

Washington State Recreational Conservation Office

Final Design of

Lower Woods Creek LW Installation

SRFB #15-1131

PREPARED BY:



860 Windrose Drive
Coupeville, Washington 98239
(360) 678-4747
Professional Consulting Engineers

PREPARED for:

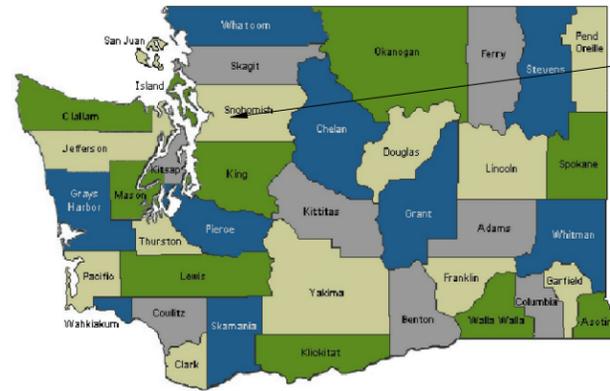
Adopt-A-Stream Foundation

Everett, WA



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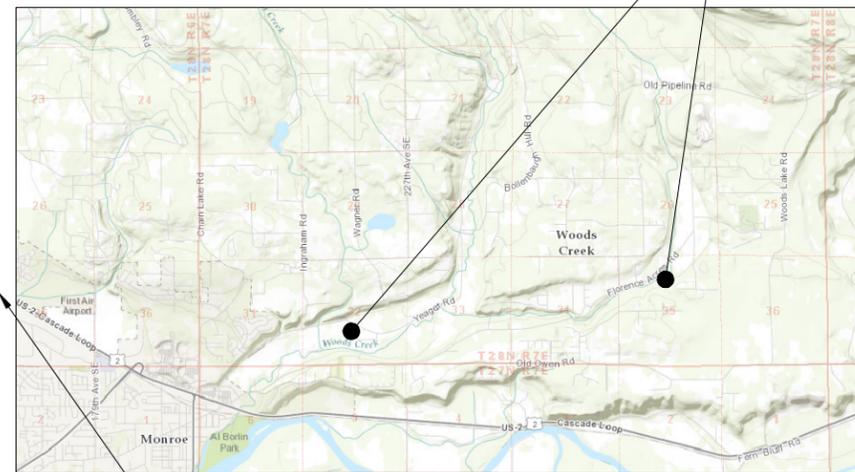
Project Location
Snohomish County



Know what's below.
Call before you dig.

Washington

Project Locations



VICINITY MAPS



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Jay S. Kidder
APPROVED AT CHINOOK ENGINEERING: DATE
June 20, 2016

1" Bar at Original Scale



REV	DATE	ISSUE	DWG	DES	CHK	APP
1	10-28-2015	Issued for Client Review	JSK	JSK	JSK	JSK
2	3-10-2016	Issued for USCOE Permits				
3	6-20-2016	Reissued for Permits				
4						

PROJECT NO. 15229

WA State Recreation Conservation Office
Salmon Recovery Funding Board 15-1131
Lower Woods Creek LW Installation
Cover

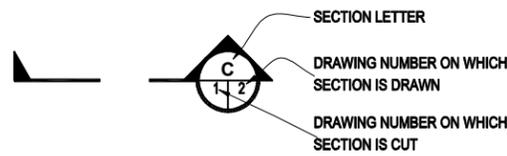
DRAWING NO.
CVR
1 OF 15

ABBREVIATIONS:

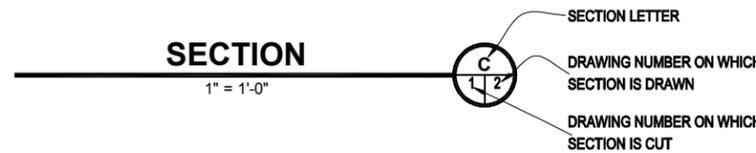
%	PERCENT	MH	MANHOLE
&	AND	MIN	MINIMUM
@	AT	MUTCD	MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES FOR STREETS AND HIGHWAYS
AB	ANCHOR BOLT	N	NORTH or NORTHING
ABV	ABOVE	NAF	NEAR AND FAR
AL	ALUMINUM	NEC	NECESSARY
ALG	ALONG	NIC	NOT IN CONTRACT
ALT	ALTERNATE	NML	NORMAL or NOMINAL
ALUM	ALUMINUM	NO or #	NUMBER
APPROX or ~	APPROXIMATELY	NTS	NOT TO SCALE
ASPH	ASPHALT	O.C.	ON CENTER
ASSOC	ASSOCIATION	PC	POINT OF CURVATURE
AVG	AVERAGE	PE	POLYETHYLENE
BOT	BOTTOM	PERF	PERFORATED
B.O.F.	BOTTOM OF FOOTING	PI	POINT OF INTERSECTION
B.O.P.	BEGINNING OF PROJECT	PL	PLATE
BF	BUTTERFLY	PL	PLATE
BLDG	BUILDING	PLCS	PLACES
BVC	BEGIN OF VERTICAL CURVE	PROP	PROPOSED
C	CHANNEL	PS	PUMP STATION
CIP	CAST-IN-PLACE	PT	POINT OF TANGENCY
CL	CENTER LINE	PVC	POINT OF VERTICAL CURVE
CLR	CLEAR	RAD	RADIUS
CMP	CORRUGATED METAL PIPE	RD	ROAD
CONC	CLEAN OUT	RED	REDUCER
CONC	CONCRETE	REF	REFERENCE
CY	CUBIC YARD	REINF	REINFORCEMENT
DEF	DEFINITION	REQD	REQUIRED
DESC	DESCRIPTION	ROW	RIGHT OF WAY
DET	DETAIL	RW	RACEWAY
DI	DUCTILE IRON	S	SOUTH
DIA or ∅	DIAMETER	SC	SQUARE CORNER
DIST	DISTRIBUTION OR DISTRIBUTOR	SCH or SCHED	SCHEDULE
DS	DOWNSTREAM	SPA or SPCS	SPACE OR SPACES
DWG	DRAWING	SPEC	SPECIFICATIONS
E	EAST or EASTING	SS	STAINLESS STEEL
E.O.P.	END OF PROJECT	STA	STATION
EA	EACH	STD	STANDARD
EF	EACH FACE	STL	STEEL
EL or ELEV	ELEVATION	T	for rebar TRANSVERSE
ELL	ELBOW	TEMP	TEMPERATURE
EQ or EQUIV	EQUIVALENT	TOC	TOP OF CONCRETE
EVC	END VERTICAL CURVE	TOF	TOP OF FOOTING
EW	EACH WAY	TOS	TOP OF SLAB
EXIST or EX	EXISTING	TS	TUBE STEEL
FAB	FABRICATOR, ED, TION	TYP	TYPICAL
FB	FLAT BAR	UON	UNLESS OTHERWISE NOTED
FCA	FLANGE COUPLING ADAPTER	VERT	VERTICAL
FF or FIN FLR	FINISH FLOOR	VIC	VICINLUC
FL	FLOW LINE	VPC	VERTICAL POINT OF CURVATURE
FOC	FACE OF CURVE	VPI	VERTICAL POINT OF INTERSECTIO
FT or'	FEET	VPT	VERTICAL POINT OF TANGENCY
GALV	GALVANIZED	W	WITH
GB	GRADE BREAK	WF	WIDE FLANGE
GS	GROUND SURFACE	WT	WIDE TEE STEEL SECTION
HDBOX	HEADBOX	WWF	WELDED WIRE FABRIC
HDPE	HIGH DENSITY POLYETHYLENE	△	DEFLECTION ANGLE
HEX	HEXAGONAL		
HORIZ	HORIZONTAL		
HP	HIGH PRESSURE		
ID	INSIDE DIAMETER		
IE	INVERT ELEVATION		
IN or"	INCHES		
INT	INTERSECTION		
L	for rebar LONGITUDINAL		
L	LENGTH OF CURVE		
L	ANGLE IRON		
L	for rebar LONGITUDINAL		
LF	LINEAR FOOT		
LG	LONG		
LOC	LOCATION		
LOD	LARGE ORGANIC DEBRIS		
LWD	LARGE WOODY DEBRIS		
LP	LOW PRESSURE		
LP	LOW POINT		
MANUF	MANUFACTURER		
MAX	MAXIMUM		
MEZZ	MEZZANINE		

SECTION INDICATOR:

DRAWING ON WHICH SECTION IS CUT FROM:

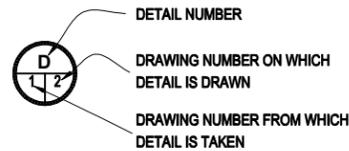


DRAWING ON WHICH SECTION APPEARS:

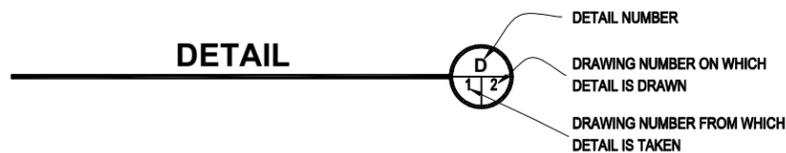


DETAIL INDICATOR:

DRAWING ON WHICH DETAIL IS PULLED FROM:



DRAWING ON WHICH DETAIL APPEARS:



**Section 31 & 32 T28N R7E NAD83
LEGEND:**

— FNC — FNC —	EXISTING FENCE
— 2200 —	EXISTING CONTOUR
— — —	EXISTING GRAVEL ROAD
— W — W —	EXISTING WATER
— P — P —	EXISTING POWER
— T — T —	EXISTING TELEPHONE
M ∅	EXISTING WATER MANHOLE W/ METER
∅	EXISTING POWER POLE
⊙	EXISTING MONITORING WELL
— FNC — FNC —	FENCE
	ASPHALT PAVED ROAD
(V)1 2(H) 2:1	SLOPE DESIGNATION
→	FLOW DIRECTION
	BUILDING
	CATCH BASIN
∅	TELEPHONE/POWER RISER
— P — P —	POWER
— W — W —	WATER (POTABLE)
— PW — PW —	PROCESS WATER
— T — T —	TELEPHONE
	TRANSVERSE DRAINAGE STRUCTURE
— 8% —	GRADE
— — —	RETAINING WALL



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WA State Recreation Conservation Office
Salmon Recovery Funding Board 15-1131
Lower Woods Creek LW Installation
Abbreviations



**Know what's below.
Call before you dig.**



1" Bar at Original Scale

SPECIFICATIONS

All work performed under these contract documents shall be in accordance with the State of Washington Standard Specifications for Road, Bridge, and Municipal Construction, M41-10, most recent version. In the event of a conflict between the following attached specifications and the State of Washington Standard Specifications for Road, Bridge, and Municipal Construction, M41-10, the attached specifications on this sheet for this contract shall prevail. Special Provisions shall follow and then the WSDOT M41-10.

The following most current provisions, codes and specific material and workmanship specifications are attached to this contract and shall be adhered to;

AAWA	Architectural Aluminum Manufacturers' Association
ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
APA	American Plywood Association
APWA	American Public Works Association
AREA	American Railway Engineering Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society For Testing of Materials
AWPA	American Wood Preservers Association
AWS	American Welding Society
AWWA	American Water Works Association
WSDOT	Washington Standard Specifications for Road, Bridge, and Municipal Construction, M41-10

Items in Specifications

Certain items described in the specification may not be utilized in this project but are listed as general items and may or may not apply specifically to this project.

Alternates

Alternative materials and construction methods are acceptable. The overall size and concept of the project shall be unchanged. Alternate methods of construction and any dimensional alternates shall be provided in writing for approval by the engineer, prior to installation. Changes in cost associated with alternates shall be at the risk of the contractor. Any alternates installed without prior written approval may be removed and replaced at the discretion of the engineer at no cost to the owner.

Submittals

Submittals for appurtenances installed under this contract shall be provided to the engineer prior to installation for approval. The following notes apply unless indicated otherwise:

Special inspection, as noted shall be provided by the owner's representative.

Code:

International Building Code, 2012 edition and AASHTO Standard Specifications for Highway Bridges 17th ed with errata.

Design soil pressure:

Surface 2ksf max dead + live load allowable as per AASHTO
Cast footings and slab on grade over 12" thick compacted granular fill over compacted subgrade 90% min. compaction. Special inspection required.

Design loads:

Snow	=25 psf
Snow drift	= ANSI 58.1
Seismic Design Category	D
Site Classification	D
Fa=	1.00
Fv=	1.50
Sms=	1.305
Sm1=	0.805
Sds=	0.870
Sd1=	0.537

Equivalent lateral Fluid pressure

Cantilevered walls	35 pcf
Restrained	50 pcf
Wind	50 psf on exposure

Culverts

Culverts shall be as specified on the drawing and shall be supplied by Pacific Corrugated, contact Janeal Campos, 360-432-1367; BigR contact Doug Meyers, (253) 797-8293 or Contech Michael Blank 253.952.1154; or equal. Culvert shall be fabricated from a minimum of 8 gage, 0.1644" steel thickness and shall be galvanized as per AASHTO M274 and ASTM A 929 UNO on the drawings. Culvert backfill soil compaction shall be constructed in multiple 8" loose soil thickness layers subsequently compacted to 95% maximum density at optimum moisture content. Care shall be taken to compact the haunches of the culvert to the same 95% maximum soil density. Shop drawing submittals shall be submitted for bevels and skews.

Bridges

Bridges shall be fabricated in accordance with AASHTO Standard Specifications for Highway Bridges, 17th Edition with errata or AASHTO LRFD Bridge Design Specifications, 5th or 6th Edition. Furnish a prefabricated concrete or steel superstructure. Prefabricated steel superstructures shall be fabricated with corrosion resistant steel meeting the requirements of ASTM A588 for the primary structural elements; steel decking may be galvanized. Fabrication of the steel bridge shall be performed in a plant certified by AISC for Simple Bridge Fabrication. Concrete super structures shall be constructed in accordance with the ACI 318. Special inspection is required for reinforcement by engineer of record. Bridge rail elements to be timber and/or weathering steel with galvanized hardware; incorporate railing bolts or attachments into the prefabricated superstructure as required by the design. The bridge superstructure shall be designed and sealed by a professional engineer licensed in the State of Washington, in accordance with the required design specifications. Submit shop drawings and calculations that have been stamped and sealed by a professional engineer licensed in the State of Washington. All bridges shall meet minimum specifications as set by AASHTO and shall be capable of resisting HL93 U80/L90 intermittent overload loads unless noted otherwise. Rail loading shall be half AASHTO (5 kip) and steel or approved equal.

Crushed gravel surfacing

Crushed gravel surfacing shall meet WSDOT spec. 9-03.9(3) for crushed surfacing rock and shall meet WSDOT spec. 9-03.9(3) for base course or top course as indicated on the drawings.

Culvert Demolition

Culverts shall be removed and disposed of offsite in a location as approved by the landowner or engineer.

Structural fill

Structural fill material shall be composed of crushed gravel, or quarry spalls as specified herein or approved by the project engineer and shall be compacted to 95% maximum density at optimum moisture content and shall be placed in 8" maximum loose lifts prior to compaction and in accordance with WSDOT 2-03.3(14)C compacting earth embankment Method C.

Riprap

WSDOT spec. 9-13.1(2) light loose rip rap. Riprap may exist on site and shall be salvaged and reused as shown in the drawings.

Quarry spalls

Quarry spalls shall be WSDOT 9-13.6

Fish mix

Fish mix gravel shall consist of washed round river gravel consisting by volume of 60% sand to 2" rock, as per WSDOT 9-03.11(1) Streambed Sediment and 20% 2" to 6" rock, per WSDOT 9-03.11(2) Streambed Cobbles and 20% 6" to 12" rock as WSDOT 9-03.11(2) Streambed Cobbles. Fish mix shall be supplemented as necessary with native bed material and/or imported pit run in order to match existing bed material gradation and prevent subsurface flow. All fish mix gravel shall be approved in writing by the engineer at the gravel pit prior to delivery of site.

Stream Dewatering

If stream dewatering is anticipated to be necessary during construction, a pump and diversion or gravity system will be required. The pump intake shall be screened and water discharged downstream of the project site. Discharge pipeline shall be placed and/or protected so as to prevent erosion in the channel. Upon completion of diversion, contractor and/or project biologist will remove stranded fish, if present. Pumped diversions shall run continuously for the duration of the diversion UNO.

Pump intakes shall be affixed with a fish screen with mesh openings of 1/16" and shall be maintained clean. Through screen velocities shall not exceed 0.33 feet per second.

Exact locations of all in-stream habitat structures are to be approved on-site by project manager or project engineer prior to installation.

Reinforced Concrete:

All concrete - $f_c = 4000$ psi at 28 days minimum, maximum w/c = 0.45, 6 sacks of cement minimum per cubic yard. Submit mix design. Special inspection required steel bars per ASTM A615, grade 60. Submit reinforcing steel shop drawings with details per ACI 315 manual of standard practice. Lap bars with a class B splice. Field bending bars not permitted w/o written approval. Welded wire fabric (WWF) per ASTM A185. Furnish WWF in flat sheets, not rolls. Lap edges 1 1/2 mesh minimum.

Concrete cover:

Footings 3". Pile caps 3". Walls 1", except 1 1/2" where Exposed to weather and 2" against earth. Beams and Columns 1 1/2" to stirrups or ties. Slabs and joists 1". Slabs on grade 1 1/2". Cover to be not less than nearest bar diameter.

Footings:

Provide 2-#5 longitudinal bottom bars in wall footings. Provide corner bars of same size and number at corners and inter-sections, 40 diameters each leg. Provide vertical dowels of same size, number and spacing as vertical bars with a 90 degree standard hook at bottom of footing.

Beams and slabs

Rigidly support bars with concrete blocks or approved accessories. Provide #5 support bars all slabs. Where main slab bars are parallel to a support, provide #4 @ 12 top bars extending 2'-0" beyond each face of support into slab. Where slab is on one side only, provide a 90 degree standard hook at discontinuous face. At slab openings over 12" square, provide two additional bottom main slab bars or 2-#5 minimum on all four sides of the opening extending 40 diameters past opening. Slabs on grade shall have contraction joints and construction joints as indicated on the plans. Contraction joints shall be saw cut to a depth of 1" by concrete sawing.

Provide 1-#5x4'-0" diagonal bottom bar all four corners. All slabs

Provide slab temperature bars as follows:

- 4" slabs, #3 @ 15 bottom,
- 5" slabs, #4 @ 18 bottom,
- 6" slabs, #4 @ 18 bottom,
- 7" slabs, #4 @ 15 bottom,
- 8" slabs, #3 @ 18 top, #4 @ 18 bottom,
- 9" slabs, #3 @ 18 top, #4 @ 18 bottom,
- 10" slabs, #3 @ 16 top, #4 @ 18 bottom,
- 11" slabs, #4 @ 18 top, #4 @ 18 bottom,
- 12" slabs, #4 @ 18 top, #4 @ 18 bottom.

Walls

Reinforce as follows:

- 6" walls, #4 @ 12 horizontal and vertical @ center of wall,
- 8" walls, #5 @ 15 horizontal and vertical @ center of wall,
- 10" walls, #4 @ 16 horizontal and vertical each face,
- 12" walls, #4 @ 12 horizontal and vertical each face.

At openings over 12" square, provide 2-#5 bars @ center of wall all four sides, except 10" walls and over provide 1-#6 bar each face all four sides, extending 40 diameters past opening. Provide 1-#5 x 4'-0" diagonal bar @ center of wall all four corners. At corners, provide corner bars in outside face of same size and spacing as horizontal bars, 40 diameter each leg. At intersections, provide corner bars of same size, number and spacing as horizontal bars of intersecting wall, 40 diameter each leg. Provide 2-#5 longitudinal bars at top and bottom of walls. Provide roughened surface at vertical bars.

Grout

Grout shall be 4000 psi minimum 7-day cube strength per ASTM C109. Grout to be premixed, non-shrink "Masterflow" by master builders or "Concresive" by adhesive engineering or approved equal. ICBO certification required. Use specific grout mix recommended by manufacturer for each grout application and follow manufacturer's instructions.

Anchor Bolts

Anchor bolts shall be hot dipped galvanized ASTM A307. Special inspection required. Set all anchor bolts by template.

Drill in Expansion Bolts

"Kwik-Bolts" by Hilti fastening systems, "Parabolics" by USM Corp, "Red Head Wedge Anchor" by ITT Phillips or approved equal ICBO certification required. Special inspection required.

Adhesive Anchors

"Hy-150" by Hilti Inc., or Simpson SET-XP use A36 or A307 threaded rod. ICBO certification required. Special inspection required.

Structural Steel

All steel ASTM A36 or A588, $f_y = 36$ ksi. Special inspection required. Fabrication and erection per AISC Specifications. Submit shop drawings. Welding per AWS D1.1. Minimum size welds 3/16" continuous fillet. Welders certified per AWS for rod and position. Use cold galvanizing spray on finished surface for field weld. High - strength bolts per ASTM A325. Typical bolted connections - friction type. Tension high-strength bolts by direct tension indicator method using load indicator washers installed per manufacturer's instructions. All steel shall be hot dip galvanized unless otherwise noted. Where ASTM A588 steel is used galvanizing is not allowed.

Revegetation NIC Sponsor to Complete

Revegetate all disturbed areas of construction. Replant riparian areas as follows: red osier dogwood and willow (salix spp.) shall be live staked along the waters edge at 2'-0" on center for 4 rows back from anticipated Ordinary

High Water (OHW) edge. Disturbed areas 10' from OHW edge shall be replanted as follows: western red cedar, black cottonwood and Douglas fir shall be interspersed and planted as pull ups with roots in soil throughout disturbed upland areas @ 25' O.C.. Erosion control seed mixture appropriate for local shall be hand broadcast or hydroseeded in all upland disturbed areas.

Streambed Cobbles and Boulders

Streambed rock including Cobbles and Boulders shall be in conformance with WSDOT spec. 9-03.11(2) and 9-03.11(3). Rock size shall be as indicated on the plans and shall be as found in a naturally occurring fluvial sediment and shall be rounded or semi-rounded.

Geotextile fabric

Geotextile fabric shall be woven material in conformance with WSDOT spec. 9-33.1 and 9-33.2. Geotextile shall be woven LayfieldLP 200 or Mirafi 500X or equal.

Erosion control seed mixture

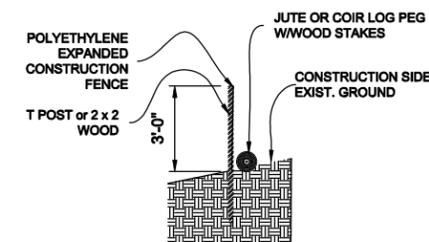
Erosion control seed mixture shall consist of 20% white clover, 20% annual rye, 60% creeping red fescue.

Rootwads and Large Organic Debris (LOD)

Rootwads and large organic debris shall be utilized from live trees and shall have a minimum of 15 feet of tree stem integral with the roots UNO. LOD shall be from live or recently live wood. All LOD shall have a minimum diameter of 10" at the small tapered end UNO. LOD shall be Douglas fir, western red cedar, spruce, or hemlock unless otherwise approved by project engineer.

T.E.S.C. PLAN:

Appropriate erosion control BMP's shall be installed and remain throughout the duration of the project where there is a risk of sediment runoff. This may include but is not limited to the use of plastic sheeting, straw mulch, hay bales and silt fence. Fences shall be installed as shown in the detail on sheet SPC. Upon completion of the project or during construction periods of inclement weather all disturbed areas shall be seeded or covered with plastic to prevent erosion.



TESC Fence Section

NTS



Section 31 & 32 T28N R7E NAD83



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Salmon Recovery Funding Board 15-1131
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Specifications

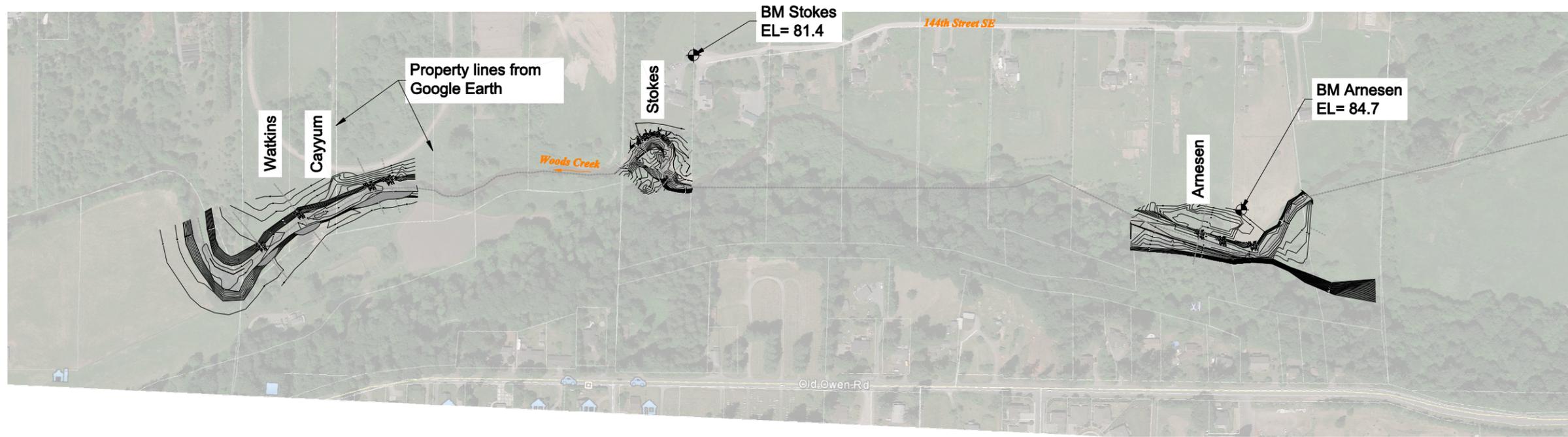


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1" Bar at Original Scale

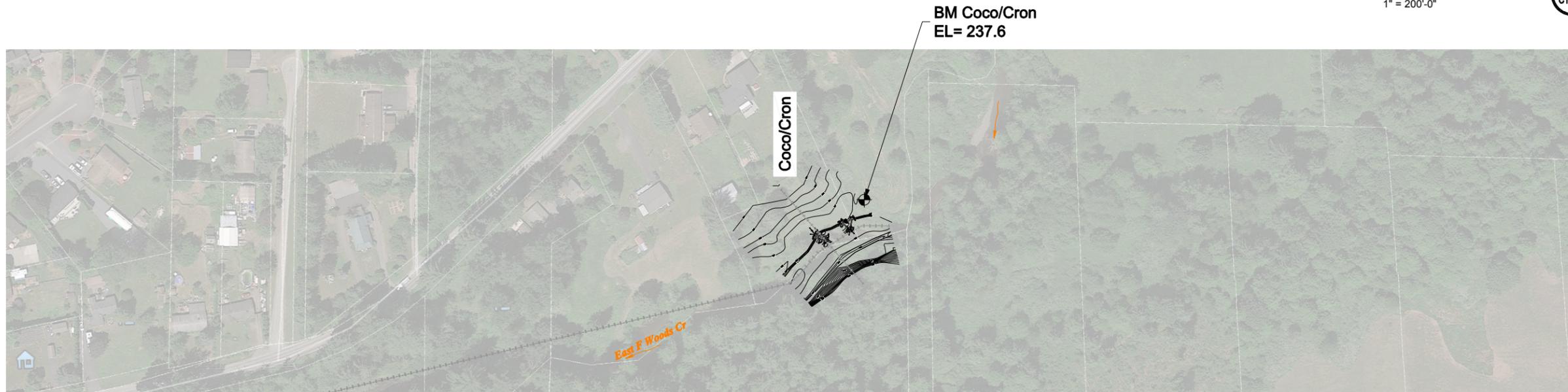
DRAWING NO.
SPC
3 OF 15



Section 31&32 T28N R7E
Lower Reach 1 Site Plan

1" = 200'-0"

1
C1 | C1



Section 35 T28N R7E
Reach 2 Site Plan

1" = 100'-0"

2
C1 | C1

Notes:

1. Elevations based on data obtained from survey completed for work on this project. Vertical Datum is NAD 83 WA N.
2. All precise elevations and locations must be field verified during construction when setting grades with engineer or surveyor.
3. Construction surveying shall be the responsibility of the contractor.
4. This project includes the installation of Large Wood (LW) for fish habitat enhancement. Most sites require excavation and burial of portions of the LW into the existing stream bank, and subsequent replanting of the area.
5. Staging of equipment and materials is allowed on the landowner property as indicated.
6. Any damage to the land surface, fencing, survey monuments, utilities from construction staging, track loads, heavy wheel loads or other activities shall be restored to original condition at Contractors cost. Determine means and methods with the landowner prior to construction and staging.



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1" Bar at Original Scale

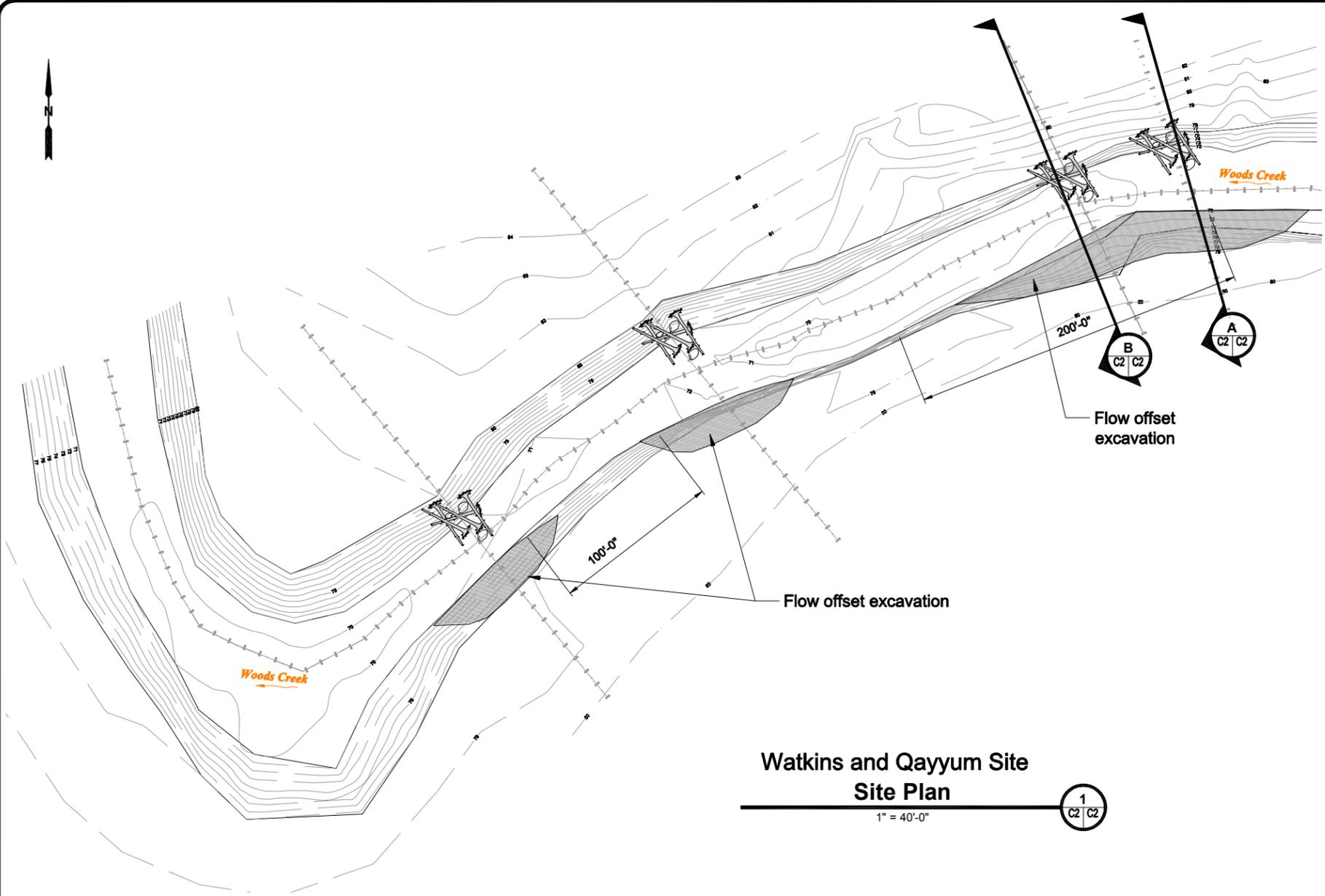


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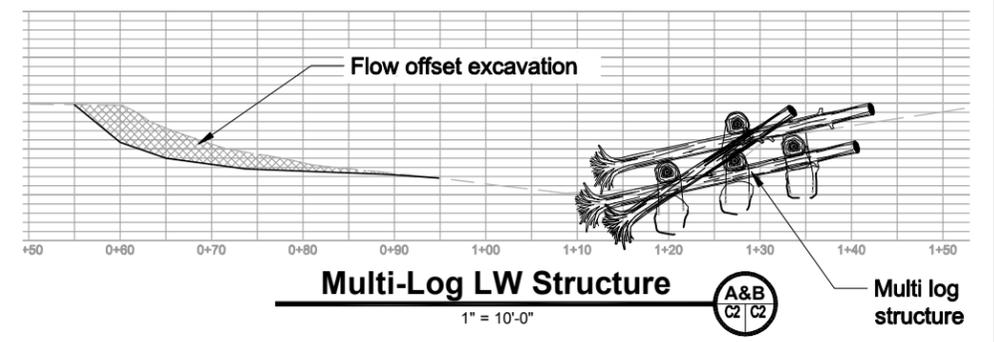
PROJECT NO. 15229

WA State Recreation Conservation Office
Salmon Recovery Funding Board 15-1131
Lower Woods Creek LW Installation
Overall Site Plan

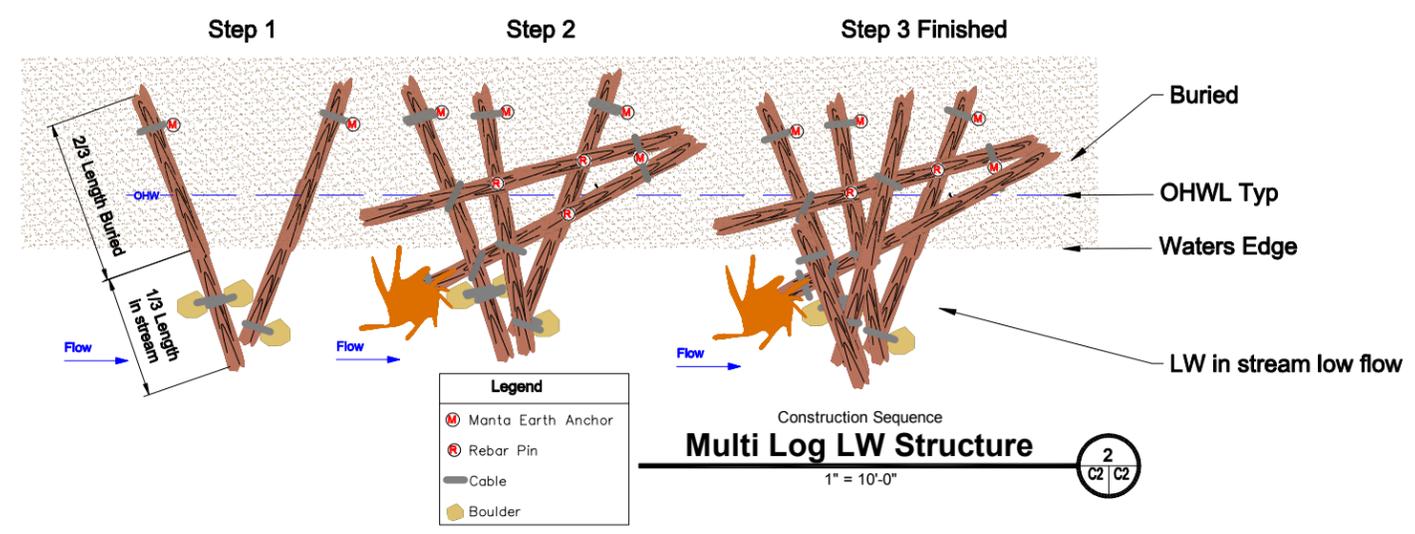
DRAWING NO.
C1
5 OF 15



**Watkins and Qayyum Site
 Site Plan**
 1
 C2 C2
 1" = 40'-0"



Multi-Log LW Structure
 A&B
 C2 C2
 1" = 10'-0"



Multi Log LW Structure
 2
 C2 C2
 1" = 10'-0"

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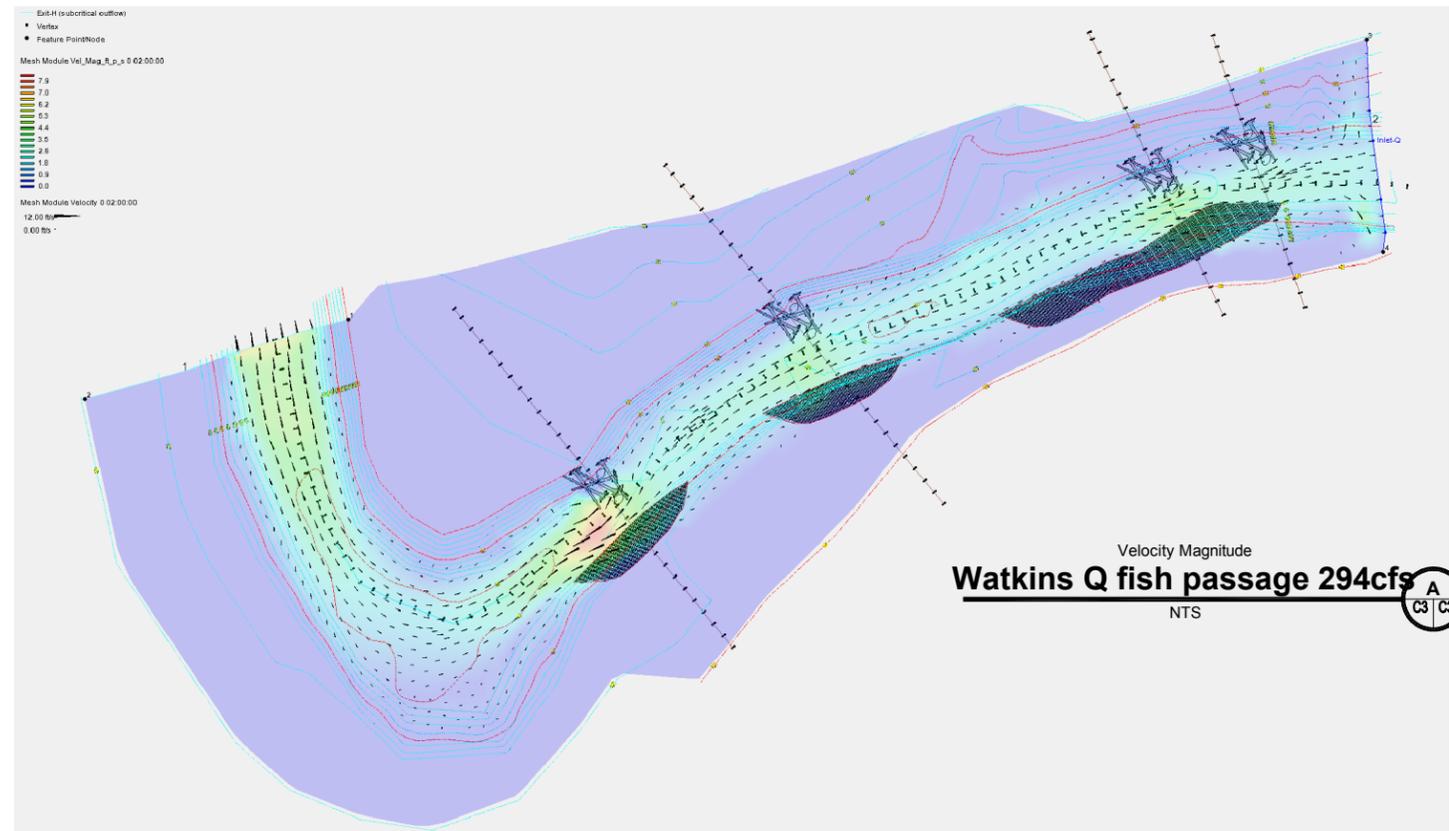
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**Lower Woods Creek LW Installation
 Watkins and Qayyum Plan**

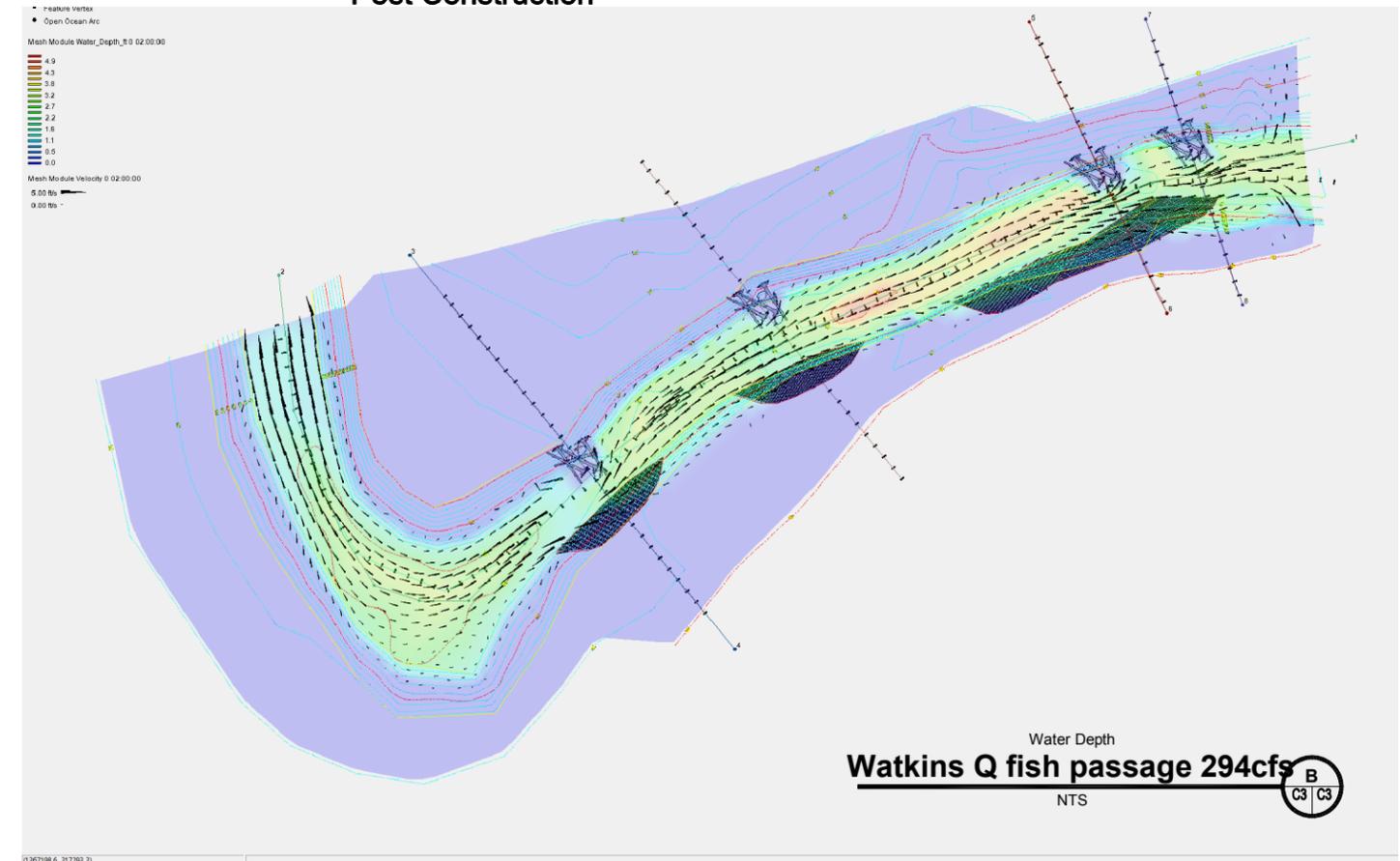


1" Bar at Original Scale

Post Construction



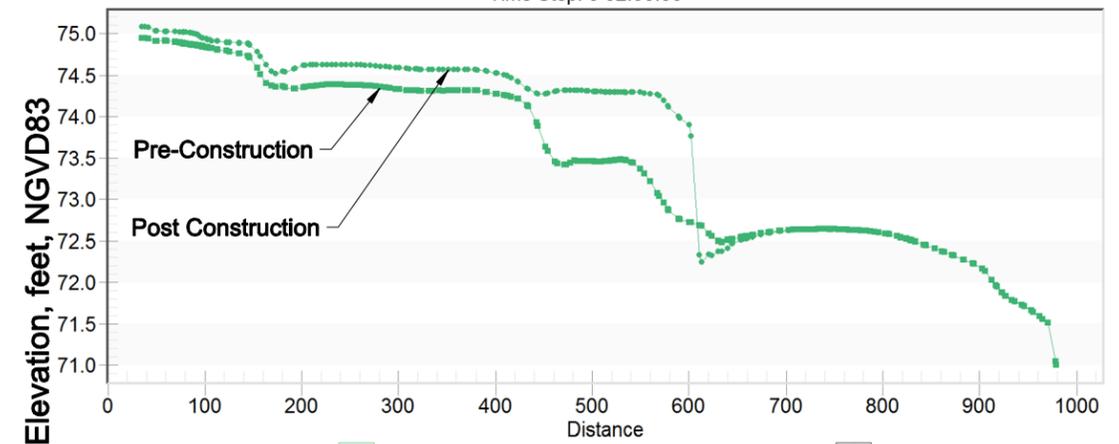
Post Construction



(36798.6, 317293.3)

Section 31 & 32 T28N R7E NAD83

Pre vs. Post Construction
Watkins Water Surface Profile 294 cfs
Time Step: 0 02:00:00



Reach Profile, Watkins Mesh PreConst\Water_Elev_ft
Watkins Mesh PostConst\Water_Elev_ft

Water Surface Elevations
Watkins Q fish passage 294cfs
NTS

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6600 Woodridge Drive
Coupeville, Washington 98239
(360) 678-4747
Professional Consulting Engineers

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3	6-20-2016	Reissued for Permits				
4						

PROJECT NO. 15229

Notes:

- Analysis completed using SRH-2D and SMS 2D hydraulic modeling software.
- Mannings n values;
 - Main channel = 0.035
 - Banklines = 0.055
 - Overbank = 0.065
- Fish passage flow rate May Q=294cfs determined as per Powers and Saunders, 1998
- LWD structures modeled as modified nodes elevated to form obstructions in bottom and bank elevations.
- No changes associated with scour are included in analysis and may effectively lower water surface elevations.

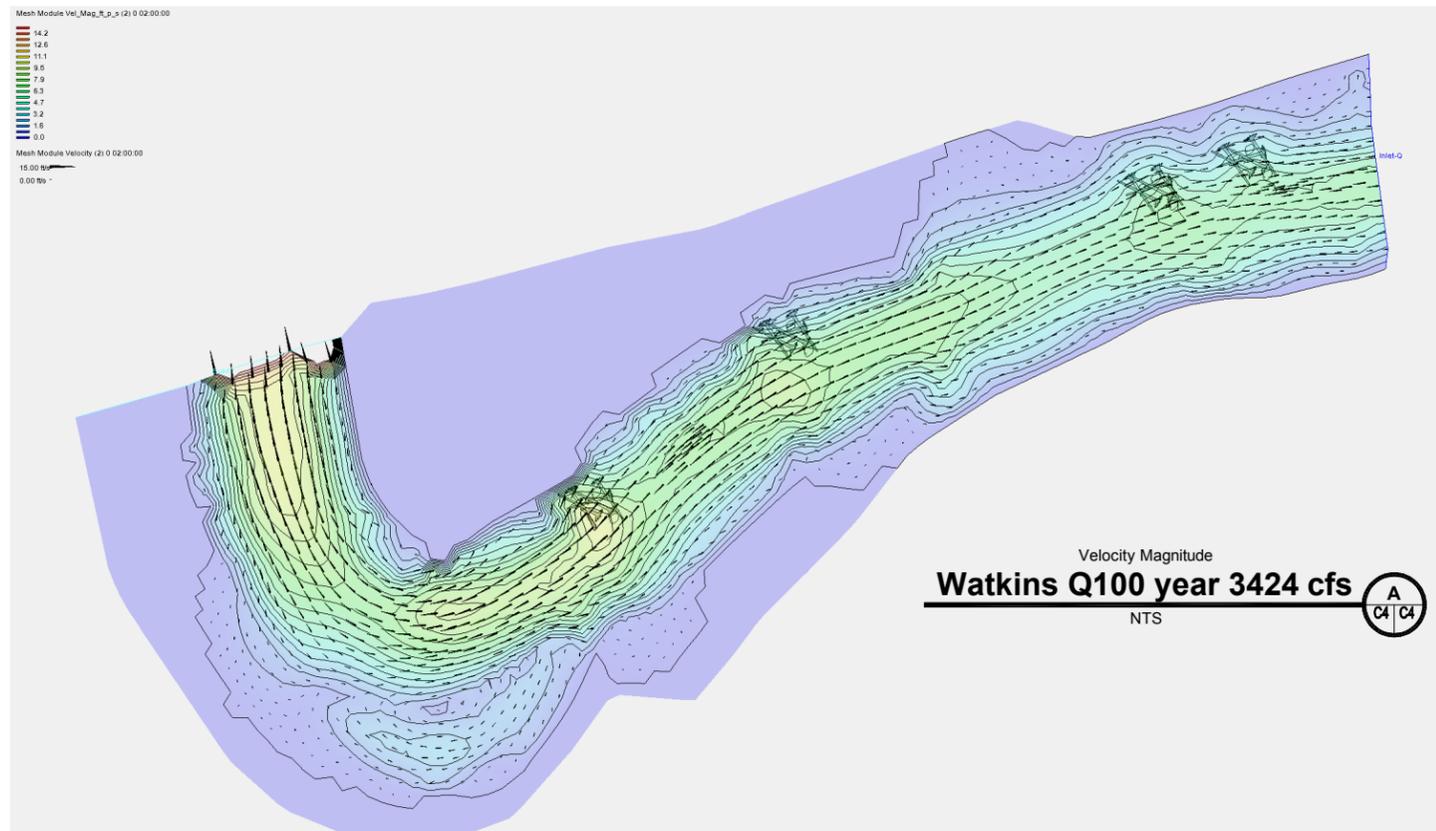


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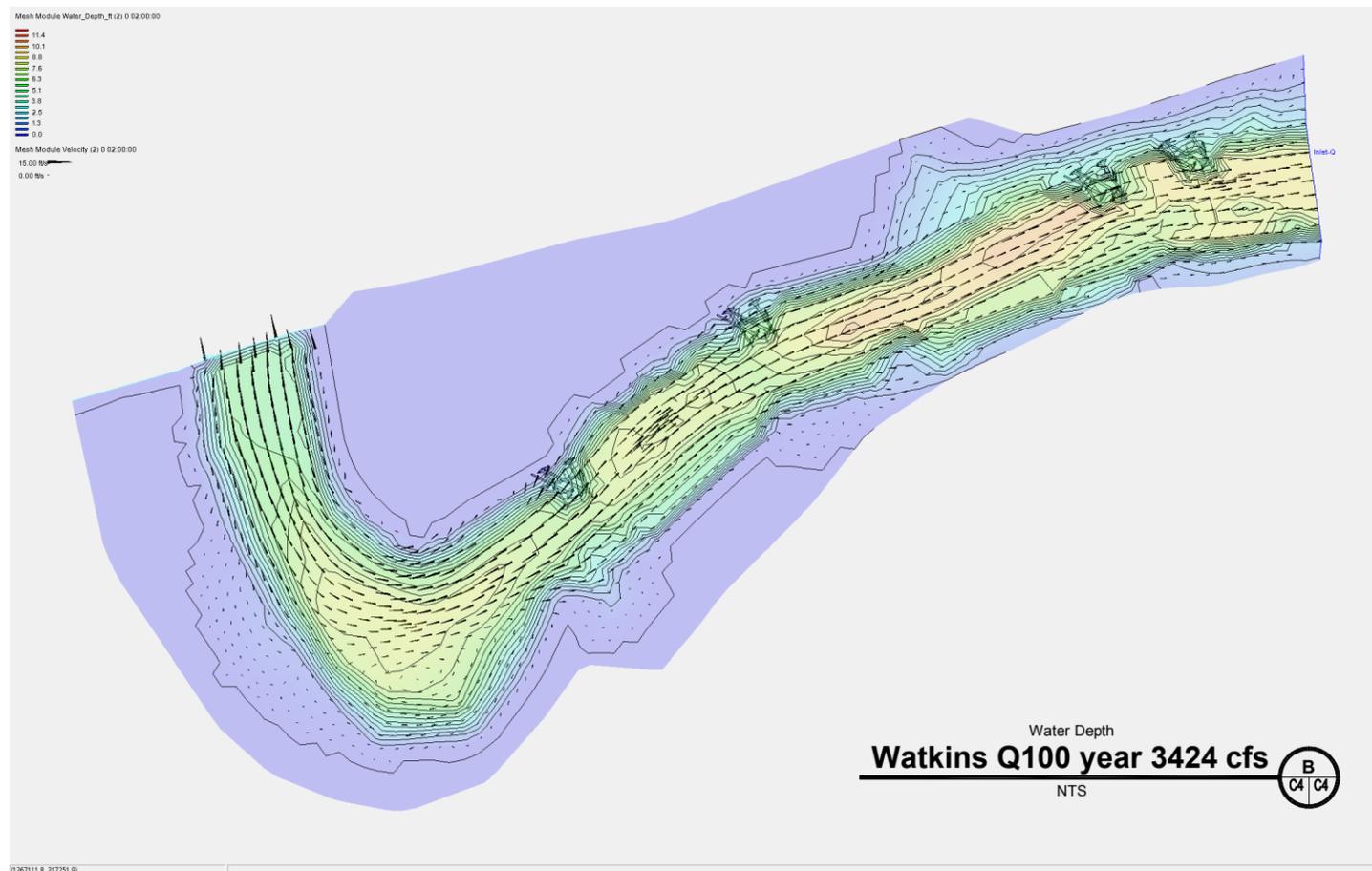
WA State Recreation Conservation Office
Salmon Recovery Funding Board 15-1131
Lower Woods Creek LW Installation
Watkins and Gerardi Hydraulics Analysis

DRAWING NO.
C3
6 OF 15

Post Construction

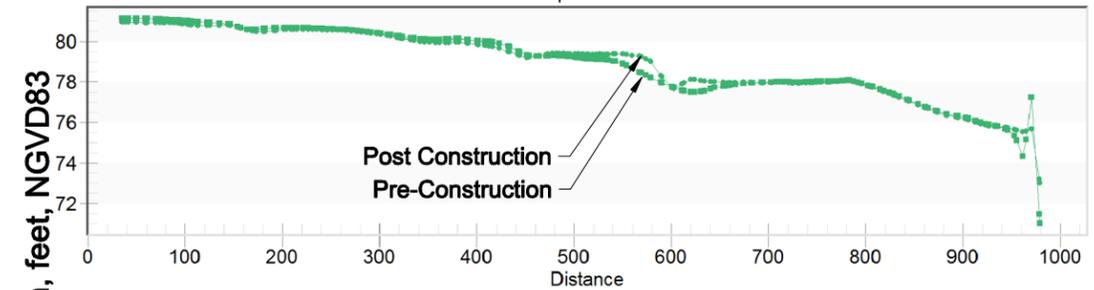


Post Construction



Section 31 & 32 T28N R7E NAD83

Pre vs. Post Construction
Water Surface Profile Q100 Year Event



Legend:
 □ Reach Profile, Watkins Mesh PreConst\Water_Elev_ft (2)
 ● Watkins Mesh PostConst\Water_Elev_ft (2)
 ■ Watkins Mesh PreConst\Water_Elev_ft (2)
 — Reach Profile

Water Surface Elevations
Watkins Q100 year 3424 cfs
 NTS



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PROJECT NO. 15229

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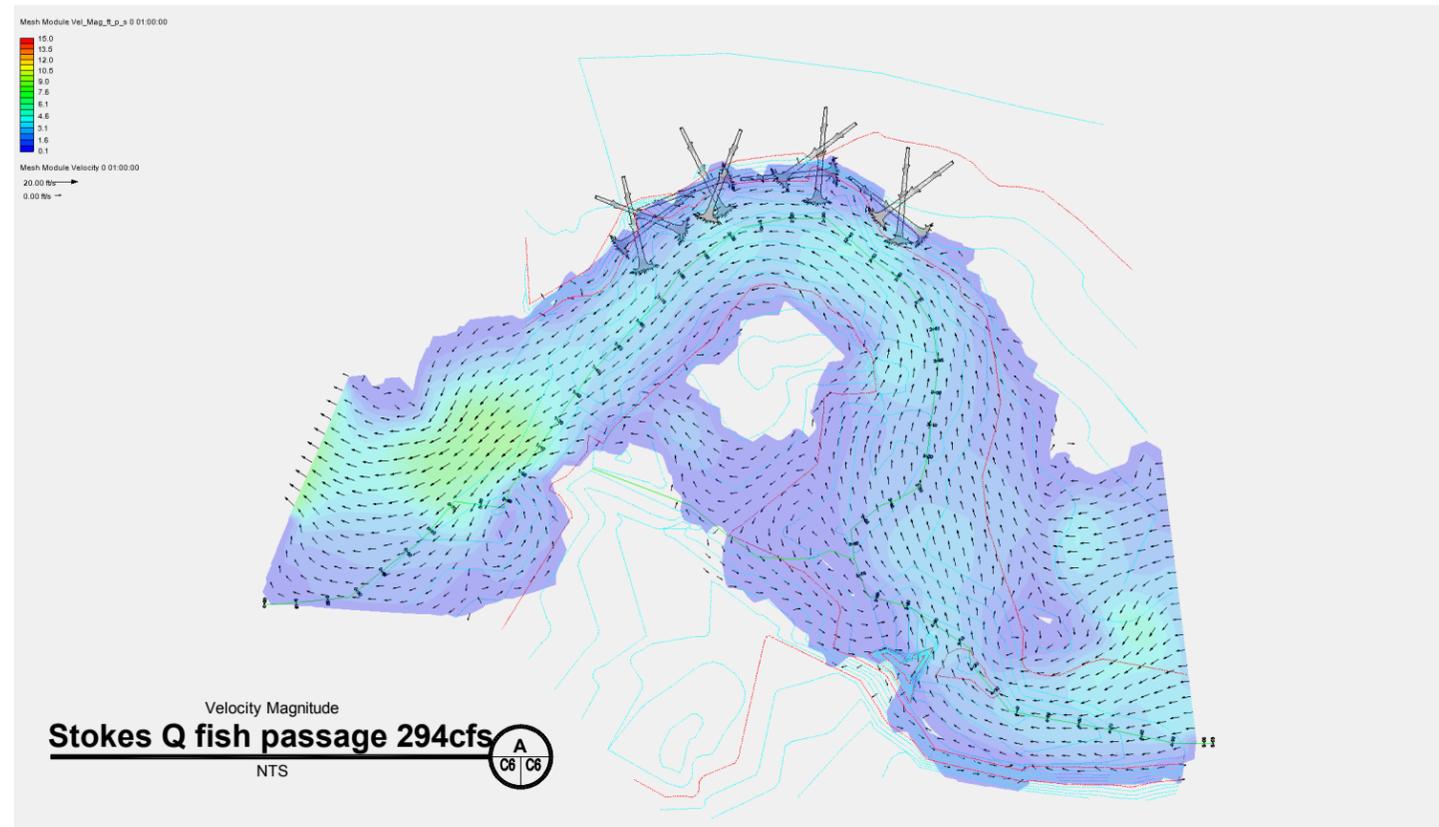


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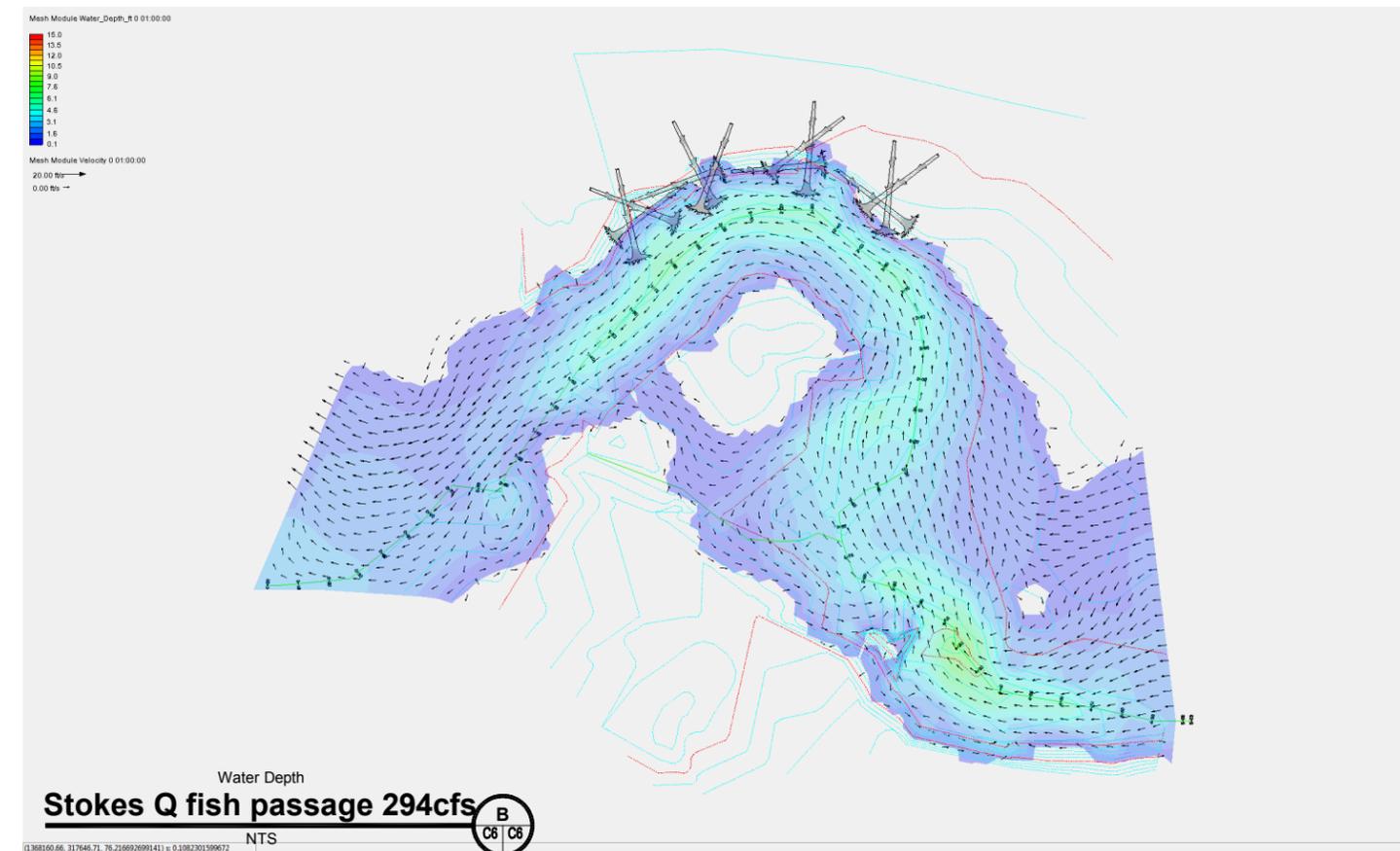
WA State Recreation Conservation Office
 Salmon Recovery Funding Board 15-1131
Lower Woods Creek LW Installation
 Watkins and Gerardi Hydraulics Analysis

DRAWING NO.
C4
 7 OF 15

Post Construction

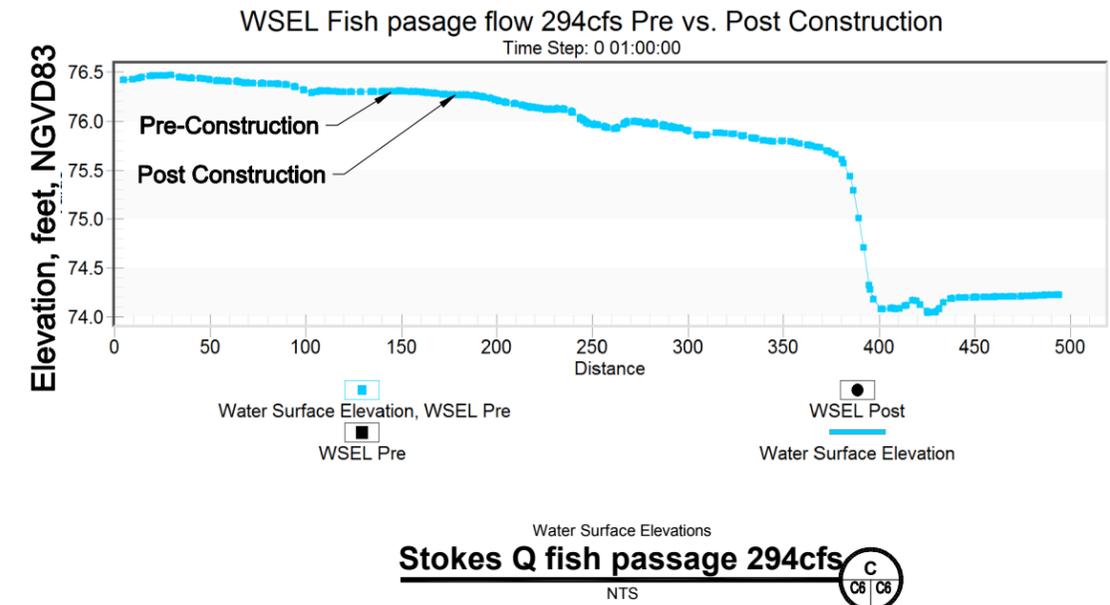


Post Construction



Section 31 & 32 T28N R7E NAD83

Pre vs. Post Construction



Notes:

1. Analysis completed using SRH-2D and SMS 2D hydraulic modeling software.
2. Mannings n values;
 - 2.1. Main channel = 0.045
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 - 2.3. Overbank = 0.065
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PROJECT NO. 15229

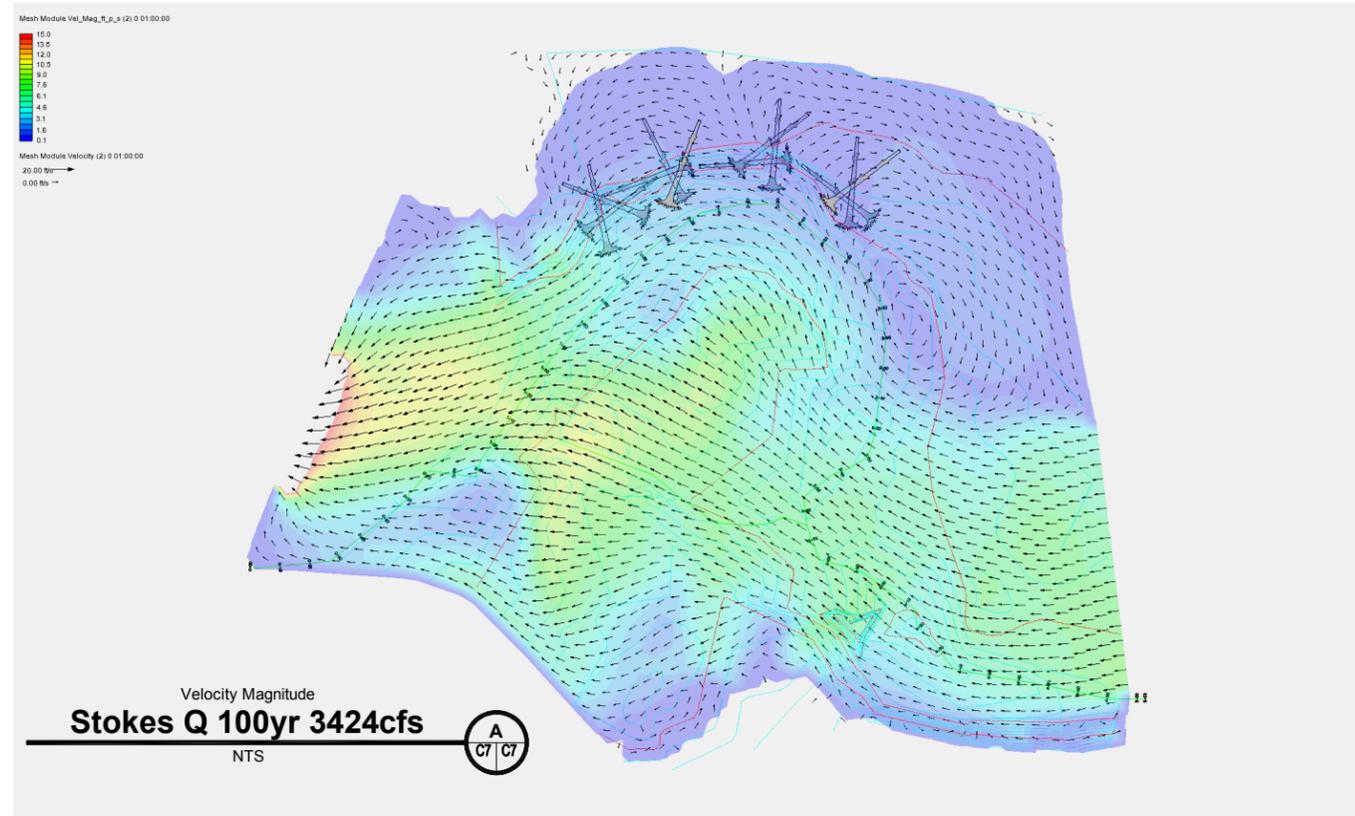
WA State Recreation Conservation Office
 Salmon Recovery Funding Board 15-1131
Lower Woods Creek LW Installation
Stokes Hydraulics Analysis



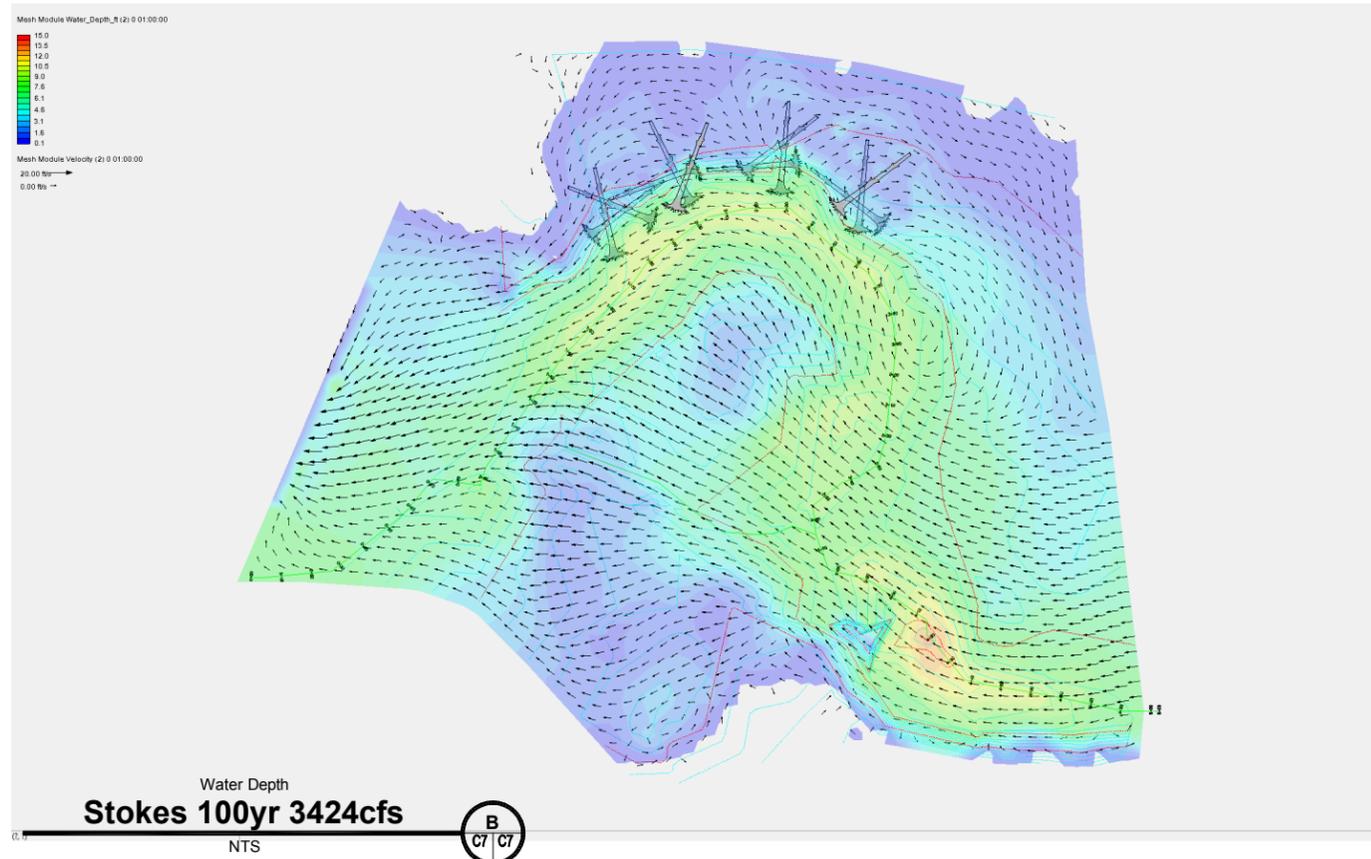
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DRAWING NO.
C6
 9 OF 15

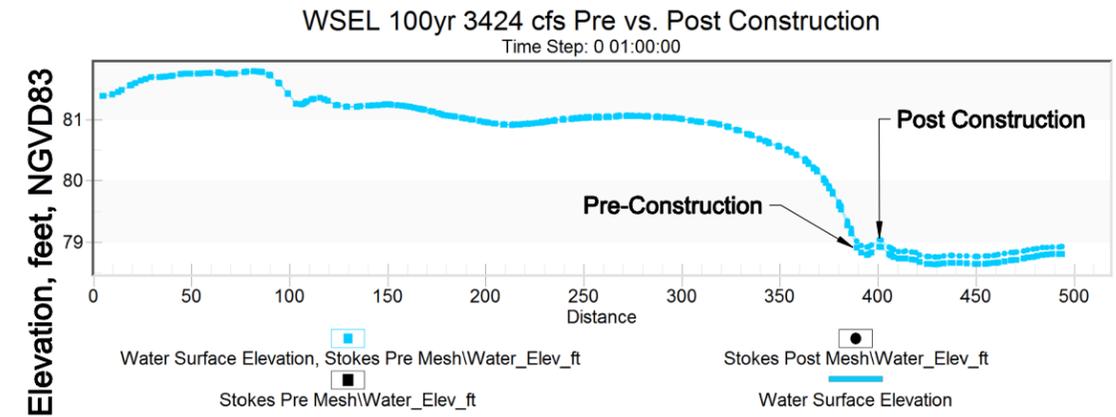
Post Construction



Post Construction



Section 31 & 32 T28N R7E NAD83



Water Surface Elevations
Stokes Q 100yr 3424 cfs
 NTS

C
C7 C7

Notes:

1. Analysis completed using SRH-2D and SMS 2D hydraulic modeling software.
2. Mannings n values;
 - 2.1. Main channel = 0.045
 - 2.2. Banklines = 0.055
 - 2.3. Overbank = 0.065
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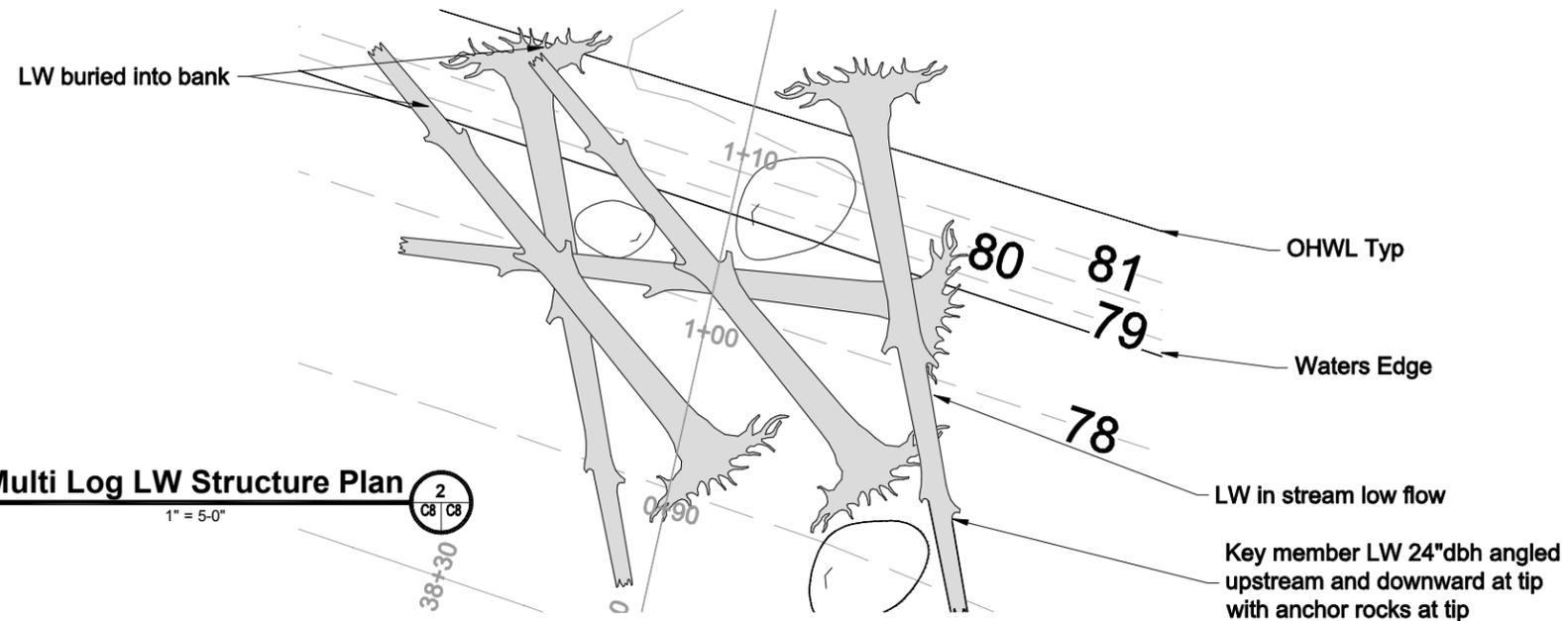
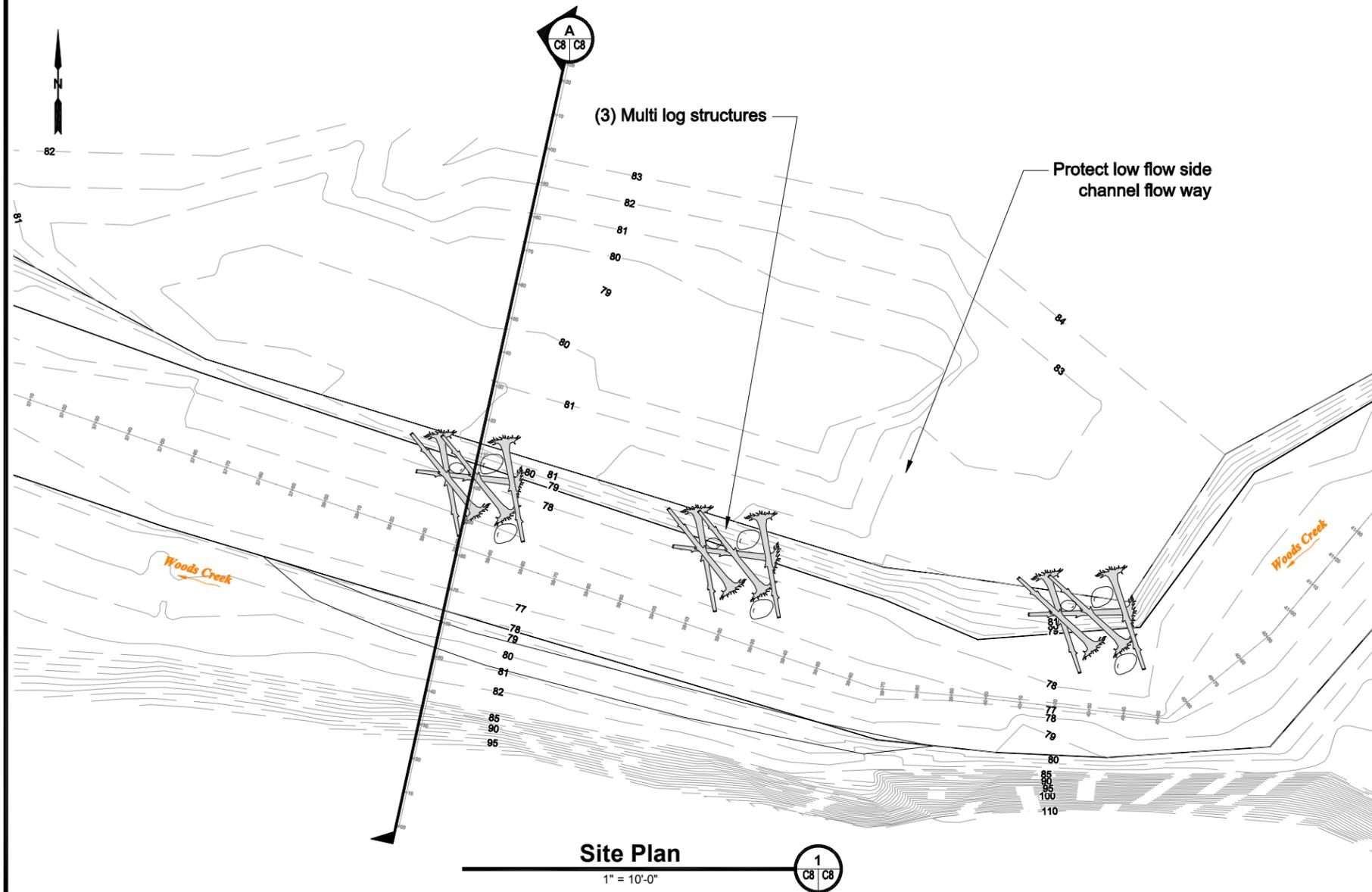
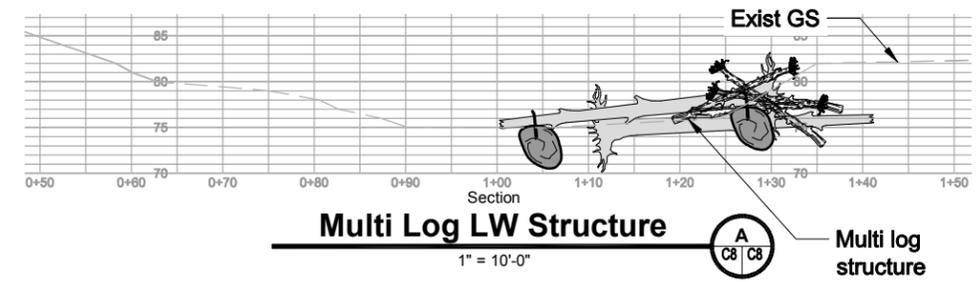
PROJECT NO. 15229

WA State Recreation Conservation Office
 Salmon Recovery Funding Board 15-1131
Lower Woods Creek LW Installation
Stokes Hydraulics Analysis



1" Bar at Original Scale

DRAWING NO.
C7
 10 OF 15



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2	3-10-2016	Issued for USCOE Permits	JSK	JSK	JSK	JSK
3	6-20-2016	Reissued for Permits				
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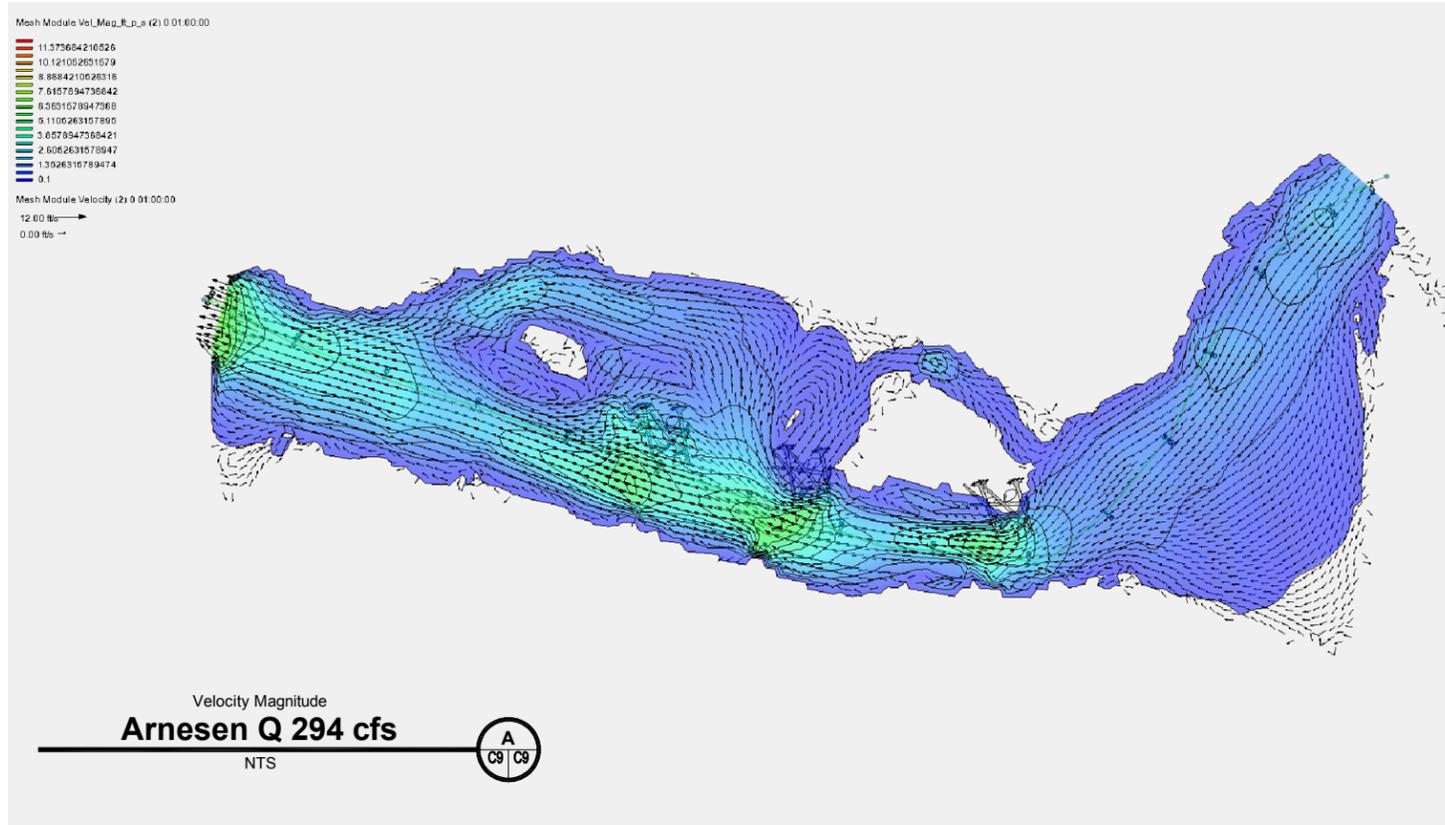
PROJECT NO. 15229

WA State Recreation Conservation Office
 Salmon Recovery Funding Board 15-1131
Lower Woods Creek LW Installation
Arnesen Plan

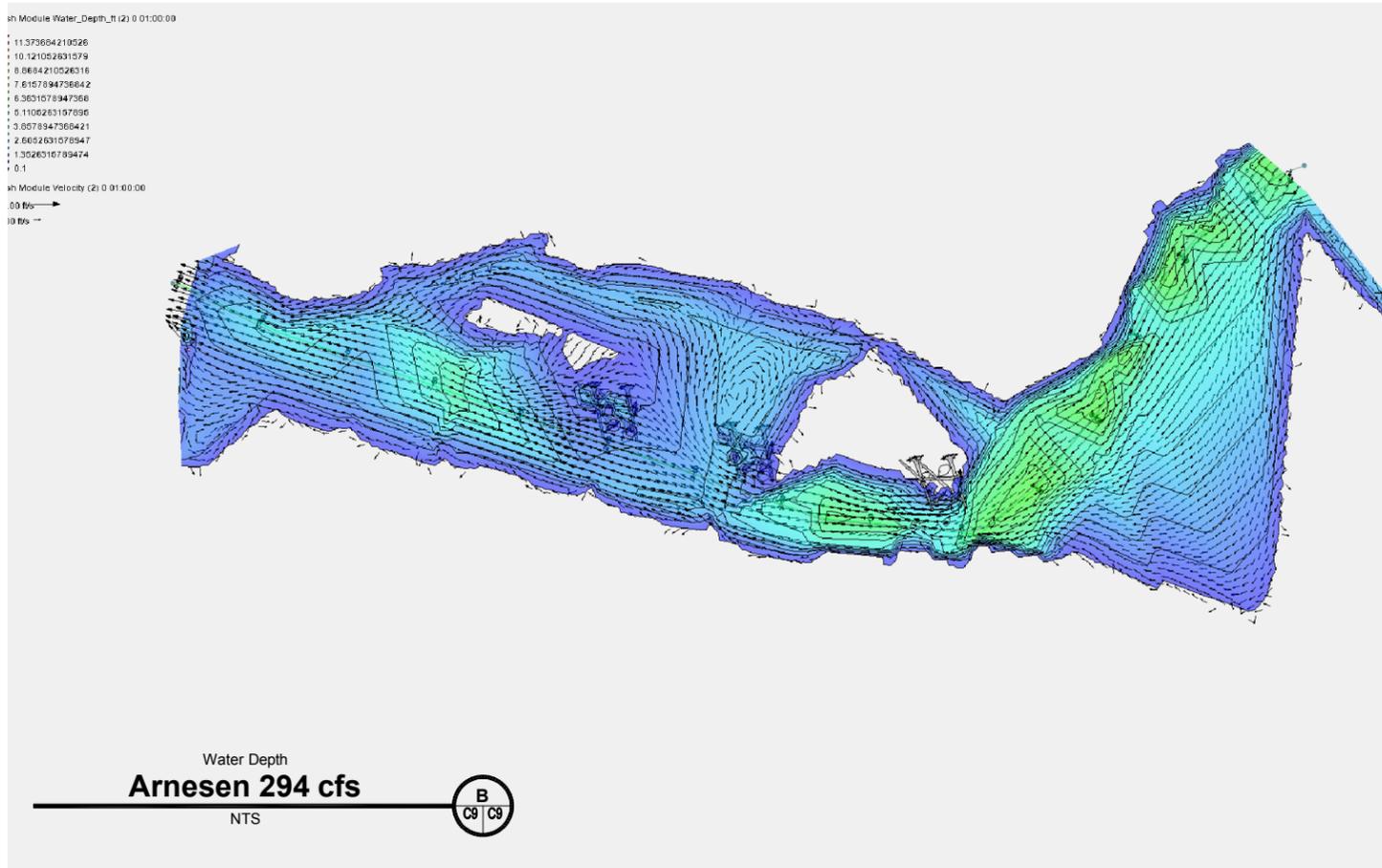


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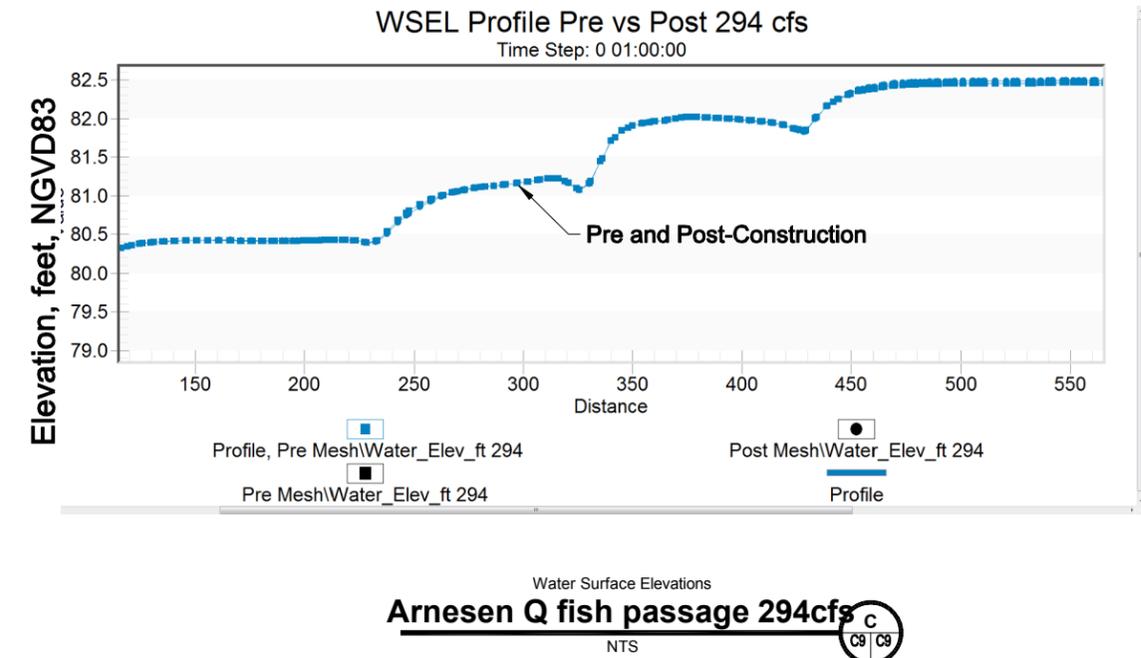
Post Construction



Post Construction



Section 31 & 32 T28N R7E NAD83



Notes:

1. Analysis completed using SRH-2D and SMS 2D hydraulic modeling software.
2. Mannings n values;
 - 2.1. Main channel = 0.045
 - 2.2. Banklines = 0.055
 - 2.3. Overbank = 0.065
3. Fish passage flow rate May Q=294cfs determined as per Powers and Saunders, 1998
4. LWD structures modeled as modified nodes elevated to form obstructions in bottom and bank elevations.
5. No changes associated with scour are included in analysis and may effectively lower water surface elevations.



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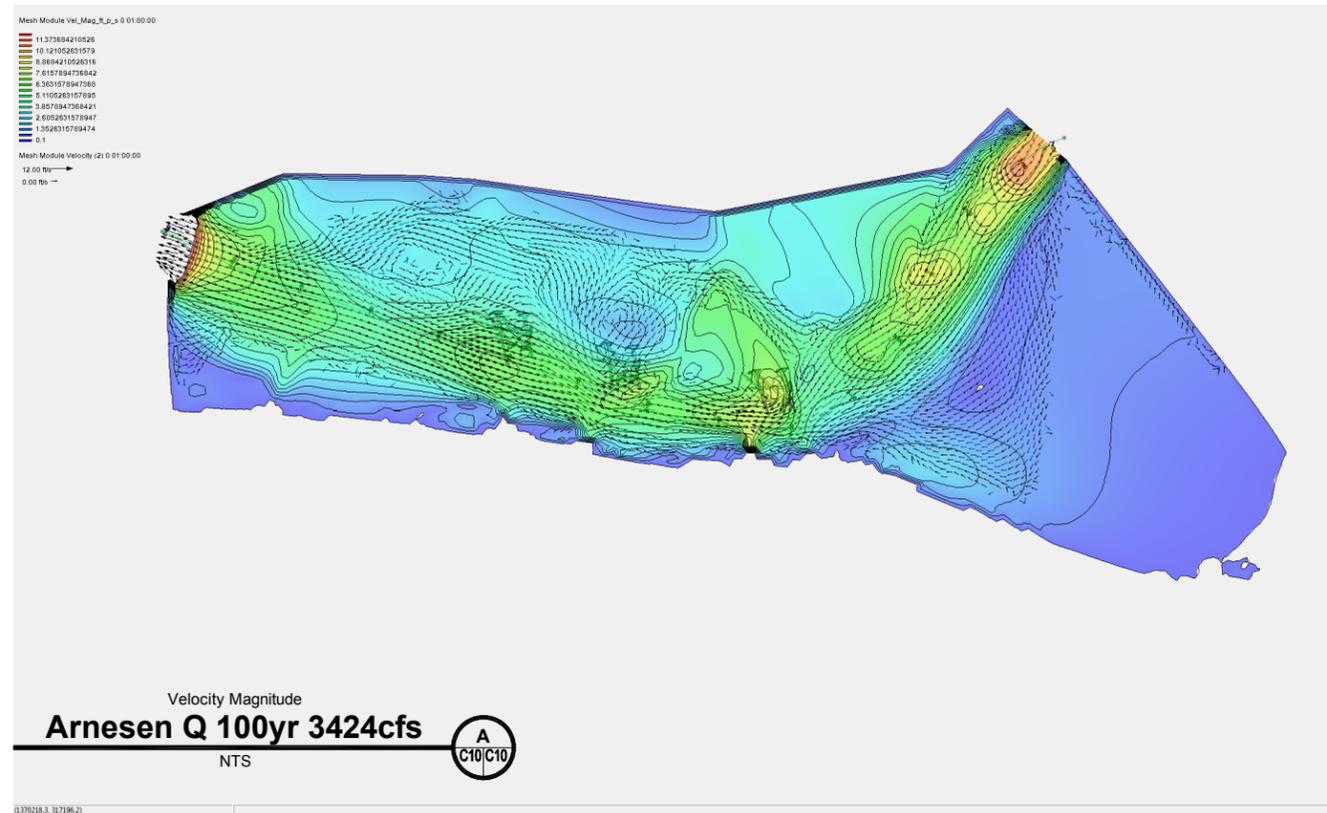
PROJECT NO. 15229

WA State Recreation Conservation Office
Salmon Recovery Funding Board 15-1131
Lower Woods Creek LW Installation
Arnesen Hydraulics Analysis 294 cfs



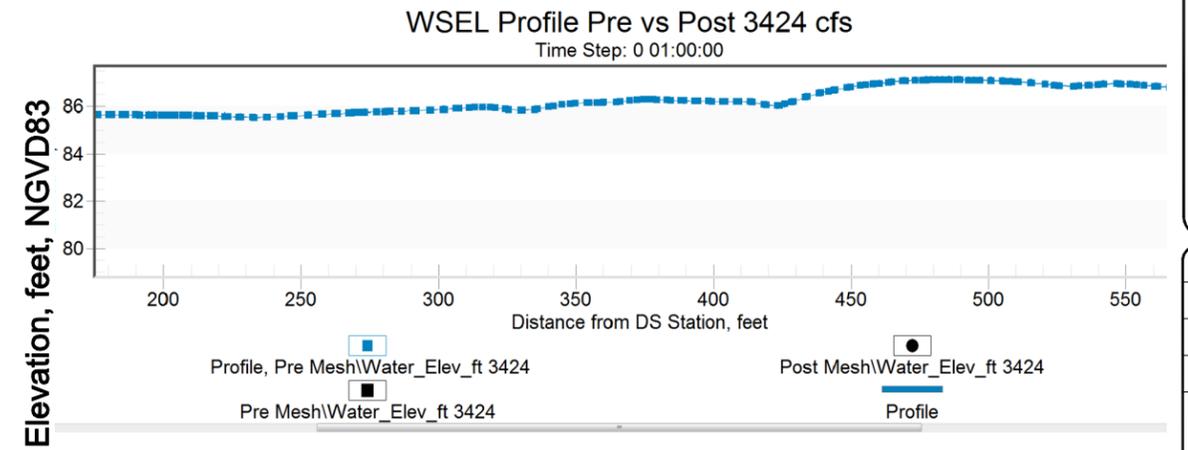
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Post Construction



0370228.3, 317196.2

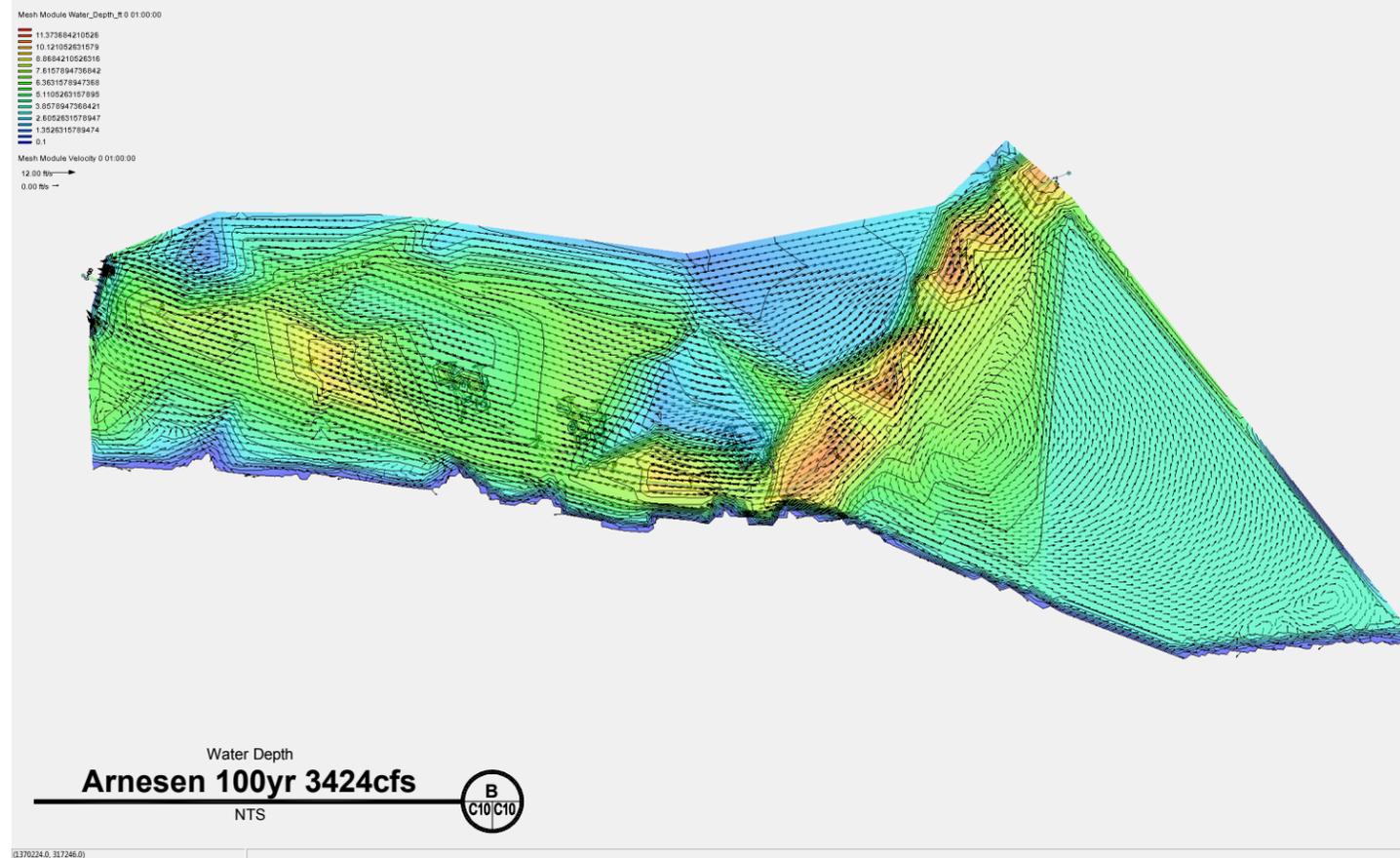
Section 31 & 32 T28N R7E NAD83



Water Surface Elevations
Arnesen Q 3424 cfs
NTS

C
C10/C10

Post Construction



0370224.0, 317246.0

Notes:

1. Analysis completed using SRH-2D and SMS 2D hydraulic modeling software.
2. Mannings n values;
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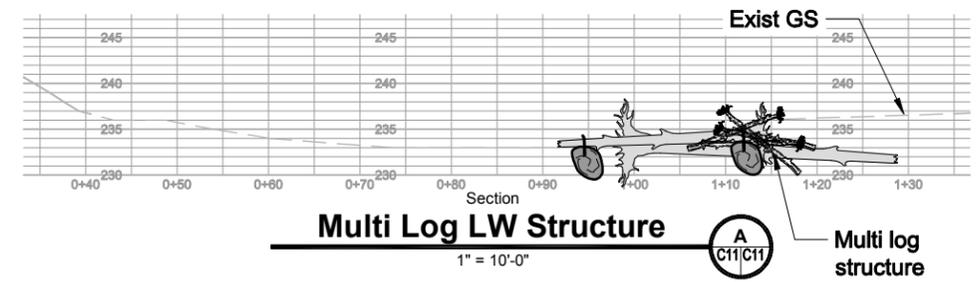
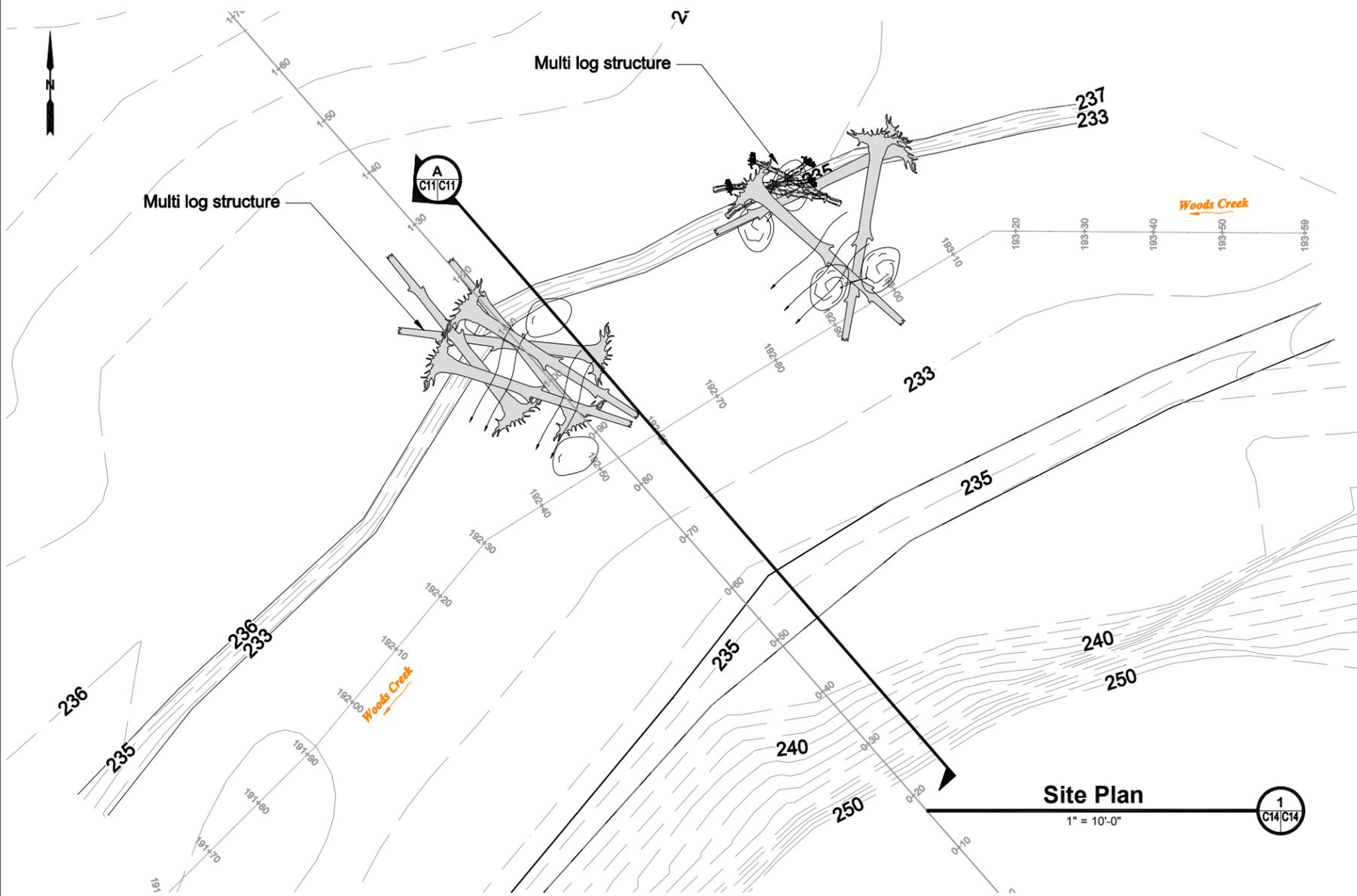
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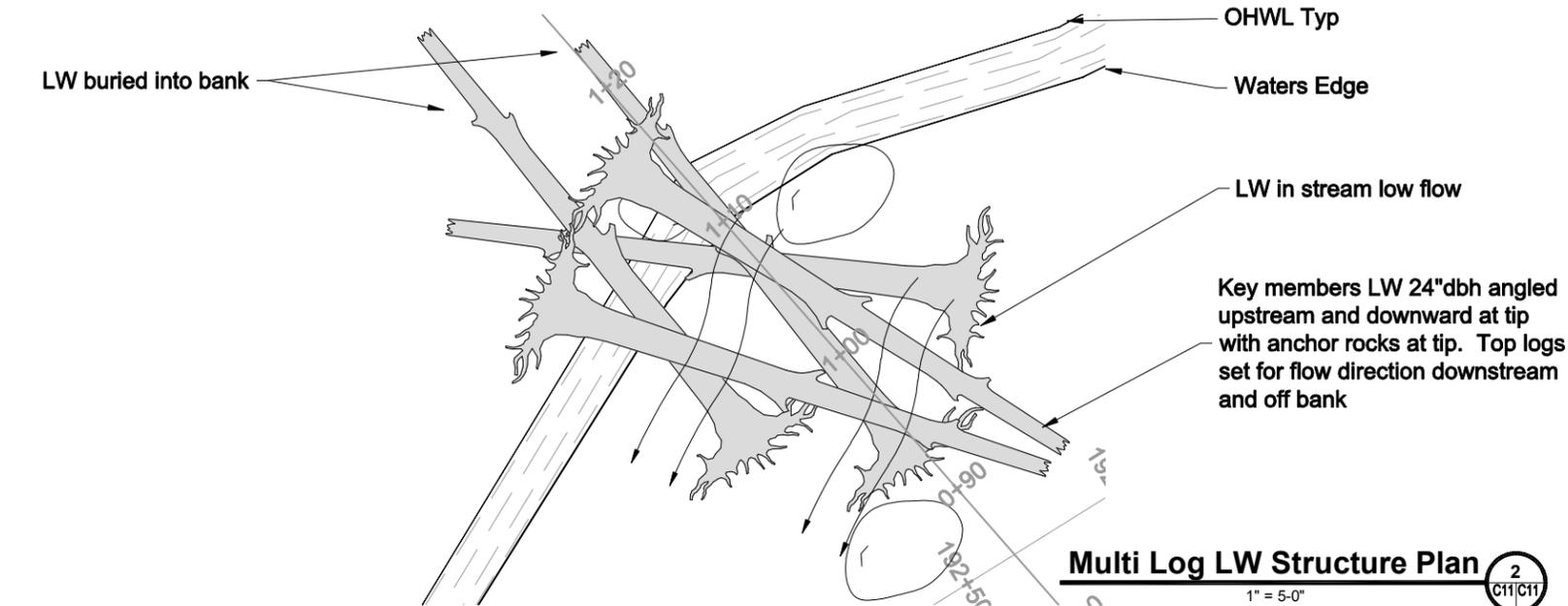
WA State Recreation Conservation Office
Salmon Recovery Funding Board 15-1131
Lower Woods Creek LW Installation
Arnesen Hydraulics Analysis 3424 cfs



1" Bar at Original Scale



Site Plan
1" = 10'-0"
1 C11/C14



Multi Log LW Structure Plan
1" = 5'-0"
2 C11/C11

- Notes:**
1. Hydraulic Analysis completed at other sites by SRH-2D and SMS 2D hydraulic modeling software indicates that during the 100 year flow rate, no difference in water surface elevations occurs.
 2. No changes associated with scour are included in analysis and may effectively lower water surface elevations. Additional scour may occur at the LW and reduce the water surface elevation further post construction.

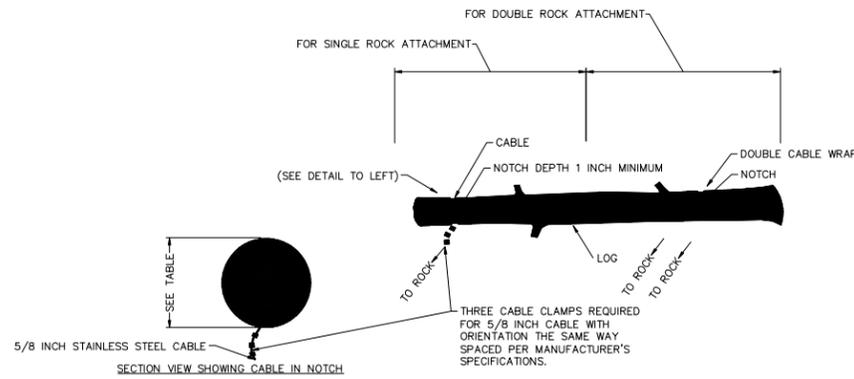
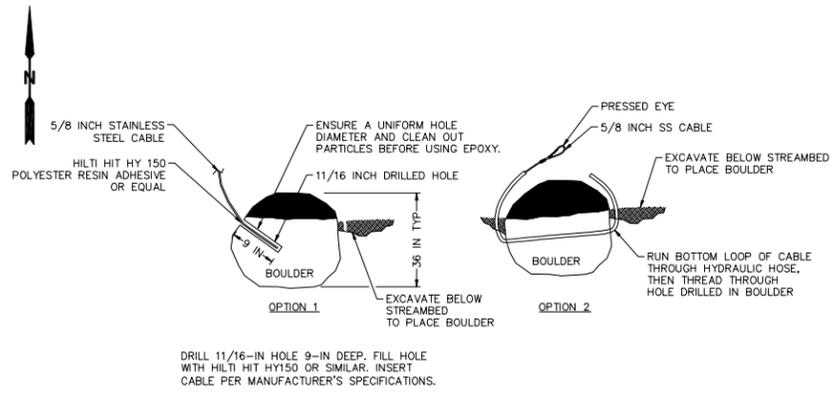
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PROJECT NO. 15229

WA State Recreation Conservation Office
 Salmon Recovery Funding Board 15-1131
Lower Woods Creek LW Installation
 Coco - Cron Site

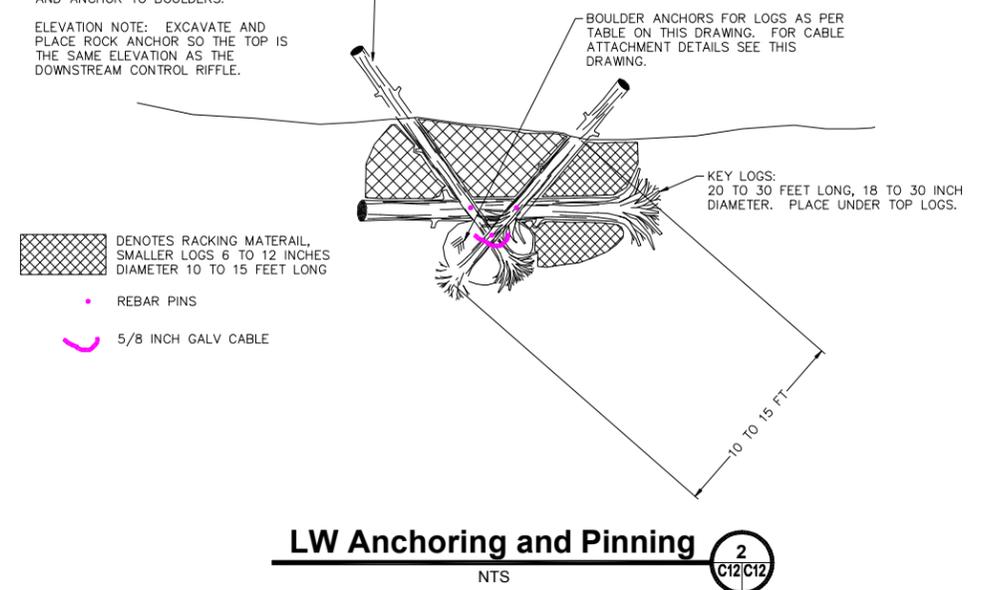


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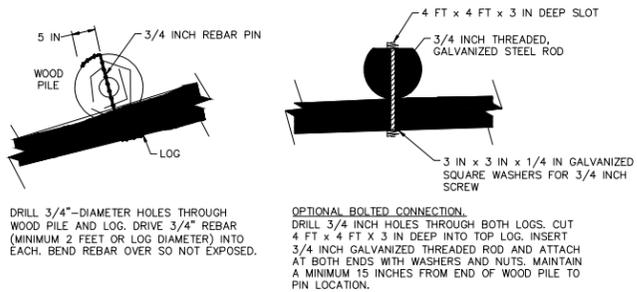


TOP LOGS:
15 TO 18 INCH DIAMETER, 20 TO 30 FEET LONG. TRENCH EXCAVATE TO BURY 10 FEET INTO EXISTING BANKS AND ANCHOR TO BOULDERS.

ELEVATION NOTE: EXCAVATE AND PLACE ROCK ANCHOR SO THE TOP IS THE SAME ELEVATION AS THE DOWNSTREAM CONTROL RIFFLE.



LW Anchoring and Pinning 2
NTS C12/C12



LWD ANCHOR TABLE ASSUMING TWO ROCKS PER LWD PIECE (WEIGHT OF EACH ROCK, ROCK DIAMETER)

LOG DIAMETER (INCHES)	LOG LENGTH (FEET, TIP TO BASE)			
	10	20	30	40
12	570 LBS, 22 INCH	1050 LBS, 27 INCH	1530 LBS, 27 INCH	
18	1150 LBS, 28 INCH	1870 LBS, 33 INCH	2600 LBS, 37 INCH	3300 LBS, 40 INCH
24	1630 LBS, 31 INCH	2600 LBS, 36 INCH	3500 LBS, 41 INCH	4500 LBS, 44 INCH
36	2400 LBS, 36 INCH	3800 LBS, 42 INCH	5300 LBS, 46 INCH	6700 LBS, 50 INCH

- ASSUMPTIONS
- VALUES ARE FOR EACH ROCK.
 - LOGS HAVE ROOTWADS ATTACHED
 - LOG DIAMETER IS AVERAGE OF BASE AND END

LW Anchoring Details 1
NTS C12/C12

Log and Anchor Boulder Schedule

Location	Materials					Total
	Watkins Gerardi	Stokes	Arnesen	Coco/Cron		
Habitat Boulders, 4-5 man assumed	26	24	41	17		108
w/Rootwad 24" DBH x 40'	2	8	9			19
w/Rootwad 24" DBH 20'	1	12	18	4		35
Straight Log 18-24" DBH x 40'	5	12	28			45
Straight Log 12-14" DBH x 20'		16		5		21
Racking material, 12" dbh and smaller	20	20	20	20		80

Notes:

- All Large Wood Debris (LWD or LW) shall be competent and not rotten and in good condition. No salvaged boom logs shall be used. Large branches and tangled roots are beneficial. Do not trim.
- LWD with rootwads shall have roots attached.
- Habitat boulders shall be sized according to table this sheet and are estimates. Size and quality shall be as per WSDOT. See specifications.
- All LWD shall be approved in writing piece by piece by engineer prior to transport to the site for staging.
- Racking material may be reservoir salvaged wood, or pieces of deciduous wood but not key members.

LW and Anchor Rock Table 3
NTS C12/C12

