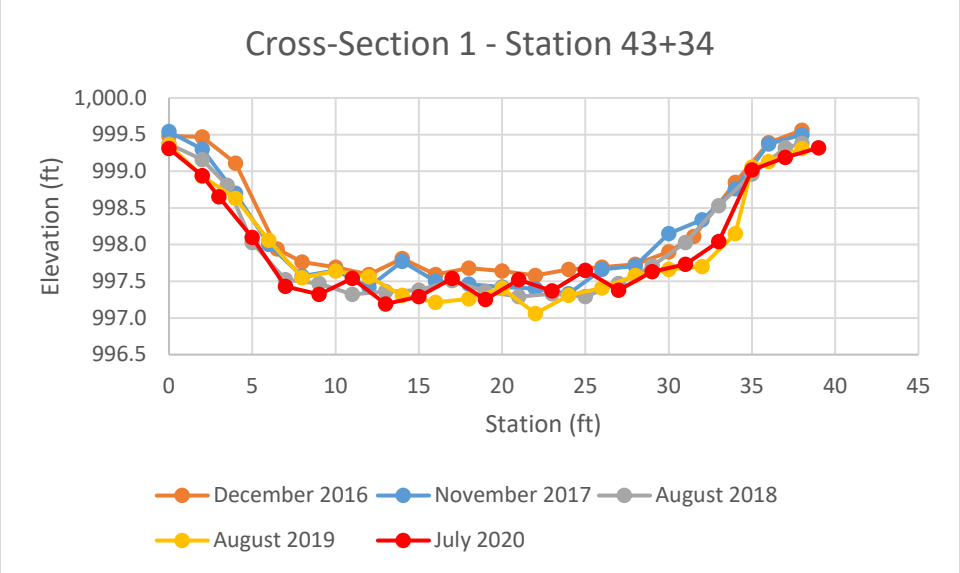
As summarized in Parameter S-1 artificial means were not employed to lock the channel in place and the stream was designed and constructed to allow it to evolve in response to flow and sediment load in the way that a natural channel would. With the project-intended natural channel design, local adjustments to the channel cross section are expected from year to year. This is especially true from the 2016 to 2017 surveys as this was the time when the natural system (flows, sediment, substrate, and overall stream gradient) adjusted to the constructed system and in years like 2019-2020 where higher than average flows occur. The channel profile provides a good indication of the overall channel bed stability and bed form diversity. The restoration will be viewed successful if, over time, the new channel cross sections maintain the general dimensions as designed and represent cross sections of a natural channel.

Results of each surveyed cross section have been tabulated showing station (from the permanent cross section bank point – rebar on each bank) and elevation. The 2020 results have been plotted and compared to results from years 2016, 2017, 2018, and 2019 to identify temporal trends in **Graphs 5, 6, 7,** and **8** below. Detailed tables providing cross section data such as stationing and elevation is enclosed as **Appendix A, Tables 2-5.**

- Cross Section 1 has remained generally stable from 2016 through 2020. Some minor amounts of bank steepening occurred in 2020 along the left bank between cross section stations 3 and 7, but the overall channel width remains unchanged.
- Cross Section 2 had aggraded a maximum of about 0.9 feet from 2016 to 2018. Following the higher flows of 2019-2020, the cross section scoured minor amounts reverting back to approximately the as-built conditions. The location of the thalweg in Cross Section 2 moved away from the right bank towards the left bank of the channel.
- Cross Section 3 has aggraded of approximately 0.8 feet from 2019 to 2020. The slope of the right bank decreased as a result of localized deposition.
- Cross Section 4 results from the 2020 survey are very similar to all of the previous surveys. The cross section has been stable with only minor local differences in points along the invert.

Overall, the surveyed cross-sections indicate that the stream has been stable in a lateral direction. Only minor adjustments have occurred since construction.

Graph 5. Cross Section 1 Survey

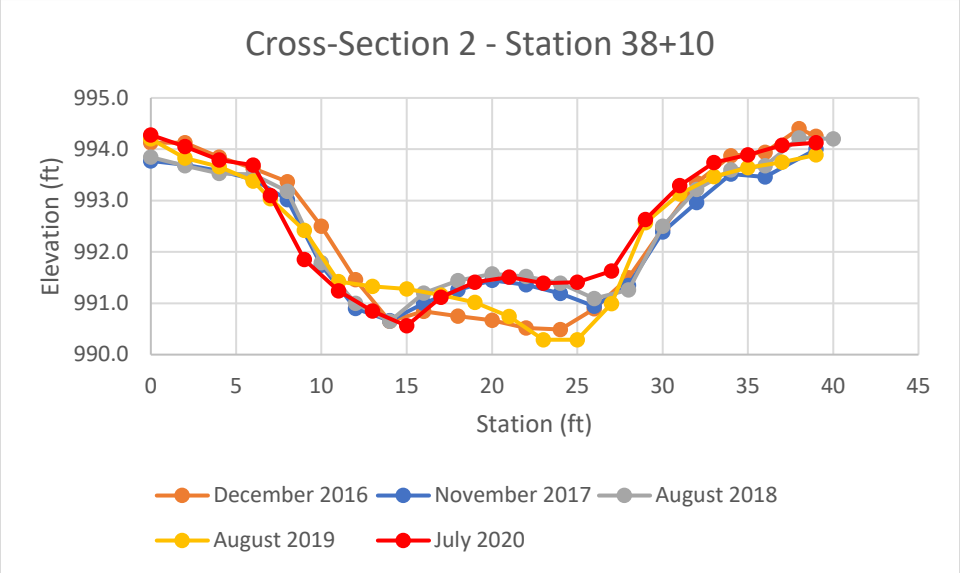


PHOTOS:

Photo 1. View from the right bank looking west towards the left bank at Cross Section 1 (XS-1). July 2020.

Photo 2. View looking downstream from the left bank at XS-1. Aug 2019

Graph 6. Cross Section 2 Survey

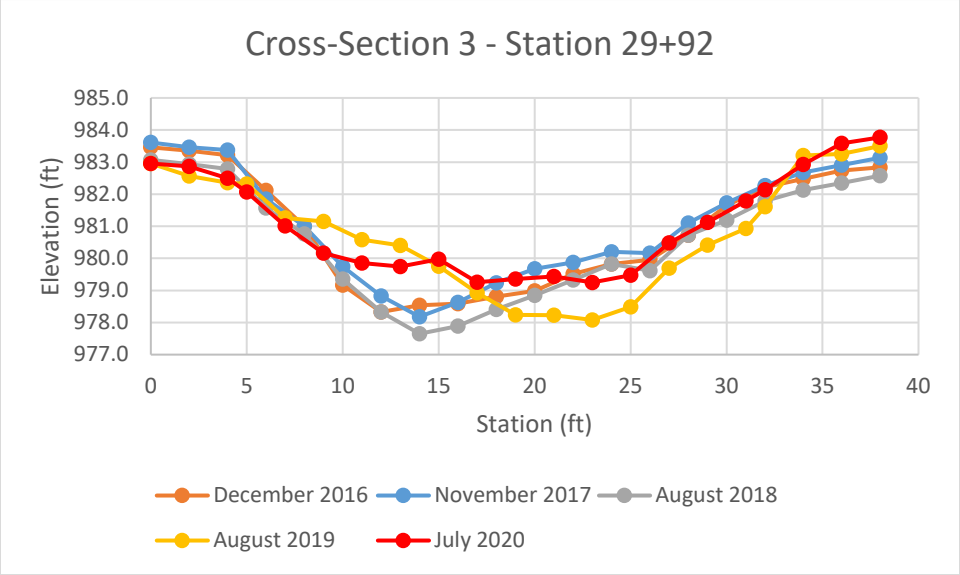


PHOTOS:

Photo 3. View from the left bank looking north towards the right bank at Cross Section 2 (XS-2). July 2020

Photo 4. View looking upstream from the left bank at XS-2. July 2020.

Graph 7. Cross Section 3 Survey

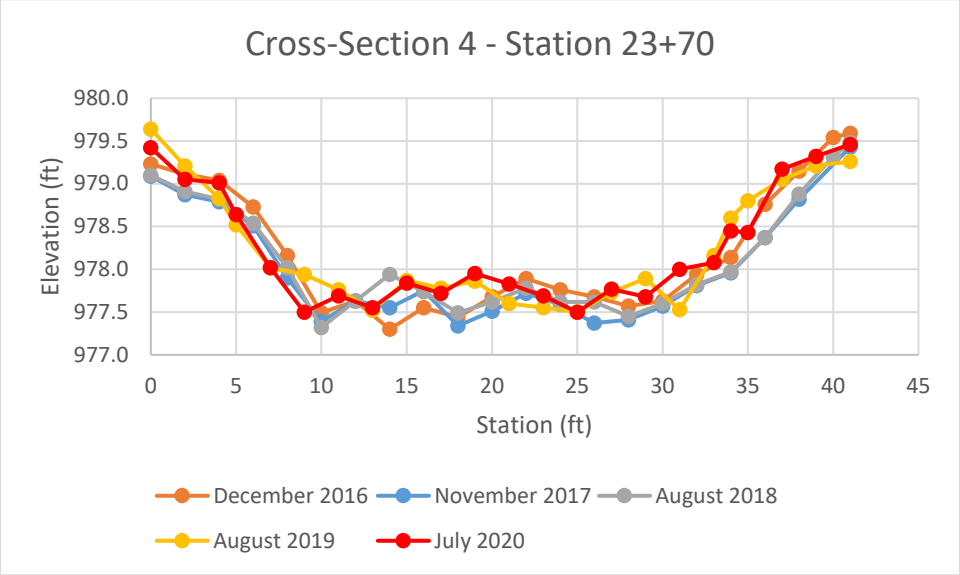


PHOTOS:

Photo 5. View from the right bank looking south towards the left bank at Cross Section 3 (XS-3). Aug 2019

Photo 6. View looking downstream from the left bank at XS-3. Aug 2019

Graph 8. Cross Section 4 Survey



PHOTOS:

Photo 7. View from the left bank looking north towards the right bank at Cross Section 4 (XS-4). July 2020

Photo 8. View looking upstream from the left bank at XS-4. July 2020

S-3. Sediment Sampling

Sediment size provides an indication of materials that are transported and deposited as part of the natural fluvial processes of a stream. Monitoring sediment size provides insight into potential erosion or armoring that may occur in the stream. 2018 was the first year that sediment sampling was part of the monitoring program, so the 2018 results established the baseline for comparison with this year's results and future monitoring.

Field Method

This parameter was evaluated in the field using Wohlman pebble counts. Sediment samples were collected at 4 locations within the length of the restored reach. Approximately 200+ randomly selected samples were collected at each location using a 1' x 1' grid. The surveyor blindly selects 4 samples from each grid (1 at each corner) while traversing the riffle from downstream to upstream. This sediment sampling method follows procedures outlined in Sampling Surface and Subsurface Particle-Size Distributions in Wadable Gravel- and Cobble-Bed Streams for Analysis in Sediment Transport, Hydraulics, and Streambed Monitoring (Bunte and Abt 2001). This method is applicable for stream beds with gravel and sand-sized material.

Evaluating Results

From the pebble count results, a gradation curve was created of the bed material at each site (provided as **Graphs 9, 10, 11,** and **12** below). The graphs show the substrate distribution at each location. The average material size (D50) was determined from this data and an HSI score was quantified from the percent fines. This data is displayed below. These results will be tabulated for comparison with subsequent monitoring periods. More detailed pebble count information is provided in **Appendix A – S-3.**

Based on gradations, substrate material at all locations classifies as well graded coarse-grained gravel. Minimal fines observed result in a high HSI score of 1, which indicates that from a sediment standpoint the riffle sections are fully functional (See **Figure 1** below). A comparison of gradations from the pebble count show a slight trend of having slightly less coarse material at the surface in 2020 than in 2019. This minor change could be the result of some coarser material being transported out of the reach during the return to more normal flows of 2020.

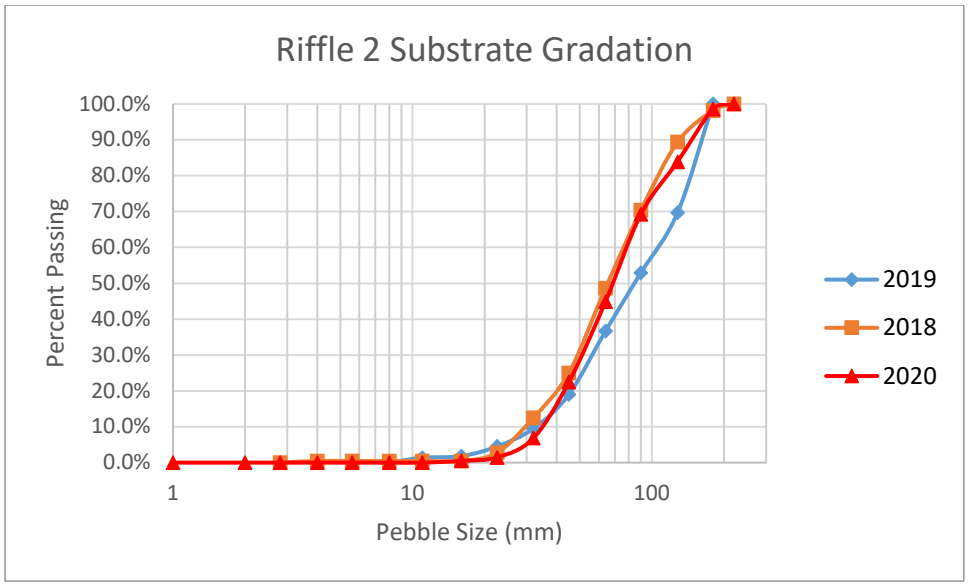
Table 5. D_{50} Material and Percent Fines at Sediment Sampling Locations

Site Name	Location (Approx. Station)	2018 D_{50} (mm)	2018 % Fines (2.8 mm)	2019 D_{50} (mm)	2019 % Fines (2.8 mm)	2020 D_{50} (mm)	2020 % Fines (2.8 mm)
Riffle 2	42+50	70.5	0%	85.3	0%	95.0	%0.5
Riffle 4	37+50	50.7	0%	44.1	0%	44.4	%0
Riffle 6	33+50	46.5	0.5%	37.1	0%	49.2	%0
N/A	12+00	59.2	0%	44.9	0%	51.0	%0.5

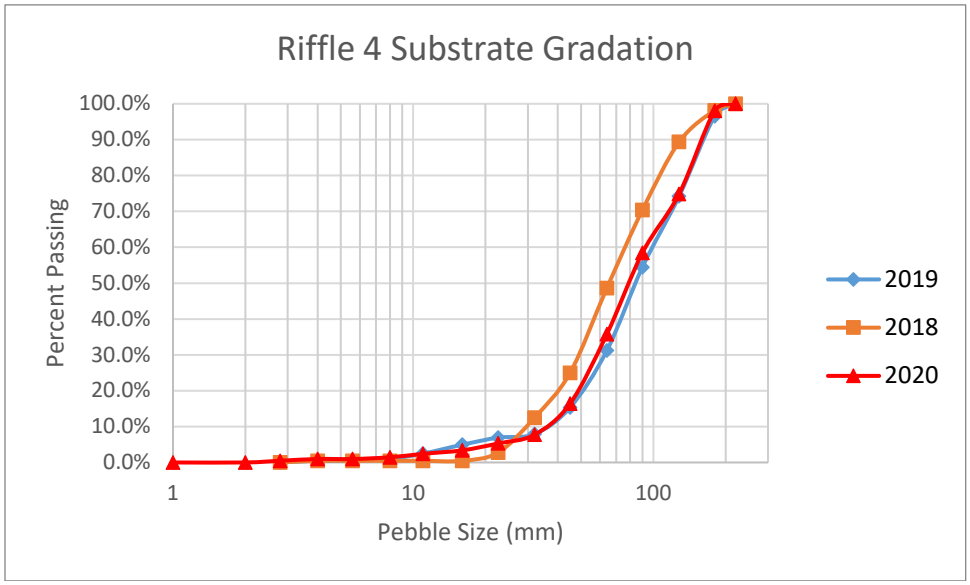
Table 6. Habitat Suitability Score for Percent Fines

Summary Measurements	2018	2019	2020	HSI Parameter Ranking (See Table 3)
Average % Fines (<3mm): (Assume 2.8 mm)	0.1%	0.0%	0.4%	-
Total Riffle Lengths:	292 ft	292 ft	292 ft	-
HSI Score	**1**	**1**	**1**	**Functioning (HSI Score ≥ 0.67)**

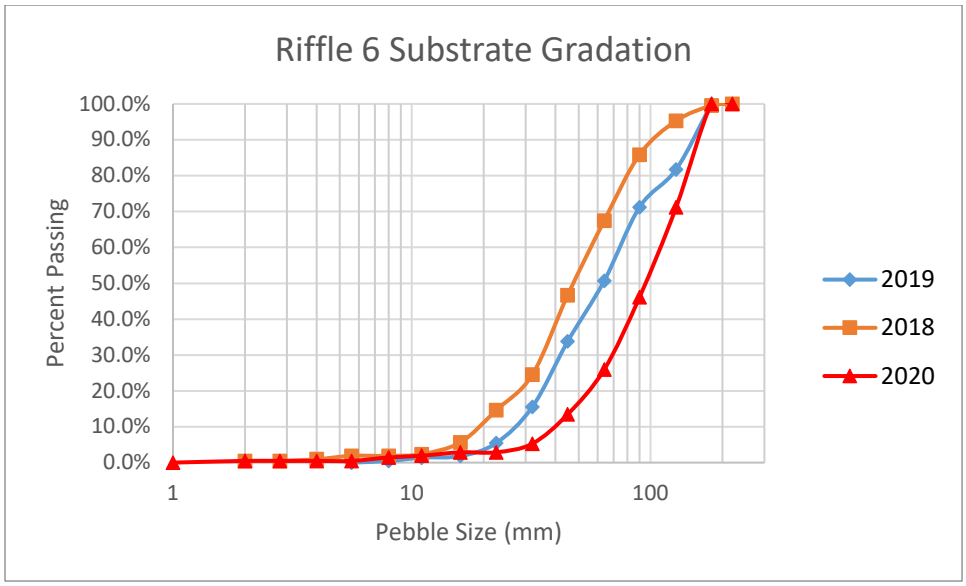
Graph 9. Gradations at Riffle 2



Graph 10. Gradations at Riffle 4



Graph 11. Gradations at Riffle 6



Graph 12. Gradations at Station 12+00

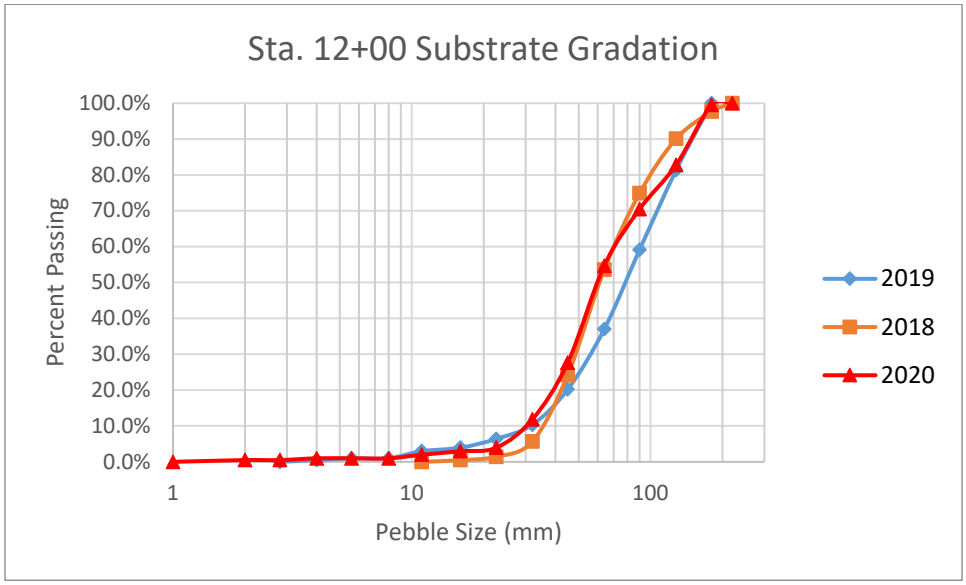
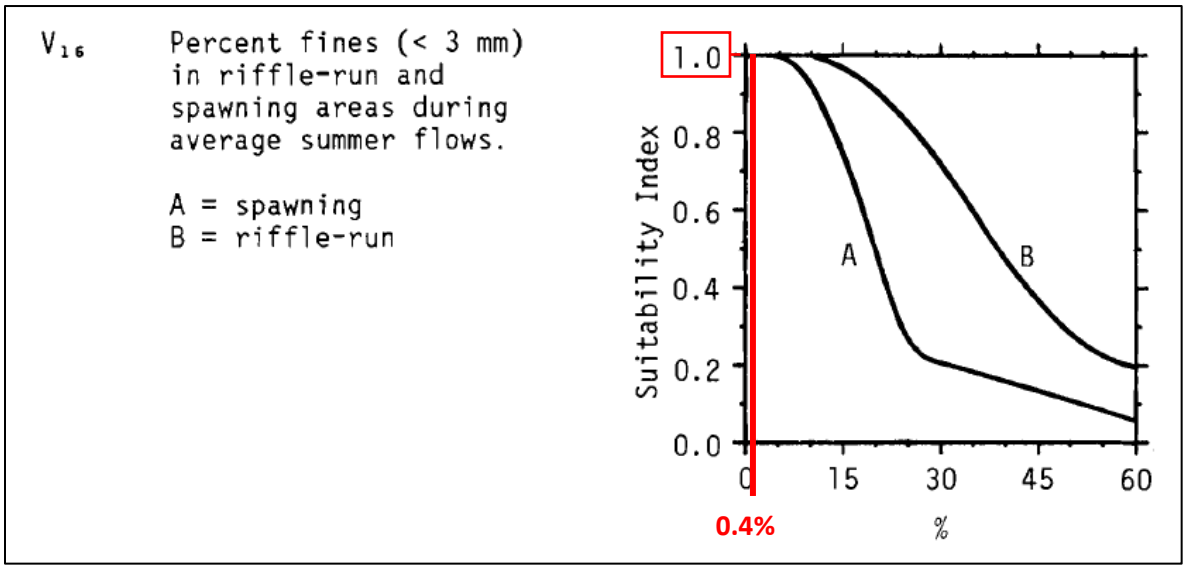


Figure 1. Sediment Transport and Substrate Conditions - Percent Fines in Riffle- runs (HSI V_{16})



S-4. Thalweg Depth

Thalweg depth is both a direct measurement of whether the stream forms a predominant low flow area within the active channel and an indirect measurement of usable aquatic habitat. Evaluating depth of the thalweg during low flow conditions provides information on the sustainability of the constructed low flow channel and illustrates trends in aquatic habitat. 2018 was the first year that thalweg depth was part of the monitoring program, so the 2018 results established the baseline for comparison with the 2019, 2020, and future monitoring.

Field Method

To assess this parameter ERC has measured the channel depth (measured from the stream bottom to the water surface) at the stream's thalweg at 50-foot increments. Measurements started at the upstream end of the channel and proceeded downstream.

Evaluating Results

Results have been tabulated showing river station and thalweg depth in **Graph 13** below. The average thalweg depth over the entire project reach was quantified and this value has been assigned an HSI score based on data published by US Fish and Wildlife Service (**Table 3**). Average thalweg depth and HSI score are provided below. More detailed information such as stationing and thalweg depth are provided in **Appendix A – S-4, Table 6.**

The average thalweg depth was measured to be 1.4 feet in 2018, 1.5 feet in 2019 and 1.5 feet in 2020 based on the 93 points sampled. This corresponds to an HSI score of 0.99 and indicates that the stream is fully functional based on this parameter (See **Figure 2** below). The HSI score of 0.99 is a slight increase from the 2018 HSI score of 0.95. The change is very minor but indicates that the project continues to provide excellent overall thalweg depth. **Graph 13** shows that the special distribution of thalweg depths was very consistent from 2018 to 2020 with the deepest pools located between Station 25+00 to 45+00.

The consistency in depths following the high flows of 2019 are another indication of overall channel stability.

Graph 13. Thalweg Depth Along Restored Reach

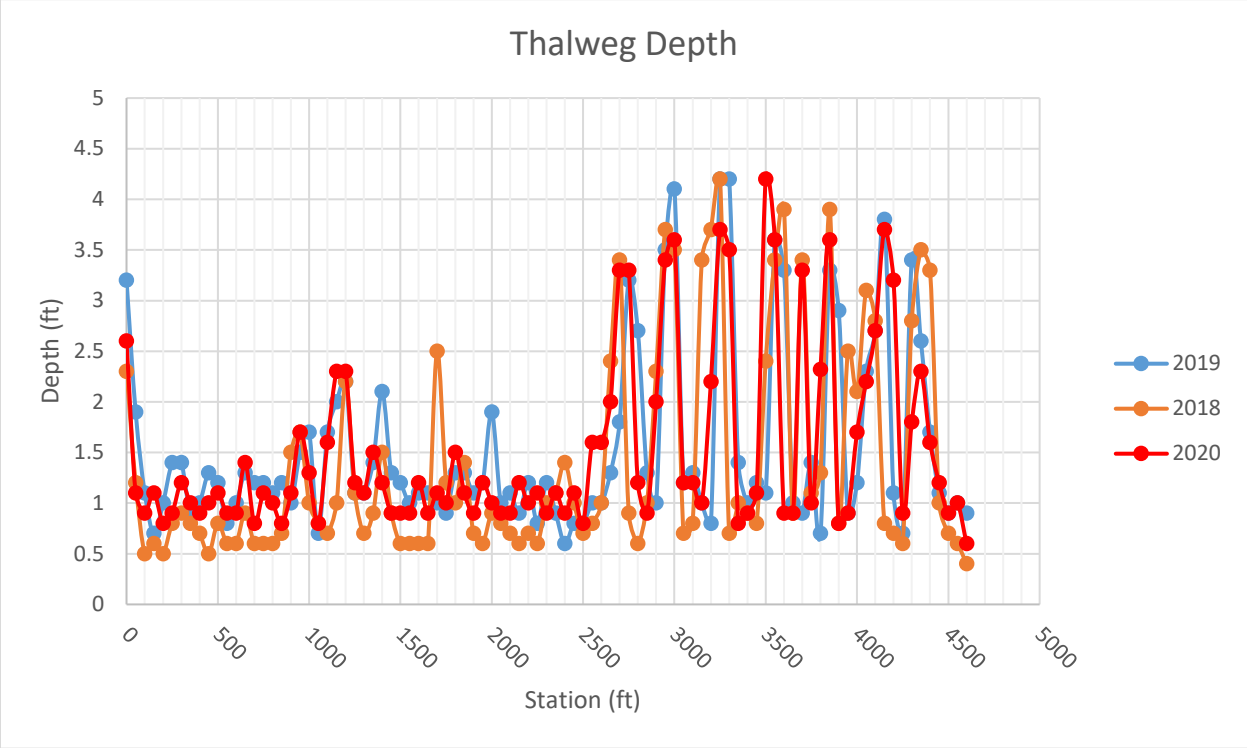
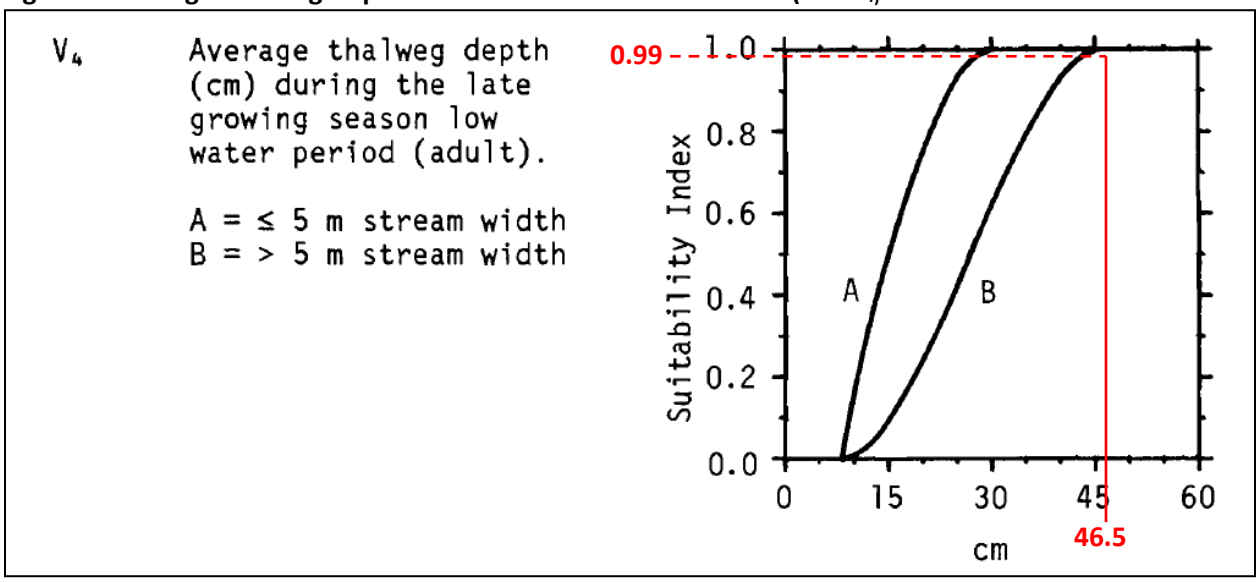


Table 7. Average Thalweg Depth

	2018	2019	2020	HSI Parameter Ranking (See
Average	1.4 ft. (42.4 cm)	1.5 ft. (46.8 cm)	1.5 ft. (46.5 cm)	Functioning (>31 cm)
HSI Score	**0.95**	**0.99**	**0.99**	Functioning (HSI Score ≥ 0.67)

Figure 2. Average Thalweg Depth - Low Flow Channel Conditions (HSI $V_{4)}$



V-1. Upland Tree Assessment

Project objectives for monitoring planted vegetation are plant survival, growth and overall plant health or vigor. For this project, the monitoring method for assessing survivorship will be direct count, as it results in the most accurate site-scale information. Additional information collected will include data on growth and overall plant health or vigor. As part of this project 65 (nursery supplied balled and burlapped) trees were installed in July 2017 and the first year of monitoring was 2018.

Field Method

A direct count of all planted trees was performed across the entire project site. The site was traversed, and a direct count of each tree was completed and recorded. Plant vigor was evaluated for each tree and rated using a scale of 1 to 3 with a value of 1 = Alive, 2 = Stressed, and 3 = Dead. An "Alive" rating was assigned if the plant had no signs of desiccation or obvious risk of mortality. A "Stressed" rating was given to plants displaying obvious signs of desiccation, animal or insect damage, unseasonable browning or curling leaves, disease, or other obvious stress indications. A "Dead" rating was assigned if mortality has occurred, or plants were not present above ground.

To assess plant growth, approximately 20% of the planted trees were tagged in the field for identification during subsequent monitoring events and long-term monitoring. Trees to be tagged were randomly selected prior to field monitoring work which included aspen trees (total of 6 trees) and spruce trees (total of 6 trees). Trunk diameter at breast height (dbh) (at approximately 54 inches above the ground) and tree height was measured and recorded for a total of 12 tagged trees across the site which are shown on the **Monitoring Map (Section v. Maps)** and summarized below in **Table 9**.

Evaluating Results

Data collected was used to calculate the percent survival of planted trees across the site, growth, and overall health. **Table 8** below displays the percent survival and total number of trees in each rating of planted trees which is based on the plant vigor scale described above. The assessment identified 65 total planted trees across the site, of which 12 were tagged for long term monitoring and are displayed below in **Table 9**. Detailed information on all 65 trees observed is enclosed as **Table 1** in **Appendix B -V-1**.

2020 results indicate exceptional survival rate of 89.2% for planted trees given the harsh high altitude environment and limited ability for care and maintenance. Of the 89.2% survival rate, 15.4% were identified as "Stressed". These trees exhibit sparse reproductive structures and canopy; however, still appear healthy and will likely survive long term. Overall, the majority of the trees have survived three full growing seasons and winters. Plant growth data for the 12 tagged trees shows that the majority of trees are increasing in size (DBH and Height) with an average total increase of 0.51 inches in DBH per tree and an average total of 3-foot increase per tree in height from 2018 to 2020.

Table 8. Overall Percent Survival of Planted Trees Across the Site.

Vigor Rating	% of Trees Across the Site	# of Trees Across the Site
1 "Alive"	73.8%	48
2 "Stressed"	15.4%	10
3 "Dead"	10.8%	7

Table 9. Plant Growth (12 Tagged Trees)

Plant Survival				Plant Growth	
Plot ID	**Species**	**Vigor**	**Comments**	**DBH (in)**	**Height (ft)**
A1	POTR	1	Good condition	1.9	16
A2	POTR	1	Good condition	2.5	6
A3	POTR	1	Good condition	2.5	22
A5	POTR	2	Good condition	4.5* (4 trunks)	16
A7	POTR	1	Good condition	3.7* (2 trunks)	14
A10	POTR	1	Dead growth in upper portion	2.8	20
S2	PIPU	1	Good condition	2.7	10
S3	PIPU	1	Good condition	2.8	10
S4	PIPU	1	Excellent condition	3.4	11
S6	PIPU	1	Good condition	2.3	10
S8	PIPU	1	Good condition	3.4	10
S11	PIPU	1	Good condition	3.0	9

*indicates tree trunk branching at measured height – total dbh inches is displayed as a sum of measured trunks – number of trunks measured for these specific trees is displayed above.

Vigor Code
1 = Alive
2 = Stressed
3 = Dead

Species Code
PIPU = *Picea pungens* (Colorado blue spruce)
POTR = *Populus tremuloides* (Quaking aspen)

V-2. Upland Shrub Assessment

The upland shrub assessment generally follows the same methods outlined in parameter V-1 (Upland Tree Assessment) for assessing survivorship of planted upland shrubs (nursery supplied #5) such as a direct count which includes data on growth and overall plant health and vigor. As part of this project uplands, 150 shrubs were installed in July 2017 and the first year of monitoring was 2018.

Field Method

Plant survival rates were determined for a subset of the shrubs planted (approximately 30%). Shrub pockets were randomly selected prior to the field monitoring work and included woods' rose pockets

(total of 20 shrubs) and sagebrush pockets (total of 31 shrubs) (51 total shrubs). Each evaluated shrub pocket is shown on the **Monitoring Map (Section v. Maps)**. Plant vigor was evaluated for the shrubs. Ratings used a scale of 1 to 3 with a value of 1=alive, 2=stressed, 3=dead. The surveyor assigns an "alive" rating if the plant had no signs of desiccation or obvious risk of mortality. A "stressed" rating is given to plants displaying obvious signs of desiccation, animal or insect damage, unseasonable browning or curling leaves, disease, or other obvious stress indications. Plants are assigned a "dead" rating when mortality had occurred, or plants were not present above ground. Plant growth was evaluated by assigning each shrub into a height class with L = Low (0.5 - <1.5 ft. height), M = Medium (1.5 - <4.5 ft. height), T = Tall (4.5 - <8 ft. height), and VT = Very Tall (8 ft. + height).

Evaluating Results

Data collected from the assessment was used to calculate the percent survival of approximately 30% of the planted upland shrubs across the site and overall health and vigor. **Table 10** below displays the percent survival of the planted upland shrubs which is based on the plant vigor scale described above. **Table 11** below provides the percent of evaluated shrubs in each height class (plant growth) described above. This assessment includes 51 total upland shrubs across the site, this number is only a subset (approximately 30%) of the total shrubs planted. Therefore, approximately 70% of the total shrubs planted were not included in this assessment due to budget and time constraints. Shrubs not included in this assessment appeared to exhibit similar vigor and growth as those evaluated by this assessment. Detailed information on individual shrubs included in this assessment is provided in **Appendix B – V-2**.

2020 results indicate a survival rate of 70.6% for planted upland shrubs. A majority of the upland shrubs have survived three full growing seasons and winters. Stressed shrubs appear to be drying and watering may be required until full establishment. Shrub vigor has declined from 2018 to 2020; however, plant growth has shown an increase from 2018 with a 17.7% increase in shrubs in the "Medium" height class and a 17.6% increase in shrubs in the "Tall" height class which indicates shrubs are becoming established and maturing. As shrubs mature and become more established, percent and height class are anticipated to further increase as we have seen from 2018 to 2020.

Table 10. Overall Percent Survival of Planted Shrubs Across the Site.

Vigor Rating	% of Shrubs Across the Site	# of Shrubs Across the Site
1 "Alive"	47.1%	24
2 "Stressed"	23.5%	12
3 "Dead"	29.4%	15

Table 11. Plant Growth

Height Class	% of Shrubs Across the Site	# of Shrubs Across the Site
L (Low) – (0.5 - <1.5 ft. height)	25.5%	13
M (Medium) – (1.5 - <4.5 ft. height)	51.0%	26
T (Tall) (4.5 - <8 ft. height)	23.5%	12
VT (Very Tall) (8 ft.+ height)	0%	0

V-3. Upland Herbaceous Community Assessment

Monitoring of upland herbaceous cover included the establishment of four permanent test plots which were placed in locations that best represent the overall condition of particular habitats across the site. The first year of monitoring was 2018.

Field Method

Four permanent test plot locations were established in randomly selected locations for monitoring the upland herbaceous vegetation community. One test plot (TP3) was selected in a riparian area in the western end of the project reach. The test plots were clearly marked in the field by cemented rebar into the ground surface and marked with location information. These test plot locations are depicted on the **Monitoring Map (Section v. Maps)** as TP1, TP2, TP3, and TP4. A test area was established within a 20-foot radius of each test point. Each test area was divided into four equal quadrangles beginning with the 12 o'clock position at due north. A 2 foot by 2-foot quadrat was utilized for evaluating ground cover plant establishment. The quadrat was randomly tossed into each quadrangle beginning in quadrangle one and proceeding clockwise. Upon random placement of the quadrat in the quadrangle, the vegetation within the limits of the quadrant was evaluated. The upland areas were traversed and examined for any noticeable problems (i.e., erosion, sedimentation, weed infestation, vandalism, herbivory, plant stress). General vegetation development, plant health, hydrologic condition and general functional quality were documented.

Evaluating Results

Data collected as part of this assessment included: overall percent vegetative cover, species present (diversity), percent coverage of each species, and general health and vigor of species present for each quadrat (4) at each test plot (4) (16 quadrats total). **Table 12** below provides a summary of the total average percent ground cover and general health and vigor at each test plot location. More detailed information such as species present, % cover in each quadrat, soil profile descriptions, photo documentation, and general comments is provided on field data forms in **Appendix B – V-3**.

The herbaceous ground cover is developing well. With an average ground cover of 45.9% after three full growing seasons it is anticipated % ground cover will continue to increase over the next few growing seasons as root mass matures and plants reseed. Average ground cover has increased 6.9% from 2018 to 2020; however, given the harsh high-altitude environment and short growing season any increase is viewed as successful. Test plot samplings indicate that at least 7 different grass species are present and developing as the planned community in 2020, an increase of 2 species from the 2018 monitoring.

Table 12. Total Average Percent Ground Cover and Plant Health & Vigor at Each Test Plot

Test Plot ID	Total Average % Ground Cover	Health & Vigor*
TP1	50%	Good
TP2	40%	Good
TP3 (Riparian)	76.25%	Good
TP4	17.25%	Good

**Health and vigor based on the following criteria:*

Good *(G) – Vegetation is robust and exhibits reproductive structures on most species within the quadrat, indicating it has undergone a full growth cycle during the first growing season.*
Fair *(F) – Overall vegetative growth is stunted and/or stressed, very few reproductive structures present, indicating initial growth took place late in the growing season. Overall root establishment appears to be good.*
Poor *(P) – Vegetation is in early stages of growth and is limited to sporadic patches within the quadrat. No reproductive structures present.*

V-4. Riparian Shrub Community Assessment Along outside Bends

The outside bends and riparian pockets establish a natural buffer zone between the stream and adjacent lands. These areas also provide wildlife habitat and restore native riparian plants to the area. The line intercept method (Firemon 2003) was used for monitoring riparian community cover type and species composition. These transects will be used to assess changes in bank cover, riparian connectivity, vegetation structure and species composition at or near the bankfull boundaries of the channel. The first year of monitoring was 2018.

Field Method
The riparian community was monitored by establishing five (5) permanent transects at representative outside bends within the site (approximately 30% of the riparian bends planted). The field method for the line intercept method has generally followed that outlined in Firemon 2003. Each transect start and end point is demarked by cemented rebar (shown on the **Monitoring Map (Section v. Maps))**, then a 4 foot length of conduit was placed on top and a measuring tape stretched across. Then the transect was walked and interception of the line (in feet, to the nearest 0.5 foot) by each shrub species was recorded within three height class categories (< 3 feet, 3-15 feet, >15 feet). Interception by herbaceous cover, litter, rock, or barren soil was also recorded along the transect where shrub species were not present.

Evaluating Results
Data collected was used to calculate the percent of vegetative cover by such species and/or percent cover of herbaceous species, barren ground, rock, or other features. **Tables 13, 14, 15, 16,** and **17** below show the cover type/species composition and percent cover of each transect. More detailed information is provided in the data forms provided in **Appendix B – V-4**.

Shrub development along the outside bends is good. Shrubs occupy approximately 85% along the outside bends with approximately 85% in the 3 to 15-foot height class, and 15% in the 0 to 3 foot height class. This represents an overall 15% increase in percent cover and an increase of 56% in the 3 to 15-foot height class from 2018 to 2020 which indicates shrubs are becoming established and maturing. As shrubs mature and become more established, percent and height class are anticipated to further increase as we have seen from 2018 to 2020.

Table 13.

Transect #1	
Length: 30 Feet	
Cover Type/Species Composition	**% Cover in Transect**
SAMO	30.0%
SABO	13.3%
SAGE	20%
SADR	16.7%
HERB	16.7%
BRRS	3.3%

Table 14.

Transect #2	
Length: 30 Feet	
Cover Type/Species Composition	**% Cover in Transect**
SABO	41.6%
SAMO	21.7%
SAGE	13.3%
SADR	15.0%
BRRS	8.4 %

Table 15.

Transect #3	
Length: 30 Feet	
Cover Type/Species Composition	**% Cover in Transect**
SAMO	50.0%
SAGE	36.6%
BRRS	13.4%

Table 16.

Transect #4	
Length: 30 Feet	
Cover Type/Species Composition	**% Cover in Transect**
SAMO	35%
SAGE	25%
SADR	13.3%
BRRS	15%
HERB	11.7%

Table 17.

Transect #5	
Length: 40 Feet	
Cover Type/Species Composition	**% Cover in Transect**
SAMO	22.5%
SAGE	27.5%
SADR	26.3%
BRRS	23.7%

Species Codes

			BRRS = Barren soil
SABO	*Salix boothii*	Booth's willow	HERB = Herbaceous
SADR	*Salix drummondiana*	Drummond's willow	LITT = Litter
SAGE	*Salix geyeriana*	Geyer's willow	REST = Restoration Structure
SAMO	*Salix monticola*	Park willow	WOOD = Wood
			ROCK = Rock
			OTST = Other structure

V-5. Soil Development

One soil test pit was dug in a random location at each of the vegetation development test areas. A soil profile description recorded per standard Natural Resources Conservation Service (NRCS) methodology for each soil test pit is included in in **Appendix B – V-5** within the Upland Herbaceous Vegetation Community Assessment data forms which are identified as TP1, TP2, TP3, and TP4. Soil samples were collected from each test pit location and were laboratory tested for nutrients. The test results are displayed below in **Table 18.** Formal copies of the lab test results are provided in **Appendix B – V-5**. Test pit locations are depicted on the **Monitoring Map (Section v. Maps)** as TP1, TP2, TP3, and TP4.

Laboratory analysis of restoration soils show pH, salts, organic matter and available nutrients within acceptable ranges as a native soil for TP1, TP2 and TP3. TP4 does show low pH and high salts which likely reflects the lower percent ground cover identified in TP4. While this condition is not ideal, native ground cover is developing. TP4 results show the pH slightly lower than and salts at the same levels as the 2019 results which is an anticipated characteristic of soil weathering. Percent organic matter and available nutrients remain relatively unchanged from 2018 to 2020, other than a significant increase in nitrate nitrogen for TP1 from 2.6 in 2019 to 25.5 in 2020.

Table 18. Laboratory Complete Nutrient Analysis of Restoration Soils

Laboratory Results	Test Pit #1	Test Pit #2	Test Pit # 3 (Riparian)	Test Pit # 4
Field Texture (EST)	Sandy Loam	Sandy Loam	Sandy Loam	Sandy Loam
pH (units)	7.3	6.9	7.2	3.2
Salts (MMHOS/CM)	0.5	0.2	0.2	1.1
CEC Est. (MEQ/100G)	9.2	11.6	8.2	9.6
Lime (Qual.)	Low	Low	Low	Low
Organic Matter (%)	2.0	3.2	1.5	2.2
Organic N (lbs/acre)	58.8	95.9	43.8	64.7
Sodium (meq/100g	0.03	0.13	0.08	0.09
Available Nutrients (ppm)				
Nitrate Nitrogen	25.5	1.4	1.0	0.6
Phosphorous	16.8	3.9	3.4	13.9
Potassium	65.4	54.6	34.3	15.8
Calcium	1761.8	1553.3	1011.8	156.2
Magnesium	81.8	97.8	75.0	46.7
Sulfur	30.9	8.96	12.7	284.9
Boron	<0.1	<0.1	<0.1	<0.1
Zinc	17.1	148.7	97.1	42.5
Iron	14.4	37.6	25.1	264.9
Manganese	1.8	3.6	1.8	5.9
Copper	4.1	35.8	23.0	20.8

iv. Visual Observation and Photo Documentation (Photos from July 2020)

Photo 9. View of upstream end of channel from right bank looking northeast

Photo 10. View of channel looking west from the left bank at approximately Station 39+05.

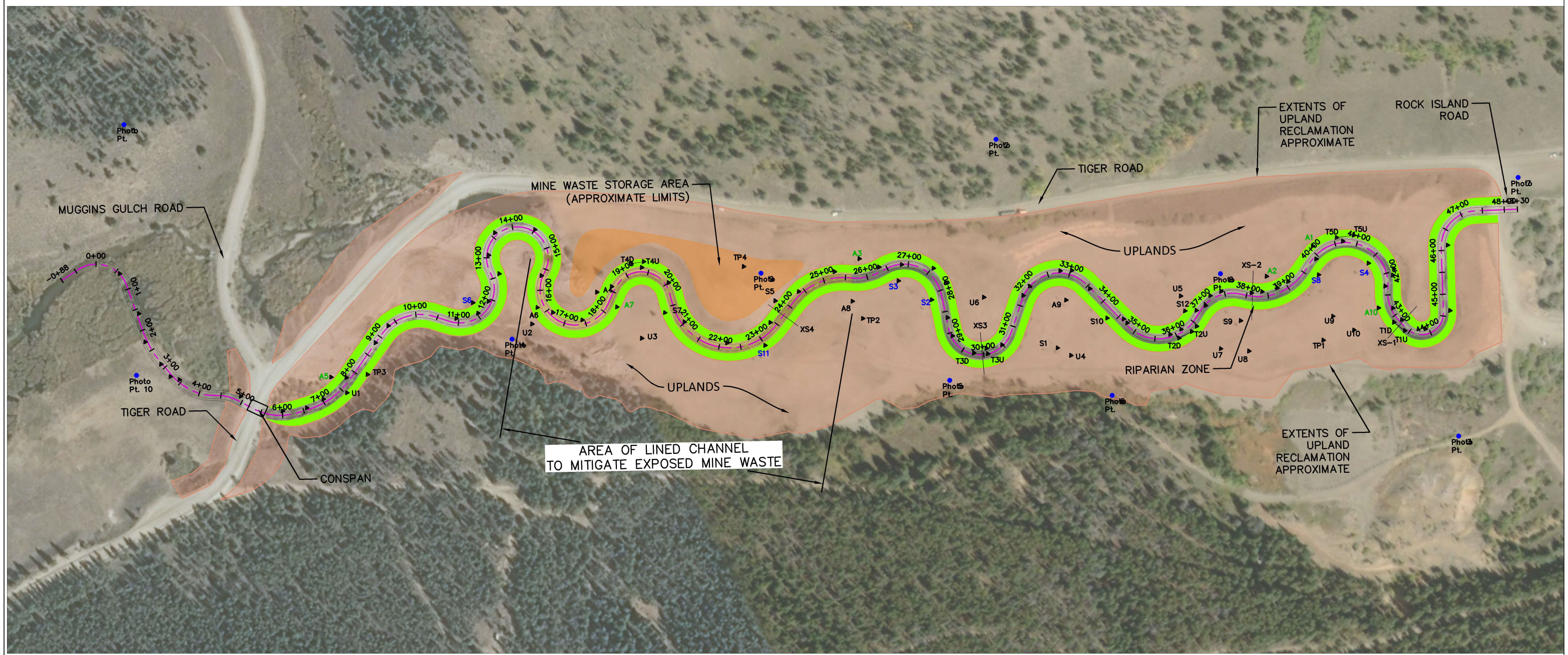
Photo 11. View of channel looking north from the left bank at approximately Station 34+00.

Photo 12. View of channel looking north from the left bank at approximately Station 25+00.

Photo 13. View of channel looking northeast from the left bank at approximately Station 13+00.

Photo 14. View of channel looking west from the right bank at approximately Station 10+50.

v. Maps - 2020 Monitoring Map



1 CHANNEL PLANVIEW

0 100 200 Feet

LEGEND:
U1 – UPLANDS SHRUB ASSESSMENT POCKETS
S2 – SPRUCE TREES (TAGGED)
A1 – ASPEN TREES (TAGGED)
S5/A6 – TREES (UNTAGGED)
TP1 – UPLAND HERBACEOUS COMMUNITY ASSESSMENT PERMANENT TEST PLOT LOCATIONS
T1U – RIPARIAN SHRUB COMMUNITY ASSESSMENT PERMANENT TRANSECT POINT (UPSTREAM)
T1D – RIPARIAN SHRUB COMMUNITY ASSESSMENT PERMANENT TRANSECT POINT (DOWNSTREAM)
XS1 – PERMANENT CROSS SECTION LOCATIONS (RIGHT AND LEFT BANK)

LEGEND:
- SUMMIT COUNTY PHOTO POINT
- RIPARIAN ZONE
- AREA OF LINED CHANNEL
- MINE WASTE STORAGE AREA
- UPLANDS

REV	DATE	DESCRIPTION

PREPARED BY
ECOLOGICAL RESOURCES CONSULTANTS, INC
225 UNION BLVD. SUITE 325
LAKEWOOD, CO 80228

CLIENT
SUMMIT COUNTY OPEN SPACE AND TRAILS

PROJECT
SWAN RIVER RESTORATION PROJECT

TITLE
2020 MONITORING MAP

SHEET NO
01

vi. Conclusions

ERC has prepared this 2020 (Year 4) Monitoring Report for Summit County. This is the fourth of five anticipated complete annual monitoring reports. Monitoring reports completed to date include 2016 As-Built, 2017 Year 1, 2018 Year 2 (first year of vegetation monitoring), and 2019 Year 3. A summary of findings, conclusions and recommendations follow for each monitoring parameter.

1. Parameter S-1: Channel Profile Results – Results of the channel profile survey, including comparison of years 2016 (as-built), 2017 – Year 1, 2018 - Year 2, 2019 - Year 3, and 2020 – Year 4 are presented above in **Graphs 1-4,** in **Table 1** and in **Appendix A. Table 4** above provides a comparison of changes in the profile over these years. The channel profile has been constructed to form distinct varying slopes creating the primary habitat features of riffles, pools, glides and general bedform diversity as is appropriate for the site's setting. It is not the intent of the design that the profile remains static with fixed elevations, but rather to allow it to evolve in response to flow and sediment load in the way that a natural channel would. The channel has developed as anticipated with distinct variation in slope forming a wide variety of riffles, pools, glides and general bedform diversity. After four full hydrologic cycles including the extended high flow periods of 2019 the channel has responded very well and is considered successful as the constructed profile remains relatively constant, exhibits no unnatural areas of aggradation or degradation and maintains bed form diversity with distinct riffle and pool features prevalent.

2. Parameter S-2: Channel Cross-section Results – Results of the channel cross-section survey including comparison of years 2016 (as-built), 2017, 2018, 2019, and 2020 are presented in **Graphs 5-8 above and Tables 2-5 in Appendix A**. The channel cross-section has been constructed along the entire project reach to form distinct and varying cross-sections. As summarized for Parameter S-1, the design intent is not to lock the channel in place but rather allow it to evolve in response to flow and sediment load in the way that a natural channel would. The channel has developed as anticipated with varied cross-sections which have shown minor evolution. After four hydrologic cycles, the channel has responded very well and is judged to be successful as the channel cross-sections have maintained the general dimensions as designed and represent cross-sections of a natural channel.

3. Parameter S-3. Sediment Sampling – Results of the sediment sampling are presented in **Tables 5-6** and **Graphs 9-12** above. More detailed sediment sampling data is provided in **Appendix A - S-3.** Average material size was calculated and an HSI score quantified. All sediment sampling results indicate materials are well graded gravels with cobbles; only minimal fine material has deposited in the riffles after initial construction and is maintaining, as 2020 sediment sampling results indicate, a very minimal increase in fine material at the sediment sampling locations (0.1% fines in 2018, 0.0% fines in 2019, and 0.4% in 2020). The resulting HSI score (1.0) indicates that the channel is fully functional based on this parameter.

4. Parameter S-4. Average Thalweg Depth- Results of the average thalweg depth measurements are presented in **Graph 13** and **Table 7** above. More detailed thalweg depth data is provided in **Appendix A – S-4, Table 6.** The average thalweg depth over the 93 sample points in 2020 was 1.53 feet, which equates to 46.5 centimeters. This corresponds to an HSI score of 0.99 and indicates that the stream is fully functional based on this parameter. The average thalweg depth measured in 2018 was 1.4 feet

and had a corresponding HSI score of 0.95, with a slight increase to 1.5 feet in 2019 and 2020. This minor change indicates that thalweg depth remains relatively constant as of the 2020 survey.

5. Parameter V-1. Upland Tree Assessment – Upland trees are developing well. 73.8% of planted trees across the site were assigned an "Alive" rating, while only 15.4% were observed as "Stressed" and 10.8% were observed as "Dead". Plant growth data for the 12 tagged trees shows that the majority of trees are increasing in size (DBH and Height) with an average total increase of 0.53 inches in DBH per tree and a 3-foot increase in height per tree from 2018 to 2020. As trees mature, overall tree size is anticipated to increase, however is expected to be slow growth due to elevation. Summit County watering program appears to be adequate to maintain trees during the establishment period. The Summit County watering program is recommended to continue for the upcoming 2021 growing season as needed upon seasonal evaluation. Herbivory does not appear to be a concern at this time. No corrective actions are recommended at this time. More detailed information including the upland tree assessment field data is enclosed in **Appendix B – V1.**

6. Parameter V-2. Upland Shrub Assessment – Upland shrubs are developing well. 47.1% of upland shrubs across the site were assigned an "Alive" rating, while only 23.5% were observed as "Stressed", and 29.4% were observed as "Dead". 2020 results indicate a survival rate of 70.6%. This survival rate is considered exceptional considered the harsh high-altitude environment and limited maintenance watering. A majority of the upland shrubs have survived three full growing seasons and winters. Stressed shrubs still appear dry and would likely benefit from additional watering. Shrub vigor has decreased from 2018 to 2020; however, plant growth has shown an increase from 2018 with a 17.7% increase in shrubs in the "Medium" height class and a 17.6% increase in shrubs in the "Tall" height class which indicates shrubs are becoming established and maturing. As shrubs mature and become more established, percent and height class are anticipated to further increase as we have seen from 2018 to 2020. Upland shrubs would likely benefit from an increase in maintenance watering. The Summit County watering program is recommended to increase frequency of watering for the upcoming 2021 growing season as needed upon seasonal evaluation. Herbivory does not appear to be a concern at this time. More detailed information including the upland shrub assessment field data is enclosed in **Appendix B – V2.**

7. Parameter V-3. Upland Herbaceous Community Assessment –Considering the high elevation and harsh growing seasons, the upland herbaceous plant community is developing well. After three full growing seasons the average percent ground cover of the four test plots is approximately 45.9% showing a dominance of native species with very limited weeds. Test plot samplings indicate that at least 7 different native grass species are present and developing as the planned community. The 2020 results indicate an increase of 6.9% in percent ground cover and species diversity (2 additional species) over 2018 results. Herbaceous plant community is expected to further develop in percent ground cover with native species as root mass develops and plants reseed. No corrective actions are recommended at this time. More detailed information including the upland herbaceous community assessment field data is enclosed in **Appendix B – V-3.**

8. Parameter V-4. Riparian Shrub Assessment Along Outside Bends – the development of shrubs along the outside bends is good. Shrubs occupy approximately 85% along the outside bends primarily in the 3 to 15-foot height class. This represents an overall 15% increase in percent cover and an increase of 56% in the 3 to 15-foot height class from 2018 to 2020 which indicates shrubs are becoming

established and maturing. As shrubs mature and become more established, percent and height class are anticipated to further increase as we have seen from 2018 to 2020. Summit County watering program appears to be adequate to maintain riparian shrubs during the establishment period. The Summit County watering program is recommended to continue for the upcoming 2021 growing season as needed upon seasonal evaluation. Herbivory does not appear to be a concern at this time. No corrective actions are recommended at this time. More detailed information including the riparian shrub assessment along outside bends field data is enclosed in **Appendix B – V4.**

9. Parameter V-5. Soil Development –Restoration soils are developing well. Laboratory soil analysis shows pH, salts, organic matter and available nutrients within acceptable native soil ranges for TP1, TP2 and TP3. TP4 does show low pH and high salts which likely reflects the lower percent ground cover identified in TP4. While this condition is not ideal, native ground cover is developing. No corrective actions are recommended at this time. TP4 results do appear to be trending towards a more favorable direction with pH slightly lower and salts similar to 2019 results. Percent organic matter and available nutrients remain relatively unchanged from 2019 to 2020, other than a significant increase in nitrate nitrogen for TP1 from 2.6 in 2019 to 25.5 in 2020. More detailed information including the official lab test results is included in **Appendix B – V-5.** Soil profile descriptions for each test pit using NRCS methodology are included in the data forms in **Appendix B – V5.** No corrective actions are recommended at this time.

10. Parameter 4: Visual Observation and Photo Documentation Results – Visual observations were made along the constructed channel. The as-built condition has notably naturalized and adjusted creating the physical characteristics as planned. The constructed channel provides varying flow velocities including fast moving riffles, deep slower pools and glides as well instream cover. Seeded and planted native vegetation is developing well as the native planned communities. Aquatic and terrestrial life have been regularly observed using the restored landscape. Summit County has established ten (10) permanent photo points around the project area which are enclosed in **Appendix C – 2020 Summit County Photo Points.**

11. Additional water for the upland shrubs is recommended at this time. During 2020 Summit County the upstream “inlet” to the restored reach had been significantly altered.

12. Summit County has conducted additional maintenance and revegetation efforts across the site from initial post construction in 2016 to present time. 2020 efforts completed by the County included:

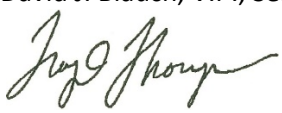
    - Limited manual watering of trees and shrubs through the 2020 summer growing season.
    - Minor weed control.
    - Installation of interpretive signage
    - Monitoring of new public natural surface trail.

Please let us know if you have any questions or require additional information at this time.

This report has been prepared by:

Ecological Resource Consultants, Inc.

David J. Blauch, V.P., Senior Ecologist



Troy D. Thompson, PE, President

Matthew Boyer, Ecologist

Appendix A
2020 Survey Data

S-1. Stream Profile

TABLE 1. PROFILE SURVEY 2020 YEAR 4		
ID#	STATION	ELEVATION
RB1	4615	1001.27
RE1	4459	997.62
P1	4390	995.42
G1	4316	996.05
RB2	4280	997.92
RE2	4210	995.78
P2	4195	991.67
G2	4069	993.48
RB3	3991	994.25
RE3	3907	992.52
P3	3875	988.92
G3	3831	989.98
RB4	3810	992.24
RE4	3742	989.88
P4	3718	986.98
G4	3692	988.12
RB5	3673	990.22
RE5	3616	988.25
P5	3586	984.89
G5	3470	985.78
RB6	3458	988.22
RE6	3300	985.15
P6	3280	981.05
G6	3200	982.61
RB7	3170	983.87
RE7	3050	980.79
P7	3010	978.51
G7	2987	977.84
RB8	2865	980.35
RE8	2788	978.28
P8	2753	976.45
G8	2688	977.87
T1	2633	978.82
T2	2528	977.92
T3	2437	977.55
T4	2342	976.74
T5	2219	975.56
T6	2095	973.84
T7	2000	972.11
T8	1935	971.50
T9	1859	970.76
T10	1742	969.45
T11	1664	968.60
T12	1572	967.34
T13	1450	964.97
T14	1361	961.25
T15	1310	962.56
T16	1195	961.49
T17	1154	959.62
T18	1088	960.73
T19	925	958.08
T20	880	957.90
T21	778	955.95
T22	700	955.06
T23	658	953.85
T24	600	953.14
T25/Bridge In	560	953.01
T26/Bridge Out	520	952.01
RB9	490	951.96
RE9	346	949.53
P9	322	947.91
G9	295	947.46
RB10	224	947.71
RM10	158	946.55
RE10	59	945.88

S-2. Stream Cross Sections (2020 – Year 4 Survey Data)

Table 2. Cross-Section 1 - 2020 Year 4	
Station (ft)	Elev.
RB Pin	999.65
0	999.31
2	998.94
3	998.65
5	998.10
7	997.43
9	997.32
11	997.54
13	997.19
15	997.29
17	997.54
19	997.25
21	997.52
23	997.37
25	997.65
27	997.38
29	997.63
31	997.73
33	998.04
35	999.02
37	999.19
39	999.32
LB Pin	999.6

Table 3. Cross-Section 2 - 2020 Year 4	
Station (ft)	Elev.
RB Pin	994.52
0	994.28
2	994.05
4	993.79
6	993.69
7	993.10
9	991.85
11	991.24
13	990.85
15	990.56
17	991.12
19	991.41
21	991.51
23	991.39
25	991.41
27	991.63
29	992.63
31	993.29
33	993.74
35	993.89
37	994.08
39	994.13
LB Pin	994.32

Table 4. Cross-Section 3 - 2020 Year 4	
Station (ft)	Elev.
RB Pin	983.55
0	982.96
2	982.87
4	982.50
5	982.07
7	981.01
9	980.16
11	979.85
13	979.74
15	979.97
17	979.26
19	979.36
21	979.44
23	979.25
25	979.48
27	980.48
29	981.12
31	981.79
32	982.14
34	982.93
36	983.58
38	983.77
LB Pin	983.79

Table 5. Cross-Section 4 - 2020 Year 4	
Station	**Elev.**
RB Pin	979.71
0	979.42
2	979.05
4	979.01
5	978.64
7	978.02
9	977.50
11	977.69
13	977.55
15	977.84
17	977.72
19	977.95
21	977.83
23	977.69
25	977.50
27	977.77
29	977.68
31	978.00
33	978.08
34	978.45
35	978.43
37	979.17
39	979.32
41	979.46
LB Pin	979.47

S-3. 2020 Sediment Sampling

Site:	Riffle 2
Station:	42+50
Riffle Length (ft):	84

Size (mm)	Count	% Finer
<2	0	0.0%
2	1	0.5%
2.8	0	0.5%
4	0	0.5%
5.6	0	0.5%
8	2	1.4%
11	1	1.9%
16	2	2.9%
22.6	0	2.9%
32	5	5.3%
45	17	13.5%
64	26	26.0%
90	42	46.2%
128	52	71.2%
180	60	100.0%
>180		100.0%
Total:	**208**	
D50 =	**95.0**	mm

Site:	Riffle 4
Station:	37+50
Riffle Length (ft):	82

Size (mm)	Count	% Finer
<2	0	0.0%
2	0	0.0%
2.8	1	0.5%
4	1	1.0%
5.6	0	1.0%
8	1	1.4%
11	2	2.4%
16	2	3.4%
22.6	4	5.3%
32	5	7.7%
45	18	16.4%
64	40	35.7%
90	47	58.5%
128	34	74.9%
180	48	98.1%
>180	4	100.0%
Total:	**207**	
D50 =	**44.4**	mm

Site:	Riffle 6
Station:	33+50
Riffle Length (ft):	53

Size (mm)	Count	% Finer
<2	0	0.0%
2	0	0.0%
2.8	0	0.0%
4	0	0.0%
5.6	0	0.0%
8	0	0.0%
11	0	0.0%
16	1	0.5%
22.6	2	1.5%
32	11	6.8%
45	32	22.4%
64	46	44.9%
90	50	69.3%
128	30	83.9%
180	30	98.5%
>180	3	100.0%
Total:	**205**	
D50 =	49.2	mm

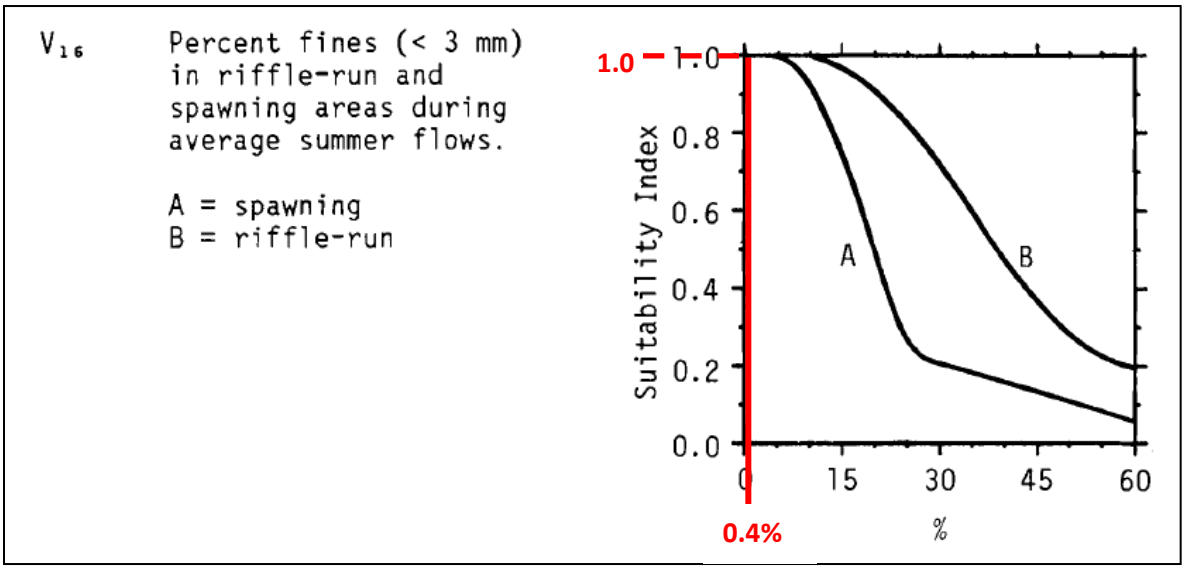
Site:	Tailings
Station:	12+00
Riffle Length (ft):	73

Size (mm)	Count	% Finer
<2	0	0.0%
2	1	0.5%
2.8	0	0.5%
4	1	1.0%
5.6	0	1.0%
8	0	1.0%
11	2	2.0%
16	2	3.0%
22.6	2	3.9%
32	16	11.8%
45	32	27.6%
64	55	54.7%
90	32	70.4%
128	25	82.8%
180	37	99.5%
>180	1	100.0%
Total:	**206**	
D50 =	51.0	mm

Summary Measurements	
Average % Fines (<3 mm): (Assume 2.8 mm)	0.4%
Total Riffle Lengths:	292 ft

V_{16} HSI:	**1.0**	*SEE FIGURE 1*

Figure 1.


V16
Percent fines (< 3 mm) in riffle-run and spawning areas during average summer flows.
A = spawning
B = riffle-run
1.0
Suitability Index
1.0
0.8
0.6
0.4
0.2
0.0
A
B
0
15
30
45
60
%
0.4%

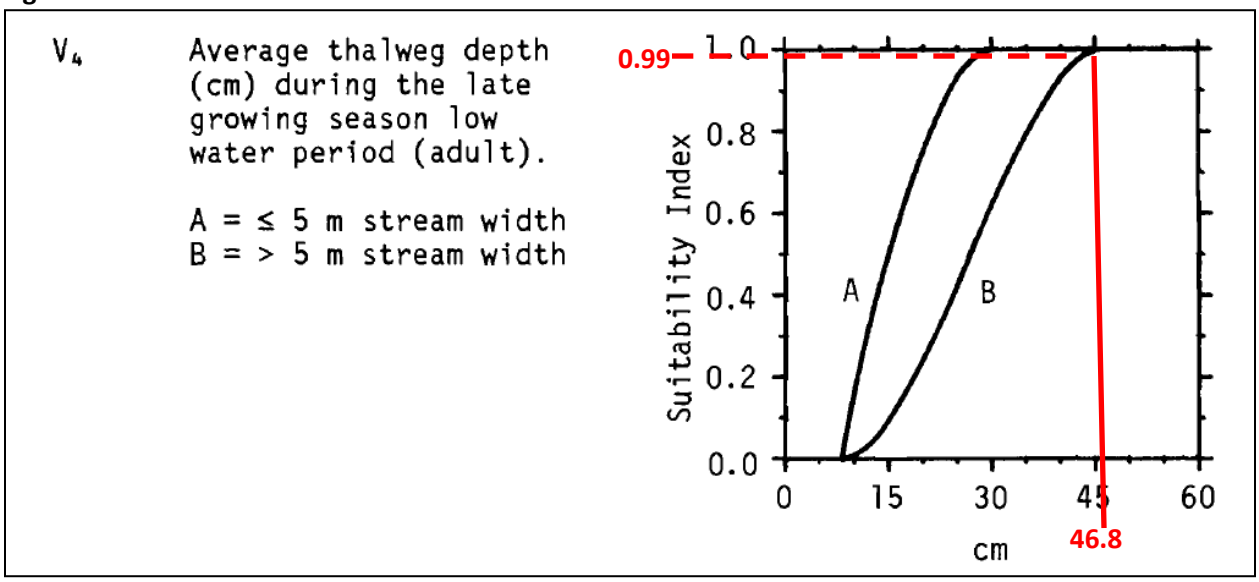
S-4. 2020 Average Thalweg Depth

Table 6. Low Flow Channel Conditions (HSI V4)

Station (ft)	Depth (ft)	Station (ft)	Depth (ft)	Station (ft)	Depth (ft)	Station (ft)	Depth (ft)
0	2.60	**1450**	0.90	**2900**	2.00	**4350**	2.30
50	1.10	**1500**	0.90	**2950**	3.40	**4400**	1.60
100	0.90	**1550**	0.90	**3000**	3.60	**4450**	1.20
150	1.10	**1600**	1.20	**3050**	1.20	**4500**	0.90
200	0.80	**1650**	0.90	**3100**	1.20	**4550**	1.00
250	0.90	**1700**	1.10	**3150**	1.00	**4600**	0.60
300	1.20	**1750**	1.00	**3200**	2.20		
350	1.00	**1800**	1.50	**3250**	3.70		
400	0.90	**1850**	1.10	**3300**	3.50		
450	1.00	**1900**	0.90	**3350**	0.80		
500	1.10	**1950**	1.20	**3400**	0.90		
550	0.90	**2000**	1.00	**3450**	1.10		
600	0.90	**2050**	0.90	**3500**	4.20		
650	1.40	**2100**	0.90	**3550**	3.60		
700	0.80	**2150**	1.20	**3600**	0.90		
750	1.10	**2200**	1.00	**3650**	0.90		
800	1.00	**2250**	1.10	**3700**	3.30		
850	0.80	**2300**	0.90	**3750**	1.00		
900	1.10	**2350**	1.10	**3800**	2.32		
950	1.70	**2400**	0.90	**3850**	3.60		
1000	1.30	**2450**	1.10	**3900**	0.80		
1050	0.80	**2500**	0.80	**3950**	0.90		
1100	1.60	**2550**	1.60	**4000**	1.70		
1150	2.30	**2600**	1.60	**4050**	2.20		
1200	2.30	**2650**	2.00	**4100**	2.70		
1250	1.20	**2700**	3.30	**4150**	3.70		
1300	1.10	**2750**	3.30	**4200**	3.20		
1350	1.50	**2800**	1.20	**4250**	0.90		
1400	1.20	**2850**	0.90	**4300**	1.80		

Summary Measurements		
Average Depth:	1.53	ft
	46.51	cm
V_4 HSI:	**0.99**	*SEE FIGURE 2*

Figure 2.


V_4
Average thalweg depth (cm) during the late growing season low water period (adult).
A = ≤ 5 m stream width
B = > 5 m stream width
0.99
1.0
0.8
0.6
0.4
0.2
0.0
Suitability Index
A
B
0
15
30
45
60
cm
46.8

Appendix B
2020 Vegetation Data

V-1. Upland Tree Assessment

Table 1.

Plant Survival				Plant Growth	
Plot ID	**Species**	**Vigor**	**Comments**	**DBH (in)**	**Height (ft)**
A1	POTR	1	Good condition	1.9	16
A1a	POTR	1	Good condition		
A2	POTR	1	Good condition/upper portion removed	2.5	6
A2a	POTR	1	Fair condition/sparse canopy		
A2b	POTR	3	Dead		
A3	POTR	1	Good condition	2.5	22
A3a	POTR	2	Good condition		
A3b	POTR	3	Dead		
A4	POTR	1	Good condition/sparse canopy		
A4a	POTR	2	Good condition		
A4b	POTR	1	Good condition		
A5	POTR	2	Fair condition/sparse canopy	4.5*- 4 trunks	16
A5a	POTR	3	Dead		
A5b	POTR	2	Fair condition/sparse canopy		
A6	POTR	1	Good condition		
A6a	POTR	1	Good condition		
A6b	POTR	1	Fair condition		
A7	POTR	1	Good condition	3.7* - 2 trunks	14
A7a	POTR	1	Good condition		
A7b	POTR	2	Good condition/sparse canopy		
A8	POTR	3	Dead		
A8a	POTR	3	Dead		
A8b	POTR	3	Dead		
A9	POTR	2	Good condition		
A9a	POTR	1	Good condition		
A9b	POTR	1	Good condition		
A10	POTR	1	Good condition	2.8	20
A10a	POTR	1	Good condition/sparse canopy		
A10b	POTR	1	Good condition/sparse canopy		
S1	PIPU	1	Good condition		
S1a	PIPU	1	Good condition		
S1b	PIPU	1	Good condition		
S2	PIPU	1	Good condition	2.7	10
S2a	PIPU	1	Good condition		
S2b	PIPU	1	Good condition		
S3	PIPU	1	Good condition	2.8	10
S3a	PIPU	3	Poor condition/Dead		
S3b	PIPU	1	Good condition		
S4	PIPU	1	Good condition	3.4	11
S4a	PIPU	1	Good condition		

S4b	PIPU	1	Good condition		
S5	PIPU	1	Good condition		
S5a	PIPU	1	Good condition		
S5b	PIPU	2	Good condition		
S6	PIPU	1	Good condition	2.3	10
S6a	PIPU	1	Good condition/many reproductive structures – cones		
S6b	PIPU	1	Good condition		
S7	PIPU	1	Good condition		
S7a	PIPU	2	Good condition		
S7b	PIPU	1	Good condition		
S8	PIPU	1	Good condition	3.2	10
S8a	PIPU	1	Good condition		
S8b	PIPU	1	Good condition		
S9	PIPU	1	Good condition		
S9a	PIPU	1	Good condition		
S9b	PIPU	1	Good condition		
S10	PIPU	1	Good condition		
S10a	PIPU	1	Good condition		
S10b	PIPU	1	Good condition		
S11	PIPU	1	Good condition	2.9	8
S11a	PIPU	2	Good condition		
S11b	PIPU	2	Good condition		
S12	PIPU	1	Good condition		
S12a	PIPU	1	Thin branching		
S12b	PIPU	1	Good condition		

*indicates tree trunk branching at measured height – total inches is displayed as a sum of measured trunks - number of trunks measured for these specific trees is displayed above.

Vigor Code

1 = Alive
2 = Stressed
3 = Dead

Species Code

PIPU = *Picea pungens* (Colorado blue spruce)
POTR = *Populus tremuloides* (Quaking aspen)

Plant Growth = 12 Trees Tagged – 6 PIPU/6 POTR

V-2. Upland Shrub Assessment

Plant Survival				Plant Growth
Plot ID	**Species**	**Vigor**	**Comments**	**Height***
U1	ROWO	2	Good condition	M
	ROWO	2	Good condition	M
	ROWO	2	Good condition	M
	ROWO	2	Good condition	M
	ROWO	2	Fair condition; sparse reproductive structures; recommended watering	T
U2	ROWO	3	Poor condition; Dead	T
	ROWO	3	Poor condition; Dead	T
	ROWO	2	Fair condition; sparse reproductive structures; recommended watering	T
	ROWO	2	Fair condition; sparse reproductive structures; recommended watering	M
	ROWO	2	Fair condition; sparse reproductive structures; recommended watering	M
U3	ROWO	2	Fair condition; sparse reproductive structures; recommended watering	T
	ROWO	2	Fair condition; sparse reproductive structures; recommended watering	T
	ROWO	2	Fair condition; sparse reproductive structures; recommended watering	T
	ROWO	3	Poor condition; Dead	T
	ROWO	3	Poor condition; Dead	T
U4	ROWO	3	Poor condition; Dead	M
	ROWO	3	Poor condition; Dead	M
	ROWO	3	Poor condition; Dead	T
	ROWO	3	Poor condition; Dead	T
	ROWO	3	Poor condition; Dead	T
U5	ARCA	1	Good condition	L
	ARCA	1	Good condition	M
	ARCA	1	Fair condition; recommended watering	L
	ARCA	3	Poor condition; Dead	L
	ARTR	1	Good condition; recommended watering	M
U6	ARTR	1	Good condition	L
	ARTR	1	Good condition	L
	ARTR	1	Good condition	L
	ARCA	1	Good condition	M
	ARCA	1	Good condition	M
U7	ARTR	1	Good condition	M
	ARTR	1	Good condition	M
	ARTR	1	Good condition	M
	ARTR	1	Good condition	L
	ARTR	3	Poor condition; Dead	M

U8	ARTR	1	Good condition	M
	ARTR	1	Good condition	M
	ARTR	1	Good condition	M
	ARTR	1	Good condition	M
	ARTR	1	Good condition	M
U9	ARTR	1	Good condition	M
	ARTR	1	Good condition	M
	ARTR	1	Good condition	M
	ARCA	2	Fair condition; sparse reproductive structures; recommended watering	L
	ARCA	3	Poor condition; Dead	L
U10	ARTR	1	Good condition	M
	ARTR	1	Good condition	M
	ARTR	1	Good condition	L
	ARTR	3	Poor condition; Dead	L
	ARCA	3	Poor condition; Dead	L
	ARCA	3	Poor condition; Dead	L

Vigor Code

1 = Alive
2 = Stressed
3 = Dead

Plant Growth

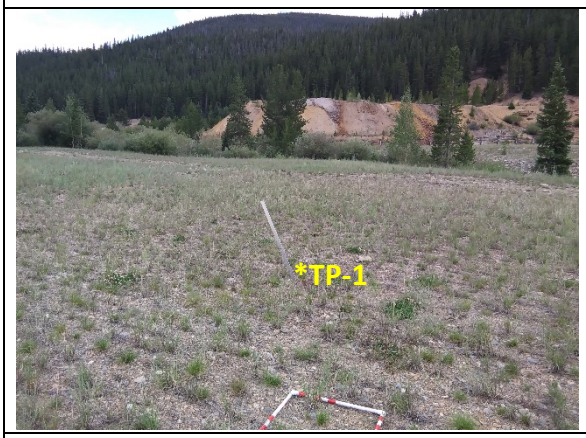
L = Low (0.5 - <1.5 ft. height)
M = Medium (1.5 - <4.5 ft. height)
T = Tall (4.5 - <8 ft. height)
VT = Very Tall (8 ft. + height)

Species Codes

ROWO = Rosa woodsia (Woods' rose)
ARCA = Artemisia cana (Silver sagebrush)
ARTR = Artemisia tridentata (Big sagebrush)

V-3. Upland Herbaceous Vegetation Community Assessment

UPLAND HERBACEOUS VEGETATION COMMUNITY ASSESSMENT							
Test Point #1 (TP1)	**Date: 7/22/2020**	**Investigators: T.W. & M.B.**					
PLANT EVALUATION							
Plant Species Identified in 20' Radius of Test Point		**WMVC Indicator Status**	**Quadrat Sample % Ground Cover**			
Scientific Name	**Common Name**		**A**	**B**	**C**	**D**
Bromus marginatus	Mountain brome	UPL	15	-	-	-
Elymus trachycaulus	Slender wheatgrass	FAC	-	15	15	15
Trifolium pratense	Red clover	FACU	20	-	20	15
Festuca saximontana	Rocky Mountain Fescue	UPL	-	25	15	15
Pascopyrum smithii	Western wheatgrass	FACU	20	-	5	5
		Total % Ground Cover per Quadrant:	*55*	*40*	*55*	*50*
Total Average Percent Ground Cover: *50.0%*							
SOIL EVALUATIONS							
Soil Profile Description: Soils within the 20' radius of the test point location are generally shallow. An approximately 4-inch layer of unstructured, sandy loam textured, bright colored (10YR 5/4) soil exists from the surface downward. Below 4 inches is comprised of coarse fragment material such as cobbles and larger rock. Root masses from the species listed above are beginning to develop within the upper 1in of the soil profile, overall root establishment appears to be good.							
GENERAL EVALUATIONS							
Weeds, Erosion, Vandalism, Herbivory, Plant Stress, etc.							
General Comments: Identified species appear to be in good health. Vegetation is robust and exhibits reproductive structures on most species within the quadrat, indicating that is has undergone a full growth cycle for three growing seasons (2018-2020).							
PHOTOS							



Test Point 1. (Overview facing east)

Test Point 1. (Quadrat B)

UPLAND HERBACEOUS VEGETATION COMMUNITY ASSESSMENT

Test Point #2 (TP2)	**Date: 7/22/2020**	**Investigators:T.W. & M.B.**

PLANT EVALUATION

Plant Species Identified in 20' Radius of Test Point		**WMVC Indicator Status**	**Quadrat Sample % Ground Cover**			
Scientific Name	**Common Name**		**A**	**B**	**C**	**D**
Pascopyrum smithii	Western wheatgrass	FACU	20	-	15	-
Bromus marginatus	Mountain brome	UPL	-	-	5	-
Deschampsia caespitosa	Tufted hairgrass	FACW	-	15	-	20
Festuca saximontana	Rocky Mountain Fescue	UPL	20	-	10	10
Elymus trachycaulus	Slender wheatgrass	FAC	-	15	10	20
	Total % Ground Cover per Quadrant:		*40*	*30*	*40*	*50*

Total Average Percent Ground Cover: *40.0%*

SOIL EVALUATIONS

Soil Profile Description:

Soils within the 20' radius of the test point location are generally shallow. An approximately 4 inch layer of unstructured, sandy loam textured, bright colored (10YR 5/4) soil exists from the surface downward. Below 4 inches is comprised of coarse fragment material such as cobbles and larger rock. Root masses from the species listed above are beginning to develop within the upper 1in of the soil profile, overall root establishment appears to be good.

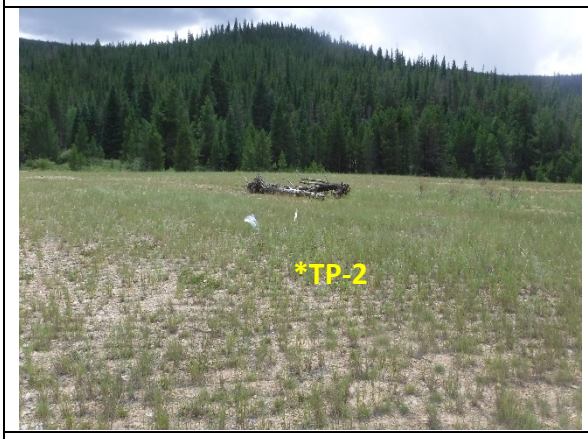
GENERAL EVALUATIONS

Weeds, Erosion, Vandalism, Herbivory, Plant Stress, etc.

General Comments:

Identified species appear to be in good health. Vegetation is robust and exhibits reproductive structures on most species within the quadrat, indicating that is has undergone a full growth cycle for two full growing seasons (2018-2020). Scentless chamomile (*Matricaria perforata*) is present at the test point location in sparse areas, mainly existing as individual plants at less than 1% cover of the 20' radius of the test point. Scentless chamomile is listed in the State of Colorado as a List B noxious weed species. Red clover (*Trifolium pratense*) was also identified at the test point location which was present in isolated clumps but appeared to exhibit excellent health and vigor.

PHOTOS



Test Point 2. (Overview facing west)

Test Point 2. (Quadrat A)

UPLAND HERBACEOUS VEGETATION COMMUNITY ASSESSMENT

Test Point #3 (TP3) (Riparian)	**Date: 7/22/2020**	**Investigators: T.W. & M.B.**

PLANT EVALUATION

Plant Species Identified in 20' Radius of Test Point		**WMVC Indicator Status**	**Quadrat Sample % Ground Cover**			
Scientific Name	**Common Name**		**A**	**B**	**C**	**D**
Elymus trachycaulus	Slender wheatgrass	FAC	30	-	25	5
Bromus marginatus	Mountain brome	UPL	-	-	-	20
Taraxacum officinale	Common dandelion	FACU	5	5	-	-
Carex microptera	Smallwing sedge	FACU	20	35	-	20
Deschampsia caespitosa	Tufted hairgrass	FACW	-	-	-	5
Equisetum arvense	Field horsetail	FAC	10	10	-	-
Poa alpina	Alpine bluegrass	FAC	-	10	35	-
Poa fendleriana	Muttongrass	UPL	-	-	20	20
Festuca saximontana	Rocky Mountain Fescue	UPL	20	20	-	-
		Total % Ground Cover per Quadrant:	*85*	*70*	*80*	*70*

Total Average Percent Ground Cover: 76.25*%*

SOIL EVALUATIONS

Soil Profile Description:

Soils within the 20' radius of the test point location were the deepest observed at any test point location likely due to location in a riparian area at a lower landscape position adjacent to the stream channel. The upper 4 inches of the soil profile is comprised of darker organic material (10YR 3/2) mixed with sandy material with excellent root mass and root establishment. Below 4 inches, an approximately 8 inch layer of sandy loam textured, bright colored (10YR 4/6) soil is present. Below 12 inches is comprised of coarse fragment material such as cobbles and larger rock.

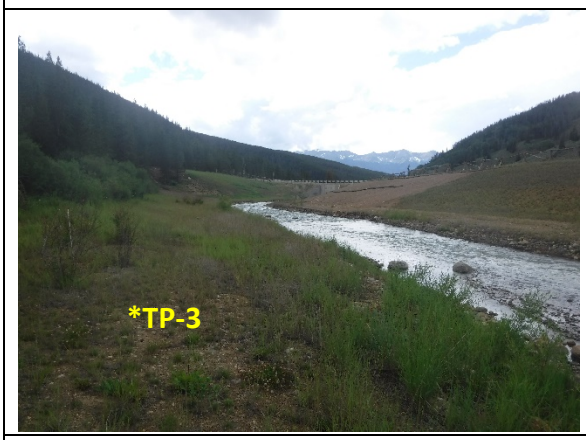
GENERAL EVALUATIONS

Weeds, Erosion, Vandalism, Herbivory, Plant Stress, etc.

General Comments:

Identified species appear to be in excellent health. Vegetation is robust and exhibits reproductive structures on most species within the quadrat. Soil development appears to be good with the most root mass and organic material observed at any test point location. The location within a riparian area adjacent to the stream channel likely promotes moisture retention which improves the health and vigor of vegetation species. Some areas around the test point location are beginning to exhibit a moss-like ground cover.

PHOTOS



Test Point 3. (Overview facing northwest)

Test Point 3. (Quadrat B)

UPLAND HERBACEOUS VEGETATION COMMUNITY ASSESSMENT

Test Point #4 (TP4)	**Date: 7/22/2020**	**Investigators: T.W. & M.B.**

PLANT EVALUATION

Plant Species Identified in 20' Radius of Test Point		**WMVC Indicator Status**	**Quadrat Sample % Ground Cover**			
Scientific Name	**Common Name**		**A**	**B**	**C**	**D**
Bromus marginatus	Mountain brome	UPL	-	-	-	5
Elymus trachycaulus	Slender wheatgrass	FAC	5	5	5	-
Pascopyrum smithii	Western wheatgrass	FACU	-	-	-	5
Deschampsia caespitosa	Tufted hairgrass	FACW	-	-	5	-
Festuca saximontana	Rocky Mountain Fescue	UPL	10	15	10	5
		Total % Ground Cover per Quadrant:	*15*	*20*	*20*	*15*

Total Average Percent Ground Cover: *17.25%*

SOIL EVALUATIONS

Soil Profile Description:

Soils within the 20' radius of the test point location are generally shallow. An approximately 4 inch layer of unstructured, silt loam textured, bright colored (10YR 5/4) soil exists from the surface downward. Below 4 inches is comprised of coarse fragment material such as cobbles and larger rock. Root masses from the species listed above are beginning to develop within the upper 1in of the soil profile, overall root establishment appears to be good.

GENERAL EVALUATIONS

Weeds, Erosion, Vandalism, Herbivory, Plant Stress, etc.

General Comments:

Identified species appear to be in good health. Vegetation is robust and exhibits reproductive structures on most species within the quadrat, indicating that is has undergone a full growth cycle for two full growing seasons. No weedy species, erosion potential, or other concerns observed. Overall vegetation establishment appears to be slow at this particular test point location and continued watering is recommended for the remainder of the 2020 and the 2021 growing season.

PHOTOS

Test Point 4. (Overview facing west)

Test Point 4. (Quadrat B)

V-4. Riparian Shrub Community Assessment Along Outside Bends

Transect #1

Length: 30 Feet

Start Point: Station 43+40

Streambank: (*Left* or *Right*) **Direction:** *(Upstream* or *Downstream)*

0-3 ft height class			**3-15 ft. height class**			**>15 ft. height class**			**Comments**
Start Distance	End Distance	Species	Start Distance	End Distance	Species	Start Distance	End Distance	Species	(Record location of other transects/plots)
-	-	-	0	2.5	SADR	-	-	-	
2.5	3.5	HERB	-	-	-	-	-	-	
-	-	-	3.5	7	SAMO	-	-	-	
7	7.5	BRRS	-	-	-	-	-	-	
-	-	-	7.5	10.5	SAGE	-	-	-	
10.5	11	BRRS	-	-	-	-	-	-	
-	-	-	11	14	SAMO	-	-	-	
14	15	HERB	-	-	-	-	-	-	
-	-	-	15	18	SAGE	-	-	-	
18	18.5	HERB	-	-	-	-	-	-	
-	-	-	18.5	21	SADR	-	-	-	
21	21.5	HERB	-	-	-	-	-	-	
-	-	-	21.5	25.5	SABO	-	-	-	
25.5	26.5	HERB	-	-	-	-	-	-	
-	-	-	26.5	30	SAMO	-	-	-	25

Species Codes

			BRRS = Barren soil
SABO	*Salix boothii*	Booth's willow	HERB = Herbaceous
SADR	*Salix drummondiana*	Drummond's willow	LITT = Litter
SAGE	*Salix geyeriana*	Geyer's willow	REST = Restoration Structure
SAMO	*Salix monticola*	Park willow	WOOD = Wood
			ROCK = Rock
			OTST = Other structure

Transect #2

Length: 30 Feet

Start Point: Station 36+30

Streambank: (*Left* or *Right*) **Direction:** *(Upstream* or *Downstream)*

0-3 ft height class			**3-15 ft. height class**			**>15 ft. height class**			**Comments**
Start Distance	End	Species	Start Distance	End	Species	Start Distance	End	Species	(Record location of other transects/plots)
-	-	-	0	4	SAMO	-	-	-	
4	5	BRRS	-	-	-	-	-	-	
-	-	-	5	9.5	SABO	-	-	-	
-	-	-	9.5	12.5	SAGE	-	-	-	
-	-	-	12.5	17	SADR	-	-	-	
17	17.5	BRRS	-	-	-	-	-	-	
-	-	-	17.5	21.5	SABO	-	-	-	
21.5	22	BRRS	-	-	-	-	-	-	
-	-	-	22	24.5	SAMO	-	-	-	
-	-	-	24.5	28.5	SABO	-	-	-	
28.5	29	BRRS	-	-	-	-	-	-	
-	-	-	29	30	SAGE	-	-	-	27.5

Species Codes

			BRRS = Barren soil
SABO	*Salix boothii*	Booth's willow	HERB = Herbaceous
SADR	*Salix drummondiana*	Drummond's willow	LITT = Litter
SAGE	*Salix geyeriana*	Geyer's willow	REST = Restoration Structure
SAMO	*Salix monticola*	Park willow	WOOD = Wood
			ROCK = Rock
			OTST = Other structure

Transect #3

Length: 30 Feet

Start Point: Station 30+10

Streambank: (*Left* or *Right*) **Direction:** *(Upstream* or *Downstream)*

0-3 ft height class			**3-15 ft. height class**			**>15 ft. height class**			**Comments**
Start Distance	End Distance	Species	Start Distance	End Distance	Species	Start Distance	End Distance	Species	(Record location of other transects/plots)
-	-	-	0	2.5	SAGE	-	-	-	
2.5	4	BRRS	-	-	-	-	-	-	
-	-	-	4	10	SAGE	-	-	-	
-	-	-	10	16.5	SAMO	-	-	-	
16.5	17	BRRS	-	-	-	-	-	-	
-	-	-	17	23	SAMO	-	-	-	
23	24	BRRS	-	-	-	-	-	-	
-	-	-	24	26.5	SAMO	-	-	-	
26.5	27.5	BRRS	-	-	-	-	-	-	
-	-	-	27.5	30	SAGE	-	-	-	26

Species Codes

			BRRS = Barren soil
SABO	*Salix boothii*	Booth's willow	HERB = Herbaceous
SADR	*Salix drummondiana*	Drummond's willow	LITT = Litter
SAGE	*Salix geyeriana*	Geyer's willow	REST = Restoration Structure
SAMO	*Salix monticola*	Park willow	WOOD = Wood
			ROCK = Rock
			OTST = Other structure

Transect #4

Length: 30 Feet

Start Point: Station 19+40

Streambank: (*Left* or *Right*) **Direction:** *(Upstream* or *Downstream)*

0-3 ft height class			**3-15 ft. height class**			**>15 ft. height class**			**Comments**
Start Distance	End Distance	Species	Start Distance	End Distance	Species	Start Distance	End Distance	Species	(Record location of other transects/plots)
0	2	BRRS	-	-	-	-	-	-	
-	-	-	2	5	SAMO	-	-	-	
5	7.5	HERB	-	-	-	-	-	-	
-	-	-	7.5	11.5	SAGE	-	-	-	
11.5	12.5	BRRS	-	-	-	-	-	-	
-	-	-	12.5	16	SAGE	-	-	-	
16	17	HERB	-	-	-	-	-	-	
-	-	-	17	21	SADR	-	-	-	
21	22	BRRS	-	-	-	-	-	-	
-	-	-	22	29.5	SAMO	-	-	-	
29.5	30	BRRS	-	-	-	-	-	-	22

Species Codes

			BRRS = Barren soil
SABO	*Salix boothii*	Booth's willow	HERB = Herbaceous
SADR	*Salix drummondiana*	Drummond's willow	LITT = Litter
SAGE	*Salix geyeriana*	Geyer's willow	REST = Restoration Structure
SAMO	*Salix monticola*	Park willow	WOOD = Wood
			ROCK = Rock
			OTST = Other structure

Transect #5

Length: 40 Feet

Start Point: Station 40+90

Streambank: (*Left* or *Right*) **Direction:** *(Upstream* or *Downstream)*

0-3 ft height class			3-15 ft. height class			>15 ft. height class			Comments
Start Distance	End Distance	Species	Start Distance	End Distance	Species	Start Distance	End Distance	Species	(Record location of other transects/plots)
-	-	-	0	2	SAMO	-	-	-	
2	3.5	BRRS	-	-	-	-	-	-	
-	-	-	3.5	6	SAGE	-	-	-	
6	6.5	BRRS	-	-	-	-	-	-	
-	-	-	6.5	10	SAGE	-	-	-	
10	11	BRRS				-	-	-	
-	-	-	11	20.5	SADR	-	-	-	
-	-	-	20.5	24.5	SAMO	-	-	-	
24.5	25.5	BRRS	-	-	-	-	-	-	
-	-	-	25.5	29.5	SAMO	-	-	-	
29.5	30	BRRS	-	-	-	-	-	-	
-	-	-	30	40	SAGE	-	-	-	35.5

Species Codes

			BRRS = Barren soil
SABO	*Salix boothii*	Booth's willow	HERB = Herbaceous
SADR	*Salix drummondiana*	Drummond's willow	LITT = Litter
SAGE	*Salix geyeriana*	Geyer's willow	REST = Restoration Structure
SAMO	*Salix monticola*	Park willow	WOOD = Wood
			ROCK = Rock
			OTST = Other structure

Appendix C
2020 Summit County Photo Points

Swan River Stream Restoration Project (Phase 1)

Photo Point Monitoring – July 2020

Figures

Figure 1: Swan River Restoration; Photo Point Monitoring Map providing an overview of the restoration area and ten photo monitoring point locations.

Photo Points

Photo Point 1: Swan River; View east across the Phase 1 restoration reach from an adjacent hillside. Muggins Gulch is visible in the foreground.

Photo Point 2: Swan River; View south across the Phase 1 restoration reach from an adjacent hillside.

Photo Point 3: Swan River; View north and west across the Phase 1 restoration reach from the top of a tailings pile adjacent to the Tiger townsite.

Photo Point 4: Swan River; View north, east, and west across the Phase 1 restoration reach.

Photo Point 5: Swan River; View north, east, and west across the Phase 1 restoration reach.

Photo Point 6: Swan River; View north, east, and west across the Phase 1 restoration reach.

Photo Point 7: Swan River; View south and west across the Phase 1 restoration reach

Photo Point 8: Swan River; View north, west, and south across Phase 1 restoration reach from within the restoration site.

Photo Point 9: Swan River; View north, east, and south across Phase 1 restoration reach from within the restoration site.

Photo Point 10: Swan River; View south and west across portion of restoration reach to the west of Tiger Road.

Photo Point 1.

July 24, 2020

Photo Point 2.

July 24, 2020

Photo Point 3.

July 24, 2020

Photo Point 4.

July 24, 2020

Photo Point 5.

July 24, 2020

Photo Point 6.

July 24, 2020

Photo Point 7.

July 24, 2020

Photo Point 8.

July 24, 2020

Photo Point 9.

July 24, 2020

Photo Point 10.

July 24, 2020