Spencer Creek Alluvial Fan and Channel Rehabilitation Status Report 2018

Partnership between Mount St. Helens Institute (MSHI) and USFS Gifford Pinchot National Forest

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MOUNT ST. HELENS INSTITUTE

August 2018

FOREST SERVICE US DEPARTMENT OF AGRICULTURE

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Project Summary

The Spencer Creek Fish Habitat Restoration Project consists of the construction of 7 complex Large Woody Debris (LWD) structures within Spencer Creek using 100 pieces of LWD and a larger structure immediately upstream of the confluence with the North Fork Lewis River using 100 pieces of LWD. The LWD structures are designed to increase habitat complexity and diversity, provide refugia during winter flows for juvenile salmonids, and provide increased spawning opportunities for adult salmonids. The project targets ESA listed species including coho and Chinook salmon, steelhead trout and bull trout.

The Forest Service hired a contractor to harvest trees with the root wad intact and haul the LWD to the project site. An excavator and skidder were used to place wood in strategic locations. The tracked excavator and rubber mounted skidder accessed the project area via a closed logging road.

The pre-implementation monitoring included three types of surveys. Longitudinal profiles, cross-section profiles, and Wolman Pebble Counts were conducted prior to structure installation in 2018. In 2019,

one year after implementation, a longitudinal profile, cross sections and Wolman Pebble Counts will be repeated to analyze the change in channel morphology and sediment deposition after winter flows. Photographs were also taken to provide further documentation.

Site Location and Description

The project site is located in the Gifford Pinchot National Forest approximately 10 miles upstream from Swift Reservoir. Spencer Creek is situated on the west (river right) side of the North Fork Lewis River.

Approximately 200 pieces of LWD were harvested during thinning operations from a nearby timber sale unit which allowed for the use long stems (60+ feet) with attached root wads. The site was accessed by reopening 9000480 road, and LWD was trucked to the 9000480 road and stockpiled. From there, the LWD was transported to the project site using a skidder where an excavator constructed the structures. . The FR 9000480 was closed after all activities were completed, by re-establishing drainage and blocking vehicular access.

Approximately 100 pieces of LWM were used to create a large structure immediately upstream of the Spence Creek alluvial fan to encourage high flow scour, salmonid refuge, and gravel retention in the North Fork Lewis River. An additional 7 structures were installed in Spencer Creek between the Lewis River and the Lewis River trail #31 using 100 pieces of LWD to form complex habitat. These additional structures are designed to increase the number of pools over 1-foot deep and spawning gravel retention which will increase salmonid spawning and rearing opportunities. The overall design will appear natural and meet scenery management objectives.

Spencer Creek is a small tributary to the North Fork of the Lewis River in which water flows year-round. The stream extends 700 feet from the Lewis River to Trail #31 with an elevation increase of 45 feet and varies in width between 15 and 30 feet. Surface substrate consists of substantial fines, with a D50 of 9, mixed with some spawning gravel and cobble. Prior to habitat restoration implementation, there were 11 pools with a cumulative pool length of 210.75 feet and an average residual pool depth of 0.76 feet. The channel is deeply entrenched where cross sections were conducted with banks averaging 10 feet in height. The alluvial fan at the confluence of Spencer Creek and the North Fork Lewis River are dominated by Alder and Big leaf Maple while the upland is a mixed conifer stand of mature Hemlock and Douglas-fir with some Vine Maple.

The longitudinal profile and cross sections from 2018 conducted before implementation show the channel's baseline geomorphology. Structures were installed in August 2018 but post-implementation surveys were not conducted. A 1-year post-Implementation survey will be conducted in 2019 to analyze changes to stream geomorphology resulting from the combination of habitat restoration and winter flow interaction with installed structures.

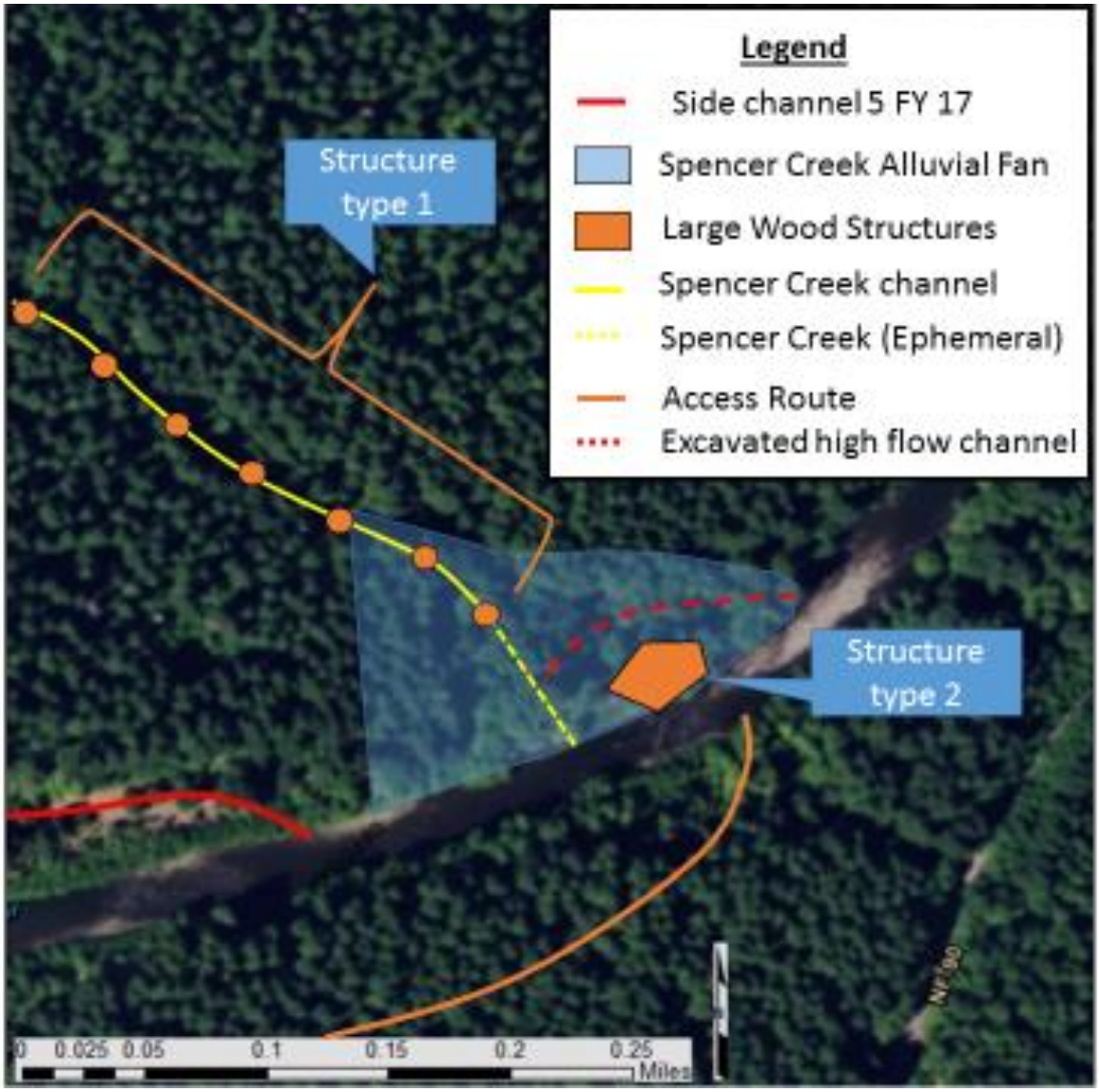


Image 1: Spencer Creek Alluvial fan and channel rehabilitation project design.

Priorities and Goals

The Aquatic Coordination Committee (ACC) three priorities for restoration projects in the Lewis River Basin are:

1. Benefit fish recovery throughout the North Fork Lewis River, with priority to federal ESA-listed species.
2. Support the reintroduction of anadromous fish throughout the basin.
3. Enhance fish habitat in the Lewis River Basin, with priority given to the North Fork Lewis River.

The project site was chosen as a fitting location to address these Lewis River Basin restoration priorities based on ACC identified priority reaches. When this tributary of the North Fork Lewis River is

restored it will act as refugia from winter flows for juveniles and increase carrying capacity of summer rearing habitat. Enhancing the habitat with woody structures will benefit multiple ESA listed species by increasing the number and size of pools over 1-foot as well as increase spawning gravel retention. As such, this project helps to ensure that fish reintroduction efforts into the upper North Fork Basin are successful and directly benefit other salmonids not included in reintroduction efforts.

The lack pools over one foot deep and quality instream LWD prior to this project were the biggest issues preventing the site from acting as functional salmonid habitat. To address this, four primary goals were given for this project:

1. Improve habitat complexity and diversity using LWD
2. Provide refugia during winter flows for juvenile salmonids
3. Provide rearing opportunities for juvenile salmonids during summer months
4. Provide increased spawning opportunities for adult salmonids

Community Outreach

The Mount St. Helens Institute provides internships for undergraduate students studying fisheries science. Interns gain experience surveying and monitoring restoration projects. This experience is a stepping stone for a career in fisheries management. In addition, the Mount St. Helens Institute trains approximately 300 school age youth each year in watershed dynamics, monitoring and water quality analysis. During the 2018 field work season, one intern from a local community college was employed to assist in the monitoring of the side channels.

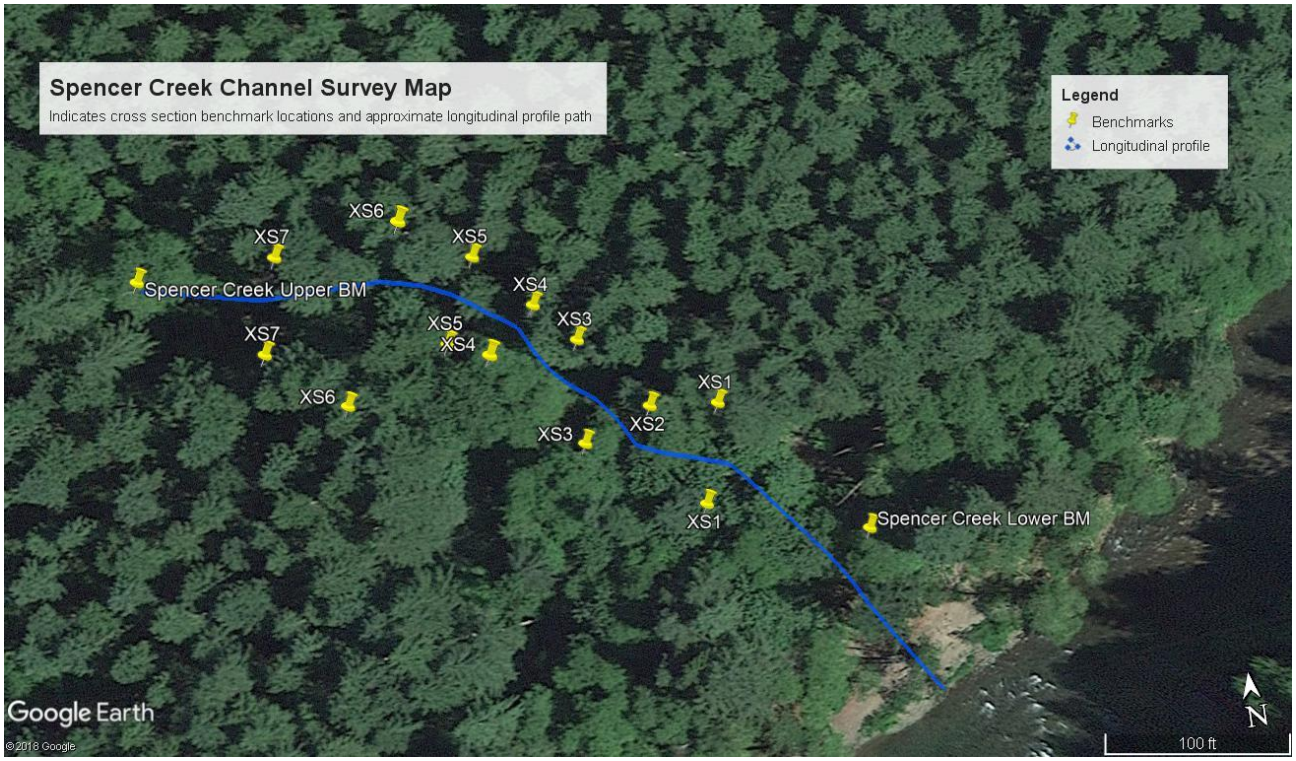


Image 2: Spencer Creek survey map indicating the location of benchmarks and approximate channel.

Monitoring Methodology

A series of monitoring surveys were conducted to quantify changes in the stream channel. A baseline longitudinal and cross section profiles were created using methodology adapted from Harrelson et al. (1994), and Wolman Pebble Counts were conducted prior to project implementation in 2018. In 2019, the same three surveys will be conducted again to determine how the structures have changed stream morphology. Photographs over two years will further document the project.

Cross Section Profiles

To monitor the effects of each LWM structure, cross section profiles were created immediately at the proposed location of each structure. The methods for measuring these cross sections were adapted from methods described by Harrelson et al. (1994). Some structures were installed to increase cover habitat and were not expected to alter geomorphology (pools, gravel beds), and as such only structures that were designed to alter geomorphology were monitored with a cross section.

Cross-sectional benchmarks (an aluminum nail protruding from lath secured to a tree) were placed in locations such that the cross section was directly perpendicular to the angle of water flow. Lath was labeled to identify each structure and improve visibility. A total of 7 structures were surveyed - numbered 1, 2, 3, 4, 5, 6, and 7, 1 being closest to the confluence with the North Fork Lewis River and 7 furthest upstream.

To conduct the survey a measuring tape was stretched tightly across the channel and attached to each benchmark. A laser level were used to map the topography of the bank and stream bed along the measuring tape. Measurements were taken as frequently as needed to capture all significant topographical

features. The height from the ground to the nail was recorded in the notes so that the nail could be used as the fixed reference point. In addition to mapping the topography of the stream bed, the survey also recorded the water level, locations of water edges, and bankfull elevations.

Wolman Pebble Count

A Wolman Pebble Count (WPC) was conducted at the approximate location of each structure, where gravel recruitment is expected to occur. The surveyor walked back and forth between the two bankfull locations in a consistent zig-zag pattern picking up substrate from the top of the stream bed. Some of the substrate picked up was inside the bankfull location but out of the water. The substrate was picked up systematically (for example, every 6 inches) and without looking at the spot prior to touching it in order to eliminate bias. A gravelometer was used to measure the substrate. Substrate too large to be picked up was measured with a ruler on the side of the gravelometer. A minimum of 100 pieces of substrate were counted for each WPC. The surveyor ended each pebble count at one of the bankfull locations and never stopped part way into the channel.

Longitudinal Profile

A longitudinal profile was created for Spencer Creek using methods closely adapted from Harrelson et al. (1994). The longitudinal profile measures the elevation changes of the thalweg - the deepest continuing line in the stream channel. From the longitudinal profile, one can assess stream type, pool depth, and pool:riffle ratio. Due to thalweg meandering the longitudinal profile is not only a measure of distance and elevation, but also of sinuosity.

The upper benchmark is a nail in a well-established large Douglas-fir. Coordinates are 10T 0584334, 5110059. The lower benchmark is a piece of rebar at the base of a large Douglas-fir on the high terrace. Coordinates are 10T 0584145, 5109957.

A laser level was used to measure changes in elevation. The distances covered between the measuring points varied depending on changes in the thalweg. Sections of frequent changes were measured more densely while sections with little change were measured less densely. Generally, as many measurements as needed were taken to record all significant changes in elevation of the thalweg. A range finder was used to measure the distance between the points. When the laser level was no longer in sight, it was moved to a new location and a reading was taken in the same location before and after the relocation in order to calculate and account for the change. In addition to measuring changes in elevation, the water level and habitat unit (pool head, pool max and pool tail, with the assumption of riffle in between pools) were recorded at each point. When the longitudinal profile intersected a cross sectional profile the measuring point was recorded in the notes.

Photos

Photos were taken at each cross section looking downstream, looking upstream, from right bank looking to left bank, and from left bank looking to right bank. Additional photos were taken when required, such as when a structure was damaged or destroyed. Select photos are included in this report but all photos are available on request.

Results and Analysis

A seven hundred long longitudinal profile was established along Spencer Creek prior to implementation (Figure 1) and a habitat analysis summary was conducted (Table 2).

Longitudinal Profile

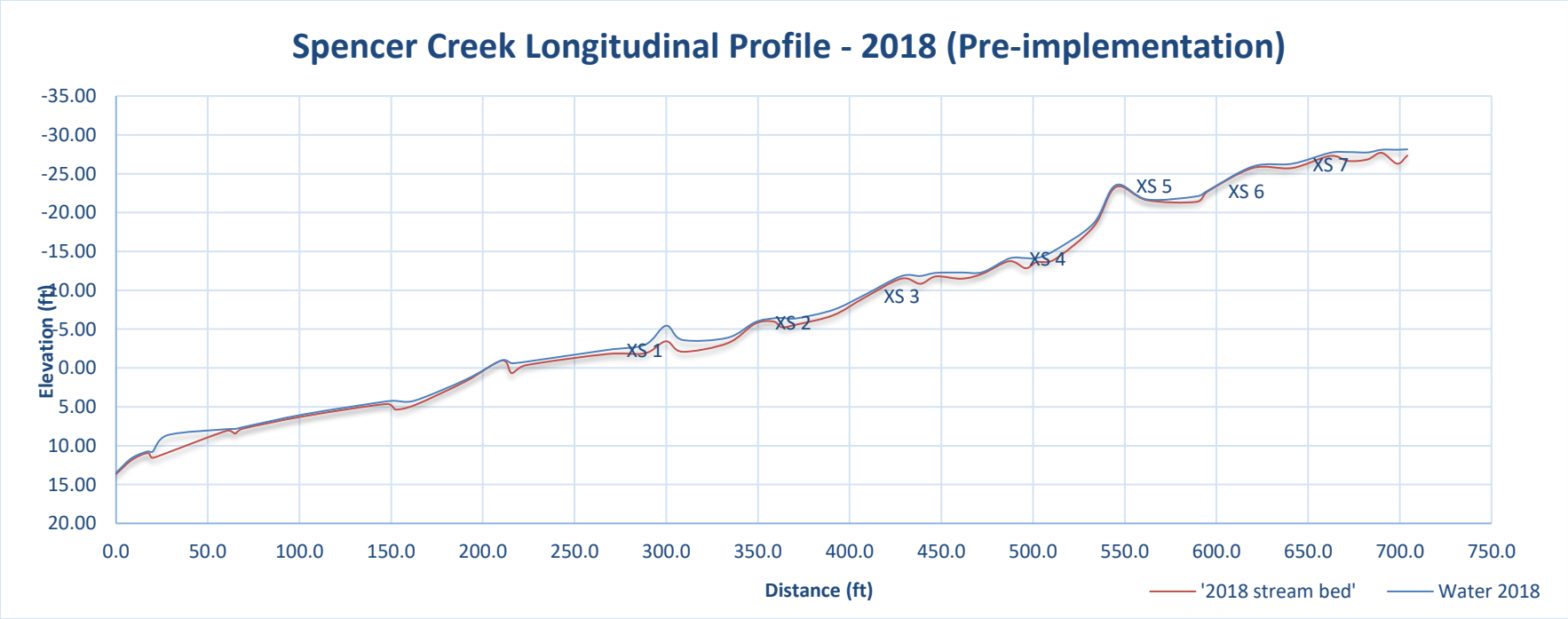


Figure 1: Longitudinal Profile for Spencer Creek analyzing pre-implementation geomorphology from survey conducted in 2018.

Table 1: Analysis of habitat units in Spencer Creek prior to habitat restoration implementation showing pool habitat in the stream between the North Fork Lewis River and trail #31.

Longitudinal Profile Statistics	**2018**
Number of pools	11
Cumulative pool length in feet	210.75
Mean Residual Pool depth in feet	0.76
Cumulative riffle length in feet	489.25

Wolman Pebble Counts

Substantial amounts of fines along with spawning gravel and cobble exist in Spencer Creek prior to implementation (Figure 2) and the D50 at the cross sections ranged from 6-14 (Table 2).

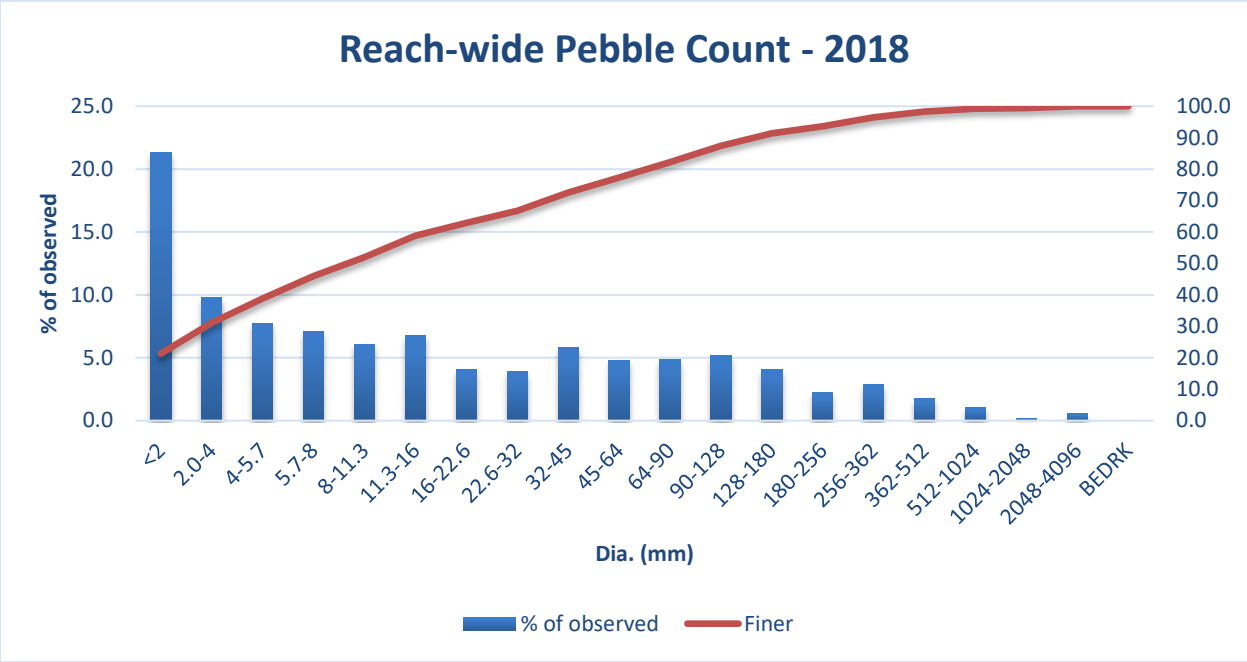


Figure 2: Reach-wide analysis for Spencer Creek Wolman Pebble Count data collected in 2018 prior to habitat restoration implementation indicating substantial fines mixed with some spawning gravel and cobble.

Table 2: Analysis of the Wolman Pebble Count including Reach-Wide and individual structure data comparing the average diameter of the most abundate substrate sizes in Spencer Creek.

2018		
ST	D50	D84
1	7	123
2	12	90
3	7	110
4	7	51
5	11	75
6	14	148
7	6	73
Reach-wide	9	88

Cross Section Profiles

Cross-section profiles are found in Appendix A with corresponding photos and structure-level pebble counts.

Conclusions

The Spencer Creek Alluvial Fan and Channel Rehabilitation project goals were to:

1. Improve habitat complexity and diversity in the side channel using LWM
2. Provide refugia during winter flows for juvenile salmonids
3. Provide rearing opportunities for juvenile salmonids during summer months
4. Provide increased spawning opportunities for adult salmonids.

The installation of 7 LWM structures inherently provide habitat complexity and diversity. The structures diversify the stream channel by altering channel morphology which includes creating refugia pools during winter flows for juvenile salmonids and rearing opportunities in the summer months. Additionally, structures provide cover in the side channel allowing full use of the channel by juvenile salmonids. Gravel will be sorted during winter flows increasing spawning opportunities.

Evidence for these accomplishments will be documented by the post-implementation monitoring survey conducted in 2019. The longitudinal profiles indicate that the stream contains 11 pools less than 1 foot deep that span 210 feet of the 700 feet surveyed between the Lewis River Trail #31 and the Spencer Creek Alluvial fan. The 7 instream structures were designed to increasing the number and depth of these pools.

Cross-section profile analysis indicates that during winter flows Spencer creek is approximately 1.5 to 2.5 feet deep based on bankfull elevations.

Reach-wide analysis of Wolman Pebble Counts shows that Spencer Creek surface substrate is roughly 40% fines (<6.4mm), 40% spawning gravel and 20% cobble. In addition to increasing habitat diversity, structures are also expected to increase spawning gravel retention. Pebble counts were not conducted in the Spencer Creek alluvial fan where a very large structure was constructed just upstream on the bank of the North Fork Lewis River with a roughened channel excavated to encourage high flow scours and increase sediment transport through the alluvial fan, large wood roughness was also added to both sides throughout the entire fan. The lower reaches of Spencer Creek are ephemeral which limits fall spawning opportunities for adult coho salmon. These actions will increase the sediment transport capability of the lower ephemeral reach by concentrating high flows and will provide fall spawning opportunities for coho salmon.

In the coming years, we expect to see an increase in the abundance of gravel sizes appropriate for spawning and reduction of fines increasing spawning opportunities for reintroduced salmonids and improving intra-gravel survival and emergence of juveniles in the Lewis River Basin. Instream structures will increase the number of pools and residual depth providing greater rearing opportunities in the summer months and refugia from winter flows for juvenile salmonids.

Appendix A: Site Level Cross Sections, Pebble Counts and Photos

Raw data and additional site photos are available on request.

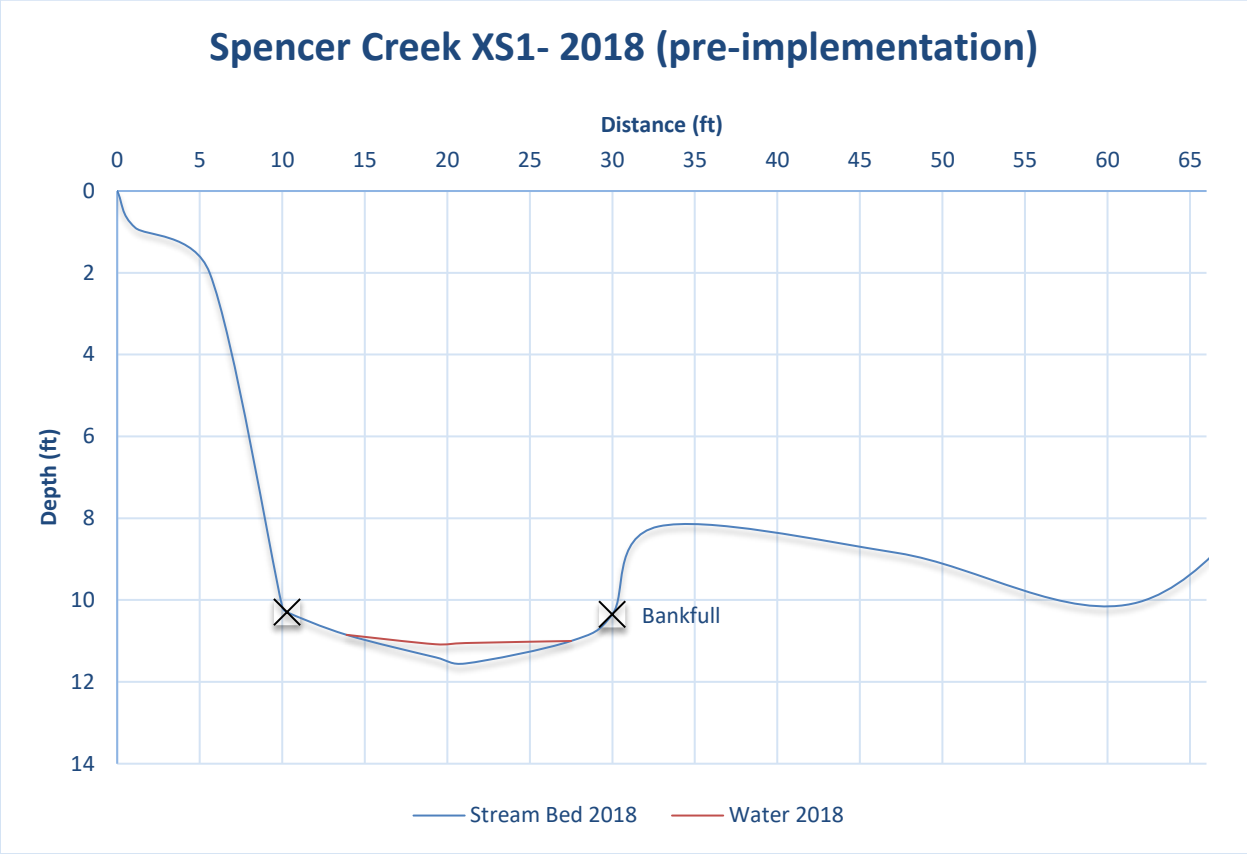
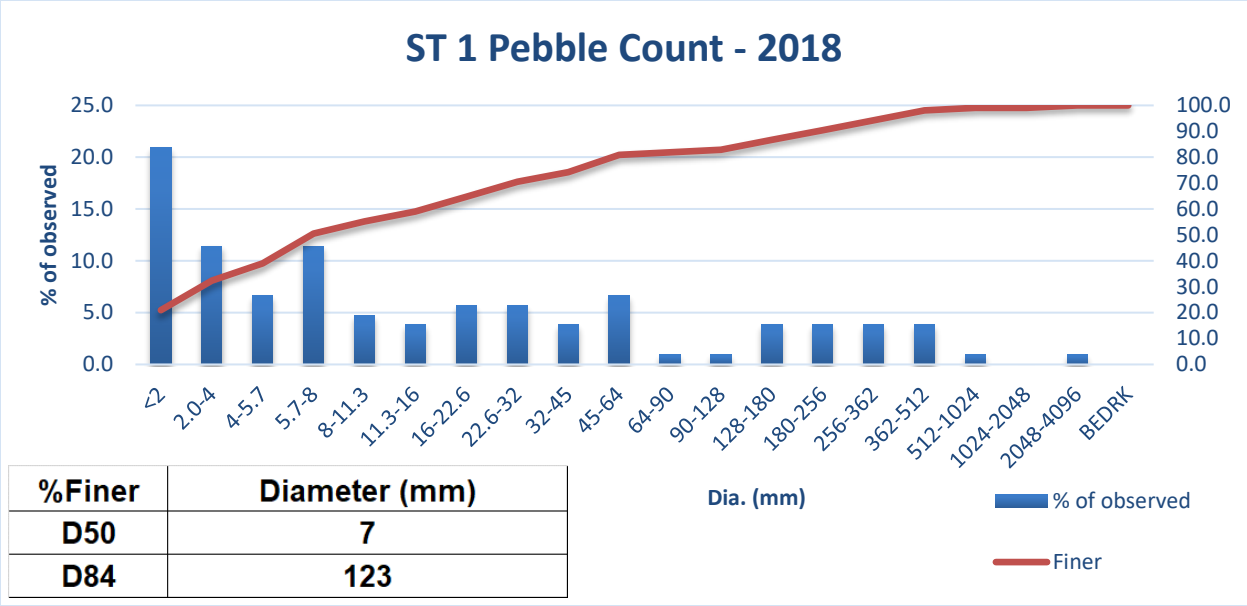


Figure 3: Cross section channel profile at proposed location of Structure 1 in Spencer Creek from survey conducted prior to habitat restoration implementation in 2018 demonstrating a high terrace left bank and lower terrace floodplain right bank.



%Finer	Diameter (mm)
D50	7
D84	123

Figure 4: Analysis of 2018 Wolman Pebble Count survey data collected at proposed location for Structure 1 in Spencer creek prior to habitat restoration implementation indicating significant deposition of fines.

Image 5: XS 1 Looking Upstream

Image 3: XS 1 Looking Downstream

Image 6: XS 1 Right Bank to Left Bank

Image 4: XS 1 Left Bank to Right Bank

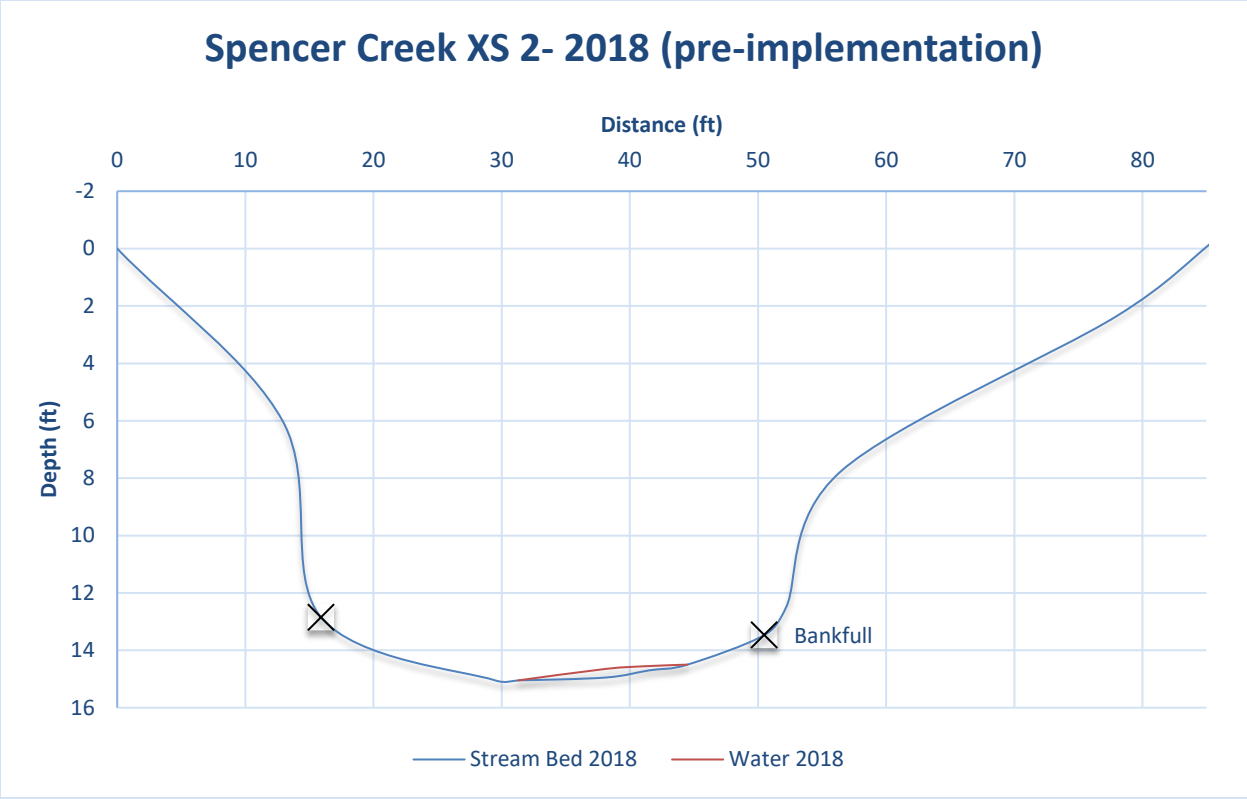
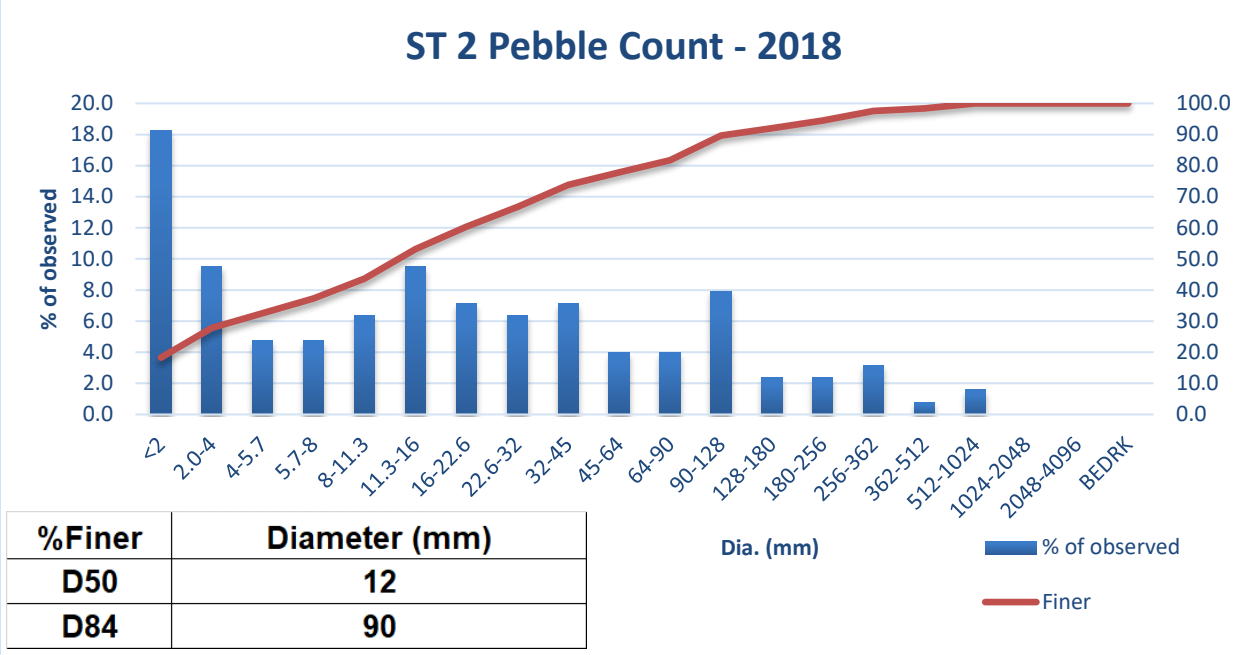


Figure 5: Cross section channel profile at proposed location of Structure 2 in Spencer Creek from survey conducted prior to habitat restoration implementation in 2018 demonstrating a high terrace left bank and lower terrace floodplain right bank.



%Finer	Diameter (mm)
D50	12
D84	90

Figure 6: Analysis of 2018 Wolman Pebble Count survey data collected at proposed location for Structure 2 in Spencer creek prior to habitat restoration implementation indicating significant deposition of fines.

Image 10: XS 2 Looking Upstream

Image 9: XS 2 Looking Upstream

Image 8: XS 2 Right Bank to Left Bank

Image 7: XS 2 Left Bank to Right Bank

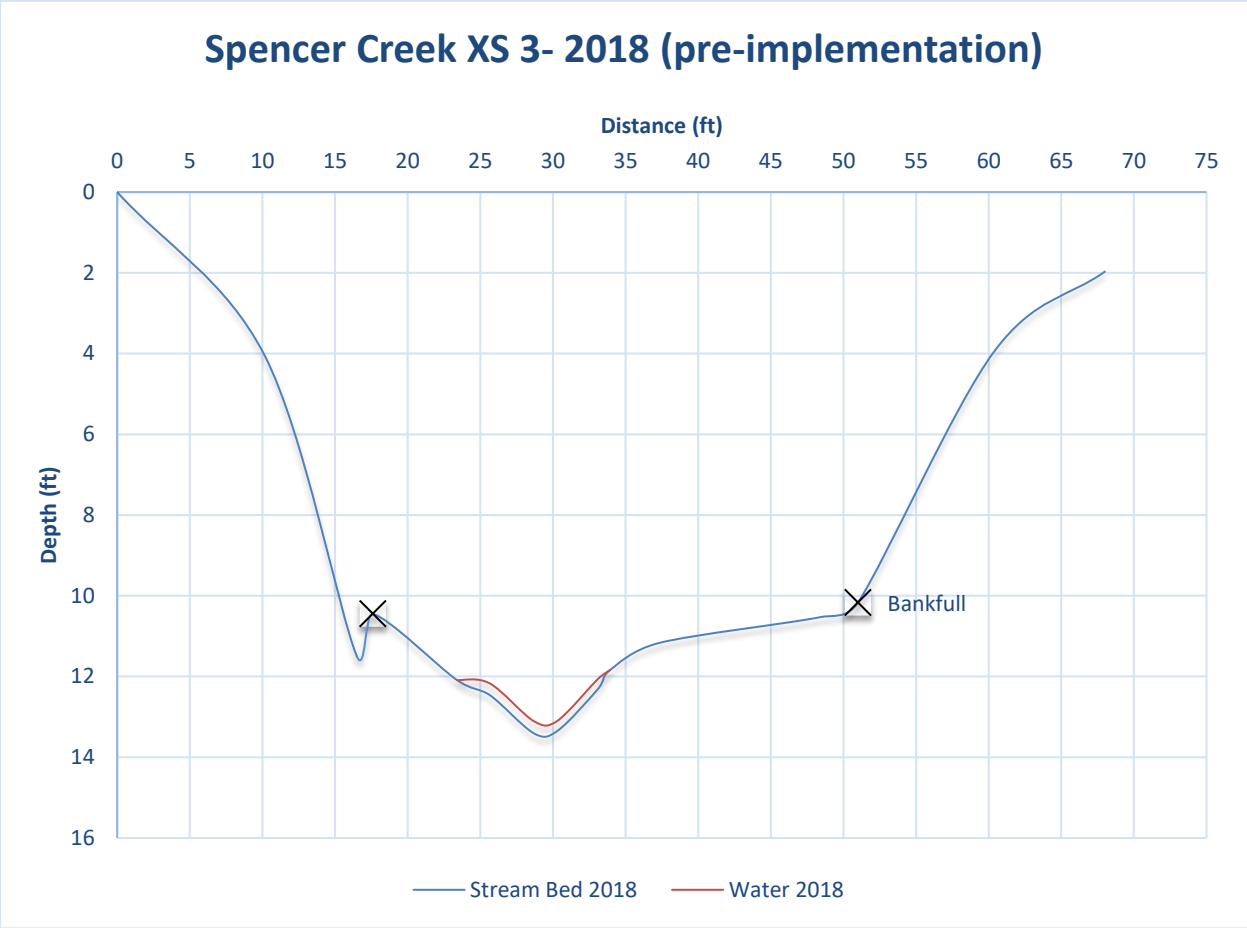
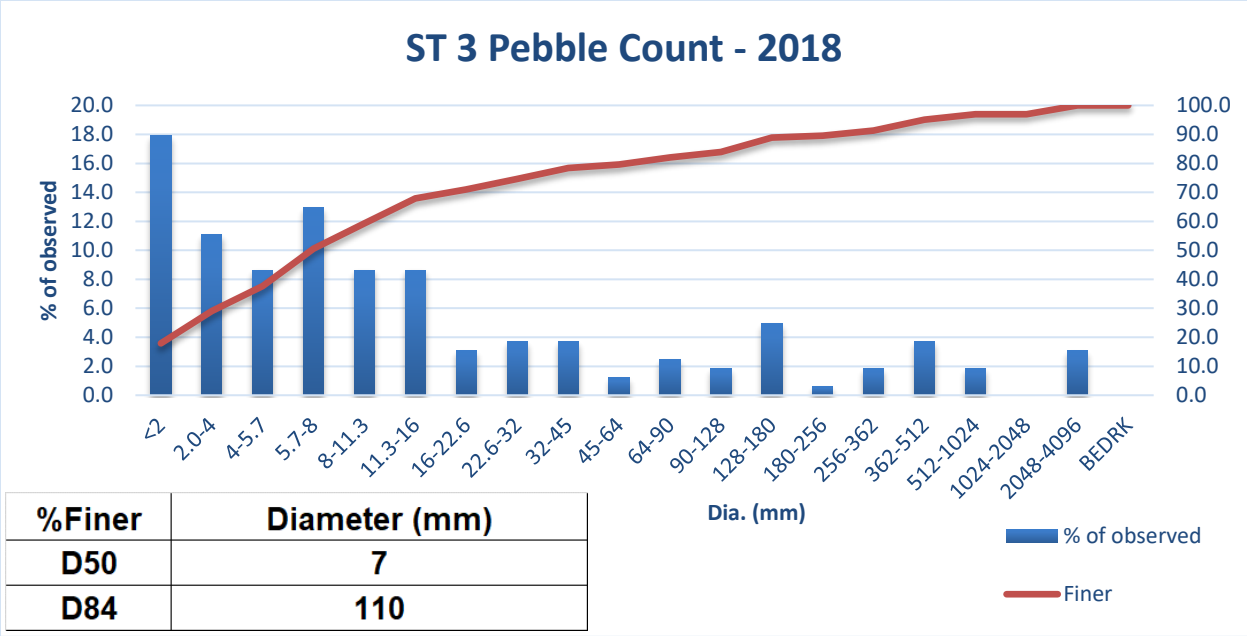


Figure 7: Cross section channel profile at proposed location of Structure 3 in Spencer Creek from survey conducted prior to habitat restoration implementation in 2018 demonstrating a high terrace left bank and lower right bank with steep elevation increase to the floodplain.



%Finer	Diameter (mm)
D50	7
D84	110

Figure 8: Analysis of 2018 Wolman Pebble Count survey data collected at proposed location for Structure 3 in Spencer creek prior to habitat restoration implementation indicating significant deposition of fines.

Image 12: XS 3 Looking Upstream

Image 11: XS 3 Looking Downstream

Image 13: XS 3 Right Bank to Left Bank

Image 14: XS 3 Left Bank to Right Bank

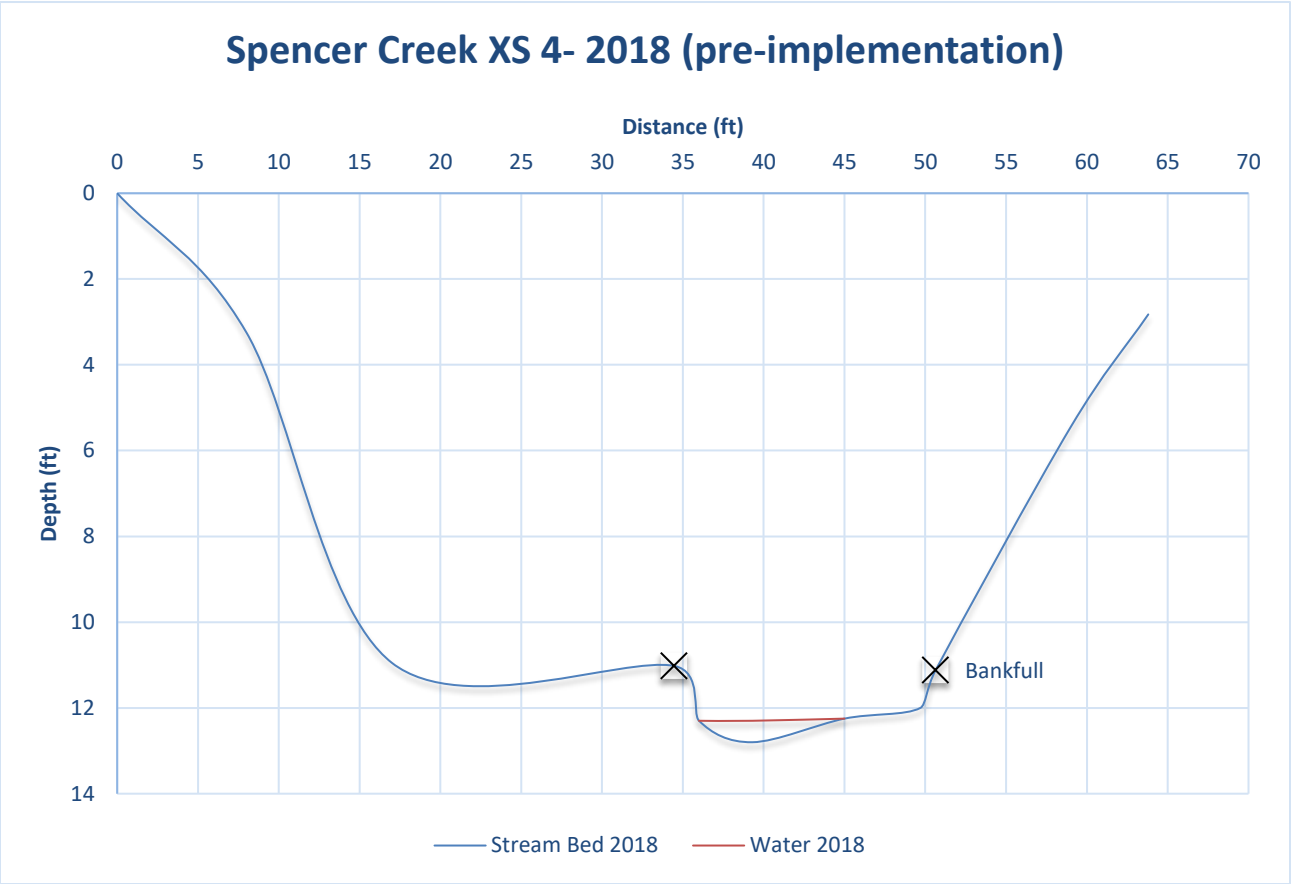
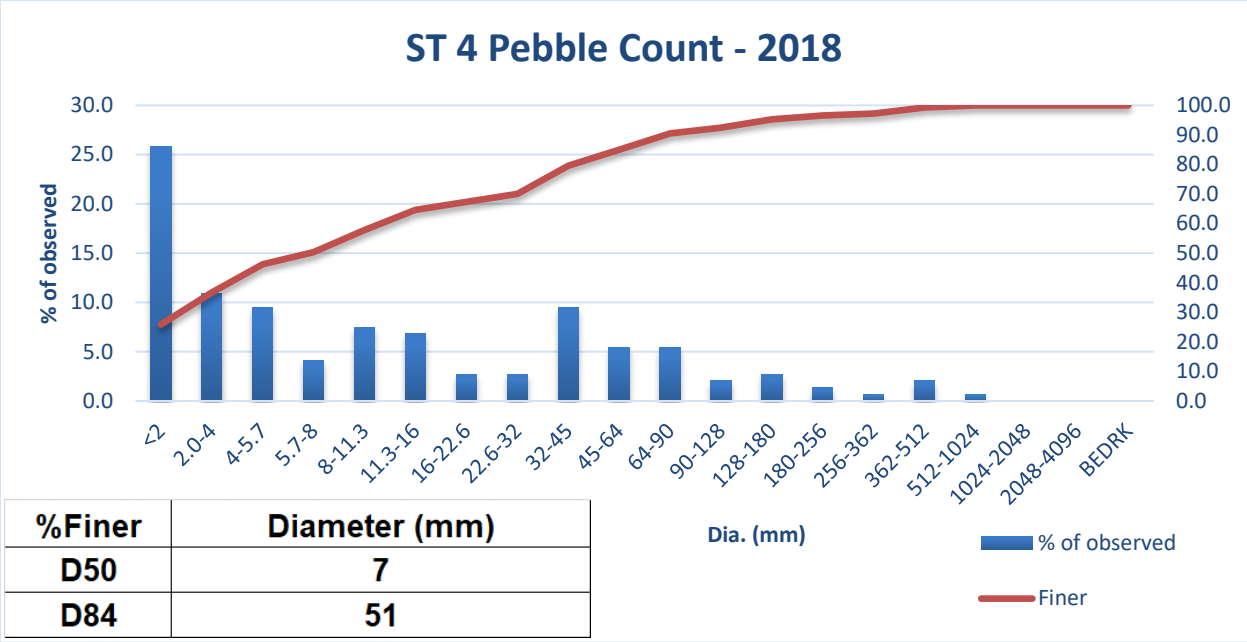


Figure 9: Cross section channel profile at proposed location of Structure 4 in Spencer Creek from survey conducted prior to habitat restoration implementation in 2018 demonstrating a lower left bank with a steep elevation increase to the high terrace and lower right bank increasing in elevation to the floodplain.



%Finer	Diameter (mm)
D50	7
D84	51

Figure 10: Analysis of 2018 Wolman Pebble Count survey data collected at proposed location for Structure 4 in Spencer creek prior to habitat restoration implementation indicating significant deposition of fines.

Image 15: XS 4 Looking Upstream

Image 16: XS 4 Looking Downstream

Image 18: XS 4 Right Bank to Left Bank

Image 17: XS 4 Left Bank to Right Bank

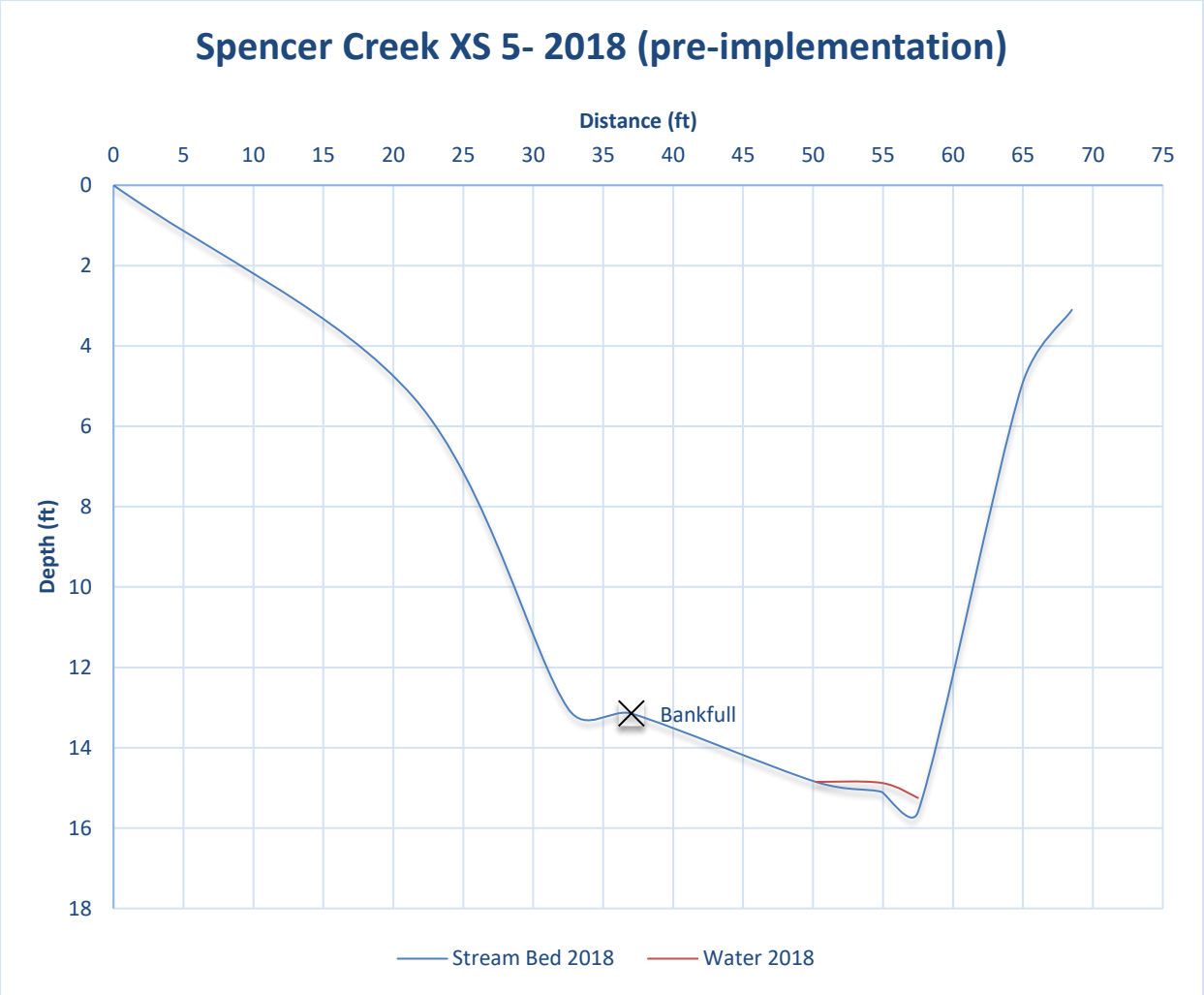
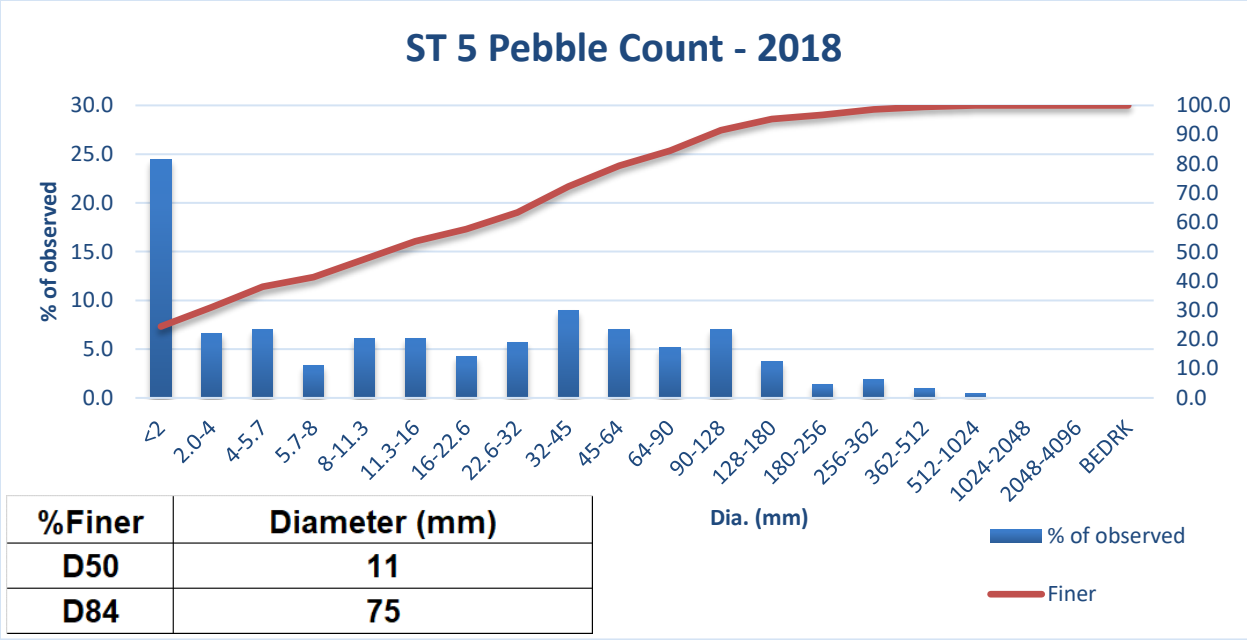


Figure 11: Cross section channel profile at proposed location of Structure 5 in Spencer Creek from survey conducted prior to habitat restoration implementation in 2018 demonstrating a lower left bank increasing in elevation to the high terrace and a steep right bank increasing in elevation to the floodplain. Note right bank is undercut making REW and bankfull indeterminable.



%Finer	Diameter (mm)
D50	11
D84	75

Figure 12: Analysis of 2018 Wolman Pebble Count survey data collected at proposed location for Structure 5 in Spencer creek prior to habitat restoration implementation indicating significant deposition of fines mixed with moderate levels of spawning gravel.

Image 20: XS 5 Looking Upstream

Image 19: XS 5 Looking Downstream

Image 22: XS 5 Right Bank to Left Bank

Image 21: XS 5 Left Bank to Right Bank

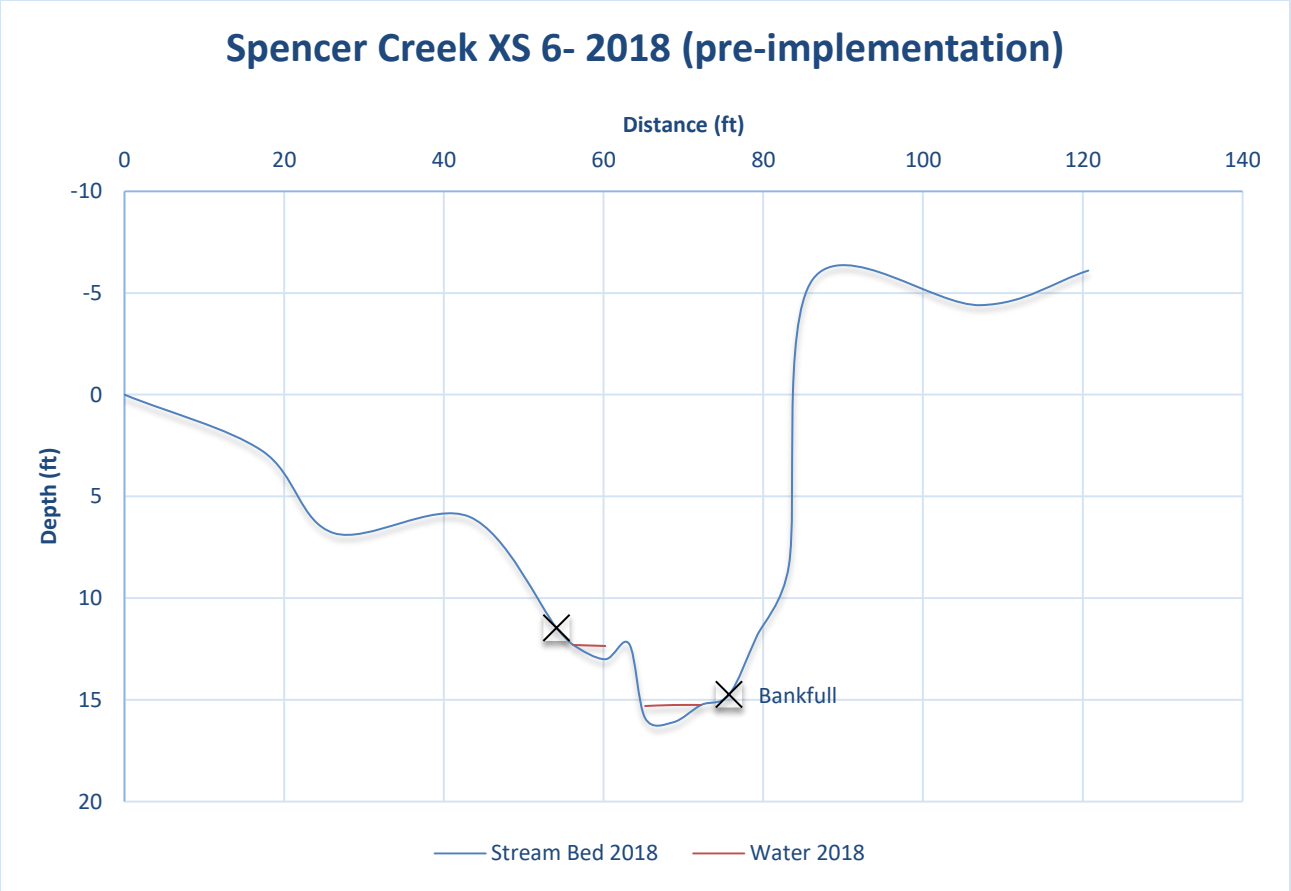
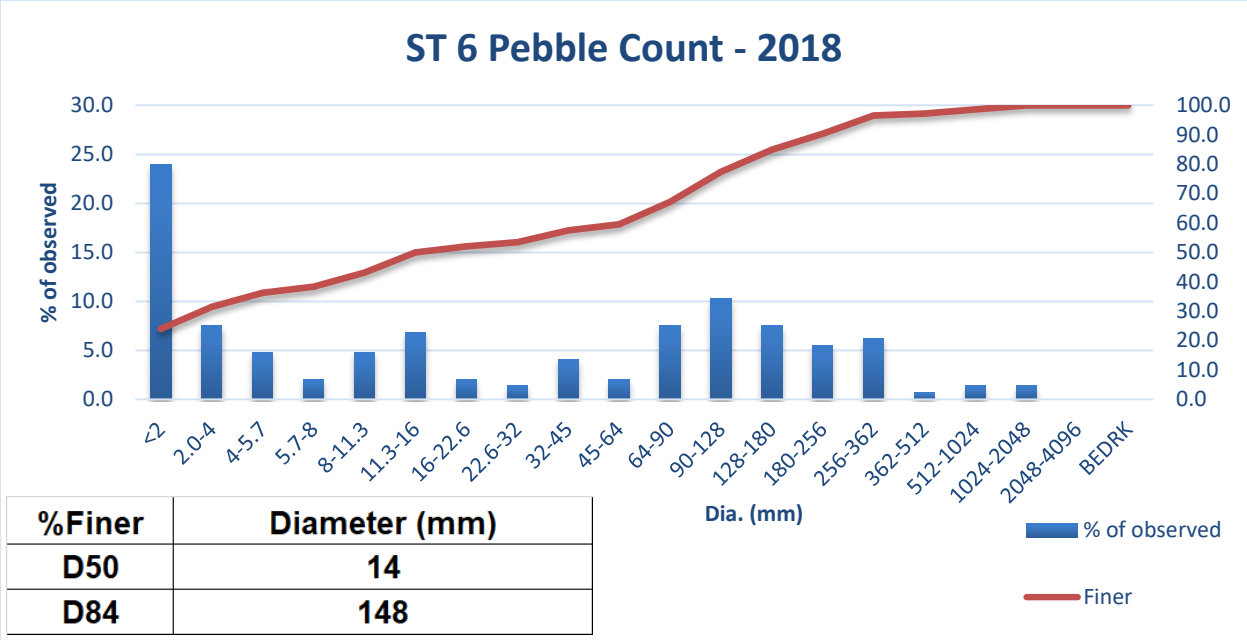


Figure 13: Cross section channel profile at proposed location of Structure 6 in Spencer Creek from survey conducted prior to habitat restoration implementation in 2018 demonstrating a stepping left bank caused by in stream LWM increasing the accumulation of boulders and cobble and creating a unique channel feature as well as the channel elevation meeting the elevation of the high terrace while the right bank has a steep elevation increase to the high terrace.



%Finer	Diameter (mm)
D50	14
D84	148

Figure 14: Analysis of 2018 Wolman Pebble Count survey data collected at proposed location for Structure 6 in Spencer creek prior to habitat restoration implementation indicating significant deposition of fines mixed with cobble.

Image 26: XS 6 Looking Upstream

Image 25: XS 6 Looking Downstream

Image 24: XS 6 Right Bank to Left Bank

Image 23: XS 6 Left Bank to Right Bank

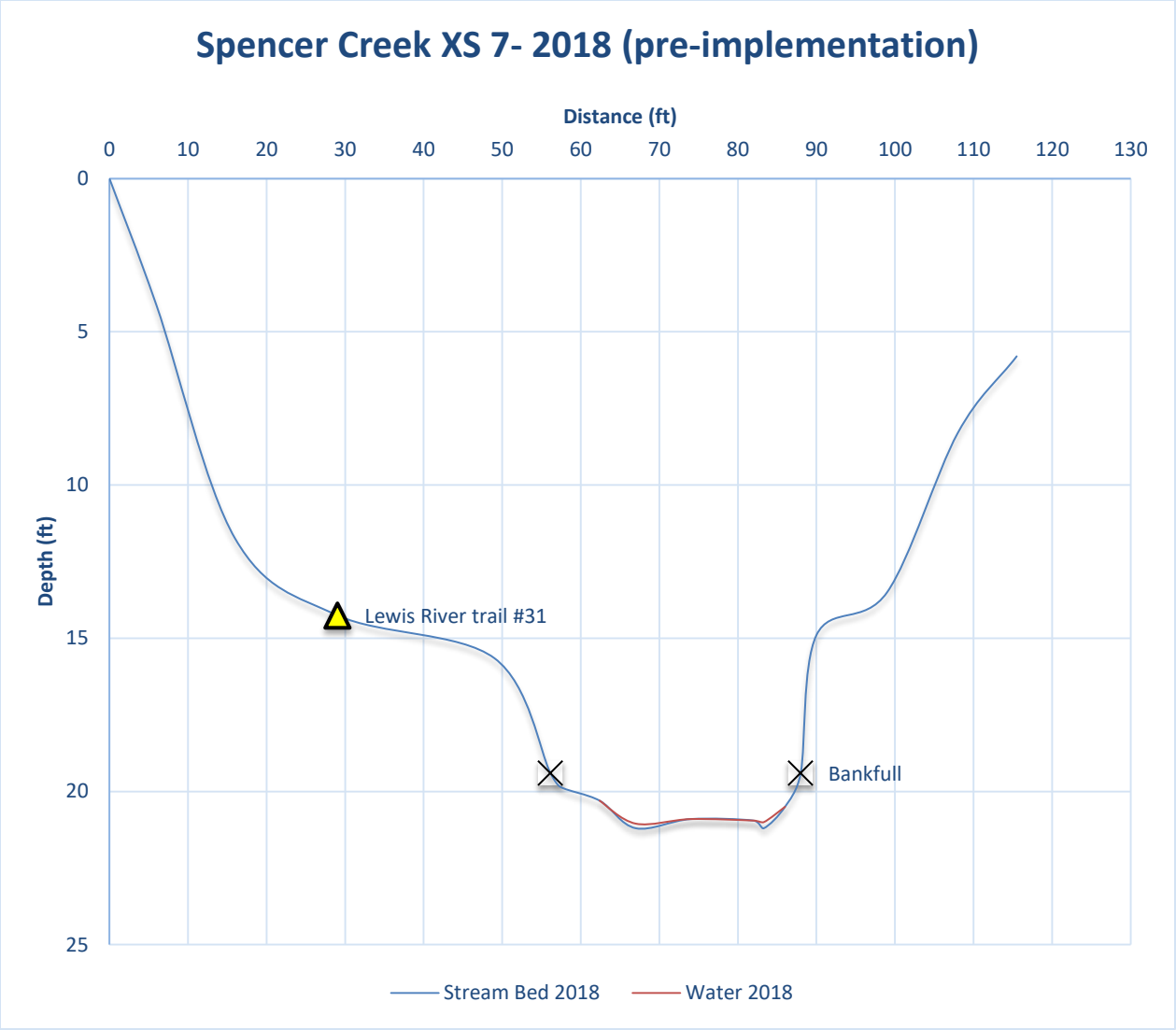
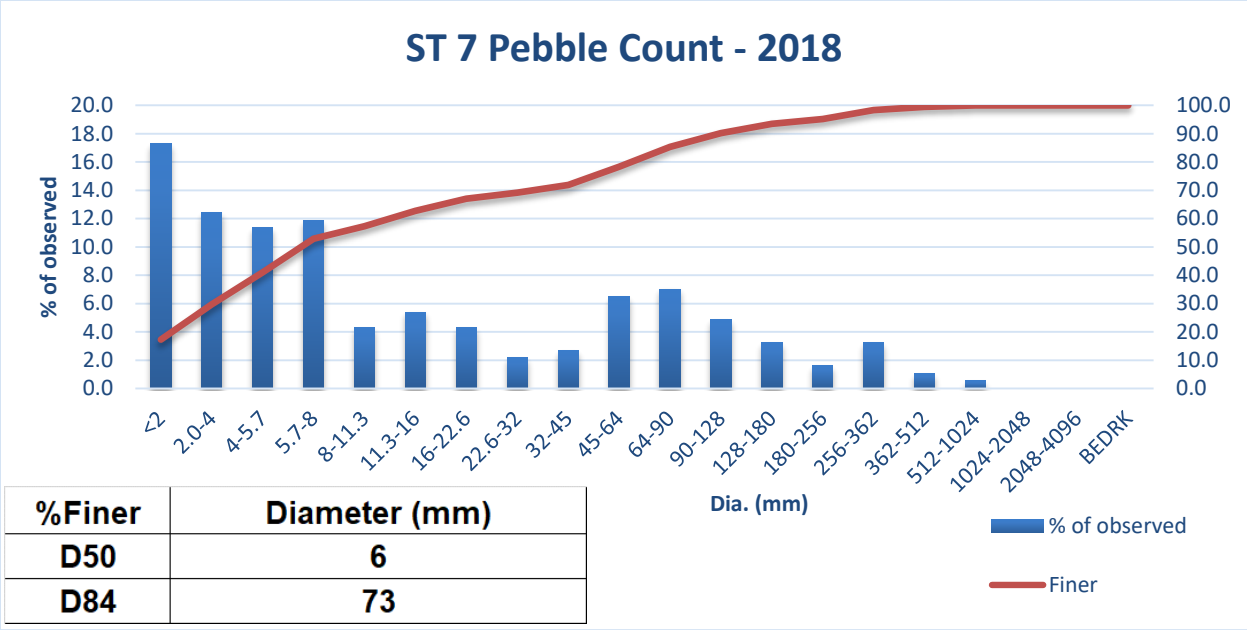


Figure 15: Cross section channel profile at proposed location of Structure 7 in Spencer Creek from survey conducted prior to habitat restoration implementation in 2018 demonstrating a low left bank resulting from channel elevation meeting the elevation of the high terrace while the right bank has a steep elevation increase to the high terrace.



%Finer	Diameter (mm)
D50	6
D84	73

Figure 16: Analysis of 2018 Wolman Pebble Count survey data collected at proposed location for Structure 6 in Spencer creek prior to habitat restoration implementation indicating significant deposition of fines.

Image 28: XS 7 Looking Upstream

Image 27: XS 7 Looking Downstream

Image 30: XS 7 Right Bank to Left Bank

Image 29: XS 7 Left Bank to Right Bank