MONTANA DEPARTMENT OF TRANSPORTATION
STREAM MITIGATION MONITORING REPORT

Swamp Creek
Lincoln County, Montana

Project Completed: 2014
Monitoring Report #1: December, 2015

Prepared for:

MONTANA MDT DEPARTMENT OF TRANSPORTATION

Prepared by:

CONFLUENCE

MONTANA DEPARTMENT OF TRANSPORTATION

STREAM MITIGATION MONITORING REPORT #1

YEAR 2015

Libby Creek South - Swamp Creek
Lincoln County, Montana

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Prepared for:

MONTANA DEPARTMENT OF TRANSPORTATION
2701 Prospect Ave
Helena, MT 59620-1001

Prepared by

Confluence Consulting, Inc.
P.O. Box 1133
Bozeman, MT 59771

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1.0 INTRODUCTION

To mitigate unavoidable impacts to Swamp Creek related to the Libby Creek - South road reconstruction project, the Montana Department of Transportation (MDT), has implemented a plan to provide onsite, in-kind, compensatory mitigation by relocating 11,263 feet of Swamp Creek away from the roadway (MDT 2012). The following report provides the results of the first year of post construction mitigation monitoring along this segment of Swamp Creek and compares these results to project performance standards outlined in the post-construction monitoring plan for the site. This project was constructed between 2013 and 2014; therefore, these results provide documentation of the site's condition one year following the project's completion.

The project restores Swamp Creek from its previously degraded condition to a naturally functioning stream by relocating Swamp Creek away from US Highway 2. This provides improved stream and riparian area ecosystem function. In and near the project area, Swamp creek has a history of anthropogenic impacts ranging from agricultural productions to infrastructure uses. Swamp Creek has been channelized to maximize grazing and hay production in the narrow valley, and occupies the Highway 2 borrow ditch in many locations. Channelization has resulted in channel incision, loss of floodplain connectivity, reduced riparian function, and degraded aquatic organism habitat. Fish migration has also been hindered by various stream crossings that have become barriers over time.

The new channel of Swamp Creek implements natural channel design components intended to improve bankfull channel dimensions, increase floodplain connectivity, increase sinuosity, and provide a healthy riparian corridor. These features will improve flow and sediment transport, increase aquatic organism habitat, and promote a self-maintaining stream system. Aside from the functional lift associated with the project, relocation of the stream channel away from the road reduces anthropogenic impacts from snow removal, road sanding, roadside litter and other sources.

Objectives intended to meet the project’s goal include:

1. Create a stream channel that effectively transports a range of flows
2. Improve sediment transport capacity, including:
    a. Suspended and bedload transport
    b. Float load transport (organic debris, wood, etc.)
3. Develop a stream/floodplain system that is dynamic and self-maintaining
4. Construct a stable stream channel that includes:
    a. Connectivity to the floodplain
    b. Appropriate bankfull channel dimensions
    c. Increased sinuosity
    d. Improved longitudinal profile characteristics (e.g. riffle-pool spacing)
5. Enhance in-stream habitats for resident and migratory fish including:
    a. Riffle-pool complexes
    b. Over-hanging banks (vegetation, log jams, etc.)

   c. Suitable spawning habitat
6. Restore the Swamp Creek floodplain and riparian habitats with native hydrophytic plant communities
7. Remove a fish migration barrier at the Farm to Market Road (Station 19+49; river mile 0.8) that will facilitate an additional 9.6 river miles of upstream spawning and rearing habitat opportunities for native Westslope cutthroat trout, a Montana Species of Concern and the federally-listed endangered bull trout;
8. Improve Swamp Creek water quality by moving the channel away from sections of the US Highway 2 roadway to reduce impacts from road maintenance activities such as winter snowplowing and sanding efforts; and
9. Reactivate approximately 853 feet of remnant Swamp Creek channel to connect Channel Change Reach 1 with Channel Change Reach 2.

Monitoring of this site will be based upon a minimum period of 5 years or longer as determined by the US Army Corps of Engineers - Montana Regulatory Office's review of annual monitoring reports for the site and whether or not the site has met stream success criteria. The performance standards for the on-site mitigation plan for Swamp Creek are outlined below.

Quantitative success criteria for Swamp Creek:

1. **Riparian Buffer Success** will be achieved when woody and riparian vegetation becomes established, and noxious weeds do not exceed 10% cover within the riparian buffer areas. Any area within the creditable buffer disturbed by the project construction must have at least 50% aerial cover of non-noxious weed species by the end the monitoring period.
   a. **Vegetation Success** will be achieved where combined aerial (sic) cover of riparian and stream bank vegetation communities is >70% and Montana State-listed noxious weeds do not exceed 10% cover, subject to the woody standards listed below.
   b. **Woody Plants**-Planted trees and shrubs will be considered successful where they exhibit 50% survival after 5 years.

2. **Vegetation along Streambanks** will be considered successful when banks are vegetated with a majority of deep-rooting riparian plant species having NRCS Root Stability Indexes of greater than or equal to six (≥6) (subject to 1.a and 1.b above). The NRCS Plant Stability Rating Table is available within Appendix F of the 2008 version of the MDT Montana Wetland Assessment Method).

3. **Stream Channel Restoration Success** will be achieved when the following criteria are met within the monitoring period:
   a. **Bankfull Channel Dimensions** will be considered successful if bankfull width/depth ratios do not exceed a value of 20. The designed channel has a range of bankfull width/depth ratios ranging from as low as 10 to as high as 18. A bankfull width/depth ratio that exceeds 20 would indicate that the channel has over-widened and/or aggraded to an unacceptable amount.

MDT would consider any natural reduction in bankfull width/depth ratio an acceptable stream response.

b. **Stream Pattern** is one of the most dynamic aspects of stream channels. Meander loops migrate naturally and cutoff as system dynamics change. Lack of vegetation and other site conditions could cause premature or accelerated erosion and or cutoff. To consider the designed stream pattern a success, no significant lateral migration should occur for the first three years, the average life span of the biodegradable materials used to stabilize the newly constructed stream banks. After the first three years success will be considered natural meander migration that does not lead the channel dimensions exceeding the thresholds in 3.a. Accelerated lateral erosion is best expressed through changes in the channel dimensions.

c. **Stream Longitudinal Profile** will be considered a success if the maximum pool depth following construction is not reduced by 20% or more. MDT would consider deepening of pools a beneficial natural response.

4. **Photo Documentatio**n of the restored stream channel and adjacent riparian vegetation community will be conducted annually from established photo points to monitor the successful development of the site, and to provide certification showing distinct positive changes from pre-construction to final monitoring year in comparison with the established reference reach. Photo points will be established at the end of each stream transect location to show the stream channel and views of the vegetation communities both upstream and downstream.

5. **Weed Control** will be based upon annual monitoring of the site to determine weed species and degree of infestation within the site. Control measures based upon the monitoring results will be implemented by MDT and/or its weed contractors in cooperation with the Lincoln County Weed District to minimize and/or eliminate the intrusion of State Listed Noxious weed species within the stream corridor.

Performance against these standards were assessed according to the monitoring protocols outlined in the Swamp Creek Mitigation Plan. Section 3 presents the specific methods used to implement these monitoring protocols at the Swamp Creek Site. Results of the first year monitoring are included in Section 5 and compared to performance standards in Section 6. Section 7 offers comments on the design of the Swamp Creek project and offers management recommendations to maximize the potential for meeting all performance standards at this and other similar mitigation sites. Additional reporting requirements including maps indicating the endpoints of riparian belt transects, perpendicular transect surveys and locations of noxious weed infestations, repeated survey results at 43 perpendicular transects and a longitudinal stream profile, photo documentation of the project site, and project design sheets are included as appendices to this report.

2.0 SITE LOCATION

The project includes five reconstructed channel segments totaling approximately 11,262 feet of stream channel along US Highway 2. The project lies approximately 11 miles south of the town of Libby, Montana (Figure 1). The project site is located on a mix of Federal, private, and MDT-owned parcels in Sections 4, 10, 15, and 22 of Township 28 North, Range 30 West, in Lincoln County, Montana. Lengths of each reconstructed channel segment are based on the design plans, and are indicated in Table 1

Table 1. Reconstructed channel segment lengths and nomenclature.

Reconstructed Channel Segment	Channel stationing From	Channel Stationing To	Length (meters)	Total Length (feet)
1	100+00.00	101+43.48	143.5	471
2	132+00.00	135+00.05	300.1	984
3	139+60.64	153+77.73	1,417.1	4,648
5	170+00.00	171+14.32	114.3	375
7	190+00.00	211+98	1198	3,929
Reactivated channel	15+80	17+80	260	853
Total			**3,433**	**11,260**

3.0 MONITORING METHODS

Monitoring field crews visited the Swamp Creek Mitigation Site in October, 2014 to establish permanent photo points and perpendicular transect locations. Field crews returned to the project site and conducted monitoring activities on August 23-25th, 2015 while survey crews visited the site on September 1-3rd, 2015. The following data were collected at the Swamp Creek stream mitigation site:

3.1. Vegetation Inventory Belt Transects

Riparian vegetation was monitored along a series of 25-foot wide belt transects established parallel to the restored channel alignment (Maps 1 – 9, Appendix A). One riparian belt transect was established within reconstructed channel segments 1, 2, and 5. Five riparian belt transects were established within channel segment 3 due to modifications to the channel's geomorphology following construction and this reach's construction over the course of two years. Two riparian belt transects were established within channel segment 7 due to its construction over the course of two years. Field data collected along each riparian belt transect included documenting areal percent cover of total vegetation, woody vegetation, and noxious weeds. A comprehensive plant species list was compiled for planted, seeded, and volunteer species observed within each belt transect.

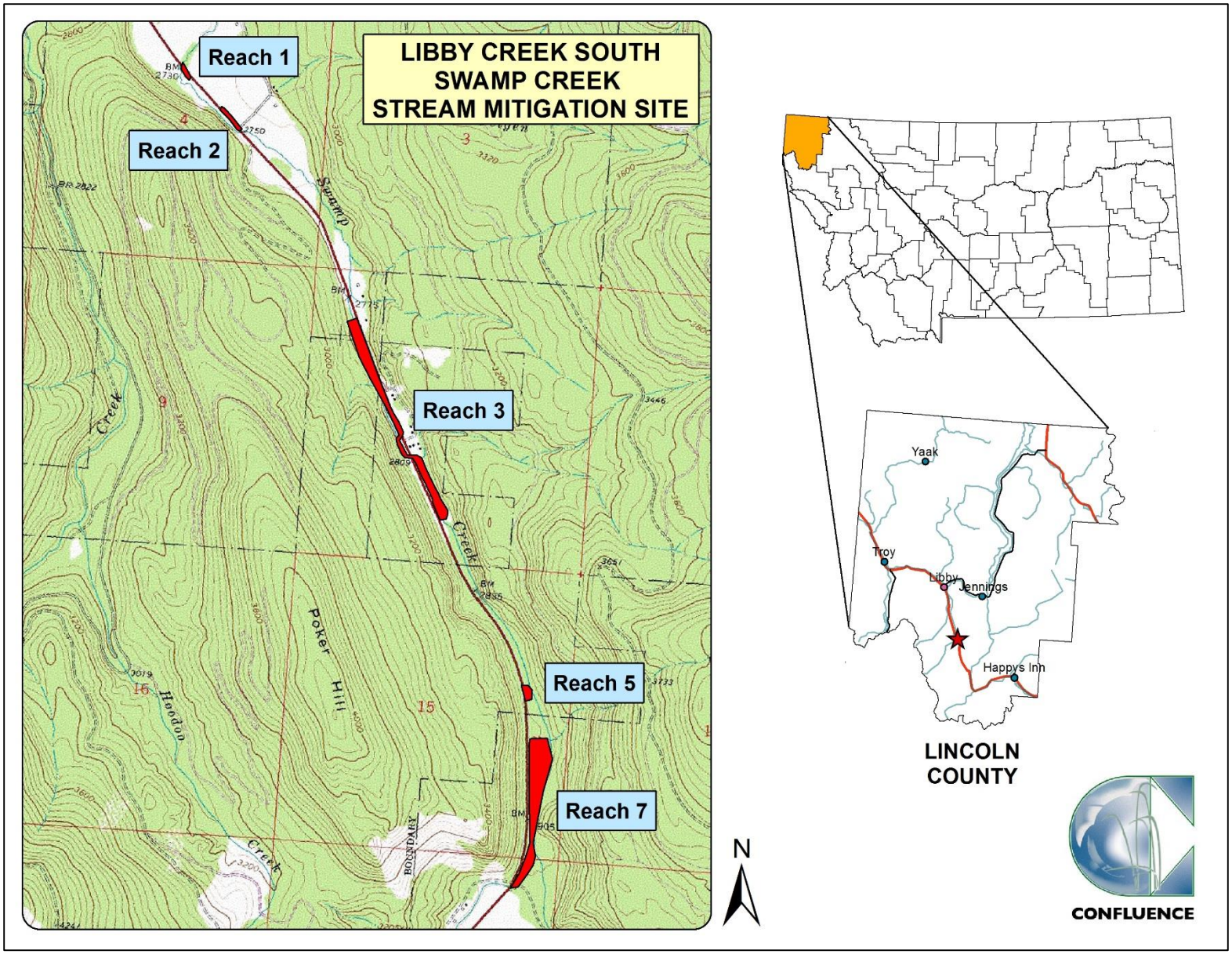


Figure 1. Location of the Swamp Creek stream mitigation site.

3.2. Stream Bank Vegetation Inventory

A more rigorous vegetation inventory was conducted along stream banks within each 25-foot wide riparian belt transect, which included compiling a list of all plant species and their associated cover classes identified within three feet of the active channel. Percent cover of all species observed along the entire length of each bank was estimated and recorded using the following classification values: 0 (less than 1 percent), 1 (1 to 5 percent), 2 (6 to 10 percent), 3 (11 to 20 percent), 4 (21 to 50 percent), and 5 (greater than 50 percent). Cover classes for one or more dominant stream bank species were used to classify stream bank communities present along the entire project reach. Bank stability indices were assigned to the dominant stream bank community types using Winward (2000) stability scores.

3.3. Woody Plant Survival Inventory

Woody plants installed during construction were inspected to determine survival rates. Survival rates were based on the total number of surviving plants observed divided by the total number of plants inspected (i.e. was not be based on the total number of plants installed by MDT during construction).

3.4. Noxious Weed Inventory

The Montana Noxious Weed List (July 2015), prepared by the Montana Department of Agriculture, was used to categorize weeds identified within the site. The location of noxious weeds was recorded in the field on aerial photo based maps along with the size of the infestation and the areal canopy cover of the noxious weed within that infestation. The locations were denoted with symbols representing 0 to 0.1 acre, 0.1 to 1 acre, or greater than 1 acre in extent, respectively. Canopy cover classes were recorded with a L, M, or H, for 1 to 5 percent, 6 to 25 percent, and 26 to 100 percent, respectively. Weed infestations with less than 1% canopy cover within the infestation were not mapped, but the presence of these trace infestations was included in the riparian belt transect and stream bank vegetation inventories.

3.5. Vegetation Community Mapping

Vegetation community boundaries were determined in the field during the active growing season and subsequently delineated on the 2015 aerial photographs. Community types were named based on the predominant vegetation species that characterized each mapped polygon and categorized according to the two plant species with the highest canopy cover.

3.6. Bank Erosion Inventory

Both stream banks within the project reach were visually inspected for the presence of eroding banks. Any eroding banks observed within the project reach were photo-documented. Potential causes of bank erosion were noted in the field.

3.7. Permanent Survey Benchmark

A permanent survey benchmark was established for each of the five reconstructed channel segments. Elevations and locations of benchmarks are not included on the

monitoring maps, but will be used to ensure survey data accuracy throughout the monitoring phase of the project.

3.8. Perpendicular Transects

A total of 43 transects were surveyed perpendicular to the channel at both riffles and pools within each of the five reconstructed channel segments as well as within the reactivated channel segment (Maps 1-9, Appendix A). Each transect was initially surveyed in October 2014 and repeated in August 2015. Multiple transects were surveyed within each channel segment to document bankfull width, maximum pool depth, and width/depth ratios (Table 2). Each transect was surveyed with point densities suitable for documenting vertical and lateral adjustments of the stream channel over time.

Table 2. Perpendicular transects surveyed along Swamp Creek mitigation site

Channel Segment	# of Pool Transects	# of Riffle Transects	Total # of Transects
1	2	2	4
Reactivated channel between Segments 1 and 2	2	2	4
2	4	2	6
3	6	7	13
5	2	2	4
7	5	7	12
Total	**21**	**22**	**43**

3.9. Longitudinal Profiles

A longitudinal profile of the channel thalweg was surveyed in October 2014 and again in August 2015 to document bedform complexity and aquatic habitat components. A longitudinal profile along the top of both stream banks was surveyed in October 2014 to document stream bed adjustments.

3.10. Stream Bed Substrate Composition

A Wolman pebble count was conducted at one riffle and one pool within each reconstructed channel segment (total of 10 pebble counts).

3.11. Photo-Documentation

A total of 28 photo-documentation points were established throughout the site to document vegetation establishment and channel stability over time. Photo points were surveyed and marked in the field to allow for repetition during subsequent monitoring years. Photo-documentation at the endpoints of each perpendicular transect included photos taken facing upstream, downstream, left, and right. Initial photos were taken during the October, 2014 monitoring event and repeated during the August, 2015 monitoring event.

3.12. Wildlife Documentation

Wildlife use was documented, developing a list of birds, mammals and herpetile species observed during field visits. Mammalian species utilizing the site were identified through

visual observation, analysis of tracks, and scat, location of dens and burrows, etc. Herpetile species were identified through visual observation only.

4.0 MONITORING REACHES

The Swamp Creek mitigation project includes five relocated channel segments constructed over the course of two years. Some channel segments were completed in 2013 and have undergone two growing seasons, whereas others were completed in 2014 and have undergone only one growing season as of the time of this report. The number of growing seasons affects several of the monitoring results; in particular those that relate to vegetation establishment. As a result of the timeline needed to complete the entire project, channel segments 3 and 5 were split into multiple reaches based on the year each reach was constructed. Table 3 provides a summary of reconstructed channel segments and reach breaks that were used to report the monitoring summary results. Aerial views of each reach are illustrated in Figures 2 through 8.

Table 3. Reconstructed channel segments and reaches used to present monitoring results

Reconstructed Channel Segment	Reach	Year Constructed
1	1	2013
2	1	2013
3	3.1	2013
	3.2	2014
	3.3	2013
	3.4	2013
5	5	2014
7	7.1	2013
	7.2	2014

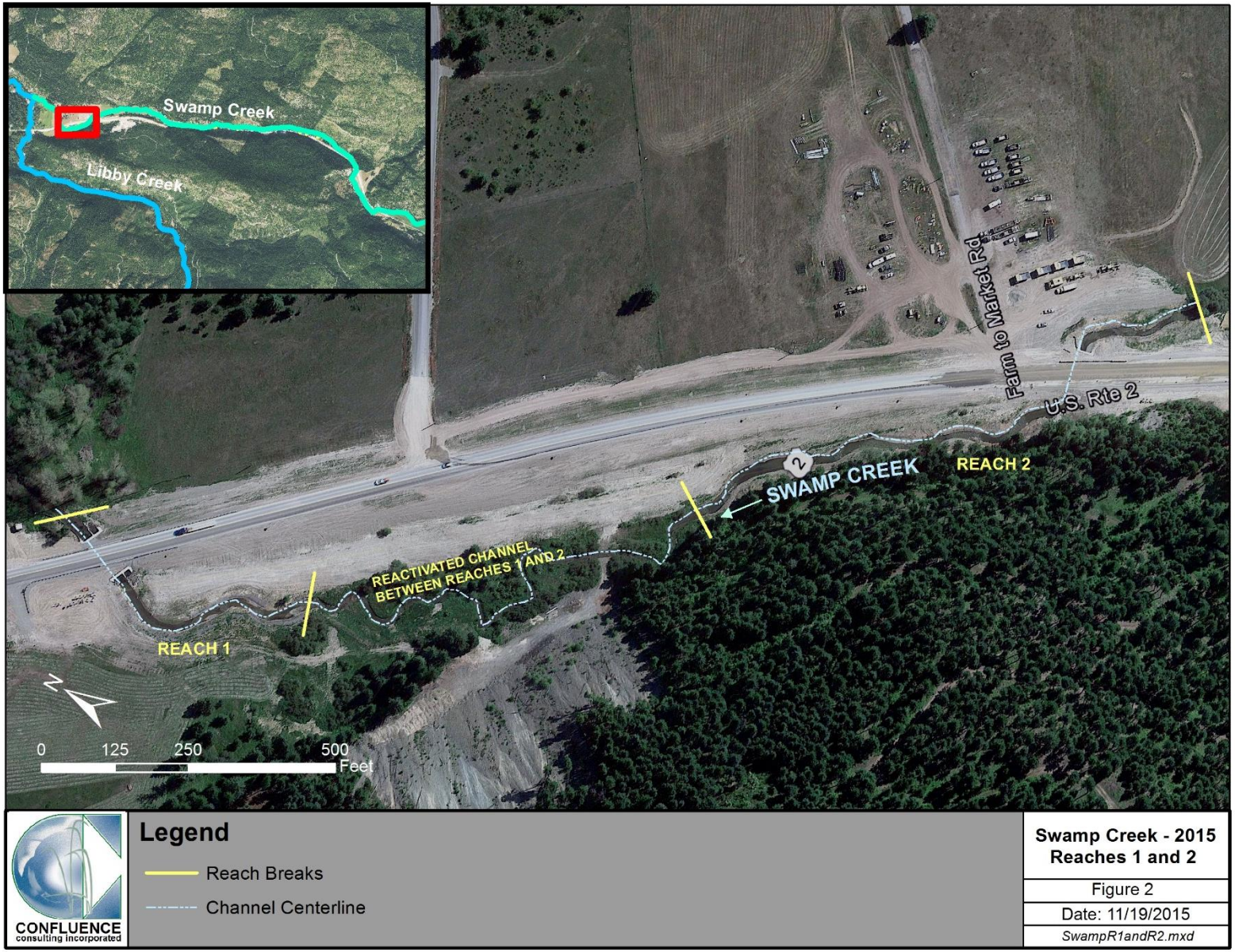


Figure 2. Monitoring Reaches 1 and 2 of Swamp Creek Mitigation Site

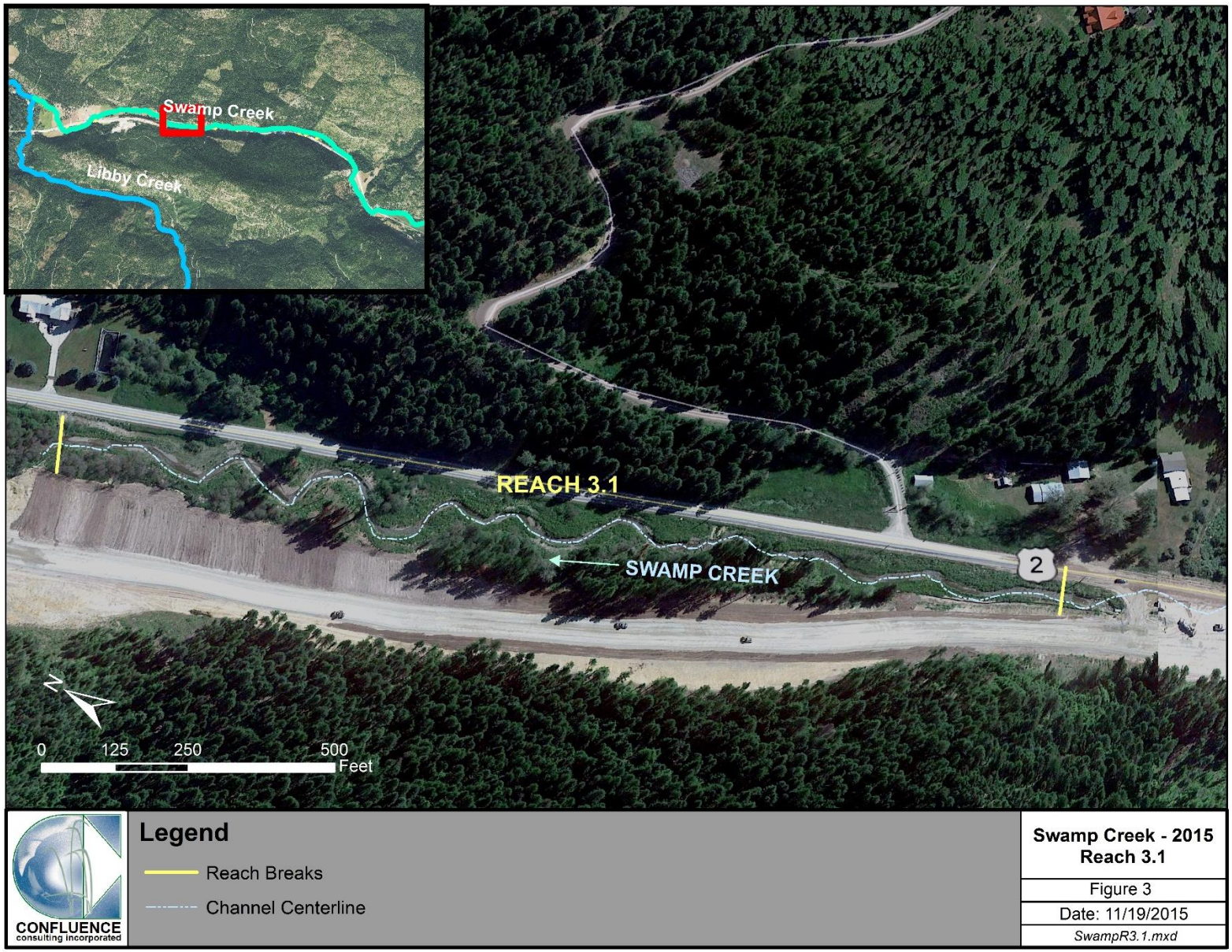


Figure 3. Monitoring Reach 3.1 of Swamp Creek Mitigation Site

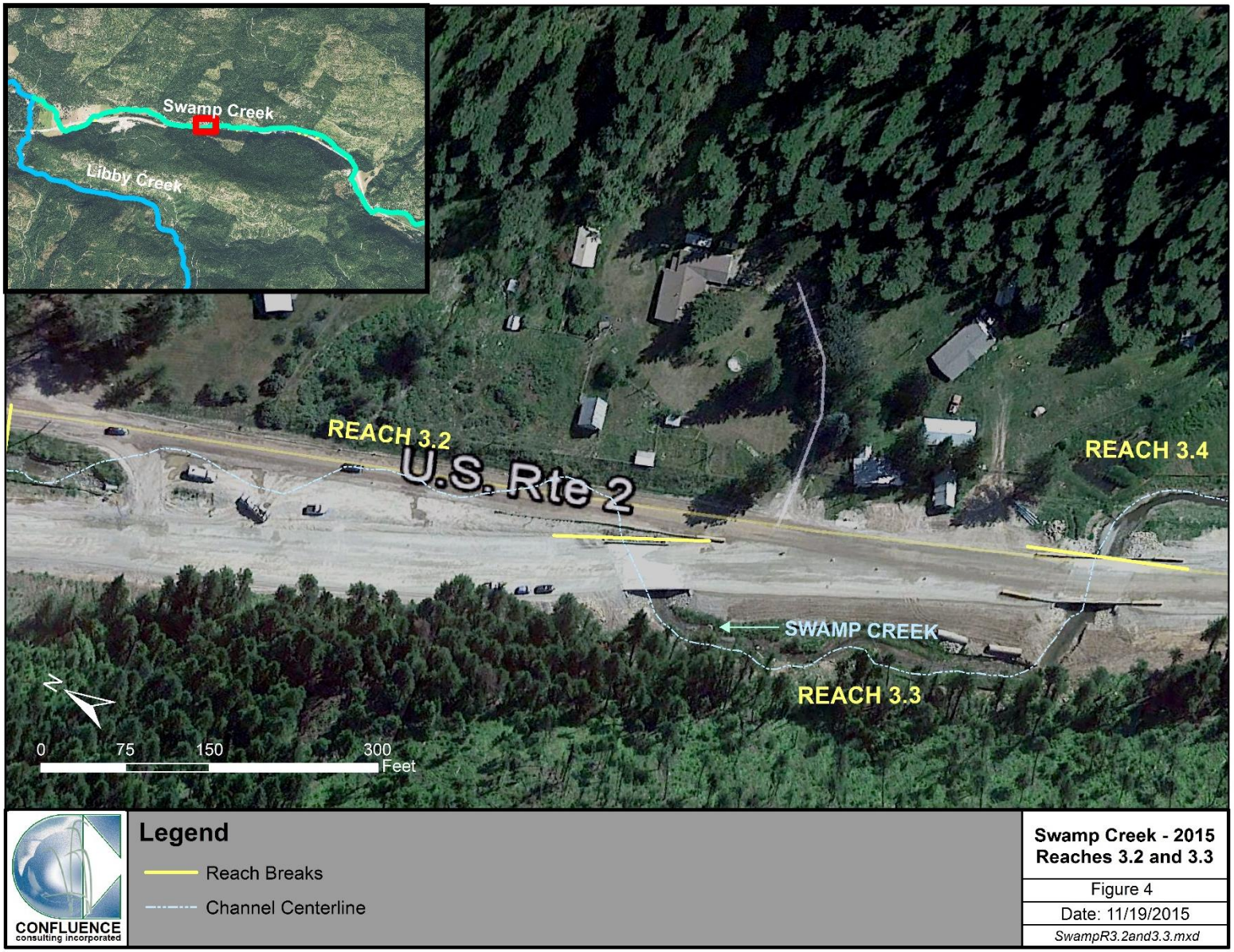


Figure 4. Monitoring Reaches 3.2 and 3.3 of Swamp Creek Mitigation Site

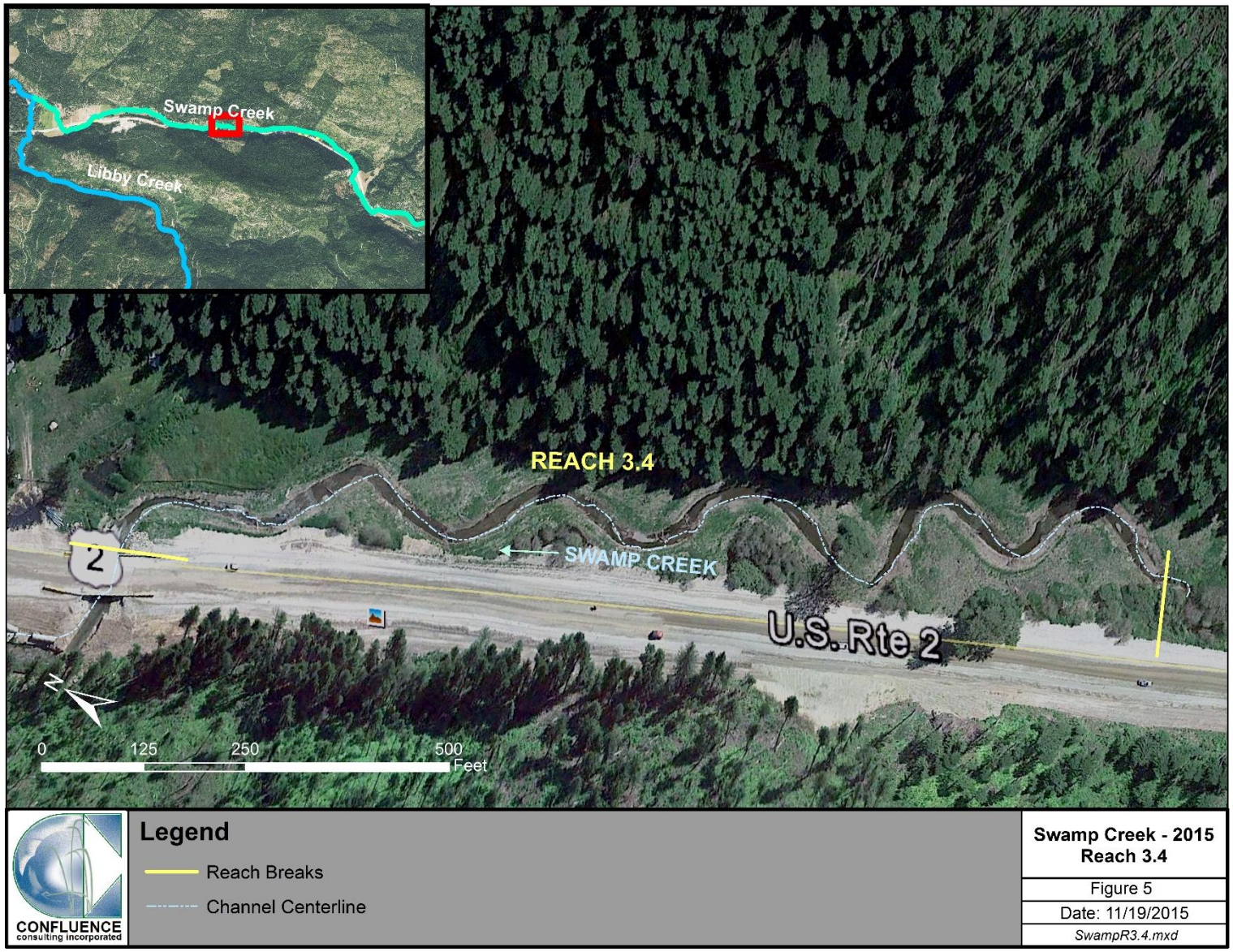


Figure 5. Monitoring Reach 3.4 of Swamp Creek Mitigation Site

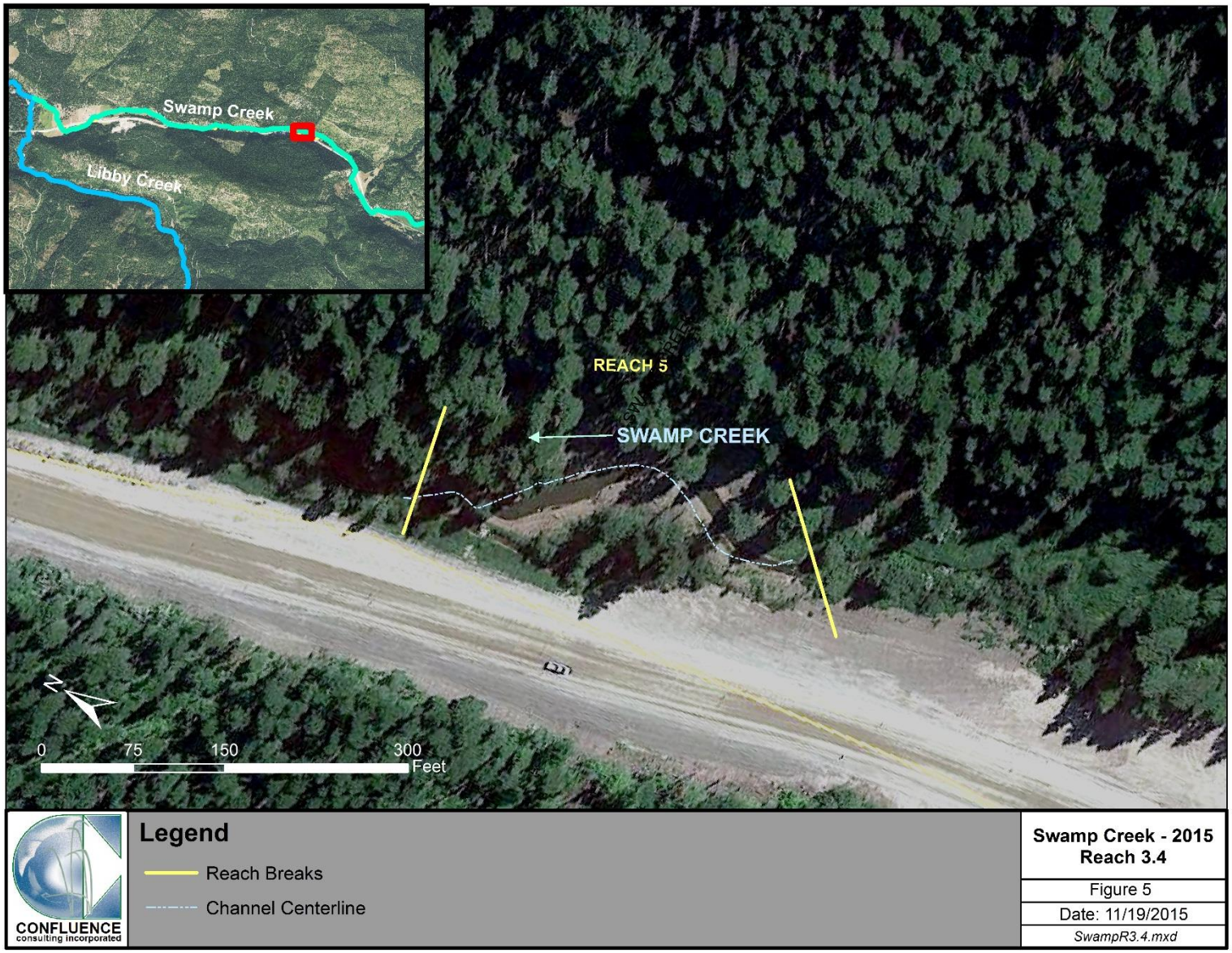


Figure 6. Monitoring Reach 5 of Swamp Creek Mitigation Site

Figure 7. Monitoring Reach 7.1 of Swamp Creek Mitigation Site

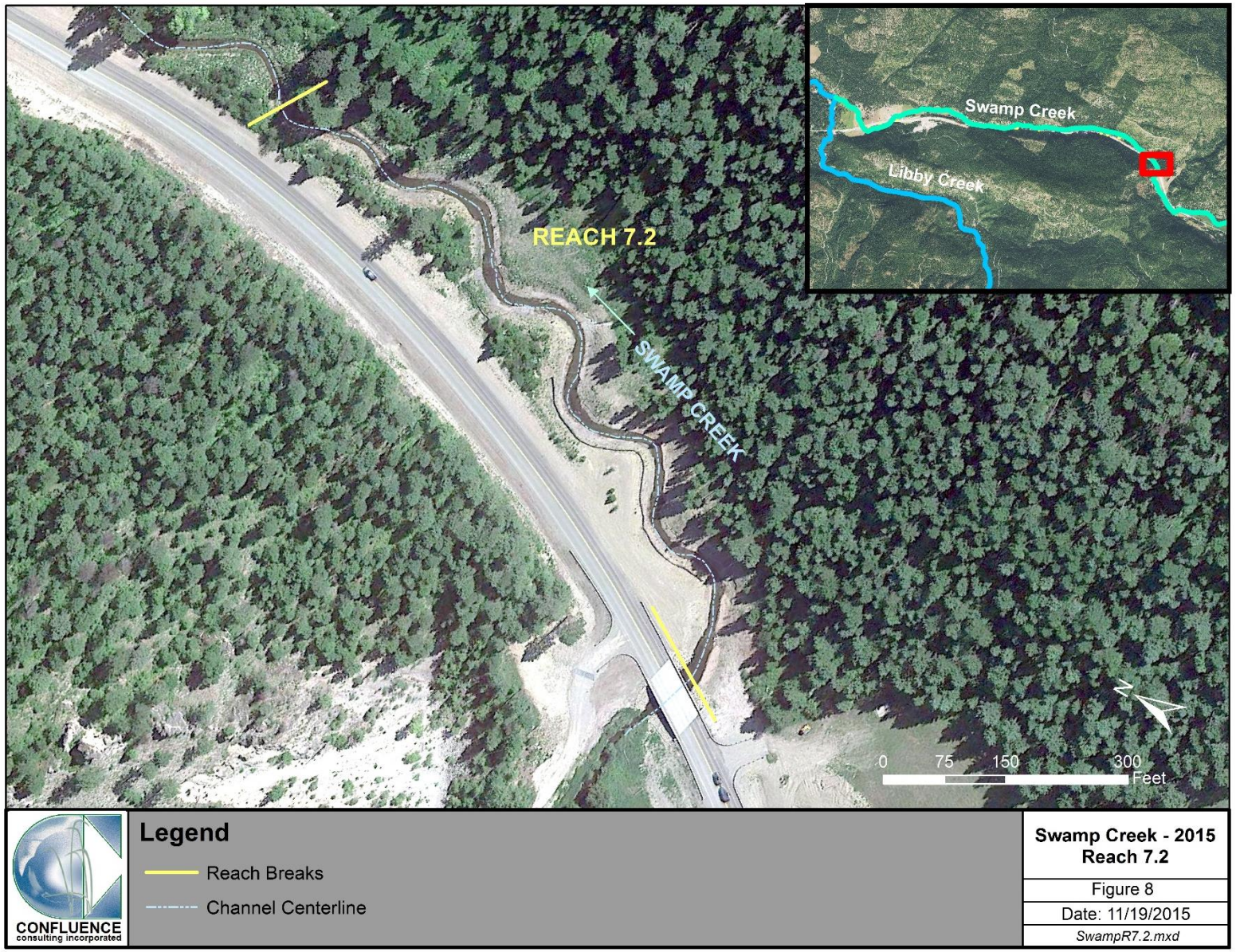


Figure 8. Monitoring Reach 7.2 of Swamp Creek Mitigation Site

5.0 MONITORING RESULTS

5.1. Vegetation Inventory - Belt Transects

Riparian and stream bank vegetation was assessed within nine 25-foot wide belt transects established within each monitoring reach (Maps 1 - 9 in Appendix A). The stream bank inventory included documenting vegetation within 3 feet of the active channel, while the riparian vegetation inventory extended an additional 22 feet from the channel. Table 4 summarizes the areal percent cover of total vegetation, woody vegetation, and noxious weeds observed within each riparian belt transect during the 2015 monitoring event. Subtotals for each riparian belt transect are provided, as well as an area-weighted total for the entire length of the project. In 2015, the total riparian cover was 84%, which included 59% herbaceous species coverage and 25% woody species coverage. Noxious weeds represented 18% of the total riparian cover in 2015. In addition to the percent cover of vegetation classifications, a comprehensive list of all vegetation species observed along each of the reconstructed channel segments was compiled and are included in Appendix C.

Total percent cover of non-noxious species was 66% for all riparian transects combined (Table 4). Riparian transects along reaches 3.2 and 7.2 exhibited 51% and 40% cover of non-noxious weed species, respectively. While the transect along reach 3.2 currently meets the performance criteria of greater than 50% aerial cover of non-noxious weed species, it is very close the 50% threshold of success. The low percent cover of desirable plant species along reaches 3.2 and 7.2 are likely a result of more recent construction of these reaches, which were completed in 2014. All other reaches were completed in 2013, and correspondingly exhibit a higher percent cover of desirable plant species. Additional information regarding noxious weed observations is included in Section 4.3.

The vegetation inventory conducted in Reach 3.1 was divided into two sub-reaches (3.1a and 3.1b) due to the geomorphic response of the channel to high flows following construction. A headcut formed on Swamp Creek and continued upstream approximately 1,100 feet, causing a drop in the stream bed elevation. The lowering of the stream bed as compared to the top of the banks through this segment of channel may affect the vegetation communities establishing within the riparian zones. As a result, Reach 3.1a assessed vegetation along a segment of the channel that maintained its constructed bed elevation; whereas vegetation assessed within Reach 3.1b is representative along an incised channel segment. Comparison of results in Reaches 3.1a and 3.1b from the 2015 monitoring event reveals little difference thus far in the total percent cover, percent woody species, and percent noxious weeds.

Total percent vegetation cover within the 3-foot wide stream bank transects is included in Table 5. Reach 3.2, which was construted in 2014, was the only monitoring reach exhibiting stream bank vegetation coverage below 80%. When combined with the total percent cover of the riparian portion of the belt transects, the area weighted percent cover for the entire project site is currently 85%. A comprehensive list and cover class

of all vegetation species observed within each monitoring reach is included in Appendix D.

Table 4. Percent cover of riparian vegetation transects at Swamp Creek in 2015.

Belt Transect by Reach	Length (ft)	Year Completed	Total % Riparian Cover	% Woody Cover	% Noxious Weed Cover	% Cover of Non-noxious species
			2015	2015	2015	2015
1	282	2013	70%	5%	10%	60%
2	556	2013	80%	20%	12%	68%
3.1a	458	2013	90%	40%	18%	72%
3.1b	796	2013	90%	40%	17%	73%
3.2	639	2014	55%	3%	4%	51%
3.3	447	2013	95%	9%	4%	91%
3.4	1530	2013	95%	35%	30%	65%
5	338	2013	75%	20%	10%	65%
7.1	1606	2013	98%	35%	18%	80%
7.2	1065	2014	60%	10%	20%	40%
Total	7717		84%	25%	18%	66%

Table 5. Area weighted average of areal vegetation cover for riparian and stream bank transects at the Swamp Creek stream mitigation site in 2015.

Monitoring Reach	Transet Length (ft)	Transect Type	Total % Vegetated Cover
			2015
1	282	Riparian	70%
		Stream Bank	95%
2	556	Riparian	80%
		Stream Bank	95%
3.1a	458	Riparian	90%
		Stream Bank	100%
3.1b	796	Riparian	90%
		Stream Bank	90%
3.2	639	Riparian	55%
		Stream Bank	50%
3.3	447	Riparian	95%
		Stream Bank	100%
3.4	1530	Riparian	95%
		Stream Bank	100%
5	338	Riparian	75%
		Stream Bank	80%
7.1	1606	Riparian	98%
		Stream Bank	100%
7.2	1065	Riparian	60%
		Stream Bank	95%
Total Transect Length	**7717**	**Total Weighted Vegetation Cover**	**85%**

5.2. Stream Bank Vegetation Communities

The Winward stability ratings are based on vegetation communities rather than individual species; therefore, vegetation communities were assigned to stream banks based on one or more dominant species (Winward 2000). The vegetation communities varied amongst reaches, and are summarized in Table 6 and Maps 10-18 in Appendix B. Stream bank stability ratings are provided for each stream bank community to assess how well these communities are stabilizing the reconstructed banks. The

stability indices range from 1 to 10, with lower scores assigned to communities that exhibit a reduced ability to resist erosion, and higher scores assigned to communities that exhibit an increased ability to resist erosion. Multiple communities were observed along the banks in Reaches 1, 2, 5, and 7.2. The majority of established vegetation communities provide beneficial bank-stabilizing properties, with scores of 6 or above for 10 of the 13 communities. To date, reaches 3.2 and 5 exhibit vegetation communities with low stability ratings. Vegetation cover and species composition is expected to increase and shift as the vegetation communities along both of these reaches become more established and recover from their recent construction in 2014.

Table 6. Dominant vegetation communities observed along the banks of Swamp Creek, 2015.

Reach	Dominant Stream Bank Communities	Community Type Stability Rating
1	Melilotus officinalis/Equisetum arvense	4
	Phalaris arundinacea/Agrostis stolonifera	9
2	Agrostis stolonifera/Alnus incana	6
	Phalaris arundinacea/Deschampsia caespitosa	9
3.1	Phalaris arundinacea/Deschampsia caespitosa	9
3.2	Bare Ground/Epilobium ciliatum	1
3.3	Phalaris arundinacea/Deschampsia caespitosa	9
3.4	Phalaris arundinacea/Agrostis stolonifera	9
5	Bromus spp./Elymus spp.	3
	Bromus spp./Alnus incana	6
7.1	Phalaris arundinacea/Deschampsia caespitosa	9
7.2	Alnus incana/Deschampsia caespitosa	6
	Phalaris arundinacea/Deschampsia caespitosa	9

5.3. Woody Plant Inventory

Table 7 summarizes results of the planted woody vegetation inventory conducted within each reach of the Swamp Creek mitigation site. Comparisons of live versus dead woody vegetation counts throughout the entire project indicated 89% of the planted vegetation observed remains alive. These results generally suggest good establishment of woody species along both banks. Results of the inventory in Reach 1 indicated the lowest live/dead counts amongst the assessed reaches, with 67% of the observed plants remaining alive. All other reaches indicated live/dead counts between 85% and 93%. Planted woody vegetation is more difficult to locate in reaches that have begun to develop a dense understory layer, which may result in under-reporting of plants that have perished. Reaches that have densely vegetated include Reach 3.1, 3.3, 3.4, and 7.1. Speckled alder appear to have established particularly well along the reconstructed channel segments, many of which have grown over five feet tall in less than two years. Volunteer woody vegetation was also observed along the reaches that were constructed in 2013, and included Wood's rose, snowberry, and occasional willows. The reconstructed channel segments disturbed a relatively narrow corridor and much of the adjacent riparian shrubs and trees remained undisturbed, allowing for an excellent seed source for woody vegetation establishment.

Table 7. Woody plant survival at the Swamp Creek stream mitigation site in 2015

Reach	Alive Healthy	Alive Stunted	Total Alive	Dead	Total 2015	Survival %
1	103	11	114	57	171	67%
2	277	6	283	39	322	88%
3.1	724	29	753	105	858	88%
3.2	220	149	369	30	399	92%
3.3	16	5	21	2	23	91%
3.4	413	63	476	86	562	85%
Subtotal Reach 3	1373	246	1619	223	1842	88%
5	274	15	289	43	332	87%
7.1	1199	60	1259	100	1359	93%
7.2	660	69	729	66	795	92%
Subtotal Reach 7	1859	129	1988	166	2154	92%
Total	3886	407	4293	528	4821	89%

5.4. Noxious Weed Inventory

Four Priority 2B noxious weeds and one Priority 3 State-Regulated weed were identified within the Swamp Creek mitigation site in 2015 (Table 8). Locations of all weed infestations, including the extent and percent cover of each infestation are indicated on Maps 10 – 18 in Appendix B. Noxious weed infestations identified in trace amounts (less than 1 percent) were noted but excluded from Maps 10 - 18. As noted in Section 5.1 the estimated total percent cover of noxious weeds within each reach ranged from 4% to 30%, with a site-wide estimate of 18% cover.

Table 8. Montana State listed noxious weed and regulated species observed in 2015 at the Swamp Creek Stream Mitigation Site.

Category*	Scientific Name	Common Name
Priority 2B	*Centaurea stoebe*	Spotted Knapweed
	Cirsium arvense	Canadian Thistle
	Leucanthemum vulgare	Ox-Eye Daisy
	Tanacetum vulgare	Common Tansy
Priority 3 State Regulated	*Bromus tectorum*	Cheatgrass

5.5. Vegetation Community Mapping

Dominant species recorded along the riparian belt transects were combined with visual observations in other areas to develop a vegetation community map for each of the five restored channel segments (Maps 10 – 18, Appendix B). Twenty-five vegetation community types were identified in 2015, including:

- Type 1 – *Bromus* spp./*Elymus* spp.
- Type 2 – *Elymus* spp.
- Type 3 – *Melilotus officinalis/Equisetum arvense*
- Type 4 – *Phalaris arundinacea/Agrostis stolonifera*

- Type 5 – *Agrostis stolonifera/Alnus incana*
- Type 6 – *Phalaris arundinacea/Deschampsia*
- Type 7 – *Melilotus officinalis/Elymus* spp.
- Type 8 – *Phalaris arundinacea*
- Type 9 – *Alnus incana/Cornus alba*
- Type 10 – *Thuja plicata/Pinus ponderosa*
- Type 11 – *Tsuga heterophylla/Thuja plicata*
- Type 12 – *Acer glabrum/Alnus incana*
- Type 13 – Bare Ground/*Epilobium ciliatum*
- Type 14 – *Carex* spp.
- Type 15 – *Phalaris arundinacea/Alnus incana*
- Type 16 – *Leucanthemum vulgare/Elymus* spp.
- Type 17 – *Alnus incana/Symphoricarpos albus*
- Type 18 – *Pseudotsuga menziesii/Crataegus douglasii*
- Type 19 – *Pseudotsuga menziesii/Thuja plicata*
- Type 20 – *Bromus* spp./*Alnus incana*
- Type 21 – *Poa* spp./*Elymus* spp.
- Type 22 – *Alnus incana/Abies lasiocarpa*
- Type 23 – *Acer glabrum/Abies lasiocarpa*
- Type 24 – *Alnus incana/Deschampsia caespitosa*
- Type 25 – *Crataegus douglasii/Philadelphus lewisii*

5.6. Bank Erosion Inventory

All laterally eroding banks observed within the mitigation site were mapped on aerial photographs and are illustrated on Maps 1 – 9 in Appendix A. With the exception of Reach 3.1, bank erosion was relatively uncommon, indicating the coir soil lifts used to construct the stream banks were successful at maintaining lateral stability. Table 9 provides a summary of the bank erosion inventory by reach, with a total length and suggested cause of each eroding bank observed.

Table 9. Bank erosion inventory for Swamp Creek Mitigation Site in 2015.

Monitoring Reach	Eroding Bank Length (ft)	Cause of Erosion
1	0	No erosion observed in Reach 1
2	0	No erosion observed in Reach 2
3.1	508	Lateral erosion is occurring along both banks within and immediately downstream of an incised channel segment. Channel is actively widening through incised reach
3.2	0	No erosion observed in Reach 3.2
3.3	0	No erosion observed in Reach 3.3
3.4	130	Erosion is occurring along the downstream extent of Reach 3.4 where the channel has downcut below its constructed stream bed
5	0	No erosion observed in Reach 5
7.1	38	Lateral erosion was observed adjacent to a constructed riffle. Constructed bank appeared incapable of withstanding erosion following partial collapse of banks due to loss of fines within coir lift
7.2	0	No erosion observed in Reach 7.2
Total	**676**	

5.6.1. Bank Erosion in Reach 3.1

Following construction of Reach 3.1, approximately 1,100 feet of the channel vertically downcut, resulting in an incised channel with lower stream bed elevation than designed. While the exact cause of the headcut is not entirely known, one hypothesis was provided by Montana Fish, Wildlife and Parks representatives, suggesting the channel was built too large to provide sufficient floodplain connectivity, and therefore vertically cut through highly erodible peat/clay soils during a runoff event following construction (MDT 2014). Throughout this 1,100-foot segment, the stream bed dropped below the coir fabric-encapsulated soil lifts installed along the stream banks to resist erosion while vegetation better establishes. Due to the lowering of the stream bed, the coir soil lifts no longer provide resistance to erosion during typical flows; therefore lateral erosion is occurring along both the inside and outside of meander bends within the incised channel segment. Lateral erosion is anticipated to continue occurring until such time as the channel widens enough to establish an inset floodplain capable of supporting vegetation.

5.6.2. Bank Erosion in Reach 3.4

One 130-foot long eroding bank was observed in Reach 3.4. Bank erosion along this channel segment is due to minor downcutting of the channel into a clay lens. The stream bed appears to have dropped by approximately 0.5 feet from its constructed elevation, causing some erosion and bank undercutting. The clay lens appears to have prevented further incision and the stream bed is armored just downstream where the channel flows beneath one of the newly constructed bridges. The combination of the clay lens upstream of the headcut and stream bed armoring beneath the bridge downstream of the headcut is likely to prevent any further vertical migration of the channel. Although the stream bank has eroded along the downcut section of the channel, the undercut banks have developed into good aquatic habitat with densely vegetated banks and deep pools. As a result of these factors, additional erosion along this 130-foot section is not anticipated in the near future.

5.7. Perpendicular Transects

Results of the perpendicular transect surveys are summarized in Table 10. This table provides bankfull width, maximum depth, cross sectional area, mean depth, and width-to-depth ratios at each surveyed transect to assess channel cross section dimensions and variability between riffle and pool features surveyed within each reach. Plots of each transect depicting the channel bed, banks, and bankfull elevation are included in Appendix E. The performance criteria for bankfull channel dimensions outlined in the Swamp Creek monitoring plan indicates a target width/depth ratio that does not exceed 20. According to the monitoring plan, width/depth ratios exceeding 20 would indicate an unacceptable level of over-widening or aggradation. Channel width/depth ratios proposed in the design ranged from 10 to 18. The results of the channel surveys performed within each reconstructed channel segment below include reference to the performance goal of width/depth ratios <20.

Transects #1 through #4 were surveyed in Reach 1 and included two riffles and two pools. Bankfull width and maximum depth at riffles averaged 22.0 feet and 1.8 feet respectively, which were close to the design width of 20.0 feet and depth 1.7 feet for riffle features. Bankfull width and maximum depth at pools averaged 17.6 and 2.9 feet respectively as compared to the design width and depth of 23.9 and 3.3 feet. Width/depth ratios averaged 16.0 for riffles and 10.6 for pools, both of which met the goal of this ratio falling below 20.

Transects #5 through #8 were surveyed in the reactivated channel segment between Reaches 1 and 2 and included two riffles and two pools. Bankfull width and maximum depth averaged 16.6 feet and 1.6 feet respectively at riffles, and 16.8 and 1.4 feet respectively at pools. Given this segment of the channel was reactivated and not reconstructed, the channel dimensions should be relatively consistent with the design dimensions specified for channel segments 1 and 2. Width/depth ratios of 14.8 for riffles and 19.8 for pools in the reactivated channel segment met the goal of this ratio falling below 20.

Transects #9 through #14 were surveyed in Reach 2 and included three riffles and three pools. Bankfull width and maximum depth at riffles averaged 19.9 feet and 1.9 feet respectively, which were very close to the design width of 19.7 feet and depth of 2.0 feet specified for riffle features in Reach 2. Bankfull width and maximum depth at pools averaged 17.0 and 2.3 feet respectively as compared to the design width and depth of 23.0 and 3.9 feet. Width/depth ratios averaged 12.9 for riffles and 11.9 for pools, both of which met the goal of this ratio falling below 20.

Table 10. Perpendicular transect survey results, Swamp Creek 2015

Channel Segment	Monitoring Reach	Transect	Type	Surveyed Bankfull Width (ft)	Surveyed Maximum Depth (ft)	Area (ft^2)	Mean Depth (ft)	W/D Ratio
1	1	1	Pool	13.6	2.8	20.2	1.5	9.2
		2	Riffle	20.6	1.7	27.7	1.3	15.3
		3	Pool	21.6	2.9	38.9	1.8	12.0
		4	Riffle	23.4	1.9	32.9	1.4	16.7
			Average Segment 1 Pools	**17.6**	**2.9**	**29.5**	**1.6**	**10.6**
			Average Segment 1 Riffles	**22.0**	**1.8**	**30.3**	**1.4**	**16.0**
			Average All Segment 1 Transects	**19.8**	**2.3**	**29.9**	**1.5**	**13.3**
Reactivated segment between Reaches 1 and 2	N/A	5	Riffle	15.6	1.8	19.0	1.2	12.9
		6	Riffle	17.6	1.4	18.5	1.0	16.8
		7	Pool	18.0	1.7	20.4	1.1	15.9
		8	Pool	15.6	1.1	10.3	0.7	23.6
			Average Pools	**16.8**	**1.4**	**15.3**	**0.9**	**19.8**
			Average Riffles	**16.6**	**1.6**	**18.7**	**1.1**	**14.8**
			Average All	**16.7**	**1.5**	**17.0**	**1.0**	**17.3**
2	2	9	Pool	26.7	2.2	43.6	1.6	16.4
		10	Riffle	18.8	2.1	32.2	1.7	11.0
		11	Riffle	21.2	2.0	32.0	1.5	14.0
		12	Pool	11.5	2.3	12.7	1.1	10.3
		13	Riffle	19.8	1.6	28.5	1.4	13.7
		14	Pool	12.9	2.3	18.2	1.4	9.1
			Average Segment 2 Pools	**17.0**	**2.3**	**24.8**	**1.4**	**11.9**
			Average Segment 2 Riffles	**19.9**	**1.9**	**30.9**	**1.6**	**12.9**
			Average All Segment 2 Transects	**18.5**	**2.1**	**27.9**	**1.5**	**12.4**
3	3.1	15	Riffle	21.9	1.2	16.6	0.8	28.8
		16	Pool	22.5	2.9	25.8	1.1	19.6
		17*	Pool	19.3	4.3	44.6	2.3	8.3
		18*	Riffle	15.6	3.8	43.5	2.8	5.6
		19*	Riffle	26.6	3.4	54.7	2.1	12.9
		20*	Pool	13.7	4.4	34.6	2.5	5.4
		21	Riffle	18.0	1.2	13.4	0.7	24.0
	3.2	22	Riffle	14.1	1.3	10.9	0.8	18.4
	3.4	23	Riffle	13.8	2.5	21.9	1.6	8.6
		24	Pool	17.2	3.3	26.1	1.5	11.3
		25	Riffle	22.4	1.9	34.2	1.5	14.6
		26	Pool	14.6	3.2	28.5	2.0	7.5
		27	Pool	11.7	3.6	22.6	1.9	6.1
			Average Segment 3 Pools	**16.5**	**3.6**	**30.3**	**1.9**	**9.7**
* Transect within incised reach			**Average Segment 3 Riffles**	**18.9**	**2.2**	**27.9**	**1.5**	**16.1**
			Average All Segment 3	**17.8**	**2.8**	**29.0**	**1.7**	**13.2**
5	5	28	Riffle	22.3	1.6	27.6	1.2	18.0
		29	Pool	17.3	2.7	25.4	1.5	11.7
		30	Riffle	19.8	2.5	35.7	1.8	11.0
		31	Pool	19.1	3.2	27.1	1.4	13.5
			Average Segment 5 Pools	**18.2**	**2.9**	**26.3**	**1.4**	**12.6**
			Average Segment 5 Riffles	**21.0**	**2.1**	**31.7**	**1.5**	**14.5**
			Average All Segment 5 Transects	**19.6**	**2.5**	**29.0**	**1.5**	**13.5**
7	7.1	32	Riffle	14.0	1.0	10.8	0.8	18.1
		33	Pool	11.5	1.9	13.7	1.2	9.7
		34	Riffle	14.0	0.9	9.8	0.7	19.9
		35	Pool	17.1	1.8	13.9	0.8	21.0
		36	Riffle	12.5	1.3	13.5	1.1	11.6
		37	Pool	24.5	2.8	39.5	1.6	15.1
		38	Pool	17.4	1.8	18.5	1.1	16.4
		39	Riffle	12.4	0.6	5.5	0.4	28.1
		40	Riffle	16.1	0.9	7.5	0.5	34.3
	7.2	41	Riffle	17.1	1.5	18.3	1.1	16.1
		42	Pool	22.1	2.3	27.3	1.2	17.8
		43	Riffle	16.6	0.8	8.3	0.5	33.1
			Average Segment 7 Pools	**18.5**	**2.1**	**22.6**	**1.2**	**16.0**
			Average Segment 7 Riffles	**14.7**	**1.0**	**10.5**	**0.7**	**23.0**
			Average All Segment 7 Transects	**16.3**	**1.5**	**15.5**	**0.9**	**20.1**

Transects #15 through #21 were surveyed in Reach 3.1, which included four riffles and three pools. Transects #17 through #20 were surveyed within the incised channel segment that downcut following completion of this reach. Inspection of the transects surveyed within the incised reach reveals average riffle depth of 3.6 feet as compared to the design depth of 1.6 feet. Average pool depths in this segment of the channel were 4.3 feet as compared to the design depth of 2.1 feet. These transect results indicate the channel may have downcut as much as 2 feet below its constructed elevation. Evidence of the channel downcutting extends roughly 1,100 feet. Results of the transects surveyed upstream and downstream of the incised channel segment (Transects 15, 16, and 21) indicate dimensions that are closer to those specified in the design, although riffles in the downstream end of Reach 3.1 appear to have aggraded some as a result of receiving materials scoured through the downcut segment immediately upstream.

Only one transect was surveyed in Reach 3.2 (Riffle Transect #22). Survey results indicate a bankfull width of 14.1 feet and maximum depth of 1.3 feet as compared to the design width of 19.7 feet and depth of 1.6 feet. The width/depth ratio of this transect was 18.4, which met the goal for this ratio falling below 20.

Transects #23 through #27 were surveyed in Reach 3.4, which included two riffles and three pools. Bankfull width and maximum depth of riffles in Reach 3.4 averaged 18.1 and 2.2 feet, respectively as compared to the bankfull width of 21.3 and depth of 1.6 feet specified in the design. Bankfull width and maximum depth at pools averaged 14.5 and 3.4 feet respectively as compared to the design width of 25.9 and depth of 3.9 feet. Riffle and pool width/depth ratios averaged 11.6 and 8.3 respectively, both of which met the goal of this ratio falling below 20.

Transects #28 through #31 were surveyed in Reach 5, which included two riffles and two pools. Bankfull width and maximum depth of riffles in Reach 5 averaged 21.0 and 2.1 feet respectively as compared to the design width of 22.3 and depth of 1.6 feet specified for Reach 5. Riffle and pool width/depth ratios averaged 14.5 and 12.6 feet respectively, both of which meet the goal of this ratio falling below 20.

Transects #32 through #40 were surveyed in Reach 7.1, and included five riffles and four pools. Bankfull width and maximum depth of riffles in Reach 7.1 averaged 13.8 and 0.9 feet deep respectively as compared to the design width of 12.5 and 1.0 feet specified for Reach 7.1. Bankfull width and maximum depth of pools through Reach 7.1 averaged 17.6 and 2.1 feet respectively as compared to the design width of 15.7 and depth of 1.6 feet specified for this reach. Riffle and pool width/depth ratios averaged 22.4 and 15.6 respectively.

Transects #41 through #43 were surveyed in Reach 7.2, which included two riffles and one pool. Average riffle bankfull width and maximum depths were 16.8 and 1.1 feet respectively as compared to the design width of 13.1 and 1.0 feet specified for this reach. The single pool surveyed in Reach 7.2 exhibited a bankfull width of 22.1 feet

and maximum depth of 2.3 feet. Riffle width/depth ratio averaged 24.6, while the width/depth ratio of the pool surveyed in Reach 7.2 was 16.0. These width/depth ratios exceed the goal for this parameter established in the monitoring criteria, which specifies a maximum width/depth ratio of 20 in the reconstructed channel segments.

The results of the perpendicular transect surveys indicate the channel dimensions throughout the majority of the reconstructed channel length is relatively close to those outlined in the design and provide a variety of aquatic habitat types including pools and riffles. Width/depth ratios calculated at each transect indicates that, with the exception of Reaches 7.1 and 7.2, this ratio has not exceeded the threshold value of 20 outlined in the performance criteria. Transect surveys performed within the incised channel segment in Reach 3.1 indicate the channel bed may have lowered by as much as two feet within an 1,100-foot section of the channel, which has compromised aquatic habitat and bank stability. Otherwise, the channel has begun to develop habitat features suitable for use by fish and other aquatic organisms.

5.8. Longitudinal Profiles

Results of longitudinal profiles surveyed along the channel thalweg for each monitoring reach are included in Appendix E. Inspection of these profiles indicates a diversity of riffle and pool habitat types present within each reconstructed channel segment. Results of the thalweg profile may be combined with surveyed transect results at pools to determine whether pool depths are being maintained throughout the project. Table 11 provides a summary of all surveyed pool depths and compares those depths to the longitudinal profile success criteria established for Swamp Creek, which states that pool depths must not decrease by more than 20%.

The thalweg profile through channel segment 1 indicates a very flat segment of the channel along the lower 300 feet as the channel transitions back into the existing channel downstream of Highway 2. This flat segment may result in depositional features occurring in the downstream end of channel segment 1 if sediment transport is compromised. Continued monitoring will provide additional evidence of transport characteristics through this segment. Development of deep pools appears restricted to the last meander bend of the channel before flowing beneath U.S. Highway 2. Both pools surveyed in segment 1 were shallower than design dimensions, but met the success criteria. No evidence of headcuts or channel incision is evident from the longitudinal profile.

The longitudinal profile of the reactivated channel between reconstructed channel segments 1 and 2 also indicates the presence of several pools. Field observations noted beaver activity in this reach, which may be helping to develop longer, backwatered pool features.

The profile through channel segment 2 indicates the presence of several shallow pool features. Maximum depth at three pools surveyed in channel segment 2 were all 1.6 feet shallower than the design depth of 3.9 feet, and do not meet the longitudinal profile

design criteria for pool depths. No evidence of headcuts or channel incision is evident from the longitudinal profile.

The profile plotted through reconstructed channel segment 3 illustrates the existence of a headcut and incised channel segment within Reach 3.1. This headcut forms a very steep channel segment approximately 150 feet long (STA 33+25 to 34+75 on Reach 3 profile, Appendix E). The Reach 3 profile also indicates the channel gradient increases in the downstream direction, which is consistent with the design. Six of the seven pools surveyed in channel segment 3 exhibited maximum depths capable of meeting the success criteria. Channel stability through the steep section caused by the headcut may be compromised, as the geomorphic response will likely move the creek toward a flatter configuration capable of accessing a floodplain. Incised channels will typically widen, then lengthen to provide added sinuosity within an inset floodplain. This evolution is likely to result in lateral erosion until the channel establishes a higher sinuosity and flatter gradient to enable dissipation of energy. Corrective actions are warranted if this channel evolutionary process is considered unacceptable. A grade control structure has been installed just upstream of the extent of the headcut; therefore additional downcutting is not expected to result assuming the grade control feature extends at least two feet below the channel bed.

The stream bed through channel segment 5 exhibits a variety of riffle and pool formations along the reconstructed length of the channel. Both pools surveyed exhibited maximum depths capable of meeting the success criteria. No evidence of headcuts or channel incision is evident from the longitudinal profile.

The longitudinal profile through channel segment 7 indicates the presence of many pools throughout Reaches 7.1 and 7.2. The channel gradient increases in the downstream direction, which is consistent with the design for segment 7. All pools surveyed in segment 7 were deeper than the design depth. No evidence of headcuts or channel incision is evident from the longitudinal profile.

Table 11. Swamp Creek pool depths surveyed in 2015 as compared to design depths and success criteria.

Monitoring Reach	Transect	Type	Surveyed Maximum Depth (ft)	Pool Design Depth (ft)	Success Criteria (Design Depth - 20%) (ft)	Max Depth - Success Criteria (ft)	Meeting Criteria?
1	1	Pool	2.8	3.3	2.6	0.2	YES
	3	Pool	2.9	3.3	2.6	0.3	YES
2	9	Pool	2.2	3.9	3.1	-0.9	NO
	12	Pool	2.3	3.9	3.1	-0.9	NO
	14	Pool	2.3	3.9	3.1	-0.8	NO
3.1	16	Pool	2.9	3.9	3.1	-0.2	NO
	17	Pool	4.3	2.1	1.7	2.6	YES
	20	Pool	4.4	2.1	1.7	2.7	YES
3.4	24	Pool	3.3	3.9	3.1	0.2	YES
	26	Pool	3.2	3.9	3.1	0.1	YES
	27	Pool	3.6	3.9	3.1	0.5	YES
5	29	Pool	2.7	3.00	2.4	0.3	YES
	31	Pool	3.2	3.00	2.4	0.8	YES
7.1	33	Pool	1.9	1.6	1.3	0.7	YES
	35	Pool	1.8	1.6	1.3	0.5	YES
	37	Pool	2.8	1.6	1.3	1.6	YES
	38	Pool	1.8	1.6	1.3	0.5	YES
7.2	42	Pool	2.3	1.8	1.4	0.9	YES

5.9. Stream Bed Substrate Composition

Results of the ten Wollman pebble counts sampled at pools and riffles along Swamp Creek are provided in Appendix F. These histograms indicate the percentage of stream bed materials that fall within various particle size classifications, including fines, gravels, cobbles, and boulders. The mean particle size (D_{50}) sampled at one riffle and one pool within each reconstructed channel segment are summarized in Figure 9.

Mean particle sizes sampled from riffles ranged from 26 to 56 millimeters, which are classified as coarse to very coarse gravel. In general, riffle gravels were coarser in the reconstructed channel segments further upstream. Coarse gravels in riffles are often observed in steeper stream channels, and help to maintain gradient during high flows. The coarser riffles are less suitable for spawning as compared to finer sized gravels. As a result, spawning is not anticipated to occur within the constructed riffles sampled in Reaches 7.1 and 7.2. Gravels suitable for spawning (0.5” – 2.0”) were observed in pool tails throughout the project reach and should provide opportunities for salmonid production.

Mean particle sizes sampled from pools was less than 2 millimeters in four of the five pools, and are classified as silt and sand. The pool sampled in channel segment 5 had a mean particle size of 35mm, but was not considered a well-developed, deep pool. These results indicate the pools are retaining the finer sized materials transporting through Swamp Creek, which include silt and sand material. Continued monitoring of

the stream bed materials will indicate whether the bed becomes coarser (indicating potential degradation or armoring of the stream), finer (indicating potential aggradation), or maintains the ability to transport its incoming sediment load.

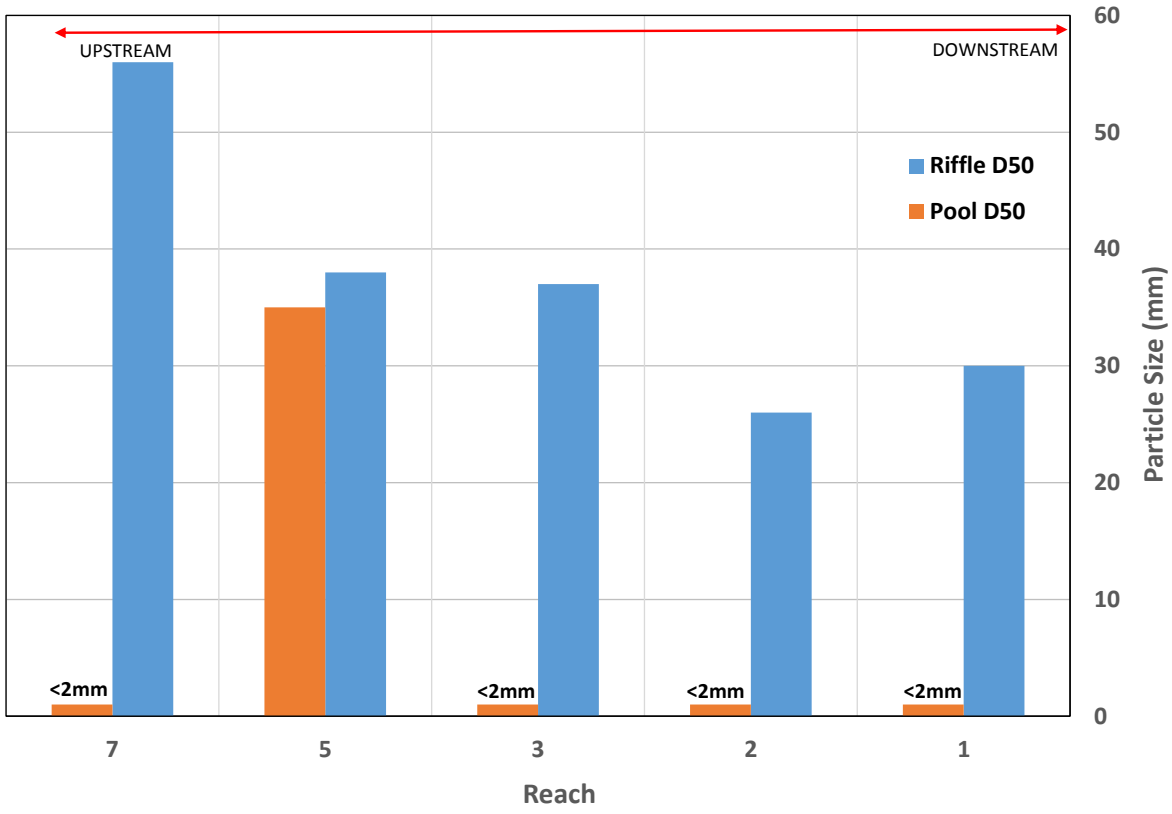


Figure 9. Summary of mean (D50) particle sizes in Segments 1, 2, 3, 5, and 7 of Swamp Creek

5.10. Photo-Documentation

Photo documentation of the project reach included the establishment of 28 permanent photo points. Locations of each photo point are included on Maps 1-8 in Appendix A. Multiple photos were taken at a variety of directions at each permanent photo point; therefore the photo documentation catalog includes 99 monitoring photos taken at the permanent photo locations (Appendix G, pages 1 through 34). In addition, photos were taken facing upstream, downstream, and towards the left and right banks from each of the left and right endpoints of each perpendicular transects (Appendix G, pages 35 through 156).

5.11. Wildlife Documentation

The 2015 monitoring event documented a total of 20 wildlife species, including direct or indirect (tracks, scat, etc.) observations of 10 birds, eight mammals, one amphibian, and one fish. The comprehensive wildlife list compiled in Table 12 includes all species observed within all reconstructed channel reaches.

Table 12. Wildlife species observed within the Swamp Creek mitigation site in 2015.

Common Name	Scientific Name
Birds	
American Dipper	*Cinclus mexicanus*
Mallard	*Anas platyrhynchos*
American Robin	*Turdus migratorius*
Sapsucker sp.	*Sphyrapicus* sp.
Canada Goose	*Branta canadensis*
Common Raven	*Corvus corax*
Great Blue Heron	*Ardea herodias*
Common Snipe	*Gallinago gallinago*
Wild Turkey	*Meleagris gallopavo*
Black Capped Chickadee	*Poecile atricapillus*
Mammals	
Deer sp. (tracks, scat)	*Odocoileus* sp.
Raccoon (tracks)	*Procyon lotor*
Elk (scat)	*Cervus canadensis*
Squirrel sp.	*Sciuridae* sp.
Chipmunk sp.	*Tamias* sp.
Mule Deer	*Odocoileus hemionus*
Bear sp. (scat)	*Ursus* sp.
Beaver (chew)	*Castor canadensis*
Amphibians	
Columbia Spotted Frog	*Rana luteiventris*
Fish	
Brook trout	*Salvelinus fontinalis*

6.0 COMPARISON OF RESULTS TO PERFORMANCE STANDARDS

Monitoring of the Swamp Creek mitigation project is intended to document whether the site is meeting, or moving toward meeting the performance standards outlined in the monitoring plan. The following section compares the results of the first year of monitoring with performance criteria to document whether the project is succeeding as intended. Table 13 provides a summary status of performance criteria adopted for the Swamp Creek site. Additional information relating to the site's condition, including photo documentation of the project site have been included as appendices to this annual monitoring report.

Table 13. Status of quantitative success criteria adopted for the Swamp Creek Mitigation Site, 2015.

Parameter	Performance Standard	Status	Site Meeting Performance Criteria?
1. Riparian Buffer Success	Areas within creditable riparian buffer disturbed during construction must have 50% or greater areal cover of non-noxious weed species by the end of the monitoring period	Of the 10 riparian belt transects assessed, nine indicate >50% cover by non-noxious weed species. Overall, **66%** of the project reach exhibits cover by desirable vegetation.	YES
	1a. Vegetation Success: Combined areal cover of riparian and stream bank vegetation communities is at least 70%	Combined riparian and stream bank vegetation cover is currently 85%.	YES
	1a. Vegetation Success: Noxious weeds do not exceed 10% cover within the riparian buffer areas.	Four of the ten riparian belt transects exhibit noxious weed cover of 10% or less. Overall, **18%** of the site exhibits noxious weeds	NO
	1b. Woody Plants: Planted trees and shrubs must exhibit 50% survival after 5 years	Woody vegetation surveys indicate **89%** survival to date.	YES[1]
2. Vegetation Along Stream Banks	Banks are vegetated with a majority of deep-rooting riparian plant species having NRCS Root Stability Indexes of greater than or equal to six (>=6) (subject to 1.a and 1.b above).	8 of the 9 assessed reaches exhibits bank vegetation communities with stablity scores of 6 or higher. Reach 3.2 (construted in 2014) has yet to fully revegetate.	YES[2]
3. Stream Channel Restoration Success	**3a. Bankfull Channel Dimensions** will be considered successful if bankfull width/depth ratios do not exceed a value of 20.	Bankfull channel dimensions remain below 20 in 8 of the 9 monitoring reaches. Average W/D ratios for riffles in Reach 7.1 are 23.0.	YES[2]
	3b. Stream Pattern: To consider the designed stream pattern a success, no significant lateral migration should occur for the first three years, the average life span of the biodegradable materials used to stabilize the newly constructed stream banks. After the first three years success will be considered natural meander migration that does not lead the channel dimensions exceeding the thresholds in 3.a.	Bank instability was noted in an 1,100-foot segment of the channel within Reach 3.1. Erosion is relatively uncommon within the remaining 10,160 feet of reconstructed channel.	YES[2]
	3c.Stream Longitudinal Profile will be considered a success if the maximum pool depth following construction is not reduced by 20% or more.	With the exception of Reach 2, surveyed pool depths are within 80% of the design depth.	YES[2]

1. Planted woody species survival based on the number of plants found alive versus dead and is not based on total number of plants installed
2. Based on 8 of 9 monitoring reaches meeting success criteria to date.

6.1. Riparian Buffer Success

The established success criteria for riparian areas within the mitigation site require a minimum of 50% cover by non-noxious weed species and less than 10% cover by noxious weeds. Riparian belt transect data indicated nine of the ten assessed riparian areas exhibit greater than 50% of non-noxious species; however, only two of the ten reaches exhibited noxious weed cover of less than 10%. Reaches exhibiting the lowest percent cover by desirable species were constructed in 2014 and have yet to fully vegetate following only one growing season. As a result, all reaches are expected to meet the performance criteria for percent cover by desirable species. Percent cover by noxious weeds is of concern, and will need to be addressed to meet the performance criteria for riparian buffer success.

6.1.1. Vegetation Success

The criteria for vegetation success state at least 70% of the combined riparian and stream bank areas must be vegetated. Results of the riparian and stream bank vegetation inventories indicate 85% of the project area has become vegetated. Monitoring Reaches 3.2, 5, and 7.2 were planted in 2014 and have sustained only one

growing season since completion. As a result, riparian and stream bank vegetation has yet to fully establish and percent cover is expected to increase in subsequent years.

6.1.2. Woody Plants

Woody vegetation planted along the Swamp Creek was assessed by comparing live versus dead plants observed within each of the reconstructed channel reaches. Of the plants located during the 2015 monitoring event, 89% remained alive. Using this assessment method, survival rates were 85% or higher within each reach with the exception of Reach 1, which indicated a 67% survival rate after two growing seasons.

The mitigation monitoring plan for Swamp Creek indicated a total of 17,800 shrubs and 1,000 trees would be installed along the reconstructed channel segments. If this number is accurate, another method to calculate survival rates would involve dividing the total number of surviving plants observed (4,293) by the total number installed (18,800), revealing a survival rate of just 23%. Many of the reaches assessed exhibited a dense understory of reed canary grass and a variety of other tall grasses and forbs. These areas with established vegetation made locating small, planted shrubs very difficult, therefore many planted shrubs were not found. As a result, this method of assessing planted shrub survival may underestimate the percent surviving.

6.2. Vegetation along Streambanks

Vegetation communities observed along the banks of Swamp Creek vary widely by reach; however, 10 of the 13 stream bank vegetation communities established to date have a bank stability index of 6 or higher. All of the reaches that were constructed in 2013 and have undergone two growing seasons have vegetation communities that score 9 out of 10 on the stability index rating. Two reaches (Reach 3.2 and Reach 5) were constructed in 2014 and have only undergone one growing season. Vegetation installed in Reach 3.2 has yet to establish; therefore this reach does not yet meet the stability performance criteria for bank vegetation. Vegetation installed in Reach 5 is promising after only one growing season, with one of the dominant communities scoring 6 for stability ratings. Vegetation installed in Reaches 3.2 and 5 is expected to more fully establish in 2016. Volunteer woody vegetation was observed sporadically throughout the mitigation site, and included Wood's rose and snowberry. Additional volunteer woody vegetation is expected to colonize along the banks of the reconstructed channel segments, as adjacent, undisturbed vegetation communities provide an excellent seed source.

6.3. Stream Channel Restoration Success

6.3.1. Bankfull Channel Dimensions

Success criteria related to bankfull channel dimensions of Swamp Creek indicate width/depth ratios should not exceed 20. Results of the perpendicular transect surveys indicate width/depth ratios measured at pool and riffle transects remain below 20 in monitoring Reaches 1, 2, 3, and 5; however, they exceed 20 in Reach 7. In particular, Transects #39, #40, and #43 surveyed at riffles in monitoring Reaches 7.1 and 7.2 indicated width/depth ratios closer to 30.

The monitoring plan states that, “a bankfull width/depth ratio that exceeds 20 would indicate that the channel has over-widened and/or/aggraded to an unacceptable amount.” Evidence does not exist indicating the channel has over-widened or aggraded through Reaches 7.1 and 7.2. High width/depth ratios observed in Reaches 7.1 and 7.2 are more likely the result of either settling of materials used to construct the banks or loss of bank material from the coir-encapsulated soil lifts, causing a decrease in bank height and loss of channel capacity. Assuming the bed elevation remains constant, a decrease in bank height results in a shallower cross section dimension with higher width/depth ratio. Based on the monitoring data collected and observations performed to date, the high width/depth ratios observed in Reach 7.1 and 7.2 may be attributed to this condition.

6.3.2. Stream Pattern

The majority of reconstructed stream segments along Swamp Creek have remained in place following one or two runoff events. Coir soil lifts appear to be providing adequate stability throughout Reaches 1, 2, 3.2, 3.3, 3.4, 5, 7.1, and 7.2. Lateral instability was observed along ten banks within Reach 3.1 along a section of the channel that downcut and became incised following construction. Erosion is occurring within an 1,100-foot segment of the channel in Reach 3.1, and is anticipated to continue until the channel widens enough to develop an inset floodplain. Formation of an inset floodplain will likely require several additional high flow events to allow the channel to effectively erode and deposit materials. As a result, the stream pattern within the 1,100-foot incised channel segment is expected to adjust for the next several years while the channel adjusts to a lower bed elevation and stable gradient. Corrective actions are warranted within this 1,100 foot section of channel if MDT wishes to claim mitigation credits for the entire project reach. Options for stabilizing the incised reach include excavating a floodplain along the incised reach or raising the bed elevation to re-establish floodplain connectivity and the proposed channel gradient as outlined in the design.

6.3.3. Stream Longitudinal Profile

Success criteria established for the longitudinal profile of the stream state maximum pool depths following construction must reduce by no more than 20%. Results from the perpendicular transect surveys indicated maximum pool depths are within 80% of the design depth in all monitoring reaches with the exception of segment 2. Pools surveyed in channel segment 2 were on average 1.6 feet shallower than the design depth of 3.9 feet. Since construction, the channel has been subject to one runoff event; therefore it remains feasible that pools will deepen over time. Continued monitoring of pool dimensions within this reach will help to determine whether they move toward the target depth.

In several locations along the reconstructed stream reaches, woody debris was placed in the channel to provide additional aquatic habitat complexity. These woody debris clusters were installed passively to allow them to shift during high flow events and generate additional scour features. Although no formal monitoring of these woody debris clusters was performed, they do appear to be functioning as intended and are

providing additional habitat complexity and cover for use by fish and other aquatic organisms.

6.4. Photo Documentation

Photo documentation of the site was conducted during October 2014 and August 2015 to document vegetation establishment and stability of the stream channel over time. Photographs of the site can be found in Appendix G.

6.5. Weed Control

No weed control efforts have been conducted along the reconstructed channel segments. Results from the riparian vegetation belt transects indicates weed control efforts will be necessary to reduce the percent cover of noxious weeds below 10%. The existing site-wide percent cover of noxious weeds is 18%, which exceeds the 10% threshold for success. Noxious weeds were particularly prevalent in Reach 3.4, with 30% of the riparian area classified as weeds.

7.0 DESIGN AND MANAGEMENT COMMENTS

In addition to the monitoring data collected to document the site's performance against the established success criteria, the monitoring team recorded several observations pertaining to design elements and construction techniques. The following section summarized the monitoring team's comments for each reconstructed channel reach.

7.1. Reconstructed Channel Segment 1

A berm has been constructed along both sides of the reconstructed channel along the length of Reach 1. The berm to the west and north side of reconstructed channel segment 1 protects adjacent agricultural fields from flooding. The berm to the east of channel segment 1 extends from the downstream end of channel segment 1 to the downstream end of channel segment 2. The combination of these berms constricts the floodplain and riparian buffer adjacent to either side of the channel to less than one bankfull width. Flood discharges that escape the bankfull channel will be confined to the narrow width between berms, and may result in scour of the stream bed and banks. Riparian vegetation establishment will be limited to this narrow floodplain corridor, as the berms are constructed to a height that will only support upland vegetation. The berm constructed to the east of the new channel alignment could be removed to prevent the constricted floodplain throughout the length of channel segment 1, as well as along the reactivated channel segment between channel segment 1 and channel segment 2.

A rock grade control structure was installed at the upstream end of Reach 1. Rock installed along the east bank of the channel was not keyed into the bank far enough or placed to an elevation to prevent the channel from scouring against the adjacent bank. As a result, the channel has begun to flank the grade control structure by eroding into the east bank. Installation of additional rock is warranted to maintain the grade control feature at this location.

7.2. Reconstructed Channel Segment 2

The berm constructed to the east of channel segment 1 and the reactivated channel segment between channel segment 1 and channel segment 2 extends to the downstream end of channel segment 2. The southeastern end of this berm is immediately adjacent to the newly constructed channel at the downstream end of segment 2. Additional fill material was placed adjacent to the channel along the west side of segment 2 immediately across the channel from the southeastern end of the berm. The combination of fill material placement to the west of the channel and the berm to the east of the channel creates a floodplain constriction and avulsion hazard at the downstream end of channel segment 2 (Figure 10). Once flood flows escape the newly constructed channel, the floodplain constriction will force water to the east of the berm, and flow parallel to the highway alignment before returning to the channel at the bridge crossing near the downstream end of segment 1. If this avulsion occurs, a headcut could form where the water returns to Reach 1 just above the Highway 2 Bridge.

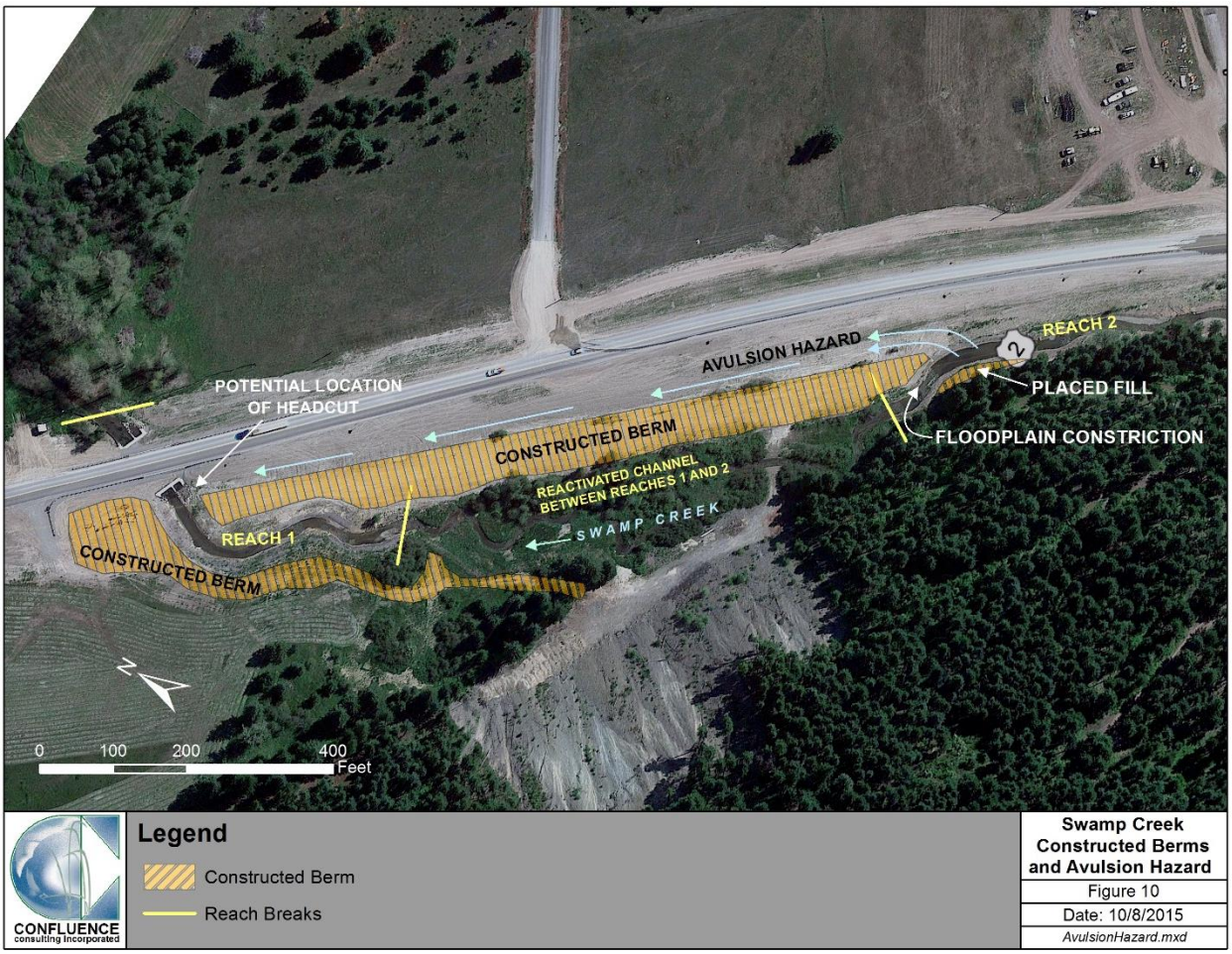


Figure 10. Avulsion hazard area at downstream end of reconstructed channel segment 2.

The following actions are recommended to reduce or prevent the likelihood of an avulsion occurring at the downstream end of channel segment 2:

- Remove the floodplain berm constructed along the east side of segment 1 and the reactivated channel segment between segment 1 and segment 2. This would substantially improve floodplain connectivity from the downstream end of segment 2 to the downstream end of segment 1.
- If removal of the berm is not feasible or desirable, installing a grade control at the downstream end of the avulsion channel alignment would prevent a headcut from developing, and potentially capturing the channel between the downstream end of segment 2 and the bridge near the downstream end of segment 1.

7.3. Reconstructed Channel Segment 7

Throughout all of the reconstructed channel length, the stream banks were built using coir-wrapped soil lifts. The woven coir fabric used to construct the banks is capable of containing gravel or gravel/soil fill materials; however, the mesh size of this fabric is too large to contain fill material that consists solely of fine materials. According to the contractor, many of the stream banks constructed in segment 7.1 and 7.2 were built using fine grained fill material generated during excavation of the new channel alignment. Laborers present during construction of these banks observed the wet fill material oozing out of the fabric during construction. Based on these observations by the contractor crew, some of the banks lost their definition immediately following construction, while others may have had additional fine material stripped from the coir lift during high flows the following spring. The loss of material from the constructed banks may reduce the channel's capacity in some areas due to lower bank heights. The use of an inner layer with finer mesh size is recommended for use in stream banks that are constructed with fine grained material. The use of a second, inner layer will prevent suction of the finer sized material from the banks and allow the bank to retain its shape and dimension while vegetation establishes.

7.4. Woody Shrub Survival Method

The current method for assessing planted woody shrub survival entails inspecting the entire length of both banks along the reconstructed channel segments (total of over 22,000 feet) and counting the number of live and dead woody plants observed. Many of the reaches have begun to develop a dense understory of herbaceous vegetation including reed canary grass, which makes locating the planted vegetation very challenging. Due to the scale of the Swamp Creek mitigation site, development of a representative sampling method to quantify planted shrub survival rates is recommended to more accurately determine establishment of woody vegetation.

8.0 LITERATURE CITED

Montana Department of Agriculture. 2015. Montana Noxious Weed List. Accessed October 2015 at:
http://agr.mt.gov/agr/Programs/Weeds/PDF/2015WeedList.pdf

Montana Department of Transportation. 2014. Memorandum from Lawrence Urban dated August 15, 2014. Subject: NH 1-1 (29)45 UPN: 1027004 Libby Creek South Swamp Creek Channel Restoration Post Construction Agency Field Meeting Summary

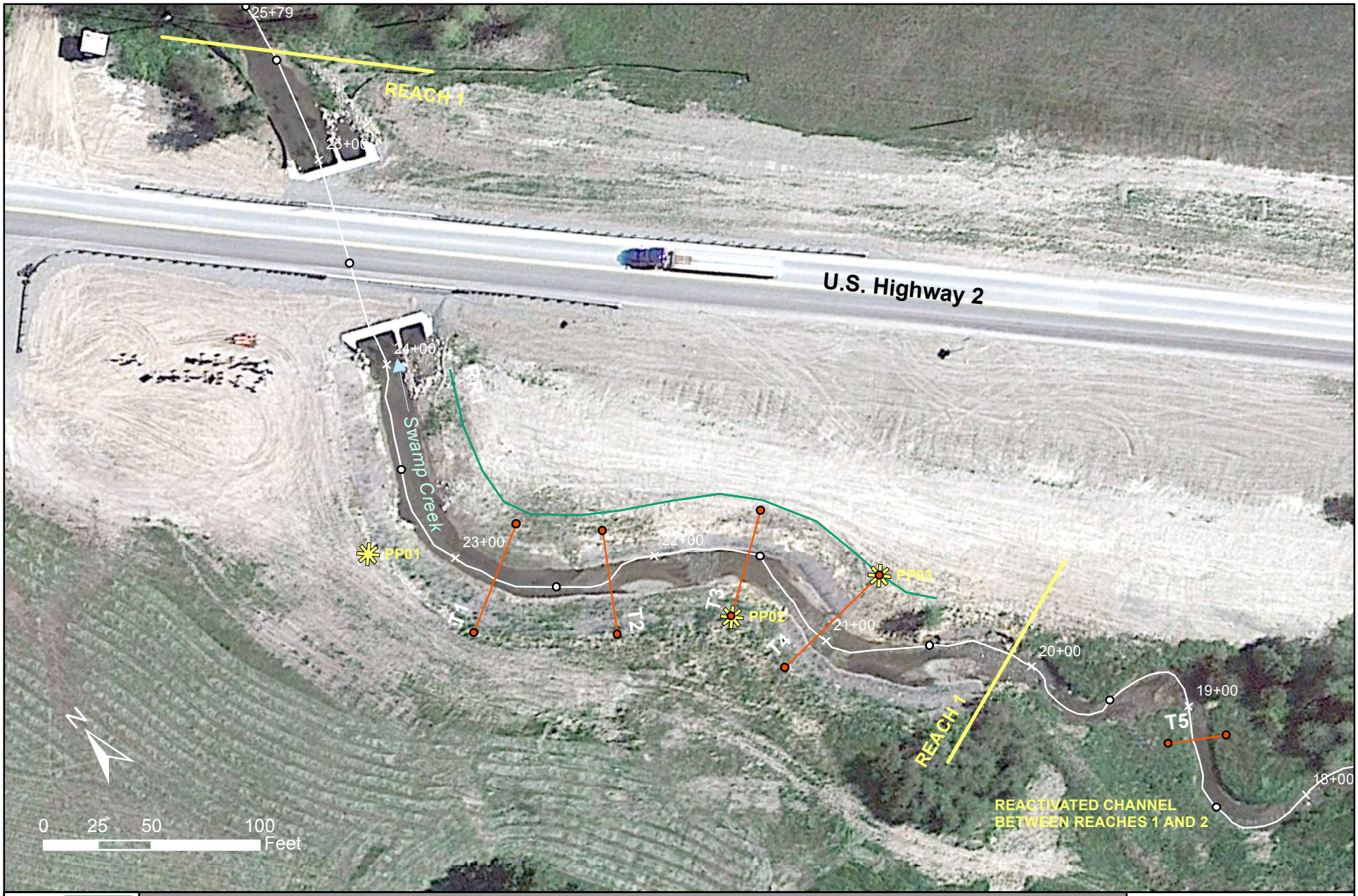
Montana Department of Transportation. 2012. On-Site Stream Mitigation Plan for Swamp Creek, Lincoln County, Montana. Libby Creek – South Project. MDT Project #NH-F 1-1(29)45 F, CN 1027004.

Winward, A.H. 2000. Monitoring the Vegetation Resources in Riparian Areas. USFS RMRS-GTR-47.

Appendix A

Monitoring Feature Maps

MDT Stream Mitigation Monitoring
Swamp Creek
Lincoln County, Montana



CONFLUENCE
consulting incorporated

Legend

- Photo Points
- Channel Thalweg
- Major Station (100')
- Minor Station (50')
- Reconstructed Channel Reach Breaks
- Eroding Banks
- Pool and Riffle Perpendicular Transects
- Riparian Vegetation Belt Transect

Swamp Creek - 2015
Reach 1
Monitoring Features

Map 1

Date: 11/17/2015

Swamp_features2015.mxd

CONFLUENCE
consulting incorporated

Legend

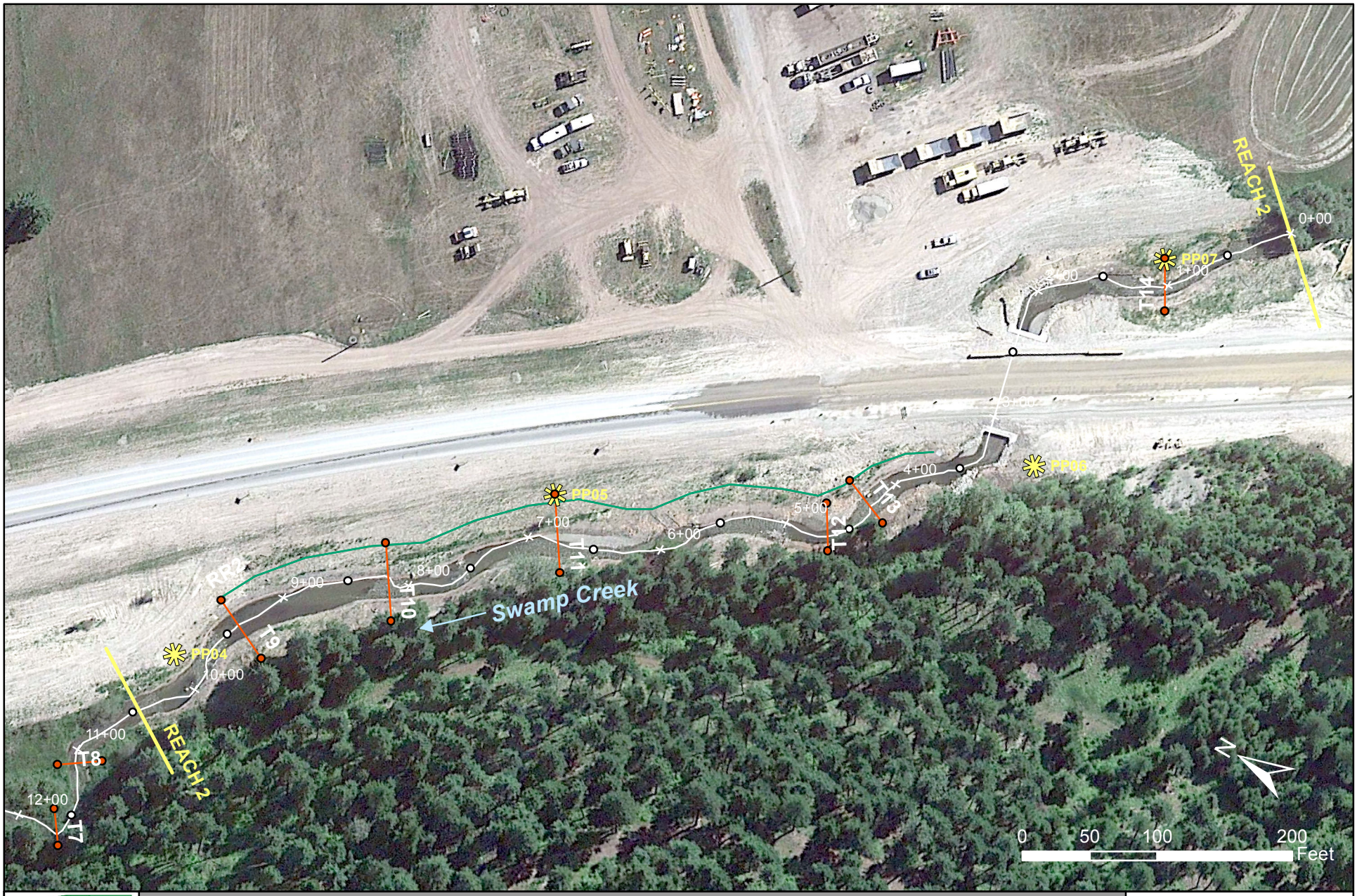
- Photo Points
- Channel Thalweg
- Major Station (100')
- Minor Station (50')
- Reconstructed Channel Reach Breaks
- Eroding Banks
- Pool and Riffle Perpendicular Transects
- Riparian Vegetation Belt Transect

Swamp Creek Reach 1/2 Transition Monitoring Features

Map 2

Date: 11/17/2015

Swamp_features2015.mxd



CONFLUENCE
consulting incorporated

Legend

- Photo Points
- Channel Thalweg
- Major Station (100')
- Minor Station (50')
- Reconstructed Channel Reach Breaks
- Eroding Banks
- Pool and Riffle Perpendicular Transects
- Riparian Vegetation Belt Transect

Swamp Creek - 2015
Reach 2
Monitoring Features

Map 3

Date: 11/17/2015

Swamp_features2015.mxd

CONFLUENCE
consulting incorporated

Legend

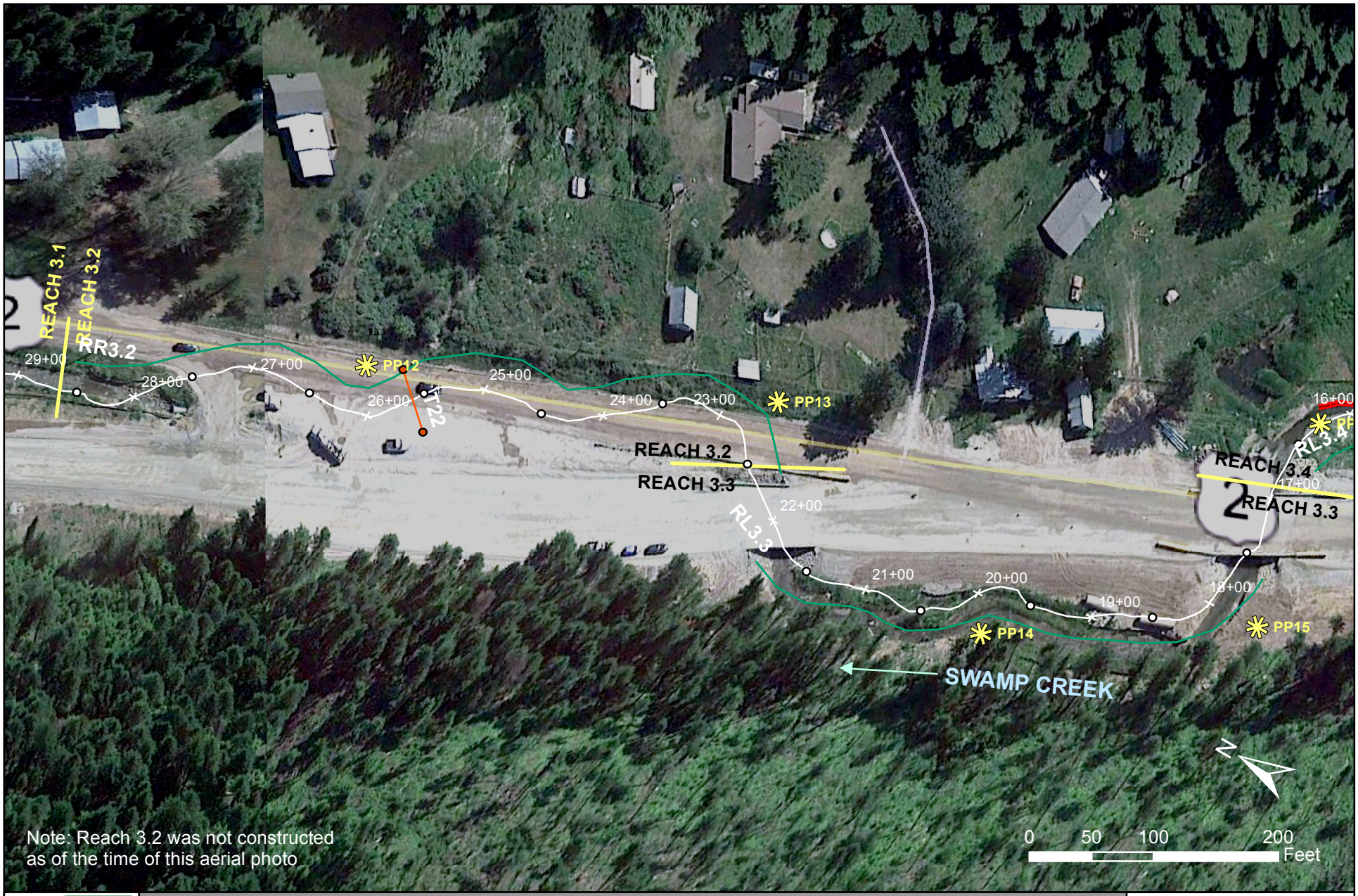
- Photo Points
- Channel Thalweg
- Major Station (100')
- Minor Station (50')
- Reconstructed Channel Reach Breaks
- Eroding Banks
- Pool and Riffle Perpendicular Transects
- Riparian Vegetation Belt Transect

Swamp Creek- 2015
Reach 3.1
Monitoring Features

Map 4

Date: 11/17/2015

Swamp3.1_Features2015.mxd



CONFLUENCE
consulting incorporated

Legend

- Photo Points
- Channel Thalweg
- Major Station (100')
- Minor Station (50')
- Reconstructed Channel Reach Breaks
- Eroding Banks
- Pool and Riffle Perpendicular Transects
- Riparian Vegetation Belt Transect

Swamp Creek - 2015
Reach 3.2 and 3.3
Monitoring Features

Map 5

Date: 11/17/2015

Swamp_features2015.mxd

CONFLUENCE
consulting incorporated

Legend

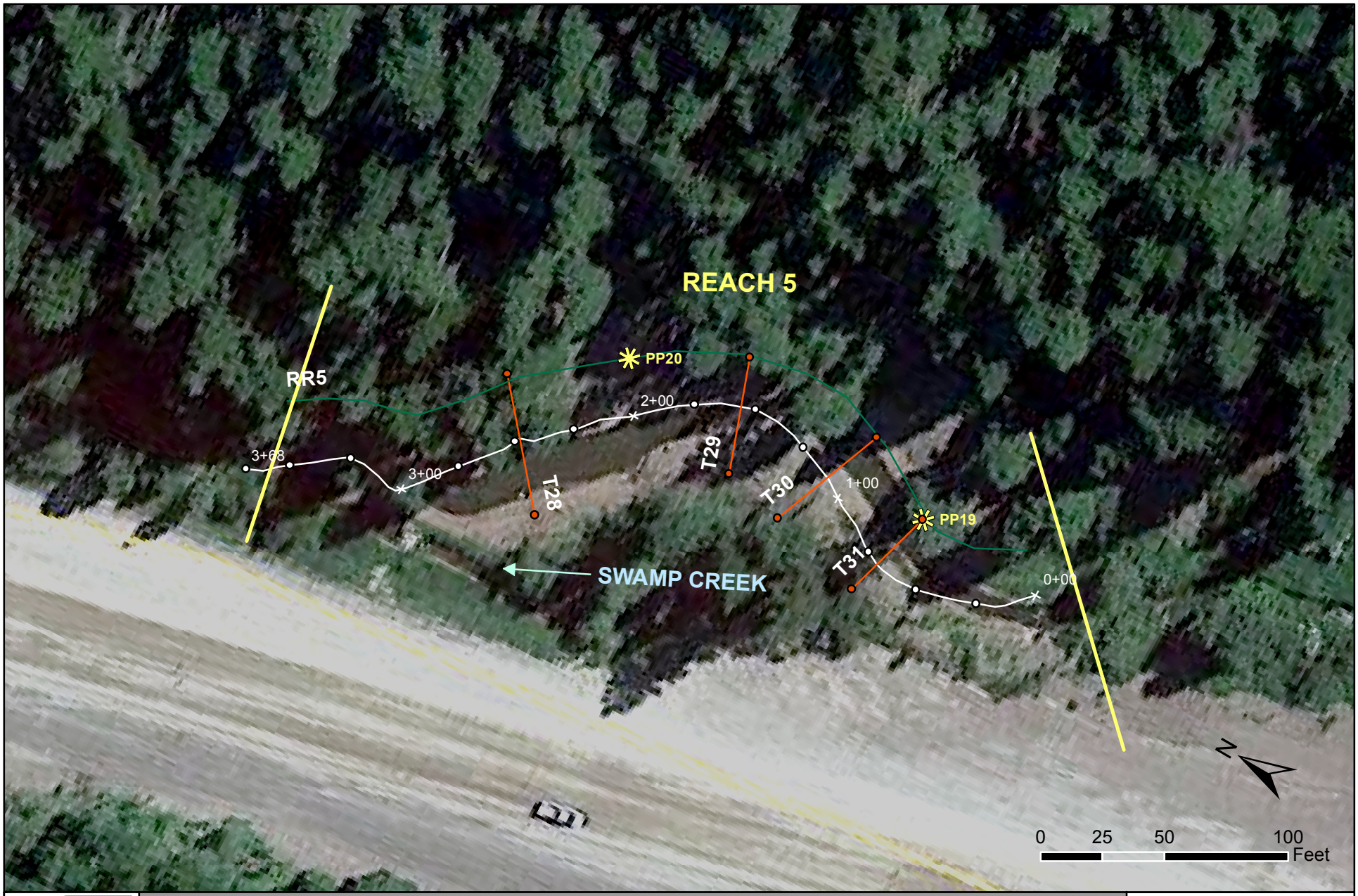
- Photo Points
- Channel Thalweg
- Major Station (100')
- Minor Station (50')
- Reconstructed Channel Reach Breaks
- Eroding Banks
- Pool and Riffle Perpendicular Transects
- Riparian Vegetation Belt Transect

Swamp Creek - 2015
Reach 3.4
Monitoring Features

Map 6

Date: 11/17/2015

Swamp_features2015.mxd



CONFLUENCE
consulting incorporated

Legend

- Photo Points
- Channel Thalweg
- Major Station (100')
- Minor Station (50')
- Reconstructed Channel Reach Breaks
- Eroding Banks
- Pool and Riffle Perpendicular Transects
- Riparian Vegetation Belt Transect

Swamp Creek - 2015
Reach 5
Monitoring Features

Map 7

Date: 11/17/2015

Swamp_features2015.mxd

CONFLUENCE

Legend

- Photo Points
- Channel Thalweg
- Major Station (100')
- Minor Station (50')
- Reconstructed Channel Reach Breaks
- Eroding Banks
- Pool and Riffle Perpendicular Transects
- Riparian Vegetation Belt Transect

Swamp Creek- 2015 Monitoring Features Reach 7.1

Map 8

Date: 11/17/2015

Swamp7.1_features2015.mxd

CONFLUENCE
consulting incorporated

Legend

- Photo Points
- Channel Thalweg
- Major Station (100')
- Minor Station (50')
- Reconstructed Channel Reach Breaks
- Eroding Banks
- Pool and Riffle Perpendicular Transects
- Riparian Vegetation Belt Transect

Swamp Creek - 2015
Reach 7.2
Monitoring Features

Map 9

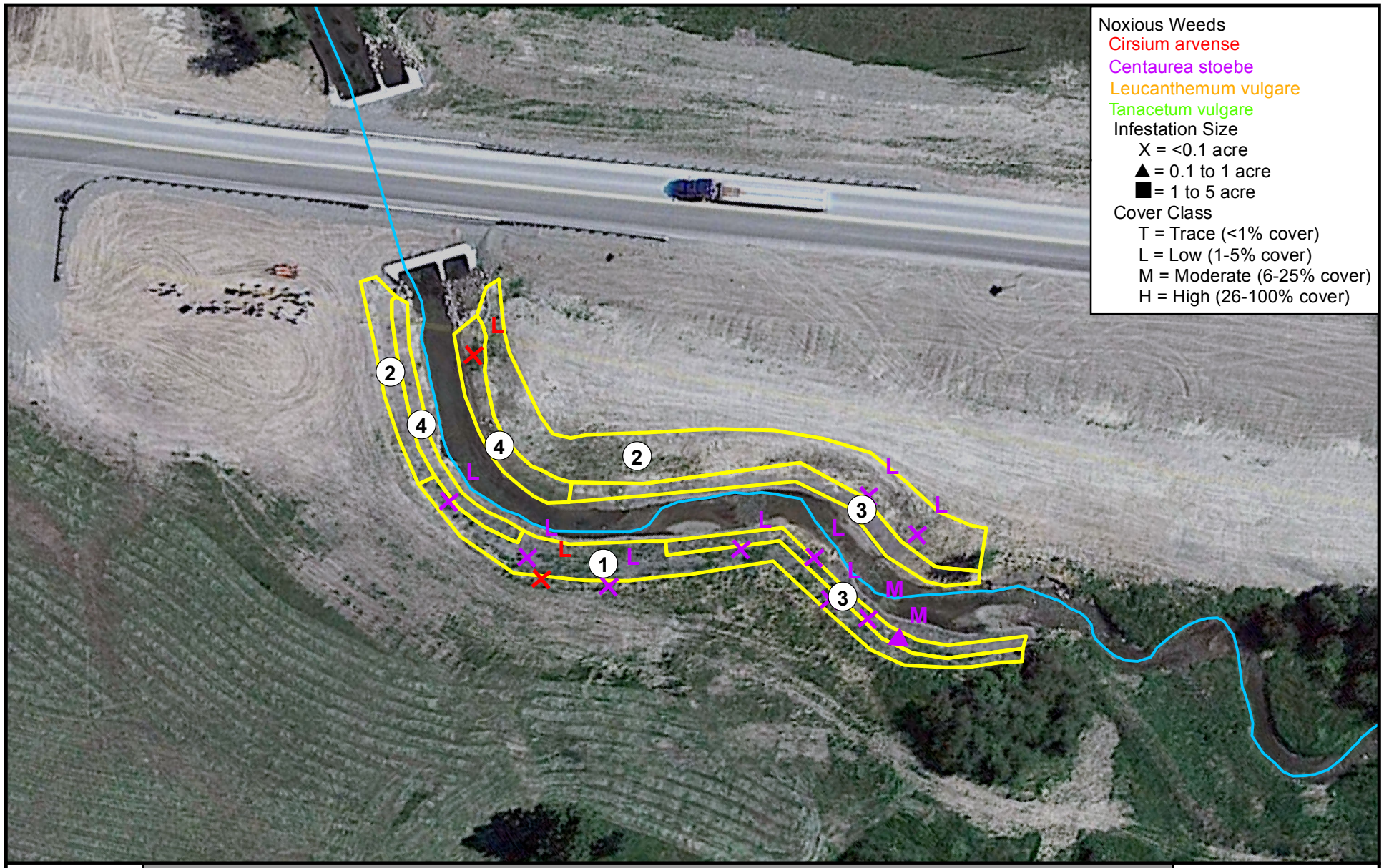
Date: 11/17/2015

Swamp_features2015.mxd

Appendix B

Noxious Weed and Vegetation Community Maps

MDT Stream Mitigation Monitoring
Swamp Creek
Lincoln County, Montana



CONFLUENCE

Legend

Reach Centerline

Vegetation Community Boundary

1 Bromus/Elymus Community

2 Elymus Community

3 Melilotus/Equisetum Community

4 Phalaris/Agrostis Community

N

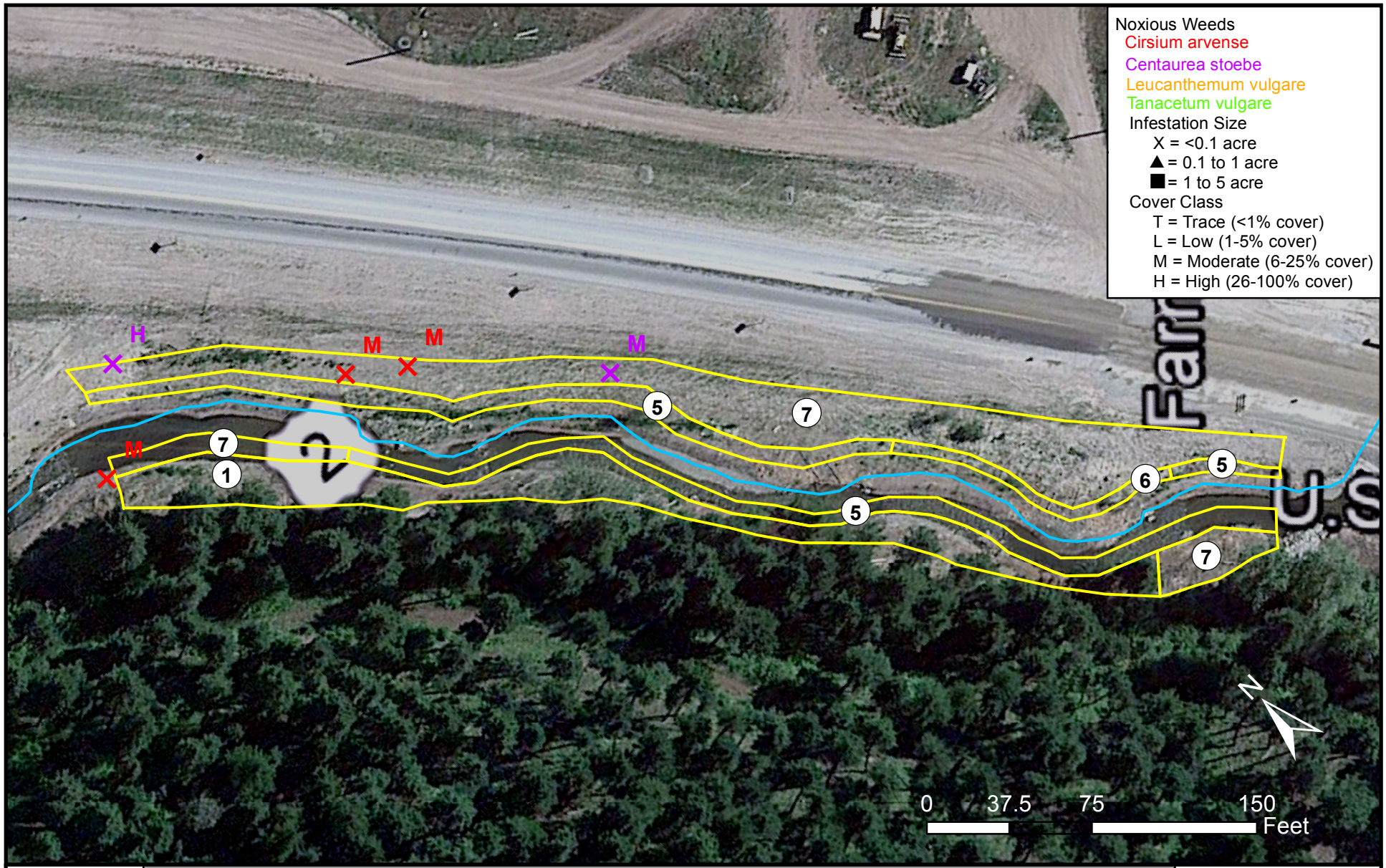
0 12.525 50 75 100 Feet

Swamp Creek- 2015 Noxious Weeds and Vegetation Communities Reach 1

Map 10

Date: 11/17/2015

Swamp1_monitor2015.mxd



CONFLUENCE

Legend

Reach Centerline

Vegetation Community Boundary

1 Bromus/Elymus Community

5 Agrostis/Alnus Community

6 Phalaris/Deschampsia Community

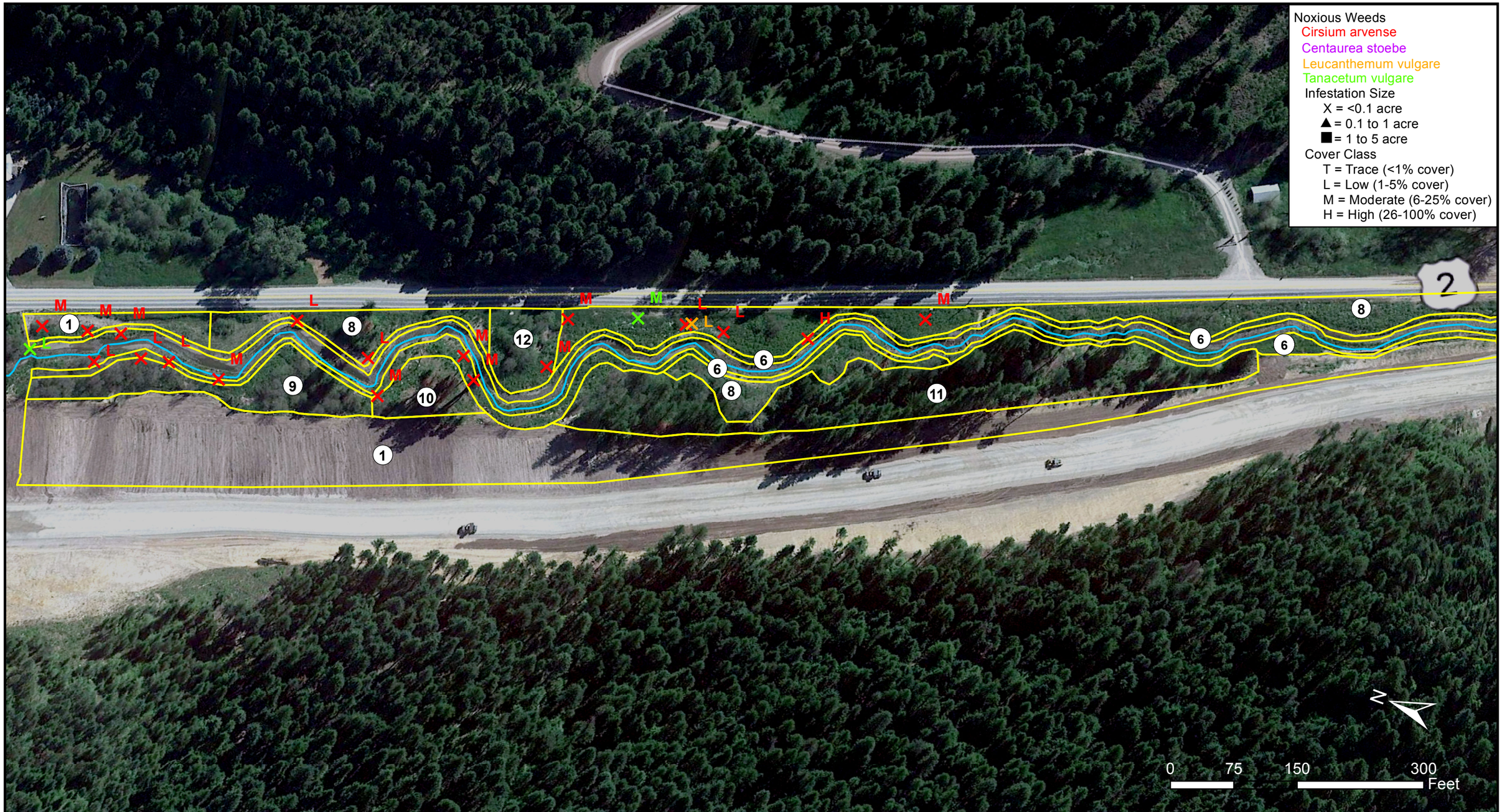
7 Melilotus/Elymus Community

Swamp Creek- 2015 Noxious Weeds and Vegetation Communities Reach 2

Map 11

Date: 11/17/2015

Swamp2_monitor2015.mxd



CONFLUENCE

Legend

Reach Centerline

Vegetation Community Boundary

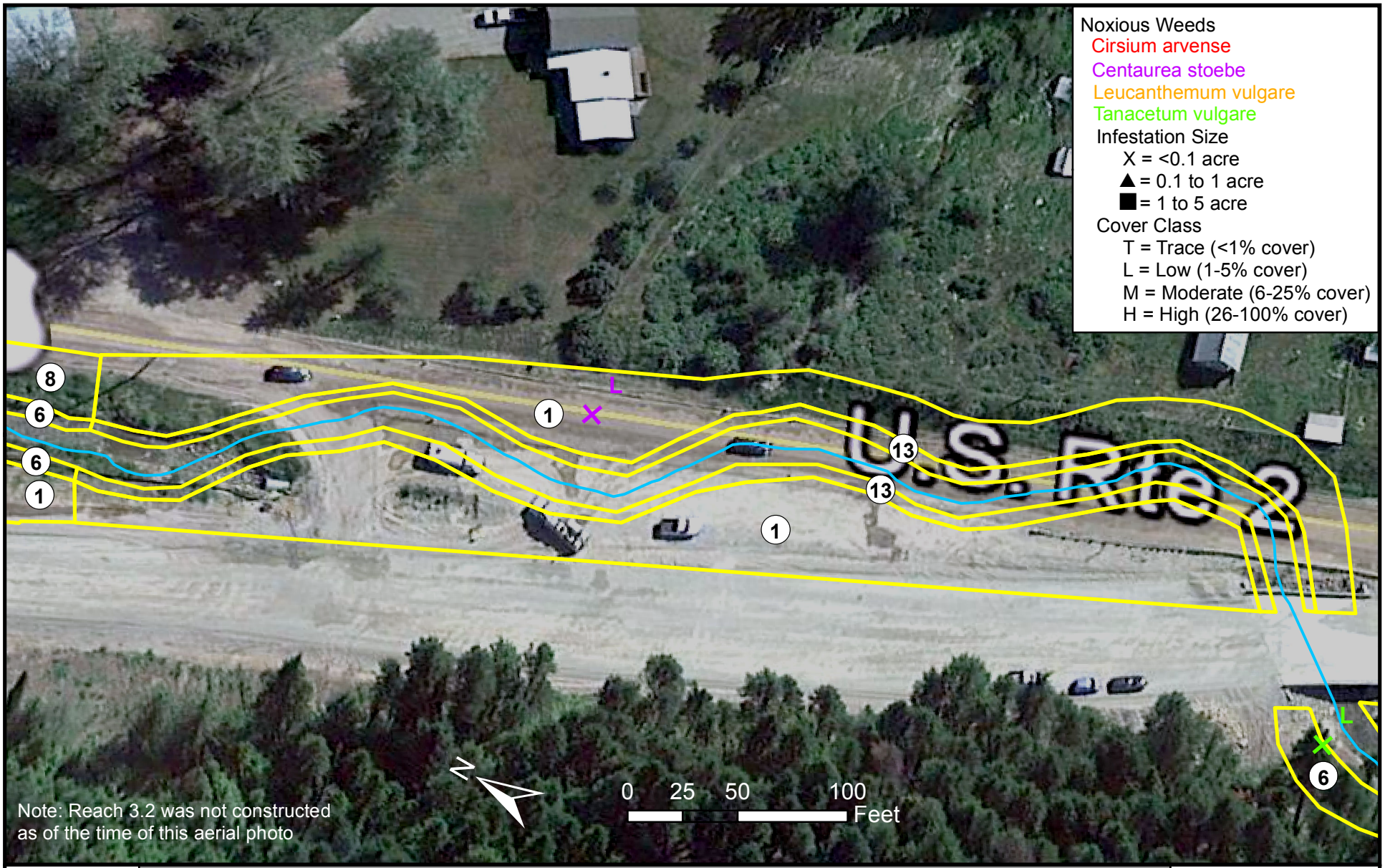
1 Bromus/Elymus Community
6 Phalaris/Deschampsia Community
8 Phalaris Community
9 Alnus/Cornus Community
10 Thuja/Pinus Community
11 Tsuga/Thuja Community
12 Acer/Alnus Community

Swamp Creek- 2015 Noxious Weeds and Vegetation Communities Reach 3.1

Map 12

Date: 11/17/2015

Swamp3_1_monitor2015.mxd



CONFLUENCE

Legend

Reach Centerline

Vegetation Community Boundary

1 Bromus/Elymus Community

13 Bare Ground/Epilobium Community

6 Phalaris/Deschampsia Community

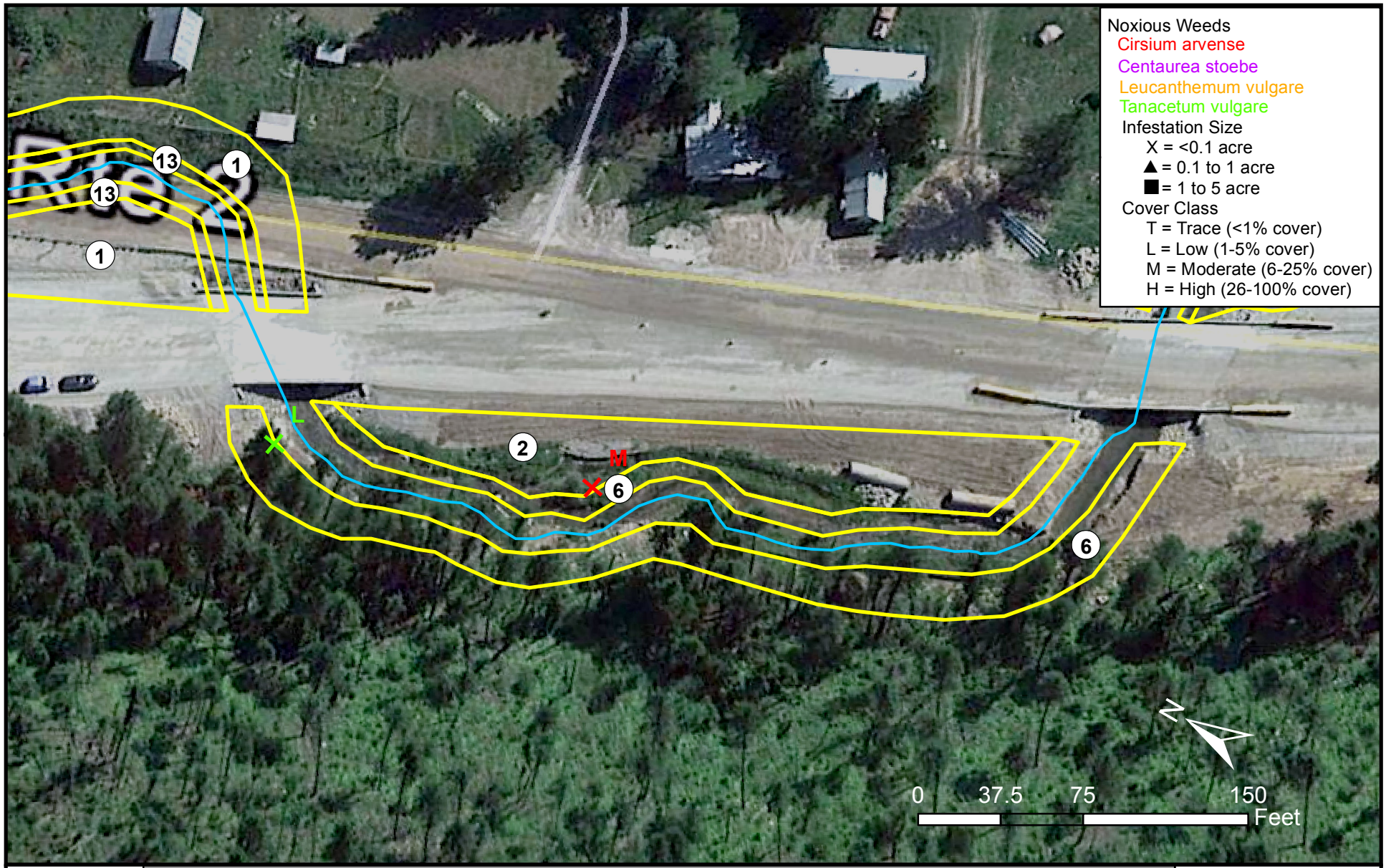
8 Phalaris Community

Swamp Creek- 2015 Noxious Weeds and Vegetation Communities Reach 3.2

Map 13

Date: 11/17/2015

Swamp3_2_monitor2015.mxd



CONFLUENCE

Legend

Reach Centerline

Vegetation Community Boundary

1 Bromus/Elymus Community

2 Elymus Community

6 Phalaris/Deschampsia Community

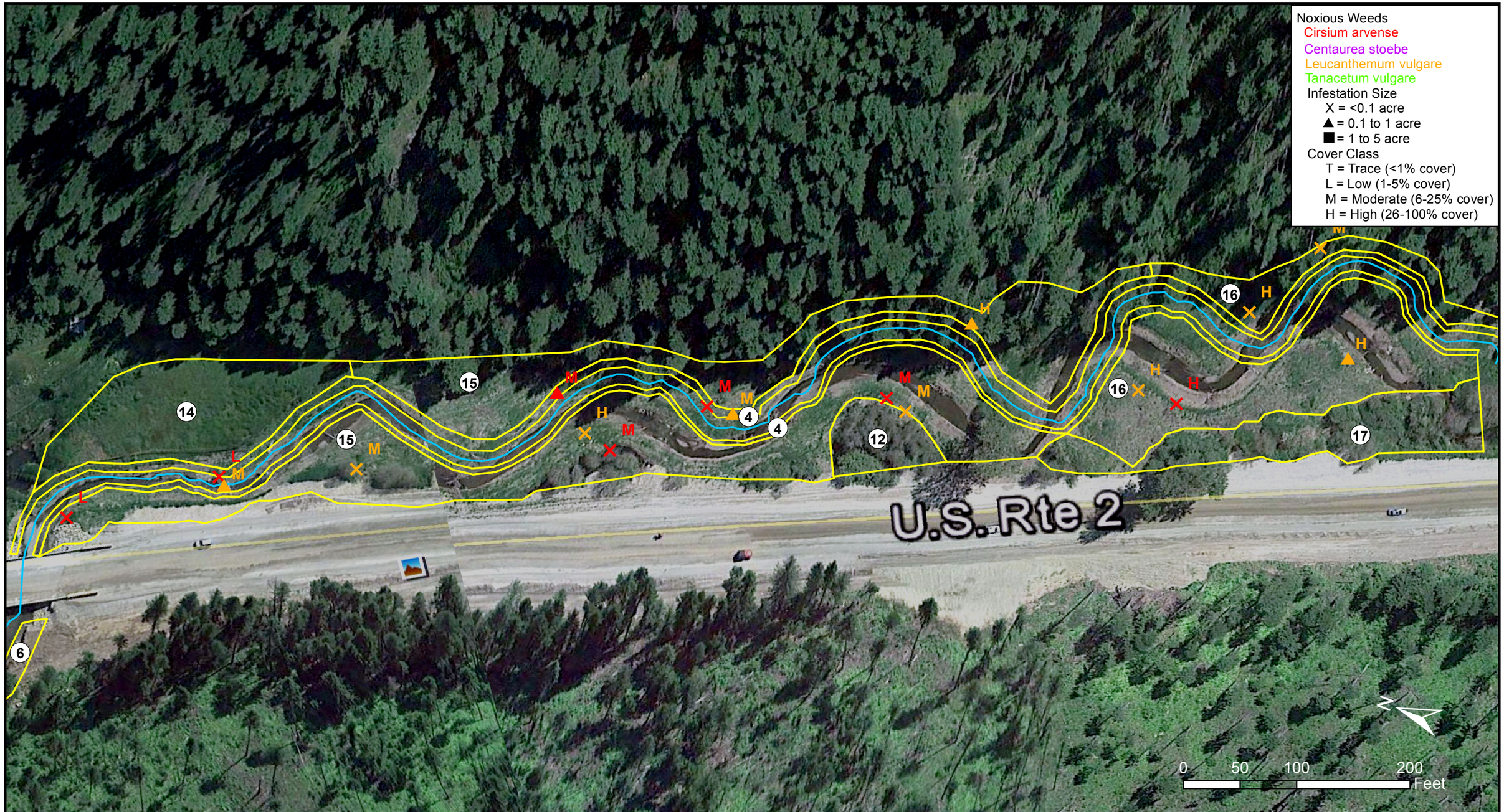
13 Bare Ground/Epilobium Community

Swamp Creek- 2015 Noxious Weeds and Vegetation Communities Reach 3.3

Map 14

Date: 11/17/2015

Swamp3_3_monitor2015.mxd



CONFLUENCE

Legend

Reach Centerline

Vegetation Community Boundary

4 Phalaris/Agrostis Community

12 Acer/Alnus Community

14 Carex Community

15 Phalaris/Alnus Community

16 Leucanthemum/Alnus Community

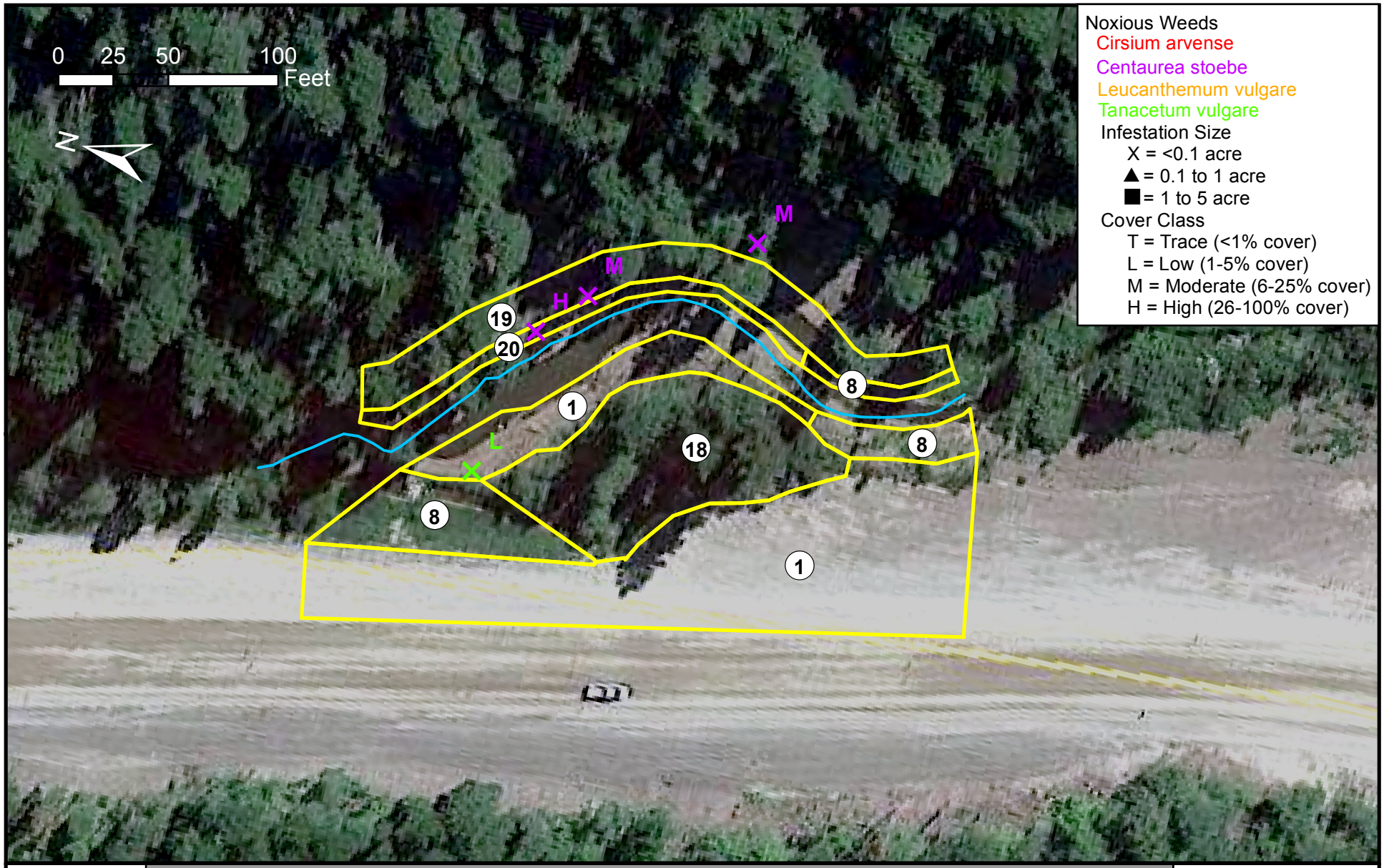
17 Alnus/Symphoricarpos Community

Swamp Creek- 2015 Noxious Weeds and Vegetation Communities Reach 3.4

Map 15

Date: 11/17/2015

Swamp3_4_monitor2015.mxd



CONFLUENCE

Legend

Reach Centerline

Vegetation Community Boundary

1 Bromus/Elymus Community

8 Phalaris Community

18 Pseudotsuga/Crataegus Community

19 Pseudotsuga/Thuja Community

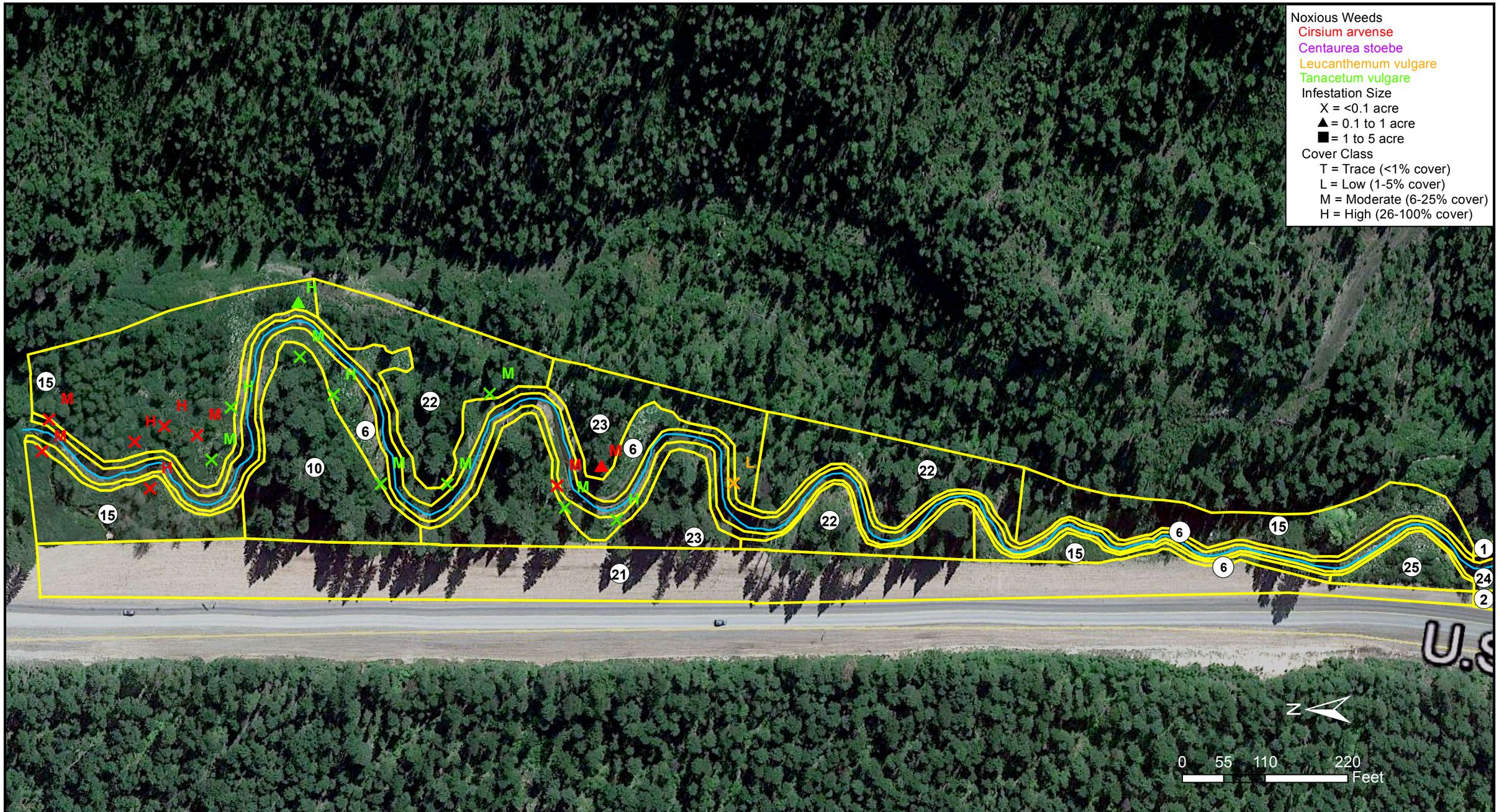
20 Bromus/Alnus Community

Swamp Creek- 2015 Noxious Weeds and Vegetation Communities Reach 5

Map 16

Date: 11/17/2015

Swamp5_monitor2015.mxd



CONFLUENCE

Legend

Reach Centerline

Vegetation Community Boundary

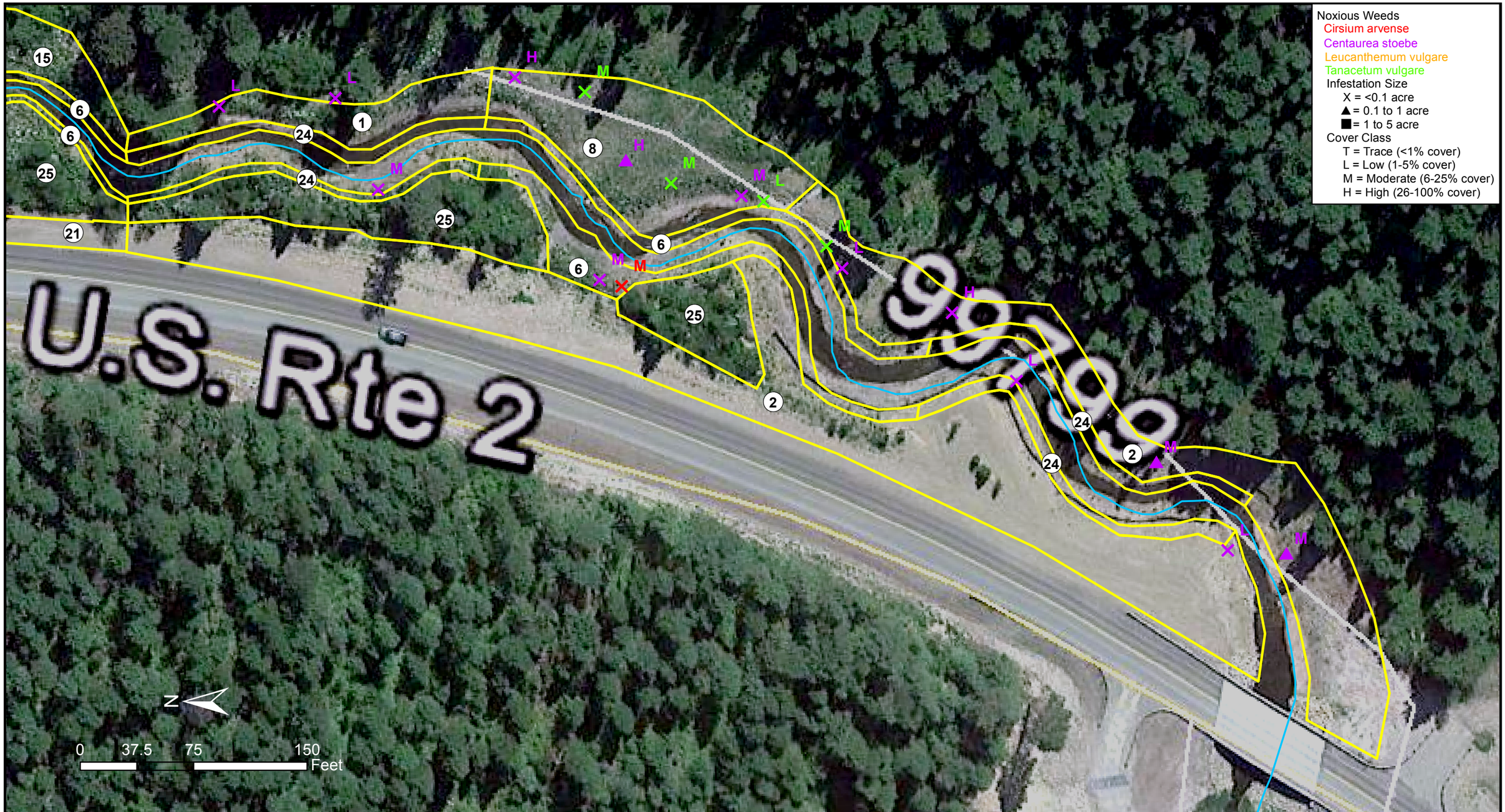
1 Bromus/Elymus Community
2 Elymus Community
6 Phalaris/Deschampsia Community
10 Thuja/Pinus Community
15 Phalaris/Alnus Community
21 Poa/Elymus Community
22 Alnus/Abies Community
23 Acer/Abies Community
24 Alnus/Deschampsia Community
25 Crataegus/Philadelphus Community

Swamp Creek- 2015 Noxious Weeds and Vegetation Communities Reach 7.1

Map 17

Date: 11/17/2015

Swamp7_1_monitor2015.mxd



CONFLUENCE

Legend

Reach Centerline

Vegetation Community Boundary

1 Bromus/Elymus Community
2 Elymus Community
6 Phalaris/Deschampsia Community
8 Phalaris Community
21 Poa/Elymus Community
24 Alnus/Deschampsia Community
25 Crataegus/Philadelphus Community

Swamp Creek- 2015 Noxious Weeds and Vegetation Communities Reach 7.2

Map 18

Date: 11/17/2015

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Appendix C

Comprehensive Vegetation Species Lists

MDT Stream Mitigation Monitoring
Swamp Creek
Lincoln County, Montana

Channel Segment 1 Vegetation Species List - 2015

Scientific Name	Common Name	Wetland Indicator Status
Achillea millefolium	Common Yarrow	FACU
Agrostis stolonifera	Spreading Bent	FAC
Alnus incana	Speckled Alder	FACW
Bare Ground	Bare Ground	NL
Beckmannia syzigachne	American Slough Grass	OBL
Bromus inermis	Smooth Brome	FAC
Bromus japonicus	Japanese Brome	NL
Carex bebbii	Bebb's Sedge	OBL
Carex pellita	Woolly Sedge	OBL
Carex sp.	Sedge	NL
Carex stipata	Stalk-Grain Sedge	OBL
Carex utriculata	Northwest Territory Sedge	OBL
Centaurea stoebe	Spotted Knapweed	NL
Cirsium arvense	Canadian Thistle	FAC
Cirsium vulgare	Bull Thistle	FACU
Crataegus douglasii	Black Hawthorn	FAC
Elymus canadensis	Nodding Wild Rye	FAC
Elymus repens	Creeping Wild Rye	FAC
Elymus trachycaulus	Slender Wild Rye	FAC
Epilobium ciliatum	Fringed Willowherb	FACW
Equisetum arvense	Field Horsetail	FAC
Glyceria grandis	American Manna Grass	OBL
Hordeum jubatum	Fox-Tail Barley	FAC
Juncus effusus	Lamp Rush	FACW
Juncus ensifolius	Dagger-Leaf Rush	FACW
Juncus nodosus	Knotted Rush	OBL
Juncus tenuis	Lesser Poverty Rush	FAC
Lactuca serriola	Prickly Lettuce	FACU
Berberis repens	Creeping Oregon-Grape	NL
Medicago lupulina	Black Medick	FACU
Melilotus officinalis	Yellow Sweet-Clover	FACU
Mentha arvensis	American Wild Mint	FACW
Mimulus guttatus	Seep Monkey-Flower	OBL
Myosotis scorpioides	True Forget-Me-Not	FACW
Nasturtium officinale	Watercress	OBL
Phalaris arundinacea	Reed Canary Grass	FACW
Phleum pratense	Common Timothy	FAC
Plantago major	Great Plantain	FAC
Poa pratensis	Kentucky Blue Grass	FAC
Populus angustifolia	Narrow-Leaf Cottonwood	FACW
Ranunculus aquatilis	White Water-Crowfoot	OBL
Rumex crispus	Curly Dock	FAC
Rumex salicifolius	Willow Dock	FACW
Salix bebbiana	Gray Willow	FACW
Salix sitchensis	Sitka Willow	FACW
Salix sp.	Willow	NL
Scirpus microcarpus	Red-Tinge Bulrush	OBL
Symphyotrichum campestre	Western Meadow Aster	NL
Symphyotrichum foliaceum	Alpine Leafy-Head American-Aster	FACU
Tragopogon dubius	Meadow Goat's-Beard	NL
Trifolium pratense	Red Clover	FACU
Trifolium repens	White Clover	FAC
Verbascum thapsus	Great Mullein	FACU
Veronica americana	American-Brooklime	OBL
Vicia americana	American Purple Vetch	FAC

Channel Segment 2 Vegetation Species List - 2015

Scientific Name	Common Name	Wetland Indicator Status
Acer glabrum	Rocky Mountain Maple	FACU
Agrostis stolonifera	Spreading Bent	FAC
Alnus incana	Speckled Alder	FACW
Alopecurus arundinaceus	Creeping Meadow-Foxtail	FAC
Anaphalis margaritacea	Pearly-Everlasting	FACU
Arctium minus	Lesser Burrdock	UPL
Astragalus cicer	Chickpea Milkvetch	NL
Bare Ground	Bare Ground	NL
Bromus inermis	Smooth Brome	FAC
Bromus japonicus	Japanese Brome	NL
Bromus tectorum	Cheatgrass	NL
Carex pellita	Woolly Sedge	OBL
Carex simulata	Analogue Sedge	OBL
Carex stipata	Stalk-Grain Sedge	OBL
Carex vesicaria	Lesser Bladder Sedge	OBL
Centaurea stoebe	Spotted Knapweed	NL
Chamaenerion angustifolium	Narrow-Leaf Fireweed	FACU
Chenopodium rubrum	Red Goosefoot	FACW
Cirsium arvense	Canadian Thistle	FAC
Cirsium vulgare	Bull Thistle	FACU
Cornus alba	Red Osier	FACW
Dactylis glomerata	Orchard Grass	FACU
Deschampsia caespitosa	Tufted Hair Grass	FACW
Elymus canadensis	Nodding Wild Rye	FAC
Elymus repens	Creeping Wild Rye	FAC
Elymus trachycaulus	Slender Wild Rye	FAC
Epilobium ciliatum	Fringed Willowherb	FACW
Equisetum arvense	Field Horsetail	FAC
Equisetum hyemale	Tall Scouring-Rush	FACW
Glyceria grandis	American Manna Grass	OBL
Heracleum lanatum	Cow-Parsnip	NL
Hordeum jubatum	Fox-Tail Barley	FAC
Juncus balticus	Baltic Rush	FACW
Juncus effusus	Lamp Rush	FACW
Juncus ensifolius	Dagger-Leaf Rush	FACW
Juncus nodosus	Knotted Rush	OBL
Juncus tenuis	Lesser Poverty Rush	FAC
Lactuca serriola	Prickly Lettuce	FACU
Leucanthemum vulgare	Ox-Eye Daisy	FACU
Matricaria discoidea	Pineapple-Weed	FACU
Medicago lupulina	Black Medick	FACU
Medicago sativa	Alfalfa	UPL
Melilotus officinalis	Yellow Sweet-Clover	FACU
Mentha arvensis	American Wild Mint	FACW
Mimulus guttatus	Seep Monkey-Flower	OBL
Myosotis scorpioides	True Forget-Me-Not	FACW
Nasturtium officinale	Watercress	OBL
Phalaris arundinacea	Reed Canary Grass	FACW
Phleum pratense	Common Timothy	FAC
Plantago major	Great Plantain	FAC
Poa palustris	Fowl Blue Grass	FAC
Poa pratensis	Kentucky Blue Grass	FAC
Persicaria amphibia	Water Smartweed	OBL
Populus angustifolia	Narrow-Leaf Cottonwood	FACW
Ranunculus aquatilis	White Water-Crowfoot	OBL
Rosa woodsii	Woods' Rose	FACU
Rumex crispus	Curly Dock	FAC
Rumex salicifolius	Willow Dock	FACW
Salix bebbiana	Gray Willow	FACW
Salix sitchensis	Sitka Willow	FACW
Sisymbrium altissimum	Tall Hedge-Mustard	FACU
Solanum dulcamara	Climbing Nightshade	FAC
Solidago canadensis	Canadian Goldenrod	FACU
Sonchus arvensis	Field Sow-Thistle	FACU
Symphyotrichum campestre	Western Meadow Aster	NL
Symphyotrichum foliaceum	Alpine Leafy-Head American-Aster	FACU
Taraxacum officinale	Common Dandelion	FACU
Tragopogon dubius	Meadow Goat's-Beard	NL
Trifolium repens	White Clover	FAC
Verbascum thapsus	Great Mullein	FACU
Veronica americana	American-Brooklime	OBL

Channel Segment 3 Vegetation Species List - 2015

Scientific Name	Common Name	Wetland Indicator Status
Abies lasiocarpa	Subalpine Fir	FACU
Acer glabrum	Rocky Mountain Maple	FACU
Achillea millefolium	Common Yarrow	FACU
Agropyron cristatum	Crested Wheatgrass	NL
Agrostis stolonifera	Spreading Bent	FAC
Algae, brown	Algae, brown	NL
Algae, green	Algae, green	NL
Alnus incana	Speckled Alder	FACW
Alopecurus arundinaceus	Creeping Meadow-Foxtail	FAC
Amelanchier alnifolia	Saskatoon Service-Berry	FACU
Bare Ground	Bare Ground	NL
Beckmannia syzigachne	American Slough Grass	OBL
Bidens cernua	Nodding Burr-Marigold	OBL
Bromus inermis	Smooth Brome	FAC
Bromus japonicus	Japanese Brome	NL
Carex bebbii	Bebb's Sedge	OBL
Carex simulata	Analogue Sedge	OBL
Carex stipata	Stalk-Grain Sedge	OBL
Carex utriculata	Northwest Territory Sedge	OBL
Carex vesicaria	Lesser Bladder Sedge	OBL
Centaurea stoebe	Spotted Knapweed	NL
Cerastium fontanum	Common Mouse-Ear Chickweed	FACU
Chamaenerion angustifolium	Narrow-Leaf Fireweed	FACU
Chenopodium album	Lamb's-Quarters	FACU
Chenopodium rubrum	Red Goosefoot	FACW
Cicuta douglasii	Western Water-Hemlock	OBL
Cirsium arvense	Canadian Thistle	FAC
Cirsium vulgare	Bull Thistle	FACU
Cornus alba	Red Osier	FACW
Crataegus douglasii	Black Hawthorn	FAC
Deschampsia caespitosa	Tufted Hair Grass	FACW
Deschampsia elongata	Slender Hair Grass	FACW
Descurainia sophia	Herb Sophia	NL
Elymus canadensis	Nodding Wild Rye	FAC
Elymus repens	Creeping Wild Rye	FAC
Elymus trachycaulus	Slender Wild Rye	FAC
Epilobium ciliatum	Fringed Willowherb	FACW
Equisetum arvense	Field Horsetail	FAC
Equisetum hyemale	Tall Scouring-Rush	FACW
Festuca idahoensis	Bluebunch Fescue	FACU
Galium aparine	Sticky-Willy	FACU
Geum macrophyllum	Large-Leaf Avens	FAC
Glyceria grandis	American Manna Grass	OBL
Hordeum jubatum	Fox-Tail Barley	FAC
Impatiens ecalcarata	Spurless Touch-Me-Not	FACW
Juncus bufonius	Toad Rush	FACW
Juncus ensifolius	Dagger-Leaf Rush	FACW
Juncus nodosus	Knotted Rush	OBL
Juncus tenuis	Lesser Poverty Rush	FAC
Lactuca serriola	Prickly Lettuce	FACU
Lathyrus sylvestris	Flat Pea	NL
Leucanthemum vulgare	Ox-Eye Daisy	FACU
Tripleurospermum inodorum	Scentless False Mayweed	NL
Medicago lupulina	Black Medick	FACU
Medicago sativa	Alfalfa	UPL
Melilotus officinalis	Yellow Sweet-Clover	FACU
Mentha arvensis	American Wild Mint	FACW
Mimulus guttatus	Seep Monkey-Flower	OBL
Myosotis scorpioides	True Forget-Me-Not	FACW
Nasturtium officinale	Watercress	OBL
Pascopyrum smithii	Western-Wheat Grass	FACU
Peritoma serrulata	Rocky Mountain Beeplant	FACU
Phalaris arundinacea	Reed Canary Grass	FACW
Philadelphus lewisii	Lewis' Mock Orange	NL
Phleum pratense	Common Timothy	FAC
Pinus ponderosa	Ponderosa Pine	FACU
Plantago major	Great Plantain	FAC
Plantago patagonica	Woolly Plaintain	NL
Poa palustris	Fowl Blue Grass	FAC
Poa pratensis	Kentucky Blue Grass	FAC

Channel Segment 3 Vegetation Species List - 2015 (CONT.)

Persicaria amphibia	Water Smartweed	OBL
Populus angustifolia	Narrow-Leaf Cottonwood	FACW
Populus balsamifera	Balsam Poplar	FAC
Potentilla norvegica	Norwegian Cinquefoil	FAC
Prunus virginiana	Choke Cherry	FACU
Ranunculus aquatilis	White Water-Crowfoot	OBL
Rosa woodsii	Woods' Rose	FACU
Rubus idaeus	Common Red Raspberry	FACU
Rubus parviflorus	Western Thimble-Berry	FACU
Rumex crispus	Curly Dock	FAC
Rumex salicifolius	Willow Dock	FACW
Salix drummondiana	Drummond's Willow	FACW
Salix lasiandra	Pacific Willow	FACW
Salix sitchensis	Sitka Willow	FACW
Sambucus racemosa	Red Elder	FACU
Scirpus microcarpus	Red-Tinge Bulrush	OBL
Sisymbrium altissimum	Tall Hedge-Mustard	FACU
Solanum dulcamara	Climbing Nightshade	FAC
Solidago canadensis	Canadian Goldenrod	FACU
Sorbus sitchensis	Sitka Mountain-Ash	FAC
Symphoricarpos albus	Common Snowberry	FACU
Symphyotrichum foliaceum	Alpine Leafy-Head American-Aster	FACU
Tanacetum vulgare	Common Tansy	FACU
Taraxacum officinale	Common Dandelion	FACU
Thlaspi arvense	Field Pennycress	UPL
Thuja plicata	Western Arborvitae	FAC
Trifolium pratense	Red Clover	FACU
Trifolium repens	White Clover	FAC
Typha angustifolia	Narrow-Leaf Cat-Tail	OBL
Urtica dioica	Stinging Nettle	FAC
Verbascum thapsus	Great Mullein	FACU
Veronica americana	American-Brooklime	OBL

Channel Segment 5 Vegetation Species List - 2015

Scientific Name	Common Name	Wetland Indicator Status
Abies lasiocarpa	Subalpine Fir	FACU
Acer glabrum	Rocky Mountain Maple	FACU
Achillea millefolium	Common Yarrow	FACU
Agrostis stolonifera	Spreading Bent	FAC
Alnus incana	Speckled Alder	FACW
Bare Ground	Bare Ground	NL
Beckmannia syzigachne	American Slough Grass	OBL
Boechera stricta	Canadian Rockcress	FACU
Bromus inermis	Smooth Brome	FAC
Bromus japonicus	Japanese Brome	NL
Bromus tectorum	Cheatgrass	NL
Centaurea stoebe	Spotted Knapweed	NL
Cerastium fontanum	Common Mouse-Ear Chickweed	FACU
Chamaenerion angustifolium	Narrow-Leaf Fireweed	FACU
Cicuta douglasii	Western Water-Hemlock	OBL
Cirsium arvense	Canadian Thistle	FAC
Cirsium vulgare	Bull Thistle	FACU
Cornus alba	Red Osier	FACW
Crataegus douglasii	Black Hawthorn	FAC
Deschampsia caespitosa	Tufted Hair Grass	FACW
Elymus repens	Creeping Wild Rye	FAC
Elymus trachycaulus	Slender Wild Rye	FAC
Epilobium ciliatum	Fringed Willowherb	FACW
Galium aparine	Sticky-Willy	FACU
Leucanthemum vulgare	Ox-Eye Daisy	FACU
Berberis repens	Creeping Oregon-Grape	NL
Medicago lupulina	Black Medick	FACU
Melilotus officinalis	Yellow Sweet-Clover	FACU
Mentha arvensis	American Wild Mint	FACW
Mimulus guttatus	Seep Monkey-Flower	OBL
Nemophila breviflora	Small-Flower Baby-Blue-Eyes	NL
Phalaris arundinacea	Reed Canary Grass	FACW
Philadelphus lewisii	Lewis' Mock Orange	NL
Phleum pratense	Common Timothy	FAC
Pinus ponderosa	Ponderosa Pine	FACU
Plantago major	Great Plantain	FAC
Poa compressa	Flat-Stem Blue Grass	FACU
Poa palustris	Fowl Blue Grass	FAC
Poa pratensis	Kentucky Blue Grass	FAC
Populus angustifolia	Narrow-Leaf Cottonwood	FACW
Potentilla norvegica	Norwegian Cinquefoil	FAC
Prunus virginiana	Choke Cherry	FACU
Pseudotsuga menziesii	Douglas-Fir	FACU
Rosa woodsii	Woods' Rose	FACU
Rubus idaeus	Common Red Raspberry	FACU
Rubus parviflorus	Western Thimble-Berry	FACU
Rumex crispus	Curly Dock	FAC
Rumex salicifolius	Willow Dock	FACW
Sambucus racemosa	Red Elder	FACU
Sonchus arvensis	Field Sow-Thistle	FACU
Spiraea betulifolia	Shiny-Leaf Meadowsweet	FACU
Symphoricarpos albus	Common Snowberry	FACU
Symphyotrichum campestre	Western Meadow Aster	NL
Symphyotrichum foliaceum	Alpine Leafy-Head American-Aster	FACU
Tanacetum vulgare	Common Tansy	FACU
Taraxacum officinale	Common Dandelion	FACU
Trifolium pratense	Red Clover	FACU
Trifolium repens	White Clover	FAC
Urtica dioica	Stinging Nettle	FAC
Verbascum thapsus	Great Mullein	FACU
Verbena stricta	Hoary Verbena	NL
Veronica americana	American-Brooklime	OBL

Channel Segment 7 Vegetation Species List - 2015

Scientific Name	Common Name	Wetland Indicator Status
Abies lasiocarpa	Subalpine Fir	FACU
Acer glabrum	Rocky Mountain Maple	FACU
Achillea millefolium	Common Yarrow	FACU
Agrostis stolonifera	Spreading Bent	FAC
Algae, green	Algae, green	NL
Alnus incana	Speckled Alder	FACW
Alopecurus arundinaceus	Creeping Meadow-Foxtail	FAC
Amelanchier alnifolia	Saskatoon Service-Berry	FACU
Bare Ground	Bare Ground	NL
Beckmannia syzigachne	American Slough Grass	OBL
Bromus inermis	Smooth Brome	FAC
Bromus japonicus	Japanese Brome	NL
Calamagrostis stricta	Slim-Stem Reed Grass	FACW
Carex bebbii	Bebb's Sedge	OBL
Carex simulata	Analogue Sedge	OBL
Carex stipata	Stalk-Grain Sedge	OBL
Centaurea stoebe	Spotted Knapweed	NL
Cerastium fontanum	Common Mouse-Ear Chickweed	FACU
Chamaenerion angustifolium	Narrow-Leaf Fireweed	FACU
Cirsium arvense	Canadian Thistle	FAC
Cirsium vulgare	Bull Thistle	FACU
Cornus alba	Red Osier	FACW
Crataegus douglasii	Black Hawthorn	FAC
Deschampsia caespitosa	Tufted Hair Grass	FACW
Descurainia sophia	Herb Sophia	NL
Elymus repens	Creeping Wild Rye	FAC
Elymus trachycaulus	Slender Wild Rye	FAC
Epilobium ciliatum	Fringed Willowherb	FACW
Equisetum arvense	Field Horsetail	FAC
Equisetum hyemale	Tall Scouring-Rush	FACW
Galium aparine	Sticky-Willy	FACU
Geum macrophyllum	Large-Leaf Avens	FAC
Glyceria grandis	American Manna Grass	OBL
Glyceria striata	Fowl Manna Grass	OBL
Heracleum lanatum	Cow-Parsnip	NL
Hordeum jubatum	Fox-Tail Barley	FAC
Juncus bufonius	Toad Rush	FACW
Juncus ensifolius	Dagger-Leaf Rush	FACW
Juncus nodosus	Knotted Rush	OBL
Juncus tenuis	Lesser Poverty Rush	FAC
Lactuca serriola	Prickly Lettuce	FACU
Lathyrus sylvestris	Flat Pea	NL
Leucanthemum vulgare	Ox-Eye Daisy	FACU
Berberis repens	Creeping Oregon-Grape	NL
Medicago lupulina	Black Medick	FACU
Melilotus officinalis	Yellow Sweet-Clover	FACU
Mentha arvensis	American Wild Mint	FACW
Mimulus guttatus	Seep Monkey-Flower	OBL
Phalaris arundinacea	Reed Canary Grass	FACW
Philadelphus lewisii	Lewis' Mock Orange	NL
Phleum pratense	Common Timothy	FAC
Plantago major	Great Plantain	FAC
Plantago patagonica	Woolly Plaintain	NL
Poa palustris	Fowl Blue Grass	FAC
Poa pratensis	Kentucky Blue Grass	FAC
Populus angustifolia	Narrow-Leaf Cottonwood	FACW
Potentilla norvegica	Norwegian Cinquefoil	FAC
Prunus virginiana	Choke Cherry	FACU
Pseudotsuga menziesii	Douglas-Fir	FACU
Ranunculus aquatilis	White Water-Crowfoot	OBL
Rosa woodsii	Woods' Rose	FACU
Rubus idaeus	Common Red Raspberry	FACU
Rubus parviflorus	Western Thimble-Berry	FACU
Rumex crispus	Curly Dock	FAC
Salix bebbiana	Gray Willow	FACW
Salix sitchensis	Sitka Willow	FACW

Channel Segment 7 Vegetation Species List - 2015 (CONT.)

Sambucus racemosa	Red Elder	FACU
Scirpus microcarpus	Red-Tinge Bulrush	OBL
Solidago canadensis	Canadian Goldenrod	FACU
Spirea betulifolia	Shiny-Leaf Meadowsweet	FACU
Symphoricarpos albus	Common Snowberry	FACU
Symphyotrichum campestre	Western Meadow Aster	NL
Symphyotrichum foliaceum	Alpine Leafy-Head American-Aster	FACU
Tanacetum vulgare	Common Tansy	FACU
Taraxacum officinale	Common Dandelion	FACU
Thalictrum occidentalis	Western Meadow-Rue	FACU
Thuja plicata	Western Arborvitae	FAC
Trifolium pratense	Red Clover	FACU
Trifolium repens	White Clover	FAC
Urtica dioica	Stinging Nettle	FAC
Verbascum thapsus	Great Mullein	FACU
Verbena stricta	Hoary Verbena	NL
Veronica americana	American-Brooklime	OBL
Viola sp.	Violet	NL

Appendix D

Stream Bank Vegetation Species Lists

MDT Stream Mitigation Monitoring
Swamp Creek
Lincoln County, Montana

Segment 1, Reach 1 Streambank Vegetation

Scientific Name	Common Name	Wetland Indicator Status	Streambank Cover Class
Alnus incana	Speckled Alder	FACW	1
Carex pellita	Woolly Sedge	OBL	1
Carex utriculata	Northwest Territory Sedge	OBL	1
Glyceria grandis	American Manna Grass	OBL	2
Juncus effusus	Lamp Rush	FACW	1
Juncus ensifolius	Dagger-Leaf Rush	FACW	1
Populus angustifolia	Narrow-Leaf Cottonwood	FACW	2
Salix bebbiana	Gray Willow	FACW	0
Salix sitchensis	Sitka Willow	FACW	0
Scirpus microcarpus	Red-Tinge Bulrush	OBL	2
Carex sp.	Sedge	NL	1
Elymus repens	Creeping Wild Rye	FAC	2
Equisetum arvense	Field Horsetail	FAC	3
Juncus nodosus	Knotted Rush	OBL	1
*Phalaris arundinacea**	Reed Canary Grass	FACW	4
Salix sp.	Willow	NL	0
Agrostis stolonifera	Spreading Bent	FAC	3
Beckmannia syzigachne	American Slough Grass	OBL	0
Bromus inermis	Smooth Brome	FAC	1
Carex bebbii	Bebb's Sedge	OBL	1
Carex stipata	Stalk-Grain Sedge	OBL	1
Cirsium arvense	Canadian Thistle	FAC	0
Epilobium ciliatum	Fringed Willowherb	FACW	2
Juncus tenuis	Lesser Poverty Rush	FAC	1
Melilotus officinalis	Yellow Sweet-Clover	FACU	3
Mentha arvensis	American Wild Mint	FACW	1
Mimulus guttatus	Seep Monkey-Flower	OBL	1
Nasturtium officinale	Watercress	OBL	2
Phleum pratense	Common Timothy	FAC	0
Plantago major	Great Plantain	FAC	0
Ranunculus aquatilis	White Water-Crowfoot	OBL	0
Rumex salicifolius	Willow Dock	FACW	0
Symphyotrichum campestre	Western Meadow Aster	NL	0
Symphyotrichum foliaceum	Alpine Leafy-Head American-Aster	FACU	0
Trifolium pratense	Red Clover	FACU	2
Trifolium repens	White Clover	FAC	1
Veronica americana	American-Brooklime	OBL	1
Bare Ground	Bare Ground	NL	2
Lactuca serriola	Prickly Lettuce	FACU	0
Medicago lupulina	Black Medick	FACU	1
Myosotis scorpioides	True Forget-Me-Not	FACW	1
Verbascum thapsus	Great Mullein	FACU	1

***Denotes dominant vegetation observed along stream bank**

Segment 2, Reach 2 Streambank Vegetation

Scientific Name	Common Name	Wetland Indicator Status	Streambank Cover Class
*Agrostis stolonifera**	Spreading Bent	FAC	3
*Alnus incana**	Speckled Alder	FACW	3
Alopecurus arundinaceus	Creeping Meadow-Foxtail	FAC	0
Bare Ground	Bare Ground	NL	2
Bromus inermis	Smooth Brome	FAC	1
Carex pellita	Woolly Sedge	OBL	0
Carex simulata	Analogue Sedge	OBL	0
Carex stipata	Stalk-Grain Sedge	OBL	0
Carex vesicaria	Lesser Bladder Sedge	OBL	0
Chamaenerion angustifolium	Narrow-Leaf Fireweed	FACU	0
Cirsium arvense	Canadian Thistle	FAC	1
Cornus alba	Red Osier	FACW	0
Dactylis glomerata	Orchard Grass	FACU	0
Deschampsia caespitosa	Tufted Hair Grass	FACW	2
Elymus repens	Creeping Wild Rye	FAC	2
Epilobium ciliatum	Fringed Willowherb	FACW	2
*Equisetum arvense**	Field Horsetail	FAC	3
Equisetum hyemale	Tall Scouring-Rush	FACW	0
Glyceria grandis	American Manna Grass	OBL	1
Juncus balticus	Baltic Rush	FACW	0
Juncus effusus	Lamp Rush	FACW	0
Juncus ensifolius	Dagger-Leaf Rush	FACW	1
Juncus nodosus	Knotted Rush	OBL	1
Juncus tenuis	Lesser Poverty Rush	FAC	1
Leucanthemum vulgare	Ox-Eye Daisy	FACU	0
Medicago lupulina	Black Medick	FACU	0
Melilotus officinalis	Yellow Sweet-Clover	FACU	1
Mentha arvensis	American Wild Mint	FACW	1
Mimulus guttatus	Seep Monkey-Flower	OBL	2
Myosotis scorpioides	True Forget-Me-Not	FACW	1
Nasturtium officinale	Watercress	OBL	2
Persicaria amphibia	Water Smartweed	OBL	0
Phalaris arundinacea	Reed Canary Grass	FACW	2
Phleum pratense	Common Timothy	FAC	0
Plantago major	Great Plantain	FAC	0
Poa palustris	Fowl Blue Grass	FAC	1
Populus angustifolia	Narrow-Leaf Cottonwood	FACW	1
Ranunculus aquatilis	White Water-Crowfoot	OBL	1
Rumex crispus	Curly Dock	FAC	0
Rumex salicifolius	Willow Dock	FACW	0
Salix bebbiana	Gray Willow	FACW	0
Solanum dulcamara	Climbing Nightshade	FAC	0
Sonchus arvensis	Field Sow-Thistle	FACU	0
Taraxacum officinale	Common Dandelion	FACU	0
Tragopogon dubius	Meadow Goat's-Beard	NL	0
Trifolium repens	White Clover	FAC	1
Verbascum thapsus	Great Mullein	FACU	1
Veronica americana	American-Brooklime	OBL	1

***Denotes dominant vegetation observed along stream bank**

Segment 3, Reach 3.1a Streambank Vegetation

Scientific Name	Common Name	Wetland Indicator Status	Streambank Cover Class
Agrostis stolonifera	Spreading Bent	FAC	2
Algae, green	Algae, green	NL	0
Alnus incana	Speckled Alder	FACW	2
Alopecurus arundinaceus	Creeping Meadow-Foxtail	FAC	0
Beckmannia syzigachne	American Slough Grass	OBL	0
Carex simulata	Analogue Sedge	OBL	0
Carex stipata	Stalk-Grain Sedge	OBL	1
Carex vesicaria	Lesser Bladder Sedge	OBL	0
Cerastium fontanum	Common Mouse-Ear Chickweed	FACU	0
Chamaenerion angustifolium	Narrow-Leaf Fireweed	FACU	0
Cicuta douglasii	Western Water-Hemlock	OBL	0
Cirsium arvense	Canadian Thistle	FAC	2
Deschampsia caespitosa	Tufted Hair Grass	FACW	3
Elymus repens	Creeping Wild Rye	FAC	0
Epilobium ciliatum	Fringed Willowherb	FACW	1
Equisetum arvense	Field Horsetail	FAC	0
Equisetum hyemale	Tall Scouring-Rush	FACW	0
Glyceria grandis	American Manna Grass	OBL	3
Hordeum jubatum	Fox-Tail Barley	FAC	0
Juncus ensifolius	Dagger-Leaf Rush	FACW	0
Juncus nodosus	Knotted Rush	OBL	0
Juncus tenuis	Lesser Poverty Rush	FAC	0
Lathyrus sylvestris	Flat Pea	NL	0
Leucanthemum vulgare	Ox-Eye Daisy	FACU	0
Medicago lupulina	Black Medick	FACU	0
Medicago sativa	Alfalfa	UPL	1
Melilotus officinalis	Yellow Sweet-Clover	FACU	1
Mentha arvensis	American Wild Mint	FACW	1
Mimulus guttatus	Seep Monkey-Flower	OBL	2
Myosotis scorpioides	True Forget-Me-Not	FACW	1
Persicaria amphibia	Water Smartweed	OBL	0
*Phalaris arundinacea**	Reed Canary Grass	FACW	4
Phleum pratense	Common Timothy	FAC	0
Plantago major	Great Plantain	FAC	0
Poa palustris	Fowl Blue Grass	FAC	1
Populus angustifolia	Narrow-Leaf Cottonwood	FACW	1
Ranunculus aquatilis	White Water-Crowfoot	OBL	0
Rumex crispus	Curly Dock	FAC	0
Rumex salicifolius	Willow Dock	FACW	0
Scirpus microcarpus	Red-Tinge Bulrush	OBL	1
Symphyotrichum foliaceum	Alpine Leafy-Head American-Aster	FACU	0
Tanacetum vulgare	Common Tansy	FACU	1
Trifolium pratense	Red Clover	FACU	0
Trifolium repens	White Clover	FAC	1
Urtica dioica	Stinging Nettle	FAC	0
Verbascum thapsus	Great Mullein	FACU	0
Veronica americana	American-Brooklime	OBL	1

***Denotes dominant vegetation observed along stream bank**

Segment 3, Reach 3.1b Streambank Vegetation

Scientific Name	Common Name	Wetland Indicator Status	Streambank Cover Class
*Agrostis stolonifera**	Spreading Bent	FAC	3
Alnus incana	Speckled Alder	FACW	1
Bare Ground*	Bare Ground	NL	3
Beckmannia syzigachne	American Slough Grass	OBL	0
Carex bebbii	Bebb's Sedge	OBL	1
Carex simulata	Analogue Sedge	OBL	1
Carex stipata	Stalk-Grain Sedge	OBL	1
Carex utriculata	Northwest Territory Sedge	OBL	2
Centaurea stoebe	Spotted Knapweed	NL	0
Cicuta douglasii	Western Water-Hemlock	OBL	0
Cirsium arvense	Canadian Thistle	FAC	1
Cirsium vulgare	Bull Thistle	FACU	0
Cornus alba	Red Osier	FACW	0
*Deschampsia caespitosa**	Tufted Hair Grass	FACW	3
Elymus repens	Creeping Wild Rye	FAC	0
Epilobium ciliatum	Fringed Willowherb	FACW	1
Equisetum arvense	Field Horsetail	FAC	1
Equisetum hyemale	Tall Scouring-Rush	FACW	0
Geum macrophyllum	Large-Leaf Avens	FAC	0
Glyceria grandis	American Manna Grass	OBL	2
Impatiens ecalcarata	Spurless Touch-Me-Not	FACW	0
Juncus ensifolius	Dagger-Leaf Rush	FACW	0
Juncus nodosus	Knotted Rush	OBL	0
Lathyrus sylvestris	Flat Pea	NL	0
Leucanthemum vulgare	Ox-Eye Daisy	FACU	1
Medicago lupulina	Black Medick	FACU	0
Medicago sativa	Alfalfa	UPL	0
Melilotus officinalis	Yellow Sweet-Clover	FACU	0
Mentha arvensis	American Wild Mint	FACW	1
Mimulus guttatus	Seep Monkey-Flower	OBL	2
Myosotis scorpioides	True Forget-Me-Not	FACW	1
Nasturtium officinale	Watercress	OBL	0
Phalaris arundinacea	Reed Canary Grass	FACW	1
Phleum pratense	Common Timothy	FAC	0
Plantago major	Great Plantain	FAC	0
Poa palustris	Fowl Blue Grass	FAC	0
Populus angustifolia	Narrow-Leaf Cottonwood	FACW	0
Ranunculus aquatilis	White Water-Crowfoot	OBL	0
Rubus parviflorus	Western Thimble-Berry	FACU	0
Rumex crispus	Curly Dock	FAC	0
Rumex salicifolius	Willow Dock	FACW	0
Salix sitchensis	Sitka Willow	FACW	0
Solidago canadensis	Canadian Goldenrod	FACU	0
Symphyotrichum foliaceum	Alpine Leafy-Head American-Aster	FACU	0
Tanacetum vulgare	Common Tansy	FACU	1
Verbascum thapsus	Great Mullein	FACU	1
Veronica americana	American-Brooklime	OBL	1

***Denotes dominant vegetation observed along stream bank**

Segment 3, Reach 3.2 Streambank Vegetation

Scientific Name	Common Name	Wetland Indicator Status	Streambank Cover Class
Alnus incana	Speckled Alder	FACW	1
Bare Ground*	Bare Ground	NL	4
Beckmannia syzigachne	American Slough Grass	OBL	0
Bidens cernua	Nodding Burr-Marigold	OBL	0
Chenopodium rubrum	Red Goosefoot	FACW	0
Cicuta douglasii	Western Water-Hemlock	OBL	0
Cornus alba	Red Osier	FACW	0
Elymus repens	Creeping Wild Rye	FAC	1
Epilobium ciliatum	Fringed Willowherb	FACW	3
Glyceria grandis	American Manna Grass	OBL	1
Impatiens ecalcarata	Spurless Touch-Me-Not	FACW	0
Juncus bufonius	Toad Rush	FACW	0
Juncus ensifolius	Dagger-Leaf Rush	FACW	0
Juncus nodosus	Knotted Rush	OBL	0
Lactuca serriola	Prickly Lettuce	FACU	0
Medicago lupulina	Black Medick	FACU	0
Mimulus guttatus	Seep Monkey-Flower	OBL	3
Myosotis scorpioides	True Forget-Me-Not	FACW	0
Persicaria amphibia	Water Smartweed	OBL	0
Phalaris arundinacea	Reed Canary Grass	FACW	1
Populus angustifolia	Narrow-Leaf Cottonwood	FACW	0
Ranunculus aquatilis	White Water-Crowfoot	OBL	0
Trifolium pratense	Red Clover	FACU	1
Trifolium repens	White Clover	FAC	1
Verbascum thapsus	Great Mullein	FACU	0
Veronica americana	American-Brooklime	OBL	1

***Denotes dominant vegetation observed along stream bank**

Segment 3, Reach 3.3 Streambank Vegetation

Scientific Name	Common Name	Wetland Indicator Status	Streambank Cover Class
Agrostis stolonifera	Spreading Bent	FAC	2
Algae, green	Algae, green	NL	1
Beckmannia syzigachne	American Slough Grass	OBL	1
Carex bebbii	Bebb's Sedge	OBL	1
Carex simulata	Analogue Sedge	OBL	1
Carex stipata	Stalk-Grain Sedge	OBL	1
Carex utriculata	Northwest Territory Sedge	OBL	0
Cicuta douglasii	Western Water-Hemlock	OBL	0
Cirsium arvense	Canadian Thistle	FAC	0
Cirsium vulgare	Bull Thistle	FACU	0
Deschampsia caespitosa	Tufted Hair Grass	FACW	3
Elymus canadensis	Nodding Wild Rye	FAC	0
Epilobium ciliatum	Fringed Willowherb	FACW	0
Equisetum arvense	Field Horsetail	FAC	2
Equisetum hyemale	Tall Scouring-Rush	FACW	0
Festuca idahoensis	Bluebunch Fescue	FACU	0
Glyceria grandis	American Manna Grass	OBL	3
Impatiens ecalcarata	Spurless Touch-Me-Not	FACW	0
Juncus bufonius	Toad Rush	FACW	0
Juncus ensifolius	Dagger-Leaf Rush	FACW	1
Juncus nodosus	Knotted Rush	OBL	1
Juncus tenuis	Lesser Poverty Rush	FAC	1
Melilotus officinalis	Yellow Sweet-Clover	FACU	0
Mentha arvensis	American Wild Mint	FACW	1
Mimulus guttatus	Seep Monkey-Flower	OBL	0
Myosotis scorpioides	True Forget-Me-Not	FACW	1
*Phalaris arundinacea**	Reed Canary Grass	FACW	4
Populus angustifolia	Narrow-Leaf Cottonwood	FACW	0
Populus balsamifera	Balsam Poplar	FAC	0
Ranunculus aquatilis	White Water-Crowfoot	OBL	1
Rumex salicifolius	Willow Dock	FACW	0
Salix lasiandra	Pacific Willow	FACW	0
Scirpus microcarpus	Red-Tinge Bulrush	OBL	1
Solanum dulcamara	Climbing Nightshade	FAC	0
Symphyotrichum foliaceum	Alpine Leafy-Head American-Aster	FACU	0
Tanacetum vulgare	Common Tansy	FACU	0
Trifolium pratense	Red Clover	FACU	0
Trifolium repens	White Clover	FAC	1
Verbascum thapsus	Great Mullein	FACU	0
Veronica americana	American-Brooklime	OBL	1

***Denotes dominant vegetation observed along stream bank**

Segment 3, Reach 3.4 Streambank Vegetation

Scientific Name	Common Name	Wetland Indicator Status	Streambank Cover Class
*Agrostis stolonifera**	Spreading Bent	FAC	4
Algae, brown	Algae, brown	NL	0
Algae, green	Algae, green	NL	0
Alnus incana	Speckled Alder	FACW	1
Beckmannia syzigachne	American Slough Grass	OBL	1
Bidens cernua	Nodding Burr-Marigold	OBL	0
Bromus japonicus	Japanese Brome	NL	0
Carex simulata	Analogue Sedge	OBL	1
Carex stipata	Stalk-Grain Sedge	OBL	1
Cerastium fontanum	Common Mouse-Ear Chickweed	FACU	0
Cicuta douglasii	Western Water-Hemlock	OBL	0
Cirsium vulgare	Bull Thistle	FACU	1
Deschampsia caespitosa	Tufted Hair Grass	FACW	2
Deschampsia elongata	Slender Hair Grass	FACW	0
Epilobium ciliatum	Fringed Willowherb	FACW	1
Equisetum arvense	Field Horsetail	FAC	1
Glyceria grandis	American Manna Grass	OBL	3
Juncus ensifolius	Dagger-Leaf Rush	FACW	2
Juncus nodosus	Knotted Rush	OBL	1
Juncus tenuis	Lesser Poverty Rush	FAC	1
Lactuca serriola	Prickly Lettuce	FACU	0
Leucanthemum vulgare	Ox-Eye Daisy	FACU	2
Melilotus officinalis	Yellow Sweet-Clover	FACU	1
Mentha arvensis	American Wild Mint	FACW	1
Mimulus guttatus	Seep Monkey-Flower	OBL	2
Myosotis scorpioides	True Forget-Me-Not	FACW	1
Persicaria amphibia	Water Smartweed	OBL	0
*Phalaris arundinacea**	Reed Canary Grass	FACW	4
Phleum pratense	Common Timothy	FAC	1
Plantago major	Great Plantain	FAC	1
Plantago patagonica	Woolly Plaintain	NL	0
Poa palustris	Fowl Blue Grass	FAC	1
Populus angustifolia	Narrow-Leaf Cottonwood	FACW	1
Potentilla norvegica	Norwegian Cinquefoil	FAC	0
Ranunculus aquatilis	White Water-Crowfoot	OBL	0
Rumex crispus	Curly Dock	FAC	0
Salix sitchensis	Sitka Willow	FACW	0
Scirpus microcarpus	Red-Tinge Bulrush	OBL	1
Tanacetum vulgare	Common Tansy	FACU	1
Trifolium pratense	Red Clover	FACU	1
Trifolium repens	White Clover	FAC	1
Typha angustifolia	Narrow-Leaf Cat-Tail	OBL	0
Verbascum thapsus	Great Mullein	FACU	0
Veronica americana	American-Brooklime	OBL	1

***Denotes dominant vegetation observed along stream bank**

Segment 5, Reach 5 Streambank Vegetation

Scientific Name	Common Name	Wetland Indicator Status	Streambank Cover Class
Achillea millefolium	Common Yarrow	FACU	0
Agrostis stolonifera	Spreading Bent	FAC	1
Alnus incana	Speckled Alder	FACW	1
Bare Ground*	Bare Ground	NL	3
Beckmannia syzigachne	American Slough Grass	OBL	0
Boechera stricta	Canadian Rockcress	FACU	0
Bromus tectorum	Cheatgrass	NL	1
Centaurea stoebe	Spotted Knapweed	NL	1
Chamaenerion angustifolium	Narrow-Leaf Fireweed	FACU	0
Cicuta douglasii	Western Water-Hemlock	OBL	0
Cirsium arvense	Canadian Thistle	FAC	0
Cornus alba	Red Osier	FACW	1
Crataegus douglasii	Black Hawthorn	FAC	0
Deschampsia caespitosa	Tufted Hair Grass	FACW	0
Epilobium ciliatum	Fringed Willowherb	FACW	2
Galium aparine	Sticky-Willy	FACU	0
Leucanthemum vulgare	Ox-Eye Daisy	FACU	1
Medicago lupulina	Black Medick	FACU	1
Mentha arvensis	American Wild Mint	FACW	0
Mimulus guttatus	Seep Monkey-Flower	OBL	2
Phalaris arundinacea	Reed Canary Grass	FACW	1
Plantago major	Great Plantain	FAC	0
Poa palustris	Fowl Blue Grass	FAC	1
Poa pratensis	Kentucky Blue Grass	FAC	0
Populus angustifolia	Narrow-Leaf Cottonwood	FACW	0
Potentilla norvegica	Norwegian Cinquefoil	FAC	0
Rumex crispus	Curly Dock	FAC	0
Rumex salicifolius	Willow Dock	FACW	0
Sonchus arvensis	Field Sow-Thistle	FACU	0
Symphoricarpos albus	Common Snowberry	FACU	0
Symphyotrichum campestre	Western Meadow Aster	NL	0
Tanacetum vulgare	Common Tansy	FACU	1
Trifolium pratense	Red Clover	FACU	1
Trifolium repens	White Clover	FAC	1
Verbascum thapsus	Great Mullein	FACU	1
Verbena stricta	Hoary Verbena	NL	0
Veronica americana	American-Brooklime	OBL	1

***Denotes dominant vegetation observed along stream bank**

Segment 7, Reach 7.1 Streambank Vegetation

Scientific Name	Common Name	Wetland Indicator Status	Streambank Cover Class
Agrostis stolonifera	Spreading Bent	FAC	2
Alnus incana	Speckled Alder	FACW	2
Beckmannia syzigachne	American Slough Grass	OBL	2
Bromus japonicus	Japanese Brome	NL	0
Calamagrostis stricta	Slim-Stem Reed Grass	FACW	1
Carex bebbii	Bebb's Sedge	OBL	1
Carex simulata	Analogue Sedge	OBL	1
Carex stipata	Stalk-Grain Sedge	OBL	1
Cirsium arvense	Canadian Thistle	FAC	1
Cornus alba	Red Osier	FACW	0
*Deschampsia caespitosa**	Tufted Hair Grass	FACW	4
Elymus repens	Creeping Wild Rye	FAC	1
Epilobium ciliatum	Fringed Willowherb	FACW	1
Equisetum arvense	Field Horsetail	FAC	1
Galium aparine	Sticky-Willy	FACU	0
Glyceria grandis	American Manna Grass	OBL	3
Glyceria striata	Fowl Manna Grass	OBL	0
Juncus bufonius	Toad Rush	FACW	0
Juncus ensifolius	Dagger-Leaf Rush	FACW	1
Juncus nodosus	Knotted Rush	OBL	1
Juncus tenuis	Lesser Poverty Rush	FAC	1
Medicago lupulina	Black Medick	FACU	0
Melilotus officinalis	Yellow Sweet-Clover	FACU	0
Mentha arvensis	American Wild Mint	FACW	1
Mimulus guttatus	Seep Monkey-Flower	OBL	1
*Phalaris arundinacea**	Reed Canary Grass	FACW	4
Phleum pratense	Common Timothy	FAC	0
Plantago major	Great Plantain	FAC	0
Plantago patagonica	Woolly Plaintain	NL	0
Poa palustris	Fowl Blue Grass	FAC	1
Populus angustifolia	Narrow-Leaf Cottonwood	FACW	1
Potentilla norvegica	Norwegian Cinquefoil	FAC	0
Ranunculus aquatilis	White Water-Crowfoot	OBL	1
Rubus idaeus	Common Red Raspberry	FACU	0
Rumex crispus	Curly Dock	FAC	0
Salix bebbiana	Gray Willow	FACW	1
Scirpus microcarpus	Red-Tinge Bulrush	OBL	1
Symphyotrichum campestre	Western Meadow Aster	NL	0
Symphyotrichum foliaceum	Alpine Leafy-Head American-Aster	FACU	0
Tanacetum vulgare	Common Tansy	FACU	1
Trifolium pratense	Red Clover	FACU	1
Trifolium repens	White Clover	FAC	1
Verbascum thapsus	Great Mullein	FACU	0
Verbena stricta	Hoary Verbena	NL	0
Veronica americana	American-Brooklime	OBL	1

***Denotes dominant vegetation observed along stream bank**

Segment 7, Reach 7.2 Streambank Vegetation

Scientific Name	Common Name	Wetland Indicator Status	Streambank Cover Class
Agrostis stolonifera	Spreading Bent	FAC	1
Algae, green	Algae, green	NL	0
Alnus incana	Speckled Alder	FACW	2
Bare Ground	Bare Ground	NL	1
Beckmannia syzigachne	American Slough Grass	OBL	0
Carex stipata	Stalk-Grain Sedge	OBL	0
Centaurea stoebe	Spotted Knapweed	NL	1
Cerastium fontanum	Common Mouse-Ear Chickweed	FACU	0
Cornus alba	Red Osier	FACW	1
*Deschampsia caespitosa**	Tufted Hair Grass	FACW	3
Elymus trachycaulus	Slender Wild Rye	FAC	1
Epilobium ciliatum	Fringed Willowherb	FACW	1
Equisetum hyemale	Tall Scouring-Rush	FACW	1
Glyceria grandis	American Manna Grass	OBL	2
Hordeum jubatum	Fox-Tail Barley	FAC	0
Juncus ensifolius	Dagger-Leaf Rush	FACW	0
Juncus nodosus	Knotted Rush	OBL	1
Medicago lupulina	Black Medick	FACU	1
Melilotus officinalis	Yellow Sweet-Clover	FACU	0
Mentha arvensis	American Wild Mint	FACW	1
Mimulus guttatus	Seep Monkey-Flower	OBL	0
*Phalaris arundinacea**	Reed Canary Grass	FACW	3
Phleum pratense	Common Timothy	FAC	0
Plantago major	Great Plantain	FAC	0
Poa palustris	Fowl Blue Grass	FAC	0
Populus angustifolia	Narrow-Leaf Cottonwood	FACW	0
Potentilla norvegica	Norwegian Cinquefoil	FAC	0
Ranunculus aquatilis	White Water-Crowfoot	OBL	1
Salix sitchensis	Sitka Willow	FACW	0
Tanacetum vulgare	Common Tansy	FACU	1
Trifolium repens	White Clover	FAC	1
Veronica americana	American-Brooklime	OBL	1

***Denotes dominant vegetation observed along stream bank**

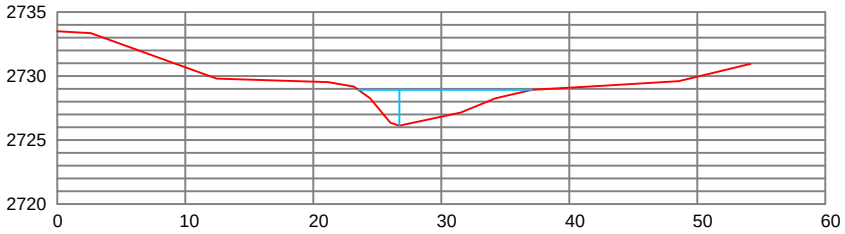
Appendix E

Perpendicular Transect and Longitudinal Profile Plots

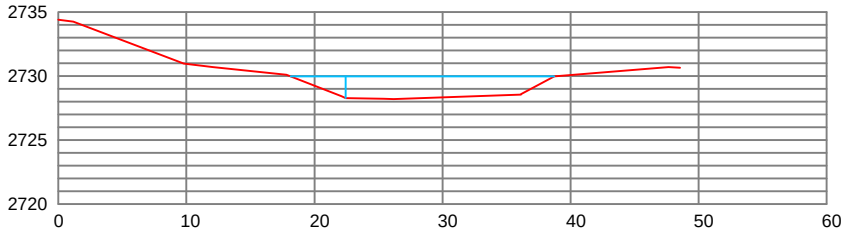
MDT Stream Mitigation Monitoring
Swamp Creek
Lincoln County, Montana

REACH 1

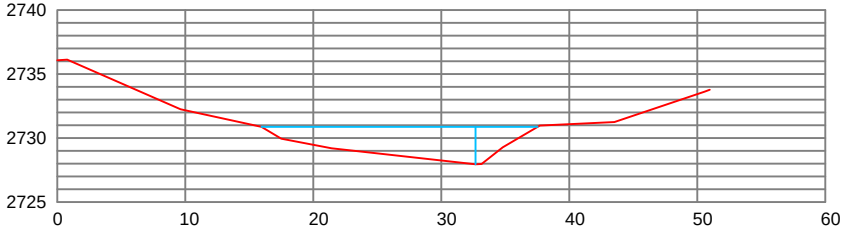
T1 POOL



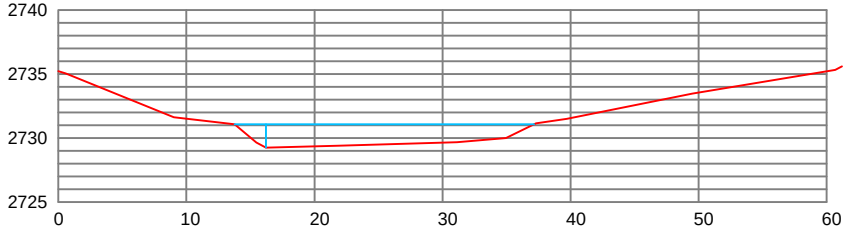
T2 RIFFLE



T3 POOL HEAD

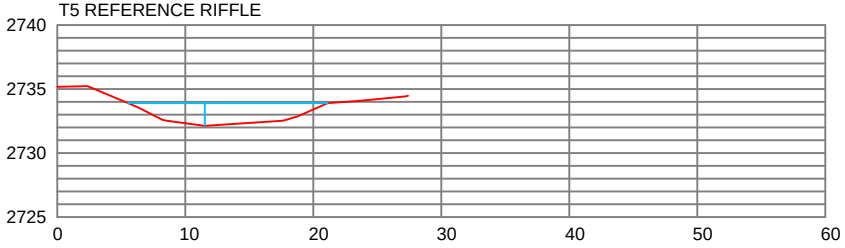


T4 RIFFLE

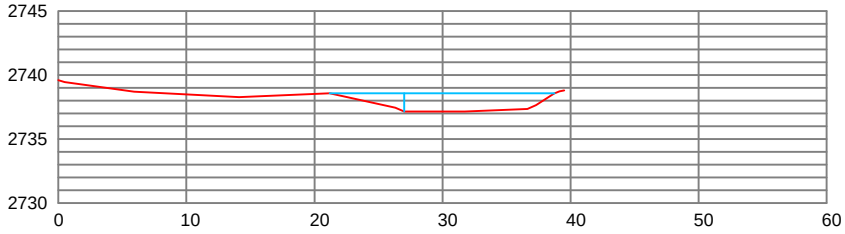


REACTIVATED CHANNEL BETWEEN REACHES 1 AND 2

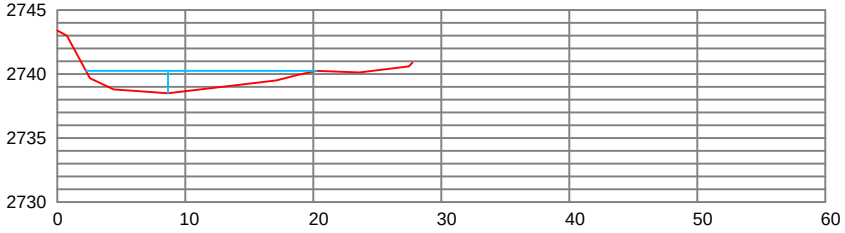
T5 REFERENCE RIFFLE



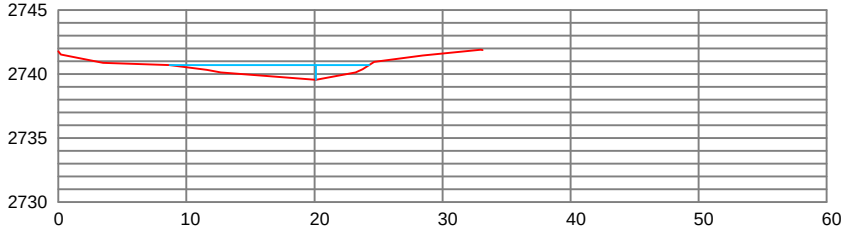
T6 REFERENCE RIFFLE



T7 REFERENCE POOL

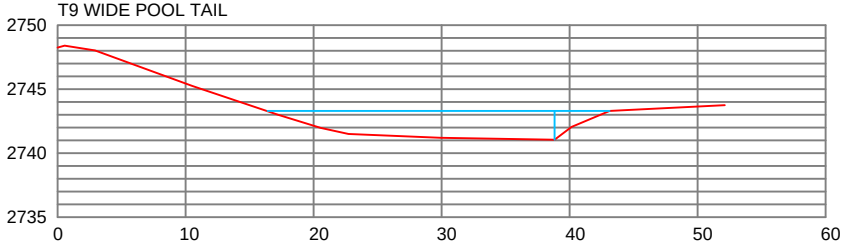


T8 REFERENCE POOL

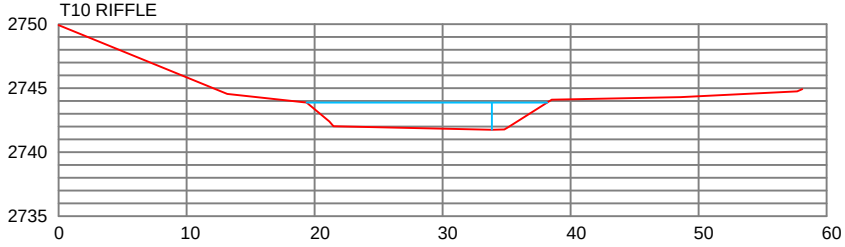


REACH 2

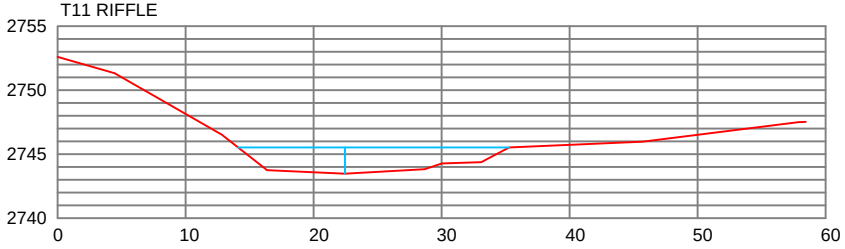
T9 WIDE POOL TAIL



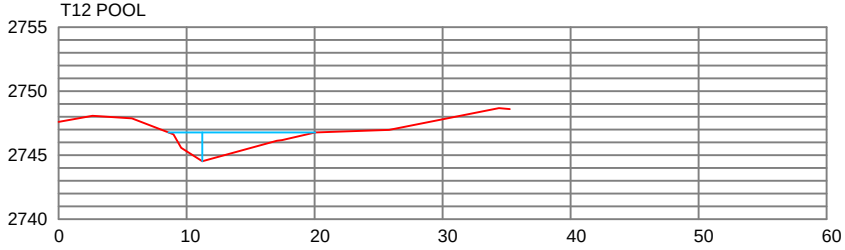
T10 RIFFLE



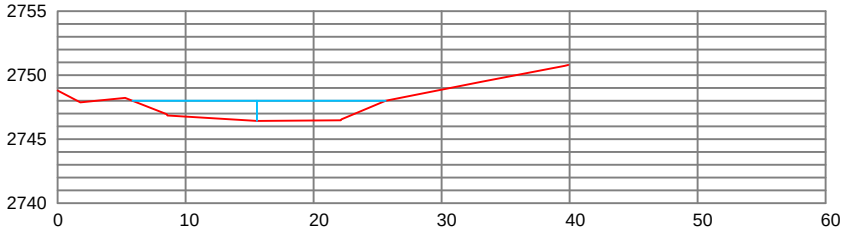
T11 RIFFLE



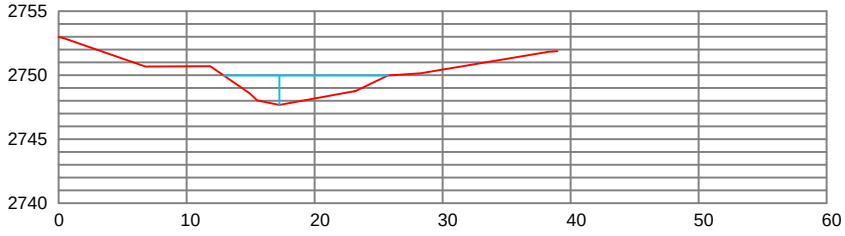
T12 POOL



T13 RIFFLE

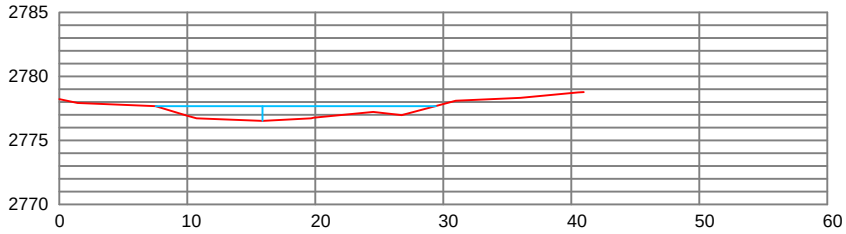


T14 POOL

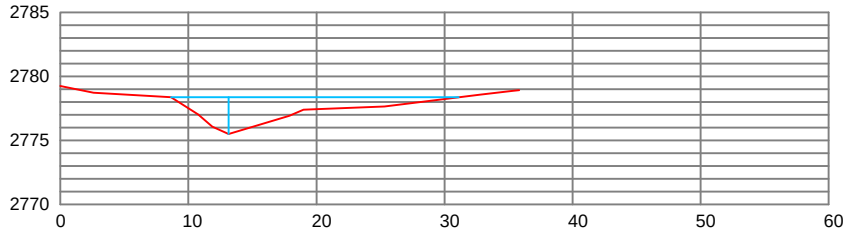


REACH 3.1

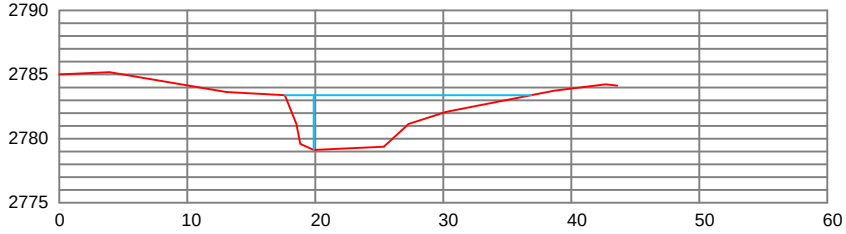
T15 RIFFLE



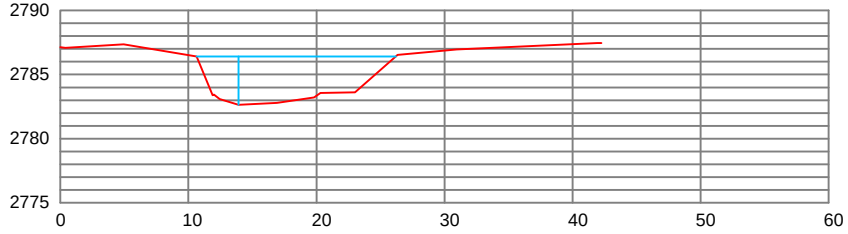
T16 POOL



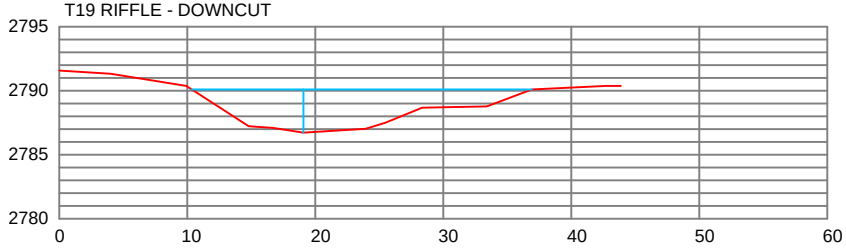
T17 POOL - DOWNCUT



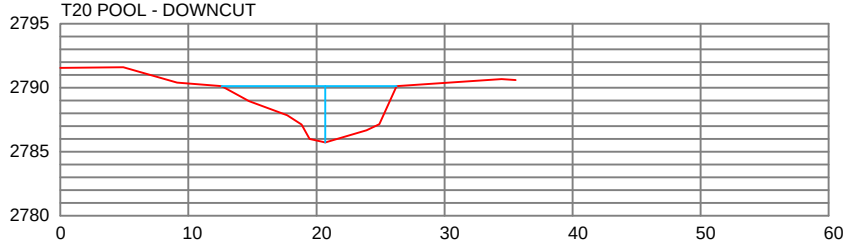
T18 RIFFLE - DOWNCUT



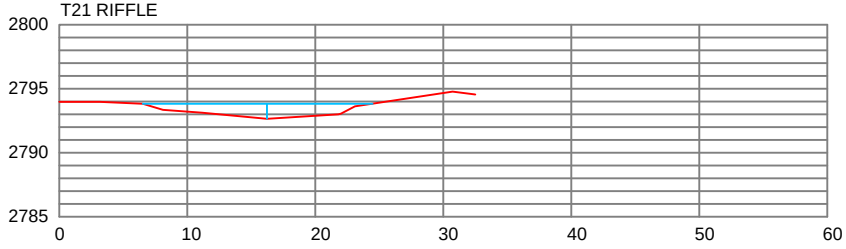
T19 RIFFLE - DOWNCUT



T20 POOL - DOWNCUT

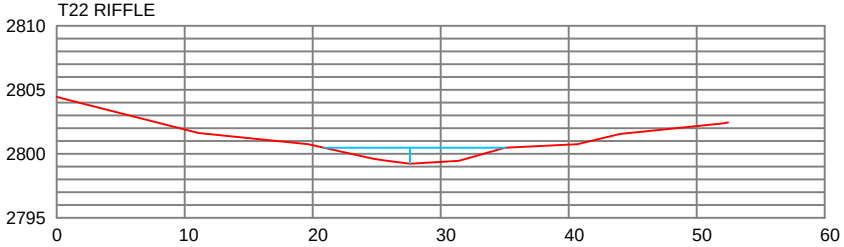


T21 RIFFLE



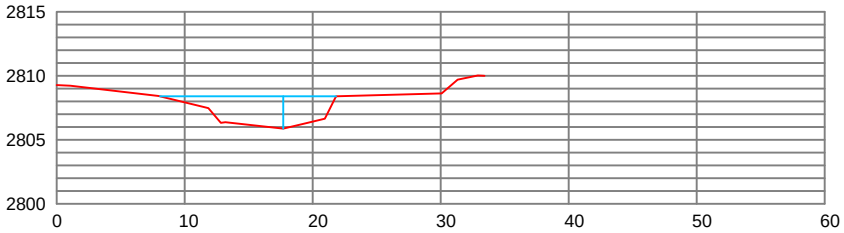
REACH 3.2

T22 RIFFLE

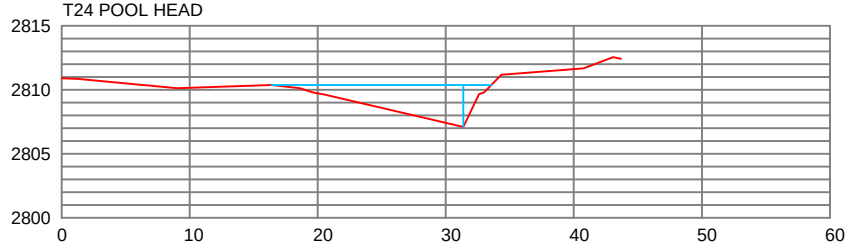


REACH 3.4

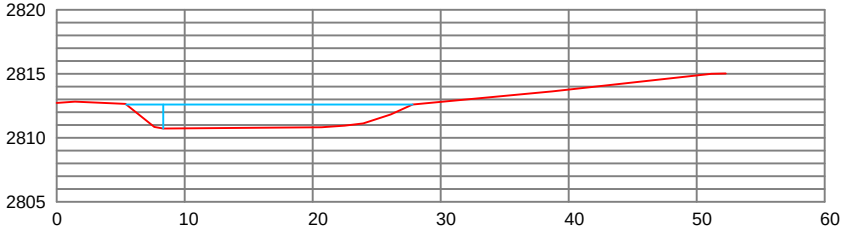
T23 RIFFLE - DOWNCUT



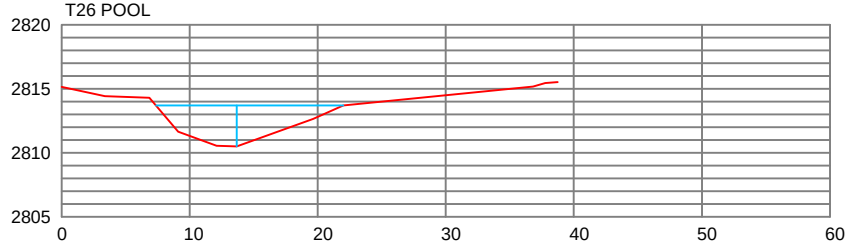
T24 POOL HEAD



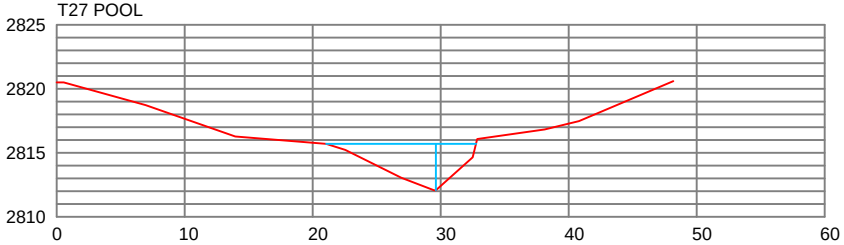
T25 RIFFLE



T26 POOL

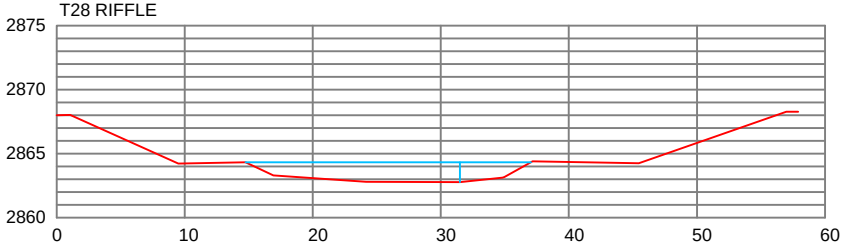


T27 POOL

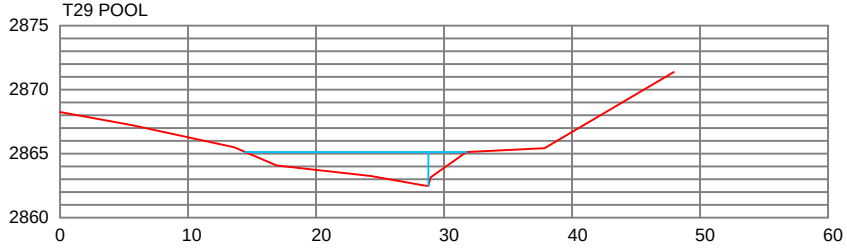


REACH 5

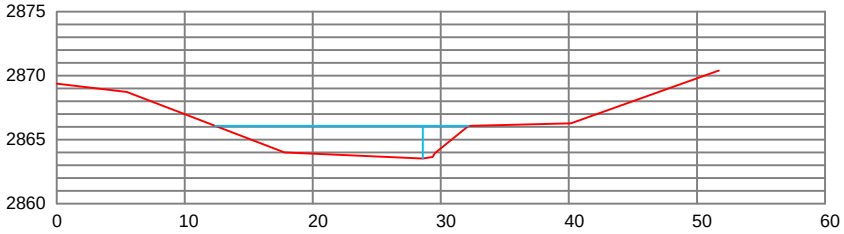
T28 RIFFLE



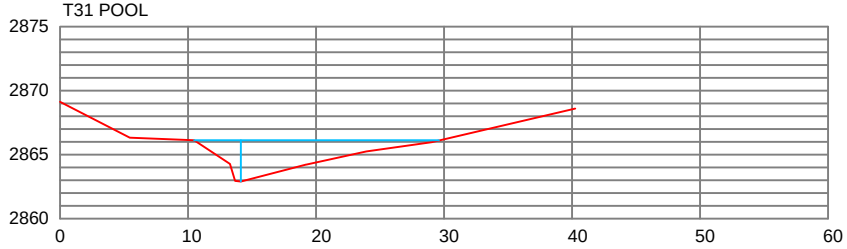
T29 POOL



T30 RIFFLE

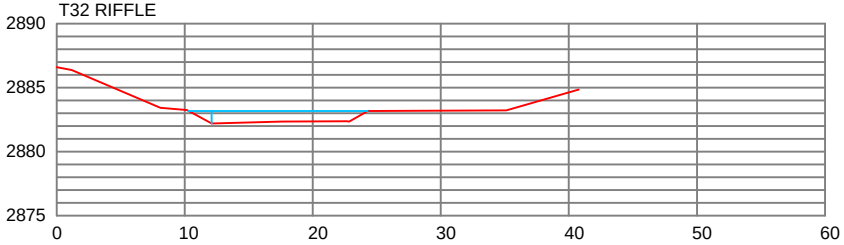


T31 POOL

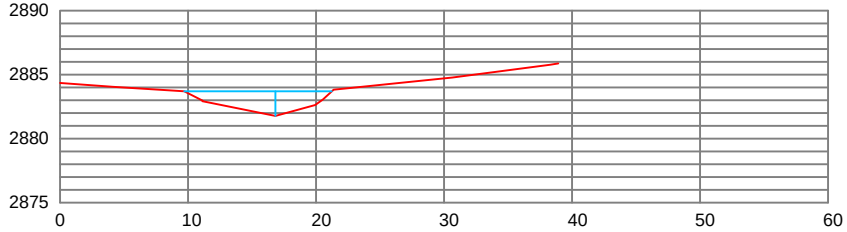


REACH 7.1

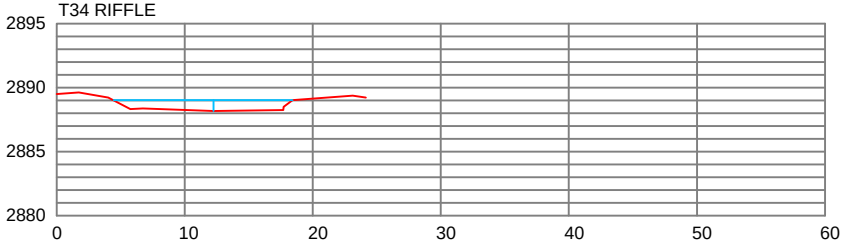
T32 RIFFLE



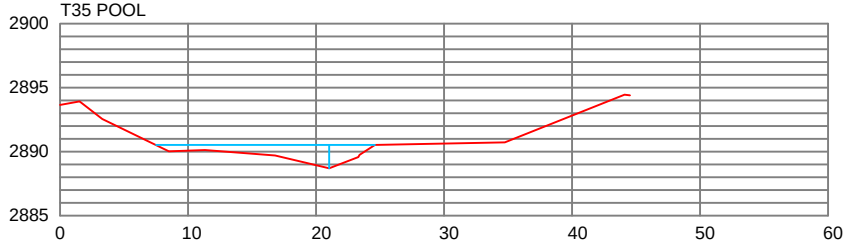
T33 POOL



T34 RIFFLE

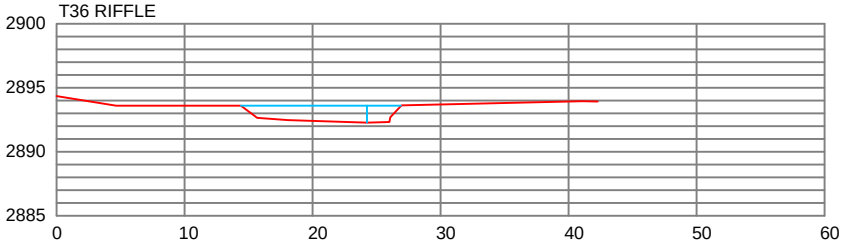


T35 POOL

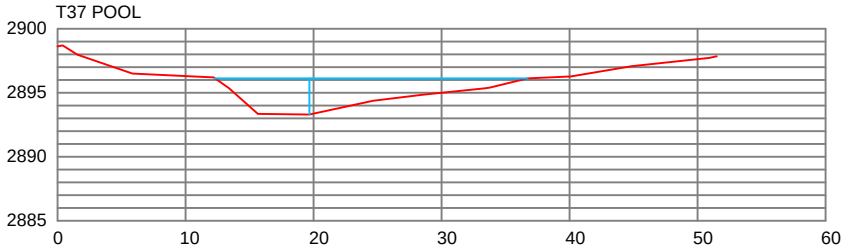


REACH 7.1 (continued)

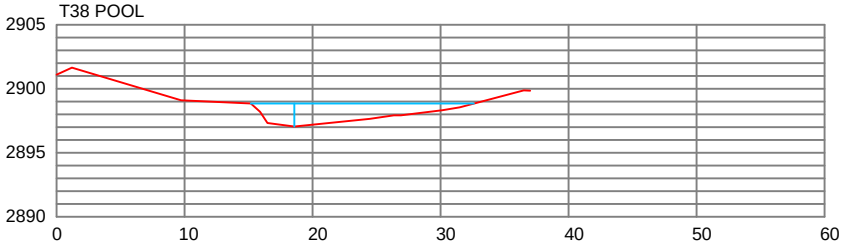
T36 RIFFLE



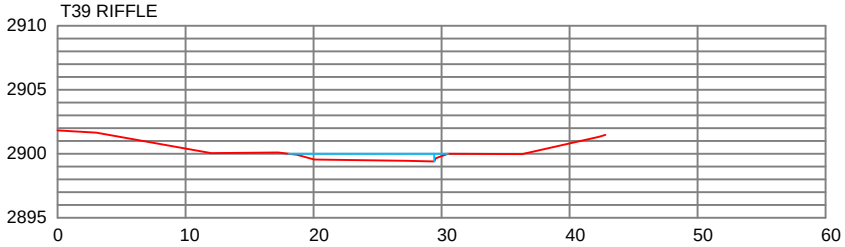
T37 POOL



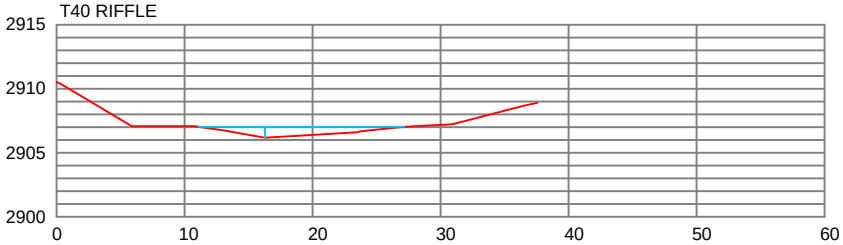
T38 POOL



T39 RIFFLE

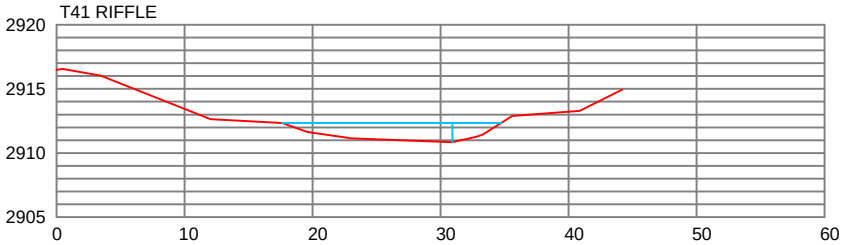


T40 RIFFLE

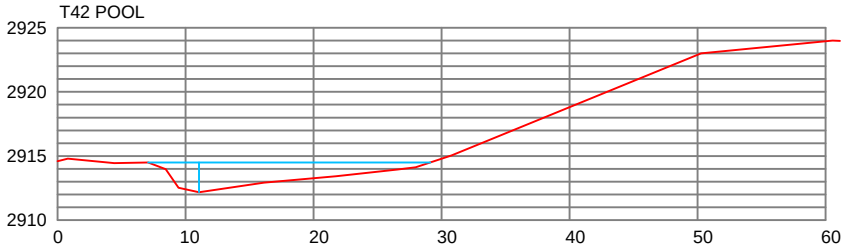


REACH 7.2

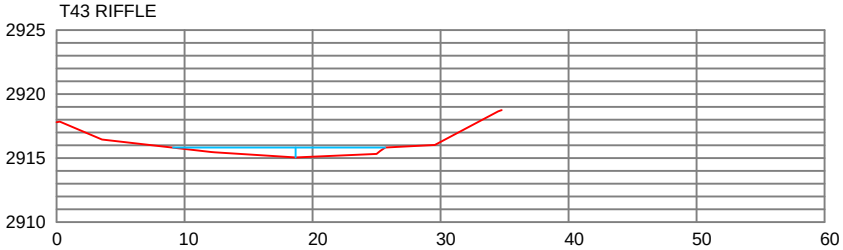
T41 RIFFLE

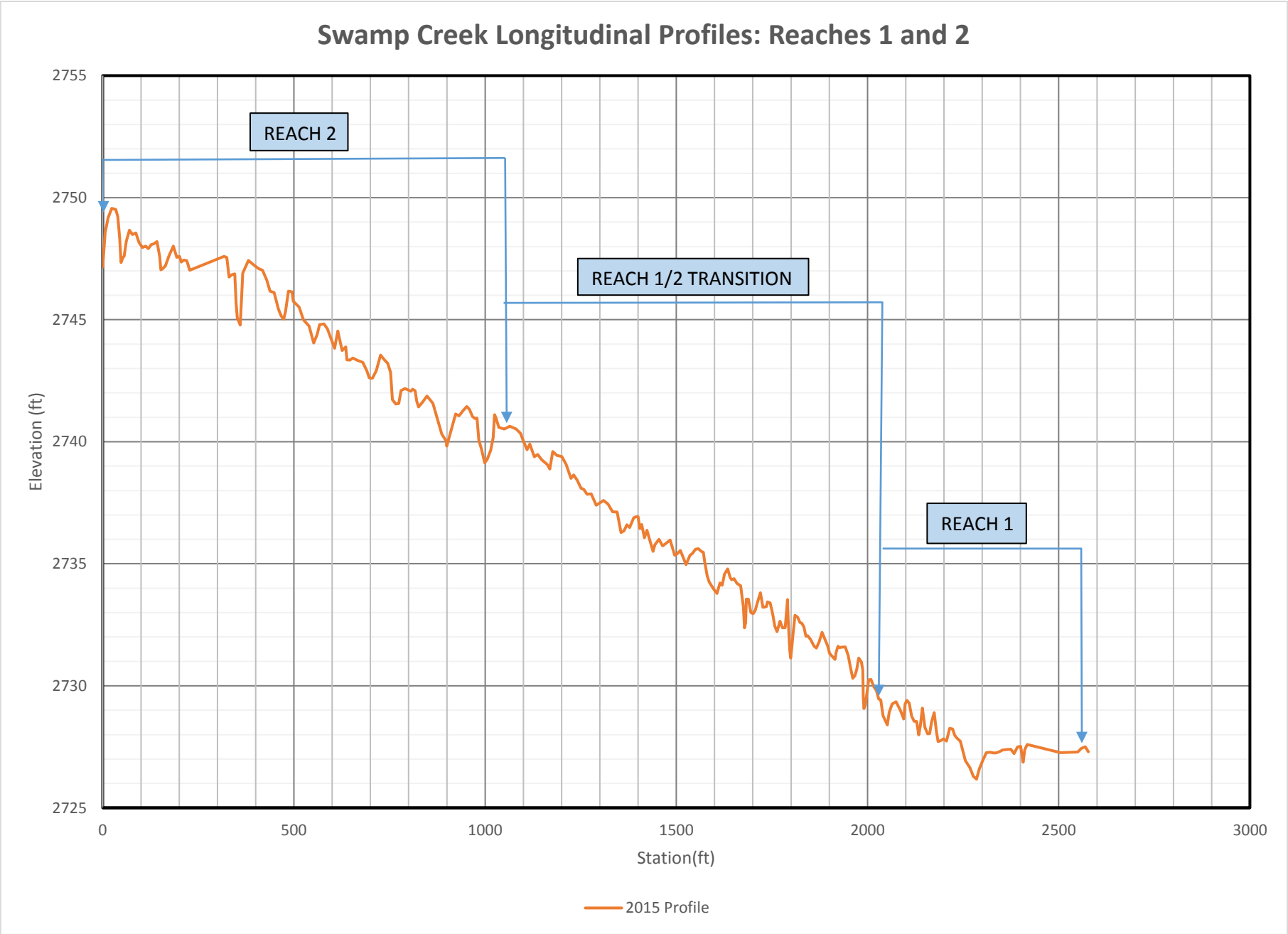


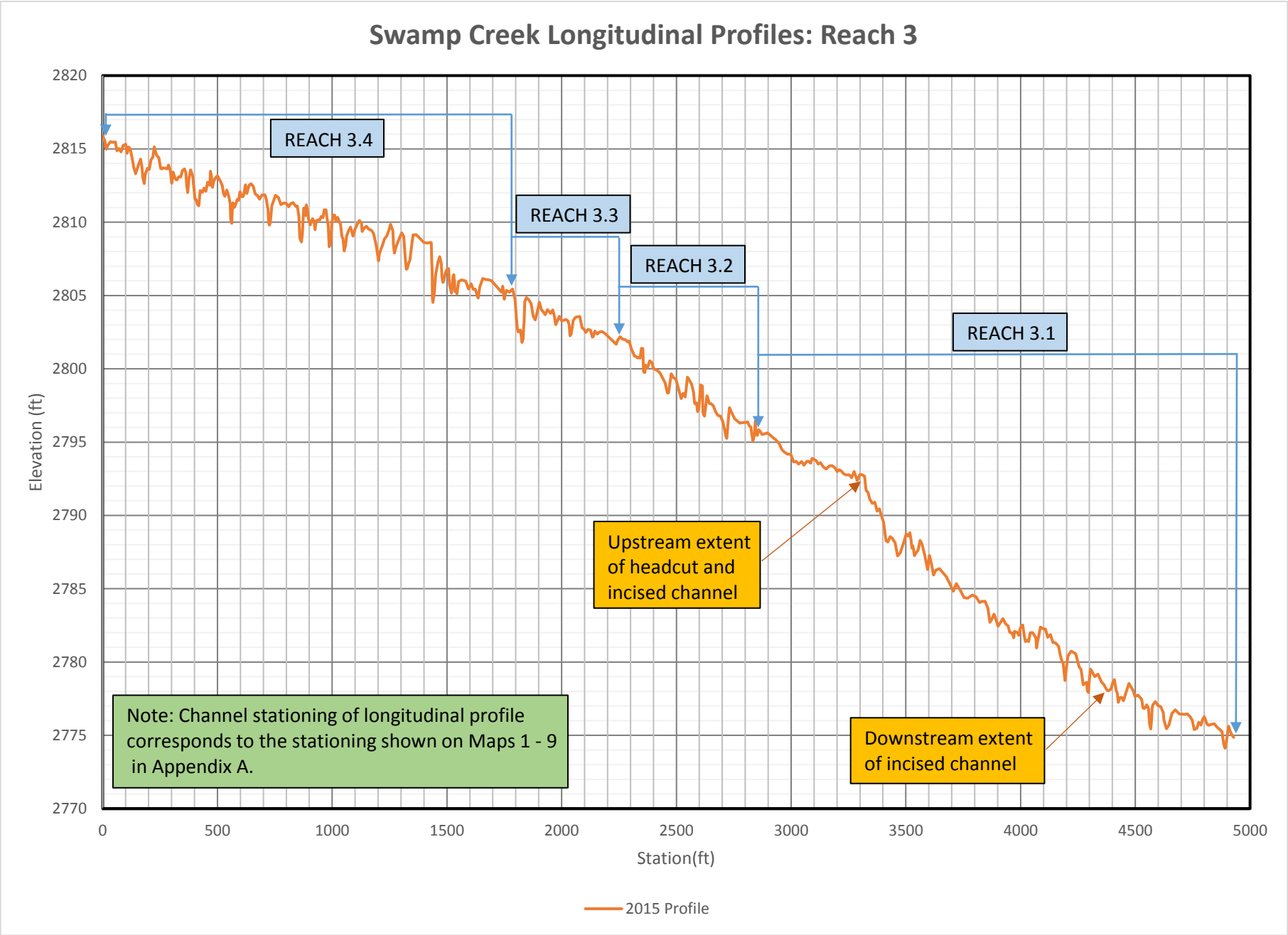
T42 POOL

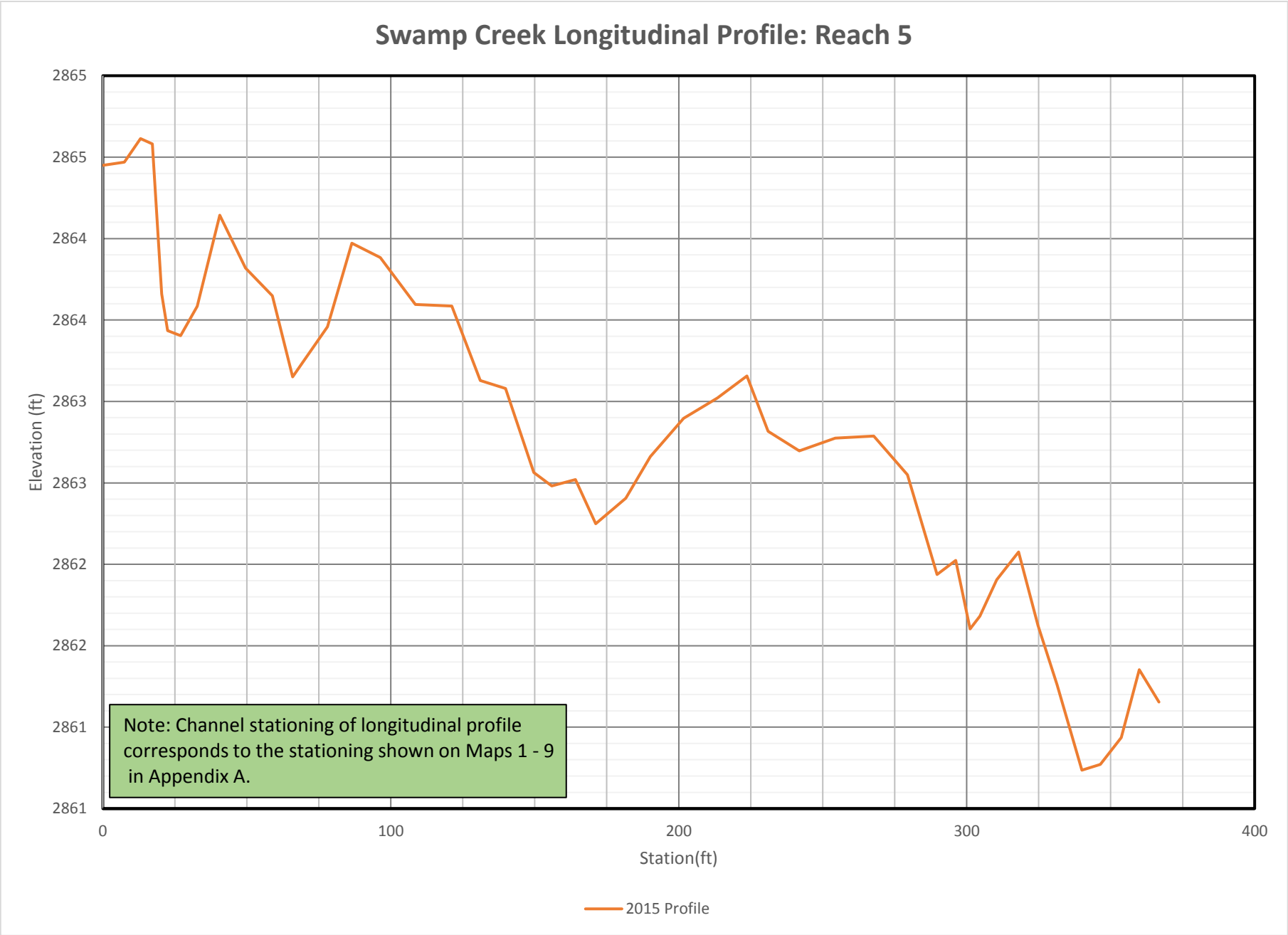


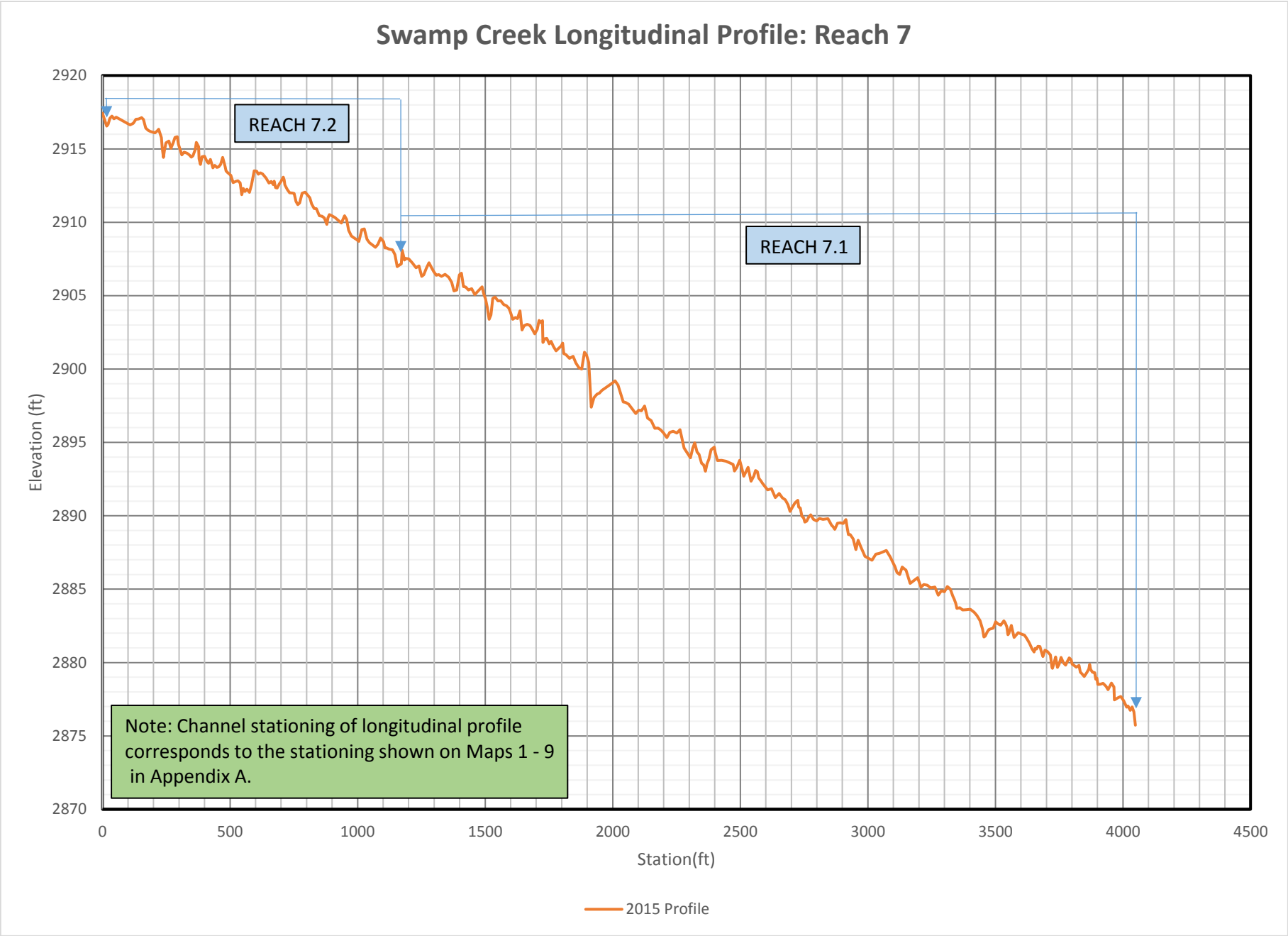
T43 RIFFLE




Swamp Creek Longitudinal Profiles: Reaches 1 and 2
REACH 2
REACH 1/2 TRANSITION
REACH 1
Elevation (ft)
2755
2750
2745
2740
2735
2730
2725
0
500
1000
1500
2000
2500
3000
Station(ft)
2015 Profile


Swamp Creek Longitudinal Profiles: Reach 3
Elevation (ft)
2820
2815
2810
2805
2800
2795
2790
2785
2780
2775
2770
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Station(ft)
REACH 3.4
REACH 3.3
REACH 3.2
REACH 3.1
Upstream extent of headcut and incised channel
Downstream extent of incised channel
Note: Channel stationing of longitudinal profile corresponds to the stationing shown on Maps 1 - 9 in Appendix A.
2015 Profile


Swamp Creek Longitudinal Profile: Reach 5
2865
2865
2864
2864
2863
2863
2862
2862
2861
2861
Elevation (ft)
0
100
200
300
400
Station(ft)
Note: Channel stationing of longitudinal profile corresponds to the stationing shown on Maps 1 - 9 in Appendix A.
2015 Profile


Swamp Creek Longitudinal Profile: Reach 7
REACH 7.2
REACH 7.1
Note: Channel stationing of longitudinal profile corresponds to the stationing shown on Maps 1 - 9 in Appendix A.
Elevation (ft)
2920
2915
2910
2905
2900
2895
2890
2885
2880
2875
2870
0
500
1000
1500
2000
2500
3000
3500
4000
4500
Station(ft)
2015 Profile

Appendix F

Wollman Pebble Count Histograms

MDT Stream Mitigation Monitoring
Swamp Creek
Lincoln County, Montana

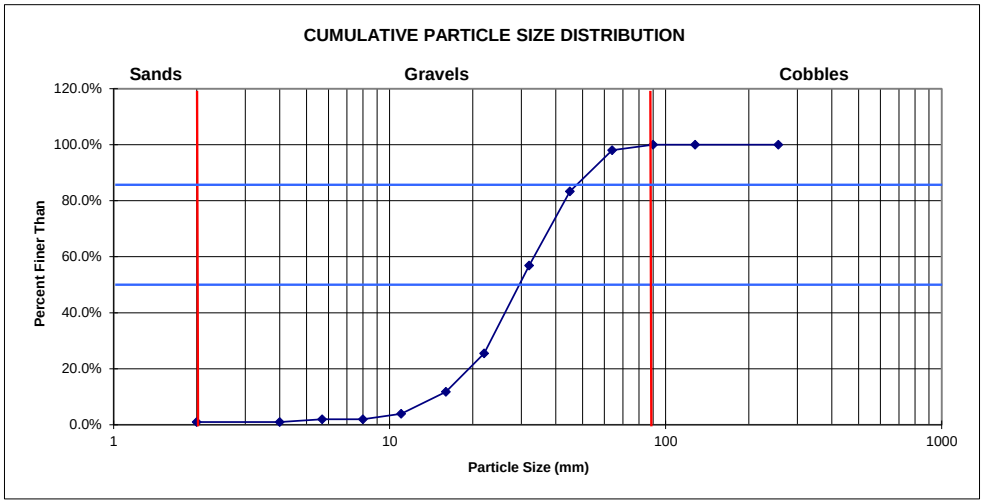
Reach 1 Wolman Pebble Count Data

Riffle @ Transect 2

PARTICLE	SEIVE OPENING MILLIMETERS	PASSING COUNT	PERCENT	CUMULATIVE PERCENT
Sand	<2	1	1.0%	1.0%
VF Gravel	2	0	0.0%	1.0%
VF Gravel	4	1	1.0%	2.0%
F Gravel	5.7	0	0.0%	2.0%
F Gravel	8	2	2.0%	3.9%
Med Gravel	11	8	7.8%	11.8%
Med Gravel	16	14	13.7%	25.5%
C Gravel	22	32	31.4%	56.9%
C Gravel	32	27	26.5%	83.3%
VC Gravel	45	15	14.7%	98.0%
VC Gravel	64	2	2.0%	100.0%
SM Cobble	90	0	0.0%	100.0%
SM Cobble	128	0	0.0%	100.0%
LG Cobble	256	0	0.0%	100.0%

total count = 102

Read From Graph		
D_{50} =	30	mm
D_{84} =	47	mm

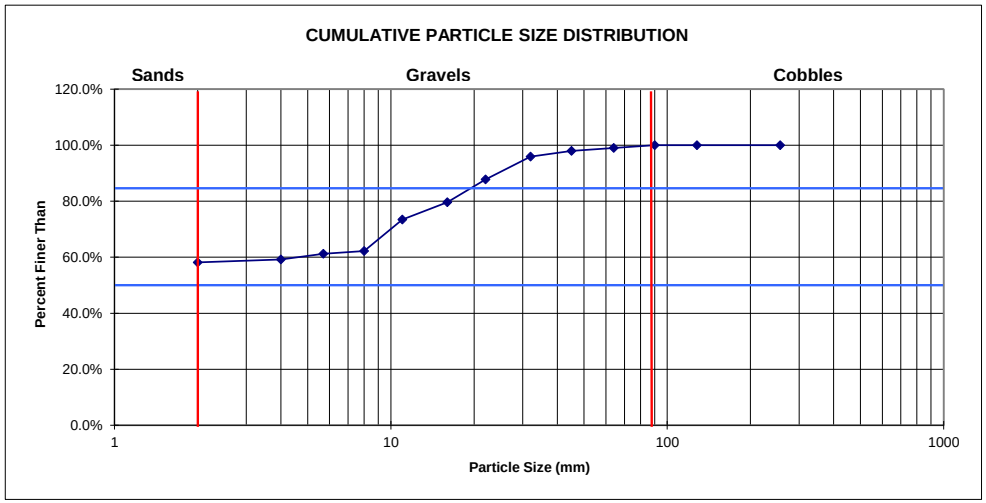


Pool @ Transect 1

PARTICLE	SEIVE OPENING MILLIMETERS	PASSING COUNT	PERCENT	CUMULATIVE PERCENT
Sand	<2	57	58.2%	58.2%
VF Gravel	2	1	1.0%	59.2%
VF Gravel	4	2	2.0%	61.2%
F Gravel	5.7	1	1.0%	62.2%
F Gravel	8	11	11.2%	73.5%
Med Gravel	11	6	6.1%	79.6%
Med Gravel	16	8	8.2%	87.8%
C Gravel	22	8	8.2%	95.9%
C Gravel	32	2	2.0%	98.0%
VC Gravel	45	1	1.0%	99.0%
VC Gravel	64	1	1.0%	100.0%
SM Cobble	90	0	0.0%	100.0%
SM Cobble	128	0	0.0%	100.0%
LG Cobble	256	0	0.0%	100.0%

total count = 98

Read From Graph		
D_{50} =	<2	mm
D_{84} =	20	mm



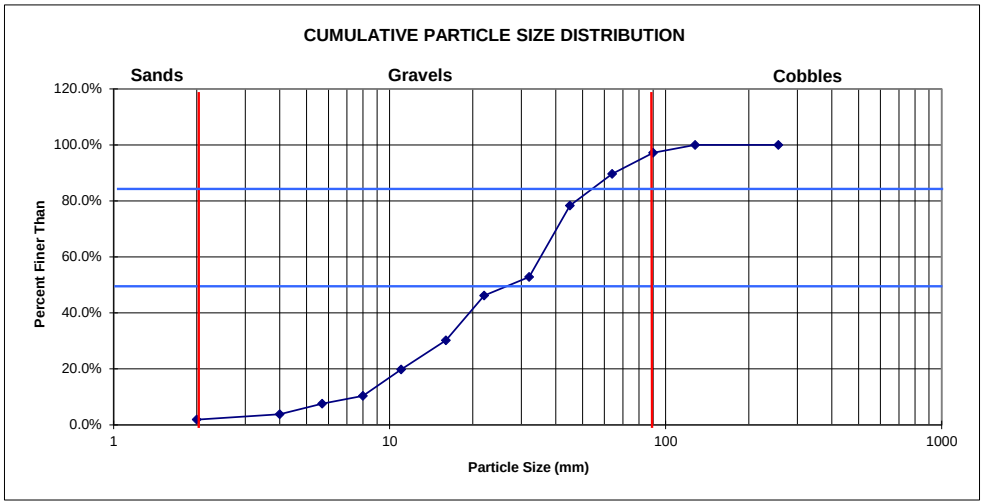
Reach 2 Wolman Pebble Count Data

Riffle @ Transect 11

PARTICLE	SEIVE OPENING MILLIMETERS	PASSING COUNT	PERCENT	CUMULATIVE PERCENT
Sand	<2	1	0.9%	0.9%
VF Gravel	2	1	0.9%	1.9%
VF Gravel	4	2	1.9%	3.8%
F Gravel	5.7	4	3.8%	7.5%
F Gravel	8	3	2.8%	10.4%
Med Gravel	11	10	9.4%	19.8%
Med Gravel	16	11	10.4%	30.2%
C Gravel	22	17	16.0%	46.2%
C Gravel	32	7	6.6%	52.8%
VC Gravel	45	27	25.5%	78.3%
VC Gravel	64	12	11.3%	89.6%
SM Cobble	90	8	7.5%	97.2%
SM Cobble	128	3	2.8%	100.0%
LG Cobble	256	0	0.0%	100.0%

total count = 106

Read From Graph		
D_{50} =	26	mm
D_{84} =	55	mm

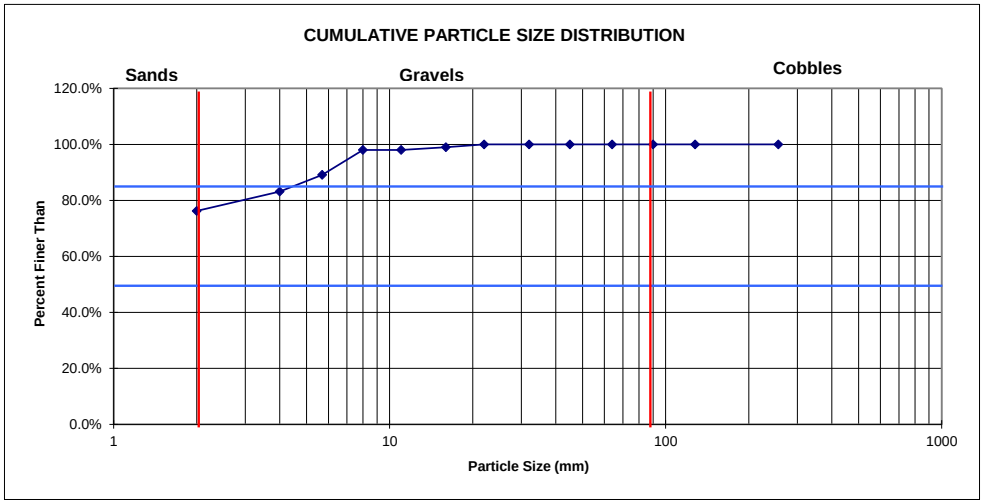


Pool @ Transect 9

PARTICLE	SEIVE OPENING MILLIMETERS	PASSING COUNT	PERCENT	CUMULATIVE PERCENT
Sand	<2	75	74.3%	74.3%
VF Gravel	2	2	2.0%	76.2%
VF Gravel	4	7	6.9%	83.2%
F Gravel	5.7	6	5.9%	89.1%
F Gravel	8	9	8.9%	98.0%
Med Gravel	11	0	0.0%	98.0%
Med Gravel	16	1	1.0%	99.0%
C Gravel	22	1	1.0%	100.0%
C Gravel	32	0	0.0%	100.0%
VC Gravel	45	0	0.0%	100.0%
VC Gravel	64	0	0.0%	100.0%
SM Cobble	90	0	0.0%	100.0%
SM Cobble	128	0	0.0%	100.0%
LG Cobble	256	0	0.0%	100.0%

total count = 101

Read From Graph		
D_{50} =	<2	mm
D_{84} =	3.5	mm



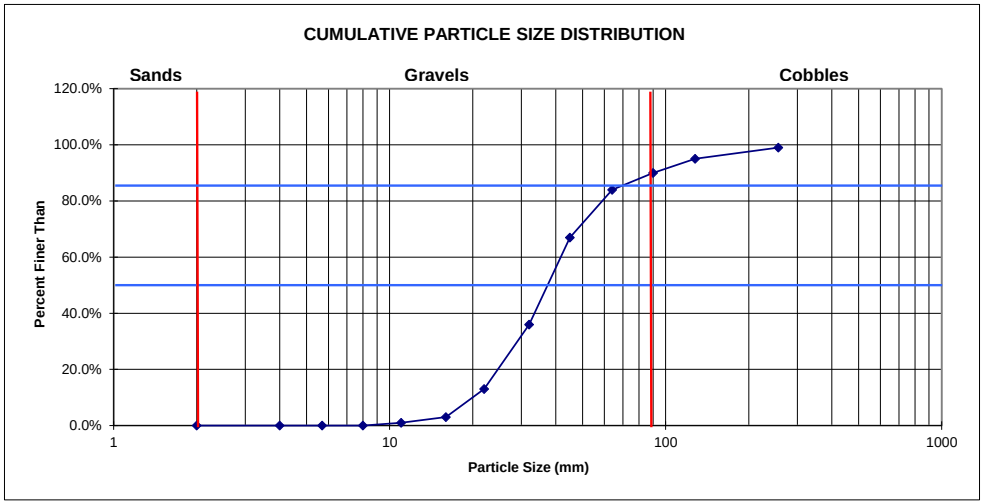
Reach 3 Wolman Pebble Count Data

Riffle @ Transect 15

PARTICLE	SEIVE OPENING MILLIMETERS	PASSING COUNT	PERCENT	CUMULATIVE PERCENT
Sand	<2	0	0.0%	0.0%
VF Gravel	2	0	0.0%	0.0%
VF Gravel	4	0	0.0%	0.0%
F Gravel	5.7	0	0.0%	0.0%
F Gravel	8	1	1.0%	1.0%
Med Gravel	11	2	2.0%	3.0%
Med Gravel	16	10	10.0%	13.0%
C Gravel	22	23	23.0%	36.0%
C Gravel	32	31	31.0%	67.0%
VC Gravel	45	17	17.0%	84.0%
VC Gravel	64	6	6.0%	90.0%
SM Cobble	90	5	5.0%	95.0%
SM Cobble	128	4	4.0%	99.0%
LG Cobble	256	1	1.0%	100.0%

total count = 100

Read From Graph		
D_{50} =	37	mm
D_{84} =	68	mm

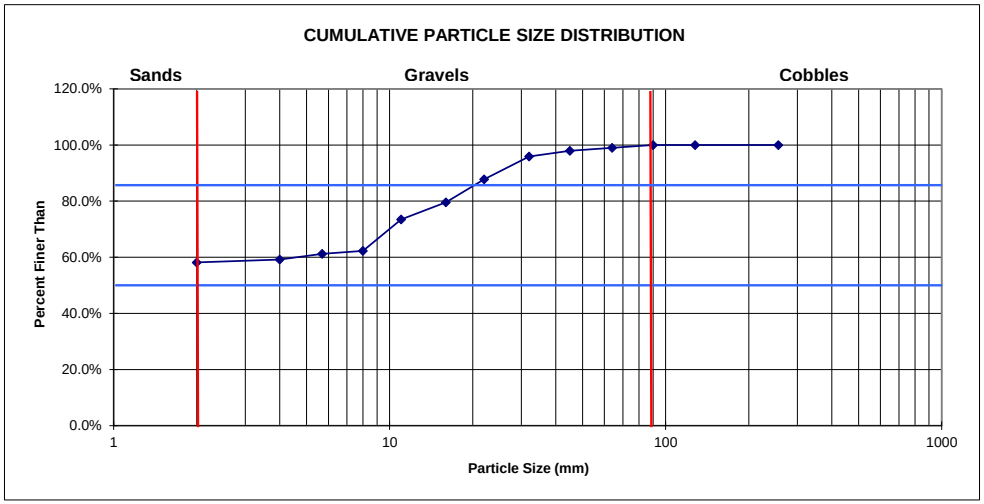


Pool @ Transect 16

PARTICLE	SEIVE OPENING MILLIMETERS	PASSING COUNT	PERCENT	CUMULATIVE PERCENT
Sand	<2	57	58.2%	58.2%
VF Gravel	2	1	1.0%	59.2%
VF Gravel	4	2	2.0%	61.2%
F Gravel	5.7	1	1.0%	62.2%
F Gravel	8	11	11.2%	73.5%
Med Gravel	11	6	6.1%	79.6%
Med Gravel	16	8	8.2%	87.8%
C Gravel	22	8	8.2%	95.9%
C Gravel	32	2	2.0%	98.0%
VC Gravel	45	1	1.0%	99.0%
VC Gravel	64	1	1.0%	100.0%
SM Cobble	90	0	0.0%	100.0%
SM Cobble	128	0	0.0%	100.0%
LG Cobble	256	0	0.0%	100.0%

total count = 98

Read From Graph		
D_{50} =	<2	mm
D_{84} =	21	mm



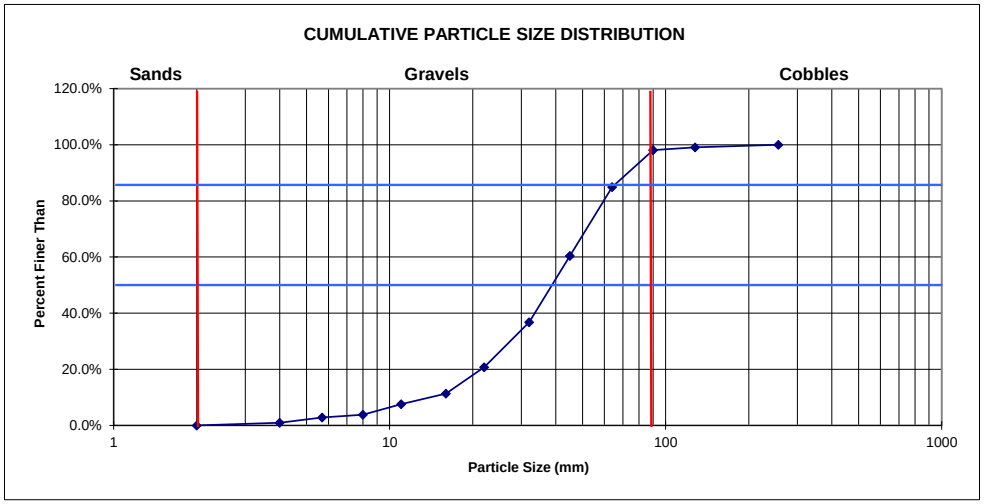
Reach 5 Wolman Pebble Count Data

Riffle @ Transect 30

PARTICLE	SEIVE OPENING MILLIMETERS	PASSING COUNT	PERCENT	CUMULATIVE PERCENT
Sand	<2	0	0.0%	0.0%
VF Gravel	2	0	0.0%	0.0%
VF Gravel	4	1	0.9%	0.9%
F Gravel	5.7	2	1.9%	2.8%
F Gravel	8	1	0.9%	3.8%
Med Gravel	11	4	3.8%	7.5%
Med Gravel	16	4	3.8%	11.3%
C Gravel	22	10	9.4%	20.8%
C Gravel	32	17	16.0%	36.8%
VC Gravel	45	25	23.6%	60.4%
VC Gravel	64	26	24.5%	84.9%
SM Cobble	90	14	13.2%	98.1%
SM Cobble	128	1	0.9%	99.1%
LG Cobble	256	1	0.9%	100.0%

total count = 106

Read From Graph		
D_{50} =	38	mm
D_{84} =	65	mm

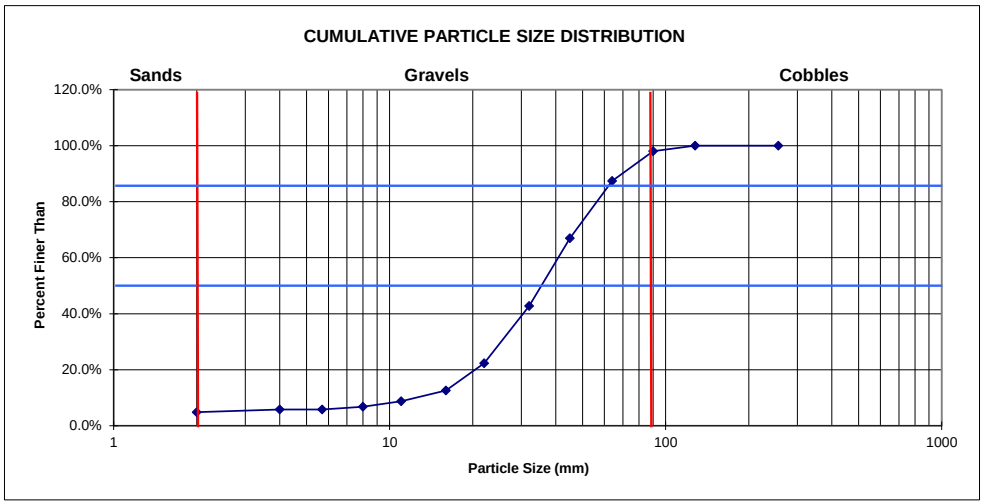


Pool @ Transect 29

PARTICLE	SEIVE OPENING MILLIMETERS	PASSING COUNT	PERCENT	CUMULATIVE PERCENT
Sand	<2	5	4.9%	4.9%
VF Gravel	2	1	1.0%	5.8%
VF Gravel	4	0	0.0%	5.8%
F Gravel	5.7	1	1.0%	6.8%
F Gravel	8	2	1.9%	8.7%
Med Gravel	11	4	3.9%	12.6%
Med Gravel	16	10	9.7%	22.3%
C Gravel	22	21	20.4%	42.7%
C Gravel	32	25	24.3%	67.0%
VC Gravel	45	21	20.4%	87.4%
VC Gravel	64	11	10.7%	98.1%
SM Cobble	90	2	1.9%	100.0%
SM Cobble	128	0	0.0%	100.0%
LG Cobble	256	0	0.0%	100.0%

total count = 103

Read From Graph		
D_{50} =	35	mm
D_{84} =	64	mm



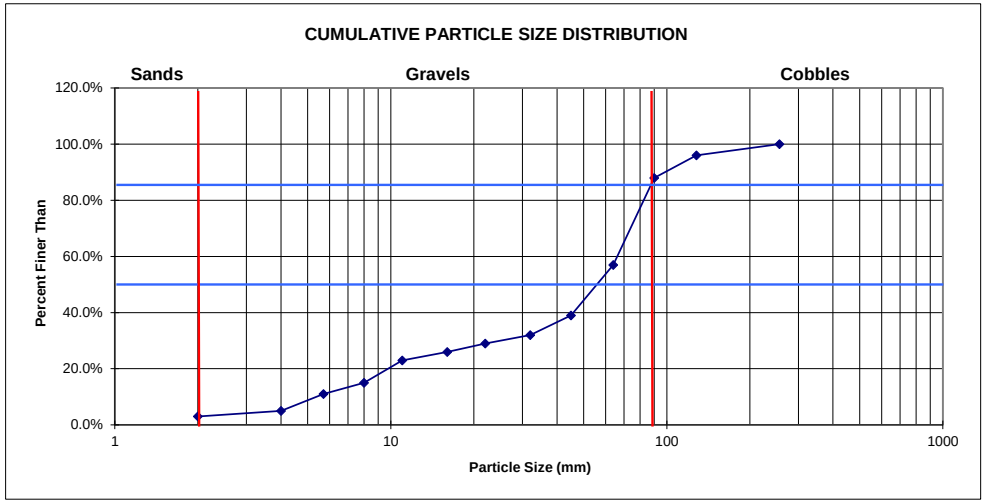
Reach 7 Wolman Pebble Count Data

Riffle @ Transect 43

PARTICLE	SEIVE OPENING MILLIMETERS	PASSING COUNT	PERCENT	CUMULATIVE PERCENT
Sand	<2	1	1.0%	1.0%
VF Gravel	2	2	2.0%	3.0%
VF Gravel	4	2	2.0%	5.0%
F Gravel	5.7	6	6.0%	11.0%
F Gravel	8	4	4.0%	15.0%
Med Gravel	11	8	8.0%	23.0%
Med Gravel	16	3	3.0%	26.0%
C Gravel	22	3	3.0%	29.0%
C Gravel	32	3	3.0%	32.0%
VC Gravel	45	7	7.0%	39.0%
VC Gravel	64	18	18.0%	57.0%
SM Cobble	90	31	31.0%	88.0%
SM Cobble	128	8	8.0%	96.0%
LG Cobble	256	4	4.0%	100.0%

total count = 100

Read From Graph		
D_{50} =	56	mm
D_{84} =	88	mm

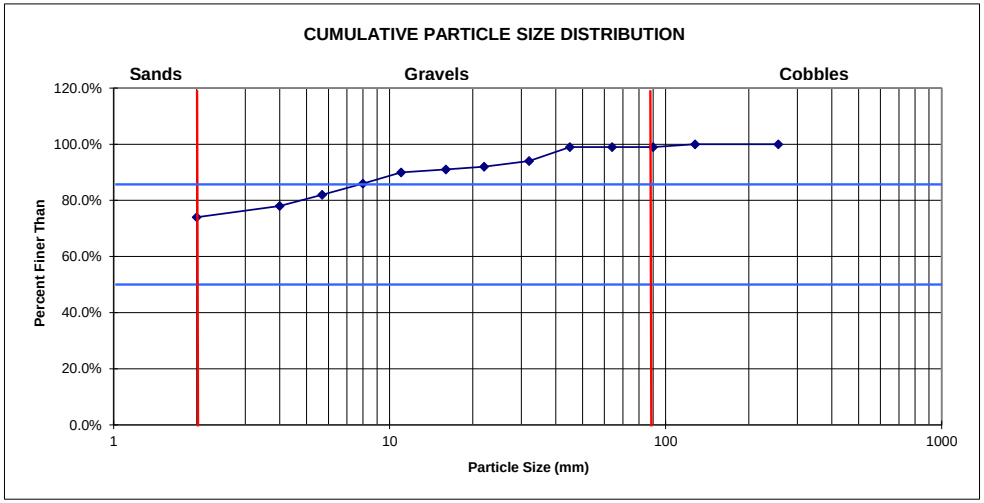


Pool @ Transect 42

PARTICLE	SEIVE OPENING MILLIMETERS	PASSING COUNT	PERCENT	CUMULATIVE PERCENT
Sand	<2	65	65.0%	65.0%
VF Gravel	2	9	9.0%	74.0%
VF Gravel	4	4	4.0%	78.0%
F Gravel	5.7	4	4.0%	82.0%
F Gravel	8	4	4.0%	86.0%
Med Gravel	11	4	4.0%	90.0%
Med Gravel	16	1	1.0%	91.0%
C Gravel	22	1	1.0%	92.0%
C Gravel	32	2	2.0%	94.0%
VC Gravel	45	5	5.0%	99.0%
VC Gravel	64	0	0.0%	99.0%
SM Cobble	90	0	0.0%	99.0%
SM Cobble	128	1	1.0%	100.0%
LG Cobble	256	0	0.0%	100.0%

total count = 100

Read From Graph		
D_{50} =	<2	mm
D_{84} =	7	mm



Appendix G

Project Area Photos

MDT Stream Mitigation Monitoring
Swamp Creek
Lincoln County, Montana

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 1.1—2014
Description: Reach 1
Direction: South

Photo Point 1.1—2015
Description: Reach 1
Direction: South

Photo Point 1.2—2014
Description: Reach 1
Direction: South South East

Photo Point 1.2—2015
Description: Reach 1
Direction: South South East

Photo Point 1.3—2014
Description: Reach 1
Direction: East South East

Photo Point 1.3—2015
Description: Reach 1
Direction: East South East

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 1.4—2014
Description: Reach 1
Direction: East

Photo Point 1.4—2015
Description: Reach 1
Direction: East

Photo Point 2.1—2014
Description: Reach 1
Direction: South South East

Photo Point 2.1—2015
Description: Reach 1
Direction: South South East

Photo Point 2.2—2014
Description: Reach 1
Direction: South East

Photo Point 2.2—2015
Description: Reach 1
Direction: South East

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 2.3—2014
Description: Reach 1
Compass: East

Photo Point 2.3—2015
Description: Reach 1
Compass: East

Photo Point 2.4—2014
Description: Reach 1
Compass: North East

Photo Point 2.4—2015
Description: Reach 1
Compass: North East

Photo Point 2.5—2014
Description: Reach 1
Compass: North

Photo Point 2.5—2015
Description: Reach 1
Compass: North

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 3.1— 2014
Description: Reach 1
Direction: South

Photo Point 3.1— 2015
Description: Reach 1
Direction: South

Photo Point 3.2—2014
Description: Reach 1
Direction: South West

Photo Point 3.2—2015
Description: Reach 1
Direction: South West

Photo Point 3.3—2014
Description: Reach 1
Direction: West

Photo Point 3.3—2015
Description: Reach 1
Direction: West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 3.4—2014
Description: **Reach 1**
Direction: North West

Photo Point 3.4—2015
Description: **Reach 1**
Direction: North West

Photo Point 3.5—2014
Description: **Reach 1**
Direction: North

Photo Point 3.5—2015
Description: **Reach 1**
Direction: North

Photo Point 4.1—2014
Description: **Reach 2**
Direction: South South East

Photo Point 4.1—2015
Description: **Reach 2**
Direction: South South East

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 4.2—2014
Description: Reach 2
Direction: South

Photo Point 4.2—2015
Description: Reach 2
Direction: South

Photo Point 4.3—2014
Description: Reach 2
Direction: South West

Photo Point 4.3—2015
Description: Reach 2
Direction: South West

Photo Point 4.4—2014
Description: Reach 2
Direction: West

Photo Point 4.4—2015
Description: Reach 2
Direction: West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 4.5—2014
Description: **Reach 2**
Direction: North West

Photo Point 4.5—2015
Description: **Reach 2**
Direction: North West

Photo Point 4.6—2014
Description: **Reach 2**
Direction: North North West

Photo Point 4.6—2015
Description: **Reach 2**
Direction: North North West

Photo Point 4.7—2014
Description: **Reach 2**
Direction: North

Photo Point 4.7—2015
Description: **Reach 2**
Direction: North

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 5.1—2014
Description: **Reach 2**
Direction: South East

Photo Point 5.1—2015
Description: **Reach 2**
Direction: South East

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 5.2—2014
Description: **Reach 2**
Direction: East South East

Photo Point 5.2—2015
Description: **Reach 2**
Direction: East South East

Photo Point 5.3—2014
Description: **Reach 2**
Direction: East

Photo Point 5.3—2015
Description: **Reach 2**
Direction: East

Photo Point 5.4—2014
Description: **Reach 2**
Direction: East North East

Photo Point 5.4—2015
Description: **Reach 2**
Direction: East North East

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 5.5—2014
Description: **Reach 2**
Direction: North East

Photo Point 5.5—2015
Description: **Reach 2**
Direction: North East

Photo Point 5.6—2014
Description: **Reach 2**
Direction: North

Photo Point 5.6—2015
Description: **Reach 2**
Direction: North

Photo Point 6.1—2014
Description: **Reach 2**
Direction: North North East

Photo Point 6.1—2015
Description: **Reach 2**
Direction: North North East

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 6.2—2014
Description: **Reach 2**
Direction: North North West

Photo Point 6.2—2015
Description: **Reach 2**
Direction: North North West

Photo Point 7.1—2014
Description: **Reach 2**
Direction: North North West

Photo Point 7.1—2015
Description: **Reach 2**
Direction: North North West

Photo Point 7.2—2014
Description: **Reach 2**
Direction: West

Photo Point 7.2—2015
Description: **Reach 2**
Direction: West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 7.3—2014
Description: **Reach 2**
Direction: West South West

Photo Point 7.3—2015
Description: **Reach 2**
Direction: West South West

Photo Point 7.4—2014
Description: **Reach 2**
Direction: South South West

Photo Point 7.4—2015
Description: **Reach 2**
Direction: South South West

Photo Point 7.5—2014
Description: **Reach 2**
Direction: South

Photo Point 7.5—2015
Description: **Reach 2**
Direction: South

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 8.1—2014
Description: **Reach 3.1**
Direction: North

Photo Point 8.1—2015
Description: **Reach 3.1**
Direction: North

Photo Point 8.2—2014
Description: **Reach 3.1**
Direction: West

Photo Point 8.2—2015
Description: **Reach 3.1**
Direction: West

Photo Point 8.3—2014
Description: **Reach 3.1**
Direction: South West

Photo Point 8.3—2015
Description: **Reach 3.1**
Direction: South West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 8.4—2014
Description: **Reach 3.1**
Direction: South South West

Photo Point 8.4—2015
Description: **Reach 3.1**
Direction: South South West

Photo Point 8.5—2014
Description: **Reach 3.1**
Direction: South

Photo Point 8.5—2015
Description: **Reach 3.1**
Direction: South

Photo Point 9.1—2014
Description: **Reach 3.1**
Direction: North

Photo Point 9.1—2015
Description: **Reach 3.1**
Direction: North

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 9.2—2014
Description: **Reach 3.1**
Direction: North East

Photo Point 9.2—2015
Description: **Reach 3.1**
Direction: North East

Photo Point 9.3—2014
Description: **Reach 3.1**
Direction: South East

Photo Point 9.3—2015
Description: **Reach 3.1**
Direction: South East

Photo Point 10.1—2014
Description: **Reach 3.1**
Direction: North North West

Photo Point 10.1—2015
Description: **Reach 3.1**
Direction: North North West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 11.1—2014
Description: **Reach 3.1**
Direction: North

Photo Point 11.1—2015
Description: **Reach 3.1**
Direction: North

Photo Point 11.2—2014
Description: **Reach 3.1**
Direction: South

Photo Point 11.2—2015
Description: **Reach 3.1**
Direction: South

Photo Point 12.1—2014
Description: **Reach 3.2**
Direction: North West

Photo Point 12.1—2015
Description: **Reach 3.2**
Direction: North West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 12.2—2014
Description: Reach 3.2
Direction: West

Photo Point 12.2—2015
Description: Reach 3.2
Direction: West

Photo Point 12.3—2014
Description: Reach 3.2
Direction: West South West

Photo Point 12.3—2015
Description: Reach 3.2
Direction: West South West

Photo Point 12.4—2014
Description: Reach 3.2
Direction: South South West

Photo Point 12.4—2015
Description: Reach 3.2
Direction: South South West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 12.5—2014
Description: **Reach 3.2**
Direction: South

Photo Point 12.5—2015
Description: **Reach 3.2**
Direction: South

Photo Point 13.1—2014
Description: **Reach 3.2**
Direction: North North West

Photo Point 13.1—2015
Description: **Reach 3.2**
Direction: North North West

Photo Point 14.1—2014
Description: **Reach 3.3**
Direction: North

Photo Point 14.1—2015
Description: **Reach 3.3**
Direction: North

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 14.2—2014
Description: **Reach 3.3**
Direction: East

Photo Point 14.2—2015
Description: **Reach 3.3**
Direction: East

Photo Point 14.3—2014
Description: **Reach 3.3**
Direction: South South East

Photo Point 14.3—2015
Description: **Reach 3.3**
Direction: South South East

Photo Point 15.1—2014
Description: **Reach 3.3**
Direction: North North West

Photo Point 15.1—2015
Description: **Reach 3.3**
Direction: North North West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 15.2—2014
Description: Reach 3.3
Direction: East

Photo Point 15.2—2015
Description: Reach 3.3
Direction: East

Photo Point 16.1—2014
Description: Reach 3.4
Direction: South South West

Photo Point 16.1—2015
Description: Description: Reach 3.4
Direction: South South West

Photo Point 16.2—2014
Description: Reach 3.4
Direction: West

Photo Point 16.2—2015
Description: Reach 3.4
Direction: West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 17.1—2014
Description: **Reach 3.4**
Direction: South

Photo Point 17.1—2015
Description: **Reach 3.4**
Direction: South

Photo Point 17.2—2014
Description: **Reach 3.4**
Direction: South East

Photo Point 17.2—2015
Description: **Reach 3.4**
Direction: South East

Photo Point 17.3—2014
Description: **Reach 3.4**
Direction: East

Photo Point 17.3—2015
Description: **Reach 3.4**
Direction: East

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 17.4—2014
Description: **Reach 3.4**
Direction: North East

Photo Point 17.4—2015
Description: **Reach 3.4**
Direction: North East

Photo Point 17.5—2014
Description: **Reach 3.4**
Direction: North

Photo Point 17.5—2014
Description: **Reach 3.4**
Direction: North

Photo Point 18.1—2014
Description: **Reach 3.4**
Direction: South West

Photo Point 18.1—2014
Description: **Reach 3.4**
Direction: South West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 18.2—2014
Description: **Reach 3.4**
Direction: West

Photo Point 18.2—2015
Description: **Reach 3.4**
Direction: West

Photo Point 18.3—2014
Description: **Reach 3.4**
Direction: North West

Photo Point 18.3—2015
Description: **Reach 3.4**
Direction: North West

Photo Point 18.4—2014
Description: **Reach 3.4**
Direction: North

Photo Point 18.4—2015
Description: **Reach 3.4**
Direction: North

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 19.1—2014
Description: **Reach 5**
Direction: South West

Photo not repeated in 2015

Photo Point 19.1—2015
Description:
Direction: South West

Photo Point 19.2—2014
Description: **Reach 5**
Direction: West

Photo not repeated in 2015

Photo Point 19.2—2015
Description: **Reach 5**
Direction: West

Photo Point 19.3—2014
Description: **Reach 5**
Direction: West North West

Photo not repeated in 2015

Photo Point 19.3—2015
Description: **Reach 5**
Direction: West North West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 19.4—2014
Description: **Reach 5**
Direction: North North West

Photo Point 19.4—2015
Description: **Reach 5**
Direction: North North West

Photo Point 19.5—2014
Description: **Reach 5**
Direction: North

Photo Point 19.5—2015
Description: **Reach 5**
Direction: North

Photo Point 20.1—2014
Description: **Reach 5**
Direction: South South West

Photo Point 20.1—2015
Description: **Reach 5**
Direction: South South West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 20.2—2014
Description: **Reach 5**
Direction: West South West

Photo Point 20.2—2015
Description: **Reach 5**
Direction: West South West

Photo Point 20.3—2014
Description: **Reach 5**
Direction: West North West

Photo Point 20.3—2015
Description: **Reach 5**
Direction: West North West

Photo Point 20.4—2014
Description: **Reach 5**
Direction: North West

Photo Point 20.4—2015
Description: **Reach 5**
Direction: North West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 21.1—2014
Description: **Reach 7.1**
Direction: South West

Photo Point 21.1—2015
Description: **Reach 7.1**
Direction: South West

Photo Point 21.2—2014
Description: **Reach 7.1**
Direction: North West

Photo Point 21.2—2015
Description: **Reach 7.1**
Direction: North West

Photo Point 22.1—2014
Description: **Reach 7.1**
Direction: West

Photo Point 22.1—2015
Description: **Reach 7.1**
Direction: West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 22.2—2014
Description: **Reach 7.1**
Direction: East

Photo Point 22.2—2014
Description: **Reach 7.1**
Direction: East

Photo Point 23.1—2014
Description: **Reach 7.1**
Direction: South

Photo Point 23.1—2014
Description: **Reach 7.1**
Direction: South

Photo Point 23.2—2014
Description: **Reach 7.1**
Direction: West

Photo Point 23.2—2014
Description: **Reach 7.1**
Direction: West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 24.1—2014
Description: **Reach 7.1**
Direction: North East

Photo Point 24.1—2014
Description: **Reach 7.1**
Direction: North East

Photo Point 24.2—2014
Description: **Reach 7.1**
Direction: East

Photo Point 24.2—2014
Description: **Reach 7.1**
Direction: East

Photo Point 24.3—2014
Description: **Reach 7.1**
Direction: East South East

Photo Point 24.3—2014
Description: **Reach 7.1**
Direction: East South East

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 23.4—2014
Description: **Reach 7.1**
Direction: South East

Photo Point 23.4—2014
Description: **Reach 7.1**
Direction: South East

Photo Point 25.1—2014
Description: **Reach 7.1**
Direction: North

Photo Point 25.1—2014
Description: **Reach 7.1**
Direction: North

Photo Point 25.2—2014
Description: **Reach 7.1**
Direction: East

Photo Point 25.2—2014
Description: **Reach 7.1**
Direction: East

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 25.3—2014
Description: **Reach 7.1**
Direction: South

Photo Point 25.3—2014
Description: **Reach 7.1**
Direction: South

Photo Point 26.1—2014
Description: **Reach 7.2**
Direction: South

Photo Point 26.1—2014
Description: **Reach 7.2**
Direction: South

Photo Point 26.2—2014
Description: **Reach 7.2**
Direction: North

Photo Point 26.2—2014
Description: **Reach 7.2**
Direction: North

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 27.1—2014
Description: **Reach 7.2**
Direction: South

Photo Point 27.1—2014
Description: **Reach 7.2**
Direction: South

Photo Point 27.2—2014
Description: **Reach 7.2**
Direction: South West

Photo Point 27.2—2014
Description: **Reach 7.2**
Direction: South West

Photo Point 27.3—2014
Description: **Reach 7.2**
Direction: West

Photo Point 27.3—2014
Description: **Reach 7.2**
Direction: West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 27.4—2014
Description: **Reach 7.2**
Direction: West North West

Photo Point 27.4—2014
Description: **Reach 7.2**
Direction: West North West

Photo Point 27.5—2014
Description: **Reach 7.2**
Direction: North

Photo Point 27.5—2014
Description: **Reach 7.2**
Direction: North

Photo Point 28.1—2014
Description: **Reach 7.2**
Direction: West South West

Photo Point 28.1—2014
Description: **Reach 7.2**
Direction: West South West

PHOTO INFORMATION

PROJECT SITE: Swamp Creek

DATE: 2014-2015 Monitoring Events

Photo Point 28.2—2014
Description: **Reach 7.2**
Direction: West

Photo Point 28.2—2014
Description: **Reach 7.2**
Direction: West

Photo Point 28.3—2014
Description: **Reach 7.2**
Direction: North North West

Photo Point 28.3—2014
Description: **Reach 7.2**
Direction: North North West

Photo Point 10.1—2014
Description:
Direction: North North West

Additional Photo 16
Description: **Gully forming east of new channel**
Taken in 2015

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T1 RIGHT—UPSTREAM LOOKING EAST

T1 RIGHT—DOWNSTREAM LOOKING NORTH

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T1 RIGHT—LOOKING NORTHEAST TO T1 LEFT

T1 LEFT—LOOKING SOUTHWEST TO T1 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T1 LEFT—LOOKING UPSTREAM EAST

T1 LEFT—LOOKING DOWNSTREAM NORTHWEST

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T2 LEFT—LOOKING UPSTREAM EAST

T2 LEFT—LOOKING DOWNSTREAM WEST

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T2 LEFT—LOOKING SOUTH TO T2 RIGHT

T2 RIGHT—LOOKING NORTH TO T2 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T2 RIGHT—LOOKING EAST UPSTREAM

T2 RIGHT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T3 RIGHT/PP2—LOOKING EAST UPSTREAM

T3 RIGHT/PP2—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T3 RIGHT/PP2—LOOKING NORTHEAST TO T3 LEFT

T3 LEFT—LOOKING SOUTHWEST TO T3 RIGHT/PP2

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T3 LEFT—LOOKING SOUTH UPSTREAM

T3 LEFT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T4 LEFT/PP4—LOOKING SOUTH UPSTREAM

T4 LEFT/PP4—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T4 LEFT/PP4—LOOKING WEST TO T4 RIGHT

T4 RIGHT—LOOKING EAST TO T4 LEFT/PP4

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T4 RIGHT—LOOKING EAST UPSTREAM

T4 RIGHT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T5 LEFT—LOOKING SOUTH UPSTREAM

T5 LEFT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T5 LEFT—LOOKING WEST TO T5 RIGHT

T5 RIGHT—LOOKING EAST TO T5 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T5 RIGHT—LOOKING SOUTH UPSTREAM

T5 RIGHT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T6 RIGHT—LOOKING EAST UPSTREAM

T6 RIGHT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T6 RIGHT—LOOKING NORTHEAST TO T6 LEFT

T6 LEFT—LOOKING SOUTHWEST TO T6 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T6 LEFT—LOOKING SOUTHEAST UPSTREAM

T6 LEFT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T7 RIGHT—LOOKING NORTHEAST UPSTREAM

T7 RIGHT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T7 RIGHT—LOOKING NORTHEAST TO T7 LEFT

T7 LEFT—LOOKING SOUTHWEST TO T7 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T7 LEFT—LOOKING EAST UPSTREAM

T7 LEFT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T8 LEFT—LOOKING EAST UPSTREAM

T8 LEFT—LOOKING SOUTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T8 LEFT—LOOKING EAST TO T8 RIGHT

T8 RIGHT—LOOKING WEST TO T8 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T8 RIGHT—LOOKING EAST UPSTREAM

T8 RIGHT—LOOKING SOUTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T9 RIGHT - LOOKING EAST UPSTREAM

T9 RIGHT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T9 RIGHT—LOOKING NORTH TO T9 LEFT

T9 LEFT—LOOKING SOUTH TO T9 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T9 LEFT—LOOKING EAST UPSTREAM

T9 LEFT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T10 LEFT—LOOKING EAST UPSTREAM

T10 LEFT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T10 LEFT—LOOKING SOUTHWEST TO T10 RIGHT

T10 RIGHT—LOOKING NORTHEAST TO T10 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T10 RIGHT—LOOKING EAST UPSTREAM

T10 RIGHT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T11 RIGHT/PP5—LOOKING EAST UPSTREAM

T11 RIGHT/PP5—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T11 RIGHT/PP5—LOOKING NORTHEAST TO T11 LEFT

T11 LEFT—LOOKING SOUTHWEST TO T11 RIGHT/PP5

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T11 LEFT—LOOKING EAST UPSTREAM

T11 LEFT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T12 LEFT—LOOKING EAST UPSTREAM

T12 LEFT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T12 LEFT—LOOKING SOUTHWEST TO T12 RIGHT

T12 RIGHT—LOOKING NORTHEAST TO T12 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T12 RIGHT—LOOKING EAST UPSTREAM

T12 RIGHT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T13 RIGHT—LOOKING NORTHEAST UPSTREAM

T13 RIGHT—LOOKING SOUTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T13 RIGHT—LOOKING NORTH TO T13 LEFT

T13 LEFT—LOOKING SOUTH TO T13 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T13 LEFT—LOOKING EAST UPSTREAM

T13 LEFT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T14 RIGHT—LOOKING NORTHEAST UPSTREAM

T14 RIGHT—LOOKING SOUTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T14 RIGHT—LOOKING NORTHEST TO T14 LEFT/PP7

T14 LEFT/PP7—LOOKING SOUTHWEST TO T14 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T14 LEFT/PP7—LOOKING EAST UPSTREAM

T14 LEFT/PP7—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T15 LEFT/PP8—LOOKING SOUTH UPSTREAM

T15 LEFT/PP8—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T15 LEFT/PP8—LOOKING WEST TO T15 RIGHT

T15 RIGHT—LOOKING EAST TO T15 LEFT/PP8

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T15 RIGHT—LOOKING SOUTHEAST UPSTREAM

T15 RIGHT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T16 LEFT—LOOKING SOUTHEAST UPSTREAM

T16 LEFT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T16 LEFT—LOOKING SOUTHWEST TO T16 RIGHT

T16 RIGHT—LOOKING NORTHEAST TO T16 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T16 RIGHT—LOOKING EAST UPSTREAM

T16 RIGHT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T17 LEFT—LOOKING SOUTH UPSTREAM

T17 LEFT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T17 LEFT—LOOKING WEST TO T17 RIGHT

T17 RIGHT—LOOKING EAST TO T17 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T17 RIGHT—LOOKING SOUTHEAST UPSTREAM

T17 RIGHT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T18 RIGHT—LOOKING SOUTHEAST UPSTREAM

T18 RIGHT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T18 RIGHT—LOOKING EAST TO T18 LEFT

T18 LEFT—LOOKING WEST TO T18 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T18 LEFT—LOOKING SOUTH UPSTREAM

T18 LEFT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T19 LEFT—LOOKING SOUTH UPSTREAM

T19 LEFT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T19 LEFT—LOOKING WEST TO T19 RIGHT

T19 RIGHT—LOOKING EAST TO T19 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T19 RIGHT—LOOKING SOUTH UPSTREAM

T19 RIGHT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T20 LEFT—LOOKING SOUTH UPSTREAM

T20 LEFT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T20 LEFT—LOOKING WEST TO T20 RIGHT

T20 RIGHT—LOOKING EAST TO T20 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T20 RIGHT—LOOKING SOUTHEAST UPSTREAM

T20 RIGHT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T21 LEFT—LOOKING SOUTHEAST UPSTREAM

T21 LEFT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T21 LEFT—LOOKING WEST TO T21 RIGHT

T21 RIGHT—LOOKING EAST TO T21 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T21 RIGHT—LOOKING SOUTHEAST UPSTREAM

T21 RIGHT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T22 LEFT—LOOKING SOUTHEAST UPSTREAM

T22 LEFT—LOOKING SOUTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T22 LEFT—LOOKING SOUTHWEST TO T22 RIGHT

T22 RIGHT—LOOKING NORTHEAST TO T22 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T22 RIGHT—LOOKING SOUTHEAST UPSTREAM

T22 RIGHT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T23 RIGHT—LOOKING SOUTHEAST UPSTREAM

T23 RIGHT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T23 RIGHT—LOOKING NORTHEAST TO T23 LEFT

T23 LEFT—LOOKING SOUTHWEST TO T23 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T23 LEFT—LOOKING SOUTHEAST UPSTREAM

T23 LEFT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T24 RIGHT—LOOKING SOUTH UPSTREAM

T24 RIGHT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T24 RIGHT—LOOKING NORTHEAST TO T24 LEFT

T24 LEFT—LOOKING SOUTHWEST TO T24 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T24 LEFT—LOOKING SOUTH UPSTREAM

T24 LEFT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T25 RIGHT/PP17—LOOKING SOUTH UPSTREAM

T25 RIGHT/PP17—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T25 RIGHT/PP17—LOOKING EAST TO T25 LEFT

T25 LEFT—LOOKING WEST TO T25 RIGHT/PP17

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T25 LEFT—LOOKING SOUTH UPSTREAM

T25 LEFT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T26 RIGTH—LOOKING NORTEAST UPSTREAM

T26 RIGHT —LOOKING NORTHEAST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T26 RIGHT—LOOKING NORTHEAST TO T26 LEFT

T26 LEFT—LOOKING SOUTHWEST TO T26 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T26 LEFT—LOOKING EAST UPSTREAM

T26 LEFT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T27 RIGHT—LOOKING SOUTHEAST UPSTREAM

T27 RIGHT/PP18 —LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T27 RIGHT/PP18 —LOOKING NORTHEAST TO T27 LEFT

T27 LEFT—LOOKING SOUTHWEST TO T27 RIGHT/PP18

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T27 LEFT—LOOKING SOUTH UPSTREAM

T27 LEFT—LOOKING SOUTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T28 RIGHT—LOOKING SOUTHEAST UPSTREAM

T28 RIGHT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T28 RIGHT—LOOKING NORTHEAST TO T28 LEFT

T28 LEFT—LOOKING SOUTHWEST TO T28 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T28 LEFT—LOOKING SOUTHEAST UPSTREAM

T28 LEFT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T29 RIGHT—LOOKING SOUTHEAST UPSTREAM

T29 RIGHT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T29 RIGHT—LOOKING NORTHEAST TO T29 LEFT

T29 LEFT—LOOKING SOUTHWEST TO T29 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T29 LEFT—LOOKING SOUTHEAST UPSTREAM

T29 LEFT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T30 RIGHT—LOOKING SOUTH UPSTREAM

T30 RIGHT—LOOKNG NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T30 RIGHT—-LOOKING EAST TO T30 LEFT

T30 LEFT—-LOOKING WEST TO T30 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T30 LEFT—LOOKING SOUTH UPSTREAM

T30 LEFT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T31 RIGHT—LOOKING SOUTH UPSTREAM

T31 RIGHT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T31 RIGHT—-LOOKING EAST TO T31 LEFT/PP19

T31 LEFT/PP19—LOOKING WEST TO T31 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T31 LEFT/PP19—LOOKING SOUTH UPSTREAM

T31 LEFT/PP19—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T32 RIGHT—LOOKING EAST UPSTREAM

T32 RIGHT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T32 RIGHT—LOOKING NORTH TO T32 LEFT

T32 LEFT—LOOKING SOUTH TO T32 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T32 LEFT—LOOKING EAST UPSTREAM

T32 LEFT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T33 LEFT—LOOKING SOUTHEAST UPSTREAM

T33 LEFT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T33 LEFT—LOOKING WEST TO T33 RIGHT

T33 RIGHT—LOOKING EAST TO T33 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T33 RIGHT—LOOKING SOUTHEAST UPSTREAM

T33 RIGHT—LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T34 RIGHT—LOOKING SOUTHEAST UPSTREAM

T34 RIGHT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T34 RIGHT—LOOKING NORTH TO T34 LEFT

T34 LEFT—LOOKING SOUTH TO T34 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T34 LEFT—LOOKING SOUTHEAST UPSTREAM

T34 LEFT—LOOKING WEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T35 RIGHT—LOOKING SOUTHWEST UPSTREAM

T35 RIGHT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T35 RIGHT—LOOKING SOUTHEAST TO T35 LEFT

T35 LEFT—LOOKING NORTHWEST TO T35 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T35 LEFT—LOOKING SOUTHWEST UPSTREAM

T35 LEFT—LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T36 LEFT—LOOKING SOUTHWEST TO T36 RIGHT

T36 RIGHT—LOOKING NORTHEST TO T36 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T36 —LOOKING SOUTHEAST UPSTREAM

T36 —LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T37 LEFT—LOOKING WEST TO T37 RIGHT

T37 RIGHT—LOOKING EAST TO T37 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T37 —LOOKING SOUTH UPSTREAM

T37 —LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T38 LEFT—LOOKING WEST TO T38 RIGHT

T38 RIGHT—LOOKING EAST TO T38 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T38 —LOOKING SOUTHEAST UPSTREAM

T38 —LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T39 LEFT—LOOKING SOUTHWEST TO T39 RIGHT

T39 RIGHT—LOOKING NORTHEAST TO T39 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T39 —LOOKING SOUTHEAST UPSTREAM

T39 —LOOKING NORTHWEST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T40 LEFT—LOOKING WEST TO T40 RIGHT/PP25

T40 RIGHT/PP25—LOOKING EAST TO T40 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T40 —LOOKING SOUTH UPSTREAM

T40 —LOOKING NORTH DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T41 LEFT—LOOKING NORTHWEST TO T41 RIGHT

T41 RIGHT—LOOKING SOUTHEAST TO T41 LEFT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T41 —LOOKING SOUTHWEST UPSTREAM

T41 —LOOKING NORTHEAST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T42 RIGHT—LOOKING SOUTHEAST TO T42 LEFT/PP27

T42 LEFT/PP27—LOOKING NORTHWEST TO T42 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T42 —LOOKING SOUTHWEST UPSTREAM

T42 —LOOKING NORTHEAST DOWNSTREAM

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T43 RIGHT—LOOKING SOUTHEAST TO T43 LEFT

T43 LEFT—LOOKING NORTHWEST TO T43 RIGHT

PROJECT NAME: Swamp Creek Transect Survey 2015

DATE: September 1, 2015

T43 —LOOKING SOUTHWEST UPSTREAM

T43 —LOOKING NORTHEAST DOWNSTREAM

Appendix H

Project Design Sheets

MDT Stream Mitigation Monitoring
Swamp Creek
Lincoln County, Montana

MONTANA DEPARTMENT OF TRANSPORTATION

CHANNEL RE–ALIGNMENT PLANS
FEDERAL AID PROJECT CBI–NHTSA–MT 1–1(79)45

LIBBY CREEK – SOUTH
LINCOLN COUNTY

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MONTANA DEPARTMENT OF TRANSPORTATION
MDT
MONTANA CADD

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7/11/2012 2:46:46 PM
EFS - U2623
DESIGNED BY
REVIEWED BY
CHECKED BY
1 2 3

STATE	PROJECT NUMBER	SHEET NO.
MONTANA	CBINHTSA MT 1-1(79 45)	CC 2

CENTERLINE COORDINATE TABLE CHANNEL 1

STATION	DESCRIPTION	N OR Y COORDINATE	E OR X COORDINATE	REMARKS
100+00.00	POT	19 473.483	10 534.773	
100+55.65	PC	19 418.830	10 524.263	
100+67.92	PI	19 406.787	10 521.947	
100+76.22	PT	19 402.124	10 533.290	
100+94.86	PC	19 395.034	10 550.538	
101+01.57	PI	19 392.484	10 556.739	
101+07.47	PT	19 386.164	10 558.975	
101+18.14	PC	19 376.106	10 562.534	
101+26.28	PI	19 368.432	10 565.250	
101+33.06	PT	19 366.526	10 573.164	
101+50.14	POT	19 362.529	10 589.767	

GPK NAME: JOB300.GPK CHAIN NAME: CHANNEL1

CENTERLINE COORDINATE TABLE CHANNEL 2

STATION	DESCRIPTION	N OR Y COORDINATE	E OR X COORDINATE	REMARKS
132+00.00	POT	19 240.183	10 748.978	
132+05.49	PC	19 237.727	10 753.887	
132+11.66	PI	19 234.965	10 759.406	
132+17.46	PT	19 235.794	10 765.522	
132+23.63	PC	19 236.622	10 771.632	
132+45.78	PI	19 239.596	10 793.584	
132+63.13	PT	19 221.029	10 805.667	
132+73.58	PC	19 212.271	10 811.367	
132+78.11	PI	19 208.474	10 813.838	
132+82.38	PT	19 206.680	10 817.997	
132+88.76	PC	19 204.152	10 823.857	
133+05.84	PI	19 197.386	10 839.541	
133+21.68	PT	19 182.438	10 847.807	
133+25.66	PC	19 178.950	10 849.736	
133+32.71	PI	19 172.784	10 853.145	
133+39.02	PT	19 170.838	10 859.917	
133+43.72	PC	19 169.540	10 864.434	
133+51.64	PI	19 167.351	10 872.047	
133+58.30	PT	19 159.831	10 874.533	
133+65.17	PC	19 153.303	10 876.690	
133+76.19	PI	19 142.839	10 880.149	
133+84.18	PT	19 143.012	10 891.169	
133+89.78	PC	19 143.101	10 896.770	
133+93.79	PI	19 143.164	10 900.779	
133+97.52	PT	19 140.804	10 904.021	
134+07.11	PC	19 135.161	10 911.775	
134+13.89	PI	19 131.171	10 917.257	
134+19.46	PT	19 133.809	10 923.504	
134+44.74	PC	19 143.645	10 946.798	
134+57.16	PI	19 148.474	10 958.234	
134+65.48	PT	19 138.143	10 965.116	
134+76.47	PC	19 128.996	10 971.210	
134+81.90	PI	19 124.478	10 974.220	
134+86.89	PT	19 122.933	10 979.425	
135+00.05	POT	19 119.190	10 992.034	

GPK NAME: JOB300.GPK CHAIN NAME: CHANNEL2

CENTERLINE COORDINATE CHC 5

STATION	DESCRIPTION	N OR Y COORDINATE	E OR X COORDINATE	REMARKS
170+00.00	POT	16 374.012	13 029.246	
170+09.36	PC	16 365.559	13 033.259	
170+17.03	PI	16 358.624	13 036.550	
170+24.25	PT	16 354.732	13 043.165	
170+45.97	PC	16 343.718	13 061.883	
170+61.34	PI	16 335.924	13 075.129	
170+73.53	PT	16 320.587	13 074.154	
170+83.59	PC	16 310.546	13 073.516	
170+96.82	PI	16 297.342	13 072.678	
171+07.93	PT	16 289.222	13 083.124	
171+14.32	POT	16 285.302	13 088.168	

GPK NAME: JOB300.GPK CHAIN NAME: HYCC5

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STATE	PROJECT NUMBER	SHEET NO.
MONTANA	CBINHTSA MT 1-1(79) 45	CC 3

CENTERLINE COORDINATE TABLE CHANNEL 3

STATION	DESCRIPTION	N OR Y COORDINATE	E OR X COORDINATE	REMARKS
139+60.64	POT	18 211.140	11 718.121	
139+82.39	PC	18 198.345	11 735.714	
140+05.65	PI	18 184.665	11 754.522	
140+24.53	PT	18 161.552	11 751.938	
140+27.60	PC	18 158.496	11 751.596	
140+40.15	PI	18 146.028	11 750.202	
140+50.01	PT	18 139.347	11 760.821	
140+63.96	PC	18 131.917	11 772.628	
140+74.69	PI	18 126.205	11 781.706	
140+82.58	PT	18 115.767	11 779.236	
140+86.90	PC	18 111.562	11 778.241	
141+03.34	PI	18 095.573	11 774.458	
141+11.83	PT	18 093.258	11 790.725	
141+19.11	PC	18 092.560	11 797.970	
141+45.46	PI	18 090.033	11 824.195	
141+47.30	PT	18 071.319	11 805.650	
141+51.50	PC	18 068.340	11 802.699	
142+18.94	PI	18 020.433	11 755.226	
142+01.78	PT	18 035.615	11 820.940	
142+01.78	PC	18 035.615	11 820.940	
142+16.42	PI	18 038.907	11 835.197	
142+21.70	PT	18 024.346	11 833.750	
142+23.30	PC	18 022.754	11 833.592	
142+33.36	PI	18 012.745	11 832.598	
142+40.74	PT	18 008.609	11 841.767	
142+40.74	PC	18 008.609	11 841.767	
142+58.15	PI	18 001.578	11 857.694	
142+69.26	PT	17 984.908	11 852.675	
142+69.26	PC	17 984.908	11 852.675	
142+83.98	PI	17 970.397	11 850.226	
142+92.53	PT	17 967.671	11 864.688	
142+97.60	PC	17 966.733	11 869.666	
143+18.01	PI	17 962.952	11 889.723	
143+30.51	PT	17 942.669	11 887.455	
143+31.32	PC	17 941.868	11 887.366	
143+44.00	PI	17 929.263	11 885.957	
143+53.92	PT	17 922.614	11 896.758	
143+67.84	PC	17 915.317	11 908.612	
143+76.52	PI	17 910.768	11 916.003	
143+83.58	PT	17 902.093	11 915.743	
143+91.10	PC	17 894.577	11 915.517	
144+00.10	PI	17 885.580	11 915.248	
144+07.31	PT	17 881.109	11 923.059	
144+17.45	PC	17 876.072	11 931.859	
144+27.66	PI	17 871.002	11 940.717	
144+35.37	PT	17 860.902	11 939.253	
144+44.59	PC	17 851.777	11 937.930	
144+57.25	PI	17 839.253	11 936.114	
144+67.16	PT	17 832.249	11 946.655	
144+85.31	PC	17 822.208	11 961.769	
144+94.49	PI	17 817.125	11 969.419	
145+01.79	PT	17 808.001	11 968.370	
145+02.48	PC	17 807.316	11 968.291	
145+11.52	PI	17 798.328	11 967.258	
145+19.47	PT	17 791.618	11 973.326	
145+36.92	PC	17 778.672	11 985.033	
145+41.16	PI	17 775.527	11 987.876	
145+45.37	PT	17 771.856	11 989.997	
145+68.39	PC	17 751.928	12 001.513	
145+77.81	PI	17 743.769	12 006.227	
145+86.90	PT	17 738.573	12 014.087	
145+99.35	PC	17 731.705	12 024.477	
146+10.53	PI	17 725.542	12 033.799	
146+20.74	PT	17 714.783	12 036.817	
146+35.33	PC	17 700.735	12 040.759	
146+42.61	PI	17 693.731	12 042.724	
146+48.88	PT	17 690.937	12 049.441	
146+60.76	PC	17 686.375	12 060.410	
146+72.53	PI	17 681.857	12 071.274	
146+82.03	PT	17 670.166	12 072.602	
146+85.23	PC	17 666.987	12 072.963	
147+00.28	PI	17 652.032	12 074.662	

CENTERLINE COORDINATE TABLE CHANNEL 3

STATION	DESCRIPTION	N OR Y COORDINATE	E OR X COORDINATE	REMARKS
147+13.00	PT	17 644.813	12 087.868	
147+14.82	PC	17 643.940	12 089.465	
147+34.78	PI	17 634.365	12 106.982	
147+46.20	PT	17 616.831	12 097.439	
147+66.62	PC	17 598.892	12 087.676	
147+99.70	PI	17 569.839	12 071.865	
148+18.53	PT	17 554.095	12 100.955	
148+21.87	PC	17 552.507	12 103.890	
148+29.55	PI	17 548.853	12 110.642	
148+36.53	PT	17 541.618	12 113.215	
148+46.20	PC	17 532.506	12 116.454	
148+77.55	PI	17 502.969	12 126.956	
148+97.79	PT	17 509.310	12 157.656	
149+24.07	PC	17 514.626	12 183.393	
149+42.43	PI	17 518.341	12 201.379	
149+54.67	PT	17 501.308	12 208.247	
149+73.71	PC	17 483.654	12 215.366	
149+85.23	PI	17 472.971	12 219.674	
149+94.93	PT	17 470.426	12 230.908	
150+11.53	PC	17 466.758	12 247.097	
150+26.30	PI	17 463.495	12 261.501	
150+34.86	PT	17 449.042	12 258.461	
150+44.56	PC	17 439.549	12 256.465	
150+69.38	PI	17 415.265	12 251.358	
150+82.82	PT	17 411.383	12 275.868	
150+86.82	PC	17 410.757	12 279.818	
151+09.73	PI	17 407.172	12 302.452	
151+23.91	PT	17 384.312	12 300.846	
151+36.69	PC	17 371.564	12 299.950	
151+53.52	PI	17 354.776	12 298.770	
151+61.98	PT	17 355.527	12 315.583	
151+63.12	PC	17 355.578	12 316.722	
152+02.67	PI	17 357.344	12 356.237	
152+18.43	PT	17 318.816	12 347.282	
152+18.43	PC	17 318.816	12 347.282	
152+24.98	PI	17 312.434	12 345.793	
152+31.39	PT	17 305.946	12 346.713	
152+31.39	PC	17 305.946	12 346.713	
152+44.92	PI	17 292.508	12 348.275	
152+53.40	PT	17 292.680	12 361.803	
152+67.71	PC	17 292.862	12 376.112	
152+82.89	PI	17 293.055	12 391.291	
152+91.46	PT	17 277.875	12 391.303	
153+03.30	PC	17 266.035	12 391.312	
153+13.00	PI	17 256.329	12 391.320	
153+19.80	PT	17 253.932	12 400.724	
153+32.24	PC	17 250.860	12 412.774	
153+48.35	PI	17 246.881	12 428.387	
153+56.87	PT	17 231.592	12 423.303	
153+77.73	POT	17 211.800	12 416.722	

GPK NAME: JOB300.GPK CHAIN NAME: SHORTENCCH3

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CENTERLINE COORDINATE TABLE CHANNEL 7

STATION	DESCRIPTION	N OR Y COORDINATE	E OR X COORDINATE	REMARKS
190+00.00	POT	16,087.419	13,176.228	
190+10.85	PC	16,076.814	13,173.924	
190+14.51	PI	16,073.236	13,173.147	
190+17.96	PT	16,070.701	13,170.505	
190+21.89	PC	16,067.984	13,167.672	
190+31.81	PI	16,061.113	13,160.508	
190+38.47	PT	16,052.788	13,165.914	
190+48.81	PC	16,044.117	13,171.546	
190+60.04	PI	16,034.696	13,177.664	
190+66.87	PT	16,027.970	13,168.666	
190+71.77	PC	16,025.037	13,164.743	
190+92.82	PI	16,012.435	13,147.884	
190+97.03	PT	16,004.347	13,167.317	
191+16.00	PC	15,997.059	13,184.828	
191+21.39	PI	15,994.987	13,189.805	
191+26.35	PT	15,996.558	13,194.963	
191+53.41	PC	16,004.444	13,220.849	
191+94.93	PI	16,016.542	13,260.566	
191+90.13	PT	15,981.853	13,237.753	
192+16.30	PC	15,959.990	13,223.375	
192+21.17	PI	15,955.918	13,220.697	
192+25.72	PT	15,954.198	13,216.138	
192+61.65	PC	15,941.515	13,182.530	
193+17.50	PI	15,921.794	13,130.274	
193+00.90	PT	15,912.682	13,185.379	
193+27.89	PC	15,908.278	13,212.011	
193+33.61	PI	15,907.345	13,217.652	
193+38.56	PT	15,902.377	13,220.481	
193+45.47	PC	15,896.372	13,223.901	
193+58.17	PI	15,885.338	13,230.185	
193+65.00	PT	15,879.687	13,218.813	
193+93.54	PC	15,866.988	13,193.256	
194+21.43	PI	15,854.577	13,168.280	
194+21.49	PT	15,844.975	13,194.464	
194+45.31	PC	15,836.773	13,216.828	
194+56.66	PI	15,832.863	13,227.489	
194+63.50	PT	15,822.003	13,224.173	
194+67.97	PC	15,817.721	13,222.866	
194+74.48	PI	15,811.497	13,220.965	
194+79.90	PT	15,809.695	13,214.711	
194+93.21	PC	15,806.009	13,201.918	
195+04.43	PI	15,802.901	13,191.134	
195+11.26	PT	15,791.934	13,193.513	
195+13.24	PC	15,789.997	13,193.933	
195+20.32	PI	15,783.079	13,195.434	
195+26.03	PT	15,781.046	13,202.215	
195+36.55	PC	15,778.027	13,212.287	
195+64.94	PI	15,769.873	13,239.486	
195+64.65	PT	15,756.050	13,214.683	
195+78.16	PC	15,749.475	13,202.885	
195+98.71	PI	15,739.469	13,184.931	
196+03.17	PT	15,728.753	13,202.471	
196+17.63	PC	15,721.218	13,214.804	
196+38.77	PI	15,710.194	13,232.848	
196+42.94	PT	15,700.356	13,214.131	
196+48.87	PC	15,697.593	13,208.874	
196+70.60	PI	15,687.482	13,189.640	
196+74.46	PT	15,676.588	13,208.441	
196+76.32	PC	15,675.659	13,210.043	
196+91.82	PI	15,667.886	13,223.459	
196+98.21	PT	15,656.849	13,212.569	
196+99.58	PC	15,655.869	13,211.602	
197+07.85	PI	15,649.985	13,205.797	
197+14.06	PT	15,642.464	13,209.225	

CENTERLINE COORDINATE TABLE CHANNEL 7

STATION	DESCRIPTION	N OR Y COORDINATE	E OR X COORDINATE	REMARKS
197+26.57	PC	15,631.083	13,214.412	
197+32.08	PI	15,626.069	13,216.697	
197+37.18	PT	15,620.711	13,215.410	
197+44.94	PC	15,613.165	13,213.598	
197+50.17	PI	15,608.084	13,212.377	
197+55.11	PT	15,603.139	13,214.068	
197+70.18	PC	15,588.886	13,218.939	
197+73.83	PI	15,585.425	13,220.122	
197+77.39	PT	15,581.775	13,219.860	
197+96.99	PC	15,562.228	13,218.457	
198+01.69	PI	15,557.541	13,218.120	
198+05.95	PT	15,553.872	13,221.055	
198+31.94	PC	15,533.576	13,237.290	
198+40.70	PI	15,526.732	13,242.765	
198+47.08	PT	15,519.434	13,237.911	
198+58.56	PC	15,509.871	13,231.550	
198+66.38	PI	15,503.362	13,227.220	
198+72.42	PT	15,496.771	13,231.425	
198+89.94	PC	15,481.999	13,240.849	
198+99.07	PI	15,474.307	13,245.756	
199+05.55	PT	15,467.522	13,239.655	
199+08.99	PC	15,464.960	13,237.351	
199+22.41	PI	15,454.986	13,228.383	
199+29.18	PT	15,447.178	13,239.290	
199+37.73	PC	15,442.198	13,246.248	
199+54.61	PI	15,432.375	13,259.971	
199+61.51	PT	15,421.613	13,246.971	
199+79.86	PC	15,409.909	13,232.833	
199+94.46	PI	15,400.598	13,221.585	
200+01.79	PT	15,390.503	13,232.135	
200+08.52	PC	15,385.846	13,237.002	
200+30.52	PI	15,370.637	13,252.896	
200+35.49	PT	15,364.050	13,231.907	
200+44.64	PC	15,361.309	13,223.176	
200+65.98	PI	15,354.920	13,202.818	
200+73.38	PT	15,337.926	13,215.721	
200+81.60	PC	15,331.385	13,220.689	
200+93.56	PI	15,321.859	13,227.922	
201+00.41	PT	15,314.595	13,218.420	
201+17.16	PC	15,304.420	13,205.112	
201+27.57	PI	15,298.099	13,196.843	
201+35.36	PT	15,288.140	13,199.872	
201+39.72	PC	15,283.964	13,201.142	
201+47.76	PI	15,276.272	13,203.480	
201+54.48	PT	15,270.065	13,198.370	
201+68.84	PC	15,258.982	13,189.244	
201+80.19	PI	15,250.218	13,182.028	
201+89.49	PT	15,251.922	13,170.804	
201+97.95	POT	15,253.191	13,162.438	

GPK NAME: JOB3.GPK CHAIN NAME: CHANNEL7

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MONTANA	CBINHTSA MT 1-1(79) 45	CC 5

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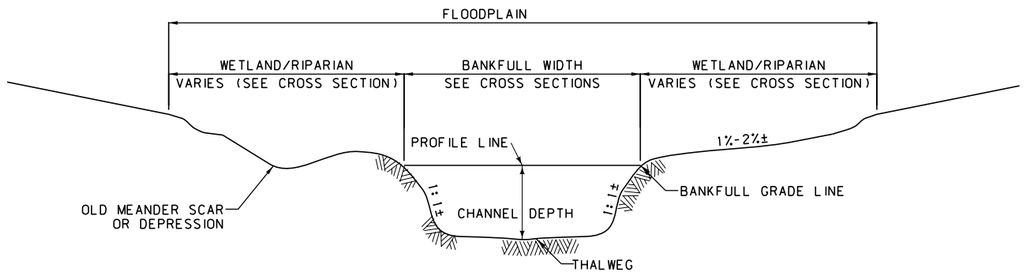
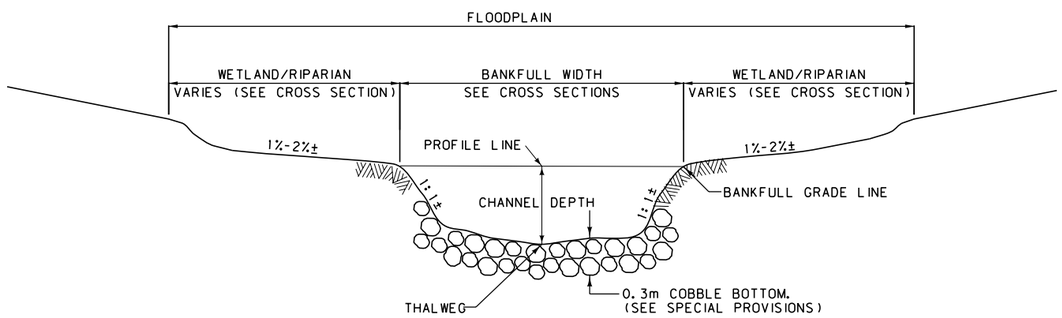
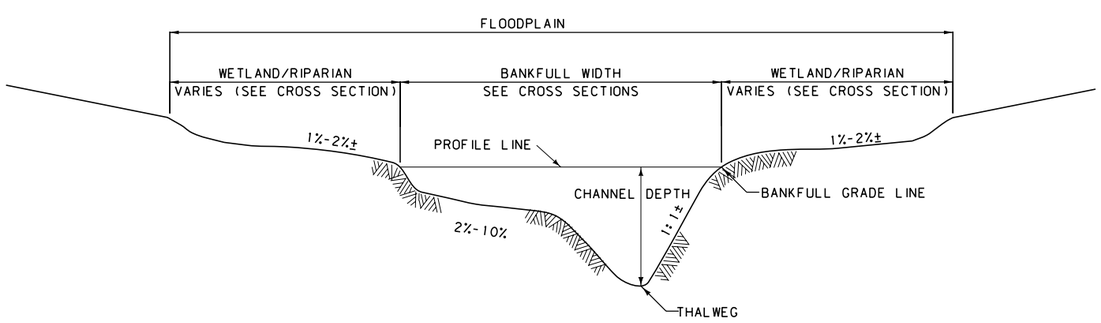


TYPICAL SECTION
RUN



TYPICAL SECTION
RIFFLE



TYPICAL SECTION
POOL

NOTES:

(1) THESE TYPICAL SECTIONS SHOW THE GENERAL PROPERTIES OF THE CROSS-SECTIONS FOR THE CHANNEL RE-CONSTRUCTION. THE PLANS, PROFILE, AND CROSS-SECTIONS PROVIDE SPECIFIC INFORMATION REGARDING THE CHANNEL CONSTRUCTION.

(2) LOCATE THE DEEPEST PORTION OF THE POOL CROSS-SECTION ON THE OUTSIDE OF THE CHANNEL BEND.

(3) SEE THE SPECIAL PROVISION FOR CHANNEL CONSTRUCTION SEQUENCING REQUIREMENTS.

CHANNEL CHANGE 1			
REACH 1 OF 1	100+00 TO 101+50		
	BANKLINE SLOPE = 0.999%		
	RIFFLE	RUN	POOL
WIDTH	6.1	5.5	7.3
DEPTH	0.53	0.64	1.00

CHANNEL CHANGE 2			
REACH 1 OF 1	132+00 TO 135+00		
	BANKLINE SLOPE = 0.937%		
	RIFFLE	RUN	POOL
WIDTH	6.0	5.3	7.0
DEPTH	0.6	0.7	1.2

CHANNEL CHANGE 3			
REACH 1 OF 4	139+60 TO 140+76		
	BANKLINE SLOPE = 0.736%		
	RIFFLE	RUN	POOL
WIDTH	6.2	5.7	7.5
DEPTH	0.6	0.7	1.2

CHANNEL CHANGE 3			
REACH 2 OF 4	140+76 TO 144+17		
	BANKLINE SLOPE = 1.261%		
	RIFFLE	RUN	POOL
WIDTH	5.7	5.7	7.5
DEPTH	0.5	0.5	0.65

CHANNEL CHANGE 3			
REACH 3 OF 4	144+17 TO 150+09		
	BANKLINE SLOPE = 0.851%		
	RIFFLE	RUN	POOL
WIDTH	6.0	5.2	7.6
DEPTH	0.5	0.7	0.9

CHANNEL CHANGE 3			
REACH 4 OF 4	150+09 TO 153+77		
	BANKLINE SLOPE = 0.565%		
	RIFFLE	RUN	POOL
WIDTH	6.5	6.1	7.9
DEPTH	0.5	0.6	1.2

CHANNEL CHANGE 5			
REACH 1 OF 1	170+00 TO 171+14		
	BANKLINE SLOPE = 0.735%		
	RIFFLE	RUN	POOL
WIDTH	6.8	5.6	8.0
DEPTH	0.5	0.6	0.9

CHANNEL CHANGE 7			
REACH 1 OF 2	190+00 TO 197+38		
	BANKLINE SLOPE = 1.043%		
	RIFFLE	RUN	POOL
WIDTH	3.8	3.6	4.8
DEPTH	0.3	0.35	0.5

CHANNEL CHANGE 7			
REACH 2 OF 2	197+38 TO 201+98		
	BANKLINE SLOPE = 0.820%		
	RIFFLE	RUN	POOL
WIDTH	4.0	3.8	5.2
DEPTH	0.3	0.35	0.55

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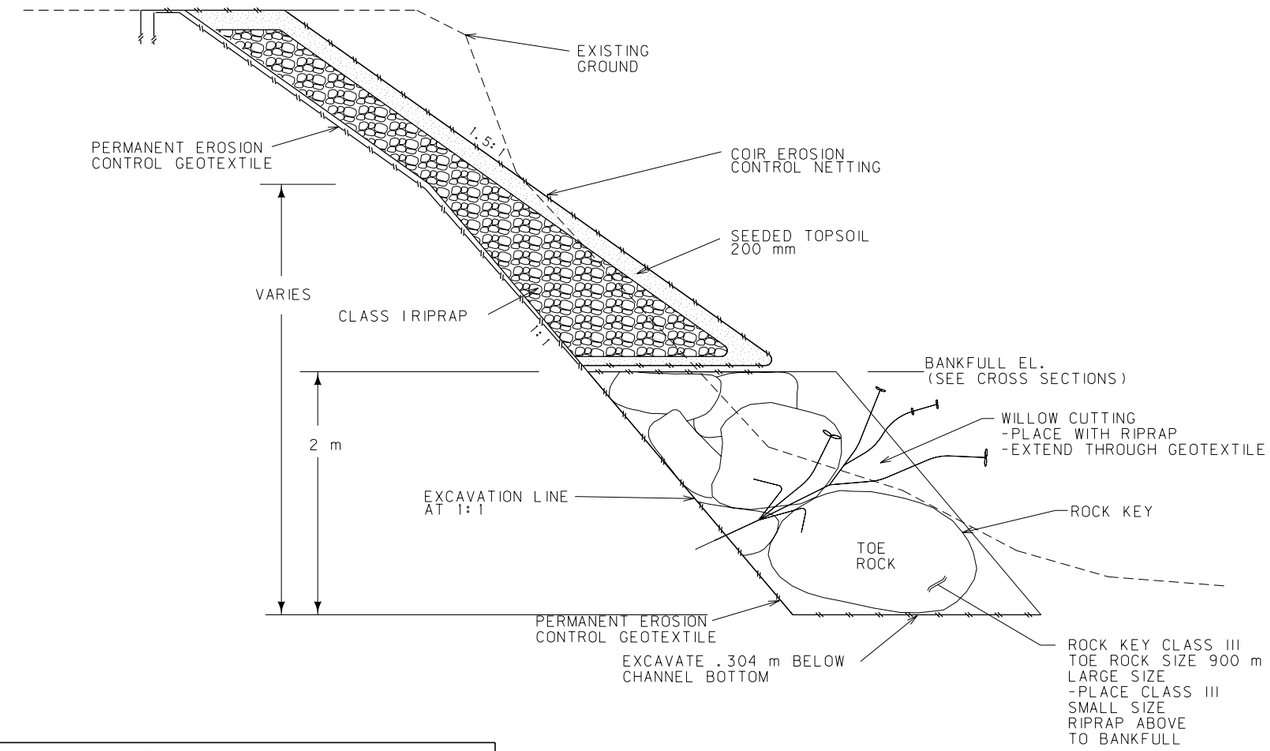

ROCKWALL

CHANNEL (INCLUDED IN ROAD PLAN SUMMARIES)

CHANNEL	CHANNEL REACH	cubic meters						square meters			hour	each			meters	STREAM
		CHANNEL EXCAVATION	* DRAIN AGG	RANDOM RIPRAP CL. 1	RANDOM RIPRAP CL. 2	RANDOM RIPRAP CL. 3	@ NATIVE SOILS	PERM. EROS. TYP. A	COIR EROS. NETTING	TOPSOIL	# DOZER	ENGINEERED LOG JAM	GRADE CONTROL	WEIR DROP	FASCINE	TYPE
CHC1	100+00 TO 101+48	3 641	14		72.0		90.0		1800.0	912	40	1	2		24	B4c
CHC2	132+00 TO 135+00	7 305	39				180.0		3600.0	1824		2	3		95	B4c
CHC3	139+60 TO 140+76	16 745	185				840.0		16800.0	705		1			500	C4
	140+76 TO 144+17									2073		1				C4
	144+17 TO 150+09			290.0		239.0		564.9		3599			4			B4c
	150+09 TO 153+77									2238		1	1			C4
CHC5	170+00 TO 171+14	1 238	14				69.0		1368.0	876		1	1		33	C4
CHC7	190+00 TO 197+38	18 515	98						9600.0	4487		2		6		B4c
CHC7	197+38 TO 201+98									2791			1			
SUBTOTAL													12	6		
TOTALS		47 444	350	290.0	72.0	239.0	1178.0	564.9	33 168.0	19505	40	9	18		652	

@ USED FOR CONSTRUCTION OF WRAPPED SOIL LIFTS MEASURED AND PAID AS CHANNEL EXCAVATION.

* DRAIN AGGREGATE ARE FOR RIFFLES USING 3 METERS IN LENGTH TO CALCULATE FOR QUANTITIES

DOZER HOURS ARE FOR RE-GRADING EXISTING CHANNEL BETWEEN CHANNEL 1 AND CHANNEL 2

MONTANA DEPARTMENT OF TRANSPORTATION

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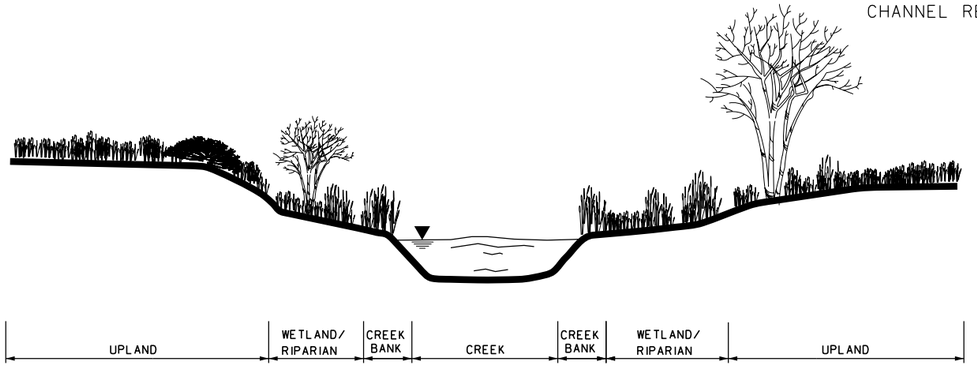
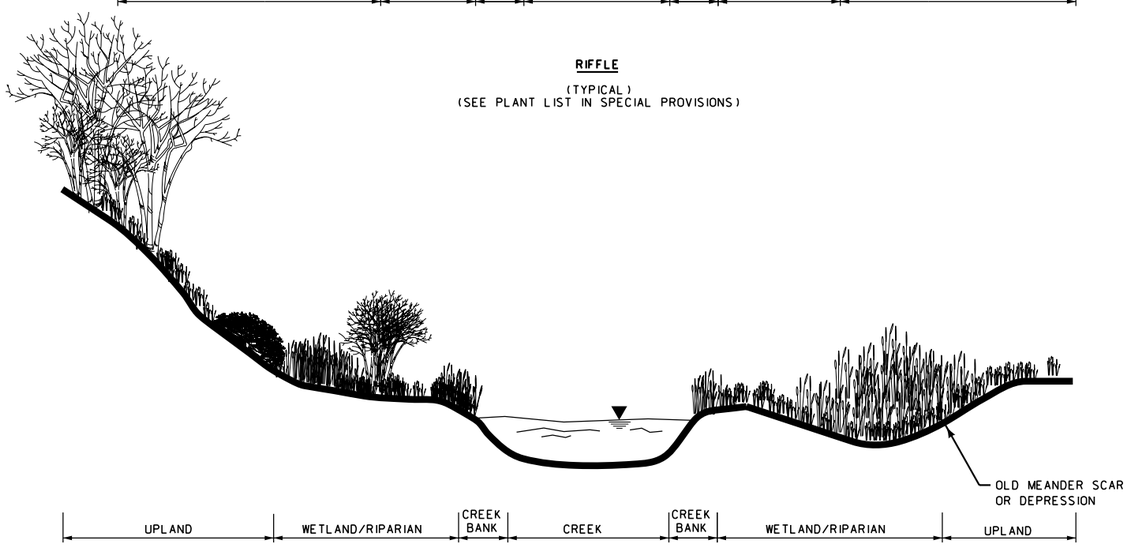
STATE	PROJECT NUMBER	SHEET NO.
MONTANA	NH 1-1(35) 45 F	CC 7

CHANNEL REVEGETATION DETAILS



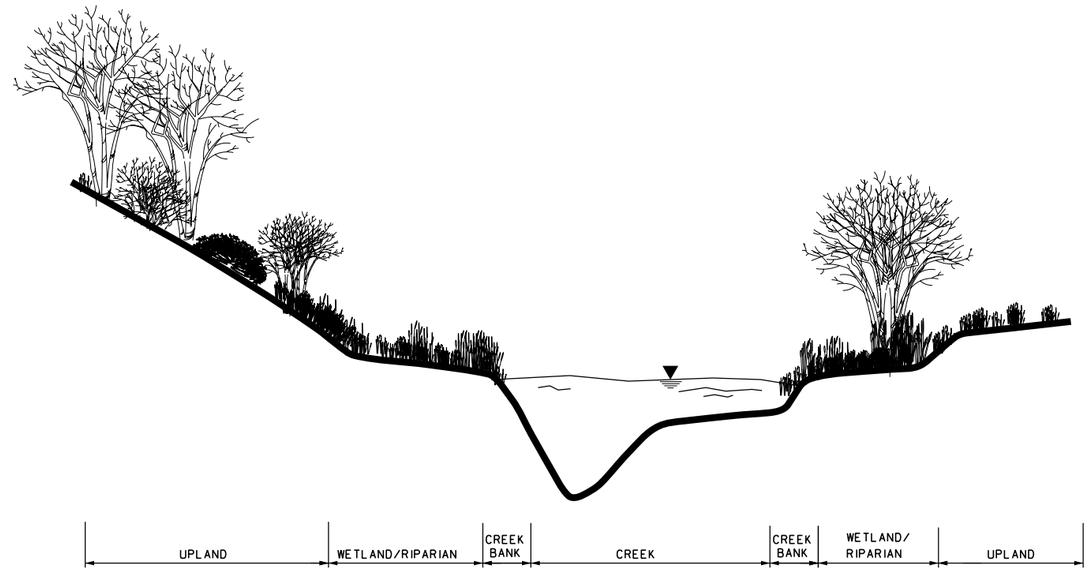
RIFFLE

(TYPICAL)
(SEE PLANT LIST IN SPECIAL PROVISIONS)



RUN

(TYPICAL)
(SEE PLANT LIST IN SPECIAL PROVISIONS)



POOL

(TYPICAL)
(SEE PLANT LIST IN SPECIAL PROVISIONS)

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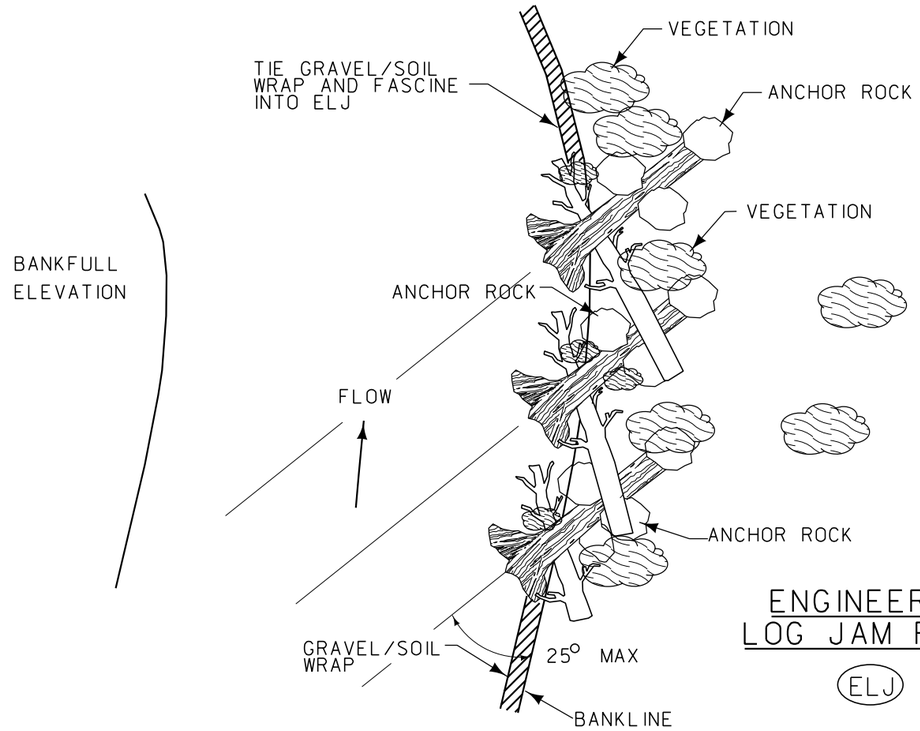
STATE	PROJECT NUMBER	SHEET NO.
MONTANA	CBI NHTSA MT 1-1(79) 45	CC 8

LIBBY CREEK-SOUTH

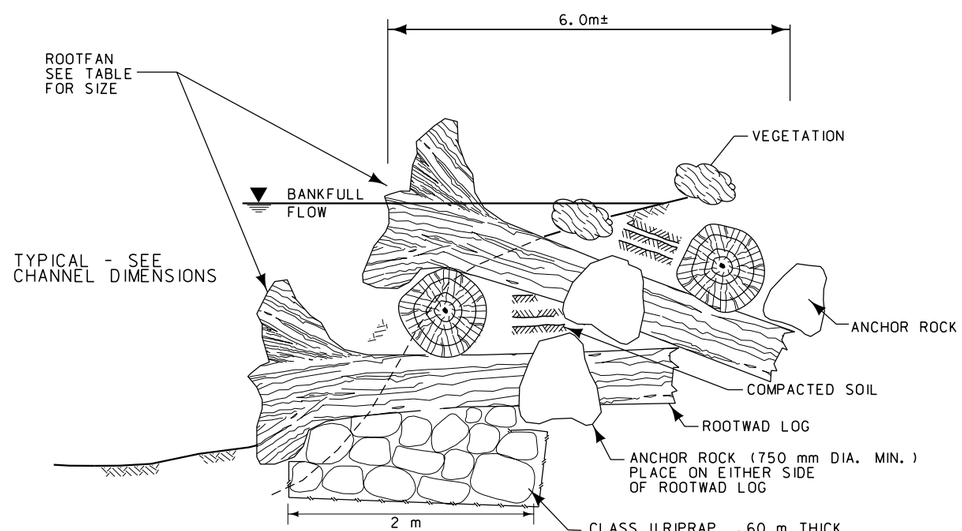
LOG STRUCTURE DETAILS



ENGINEERED LOG JAM PLAN

(ELJ)

ROOTFAN DIAMETERS		
SECTION	REACH	ELJ ROOTFAN DIAMETER (m)
CHC 1	100+00 to 101+48	0.5
CHC 2	132+00 to 135+00	0.6
CHC 3	139+60 to 140+76	0.6
CHC 3	140+76 to 144+17	0.3
CHC 3	144+17 to 150+09	0.45
CHC 3	150+09 to 153+77	0.6
CHC 5	170+00 to 171+14	0.45
CHC 7	190+00 to 201+98	0.3



ENGINEERED LOG JAM SECTION

(ELJ)

LOCATED AS DIRECTED BY ENGINEER

QUANTITIES FOR ELJ

LOGS - 6
ANCHOR ROCKS - 18
CLASS II RIPRAP 9 m^3
PERM. EROS. CONTRL. - 18 m^2

LOG STRUCTURE DETAILS

NTS

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LIBBY CREEK - SOUTH

MONTANA DEPARTMENT OF TRANSPORTATION

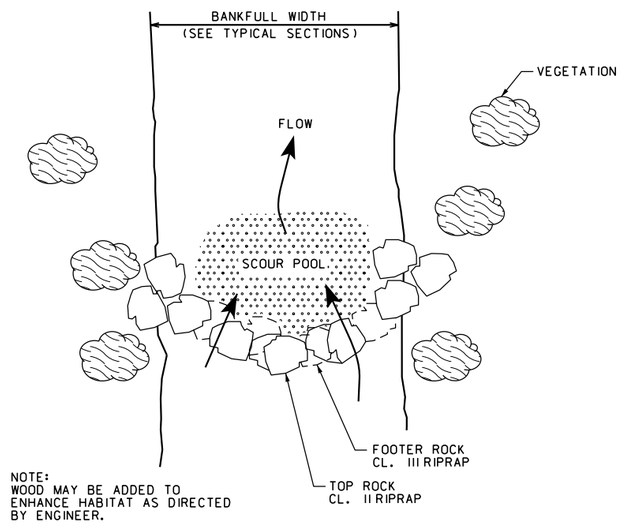
MONTANA CADD

QUANTITIES FOR WEIR DROP/GRADE CONTROL

CLASS III RANDOM RIPRAP - 6 m^3

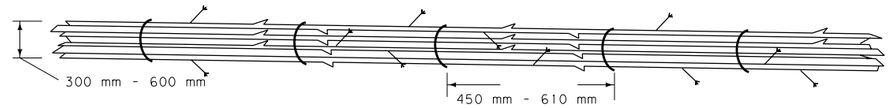
CLASS II RANDOM RIPRAP - 3 m^3

DRAIN AGGREGATE - 5.4 m^3



NOTE:
WOOD MAY BE ADDED TO ENHANCE HABITAT AS DIRECTED BY ENGINEER.

WEIR DROP/GRADE CONTROL PLAN



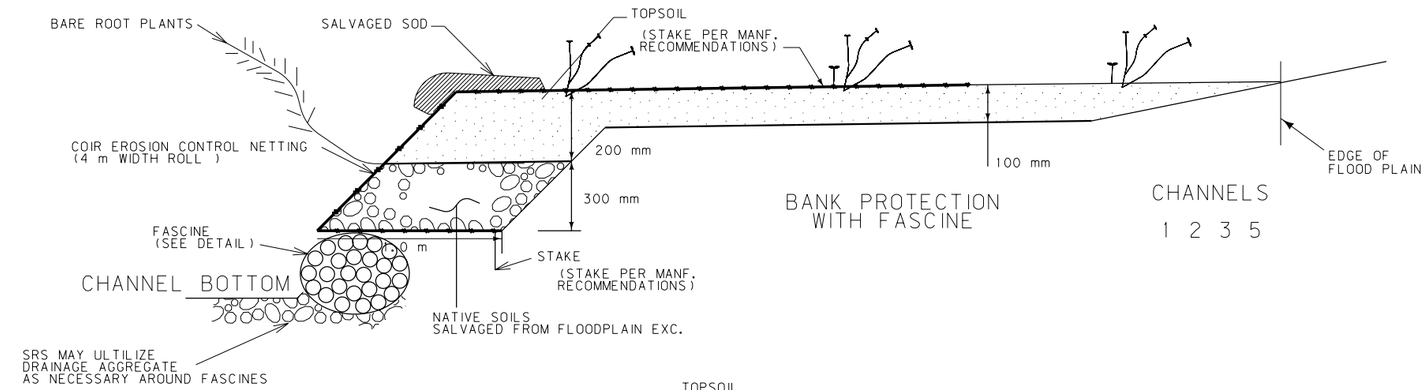
FASCINE

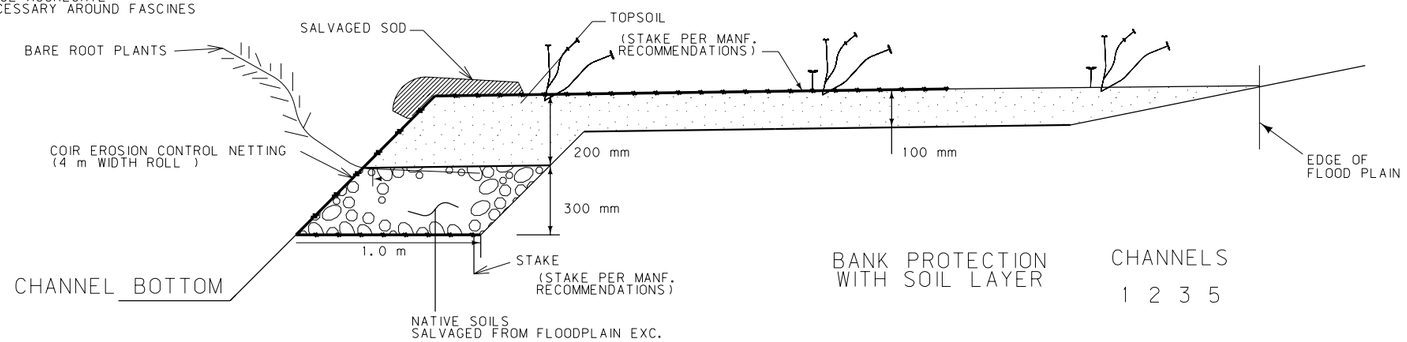
NOTE: OBTAIN LIVE CONIFER BRANCHES 13 mm TO 50 mm DIAMETER, 1.5 m TO 3.0 m LONG.

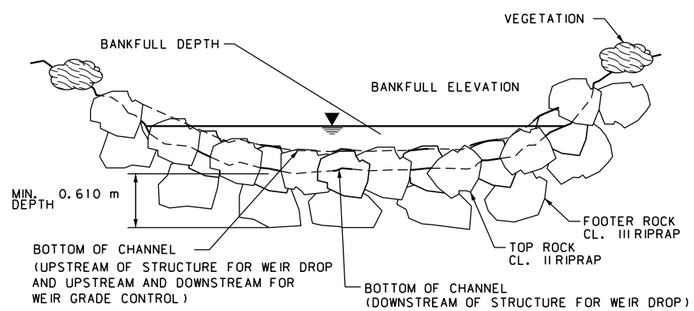
SIDE BRANCHES CAN BE LEFT INTACT.

STAGGER CUTTINGS IN A UNIFORM BUNDLE, 1.5 m TO 6.0 m LONG DEPENDING ON SITE CONDIDITIONS AND HANDLING CAPABILITIES. VARY ORIENTATION OF CUTTINGS.

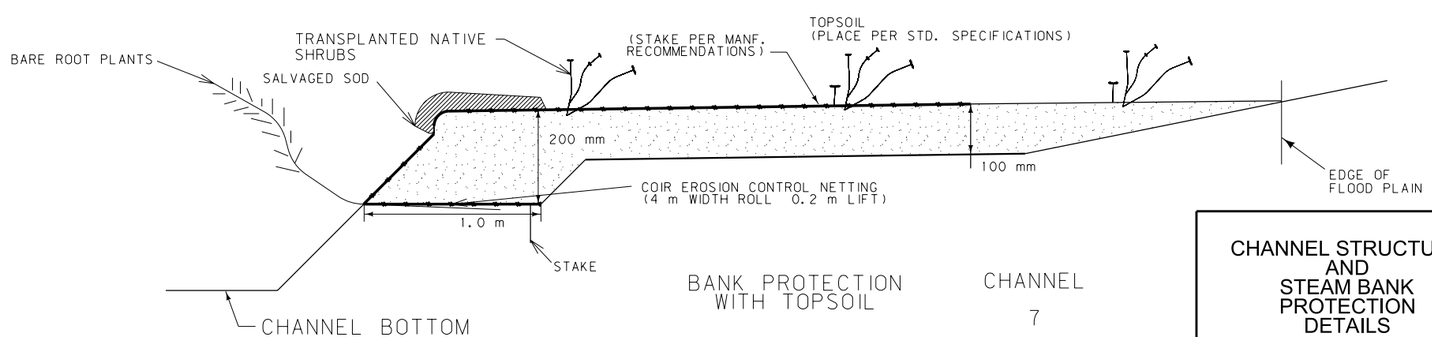
TIE BUNDLE WITH 100% BIODEGRADABLE BINDING MATERIAL

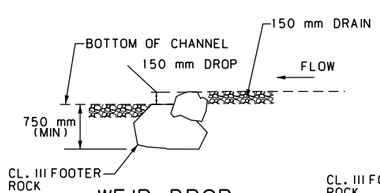






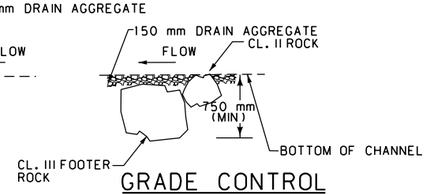
WEIR DROP/GRADE CONTROL SECTION





WEIR DROP SECTION

WD



GRADE CONTROL SECTION

GC

NOTE: PLACE 150 mm DRAIN AGGREGATE 3 m UPSTREAM AND DOWNSTREAM OF WEIR DROP AND GRADE AND GRADE CONTROL STRUCTURES

CHANNEL STRUCTURE AND STEAM BANK PROTECTION DETAILS

NTS

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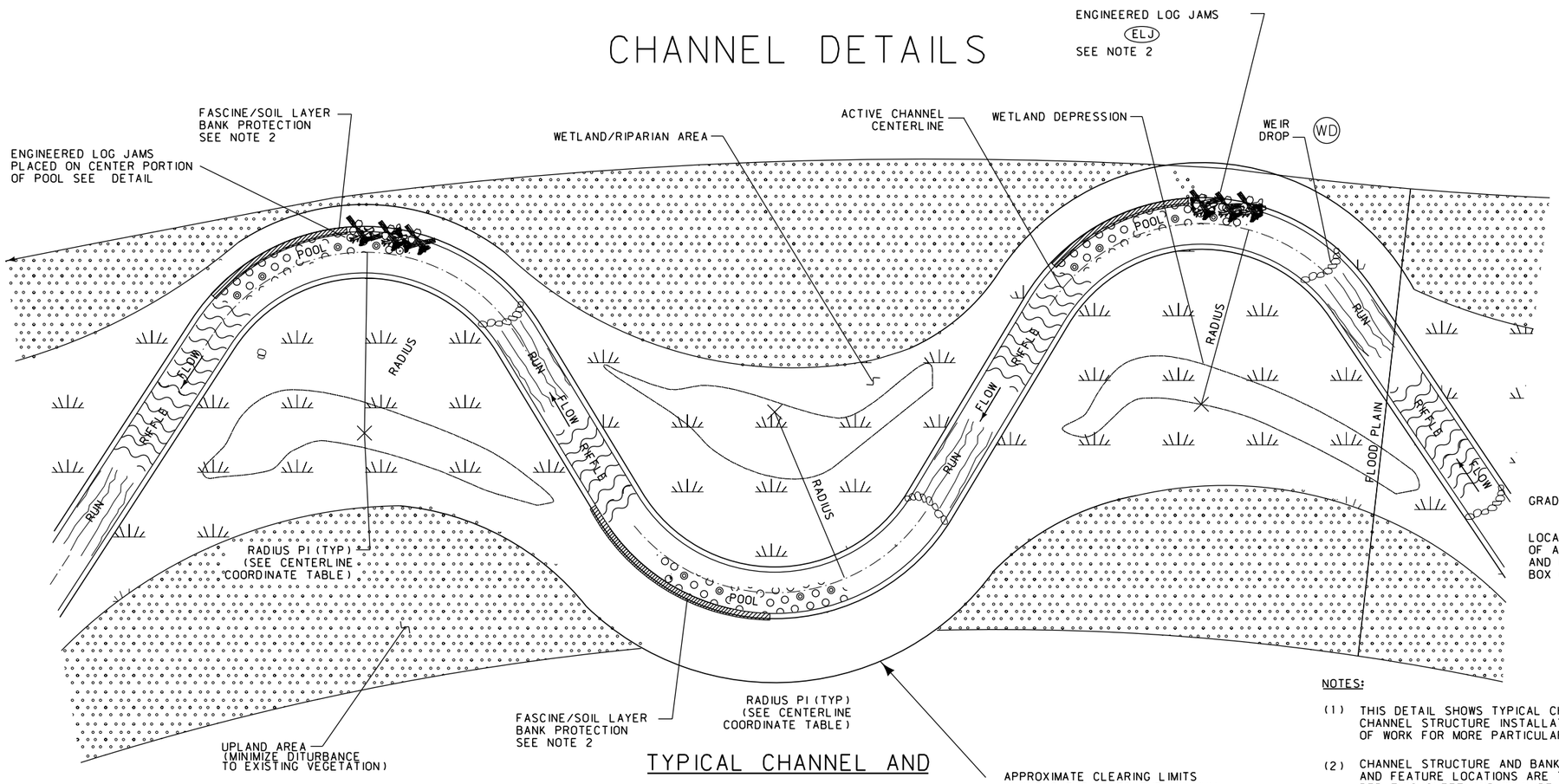
LIBBY CREEK-SOUTH

CHANNEL DETAILS



TYPICAL CHANNEL AND STRUCTURE PLAN

GRADE CONTROL WIER

GC

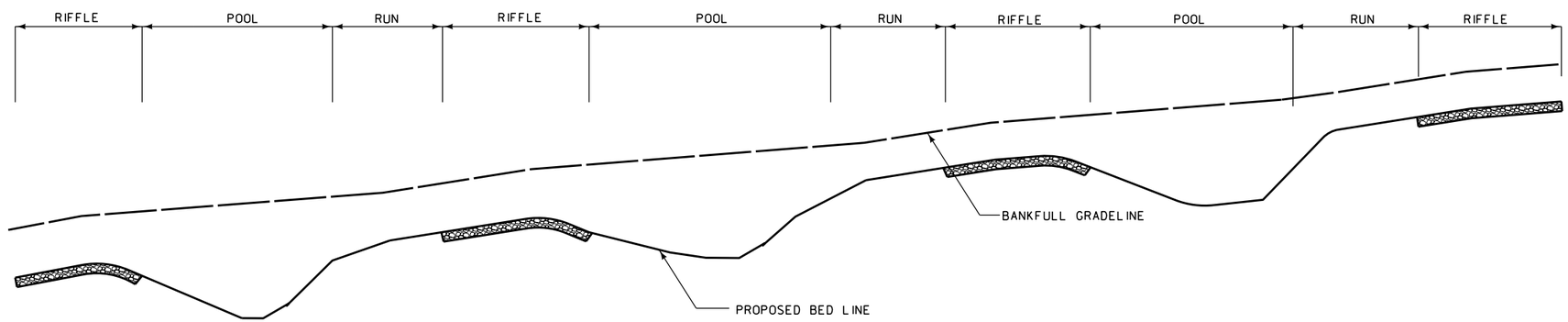
LOCATED AT BEGINNING AND END OF ALL NEW CHANNEL CHANGES AND UPSTREAM AND DOWNSTREAM OF BOX CULVERTS AND BRIDGES

NOTES:

(1) THIS DETAIL SHOWS TYPICAL CHANNEL CONSTRUCTION AND CHANNEL STRUCTURE INSTALLATION. SEE PLANS AND ITEMS OF WORK FOR MORE PARTICULAR INFORMATION.

(2) CHANNEL STRUCTURE AND BANK PROTECTION AND FEATURE LOCATIONS ARE TYPICAL PER THIS SHEET AND WILL BE LOCATED PER PLANS OR AS DIRECTED BY THE SRS. CHANNEL STRUCTURES WILL NOT BE LOCATED ON EVERY CURVE

(3) SEE CROSS SECTIONS FOR INFORMATION FOR POOLS, RIFFLES AND RUN LOCATIONS.



POOL-RUN-RIFFLE TYPICAL PROFILE

TYPICAL CHANNEL AND STRUCTURE LOCATION PLAN

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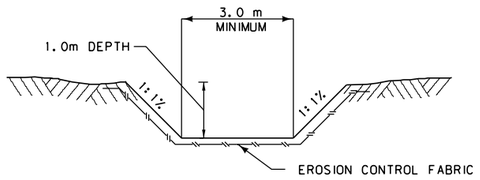
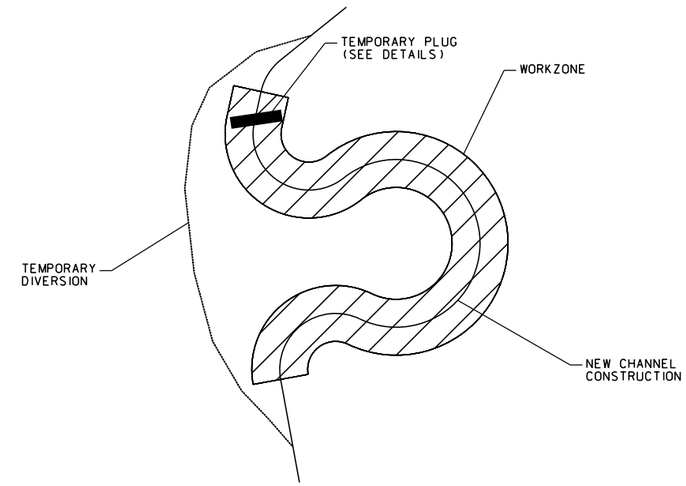
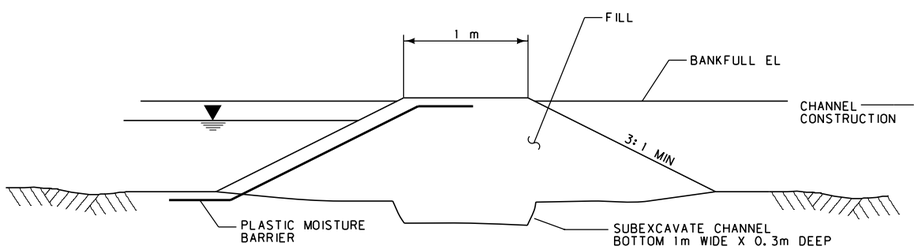


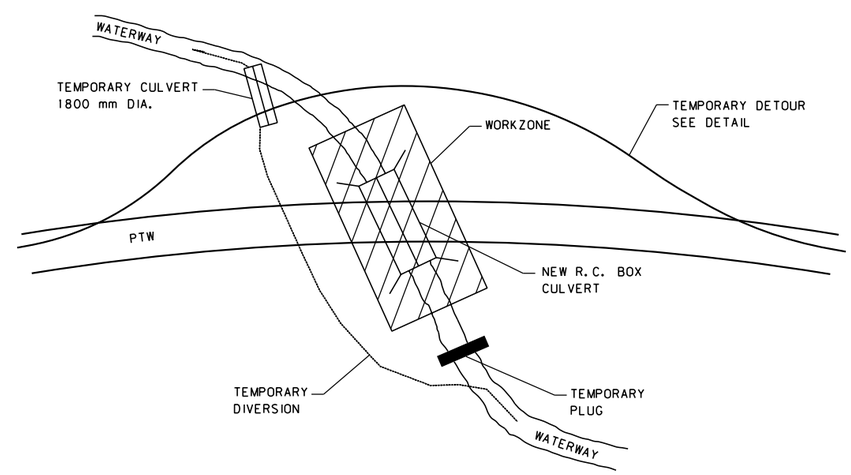
TYPICAL SECTION
TEMPORARY DIVERSION



TYPICAL TEMPORARY DIVERSION
FOR CHANNEL CONSTRUCTION



TEMPORARY PLUG SECTION



TYPICAL TEMPORARY DIVERSION
FOR R.C. BOX CULVERT
CONSTRUCTION

TEMPORARY DIVERSION DETAILS

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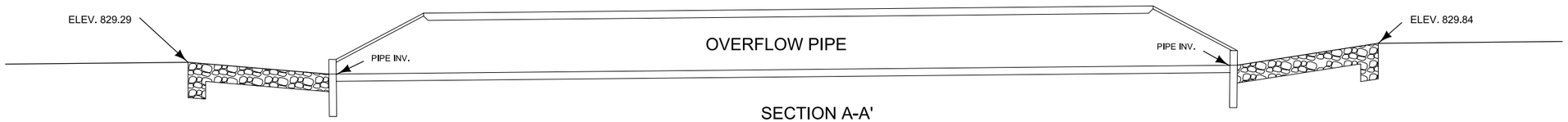
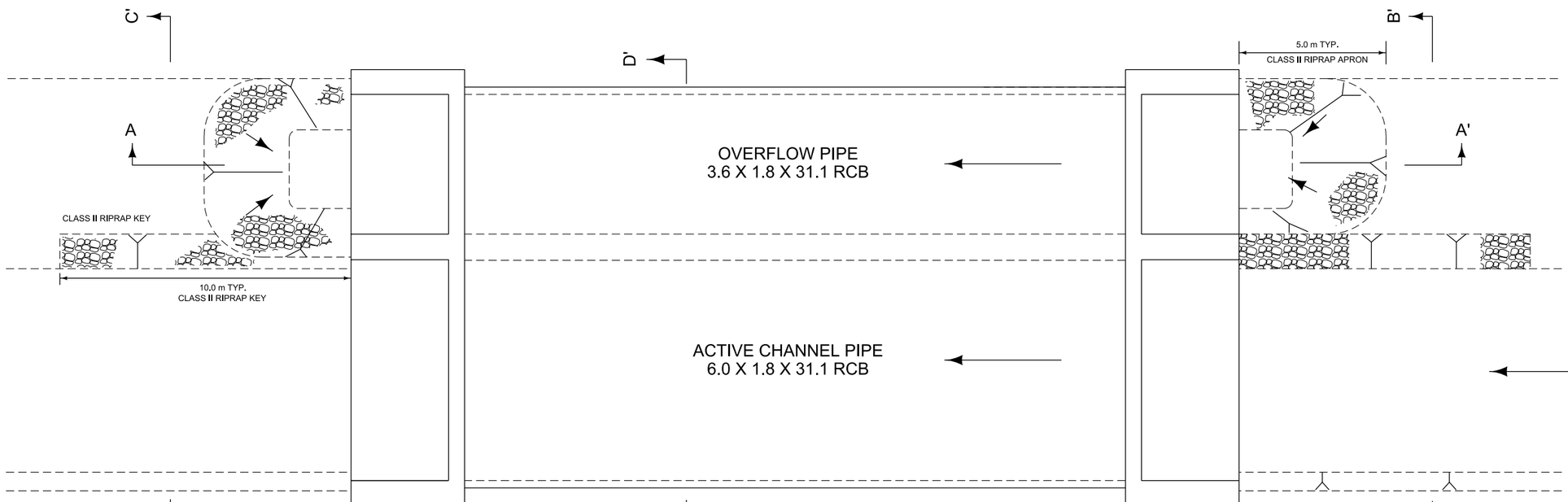
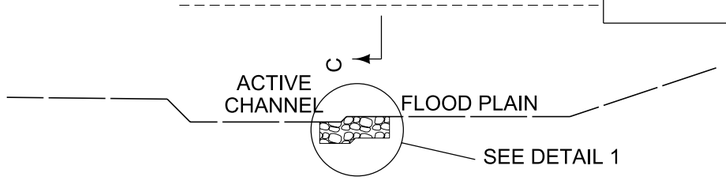
MONTANA	CBI NHTSA MT 1-1(79) 45	CC 12

LIBBY CREEK - SOUTH

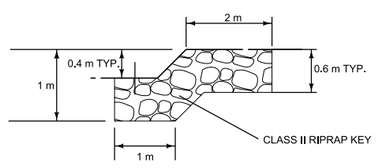


SECTION A-A'

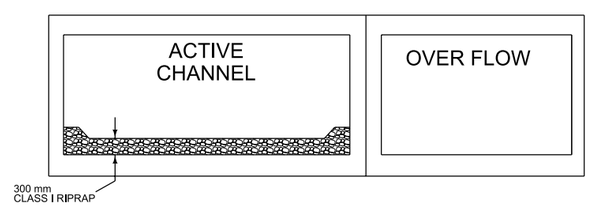




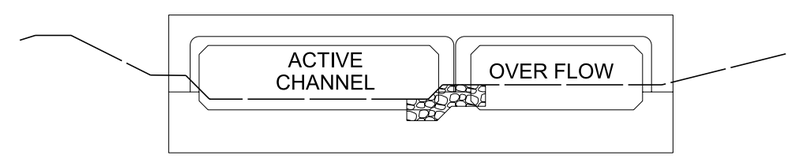
SECTION C-C'



DETAIL 1



SECTION D-D'



SECTION B-B'

CHANNEL DETAILS
AT DOUBLE RCB
STA. 14+72

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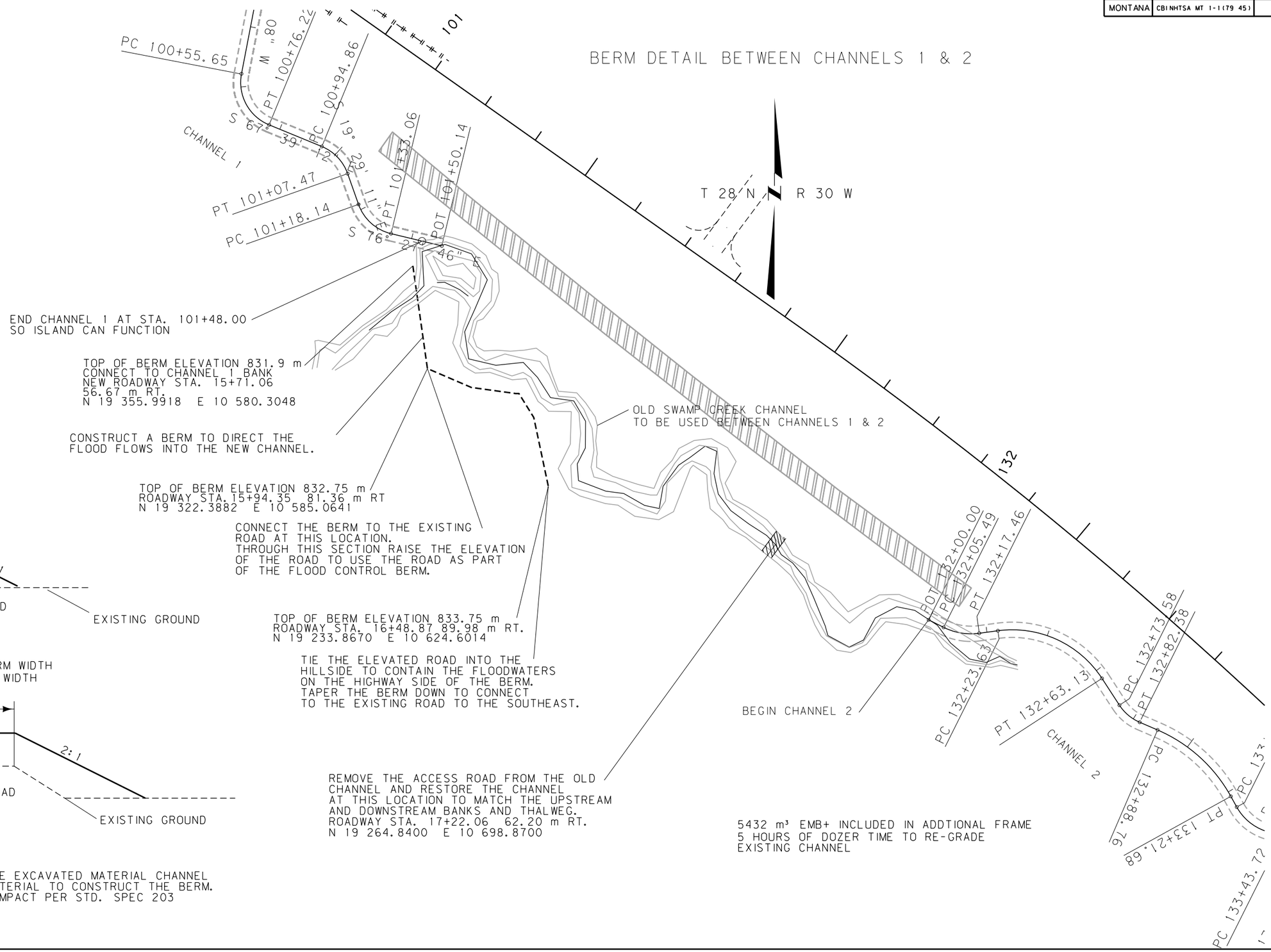
BERM DETAIL BETWEEN CHANNELS 1 & 2



NOTE: USE EXCAVATED MATERIAL CHANNEL
MATERIAL TO CONSTRUCT THE BERM.
COMPACT PER STD. SPEC 203

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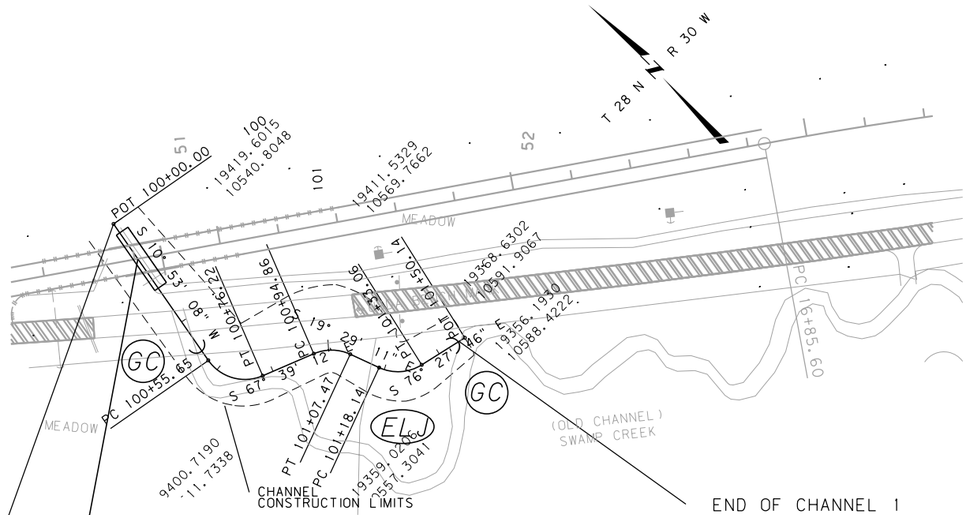
LIBBY CREEK SOUTH

CHANNEL 1



BEGIN OF CHANNEL 1
STA. 100+00.00=

MAINLINE STA. 14+66.05
12.97 m LT.

CULVERT CROSSING 1
℄ ROADWAY STA. 14+71.96
℄ CHANNEL STA. 100+14.26
6.0 m X 1.8 m X 31.1
3.6 m X 1.8 m X 31.1

END OF CHANNEL 1
STA. 101+48.00 =

MAINLINE STA. 15+74.87
45.84m RT.

PI = 100+67.92
Δ = 78° 32' 20" (LT)
R = 15 m
T = 12.26 m
L = 20.56 m
E = 4.38 m

PI = 101+01.57
Δ = 48° 10' 01" (RT)
R = 15 m
T = 6.70 m
L = 12.61 m
E = 1.43 m

PI = 101+26.28
Δ = 56° 58' 35" (LT)
R = 15 m
T = 8.14 m
L = 14.92 m
E = 2.07 m

BANK PROTECTION ALLOTTED FOR CHANNEL 1

24 m -FASCINE

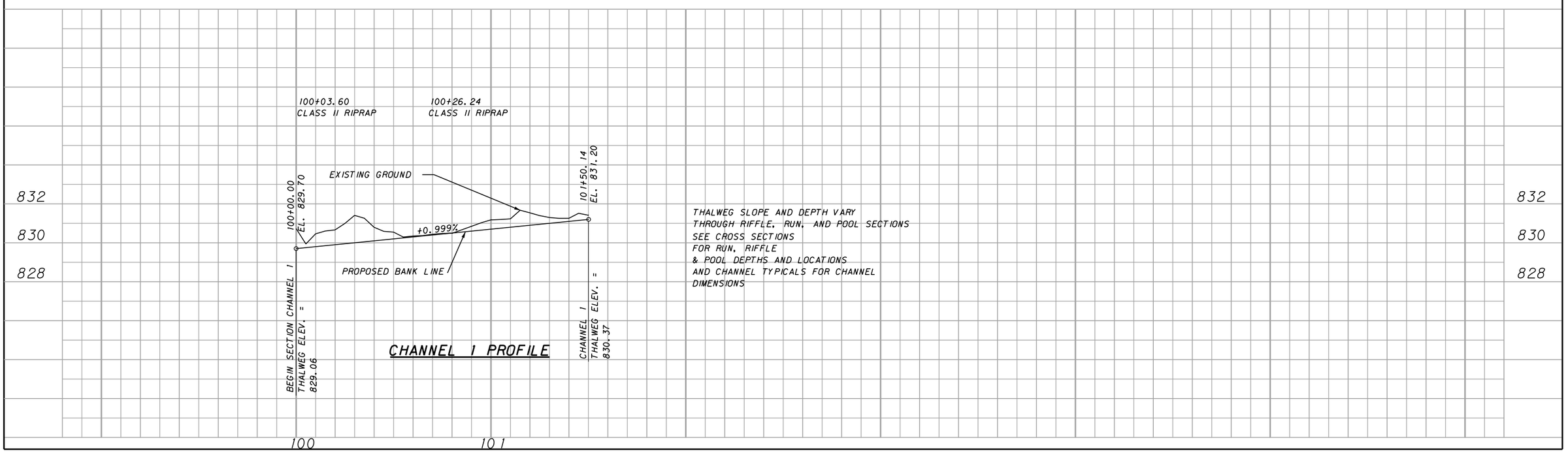
300 m - BANK PROTECTION WITH SOIL LAYER

STRUCTURES ALLOTTED FOR CHANNEL 1

1 - ENGINEERED LOG JAM (ELJ)

2 - GRADE CONTROL (REQUIRED) (GC)

NOTE: FINAL LOCATIONS FOR THE ELJ AND STREAM BANK PROTECTION TO BE DETERMINED BY STREAM RESTORATION SPECIALIST



CHANNEL 1 PROFILE

THALWEG SLOPE AND DEPTH VARY THROUGH RIFFLE, RUN, AND POOL SECTIONS SEE CROSS SECTIONS FOR RUN, RIFFLE & POOL DEPTHS AND LOCATIONS AND CHANNEL TYPICALS FOR CHANNEL DIMENSIONS

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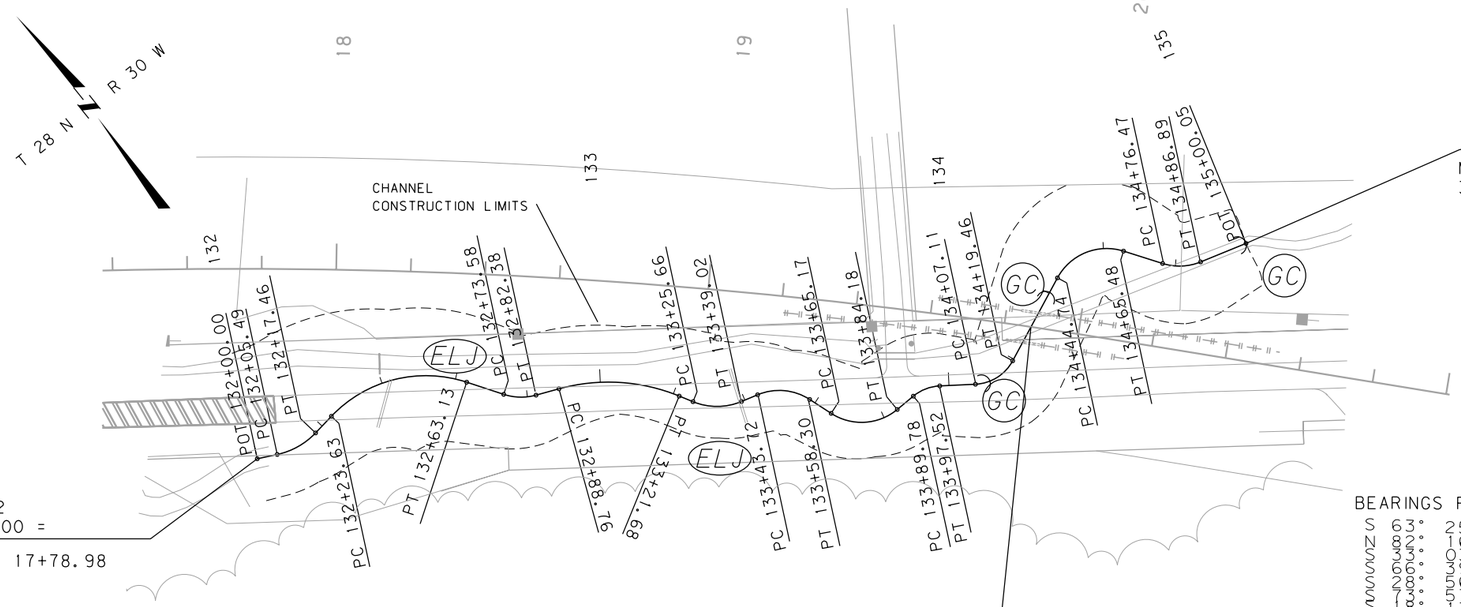
LIBBY CREEK SOUTH

CHANNEL 2



END OF CHC2
STA. 135+00.05=

MAINLINE STA. 20+40.49
31.23 m LT.

BEGIN OF CHC2
STA. 132+00.00 =

MAINLINE STA. 17+78.98
50.95 m RT.

CULVERT CROSSING 2
℄ ROADWAY STA. 19+87.24
℄ CHANNEL STA. 134+29.80
SINGLE 6.0 m X 1.8 m X 31.1. m RCB

BANK PROTECTION ALLOTTED FOR CHANNEL 2

95 m - FASCINE

600 m - BANK PROTECTION WITH SOIL LAYER

BEARINGS FOR CHANNEL

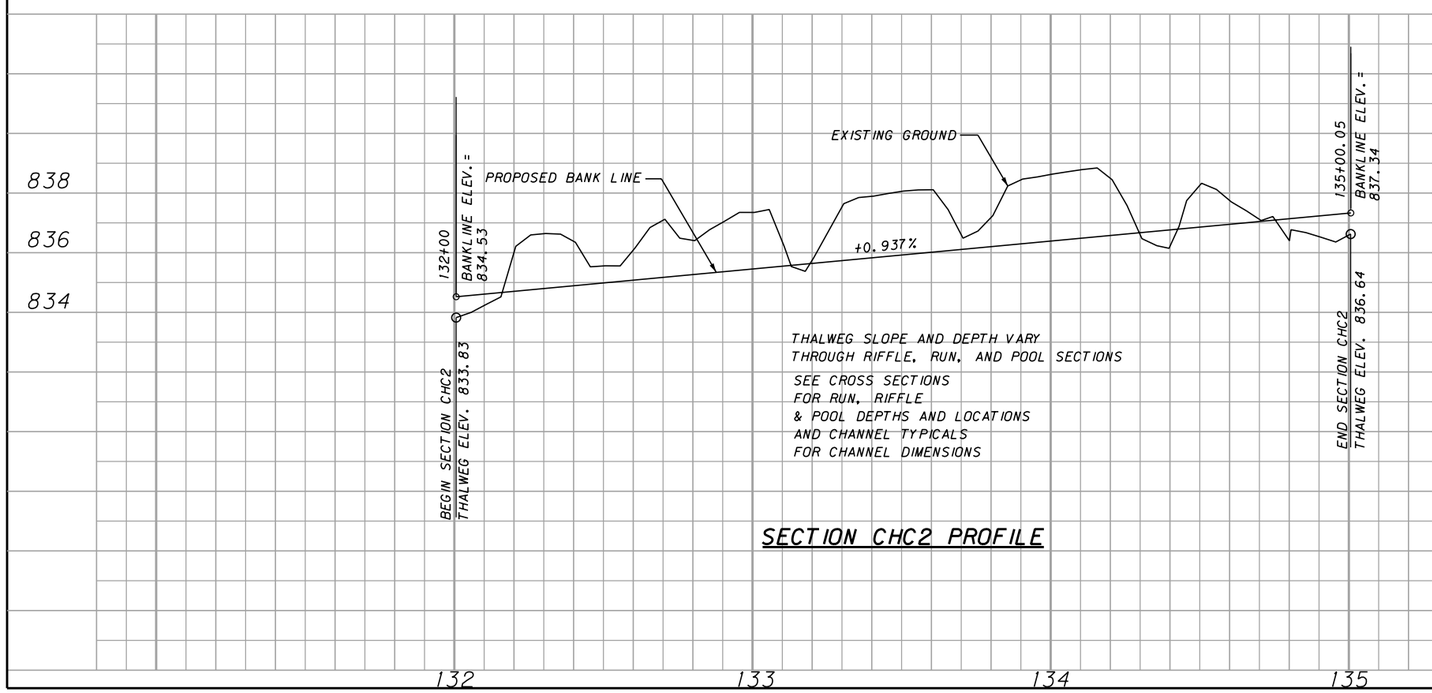
S 63° 25' 01" E
N 82° 16' 59" E
N 33° 03' 17" E
N 66° 39' 54" E
N 28° 56' 30" E
N 13° 57' 50" E
N 18° 17' 21" E
N 83° 05' 45" E
N 50° 57' 03" E
N 37° 46' 20" E
N 73° 28' 06" E

STRUCTURES ALLOTTED FOR CHANNEL 2

2 - ENGINEERED LOG JAMS (ELJ)

3 - GRADE CONTROL (REQUIRED) (GC)

FINAL LOCATION FOR ELJS AND STREAM BANK PROTECTION WILL BE DETERMINED BY THE STREAM RESTORATION SPECIALIST



SECTION CHC2 PROFILE

PI=132+11.66
Δ =34° 18' 00" (LT)
R =20 m
T =6.17 m
L =11.97 m
E =0.93 m

PI=132+45.78
Δ =64° 39' 44" (RT)
R =35 m
T =22.15 m
L =39.50 m
E =6.42 m

PI=132+78.11
Δ =33° 36' 37" (LT)
R =15 m
T =4.53 m
L =8.80 m
E =0.67 m

PI=133+05.84
Δ =37° 43' 24" (RT)
R =50 m
T =17.08 m
L =32.92 m
E =2.84 m

PI=133+32.71
Δ =45° 01' 19" (LT)
R =17 m
T =7.05 m
L =13.36 m
E =1.40 m

PI=133+51.64
Δ =55° 40' 29" (RT)
R =15 m
T =7.92 m
L =14.58 m
E =1.96 m

PI=133+76.19
Δ =72° 36' 54" (LT)
R =15 m
T =11.02 m
L =19.01 m
E =3.61 m

PI=133+93.79
Δ =36° 57' 12" (RT)
R =12 m
T =4.01 m
L =7.74 m
E =0.65 m

PI=134+13.89
Δ =58° 56' 32" (LT)
R =12 m
T =6.78 m
L =12.34 m
E =1.78 m

PI=134+57.16
Δ =79° 13' 18" (RT)
R =15 m
T =12.41 m
L =20.74 m
E =4.47 m

PI=134+81.90
Δ =39° 47' 50" (LT)
R =15 m
T =5.43 m
L =10.42 m
E =0.95 m

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MONTANA	CBI NHTSA MT 1-1(79)45	CC 16

LIBBY CREEK SOUTH

CHANNEL 3

BANK PROTECTION ALLOTTED FOR CHANNEL 3

500 m - FASCINE

2800 m -BANK PROTECTION WITH SOIL LAYER

STRUCTURES ALLOTTED FOR CHANNEL 3

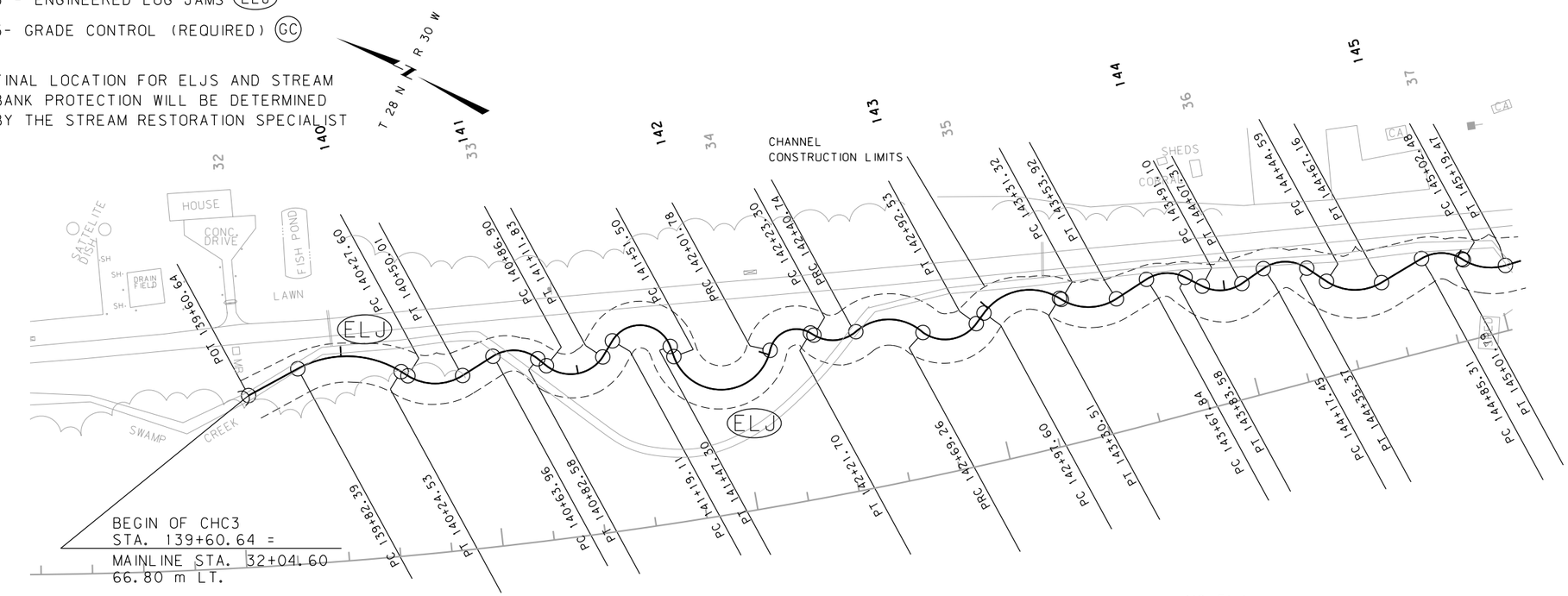
3 - ENGINEERED LOG JAMS (ELJ)

5- GRADE CONTROL (REQUIRED) (GC)

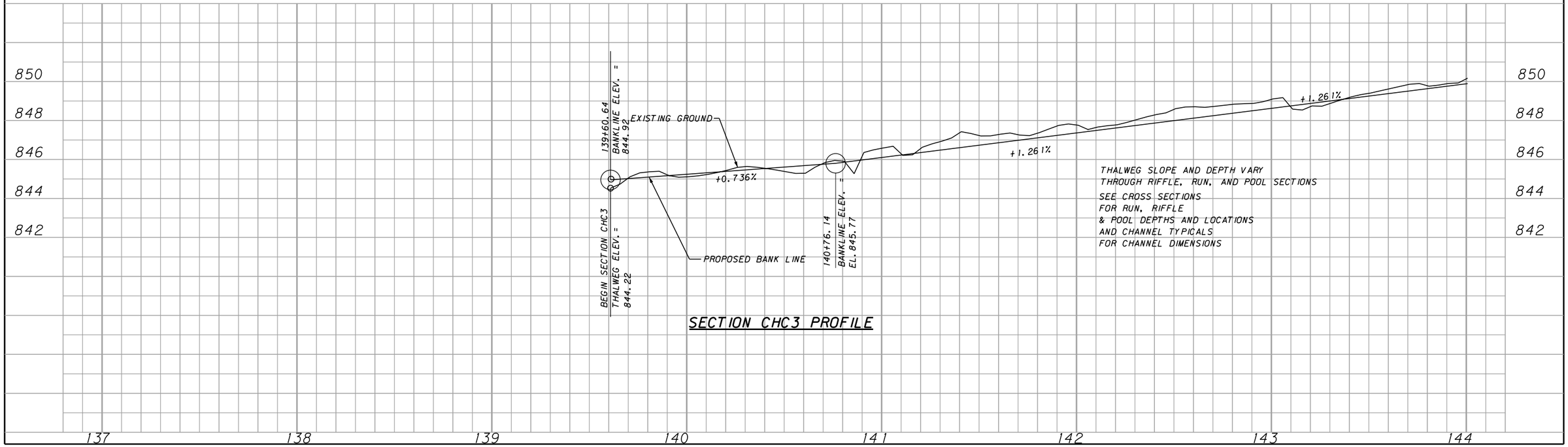
FINAL LOCATION FOR ELJS AND STREAM BANK PROTECTION WILL BE DETERMINED BY THE STREAM RESTORATION SPECIALIST

BEARINGS FOR CHANNEL

S 53° 58' 15" E
S 6° 22' 45" W
S 57° 49' 15" E
S 13° 18' 47" W
S 84° 29' 49" E
S 44° 44' 20" W
S 5° 40' 25" W
S 79° 19' 35" E
S 6° 22' 45" W
S 58° 23' 09" E
S 1° 43' 03" W
S 60° 12' 47" E
S 8° 14' 54" W
S 56° 24' 00" E
S 6° 33' 25" W
S 42° 07' 18" E
S 30° 01' 15" E
S 56° 31' 54" E
S 15° 40' 20" E
S 67° 25' 02" E
S 6° 28' 50" E
S 61° 20' 16" E
S 28° 33' 23" W
S 61° 34' 40" E
S 19° 34' 22" E
N 78° 19' 49" E
S 21° 57' 41" E
S 77° 14' 06" E
S 11° 52' 38" W
S 80° 59' 58" E
S 4° 01' 11" W
N 87° 26' 26" E
N 89° 16' 18" E
S 0° 02' 41" E
S 75° 42' 00" E
S 18° 23' 33" W



NO ELJ
FROM 144+00 TO 149+00 DUE TO ICE



SECTION CHC3 PROFILE

MONTANA DEPARTMENT OF TRANSPORTATION
MDT
MONTANA CADD

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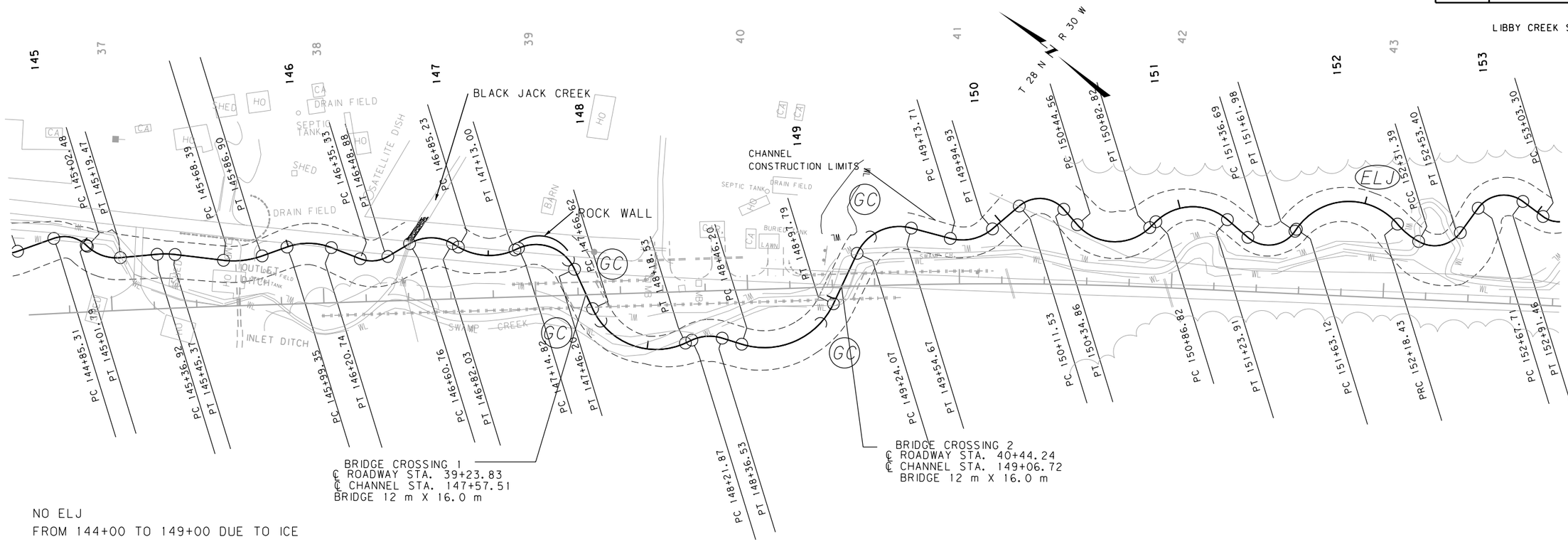
1 2 3

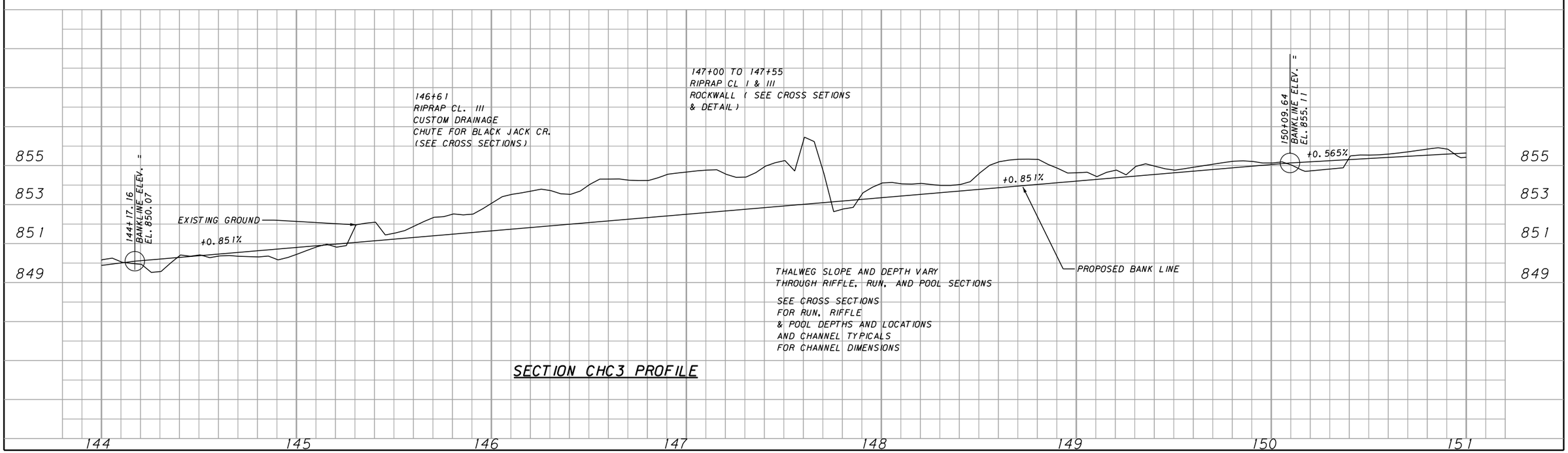
STATE	PROJECT NUMBER	SHEET NO.
MONTANA	CBI NHTSA MT 1-1(79)45	CC 17

CHANNEL 3

LIBBY CREEK SOUTH



NO ELJ
FROM 144+00 TO 149+00 DUE TO ICE



SECTION CHC3 PROFILE

MONTANA DEPARTMENT OF TRANSPORTATION
MDT
MONTANA CADD

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CPS - U2623

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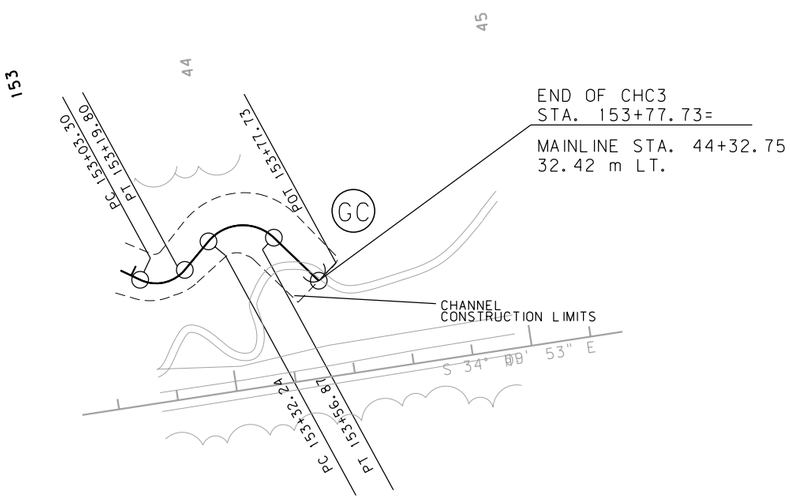
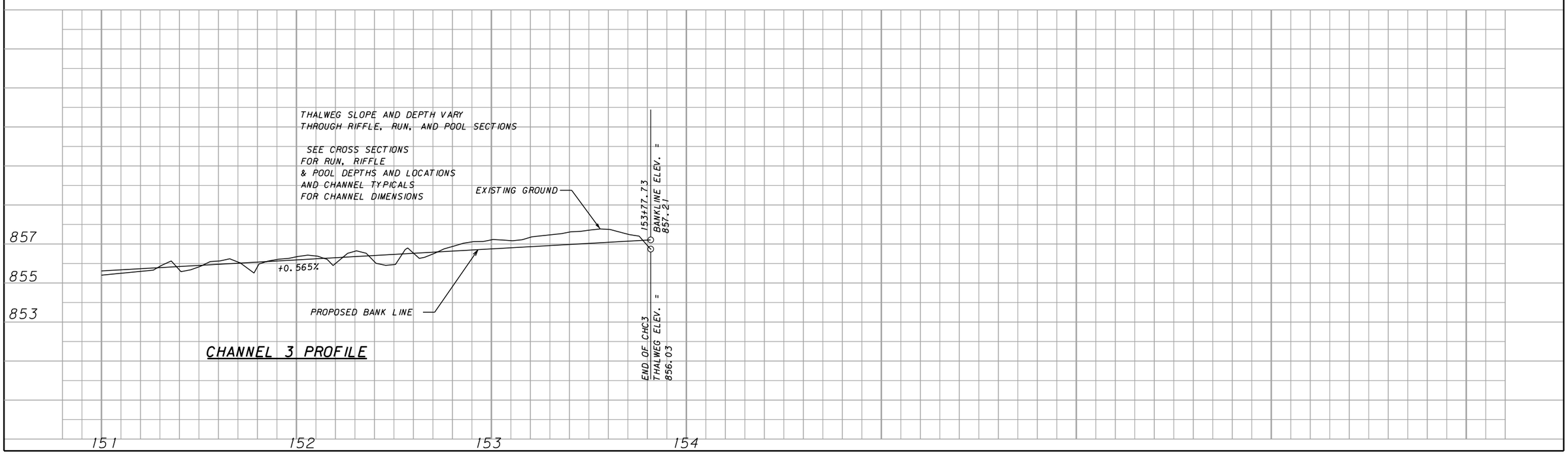
2		REVIEWED BY
3		CHECKED BY

STATE	PROJECT NUMBER	SHEET NO.
MONTANA	CBI NHTSA MT 1-1(79)45	CC 18

LIBBY CREEK SOUTH

CHANNEL 3





CHANNEL 3 PROFILE

MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

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CPS - U2623

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DESIGNED BY
REVIEWED BY
CHECKED BY

CURVE DATA FOR CHC3

PI=140+05.65
Δ =60° 21' 00" (RT)
R =40'
T =23.26'
L =42.13'
E =6.27'

PI=140+40.15
Δ =64° 12' 00" (LT)
R =20'
T =12.55'
L =22.41'
E =3.61'

PI=140+74.69
Δ =71° 08' 02" (RT)
R =15'
T =10.73'
L =18.62'
E =3.44'

PI=141+03.34
Δ =95° 12' 49" (LT)
R =15'
T =16.43'
L =24.93'
E =7.25'

PI=141+45.46
Δ =129° 14' 09" (RT)
R =13'
T =26.35'
L =28.19'
E =16.66'

PI=142+18.94
Δ =147° 44' 53" (LT)
R =20'
T =67.44'
L =50.28'
E =50.71'

PI=142+16.42
Δ =108° 40' 29" (RT)
R =11'
T =14.63'
L =19.92'
E =7.51'

PI=142+33.36
Δ =71° 23' 37" (LT)
R =14'
T =10.06'
L =17.44'
E =3.24'

PI=142+58.15
Δ =82° 56' 12" (RT)
R =20'
T =17.41'
L =28.52'
E =6.59'

PI=142+83.98
Δ =88° 54' 21" (LT)
R =15'
T =14.72'
L =23.28'
E =6.01'

PI=143+18.01
Δ =85° 42' 20" (RT)
R =22'
T =20.41'
L =32.91'
E =8.01'

PI=143+44.00
Δ =64° 45' 54" (LT)
R =20'
T =12.68'
L =22.61'
E =3.68'

PI=143+76.52
Δ =60° 06' 13" (RT)
R =15'
T =8.68'
L =15.74'
E =2.33'

PI=144+00.10
Δ =61° 55' 50" (LT)
R =15'
T =9.00'
L =16.21'
E =2.49'

PI=144+27.66
Δ =68° 27' 41" (RT)
R =15'
T =10.21'
L =17.92'
E =3.14'

PI=144+57.25
Δ =64° 38' 54" (LT)
R =20'
T =12.66'
L =22.57'
E =3.67'

PI=144+94.49
Δ =62° 57' 25" (RT)
R =15'
T =9.18'
L =16.48'
E =2.59'

PI=145+11.52
Δ =48° 40' 43" (LT)
R =20'
T =9.05'
L =16.99'
E =1.95'

PI=145+41.16
Δ =12° 06' 03" (RT)
R =40'
T =4.24'
L =8.45'
E =0.22'

PI=145+77.81
Δ =26° 30' 40" (LT)
R =40'
T =9.42'
L =18.51'
E =1.09'

PI=146+10.53
Δ =40° 51' 35" (RT)
R =30'
T =11.17'
L =21.39'
E =2.01'

PI=146+42.61
Δ =51° 44' 43" (LT)
R =15'
T =7.27'
L =13.55'
E =1.67'

PI=146+72.53
Δ =60° 56' 12" (RT)
R =20'
T =11.77'
L =21.27'
E =3.20'

PI=147+00.28
Δ =54° 51' 26" (LT)
R =29'
T =15.05'
L =27.77'
E =3.67'

PI=147+34.78
Δ =89° 53' 40" (RT)
R =20'
T =19.96'
L =31.38'
E =8.26'

PI=147+99.70
Δ =90° 08' 03" (LT)
R =33'
T =33.08'
L =51.91'
E =13.72'

PI=148+29.55
Δ =42° 00' 18" (RT)
R =20'
T =7.68'
L =14.66'
E =1.42'

PI=148+77.55
Δ =82° 05' 49" (LT)
R =36'
T =31.35'
L =51.58'
E =11.74'

PI=149+42.43
Δ =79° 42' 31" (RT)
R =22'
T =18.37'
L =30.61'
E =6.66'

PI=149+85.23
Δ =55° 16' 25" (LT)
R =22'
T =11.52'
L =21.22'
E =2.83'

PI=150+26.30
Δ =89° 06' 43" (RT)
R =15'
T =14.77'
L =23.33'
E =6.05'

PI=150+69.38
Δ =92° 52' 36" (LT)
R =24'
T =24.82'
L =38.26'
E =10.65'

PI=151+09.73
Δ =85° 01' 08" (RT)
R =25'
T =22.92'
L =37.10'
E =8.91'

PI=151+53.52
Δ =96° 34' 44" (LT)
R =15'
T =16.83'
L =25.28'
E =7.54'

PI=152+02.67
Δ =105° 38' 39" (RT)
R =30'
T =39.56'
L =55.32'
E =19.64'

PI=152+24.98
Δ =21° 12' 35" (LT)
R =35'
T =6.55'
L =12.96'
E =0.61'

PI=152+44.92
Δ =84° 05' 47" (LT)
R =15'
T =13.53'
L =22.02'
E =5.20'

PI=152+82.89
Δ =90° 41' 01" (RT)
R =15'
T =15.18'
L =23.74'
E =6.34'

PI=153+13.00
Δ =75° 39' 19" (LT)
R =13'
T =9.71'
L =16.51'
E =3.33'

PI=153+48.35
Δ =94° 05' 33" (RT)
R =15'
T =16.11'
L =24.63'
E =7.01'

MDT MONTANA DEPARTMENT OF TRANSPORTATION
MONTANA CADD
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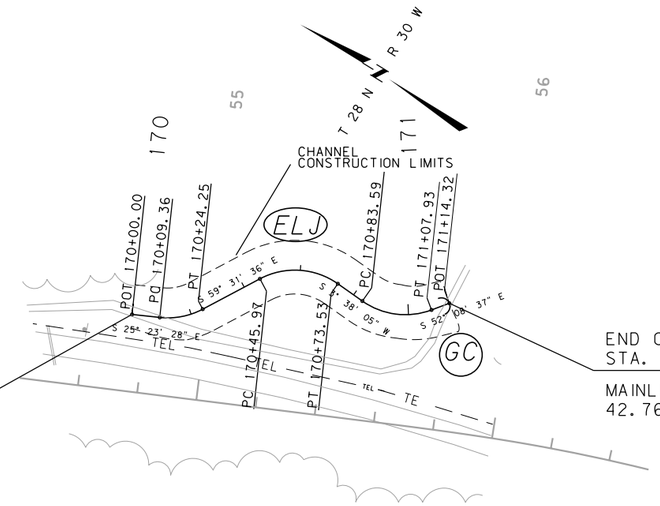
1 2 3

STATE	PROJECT NUMBER	SHEET NO.
MONTANA	CBI NHTSA MT 1-1(79)45	CC 20

LIBBY CREEK SOUTH

CHANNEL 5



BEGIN OF CHC5
STA. 170+00.00 =

MAINLINE STA. 54+75.05
25.81 m LT.

END OF CHC5
STA. 171+14.32 =

MAINLINE STA. 55+79.76
42.76 m LT.

PI = 170+17.03
Δ = 34° 08' 08" (LT)
R = 25 m
T = 7.68 m
L = 14.89 m
E = 1.15 m

PI = 170+61.34
Δ = 63° 09' 42" (RT)
R = 25 m
T = 15.37 m
L = 27.56 m
E = 4.35 m

PI = 170+96.82
Δ = 55° 46' 42" (LT)
R = 25 m
T = 13.23 m
L = 24.34 m
E = 3.29 m

BANK PROTECTION ALLOTTED FOR CHANNEL 5

33 m - BANK PROTE33CTION WITH FASCINE

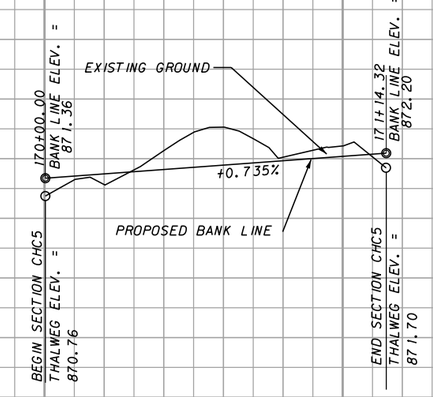
228 m - BANK PROTECTION WITH GRAVEL/SOIL

STRUCTURES ALLOTTED FOR CHANNEL 5

1 - ENGINEERED LOG JAM (ELJ)

1- GRADE CONTROL (REQUIRED) (GC)

NOTE: FINAL LOCATION FOR THE ELJ AND STREAM BANK PROTECTION TO BE DETERMINED BY STREAM RESTORATION SPECIALIST



THALWEG SLOPE AND DEPTH VARY THROUGH RIFFLE, RUN, AND POOL SECTIONS SEE CROSS SECTIONS FOR RUN, RIFFLE & POOL DEPTHS AND LOCATIONS AND CHANNEL TYPICALS FOR CHANNEL DIMENSIONS

SECTION CHANNEL 5 PROFILE

MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

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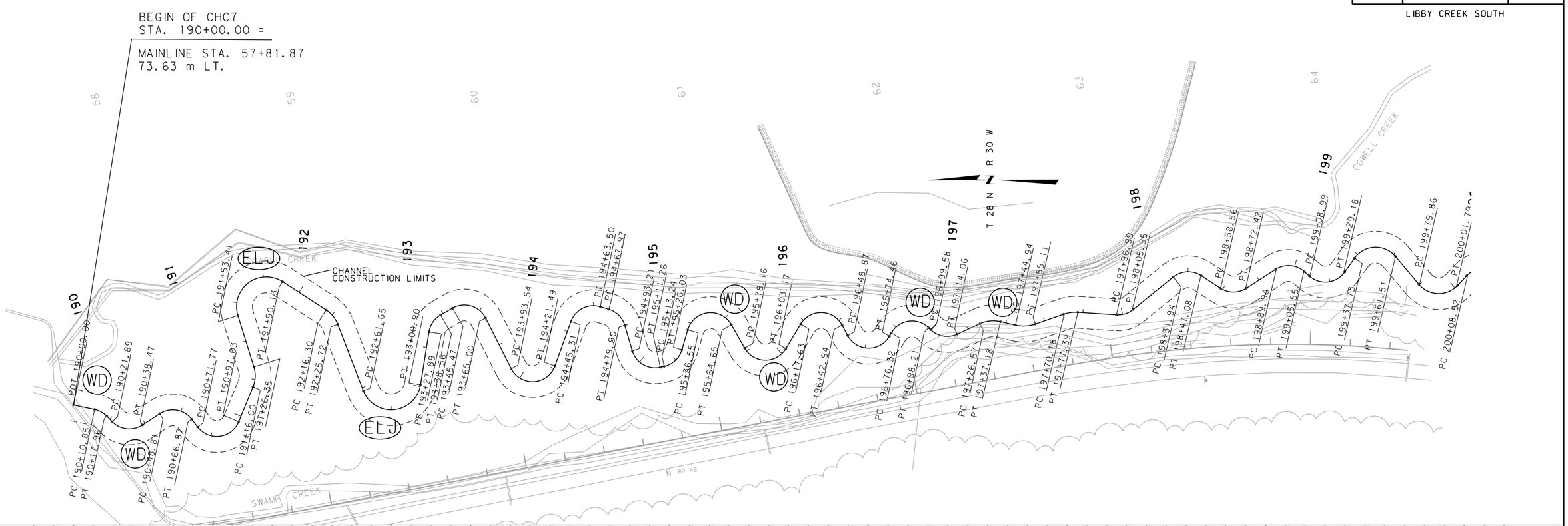
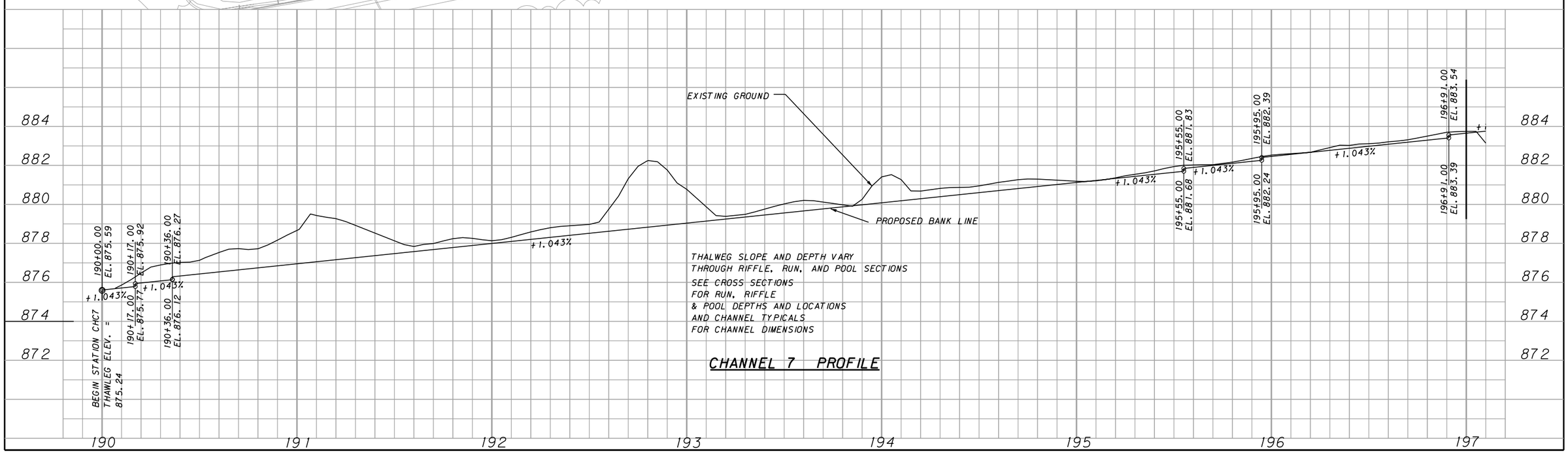
1 2 3

STATE	PROJECT NUMBER	SHEET NO.
MONTANA	CBI NHTSA MT 1-1(79)45	CC 21

LIBBY CREEK SOUTH

CHANNEL 7





CHANNEL 7 PROFILE

MONTANA DEPARTMENT OF TRANSPORTATION

MONTANA CADD

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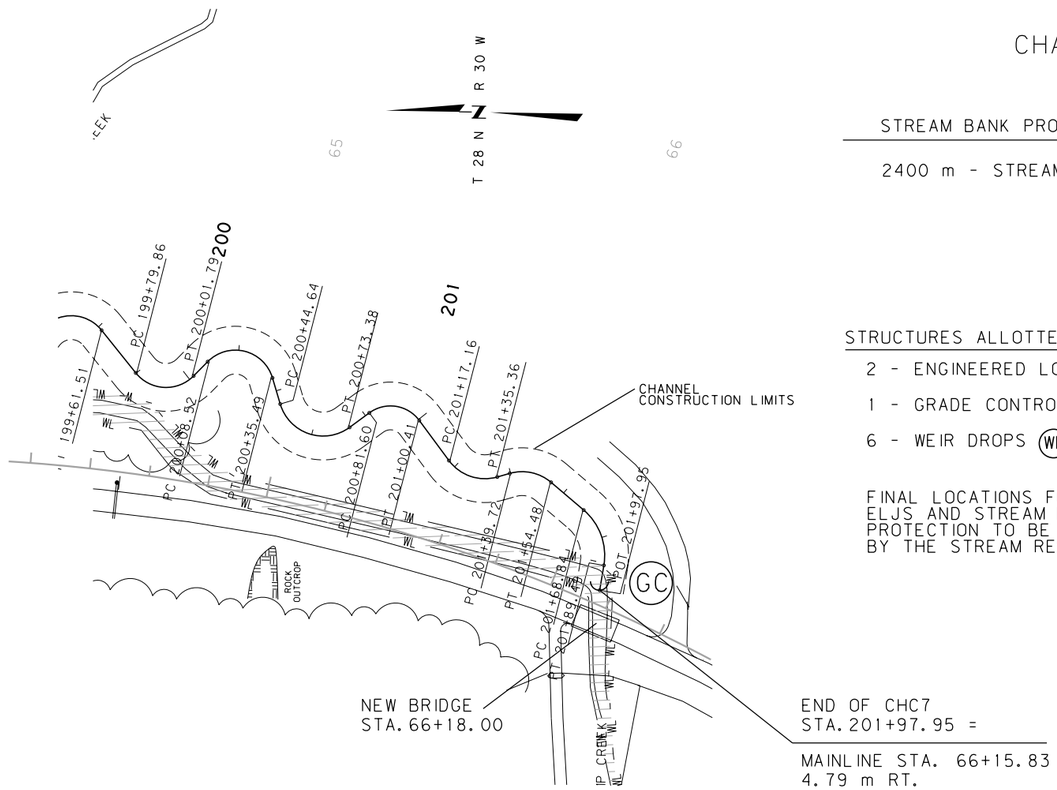
1		CHECKED BY

STATE	PROJECT NUMBER	SHEET NO.
MONTANA	CBI NHTSA MT 1-1(79)45	CC 22

LIBBY CREEK SOUTH

CHANNEL 7



STREAM BANK PROTECTION ALLOTTED FOR CHANNEL 7

2400 m - STREAM BANK PROTECTION WITH SOIL LAYER

STRUCTURES ALLOTTED FOR CHANNEL 7

2 - ENGINEERED LOG JAMS (ELJ)

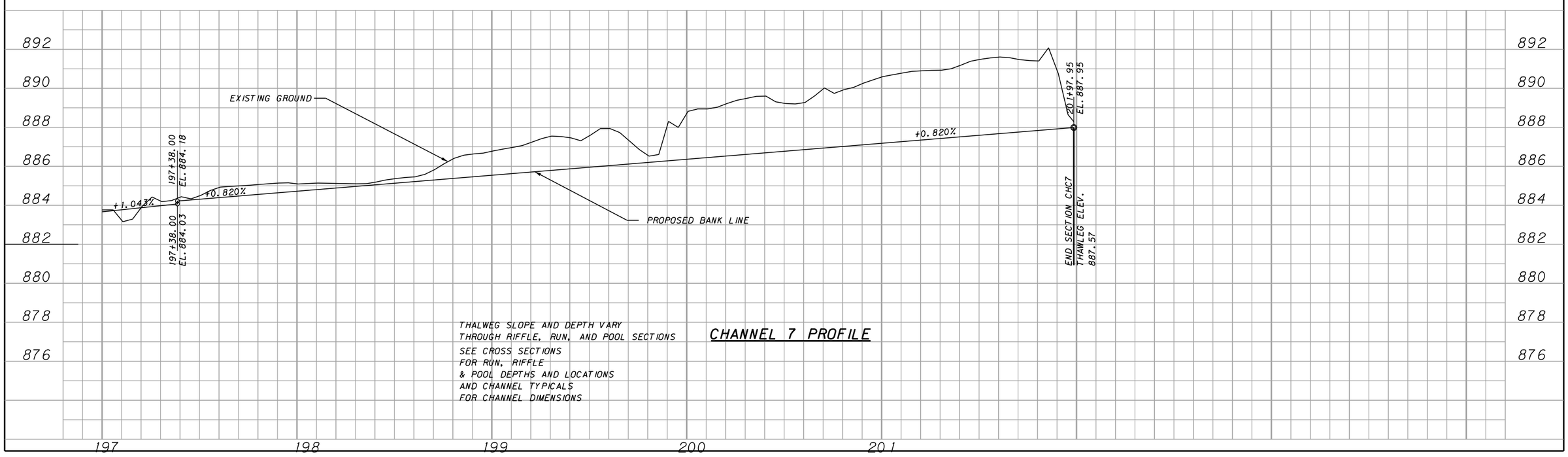
1 - GRADE CONTROL (REQUIRED) (GC)

6 - WEIR DROPS (WD)

FINAL LOCATIONS FOR THE ELJS AND STREAM BANK PROTECTION TO BE DETERMINED BY THE STREAM RESTORATION SPECIALIST

BEARINGS FOR CHANNEL 7

S 12° 15' 18" W	S 44° 36' 51" W
S 46° 11' 36" W	S 24° 30' 04" E
S 33° 00' 02" E	S 13° 30' 24" W
S 53° 13' 19" W	S 18° 52' 14" E
S 67° 24' 08" E	S 4° 06' 26" W
N 73° 03' 30" E	S 38° 39' 25" E
S 33° 19' 50" W	S 33° 37' 51" W
S 69° 19' 27" W	S 32° 32' 11" E
S 80° 36' 38" E	S 41° 57' 39" W
S 29° 39' 40" E	S 54° 24' 17" E
S 69° 51' 36" E	S 50° 22' 51" W
S 63° 34' 39" W	S 46° 15' 43" E
S 16° 58' 48" W	S 72° 34' 34" W
S 73° 55' 32" W	S 37° 12' 37" E
S 12° 14' 19" E	S 52° 36' 03" W
S 58° 34' 40" E	S 16° 54' 48" E
S 73° 18' 46" E	S 39° 28' 03" W
S 60° 52' 06" W	N 81° 22' 16" W
S 62° 16' 17" W	
S 59° 54' 33" E	



THALWEG SLOPE AND DEPTH VARY THROUGH RIFFLE, RUN, AND POOL SECTIONS

SEE CROSS SECTIONS FOR RUN, RIFFLE & POOL DEPTHS AND LOCATIONS AND CHANNEL TYPICALS FOR CHANNEL DIMENSIONS

CHANNEL 7 PROFILE

MONTANA DEPARTMENT OF TRANSPORTATION

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CURVE DATA FOR CHC7

PI=190+14.51
Δ =33° 56' 18" (RT)
R =12 m
T =3.66 m
L =7.11 m
E =0.55 m

PI=190+31.81
Δ =79° 11' 38" (LT)
R =12 m
T =9.93 m
L =16.59 m
E =3.57 m

PI=190+60.04
Δ =86° 13' 21" (RT)
R =12 m
T =11.23 m
L =18.06 m
E =4.44 m

PI=190+92.82
Δ =120° 37' 27" (LT)
R =12 m
T =21.05 m
L =25.26 m
E =12.23 m

PI=191+21.39
Δ =39° 32' 22" (LT)
R =15 m
T =5.39 m
L =10.35 m
E =0.94 m

PI=191+94.93
Δ =140° 16' 20" (RT)
R =15 m
T =41.52 m
L =36.72 m
E =29.15 m

PI=192+21.17
Δ =35° 59' 37" (RT)
R =15 m
T =4.87 m
L =9.42 m
E =0.77 m

PI=193+17.50
Δ =149° 56' 05" (LT)
R =15 m
T =55.85 m
L =39.25 m
E =42.83 m

PI=193+33.61
Δ =50° 56' 58" (RT)
R =12 m
T =5.72 m
L =10.67 m
E =1.29 m

PI=193+58.17
Δ =93° 14' 18" (RT)
R =12 m
T =12.70 m
L =19.53 m
E =5.47 m

PI=194+21.43
Δ =133° 26' 15" (LT)
R =12 m
T =27.89 m
L =27.95 m
E =18.36 m

PI=194+56.66
Δ =86° 50' 25" (RT)
R =12 m
T =11.36 m
L =18.19 m
E =4.52 m

PI=194+74.48
Δ =56° 56' 44" (RT)
R =12 m
T =6.51 m
L =11.93 m
E =1.65 m

PI=195+04.43
Δ =86° 09' 51" (LT)
R =12 m
T =11.22 m
L =18.05 m
E =4.43 m

PI=195+20.32
Δ =61° 04' 28" (LT)
R =12 m
T =7.08 m
L =12.79 m
E =1.93 m

PI=195+64.94
Δ =134° 10' 53" (RT)
R =12 m
T =28.40 m
L =28.10 m
E =18.83 m

PI=195+98.71
Δ =119° 26' 47" (LT)
R =12 m
T =20.55 m
L =25.02 m
E =11.80 m

PI=196+38.77
Δ =120° 50' 57" (RT)
R =12 m
T =21.14 m
L =25.31 m
E =12.31 m

PI=196+70.60
Δ =122° 10' 51" (LT)
R =12 m
T =21.73 m
L =25.59 m
E =12.82 m

PI=196+91.82
Δ =104° 31' 24" (RT)
R =12 m
T =15.50 m
L =21.89 m
E =7.61 m

PI=197+07.85
Δ =69° 06' 55" (LT)
R =12 m
T =8.27 m
L =14.48 m
E =2.57 m

PI=197+32.08
Δ =38° 00' 28" (RT)
R =16 m
T =5.51 m
L =10.61 m
E =0.92 m

PI=197+50.17
Δ =32° 22' 38" (LT)
R =18 m
T =5.23 m
L =10.17 m
E =0.74 m

PI=197+73.83
Δ =22° 58' 40" (RT)
R =18 m
T =3.66 m
L =7.22 m
E =0.37 m

PI=198+01.69
Δ =42° 45' 51" (LT)
R =12 m
T =4.70 m
L =8.96 m
E =0.89 m

PI=198+40.70
Δ =72° 17' 15" (RT)
R =12 m
T =8.76 m
L =15.14 m
E =2.86 m

PI=198+66.38
Δ =66° 10' 02" (LT)
R =12 m
T =7.82 m
L =13.86 m
E =2.32 m

PI=198+99.07
Δ =74° 29' 50" (RT)
R =12 m
T =9.12 m
L =15.60 m
E =3.08 m

PI=199+22.41
Δ =96° 21' 56" (LT)
R =12 m
T =13.41 m
L =20.18 m
E =6.00 m

PI=199+54.61
Δ =104° 47' 08" (RT)
R =13 m
T =16.88 m
L =23.78 m
E =8.30 m

PI=199+94.46
Δ =96° 38' 34" (LT)
R =13 m
T =14.60 m
L =21.93 m
E =6.55 m

PI=200+30.52
Δ =118° 50' 17" (RT)
R =13 m
T =22.00 m
L =26.96 m
E =12.55 m

PI=200+65.98
Δ =109° 47' 11" (LT)
R =15 m
T =21.34 m
L =28.74 m
E =11.08 m

PI=200+93.56
Δ =89° 48' 40" (RT)
R =12 m
T =11.96 m
L =18.81 m
E =4.94 m

PI=201+27.57
Δ =69° 30' 51" (LT)
R =15 m
T =10.41 m
L =18.20 m
E =3.26 m

PI=201+47.76
Δ =56° 22' 51" (RT)
R =15 m
T =8.04 m
L =14.76 m
E =2.02 m

PI=201+80.19
Δ =59° 09' 40" (RT)
R =20 m
T =11.35 m
L =20.65 m
E =3.00 m

MDT MONTANA DEPARTMENT OF TRANSPORTATION
MONTANA CADD
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