Little Creek

(LC5 and LC6) Fish Passage Improvements

Basis of Design Report
80 Percent

PREPARED FOR:

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7.0 APPENDICES

PREFACE

BACKGROUND

For medium and high risk projects, Basis of Design Report (BDR) shall be included as part of any engineering design contract. The BDR requirements serve as the design submittal framework that is needed to assess and evaluate the adequacy of the proposed project. The requirements were developed using the River Restoration Analysis Tool and address the 16 overarching questions proposed within the RiverRAT Framework.

The BDR will be submitted for HIP review to determine if the technical deliverables provided are adequate for *functionality (adherence to HIP Conservation Measures)* and technical quality (competent execution of design and project plans – contract documents).

PROJECT REVIEW JUNCTURES (typical steps in the RRT review process)

The following project review junctures are proposed as standard project quality assurance junctures for high risk projects and may be used for medium risk projects based on the scope and complexity of the project. The number of review junctures depends on the adequacy of information provided, incorporation of comments recommendations, and may be modified to align with identified project junctures.

Conceptual Project Review (typically 15%): The project sponsor will notify BPA at 15% or project concept stage by submitting conceptual drawings and a description of limiting factors, periodicity, and project objectives (or Chapter 1 of the BDR). The project sponsor will help the EC Lead coordinate a site visit (if needed) to review concepts and confirm the direction and planning for subsequent phases of project design. Staff biologists from the NMFS and USFWS shall be invited to the site visit. A typical site visit will include the review of limiting factors and any pertinent studies or reports that document restoration targets for implementation and draft project concepts. Additional data that may be presented and reviewed include other data sources (e.g., high resolution aerial photography, topographic maps, soil maps, GIS/CAD data layers, or other resource data). After the site visit, BPA will collate and provide comments from BPA engineering and interagency partners. Once comments are resolved, the EC Lead will notify the sponsor to proceed with the next design iteration.

Initial Review of Plans and BDR (typically 30%): Preliminary drawings, specifications, a draft Basis of Design Report (typically Chapters 1 through 3), and other supporting documentation (profiles, details, cross sections, quantities, technical analyses/appendixes, etc.) for the preferred project alternative will be submitted for review. The 30% design should demonstrate incorporation of technical comments and recommendations from the previous review.

In addition to BPA technical and functional reviews, NMFS may require a separate Engineering Review. The EC Lead will collate comments from reviewers and interagency partners, and submit them to the sponsor. The EC Lead will notify the Sponsor to proceed to the 80% design plans once 30% comments are resolved.

Final Project Review (typically 80%): The 80% project drawings and BDR (all chapters and appendices) will be submitted to the EC Lead. Technical, functional, and interagency reviews will take place. The 80% design should demonstrate complete incorporation of technical comments and recommendations developed at the previous design review. The 80% design materials should include near-final drawings and specifications, including specific site locations, site plans, profiles, cross sections, details, construction quantities, implementation resource plans, and design technical analyses. If HIP requirements are not met, an additional review iteration may be necessary. Once the EC Lead and BPA Engineering have approved the final design, the EC Lead will proceed with final agency approval and notifications.

1.0 PROJECT BACKGROUND

1.1 NAME AND TITLES OF SPONSOR, FIRMS AND INDIVIDUALS RESPONSIBLE FOR DESIGN.

The Union Soil and Water Conservation District (SWCD) entered into an agreement with Anderson Perry & Associates, Inc. (AP) to provide an engineering analysis and design for the Little Creek (LC5 and LC6) Fish Passage Improvements project located near Union, Oregon. Jadon Herron, P.E., is the engineer of record for the project.

Little Creek Diversion No. 5 (LC5) and Little Creek Diversion No. 6 (LC6) are existing irrigation diversion structures along Little Creek in the City of Union. The project will reconstruct the existing in-stream structures and construct a fish bypass channel to improve year-round fish passage. Additionally, a screen will be added to the diversions to prevent fish from entering the irrigation system.

LC5 is a channel-spanning concrete structure with two intermediate concrete walls extending above the channel, creating three bays where stop logs are placed to raise the upstream water surface elevation (WSE) and allow diversion of irrigation water. When the stop logs are installed, a fish passage barrier is created in Little Creek. The diverted water is not screened, allowing fish to enter the irrigation system. The concrete abutments on both sides of the diversion appear to constrict flow in the channel, and the intermediate concrete walls inhibit debris flow during floods, which increases the risk of ice and debris jams forming. LC5 is shown in Photos 1 and 2.

Photo 1: Looking upstream at LC5.

Photo 2: Looking at LC5 from the southwest.

LC6 is located approximately 2,000 feet upstream of LC5 and consists of a single channel-spanning concrete weir. The weir has a low-flow notch that allows placement of stop logs during the irrigation season. There is an approximately 3-foot drop over the weir to the downstream channel, effectively blocking fish passage during most flow conditions. The weir has artificially raised the channel

thalweg upstream and likely contributes to the flooding Little Creek experiences on a regular basis. LC6 is shown in Photos 3 and 4.

Photo 3: Looking at LC6 from the northwest.

Photo 4: Looking upstream at LC6.

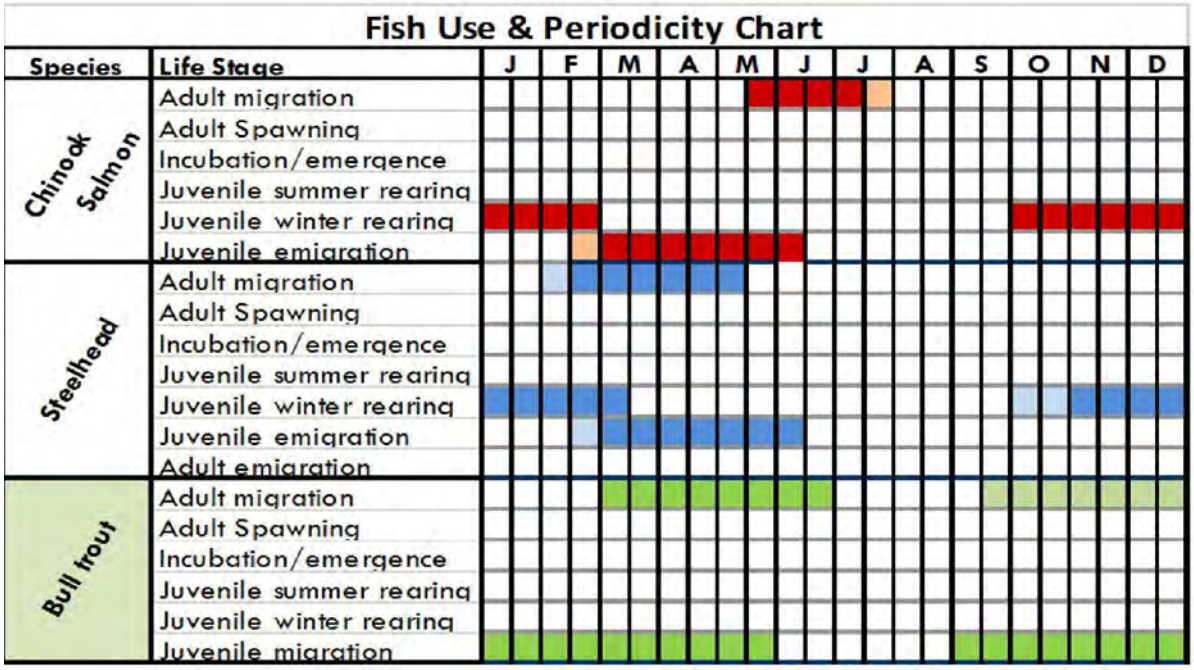
1.2 LIST OF PROJECT ELEMENTS THAT HAVE BEEN DESIGNED BY A LICENSED PROFESSIONAL ENGINEER.

Engineered design Drawings are included in Section 7.1. The Drawings include the design of the new concrete diversion structures, diversion intakes, and fish bypass channels.

1.3 EXPLANATION AND BACKGROUND ON FISHERIES USE (BY LIFE STAGE - PERIOD) AND LIMITING FACTORS ADDRESSED BY PROJECT.

Restoration within the Catherine Creek watershed is guided by the Atlas Prioritization Framework developed by local restoration teams and the Bonneville Power Administration (BPA). Little Creek is within the CC-2C Biologically Significant Reach (BSR). The CC-2C BSR is utilized by spring Chinook salmon, steelhead, bull trout, and Pacific lamprey. As Little Creek is a tributary to Lower Catherine Creek, these species are expected to use the LC5 and LC6 project reach as well. The periodicity and life stage usage are outlined on Chart 1 for key species. No periodicity chart is available for lamprey.

Chart 1
Fish Use and Periodicity of Key Species Likely Present in Little Creek



Through the Atlas Prioritization Framework process, several limiting factors were identified in the CC-2C BSR. This project focuses almost exclusively on addressing anthropogenic barriers (National Oceanic and Atmospheric Administration ID 1.1). Currently, Little Creek has multiple unscreened irrigation diversions that create passage barriers. The Little Creek (LC5 and LC6) Fish Passage Improvements project will restore passage at the two farthest upstream barriers on the creek. The LC1 diversion is located approximately 2 miles downstream of LC5 and was replaced with a new concrete fish ladder and Oregon Department of Fish and Wildlife (ODFW) fish screens in 2011. LC5 and LC6 were identified for replacement next since the U.S. Bureau of Reclamation (Reclamation) completed Alternative Evaluation Reports in 2011 and the project stakeholders have been engaged.

The LC5 and LC6 designs will be based on fish passage criteria to allow passage of both bull trout and Pacific lamprey. Bull trout criteria were selected since those include the most stringent fish passage requirements for salmonids that could be applied to Little Creek. Lamprey criteria were selected to include the unique needs of this culturally and ecologically important anadromous species. Fish passage design criteria will be applied to provide year-round upstream and downstream passage for both adults and juvenile salmonids and adult lamprey. Specific passage criteria will be based on

National Marine Fisheries Service's (NMFS) Anadromous Salmonid Passage Facility Design (NMFS 2011), Oregon's Fish Passage Criteria (Oregon Administrative Rules 635-412-0035), and the Lamprey Technical Workgroup's Passage Guidelines (2017 and 2020). Early coordination with the ODFW, NMFS, U.S. Fish and Wildlife Service (USFWS), and BPA biologists and engineers will also provide site-specific design guidance.

All diverted irrigation flows will be screened to prevent fish from entering the irrigation system. Screening will be accomplished through an ODFW rotary drum fish screen at each diversion. The concrete structures for the screens will be constructed by the contractor, and ODFW will fabricate and install the screen components.

1.4 LIST OF PRIMARY PROJECT FEATURES INCLUDING CONSTRUCTED OR NATURAL ELEMENTS.

Diversion Improvements

The improvements for each diversion can be divided into two main components: the diversion structure and the fish passage structure. The diversion structure improvements will result in the complete replacement of the existing diversion and construction of a new cast-in-place structure with steel stanchions. The diversion structure will be designed to allow for the placement of stop logs without entering the stream channel. The sill elevations of the new structures will be designed to align with the natural stream profile of Little Creek. The diversions will need to maintain a constant check WSE as summarized on Table 1. The elevations are set to help ensure there is adequate available head to allow fish screen installation, proper delivery to downstream water users, and operation of the downstream irrigation system. This will be achieved by managing the crest elevation of the stop logs in the stream channel. The diversion structures will utilize a rotary drum fish screen manufactured and installed by ODFW. The hydraulic calculations for the required check WSEs are included in Section 7.2.

TABLE 1
PROPOSED CHECK WATER SURFACE ELEVATION

Diversion	Check Water Surface Elevation (feet)	Structure Sill Elevation (feet)
LC5	2781.5	2777.5
LC6	2795.9	2792.0

Fishway

A fish bypass channel will be constructed off the main channel on river left at the diversions. To control flows, a 2-foot, 6-inch wide submerged concrete weir will be constructed at the exit of the bypass channel. Flow will be controlled utilizing a submerged weir and wooden stop logs as required. Downstream of the fishway exit structure, a plunge pool will be provided to dissipate energy before water continues down the bypass channel. The hydraulic drop between the upstream water surface and the plunge pool will be maintained to be less than 0.5 foot.

A typical bypass channel cross section will be designed with a bottom approximately 1.5 feet wide with 2H:1V side slopes. Each channel will be approximately 75 feet long, with a slope of 0.043 feet

per foot. The channel will be constructed with streambed simulation material (SSM) to mimic natural channel design, help prevent erosion, and maintain appropriate velocities for fish passage. The rock in the channel will be appropriately sized to help ensure the long-term stability of the channel. Large boulders will be placed in clusters that alternate between the left and right sides of the channel. The clusters will create flow variability, areas of lower velocity, resting areas, and a more sinuous flow path through the bypass channel to improve fish passage conditions.

Due to the bypass channel being above the invert of the natural stream channel at the fishway exit, the bypass channel will likely not receive bedload naturally transported or deposited within the Little Creek system. Shade and cover, which reduce predation, will be provided via riparian plantings along the bypass channel banks. The fish bypass channel may require periodic maintenance to maintain the SSM.

1.5 DESCRIPTION OF PERFORMANCE / SUSTAINABILITY CRITERIA FOR PROJECT ELEMENTS AND ASSESSMENT OF RISK OF FAILURE TO PERFORM, RISK TO INFRASTRUCTURE, POTENTIAL CONSEQUENCES AND COMPENSATING ANALYSIS TO REDUCE UNCERTAINTY.

The three primary objectives of the project are to provide year-round fish passage, fish screening, and reliable delivery of irrigation water. Installation of the concrete diversion structures will provide a stable means of delivering reliable and screened irrigation water. The ability to place check boards across the channel will provide flexibility to ensure water delivery as well as to maintain appropriate WSEs upstream of the diversion for proper fish bypass channel operation.

The fish bypass channel will be constructed with SSM. The shear stress in the bypass channel was calculated, and the SSM was appropriately sized. The concrete wall at the fishway exit will extend above the surrounding floodplain to help prevent high flows from entering and damaging the fishway. However, the fishway will be located in the floodplain and, if flow activates the floodplain, there is a risk the natural rock bypass channel could experience some erosion. This is not anticipated to be a normal occurrence, and the required maintenance is anticipated to be minimal if this does occur.

The diversion at LC6 consists of a permanent concrete sill that is raised above the natural channel profile. This is causing sediment to deposit upstream, resulting in erosion along the river left bank. The concrete sill for the LC6 diversion will be placed lower and in line with the natural channel profile. This will help maintain sediment transport continuity through the reach, reducing the erosive potential on the river left bank. Additionally, the concrete fishway exit will be located where the bank is currently experiencing erosion. The concrete fishway exit, along with a more natural stream profile, is anticipated to reduce the risk for continued erosion and the potential for the channel to flank the diversion structure.

Existing culverts are located downstream of both LC5 and LC6. These culverts are aging and create constrictions during higher flows. The overall channel profile through the LC5 and LC6 sites was evaluated to consider potential future impacts if these culverts are replaced with larger, more geomorphically appropriate structures in the future. The proposed LC5 and LC6 diversion widths and invert elevations were designed to function with the current culverts and the potential future

installation of larger replacement bridges. Diversion improvements are designed based on the ordinary high water (OHW) measured at areas outside the influence from the bridges and diversions. Scour holes downstream of the existing diversions are caused by flow over the concrete sills. The existing scour holes are approximately 1.5 feet deep. The proposed diversion structures will incorporate a pool-glide-riffle sequence downstream of each diversion. These pools will help dissipate the energy of the water flowing over the concrete structures with a natural pool sequence. The riffle will be constructed with slightly oversized SSM to help maintain the riffle crest elevation and prevent development of a water surface drop over the new concrete diversion structures when the check boards are not installed.

A 5-foot deep cut-off wall will be buried downstream of the diversion structures and a 3-foot deep cut-off wall will be buried upstream of the diversions. These cut-off walls will help protect the structures from potential scour. One-inch diameter polyvinyl chloride pipes will be constructed in the cut-off walls to help maintain hyporheic flow under the diversions. The bottom of the footings for the fish screen and the fishway wall will also be buried 4 feet below the channel.

1.6 DESCRIPTION OF DISTURBANCE INCLUDING TIMING AND AREAL EXTENT AND POTENTIAL IMPACTS ASSOCIATED WITH IMPLEMENTATION OF EACH ELEMENT.

Permanent impacts to the creek bed and banks will result from the replacement of the concrete diversion structures and the installation of the fish screens and fish bypass channels.

Timing - The contractor will perform all work located below the OHW elevation within the designated in-stream work window for this project. The work area will be isolated from flowing water to minimize impacts to listed species.

Staging and Access - Prior to construction, the project area will be clearly flagged to identify sensitive areas, equipment entry and exit points, and staging, storage, and stockpile areas. Existing access roads will be used to lessen soil disturbance, compaction, and impacts to vegetation. Since the project sites are located in the city limits, the staging areas are constrained and all material and equipment will not be able to be staged more than 150 feet from Little Creek. The far edge of the staging areas will be approximately 100 to 130 feet away from Little Creek. Since staging will occur within 150 feet of the channel and within the 100-year floodplain, spill prevention measures are included in the Technical Specifications. Since construction is anticipated to occur during the summer when flows are low, the risk of the staging areas becoming inundated with flows is extremely low.

Equipment Limitations - In-stream work will be accomplished using excavators equipped with a "thumb" or equivalent piece of equipment. Mechanized equipment and vehicles will be selected, operated, and maintained in a manner that will minimize adverse effects on the environment. Equipment will operate from the bank and within the dewatered and isolated sections of Little Creek as much as possible. The excavator may enter and operate within the wetted perimeter during the dewatering phase. All equipment will be washed prior to entering the project area so it is clean of debris and petroleum products. Equipment will be in good working order and will be inspected daily for leaks. Equipment working near the banks or within the OHW mark will have biodegradable lubricants and fish-friendly fluids in the hydraulic lines. Refueling and maintenance of equipment or vehicles will occur in the staging area as far from the creek as possible. For phases of construction

that require pumping, an adequately sized pump screen will be attached to ensure fish protection. The contractor will have a spill containment kit on site at all times.

Aquatic Worksite Isolation - A stream bypass will be installed, and work will occur in isolation from flowing water to minimize impacts to aquatic life and water quality. Work site isolation and salvage operations will follow the ordering, methodologies, and conservation measures specified in the BPA Habitat Improvement Program (HIP) Biological Opinion. Sediment and erosion control best management practices (BMPs) will be implemented during all phases of construction. A fish salvage will be performed, and block nets will be installed to isolate fish from the work area as needed. Fish biologists will be present on site during the dewatering process to monitor for any remaining fish. If adult salmon are captured, they will be relocated immediately.

Erosion Control - Temporary erosion controls will be in place before alteration of the project site and appropriately installed downslope of the project activity within the riparian buffer area until site rehabilitation is complete. Sediment barriers will be installed and maintained for the duration of project implementation. Temporary erosion control measures may include fiber wattles, silt fences, jute matting, wood fiber mulch and soil binder, or geotextiles and geosynthetic fabric. Erosion control measure are shown on Sheets D-101 and D-201.

Site Restoration and Revegetation - Upon project completion, all disturbed areas will be cleaned up, seeded, and replanted with native vegetation where appropriate. Erosion control seed mix will be placed in disturbed areas.

Project Monitoring - The Union SWCD and design engineers will provide construction observation to help ensure the project is built as designed.

2.0 RESOURCE INVENTORY AND EVALUATION.

2.1 DESCRIPTION OF PAST AND PRESENT IMPACTS ON CHANNEL, RIPARIAN AND FLOODPLAIN CONDITIONS.

The existing diversion structures have been in place for many years. Water rights associated with these diversions have priority dates ranging from 1863 to 1972, and there have likely been impacts from irrigation diversions along this reach for more than a century. The project reach is within the city limits of Union, Oregon. While there are no formal levees along the reach, there is evidence of small berms on the overbanks that were likely installed to help reduce localized flooding in the area. The floodplain throughout the project reach varies among agricultural fields, pastures, and backyards.

2.2 INSTREAM FLOW MANAGEMENT AND CONSTRAINTS IN THE PROJECT REACH.

There is an in-stream water right for anadromous and resident fish habitat through the project reach. The in-stream water right is junior to the LC5 and LC6 irrigation water rights and has a priority date of June 7, 1991. The in-stream water right varies throughout the year from a low of 6.8 cubic feet per second (cfs) in November to a high of 34 cfs in April.

2.3 DESCRIPTION OF EXISTING GEOMORPHIC CONDITIONS AND CONSTRAINTS ON PHYSICAL PROCESSES.

Approximately 1.5-foot deep scour holes exist downstream of each diversion that have exposed the bottom of the concrete sills, which could suggest there has been some modest historic incision since the original installation. Existing road crossings are located downstream of each diversion. The crossing downstream of LC6 is a concrete box culvert with a concrete bottom. The crossing downstream of LC5 has a steel girder superstructure with concrete abutments. Riprap has been placed along the banks, with some large rocks extending into the channel. These large rocks appear to function similarly to an oversized SSM material and appear to create stable riffle downstream of the scour hole created by the concrete structure. If there was historic incision in Little Creek, the stream crossings downstream of LC5 and LC6 appear to be effectively limiting future incision.

The permanent concrete sill at LC6 is artificially raised above the natural channel profile and is causing sediment deposition upstream that is attributing to the bank erosion along river left. The proposed concrete sill will be set at a lower elevation along the natural channel profile. The proposed project consists of regrading the channel upstream of the LC6 diversion approximately 25 feet where there will be disturbance associated with the installation of the new structure. The reconstructed channel will then be smoothly graded into the existing channel, leaving much of the deposited sediment upstream. It is anticipated that as the check boards are removed from the diversion during high flows, some of this sediment will begin to naturally mobilize, helping improve sediment transport continuity through this reach of Little Creek.

The width of the new diversion structures will be 20 feet, which matches the width of the existing LC5 structure. The existing OHW width through this reach is approximately 16 feet. With the sediment deposition present upstream of LC6, the risk of over-narrowing the diversion structures appears to be higher than over-widening the structures, and the 20-foot width appears to be the most appropriate. This will allow Little Creek to return to a more natural channel width without creating a constriction that would potentially increase channel velocities and increase the streambed coarseness.

2.4 DESCRIPTION OF EXISTING RIPARIAN CONDITION AND HISTORICAL RIPARIAN IMPACTS.

Through this reach, Little Creek has a narrow band of riparian vegetation immediately along the bank while the overbank areas are mostly devoid of riparian vegetation. The vegetation along LC5 is relatively sparse, as shown in Photo 5. The banks along LC6 are more densely vegetated with a mix of shrubs and larger trees, specifically along river left. The riparian vegetation is shown in Photo 6.

Photo 5: Riparian vegetation looking upstream of LC5.

2.5 DESCRIPTION OF LATERAL CONNECTIVITY TO FLOODPLAIN AND HISTORICAL FLOODPLAIN IMPACTS.

Photo 6: Riparian vegetation looking upstream at LC6.

The OHW width of Little Creek through the project reach is approxiamtely 16 feet while the top of bank varies between 25 and 30 feet. The channel has the capacity to carry flows above the OHW before activiating the floodplain. Once flows overtop the banks, the floodplain is relatively flat, resulting in wide shallow flooding across pastures and through yards. Since the project reach is within the city limits, infrastructure is built within the floodplain and adjacent to the channel. There is also evidence of small berms constucted to help reduce flooding. These berms are small and non-continuous and do not form a levee system.

The concrete sill elevation at LC6 is above the natural channel profile. This causes backwater upstream that likely contributes to flooding in the area. The proposed LC6 diversion structure concrete sill will be in line with the natural channel profile. This will allow the check boards to be removed during high flow events, lowering the upstream backwater and reducing flooding to adjacent infrastructure. The lowered concrete sill will also benefit the channel by improving sediment transport continuity through the project reach.

The project reach is mapped on the Federal Emergency Management Agency (FEMA) Floodplain Insurance Rate Map Panel No. 410223 001 B and is located in Zone A1, areas of the 100-year flood where base flood elevations have been determined. A floodway has not been defined. The mapped 100-year floodplain varies between approximately 300 and 600 feet wide through the project reach.

2.6 TIDAL INFLUENCE IN PROJECT REACH AND INFLUENCE OF STRUCTURAL CONTROLS (DIKES OR GATES).

Not applicable.

3.0 TECHNICAL DATA.

3.1 INCORPORATION OF HIP IV SPECIFIC ACTIVITY CONSERVATION MEASURES FOR ALL INCLUDED PROJECT ELEMENTS.

The following HIP IV specific activity conservation measure were included in the project elements:

Category 1b) Consolidate or Replace Existing Irrigation Diversions

1) If structures are removed, see Activity Category 1a) Dams, Water Control Structures, or Legacy Structures Removal for appropriate conservation measures.

a. *Not applicable. The structures are being replaced, not removed.*

2) If placement of rock structures or engineered riffles is required for headcut or grade stabilization, see Activity Category 1c) Headcut and Grade Stabilization for appropriate conservation measures.
   a. *Conservation measures for Activity Category 1c) have been included.*

3) If fish exclusion is added or modified, see Activity Category 7g) Install, Upgrade, or Maintain Fish Exclusion Devices and Bypass Systems for appropriate conservation measures.
   a. *Conservation measure for Activity Category 7g) have been included.*

4) Diversion structures shall be designed to meet NMFS Anadromous Salmonid Passage Facility Design Guidelines (NMFS 2011 or more recent version) and, where appropriate, *Guidelines for Incorporating Adult Pacific Lamprey Passage at Fishways (PLTW 2017)*.
   a. *The project will be designed in accordance with NMFS Anadromous Salmonid Passage Facility Design Guidelines and Guidelines for Incorporating Adult Pacific Lamprey Passage at Fishways.*

5) Irrigation diversion intake and return points will be designed or replaced to prevent Endangered Species Act-listed and threatened fish species from swimming or being entrained in the irrigation system.
   a. *Rotary drum fish screens manufactured by ODFW will be included at both sites. Currently, an overflow on the ditch at LC6 can return diverted water to the channel downstream of Highway 237. Eliminating this return will be discussed with the irrigators since it may not be required with the new diversion. The irrigation ditches that LC5 and LC6 serve, flow approximately 6 miles to the north. A detailed evaluation of the ditch system is outside the scope of this project. If there is excess flow in the ditch, it appears the flow may enter a slough near the confluence of Little Creek and Mill Creek approximately 2.5 miles west of Cove, Oregon.*

6) For irrigation efficiency and water conservation actions within this activity category, HIP will only cover projects that use state-approved regulatory mechanisms (e.g., Oregon Revised Statutes 537.455-.500, Revised Code of Washington 90.42) for ensuring that water savings will be protected as in-stream water rights, or in cases where project implementers identify how the water conserved will remain in-stream to benefit fish without any substantial loss of the in-stream flows to downstream diversions.
   a. *Not applicable. This project does not include irrigation efficiency improvements.*

7) Project design shall include the installation of a totalizing flow meter on all diversions for which installation of this device is possible. A staff gauge or other device capable of measuring instantaneous flow will be utilized on all other diversions.
   a. *A totalizing flowmeter will be installed at each site.*

8) Multiple existing diversions may be consolidated into one diversion if the consolidated diversion is located at the most downstream existing diversion point unless sufficient water is available to support unimpeded passage at low flows. The design will clearly identify the low flow conditions within the stream reach relative to the cumulative diverted water right. If in-stream flow conditions are proven favorable for fish passage and habitat use, then diversion consolidation may occur upstream of the lowest original structure.
    a. *Not applicable. The diversions are not being consolidated. Consolidating diversions would require the design of a pump station at a downstream diversion and building a pipeline through the City. This was determined not to be feasible.*

9) Diversions will be designed to incorporate Point of Diversion (POD) flow restrictions to limit the diverted flow to satisfy the irrigator's water right at the 95 percent exceedance stream flow stage. Diversion flow restriction may be accomplished by any practical means available but must be supported by hydraulic calculations and a stage rating curve. POD flow restriction may be accomplished by:
    a. Incorporation of a restricted orifice plate or screen at the POD that provides, at a maximum, the required area to pass the irrigator's water right;
    b. Mechanically restricting the opening of a variable head gate to the maximum area required to pass the irrigator's water right; or
    c. Any other method that will satisfy the intent of the diversion flow governance requirement that can be justified by the design documents.
        i. *Each diversion will be constructed with a variable head gate that will be used to restrict the diversion rate. The headgate will have the ability to be locked in place by the local watermaster.*

10) Treated wood and copper- or zinc-plated hardware shall not be used in the construction of irrigation diversions. Concrete must be sufficiently cured or dried (48 to 72 hours depending on temperature) before coming into contact with stream flow.
    a. *Treated wood and copper- or zinc-plated hardware will not be used in the construction. Concrete will be sufficiently cured before coming into contact with stream flow; the HIP IV conservation measures have been included in the Drawings.*

Category 1c) Headcut and Grade Stabilization

CONSERVATION MEASURES (GENERAL)

1) All structures will be designed to the design benchmarks set forth in NMFS Anadromous Salmonid Passage Facility Design Guidelines (or most recent version).
    a. *The project will be designed in accordance with NMFS Anadromous Salmonid Passage Facility Design Guidelines and Guidelines for Incorporating Adult Pacific Lamprey Passage at Fishways.*

2) For grade control structures that are greater than or equal to 18 inches in height, provide the profile of the stream thalweg for a minimum of ten upstream and ten downstream channel widths beyond the extent of the proposed construction. The design documentation shall provide enough information to clearly demonstrate project impacts to the stream channel and the potential for channel degradation.
    a. *The OHW width of Little Creek is approximately 16 feet, which would require a channel profile for approximately 160 feet upstream and downstream of the diversions. A full topographic survey was completed for approximately 1,100 feet at LC5 and 1,300 feet at LC6. The longitudinal profile was created throughout the entire survey and was evaluated as part of the design, and the natural channel slope was included on the channel profiles on Sheets C-102 and C-202. Due to scale constraints, only 450 feet of the channel profile at each site is shown on the Drawings.*

CONSERVATION MEASURES (BOULDER AND LOG WEIRS)

a. *Not applicable. Boulder and log weirs will not be used in the project.*

CONSERVATION MEASURES (HEADCUT STABILIZATION AND ROUGHENED RIFFLES)

1) Provide fish passage over stabilized head-cut or constructed riffle according to NMFS Anadromous Salmonid Passage Facility Design Guidelines (or most recent version). Passage can be provided through a series of log or rock weir structures or a roughened channel.
    a. *A pool will be constructed downstream of each diversion structure to help dissipate energy as water flows over the concrete sill. A riffle will be constructed with SSM downstream of the pool to help prevent a water surface drop over the concrete sill when check boards are not installed. The elevations of the riffle and the concrete sill were established based on an evaluation of the natural channel profile throughout the project reach. The riffle will be constructed to mimic the natural channel. Since the diversion and riffle elevations are established based on the natural channel profile, the slope of the elements will match the natural channel slope. A low flow notch will be constructed in the concrete sill that is 6 inches lower than the adjacent sill. The downstream riffle elevation will be approximately 2 inches higher than the low flow notch, which will help create a backwater through the low flow notch in the concrete sill.*
2) Armor features intended for grade stabilization with sufficiently sized and sufficient amounts of material to provide a structure capable of withstanding a 100-year flow event (or other approved design flow) without further progressing the headcut or substantially degrading the riffle.
    a. *The SSM sizing for the constructed riffle is outlined is Section 3.6.*

3) Headcut stabilization structures and roughened riffles will be constructed utilizing an engineered SSM, which will be pressure-washed into place until surface flow is apparent and minimal subsurface material to ensure fish passage immediately following construction (if natural flows are sufficient). Successful washing will be determined by minimizing voids within placed matrix such that ponding occurs with little to no percolation losses.
    a. *SSM notes are included on the Drawings.*

4) For grade stabilization efforts, design considerations should extend beyond the control structure to include the plunge pool downstream and the upstream approach. Also consider floodplain

return flows and flanking that could create potential new headcut conditions and potential changes in bank erosion conditions due to structure placement.

a. *A plunge pool has been incorporated downstream of the concrete diversion sill. The existing diversions have been in place for many years and appear to be in stable locations along the channel. The risk of the channel flanking the diversion structures was determined to be low.*

5) Minimize lateral migration of the channel around the head cut or riffle ("flanking") by designing the downstream face with a lower elevation in the center of the channel cross section to direct flows to the middle of channel.

a. *A low flow notch is included in the concrete diversion structures to concentrate the flow. The constructed riffle downstream of the plunge pool will be constructed with SSM and will be constructed with a low flow thalweg to concentrate the flow in the middle of the channel.*

6) Materials used for construction can be native to the area if gradation is shown to be appropriate.

a. *The material for the constructed riffle is anticipated to be a combination of native streambed material and imported rock to create an appropriate gradation.*

Category 1e) Provide Fish Passage at an Existing Facility

CONSERVATION MEASURES

1) For maintenance activities where sediment is placed in stream, see activity category 2g) Install Habitat-Forming Natural Materials (Sediment and Gravel) for appropriate conservation measures.

a. *Not applicable. The project does not include installing habitat-forming sediment and gravel.*

2) Fish Passage will be designed to the design benchmarks set forth in NMFS Anadromous Salmonid Passage Facility Design Guidelines (or most recent version).

a. *The project will be designed in accordance with NMFS Anadromous Salmonid Passage Facility Design Guidelines and Guidelines for Incorporating Adult Pacific Lamprey Passage at Fishways.*

3) Design consideration should be given for Pacific lamprey passage, as described in guidelines set forth in Pacific Lamprey Technical Workgroup 2017. Fish ladders that are primarily designed for salmonids are usually impediments to lamprey passage as they do not have continuous, adequate surfaces for attachment, velocities are often too high, and there are inadequate places for resting. Providing rounded corners, smooth continuous floor for attachment, resting areas, or providing a natural stream channel (stream simulation) or wetted ramp for passage over the impediment have been effective in facilitating lamprey passage.

a. *The project will utilize a natural channel bypass for fish passage, which is more conducive for lamprey passage than a concrete fish ladder. The upstream exit of the natural channel bypass will be made of concrete to control flow. BMPs outlined in the Pacific Lamprey Technical Workgroup paper, such as rounded concrete edges, have been incorporated to improve lamprey passage.*

4) Treated wood and copper- or zinc-plated hardware shall not be used in the construction of fish ladders. Concrete must be sufficiently cured or dried 21 days before coming into contact with stream flow.
    a. *Treated wood and copper- or zinc-plated hardware will not be used in the construction. Concrete will be sufficiently cured before coming into contact with stream flow; the HIP IV conservation measures have been included in the Drawings.*

Category 7g) Install, Upgrade, or Maintain Fish Exclusion Devices and Bypass

CONSERVATION MEASURES

1) Construction and modifications to the in-stream diversion structure or other in-water structures upstream of the headgate shall meet conservation measures of the appropriate activity category in Section 4.1, most likely Category 1b) Consolidate or Replace Existing Irrigation Diversion.
    a. *Conservation measures for Activity Categories 1b, 1c, and 1e have been incorporated.*

2) All fish screens (including screens installed on temporary and permanent pump intakes) and fish bypass systems will be designed, constructed, installed, operated, and maintained according to NMFS fish screen criteria, detailed in Anadromous Salmonid Passage Facility Design (NMFS 2011 or most recent version).
    a. *A rotary drum fish screen fabricated by ODFW will be installed at each diversion.*

3) In-water maintenance upstream of screens shall provide fish exclusion or fish passage benefits.
    a. *The screens will be installed off channel. Long-term maintenance is anticipated to be minor and could likely occur behind a closed irrigation intake headgate to provide fish exclusion to the screen during maintenance and not impede fish passage in the main channel.*

4) In order to reduce entrainment of larval lamprey, the use of wire cloth for screening should be avoided; perforated plate, vertical bar or interlocking bar screens should be used instead (Rose and Mesa 2012).
    a. *A rotary drum fish screen fabricated by ODFW will be installed at each diversion.*

5) Diversion water intake and return points will be installed, replaced, upgraded, or removed, to prevent salmonids of all life stages from swimming into, or being entrained within, the diversion system.
    a. *The project does not include diversion return points, and the diversion points will be screened.*
6) All large wood and sediment recovered during cleaning and maintenance may be placed downstream of the diversion.
    a. *Not applicable. The project consists of screen installation, not maintenance.*

3.2 SUMMARY OF SITE INFORMATION AND MEASUREMENTS (SURVEY, BED MATERIAL, ETC.) USED TO SUPPORT ASSESSMENT AND DESIGN.

AP conducted a topographic survey of the project site in September 2020. The survey extent of the project site included approximately 1,100 feet along the channel at LC5 and 1,300 feet at LC6. Other data collected include diversion dimensions and invert elevations, edge of water, and other various features needed to characterize the existing area and project site conditions. The survey data were

compiled and imported into AutoCAD to be used to prepare site maps and drawing details. The survey data were used to create hydraulic models of the flows through the diversions. The project site was flown in late summer 2020 to collect up-to-date light detection and ranging (LiDAR) data for the Grande Ronde Model Watershed. AP was able to obtain a copy of these data for use with the project. LiDAR data were used to create the terrain data for the wider floodplain area in the project vicinity. The vertical datum is North American Vertical Datum of 1988, and the horizontal datum is Oregon State Plane Coordinate System - North Zone.

3.3 SUMMARY OF HYDROLOGIC ANALYSES CONDUCTED, INCLUDING DATA SOURCES AND PERIOD OF RECORD INCLUDING A LIST OF DESIGN DISCHARGE (Q) AND RETURN INTERVAL (RI) FOR EACH DESIGN ELEMENT.

Design flows for Little Creek were determined by Reclamation through development of a hydrograph for the mean daily discharges for a 25-year period for Little Creek. Since no stream gauge data are available for Little Creek, a reduction ratio was applied to the discharge data from Catherine Creek near the Union stream gauge to develop the synthetic hydrograph for Little Creek. The exceedance intervals can be found on Table 2. These flow values were validated after comparing them to flow duration statistics calculated for the project site by StreamStats.

TABLE 2
LITTLE CREEK NATURAL FLOWS

Exceedance Interval (Percent)	Flow[1] (cfs)
5	120
95	7

[1]*Flows represent the natural flow prior to any diversions on Little Creek, as determined from the synthetic hydrograph created by Reclamation.*

A flood frequency analysis was performed for Little Creek by Inter-Fluv for the Buffalo Flats project, approximately 1 mile upstream on Little Creek. These results were validated after comparing them to peak flow estimates using regression equations calculated through the Oregon Water Resources Department auto-delineation program. Table 3 provides a flow summary calculated for the project site.

TABLE 3
SUMMARY OF LITTLE CREEK HYDROLOGY ANALYSIS

Return Period (Years)	Flow Values (cfs)
2	218
5	299
10	351
25	417
50	466
100	514

The project site is within a mapped floodplain where the base flood elevations and flood hazard factors have been determined. For regulatory floodplain compliance, the published FEMA flows for Little Creek will be used for the base flood. Table 4 summarizes the published FEMA flows.

TABLE 4
PUBLISHED FEDERAL EMERGENCY MANAGEMENT AGENCY FLOWS FOR LITTLE CREEK

Return Period (Years)	Peak Discharge (cfs)
10	653
50	813
100	882
500	1036

3.4 SUMMARY OF SEDIMENT SUPPLY AND TRANSPORT ANALYSES CONDUCTED, INCLUDING DATA SOURCES INCLUDING SEDIMENT SIZE GRADATION USED IN STREAMBED DESIGN.

A discussion of the SSM material calculations, sizing, and gradation is included in Section 3.6. The SSM is designed to remain stable for the range of design flows.

3.5 SUMMARY OF HYDRAULIC MODELING OR ANALYSES CONDUCTED AND OUTCOMES – IMPLICATIONS RELATIVE TO PROPOSED DESIGN.

A profile was created along the thalweg of Little Creek from approximately 550 feet upstream and downstream of each diversion structure. The profile was evaluated to understand channel slope, locate fish passage areas of concern, and help develop the proposed improvements. Through the project site, the average channel slope is approximately 0.007 feet per foot. A two-dimensional hydraulic model was developed in Hydrologic Engineering Center's River Analysis System (HEC-RAS) 6.0 to evaluate Little Creek throughout the project reach. The combined terrain data were used to model the existing channel conditions. The existing bridges and diversion structures were coded into the hydraulic model. Figures in Section 7.3 show the 2D HEC-RAS model and results.
Changes to the hydraulic model and terrain were made to appropriately model the proposed conditions. Changes to the terrain were made to allow the fish bypass channel to be graded into the terrain. Additional grading within the channel of Little Creek was completed at LC6. This was done to create a new terrain within the model domain that accurately represents the proposed grading to accommodate the lowered diversion sill to match the natural channel profile more closely.

The main diversion structures were modeled as weirs with adjustable crest elevations to control the forebay WSE. The concrete fish bypass channel control structure was modeled with an adjustable weir with a low orifice. The weir for the fish bypass channel will be used to help maintain forebay WSEs while still achieving adequate attraction flow in the bypass channel. During the 95 percent exceedance flow, the weir is at its upper elevation. This will help maintain the forebay elevation for irrigation delivery but allow all 7.0 cfs of remaining stream flow to enter the fish bypass channel. During the 5 percent exceedance flow, the weir will be at its lowest elevation to allow more water to enter the fish bypass channel to increase attraction flow. The orifice is in place to minimize

the possibility of fish becoming stranded in the pool directly downstream of the concrete fish bypass channel control structure. Additionally, the weir for the control structure is designed to have less than a 6-inch jump height throughout the range of flows. The hydraulic model shows that there will be less than a 0.5-foot drop in WSE between the forebay and upstream limits of the fish bypass channel for both the 5 percent and 95 percent exceedance flows. Table 5 summarizes the flow conditions within the bypass channels at each diversion.

TABLE 5
HYDRAULIC SUMMARY

Fish Bypass Channel		Flow Through Fish Bypass Channel (cfs)	Percent Flow Through Fish Bypass Channel	Average Channel Velocity (fps)	Max Channel Depth (ft)
LC5	95 Percent Exceedance Flow	7.0	100	2.2	0.9
	5 Percent Exceedance Flow	9.3	7.8	2.5	1.1
LC6	95 Percent Exceedance Flow	7.0	100	2.2	0.9
	5 Percent Exceedance Flow	9.4	7.8	2.4	1.1

fps = feet per second
ft = feet

3.6 STABILITY ANALYSES AND COMPUTATIONS FOR PROJECT ELEMENTS, AND COMPREHENSIVE PROJECT PLAN.

Rock Sizing for Large-Scale Roughness Boulders

Sizing calculations for the large-scale roughness boulders in the bypass channel and the main channel were completed based on the U.S. Army Corps of Engineers (USACE) Habitat Boulder Design as outlined in Natural Resources Conservation Service Technical Supplement 14C Stone Sizing Criteria Part 654 National Engineering Handbook. The calculations are attached in Section 7.4. The calculated boulder size for the main channel and the bypass channel is 5 and 11 inches, respectively. Although the sizing calculations showed that a smaller boulder would remain stable, 24-inch and 18-inch diameter boulders were selected for the main channel and bypass channel, respectively. The larger boulders were selected to provide the desired roughness and flow characteristics.

Streambed Simulation Material Sizing

Sizing calculation for the SSM in the main channel and the bypass channel were completed using the Bathurst method, the critical shear stress method, and the USACE riprap design method. These methodologies and the corresponding SSM gradations are taken from the 2013 Washington Department of Fish and Wildlife Water Crossing Design Guidelines and help determine the appropriate SSM size for the full range of design flows anticipated. The calculations are attached in Section 7.4.

The calculated SSM D_{84} size for the main channel ranged from 2 to 5 inches. The road crossings downstream of the diversions are undersized, causing the project sites to be within the backwater effect of the road crossings during peak flow events. This is contributing to the small calculated SSM size. The channel downstream of a diversion typically experiences erosion due to the flow patterns over a concrete sill, so an SSM with a D_{84} of 24 inches was selected for the downstream channel.

This material is oversized to help stabilize the channel, prevent a hydraulic drop from forming over the diversion, and maintain stability at the diversion if the road crossings are replaced in the future. An SSM with a D_{84} of 10 inches was selected upstream of the diversion to more closely mimic the natural channel gradation more closely.

The calculated SSM D_{84} size for the bypass channel ranged from 4 to 6 inches for the bypass channel. Since the bypass channel slope is more than 4 percent, includes a concrete control structure at the upstream face, and must remain stable without bedload contribution from the main channel, an SSM with a D_{84} of 18 inches was selected. This material will also help maintain the bypass channel's stability if the downstream road crossings are replaced in the future. The SSM gradation is outlined in the Technical Specifications attached in Section 7.5.

Sill Elevation for Diversion Structures

The still elevations were determined by analyzing the long profile of Little Creek at each diversion. This allowed for the sill elevations to be placed approximately at the natural stream grade. At LC6, the existing diversion has been a grade control structure and has artificially raised the channel upstream of the diversion. The sill elevation will be lowered to better match into the long profile for Little Creek.

3.7 DESCRIPTION OF HOW PRECEDING TECHNICAL ANALYSIS HAS BEEN INCORPORATED INTO AND INTEGRATED WITH THE CONSTRUCTION – CONTRACT DOCUMENTATION.

The technical analysis was used to size the SSM, large-scale roughness boulders, and channel elevations. The design integrates the requirements determined from the calculations and sizing methods discussed earlier. These requirements are incorporated into the Drawings and Technical Specifications.

3.8 FOR PROJECTS THAT ADDRESS PROFILE DISCONTINUITIES (GRADE STABILIZATION, SMALL DAM AND STRUCTURE REMOVALS): A LONGITUDINAL PROFILE OF THE STREAM CHANNEL THALWEG FOR 20 CHANNEL WIDTHS UPSTREAM AND DOWNSTREAM OF THE STRUCTURE SHALL BE USED TO DETERMINE THE POTENTIAL FOR CHANNEL DEGRADATION.

AP conducted a topographic survey of the project site in September 2020. The survey extent of the project site included approximately 1,100 feet along the channel at LC5 and 1,300 feet at LC6.

3.9 FOR PROJECTS THAT ADDRESS PROFILE DISCONTINUITIES (GRADE STABILIZATION, SMALL DAM AND STRUCTURE REMOVALS): A MINIMUM OF THREE CROSS-SECTIONS – ONE DOWNSTREAM OF THE STRUCTURE, ONE THROUGH THE RESERVOIR AREA UPSTREAM OF THE STRUCTURE, AND ONE UPSTREAM OF THE RESERVOIR AREA OUTSIDE OF THE INFLUENCE OF THE STRUCTURE) TO CHARACTERIZE THE CHANNEL MORPHOLOGY AND QUANTIFY THE STORED SEDIMENT.

Cross sections downstream, through, and above the existing irrigation diversions were taken as part of the full topographic survey completed at each diversion.

4.0 CONSTRUCTION – CONTRACT DOCUMENTATION.

4.1 INCORPORATION OF HIP IV GENERAL AND CONSTRUCTION CONSERVATION MEASURES

The HIP IV conservation measures are presented in the design Drawings on Sheets G-002 through G-004.

4.2 DESIGN – CONSTRUCTION PLAN SET INCLUDING BUT NOT LIMITED TO PLAN, PROFILE, SECTION AND DETAIL SHEETS THAT IDENTIFY ALL PROJECT ELEMENTS AND CONSTRUCTION ACTIVITIES OF SUFFICIENT DETAIL TO GOVERN COMPETENT EXECUTION OF PROJECT BIDDING AND IMPLEMENTATION.

The design Drawings are attached in Section 7.1, the Technical Specification are attached in Section 7.5, and the cost estimate is attached in Section 7.6.

4.3 LIST OF ALL PROPOSED PROJECT MATERIALS AND QUANTITIES.

The project materials will be specified on the Drawings and in the Technical Specifications, and a bid schedule is included in Section 7.5 with the Technical Specifications.

4.4 DESCRIPTION OF BEST MANAGEMENT PRACTICES THAT WILL BE IMPLEMENTED AND IMPLEMENTATION RESOURCE PLANS INCLUDING:

1. SITE ACCESS STAGING AND SEQUENCING PLAN.

All equipment and materials will be transported to the project site and located in designated staging areas. The contractor will use existing access roads and paths whenever reasonable and will minimize the number and length of temporary access roads and paths through riparian areas and floodplains to minimize soil disturbance and compaction and impacts to vegetation.

Staging areas used for construction equipment storage; vehicle storage, fueling, and servicing; and hazardous materials storage will be located in the designated staging area. Erosion and sediment control measures will be implemented to prevent sediment and hazardous materials from entering the waterway. Natural materials used for habitat restoration, such as gravel and boulders, may be staged within the 100-year floodplain.

Existing native vegetation will be protected and preserved, to the greatest extent possible, during construction. When working in the riparian area, topsoil will be cleared and grubbed with an excavator prior to general excavation. Topsoil will be segregated and stockpiled separately from other material in areas immediately adjacent to the work area. Stockpiles will not be located below the OHW elevation but may be located in the floodplain. Once construction is complete, the topsoil will be used as backfill in the area from where it was removed. Excess material from the improvements is not anticipated.

The contractor will minimize the removal of riparian vegetation during construction of the temporary access roads or paths. When temporary removal of vegetation is necessary, the contractor will cut the vegetation at ground level as opposed to grubbing the site. All temporary access roads and paths will be obliterated upon project completion and the soil will be stabilized and revegetated, at a minimum, to pre-construction conditions. Temporary roads and paths in wet areas or areas prone to flooding will be obliterated by the contractor by the end of the in-water work window.

All work below the OHW elevation will be performed within the ODFW-designated in-stream work window.

Construction will follow the Oregon Department of State Lands Removal/Fill Permit, USACE 404 Permit requirements, and any other appropriate laws. Care will be taken to control sediment and protect fish and vegetation. BMPs, including erosion control measures, the use of biodegradable lubricants in equipment operating near a waterway, and washing equipment prior to entering the work area, will be implemented to minimize the adverse effects of operating equipment near waterways.

Summary of Construction Sequence

- Project staging and access
- Construction of the temporary bypass channel
- Work area isolation and fish salvage
- Installation of temporary irrigation delivery pipe
- Demolition of existing concrete structure
- Construction of new concrete diversion structure and reconstruction of main channel
- Concrete cure (48 to 72 hours)
- Flows returned to the main channel
- Installation of irrigation pipe, fish screen, and flowmeter
- Construction of the permanent fish bypass channel
- Restoration and enhancement of the site by seeding and planting with native species

The construction sequence will be implemented independently at each site.

2. WORK AREA ISOLATION AND DEWATERING PLAN.

The temporary bypass channel will be installed, and the work area will be isolated using isolation barriers constructed of sandbags, plastic sheeting, or other appropriate materials. Once flows have been diverted from the work area, fish salvage will be conducted to remove any stranded fish in the isolated area. The area will first be cleared utilizing hand or dip nets, seining, or trapping with minnow traps. Electrofishing will be completed according to NMFS and ODFW electrofishing guidelines by an ODFW or other qualified biologist. All handled fish will be recorded. Captured fish will be placed in aerated buckets, examined, identified, and then released outside the project area in similar habitat from which they were obtained or pools located outside the project area. If adult salmon are captured, they will be relocated immediately. Any fish injuries observed will result in a modification of the electrofishing settings. Fish capture will be conducted when stream temperatures are at or below 15° Celsius (59° Fahrenheit) to the extent practical. Electrofishing will

be conducted early in the day to minimize stress to salmonids. Care will be taken to avoid putting predators (if any are captured) into the same bucket as prey species. To reduce impacts, the amount of time fish spend in the buckets will be minimized. Any listed fish will be noted, and if mortality occurs to a listed fish species, it will be collected according to NMFS and USFWS requirements. Next, the in-stream work will be completed and flow will be returned to the main channel once the concrete has cured appropriately.

3. EROSION AND POLLUTION CONTROL PLAN.

The area of impact above the OHW will be approximately 1 acre. If the impacted area is greater than 1 acre, the contractor will be responsible for obtaining a 1200-C permit. The HIP IV erosion control BMPs are included in the Drawings, and the contractor will be responsible for installing erosion control measures such as straw wattles or silt fence to prevent sediment-laden water from entering the stream. Erosion control measure are shown on Sheets D-101 and D-201.

4. SITE RECLAMATION AND RESTORATION PLAN.

All areas disturbed during construction will be reseeded and planted with native vegetation to improve habitat quantity and quality for all life stages of aquatic species present along the project reach. The planting will be completed by the Union SWCD following construction.

5. LIST PROPOSED EQUIPMENT AND FUELS MANAGEMENT PLAN.

Anticipated equipment includes an excavator, a dump truck, a front-end loader, and other miscellaneous construction equipment. Refueling will occur in the designated staging areas and as far as practicable away from the stream. The HIP IV fuel management and spill prevention BMPs are included in the Drawings.

4.5 CALENDAR SCHEDULE FOR CONSTRUCTION/IMPLEMENTATION PROCEDURES.

Work will be completed during the in-water work window for Little Creek. Construction is anticipated to occur July 1 through October 15, 2023. Work in the upland may occur past the in-water work window as construction is finished.

4.6 SITE OR PROJECT SPECIFIC MONITORING TO SUPPORT POLLUTION PREVENTION AND/OR ABATEMENT.

The contractor is responsible for monitoring pollution prevention and/or abatement in accordance with the permits obtained for the project and the HIP IV general conservation measures. Stakeholders will also be on site throughout the project to observe the construction. Since staging will occur within 150 feet of the channel and within the 100-year floodplain, spill prevention measures are included in the Technical Specifications.

5.0 MONITORING AND ADAPTIVE MANAGEMENT PLAN

5.1 INTRODUCTION

5.2 EXISTING MONITORING PROTOCOLS

5.3 PROJECT EFFECTIVENESS MONITORING PLAN

OBJECTIVE 1

OBJECTIVE 2

5.4 PROJECT REVIEW TEAM TRIGGERS

5.5 MONITORING FREQUENCY, TIMING, AND DURATION

BASELINE SURVEY

AS-BUILT SURVEY

MONITORING SITE LAYOUT

POST-BANKFULL EVENT SURVEY

FUTURE SURVEY (RELATED TO FLOW EVENT)

5.6 MONITORING TECHNIQUE PROTOCOLS

PHOTO DOCUMENTATION AND VISUAL INSPECTION

LONGITUDINAL PROFILE

HABITAT SURVEY

SURVIVAL PLOTS

CHANNEL AND FLOODPLAIN CROSS-SECTIONS

FISH PASSAGE

5.7 DATA STORAGE AND ANALYSIS

5.8 MONITORING QUALITY ASSURANCE PLAN

6.0 References

National Marine Fisheries Service (NMFS). 2011. Anadromous Salmonid Passage Facility Design. NMFS, Northwest Region, Portland, Oregon.

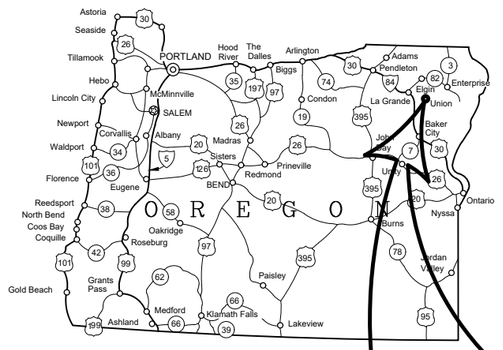
Pacific Lamprey Technical Workgroup. 2017. Practical Guidelines for Incorporating Adult Pacific Lamprey Passage at Fishways. June 2017. White Paper. 44 pp + Appendix. Available online: https://www.fws.gov/pacificlamprey/mainpage.cfm

Pacific Lamprey Technical Workgroup. 2020. Barriers to Adult Pacific Lamprey at Road Crossings: Guidelines for Evaluating and Providing Passage. Original Version 1.0, June 29, 2020. 31 pp + Appendices.

Rose, Brien P. and Matthew G. Mesa. 2012. Effectiveness of Common Fish Screen Materials to Protect Lamprey Ammocoetes.

7.0 APPENDICES

7.1 PROJECT DRAWINGS



UNION SOIL AND WATER CONSERVATION DISTRICT

LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

2023

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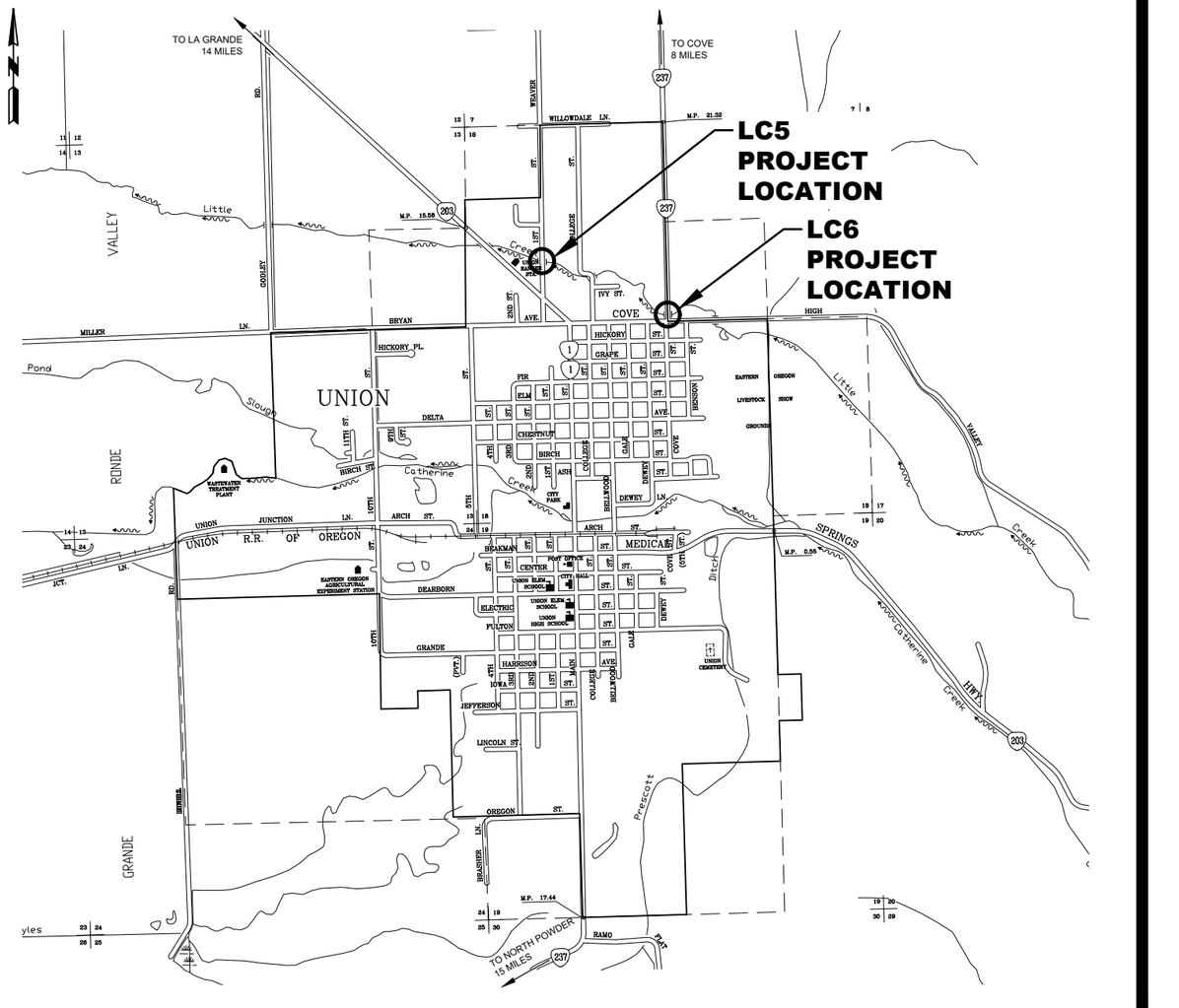
80% DESIGN PLANS
FOR REVIEW ONLY
NOT FOR CONSTRUCTION



VICINITY MAP
N.T.S.

INDEX

This project was designed in accordance with the BPA Habitat Improvement Program, Programmatic Biological Opinion (HIP IV).

anderson perry & associates, inc.
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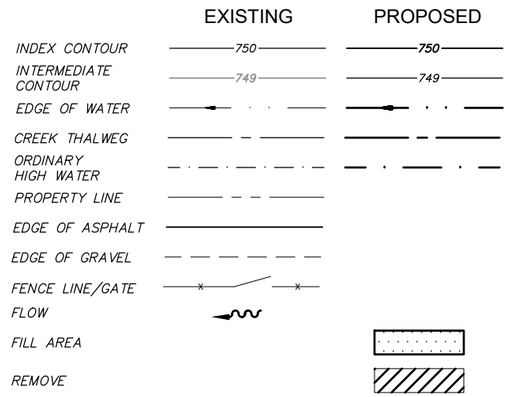
LEGEND



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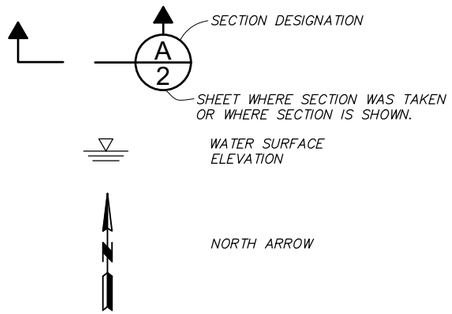

LC5 WATER RIGHTS SUMMARY

Priority Date	Water Rights (cfs)
1863	0.15
1863	0.15
1863	0.05
1863	1.03
1869	3.63
1874	0.08
Total	**5.09**

LC6 WATER RIGHTS SUMMARY

Priority Date	Water Rights (cfs)
1863	0.10
1863	0.25
1863	0.21
1863	0.05
1863	0.20
1863	0.08
1863	0.10
1863	0.38
1863	0.08
1863	0.13
1863	0.16
1863	0.08
1863	0.15
1863	0.13
1863	0.10
1864	0.06
1883	0.08
1928	0.13
1972	0.13
Total	**2.60**

NOTE:
IRRIGATION DESIGN CRITERIA IS BASED ON THE WATER RIGHT DATA DEVELOPED BY THE BUREAU OF RECLAMATION IN 2011.

STREAM DESIGN CRITERIA

95% EXCEEDANCE FLOW	*7 CFS*
5% EXCEEDANCE FLOW	*120 CFS*
2 YEAR FLOW	*218 CFS*
5 YEAR FLOW	*299 CFS*
10 YEAR FLOW	*351 CFS*
25 YEAR FLOW	*417 CFS*
50 YEAR FLOW	*466 CFS*
*100 YEAR FLOW**	*882 CFS*

** PUBLISHED FEMA FLOW*

PROJECT OBJECTIVE

THE PURPOSE OF THE PROJECT IS TO IMPROVE FISH PASSAGE AND PROVIDE RELIABLE FISH SCREENING FOR THESE IRRIGATION DIVERSIONS ON LITTLE CREEK.

GENERAL NOTES

1. *ALL DIMENSIONS, STATIONS, AND ELEVATIONS ARE IN FEET UNLESS OTHERWISE NOTED.*
2. *ALL IN-STREAM WORK SHALL BE PERFORMED WITHIN THE IN-STREAM WORK WINDOW AS DESIGNATED IN THE OREGON DEPARTMENT OF STATE LANDS (DSL) AND CORPS OF ENGINEERS (COE) PERMITS.*
3. *ALL WORK, INCLUDING EROSION CONTROL MEASURES, SHALL BE CONSTRUCTED IN ACCORDANCE WITH THE DSL AND COE PERMITS.*
4. *VERTICAL DATUM NAVD 88*
5. *HORIZONTAL DATUM NAD83, OREGON STATE PLANE NORTH*
6. *SURVEY DATA WAS GATHERED IN APRIL 2021. CONTRACTOR TO VERIFY ACTUAL TOPOGRAPHY AT THE TIME OF CONSTRUCTION AND NOTIFY ENGINEER OF ANY DISCREPANCIES.*
7. *FIELD VERIFY LOCATION OF UTILITIES AND CULVERTS.*
8. *LOCATE AND PROTECT EXISTING UTILITIES. 48-HOUR NOTIFICATIONS SHOULD BE GIVEN PER ORS 757.542-546. "CALL BEFORE YOU DIG" NUMBER FOR OREGON IS 1-800-332-2344 (OR 811).*

REVISION	BY	DATE

DESIGNED BY J. HERRON
DRAWN BY P. RICHARDSON
REVIEWED BY C. HUTCHINS

JOB NUMBER 596-07 DATE 2022
ACAD FILE: 596-07-G-001.dwg

80% DESIGN PLANS
FOR REVIEW ONLY
NOT FOR CONSTRUCTION

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UNION SOIL AND WATER CONSERVATION DISTRICT
LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

LEGEND AND NOTES

SHEET
G-001
1 OF 19

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HIP GENERAL CONSERVATION MEASURES APPLICABLE TO ALL ACTIONS

THE ACTIVITIES COVERED UNDER THE HIP ARE INTENDED TO PROTECT AND RESTORE FISH AND WILDLIFE HABITAT WITH LONG-TERM BENEFITS TO ESA-LISTED SPECIES. THE FOLLOWING GENERAL CONSERVATION MEASURES (DEVELOPED IN COORDINATION WITH USFWS AND NMFS) WILL BE APPLIED TO ALL ACTIONS OF THIS PROJECT.

PROJECT DESIGN AND SITE PREPARATION.

1. STATE AND FEDERAL PERMITS.

A. ALL APPLICABLE REGULATORY PERMITS AND OFFICIAL PROJECT AUTHORIZATIONS WILL BE OBTAINED BEFORE PROJECT IMPLEMENTATION.

B. THESE PERMITS AND AUTHORIZATIONS INCLUDE, BUT ARE NOT LIMITED TO, NATIONAL ENVIRONMENTAL POLICY ACT, NATIONAL HISTORIC PRESERVATION ACT, THE APPROPRIATE STATE AGENCY REMOVAL AND FILL PERMIT, USACE CLEAN WATER ACT (CWA) 404 PERMITS, CWA SECTION 401 WATER QUALITY CERTIFICATIONS, AND FEMA NO-RISE ANALYSES.

2. TIMING OF IN-WATER WORK.

A. APPROPRIATE STATE (OREGON DEPARTMENT OF FISH AND WILDLIFE (ODFW), WASHINGTON DEPARTMENT OF FISH AND WILDLIFE (WDFW), IDAHO DEPARTMENT OF FISH AND GAME (IDFG), AND MONTANA FISH WILDLIFE AND PARKS (MFWP)) GUIDELINES FOR TIMING OF IN-WATER WORK WINDOWS (IWW) WILL BE FOLLOWED.

B. CHANGES TO ESTABLISHED WORK WINDOWS WILL BE APPROVED BY REGIONAL STATE BIOLOGISTS AND BPA'S EC LEAD.

C. BULL TROUT. FOR AREAS WITH DESIGNATED IN-WATER WORK WINDOWS FOR BULL TROUT OR AREAS KNOWN TO HAVE BULL TROUT, PROJECT PROPONENTS WILL CONTACT THE APPROPRIATE USFWS FIELD OFFICE TO INSURE THAT ALL REASONABLE IMPLEMENTATION MEASURES ARE CONSIDERED AND AN APPROPRIATE IN-WATER WORK WINDOW IS BEING USED TO MINIMIZE PROJECT EFFECTS.

D. LAMPREY. WORKING IN STREAM OR RIVER CHANNELS THAT CONTAIN PACIFIC LAMPREY WILL BE AVOIDED FROM MARCH 1 TO JULY 1 FOR REACHES <5,000 FEET IN ELEVATION AND FROM MARCH 1 TO AUGUST 1 FOR REACHES >5,000 FEET. IF EITHER TIMEFRAME IS INCOMPATIBLE WITH OTHER OBJECTIVES, THE AREA WILL BE SURVEYED FOR NESTS AND LAMPREY PRESENCE, AND AVOIDED IF POSSIBLE. IF LAMPREYS ARE KNOWN TO EXIST, THE PROJECT SPONSOR WILL UTILIZE DEWATERING AND SALVAGE PROCEDURES (SEE FISH SALVAGE AND ELECTROFISHING SECTIONS) TO MINIMIZE ADVERSE EFFECTS.

E. THE IN-WATER WORK WINDOW WILL BE PROVIDED IN THE CONSTRUCTION PLANS.

3. CONTAMINANTS.

A. EXCAVATION OF MORE THAN 20 CUBIC YARDS WILL REQUIRE A SITE VISIT AND DOCUMENTED ASSESSMENT FOR POTENTIAL CONTAMINANT SOURCES. THE SITE ASSESSMENT WILL BE STORED WITH PROJECT FILES OR AS AN APPENDIX TO THE BASIS OF DESIGN REPORT.

B. THE SITE ASSESSMENT WILL SUMMARIZE:

1. THE SITE VISIT, CONDITION OF THE PROPERTY, AND IDENTIFICATION OF ANY AREAS USED FOR VARIOUS INDUSTRIAL PROCESSES;
2. AVAILABLE RECORDS, SUCH AS FORMER SITE USE, BUILDING PLANS, AND RECORDS OF ANY PRIOR CONTAMINATION EVENTS;
3. INTERVIEWS WITH KNOWLEDGEABLE PEOPLE, SUCH AS SITE OWNERS, OPERATORS, OCCUPANTS, NEIGHBORS, OR LOCAL GOVERNMENT OFFICIALS; AND
4. THE TYPE, QUANTITY, AND EXTENT OF ANY POTENTIAL CONTAMINATION SOURCES.

4. SITE LAYOUT AND FLAGGING.

A. CONSTRUCTION AREAS TO BE CLEARLY FLAGGED PRIOR TO CONSTRUCTION.

B. AREAS TO BE FLAGGED WILL INCLUDE:

1. SENSITIVE RESOURCE AREAS, SUCH AS AREAS BELOW ORDINARY HIGH WATER, SPAWNING AREAS, SPRINGS, AND WETLANDS;
2. EQUIPMENT ENTRY AND EXIT POINTS;
3. ROAD AND STREAM CROSSING ALIGNMENTS;
4. STAGING, STORAGE, AND STOCKPILE AREAS; AND
5. NO-SPRAY AREAS AND BUFFERS.

5. TEMPORARY ACCESS ROADS AND PATHS.

A. EXISTING ACCESS ROADS AND PATHS WILL BE PREFERENTIALLY USED WHENEVER REASONABLE, AND THE NUMBER AND LENGTH OF TEMPORARY ACCESS ROADS AND PATHS THROUGH RIPARIAN AREAS AND FLOODPLAINS WILL BE MINIMIZED.

B. VEHICLE USE AND HUMAN ACTIVITIES, INCLUDING WALKING, IN AREAS OCCUPIED BY TERRESTRIAL ESA-LISTED SPECIES WILL BE MINIMIZED.

C. TEMPORARY ACCESS ROADS AND PATHS WILL NOT BE BUILT ON SLOPES WHERE GRADE, SOIL, OR OTHER FEATURES SUGGEST A LIKELIHOOD OF EXCESSIVE EROSION OR FAILURE. IF SLOPES ARE STEEPER THAN 30%, THEN THE ROAD WILL BE DESIGNED BY A CIVIL ENGINEER WITH EXPERIENCE IN STEEP ROAD DESIGN.

D. THE REMOVAL OF RIPARIAN VEGETATION DURING CONSTRUCTION OF TEMPORARY ACCESS ROADS WILL BE MINIMIZED. WHEN TEMPORARY VEGETATION REMOVAL IS REQUIRED, VEGETATION WILL BE CUT AT GROUND LEVEL (NOT GRUBBED).

E. AT PROJECT COMPLETION, ALL TEMPORARY ACCESS ROADS AND PATHS WILL BE OBLITERATED, AND THE SOIL WILL BE STABILIZED AND REVEGETATED. ROAD AND PATH OBLITERATION REFERS TO THE MOST COMPREHENSIVE DEGREE OF DECOMMISSIONING AND INVOLVES DECOMPACTING THE SURFACE AND DITCH, PULLING THE FILL MATERIAL ONTO THE RUNNING SURFACE, AND RESHAPING TO MATCH THE ORIGINAL CONTOUR.

F. HELICOPTER FLIGHT PATTERNS WILL BE ESTABLISHED IN ADVANCE AND LOCATED TO AVOID TERRESTRIAL ESA-LISTED SPECIES AND THEIR OCCUPIED HABITAT DURING SENSITIVE LIFE STAGES.

6. TEMPORARY STREAM CROSSINGS.

A. EXISTING STREAM CROSSINGS OR BEDROCK WILL BE PREFERENTIALLY USED WHENEVER REASONABLE, AND THE NUMBER OF TEMPORARY STREAM CROSSINGS WILL BE MINIMIZED.

B. TEMPORARY BRIDGES AND CULVERTS WILL BE INSTALLED TO ALLOW FOR EQUIPMENT AND VEHICLE CROSSING OVER PERENNIAL STREAMS DURING CONSTRUCTION. TREATED WOOD SHALL NOT BE USED ON TEMPORARY BRIDGE CROSSINGS OR IN LOCATIONS IN CONTACT WITH OR DIRECTLY OVER WATER.

C. FOR PROJECTS THAT REQUIRE EQUIPMENT AND VEHICLES TO CROSS IN THE WET:

1. THE LOCATION AND NUMBER OF ALL WET CROSSINGS SHALL BE APPROVED BY THE BPA EC LEAD AND DOCUMENTED IN THE CONSTRUCTION PLANS;
2. VEHICLES AND MACHINERY SHALL CROSS STREAMS AT RIGHT ANGLES TO THE MAIN CHANNEL WHENEVER POSSIBLE;
3. NO STREAM CROSSINGS WILL OCCUR 300 FEET UPSTREAM OR 100 FEET DOWNSTREAM OF AN EXISTING REDD OR SPAWNING FISH; AND
4. AFTER PROJECT COMPLETION, TEMPORARY STREAM CROSSINGS WILL BE OBLITERATED AND BANKS RESTORED.

7. STAGING, STORAGE, AND STOCKPILE AREAS.

A. STAGING AREAS (USED FOR CONSTRUCTION EQUIPMENT STORAGE, VEHICLE STORAGE, FUELING, SERVICING, AND HAZARDOUS MATERIAL STORAGE) WILL BE 150 FEET OR MORE FROM ANY NATURAL WATER BODY OR WETLAND. STAGING AREAS CLOSER THAN 150 FEET WILL BE APPROVED BY THE EC LEAD.

B. NATURAL MATERIALS USED FOR IMPLEMENTATION OF AQUATIC RESTORATION, SUCH AS LARGE WOOD, GRAVEL, AND BOULDERS, MAY BE STAGED WITHIN 150 FEET IF CLEARLY INDICATED IN THE PLANS THAT AREA IS FOR NATURAL MATERIALS ONLY.

C. ANY LARGE WOOD, TOPSOIL, AND NATIVE CHANNEL MATERIAL DISPLACED BY CONSTRUCTION WILL BE STOCKPILED FOR USE DURING SITE RESTORATION AT A SPECIFICALLY IDENTIFIED AND FLAGGED AREA.

D. ANY MATERIAL NOT USED IN RESTORATION, AND NOT NATIVE TO THE FLOODPLAIN, WILL BE DISPOSED OF OUTSIDE THE 100-YEAR FLOODPLAIN.

8. EQUIPMENT.

A. MECHANIZED EQUIPMENT AND VEHICLES WILL BE SELECTED, OPERATED, AND MAINTAINED IN A MANNER THAT MINIMIZES ADVERSE EFFECTS ON THE ENVIRONMENT (E.G., MINIMALLY-SIZED, LOW PRESSURE TIRES; MINIMAL HARD-TURN PATHS FOR TRACKED VEHICLES; TEMPORARY MATS OR PLATES WITHIN WET AREAS OR ON SENSITIVE SOILS).

B. EQUIPMENT WILL BE STORED, FUELED, AND MAINTAINED IN AN CLEARLY IDENTIFIED STAGING AREA THAT MEETS STAGING AREA CONSERVATION MEASURES.

C. EQUIPMENT WILL BE REFUELED IN A VEHICLE STAGING AREA OR IN AN ISOLATED HARD ZONE, SUCH AS A PAVED PARKING LOT OR ADJACENT, ESTABLISHED ROAD (THIS MEASURE APPLIES ONLY TO GAS-POWERED EQUIPMENT WITH TANKS LARGER THAN 5 GALLONS).

D. BIODEGRADABLE LUBRICANTS AND FLUIDS WILL BE USED ON EQUIPMENT OPERATING IN AND ADJACENT TO THE STREAM CHANNEL AND LIVE WATER.

E. EQUIPMENT WILL BE INSPECTED DAILY FOR FLUID LEAKS BEFORE LEAVING THE VEHICLE STAGING AREA FOR OPERATION WITHIN 150 FEET OF ANY NATURAL WATER BODY OR WETLAND.

F. EQUIPMENT WILL BE THOROUGHLY CLEANED BEFORE OPERATION BELOW ORDINARY HIGH WATER, AND AS OFTEN AS NECESSARY DURING OPERATION, TO REMAIN GREASE FREE.

9. EROSION CONTROL.

A. TEMPORARY EROSION CONTROL MEASURES INCLUDE:

1. TEMPORARY EROSION CONTROLS WILL BE IN PLACE BEFORE ANY SIGNIFICANT ALTERATION OF THE ACTION SITE AND APPROPRIATELY INSTALLED DOWNSLOPE OF PROJECT ACTIVITY WITHIN THE RIPARIAN BUFFER AREA UNTIL SITE REHABILITATION IS COMPLETE;
2. IF THERE IS A POTENTIAL FOR ERODED SEDIMENT TO ENTER THE STREAM, SEDIMENT BARRIERS WILL BE INSTALLED AND MAINTAINED FOR THE DURATION OF PROJECT IMPLEMENTATION;
3. TEMPORARY EROSION CONTROL MEASURES MAY INCLUDE SEDGE MATS, FIBER WATTLES, SILT FENCES, JUTE MATTING, WOOD FIBER MULCH AND SOIL BINDER, OR GEOTEXTILES AND GEOSYNTHETIC FABRIC;
4. SOIL STABILIZATION UTILIZING WOOD FIBER MULCH AND TACKIFIER (HYDRO-APPLIED) MAY BE USED TO REDUCE EROSION OF BARE SOIL IF THE MATERIALS ARE NOXIOUS WEED FREE AND NONTOXIC TO AQUATIC AND TERRESTRIAL ANIMALS, SOIL MICROORGANISMS, AND VEGETATION;
5. SEDIMENT WILL BE REMOVED FROM EROSION CONTROLS ONCE IT HAS REACHED 1/3 OF THE EXPOSED HEIGHT OF THE CONTROL; AND
6. ONCE THE SITE IS STABILIZED AFTER CONSTRUCTION, TEMPORARY EROSION CONTROL MEASURES WILL BE REMOVED.

B. EMERGENCY EROSION CONTROLS. THE FOLLOWING MATERIALS FOR EMERGENCY EROSION CONTROL WILL BE AVAILABLE AT THE WORK SITE:

1. A SUPPLY OF SEDIMENT CONTROL MATERIALS; AND
2. AN OIL-ABSORBING FLOATING BOOM WHENEVER SURFACE WATER IS PRESENT.

10. DUST ABATEMENT.

A. THE PROJECT SPONSOR WILL DETERMINE THE APPROPRIATE DUST CONTROL MEASURES BY CONSIDERING SOIL TYPE, EQUIPMENT USAGE, PREVAILING WIND DIRECTION, AND THE EFFECTS CAUSED BY OTHER EROSION AND SEDIMENT CONTROL MEASURES.

B. WORK WILL BE SEQUENCED AND SCHEDULED TO REDUCE EXPOSED BARE SOIL SUBJECT TO WIND EROSION.

C. DUST-ABATEMENT ADDITIVES AND STABILIZATION CHEMICALS (TYPICALLY MAGNESIUM CHLORIDE, CALCIUM CHLORIDE SALTS, OR LIGNINSULFONATE) WILL NOT BE APPLIED WITHIN 25 FEET OF WATER OR A STREAM CHANNEL AND WILL BE APPLIED SO AS TO MINIMIZE THE LIKELIHOOD THAT THEY WILL ENTER STREAMS. APPLICATIONS OF LIGNINSULFONATE WILL BE LIMITED TO A MAXIMUM RATE OF 0.5 GALLONS PER SQUARE YARD OF ROAD SURFACE, ASSUMING MIXED 50:50 WITH WATER.

D. APPLICATION OF DUST ABATEMENT CHEMICALS WILL BE AVOIDED DURING OR JUST BEFORE WET WEATHER, AND AT STREAM CROSSINGS OR OTHER AREAS THAT COULD RESULT IN UNFILTERED DELIVERY OF THE DUST ABATEMENT MATERIALS TO A WATERBODY (TYPICALLY THESE WOULD BE AREAS WITHIN 25 FEET OF A WATERBODY OR STREAM CHANNEL; DISTANCES MAY BE GREATER WHERE VEGETATION IS SPARSE OR SLOPES ARE STEEP).

E. SPILL CONTAINMENT EQUIPMENT WILL BE AVAILABLE DURING APPLICATION OF DUST ABATEMENT CHEMICALS.

F. PETROLEUM-BASED PRODUCTS WILL NOT BE USED FOR DUST ABATEMENT.

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REVISION	BY	DATE

DESIGNED BY J. HERRON
DRAWN BY P. RICHARDSON
REVIEWED BY C. HUTCHINS

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engineering - surveying - natural resources

UNION SOIL AND WATER CONSERVATION DISTRICT
LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

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PROJECT DESIGN AND SITE PREPARATION (CONTINUED).

11. SPILL PREVENTION, CONTROL, AND COUNTER MEASURES.

A. A DESCRIPTION OF HAZARDOUS MATERIALS THAT WILL BE USED, INCLUDING INVENTORY, STORAGE, AND HANDLING PROCEDURES WILL BE AVAILABLE ON-SITE.

B. WRITTEN PROCEDURES FOR NOTIFYING ENVIRONMENTAL RESPONSE AGENCIES WILL BE POSTED AT THE WORK SITE.

C. SPILL CONTAINMENT KITS (INCLUDING INSTRUCTIONS FOR CLEANUP AND DISPOSAL) ADEQUATE FOR THE TYPES AND QUANTITY OF HAZARDOUS MATERIALS USED AT THE SITE WILL BE AVAILABLE AT THE WORK SITE.

D. WORKERS WILL BE TRAINED IN SPILL CONTAINMENT PROCEDURES AND WILL BE INFORMED OF THE LOCATION OF SPILL CONTAINMENT KITS.

E. ANY WASTE LIQUIDS GENERATED AT THE STAGING AREAS WILL BE TEMPORARILY STORED UNDER AN IMPERVIOUS COVER, SUCH AS A TARPAULIN, UNTIL THEY CAN BE PROPERLY TRANSPORTED TO AND DISPOSED OF AT A FACILITY THAT IS APPROVED FOR RECEIPT OF HAZARDOUS MATERIALS.

F. PUMPS USED ADJACENT TO WATER SHALL USE SPILL CONTAINMENT SYSTEMS.

12. INVASIVE SPECIES CONTROL.

A. PRIOR TO ENTERING THE SITE, ALL VEHICLES AND EQUIPMENT WILL BE POWER WASHED, ALLOWED TO FULLY DRY, AND INSPECTED TO MAKE SURE NO PLANTS, SOIL, OR OTHER ORGANIC MATERIAL ADHERES TO THE SURFACE.

B. WATERCRAFT, WADERS, BOOTS, AND ANY OTHER GEAR TO BE USED IN OR NEAR WATER WILL BE INSPECTED FOR AQUATIC INVASIVE SPECIES.

C. WADING BOOTS WITH FELT SOLES ARE NOT TO BE USED DUE TO THEIR PROPENSITY FOR AIDING IN THE TRANSFER OF INVASIVE SPECIES UNLESS DECONTAMINATION PROCEDURES HAVE BEEN APPROVED BY THE EC LEAD.

WORK AREA ISOLATION AND FISH SALVAGE.

1. WORK AREA ISOLATION.

A. ANY WORK AREA WITHIN THE WETTED CHANNEL WILL BE ISOLATED FROM THE ACTIVE STREAM WHENEVER ESA-LISTED FISH ARE REASONABLY CERTAIN TO BE PRESENT, OR IF THE WORK AREA IS LESS THAN 300-FEET UPSTREAM FROM KNOWN SPAWNING HABITATS.

B. WORK AREA ISOLATION AND FISH SALVAGE ACTIVITIES WILL COMPLY WITH THE IN-WATER WORK WINDOW.

C. DESIGN PLANS WILL INCLUDE ALL ISOLATION ELEMENTS AND AREAS (COFFER DAMS, PUMPS, DISCHARGE AREAS, FISH SCREENS, FISH RELEASE AREAS, ETC.).

D. WORK AREA ISOLATION AND FISH CAPTURE ACTIVITIES WILL OCCUR DURING PERIODS OF THE COOLEST AIR AND WATER TEMPERATURES POSSIBLE, NORMALLY EARLY IN THE MORNING VERSUS LATE IN THE DAY, AND DURING CONDITIONS APPROPRIATE TO MINIMIZE STRESS AND DEATH OF SPECIES PRESENT.

2. FISH SALVAGE.

A. MONITORING AND RECORDING WILL TAKE PLACE FOR DURATION OF SALVAGE. THE SALVAGE REPORT WILL BE COMMUNICATED TO AGENCIES VIA THE PROJECT COMPLETION FORM (PCF).

B. SALVAGE ACTIVITIES SHOULD TAKE PLACE DURING CONDITIONS TO MINIMIZE STRESS TO FISH SPECIES, TYPICALLY PERIODS OF THE COOLEST AIR AND WATER TEMPERATURES WHICH OCCUR IN THE MORNING VERSUS LATE IN THE DAY.

C. SALVAGE OPERATIONS WILL FOLLOW THE ORDERING, METHODS, AND CONSERVATION MEASURES SPECIFIED BELOW:

1. SLOWLY REDUCE WATER FROM THE WORK AREA TO ALLOW SOME FISH TO LEAVE VOLITIONALLY.
2. BLOCK NETS WILL BE INSTALLED AT UPSTREAM AND DOWNSTREAM LOCATIONS AND MAINTAINED IN A SECURED POSITION TO EXCLUDE FISH FROM ENTERING THE PROJECT AREA.
3. BLOCK NETS WILL BE SECURED TO THE STREAM CHANNEL BED AND BANKS UNTIL FISH CAPTURE AND TRANSPORT ACTIVITIES ARE COMPLETE. BLOCK NETS MAY BE LEFT IN PLACE FOR THE DURATION OF THE PROJECT TO EXCLUDE FISH AS LONG AS PASSAGE REQUIREMENTS ARE MET.
4. NETS WILL BE MONITORED HOURLY DURING IN-STREAM DISTURBANCE.
5. IF BLOCK NETS REMAIN IN PLACE MORE THAN ONE DAY, THE NETS WILL BE MONITORED AT LEAST DAILY TO ENSURE THEY ARE SECURED AND FREE OF ORGANIC ACCUMULATION. IF BULL TROUT ARE PRESENT, NETS ARE TO BE CHECKED EVERY 4 HOURS FOR FISH IMPINGEMENT.
6. CAPTURE FISH THROUGH SEINING AND RELOCATE TO STREAMS.
7. WHILE DEWATERING, ANY REMAINING FISH WILL BE COLLECTED BY HAND OR DIP NETS.
8. SEINES WITH A MESH SIZE TO ENSURE CAPTURE OF THE RESIDING ESA-LISTED FISH WILL BE USED.
9. MINNOW TRAPS WILL BE LEFT IN PLACE OVERNIGHT AND USED IN CONJUNCTION WITH SEINING.
10. ELECTROFISH TO CAPTURE AND RELOCATED FISH NOT CAUGHT DURING SEINING PER ELECTROFISH CONSERVATION MEASURES.
11. CONTINUE TO SLOWLY DEWATER STREAM REACH.
12. COLLECT ANY REMAINING FISH IN COLD-WATER BUCKETS AND RELOCATED TO THE STREAM.
13. LIMIT THE TIME FISH ARE IN A TRANSPORT BUCKET.
14. MINIMIZE PREDATION BY TRANSPORTING COMPARABLE SIZES IN BUCKETS.
15. BUCKET WATER TO BE CHANGED EVERY 15 MINUTES OR AERATED.
16. BUCKETS WILL BE KEPT IN SHADED AREAS OR COVERED.
17. DEAD FISH WILL NOT BE STORED IN TRANSPORT BUCKETS, BUT WILL BE LEFT ON THE STREAM BANK TO AVOID MORTALITY COUNTING ERRORS.

D. SALVAGE GUIDELINES FOR BULL TROUT, LAMPREY, MUSSELS, AND NATIVE FISH.

1. CONDUCT SITE SURVEY TO ESTIMATE SALVAGE NUMBERS.
2. PRE-SELECT SITE(S) FOR RELEASE AND/OR MUSSEL BED RELOCATION.
3. SALVAGE OF BULL TROUT WILL NOT TAKE PLACE WHEN WATER TEMPERATURES EXCEED 15 DEGREES CELSIUS.
4. IF DRAWDOWN LESS THAN 48 HOURS, SALVAGE OF LAMPREY AND MUSSELS MAY NOT BE NECESSARY IF TEMPERATURES SUPPORT SURVIVAL IN SEDIMENTS.
5. SALVAGE MUSSELS BY HAND, LOCATING BY SNORKELING OR WADING.
6. SALVAGE LAMPREY BY ELECTROFISHING (SEE ELECTROFISHING FOR LARVAL LAMPREY SETTINGS AND LARVAL LAMPREY DRY SHOCKING SETTINGS).
7. SALVAGE BONY FISH AFTER LAMPREY WITH NETS OR ELECTROFISHING (SEE ELECTROFISHING FOR APPROPRIATE SETTINGS).
8. REGULARLY INSPECT DEWATERED SITE SINCE LAMPREY LIKELY TO EMERGE AFTER DEWATERING AND MUSSELS MAY BECOME VISIBLE.
9. MUSSELS MAY BE TRANSFERRED IN COOLERS.
10. MUSSELS WILL BE PLACED INDIVIDUALLY TO ENSURE ABILITY TO BURROW INTO NEW HABITAT.

3. ELECTROFISHING.

A. INITIAL SITE SURVEY AND INITIAL SETTINGS.

1. IDENTIFY SPAWNING ADULTS AND ACTIVE REDDS TO AVOID.
2. RECORD WATER TEMPERATURE. ELECTROFISHING WILL NOT OCCUR WHEN WATER TEMPERATURES ARE ABOVE 18 DEGREES CELSIUS.
3. IF POSSIBLE, A BLOCK NET WILL BE PLACED DOWNSTREAM AND CHECKED REGULARLY TO CAPTURE STUNNED FISH THAT DRIFT DOWNSTREAM.
4. INITIAL SETTINGS WILL BE 100 VOLTS, PULSE WIDTH OF 500 MICRO SECONDS, AND PULSE RATE OF 30 HERTZ.
5. RECORDS FOR CONDUCTIVITY, WATER TEMPERATURE, AIR TEMPERATURE, ELECTROFISHING SETTINGS, ELECTROFISHER MODEL, ELECTROFISHER CALIBRATION, FISH CONDITIONS, FISH MORTALITIES, AND TOTAL CAPTURE RATES WILL BE INCLUDED IN THE SALVAGE LOG BOOK.

B. ELECTROFISHING TECHNIQUE.

1. SAMPLING WILL BEGIN USING STRAIGHT DC. POWER WILL REMAIN ON UNTIL THE FISH IS NETTED WHEN USING STRAIGHT DC. GRADUALLY INCREASE VOLTAGE WHILE REMAINING BELOW MAXIMUM LEVELS.
2. MAXIMUM VOLTAGE WILL BE 1100 VOLTS WHEN CONDUCTIVITY IS <100 MILLISECONDS, 800 VOLTS WHEN CONDUCTIVITY IS BETWEEN 100 AND 300 MILLISECONDS, AND 400 VOLTS WHEN CONDUCTIVITY IS >300 MILLISECONDS.
3. IF FISH CAPTURE IS NOT SUCCESSFUL USING STRAIGHT DC, THE ELECTROFISHER WILL BE SET TO INITIAL VOLTAGE FOR PDC. VOLTAGE, PULSE WIDTH, AND PULSE FREQUENCY WILL BE GRADUALLY INCREASED WITHIN MAXIMUM VALUES UNTIL CAPTURE IS SUCCESSFUL.
4. MAXIMUM PULSE WIDTH IS 5 MILLISECONDS. MAXIMUM PULSE RATE IS 70 HERTZ
5. ELECTROFISHING WILL NOT OCCUR IN ONE AREA FOR AN EXTENDED PERIOD.
6. THE ANODE WILL NOT INTENTIONALLY COME INTO CONTACT WITH FISH. THE ZONE FOR POTENTIAL INJURY OF 0.5 M FROM THE ANODE WILL BE AVOIDED.
7. SETTINGS WILL BE LOWERED IN SHALLOWER WATER SINCE VOLTAGE GRADIENTS LIKELY TO INCREASE.
8. ELECTROFISHING WILL NOT OCCUR IN TURBID WATER WHERE VISIBILITY IS POOR (I.E. UNABLE TO SEE THE BED OF THE STREAM).
9. OPERATIONS WILL IMMEDIATELY STOP IF MORTALITY OR OBVIOUS FISH INJURY IS OBSERVED. ELECTROFISHING SETTINGS WILL BE REEVALUATED.

C. SAMPLE PROCESSING.

1. FISH SHALL BE SORTED BY SIZE TO AVOID PREDATION DURING CONTAINMENT.
2. SAMPLERS WILL REGULARLY CHECK CONDITIONS OF FISH HOLDING CONTAINERS, AIR PUMPS, WATER TRANSFERS, ETC.
3. FISH WILL BE OBSERVED FOR GENERAL CONDITIONS AND INJURIES
4. EACH FISH WILL BE COMPLETELY REVIVED BEFORE RELEASE. ESA-LISTED SPECIES WILL BE PRIORITIZED FOR SUCCESSFUL RELEASE.

D. BULL TROUT ELECTROFISHING.

1. ELECTROFISHING FOR BULL TROUT WILL ONLY OCCUR FROM MAY 1 TO JULY 31. NO ELECTROFISHING WILL OCCUR IN ANY BULL TROUT OCCUPIED HABITAT AFTER AUGUST 15. IN FMO HABITATS ELECTROFISHING MAY OCCUR ANY TIME.
2. ELECTROFISHING OF BULL TROUT WILL NOT OCCUR WHEN WATER TEMPERATURES EXCEED 15 DEGREES CELSIUS.

E. LARVAL LAMPREY ELECTROFISHING.

1. PERMISSION FROM EC LEAD WILL BE OBTAINED IF LARVAL LAMPREY ELECTROFISHER IS NOT ONE OF FOLLOWING PRE-APPROVED MODELS: ABP-2 "WISCONSIN", SMITH-ROOT LR-24, OR SMITH-ROOT APEX BACKPACK.
2. LARVAL LAMPREY SAMPLING WILL INCORPORATE 2-STAGE METHOD: "TICKLE" AND "STUN".
3. FIRST STAGE: USE 125 VOLT DC WITH A 25 PERCENT DUTY CYCLE APPLIED AT A SLOW RATE OF 3 PULSES PER SECOND. IF TEMPERATURES ARE BELOW 10 DEGREES CELSIUS, VOLTAGE MAY BE INCREASED GRADUALLY (NOT TO EXCEED 200 VOLTS). BURSTED PULSES (THREE SLOW AND ONE SKIPPED) RECOMMENDED TO INCREASE EMERGENCE.
4. SECOND STAGE (OPTIONAL FOR EXPERIENCED NETTERS): IMMEDIATELY AFTER LAMPREY EMERGE, USE A FAST PULSE SETTING OF 30 PULSES PER SECOND.
5. USE DIP NETS FOR VISIBLE LAMPREY. SIENES AND FINE MESH NET SWEEPS MAY BE USED IN POOR VISIBILITY.
6. SAMPLING WILL OCCUR SLOWLY (>60 SECONDS PER METER) STARTING AT UPSTREAM AND WORKING DOWNSTREAM.
7. MULTIPLE SWEEPS TO OCCUR WITH 15 MINUTES BETWEEN SWEEPS.
8. POST-DRAWDOWN "DRY-SHOCKING" WILL BE APPLIED IF LARVAL LAMPREY CONTINUE TO EMERGE. ANODES TO BE PLACED ONE METER APART TO SAMPLE ONE SQUARE METER AT A TIME FOR AT LEAST 60 SECONDS. FOR TEMPERATURES LESS THAN 10 DEGREES CELSIUS, MAXIMUM VOLTAGE MAY BE GRADUALLY INCREASED TO 400 VOLTS (DRY-SHOCKING ONLY).

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REVISION	BY	DATE

DESIGNED BY J. HERRON
DRAWN BY P. RICHARDSON
REVIEWED BY C. HUTCHINS

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80% DESIGN PLANS FOR REVIEW ONLY NOT FOR CONSTRUCTION

anderson perry & associates, inc.
engineering - surveying - natural resources

UNION SOIL AND WATER CONSERVATION DISTRICT
LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

HIP GENERAL CONSERVATION MEASURES II

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WORK AREA ISOLATION AND FISH SALVAGE (CONTINUED).

4. DEWATERING.

A. DEWATERING WILL OCCUR AT A RATE SLOW ENOUGH TO ALLOW SPECIES TO NATURALLY MIGRATE OUT OF THE WORK AREA.

B. WHERE A GRAVITY FEED DIVERSION IS NOT POSSIBLE, A PUMP MAY BE USED. PUMPS WILL BE INSTALLED TO AVOID REPETIVE DEWATERING AND REWATERING.

C. WHEN FISH ARE PRESENT, PUMPS WILL BE SCREENED IN ACCORDANCE WITH NMFS FISH SCREEN CRITERIA. NMFS ENGINEERING REVIEW AND APPROVAL WILL BE OBTAINED FOR PUMPS EXCEEDING 3 CUBIC FEET PER SECOND.

D. DISSIPATION OF FLOW ENERGY AT THE BYPASS OUTFLOW WILL BE PROVIDED TO PREVENT DAMAGE TO THE STREAM CHANNEL AND RIPARIAN VEGETATION.

E. SEEPAGE WATER WILL BE PUMPED TO A TEMPORARY STORAGE AND TREATMENT SITE OF INTO UPLAND AREAS TO ALLOW WATER TO PERCOLATE THROUGH SOIL AND VEGETATION PRIOR TO REENTERING THE STREAM CHANNEL.

CONSTRUCTION AND POST CONSTRUCTION CONSERVATION MEASURES.

1. FISH PASSAGE.

A. FISH PASSAGE WILL BE PROVIDED FOR ADULT AND JUVENILE FISH LIKELY TO BE PRESENT DURING CONSTRUCTION UNLESS PASSAGE DID NOT EXIST BEFORE CONSTRUCTION, THE STREAM IS NATURALLY IMPASSABLE, OR PASSAGE WILL NEGATIVELY IMPACT ESA-LISTED SPECIES OR THEIR HABITAT.

B. FISH PASSAGE ALTERNATIVES WILL BE APPROVED BY THE BPA EC LEAD UNDER ADVISEMENT BY THE NMFS HABITAT BIOLOGIST.

2. CONSTRUCTION AND DISCHARGE WATER.

A. SURFACE WATER MAY BE DIVERTED TO MEET CONSTRUCTION NEEDS ONLY IF DEVELOPED SOURCES ARE UNAVAILABLE OR INADEQUATE.

B. DIVERSIONS WILL NOT EXCEED 10% OF THE AVAILABLE FLOW.

C. CONSTRUCTION DISCHARGE WATER WILL BE COLLECTED AND TREATED TO REMOVE DEBRIS, NUTRIENTS, SEDIMENT, PETROLEUM HYDROCARBONS, METALS, AND OTHER POLLUTANTS.

3. TIME AND EXTENT OF DISTURBANCE.

A. EARTHWORK REQUIRING IN-STREAM MECHANIZED EQUIPMENT (INCLUDING DRILLING, EXCAVATION, DREDGING, FILLING, AND COMPACTING) WILL BE COMPLETED AS QUICKLY AS POSSIBLE.

B. MECHANIZED EQUIPMENT WILL WORK FROM TOP OF BANK UNLESS WORK FROM ANOTHER LOCATION WILL RESULT IN LESS HABITAT DISTURBANCE (TURBIDITY, VEGETATION DISTURBANCE, ETC.).

4. CESSATION OF WORK.

A. PROJECT OPERATIONS WILL CEASE WHEN HIGH FLOW CONDITIONS MAY RESULT IN INUNDATION OF THE PROJECT AREA (FLOOD EFFORTS TO DECREASE DAMAGES TO NATURAL RESOURCES PERMITTED).

B. WATER QUALITY LEVELS EXCEEDED. SEE CWA SECTION 401 WATER QUALITY CERTIFICATION AND TURBIDITY MEASURES.

5. SITE RESTORATION.

A. DISTURBED AREAS, STREAM BANKS, SOILS, AND VEGETATION WILL BE CLEANED UP AND RESTORED TO IMPROVED OR PRE-PROJECT CONDITIONS.

B. PROJECT-RELATED WASTE WILL BE REMOVED.

C. TEMPORARY ACCESS ROADS AND STAGING WILL BE DECOMPACTED AND RESTORED. SOILS WILL BE LOOSENED IF NEEDED FOR REVEGETATION OR WATER INFILTRATION.

D. THE PROJECT SPONSOR WILL RETAIN THE RIGHT OF REASONABLE ACCESS TO THE SITE TO MONITOR AND MAINTAIN THE SITE OVER THE LIFE OF THE PROJECT.

6. REVEGETATION.

A. PLANTING AND SEEDING WILL OCCUR PRIOR TO OR AT THE BEGINNING OF THE FIRST GROWING SEASON AFTER CONSTRUCTION.

B. A MIX OF NATIVE SPECIES (INVASIVE SPECIES NOT ALLOWED) APPROPRIATE TO THE SITE WILL BE USED TO REESTABLISH VEGETATION, PROVIDE SHADE, AND REDUCE EROSION. REESTABLISHED VEGETATION SHOULD BE AT LEAST 70% OF PRE-PROJECT CONDITIONS WITHIN THREE YEARS.

C. VEGETATION SUCH AS WILLOWS, SEDGES, OR RUSH MATS WILL BE SALVAGED FROM DISTURBED OR ABANDONED AREAS TO BE REPLANTED.

D. SHORT-TERM STABILIZATION MEASURE MAY INCLUDE THE USE OF NON-NATIVE STERILE SEED MIX (WHEN NATIVE NOT AVAILABLE), WEED-FREE CERTIFIED STRAW, OR OTHER SIMILAR TECHNIQUES.

E. SURFACE FERTILIZER WILL NOT BE APPLIED WITHIN 50 FEET OF ANY STREAM, WATE BODY, OR WETLAND.

F. FENCING WILL BE INSTALLED AS NECESSARY TO PREVENT ACCESS TO REVEGETATED SITES BY LIVESTOCK OR UNAUTHORIZED PERSONS.

G. INVASIVE PLANTS WILL BE REMOVED OR CONTROLLED UNTIL NATIVE PLANT SPECIES ARE WELL ESTABLISHED (TYPICALLY THREE YEARS POST-CONSTRUCTION).

7. SITE ACCESS AND IMPLEMENTATION MONITORING.

A. THE PROJECT SPONSOR WILL PROVIDE CONSTRUCTION MONITORING DURING IMPLEMENTATION TO ENSURE ALL CONSERVATION MEASURES ARE ADEQUATELY FOLLOWED, EFFECTS TO LISTED SPECIES ARE NOT GREATER THAN PREDICTED, AND INCIDENTAL TAKE LIMITATIONS ARE NOT EXCEEDED.

B. THE PROJECT SPONSOR OR DESIGNATED REPRESENTATIVE WILL SUBMIT THE PROJECT COMPLETION FORM (PCF) WITHIN 30 DAYS OF PROJECT COMPLETION.

8. CWA SECTION 401 WATER QUALITY CERTIFICATION.

A. THE PROJECT SPONSOR OR DESIGNATED REPRESENTATIVE WILL COMPLETE AND RECORD WATER QUALITY OBSERVATIONS (SEE TURBIDITY MONITORING) TO ENSURE IN-WATER WORK IS NOT DEGRADING WATER QUALITY.

B. DURING CONSTRUCTION, WATER QUALITY PROVISIONS PROVIDED BY THE OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY, WASHINGTON DEPARTMENT OF ECOLOGY, IDAHO DEPARTMENT OF ENVIRONMENTAL QUALITY WILL BE FOLLOWED.

STAGED REWATERING PLAN.

A. WHEN REINTRODUCING WATER TO DEWATERED AREAS AND NEWLY CONSTRUCTED CHANNELS, A STAGED REWATERING PLAN WILL BE APPLIED.

B. THE FOLLOWING WILL BE APPLIED TO ALL REWATERING EFFORTS. COMPLEX REWATERING EFFORTS MAY REQUIRE ADDITIONAL NOTES OR A DEDICATED SHEET IN THE CONSTRUCTION DETAILS.

1. TURBIDITY MONITORING PROTOCOL WILL BE APPLIED TO REWATERING EFFORTS.
2. PRE-WASH THE AREA BEFORE REWATERING. TURBID WASH WATER WILL BE DETAINED AND PUMPED TO THE FLOODPLAIN OR SEDIMENT CAPTURE AREAS RATHER THAN DISCHARGING TO FISH-BEARING STREAMS.
3. INSTALL SEINE NETS AT UPSTREAM END TO PREVENT FISH FROM MOVING DOWNSTREAM UNTIL 2/3 OF TOTAL FLOW IS RESTORED TO THE CHANNEL.
4. STARTING IN EARLY MORNING INTRODUCE 1/3 OF NEW CHANNEL FLOW OVER PERIOD OF 1-2 HOURS.
5. INTRODUCE SECOND THIRD OF FLOW OVER NEXT 1 TO 2 HOURS AND BEGIN FISH SALVAGE OF BYPASS CHANNEL IF FISH ARE PRESENT.
6. REMOVE UPSTREAM SEINE NETS ONCE 2/3 FLOW IN REWATERED CHANNEL AND DOWNSTREAM TURBIDITY IS WITHIN ACCEPTABLE RANGE (LESS THAN 40 NTU OR LESS THAN 10% BACKGROUND).
7. INTRODUCE FINAL THIRD OF FLOW ONCE FISH SALVAGE EFFORTS ARE COMPLETE AND DOWNSTREAM TURBIDITY VERIFIED TO BE WITHIN ACCEPTABLE RANGE.
8. INSTALL PLUG TO BLOCK FLOW INTO OLD CHANNEL OR BYPASS. REMOVE ANY REMAINING SEINE NETS.
9. IN LAMPREY SYSTEMS, LAMPREY SALVAGE AND DRY SHOCKING MAY BE NECESSARY.

TURBIDITY MONITORING.

A. RECORD THE READING, LOCATION, AND TIME FOR THE BACKGROUND READING APPROXIMATELY 100 FEET UPSTREAM OF THE PROJECT AREA USING A RECENTLY CALIBRATED TURBIDIMETER OR VIA VISUAL OBSERVATION (SEE THE HIP HANDBOOK TURBIDITY MONITORING SECTION FOR A VISUAL OBSERVATION KEY).

B. RECORD THE TURBIDITY READING, LOCATION, AND TIME AT THE MEASUREMENT COMPLIANCE LOCATION POINT.

1. 50 FEET DOWNSTREAM FOR STREAMS LESS THAN 30 FEET WIDE.
2. 100 FEET DOWNSTREAM FOR STREAMS BETWEEN 30 AND 100 FEET WIDE.
3. 200 FEET DOWNSTREAM FOR STREAMS GREATER THAN 100 FEET WIDE.
4. 300 FEET FROM THE DISCHARGE POINT OR NONPOINT SOURCE FOR LOCATIONS SUBJECT TO TIDAL OR COASTAL SCOUR.

C. TURBIDITY SHALL BE MEASURED (BACKGROUND LOCATION AND COMPLIANCE POINTS) EVERY 4 HOURS WHILE WORK IS BEING IMPLEMENTED.

D. IF THERE IS A VISIBLE DIFFERENCE BETWEEN A COMPLIANCE POINT AND THE BACKGROUND, THE EXCEEDANCE WILL BE NOTED IN THE PROJECT COMPLETION FORM (PCF). ADJUSTMENTS OR CORRECTIVE MEASURES WILL BE TAKEN IN ORDER TO REDUCE TURBIDITY.

E. IF EXCEEDANCES OCCUR FOR MORE THAN TWO CONSECUTIVE MONITORING INTERVALS (AFTER 8 HOURS), THE ACTIVITY WILL STOP UNTIL THE TURBIDITY LEVEL RETURNS TO BACKGROUND. THE BPA EC LEAD WILL BE NOTIFIED OF ALL EXCEEDANCES AND CORRECTIVE ACTIONS AT PROJECT COMPLETION.

F. IF TURBIDITY CONTROLS (COFFER DAMS, WADDLES, FENCING, ETC.) ARE DETERMINED INEFFECTIVE, CREWS WILL BE MOBILIZED TO MODIFY AS NECESSARY. OCCURRENCES WILL BE DOCUMENTED IN THE PROJECT COMPLETION FORM (PCF).

G. FINAL TURBIDITY READINGS, EXCEEDANCES, AND CONTROL FAILURES WILL BE SUBMITTED TO THE BPA EC LEAD USING THE PROJECT COMPLETION FORM (PCF).

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REVISION	BY	DATE

DESIGNED BY J. HERRON
DRAWN BY P. RICHARDSON
REVIEWED BY C. HUTCHINS

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ACAD FILE: 596-07-G-004.dwg

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UNION SOIL AND WATER CONSERVATION DISTRICT
LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

HIP GENERAL CONSERVATION MEASURES III

SHEET
G-004
4 OF 19

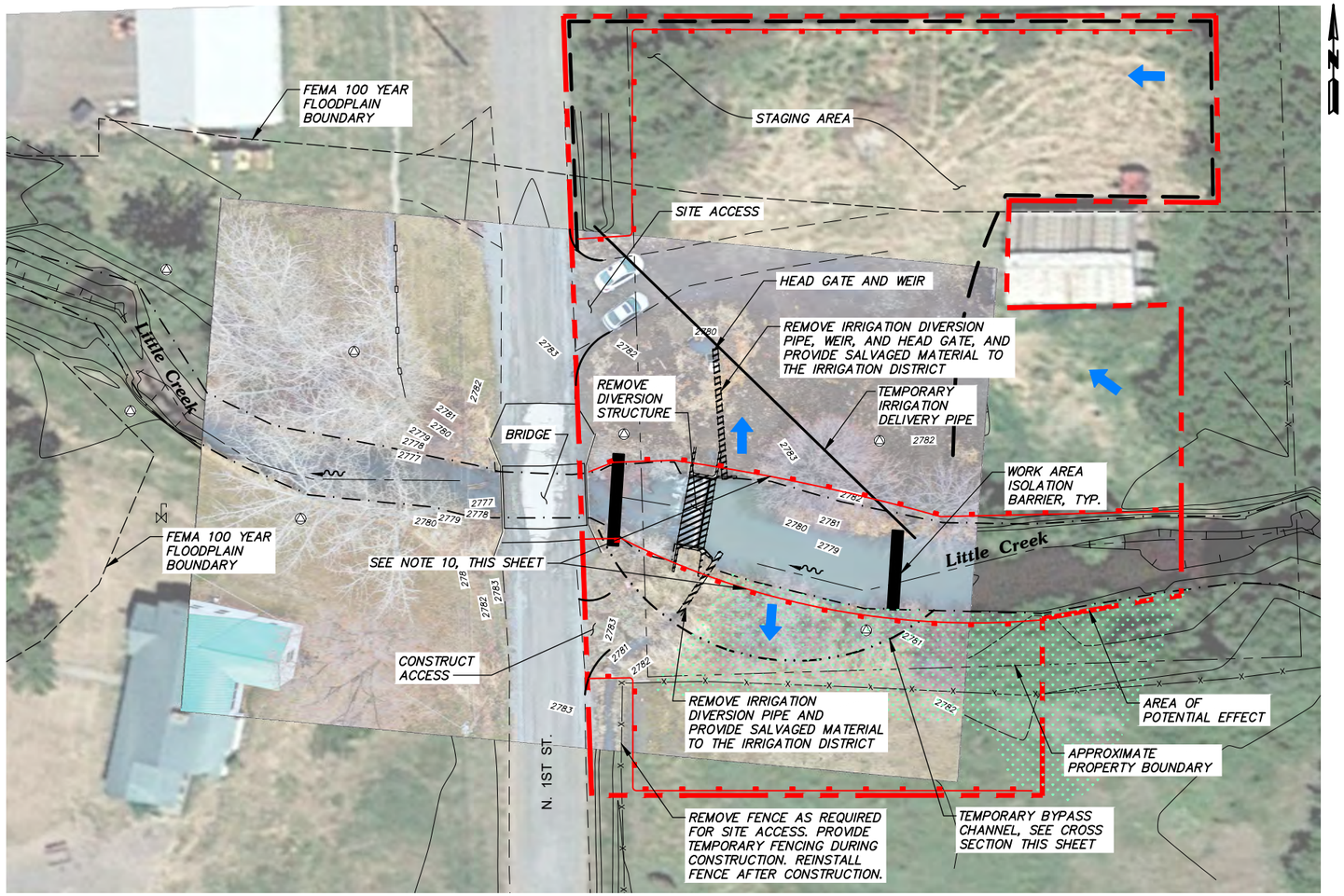
NOTES

1. COORDINATE WITH OWNER FOR ACCESS AND STAGING AREAS PRIOR TO MOBILIZING TO THE SITE.
2. CONTRACTOR SHALL RESTORE ALL DISTURBED AREAS TO PRE-PROJECT CONDITIONS OR BETTER PRIOR TO DEMOBILIZING FROM THE SITE. SEED MIXTURE SHOWN IN SPECIFICATIONS SHALL BE APPLIED AT ALL DISTURBED AREAS.
3. LOCATION OF BYPASS DITCH AND TEMPORARY IRRIGATION DELIVERY PIPE SHOWN IS APPROXIMATE. THE ACTUAL LOCATION SHALL BE DETERMINED IN THE FIELD UNDER THE DIRECTION OF THE ENGINEER.
4. THE CONTRACTOR IS RESPONSIBLE FOR ALL WORK AREA ISOLATION AND WATER CONTROL, SEE TECHNICAL SPECIFICATIONS.
5. FISH SALVAGE TO BE PERFORMED BY OTHERS. THE CONTRACTOR SHALL COORDINATE BYPASS EFFORTS AND FISH SALVAGE WITH THE OWNER. ESTIMATED TIME FOR SALVAGE IS ONE DAY. CONTRACTOR SHALL PROVIDE FISH SCREEN AND PUMP TO DEWATER ENTIRE ISOLATION AREA.
6. ANTICIPATED FLOWS IN LITTLE CREEK AT THE TIME OF CONSTRUCTION RANGE FROM APPROXIMATELY 5 TO 30 CFS.
7. BOULDERS SHALL BE INSTALLED IN THE BYPASS DITCH TO REDUCE VELOCITY TO 2 FT/S OR LESS.
8. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING IRRIGATION FLOWS THROUGHOUT THE ENTIRE PROJECT AND SHALL COORDINATE ANY UNAVOIDABLE IRRIGATION SHUTDOWNS WITH THE OWNER 48 HOURS IN ADVANCE.
9. ONCE THE IN-STREAM WORK IS COMPLETED ON THE DIVERSION STRUCTURE, CONTRACTOR SHALL REMOVE THE TEMPORARY BYPASS CHANNEL, ADJUST THE WORK AREA ISOLATION BARRIERS, AND CONSTRUCT THE PERMANENT FISH BYPASS CHANNEL.
10. EROSION AND SEDIMENT CONTROLS ALONG THE BANK MAY BE REMOVED TO FACILITATE CONSTRUCTION AND ACCESS WHEN WITHIN AN ISOLATED WORK AREA.

EROSION AND SEDIMENT CONTROL LEGEND

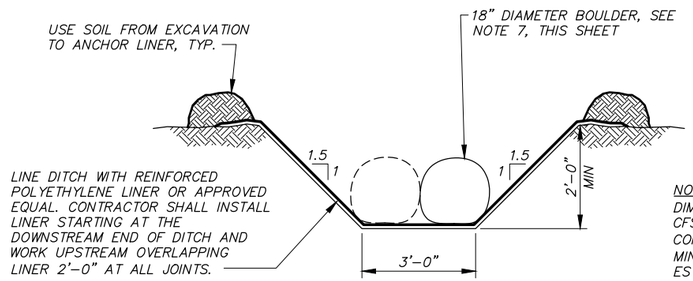
STRAW WATTLE

FLOW DIRECTION



SPILL PREVENTION

STAGING AREAS ARE WITHIN THE 100-YEAR FLOODPLAIN AND WITHIN 150 FEET OF THE STREAM. SEE THE TECHNICAL SPECIFICATIONS FOR SPILL PREVENTION REQUIREMENTS.



NOTES:
DIMENSIONS SHOWN ARE FOR FLOWS LESS THAN 30 CFS. IF FLOWS EXCEED 30 CFS, CHANNEL SHALL BE CONSTRUCTED WITH A BOTTOM WIDTH OF 7'-0" AND MINIMUM DEPTH OF 2'-6". CONTRACTOR SHALL ESTIMATE FLOWS AND NOTIFY ENGINEER PRIOR TO CONSTRUCTION. SEE NOTE 6, THIS SHEET.

TEMPORARY BYPASS CHANNEL SECTION

N.T.S.

REVISION	BY	DATE

20 0 20 40 60
SCALE IN FEET

DESIGNED BY	A. HAMILTON
DRAWN BY	P. RICHARDSON
REVIEWED BY	J. HERRON

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ACAD FILE: 596-07-D-101.dwg

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UNION SOIL AND WATER CONSERVATION DISTRICT

LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

LC5
EXISTING SITE PLAN, STAGING, DEMOLITION, AND WATER CONTROL PLAN

SHEET
D-101
5 OF 19

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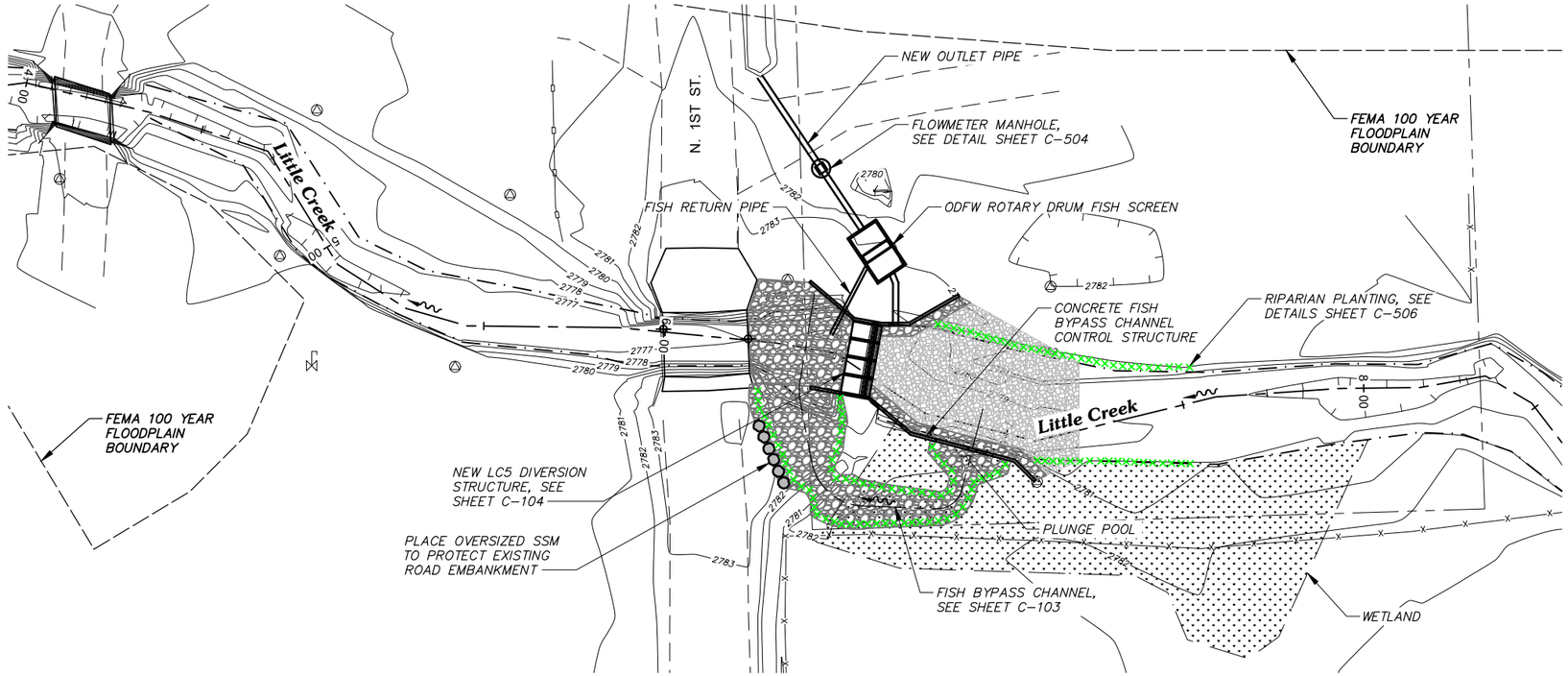
STREAM RESTORATION NOTES:

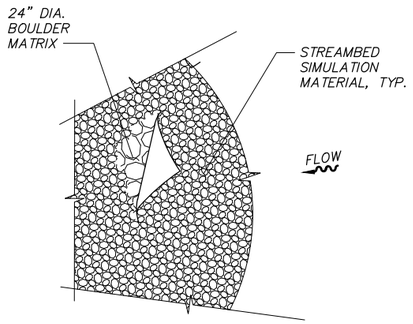
1. STREAMBED SIMULATION MATERIAL SHALL BE PLACED 6" ABOVE DESIGN FINISHED GRADE SHOWN ON THE DRAWINGS PER ENGINEER'S DIRECTION TO ACCOUNT FOR ANTICIPATED SETTLING. MATERIAL SHALL BE PLACED BY FIRST INSTALLING THE LARGEST MATERIAL. THE SMALLER MATERIAL SHALL THEN BE USED TO FILL THE VOIDS BETWEEN THE LARGE MATERIAL. THIS MATERIAL SHALL BE TAMPED IN PLACE IN 12" LIFTS FOLLOWED BY JETTING OR FLOODING THE SURFACE WITH WATER TO WASH THE FINER MATERIAL INTO REMAINING VOIDS. FINES SHALL CONTINUE TO BE ADDED AND WASHED INTO THE STREAM SIMULATION MATERIAL UNTIL WATER POOLS ON THE STREAMBED SURFACE.

2. LARGE BOULDERS RANGING IN SIZE FROM 18" TO 24" SHALL BE PLACED NEAR THE SURFACE OF THE STREAMBED AND SHALL BE BURIED APPROXIMATELY 60% TO ACHIEVE LARGE SCALE HYDRAULIC ROUGHNESS AND RESTING LOCATIONS FOR FISH. SPACING SHALL BE ON AVERAGE APPROXIMATELY 10' O.C. THROUGHOUT THE NEWLY CONSTRUCTED REACH. ACTUAL LOCATIONS OF BOULDERS TO BE DETERMINED IN THE FIELD UNDER THE DIRECTION OF THE ENGINEER.

3. CONTRACTOR SHALL PLACE 24" DIAMETER BOULDER MATRIX PRIOR TO PLACING STREAMBED SIMULATION MATERIAL. CONTRACTOR SHALL INCORPORATE BED CLASS 6 STREAMBED SIMULATION MATERIAL INTO BED CLASS 24 STREAMBED SIMULATION MATERIAL AS REQUIRED TO FILL THE VOIDS BETWEEN 24" DIAMETER BOULDERS UNDER THE ENGINEER'S DIRECTION. THE BOULDERS SHALL BE PLACED ON A PREPARED BED TO ENSURE STREAMBED MATERIAL IS PLACED UP TO THE SPRING LINE OF THE ROCK. THE LARGE BOULDER MATRIX ARE NOT SHOWN ON THE PLAN VIEW FOR CLARITY.

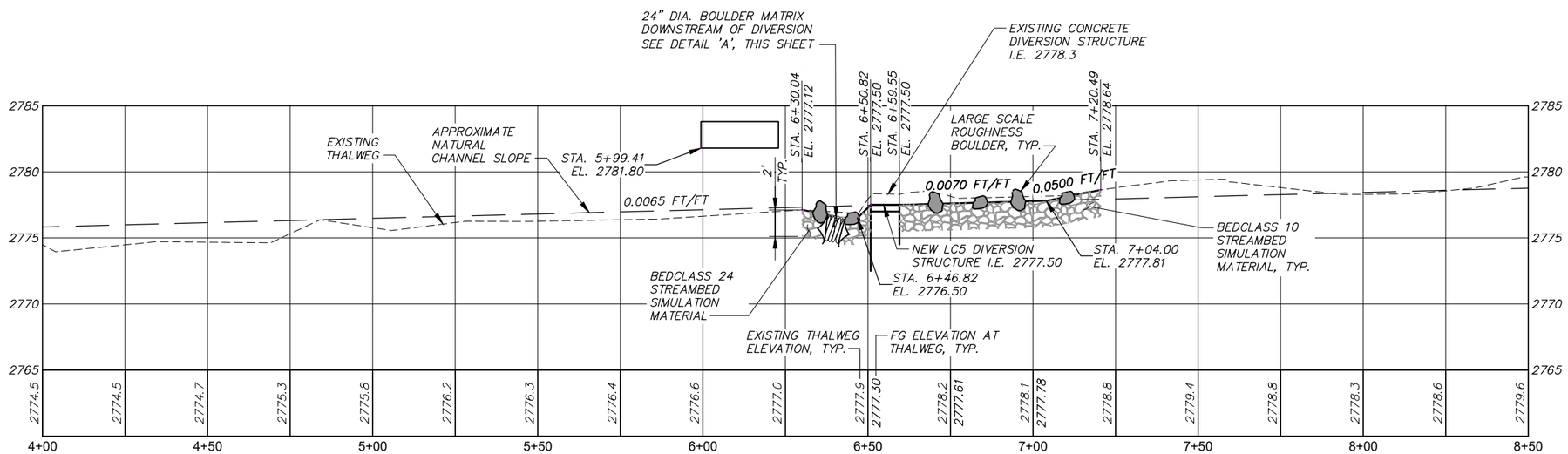
4. CONTRACTOR SHALL INSTALL LOW FLOW THALWEG THROUGH NEWLY CONSTRUCTED CHANNEL PER ENGINEERS DIRECTION.





NOTE
24" DIA BOULDER MATRIX SHALL BE INSTALLED IN ONE CONTINUOUS LAYER WITH STREAMBED SIMULATION MATERIAL INSTALLED TO FILL IN THE VOIDS. SEE STREAM RESTORATION NOTE 3, THIS SHEET.

DETAIL 'A'
N.T.S.



REVISION	BY	DATE	
DESIGNED BY	A. HAMILTON		
DRAWN BY	P. RICHARDSON		
REVIEWED BY	J. HERRON		

20 0 20 40 60 HORZ. SCALE IN FEET
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ACAD FILE: 596-07-C-102.dwg

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UNION SOIL AND WATER CONSERVATION DISTRICT
LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

LC5
SITE PLAN AND PROFILE

SHEET
C-102
6 OF 19

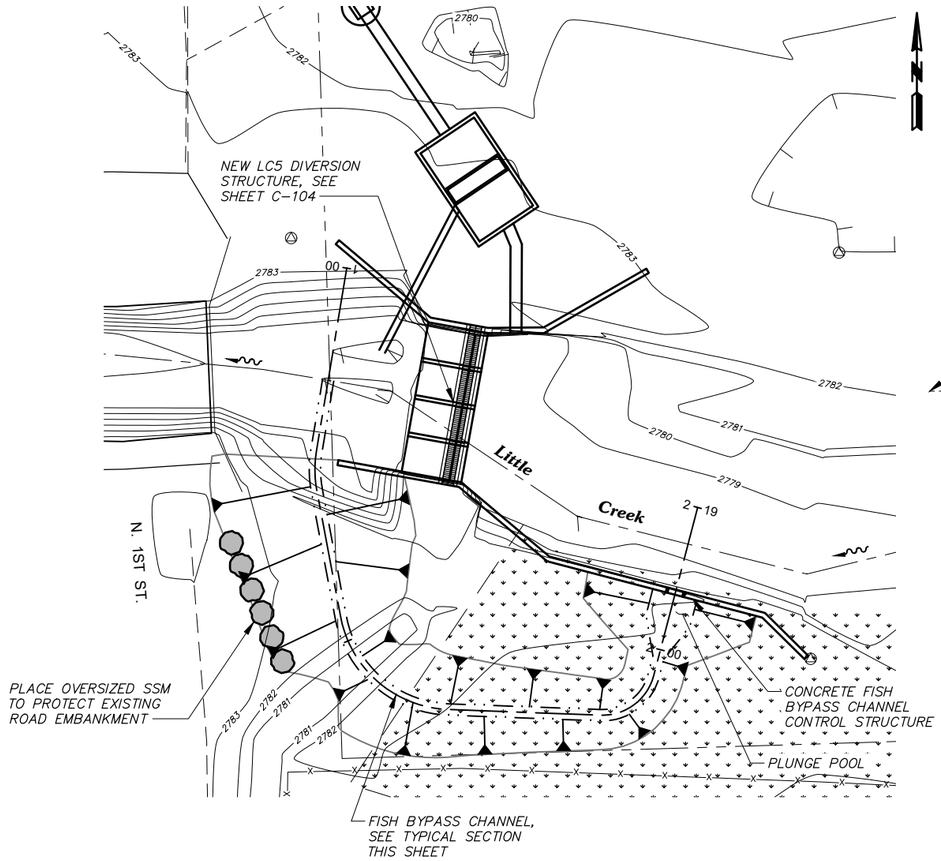
STREAM RESTORATION NOTES:

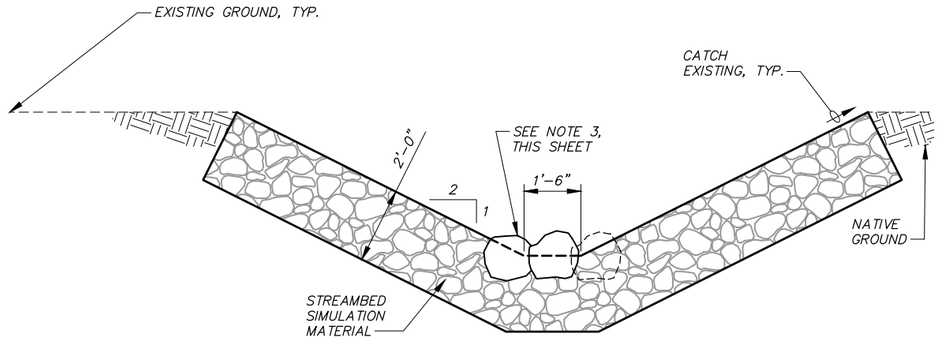
1. STREAMBED SIMULATION MATERIAL SHALL BE PLACED 6" ABOVE DESIGN FINISHED GRADE SHOWN ON THE DRAWINGS PER ENGINEER'S DIRECTION TO ACCOUNT FOR ANTICIPATED SETTLING. MATERIAL SHALL BE PLACED BY FIRST INSTALLING THE LARGEST MATERIAL. THE SMALLER MATERIAL SHALL THEN BE USED TO FILL THE VOIDS BETWEEN THE LARGE MATERIAL. THIS MATERIAL SHALL BE TAMPED IN PLACE IN 12" LIFTS FOLLOWED BY JETTING OR FLOODING THE SURFACE WITH WATER TO WASH THE FINER MATERIAL INTO REMAINING VOIDS. FINES SHALL CONTINUE TO BE ADDED AND WASHED INTO THE STREAM SIMULATION MATERIAL UNTIL WATER POOLS ON THE STREAMBED SURFACE.

2. LARGE BOULDERS RANGING IN SIZE FROM 18" TO 24" SHALL BE PLACED NEAR THE SURFACE OF THE STREAMBED AND SHALL BE BURIED APPROXIMATELY 60% TO achieve LARGE SCALE HYDRAULIC ROUGHNESS AND RESTING LOCATIONS FOR FISH. SPACING SHALL BE ON AVERAGE APPROXIMATELY 10' O.C. THROUGHOUT THE NEWLY CONSTRUCTED REACH. ACTUAL LOCATIONS OF BOULDERS TO BE DETERMINED IN THE FIELD UNDER THE DIRECTION OF THE ENGINEER.

3. 18" BOULDERS SHALL BE PLACED IN ALTERNATING CLUSTERS TO CREATE A SINUOUS FLOW PATH IN THE BYPASS CHANNEL.

4. SSM IS NOT SHOWN IN PLAN FOR CLARITY.





TYPICAL BYPASS CHANNEL SECTION

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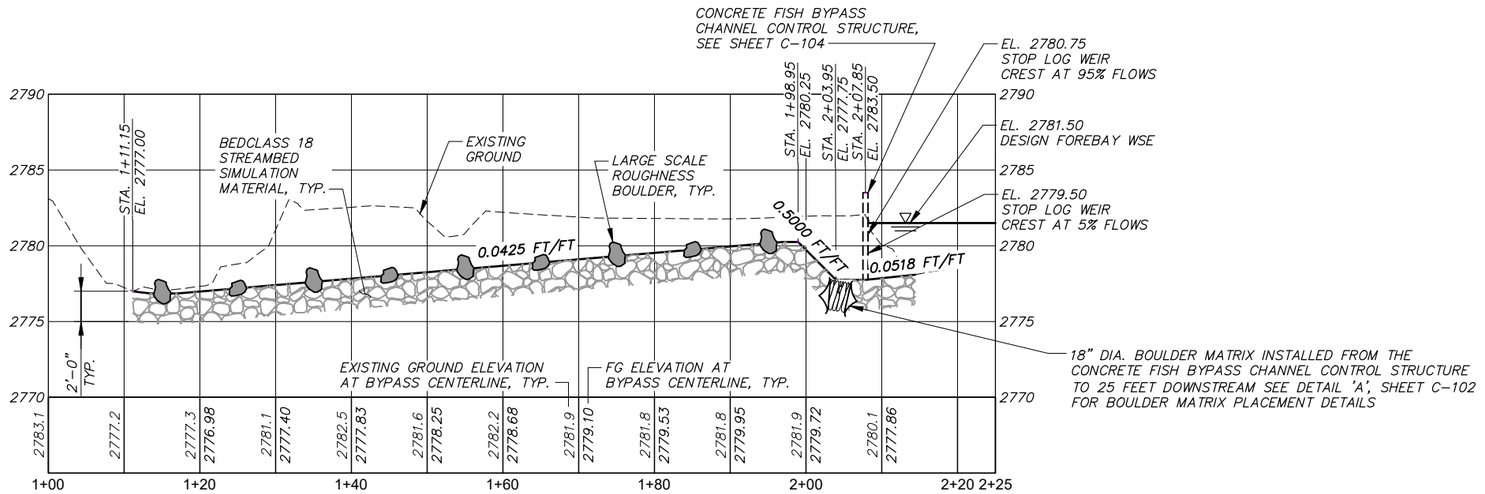

REVISION	BY	DATE

DESIGNED BY	A. HAMILTON
DRAWN BY	P. RICHARDSON
REVIEWED BY	J. HERRON

10 0 10 20 30
HORZ. SCALE IN FEET
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VERT. SCALE IN FEET

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LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

LC5
FISH BYPASS CHANNEL PLAN AND PROFILE

SHEET
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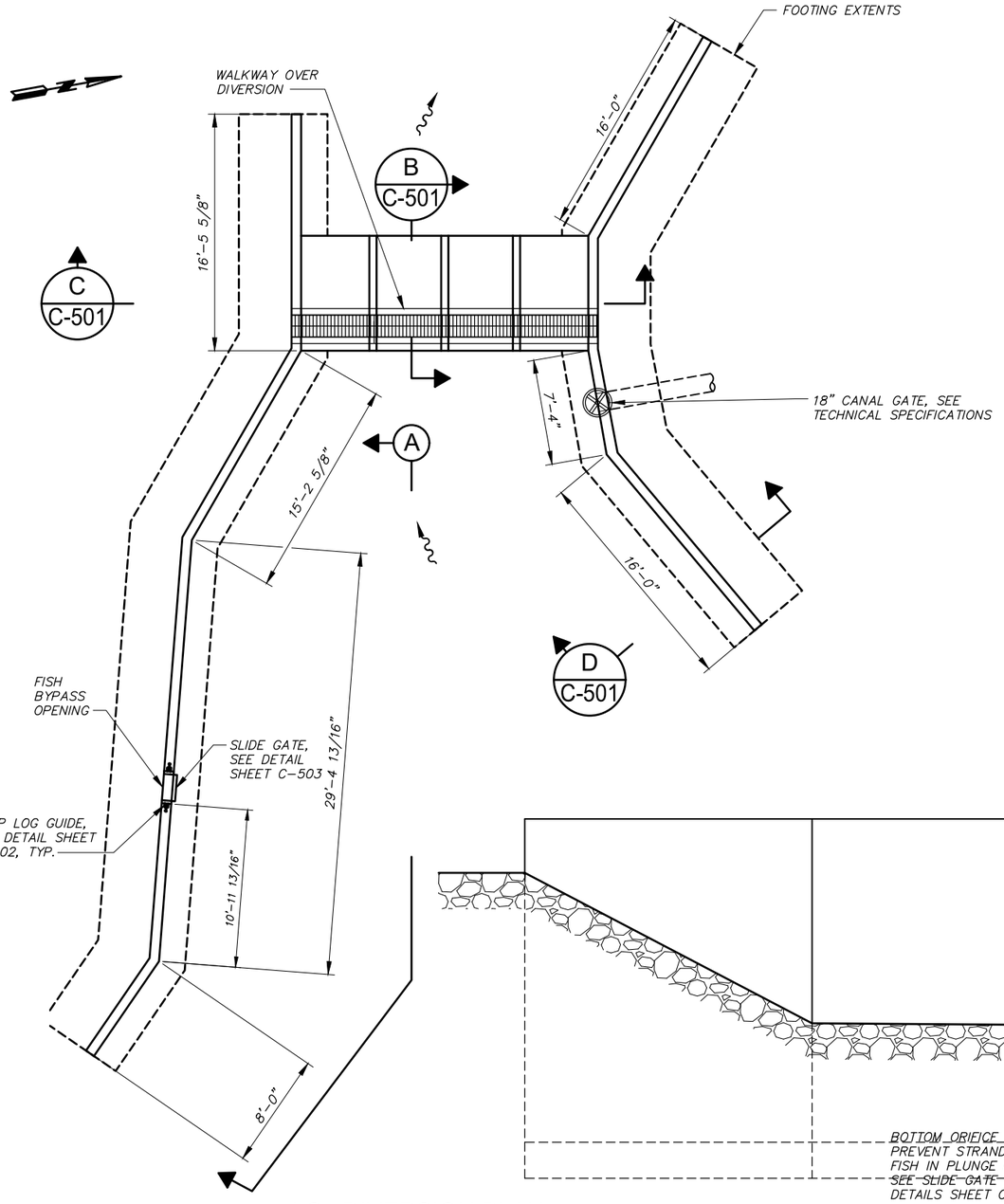
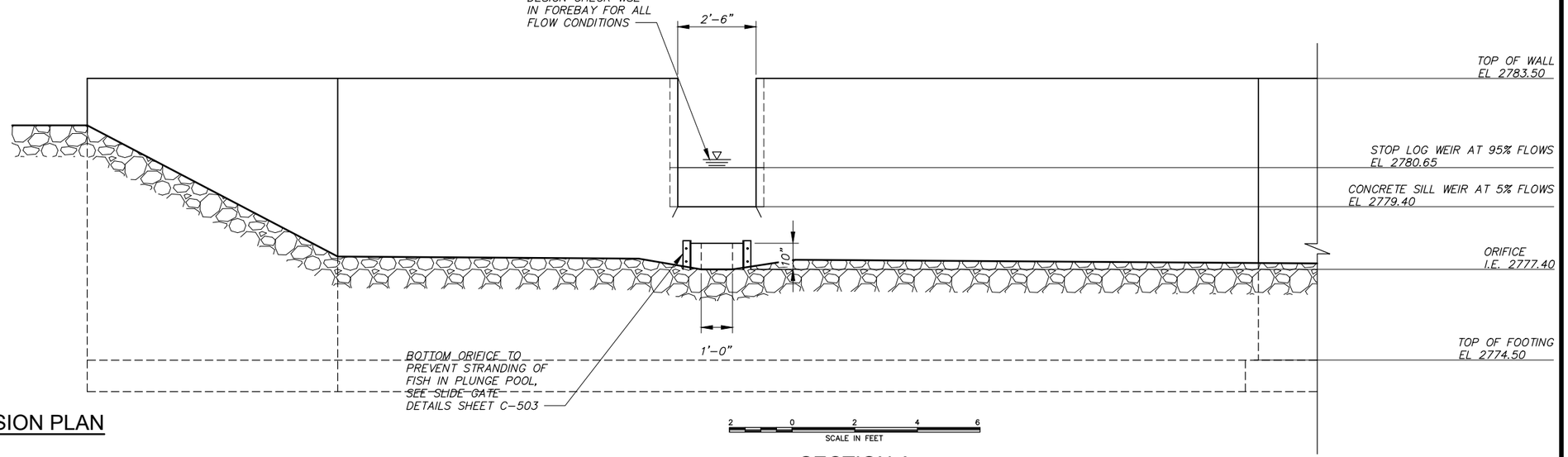


LC5 DIVERSION PLAN



SECTION A

CONCRETE FISH BYPASS CHANNEL CONTROL STRUCTURE

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REVISION	BY	DATE

5 0 5 10 15
PLAN SCALE IN FEET

DESIGNED BY	J. HERRON
DRAWN BY	P. RICHARDSON
REVIEWED BY	C. HUTCHINS

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UNION SOIL AND WATER CONSERVATION DISTRICT
LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

LC5 DIVERSION PLAN

SHEET
C-104
8 OF 19

NOTES

1. COORDINATE WITH OWNER FOR ACCESS AND STAGING AREAS PRIOR TO MOBILIZING TO THE SITE.
2. CONTRACTOR SHALL RESTORE ALL DISTURBED AREAS TO PRE-PROJECT CONDITIONS OR BETTER PRIOR TO DEMOBILIZING FROM THE SITE. SEED MIXTURE SHOWN IN SPECIFICATIONS SHALL BE APPLIED AT ALL DISTURBED AREAS.
3. LOCATION OF BYPASS DITCH AND TEMPORARY IRRIGATION DELIVERY PIPE SHOWN IS APPROXIMATE. THE ACTUAL LOCATION SHALL BE DETERMINED IN THE FIELD UNDER THE DIRECTION OF THE ENGINEER.
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7. BOULDERS SHALL BE INSTALLED IN THE BYPASS DITCH TO REDUCE VELOCITY TO 2 FT/S OR LESS.
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9. ONCE THE IN-STREAM WORK IS COMPLETED ON THE DIVERSION STRUCTURE, CONTRACTOR SHALL REMOVE THE TEMPORARY BYPASS CHANNEL, ADJUST THE WORK AREA ISOLATION BARRIERS, AND CONSTRUCT THE PERMANENT FISH BYPASS CHANNEL.
10. EROSION AND SEDIMENT CONTROLS ALONG THE BANK MAY BE REMOVED TO FACILITATE CONSTRUCTION AND ACCESS WHEN WITHIN AN ISOLATED WORK AREA.

SPILL PREVENTION

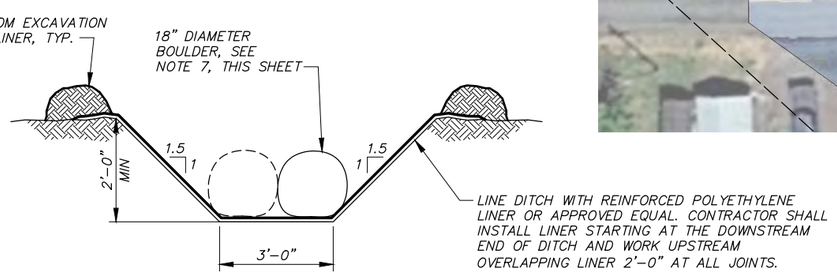
STAGING AREAS ARE WITHIN THE 100-YEAR FLOODPLAIN AND WITHIN 150 FEET OF THE STREAM. SEE THE TECHNICAL SPECIFICATIONS FOR SPILL PREVENTION REQUIREMENTS.

EROSION AND SEDIMENT CONTROL LEGEND

STRAW WATTLE

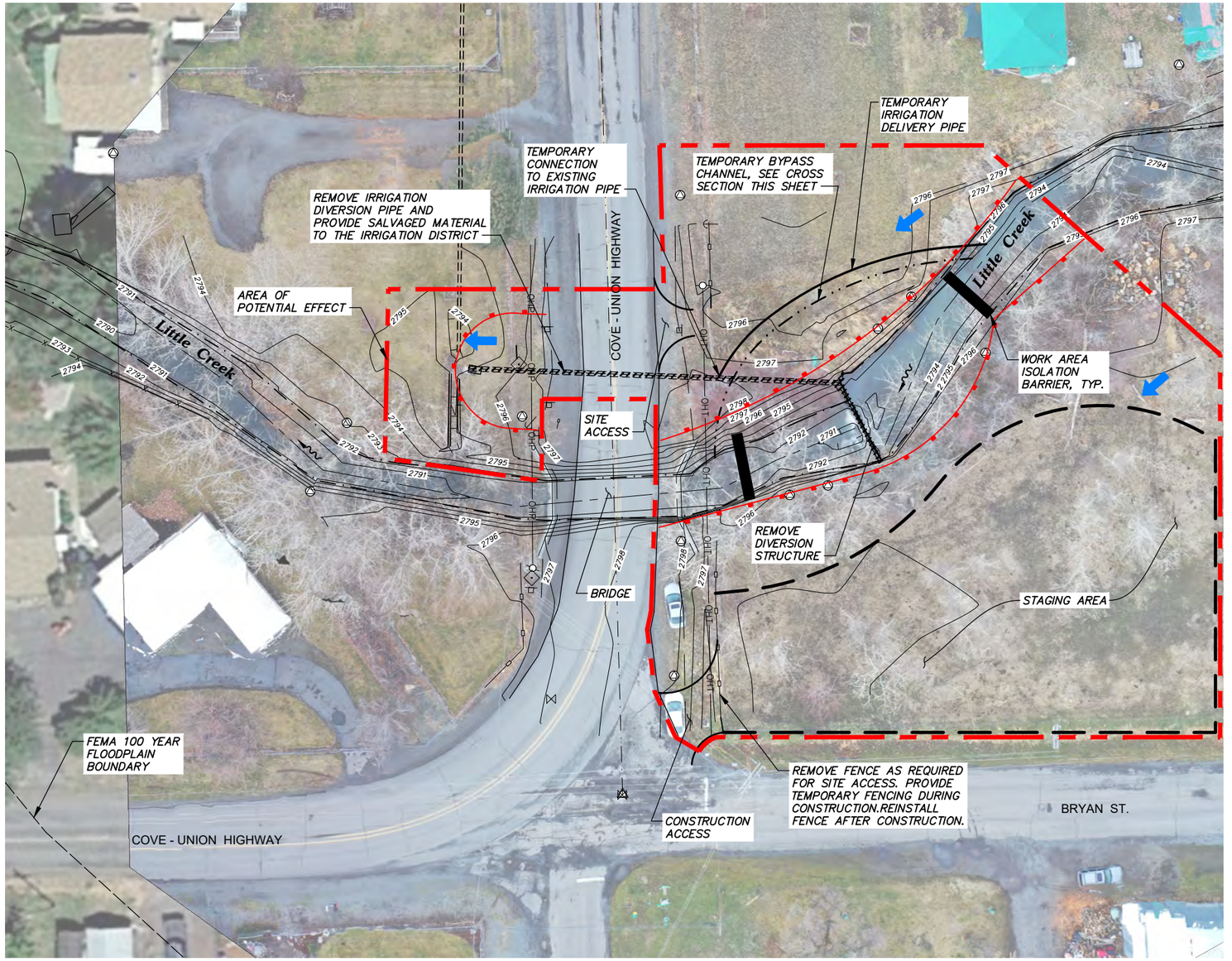
FLOW DIRECTION

NOTES:
DIMENSIONS SHOWN ARE FOR FLOWS LESS THAN 30 CFS. IF FLOWS EXCEED 30 CFS, CHANNEL SHALL BE CONSTRUCTED WITH A BOTTOM WIDTH OF 7'-0" AND MINIMUM DEPTH OF 2'-6". CONTRACTOR SHALL ESTIMATE FLOWS AND NOTIFY ENGINEER PRIOR TO CONSTRUCTION. SEE NOTE 6, THIS SHEET.



TEMPORARY BYPASS CHANNEL SECTION

N.T.S.



REVISION	BY	DATE

DESIGNED BY A. HAMILTON
DRAWN BY P. RICHARDSON
REVIEWED BY J. HERRON

SCALE IN FEET: 20 0 20 40 60

JOB NUMBER 596-07 DATE 2022
ACAD FILE: 596-07-D-201.dwg

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UNION SOIL AND WATER CONSERVATION DISTRICT
LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS
LC6
EXISTING SITE PLAN, STAGING, DEMOLITION, AND WATER CONTROL PLAN

SHEET
D-201
9 OF 19

S:\UNION_SWCD\596-07 Little Creek Fish Passage\Drafting\596-07-D-201.dwg, 9, 9/22/2022 11:54 AM, smagner

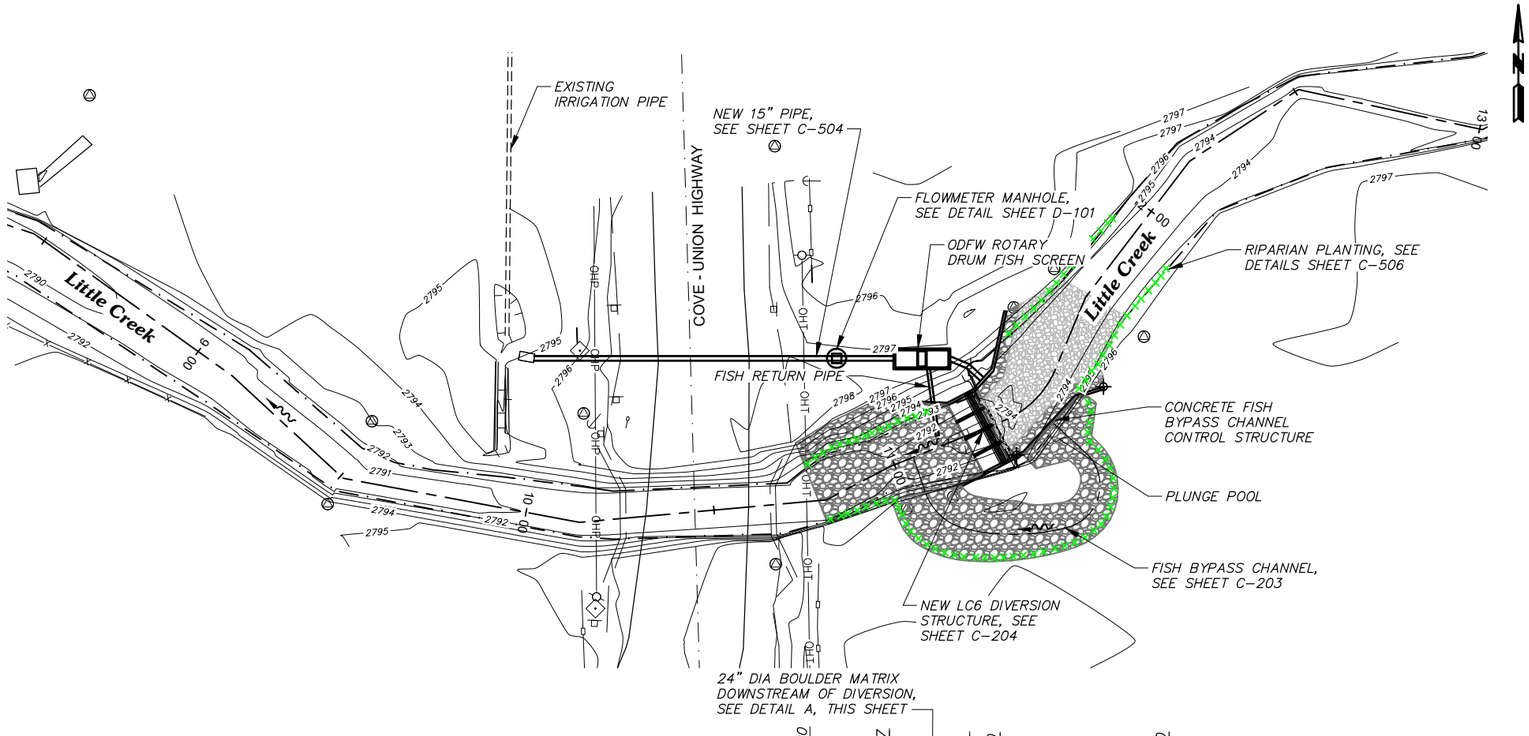
STREAM RESTORATION NOTES:

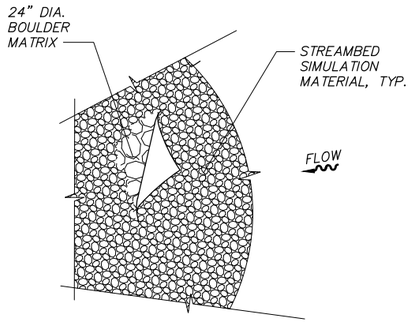
1. STREAMBED SIMULATION MATERIAL SHALL BE PLACED 6" ABOVE DESIGN FINISHED GRADE SHOWN ON THE DRAWINGS PER ENGINEER'S DIRECTION TO ACCOUNT FOR ANTICIPATED SETTLING. MATERIAL SHALL BE PLACED BY FIRST INSTALLING THE LARGEST MATERIAL. THE SMALLER MATERIAL SHALL THEN BE USED TO FILL THE VOIDS BETWEEN THE LARGE MATERIAL. THIS MATERIAL SHALL BE TAMPED IN PLACE IN 12" LIFTS FOLLOWED BY JETTING OR FLOODING THE SURFACE WITH WATER TO WASH THE FINER MATERIAL INTO REMAINING VOIDS. FINES SHALL CONTINUE TO BE ADDED AND WASHED INTO THE STREAM SIMULATION MATERIAL UNTIL WATER POOLS ON THE STREAMBED SURFACE.

2. LARGE BOULDERS RANGING IN SIZE FROM 18" TO 24" SHALL BE PLACED NEAR THE SURFACE OF THE STREAMBED AND SHALL BE BURIED APPROXIMATELY 60% TO ACHIEVE LARGE SCALE HYDRAULIC ROUGHNESS AND RESTING LOCATIONS FOR FISH. SPACING SHALL BE ON AVERAGE APPROXIMATELY 10' O.C. THROUGHOUT THE NEWLY CONSTRUCTED REACH. ACTUAL LOCATIONS OF BOULDERS TO BE DETERMINED IN THE FIELD UNDER THE DIRECTION OF THE ENGINEER.

3. CONTRACTOR SHALL PLACE 24" DIAMETER BOULDER MATRIX PRIOR TO PLACING STREAMBED SIMULATION MATERIAL. CONTRACTOR SHALL INCORPORATE BED CLASS 6 STREAMBED SIMULATION MATERIAL INTO BED CLASS 24 STREAMBED SIMULATION MATERIAL AS REQUIRED TO FILL THE VOIDS BETWEEN 24" DIAMETER BOULDERS UNDER THE ENGINEER'S DIRECTION. THE BOULDERS SHALL BE PLACED ON A PREPARED BED TO ENSURE STREAMBED MATERIAL IS PLACED UP TO THE SPRING LINE OF THE ROCK. THE LARGE BOULDER MATRIX ARE NOT SHOWN ON THE PLAN VIEW FOR CLARITY.

4. CONTRACTOR SHALL INSTALL LOW FLOW THALWEG THROUGH NEWLY CONSTRUCTED CHANNEL PER ENGINEERS DIRECTION.

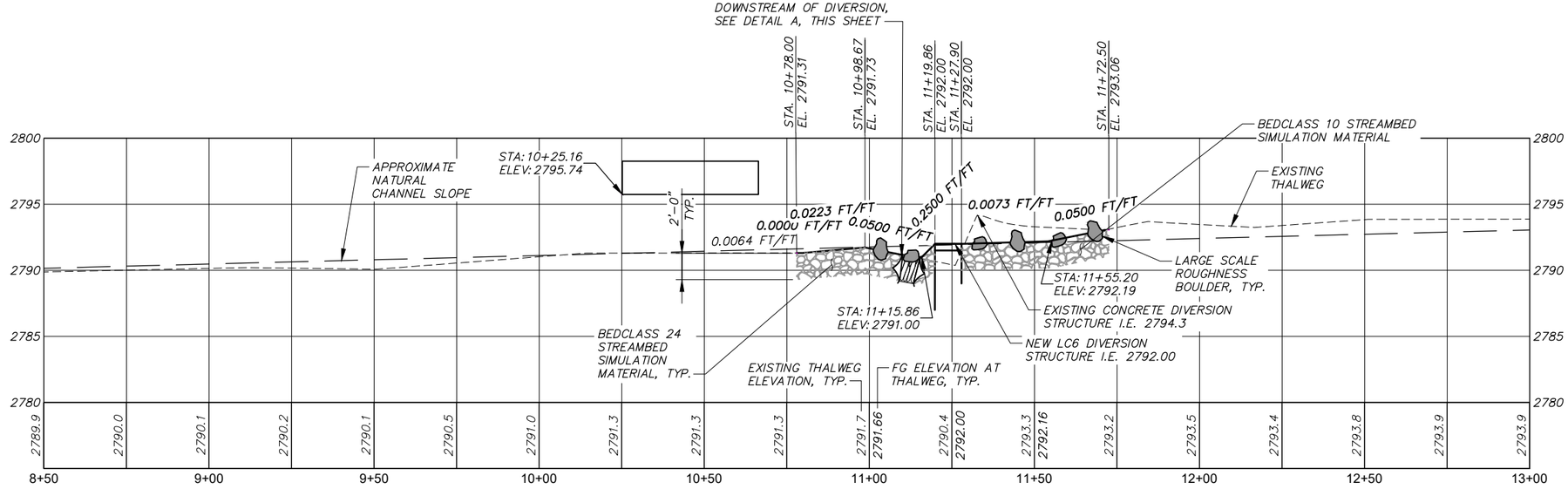




NOTE
24" DIA BOULDER MATRIX SHALL BE INSTALLED IN ONE CONTINUOUS LAYER WITH STREAMBED SIMULATION MATERIAL INSTALLED TO FILL IN THE VOIDS. SEE STREAM RESTORATION NOTE 3, THIS SHEET.

DETAIL 'A'

N.T.S.



REVISION	BY	DATE	
DESIGNED BY A. HAMILTON			
DRAWN BY P. RICHARDSON			
REVIEWED BY J. HERRON			

20 0 20 40 60 HORZ. SCALE IN FEET

5 0 5 10 15 VERT. SCALE IN FEET

JOB NUMBER 596-07 DATE 2022

ACAD FILE: 596-07-C-202.dwg

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UNION SOIL AND WATER CONSERVATION DISTRICT

LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

LC6 SITE PLAN AND PROFILE

SHEET C-202

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S:\UNION_SWCD\596-07 Little Creek Fish Passage\Drafting\596-07-C-202.dwg, 10, 9/22/2022 11:54 AM, smagner

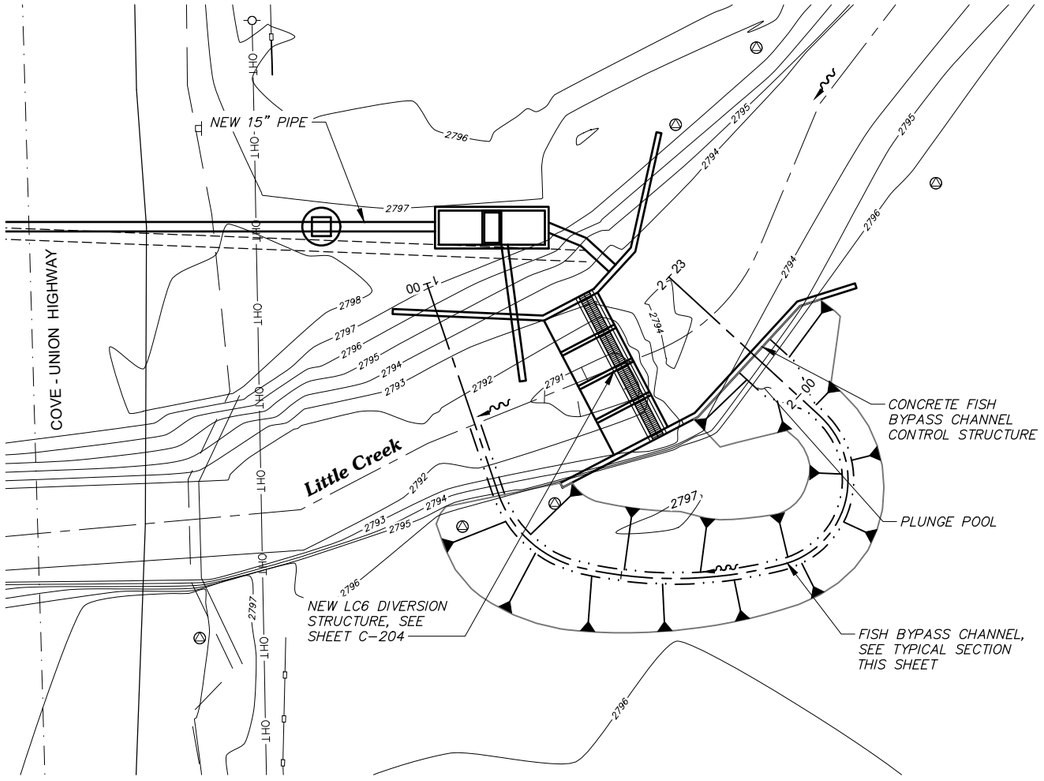
STREAM RESTORATION NOTES:

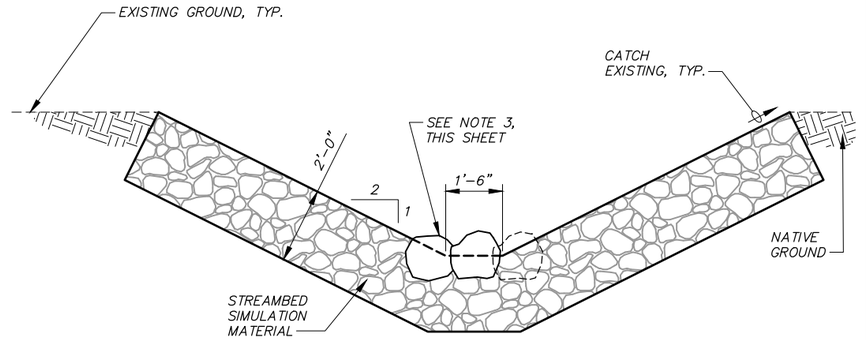
1. STREAMBED SIMULATION MATERIAL SHALL BE PLACED 6" ABOVE DESIGN FINISHED GRADE SHOWN ON THE DRAWINGS PER ENGINEER'S DIRECTION TO ACCOUNT FOR ANTICIPATED SETTLING. MATERIAL SHALL BE PLACED BY FIRST INSTALLING THE LARGEST MATERIAL. THE SMALLER MATERIAL SHALL THEN BE USED TO FILL THE VOIDS BETWEEN THE LARGE MATERIAL. THIS MATERIAL SHALL BE TAMPED IN PLACE IN 12" LIFTS FOLLOWED BY JETTING OR FLOODING THE SURFACE WITH WATER TO WASH THE FINER MATERIAL INTO REMAINING VOIDS. FINES SHALL CONTINUE TO BE ADDED AND WASHED INTO THE STREAM SIMULATION MATERIAL UNTIL WATER POOLS ON THE STREAMBED SURFACE.

2. LARGE BOULDERS RANGING IN SIZE FROM 18" TO 24" SHALL BE PLACED NEAR THE SURFACE OF THE STREAMBED AND SHALL BE BURIED APPROXIMATELY 60% TO ACHIEVE LARGE SCALE HYDRAULIC ROUGHNESS AND RESTING LOCATIONS FOR FISH. SPACING SHALL BE ON AVERAGE APPROXIMATELY 10' O.C. THROUGHOUT THE NEWLY CONSTRUCTED REACH. ACTUAL LOCATIONS OF BOULDERS TO BE DETERMINED IN THE FIELD UNDER THE DIRECTION OF THE ENGINEER.

3. 18" BOULDERS SHALL BE PLACED IN ALTERNATING CLUSTERS TO CREATE A SINUOUS FLOW PATH IN THE BYPASS CHANNEL.

4. SSM IS NOT SHOWN IN PLAN FOR CLARITY.





TYPICAL BYPASS CHANNEL SECTION

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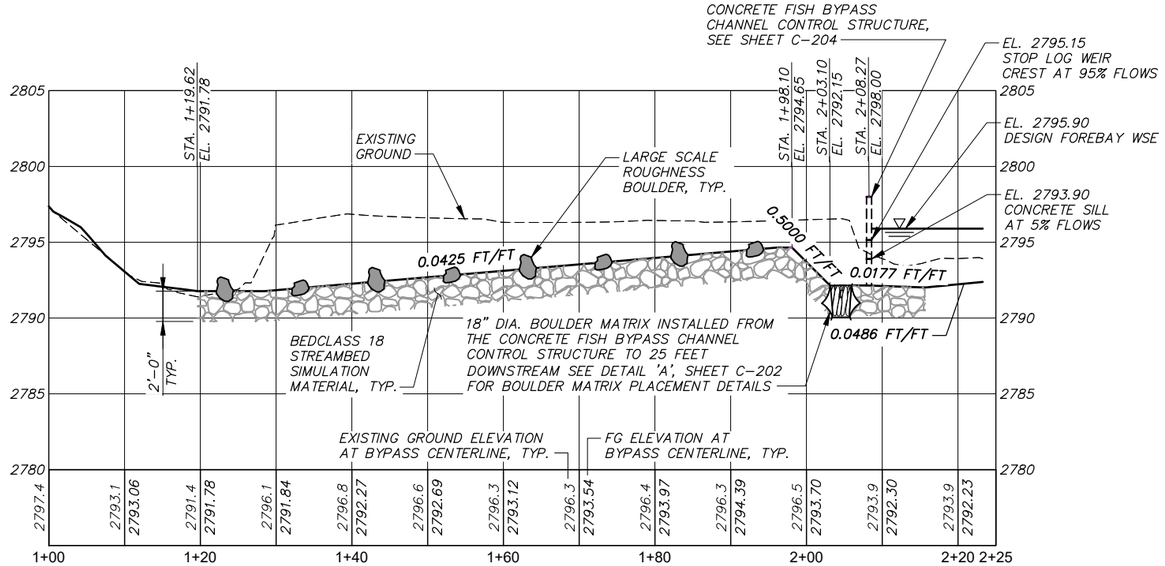

REVISION	BY	DATE	
DESIGNED BY	A. HAMILTON		
DRAWN BY	P. RICHARDSON		
REVIEWED BY	J. HERRON		

10 0 10 20 30 HORZ. SCALE IN FEET

2 0 2 4 6 VERT. SCALE IN FEET

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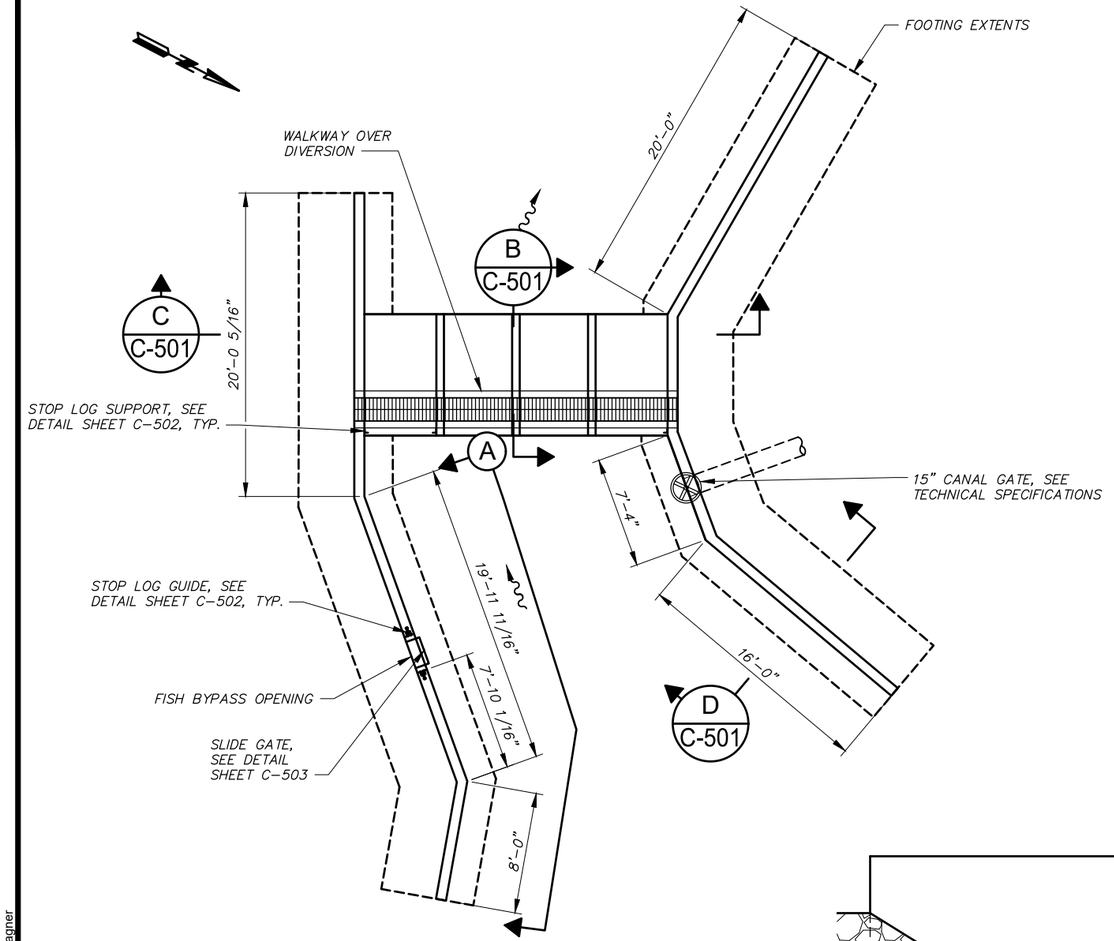
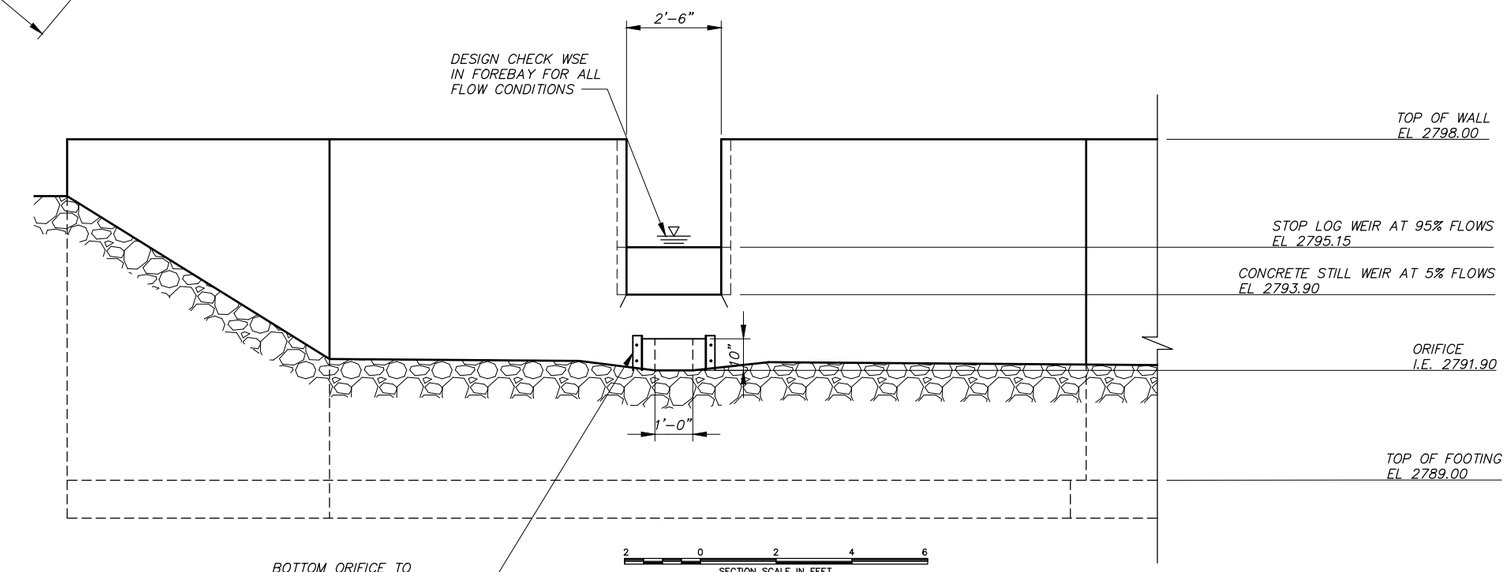
UNION SOIL AND WATER CONSERVATION DISTRICT
LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

LC6
FISH BYPASS CHANNEL PLAN AND PROFILE

SHEET
C-203
11 OF 19



LC6 DIVERSION PLAN



SECTION A

CONCRETE FISH BYPASS CHANNEL CONTROL STRUCTURE

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REVISION	BY	DATE

5 0 5 10 15
PLAN SCALE IN FEET

DESIGNED BY	J. HERRON
DRAWN BY	P. RICHARDSON
REVIEWED BY	C. HUTCHINS

JOB NUMBER 596-07 DATE 2022
ACAD FILE: 596-07-C-204.dwg

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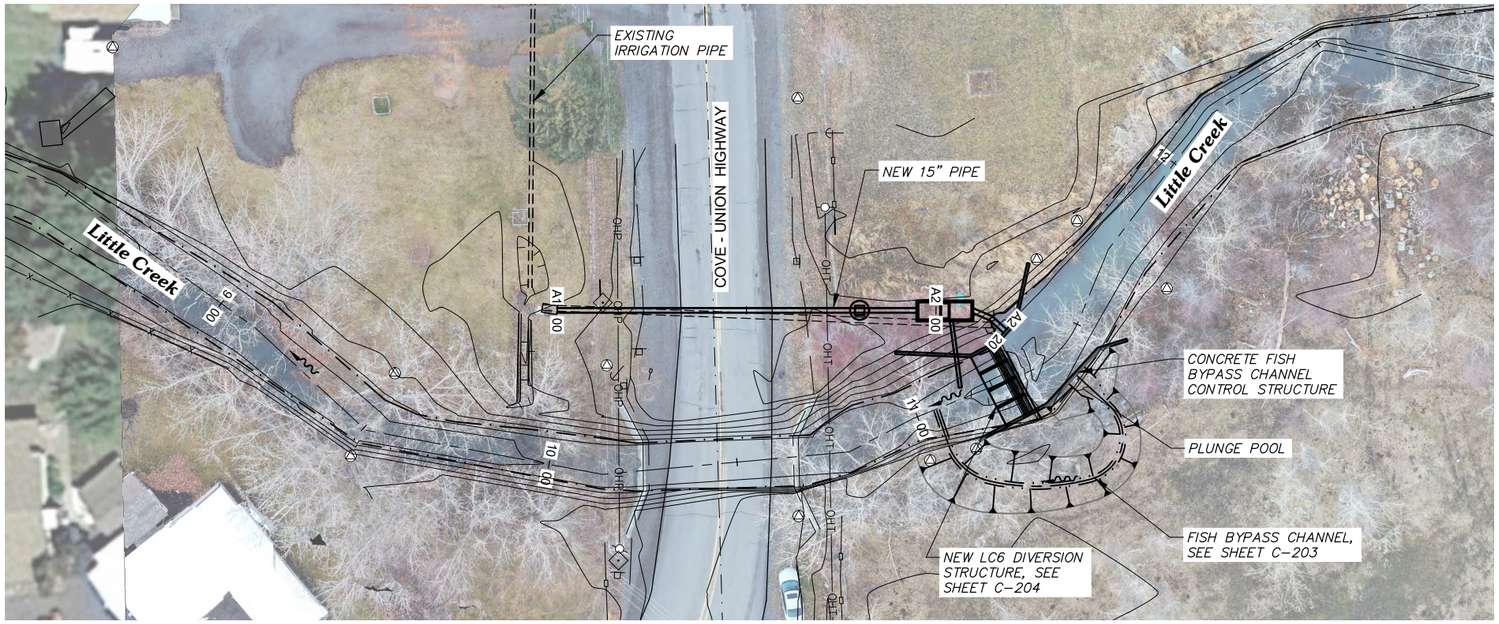
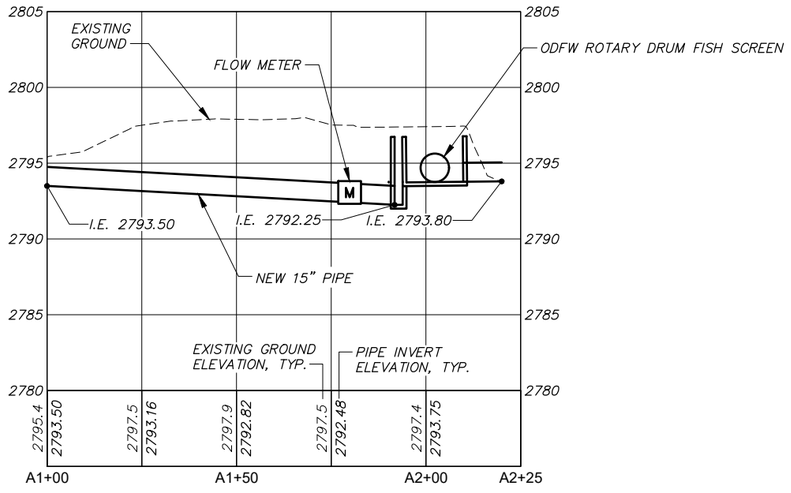
LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

LC6 DIVERSION PLAN

SHEET
C-204
12 OF 19





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DESIGNED BY J. HERRON		JOB NUMBER 596-07	DATE 2022
DRAWN BY P. RICHARDSON		ACAD FILE: 596-07-C-205.dwg	
REVIEWED BY C. HUTCHINS		COPYRIGHT 2022 BY ANDERSON PERRY & ASSOC., INC.	

HORZ. SCALE IN FEET: 20 0 20 40 60

VERT. SCALE IN FEET: 5 0 5 10 15

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UNION SOIL AND WATER CONSERVATION DISTRICT

LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

LC6
STATE HIGHWAY CROSSING

SHEET
C-205
13 OF 19

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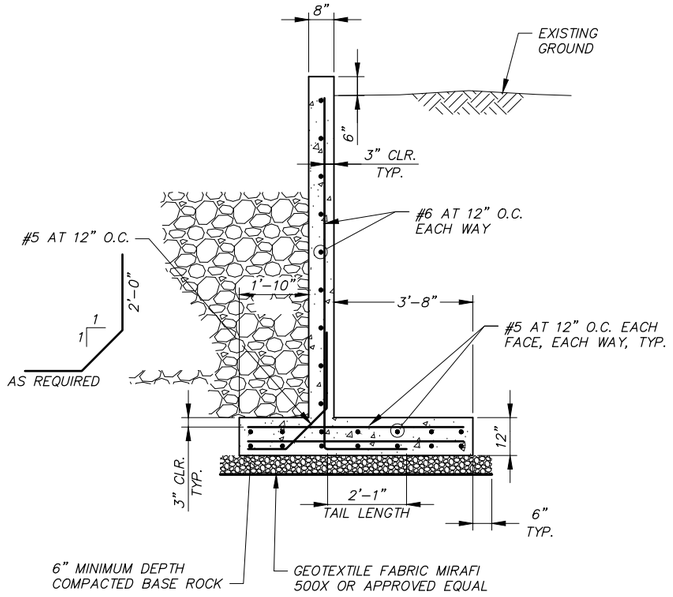

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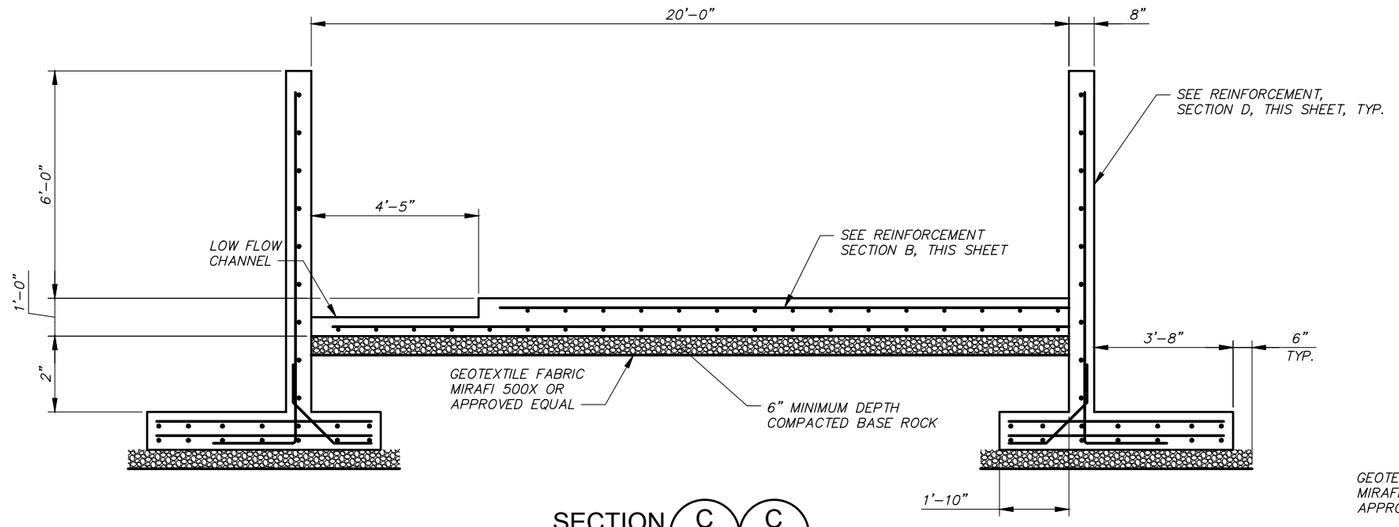

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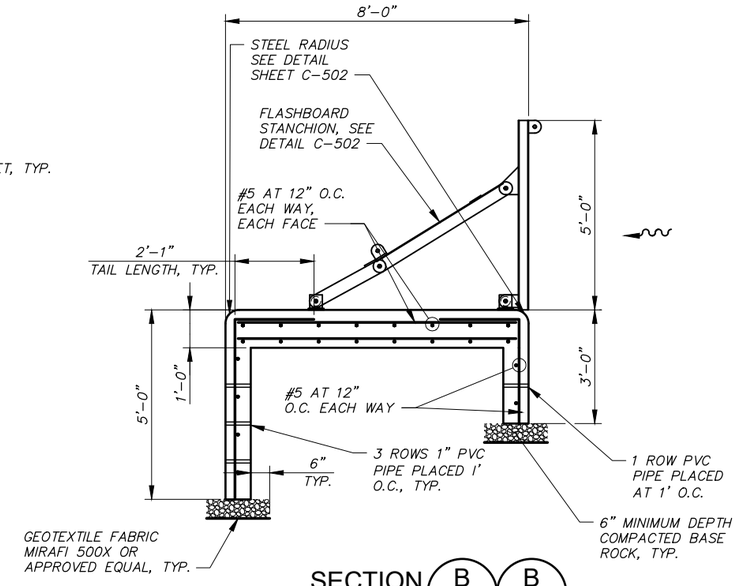

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REVISION	BY	DATE

2 0 2 4 6
SCALE IN FEET

DESIGNED BY	J. HERRON
DRAWN BY	P. RICHARDSON
REVIEWED BY	C. HUTCHINS

JOB NUMBER 596-07 DATE 2022
ACAD FILE: 596-07-C-501.dwg

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LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

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DIVERSION SECTIONS

SHEET
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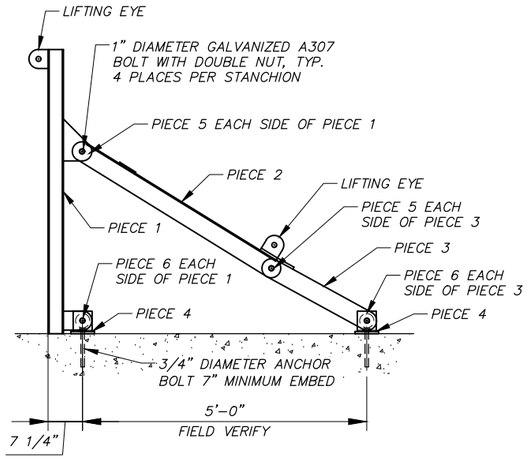
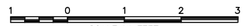


NOTES
1. PIECES 1,2,3,4 SHALL BE HOT DIP GALVANIZED AFTER FABRICATION.
2. PIECES 5 AND 6 SHALL BE ULTRA HIGH MOLECULAR WEIGHT PLASTIC.



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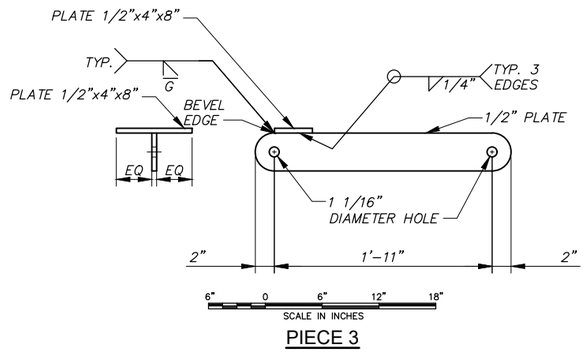

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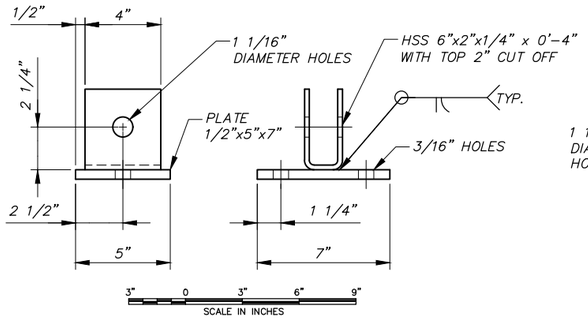

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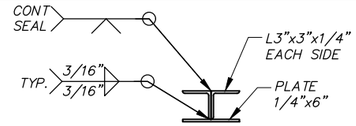
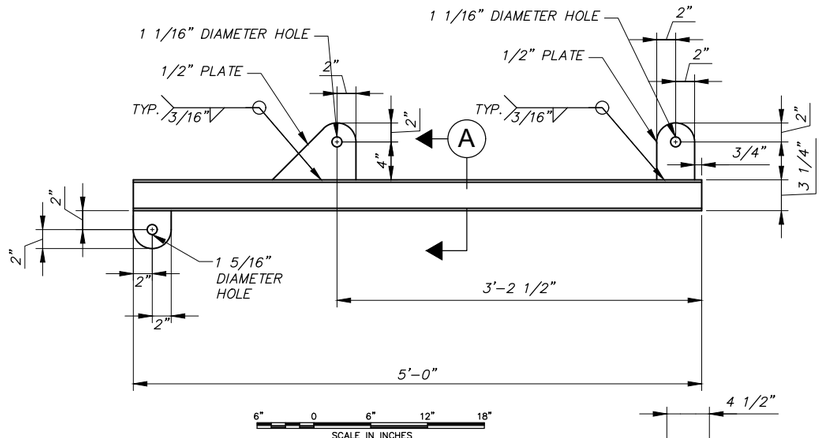


SECTION A



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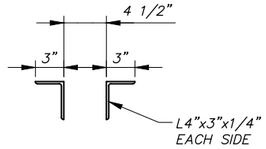

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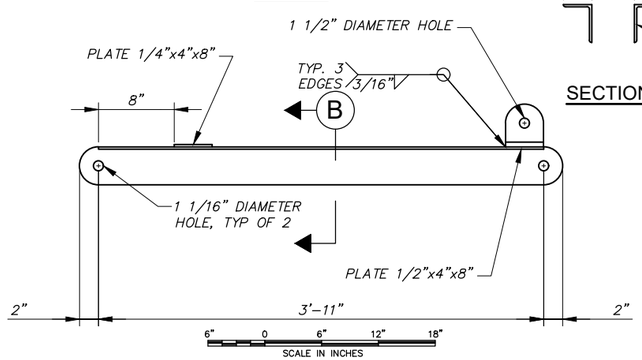

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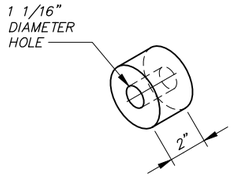

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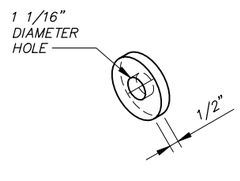

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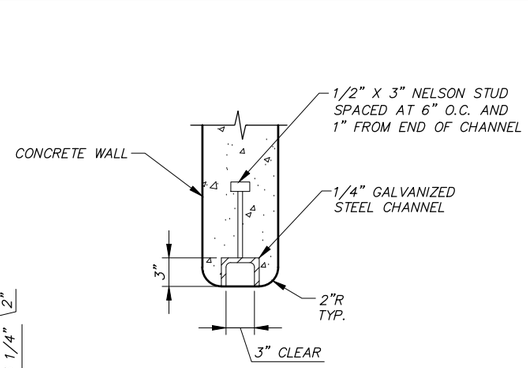
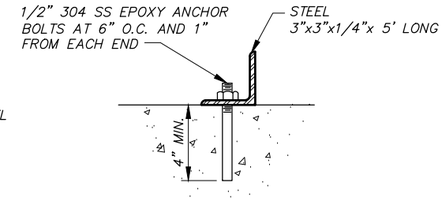


STOP LOG GUIDE DETAIL

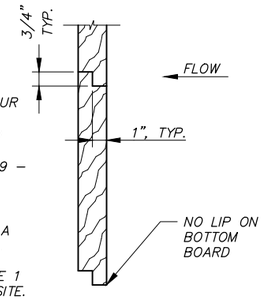
N.T.S.



STOP LOG SUPPORT DETAIL

N.T.S.

NOTES
1. 40 – ROUGH CUT 2"x6"x4'-10" STOP LOGS TO BE PROVIDED; FOUR SHALL NOT HAVE BOTTOM LIP. PROVIDE 2"x2" NOTCHES SPACED APPROXIMATELY 12" ON CENTER ALONG THE BOTTOM 4 BOARDS. 9 – 2"x5"x2'-10" STOP LOGS TO BE PROVIDED. 1 SHALL NOT HAVE BOTTOM LIP. 1 ROUGH CUT 2"x6"x4'-3" STOP LOG WITHOUT A BOTTOM LIP SHALL BE PROVIDED.
2. THE NUMBER OF BOARDS IN NOTE 1 SHALL BE PROVIDED FOR EACH SITE.



STOP LOG DETAIL

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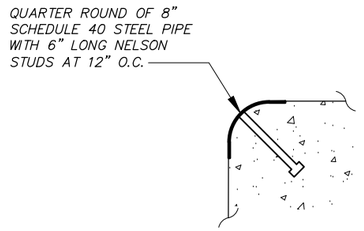

STEEL RADIUS DETAIL

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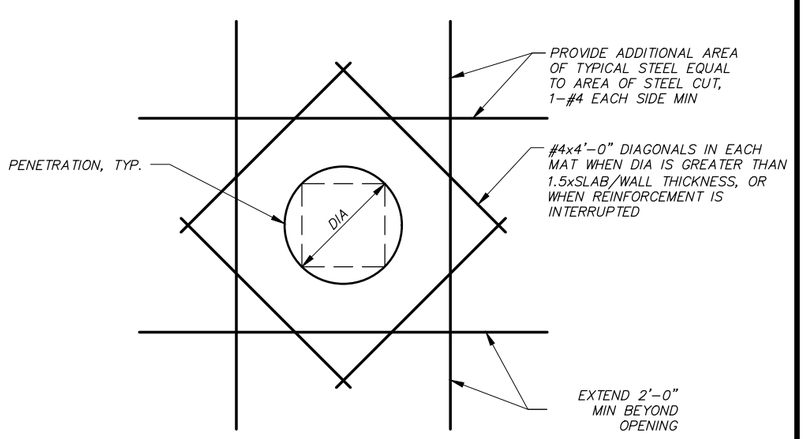

PIPE PENETRATION ADDITIONAL REINFORCEMENT

N.T.S.

FLASHBOARD STANCHION DETAIL

REVISION	BY	DATE

DESIGNED BY J. HERRON
DRAWN BY S. MAGNER
REVIEWED BY C. HUTCHINS

JOB NUMBER 596-07 DATE 2022
ACAD FILE: 596-07-C-502.dwg

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LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

DIVERSION DETAILS I

SHEET
C-502
15 OF 19

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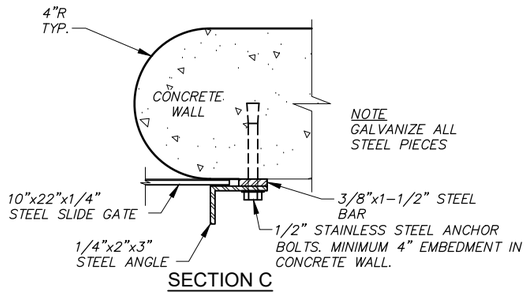

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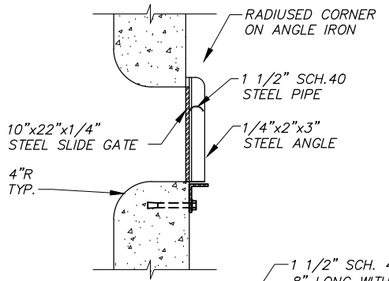

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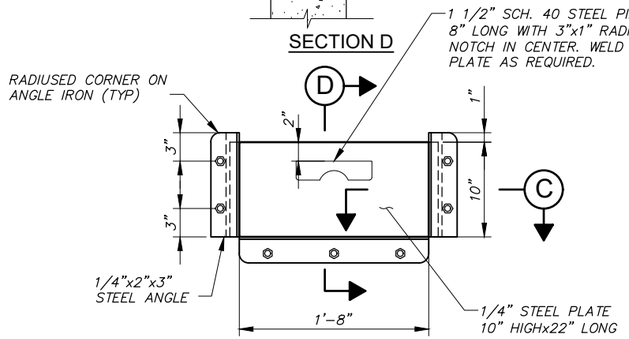
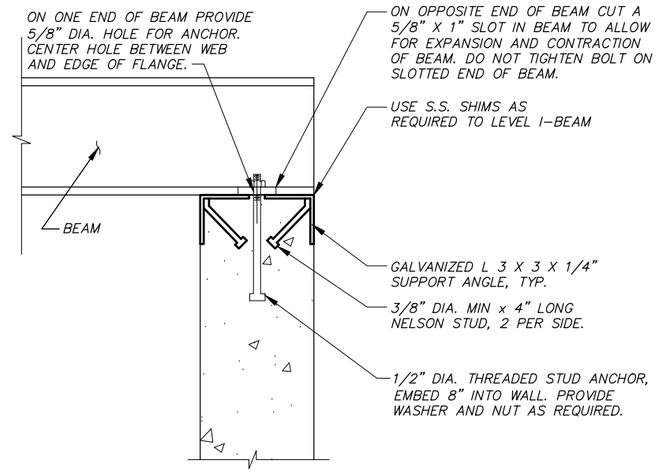


ELEVATION

SLIDE GATE DETAILS

N.T.S.



BEAM TO CONCRETE CONNECTION DETAIL

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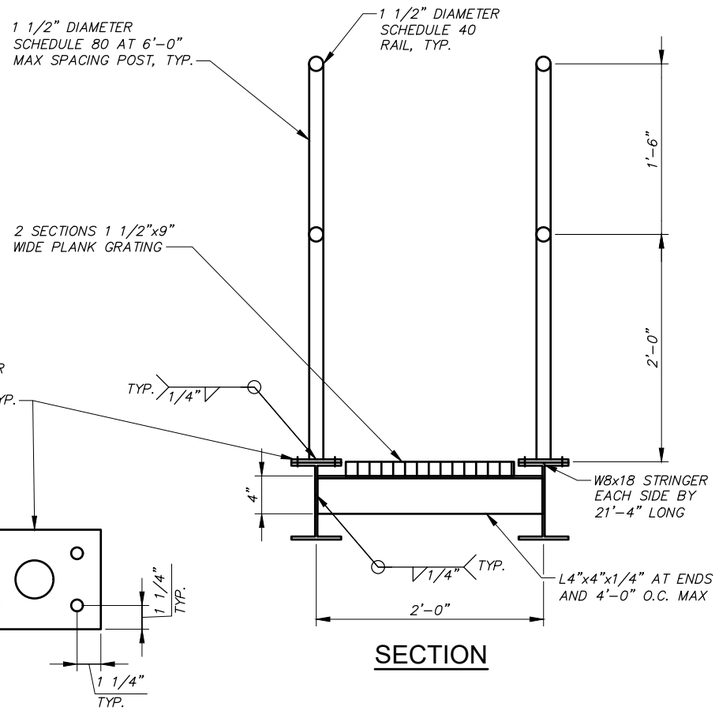

SECTION

NOTE
HOT DIP GALVANIZE AFTER FABRICATION

WALKWAY DETAIL

N.T.S.

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REVISION	BY	DATE

DESIGNED BY	J. HERRON
DRAWN BY	S. MAGNER
REVIEWED BY	C. HUTCHINS

JOB NUMBER 596-07 | DATE 2022
ACAD FILE: 596-07-C-503.dwg

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LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

DIVERSION DETAILS II

SHEET
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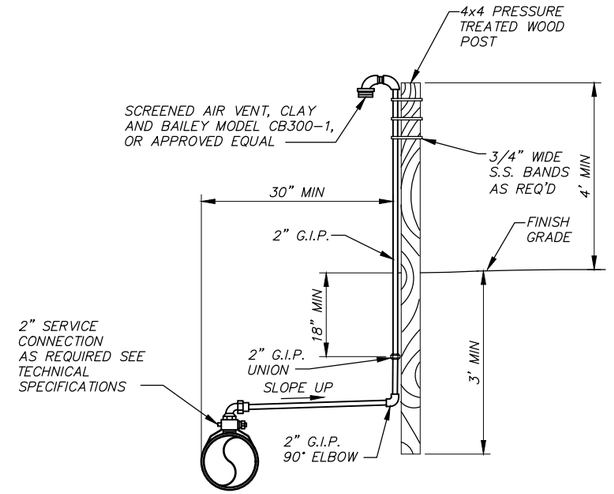
16 OF 19



AIR RELEASE STATION DETAIL

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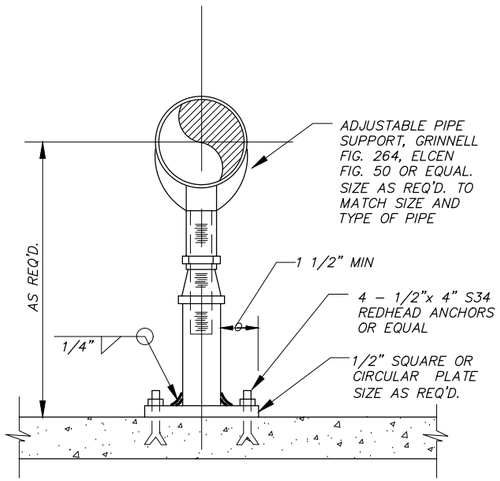

PIPE SUPPORT DETAIL

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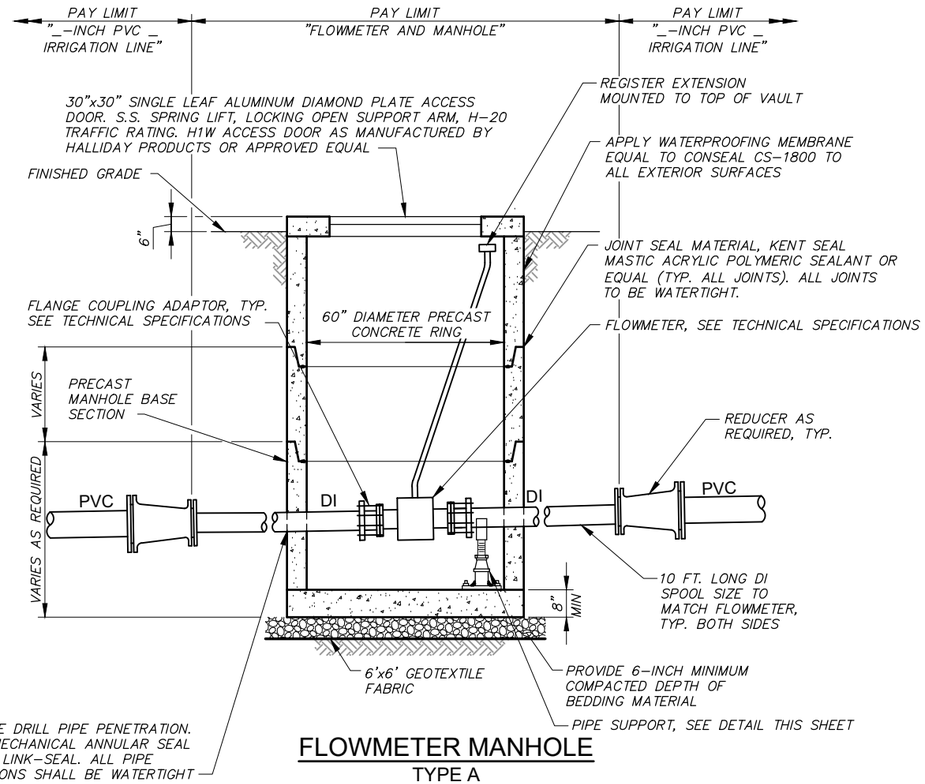

FLOWMETER MANHOLE

TYPE A

N.T.S.

REVISION	BY	DATE

DESIGNED BY J. HERRON
DRAWN BY S. MAGNER
REVIEWED BY C. HUTCHINS

JOB NUMBER 596-07 DATE 2022
ACAD FILE: 596-07-C-504.dwg

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LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

FLOWMETER AND MISCELLANEOUS DETAILS

SHEET
C-504
17 OF 19

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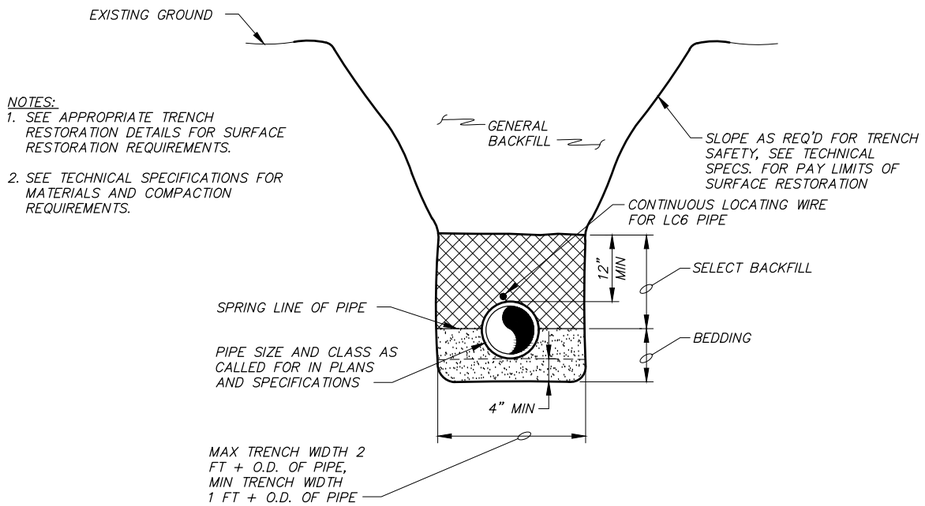
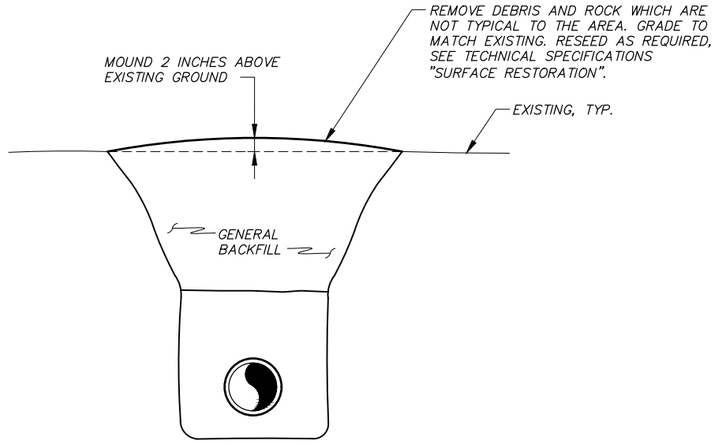
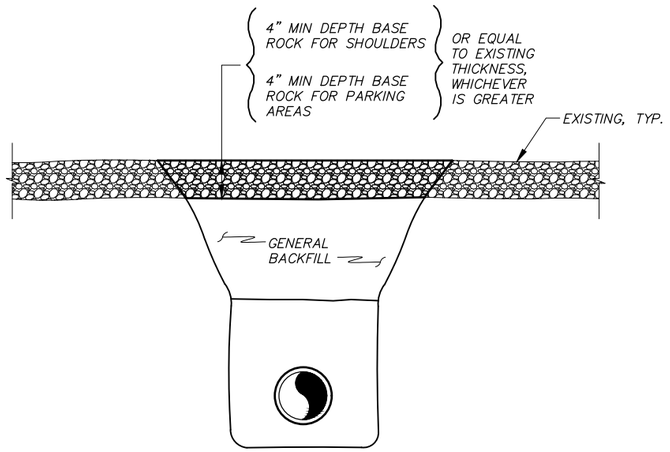


TRENCH EXCAVATION AND BACKFILL
(WITH LOCATING WIRE)
N.T.S.



TRENCH RESTORATION
NATURAL AREAS
N.T.S.



TRENCH RESTORATION
SHOULDERS AND PARKING AREAS
N.T.S.
("GRAVEL SURFACE RESTORATION" PAY ITEM)

REVISION	BY	DATE

DESIGNED BY J. HERRON
DRAWN BY S. MAGNER
REVIEWED BY C. HUTCHINS

JOB NUMBER 596-07 DATE 2022
ACAD FILE: 596-07-C-505.dwg

80% DESIGN PLANS
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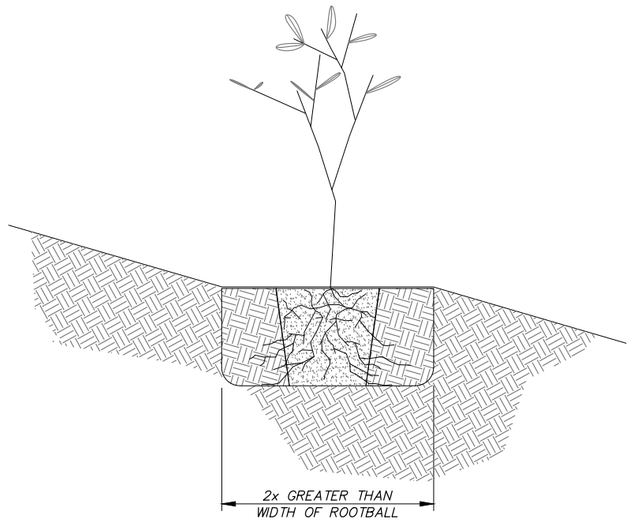
UNION SOIL AND WATER CONSERVATION DISTRICT
LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS

TRENCH DETAILS

SHEET
C-505
18 OF 19

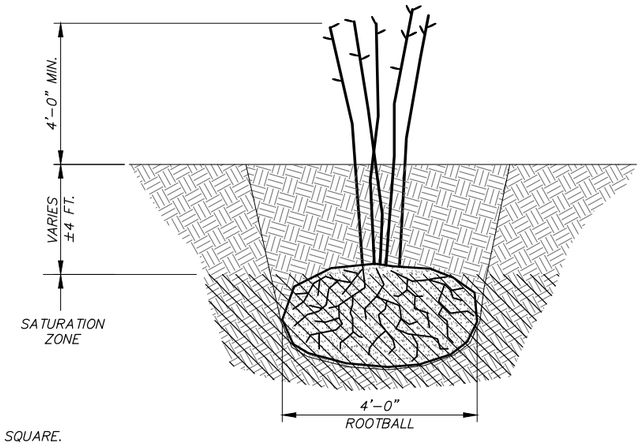


CONTAINER PLANT DETAIL

N.T.S.

CONTAINER PLANT INSTALLATION NOTES

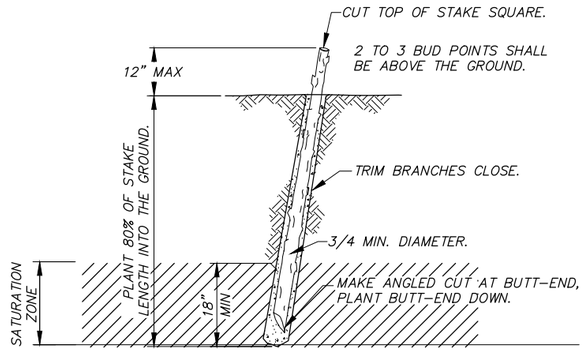
1. PRIOR TO INSTALLATION OF CONTAINER PLANT, CLEANLY PRUNE ANY BROKEN BRANCHES AND SCARIFY OUTER 1" OF ROOTBALL. CLEANLY PRUNE BROKEN, DEAD, OR DISEASED ROOTS. ROOTBOUND PLANTS SHALL BE REJECTED.
2. EXCAVATE CIRCULAR PLANTING HOLE WITH VERTICAL SIDES. SCARIFY SIDES AND BOTTOM OF PLANTING HOLE.
3. PLACE ROOTBALL ON UNDISTURBED NATIVE SOIL AT BASE OF PLANTING HOLE AND SPREAD ROOTS OUT TO SIDES OF HOLE. CLEANLY TRIM ANY ROOTS THAT ARE TOO LONG TO LAY STRAIGHT IN PLANTING HOLE. PLANTS SHALL BE UPRIGHT, PLUMB, AND TOP OF ROOTBALL SHALL BE EVEN WITH FINISH GRADE. WHEN PLANTING ON SLOPES, CREATE LEVEL PLANTING SURFACE TO ENSURE COVER OF ROOTS ON DOWNHILL SIDE OF PLANT.
4. BACKFILL PLANTING HOLE WITH SOIL EXCAVATED FROM PLANTING HOLE AND TAMP SOIL AROUND ROOTS. ANY TRASH OR DEBRIS FOUND IN EXCAVATED SOIL SHALL NOT BE USED TO BACKFILL THE PLANTING HOLE. BACKFILL SOIL SHALL MAKE GOOD CONTACT WITH THE ROOTBALL, LEAVING NO VOIDS.
5. PLANTS SHALL BE PLANTED IN CLUSTERS USING TYPICAL SPACING SHOWN ON THE SCHEDULE WHILE OTHER AREAS ARE LEFT UNPLANTED TO ALLOW FOR DISTRIBUTION OF THE PLANTS THROUGHOUT THE PLANTING AREA.
6. WITHIN 4 HOURS OF PLANT INSTALLATION, THOROUGHLY WATER IN EACH INSTALLED PLANT.



PLANT MATERIAL SCHEDULE AND DENSITY PRESCRIPTION

PLANTING AREA	LENGTH	REDOSIER DOGWOOD (CP)	COYOTE WILLOW (PP)	WOODS ROSE (CP)	WILLOW CLUMP (LOCAL)
LC5					
LC6					

CP = CONTAINER PLANTS
PP = POLE PLANTING
LOCAL = LOCAL WILLOW SPECIES



POLE PLANTING INSTALLATION NOTES

1. USE HEALTHY, STRAIGHT AND LIVE WOOD AT LEAST 1 YEAR OLD.
2. MAKE CLEAN CUTS AND DO NOT DAMAGE STAKES OR SPLIT ENDS DURING INSTALLATION, USE A PILOT BAR OR OTHER APPROVED METHOD IN FIRM SOILS.
3. CUTTINGS HARVESTED FRESH AT THE TIME OF INSTALLATION SHALL BE SOAKED FOR A MINIMUM OF 24 HOURS PRIOR TO INSTALLATION PLANTING. CUTTINGS HARVESTED AND STORED SHALL BE SOAKED FOR A MINIMUM OF 10 DAYS PRIOR TO PLANTING.
4. TAMP THE SOIL AROUND THE STAKE.
5. EXTEND STAKES INTO WATER SATURATION ZONE.

TYPICAL POLE PLANTING DETAIL

N.T.S.

WILLOW CLUMP INSTALLATION NOTES:

1. HARVEST THE ENTIRE LIVE WILLOW CLUMP INCLUDING THE ABOVEGROUND STEMS AND THE BELOWGROUND ROOTS.
2. USE WILLOWS THAT ARE YOUNG AND VIGOROUS, RANGE IN HEIGHT FROM 8 TO 15 FEET, AND ARE APPROXIMATELY THE DIAMETER OF A 4–FOOT BACKHOE BUCKET.
3. START THE HOLE FOR THE WILLOW CLUMP BY DIGGING APPROXIMATELY 10 INCHES AWAY FROM THE STEMS AND DIG DOWN APPROXIMATELY 2 FEET IN ORDER TO GET AS MUCH OF THE ROOT MASS AS POSSIBLE.
4. TRANSPORT THE WILLOW CLUMP TO THE PLANTING LOCATION IMMEDIATELY UPON DIGGING THE WILLOW CLUMP AND PLANT IT SO THE WILLOW CLUMP DOES NOT DRY OUT. TARPING OF THE WILLOW CLUMP MAY BE NECESSARY IF TRANSPORTING THE CLUMP A LONG DISTANCE AND IF THE WEATHER IS SUNNY AND HOT.
5. PRE–DIG THE PLANTING LOCATION FOR THE WILLOW CLUMP AND EXCAVATE DOWN TO THE SOIL SATURATION ZONE BUT NOT INTO THE GROUNDWATER TABLE.
6. PLACE THE WILLOW CLUMP INTO THE PLANTING HOLE AND BACKFILL IN AND AROUND THE WILLOW CLUMP WITH SOIL AND WATER TO REMOVE AIR POCKETS AROUND THE CLUMP.
7. A MINIMUM 4 TO 5 FEET OF THE WILLOW STEMS SHALL PROTRUDE ABOVE THE FINISHED GROUND SURFACE.
8. CUT OFF ABOUT ONE–THIRD TO ONE–HALF OF THE WILLOW TOPS STRAIGHT ACROSS AT THE FINISHED GROUND SURFACE ONCE PLACED AND BACKFILLED.

WILLOW CLUMP DETAIL

N.T.S.

S:\UNION_SWCD\596-07 Little Creek Fish Passage\Drafting\596-07-C-506.dwg, Layout1, 9/22/2022 11:55 AM, smagner

REVISION	BY	DATE

DESIGNED BY J. HERRON
DRAWN BY P. RICHARDSON
REVIEWED BY C. HUTCHINS

JOB NUMBER 596–07 DATE 2022
ACAD FILE: 596–07–C–506.dwg

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UNION SOIL AND WATER CONSERVATION DISTRICT
LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS
PLANTING DETAILS

SHEET
C-506
19 OF 19

7.2 HYDRAULIC CALCULATIONS

LC5 Irrigation Hydraulic Profile

Client: Union County Soil and Water Conservation District
Project: Little Creek (LC5 and LC6) Fish Passage Improvements
Designed By: Aaron Hamilton, P.E.
Checked by: Jadon Herron, P.E.
Notes: Hazen-Williams Equation

$$h_f = \frac{3.022 * v^{1.85} * L}{C^{1.85} * D^{1.17}}$$

Variables

Flow 5.09 cfs
Pipe Friction 120 Hazen-Williams

Section	Start WSE ft	Length ft	Pipe ft	Flow Area ft^2	Velocity ft/sec	Velocity ft	Minor Loss	Pipe ft	Minor ft	End WSE ft	Notes:	Existing WSE
Forebay WSE	2781.50									2781.50		
Enterence Loss	2781.50		1.50	1.77	2.88	0.129	0.5		0.06	2781.44	Into pipe from diversion	
Pipe Loss	2781.44	15	1.50	1.77	2.88	0.129		0.03		2781.41	Pipe Loss	
Screen Loss	2781.41								0.50	2780.91	ODFW Fish Screen	
Enterence Loss	2780.91		1.50	1.77	2.88	0.129	0.5		0.06	2780.84	Into pipe from diversion	
Pipe Loss	2780.84	50	1.50	1.77	2.88	0.129		0.09		2780.75	Pipe Loss	
Exit Loss	2780.75		1.50	1.77	2.88	0.129	1		0.13	2780.62	Exit into open ditch	2780.5

WSE = water surface elevation

LC6 Irrigation Hydraulic Profile

Client: Union County Soil and Water Conservation District
Project: Little Creek (LC5 and LC6) Fish Passage Improvements
Designed By: Aaron Hamilton, P.E.
Checked by: Jadon Herron, P.E.
Notes: Hazen-Williams Equation

$$h_f = \frac{3.022 * v^{1.85} * L}{C^{1.85} * D^{1.17}}$$

Variables

Flow	2.6	cfs
Pipe Friction	120	Hazen-Williams

Losses within Weir Boxes

Enterence	0.2	HEC-22 7-16
Exit	0.4	HEC-22 7-32

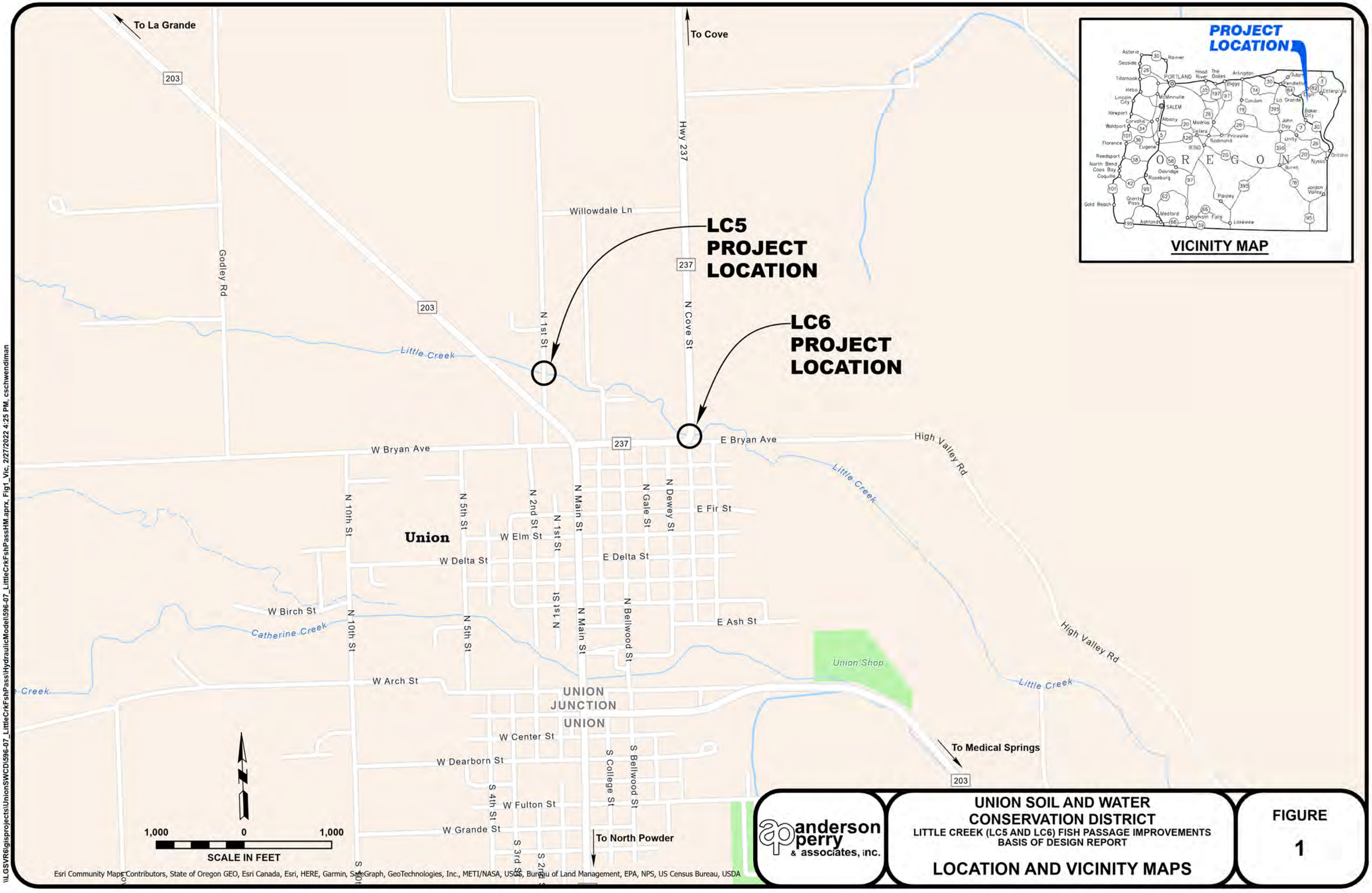
Section	Start WSE ft	Length ft	Pipe ft	Flow Area ft^2	Velocity ft/sec	Velocity ft	Minor Loss	Pipe ft	Minor ft	End WSE ft	Notes:	Existing WSE
Forebay WSE	2795.90									2795.90		2795.5
Entrance Loss	2795.90		1.25	1.23	2.12	0.070	0.5		0.03	2795.87	Into pipe from diversion	
Pipe Loss	2795.87	10	1.25	1.23	2.12	0.070		0.01		2795.85	Pipe Loss	
Screen Loss	2795.85								0.50	2795.35	ODFW Fish Screen	
Entrance Loss	2795.35		1.25	1.23	2.12	0.070	0.5		0.03	2795.32	Into pipe under road	
Pipe Loss	2795.32	95	1.25	1.23	2.12	0.070		0.13		2795.19	Pipe Loss	
Exist Loss	2795.19		1.25	1.23	2.12	0.070	1		0.07	2795.12	Exit into overflow structure	2795.27

WSE = water surface elevation

Little Creek Fish Passage Construction
Little Creek Fish Passage LC5 LC6
Union Soil & Water Conservation District

	A	B	C	D	E	F	G
Item #	Work Item Description	Quantity	Units	Estimated Unit Cost	Subtotal	BPA	In Kind Match
Salaries, Wages and Benefits							
	Jim Webster (District Manager)	90	HR	$ 48.00	$ 4,320.00	$ 2,160.00	$ 2,160.00
	Aaron Bliesner (Project Manager)	200	HR	$ 31.00	$ 6,200.00	$ 3,100.00	$ 3,100.00
	Deric Carson USWCD	200	HR	$ 29.00	$ 5,800.00	$ 2,900.00	$ 2,900.00
		Subtotal Salaries, Wages and Benefits			**$ 16,320.00**	$ 8,160.00	$ 8,160.00
Travel							
	24 Miles round trip at 75 trips	1800	EA	$ 0.625	$ 1,125.00		
		Subtotal Travel			**$ 1,125.00**	**$ 1,125.00**	
Contracted Services							
	Item Group A: LC5						
1	Erosion and Sediment Control	1	LS	$16,900.00	$16,900.00	$16,900.00	
2	Construction Survey and Stakeout	1	LS	$33,800.00	$33,800.00	$33,800.00	
3	Water Control	1	LS	$39,000.00	$39,000.00	$39,000.00	
4	Clearing and Grubbing	1	SY	$13,000.00	$13,000.00	$13,000.00	
5	Remove Existing Concrete Diversion	1	CY	$75,000.00	$75,000.00	$75,000.00	
6	Concrete Diversion Structure	1	CY	$130,000.00	$130,000.00	$130,000.00	
7	Walkway and Railing	1	CY	$26,000.00	$26,000.00	$26,000.00	
8	Fish bypass earth work	1	SF	$1,300.00	$1,300.00	$1,300.00	
9	Main Channel Streambed Simultion Material (SSM)	1	LS	$45,500.00	$45,500.00	$45,500.00	
10	Fish Bypass Channel SSM	1	SF	$32,500.00	$32,500.00	$32,500.00	
11	Large Scale Roughness Boulders	1	CY	$13,000.00	$13,000.00	$13,000.00	
12	18-Inch Polyvinyl Chloride (PVC) Pipe	45	LB	$221.00	$9,945.00	$9,945.00	
13	10-inch PVC Pipe	20	LB	$91.00	$1,820.00	$1,820.00	
14	Flowmeter and Manhole	1	LB	$19,500.00	$19,500.00	$19,500.00	
15	Surface Restoration	1	LB	$13,000.00	$13,000.00	$13,000.00	
16	Planting	0	LB	$19,499.00	$0.00	$0.00	
17	ODFW Rotary Drum Fish Screen	1	EA	$130,000.00	$130,000.00	$130,000.00	
				Subtotal Group A:	**$600,265.00**	**$600,265.00**	**$0.00**
	Item Group B: LC6						
18	Water Control	1	LS	$75,000.00	$75,000.00	$75,000.00	
19	Clearing and Grubbing	1	SY	$13,000.00	$13,000.00	$13,000.00	
20	Remove Existing Concrete Diversion	1	CY	$19,500.00	$19,500.00	$19,500.00	
21	Concrete Diversion Structure	1	CY	$130,000.00	$130,000.00	$130,000.00	
22	Walkway and Railing	1	CY	$26,000.00	$26,000.00	$26,000.00	
23	Fishway Bypass Channel Earthwork	1	SF	$13,000.00	$13,000.00	$13,000.00	
24	Main Channel SSM	1	EA	$39,000.00	$39,000.00	$39,000.00	
25	Fish Bypass Channel SSM	1	EA	$32,500.00	$32,500.00	$32,500.00	
26	Large Scale Roughness Boulders	1	EA	$13,000.00	$13,000.00	$13,000.00	
27	18- Inch PVC Pipe	85	EA	$221	$18,785.00	$18,785.00	
28	10-Inch PVC Pipe	20	SF	$91.00	$1,820.00	$1,820.00	
29	Flowmeter and Manhole	1	SF	$19,500.00	$19,500.00	$19,500.00	
30	State Highway Asphalt Surface Restoration	20	EA	$325.00	$6,500.00	$6,500.00	
31	Gravel Surface Restoration	16	EA	$39.00	$624.00	$624.00	
32	Surface Restoration	1	EA	$13,000.00	$13,000.00	$13,000.00	
33	Temporary Protection and Direction of Traffic	1	EA	$20,000.00	$20,000.00	$20,000.00	
34	ODFW Rotary Drum Fish Screen	1	EA	$130,000.00	$130,000.00	$130,000.00	
35	Planting	3	EA	$19,502.00	$58,506.00	$58,506.00	
				Subtotal Group B:	**$629,735.00**	**$629,735.00**	
36	Mobilization and De Mobilization	2	EA	$ 41,106.00	**$82,212.00**		
				Subtotal Group C:	**$82,212.00**	**$82,212.00**	
		Subtotal Contracted			**$1,329,657.00**	**$1,321,497.00**	
Indirect Cost (applies to Salary, Wage, Benefits only)							
	Direct Expenses to apply ICR			$ 16,320.00	$16,320.00	$ 8,160.00	
	Indirect Cost			61.04%	$9,961.73	$ 4,980.86	
		Subtotal Indirect Cost			**$ 9,961.73**	**$8,160.00**	**$0.00**
	PROJECT TOTAL				**$1,357,063.73**	**$1,421,154.00**	**$8,160.00**

7.3 HEC-RAS RESULTS



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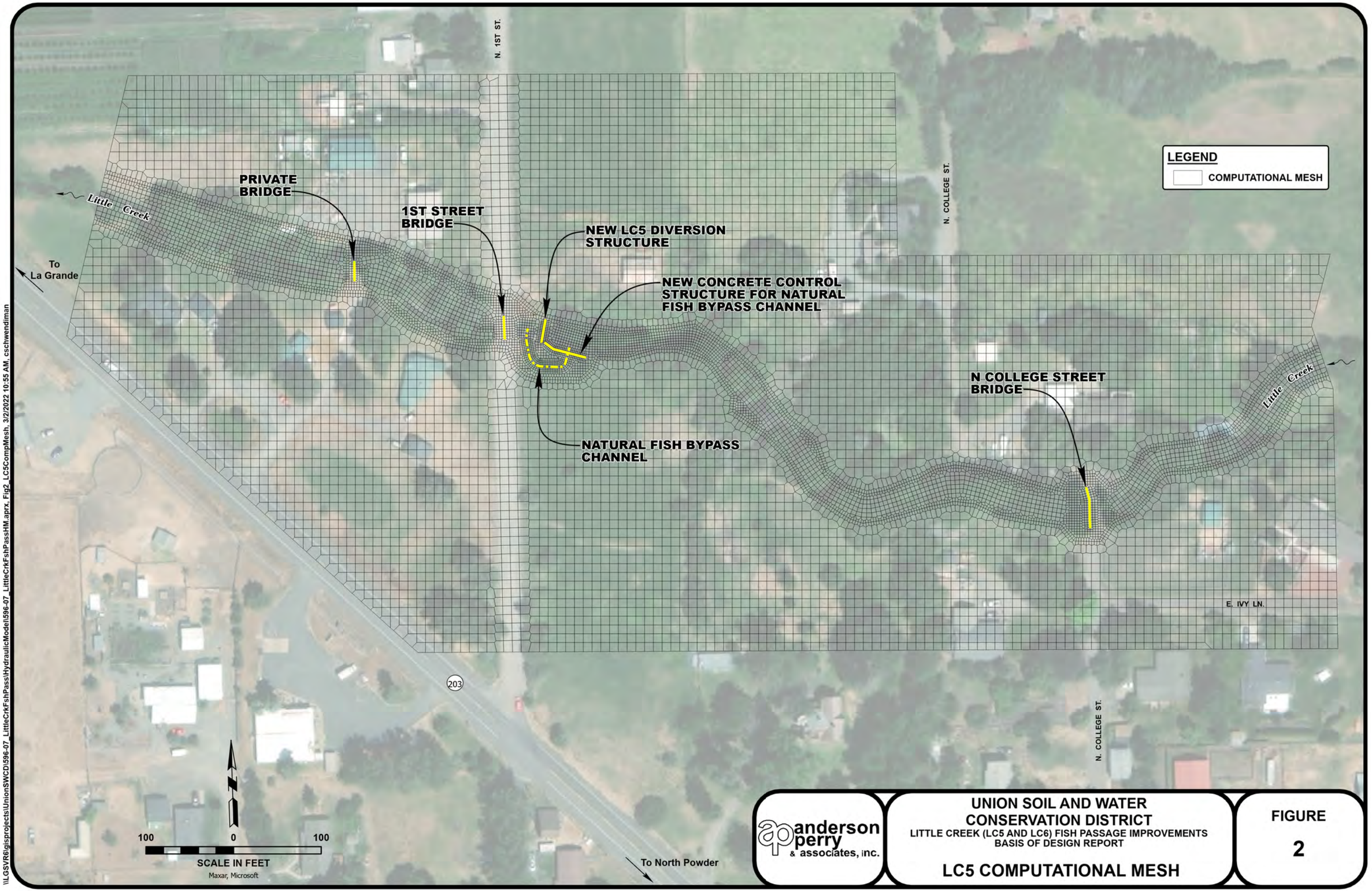
anderson perry & associates, inc.

UNION SOIL AND WATER CONSERVATION DISTRICT
LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS
BASIS OF DESIGN REPORT

LOCATION AND VICINITY MAPS

FIGURE 1



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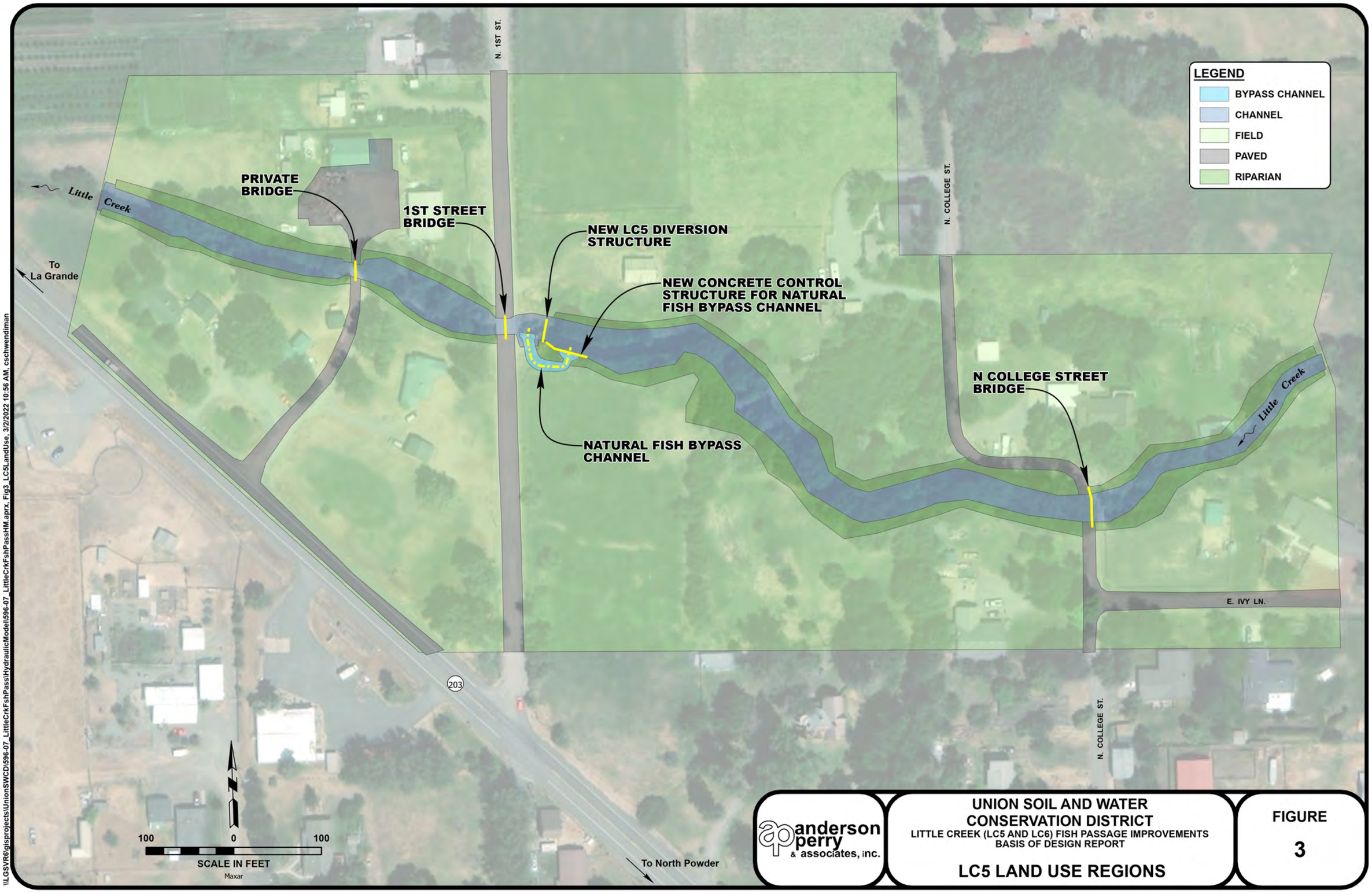
UNION SOIL AND WATER CONSERVATION DISTRICT
LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS
BASIS OF DESIGN REPORT

LC5 COMPUTATIONAL MESH

FIGURE 2



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UNION SOIL AND WATER CONSERVATION DISTRICT
LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS
BASIS OF DESIGN REPORT

LC5 LAND USE REGIONS

FIGURE 3

1ST STREET BRIDGE

NEW LC5 DIVERSION STRUCTURE

NATURAL FISH BYPASS CHANNEL

NEW CONCRETE CONTROL STRUCTURE FOR NATURAL FISH BYPASS CHANNEL

Little Creek

Little Creek

N. 1ST ST.

LEGEND

WATER DEPTH CONTOUR

0.5 FT CONTOUR

VELOCITY

0 TO 1 FPS

1 TO 2 FPS

2 TO 3 FPS

10 0 10

SCALE IN FEET

anderson perry & associates, inc.

UNION SOIL AND WATER CONSERVATION DISTRICT

LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS
BASIS OF DESIGN REPORT

LC5 95% ANNUAL EXCEEDANCE VELOCITY AND DEPTH

FIGURE 4

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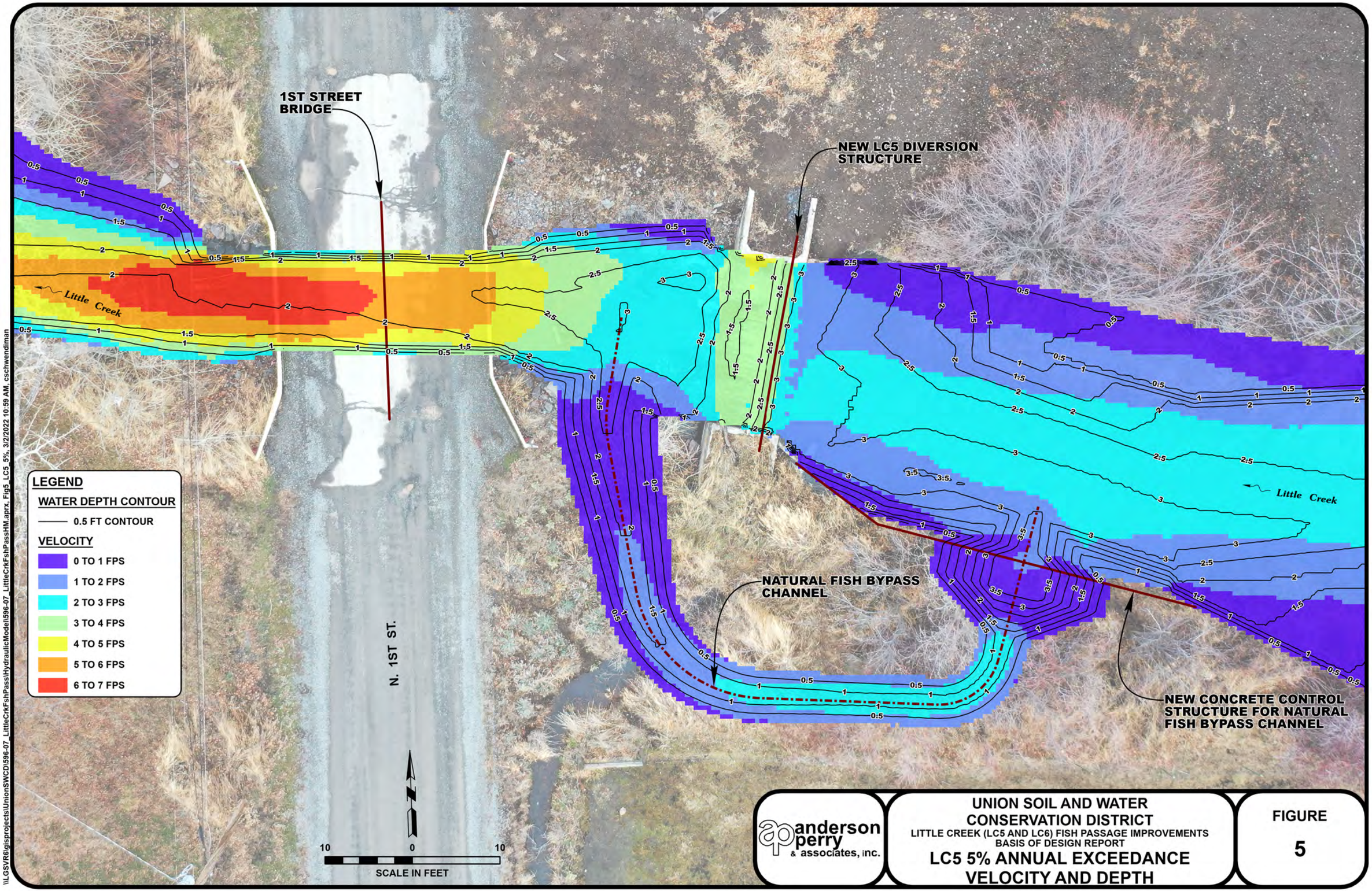

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UNION SOIL AND WATER CONSERVATION DISTRICT

LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS BASIS OF DESIGN REPORT

LC5 5% ANNUAL EXCEEDANCE VELOCITY AND DEPTH

FIGURE 5

To Cove

237

Little Creek

COVE HIGHWAY BRIDGE

NEW LC6 DIVERSION STRUCTURE

NEW CONCRETE CONTROL STRUCTURE FOR NATURAL FISH BYPASS CHANNEL

NATURAL FISH BYPASS CHANNEL

E. BRYAN ST.

N. DEWEY ST.

N. COVE ST.

N. BENSON ST.

E. HICKORY ST.

Little Creek

LEGEND

COMPUTATIONAL MESH

100 0 100

SCALE IN FEET

Maxar, Microsoft

anderson perry & associates, inc.

UNION SOIL AND WATER CONSERVATION DISTRICT

LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS
BASIS OF DESIGN REPORT

LC6 COMPUTATIONAL MESH

FIGURE 6

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To Cove

237

Little Creek

COVE HIGHWAY BRIDGE

NEW LC6 DIVERSION STRUCTURE

NEW CONCRETE CONTROL STRUCTURE FOR NATURAL FISH BYPASS CHANNEL

NATURAL FISH BYPASS CHANNEL

LEGEND

- BYPASS CHANNEL
- CHANNEL
- FIELD
- PAVED
- RIPARIAN

E. BRYAN ST.

N. DEWEY ST.

N. COVE ST.

N. BENSON ST.

E. HICKORY ST.

Little Creek

100 0 100

SCALE IN FEET

Maxar, Microsoft

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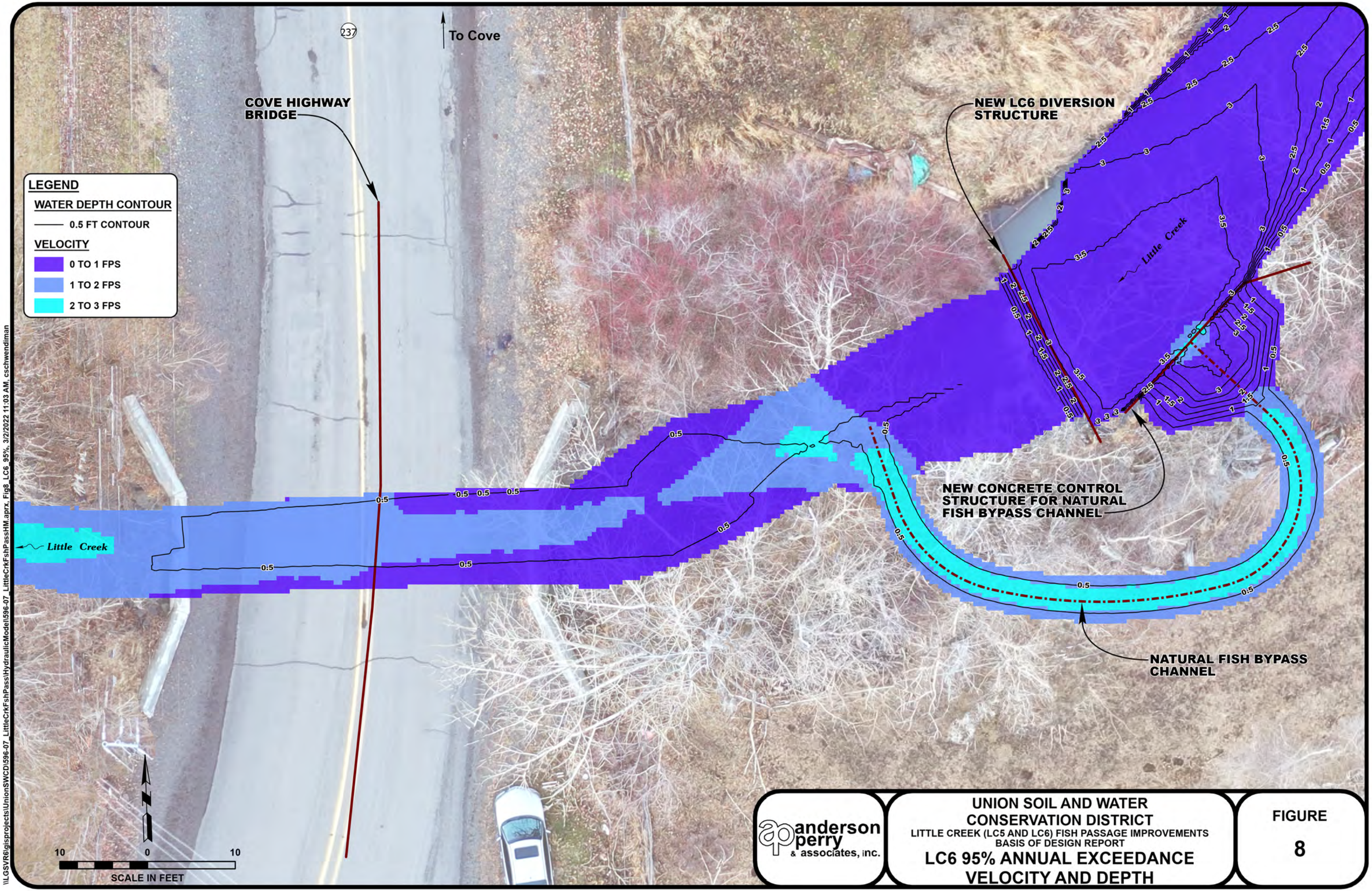
UNION SOIL AND WATER CONSERVATION DISTRICT

LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS
BASIS OF DESIGN REPORT

LC6 LAND USE REGIONS

FIGURE

7



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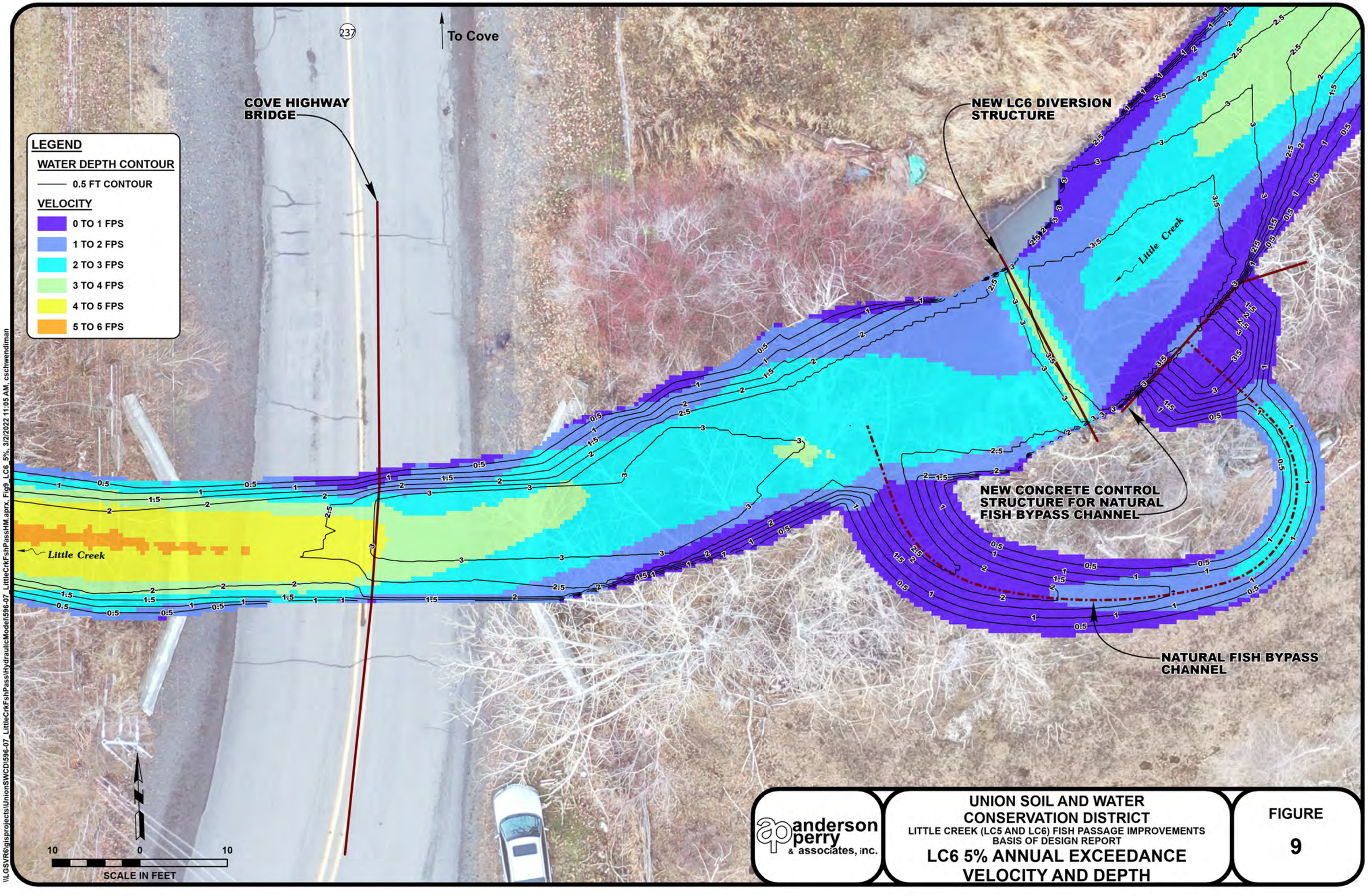
UNION SOIL AND WATER CONSERVATION DISTRICT

LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS
BASIS OF DESIGN REPORT

LC6 95% ANNUAL EXCEEDANCE VELOCITY AND DEPTH

FIGURE 8



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anderson perry & associates, inc.

UNION SOIL AND WATER CONSERVATION DISTRICT

LITTLE CREEK (LC5 AND LC6) FISH PASSAGE IMPROVEMENTS BASIS OF DESIGN REPORT

LC6 5% ANNUAL EXCEEDANCE VELOCITY AND DEPTH

FIGURE 9

7.4 SIZING CALCULATIONS

CLIENT: Union SWCD
PROJECT: Little Creek (LC5 and LC6) Fish Passage Improvements
Designed By: Jadon Herron, P.E.
Checked By:
Date: September 15, 2022
Notes: Main Channel
Job No.: 596-07

Equation: U.S. Army Corps of Engineers (USACE) Habitat Boulder Design as outlined in Natural Resources Conservation Service Technical Supplement 14C Stone Sizing Criteria Part 654 National Engineering Handbook (210-VI-NEH, August 2007)
USACE EMRRP-SR-11

$$D = \frac{18(\text{depth})S_f}{(SG-1)} \qquad \text{(eq. TS14C–13)}$$

where:

D	= minimum stone size
depth	= channel depth
S_f	= channel friction slope
SG	= specific gravity of the stone

Given:

0.007	S, ft/ft
5	depth
2.65	SG

Calculation:

D= 0.4 ft

USACE habitat boulder design

This technique is outlined in USACE guidance provided in EMRRP–SR–11. It is developed for sizing boulder clusters in a channel for habitat enhancement. This high-energy relationship is an incipient motion relation for fully immersed boulders in turbulent flow on a flat bed. This method is for impinging flow. The formula is:

$$D = \frac{18(\text{depth})S_f}{(SG-1)} \qquad \text{(eq. TS14C–13)}$$

where:

D	= minimum stone size
depth	= channel depth
S_f	= channel friction slope
SG	= specific gravity of the stone

CLIENT: Union SWCD
PROJECT: Little Creek (LC5 and LC6) Fish Passage Improvements
Designed By: Jadon Herron, P.E.
Checked By:
Date: September 15, 2022
Notes: Bypass Channel
Job No.: 596-07

Equation: U.S. Army Corps of Engineers (USACE) Habitat Boulder Design as outlined in Natural Resources Conservation Service Technical Supplement 14C Stone Sizing Criteria Part 654 National Engineering Handbook (210-VI-NEH, August 2007)
USACE EMRRP-SR-11

$$D = \frac{18(\text{depth})S_f}{(SG-1)} \qquad \text{(eq. TS14C–13)}$$

where:

D	= minimum stone size
depth	= channel depth
S_f	= channel friction slope
SG	= specific gravity of the stone

Given:

0.0425	S, ft/ft
2	depth
2.65	SG

Calculation:

D= 0.9 ft

USACE habitat boulder design

This technique is outlined in USACE guidance provided in EMRRP–SR–11. It is developed for sizing boulder clusters in a channel for habitat enhancement. This high-energy relationship is an incipient motion relation for fully immersed boulders in turbulent flow on a flat bed. This method is for impinging flow. The formula is:

$$D = \frac{18(\text{depth})S_f}{(SG-1)} \qquad \text{(eq. TS14C–13)}$$

where:

D	= minimum stone size
depth	= channel depth
S_f	= channel friction slope
SG	= specific gravity of the stone

CLIENT: Union County SWCD
PROJECT: Little Creek (LC5 and LC6) Fish Passage Improvements
Designed By: Aaron Hamilton, P.E.
Checked By: Jadon Herron, P.E.
Date: September 16, 2022
Notes: Fishway for LC5
Job No.: 596-07

Equation: 2013 Water Crossing Design Guidelines, Washington Dept. of Fish and Wildlife
Unit-Discharge Bed Design (Bathurst 1987, rearranged to predict D_{84})

$D_{84} = 3.54 S^{0.747} (1.25 q_c)^{2/3} / g^{1/3}$ **Equation 3.3**

Where:

D_{84} = intermediate axis of the 84th percentile particle in the sediment distribution, expressed in feet

S = energy slope of the proposed channel, ft/ft.

q_c = the critical unit discharge (total design discharge divided by the width of the bankfull channel) at which incipient motion of D84 occurs, in cubic feet per second per foot.

G = The acceleration due to gravity, feet/sec^2.

Given:

0.0425	S, ft/ft
7.55	Design Discharge (100-year), cfs
2	Bankfull channel width, ft
3.8	q_c, cfs/ft
32.2	g, ft/sec^2

Calculation:

Particle Percent Smaller Than	100-year Particle Size Diameter (inches)
D_{16}	**0.4**
D_{50}	**1.4**
D_{84}	**3.5**
D_{100}	**8.9**

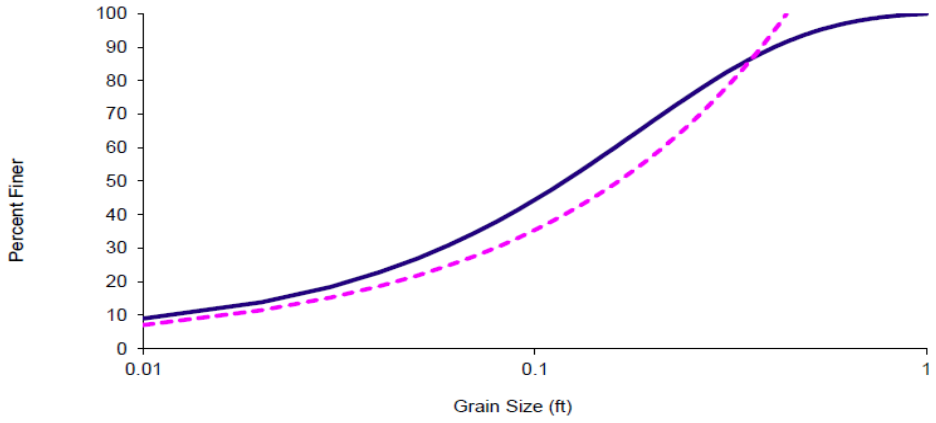


Figure 3.9: Cumulative distribution of streambed sediment sizes. Solid blue is a typical natural distribution with a maximum size of 1 foot. Dashed red line is a Fuller-Thompson maximum density curve with the same size D_{84} particle as the natural distribution.

Figure 3.8 represents a smooth curve between some basic relationships found in natural distributions, summarized in the following relationships as a function of D_{84}:

$D_{84}/D_{100} = 0.4$ **Equation 3.6**

$D_{84}/D_{50} = 2.5$ **Equation 3.7**

$D_{84}/D_{16} = 8.0$ **Equation 3.8**

In order to create a non-porous bed there must be a minimum of 5% to a maximum of 10% fines in the mix.

For comparison, a typical ratio for riprap gradations is $D_{84}/D_{16} < 2.0$. This uniform gradation creates a very narrow size distribution that is too porous for use in a stream simulation culvert. This

CLIENT: Union County SWCD
PROJECT: Little Creek (LC5 and LC6) Fish Passage Improvements
Designed By: Aaron Hamilton, P.E.
Checked By: Jadon Herron, P.E.
Date: September 16, 2022
Notes: Fishway for LC5
Job No.: 596-07

Equation: 2013 Water Crossing Design Guidelines, Washington Dept. of Fish and Wildlife
Critical-Shear-Stress Method, pg 126

T_c=Critical Shear Stress

T_c=4 D_{50}

Calculation:

Reach	River Sta	Profile	Shear Chan (lb/sq ft)	Shields Curve size in	Shields T size mm	Shields T size in	Rosgen T size mm	Rosgen T size in	Max size in
LC5 Fish Way	Crest	MAX	1.89	4	151	6	240	9	**9**
LC5 Fish Way	Middle	MAX	2.14	4	172	7	262	10	**10**
LC5 Fish Way	Bottom	MAX	2.11	4	170	7	259	10	**10**
			Ave	4	164	6	254	10	**10**
			Min	4	151	6	240	9	**9**
			Max	4	172	7	262	10	**10**

Calculation: **$4*D_{50}$= 10.0** **inches**

Particle Percent Smaller Than	Size Diameter (inches)
D_{16}	**0.8**
D_{50}	**2.5**
D_{84}	**6.2**
D_{100}	**15.6**

CLIENT: Union County SWCD
PROJECT: Little Creek (LC5 and LC6) Fish Passage Improvements
Designed By: Aaron Hamilton, P.E.
Checked By: Jadon Herron, P.E.
Date: September 16, 2022
Notes: Fishway for LC5
Job No.: 596-07

anderson perry & associates, inc.
engineering · surveying · natural resources

Equation: 2013 Water Crossing Design Guidelines, Washington Dept. of Fish and Wildlife
U.S. Army Corps of Engineers (USACE) Riprap Design
USACE reference, EM 1110-2-1601, Section e., pg 3-8 steep slope riprap design (USACE. 1994)

$$D_{30} = 1.95S^{0.555}(1.25q)^{2/3}/g^{1/3}$$ **Equation 6.4**

Where:

D_{30}	=	the dimension of the intermediate axis of the 30th percentile particle
S	=	the bed slope
q	=	the unit discharge
g	=	acceleration due to gravity.

q=Q/b where b=bottom width
D_{84}=1.5 D_{30}

Given:

0.045	S, ft/ft
7.55	Design Discharge (100-year), cfs
2	Channel Width
3.8	q, cfs/ft
32.2	g, ft/sec^2

Calculation: **D_{30}= 3.7 inches**

Particle Percent Smaller Than	100-year Particle Size Diameter (inches)
D_{16}	**0.7**
D_{50}	**2.2**
D_{84}	**5.6**
D_{100}	**13.9**

2013 Water Crossing Design Guidelines, Washington Dept. of Fish and Wildlife, pg 126

U.S. ARMY CORPS OF ENGINEERS RIPRAP DESIGN

U.S. Army Corps of Engineers reference, EM 1110-2-1601, Section ***e.***, steep slope riprap design (Corps of Engineers. 1994), gives this equation for cases where slopes range from two to 20 percent, and unit discharge is low:

$$D_{30} = 1.95S^{0.555}(1.25q)^{2/3}/g^{1/3}$$ **Equation 6.4**

Where:

D_{30}	=	the dimension of the intermediate axis of the 30th percentile particle
S	=	the bed slope
q	=	the unit discharge
g	=	acceleration due to gravity.

The recommended value of 1.25 as a safety factor may be increased. The study from which this equation was derived cautions against using it for rock sizes greater than 6 inches (Abt, Wittler et al. 1988). The equation predicts sizes reasonably in hypothetical situations above this, but it has not been specifically tested in real applications.

The U.S. Army Corps of Engineers recommends angular rock with a uniform gradation (D85/D15 = 2). This material is not preferred for use in a fish-passage structure (see the section on bed porosity, below). An approximate factor to scale D_{30} of a uniform riprap gradation for one that is appropriate for stream channels is 1.5, so that, $D_{84} = 1.5\ D_{30,}$ where D_{84} is the dimension of the intermediate axis of the 84th percentile particle, and similarly for the 30th percentile.

U.S. Army Corps of Engineers reference, EM 1110-2-1601, Section e., pg 3-8
steep slope riprap design (Corps of Engineers. 1994)

In cases where unit discharge is low, riprap can be used on steep slopes ranging from 2 to 20 percent. A typical application is a rock-lined chute. The stone size equation is

$$D_{30} = \frac{1.95\ S^{0.555}\ q^{2/3}}{g^{1/3}} \qquad (3\text{-}5)$$

where

S = slope of bed

q = unit discharge

Equation 3-5 is applicable to thickness = 1.5 D_{100}, angular rock, unit weight of 167 pcf, D_{85}/D_{15} from 1.7 to 2.7, slopes from 2 to 20 percent, and uniform flow on a down-slope with no tailwater. The following steps should be used in application of Equation 3-5:

(1) Estimate $q = Q/b$ where b = bottom width of chute.

(2) Multiply q by flow concentration factor of 1.25. Use greater factor if approach flow is skewed.

(3) Compute D_{30} using Equation 3-5.

(4) Use uniform gradation having $D_{85}/D_{15} \leq 2$ such as Table 3-1.

(5) Restrict application to straight channels with side slope of 1V:2.5H or flatter.

(6) Use filter fabric beneath rock.

The guidance for steep slope riprap generally results in large riprap sizes. Grouted riprap is often used instead of loose riprap in steep slope applications. *

CLIENT: Union County SWCD
PROJECT: Little Creek (LC5 and LC6) Fish Passage Improvements
Designed By: Aaron Hamilton, P.E.
Checked By: Jadon Herron, P.E.
Date: September 16, 2022
Notes: Main Channel
Job No.: 596-07

Equation: 2013 Water Crossing Design Guidelines, Washington Dept. of Fish and Wildlife
Unit-Discharge Bed Design (Bathurst 1987, rearranged to predict D_{84})

$D_{84} = 3.54 S^{0.747} (1.25 q_c)^{2/3} / g^{1/3}$ **Equation 3.3**

Where:

D_{84} = intermediate axis of the 84th percentile particle in the sediment distribution, expressed in feet

S = energy slope of the proposed channel, ft/ft.

q_c = the critical unit discharge (total design discharge divided by the width of the bankfull channel) at which incipient motion of D84 occurs, in cubic feet per second per foot.

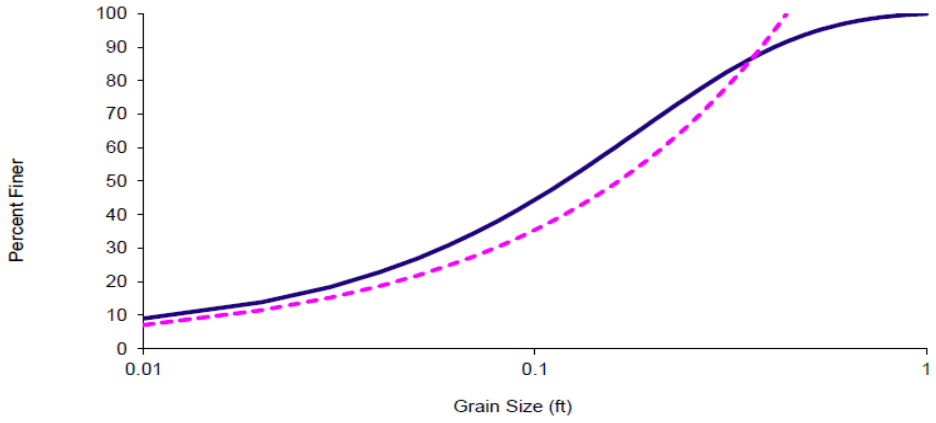
G = The acceleration due to gravity, feet/sec^2.

Given:

0.01	S, ft/ft
300	Design Discharge (100-year), cfs
30	Bankfull channel width, ft
10.0	q_c, cfs/ft
32.2	g, ft/sec^2

Calculation:

Particle Percent Smaller Than	100-year Particle Size Diameter (inches)
D_{16}	**0.3**
D_{50}	**0.9**
D_{84}	**2.3**
D_{100}	**5.8**



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$D_{84}/D_{50} = 2.5$ **Equation 3.7**

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In order to create a non-porous bed there must be a minimum of 5% to a maximum of 10% fines in the mix.

For comparison, a typical ratio for riprap gradations is $D_{84}/D_{16} < 2.0$. This uniform gradation creates a very narrow size distribution that is too porous for use in a stream simulation culvert. This

CLIENT: Union County SWCD
PROJECT: Little Creek (LC5 and LC6) Fish Passage Improvements
Designed By: Aaron Hamilton, P.E.
Checked By: Jadon Herron, P.E.
Date: September 16, 2022
Notes: Main Channel
Job No.: 596-07

Equation: 2013 Water Crossing Design Guidelines, Washington Dept. of Fish and Wildlife
Critical-Shear-Stress Method, pg 126

T_c=Critical Shear Stress

T_c=4 D_{50}

Calculation:

Reach	River Sta	Profile	Shear Chan (lb/sq ft)	Shields Curve size in	Shields T size mm	Shields T size in	Rosgen T size mm	Rosgen T size in	Max size in
Little Creek	1078	MAX	2	4	161	6	250	10	**10**
Little Creek	1015	MAX	1.2						
Little Creek	360	MAX	1	2	78	3	152	6	**6**
			Ave	3	119	5	201	8	**8**
			Min	2	78	3	152	6	**6**
			Max	4	161	6	250	10	**10**

Calculation: **$4*D_{50}$= 7.9** **inches**

Particle Percent Smaller Than	Size Diameter (inches)
D_{16}	**0.6**
D_{50}	**2.0**
D_{84}	**4.9**
D_{100}	**12.4**

CLIENT: Union County SWCD
PROJECT: Little Creek (LC5 and LC6) Fish Passage Improvements
Designed By: Aaron Hamilton, P.E.
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Date: September 16, 2022
Notes: Main Channel
Job No.: 596-07

Equation: 2013 Water Crossing Design Guidelines, Washington Dept. of Fish and Wildlife
U.S. Army Corps of Engineers (USACE)Riprap Design
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S	=	the bed slope
q	=	the unit discharge
g	=	acceleration due to gravity.

q=Q/b where b=bottom width
D_{84}=1.5 D_{30}

Given:

0.01	S, ft/ft
300	Design Discharge (100-year), cfs
30	Channel Width
10.0	q, cfs/ft
32.2	g, ft/sec^2

Calculation: **D_{30}= 3.1 inches**

Particle Percent Smaller Than	100-year Particle Size Diameter (inches)
D_{16}	**0.6**
D_{50}	**1.8**
D_{84}	**4.6**
D_{100}	**11.5**

2013 Water Crossing Design Guidelines, Washington Dept. of Fish and Wildlife, pg 126

U.S. ARMY CORPS OF ENGINEERS RIPRAP DESIGN

U.S. Army Corps of Engineers reference, EM 1110-2-1601, Section ***e***., steep slope riprap design (Corps of Engineers. 1994), gives this equation for cases where slopes range from two to 20 percent, and unit discharge is low:

$$D_{30} = 1.95S^{0.555}(1.25q)^{2/3}/g^{1/3}$$ **Equation 6.4**

Where:

D_{30}	=	the dimension of the intermediate axis of the 30th percentile particle
S	=	the bed slope
q	=	the unit discharge
g	=	acceleration due to gravity.

The recommended value of 1.25 as a safety factor may be increased. The study from which this equation was derived cautions against using it for rock sizes greater than 6 inches (Abt, Wittler et al. 1988). The equation predicts sizes reasonably in hypothetical situations above this, but it has not been specifically tested in real applications.

The U.S. Army Corps of Engineers recommends angular rock with a uniform gradation (D85/D15 = 2). This material is not preferred for use in a fish-passage structure (see the section on bed porosity, below). An approximate factor to scale D_{30} of a uniform riprap gradation for one that is appropriate for stream channels is 1.5, so that, $D_{84} = 1.5\ D_{30,}$ where D_{84} is the dimension of the intermediate axis of the 84th percentile particle, and similarly for the 30th percentile.

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(4) Use uniform gradation having $D_{85}/D_{15} \leq 2$ such as Table 3-1.

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(6) Use filter fabric beneath rock.

The guidance for steep slope riprap generally results in large riprap sizes. Grouted riprap is often used instead of loose riprap in steep slope applications. *

7.5 TECHNICAL SPECIFICATIONS (FORTHCOMING)

7.6 COST ESTIMATE

7.7 HIP REVIEW COMMENTS AND RESPONSES

HIP Project Review
Comment Tracking

Project Information:

Project Name:	Little Creek Fish Passage
BPA Project #:	1992-026-01
Contract #:	85944
Sponsor:	Union County Soil and Water Conservation District
Designer:	Anderson Perry & Associates, Inc.
Area Lead:	André L'Heureux, EWU, Lower Snake Lead
COR/PM:	Tracy Hauser
HIP Program Lead:	Daniel A. Gambetta, ECF

HIP Review Team:

BPA EC Lead:	Thomas DeLorenzo, ECF
BPA Technical Lead:	Douglas D. Knapp, P.E., EWL
NMFS Branch Chief:	Bill Lind, NMFS, Southern Snake Branch Chief
NMFS Biologist:	N/A (Addressed during Atlas review)
NMFS Engineer:	Jeff Brown, NOAA Fisheries, West Coast Region
USFWS Field Office:	Marisa Meyers, USFWS La Grande Field Office
USFWS Reviewer:	Carmen Leguizamon, USFWS La Grande Field Office

Documents Reviewed:

Little Creek (LC5 and LC6) Fish Passage Conceptual 15% Design	April 26, 2021
Little Creek (LC5 and LC6) Fish Passage 30% Design	April 29, 2022
30% Basis of Design (BOD) Report	April 29, 2022

Activity Categories:	**Risk Level:**
1b - Consolidate or Replace Existing Irrigation Structures	High
1c - Headcut and Grade Stabilization	Medium
1e - Provide Fish Passage at an Existing Facility	High
7g - Install, Upgrade, or Maintain Fish Exclusion/Bypass Structures	Medium
Overall Project Risk	**High**

Review Timeline:	**Date Completed**
• Conceptual Review (typically 15%)	
o Site visit, if needed	N/A
o Sponsor to submit conceptual design to EC Lead and COR	4/26/2021
o EC Lead to submit concept to HIP Review Team to initiate review	5/3/2021
o EC Lead to send design package to appropriate HIP Review members	5/3/2021
o EC Lead to compile comments and forward to Sponsor	5/17/2021
o Sponsor to provide responses to EC Lead	6/3/2021
o HIP Review Team and Sponsor to resolve "open" comments	6/4/2021
o EC Lead to notify Sponsor to proceed to preliminary design	6/4/2021
• Preliminary Design or Alternatives Analysis Review (typically 30%)	
o Sponsor to submit preliminary design to EC Lead and COR	4/15/2022
o EC Lead to submit design package to HIP Review Team	4/15/2022
o EC Lead to submit design to NMFS Engineer if applicable	4/29/2022
o NMFS Engineer approves project, if applicable	6/8/2022
o EC Lead to compile comments and forward to Sponsor	5/16/2022
o Sponsor to provide responses to EC Lead	6/3/2022
o HIP Review Team and Sponsor to resolve "open" comments	6/8/2022
o EC Lead to notify Sponsor to proceed with design	6/13/2022
• Permit Level Design Review (typically 60% to 80%)	
o Sponsor to submit design package to EC lead and COR	Not Started
o EC Lead to submit design package to HIP Review Team	Not Started
o EC Lead to compile comments and forward to Sponsor	Not Started
o Sponsor to provide responses to EC Lead	Not Started
o HIP Review Team and Sponsor to resolve "open" comments	Not Started
o EC Lead to notify Sponsor to proceed to final design	Not Started
• Final Design Package (100%)	
o Sponsor to submit final designs to EC Lead and COR	Not Started
o EC Lead and BPA Technical Lead to verify no critical changes	Not Started

Comments:

#	Reviewer (Org.)	Date	Document	Page/ Section	Comment		Response by (Org.)	Date	Response to Comment	Status (BPA to Update)
1	BPA	5/12/21 4/15/22	15% Design Report 30% Design		Please submit the referenced BOR alternative study and hydraulic analysis. **Update 4/15/22**: Reports received and saved in HIP review folder.					Closed
2	BPA	5/12/21 4/29/22	15% Design 30% Design		Please add the statement "This project was designed in accordance with the BPA Habitat Improvement Program, Programmatic Biological Opinion (HIP IV)" on the Cover Sheet of the plans. The final project drawings shall be sealed by the Project Engineer per Oregon Revised Statutes 672.020 and 025: *"Every final document including drawings, specifications, designs, reports, narratives, maps and plans issued by a registrant shall be stamped with the seal and signed by the registrant. The signature and stamp of a registrant constitute a certification that the document was prepared by the registrant or under the supervision and control of the registrant."* **Update 4/29/22:** HIP cover sheet language included in 30% design. Engineering Seal will be required for final designs.					To be Addressed at Next Review

#	Reviewer (Org.)	Date	Document	Page/ Section	Comment		Response by (Org.)	Date	Response to Comment	Status (BPA to Update)
3	BPA	5/12/21 4/29/22	15% Design Report 30% BDR		The HIP activity categories vary depending on alternatives selected. At the 15% design, the following categories are identified and will be adjusted as plans develop. Please review the HIP Handbook for applicable conservation measures and ensure that they are addressed in the BDR, Plans and Specifications. **Update 4/29/22**: Comment closed, all conservation measures for the following included in 30% design: 1b - Consolidate or Replace Existing Irrigation Structures 1c - Headcut and Grade Stabilization 1e - Provide Fish Passage at an Existing Facility 7g - Install, Upgrade, or Maintain Fish Exclusion/Bypass Structures					Closed
4	BPA	5/12/21 4/29/2022	15% design 30% Design		The 15% product notes that fish screening will be part of the part of the project and designed by ODFW. HIP category 1b requires screening as part of the diversion modification. Screening plans will need to be developed in conjunction with the passage and modification at the existing diversions to comply with HIP. **Update** 4/29: Per 30% design pages, will be added at 80%.		AP	9/22/22	We are still coordinating with ODFW, and screening plans are still being developed.	To be Addressed at Next Review

#	Reviewer (Org.)	Date	Document	Page/ Section	Comment		Response by (Org.)	Date	Response to Comment	Status (BPA to Update)
5	BPA	5/12/21 4/29/2022	15% Design Report 30% BDR		Please provide preliminary hydraulic analysis for existing conditions in accordance with NOASS Fish Passage criteria and the selected alternative in the next design submittal Include at a minimum: rating curves for the diversion intakes, demonstration of compliance with passage criterial conditions, flood flow profiles. **Update** 4/29/22: closed, see comment #11.		USWCD	6/2/21	Existing condition hydrology and initial hydraulic modeling results of existing conditions will be provided at the 30% design level.	Closed
6	BPA	5/12/21 4/29/22 6/8/2022	15% Design Report 30% BDR 30% BDR		Plan sheets for LC6 note, "Channel to be regraded approximately 300 ft upstream of the existing bridge and downstream of the diversion." Please provide additional information on the purpose and need for the work and a brief description of the design goals. **Update** 4/29/22: Is this regrading still being proposed? If so, details will be needed in 80% design. Please provide updated APE including the area that will be regraded. **Update 6/8/22**: Design report updated for 50ft regrading, closing comment.		USWCD AP	6/2/21 5/27/22	The existing LC6 diversion structure creates a backwater condition upstream and a depositional condition downstream. Deposition of bedload in the channel is decreasing channel capacity and increasing bank erosion. The proposed action alternative may allow lowering the diversion structure elevation and will require shaping the existing bedload accumulation to restore a more natural channel form. The channel grading is shown on the profile on Sheet C-202. The grading will extend approximately 50 feet upstream of the diversion structure and is included in the APE. A streambed simulation material hatch will be added to the plan view in the 80% design to clarify the grading location.	Closed

#	Reviewer (Org.)	Date	Document	Page/ Section	Comment		Response by (Org.)	Date	Response to Comment	Status (BPA to Update)
7	BPA	5/12/21 4/29/22	15% Design Report 30% Design		Alternative 1 at LC5 shows RipRap bank protection at the roadway. Note that the HIP programmatic does not allow for the use of RipRap for bank protection. **Update 4/29/22**: Will need to discuss riprap placement with NMFS and USFWS if still to be included for roadway hardening.		USWCD AP	6/2/21 5/27/22	Understood. The proposed location and orientation of the bypass fishway channel will increase the risk of flood damage to the roadway base. Hardening along the roadway will be necessary and required in this location. The rock still needs to be included due to location of the bypass channel relative to the roadway.	EC Lead coordinating with services, to be addressed at next review
8	BPA	5/25/2021 4/29/22 6/8/22	15% Design 30% Design 30% Design		All materials that are to be removed by the contractor to a place of their designation shall be defined. **Update 4/29/22**: 30% design notes that old irrigation materials will be salvaged by irrigation district. How will excavated materials be disposed? **Update 6/8/22**: Will review at 80%.		USWCD AP	6/2/21 5/27/22	Understood and will be defined in future design products. Excess earthwork material will be disposed of at a location selected by the Contractor outside the project boundaries. The concrete and other miscellaneous debris will be disposed of by the Contractor in accordance with prevailing laws at the Contractor's expense. These requirements will be included in the Technical Specifications developed with the 80% design.	To be Addressed at Next Review
9	BPA	5/25/2021	15% Design		Please provide documentation of ODFW Fish Passage and NMFS fish passage review, comments and approvals.		USWCD	6/2/21	The USWCD will coordinate with ODFW Fish Passage and NMFS for review of each design milestone and will document the comments and approvals.	For Information Only
10	BPA	5/25/2021	15% Design		Please provide the operations and maintenance agreement for the proposed diversion and identification of the proposed party whom will hold responsibility for maintenance and operational requirements (including debris removal, maintenance, operation etc.).		USWCD	6/2/21	An operations and maintenance agreement will be developed in future stages of the design.	To be Addressed at Next Review

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11	BPA	5/25/2021	15% Design		Please demonstrate how the proposed diversion will meet the volitional passage objectives with minimal operational manipulation or constraint. Specifically, how will forebay intake flow and stage vary with water withdrawal scenarios relative to species and lifestage migratory periods? As a component of this assessment please demonstrate any risks to functional passage as a result of operational characteristics of the system. It is expected that the appropriate hydraulic analysis will be provided to substantiate this assessment.		USWCD	6/2/21	This will be addressed in future design milestones. The preferred alternatives for each site need to be selected and hydraulic analysis completed on existing and proposed conditions.	Closed
		4/29/2022	30% Design		**Update 4/29/22**: NMFS Engineering to assess if 2D modeling approach meets needs of NMFS fish passage guidelines.					
		6/8/2022	30% Design		**Update 6/8/22**: NMFS Engineering confirms modeling is appropriate. Comment closed.					

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12	BPA	5/25/2021 4/29/2022 6/8/2022	15% Design 30% Design 30% Design		Please describe and show the spill prevention and erosion control measures being used to limit sediment from entering Little Creek. **Update 4/29/22**: LC6 will need detailed spill and erosion prevention measures for the staging area included in 80% design since staging area is within 100 yr floodplain and closer than 150 ft. **Update 6/8/22**: Will review at 80%.		USWCD AP AP	6/2/21 5/27/22 9/22/22	The spill prevention and erosion control measures are part of the complete BMP's applied to the implementation plan and included as a sheet in the design drawings. These will be presented as part of the 80% Preliminary Design package. Spill and erosion prevention measures will be included in the 80% design. **Update:** Erosion control measures have been added to the Drawings, and spill prevention measures have been added to the Technical Specifications.	To be Addressed at Next Review
13	BPA	5/17/2021 4/29/22	15% Design 30% Design		Conservation measures will be provided by EC lead to include in the 30% design **Update 4/29/22**: Comment closed, conservation measures included in 30% design.		USWCD	6/2/21	Understood.	Closed
14	BPA	5/17/2021 4/29/2022 6/8/2022	15% Design 30% Design 30% Design		Please provide APE maps to the EC Lead for cultural resource consultation. APE maps should include any additional information pertaining to project activities (e.g. access roads, staging areas, vegetation planting etc.) **Update 4/29/22**: Please provide APE maps to the EC lead so that CR review may begin. See also comment #6 for APE of upstream regrading area. **Update**: APE included. Closing comment.		USWCD AP	6/2/21 5/27/22	The APE boundaries and map will be provided after preferred alternatives are selected for each site at the 30% design level The APE is shown on Sheets D-101 and D-201. The APE on Sheet D-201 includes the area to be regraded at LC6.	Closed

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15	BPA	5/17/2021	15% Design		Please show any access roads as well as staging, storage, and stockpile areas that would be used for equipment and construction materials. Keep these areas 150 feet or more from natural waterbodies and wetlands or on an adjacent established road area in a location and manner that will preclude erosion into, or contamination of, the stream or floodplain. Staging areas may be closer than 150 feet if the area is above (elevation) the 100-yr floodplain and spill prevention measures are approved by BPA. Please include all areas where ground disturbing activities, temporary access roads, equipment and vehicle storage, and stockpiling will occur within the APE. If any areas of the project occur outside of these areas after BPA consults on the original APE, they will have to be re-consulted on. Encompassing the entire project area within the APE the first time around will greatly reduce any back and forth with the contractor archaeologist and BPA. **Update 4/29/22**: Staging areas included in 30% design. See comment #12 for spill and erosion measure requirements for staging areas.		USWCD	6/2/21	Understood	Closed
		4/29/22	30% Design							

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16	BPA	5/21/2021 4/29/2022	15% Design 30% Design		Please ensure the Ordinary High Water (OHW) line and FEMA 100- year floodplain boundary are included on all plan sheets. **Update 4/29/22**: 100 yr floodplain limit included in 30% designs, comment closed.		USWCD	6/2/21	Understood.	Closed
17	BPA	5/25/2021 4/29/2022	15% Design 30% Design		Please include erosion control best management practices that will be utilized for the project to limit sediments from entering Little Creek and adjacent wetlands. **Update 4/29/22**: See comment #12.		USWCD	6/2/21	Understood.	Closed
18	BPA	5/25/2021 4/29/2022	15% Design 30% Design		Please include all areas where ground disturbing activities, temporary access roads, equipment and vehicle storage, and stockpiling will occur within the APE. If any areas of the project occur outside of these areas after BPA consults on the original APE, they will have to be re-consulted on. Encompassing the entire project area within the APE the first time around will greatly reduce any back and forth with the contractor archaeologist and BPA. **Update 4/29**/22: See comment #14.		USWCD	6/2/21	Understood.	Closed

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19	BPA	5/25/2021	15% Design		Has the APE had a wetland delineation completed recently? If not, what is the wetland delineation schedule? Please consult with the USACE project manager early in the process to determine whether or not a delineation is necessary for the site.		USWCD	6/2/21	We will be looking into this issue as the design progresses.	To be Addressed at Next Review
		4/29/2022	30% Design		**Update 4/29/22**: Please provide status update for wetland delineation process.		AP	5/27/22	A site investigation was completed in May 2022 to determine the presence or absence of wetlands. A wetland was found in within the APE on the south side of Little Creek at LC5, so a wetland delineation will be completed.	
		6/8/2022	30% Design		**Update 6/8/22**: Will review at 80%.					
							AP	9/22/22	**Update:** The USACE and DSL have indicated that a full Wetland Delineation Report will not be required. Impacts to the wetland will be outlined in the JPA, and wetland is shown on the Drawings.	
20	BPA	5/25/2021	15% Design		Considering the questions around operational management and performance on technical fishways – diversions on previous Little Creek projects; an additional approach has been provided for a BOR designed diversion with partial alluvial passage. (see the attached addendum). BPA would like to discuss this alternative or a hybrid approach. **Update 4/29**: Discussed with Welch, comment closed.		USWCD	6/2/21	As per conversation with S. Welch, the USWCD and design engineer will be investigating the use of a naturalized bypass channel and laydown stanchions.	Closed
21	BPA	4/29/2022	30% design		Please add distance scales to all plan view images in the design for 80% design.		AP	5/27/22	Scales are included in the title block for each sheet.	For Information Only

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22	NMFS Engineering	5/12/2022	30% Design		Consider adding porosity to cutoff walls in both diversions to prevent stoppage of hyporheic flows.		AP AP	5/27/22 9/22/22	Small PVC pipes will be included in the cutoff walls at both diversions as part of the 80% design to help support hyporheic flow. **Update:** PVC pipes were included in the cutoff walls.	To be Addressed at Next Review
23	NMFS Engineering	5/12/2022	30% Design		LC5: Intake to new screen structure appears to possibly be at risk of sediment aggradation. Please investigate and consider potential issues.		AP	5/27/22	The intake screen is on an inside bend of the channel where sediment deposition could occur. The orientation of the intake structure and concrete fish bypass channel control structure will be reviewed as part of the 80% design to see if these structures could be narrowed to help maintain sediment transport in front of the intake. The invert elevation of the intake will also be reviewed relative to the invert elevation of the concrete diversion structure to help ensure sediment could be flushed from in front of the intake when the check boards are not installed in the diversion. The intakes at LC5 and LC6 are both located on inside bends where sediment deposition could occur. Periodic maintenance will likely be required to pull the check boards and help flush sediment.	Closed

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24	NMFS Engineering	5/12/2022	30% Design		There appears to be a risk of development of a scour hole at the downstream edge of the new dam structure and bypass channel. Consider additional armoring to protect against scour.		AP AP	5/27/22 9/22/22	Agreed. Additional armoring will be considered at the 80% design. **Update:** The streambed simulation material downstream of the diversion was sized with a D_{84} of 24 inches and a large rock matrix was included to help stabilize the channel downstream of the diversion.	To be Addressed at Next Review
25	NMFS Engineering	5/12/2022	30% Design		It isn't clear whether the plan is to selectively install check-boards in the dam to orient flow to intake side to reduce risk of fish passing up the fishway and being recycled downstream.		AP AP	5/27/22 9/22/22	This can be added to the 80% design. **Update:** The fish screen was changed to a rotary drum due to the concern of ice during the winter when stock water is being provided. There is a potential for fish to enter the irrigation intake upstream of the diversion and then return to the channel downstream of the diversion. The fishway exit is located farther upstream of the diversion than the irrigation intake. Would it be better to orient flow to the fishway side of the channel?	To be Addressed at Next Review
26	NMFS Engineering	5/12/2022	30% Design		How low is low flow? If flow is biased to the diversion side, will flow be a problem for bypass channel side?		AP	5/27/22	The 95 percent exceedance flow is 7 cubic feet per second. During the low flow, check boards would be installed so all flow is going down the bypass channel and no flow is overtopping the checkboards in the main channel.	Closed
27	USFWS	6/1/2022	30% Design		Are mussels present within this project reach? Surveys should be conducted prior to implementation and during design development in order to assess presence, identify species, and determine if a mussel salvage/relocation will be necessary.		USWCD	6/1/22	Mussels have not been sampled or observed in this portion of Little Creek, but surveys will be completed during the summer of 2022 and prior to the completion of the 80% design. Presence and species will be identified to determine salvage/relocation needs.	To be Addressed at Next Review

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28	USFWS	6/1/2022	30% Design		Will biologists remain on-site during the entirety of the dewatering process to continue salvaging fish missed in initial salvage efforts? If adult salmon are captured during salvage, please relocate immediately (as opposed to holding over before releasing).		USWCD	6/1/22	Fish biologists will be present on site during the dewatering process to monitor for any remaining fish. If adult salmon are captured, they will be relocated immediately.	Closed
29	ODFW	6/9/2022	30% Design		Flow perpendicular to fish bypass exit could present risk of sweeping flows and/or impingement; determine flow direction and velocity at exit of fish bypass and adjust as needed to minimize this risk.		AP	6/9/22	A 2D HEC-RAS model was completed as part of the 30% design. Figures showing the proposed velocity and depth are included on Figures 4,5,8, and 9 in Section 7.3 of the Basis of Design Report. AP is open to input on these results relative to risk of sweeping and impingement.	Closed

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30	ODFW	6/9/2022	30% Design		Determine flow depth and velocity through bypass structures meets passage criteria and adjust as needed.		AP	6/9/22	A discussion of the results of the 2D HEC-RAS model relative to fish passage conditions is included in Section 3.5 of the Basis of Design Report, and velocity and depth figures are included in Section 7.3. Please review and provide any comments. The water surface elevation drop across the bypass channel control structure will be less than 0.5 feet, and the water depth across this inlet will be approximately 0.75 feet during the 95 percent exceedance flow. The water depth in the bypass channel is 0.9 feet during the 95 percent exceedance flows, and the average channel velocity ranges from approximately 2.2 to 2.5 feet per second depending on the flow. Although the average channel velocity is great than 2 feet per second, the hydraulic model shows velocity on the fringes of the bypass channel less than 2 feet per second.	Closed
31	ODFW	6/9/2022	30% Design		Will minimum flow conditions provide ample attractive flow for fish identify and utilize bypass channels?		AP	6/9/22	Section 7.3 of the Basis of Design Report outlines the attraction flow conditions of the bypass channel. During the 5 percent exceedance flow of 120 cfs in Little Creek, 9.3 cfs (7.8%) will be flowing in the bypass channel. During the 95 percent exceedance flow of 7 cfs, all flow will be in the bypass channel.	Closed

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32	ODFW	6/8/2022	30% Design		Lay-flay stanchion structures tend to present future passage issues through scouring at the downstream sill – what measures are being taken to prevent this from happening?		AP	6/9/22	Agreed. A scour pool will be constructed downstream of the concrete sill to help dissipate energy. This is a technique commonly used on culvert fish passage retrofits. A concrete cutoff will be installed on the downstream end of the concrete sill to help protect the structure. Oversized streambed simulation material will be placed in the channel along with roughness boulders to help prevent scour.	Closed
33	ODFW	6/9/2022	30% Design		Is there a chance the diversion could be moved upstream (without triggering POD change and injury assessment) to provide more length and decrease gradient to fish bypass channel?		AP	6/9/22	The existing irrigation delivery systems require that the water be checked up in the channel multiple feet at the current POD. The average slope of Little Creek is just over 0.006 ft/ft. Moving the POD upstream 50 feet would only gain approximately 0.3 feet in water surface elevation at this channel slope. Moving the POD upstream enough to achieve the required water surface elevation would likely trigger a POD transfer.	Closed
34	ODFW	6/9/2022	30% Design		Please add Greg Apke and Joel Watts to email list for future iterations of this project. Greg.d.apke@odfw.oregon.gov Joel.watts@odfe.oregon.gov		USWCD	6/9/22	As discussed between J.Webster and G.Apke, the single contact for ODFW will be Joe Lemanski.	For Information Only
35	ODFW	6/9/2022	30% Design		On-site discussion with Union SWCD to go over comments above. Many questions of ODFW's were addressed through responses to comments from other agencies.					For Information Only