Emergency Center Street Bridge Foundation Stabilization

Rec. by	
Fee Rec.	
Receipt #	

JOINT PERMIT APPLICATION FORM

U.S ARMY CORPS OF ENGINEERS – FOR SECTIONS 404 AND 10
UTAH STATE ENGINEER'S OFFICE – FOR NATURAL STREAM CHANNELS

Application Number (assigned by): ____________ Corps / ____________ State Engineer

Applicant's Name (Last, First M.I. or entity if not an individual)	Authorized Applicant Representative (if any)	Applicant's Telephone Number and Area Code
Logan City	Tom Dickinson	(435) 716-9152
		Representative's Telephone Number and Area Code: (435) 757-9848

Applicant's Address (Street, RFD, Box, Number, City, State, Zip)

290 North 100 West
Logan, UT 84321

PROJECT LOCATION

Quarter Section(s)	Section	Township	Range	Base & Meridian
SE	34	12 N	1 E	SLB&M

County	Associated Watercourse or Watercourse to be Altered	Check one: ☑ Within City Limits ☐ Outside City Limits List town or nearest town:
Cache	Logan River	Logan, UT

Project location or address:

Center Street Bridge Crossing Logan River

Brief description of project including methods and equipment to be employed to complete the work:

This project will remove the concrete rubble and debris placed over decades under the Center Street Bridge, clean out around the spread footings, stabilize the footings with formed reinforced concrete, remove concrete rubble and debris downstream of the bridge for about 75 feet, armor the channel with nearly native graded rock similar to undisturbed sections of the channel, and stabilize the leftside bank downstream of the bridge. See the attached plans.

Purpose (justification) of project:

Over the last decades, the Center Street bridge has had problems with erosion on the footings. The City tried numerous times to protect the footings by the use of "patchwork" solutions. However, these have all failed due to the high velocities under this bridge. While the City seeks to obtain funding to replace this bridge, they are going to stabilize and armor the bridge to allow them 10 years to save enough funds to construct a new bridge. This bridge is the only access through Logan City serving the Cliffside area for residents, school busing, and emergency vehicles. See the attached technical report.

Is this a single and complete project or is part of a larger project, continuing project, or other related activities? If so, please describe the larger project or other related activities.

Single Project

If project included the discharge of dredged or fill material into a watercourse or wetland:

Cubic yards of material:	300
Acreage or square footage of waters of the United States affected by the project:	0.13 Acres
Source and type of fill material:	Clean rip rap and rock, recycled bed material where possible
Length of stream that will be impacted below ordinary high water elevation:	150 feet

Alternatives (other ways to accomplish project purpose): The past efforts were not successful. Based on the velocities, the rubble did not work. Other alternatives would include more invasive solutions, including the replacement of the bridge which is the long term solution.
Describe any proposed mitigation to offset impacts to the stream channel. The use of rocks similar to the native stones will facilitate the restoration of aquatic insects and fish in this area quickly. Dormant pole plantings in the rocks and gabions combined with the planting of grass on the banks will also help with the vegetative restoration.
Cultural resource impacts: Are you aware of any cultural resources or any historic properties that will be impacted by the proposed project? ☐ Yes ☑ No If Yes, please explain: Has a cultural resource survey been conducted on the property where the proposed project is to occur? ☐ Yes ☑ No If Yes, please briefly explain the survey results:
List other authorizations required by Federal, state, or local governments (i.e. National Flood Insurance Program), and the status of those authorizations. NFIP requires a flood plain permit. This has been submitted also and approved by Logan City.

Estimated starting date of project:	Estimated completion date:
July 1, 2019	October 31, 2019

Please complete the following checklist

Failure to indicate that all pertinent information has been submitted will result in your application being returned.

- ☒ Appropriate application processing fee payment (see fee schedule below).
- ☒ A clear site location map with enough detail to easily find the site, a recent aerial/satellite image of the site, and a USGS topography map (7.5 minute quadrangle map is recommended).
- ☒ Plan view and cross-sectional drawings showing all work requiring a permit, including fills, structures, borrow sites, staging areas and storage areas. The drawings must clearly demarcate the ordinary high water mark of the waters of the U.S. to be impacted and clearly illustrate where fill will be placed below the ordinary high water mark. Professional drawings are not required; however, drawings must be scaled or indicate dimensions of the work to be completed. See the attached plan set
- ☒ A restoration plan for any areas temporarily disturbed during work, including re-contouring, revegetation with appropriate native plants and maintenance and monitoring to ensure success for the restored area. See the attached plan set
- ☒ Ground photographs taken from various locations of the proposed disturbance area. See the attached technical report
- ☒ Please check the box if the proposed project involves bank stabilization or protection. If so, please complete the following:
  - ☒ A description of the need for the work, including the cause of the erosion and the threat posed to structures, infrastructure, and/or public safety. See the attached technical report
  - ☒ A narrative demonstrating the proposed activity incorporates the least damaging bank protection methods. These methods include, but are not limited to, the use of bioengineering, biotechnical design, root wads, large

woody debris, native plantings, and beach nourishment in certain circumstances. If rock must be used due to site erosion conditions, explain how the bank stabilization structure incorporates elements beneficial to aquatic organisms. See the attached plan set and technical report

- ☒ A planting plan which involves the use of native riparian plants, unless the applicant demonstrates it is not appropriate or not practicable. See attached plan set

☒ An assessment of the likely impact the work would have on upstream, downstream and cross-stream properties. Specifically, discuss the following: See the attached technical report

- ☒ Will the activity accelerate deposition or erosion? No.
- ☒ Will the activity involve relocation, channelization or realignment of a natural channel? No.
- ☒ Will the activity result in a shift in the main flow patterns? No

Application is hereby made for a permit or permits to authorize the activities described herein. I certify that I am familiar with the information contained in the application, and that to the best of my knowledge and belief, such information is true, complete and accurate. I further certify that I possess the authority to undertake the proposed activities or am acting as the duly authorized agent of the applicant which is a **(check one of the following) commercial ☐, non-commercial ☐, or governmental ☒ entity.**

Signature of Applicant Holly H. Daines Date: 6/4/19

I hereby certify that Tom Dickinson, Assistant City Engineer is acting as my agent on this project.

Agent's address and telephone number: Logan City Engineering, 290 North 100 West, Logan, UT 84321

Office: (435) 716-9152, Mobile: (435) 757-9848

Filing Instructions

Application supplements should be submitted on paper no larger than 11 x 17 inches or alternatively as PDF format electronic files. If more than one watercourse is to be altered as a result of the project, a separate application must be submitted for each watercourse. Application fees must be received by the Division of Water Rights at the time of application submission and must be either hand delivered or submitted through standard mail to the following address:

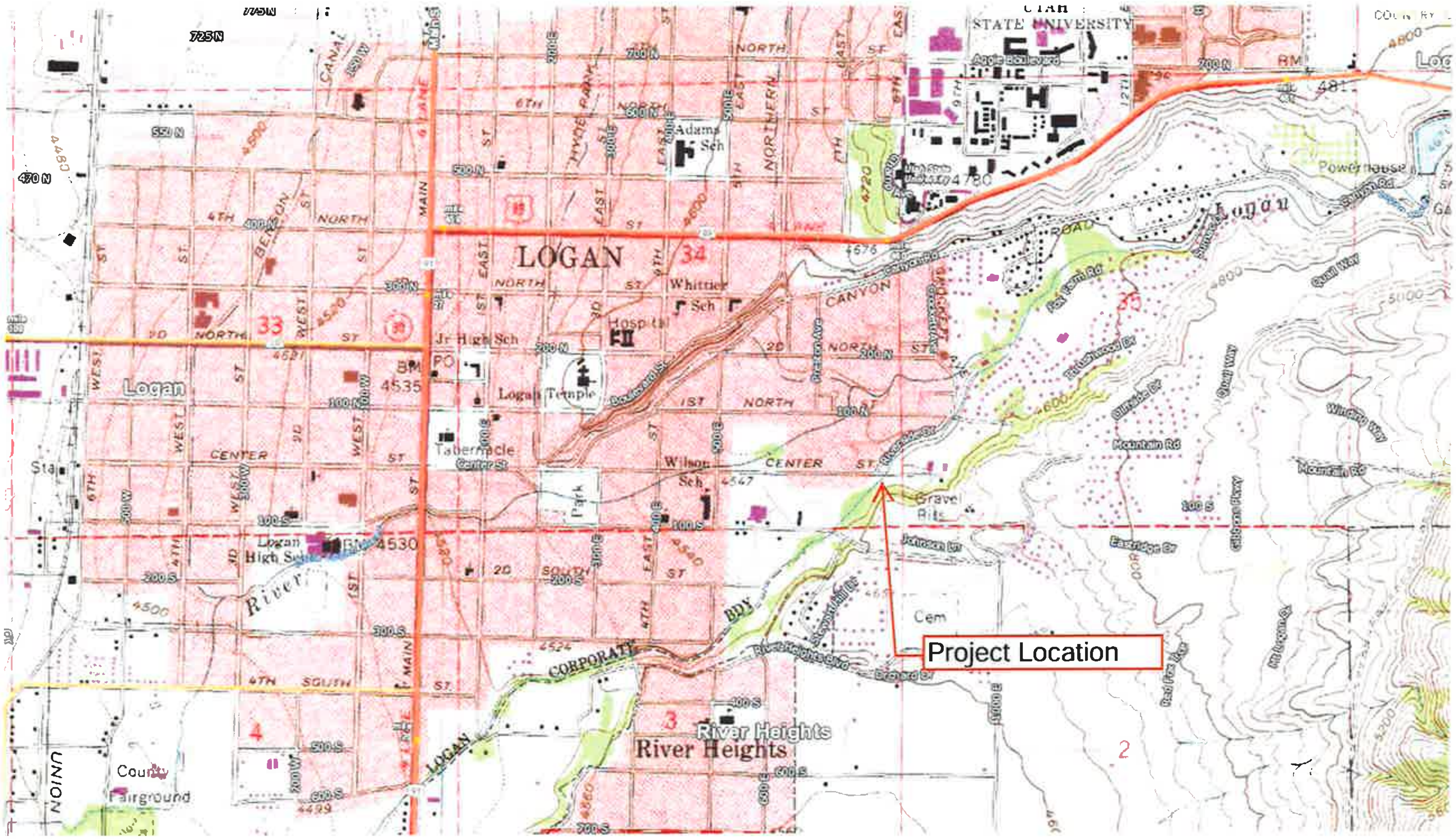
Utah Division of Water Rights
1594 W. North Temple, Suite 220
Salt Lake City, UT 84114-6300

Application Processing Fees

Application fees are based on the type of entity applying for the proposed stream alteration project.

Commercial Entities:	$2000.00	per application processed.
Non-Commercial Entities:	$100.00	per application processed.
Governmental Entities:	$500.00	per application processed.

CENTER STREET BRIDGE FOUNDATION STABILIZATION



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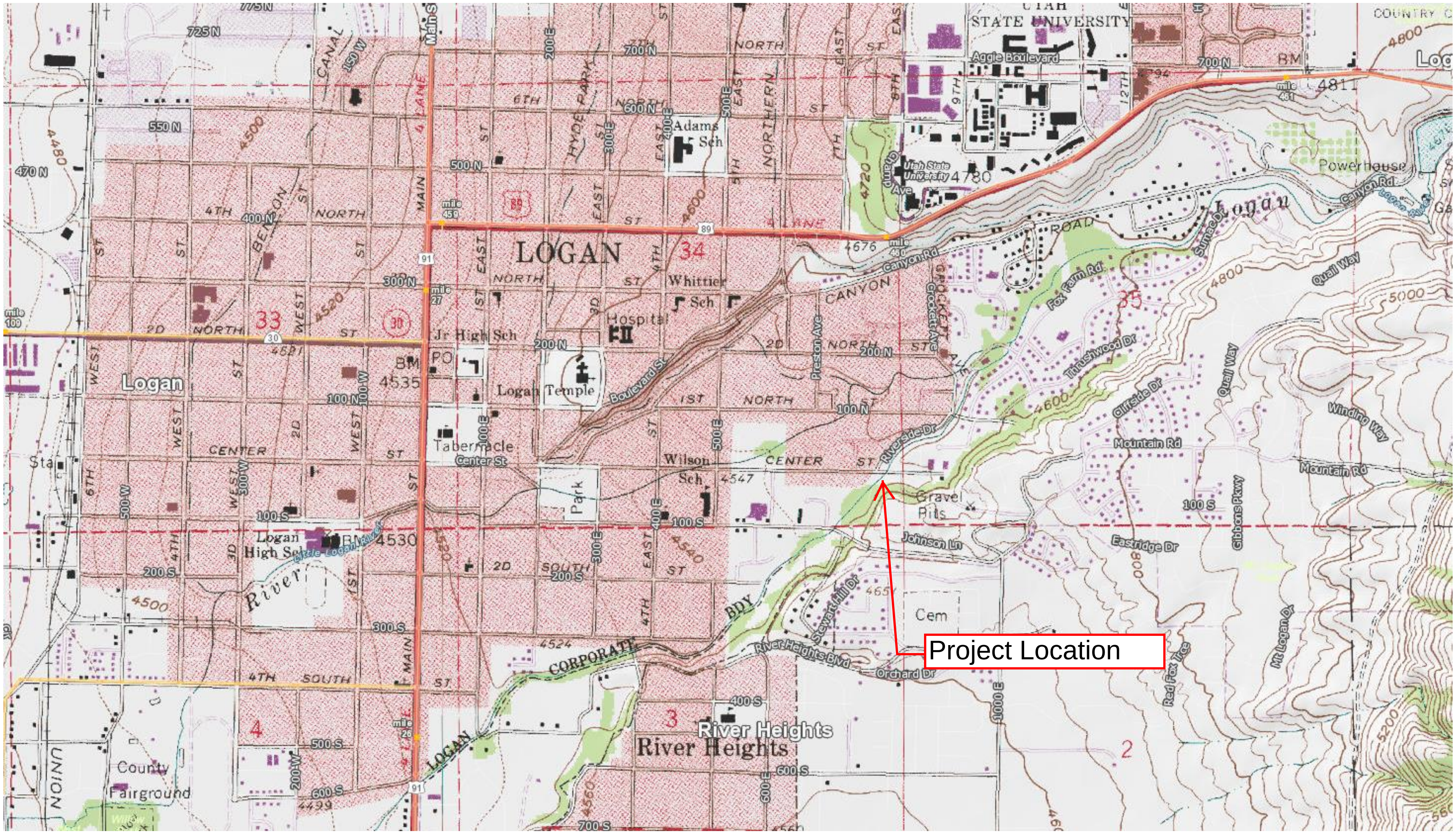

CENTER STREET BRIDGE FOUNDATION STABILIZATION

TECHNICAL REPORT

Logan River

CENTER STREET BRIDGE FOUNDATION STABILIZATION

Prepared for

LOGAN CITY

May 2019

FRANSON CIVIL ENGINEERS

115 Golf Course Road, Suite D, Logan, Utah 84321

1276 South 820 East, Suite 100, American Fork, Utah 84003
T 801 756-0309 or 888 756-3726 (toll free) **F** 801 756-0481

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1. INTRODUCTION

Franson Civil Engineers (FCE) was asked to look at modifications to the Logan River at the Center Street Bridge location. The Center Street bridge has experienced severe scouring beneath the bridge footings. Over the years several attempts have been made by Logan City and others to try and protect the bridge. This has mostly consisted of dumping concrete debris around the bridge. Consequently, the concrete debris and rubble have partially accumulated beneath the bridge, while previous attempts at patching have just broken off.

Figures 1.1 and 1.2 illustrate the problems that exist around the footings and foundations, including the scour beneath the footings, the rubble piles that have accumulated, and the further scour that has taken place. The figures also show the concrete rubble in the channel itself.

Figures 1.3 and 1.4 show the dumping and concrete debris that has taken place, either to help stabilize the footings or simply as a disposal method. This has in turn choked the outlet of the bridge, causing localized higher velocities. An additional problem has been caused by a Siberian elm on the downstream right side bank, an invasive species of tree that has started growing in the cracks of the concrete, further complicating issues.

Figure 1.1 Picture of Footings on Bank Left

Figure 1.2 Footings on Bank Right

Figure 1.3 Downstream Face on Bank Left

Figure 1.4 Concrete Rubble at Downstream Face Bank Right

Logan City has asked FCE to evaluate the conditions of the bridge and design a hydraulic repair to the Bridge in order to extend its life by at least 10 years.

FCE has reviewed the hydraulic model and the reports submitted to Logan City by Anderson Consulting (ACE), including the hydraulic profiles. Additionally, FCE has been onsite and made the following observations.

1.1 Existing Condition

- The upstream was modified and benched out as part of the Emergency Watershed Project (EWP) completed by Logan City between 2013 to 2015. This area was also vegetated with native vegetation on both banks. The vegetation, which includes water birch, coyote willow, Redozier dogwood, Wood’s rose, and native perennial grasses is flourishing.
- The property on the right bank of the river (north side) downstream of the bridge is benched and stepped either naturally or by the property owner. Additionally, the owner has installed rip rap along the bank.

- The property on the left bank of the river (south side) downstream of the bridge is very steep, armored with rock rip rap (placed by the downstream property owner), concrete that was dumped or poured on the abutments, and chunks of old concrete rubble that was dumped into the channel. This debris has abnormally choked the river in this area, particularly on the west end of the bridge.
- The river upstream and downstream of the bridge has been highly altered by development over the decades. However, small sections of the existing channel, where managed landscaping and crack willows do not dominate, consist of rocks ranging in size from 3 to 9 inches with intermittently larger boulders. The banks tend to be protected by native growing coyote willow and Redozier dogwood.
- Both foundations for the bridge consist of spread footings that were built at different times. The footings on both sides of the bridge have been scoured and eroded. When a tape measure was pushed up beneath them, the tape went in approximately 36 inches. Approximately ½ of the footing that is not supporting the structure.
- There are also settlement cracks in the road section along both abutments. The Logan City Streets Department fixes them annually, though they are getting worse. This places this structure at risk, particularly in a seismic event or extreme flood events.

2. METHODOLOGY

The following assumptions and model procedures have been used to evaluate alternative solutions for stabilizing the bridge footings.

2.1 Existing Terrain Model

The existing channel was surveyed by the Logan City Surveyor. The data points were used to create a surveyed surface. The areas outside of the survey boundary were evaluated using 2013 LIDAR data, vertically corrected based on the completed survey. The two sources of information were then merged together in Civil 3D to create a surface terrain model of the existing conditions.

2.2 Manning's Roughness Coefficients Assumed

The following Manning's coefficients were used to represent the existing conditions and the proposed final conditions of the river restoration.

Table 2.1 Manning's Roughness Assumptions

Area Description	Type	Existing Manning's "n"	Proposed Manning's "n"	Source
Large Tree Trunks	Tree	100	100	Obstructed Flow
Parking Lots and Concrete	Asphalt/ Concrete	0.020	0.020	Anderson Model
Grassed Areas	Grass	0.035	0.035	Anderson Model
Buildings	Bldg.	100	N/A	Obstructed Flow
Rock RipRap	Rock	0.060	0.060	HEC-RAS Reference Manual
River	River	0.046	0.046	Anderson Model
Boulder Walls and Boulders Stacked along Bank (not riprap)	Boulders	0.080	0.080	HEC-RAS Reference Manual
Dirt Areas without Vegetation including Dirt Roads	Dirt	0.025	0.025	HEC-RAS Reference Manual
Gravel Trails	Gravel	0.035	0.035	
Native Willows	Willows/ Dogwood	N/A	0.090	Anderson Model
Native Grass and Flowers with Trees and Shrubs	Native Grass	N/A	0.080	Anderson Model Conservative
Native Trees in Clusters	Native Trees	N/A	0.090	Anderson Model

2.3 Flow Rates Evaluated

To compare the existing conditions to the proposed alternative, the flow rates modeled were stair stepped in order to allow for a steady-state analysis at the various regulatory conditions. The flows are summarized in Table 2.2.

Table 2.2 Flows Modeled

Recurrence Interval	Flow Rate (cfs)	Source
Ordinary High Water (OHW)	870	Average Peak Day Flows (USGS Annual Peak Flow Records)
10-Year	1,610	Anderson
25-Year	1,900	Anderson
50-Year	2,100	Anderson
100-Year	2,280	Anderson

3. EXISTING CONDITION COMPARISON RESULTS

The existing flood plain model completed by Anderson Consulting was calibrated using the results of the 2004, 2011, and 2017 flood flows based on bridge flow conditions. Anderson Consulting adjusted the model roughness coefficients until the model closely replicated those flood conditions.

The goal is for the 2D model to closely represent the Anderson Model, which is similar to other reaches. However, one of the problems encountered with calibration in this area is the changing conditions through the bridge, as represented by the scouring under the footings. Additionally, the evaluation of the bridge included a much higher resolution survey under the bridge as well as over the bridge.

Table 3.1 summarizes the boundary conditions at the downstream end of the reach just upstream of the Main Street Bridge used in calibration.

Table 3.1 Water Surface Elevations Upstream of Center Street Bridge (ACE Model)

Recurrence Interval	US Elevations	DS Elevations	Source
10-Year	4562.6	4561.0	Anderson Model
25-Year	4562.8	4561.6	Anderson Model
50-Year	4562.9	4561.9	Anderson Model
100-Year	4563.2	4562.2	Anderson Model

The existing condition model results at the upstream cross section of the proposed project were compared with the results of the Anderson Model. Table 3.2 summarizes the results of the two models. It is also important to note that the girder bottom elevations are at 4562.65 at the upstream bottom chord and 4562.69 at the downstream bottom chord. Whenever the elevations exceed these conditions, particularly on the upstream chord, the flows function as a culvert type scenario and the 2D model is not going to be applicable.

Table 3.2 Comparison Model Results

Recurrence Interval	Model US Elevations	Model Error	Model DS Elevations	Error	Comment
10-Year	4561.4	-1.2	4560.33	+.33	
25-Year	4562.09	-0.71	4561.02	-.58	
50-Year	4562.43	-.57	4561.36	-.54	
100-Year	4563.48	+.28	4562.36	+.16	Culvert Flow, Elevations are off

An additional review of the velocities shows the average velocities shown in the Anderson Model, using the bridge flow conditions, to be substantially lower than the point velocities experienced in the 2D model. The point velocities in the 2D model at the downstream face are as high as 14 ft/sec under the existing condition compared to the average velocity of 7.6 ft/sec in the Anderson Model.

While it is always better to have the models reflect and completely agree on the results, the differences in the survey detail under the bridge, the detailed modeling approach, and the variation in the numeric models under the bridge have made that comparison impossible at this stage.

4. DESIGN CROSS SECTION EVALUATION AND PLAN LAYOUT

Based on site visits and preliminary evaluations, FCE has evaluated the following configuration including armoring the toes of the bridge on bank right, the north side of the bridge. The work under the bridge will tie into the upstream rock wall on bank left, the south side of the bridge. However, the left bank downstream of the bridge will need either a rock wall or a gabion wall due to the steeper slope which currently approaches 45 degrees.

Figure 4.1 shows the general plan approach from the design drawings. The design incorporates the use of engineered rip rap (based on the USACE EM-1110 references) to armor beneath the bridge and to reinforce the banks. A gabion wall is used on the south bank where the existing slopes are extremely steep.

Figure 4.1 Armoring of Toes of Bridge and Abutments

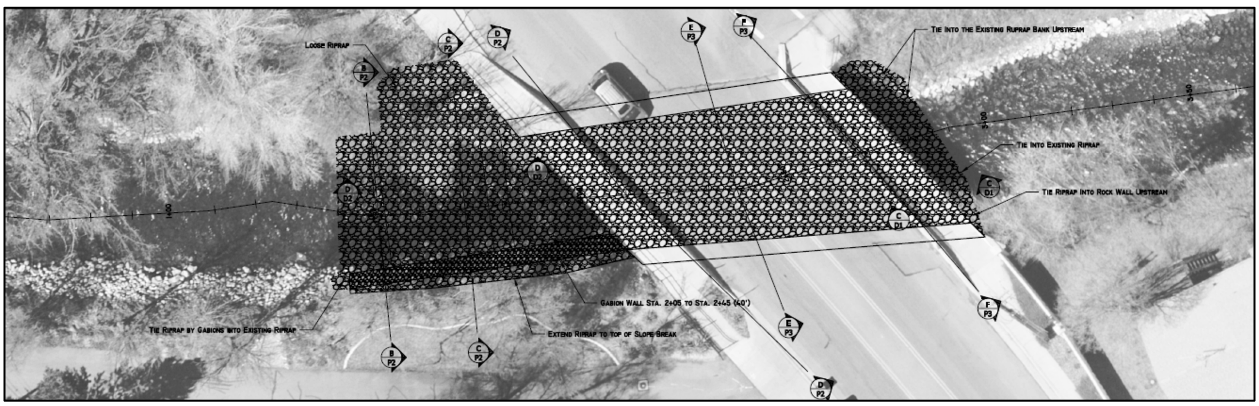


Figure 4.2 illustrates the centerline section running through the bridge and the mitigation area. To mitigate velocities through the bridge a “stilling basin”, for lack of a better term, was designed to calm the flows somewhat and disperse the flows throughout the channel. During low flows, when oxygen levels can be a concern, this will create a habitat pool for fish and aquatic life. During high flows, it breaks energy and prevents the concentrated bridge velocities from scouring the channel downstream. The “stilling basin” is only about 30 inches deep and is located in the area where the existing flows were trying to cut through the accumulated concrete rubble.

Figure 4.2 Centerline Through Bridge Showing a Stilling Basin and Armored Crest

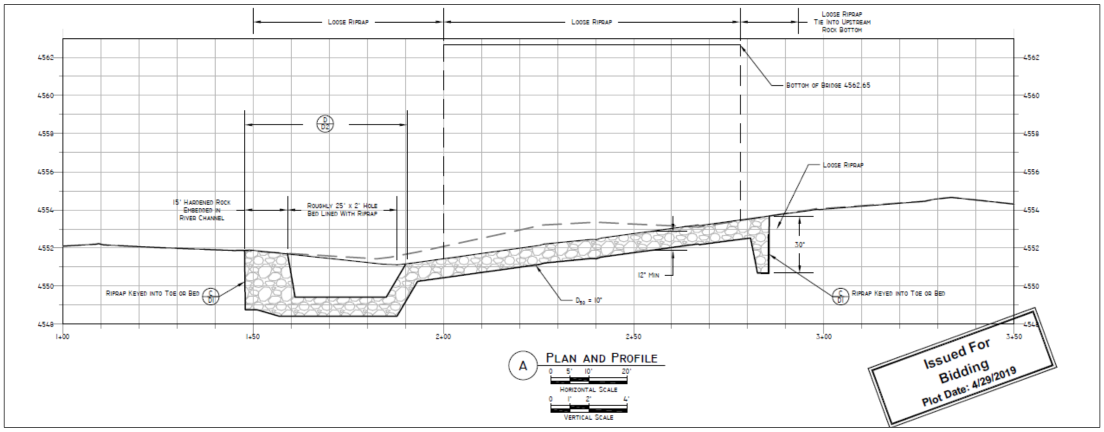


Figure 4.3 is a cross section showing the work that will be done beneath the existing bridge. The concrete rubble and debris will be removed, the footings reinforced, and the channel shaped to coincide with the upstream and downstream energy lines and flow patterns. The channel is armored with engineered rip rap.

Figure 4.3 Cross Section Through Bridge Showing the Armored and Stabilized Footings

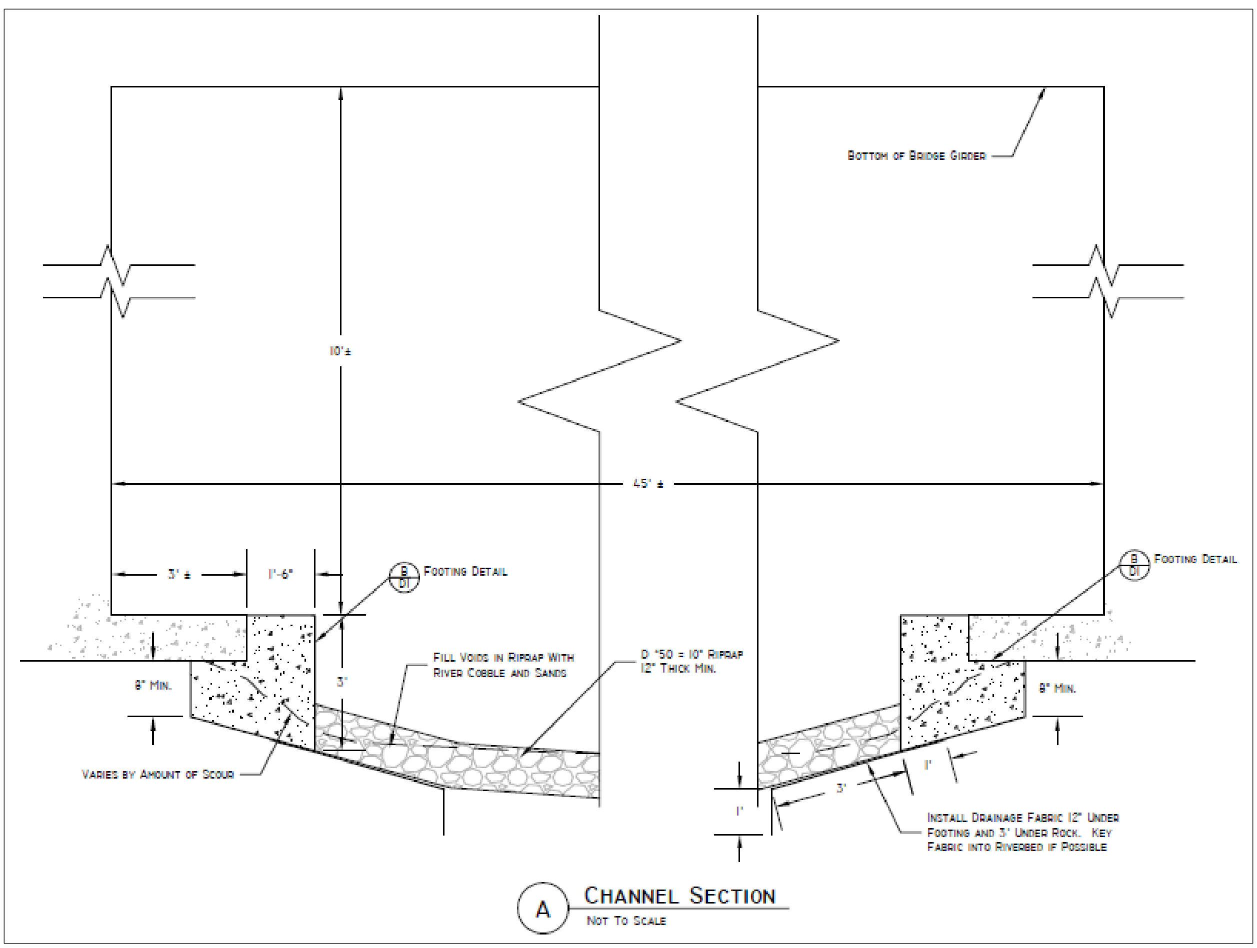
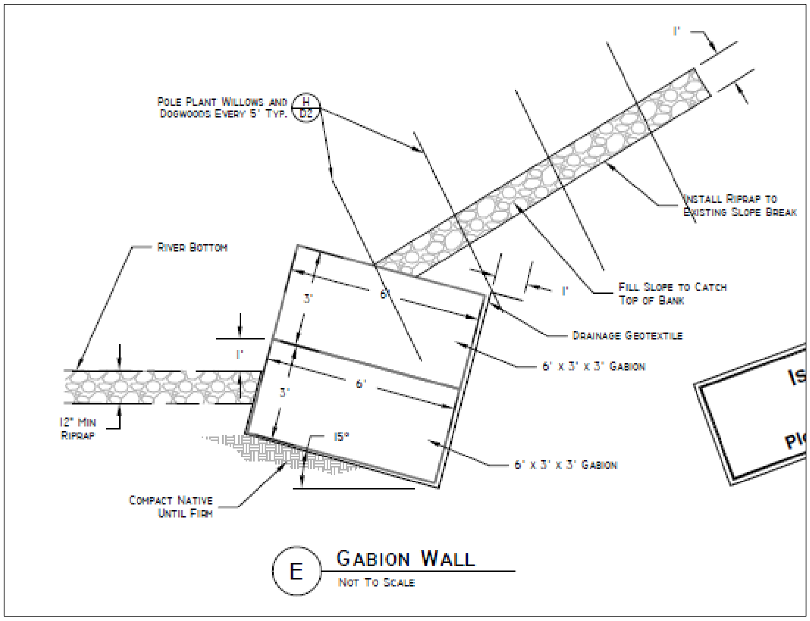


Figure 4.4 shows the use of the gabion wall. It is only two gabions high and is designed to catch the slope above, which will be graded to a 2h:1v slope. This slope will be armored with engineered rip rap to protect the bank during flood events. The rip rap and gabions will have pole plantings of coyote willow and Redozier dogwood to help revegetate the area. They will be placed on a five foot spacing in the rocks. Where possible, they will be planted at the same time the rock is being placed during the summer (least effective timing) to try and jump-start some of the growth with additional late fall dormant plantings (most effective) to further increase the density of the plantings.

Figure 4.4 Gabion Wall Protection and Rip Rap Armoring



4.1 Proposed Cross Section Results

The results of the proposed model were then compared to the existing conditions at the upstream and downstream boundaries of the bridge. Table 4.1 compares the existing model with the proposed design model. It should be noted that in almost all conditions, the water surface elevations were either lower or statistically unchanged, compared to the existing conditions, after the improvements were made except at the ordinary high-water condition (OHW), where the rock crest causes the low flows to slow and reduce erosion. Additionally, the proposed design lowers the 100-year event slightly below the bottom chord of the bridge.

Based on the proposed design section, there is a significant reduction in the effective water surface at the upstream face of the bridge. By reducing this water surface significantly during the 100-year event, the city will have less risk of damage to the bridge. However, there is less than 0.5 feet of free board, so the improvement, while helpful, does not eliminate all risks to the bridge. Trees and debris catching in the bridge are still a risk. As a result, it is critical to configure the armoring and protection of the bridge in order to prevent as much debris collection as possible.

With the removal of the concrete rubble at the toe of the footings, there is a slight velocity increase at the upstream face of the bridge during lower flows. During the higher flows, the velocities at the upstream face are either close to the same or less than the existing conditions. This would relate to no significant change in velocity due to the additional riprap and repairs to the bridge.

However, through the bridge and at the downstream face of the bridge, the velocities are all reduced. For the OHW (870 cfs) through the 50-year event (2100 cfs) the velocities are significantly reduced. This will result in a substantial reduction in risk to the bridge when combined with the proposed mitigation.

Table 4.1 Modeling Elevation Results

Section Station	Recurrence Interval	Existing Model	Proposed Design Model	Variation	Comments
Upstream					
	OHW	4558.92	4559.09	0.17	
	10-Year	4561.4	4560.87	-0.53	
	25-Year	4562.09	4561.50	-0.59	
	50-Year	4562.43	4562.28	-0.15	
	100-Year	4563.48	4562.31	-1.17	Proposed Design is below bridge bottom chord
Downstream					
	OHW	4557.43	4558.39	0.96	
	10-Year	4560.33	4560.39	.06	
	25-Year	4561.02	4561.02	0.00	
	50-Year	4561.36	4561.43	.07	
	100-Year	4562.36	4561.85	-0.51	

Table 4.2 2D Model Peak Velocity Results

Section Station	Recurrence Interval	Existing Condition	Proposed Design Model	Variation
Upstream				
	OHW	7.32	8.05	0.73
	10-Year	7.64	8.13	0.49
	25-Year	8.29	8.30	0.01
	50-Year	8.44	8.52	0.08
	100-Year	9.21	8.75	-0.46
Downstream				
	OHW	7.59	6.56	-1.03
	10-Year	8.25	6.73	-1.52
	25-Year	8.53	7.39	-1.14
	50-Year	8.87	8.52	-0.35
	100-Year	8.90	8.75	-0.15

These results are shown in the side by side comparison of shear stresses throughout the section. The shear units in HEC-RAS are in lbs per square foot. Figure 4.5 shows the shear stress through the bridge under the existing conditions in the two-percent chance event (50-year).This is a consequence of the concrete and rocks being dumped in order to try and protect the footings. However, as the model shows, the shear stresses created ranges from 6 to 10 lbs per square foot consistently, which tends to move the sediments and rock quite easily. However, Figure 4.6 shows that with the section being cleaned up, proper armor being installed, and the footing erosion being mitigated, the shear stresses are decreased to a range of 2.5 to 3.5 lbs per square foot. This significant reduction in shear stresses combined with improved armoring placement and construction will improve the flow through the bridge and help mitigate the bridge foundation scour.

Figure 4.5 Existing Shear Stress at 2% Chance Flows Downward

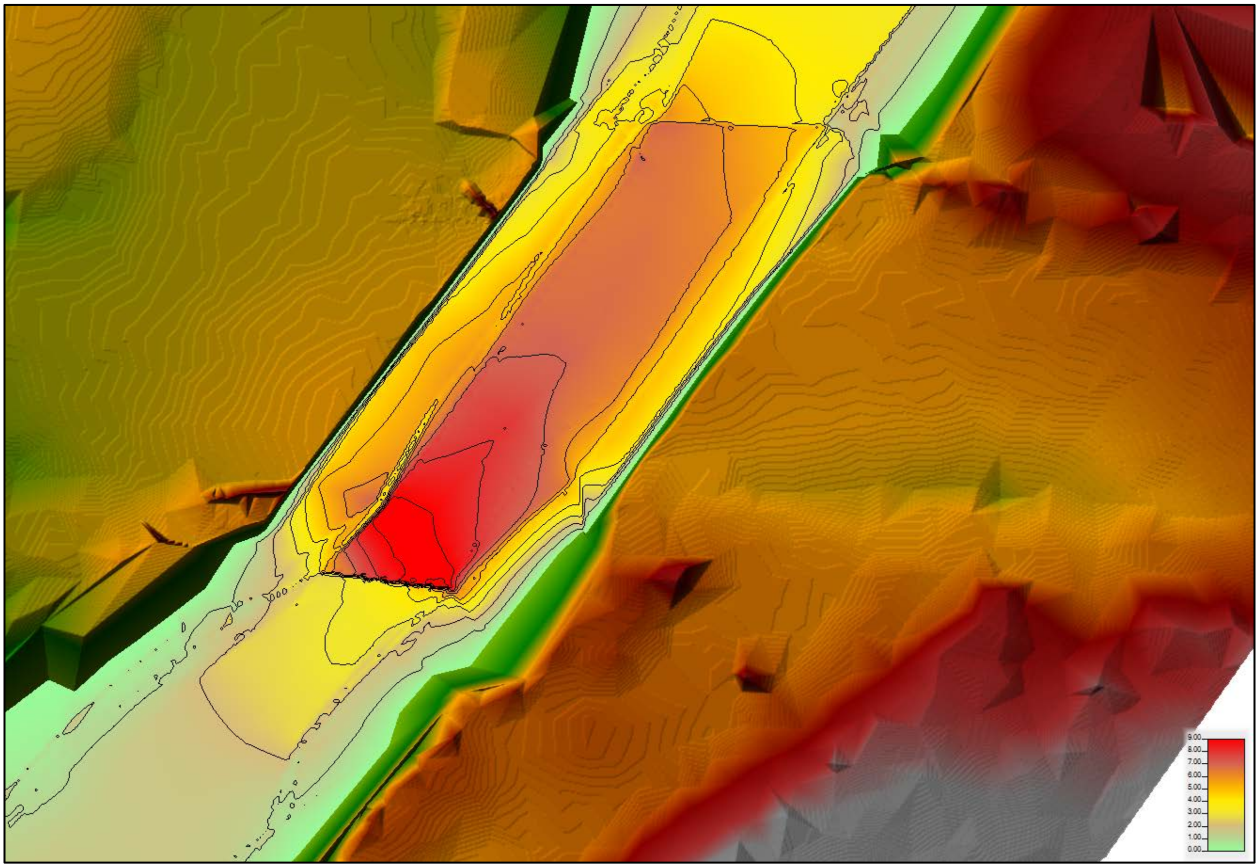
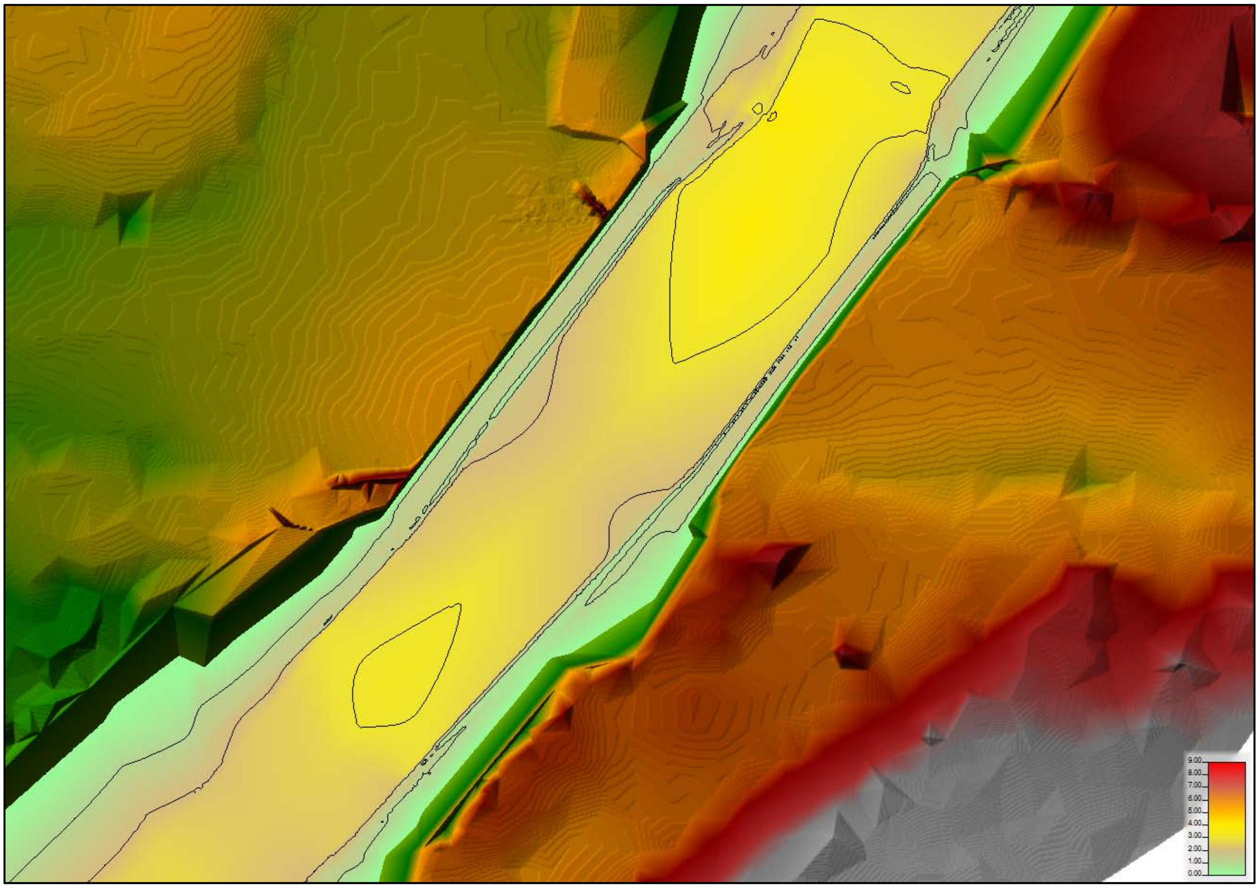


Figure 4.6 Modeled Shear Stresses Under Proposed Condition in 2% Chance Flows



4.2 Refined Rip Rap Sizing

Based on the model results, as documented in Appendix A, the rip rap sizing required for the 2:1 side slopes and the channel bottom is substantially smaller than previously required. Based on the HEC-11 gradation profiles and the EM1110-1601 sizing algorithm from the US Army Corp of Engineers, the following gradation is suggested.

Table 4.3 Riprap Gradation if Loose Placed

Rock Riprap gradation limits (HEC-11, 4.2 Table 2)

	Lower Range			Higher Range		
	Ft	Inches	lbs	Ft	Inches	lbs
D_{100}	**1.05**	**13**	**101**	**1.19**	**14**	**147**
D_{85}	**0.84**	**10**	**52**	**0.98**	**12**	**82**
D_{50}	**0.70**	**8**	**30**	**0.81**	**10**	**46**
D_{30}	**0.65**	**8**	**24**	**0.75**	**9**	**36**
D_{15}	**0.28**	**3**	**2**	**0.42**	**5**	**6**

Based on the sizing, it appears that much of the riprap placed around the toe in previous years can be recycled and reused as the concrete rubble and debris is removed and the area under the bridge is graded appropriately. This will help save the City some of their costs. Additionally, it appears the proposed gabion baskets may be filled with the material removed from the river channel as well.

5. AQUATIC IMPACTS

The existing rubble and debris in the channel bed around the bridge, as shown in the previous photos, are predominately concrete. Removing this concrete and replacing it with angular rock and stone similar to what is in the channel naturally will allow the insects to quickly move into this area comparable to other sections of the Logan River. As part of other work completed in the Logan River, other sections have responded very positively to the revegetation proposed as well as the removal of concrete rubble and debris.

6. BMPS DURING CONSTRUCTION

Working under this bridge will require equipment access into the river. The concrete chunks are simply too large to manage any other way. Construction during low flows on this section of the Logan River will occur in July and August. This work will need to be completed in this narrow window of time while flows can be more easily managed. Recommendations in the proposed approach include the following:

- Water can be diverted with sandbags, temporary pre-manufactured barricades, or other similar methods in order to coffer dam the water around the bridge footings, allowing one half of the river to be constructed at a time. This will be an issue primarily during concrete work.
- Water can be temporarily piped through this section during low flows in large diameter culverts and diverted into it with sandbags or similar structures. This would allow all concrete work under the footings to occur simultaneously, as well as much of the bank stabilization and maintenance.
- The work of removing debris will need to be completed in a periodic pause method in order to allow the water to clear up after sediments are disturbed. This will be necessary to minimize stress on the environment during the low flow periods in July and August.
- The standard BMPs for protecting the river, including verifying that no grease, oil, hydraulic fluid, or fuel leaks into the river, and ensuring equipment is cleaned before entering the river will be necessary. Additionally, spill kits for this work must be included.

DWQ will require various additional BMPs.