

CITY ADMINISTRATOR
ROBERT OMANS

CITY CLERK
DEBBIE LEE

FINANCE DIRECTOR
ROBIN NEWCOMB

PUBLIC WORKS

POLICE CHIEF
RICH ALBO

FIRE CHIEF
ED MILLS

PLANNER

City Council
Agenda
August 12, 2024
5:00 PM



119 W FIRST STREET
CLE ELUM, WA 98922

MAYOR
MATTHEW LUNDH

MAYOR PRO TEM
STEVEN HARPER

CITY COUNCIL
JOHN GLONDO
BETH WILLIAMS
JERRED WEIS
KEN RATLIFF
STEVEN COOK
AUDREY MALEK

CITY ATTORNEY
ALEXANDRA KENYON

Join Virtually with Zoom: <https://zoom.us/j/7573184018?pwd=dERndjBJVC9GdVQ1d2lSRExwZFhXZz09>
Meeting ID: 757 318 4018 Passcode: 98922

Join by Phone: 1-(253)215-8782, Meeting ID: 757 318 4018, Passcode:98922

TextMyGov Receive city text alert notifications: text CLEELUM to 91896

DISCLAIMER: The City does not guarantee that virtual or telephonic access to the City Council meeting will be available and the City does not warrant audio quality. Attendees are encouraged to attend in-person.

1. **Call to Order, Pledge of Allegiance, and Roll Call**
 - a. August 12, 2024, Special Meeting Sign In Sheet
2. **New Business**
 - a. Hanson Pond Update - Mel Babik
3. **Adjournment by Motion**

Upcoming Meetings:

Regular Council Meeting: August 13, 2024 @ 6:00 p.m.

Planning Commission Meeting: August 20, 2024 @ 6:00 p.m.

General Government Committee Meeting: August 28, 2024 @ 8:30 a.m.

Lodging Tax & Events Committee Meeting: August 12, 2024 @ 8:30 a.m.

Public Safety & Health Committee Meeting: August 20, 2024 @ 1:00 p.m.

Public Works & Community Development Committee Meeting: September 5, 2024 @ 12:00 p.m.

Coal Mines Trail Commission Meeting: September 9, 2024 @ 6:00 p.m.

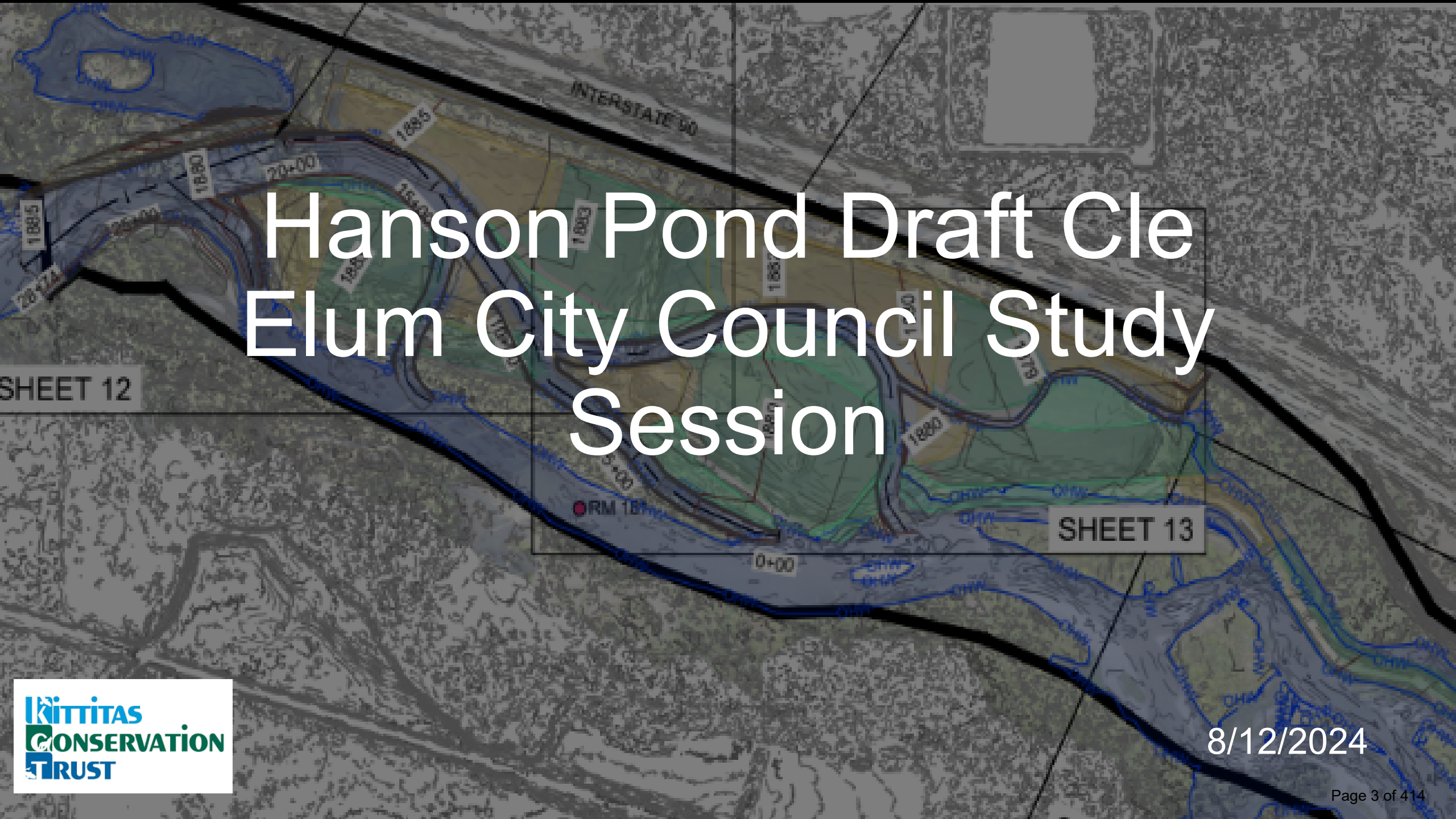
City of Cle Elum Study Session Hanson Ponds

August 12, 2024, 5:00 p.m.

PLEASE SIGN IN BELOW

Please sign in:

Name	Address
Mel Babik	KCT
Mitch Long	KCT
Larry Stauffer	2061 Lower Leach Rd, Cle Elum
Pat Densen	509 2600 462 / 1890 Nelson Siding Rd, Cle Elum
Polyanna Lind	501 Parkway Idona River
Jean Glorioso	CITY COUNCIL



Hanson Pond Draft Cle Elum City Council Study Session

Team Introductions

Kittitas Conservation Trust

501(c) (3) nonprofit

Mission: to protect and enhance critical fish and wildlife habitat in the Upper Yakima River Basin

Role: Project Sponsor holding DOE & RCO funds for full design and permitting

- Mitch Long, Executive Director
- Mel Babik, Restoration Director



Team Introductions

Interfluve

Mission: to heal aquatic ecosystems through applied science and engineering.

Role: Modeling and Design Team



- Pollyanna Lind, PhD Senior Geomorphologist
- Dan Miller, PE Principal Hydraulic Engineer
- Josh Barza, PE Water Resources Engineer
- Andrea Judge, PE Senior Water Resources Engineer
- Michael Rafferty, PE Senior Water Resources Engineer

Team Introductions

Jacobs Engineering Group

Mission: challenging today to reinvent tomorrow by solving the world's most critical problems

Role: Civil design of outfall & permitting support

Jacobs

- Jennifer Bader, Senior Biologist
- Allan Evans, Senior Civil Water Conveyance Engineer
- John Nelson, Fisheries Engineer Subject Matter Expert

Team Introductions

Aspect

Mission: focus on sustainable development of earth and water resources

Role: Subsurface analysis and levee realignment

- Andy Holmson, Principal Geotechnical Engineer
- Jane Gregg, Senior Geotechnical Engineer



4 Goals of the Hanson Pond Project

1. Improve anadromous salmonid habitat
2. Improve floodplain connectivity and function
3. Maintain and protect critical infrastructure (sewer outfall and I-90).
4. Provide recreational opportunities for the public, where appropriate.



Stakeholder List

Technical Advisory Committee (TAG)	Affiliation	Role
Matthew Lundh, William LaRue, Ben Annen, Rob Omans	City of Cle Elum	Landowner
Mitch Long, Mel Babik	KCT	Sponsor
Todd Newsome, Brandon Rossi, John Marvin, D. Squeochs	Yakama Nation	Ceded Land/ Technical Expert
Alex Conley	YBFWRB	Technical Expert
William Sauriol & Katie Jones	WSDOT	Technical Expert
Sean Gross	NOAA	Technical Expert
Elizabeth Butler & Review Board	RCO	Funder/ Technical Expert
Jenae Churchill	USACE	Regulator
Jen Nelson, Cassandra Weekes, Marc Divens	WDFW	Regulator
Katy Pfannenstien, Jason Romine, David Dayan	USFWS	Regulator
Cindy Preston	DNR	Regulator
Arden Thomas & Samantha Cox	County	Regulator
Coleman Miller	ECY	Regulator

Stakeholder List



Citizen Advisory Group (CAG) / City of Cle Elum	Affiliation
Ken Ratliff & Steve Cook	Cle Elum City Council
Gary Berndt, Paul Kantwill, Matt Fluegge, John Cornelius, Marc Kirkpatrick, Colin Brissey, Ian Steele	Planning Commission
Larry & Dana Stauffer	Adjacent Landowner
Ellis Nale	Swiftwater Rescue
Lucy Temple	Citizen
Jaimee Mosack	Citizen
Elizabeth Kurtz	Citizen
Jim DeVere, Darian Osiadacz, T. Smith, Michelle Geiger, Mark Thorne, Tom Uren, Tucker Stevens, Jeff Adams	Regional Wastewater

Project Evolution



Desired future condition

Project Evolution

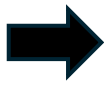


Desired future condition



Define goals

Project Evolution



Desired future condition

Define goals

Assemble Team
(Refine goals)

Project Evolution



Desired future condition



Define goals



Assemble Team
(Refine goals)



Find money (grants)

Project Evolution



Desired future condition



Define goals



Assemble Team
(Refine goals)



Find money (grants)

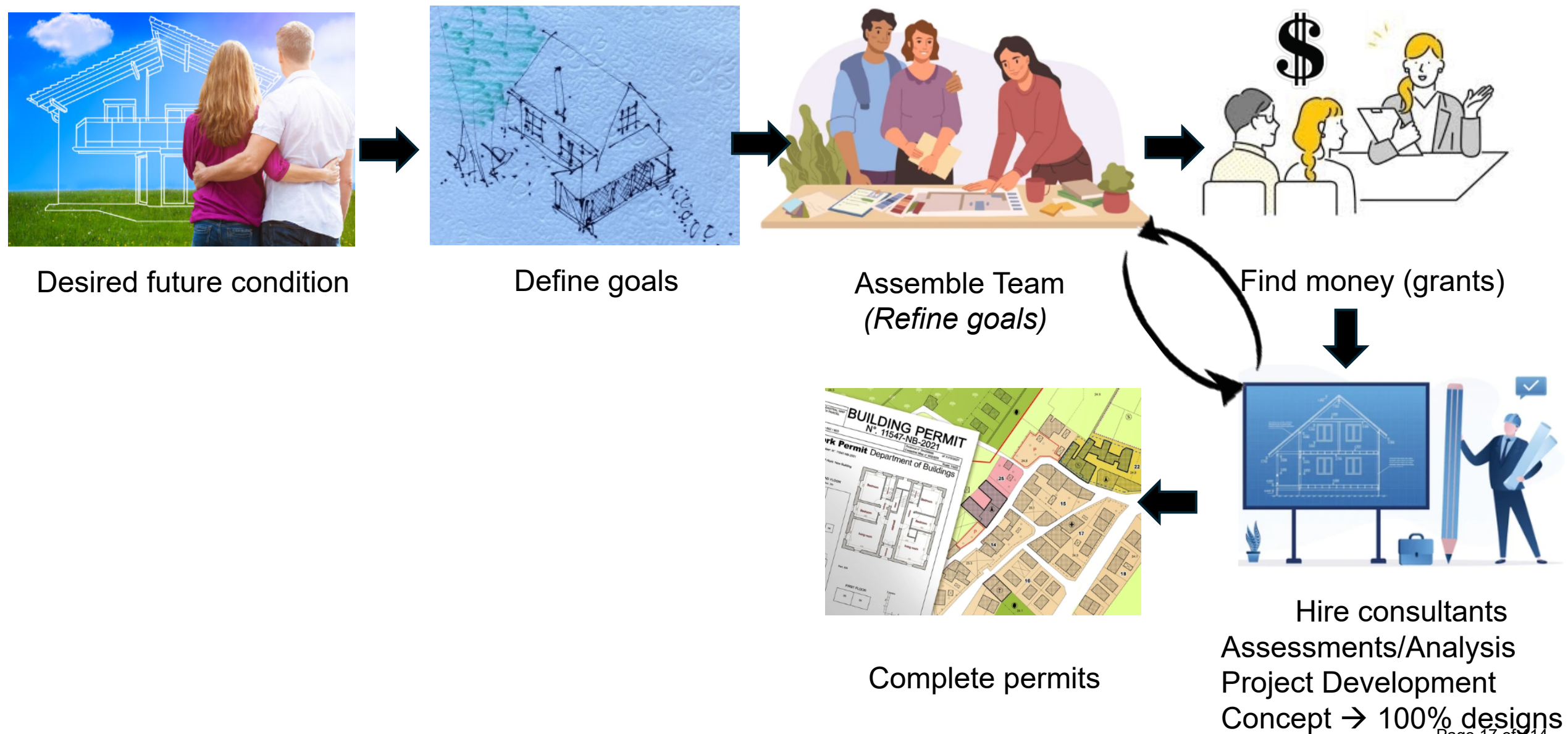


Hire consultants
Assessments/Analysis
Project Development
Concept → 100% designs

Project Evolution



Project Evolution



Project Evolution



Desired future condition



Define goals



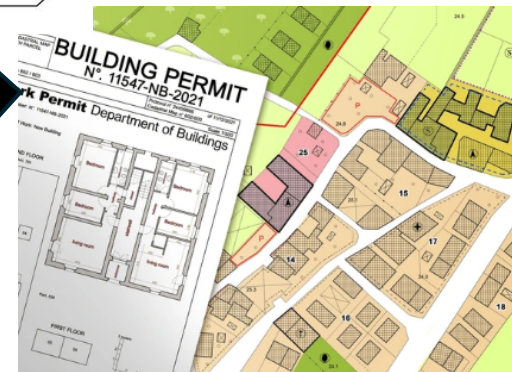
Assemble Team
(Refine goals)



Find money (grants)



Hire consultants
Assessments/Analysis
Project Development
Concept → 100% designs



Complete permits

Project Evolution



Project Evolution

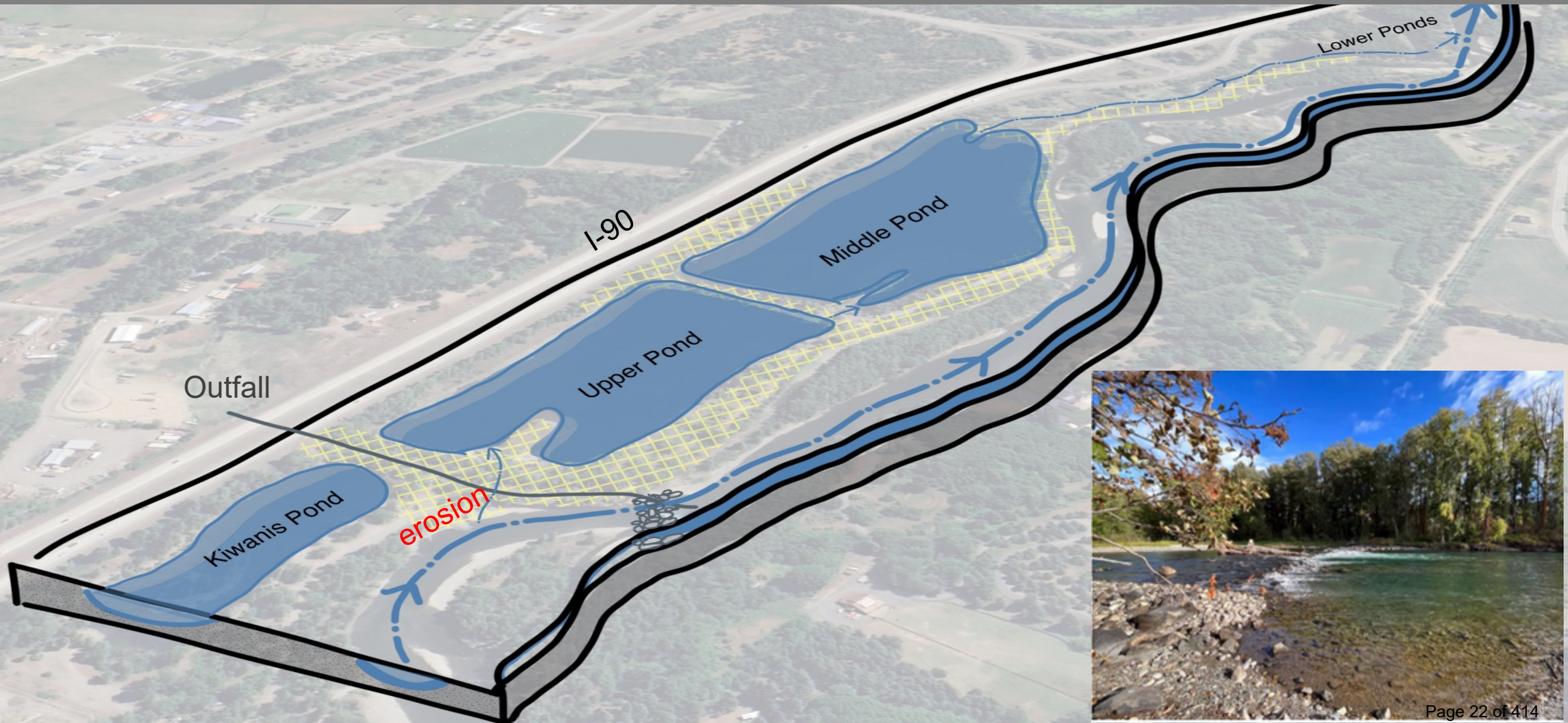


Ownership / Jurisdiction



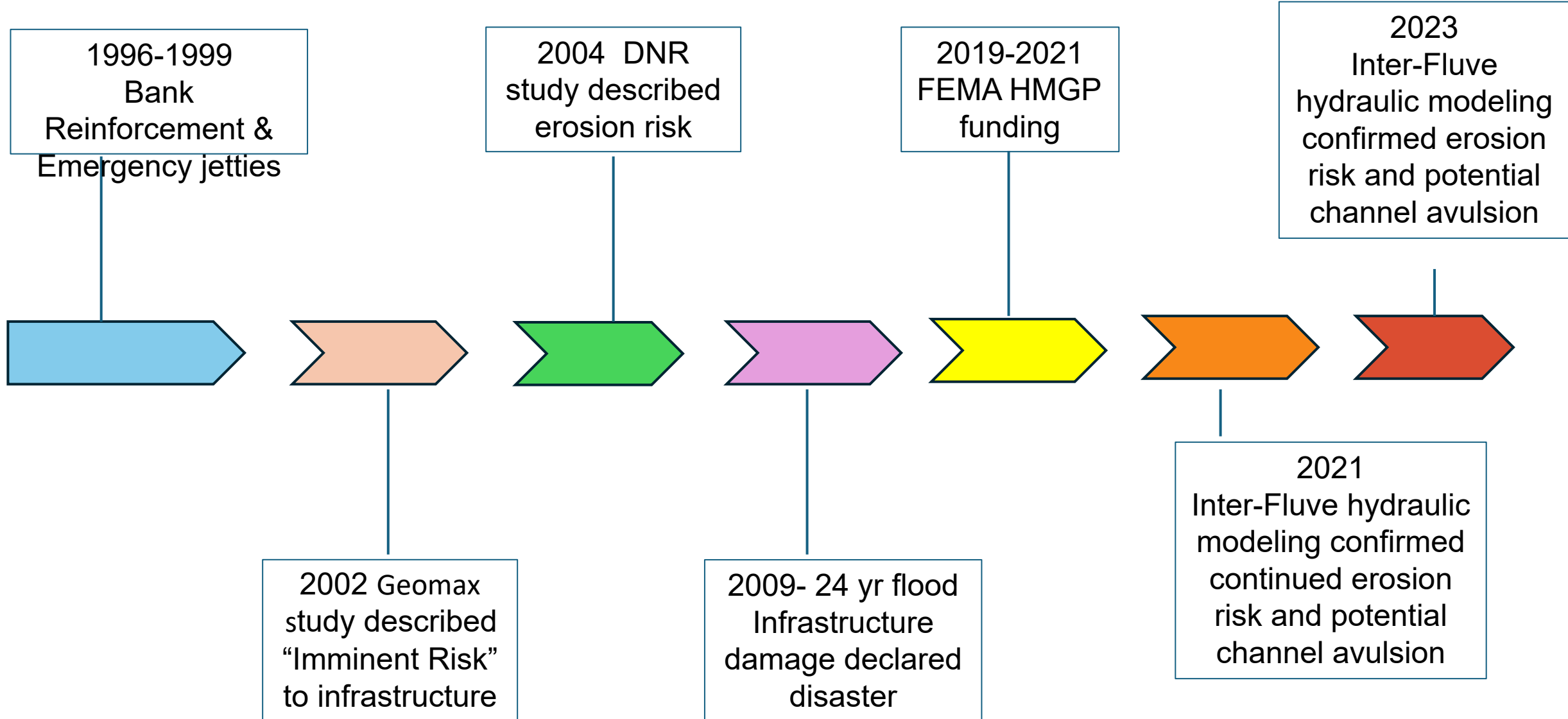
City of Cle Elum
State-owned Aquatic Lands (DNR)

Project Background

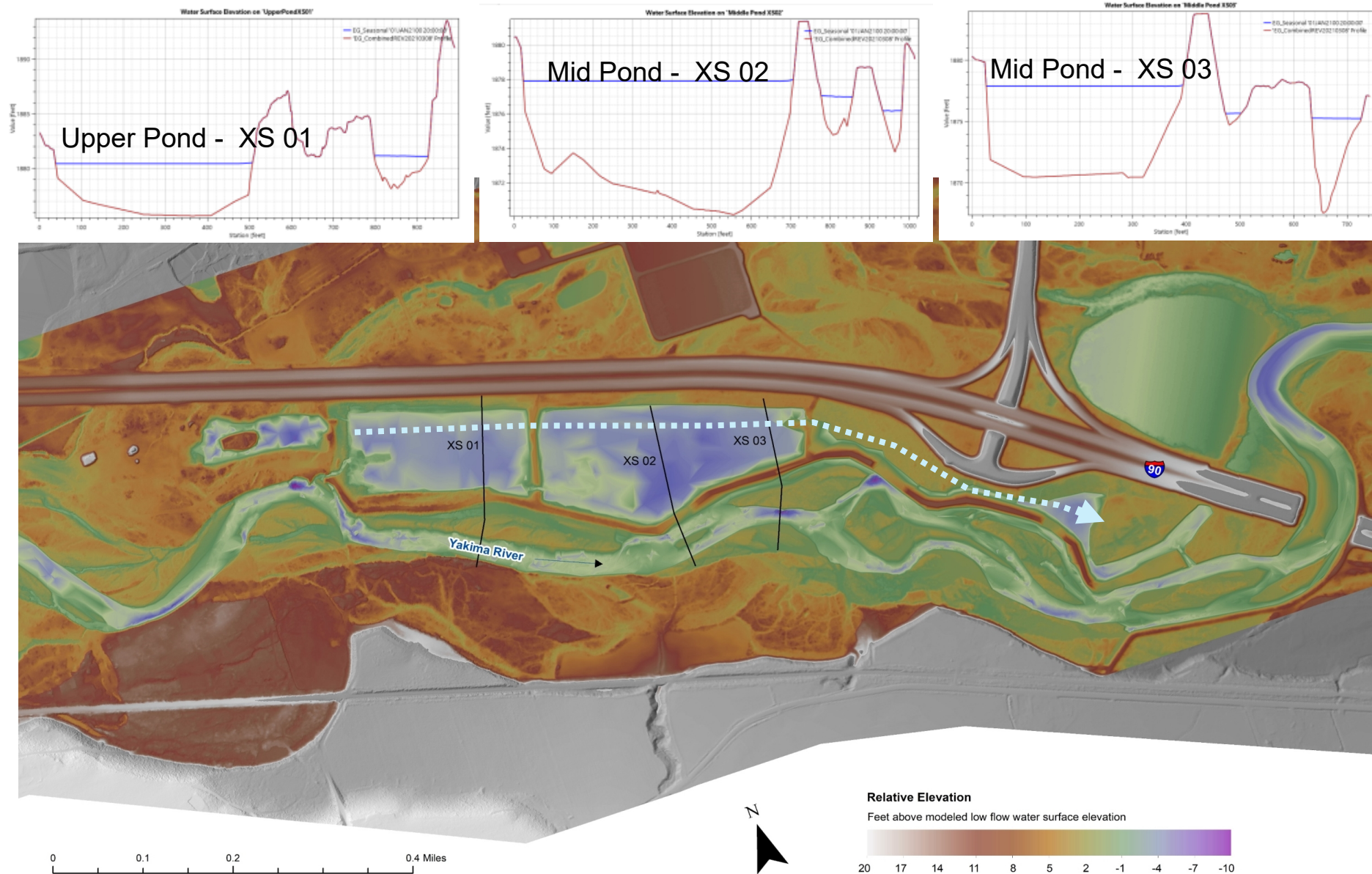


Q: What was the impetus of the project?

A: Identified imminent risk to City Infrastructure



Risk- River Capture by Ponds / Outfall R



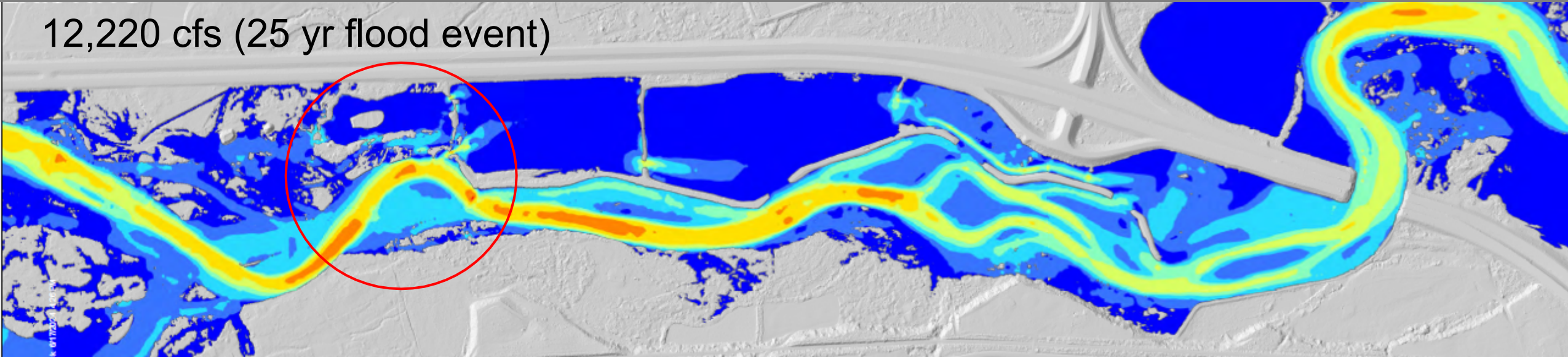
Risk- River Capture by Ponds / Outfall Ri



Progression of continued bank erosion

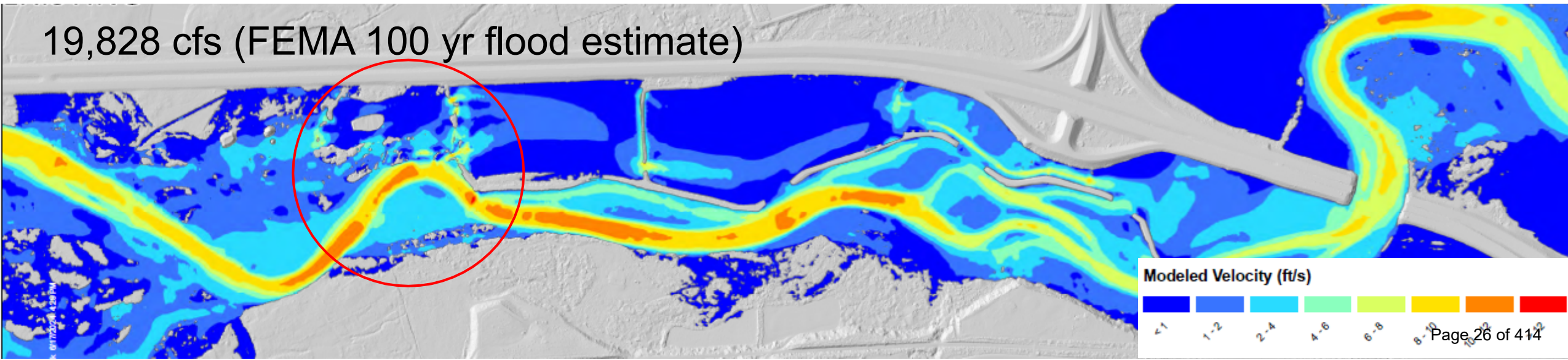
Risk- River Capture by Ponds / Outfall Ri

12,220 cfs (25 yr flood event)



Existing Conditions Flood Event Routing

19,828 cfs (FEMA 100 yr flood estimate)

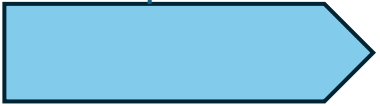


Alternative Analysis and Design Approach

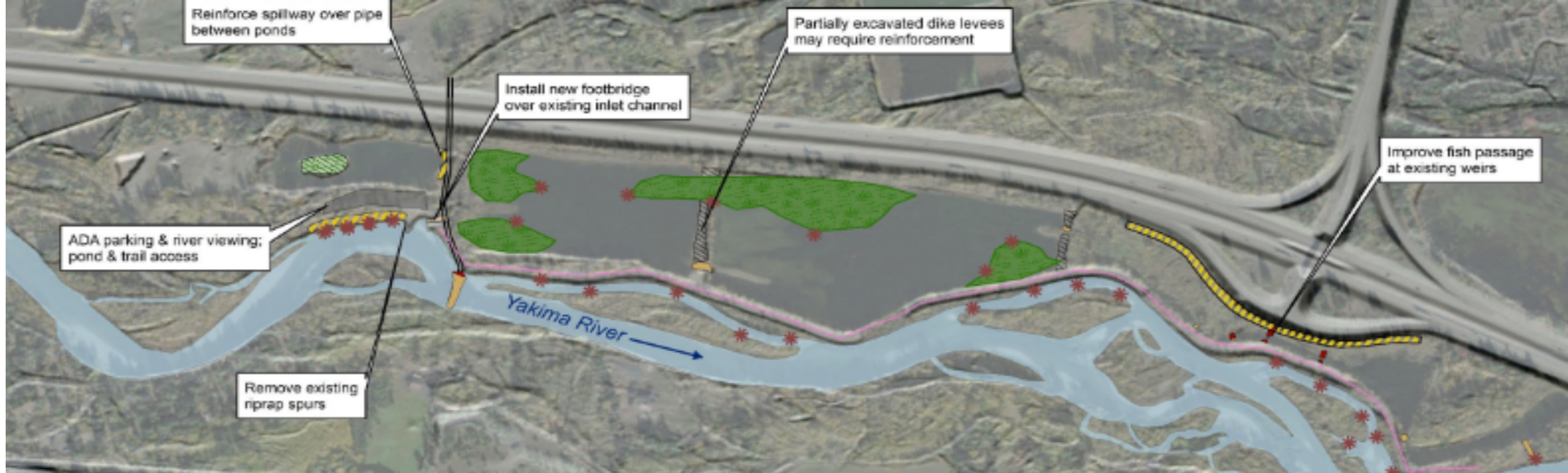
2021

Developed 3 alternatives

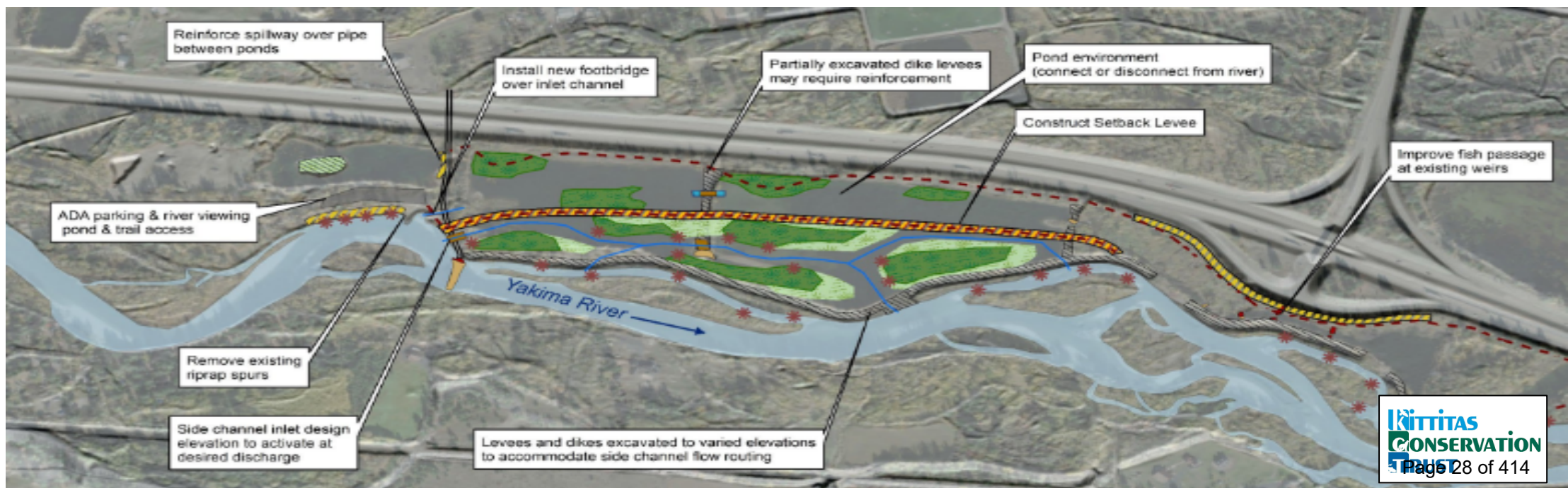
*(understanding that outfall to
remain at its existing location)*



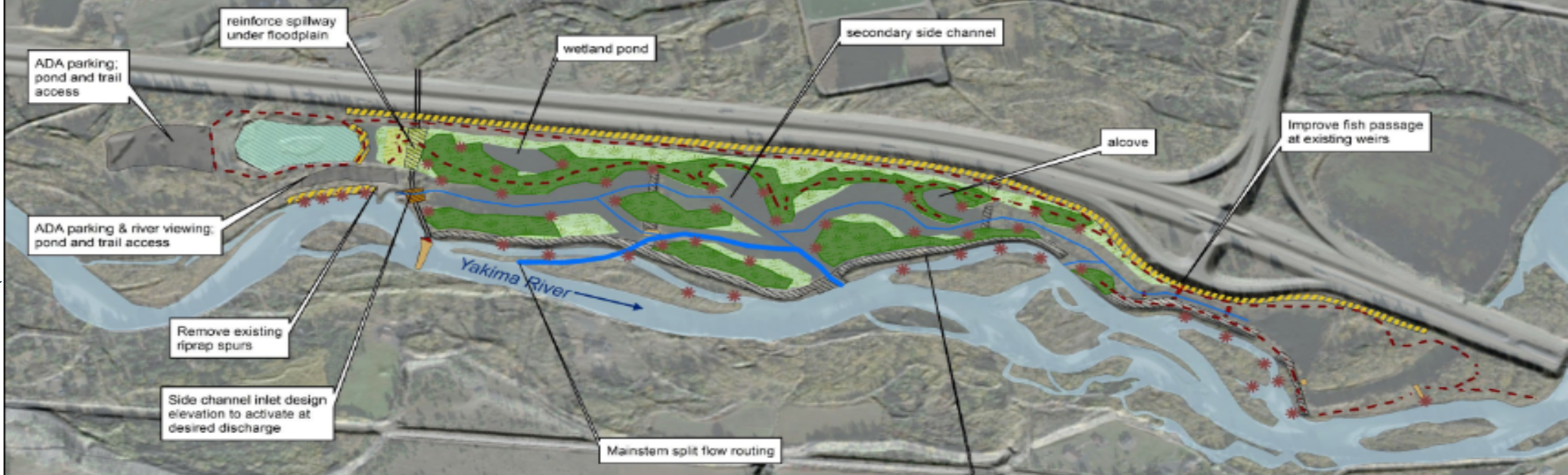
Concept Alternative 1



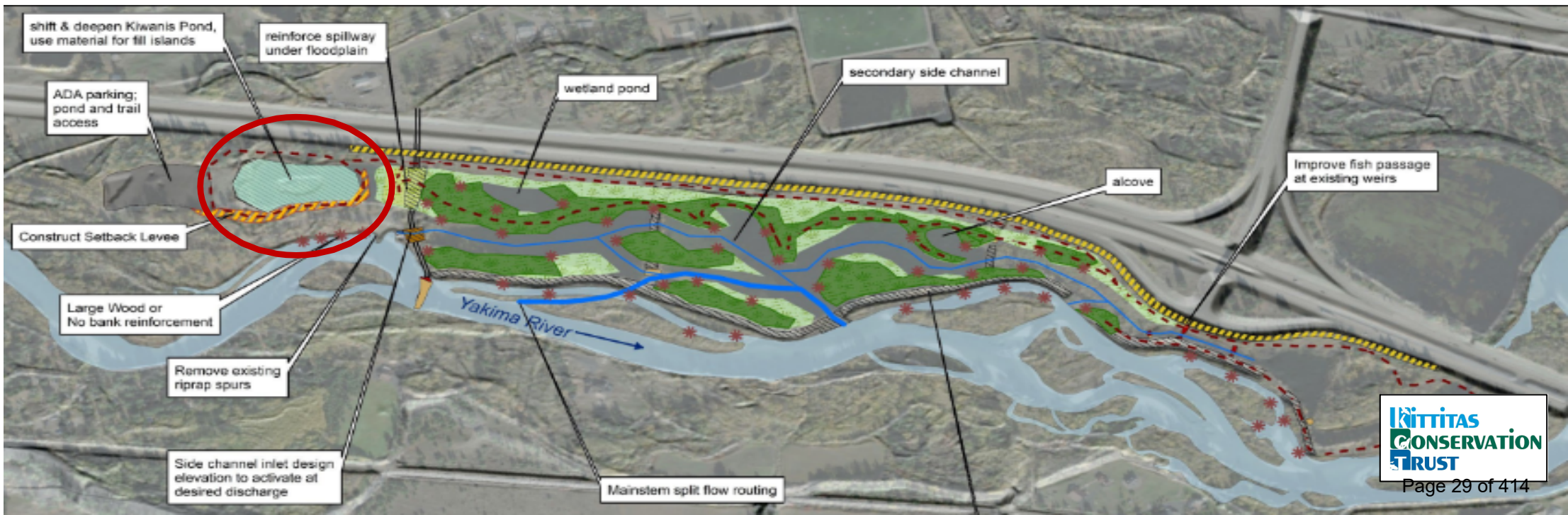
Concept Alternative 2



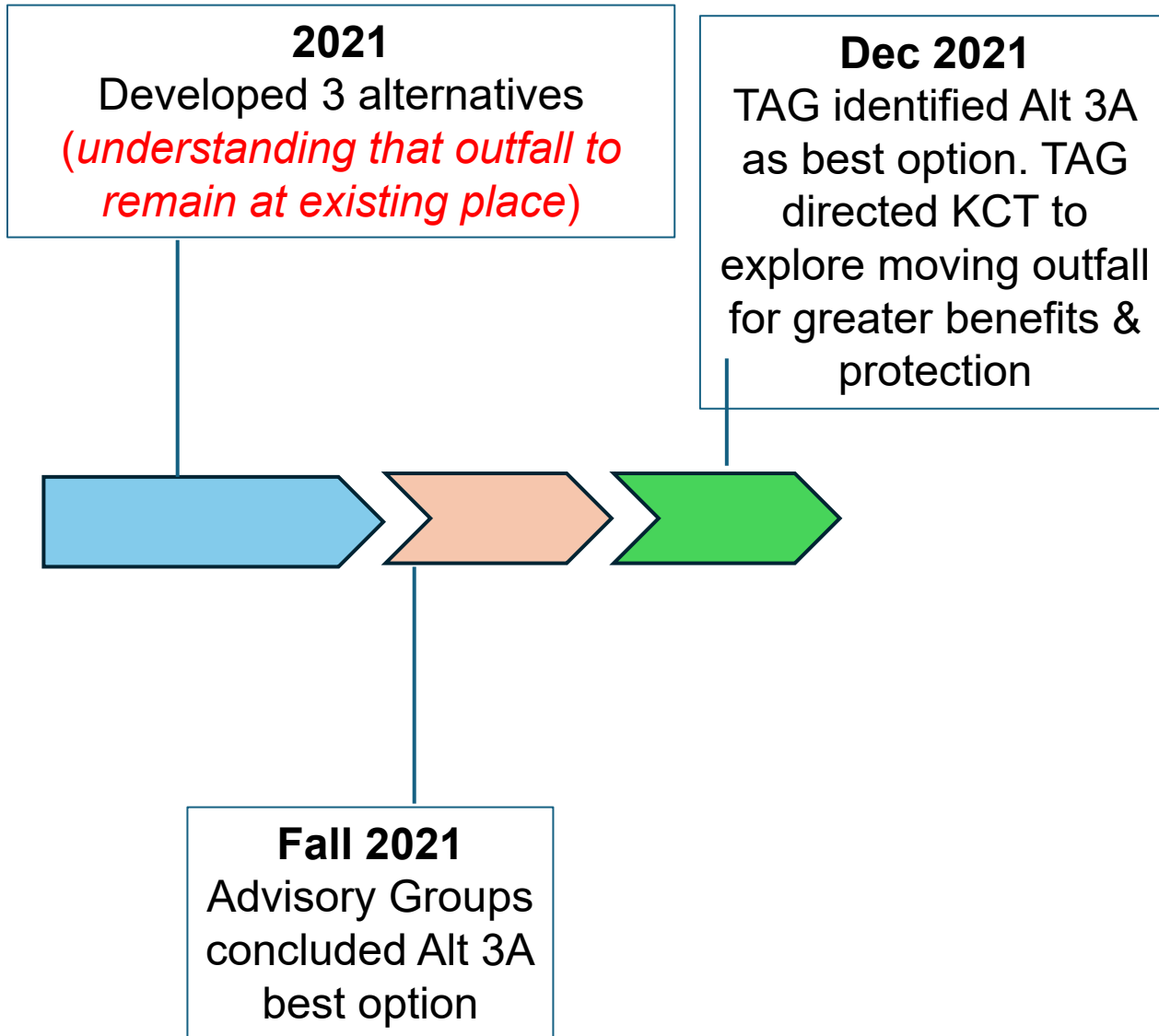
Concept Alternative 3A



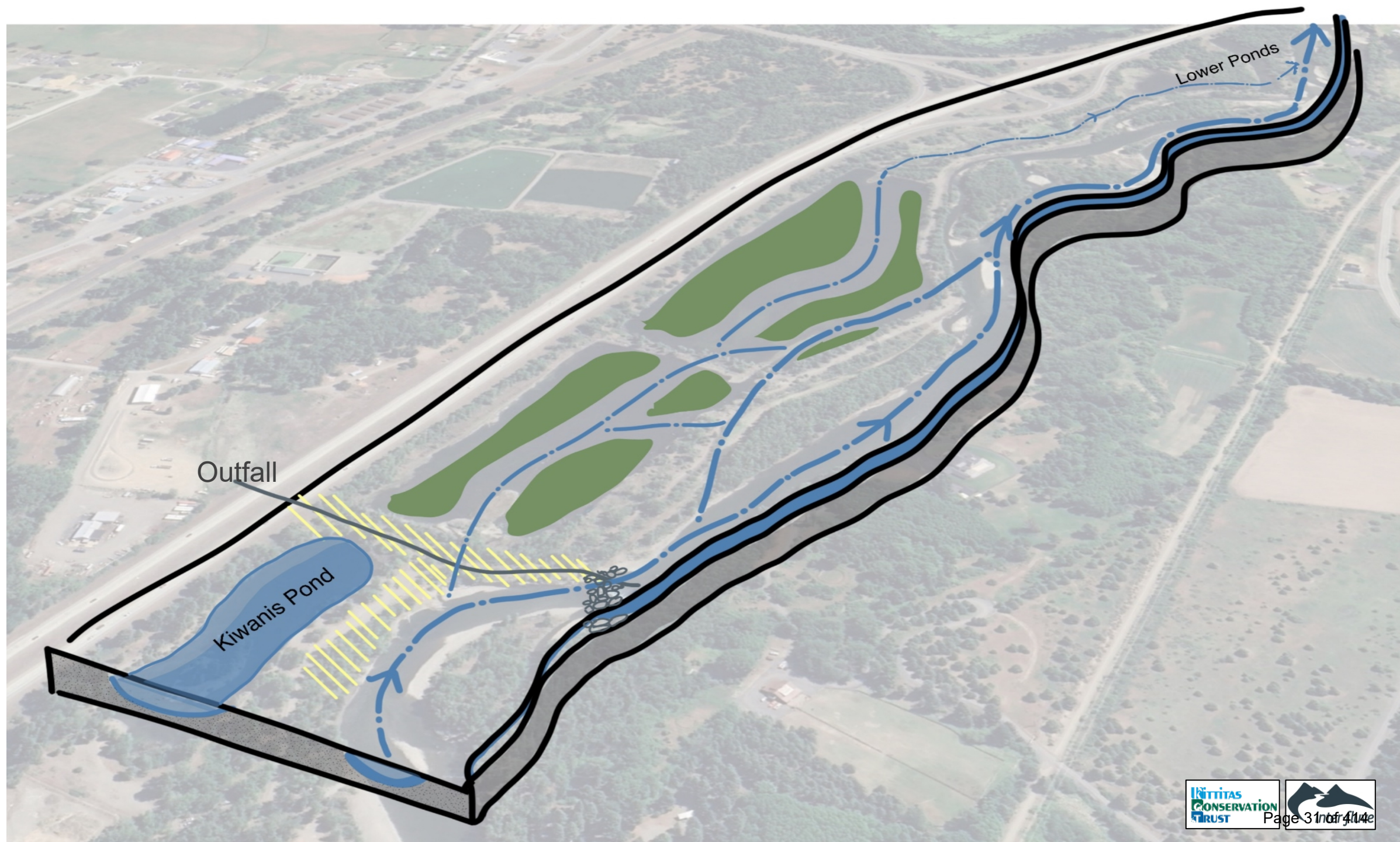
Concept Alternative 3B



Alternative Analysis and Design Approach



Concept Alternative 3A (retain outfall location)

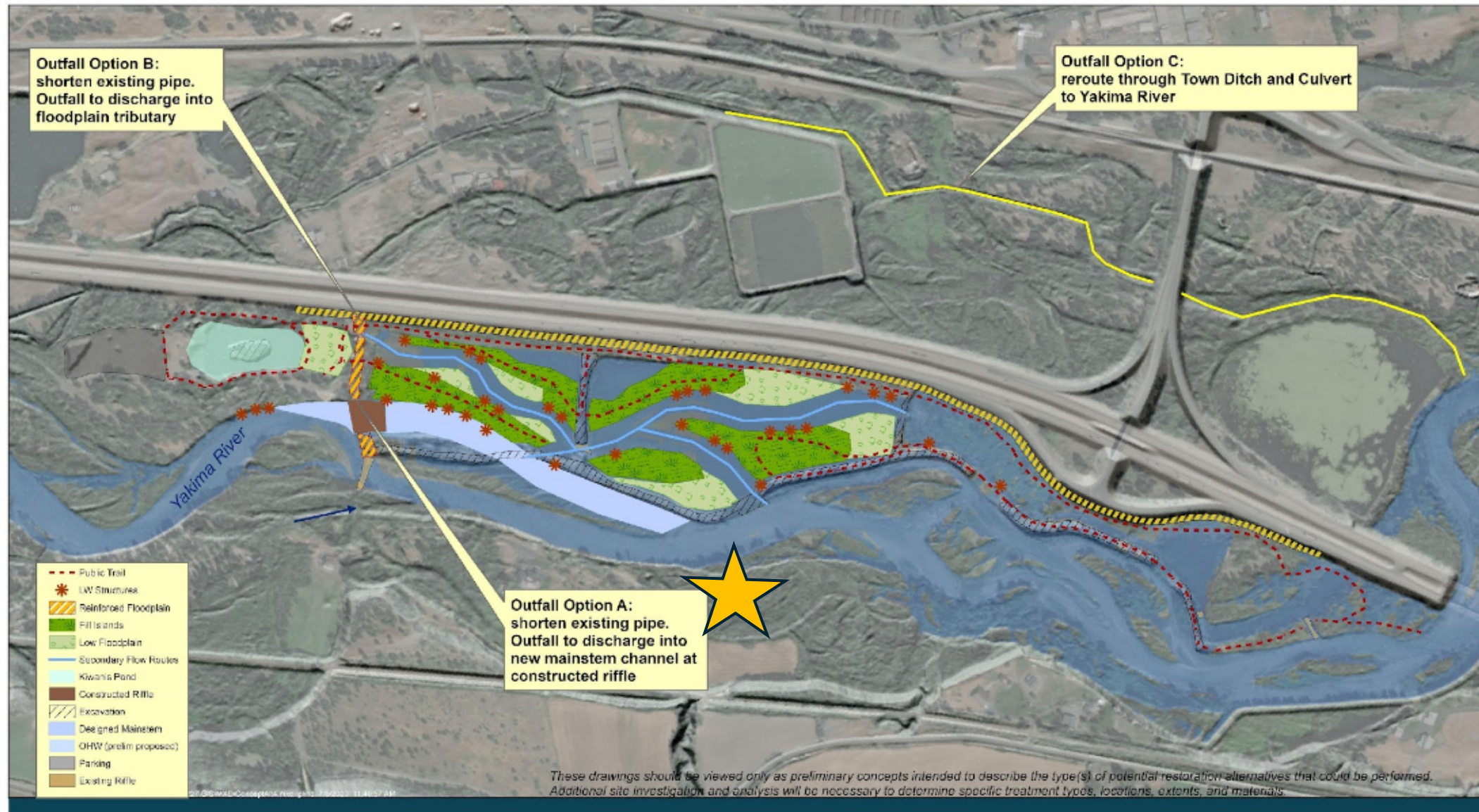


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Conceptual Alternative 4

Sewer Outfall Relocations



501 Portway Ave, Suite 101
Hood River, Oregon 97031
www.interfluve.com
541.386.9003

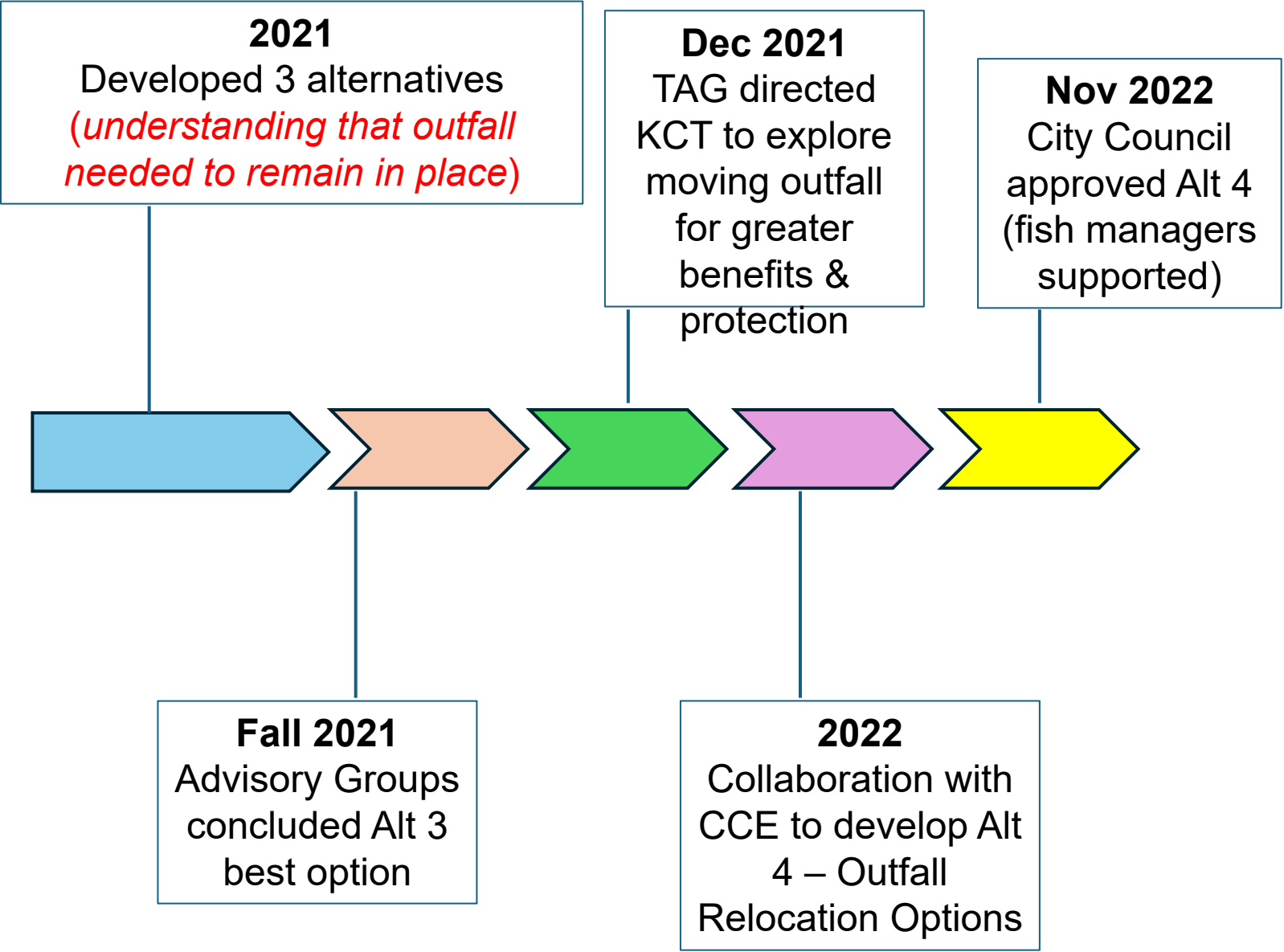
Selected Concept Alternative: Wastewater Outfall Options

Coordinate System: NAD 1983
State Plane Washington South FIPS 4602
Vertical Datum: NAVD88

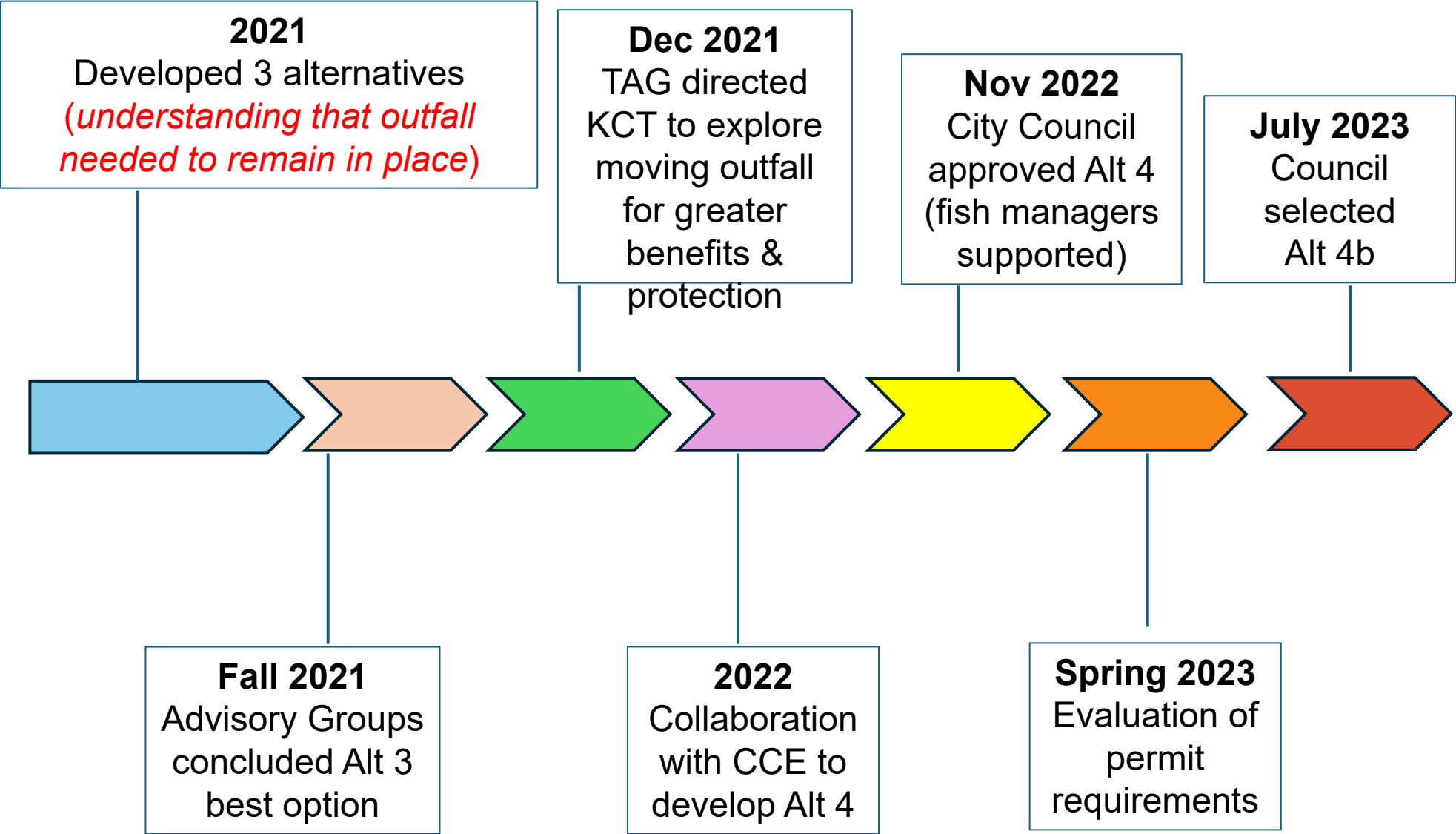
0 350 700 1,050 1,400
Feet



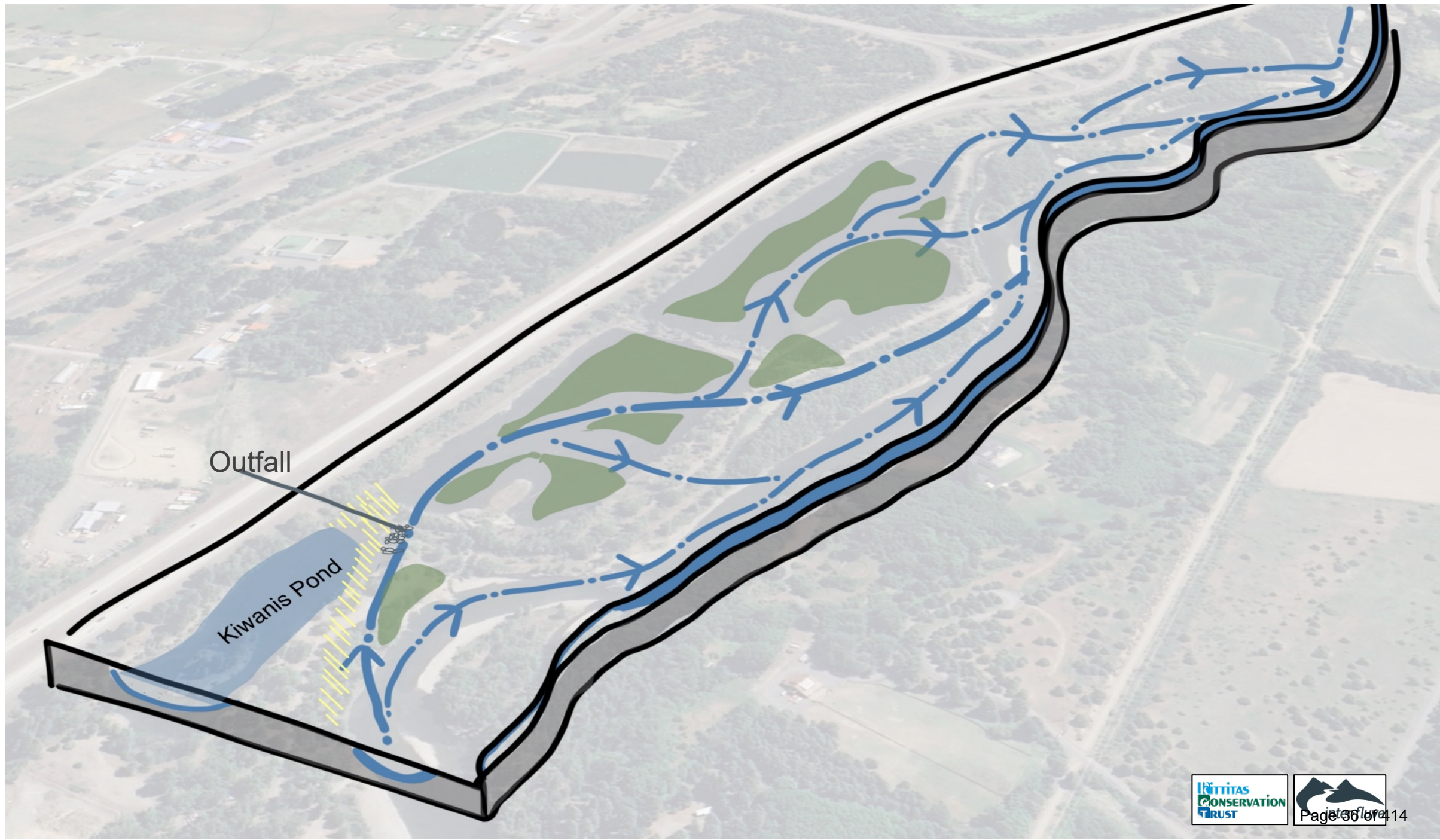
Alternative Analysis and Design Approach



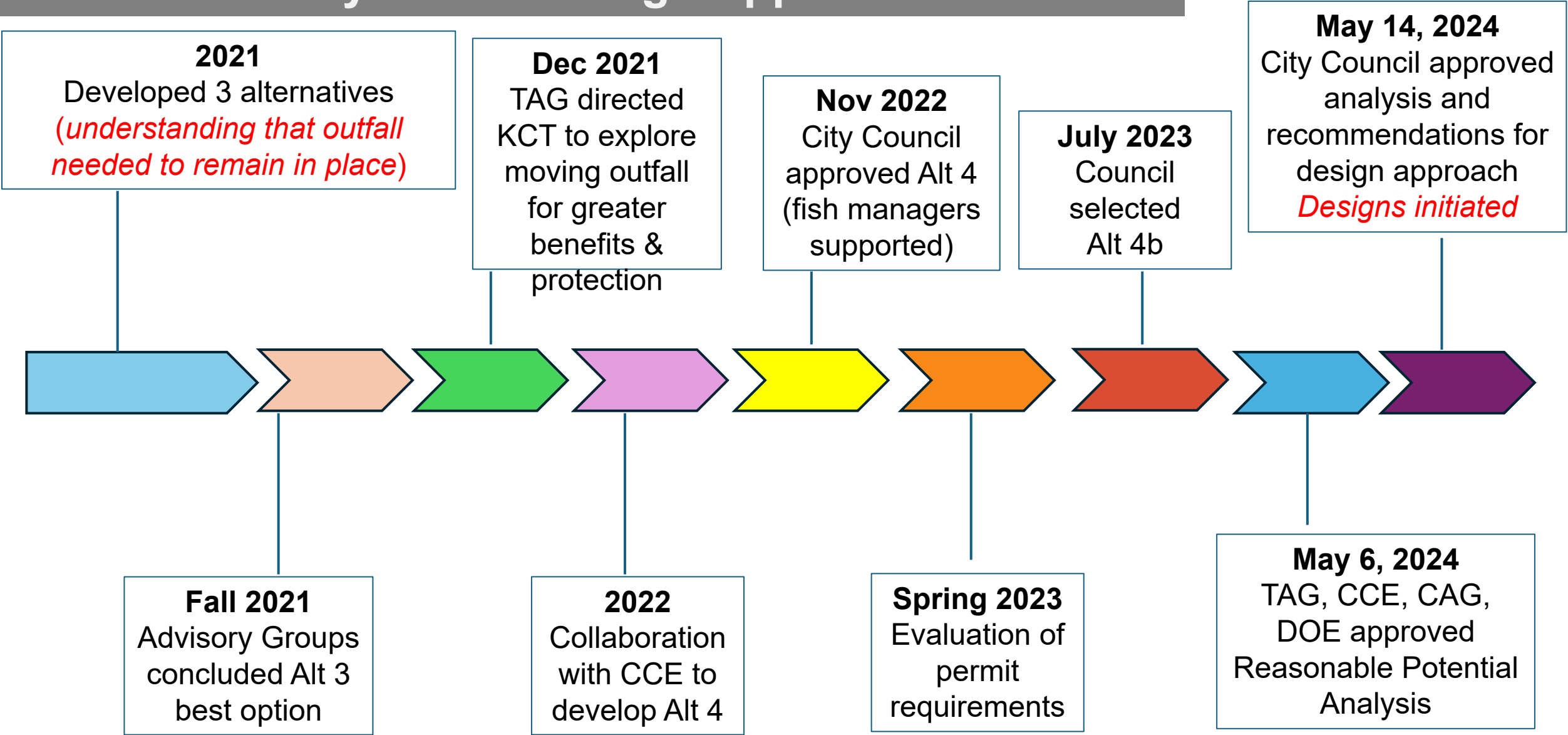
Alternative Analysis and Design Approach



Concept Alternative 4 (selected approach)



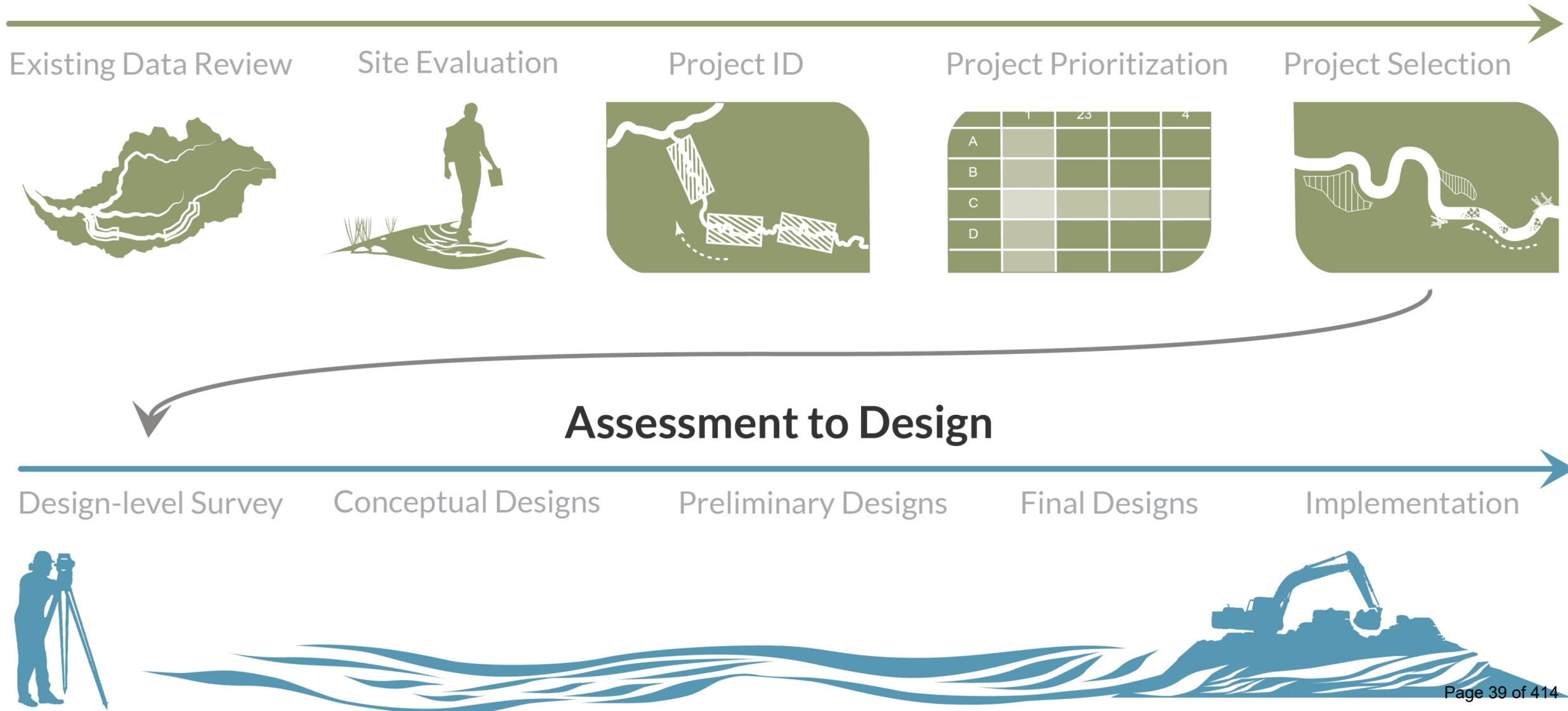
Alternative Analysis and Design Approach



Proactive Approach

- ✓ Identified Risk
- ✓ KCT is willing to sponsor the project
 - Leverage more funding
- ✓ Emergencies are costly and corrections are restrictive
 - Unable to fund holistic approaches
- ✓ Degraded water quality while reacting to emergency
- ✓ Likely the restoration project will cover the mitigation

Assessment – Modeling/Analysis - Design



Basic design processes

Establish Design
Criteria

Hydrology + basic
geomorph

Acknowledge Risk & Uncertainty

1-D, 2-D or other
hydraulic model

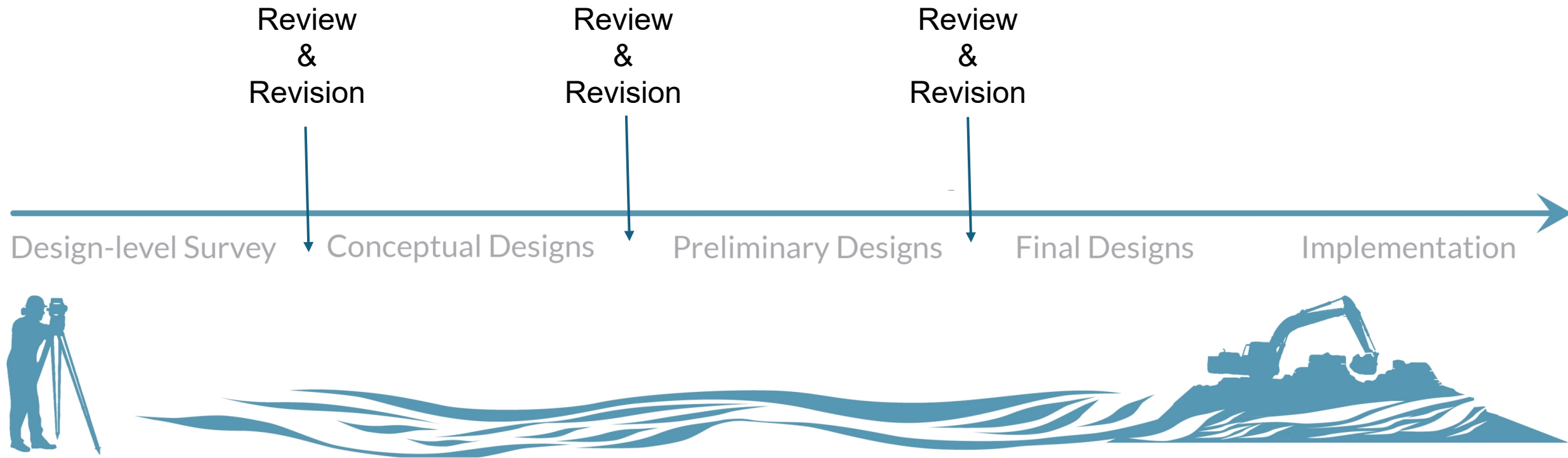
Identify
Constraints

Moment force & other
analysis

Fit the project to the
site setting, conditions,
and constraints

Due Diligence

Assessment – Modeling/Analysis - Design



Draft 30% Preliminary – 30% Preliminary – Draft 60% Permit-level – 60% Permit Level – Draft 100% Final

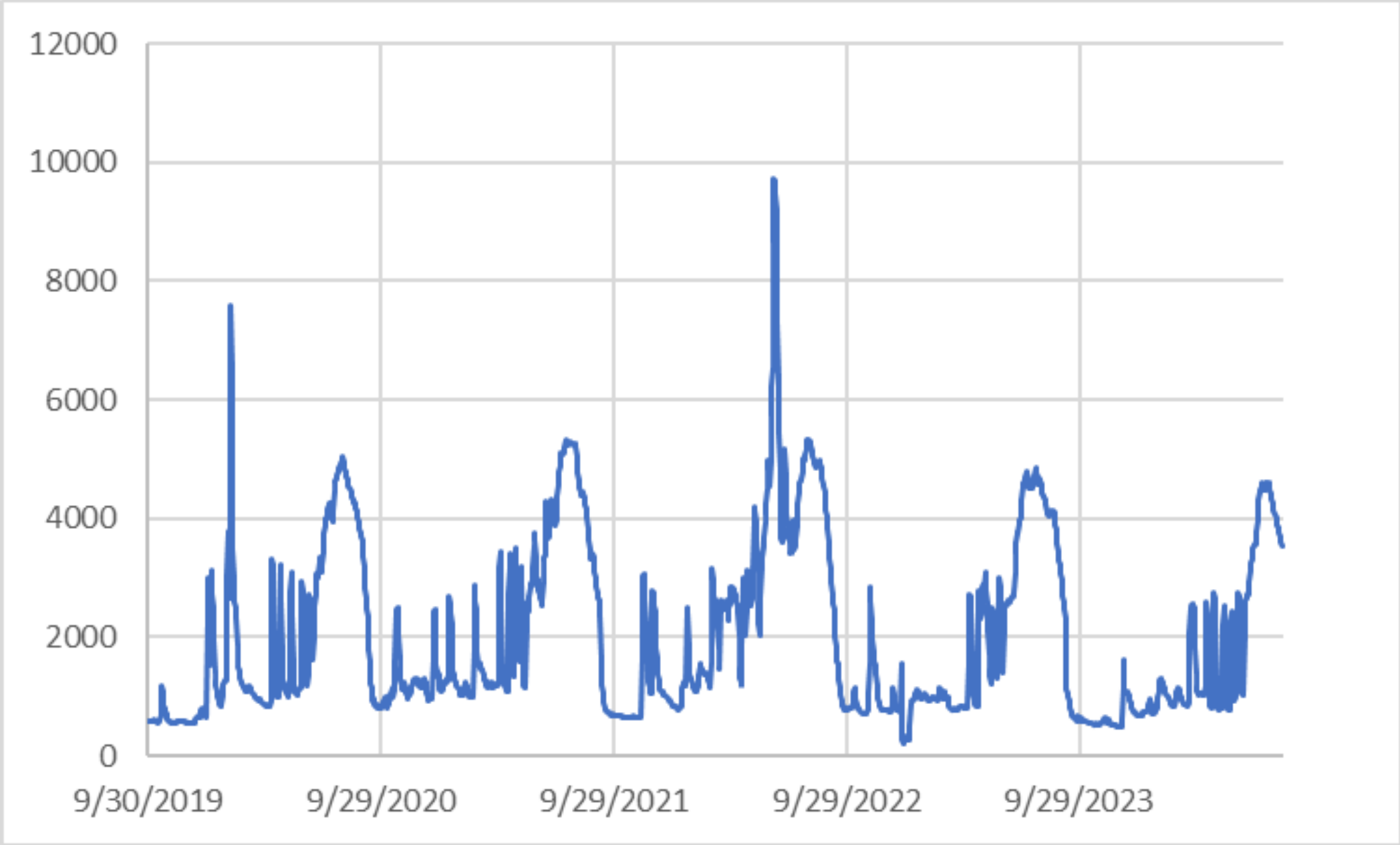
DRAFT 30% Design and Modeling Review

Schedule

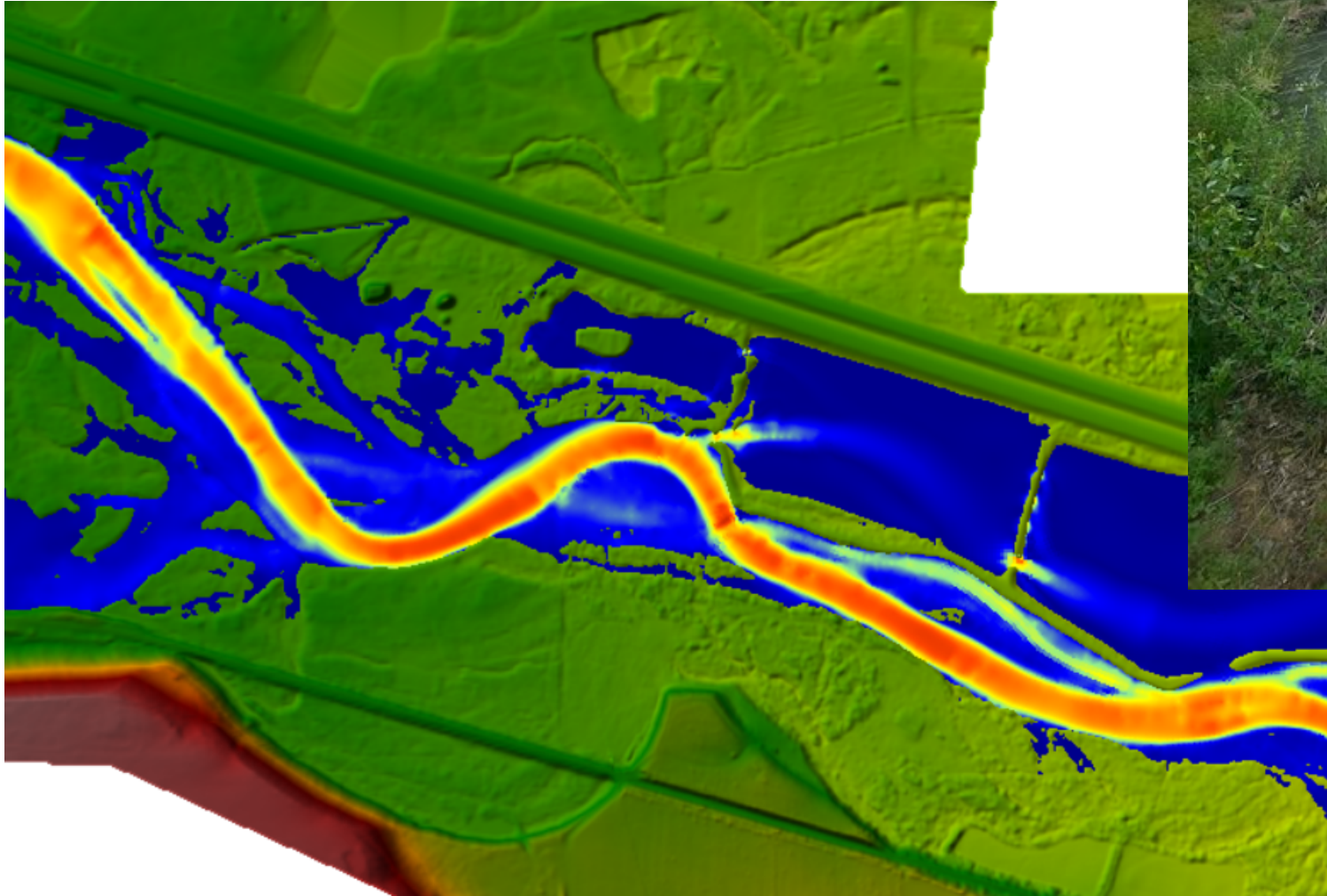


Task	Timeline
Draft 30% TAG/CAG comments	July 30 th
RCO Review Panel 30% comments	Aug 9 th
City Council Study Session	Aug 12 th
Regional Wastewater team	Sept 5 th
City Council (Study Session/ Council meeting)	Sept. ?
Final 30% Designs	Nov 2024
<i>**repeat process TAG/CAG/ Council/ Regional</i>	Dec 2024

Yakima River at South Cle Elum – Hydrograph (9/2019 – today)



10-Year flow of 10,020 cfsv



June 9, 2022: 9,400 cfsv



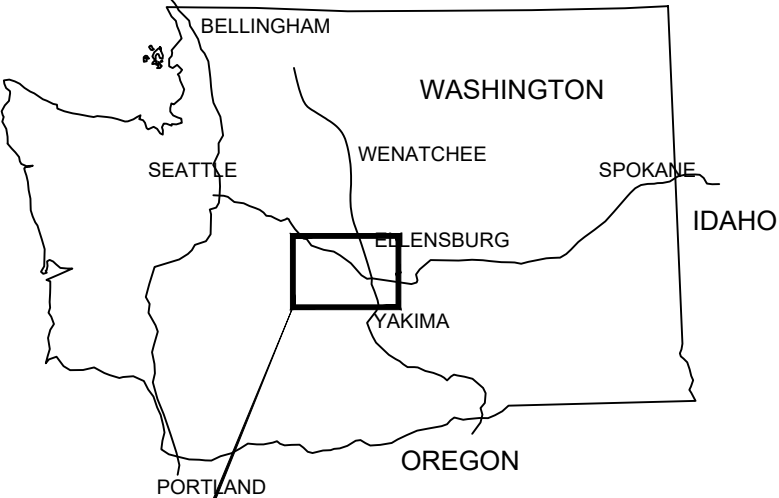
Appendix A : Hanson Ponds -- DRAFT Preliminary (30%) Plans Regional Wastewater Outfall Mitigation and Yakima River & Floodplain Reconnection

HANSON PONDS

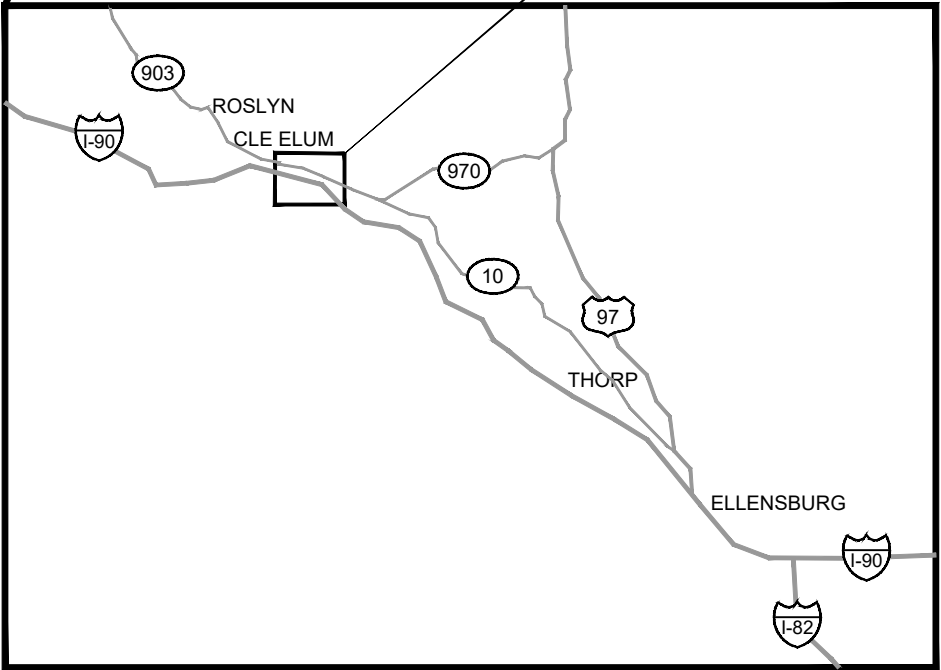
REGIONAL WASTEWATER OUTFALL MITIGATION & YAKIMA RIVER AND FLOODPLAIN RECONNECTION

DRAFT 30% DESIGN PHASE

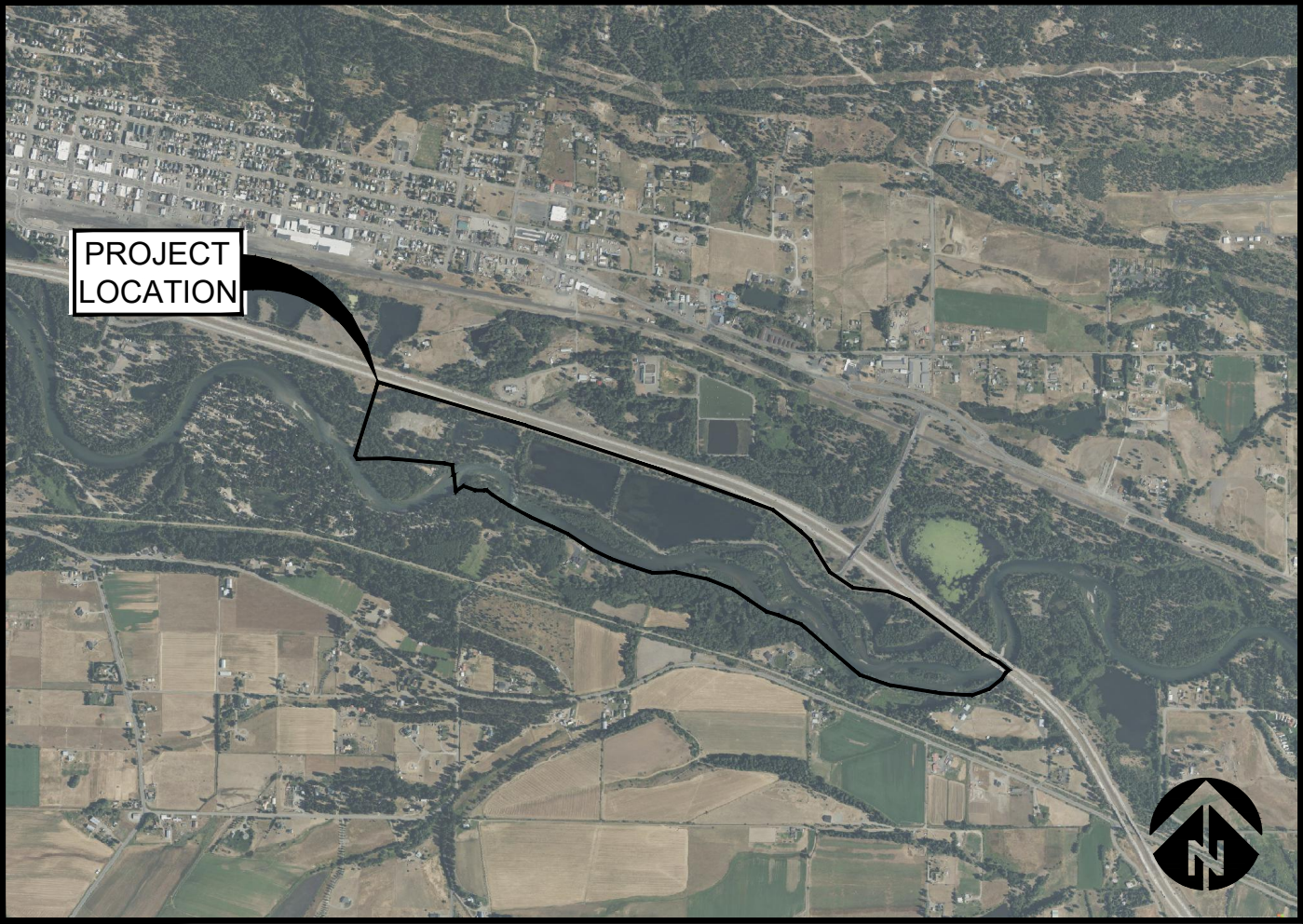
JUNE 2024



LOCATION MAP
STATE OF WASHINGTON



VICINITY MAP
1" = 40,000'



SITE MAP
1" = 2,000'

SHEET LIST

- | | | | |
|----|--|----------|--|
| 1 | COVER SHEET, LOCATION, AND SHEET LIST | 20 | LW DETAILS (1 OF 2) |
| 2 | GENERAL NOTES & QUANTITIES | 21 | LW DETAILS (2 OF 2) |
| 3 | HIP MEASURES (1 OF 3) | 22 | RECREATION ACCESS & TRAILS PLAN |
| 4 | HIP MEASURES (2 OF 3) | 23 | REVEGETATION- PROPOSED PLANT & SEED LIST |
| 5 | HIP MEASURES (3 OF 3) | J1/G-001 | GENERAL NOTES |
| 6 | ENVIRONMENTAL CONTROL DETAILS (1 OF 3) | J2/G-002 | LEGEND, SYMBOLS, AND ABBREVIATIONS |
| 7 | ENVIRONMENTAL CONTROL DETAILS (2 OF 3) | J3/C-101 | DEMOLITION PLAN AND PROFILE |
| 8 | ENVIRONMENTAL CONTROL DETAILS (3 OF 3) | J4/C-102 | GENERAL CONSTRUCTION PLAN AND BYPASS |
| 9 | EXISTING CONDITIONS AND SURVEY CONTROL | J5/C-103 | OUTFALL CONVEYANCE PIPE PLAN AND PROFILE |
| 10 | PROPOSED STAGING AND ACCESS | J6/C-104 | OUTFALL ARMORING/ PROTECTION STRUCTURE PLAN |
| 11 | PROPOSED CONDITIONS OVERVIEW | J7/C-105 | OUTFALL ARMORING/ PROTECTION STRUCTURE SECTION |
| 12 | PROPOSED CONDITIONS (1 OF 3) | J8/C-106 | OUTFALL CIVIC DETAILS |
| 13 | PROPOSED CONDITIONS (2 OF 3) | | |
| 14 | PROPOSED CONDITIONS (3 OF 3) | | |
| 15 | SIDE CHANNEL PROFILES | | |
| 16 | SIDE CHANNEL SECTIONS | | |
| 17 | MAIN STEM SECTIONS | | |
| 18 | POND FILL SECTIONS | | |
| 19 | CHANNEL DETAILS | | |

COORDINATES:
LATITUDE: 47°11'00"N
LONGITUDE: 120°54'42"W

SECTION 36, TOWNSHIP 20N, RANGE 15E

WATERBODY: YAKIMA RIVER
TRIBUTARY OF: COLUMBIA RIVER

Preliminary
Not for Construction

				BB	PL,DM,JB,AJ	PL,DM,JB
				DRAWN	DESIGNED	CHECKED
				PL	06/28/24	23-02-27
				APPROVED	DATE	PROJECT
NO.	BY	DATE	REVISION DESCRIPTION			

HANSON PONDS
RWOM & YAK RIV/FP RECON
DRAFT 30% DESIGN



501 Portway Avenue, Suite 101
Hood River, OR 97031
541.386.9003
www.interfluve.com

COVER SHEET, LOCATION, AND
SHEET LIST

SHEET
1 OF 23

ALL WORK SHALL CONFORM TO THE 2024 EDITION OF STANDARD PLANS AND SPECIFICATIONS OF THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION (WSDOT), AND CURRENT LOCAL STANDARDS UNLESS INDICATED OTHERWISE BY THE CONTRACT DOCUMENTS. IN CASE OF A CONFLICT BETWEEN THE REGULATORY STANDARDS OR SPECIFICATIONS, THE MORE STRINGENT SHALL PREVAIL.

IN CASE OF DISCREPANCY, BETWEEN NOTES, LOCAL REGULATIONS, OR OTHER CONTRACT DOCUMENTATION, CONTRACTOR SHALL OBTAIN CLARIFICATION/DIRECTION FROM OWNER.

EXISTING DATA

TOPOGRAPHY AND BATHYMETRY WAS COLLECTED TO SUPPORT MODELING AND DESIGN. DATA WAS COLLECTED BY INTER-FLUVE WITH RTK GNSS ON SEPTEMBER 23-25, 2020 AND SEPTEMBER 26-28, 2023.

SOILS

SOIL IS CLASSIFIED BY NRCS (2020) AS XEROFLUVENT FLOODPLAIN: SOMEWHAT EXCESSIVELY WELL DRAINED AND COMPOSED OF EXTREMELY COBBLEY SAND AT 60 INCHES DEPTH THAT FINES UPWARD TO GRAVELY SAND, LOAMY SAND WITH MODERATELY DECOMPOSED PLANT MATERIAL IN THE TOP 0-2 INCHES. ASPECT CONSULTING COMPLETED ADDITIONAL GEOTECHNICAL INVESTIGATIONS THROUGHOUT THE SITE (GEOTECHNICAL DATA REPORT: HANSON PONDS. ASPECT, APRIL 14,2024)

WETLANDS DELINEATION BY GG ENVIRONMENTAL (NOV 4, 2020)

UTILITIES

THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR HAVING UTILITIES LOCATED PRIOR TO CONSTRUCTION ACTIVITIES.

THE CONTRACTOR SHALL IMMEDIATELY CONTACT THE AFFECTED UTILITY SERVICE TO REPORT ANY DAMAGED OR DESTROYED UTILITIES. THE CONTRACTOR SHALL PROVIDE EQUIPMENT OR LABOR TO AID THE AFFECTED UTILITY SERVICE IN REPAIRING DAMAGED OR DESTROYED UTILITIES AT NO COST TO THE OWNER.

WATERS OF THE U.S.

THE ORDINARY HIGH WATER (OHW) LINES DISPLAYED IN THE DESIGN PACKAGE WERE DELINEATED BY INTER-FLUVE STAFF IN 2019. AND ARE BASED UPON ANALYSIS, MODELING AND BEST PROFESSIONAL JUDGEMENT. OHW IS THE MEDIAN JUNE FLOW.

WETLAND DELINEATION PERFORMED BY GG ENVIRONMENTAL (NOV 4, 2020)

THESE LINES DO NOT NECESSARILY REPRESENT JURISDICTIONAL BOUNDARIES. IN THE STATE OF WASHINGTON, THE DEPARTMENT OF ECOLOGY AND THE UNITED STATE ARMY CORPS OF ENGINEERS (USACE) HAVE THE FINAL AUTHORITY IN DELINEATING WATERS AND WETLAND BOUNDARIES.

CONSTRUCTION ACCESS

THE CONTRACTOR IS ADVISED THAT ACCESS TO THE SITE WILL BE BY PUBLIC ROADS. PUBLIC ACCESS ALONG ROADS, PARKING, AND PARK USE SHALL BE MAINTAINED FOR DURATION OF CONSTRUCTION.

THE CONTRACTOR IS SOLELY RESPONSIBLE FOR OBTAINING ANY REQUIRED TRAFFIC CONTROL OR ACCESS PERMITS, AND PROVIDING REQUIRED TRAFFIC CONTROL MEASURES INCLUDING, BUT NOT LIMITED TO, SIGNAGE AND FLAGGERS.

CONSTRUCTION STAKING

THE OWNER OR DESIGNATED REPRESENTATIVE WILL INSTALL STAKES AND OR FLAGGING TO DELINEATE WETLANDS, EQUIPMENT ENTRY AND EXIT POINTS, STAGING AND STOCKPILE AREAS, AND PROJECT LIMITS. THE OWNER WILL PROVIDE CONTROL POINTS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR GRADE STAKING AND REPLACING DAMAGED OR MISSING STAKES.

CONTRACTOR SHALL MEET WITH THE OWNER AND OWNER'S REPRESENTATIVE TO DEFINE AND MARK LIMITS OF DISTURBANCE PRIOR TO MOBILIZATION OF EQUIPMENT OR MATERIALS ONTO THE SITE.

SOME FIELD ADJUSTMENTS TO THE LINES AND GRADES ARE TO BE EXPECTED. LOCATION, ALIGNMENT, AND ELEVATION OF LOGS AND LOGS WITH ROOTWADS ARE SUBJECT TO ADJUSTMENT BASED ON FIELD CONDITIONS, AND MATERIAL SIZE.

ABBREVIATIONS

APPROX	APPROXIMATE	INV	INVERT
CY	CUBIC YARDS	LWM	LARGE WOODY MATERIAL
°	DEGREES	MAX	MAXIMUM
DIA OR Ø	DIAMETER	MIN	MINIMUM
DBH	DIAMETER AT BREAST HEIGHT	OHW	ORDINARY HIGH WATER
EA	EACH	OLW	ORDINARY LOW WATER
EL OR ELEV	ELEVATION	%	PERCENT
ESC	EROSION AND SEDIMENT CONTROL	RL	RIVER LEFT
EXIST	EXISTING	RMx	RIVER MILE x
FT OR '	FEET	RR	RIVER RIGHT
FTR	FULLY THREADED ROD	STA	STATION
HORIZ	HORIZONTAL	TBD	TO BE DETERMINED
IN OR "	INCH	TYP	TYPICAL
		VERT	VERTICAL
		WDFW	WASHINGTON DEPARTMENT OF FISH AND WILDLIFE
		WDOE	WASHINGTON DEPARTMENT OF ECOLOGY
		WSDOT	WASHINGTON DEPARTMENT OF TRANSPORTATION
		WSE	WATER SURFACE ELEVATION
		YR	YEAR

HOLD FOR ESTIMATED QUANTITIES

Preliminary
Not for Construction

Z:\ClientFiles\E-H\HansonPonds\Design\Permitting_230227\Drawings\HansonPonds_D.dwg - bbroderick - 6/26/24

				BB DRAWN	PL_DM,JB,AJ DESIGNED	PL_DM,JB CHECKED	HANSON PONDS RWOM & YAK RIV/FP RECON DRAFT 30% DESIGN	 501 Portway Avenue, Suite 101 Hood River, OR 97031 541.386.9003 www.interfluve.com	GENERAL NOTES & QUANTITIES	SHEET
				PL	06/28/24	23-02-27				2 OF 23
NO.	BY	DATE	REVISION DESCRIPTION	APPROVED	DATE	PROJECT				

Z:\ClientFiles\E-H\HansonPonds\Design\Permitting 230227\Drawings\HansonPonds_D.dwg - bbroderick - 6/26/24

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. 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 AND ALLOWED ONLY IN LOCATIONS IDENTIFIED BY THE OWNER.
- 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.

NO.	BY	DATE	REVISION	DESCRIPTION

BB

DRAWN

PL,DM,JB,AJ

DESIGNED

PL,DM,JB

CHECKED

PL

APPROVED

06/28/24

DATE

23-02-27

PROJECT

HANSON PONDS

RWOM & YAK RIV/FP RECON

DRAFT 30% DESIGN



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3 OF 23

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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 LOOSENEED 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. RIPARIAN 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).

				BB	PL,DM,JB,AJ	PL,DM,JB
				DRAWN	DESIGNED	CHECKED
				PL	06/28/24	23-02-27
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HANSON PONDS
RWOM & YAK RIV/FP RECON
DRAFT 30% DESIGN



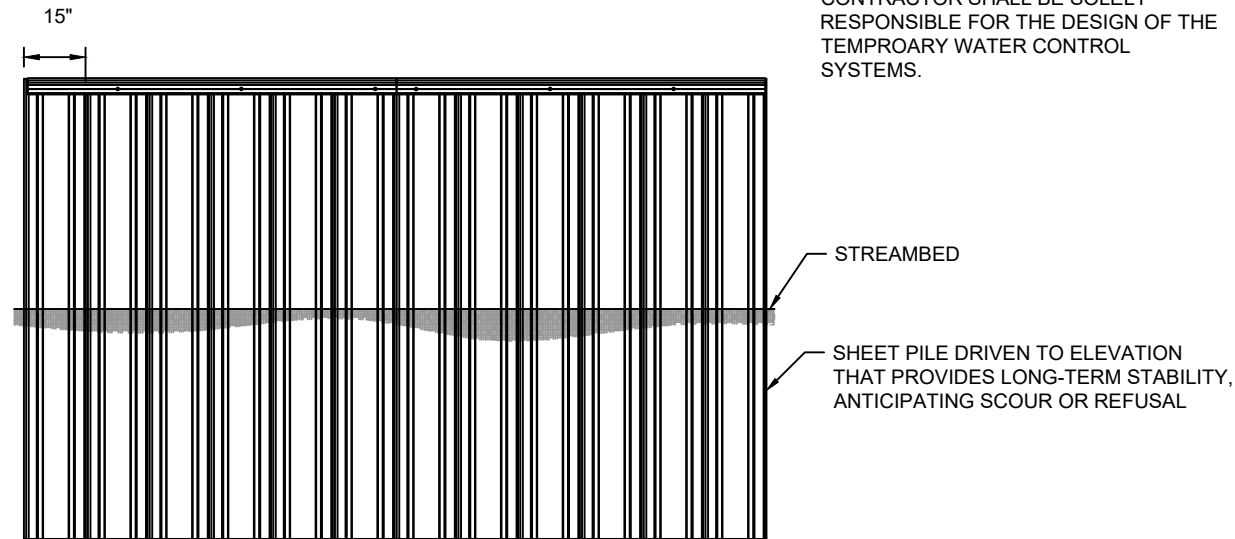
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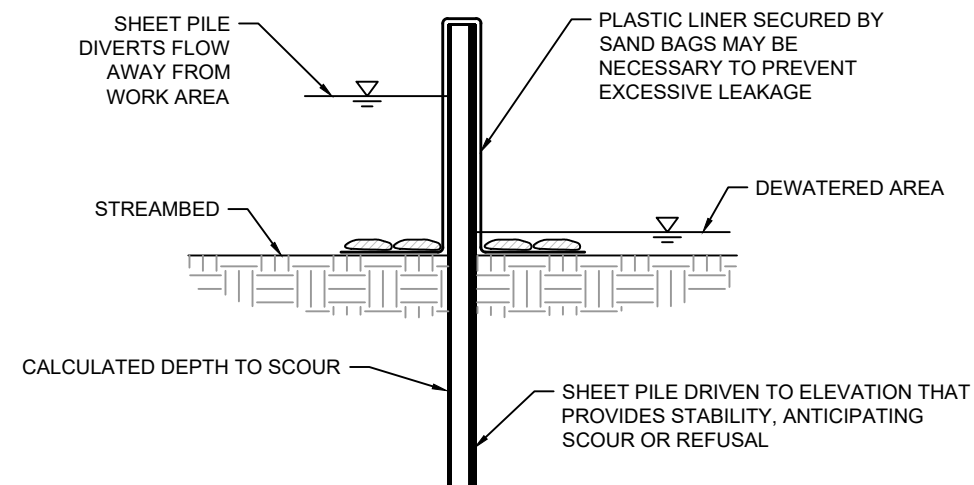
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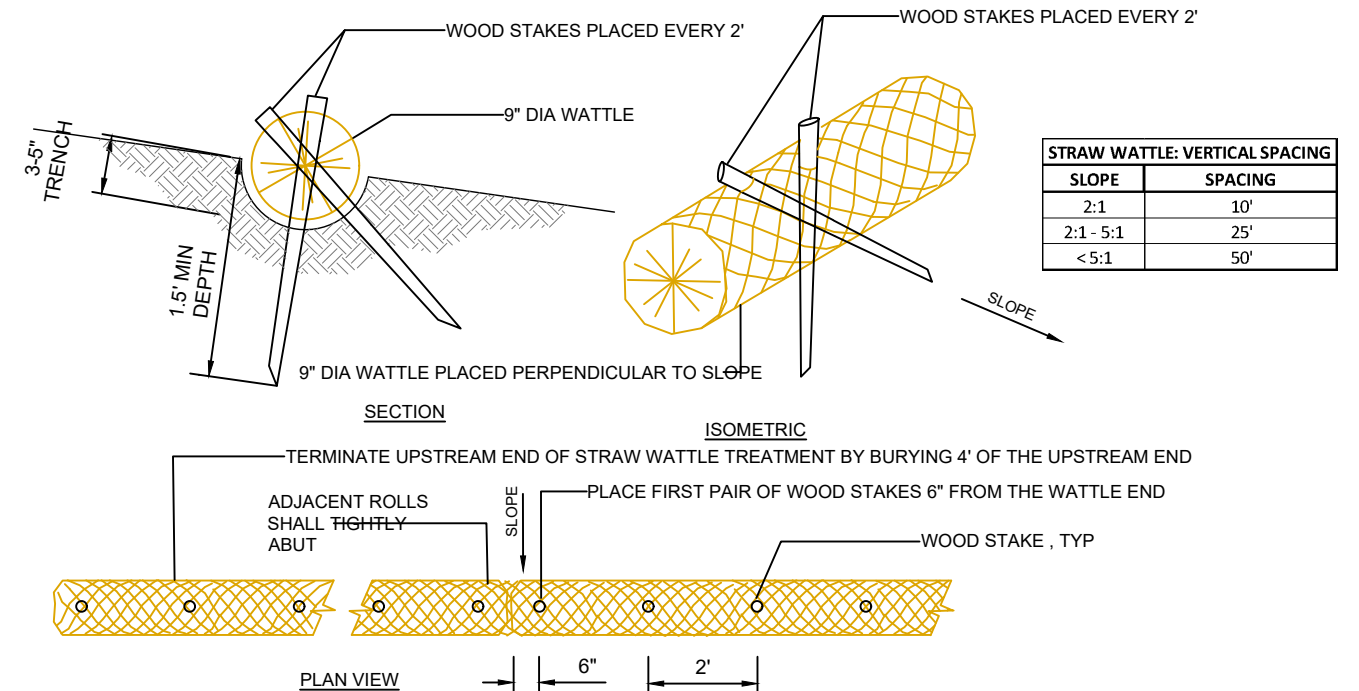


ELEVATION



SECTION

1
6 TYPICAL DETAIL - TEMPORARY SHEET PILE COFFERDAM
NOT TO SCALE



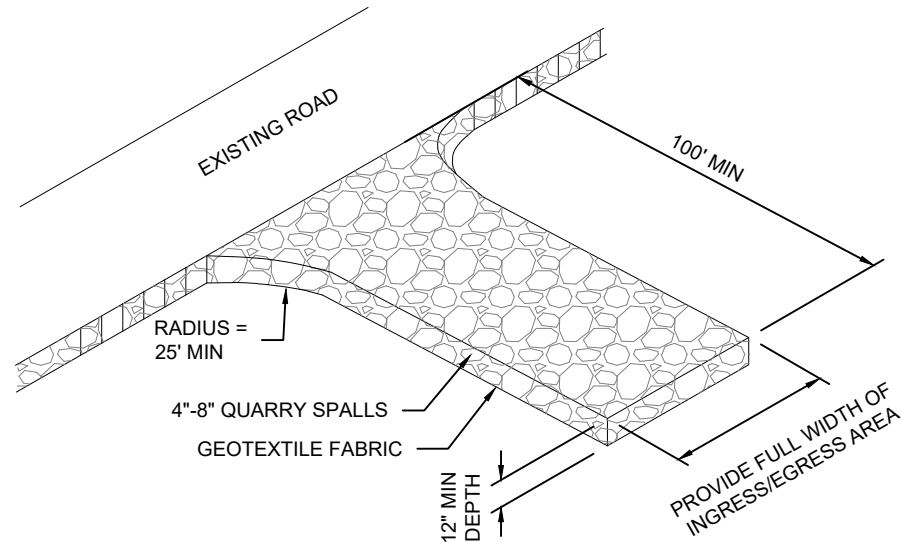
2
6 TYPICAL DETAIL - STRAW WATTLE
NOT TO SCALE

GENERAL NOTES ON INSTALLING STRAW WATTLES

1. INSTALL WATTLES WITHIN TRENCH, SO THAT NO GAPS EXIST BETWEEN THE SOIL AND THE BOTTOM OF THE WATTLE. THE ENDS OF ADJACENT WATTLES SHALL BE TIGHTLY ABUTTED SO THAT NO OPENING EXISTS FOR WATER OR SEDIMENT TO PASS THROUGH.
2. WOOD STAKES SHALL BE USED TO FASTEN THE WATTLES TO THE SOIL. WHEN CONDITIONS WARRANT, A STRAIGHT METAL BAR CAN BE USED TO DRIVE A "PILOT HOLE" THROUGH THE WATTLE AND INTO THE SOIL.
3. PAIRS OF WOOD STAKES SHALL BE PLACED 6" FROM THE WATTLE END, ANGLED SUCH THAT ONE STAKE IS PERPENDICULAR TO GRADE AND ONE IS AT A 45° ANGLE TO GRADE. WOOD STAKE PAIRS SHALL BE SPACED AT 2-FEET CENTERS LEAVING LESS THAN 1-2 INCHES OF STAKE EXPOSED ABOVE THE WATTLE.
4. AT TERMINAL ENDS OF WATTLES, EXCAVATE MIN 2' DEEP KEY TRENCH AND BURY A MIN 4' OF WATTLE END.
5. CARE SHALL BE TAKEN DURING INSTALLATION SO AS TO AVOID DAMAGE OCCURRING TO THE WATTLE AS A RESULT OF THE INSTALLATION PROCESS. SHOULD THE WATTLE BE DAMAGED DURING INSTALLATION, A WOODEN STAKE SHALL BE PLACED EITHER SIDE OF THE DAMAGED AREA TERMINATING THE WATTLE SEGMENT.
6. ANY WATTLE DAMAGED DURING PLACEMENT SHALL BE REPLACED AS DIRECTED BY AGENCY STAFF, AT THE CONTRACTOR'S EXPENSE.
7. INSTALL WATTLES IN FILL LOCATIONS ACCORDING TO THE FOLLOWING GUIDELINES:

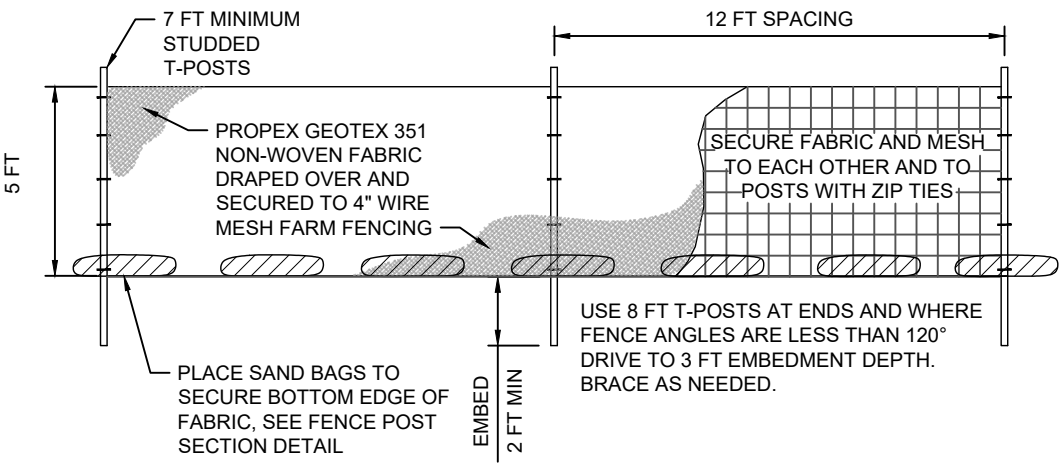
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NO.	BY	DATE	REVISION DESCRIPTION
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	PL	06/28/24	23-02-27
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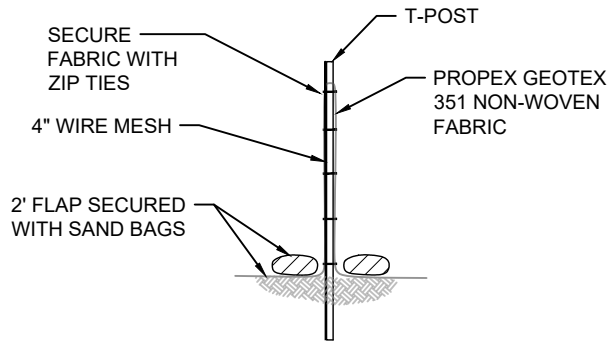


- CONSTRUCTION ENTRANCE NOTES:**
1. STABILIZED ACCESS MUST BE USED IN ALL AREAS OF THE SITE WITH VEHICLE TRAFFIC AND PARKING.
 2. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHT-OF-WAYS. THIS MAY REQUIRE TOP DRESSING, REPAIR AND/OR CLEAN OUT OF ANY MEASURES USED TO TRAP SEDIMENT.
 3. WHEN NECESSARY, WHEELS SHALL BE CLEANED PRIOR TO ENTRANCE ONTO PUBLIC RIGHT-OF-WAY.
 4. SEE SECTION 9-37.2 (TABLE 3) FOR GEOTEXTILE REQUIREMENTS. GEOTEXTILE MODIFICATIONS BASED ON SPECIFIC PROJECT SITE CONDITIONS MAY BE APPROVED BY THE ENGINEER.
 5. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABILIZED WITH CRUSHED STONE THAT DRAINS INTO AN APPROVED SEDIMENT TRAP OR SEDIMENT BASIN.

1
7 **CONSTRUCTION ENTRANCE**
NOT TO SCALE



ELEVATION



SECTION

2
7 **TYPICAL DETAIL - SILT FENCE**
NOT TO SCALE

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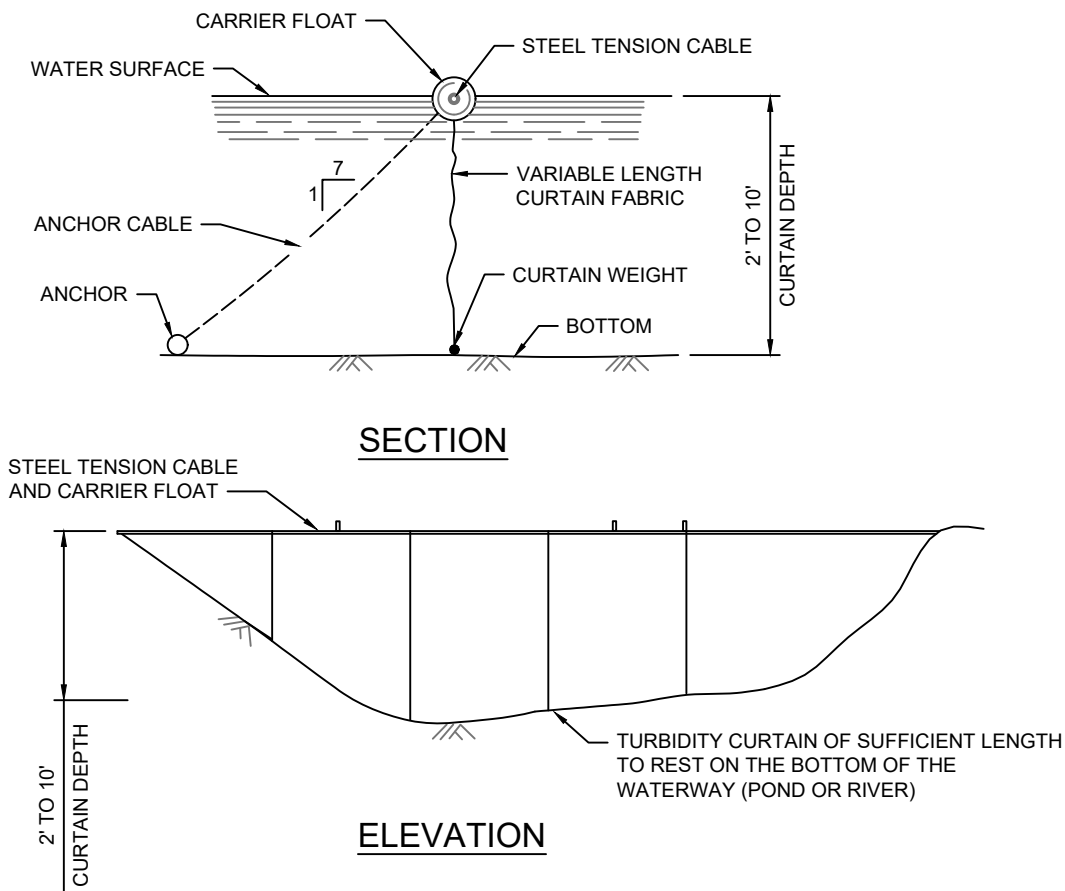
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**ENVIORNMENTAL CONTROL
DETAILS (2 OF 3)**

**SHEET
7 OF 23**



1
8 FLOATING TURBIDITY CURTAIN

TURBIDITY CURTAIN NOTES:

1.

ONLY TURBIDITY CURTAINS OF TYPE II OR GREATER STRENGTH SHALL BE ACCEPTED. THE TURBIDITY CURTAIN IS TO BE INSTALLED AT LOCATIONS SHOWN ON THE DRAWINGS. FISH SHALL BE SALVAGED FROM THE ENCLOSED AREA.
2.

THE TURBIDITY CURTAIN SHALL BE A CONTINUOUS ROLL OF GEOTEXTILE FABRIC SUFFICIENT TO ENCLOSE THE ENTIRE WORK AREA AND PREVENT A VISUALLY DETECTABLE DIFFERENCE IN TURBIDITY BETWEEN THE BACKGROUND AND COMPLIANCE TURBIDITY MONITORING SITES. IF ADDITIONAL FABRIC IS NEEDED TO ENCLOSE WORK AREA, SEE "PANEL CONNECTORS."
3.

FABRIC - WITHIN NAVIGABLE WATERS, THE FABRIC SHALL BE A BRIGHT COLOR (YELLOW OR ORANGE) TO ATTRACT THE ATTENTION OF ANY BOATERS OR SWIMMERS. THE FABRIC SELECTION SHALL TAKE INTO ACCOUNT THE VOLUME OF WATER THAT MUST PASS THROUGH BASED ON THE ANTICIPATED VOLUME OF WATER FLOWING INTO THE PROTECTED AREA. THE FABRIC SELECTION SHALL ALSO TAKE INTO ACCOUNT THE EXPECTED POLLUTANT PARTICLE SIZE BASED ON THE PRIMARY SEDIMENT IDENTIFIED.
4.

PANEL CONNECTORS - IF ADDITIONAL FABRIC PANELS ARE NEEDED, THE SEAMS OF THE FABRIC SHALL BE GLUED, WELDED, OR SEWN AND SHALL HAVE 90% OF THE STRENGTH CHARACTERISTICS AS THE FABRIC. IF ADJACENT PANELS ARE NECESSARY, THEY SHALL BE CONNECTED USING ONE OF THE FOLLOWING METHODS: A) SEW THE PANELS TOGETHER USING TWO STITCH LINES PER SEAM AND A STITCH DENSITY OF SIX TO TEN STITCHES PER INCH, B) JOIN THE PANELS OF FABRIC USING GROMMETED HOLES AND ROPE LACING. THE HOLES SHALL BE ONLY SLIGHTLY LARGER THAN THE ROPE TO MINIMIZE LEAKAGE. C) USE COMMERCIALY AVAILABLE ALUMINUM SLIDE-CONNECTORS.
5.

THE TURBIDITY CURTAIN SHALL BE OF SUFFICIENT LENGTH TO REST ON THE BOTTOM OF THE RIVER.
6.

FLOTATION - FLOTATION SEGMENTS SHALL BE RETAINED INTO A SEWN OR HEAT WELDED SEAM ALONG THE ENTIRE TOP OF THE TURBIDITY CURTAIN TO FORM A CONTINUOUS FLOAT. POSSIBLE FLOTATION MATERIAL INCLUDES EXPANDED POLYSTYRENE, FLOATS, OR CLOSED CELL SOLID PLASTIC FOAM FLOATS.
7.

LOAD LINE - TURBIDITY CURTAINS SHALL REQUIRE A LOAD LINE. THE LOAD LINE SHALL BE A MINIMUM 5/16" STEEL CABLE INSTALLED IN THE SLEEVE WITHIN THE FLOTATION SEGMENTS OR JUST BELOW THE FLOATS IF IN ITS OWN SLEEVE.
8.

MOORING - THE TURBIDITY CURTAIN SHALL BE PROPERLY ANCHORED BOTH ONSHORE AND IN THE WATER. THE TURBIDITY CURTAIN SHALL EXTEND UP ONTO SHORE AND BE TIED TO A POST OR STABLE, LARGE DIAMETER TREE (8" DIAMETER OR MORE AT BREAST HEIGHT). THE ANCHORING SYSTEM SHALL BE DESIGNED BASED ON THE ANTICIPATED CONDITIONS. THE IN-WATER ANCHOR SYSTEM SHALL CONSIST OF AN ANCHOR, CHAIN, ANCHOR LINE, BUOY, CROWN BUOY, AND MOORING CABLE - AS NEEDED. THE CURTAIN SHALL BE ANCHORED EVERY 100 FEET AT A MINIMUM. FOR HIGHER FLOW SITUATIONS - WHERE THE CURRENT APPROACHES 5 FPS AND/OR WAVES OVER 1 FOOT ARE ANTICIPATED - THE TURBIDITY CURTAIN SHALL BE ANCHORED EVERY 50 FEET. TURBIDITY CURTAINS SUBJECT TO REVERSING CURRENTS, WAVES, OR FLOW FROM BOTH SIDES SHALL BE ANCHORED ON BOTH SIDES. THE ANCHORS SHALL BE PLACED SUCH THAT THE SLOPE OF THE ANCHOR LINE IS 7 HORIZONTAL TO 1 VERTICAL - THIS WILL MINIMIZE THE STRESS ON THE SILT CURTAIN AND INCREASE THE HOLDING POWER OF THE ANCHOR. A MINIMUM 1/2" DIAMETER ROPE SHALL BE USED FOR THE ANCHOR LINE.
9.

REMOVAL - THE TURBIDITY CURTAIN SHALL ONLY BE REMOVED WHEN A THERE IS NO VISUALLY DETECTABLE DIFFERENCE IN TURBIDITY BETWEEN THE BACKGROUND AND COMPLIANCE TURBIDITY MONITORING SITES.

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ENVIRONMENTAL CONTROL DETAILS (3 OF 3)	SHEET 8 OF 23
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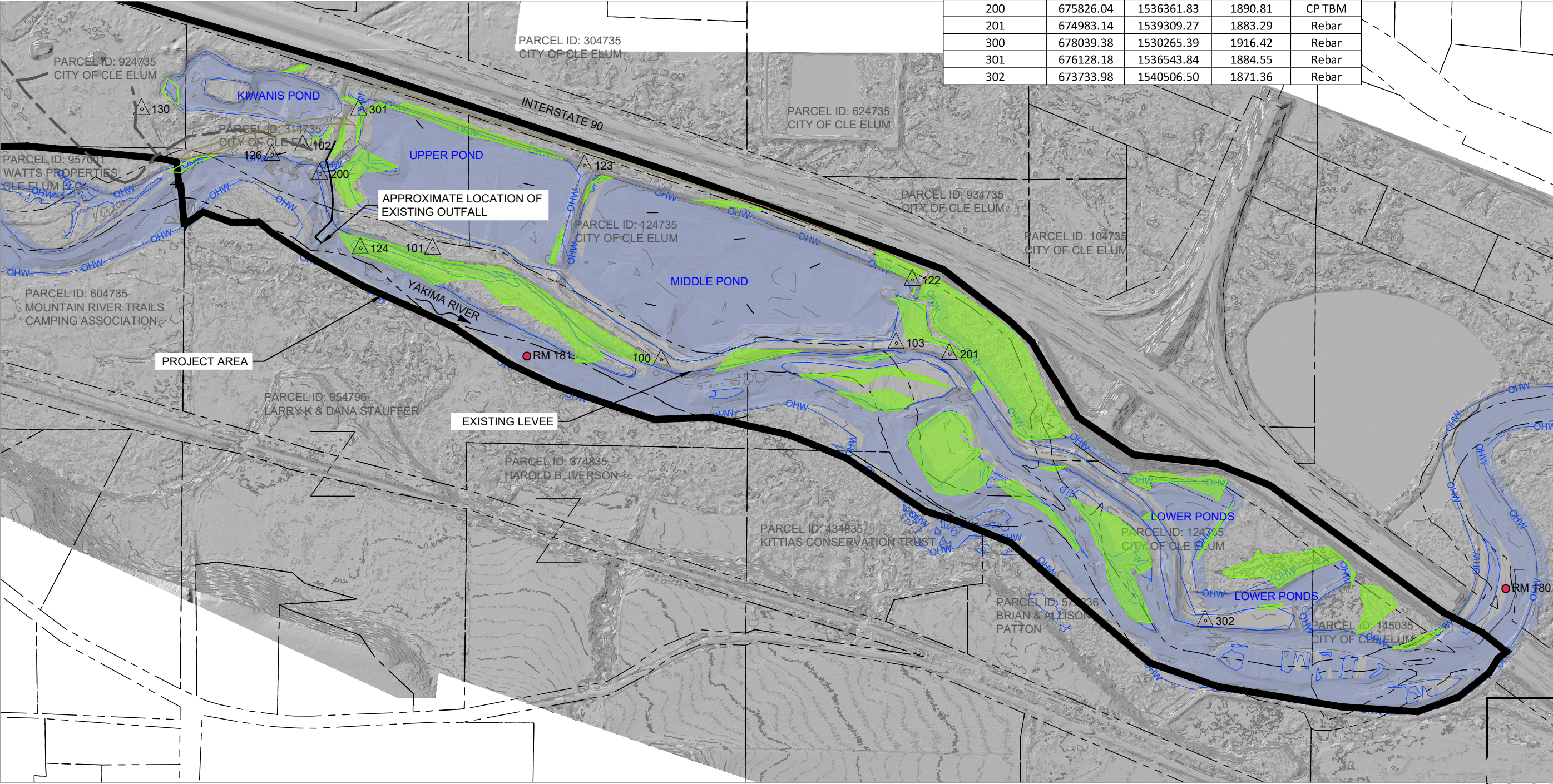
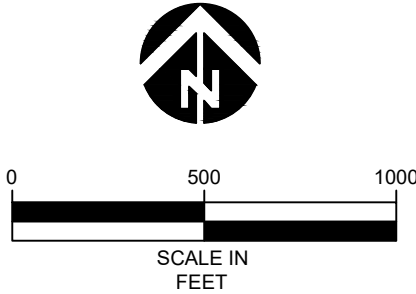
LEGEND

- EXISTING CONTOURS (1 FT)
- - - TAXLOTS
- OHW — OHW — ORDINARY HIGH WATER
- - - EXISTING ACCESS
- RM XX RIVER MILE
- △ SURVEY CONTROL POINT
- WETLAND (GG ENVIRONMENTAL 2020)

NOTE:
TAXLOT LINES WERE ACQUIRED FROM
KITITAS COUNTY OPEN DATA PORTAL
IN JANUARY OF 2024, AND ARE APPROXIMATE

SURVEY CONTROL POINTS

Point Number	Northing	Easting	Elevation	Description
100	674957.14	1537959.86	1884.99	Rebar
101	675476.02	1536889.38	1889.48	Rebar
102	675960.23	1536281.46	1887.43	Rebar
103	675034.54	1539059.24	1881.94	Rebar
112	677236.87	1531205.30	1912.29	Rebar
122	675329.54	1539135.03	1880.59	Rebar
123	675866.03	1537600.32	1883.42	Rebar
124	675478.75	1536551.44	1885.80	Rebar
126	675915.70	1536136.88	1890.57	Rebar
130	676130.15	1535526.58	1892.80	Rebar
200	675826.04	1536361.83	1890.81	CP TBM
201	674983.14	1539309.27	1883.29	Rebar
300	678039.38	1530265.39	1916.42	Rebar
301	676128.18	1536543.84	1884.55	Rebar
302	673733.98	1540506.50	1871.36	Rebar



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EXISTING CONDITIONS AND
SURVEY CONTROL

SHEET
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LEGEND

- RM XX

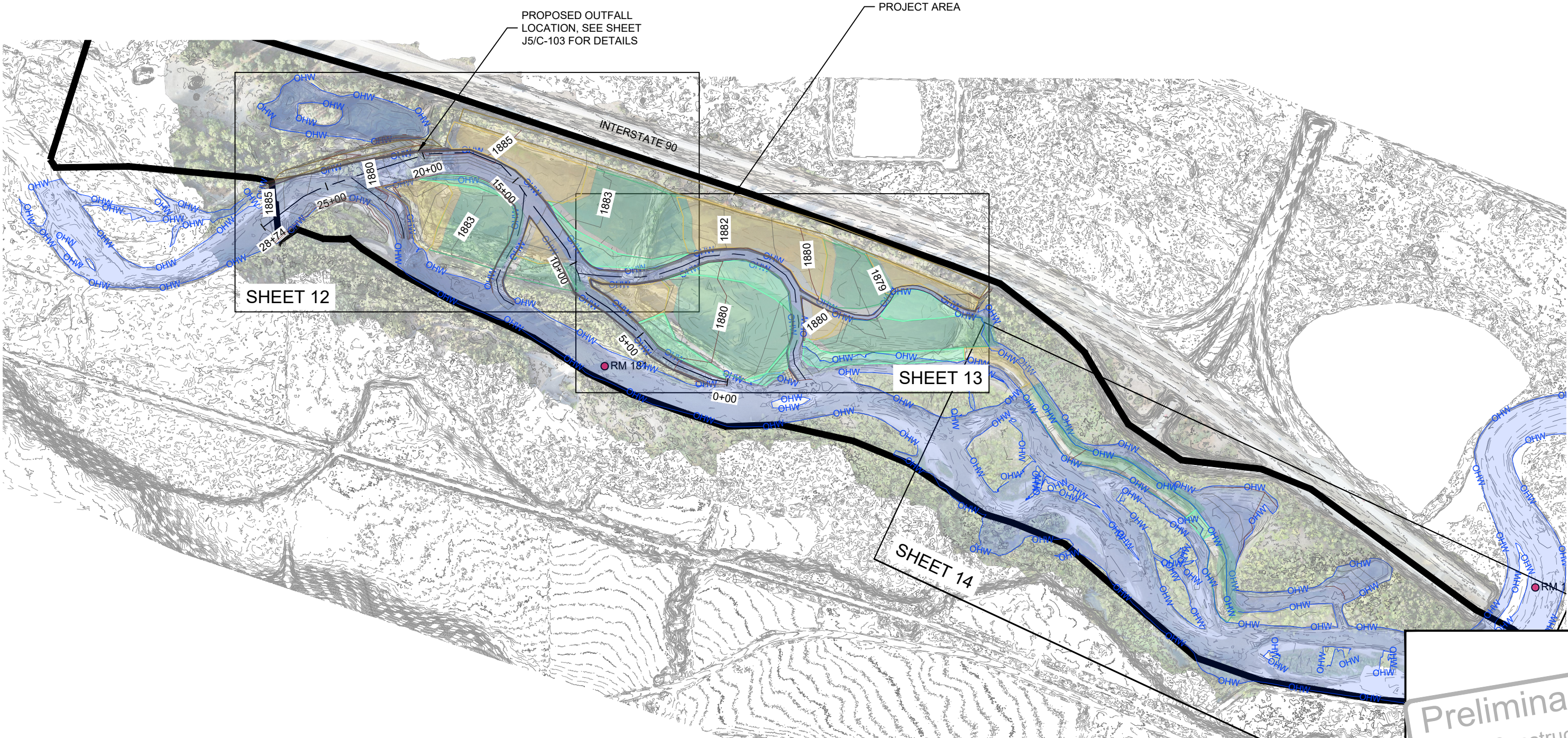
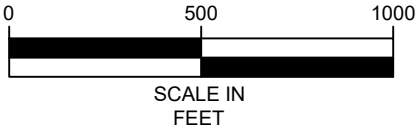
RIVER MILE

PROPOSED ACCESS

PROPOSED STAGING AREA
-
-
- SCALE IN FEET
-
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| DRAWN | DESIGNED | CHECKED |
| PL | 06/28/24 | 23-02-27 |
| APPROVED | DATE | PROJECT |
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- PROPOSED STAGING AND ACCESS
- | SHEET |
|----------|
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- Preliminary
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LEGEND

- EXISTING CONTOURS (1 FT)
- PROPOSED CONTOURS (1 FT)
- ORDINARY HIGH WATER
- PROPOSED YAKIMA RIVER ALIGNMENT
- RIVER MILE
- PROPOSED OHW INUNDATION AREA
- PROPOSED 1 YEAR FLOODPLAIN
- PROPOSED 2 YEAR FLOODPLAIN
- PROPOSED 5 YEAR FLOODPLAIN



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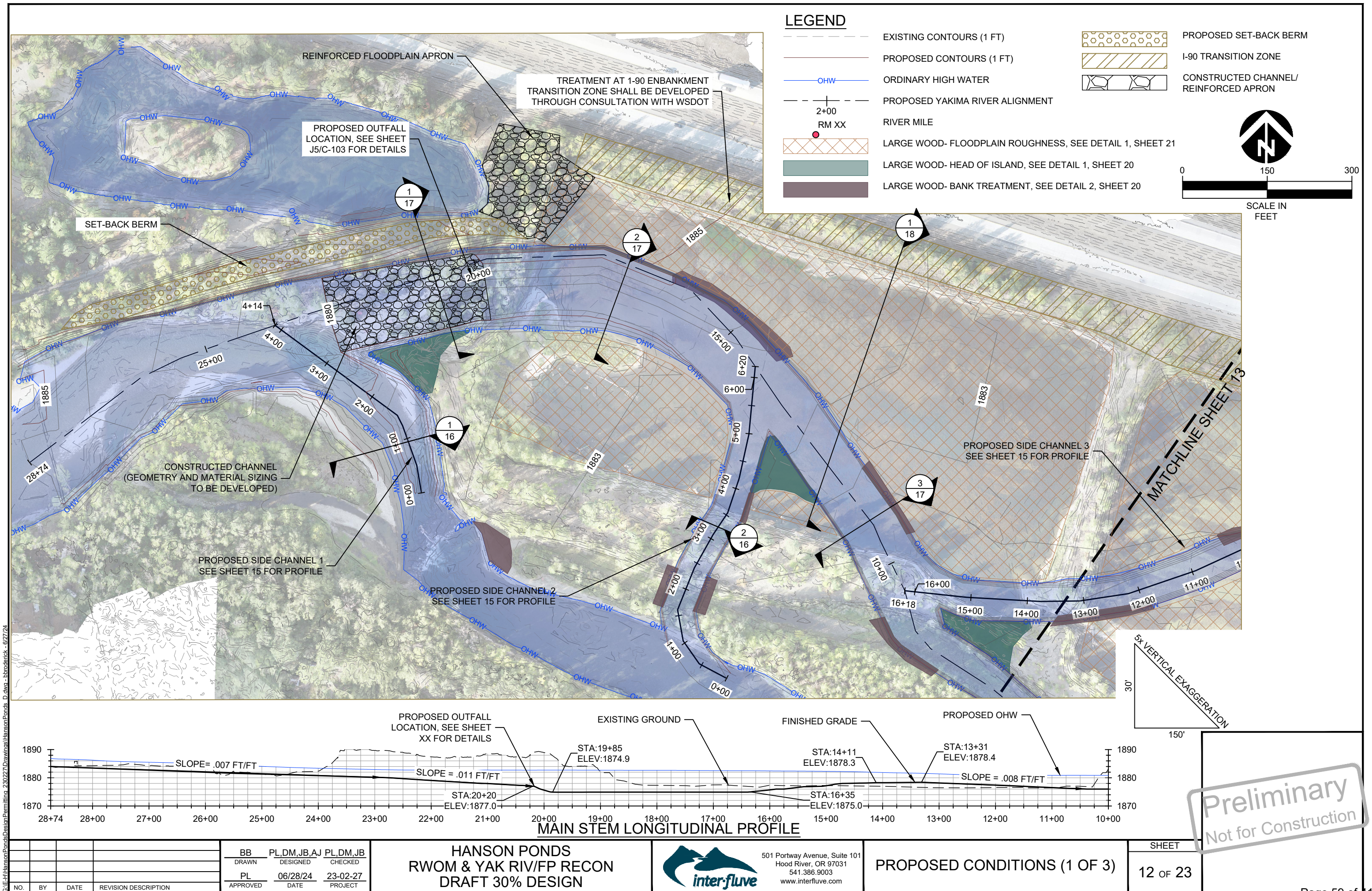
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PROPOSED CONDITIONS
OVERVIEW

SHEET
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LEGEND

- EXISTING CONTOURS (1 FT)

PROPOSED CONTOURS (1 FT)

ORDINARY HIGH WATER

PROPOSED YAKIMA RIVER ALIGNMENT

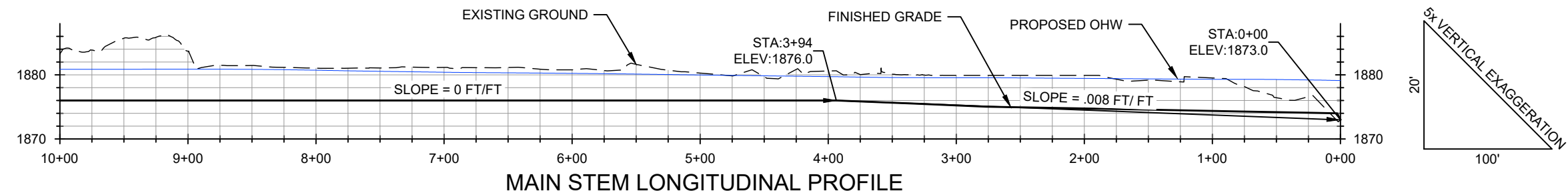
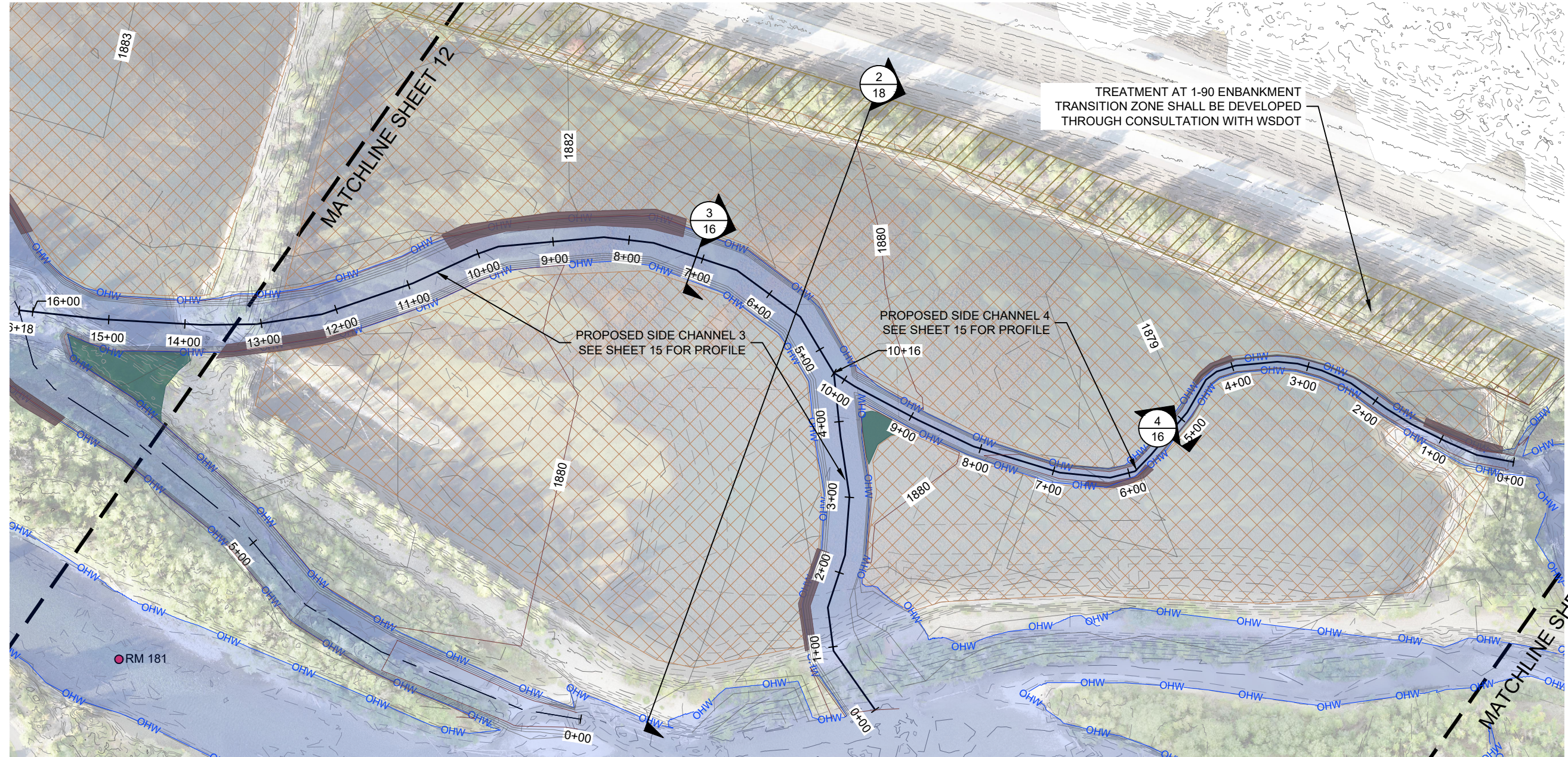
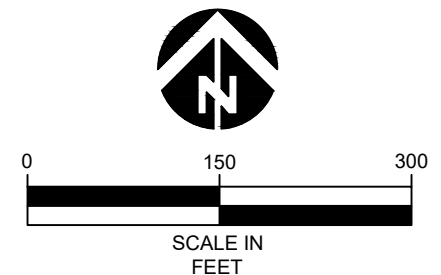
2+00

RIVER MILE
- LARGE WOOD- FLOODPLAIN ROUGHNESS, SEE DETAIL 1, SHEET 21

LARGE WOOD- HEAD OF ISLAND, SEE DETAIL 1, SHEET 20

LARGE WOOD- BANK TREATMENT, SEE DETAIL 2, SHEET 20

I-90 TRANSITION ZONE



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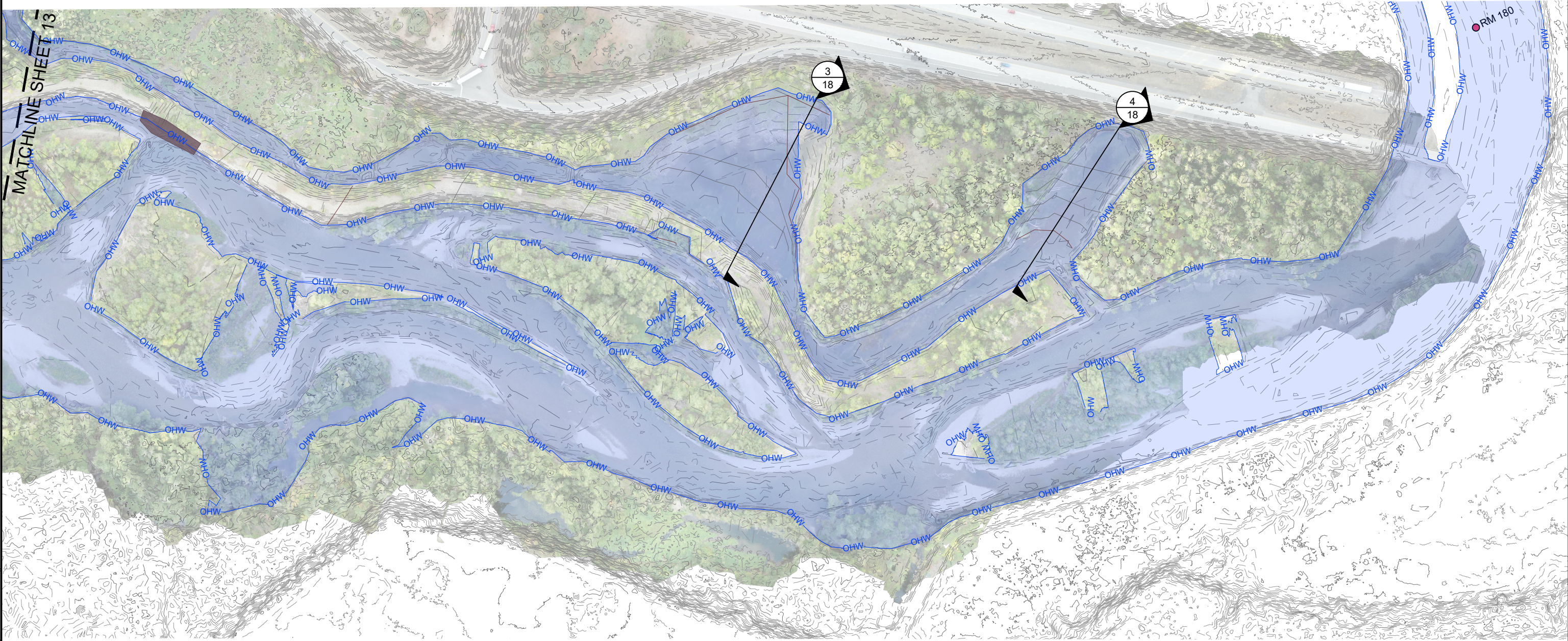
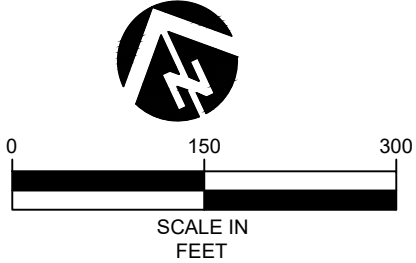
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PROPOSED CONDITIONS (2 OF 3)

SHEET
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LEGEND

- EXISTING CONTOURS (1 FT)
- PROPOSED CONTOURS (1 FT)
- OHW
- PROPOSED YAKIMA RIVER ALIGNMENT
- 2+00
- RM XX
- LARGE WOOD- BANK TREATMENT, SEE DETAIL 2, SHEET 20



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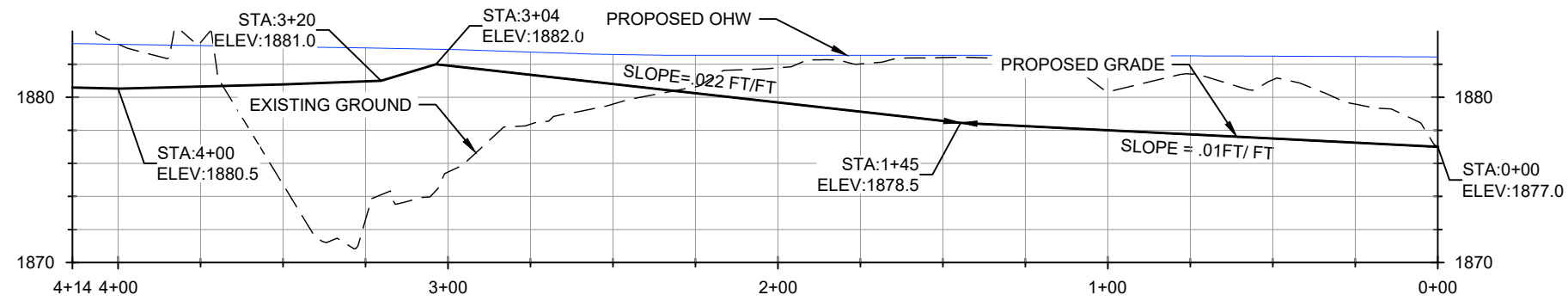
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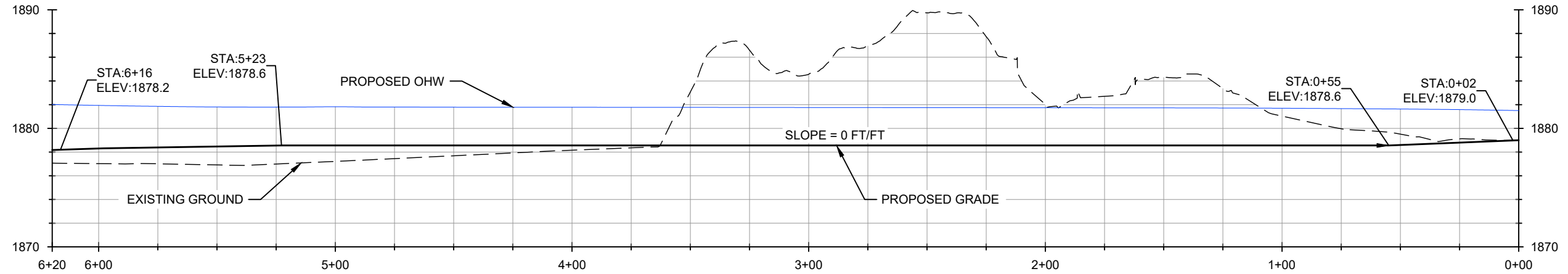
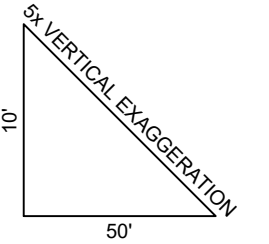
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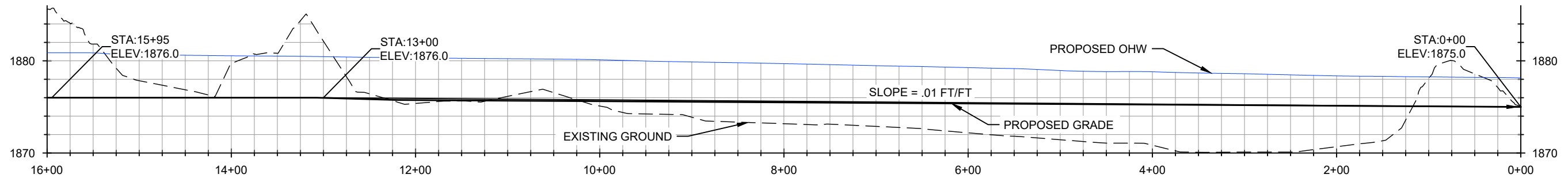
SIDE CHANNEL 1 PROFILE

LEGEND

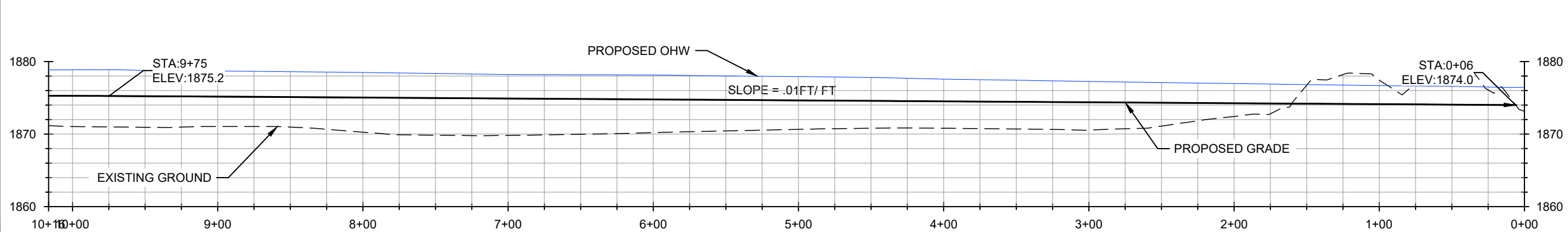
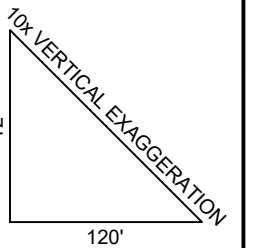
- EXISTING GRADE
- PROPOSED GRADE
- PROPOSED OHW



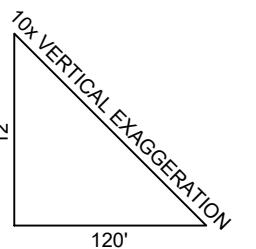
SIDE CHANNEL 2 PROFILE



SIDE CHANNEL 3 PROFILE



SIDE CHANNEL 4 PROFILE



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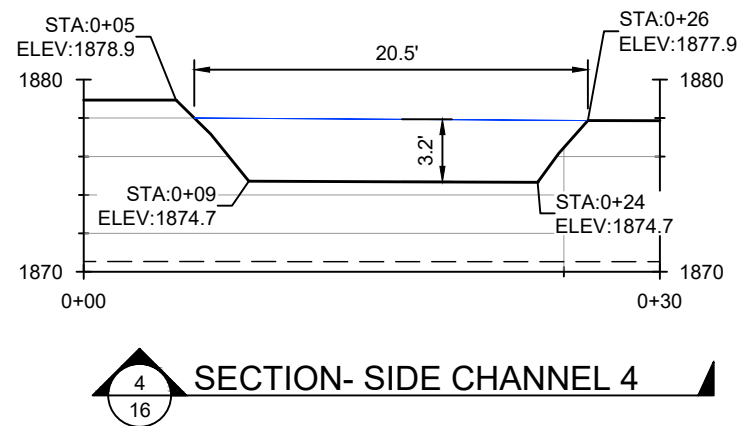
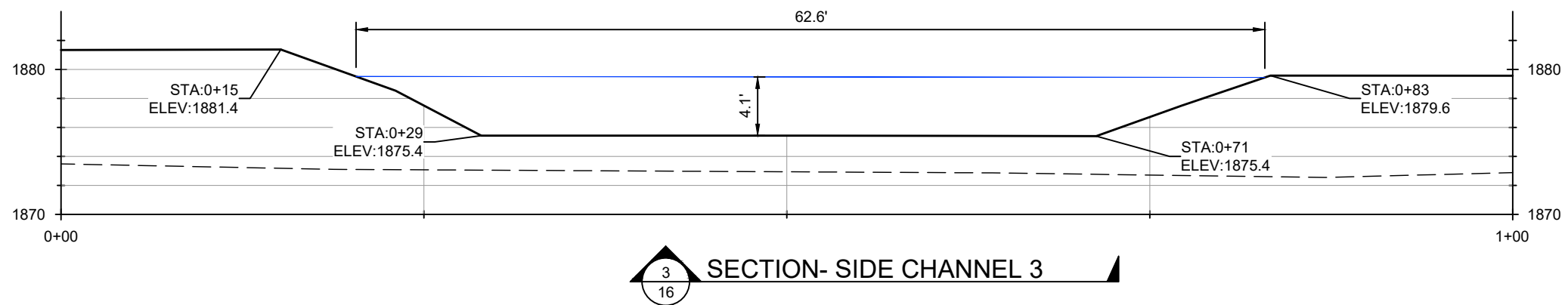
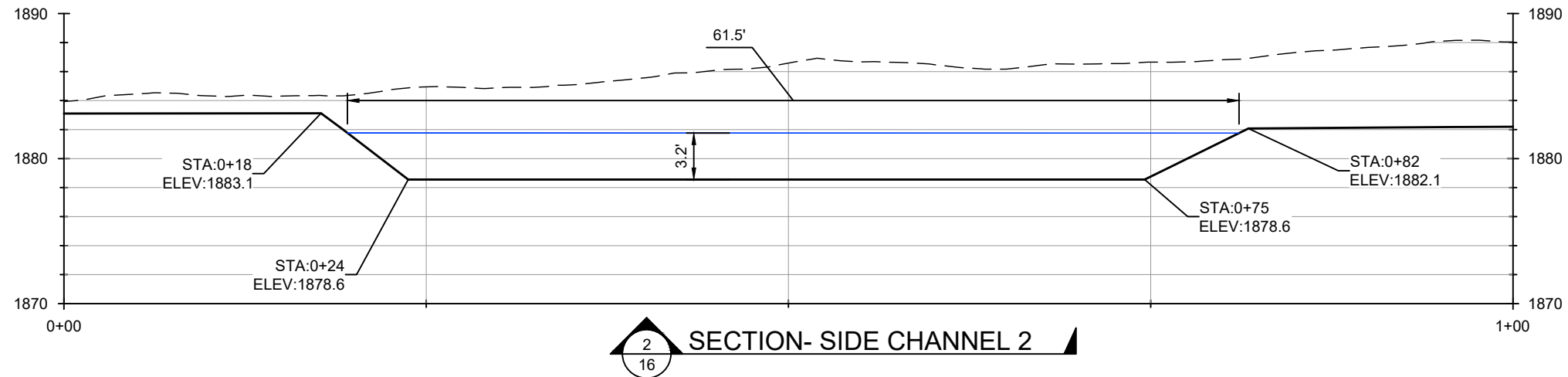
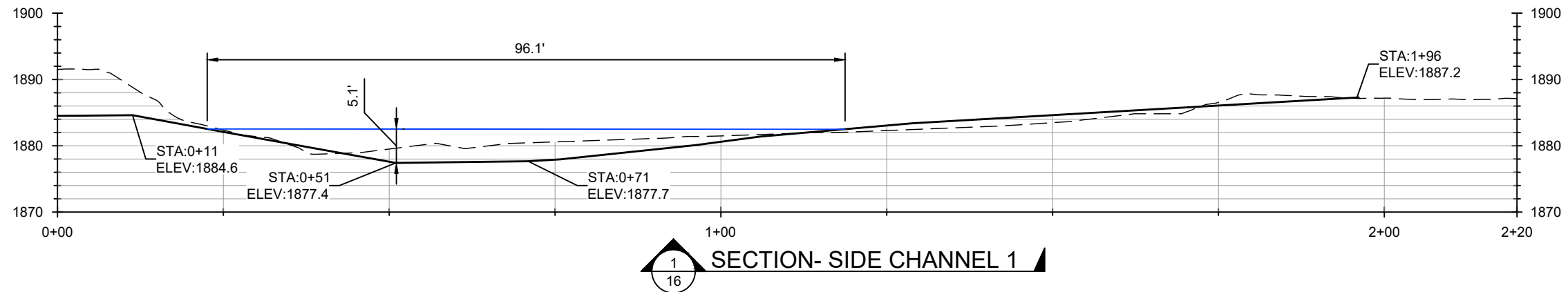
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SIDE CHANNEL PROFILES

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LEGEND

- EXISTING GRADE
- PROPOSED GRADE
- PROPOSED OHW

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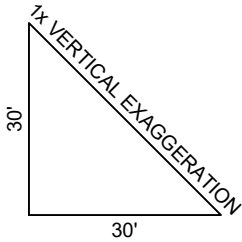
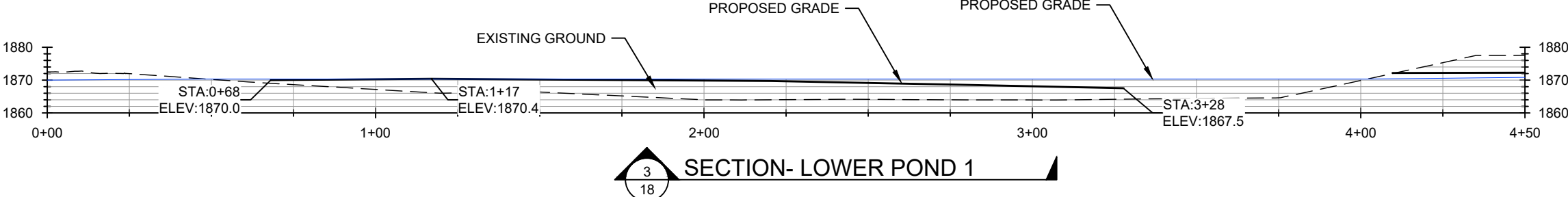
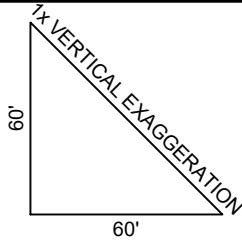
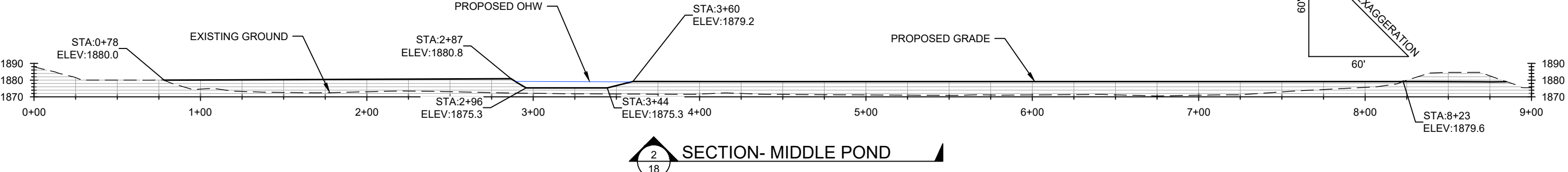
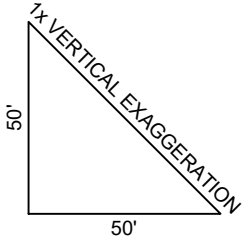
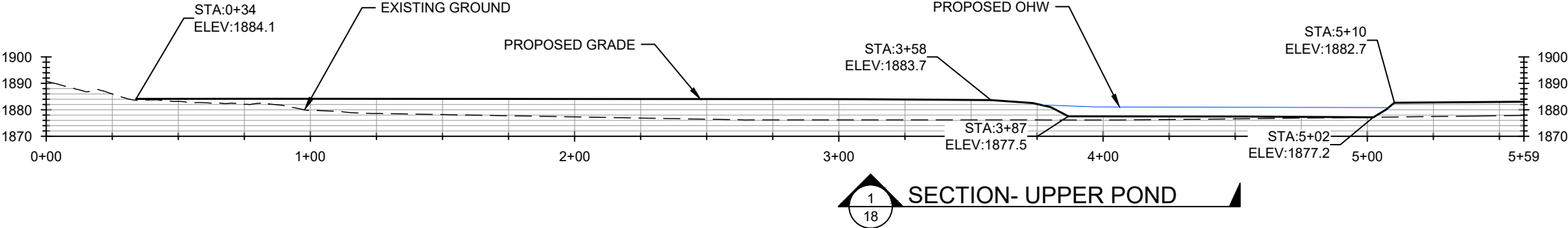
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SIDE CHANNEL SECTIONS

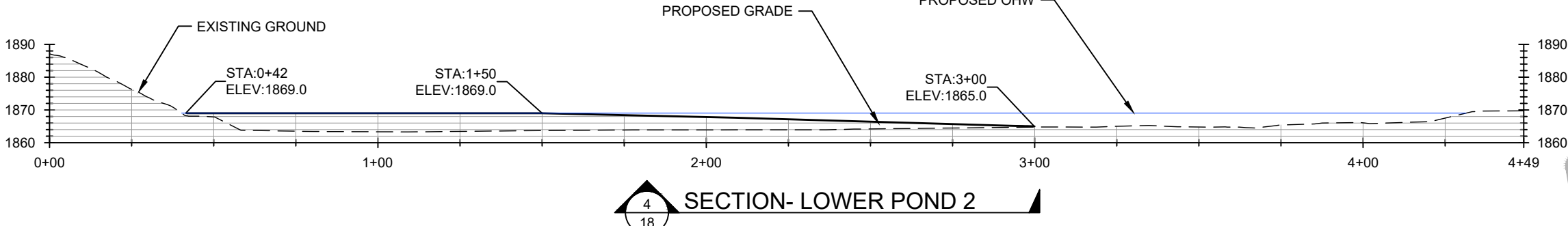
SHEET
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LEGEND

- EXISTING GRADE
- PROPOSED GRADE
- PROPOSED OHW



NOTE: ORIENTATION IS LEFT TO RIGHT LOOKING DOWNSTREAM



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POND FILL SECTIONS

SHEET
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HOLD FOR ROUGHENED CHANNEL DETAIL

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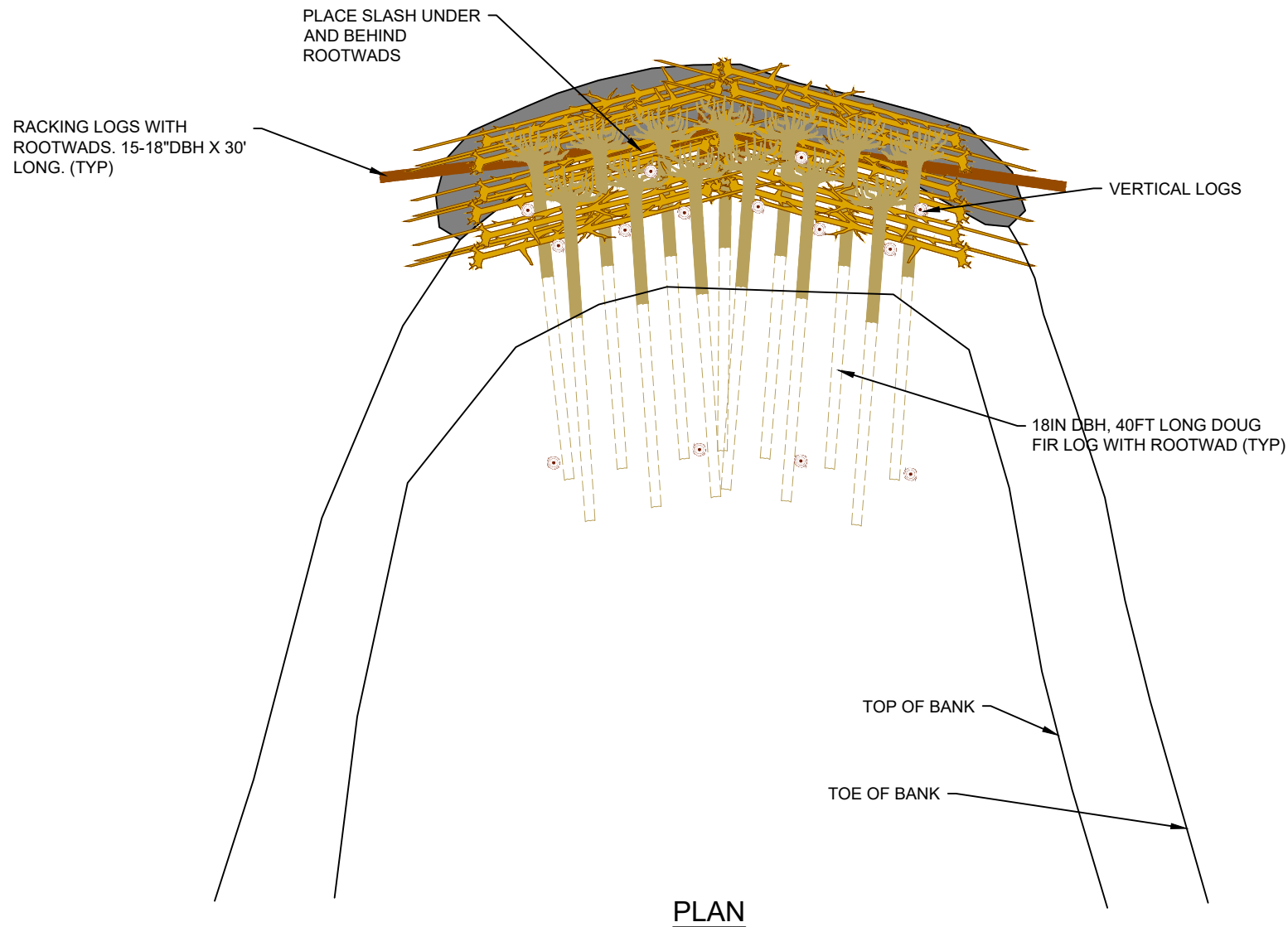
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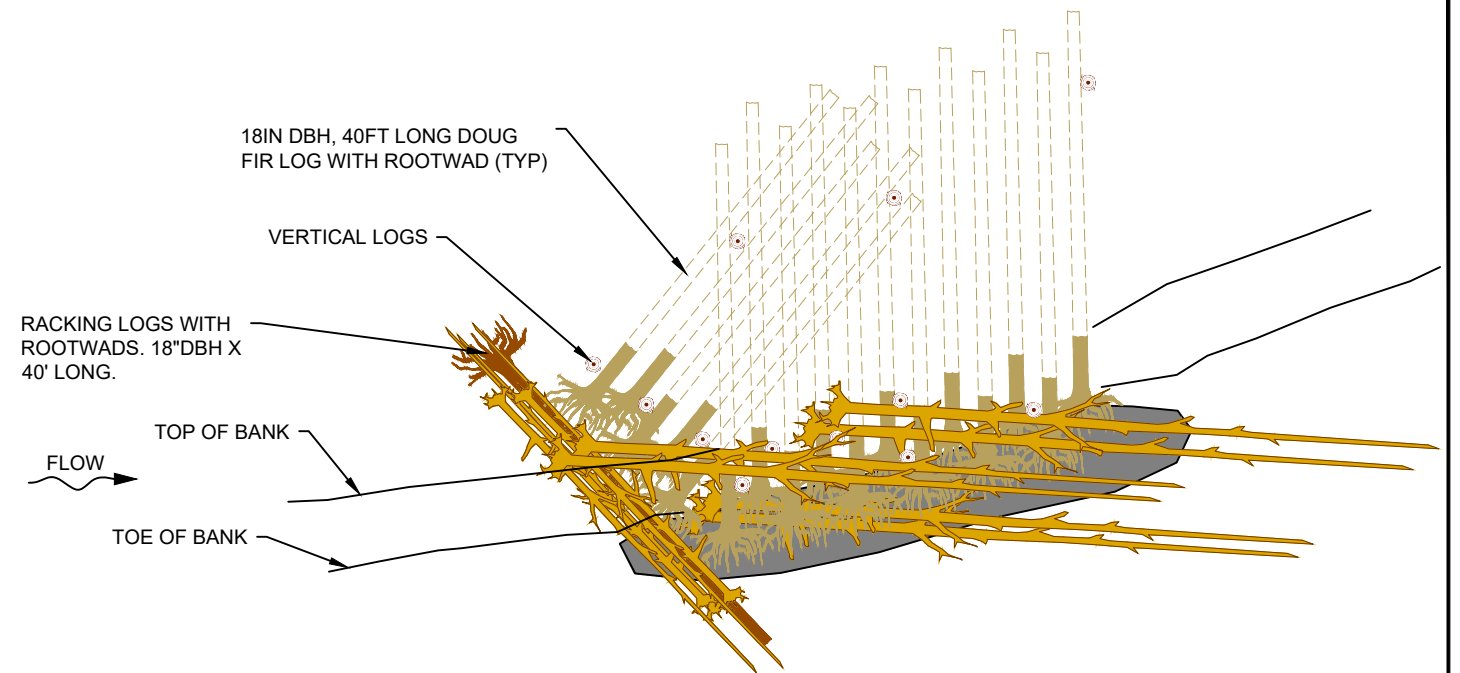
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CHANNEL DETAILS

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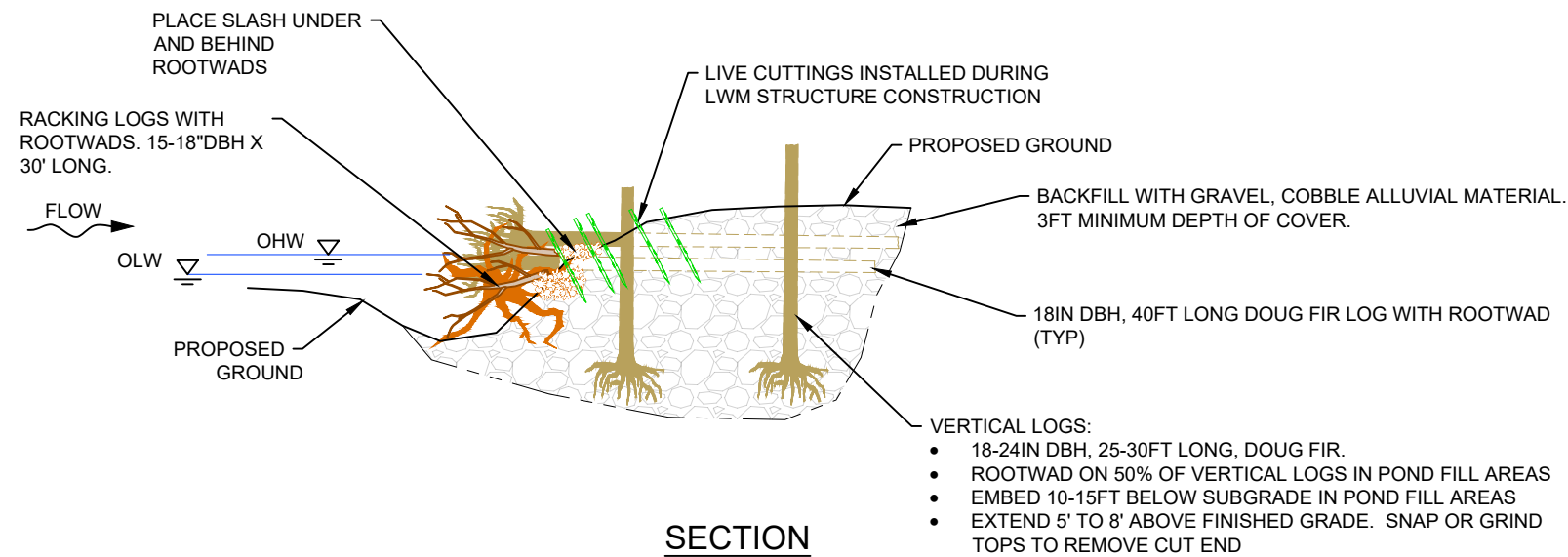


PLAN



PLAN

2
20 **BANK BURIED LARGE WOOD**
NOT TO SCALE



SECTION

NOTE: HEAD OF ISLAND SECTION IN DETAIL 1, SHEET 20 IS ALSO REPRESENTATIVE OF BANK BURIED WOOD SECTION AT THIS LEVEL OF DESIGN.

1
20 **HEAD OF ISLAND LARGE WOOD**
NOT TO SCALE

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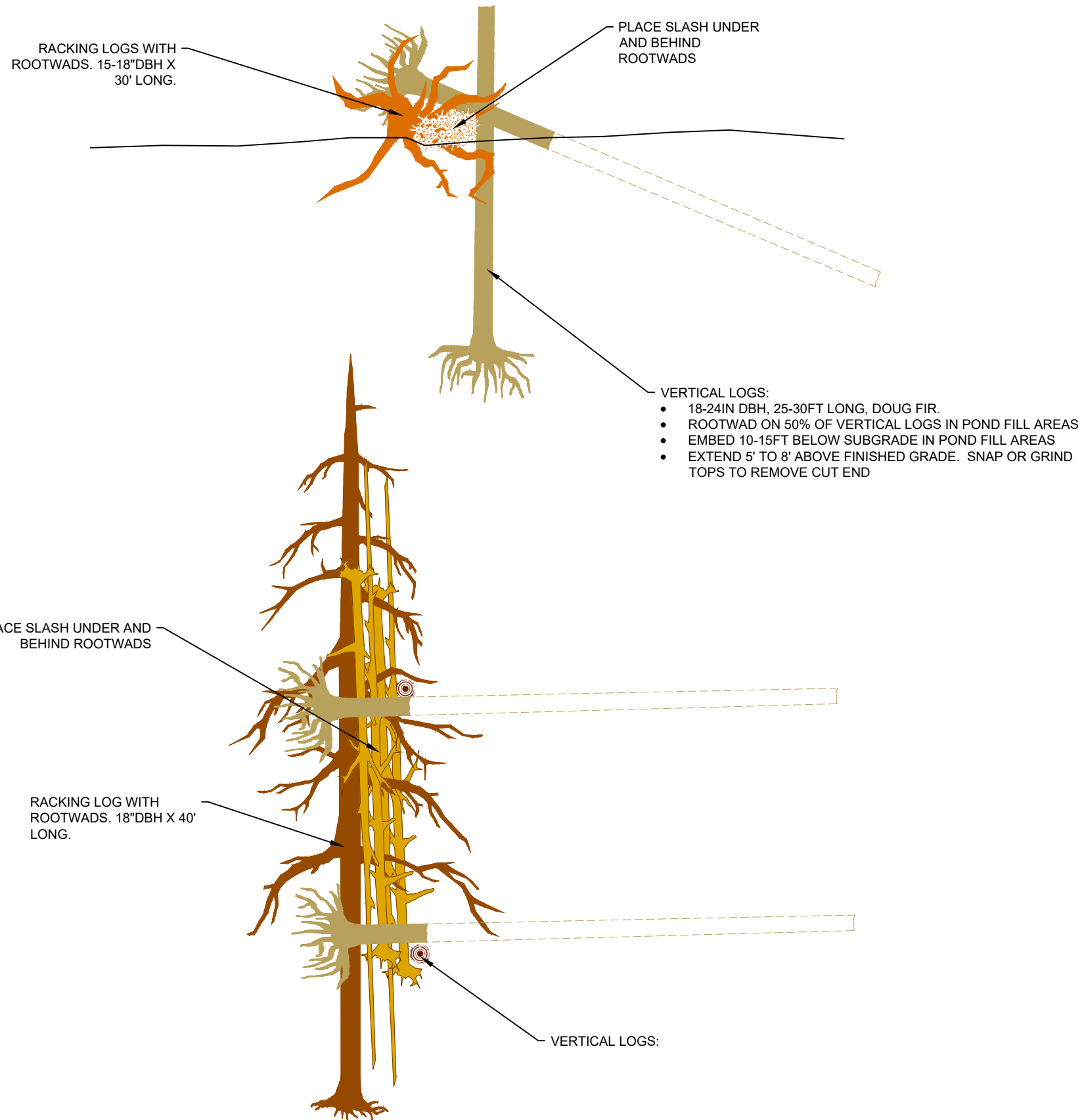
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LW DETAILS (1 OF 2)

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1
21

FLOODPLAIN ROUGHNESS LARGE WOOD
NOT TO SCALE

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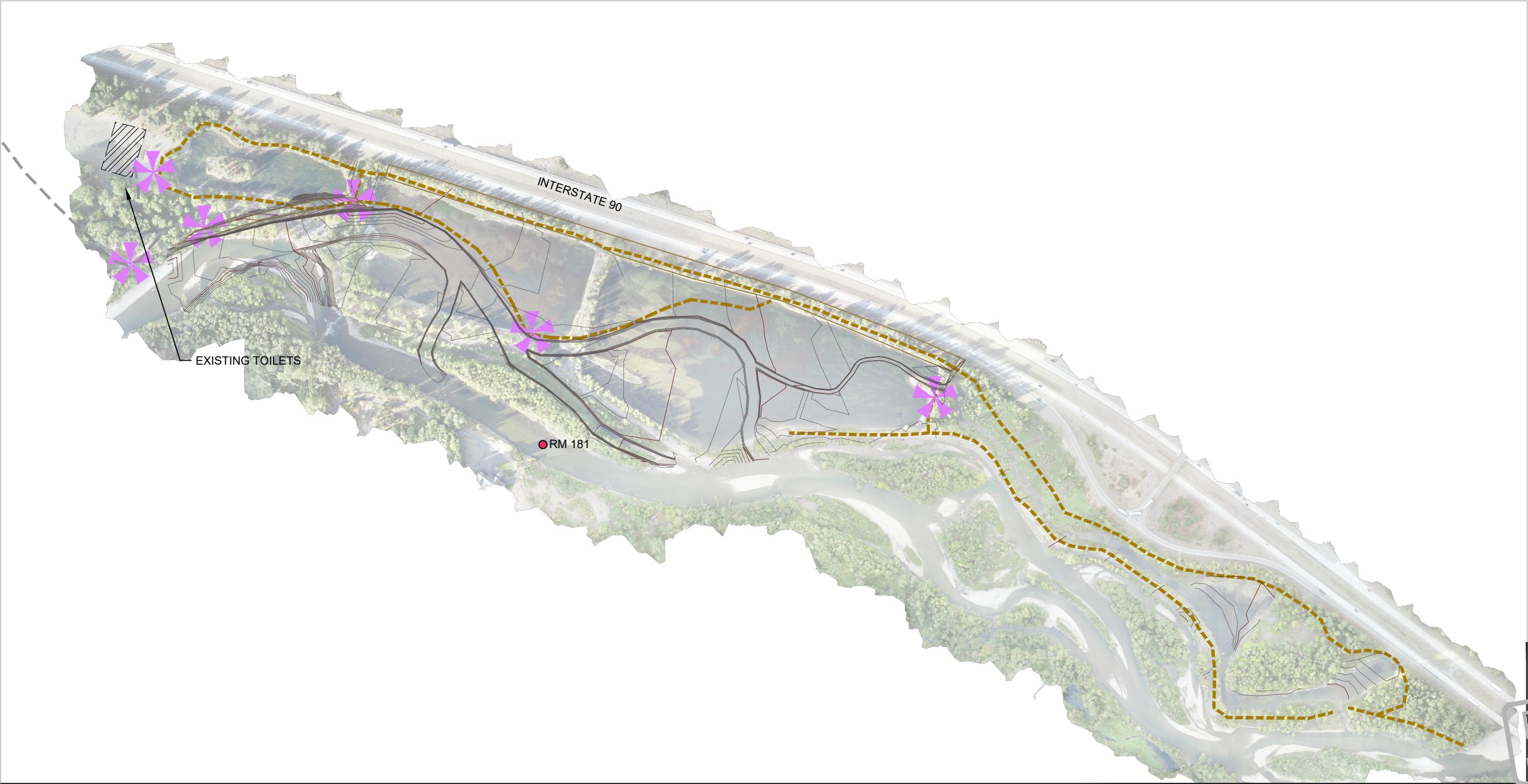
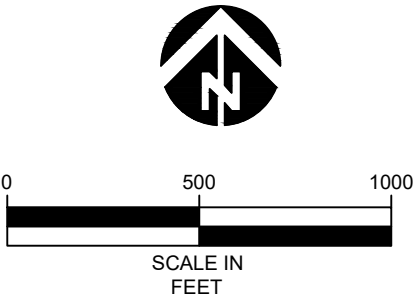
LW DETAILS (2 OF 2)

SHEET
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LEGEND

- PROPOSED CONTOURS (1 FT)
- ACCESS
- RM XX RIVER MILE
- △ SURVEY CONTROL POINT
- POTENTIAL INFORMAL TRAIL
- PROPOSED OVERLOOKS/ACCESS POINTS
- PROPOSED INFORMAL PARKING



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NO.	BY	DATE	REVISION DESCRIPTION

BB	PL,DM,JB,AJ	PL,DM,JB
DRAWN	DESIGNED	CHECKED
PL	06/28/24	23-02-27
APPROVED	DATE	PROJECT

HANSON PONDS
RWOM & YAK RIV/FP RECON
DRAFT 30% DESIGN



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RECREATION ACCESS & TRAILS
PLAN

SHEET
22 OF 23

REVEGETATION PLANT & SEED LIST

Zone 1		
Emergent Fringe: plantings-seeds		
Common Name	Botanical Name	Wetland Status
Slough sedge	Carex obnupta	OBL
Sawbeak sedge	Carex stipata	OBL
Beaked sedge	Carex utriculata	OBL
Reed mannagrass	Glyceria grandis	OBL
Tapered rush	Juncus acuminatus	OBL
Small-fruited bulrush	Scirpus microcarpus	OBL
Cattail	Typha latifolia	OBL
Common rush	Juncus effusus	FAQW
Sender rush	Juncus tenuis	FAC

Zone 2		
Riparian: plantings-live cuttings-seeds		
Common Name	Botanical Name	Wetland Status
Pacific ninebark	Physocarpus capitatus	FAQW
Narrowleaf cottonwood	Populus angustifolia	FAQW
Pacific willow	Salix lucida spp. lasiandra	FAQW
Stka willow	Salix sitchensis	FAQW
Coyote willow	Salix exigua	FAQW
Red alder	Alnus rubra	FAC
Black cottonwood	Populus balsamifera ssp. trichocarpa	FAC
Common rush	Juncus effusus	FAQW
Tufted hairgrass	Deschampsia cespitosa	FAQW
Sender wheatgrass	Elymus trachycaulus	FAC
Sender rush	Juncus tenuis	FAC

Zone 3		
Transitional: plantings-seeds		
Common Name	Botanical Name	Wetland Status
Red alder	Alnus rubra	FAC
Black cottonwood	Populus balsamifera ssp. trichocarpa	FAC
Nootka rose	Rosa nutkana	FAC
Douglas fir	Pseudotsuga menziesii	FAQJ
Thimbleberry	Rubus parviflorus	FAQJ
Common snowberry	Symphoricarpos albus	FAQJ
Sender wheatgrass	Elymus trachycaulus	FAC
Idaho fescue	Festuca idahoensis	FAQJ

Zone 4		
Upland: plantings-seeds		
Common Name	Botanical Name	Wetland Status
Tall Oregon grape	Mahonia aquifolium	FAQJ
Ponderosa pine	Pinus ponderosa	FAQJ
Choke cherry	Prunus virginiana	FAQJ
Douglas fir	Pseudotsuga menziesii	FAQJ
Common snowberry	Symphoricarpos albus	FAQJ
Idaho fescue	Festuca idahoensis	FAQJ
Bluebunch wheatgrass	Pseudoroegneria spicata	UPL

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REVEGETATION- PROPOSED
PLANT & SEED LIST

SHEET
23 OF 23

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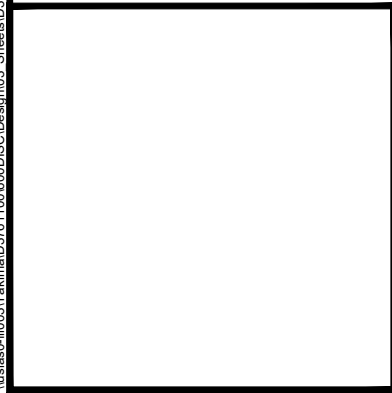
GENERAL PROJECT NOTES

- 1. ALL WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE PROJECT PLANS, SPECIFICATIONS, AND SPECIAL PROVISIONS (CONTRACT DOCUMENT) AND ALL WORK SHALL COMPLY WITH THE ORDER OF PRECEDENCE ESTABLISHED IN SECTIONS 1-04.2 OF THE SPECIAL PROVISIONS.
- 2. A PRE-CONSTRUCTION CONFERENCE SHALL BE HELD WITH THE CITY PRIOR TO STARTING ANY CONSTRUCTION ON THE PROJECT.
- 3. TEMPORARY EROSION AND SEDIMENT CONTROL (TESC) MEASURES SHALL BE IN PLACE AND OPERATING PRIOR TO DEMOLITION AND CONSTRUCTION ACTIVITIES. ADDITIONAL EROSION CONTROL MEASURES MAY BE REQUIRED BY THE CITY DEPENDING ON SITE AND WEATHER CONDITIONS.
- 4. ALL EXISTING AND PROPOSED CATCH BASINS DOWNSTREAM OF DISTURBED AREAS SHALL BE CONSTRUCTED PER WSDOT STANDARD PLAN NO. I-40.20-00.
- 5. KEEP STREETS CLEAN AT ALL TIMES. FLUSHING STREETS WILL NOT BE PERMITTED. DEBRIS SHALL BE SWEPT FROM ALL STREETS.
- 6. THE CONTRACTOR SHALL PROTECT ALL AREAS OUTSIDE THE WORK ZONE AND OUTSIDE THE RIGHT-OF-WAY FROM DISTURBANCE. ALL DISTURBED AREAS SHALL BE FULLY RESTORED TO PROPOSED OR PRE-EXISTING CONDITIONS.
- 7. AN APPROVED SET OF CONSTRUCTION PLANS FOR ALL WORK SHALL BE KEPT ON THE CONSTRUCTION SITE AT ALL TIMES. IN ADDITION, A COPY OF THE CURRENT CITY OF EVERETT DESIGN AND CONSTRUCTION STANDARDS AND SPECIFICATIONS SHALL ALSO BE AVAILABLE AT THE CONSTRUCTION SITE.
- 8. LOCAL AND EMERGENCY ACCESS SHALL BE MAINTAINED AT ALL TIMES.
- 9. A TEMPORARY TRENCH PATCH SHALL BE ACCOMPLISHED BY USING COLD MIX, ATB, OR STEEL PLATES.
- 10. WHERE EXISTING PAVEMENT, CURBS, SIDEWALKS, DRIVEWAYS, OR LANDSCAPE FEATURES ARE NOT INDICATED TO BE REMOVED/REPLACED, THE CONTRACTOR SHALL IMPLEMENT MEASURES TO PROTECT AND MAINTAIN EXISTING CONDITIONS. IF DAMAGED DURING CONSTRUCTION, THE CONTRACTOR SHALL REPLACE OR RESTORE AT THE CONTRACTOR'S EXPENSE.

GENERAL CONSTRUCTION NOTES

- 1. EXISTING WATER SERVICES SHOWN ARE BASED ON CITY GIS DATA AND ARE APPROXIMATE ONLY. THE CONTRACTOR SHALL VERIFY PRIOR TO CONSTRUCTION.
- 2. EXISTING SIDE SEWERS ARE SHOWN BASED ON CITY GIS DATA AND ARE APPROXIMATE ONLY. WHERE PRE-CONSTRUCTION CCTV INSPECTION WAS COMPLETED THE LOCATION OF SIDE SEWER LATERALS AT THE CS MAINS ARE ALSO SHOWN FOR CONVENIENCE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE VERIFICATION OF SIDE SEWER LOCATIONS PRIOR TO CONSTRUCTION.
- 3. APPROXIMATE LOCATIONS OF EXISTING UTILITIES HAVE BEEN OBTAINED FROM AVAILABLE RECORDS AND ARE SHOWN FOR CONVENIENCE. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE VERIFICATION OF LOCATIONS AND TO AVOID DAMAGE TO ANY ADDITIONAL UTILITIES NOT SHOWN. IF CONFLICTS WITH EXISTING UTILITIES ARISE DURING CONSTRUCTION, THE CONTRACTOR SHALL NOTIFY THE ENGINEER. ANY CHANGES REQUIRED SHALL BE APPROVED BY THE CITY PRIOR TO THE COMMENCEMENT OF RELATED CONSTRUCTION ON THE PROJECT.
- 4. THE CONTRACTOR SHALL NOTE INVERT ELEVATIONS ON EXISTING AND PROPOSED MANHOLES. NOTIFY THE ENGINEER IF ELEVATIONS DIFFER FROM PLANS PRIOR TO ORDERING MANHOLES.
- 5. SOME EXISTING DRY-SIDE SEWERS AND CAPPED TEES MAY BE ENCOUNTERED. VERIFY WITH THE INSPECTOR IF REPLACEMENT SIDE SEWER IS REQUIRED.
- 6. DO NOT ALLOW SEDIMENT-LADEN WATERS TO ENTER CS SYSTEM. AT A MINIMUM PROVIDE CB PROTECTION IMMEDIATELY DOWNSTREAM OF THE PROJECT. PROVIDE ADDITIONAL EROSION AND SEDIMENT CONTROL AS DIRECTED BY INSPECTOR.
- 7. DO NOT ALLOW THE FLOW OF GROUNDWATER STORMWATER OR RAW SEWAGE INTO THE EXCAVATION. USE TEMPORARY BYPASS PIPING AND PUMPS TO INTERCEPT FLOWS UPSTREAM OF THE WORK AREA AND DISCHARGE TO CS DOWNSTREAM OF THE WORK AREA. SEE SECTION 31 23 19.01 DEWATERING, OF THE SPECIFICATIONS FOR REQUIREMENTS FOR EXCAVATION DEWATERING OF GROUNDWATER.
- 8. ALL SAWCUT PAVEMENT TO BE RESTORED AT THE LIMITS INDICATED ON THE DRAWINGS.

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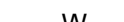
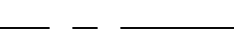
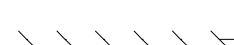
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GENERAL NOTES

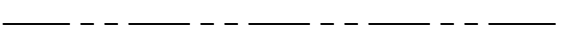
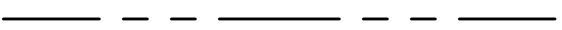
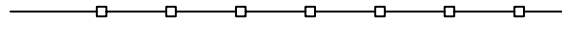
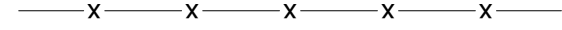
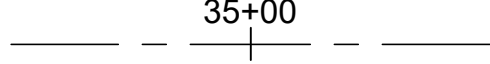
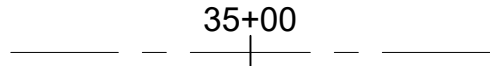
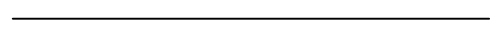
Drawing	G-001
Sheet No.	1 OF XX

ABBREVIATIONS

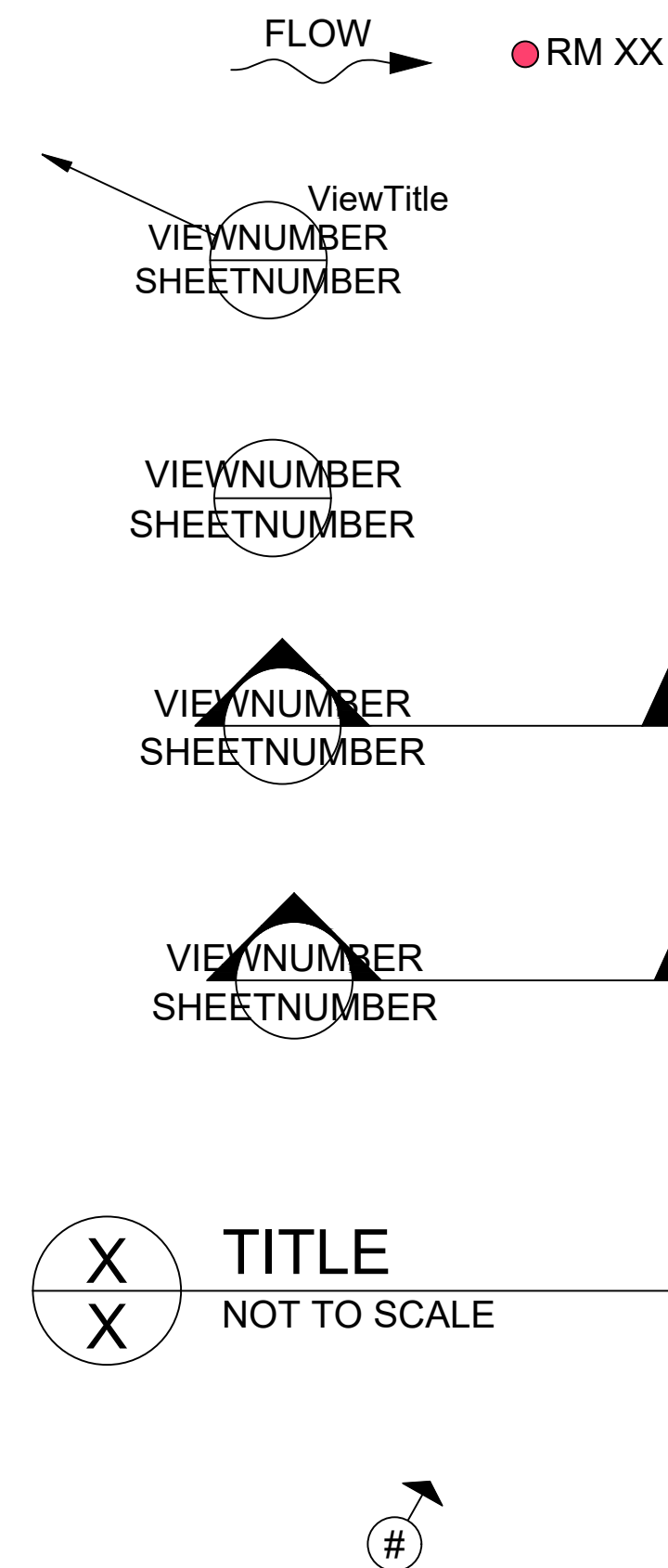
°	DEGREE
%	PERCENT
APPROX	APPROXIMATE
CONT	CONTINUED
CT	COURT
CY	CUBIC YARD
DIA	DIAMETER
D.S.	DOWNSTREAM
ELEV	ELEVATION
ESC	EROSION SEDIMENT AND CONTROL
EXIST	EXISTING
FES	FABRIC ENCAPSULATED SOIL
FT	FEET
I.D.	IDENTIFICATION
IN	INCH
INV	INVERT
HDPE	HIGH DENSITY POLYETHYLENE
LLC	LIMITED LIABILITY COMPANY
LWD	LARGE WOODY DEBRIS
MAX	MAXIMUM
MIN	MINIMUM
NO.	NUMBER
OHW	ORDINARY HIGH WATER
RD	ROAD
SIM	SIMILAR
STA	STATION
TYP	TYPICAL
U.S.	UPSTREAM
WA	WASHINGTON
YR	YEAR

	CB	CATCH BASIN
		POWER POLE
		GUY
		CULVERT
		SIGN
	W	WATERLINE
	SD	STORM CONVEYANCE
	SS	SANITARY SEWER
	G	GAS
	UE	UNDERGROUND LINE
	OH	OVERHEAD LINE
		DRAINAGE
		TRACKS
		ROAD CENTERLINE
		EDGE OF PAVEMENT
		DEMO EXISTING ITEM
		ABANDON EXISTING ITEM

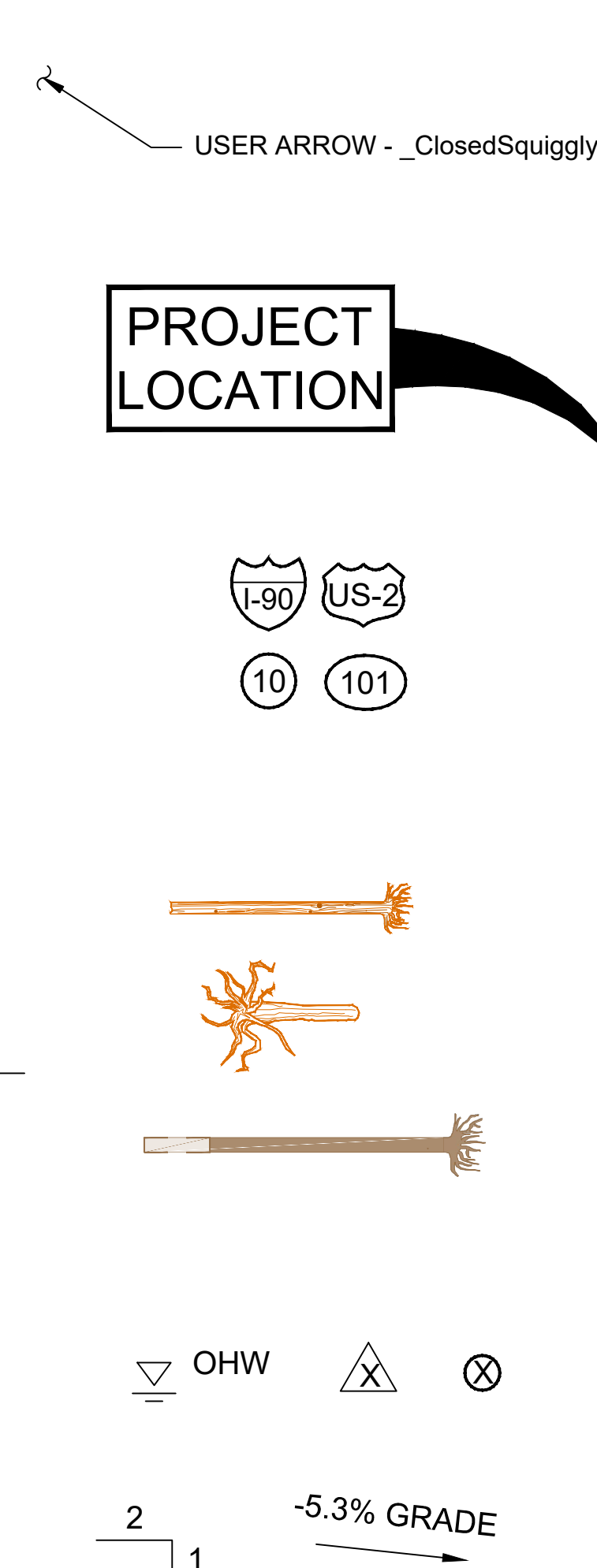
LEGEND

	RIVER MILE MARKER
	TEMPORARY CONSTRUCTION ACCESS
	LIMITS OF DISTURBANCE
	COFFER DAM
	STRAW BALES (lines are offset bale width)
	SHEET PILES
	PROPOSED CHANNEL
	GROUND WATER GALLERY AND PIPE
	LOG JAM (Note: wood symbology in the legend should match what is in the plans and be named accordingly)
	CONSTRUCTION ACCESS (Note: This symbol for access is used rarely, in cases where it is just necessary to show point of access onto the construction site)
	PARCEL BOUNDARY
	MUNICIPAL BOUNDARY
	EDGE OF WATER
	ORDINARY HIGH WATER
	WETLAND EDGE
	SILT FENCE
	FENCE
	PONDS
	EXISTING 1 FT CONTOUR
	EXISTING 5 FT CONTOUR
	PROPOSED ALIGNMENT
	EXISTING ALIGNMENT
	PROPOSED CONTOUR
	SEDIMENT SAMPLE, OR TEST PIT, OR GROUNDWATER WELL LOCATION ID MARKER

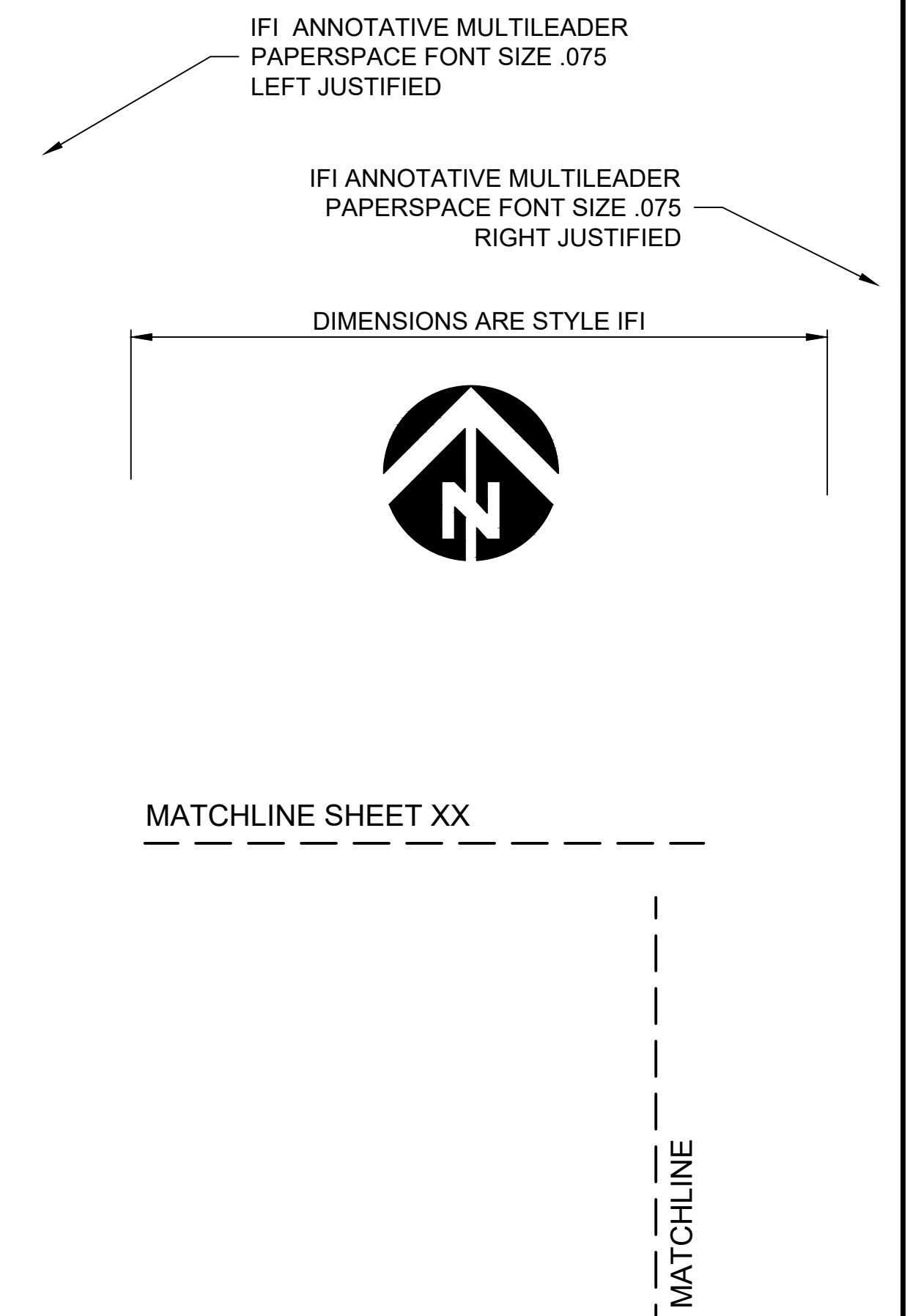
ANNOTATIVE AND DYNAMIC BLOCKS



MISC BLOCKS



MULTI-LEADERS



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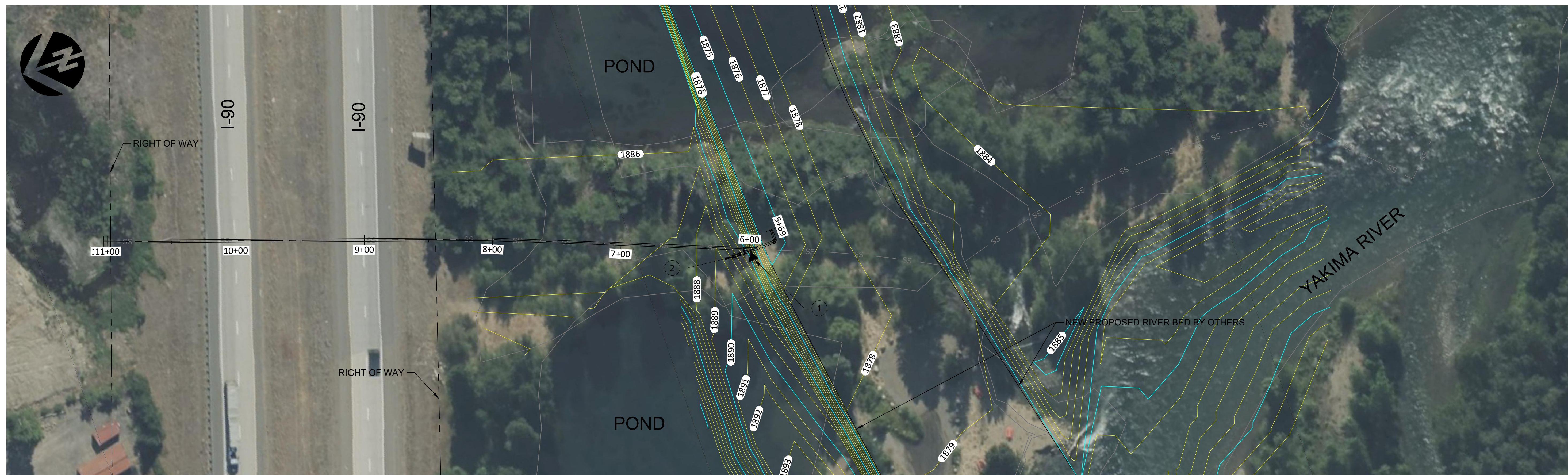
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LEGEND, SYMBOLS AND ABBREVIATIONS

Drawing	G-002
Sheet No.	2 OF XX



GENERAL NOTES:

1. NAVD88 VERTICAL DATUM IS USED. AS-BUILT RECORDS VERTICAL DATUM WERE IN NGVD29. TO CONVERT NGVD29 TO NAVD88, ADD 3.79 FT.

KEY NOTES:

- ① USE EITHER GABION BASKET OR APPROVED EQUIVALENT TO PROVIDE THRUST RESTRAINT.
- ② STANDARD CLEANOUT, SEE DETAIL X/C-XXX.

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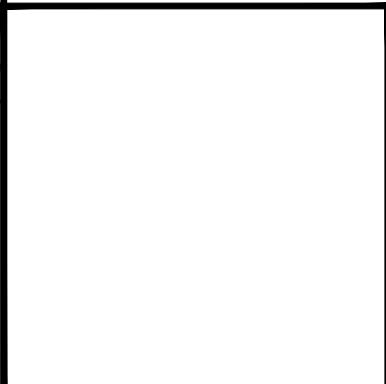
OUTFALL AND CONVEYANCE PIPE PLAN AND PROFILE

Drawing	C-103
Sheet No.	5 OF XX

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TO BE COMPLETED IN FUTURE MILESTONES

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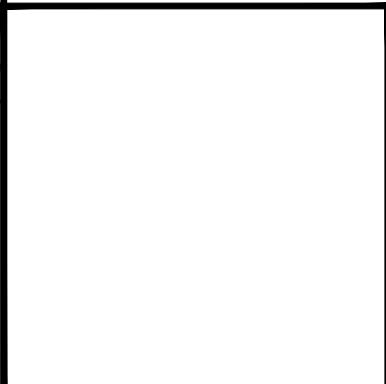
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OUTFALL ARMORING/PROTECTION
STRUCTURE SECTION

Drawing	C-105
Sheet No.	7 OF XX

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OUTFALL CIVIL DETAILS

Drawing	C-106
Sheet No.	8 OF XX

Appendix B : DRAFT 30% Preliminary Hydraulic Model Description & Results

Hydraulic Model and Analysis

The hydraulic analysis was conducted using a two-dimensional (2D) hydraulic model that was developed for existing and preliminary proposed conditions within the U.S. Army Corps of Engineers HEC-RAS 6.4.1 software (USACE, 2023). 2D hydraulic computations are typically superior to one-dimensional (1D) computations when detailed analysis of river systems with multiple channels or flow paths is required. Given the conditions of the Yakima River through the project reach, along with the complex interactions between the river, ponds, and surrounding floodplain, 2D computations were chosen for this project model.

An existing conditions 2D hydraulic model was developed to assess the current channel/floodplain dynamics as well as assess the overall impacts of a wide range of flows on the existing landscape. In addition, a preliminary proposed conditions 2D hydraulic model was created and several iterations completed for the DRAFT 30% design and used to assess the functionality of design elements, as well as the relative changes between existing and preliminary proposed condition hydraulics within the project reach. The preliminary hydraulic model results will be used to further guide design development.

A - 1 MODEL GEOMETRY

A - 1.1 Digital Terrain Model

The existing model geometry is based on an existing conditions digital terrain model (DTM) that was developed using a combination of aerial LiDAR acquired in 2014 and 2020 (DNR Lidar Portal) and ground/bathymetric survey data collected by Inter-Fluve staff in the fall of 2020 and 2023. Channel bathymetry data were collected via ground survey in wadable sections of the river along the project reach, in combination with a single-beam echo sounder equipped with an RTK GPS unit attached to a single-person pontoon raft. The floodplain topography primarily consists of LiDAR data supplemented with select ground survey data. Channel bathymetry data downstream of the project area were extrapolated using interpolated cross-section data from the FEMA model for the Yakima River Basin that was provided to Inter-Fluve in 2020 (FEMA, 2018). The proposed condition DTM was developed in AutoCAD Civil 3D, which was used to fill in the existing ponds, remove the levees, and grade the new Yakima River mainstem and side channels.

A - 1.2 Computational Domain

The computational domain for the hydraulic models extends from approximately 6,600 feet downstream of the I-90 bridge to just upstream of the S. Cle Elum Way bridge. The width of the computational domain along the project reach spans between I-90 to the north and the upper terrace along the south side of the valley. An overview of the extent of the 2D model computational domain is provided in Figure A-1. The computational domain was the same for the existing and proposed models.

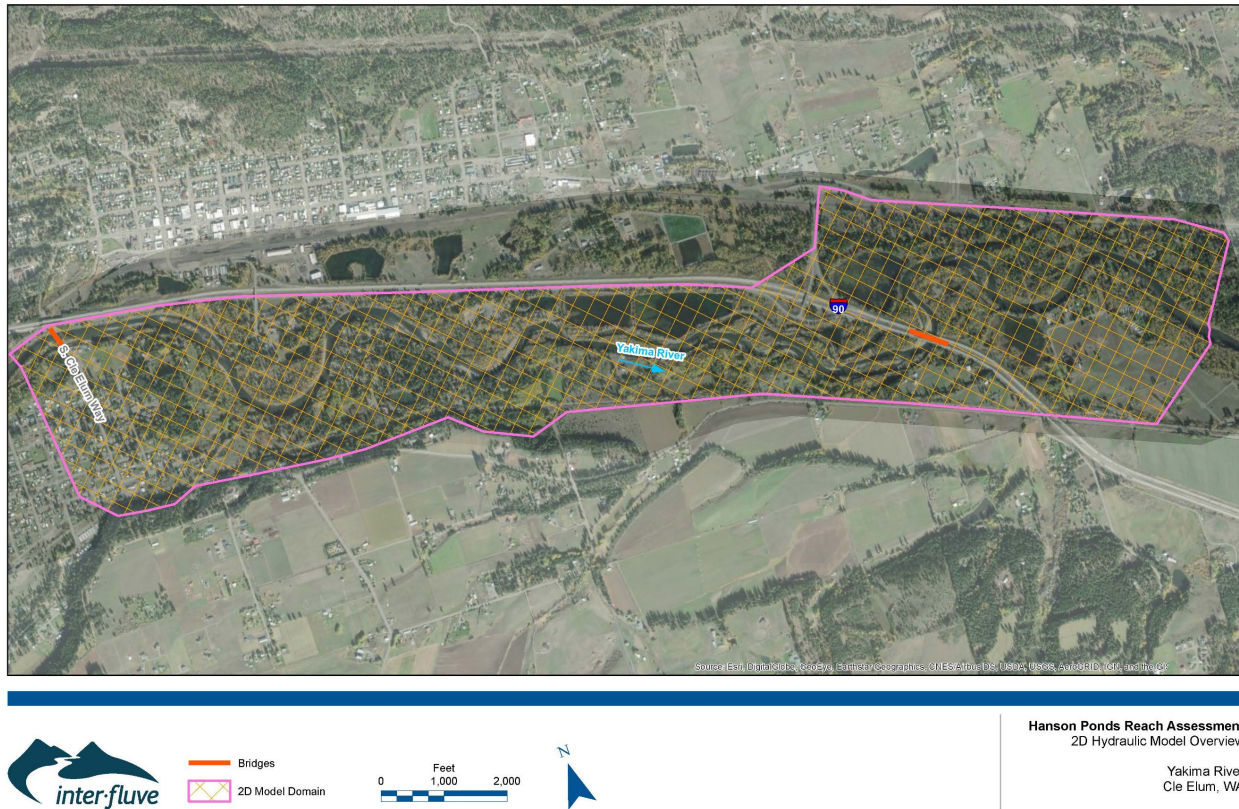


Figure A-1. Overview of the 2D hydraulic model computational domain. Note: Hatching is graphical depiction and does not represent computational domain.

The model domain consists of a computational grid with average cell spacing ranging between 10 ft within the active channel to 50 feet in the floodplain. The resolution of the grid was adjusted based on terrain complexity and areas of interest, with smaller cell sizes applied to areas where higher resolution results were desired. Break lines were added along the tops of banks, levee tops, channel alignments, and various high ground features to further refine the computational mesh where needed. Additional mesh refinements were made in the proposed models where needed to represent proposed changes in topography.

A - 2 INPUT PARAMETERS

A - 2.1 Boundary Conditions

2D hydraulic models require boundary conditions at locations where flow is expected to enter or exit the computational domain. The inflow hydrograph is based on the hydrology estimates discussed in Section 2.1 and the discharges of interest listed in Table A-1. Summary of flows used in hydraulic modeling. These discharges were incorporated into a synthetic quasi-steady state hydrograph with periods of steady flow (at the discharges of interest and other intermediate discharges) connected by smooth transition periods to create a stair-step like pattern. A representative quasi-steady flow hydrograph is depicted in Figure A-2. The periods of steady flow allow the model to come to a quasi-steady state condition, which facilitates the interpretation of hydraulics at specific discharges. This approach does not allow for analysis of the receding limb of the hydrograph, and likely provides conservatively high results with respect to large floods, as floodplain storage areas are allowed to fill completely to allow the model to reach a steady state.

Table A-1. Summary of flows used in hydraulic modeling

Flow Recurrence Interval	Flow (cfs)
7Q10	260
October Median Flows ¹	615
January Median Flows ¹	980
April Median Flows ¹	1,600
June Median Flows ¹	2,743
July Median Flows ¹	3,660
2-year Flood	5,915
5-year Flood	8,336
10-year Flood	10,020
25-year Flood	12,220
50-year Flood	13,920
100-year Flood	15,670
100-year Flood – FEMA ²	19,828

¹Median Flows are for water years 2000-2020

² The FEMA 100-year flood was taken directly from the FEMA model (FEMA, 2018)

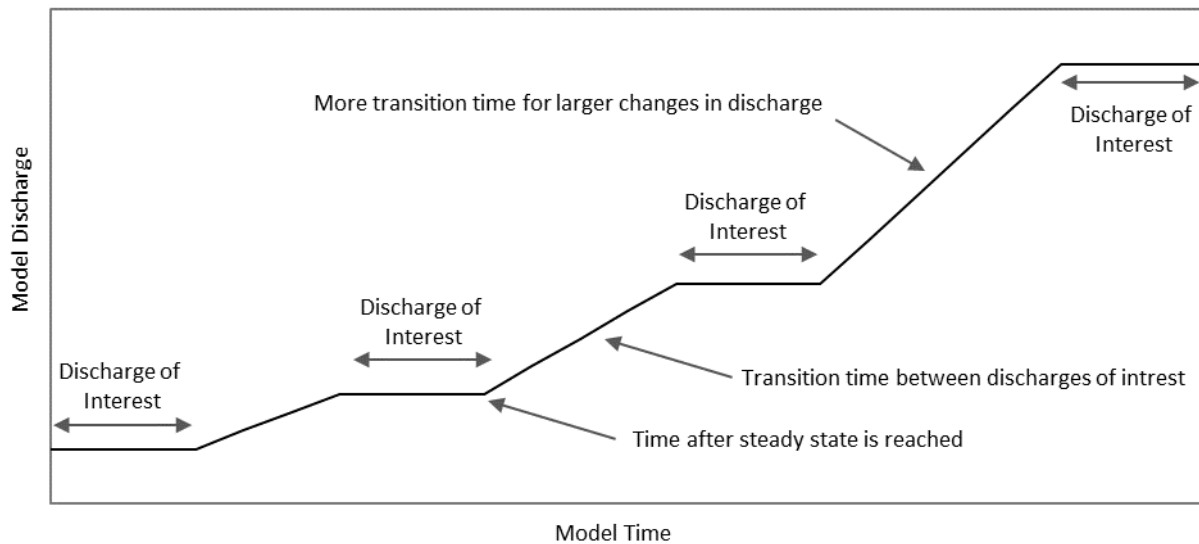


Figure A-2. Demonstrative quasi-steady flow model input hydrograph.

The downstream boundary condition consists of assumed normal flow depth at a friction slope estimated from the average channel slope (0.002 feet per foot) near the downstream end of the model domain. Both the upstream and downstream boundary conditions were placed a significant distance away from the project area, to dampen the effects of any potential uncertainties associated with boundary condition assumptions, or the extrapolated bathymetric terrain data.

A - 2.2 Bridges

The I-90 bridge was included in the model using the 2D model internal bridge routine tools available in HEC-RAS. The input data for the bridge was approximated based on the data included in the FEMA model (FEMA, 2018). The S. Cle Elum Way bridge near the upstream end of the model domain (Figure 41) was not included in the 2D model, as the bridge crossing is located a substantial distance upstream of the project area and adding bridge computations to the upstream extent of the model would likely introduce model instabilities.

A - 2.3 Hydraulic Roughness

A spatially varying hydraulic roughness (Manning's n) layer was created by hand-digitizing regions with similar land cover throughout the model domain in ArcGIS software. In general, roughness coefficients were applied to these regions based on field observations, aerial photos, and professional judgement. Vegetation heights from the 2014 LiDAR data were also used as a basis for land cover classification where feasible, although the data only cover a small portion of the project reach. Roughness values for each landcover region were based on published guidelines of one-dimensional roughness coefficients (Arcement & Schneider, 1989) for corresponding channel types and vegetation conditions, with the understanding that 2D roughness values can often vary substantially from those published for 1D models (Robinson et al., 2019). Table A-2 summarizes the roughness coefficients used in the existing and proposed conditions model.

The proposed design includes filling in the existing ponds, creating a new mainstem and side channels for the Yakama River, and placing large wood structures on the banks of the channel and in the floodplain for roughness and habitat complexity.

Table A-2: Roughness coefficients used in the 2D model

Land Cover Region Description	Manning's n Value
Active Main River Channel (typical gravels)	0.03
Active Side Channel	0.042
Vegetated Bar	0.07
Woody Debris	0.2
Riprap Weir	0.1
Pond	0.02
Connector Channels	0.08
Levee	0.055
Bare Ground/Gravel Parking Areas	0.035
Miscellaneous Vegetation	0.065
Wetland	0.1
Riparian	0.1
Dense Riparian	0.12
Very Dense Riparian	0.15
Light Understory	0.07
Medium Understory	0.085
Vegetation (8-30 ft) ¹	0.1
Vegetation (30-80 ft) ¹	0.08
Vegetation (50-80 ft) ¹	0.075
Residential	0.085
Residential – Forested	0.09
Residential – Landscaped	0.05
Proposed – Main Flow Routes	0.03
Proposed – Side Channels	0.042
Proposed – Large Wood Structure Areas	0.15
Proposed – Misc Fill & Grading	0.065

¹Vegetation heights are visually approximated from a canopy height raster derived from the 2014 LiDAR data that only partially covers the project site.

A - 2.4 Calibration and Validation

The existing model was calibrated to surveyed water surface elevation points collected during the topographic and bathymetric surveys in 2020. The flow at the Yakima River at Cle Elum gage (USBR gage “YUMW”) during the survey ranged between 813 and 865 cfs, and a single average flow of 840 cfs was used for model calibration. Calibration was achieved by adjusting the Manning’s n values until a reasonable level of agreement was achieved between modeled and surveyed water surface elevations for the 840 cfs simulation. The calibration results for the main channel are displayed in Figure A-3, and the mean residual between modeled and surveyed data is approximately 0.3 ft. Given the absence of reliable high flow calibration data, additional model validation at higher flows was based on professional judgement, field observations, anecdotal observations provided by stakeholders whom are familiar with the project reach, and limited surrogate data such as the ordinary high water (OHW) survey of the vegetation line along the channel banks.

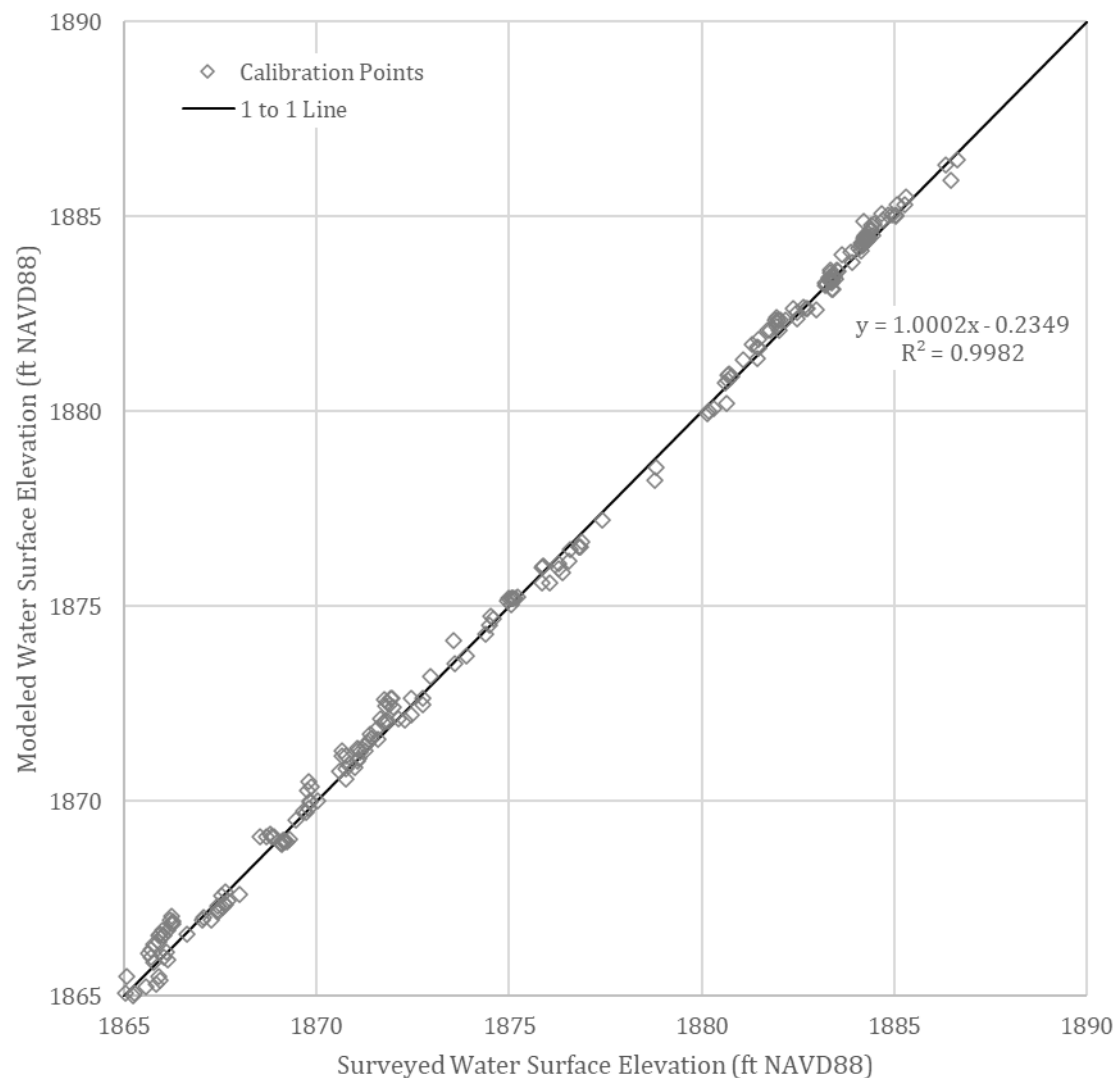


Figure A-3. Model calibration results for a modeled flow of 840 cfs.

Water level loggers were installed throughout the pond network within the project area during the September 2020 survey. Limited data were downloaded from the water level loggers in early March of 2020, and these data were used to perform validation checks on water surface elevations for various model simulations. The average differences for these “spot checks” are summarized in Table 3. The average differences are generally within 0.5 feet, which is reasonable given the potential influence of additional processes such as hyporheic flow and evaporation. These processes are not explicitly represented in the 2D hydraulic model and further refinement to model parameters to reflect these processes may be necessary as additional data become available. Logger R2 is meant to collect water surface elevations in the river; however, the logger is situated in the pond outlet channel rather than the main river channel. As such, the water surface is affected by backwater from the river, as well as outflow from the ponds. A longer data set is needed to better understand the interactions between the river and the ponds at this location.

Table A-3. “Spot Check” comparisons between modeled and recorded water surface elevations at the installed water level loggers.

Approximate River Flow (cfs)	Difference in Modeled and Recorded Water Surface Elevations (ft)				
	R1	HP1	HP2	HP3	R2*
865	0.2	-0.4	0.2	0.5	0.7
1327	-0.6	-0.2	-0.8	0.0	1.0
1194	-0.8	-0.4	-0.9	0.3	0.8
1504	-0.5	-0.5	-0.7	-0.1	1.0
Average	-0.4	-0.4	-0.5	0.2	0.9
*Logger R2 is directly affected by backwater from the Yakima River					

A - 3 MODEL RESULTS

Outputs from the Draft 30% Preliminary hydraulic model were used in various capacities to assess the hydraulic conditions at various discharges. These results are described below.

A - 3.1 Existing Model Results

In general, the existing model results highlight that flow is distributed between multiple channels at seasonal flows, and the overall inundation extents remain relatively constrained within the active channel corridor as flows increase up to the 100-year flood. The model results show that the levee separating the ponds and main channel begins to overtop at some of the previous breach locations at approximately the 5-year flood. Modeled velocities at the 100-year flood are generally in the 9 to 12 ft/second range in the main channel, with the highest velocities through the ponds in the 6 to 9 ft/second range. Modeled depths and velocities for a range of flows are provided in Appendix A.

Despite the multi-threaded nature of the active channel, particularly downstream of the ponds, the model results demonstrate that hydraulic complexity at seasonal (i.e., monthly median) flows is somewhat lacking. Depths at these flows are relatively uniform throughout the project reach, with the exception of a few isolated pools. During the median flows for the spring months, off channel low velocity areas do exist; however, these areas are relatively shallow with the exception of the ponds. At larger flood events, the off-channel low velocity areas are generally confined to the ponds, which lack diverse habitats.

The inundation extents of the June Median Flow of 2743 cfs was selected as the existing conditions ordinary high flow line based on a comparison to vegetation lines and other field markers surveyed at the project site.

A - 3.2 Proposed Model Results – Draft 30% Preliminary

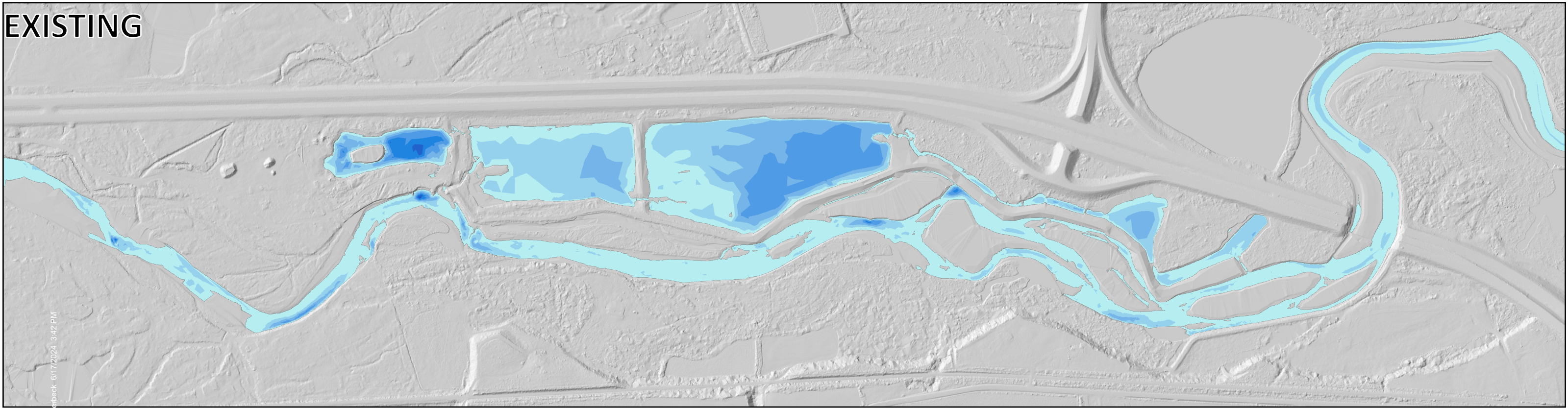
The proposed conditions model shows that the mainstem of the Yakama river has been shifted from the existing channel to a channel through the former pond sites. Up to 260 cfs, the 7Q10 discharge, all of the flow goes into the new channel which contains the new waste water treatment outfall location. Above 260 cfs, the existing channel is activated and conveys flow. Downstream of the wastewater treatment outfall, the flow splits into several smaller channels which are active at all flows. The filled in floodplain areas of the ponds are activated between the July Median Discharge (3660 cfs) to the 5-Year Discharge (8336 cfs). Areas closer to the active channel are active earlier whereas the heads of islands and floodplain areas near I-90 are activated at the 5-Year.

Modeled velocities at the 100-year flood are in the 9 to 14 ft/second range in the main channels and 5 to 8 ft/second in the side channels. Modeled depths and velocities for a range of flows are provided in Appendix A. The model shows that the proposed water surface elevation (WSE) is lower compared to the existing conditions in the existing channel location and higher in the active channel. A 1D model will be created in future design phases with the purpose of comparing the 100-Year WSEs and for a FEMA conditional letter of map revision submittal.

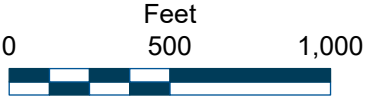
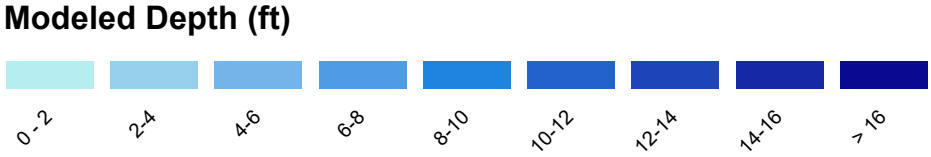
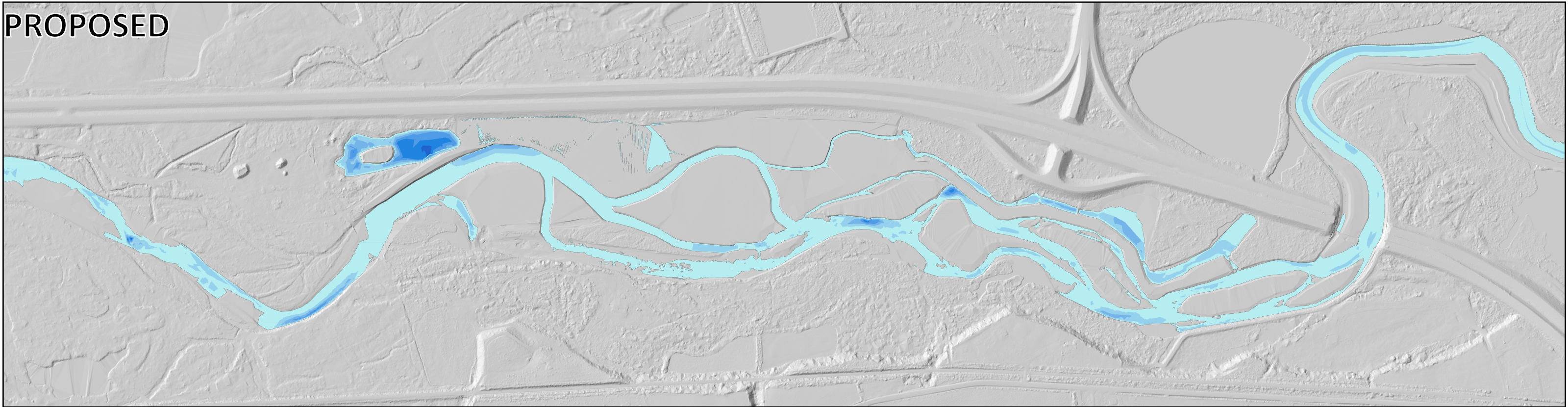
References

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- USACE. (2023). *Hydrologic Engineering Center River Analysis System (HEC-RAS), HEC-RAS version 6.4.1* US Army Corp of Engineers.

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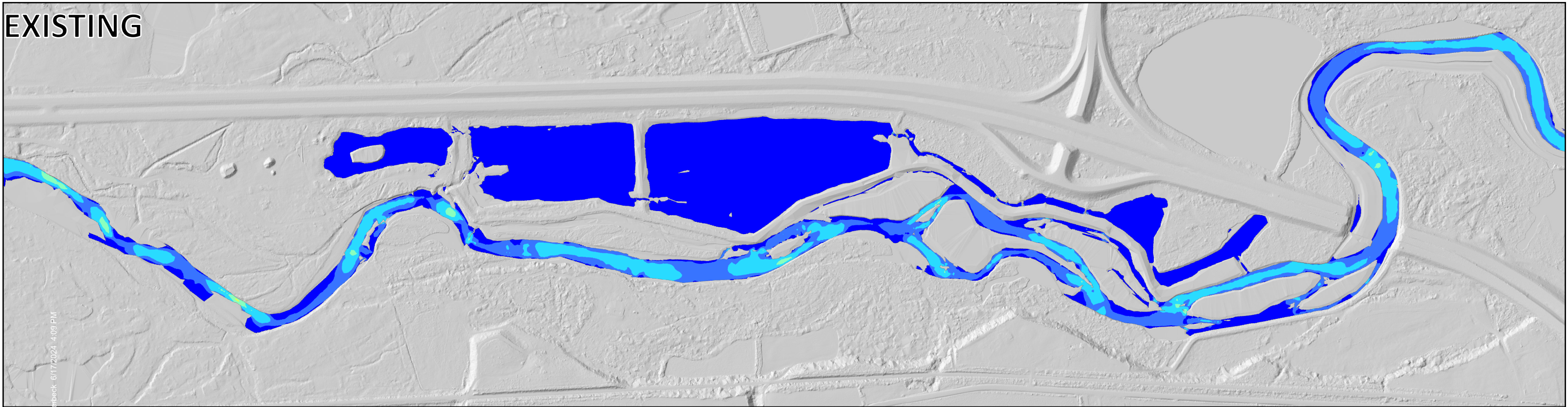
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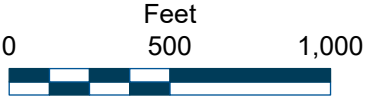
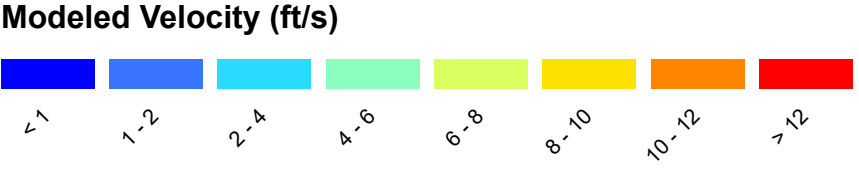
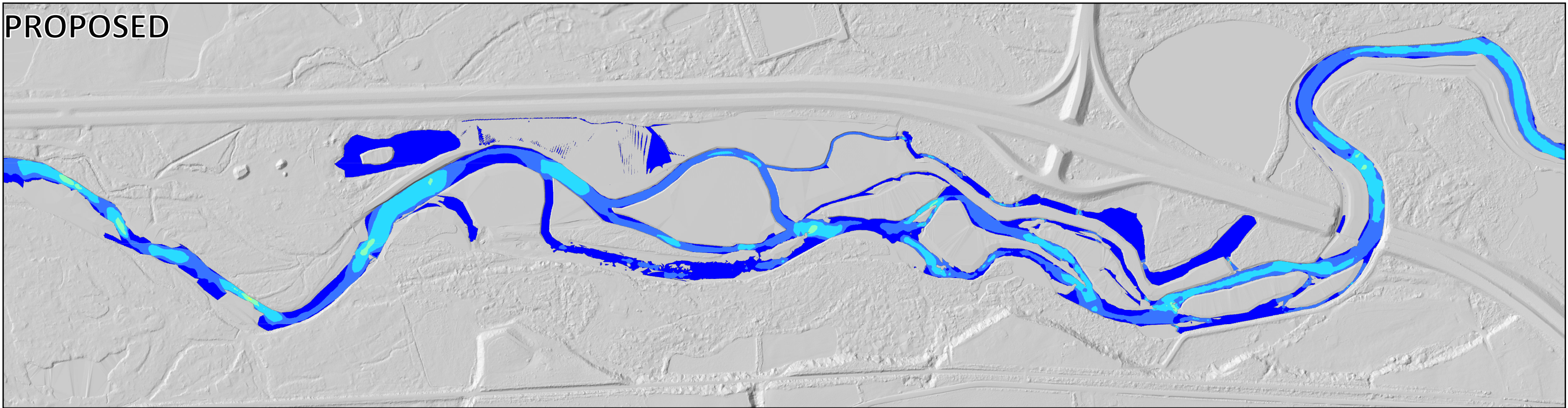
Hanson Ponds Design

7Q10 Flow (260 cfs)

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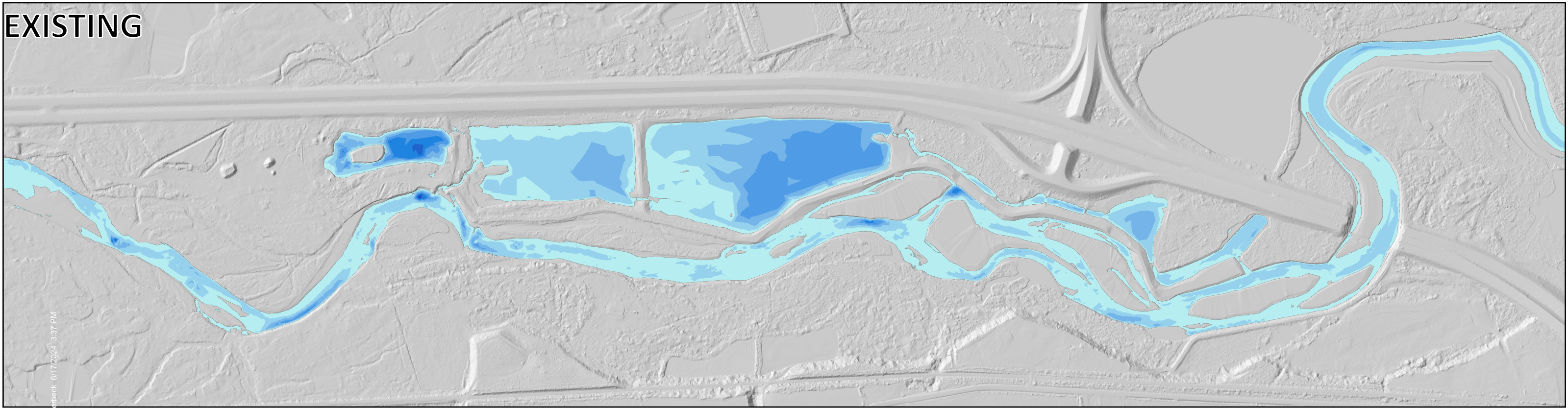


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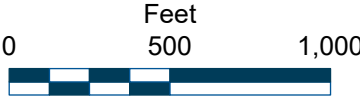
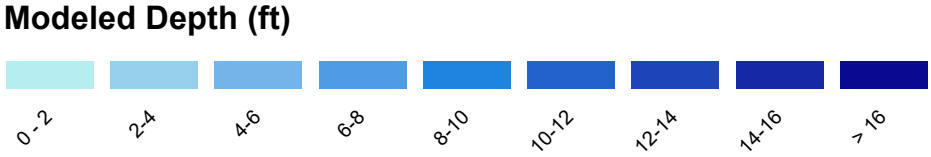
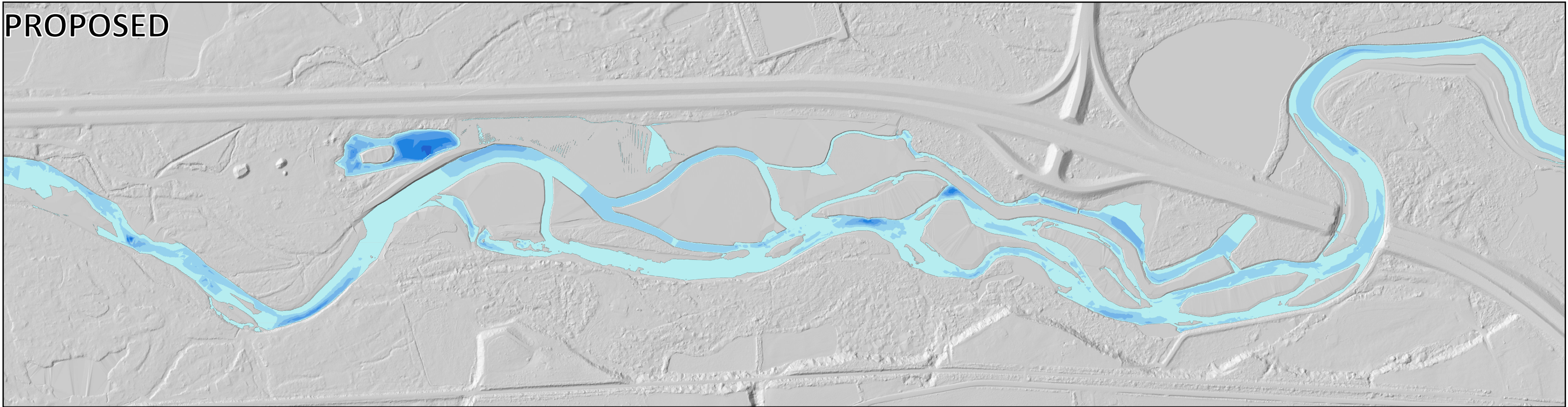
7Q10 Flow (260 cfs)

Yakima River
Cle Elum, WA
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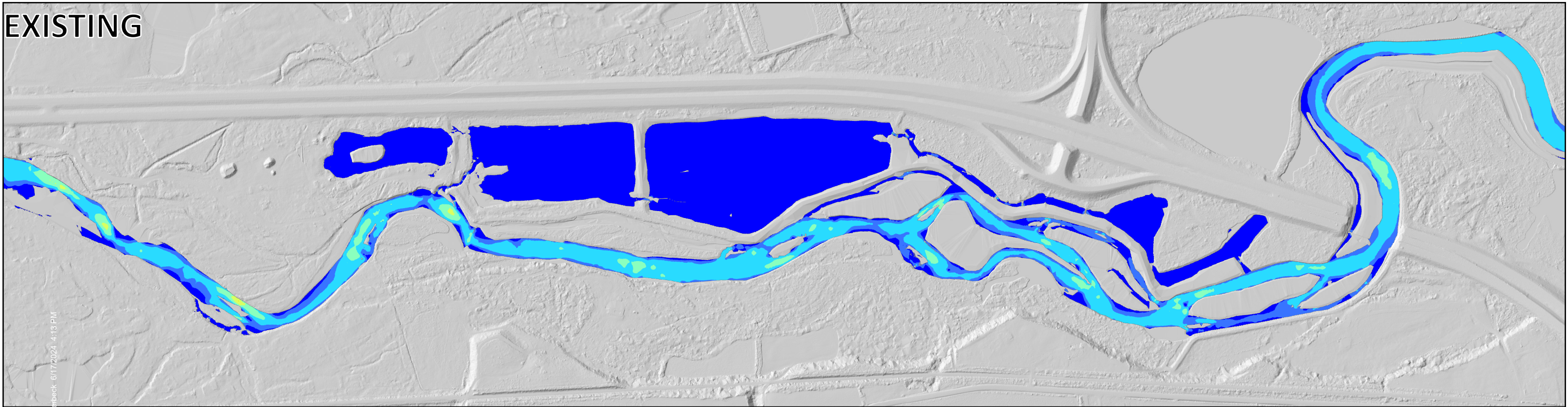


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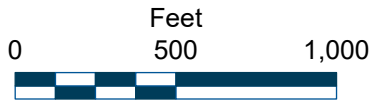
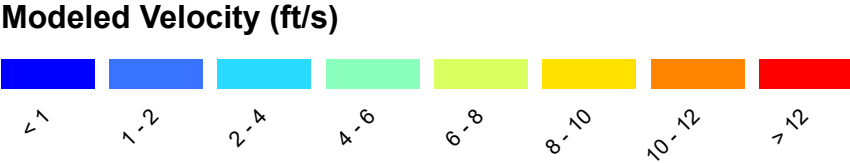
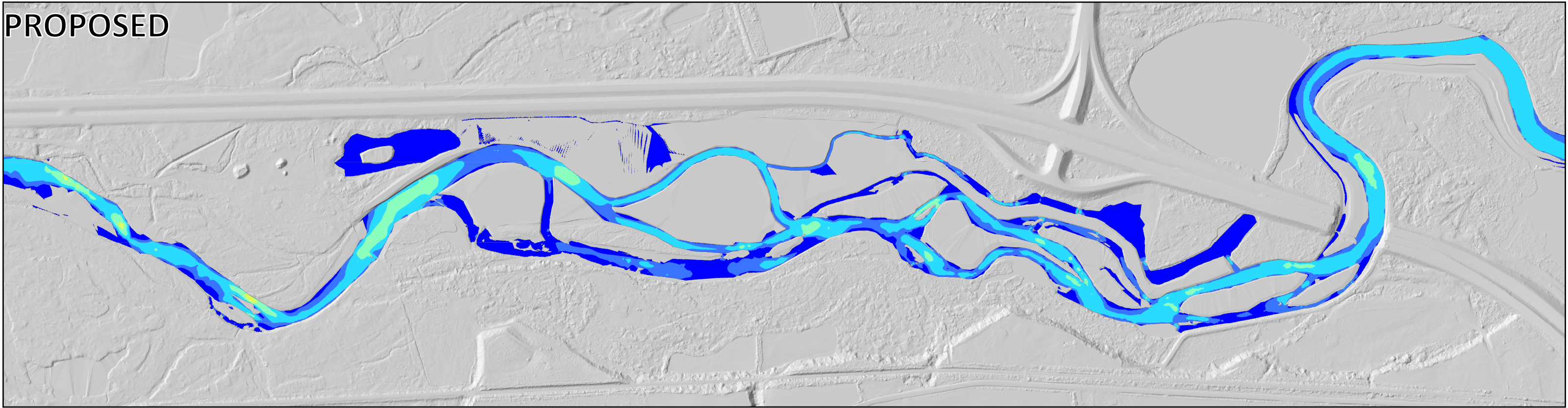


Hanson Ponds Design
Median October Flow (615 cfs)

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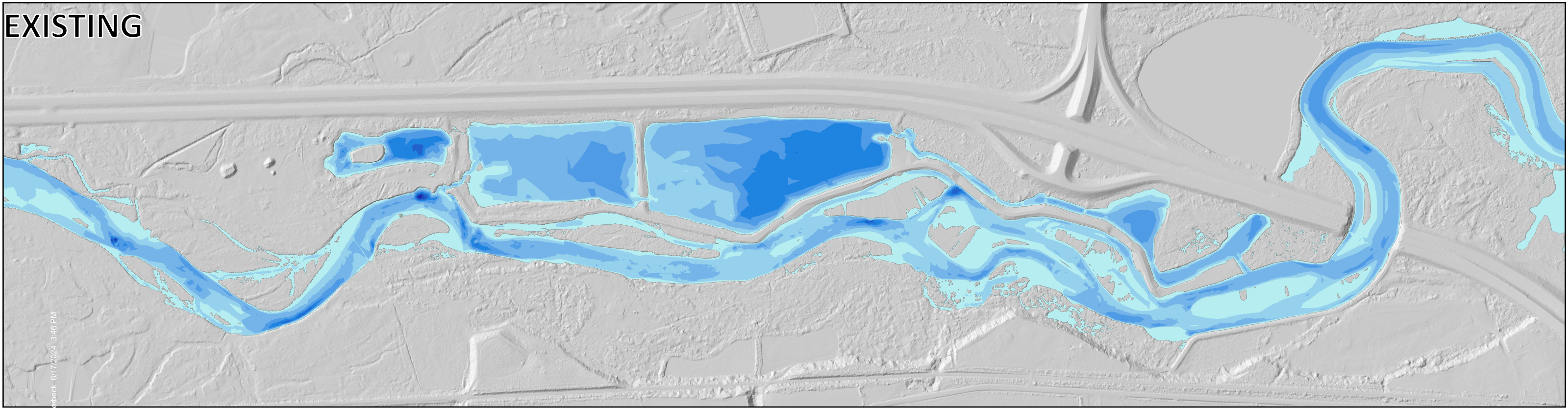
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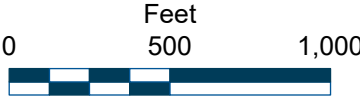
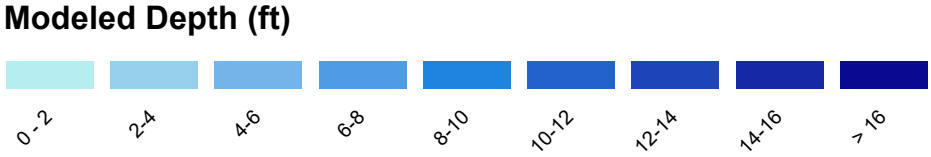
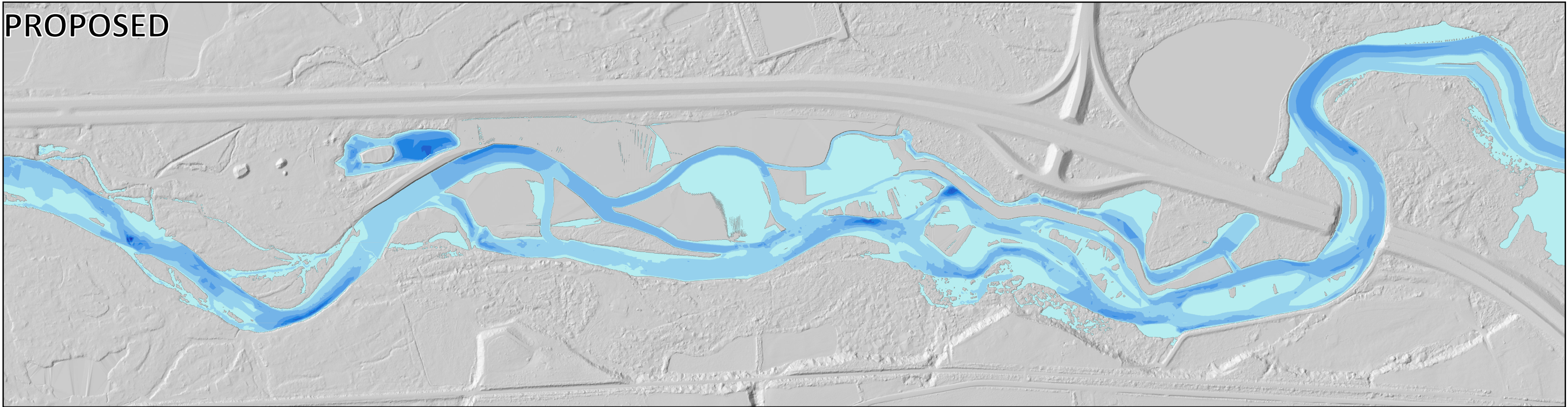
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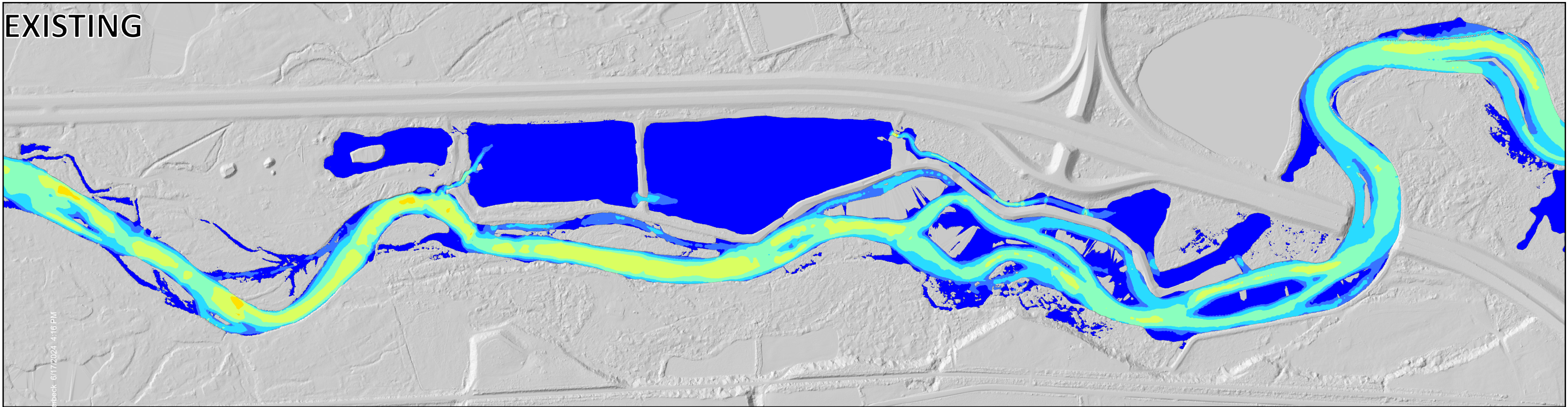
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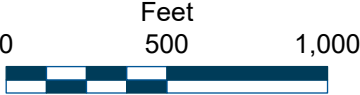
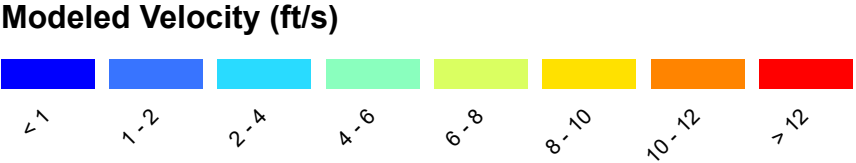
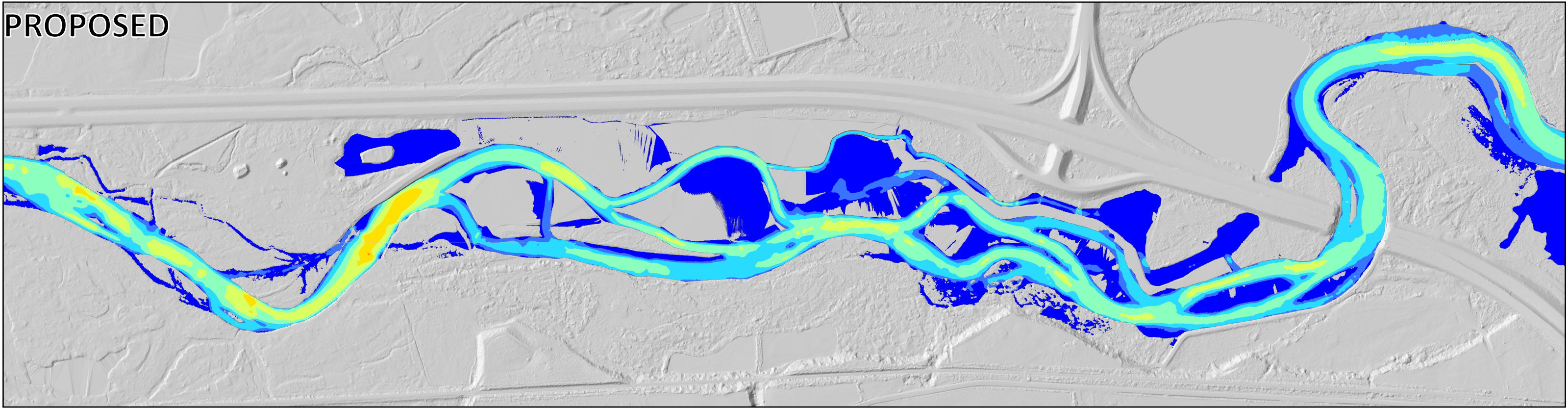
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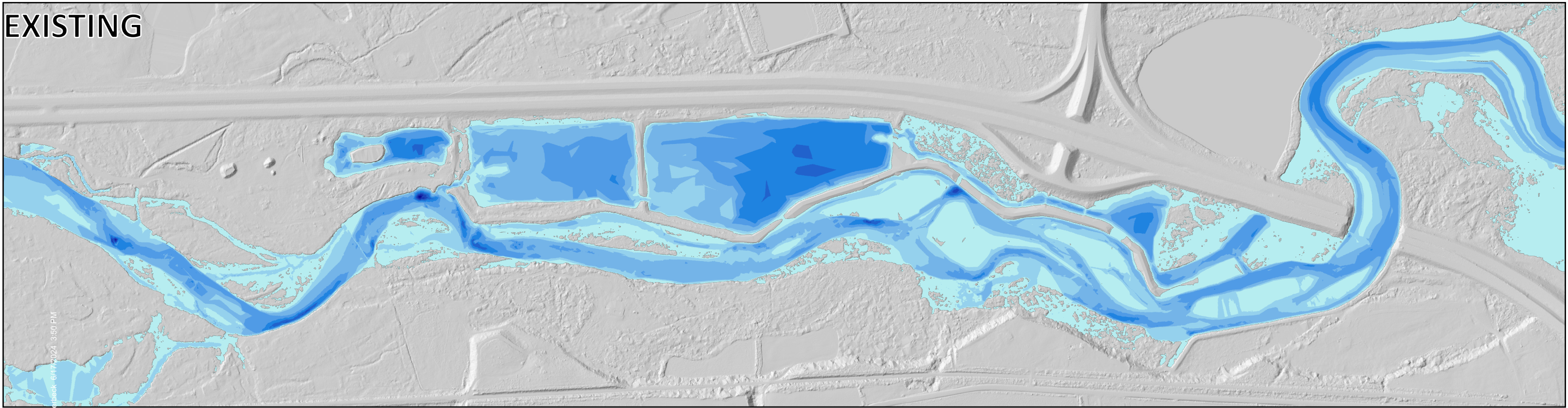
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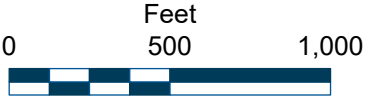
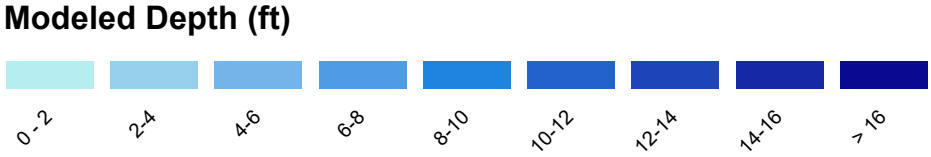
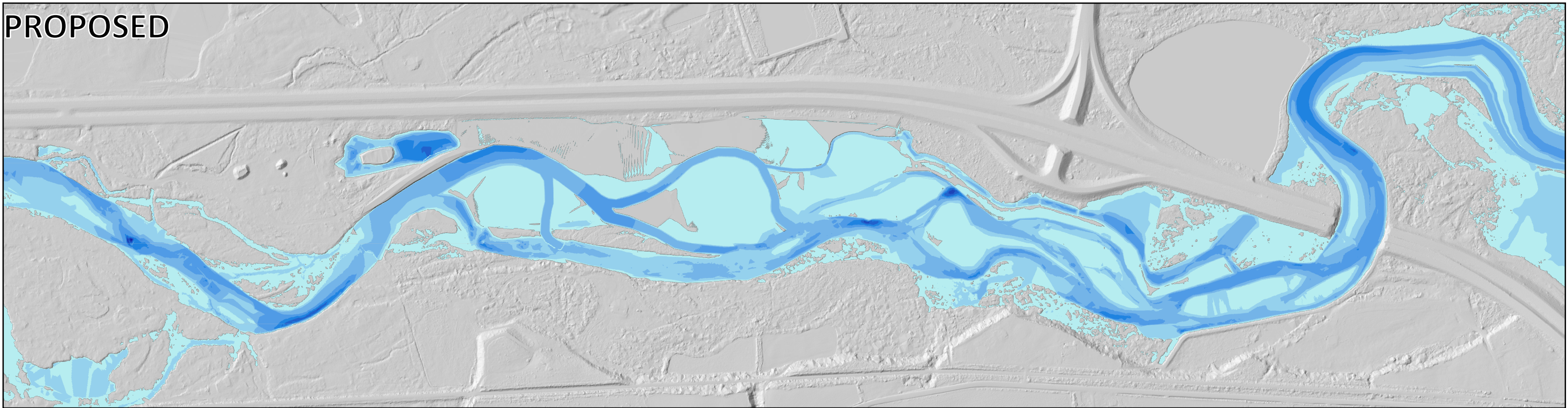
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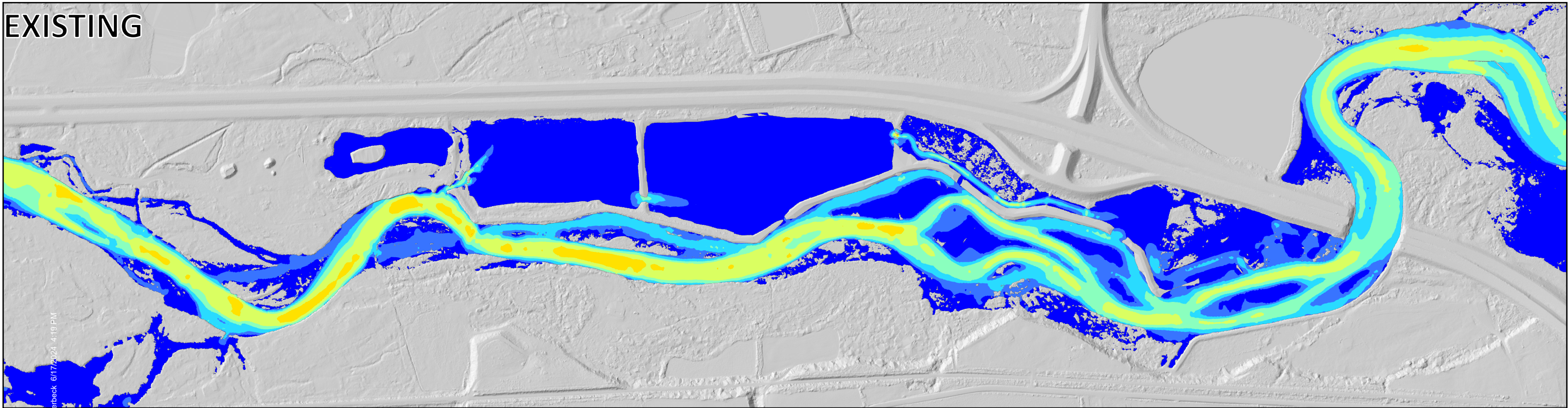
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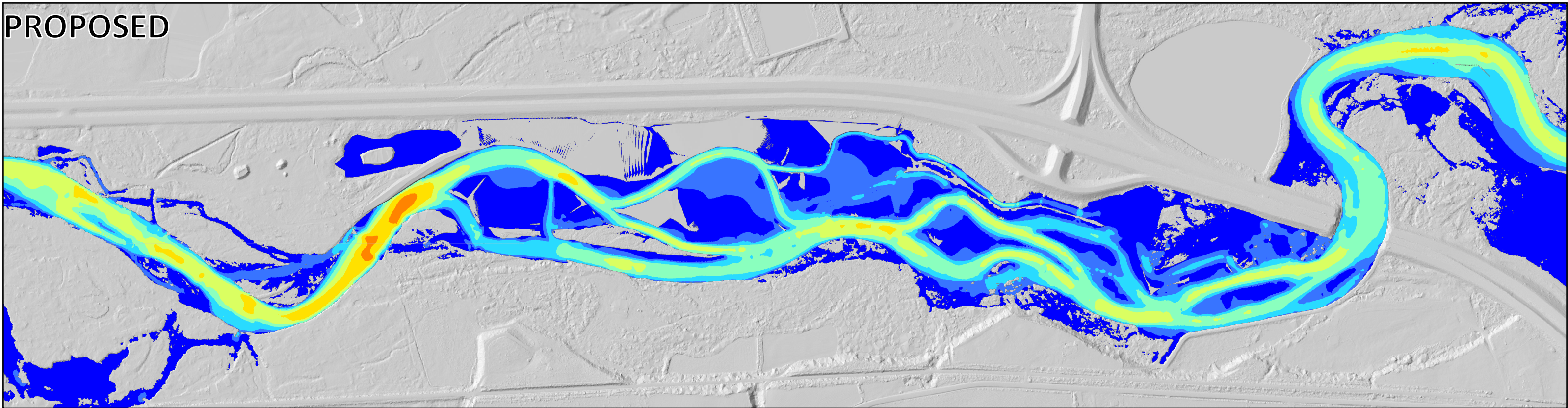
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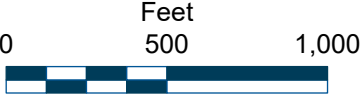
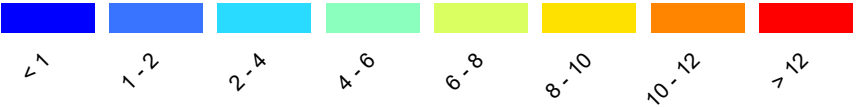
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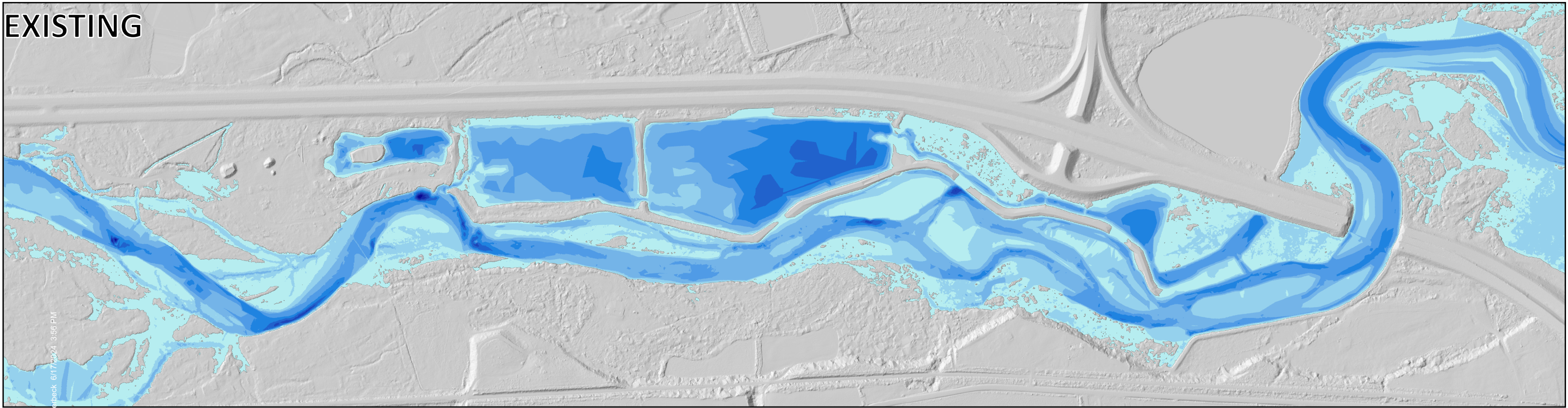
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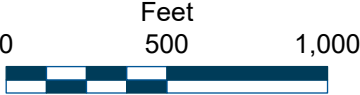
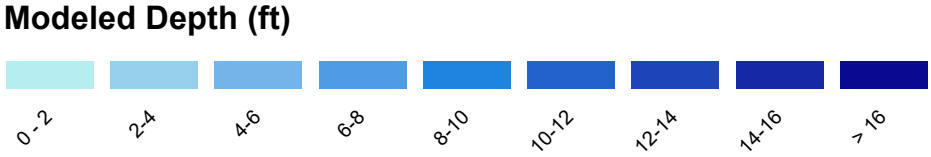
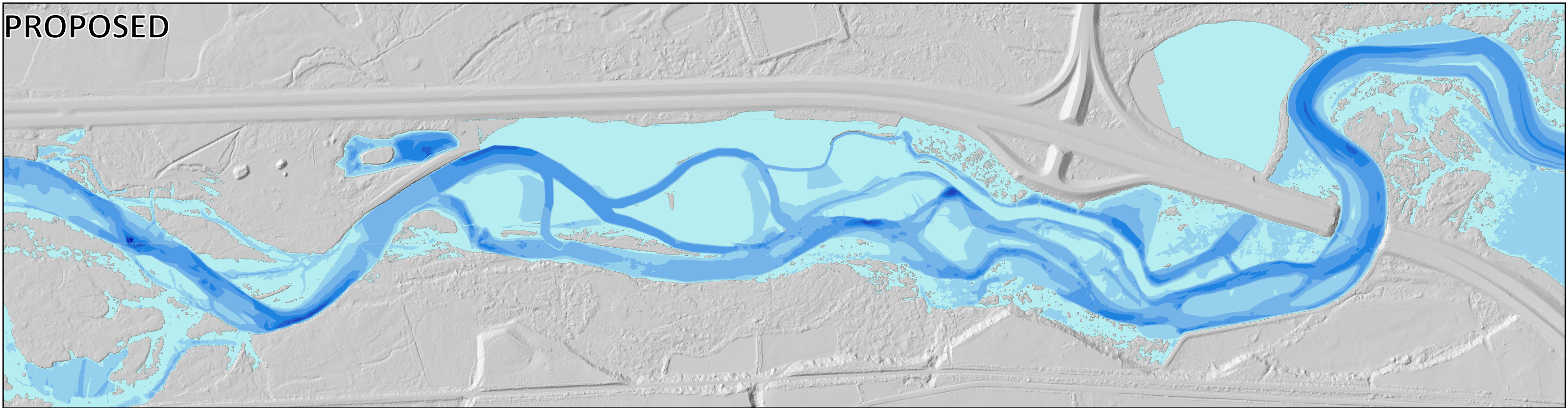
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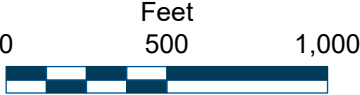
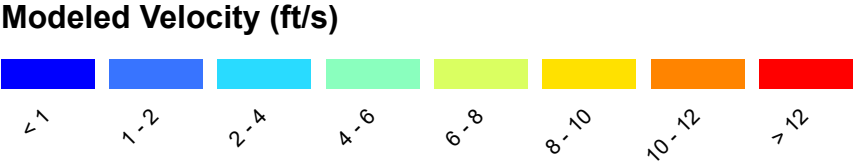
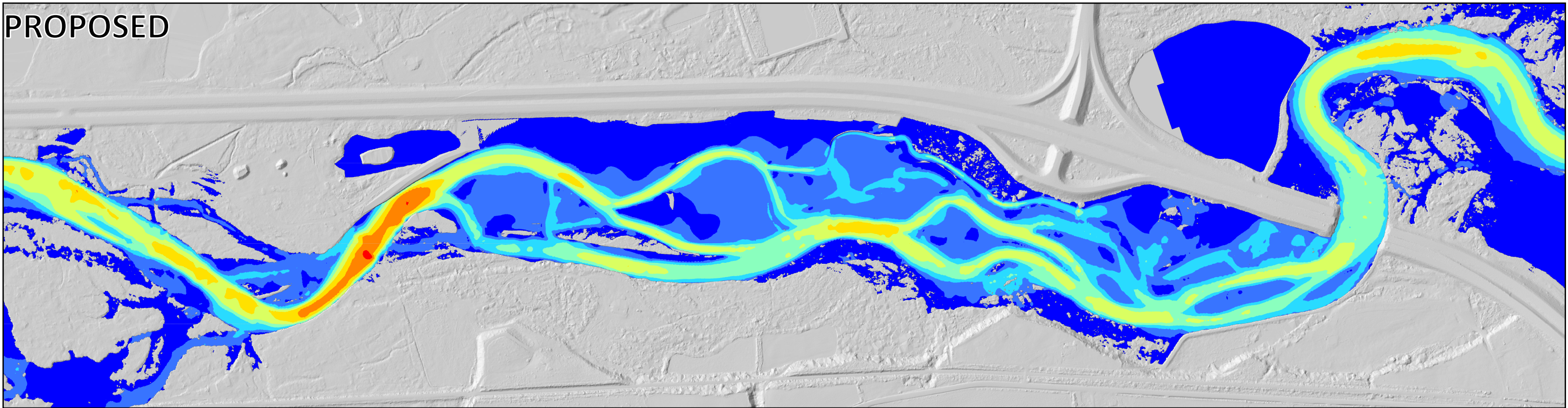
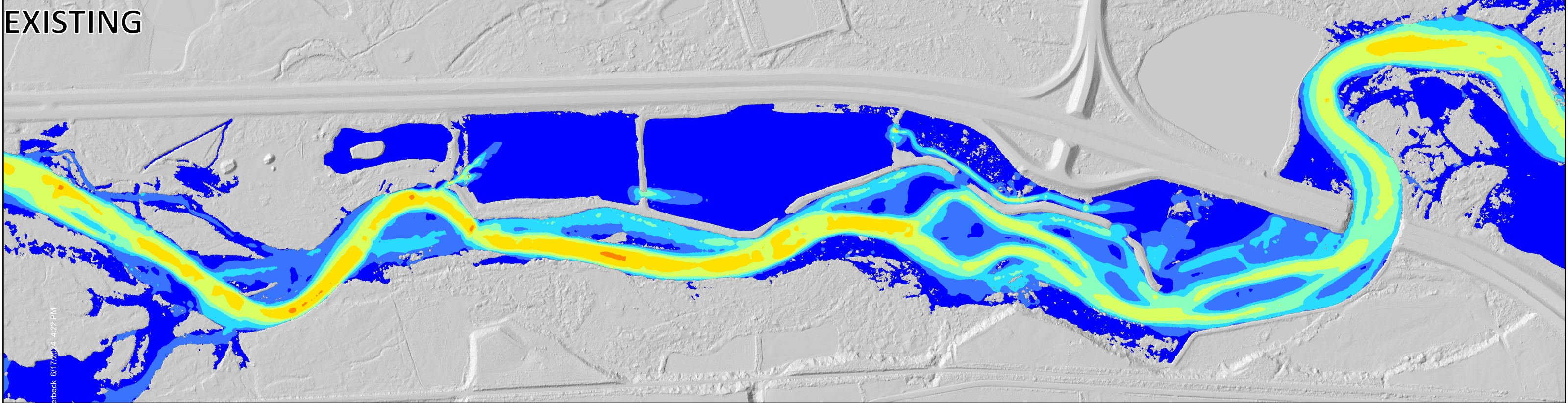


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Hanson Ponds Design

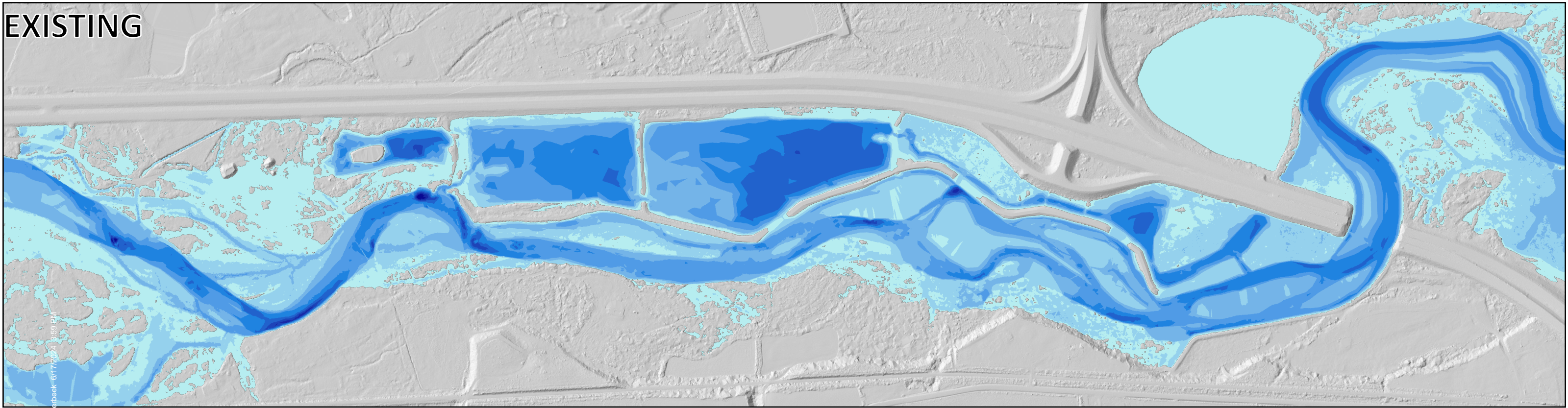
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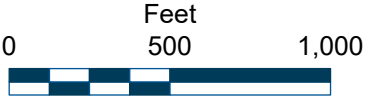
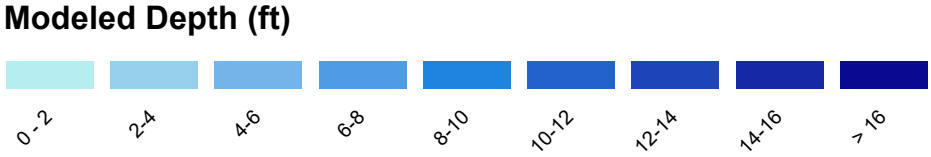
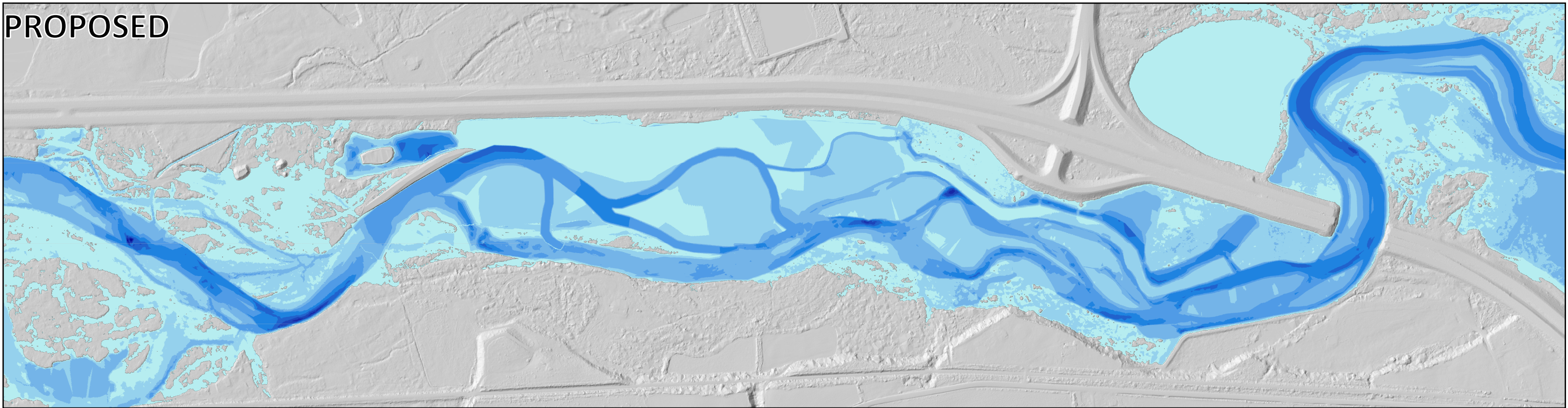
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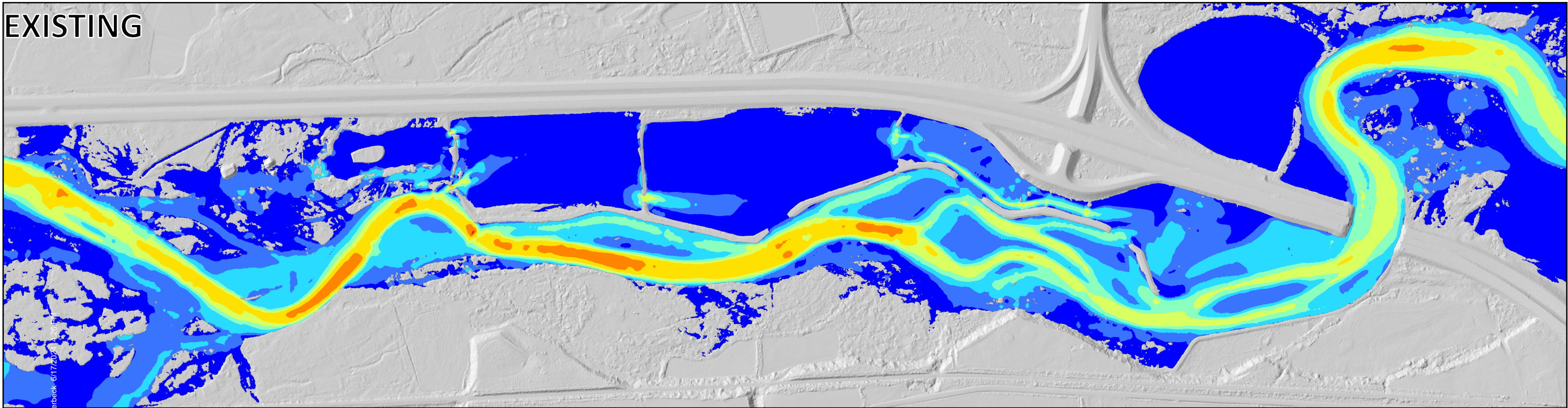
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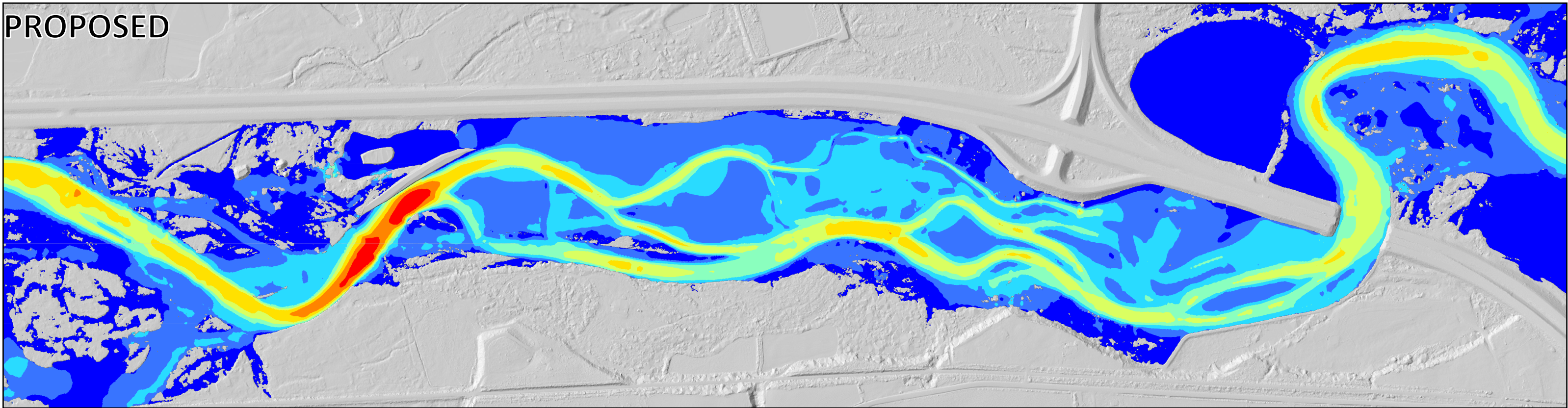
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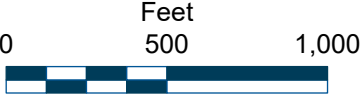
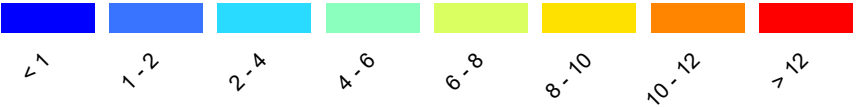
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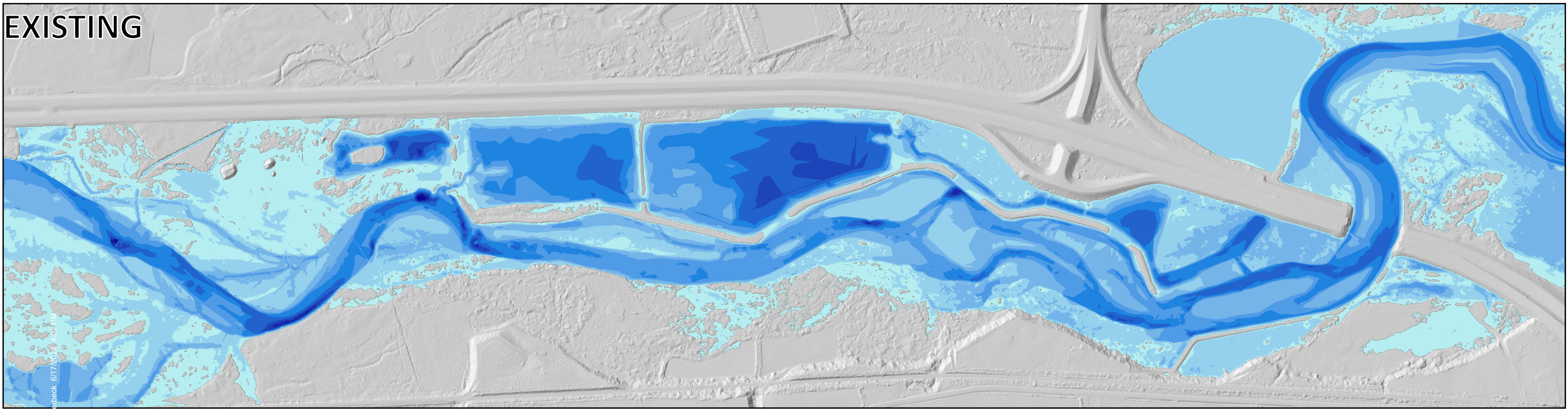
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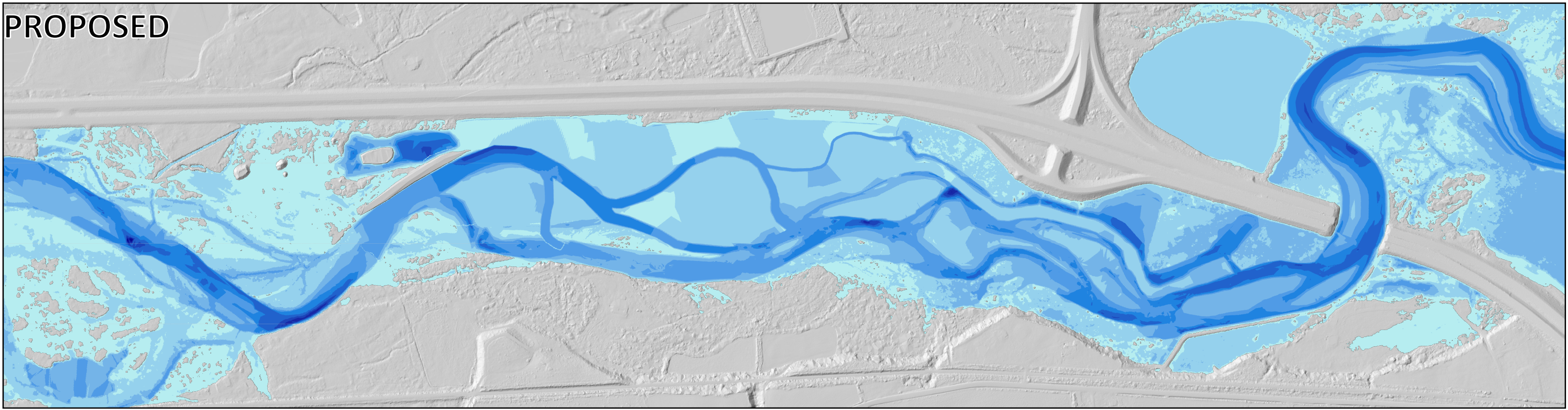
Hanson Ponds Design
25-year Flood (12,220 cfs)

Yakima River
Cle Elum, WA
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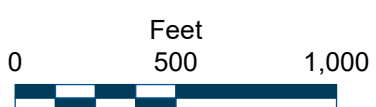
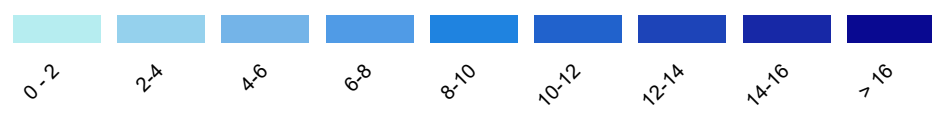
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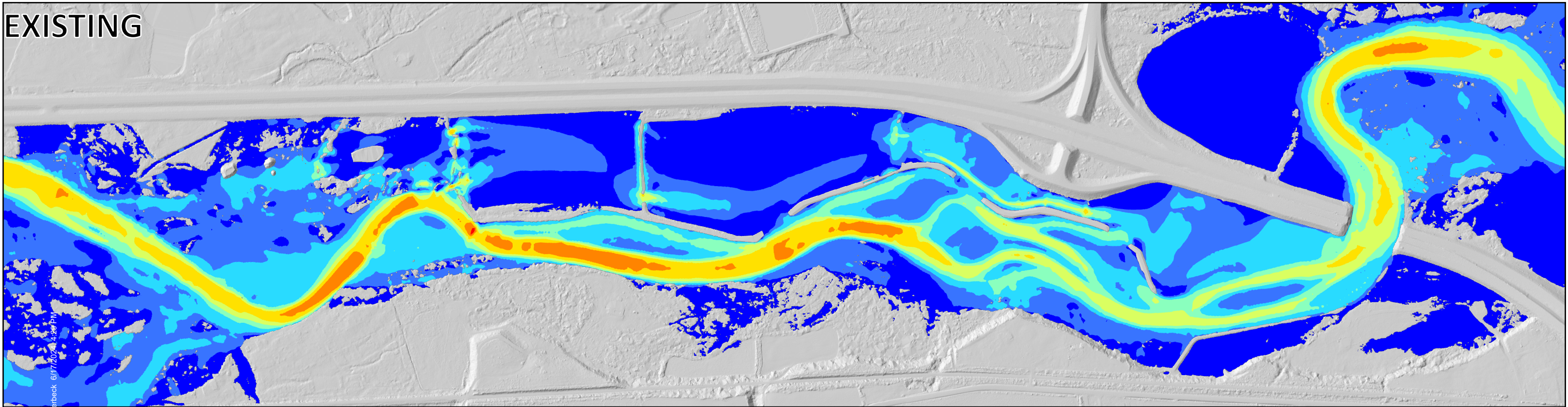


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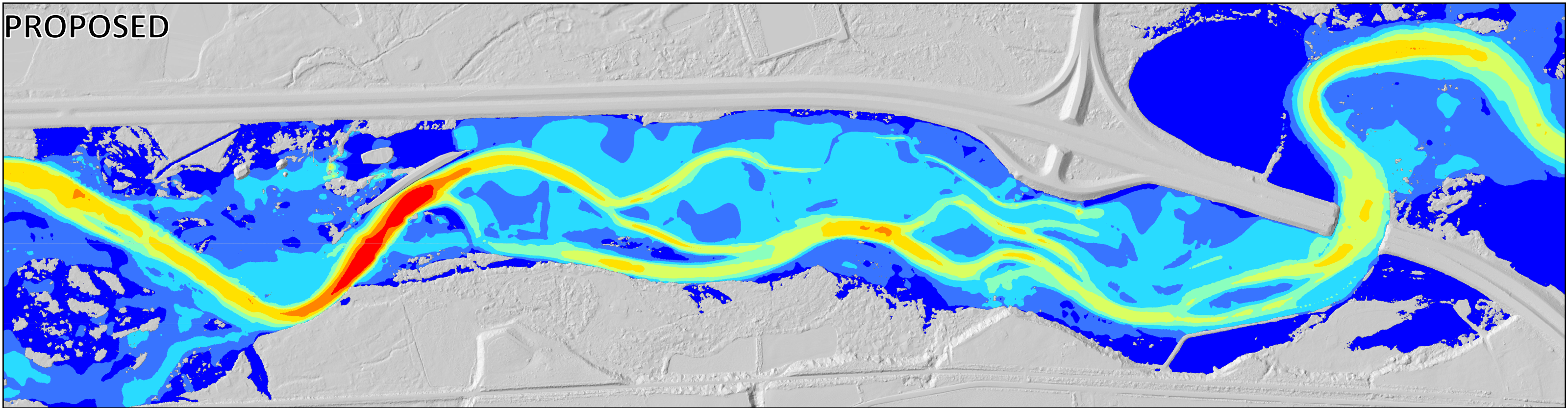


Hanson Ponds Design
100-year Flood (15,670 cfs)

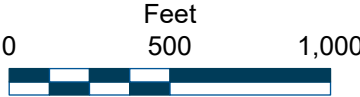
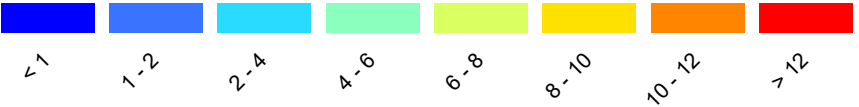
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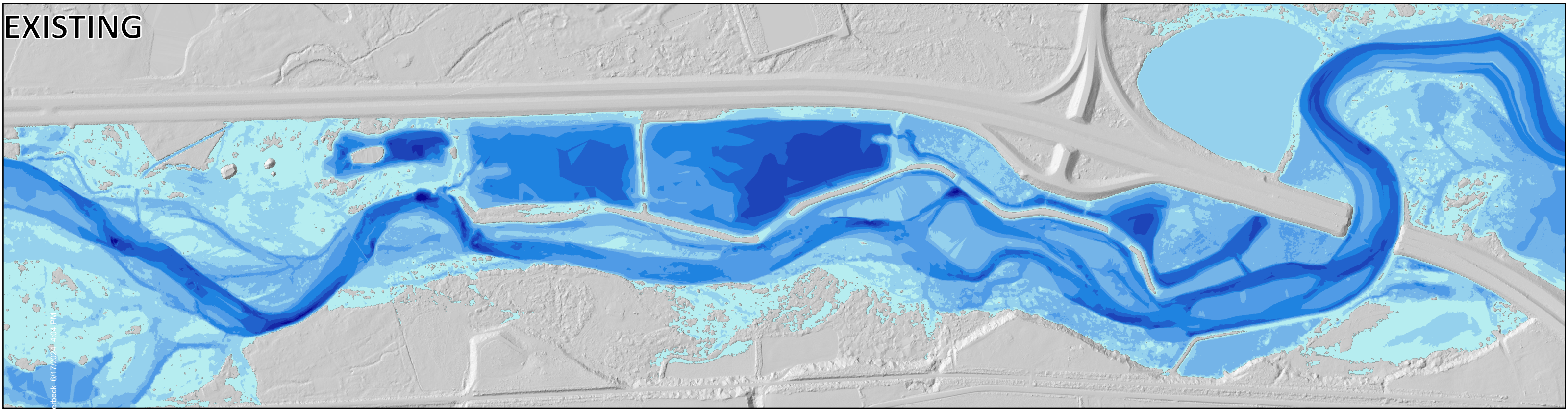


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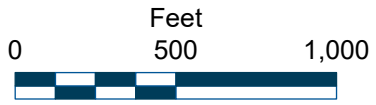
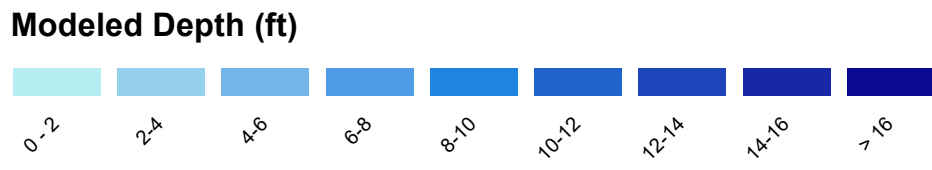
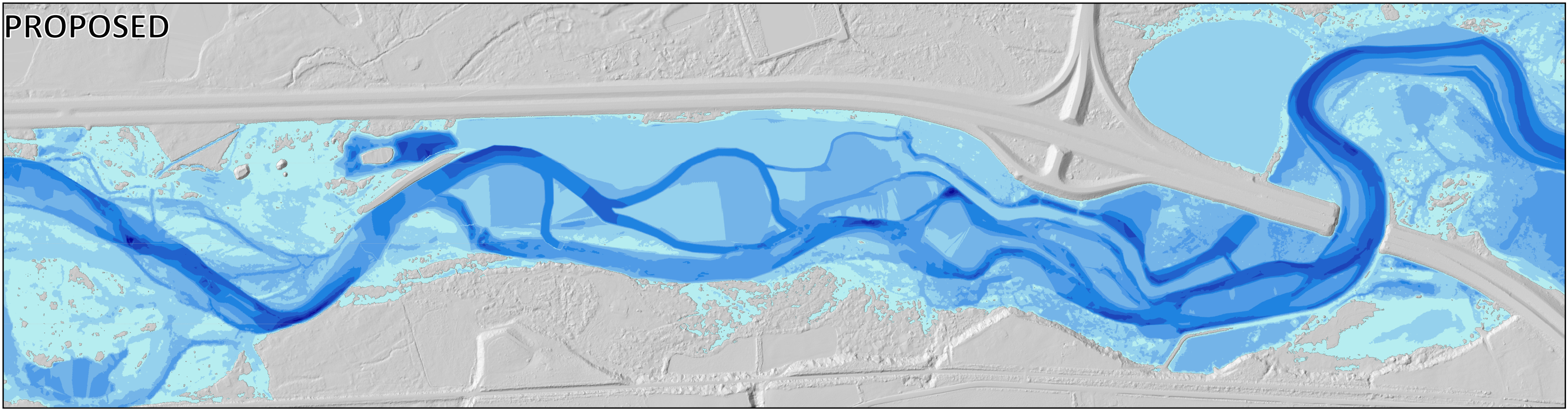


Hanson Ponds Design
100-year Flood (15,670 cfs)

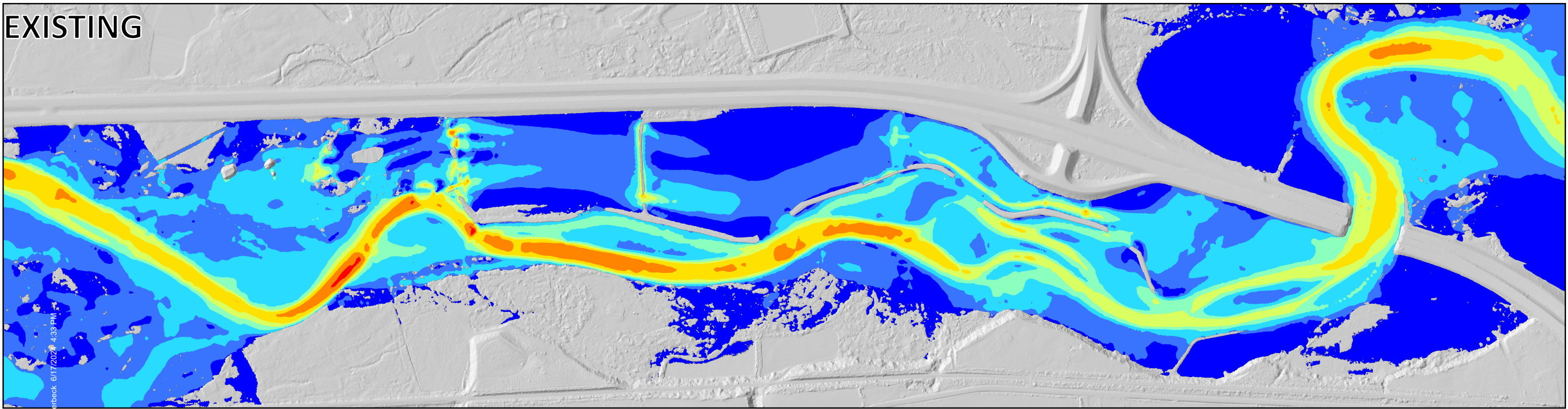
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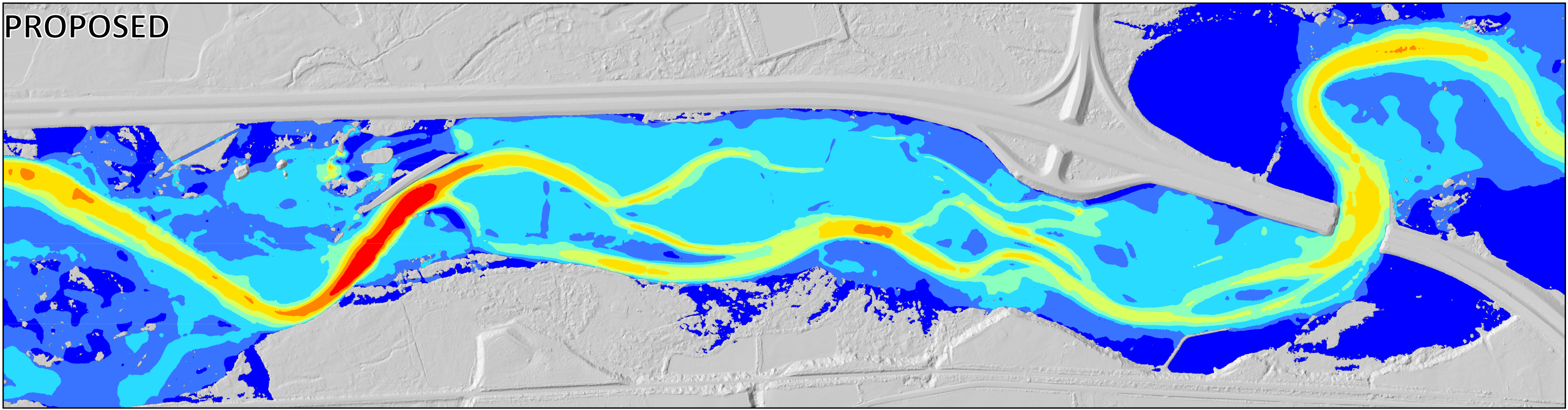
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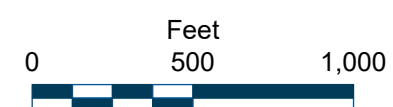
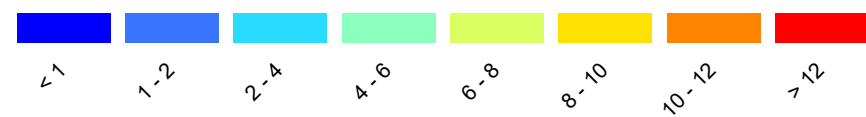
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PROPOSED



Modeled Velocity (ft/s)



Hanson Ponds Design
FEMA 100-year Flood (19,828 cfs)

Appendix C : Geo-Technical Report (Aspect)

DRAFT

GEOTECHNICAL DATA REPORT

Hanson Ponds Restoration

Prepared for: Inter-Fluve, Inc.

Project No. 220580 • April 12, 2024 • FINAL



e a r t h + w a t e r

GEOTECHNICAL DATA REPORT

Hanson Ponds Restoration

Prepared for: Inter-Fluve, Inc.

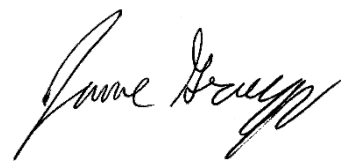
Project No. 220580 • April 12, 2024 • FINAL

Aspect Consulting

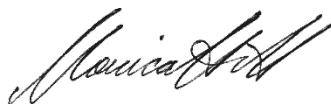


4/12/2024

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- D Report Limitations and Guidelines for Use

1 Introduction

This geotechnical data report (GDR) presents the results of the geotechnical data collected and documented by Aspect Consulting (Aspect) for the Hanson Ponds Restoration Project (Project). The Project is intended to improve habitat and floodplain connectivity on the Yakima River near Cle Elum, Washington. The Project location is from river mile (RM) 185.7 to 187.1 along the upper Yakima River (Site; Figure 1).

The Project is being led by the Kittitas Conservation Trust (KCT) and the City of Cle Elum (City) along with a team of regional and local stakeholders. Inter-Fluve, Inc. (Inter-Fluve) is the prime consultant for the Project. We understand the evaluation of conceptual alternatives is ongoing and Project elements have not been finalized. This report summarizes the results of the geotechnical investigations to inform the alternatives assessment. As the Project progresses, this report will be updated and refined.

2 Site Conditions

This section presents our Site observations including topography, surface conditions, and infrastructure. The general Site layout is shown on Figure 2.

2.1 Site Location and Land Use

The Hanson Ponds Project Site is in Kittitas County within the city limits of Cle Elum, Washington (Figure 1). The Site is bounded by the waters of the Yakima River to the south, Interstate 90 to the north, and undeveloped parcels owned by Whispering Pines RV Park to the west (County, 2023). The Site is currently used as a Cle Elum city park that provides public access to walking trails, fishing ponds, and recreation along the Yakima River. The Site is accessed from the west via Whispering Pines Road, a gravel road that dead ends at a parking area at the west end of the Site.

2.2 Topography and Vegetation

The Site is in the Yakima River valley along the north bank of the main stem Yakima River. The relatively flat topography throughout the Site ranges in elevation from EL 1887 in the floodplain west of Kiwanis Pond to EL 1880¹ at the east end of the levee near the Lower Ponds (DNR, 2023). At the time of our Site visits in October and November 2023, the top of the existing levee was generally around 4 feet above the water surface in the ponds.

The levee and surrounding areas are vegetated with riparian and woodland vegetation including ponderosa pine, willow, alder, cottonwood, grasses and forbs. Relatively small areas of wetland-like terrain were observed in low-lying portions of the Site. At the ground surface along the western portion of the Site, we observed up to 2 inches of undecomposed organic litter material consisting of pine needles, leaves, fine rootlets, grass, and/or bark. Typical vegetation found at the Site is shown in Photograph 1 (Appendix A²).

2.3 Levees and Ponds

There are five ponds at the Site designated from west to east as the Kiwanis Pond, Upper Pond, Middle Pond, and the two Lower Ponds (Figure 2). A series of levees and dikes separate the ponds from each other and from the waters of the Yakima River. The main levee alignment runs generally from west to east for about 5200 feet and roughly parallels the Yakima River from river mile (RM) 185.8 to RM 187. Two dikes are aligned roughly perpendicular to the levee and separate Kiwanis Pond, Upper Pond, and Middle Pond (Photograph 2). The levees confine the main channel of the Yakima River and dissect and separate the floodplain from the ponds while also restricting the potential for lateral channel migration. Most sections of the levee have been armored with cobble to boulder-sized riprap and large woody debris (Photograph 3).

The rock and earthen levees and dikes were originally constructed in the late 1960s as part of gravel mining operations that took place in the present-day pond areas (DNR,

¹ All elevations are determined using North American Vertical Datum of 1988 (NAVD88).

² Refer to Appendix A for all photograph references in this report.

2004). The ponds were mined to about 10 feet below the existing ground surface elevation (Reichmuth et al., 2002).

In the early 2000s, the Yakama Nation established an inlet, spill channels, and an outlet through the levee and dikes to allow for a fraction of the Yakima River flow to pass through the Upper, Middle and Lower Ponds and return to the main stem downstream (Inter-Fluve, 2021; Photograph 4). The inlet is through the southwest corner of the Upper Pond and the outlet is on the easternmost end of the Lower Ponds. Kiwanis Pond is not directly connected to the waters of the Yakima River and receives recharge from the floodplain and surface flows.

Lateral migration of the Yakima River has caused erosion of the embankment upstream of the Upper Pond area (Figure 2). We observed exposed soils and roots along the channel bank near the main parking area (Photograph 5).

2.4 Existing Sewer Outfall Infrastructure

An existing sewer outfall pipe is buried within the levee between the Upper and Kiwanis Ponds. The outfall crosses beneath the inlet channel before discharging into the mainstem of the Yakima River near the southwest corner of the Upper Pond (Inter-Fluve, 2021; Photograph 6). We understand that the outfall pipe was installed in 2003 using open cut methods south of Interstate 90.

3 Field Investigations

Aspect completed 12 subsurface explorations along the existing levee alignment and within the surrounding floodplain between October and November 2023. The explorations included:

- 6 test pits, designated ATP-01 through ATP-06, advanced using a tracked excavator to depths between 7 and 10.5 feet below ground surface (bgs) by Mass X Construction, LLC.
- 6 geotechnical soil borings, designated AB-01 through AB-06, advanced using sonic drilling techniques to depths between 31.5 and 41.5 feet bgs by Western States Soil Conservation, Inc.

An Aspect geologist was present throughout the field exploration program to observe and direct the explorations, collect soil samples, and prepare descriptive logs of each exploration. The approximate locations of our explorations are shown on Figure 2 and exploration logs are presented in Appendix B.

3.1 Test Pit Excavations

The test pits were excavated on October 24, 2023, using a Hitachi 85USB tracked excavator equipped with a 24-inch-wide bucket. The relative density/consistency of the soils was evaluated qualitatively with a 0.5-inch-diameter steel probe (T-probe) and observation of digging difficulty. We recorded descriptive logs of the soils observed in each test pit and collected samples of each representative soil type encountered. After the completion of each test pit, the excavation was backfilled with the excavated soils and tamped into place in lifts using the excavator bucket.

3.2 Sonic Drilled Borings

The soil borings were advanced between October 30 and November 7, 2023, using a track-mounted Geoprobe 8150LS sonic drill rig advancing a continuous 4-inch inner-diameter core barrel. The core barrel was equipped with an oscillating sonic head which allowed the core to be pushed steadily into soils. The cores returned continuous, disturbed samples in plastic bags for examination.

Standard penetration testing (SPT) was performed, and samples were collected at regular intervals within each boring. SPT methods were in accordance with ASTM International (ASTM) Method D1586³, Standard Test Method for Standard Penetration Test and Split-Barrel Sampling of Soils. The SPT method involved driving a 2-inch-outside-diameter split-barrel sampler with a 140-pound hammer free-falling from 30 inches. The number of blows for each 6-inch interval was recorded.

The number of blows required to drive the sampler the final 12 inches is known as the Standard Penetration Resistance (“N-value”) or blow count, which provides a measure of the relative density of granular soils or the relative consistency of cohesive soils. If a total

³ ASTM Standards are in accordance with the 2023 Annual Book of ASTM Standards (ASTM, 2023) unless otherwise noted.

of 50 blows was recorded for a single 6-inch interval, the test was terminated, and the blow count was recorded as 50 blows for the total inches of penetration. Samples from sonic cores and split spoons were placed in labeled plastic bags and taken to a laboratory for further classification (Appendix C).

Upon completion, each boring was backfilled with hydrated 3/8-inch bentonite chips in accordance with requirements of the Washington State Department of Ecology. Each boring was topped with soil to match surrounding surface conditions. Excess soil cuttings were dispersed on Site in areas above the limits of anticipated floodwater.

3.3 Exploration Logging Methods

Aspect observed and documented soil, groundwater, and excavation characteristics for all test pits and borings. Exploration logs were created using the Unified Soil Classification System (USCS), as defined in ASTM D2488, and standard geologic unit nomenclature. Terminology used in soil descriptions is presented in the Exploration Log key in Appendix B, followed by the exploration logs themselves.

Assignment of geologic units to a particular grouping of soil types was based on our interpretation of the depositional environment, stratigraphic relationships, results of engineering property determinations, and laboratory testing. The stratigraphic contacts shown on the exploration logs represent the approximate boundaries between soil types; actual transitions may be more gradual. The subsurface conditions depicted are only for the specific date and location reported, and therefore, are not necessarily representative of other locations and times.

4 Laboratory Testing Methods

We submitted selected soil samples from the subsurface explorations to the subcontracted geotechnical testing laboratory, Hayre McElroy & Associates, LLC, to complete index testing consisting of moisture content, grain-size distribution, and Atterberg Limits (plasticity) to inform our geotechnical analyses.

The complete results of laboratory testing are presented in Appendix C. The results of the tests are also incorporated into the exploration logs in Appendix B. The following is a summary of geotechnical laboratory testing methods utilized for the Project.

4.1 Moisture Content Determination

Moisture contents were determined for samples recovered in the explorations in general accordance with ASTM D2216. This test method allows for the laboratory determination of the moisture (water) content of a soil sample by measuring and recording the mass of a sample before and then after drying.

4.2 Grain Size Analysis

Particle-size analyses were performed on select soil samples in general accordance with ASTM C136 and D1140 to determine their grain-size distributions. The Sieve Analysis of Fine and Coarse Aggregates was performed by wet sieve analyses, determining percentages (by weight) of the sample passing a series of sieves from the 1-inch sieve, down to the No. 200 (0.75 mm) sieve. Test Method for Materials Finer than 75 μm (No. 200) in Mineral Aggregates was performed by washing, determining a percentage (by weight) of the sample passing the No. 200 (0.75 mm) sieve.

4.3 Plasticity Index (Atterberg Limits) Determination

One subsurface soil sample was submitted for plasticity index analysis (Atterberg Limits) by the ASTM D4318 test method. This test method allows for the laboratory determination of the liquid limit and the plastic limit of the fines in a soil sample.

5 Subsurface Conditions

Subsurface conditions at the Site were inferred from our field investigations, a review of applicable geologic literature, local geologic experience, and laboratory testing.

5.1 Regional Geologic Setting

The geology of the upper Yakima River basin consists of complex volcanic and metamorphic assemblages that have been shaped by glacial and post-glacial erosion and sedimentation (Tabor, et al., 2005). The lower lying valleys are filled with unconsolidated glacial sediments that were deposited during repeated alpine glaciations during the Pleistocene (Booth et al., 2003). Repeated glacial advances and retreats through the Pleistocene and early Holocene resulted in the formation of outwash and till terraces, lateral moraines, thick glaciolacustrine deposits and alluvial floodplains. Within the Site area, the geology generally consists of the modern Yakima River alluvium and associated floodplain deposits overlying older glacial deposits. Geologic units observed at the Site are described in detail in Section 5.2.

5.2 Site Stratigraphy

The results of our subsurface explorations and laboratory testing generally agree with the geologic mapping. We grouped the soils encountered at the Site into the following units: topsoil, existing levee fill, Alluvium of the Yakima River, and Kittitas Drift – Indian John Subdrift Lacustrine Deposits. The soil layers we encountered are described in more detail below. Figure 2 provides exploration locations and Figure 3 provides a geologic cross section with inferred contacts between geologic units. The location of the geologic cross section is shown on Figure 2 and it spans from the western edge of Kiwanis Pond to the Lower Hanson Ponds.

5.2.1 Topsoil

In all explorations except AB-04, we observed topsoil primarily consisting of sand and gravel with silt, abundant roots, and organic debris from the ground surface to depths of 2 to 6 inches bgs (Photographs 7 to 10). This topsoil layer was darker in color, contained more organic material and was generally looser than the underlying levee fill, which is described in the following section.

In general, the topsoil was thickest in the vicinity of Kiwanis Pond and was thinner (or absent) atop the levee along the Upper, Middle and Lower Ponds. We anticipate about 4 inches or less of topsoil will be encountered throughout levee and floodplain areas, with occasional areas of deeper or shallower topsoil.

5.2.2 Existing Levee Fill

Below the topsoil material (Photographs 7-10), we observed fill material consisting of moist, dense to very dense gravel with varying amounts of silt, sand, cobbles and boulders up to 3 feet in diameter. We observed variable amounts of woody material, from rootlets to logs. The fill material was 6 to 8 feet thick in our explorations.

During the installation of the sewer outfall pipe in 2003 (by others), the levee fill material observed consisted of cobble-gravel alluvium with sand and silt (Reichmuth et al., 2002). It was presumed that the levees were constructed of reused native alluvium excavated from the ponds.

5.2.3 Alluvium of the Yakima River

Below the existing levee fill material, we encountered sand, gravel, and cobble alluvium deposited by the modern Yakima River beginning at depths ranging between 6.5 and 9.5 feet bgs. The alluvium deposits extended to depths ranging between 12.5 and 17 feet bgs in all explorations except AB-05, where we observed alluvium extending up to 25 feet bgs. The material generally consisted of medium dense to very dense, wet, gray-brown gravel with silt, sand and cobbles with variable amounts of iron-oxide staining (GP, GP-GM) as shown in Photograph 11. We encountered no significant organic materials within this unit.

5.2.4 Kittitas Drift – Indian John Subdrift Lacustrine Deposits

Beneath the alluvium, we encountered fine-grained, glaciolacustrine deposits of the Indian John glacial drift that generally consisted of stiff to very stiff, wet, brown to blue-gray silt with fine sand and clay (Photograph 11). We encountered high plasticity, blocky clay beds up to 3 inches thick interbedded with the laminated silt and fine sand. We also encountered few discrete beds of silty gravel and silty sand with gravel up to 1.5 feet thick in most of the explorations. The glaciolacustrine deposits extended from depths ranging between 12.5 and 25 feet bgs to the bottom of our deepest explorations at approximately 41.5 feet bgs.

5.3 Groundwater Conditions

Relatively shallow groundwater is present throughout the Site and appears to be in hydraulic continuity with the Yakima River and Hanson Ponds. At the time of our explorations, groundwater was observed between 6.25 and 10 feet bgs (EL 1876 to EL 1881.75). Groundwater levels at the Site will fluctuate seasonally and during the wet-weather and irrigation seasons.

6 References

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- Inter-Fluve, Inc. (Inter-Fluve), 2021, Hanson Ponds Assessment – Draft Final Report, Prepared for Kittitas Conservation Trust. Dated April, 2021.
- Kittitas County (County), 2023, Compass Open Data Portal, Accessed December 1, 2023, <https://kitcogis.maps.arcgis.com/apps/webappviewer/index.html>.
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- Washington Department of Natural Resources (DNR), 2023, Washington Geologic Information Portal, Accessed September 9, 2023, <https://geologyportal.dnr.wa.gov/>.

7 Limitations

Work for this project was performed for Inter-Fluve, Inc. (Client), and this report was prepared consistent with recognized standards of professionals in the same locality and involving similar conditions, at the time the work was performed. No other warranty, expressed or implied, is made by Aspect Consulting (Aspect).

Recommendations presented herein are based on our interpretation of site conditions, geotechnical engineering calculations, and judgment in accordance with our mutually agreed-upon scope of work. Our recommendations are unique and specific to the project, site, and Client. Application of this report for any purpose other than the project should be done only after consultation with Aspect.

Variations may exist between the soil and groundwater conditions reported and those actually underlying the site. The nature and extent of such soil variations may change over time and may not be evident before construction begins. If any soil conditions are encountered at the site that are different from those described in this report, Aspect should be notified immediately to review the applicability of our recommendations. If new information, such as existing levee history and repairs, or levee performance during a significant flood event, the professional opinions, recommendations, and conclusions contained in this report may be modified by Aspect.

Risks are inherent with any site involving levees and flood control structures subject to flooding and geologic hazards and no recommendations, geologic analysis, or engineering design can assure performance. Our observations, findings, and opinions are a means to identify and reduce the inherent risks to the Client.

It is the Client's responsibility to see that all parties to this project, including the designer, contractor, subcontractors, and agents, are made aware of this report in its entirety. At the time of this report, design plans and construction methods have not been finalized, and the recommendations presented herein are based on preliminary project information. If project developments result in changes from the preliminary project information, Aspect should be contacted to determine if our recommendations contained in this report should be revised and/or expanded upon.

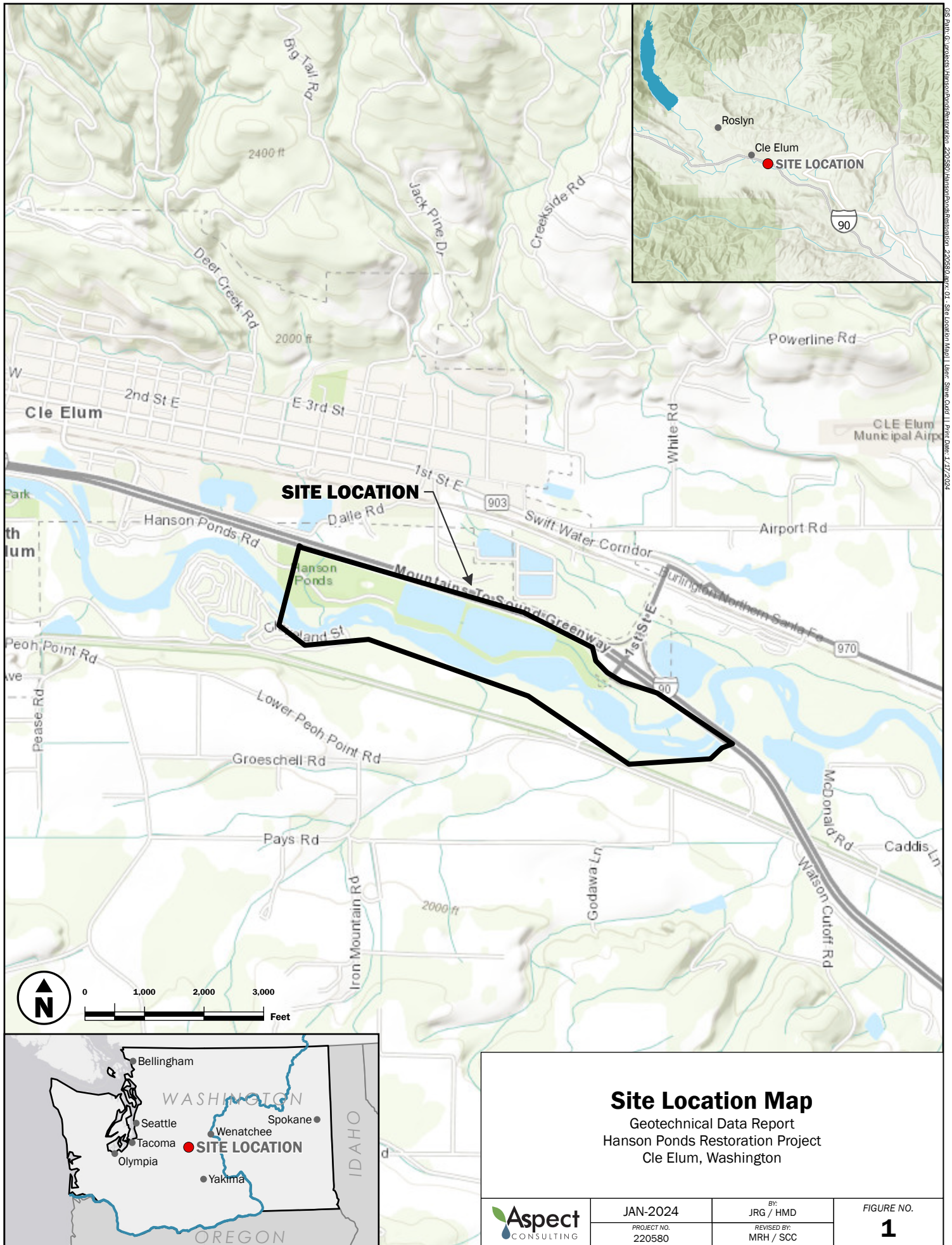
The scope of work does not include services related to construction safety precautions. Site safety is typically the responsibility of the contractor, and our recommendations are not intended to direct the contractor's site safety methods, techniques, sequences, or procedures. The scope of our work also does not include the assessment of environmental characteristics, particularly those involving potentially hazardous substances in soil or groundwater.

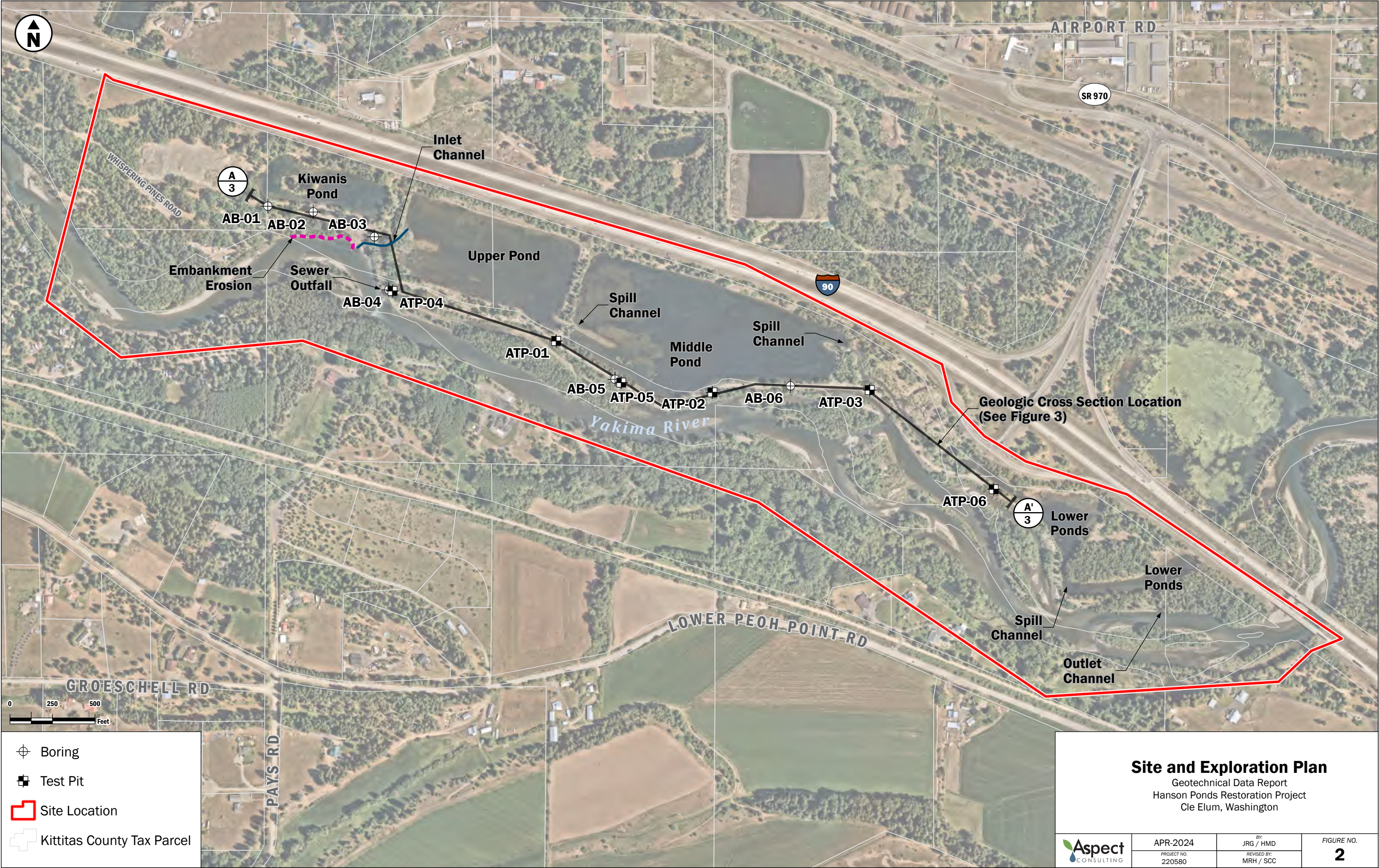
All reports prepared by Aspect for the Client apply only to the services described in the Agreement(s) with the Client. Any use or reuse by any party other than the Client is at the sole risk of that party, and without liability to Aspect. Aspect's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

Please refer to Appendix D titled “Report Limitations and Guidelines for Use” for additional information governing the use of this report.

We appreciate the opportunity to perform these services. If you have any questions, please call Andrew Holmson, PE, Senior Associate Geotechnical Engineer, 971.865.5894.

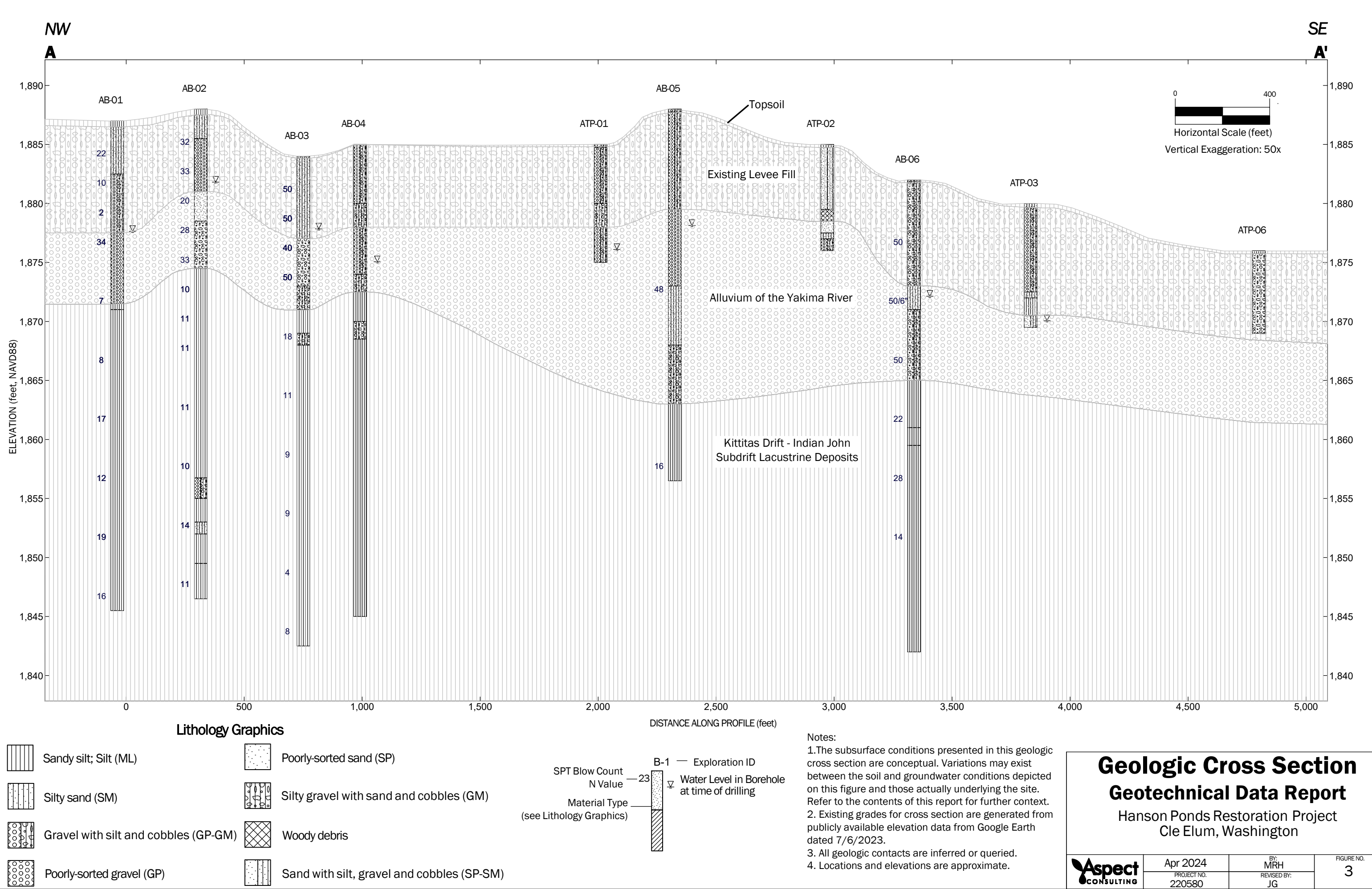
FIGURES





Data source credits: None | | Basemap Service Layer Credits: © OpenStreetMap (and) contributors, CC-BY-SA

OS Path: G:\projects\HansonPondsRestoration\220580\HansonPondsRestoration_220580.mxd; CO: Site Map | User: halsedun | Print Date: 4/9/2024



APPENDIX A

Photograph Log

PHOTO 1: Typical vegetation observed along the levee including ponderosa pine, cottonwood and grasses. Photo viewing east from Upper Pond.



PHOTO 2: Section of levee between Upper (left) and Middle Ponds (right). Photo viewing north.



PHOTO 3: Section of levee with rock face armoring. The main stem of the Yakima River is located on the right side of frame. Photo viewing east.



PHOTO 4: Spill channel constructed in 2004 to allow a fraction of flow from the Yakima River to enter the Upper Pond. Photo viewing east.



PHOTO 5: Embankment erosion near parking area from Yakima River flows. Photo viewing east.



PHOTO 6: Location of City sewer outfall pipe. Photo viewing southwest with Yakima River in background.



Photograph Log

Geotechnical Data Report
Hanson Ponds Restoration Project
Cle Elum, Washington



MAR 2024
PROJECT NO.
220580

BY:
MRH
REV BY:
AJH

FIGURE NO.
A-1

PHOTO 7: ATP-01 sidewall with darker topsoil layer overlying levee fill consisting of sand, gravel and cobbles.



PHOTO 10: Sonic core samples from AB-02 from 0 to 2.5 feet bgs (on right) and 2.5 to 5 feet bgs (on left). Topsoil and organic material observed at surface.



PHOTO 8: ATP-03 excavated in levee fill to 8.5 feet below ground surface.



PHOTO 11: Sonic core samples from AB-06 showing transition from alluvium of the Yakima River (upper bag) to the Kittitas Drift - Indian John Subdrift Lacustrine Deposits (lower bag)



PHOTO 9: ATP-02 excavated in levee fill with thin layer of topsoil visible near surface.



Photograph Log

Geotechnical Data Report
Hanson Ponds Restoration Project
Cle Elum, Washington



MAR 2024
PROJECT NO.
220580

BY:
MRH
REV BY:
AJH

FIGURE NO.
A-2

APPENDIX B

Subsurface Explorations

Coarse-Grained Soils - More than 50% ¹ Retained on No. 200 Sieve					
	Sands - 50% ¹ or More of Coarse Fraction Passes No. 4 Sieve	Gravels - More than 50% ¹ of Coarse Fraction Retained on No. 4 Sieve			
		≤5% Fines	≥15% Fines		
Fine-Grained Soils - 50% ¹ or More Passes No. 200 Sieve	Silts and Clays Liquid Limit Less than 50%			GW	Well-graded GRAVEL Well-graded GRAVEL WITH SAND
				GP	Poorly-graded GRAVEL Poorly-graded GRAVEL WITH SAND
				GM	SILTY GRAVEL SILTY GRAVEL WITH SAND
				GC	CLAYEY GRAVEL CLAYEY GRAVEL WITH SAND
				SW	Well-graded SAND Well-graded SAND WITH GRAVEL
	Silts and Clays Liquid Limit 50% or More			SP	Poorly-graded SAND Poorly-graded SAND WITH GRAVEL
				SM	SILTY SAND SILTY SAND WITH GRAVEL
				SC	CLAYEY SAND CLAYEY SAND WITH GRAVEL
				ML	SILT SANDY or GRAVELLY SILT SILT WITH SAND SILT WITH GRAVEL
				CL	LEAN CLAY SANDY or GRAVELLY LEAN CLAY LEAN CLAY WITH SAND LEAN CLAY WITH GRAVEL
Highly Organic Soils				OL	ORGANIC SILT SANDY or GRAVELLY ORGANIC SILT ORGANIC SILT WITH SAND ORGANIC SILT WITH GRAVEL
				MH	ELASTIC SILT SANDY or GRAVELLY ELASTIC SILT ELASTIC SILT WITH SAND ELASTIC SILT WITH GRAVEL
				CH	FAT CLAY SANDY or GRAVELLY FAT CLAY FAT CLAY WITH SAND FAT CLAY WITH GRAVEL
				OH	ORGANIC CLAY SANDY or GRAVELLY ORGANIC CLAY ORGANIC CLAY WITH SAND ORGANIC CLAY WITH GRAVEL
				PT	PEAT and other mostly organic soils

"WITH SILT" or "WITH CLAY" means 5 to 15% silt and clay, denoted by a "-" in the group name; e.g., SP-SM • "SILTY" or "CLAYEY" means >15% silt and clay • "WITH SAND" or "WITH GRAVEL" means 15 to 30% sand and gravel. • "SANDY" or "GRAVELLY" means >30% sand and gravel. • "Well-graded" means approximately equal amounts of fine to coarse grain sizes • "Poorly graded" means unequal amounts of grain sizes • Group names separated by "/" means soil contains layers of the two soil types; e.g., SM/ML.

Soils were described and identified in the field in general accordance with the methods described in ASTM D2488. Where indicated in the log, soils were classified using ASTM D2487 or other laboratory tests as appropriate. Refer to the report accompanying these exploration logs for details.

1. Estimated or measured percentage by dry weight
2. (SPT) Standard Penetration Test (ASTM D1586)
3. Determined by SPT, DCPT (ASTM STP399) or other field methods. See report text for details.

MC	=	Natural Moisture Content	GEOTECHNICAL LAB TESTS	
PS	=	Particle Size Distribution		
FC	=	Fines Content (% < 0.075 mm)		
GH	=	Hydrometer Test		
AL	=	Atterberg Limits		
C	=	Consolidation Test		
Str	=	Strength Test		
OC	=	Organic Content (% Loss by Ignition)		
Comp	=	Proctor Test		
K	=	Hydraulic Conductivity Test		
SG	=	Specific Gravity Test		
<u>Organic Chemicals</u>			CHEMICAL LAB TESTS	
BTEX	=	Benzene, Toluene, Ethylbenzene, Xylenes		
TPH-Dx	=	Diesel and Oil-Range Petroleum Hydrocarbons		
TPH-G	=	Gasoline-Range Petroleum Hydrocarbons		
VOCs	=	Volatile Organic Compounds		
SVOCs	=	Semi-Volatile Organic Compounds		
PAHs	=	Polycyclic Aromatic Hydrocarbon Compounds		
PCBs	=	Polychlorinated Biphenyls		
<u>Metals</u>				
RCRA8	=	As, Ba, Cd, Cr, Pb, Hg, Se, Ag, (d = dissolved, t = total)		
MTCA5	=	As, Cd, Cr, Hg, Pb (d = dissolved, t = total)		
PP-13	=	Ag, As, Be, Cd, Cr, Cu, Hg, Ni, Pb, Sb, Se, Tl, Zn (d=dissolved, t=total)		
PID = Photoionization Detector			FIELD TESTS	
Sheen	=	Oil Sheen Test		
SPT ²	=	Standard Penetration Test		
NSPT	=	Non-Standard Penetration Test		
DCPT	=	Dynamic Cone Penetration Test		
<u>Descriptive Term</u>			<u>Size Range and Sieve Number</u>	
Boulders	=	Larger than 12 inches	COMPONENT DEFINITIONS	
Cobbles	=	3 inches to 12 inches		
Coarse Gravel	=	3 inches to 3/4 inches		
Fine Gravel	=	3/4 inches to No. 4 (4.75 mm)		
Coarse Sand	=	No. 4 (4.75 mm) to No. 10 (2.00 mm)		
Medium Sand	=	No. 10 (2.00 mm) to No. 40 (0.425 mm)		
Fine Sand	=	No. 40 (0.425 mm) to No. 200 (0.075 mm)		
Silt and Clay	=	Smaller than No. 200 (0.075 mm)		
<u>% by Weight</u>			<u>Modifier</u>	
<1	=	Subtrace	15 to 25	= Little
1 to <5	=	Trace	30 to 45	= Some
5 to 10	=	Few	>50	= Mostly
<u>% by Weight</u>			<u>Modifier</u>	
<1	=	Subtrace	15 to 25	= Little
1 to <5	=	Trace	30 to 45	= Some
5 to 10	=	Few	>50	= Mostly
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<1	=	Subtrace	15 to 25	= Little
1 to <5	=	Trace	30 to 45	= Some
5 to 10	=	Few	>50	= Mostly
<u>% by Weight</u>			<u>Modifier</u>	
<1	=	Subtrace	15 to 25	= Little
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Hanson Ponds Restoration - 220580

Project Address & Site Specific Location

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

Geotechnical Exploration Log

Coordinates (Lat, Lon WGS84)

47.1867, -120.9216 (est)

Exploration Number

AB-01

Contractor
Western States Soil
Conservation, Inc.

Equipment
Geoprobe 8150LS Drill
Rig

Sampling Method
Autohammer; 140 lb hammer; 30" drop

Ground Surface Elev. (NAVD88)
1887' (est)

Operator

Alex

Exploration Method(s)

Sonic

Work Start/Completion Dates

10/31/2023

Top of Casing Elev. (NAVD88)

NA

Depth to Water (Below GS)

9.5' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot Water Content (%)					Blows/6"	Tests	Material Type	Description	Depth (ft)
				0	10	20	30	40	50				
1	1886	Boring backfilled with 3/8-inch, hydrated bentonite chips.										TOPSOIL SANDY SILT WITH GRAVEL (ML); loose, slightly moist, dark brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; trace rounded to subrounded cobbles; few rootlets.	1
2	1885											LEVEE FILL SILTY SAND WITH GRAVEL (SM); medium dense, slightly moist, light brown; fine to trace coarse sand; fine, subrounded to subangular gravel.	2
3	1884	Blow counts may be overstated where gravel and cobbles are present.	S1							5 10 12	FC FC=18.9%		3
4	1883												4
5	1882		S2							4 4 6		GRAVEL WITH SILT, SAND, AND COBBLES (GP-GM); loose, slightly moist, brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; few to little rounded to subangular cobbles; trace fine rootlets.	5
6	1881												6
7	1880												7
8	1879		S3							1 1 1			8
9	1878												9
10	1877	10/31/2023	S4							10 21 13	PS FC=1%	ALLUVIUM OF YAKIMA RIVER (Qy) GRAVEL WITH SAND AND COBBLES (GP); dense, wet, gray brown; medium to coarse sand; fine to coarse, rounded to angular gravel; few rounded to subrounded cobbles.	10
11	1876												11
12	1875												12
13	1874												13
14	1873												14

Legend

□ No Soil Sample Recovery

■ Split Barrel 2" X 1.375" (SPT)

Plastic Limit — Liquid Limit

▽ Water Level ATD

Water
Level

See Exploration Log Key for
explanation of symbols

Logged by: MRH
Approved by: JG

**Exploration
Log
AB-01**

Sheet 1 of 3



Hanson Ponds Restoration - 220580

Geotechnical Exploration Log

Project Address & Site Specific Location

Coordinates (Lat, Lon WGS84)

Exploration Number

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

47.1867, -120.9216 (est)

AB-01

Contractor
Western States Soil
Conservation, Inc.

Equipment
Geoprobe 8150LS Drill
Rig

Sampling Method
Autohammer; 140 lb hammer; 30" drop

Ground Surface Elev. (NAVD88)
1887' (est)

Operator

Exploration Method(s)

Work Start/Completion Dates

Top of Casing Elev. (NAVD88)

Depth to Water (Below GS)

Alex

Sonic

10/31/2023

NA

9.5' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot Water Content (%)					Blows/6"	Tests	Material Type	Description	Depth (ft)
				0	10	20	30	40	50				
16	1871		S5							8		KITTITAS DRIFT - INDIAN JOHN SUBDRIFT LACUSTRINE DEPOSITS (Qkil) SILT WITH SAND (ML); medium stiff, wet, brown; non-plastic to low plasticity; slow dilatency; oxidized laminations. SILT (ML); medium stiff, wet, blue gray; non-plastic to low plasticity; slow dilatency; fine sand; laminated silt and sand with 1-to-1.5-inch-thick clay beds.	16
17	1870									1			17
18	1869									6			18
19	1868												19
20	1867												20
21	1866		S6							0		Becomes very stiff at 22.5 feet bgs.	21
22	1865									3			22
23	1864									5			23
24	1863												24
25	1862												25
26	1861		S7							4			26
27	1860									7			27
28	1859									10			28
29	1858												29

Legend

□ No Soil Sample Recovery

■ Split Barrel 2" X 1.375" (SPT)

Plastic Limit — Liquid Limit

▽ Water Level ATD

See Exploration Log Key for
explanation of symbols

Logged by: MRH
Approved by: JG

**Exploration
Log
AB-01**

Sheet 2 of 3

Hanson Ponds Restoration - 220580

Project Address & Site Specific Location

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

Geotechnical Exploration Log

Coordinates (Lat, Lon WGS84)

47.1867, -120.9216 (est)

Exploration Number

AB-01

Contractor

Western States Soil Conservation, Inc.

Equipment

Geoprobe 8150LS Drill Rig

Sampling Method

Autohammer; 140 lb hammer; 30" drop

Ground Surface Elev. (NAVD88)

1887' (est)

Operator

Alex

Exploration Method(s)

Sonic

Work Start/Completion Dates

10/31/2023

Top of Casing Elev. (NAVD88)

NA

Depth to Water (Below GS)

9.5' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot					Blows/6"	Tests	Material Type	Description	Depth (ft)
				0	10	20	30	40					
31	1856	[Patterned Box]	S8						2	FC FC=92.3%	[Vertical Lines]	SILT (ML); medium stiff, wet, blue gray; non-plastic to low plasticity; slow dilatency; fine sand; laminated silt and sand with 1-to-1.5-inch-thick clay beds. (continued) Becomes stiff at 30 feet bgs.	31
32	1855								5				
33	1854								7				
34	1853												
35	1852	[Patterned Box]	S9						4		Becomes very stiff at 33.5 feet bgs.	35	
36	1851								6				
37	1850								13				
38	1849	[Patterned Box]	S10						3		Bottom of exploration at 41.5 ft. bgs.	38	
39	1848								6				
40	1847								10				
41	1846												
42	1845												42
43	1844												43
44	1843												44

Legend

No Soil Sample Recovery

Split Barrel 2" X 1.375" (SPT)

Plastic Limit

Liquid Limit

Water Level

Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: MRH

Approved by: JG

Exploration Log

AB-01

Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINT\PROJECTS\HANSON PONDS TEST PITTS - 220580.GPJ April 8, 2024

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Hanson Ponds Restoration - 220580

Project Address & Site Specific Location

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

Geotechnical Exploration Log

Coordinates (Lat, Lon WGS84)

47.1864, -120.9202 (est)

Exploration Number

AB-02

Contractor
Western States Soil
Conservation, Inc.

Equipment
Geoprobe 8150LS Drill
Rig

Sampling Method

Autohammer; 140 lb hammer; 30" drop

Ground Surface Elev. (NAVD88)

1888' (est)

Operator

Alex

Exploration Method(s)

Sonic

Work Start/Completion Dates

10/30/2023

Top of Casing Elev. (NAVD88)

NA

Depth to Water (Below GS)

6.25' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot					Blows/6"	Tests	Material Type	Description	Depth (ft)
				0	10	20	30	40	50				
1	1887	Boring backfilled with 3/8-inch, hydrated bentonite chips.										TOPSOIL SANDY SILT WITH GRAVEL (ML); loose, moist, brown; fine to coarse sand; fine to trace coarse, rounded to subangular gravel.	1
2	1886											LEVEE FILL SILTY SAND WITH GRAVEL AND COBBLES (SM); dense, slightly moist, light brown; fine to trace coarse sand; fine to coarse, rounded to subangular gravel; few rounded to subrounded cobbles.	2
3	1885		S1							3 13 19		GRAVEL WITH SAND AND COBBLES (GP); dense, slightly moist, light brown; fine to coarse sand; fine to coarse, subrounded to subangular gravel; few to little rounded to subrounded cobbles.	3
4	1884	Blow counts may be overstated where gravel and cobbles are present.											4
5	1883		S2							9 15 18	PS FC=4.8%		5
6	1882	10/30/2023										Becomes wet at 6.25 feet bgs.	6
7	1881											ALLUVIUM OF YAKIMA RIVER (Qy) SAND (SP); medium dense, wet, gray brown; fine to coarse sand.	7
8	1880		S3							8 13 7			8
9	1879												9
10	1878		S4							7 16 12	PS FC=1.5%	GRAVEL WITH SAND AND COBBLES (GW); medium dense, wet, gray brown; fine to coarse, angular sand; fine to coarse, subrounded to subangular gravel; few rounded to subrounded cobbles.	10
11	1877											Becomes with more silt at 11.25 feet bgs.	11
12	1876											Becomes dense at 12 feet bgs.	12
13	1875		S5							8 13 20			13
14	1874											KITTITAS DRIFT - INDIAN JOHN SUBDRIFT LACUSTRINE DEPOSITS (Qkil) SILT (ML); stiff, wet, brown; non-plastic to low plasticity; slow dilatency; fine sand; oxidized laminations; 0.5-to-3-inch-thick clay beds.	14

Legend

□ No Soil Sample Recovery

■ Split Barrel 2" X 1.375" (SPT)

Plastic Limit — Liquid Limit

▽ Water Level ATD

Water
Level

See Exploration Log Key for
explanation of symbols

Logged by: MRH

Approved by: JG

**Exploration
Log
AB-02**

Sheet 1 of 3

Hanson Ponds Restoration - 220580

Project Address & Site Specific Location

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

Geotechnical Exploration Log

Coordinates (Lat,Lon WGS84)

47.1864, -120.9202 (est)

Exploration Number

AB-02

Contractor

Western States Soil Conservation, Inc.

Equipment

Geoprobe 8150LS Drill Rig

Sampling Method

Autohammer; 140 lb hammer; 30" drop

Ground Surface Elev. (NAVD88)

1888' (est)

Operator

Alex

Exploration Method(s)

Sonic

Work Start/Completion Dates

10/30/2023

Top of Casing Elev. (NAVD88)

NA

Depth to Water (Below GS)

6.25' (ATD)

Legend

No Soil Sample Recovery

Split Barrel 2" X 1.375" (SPT)

Plastic Limit

Liquid Limit

Water Level

Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: MRH

Approved by: JG

Exploration Log

AB-02

Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINT\PROJECTS\HANSON PONDS TEST PITTS - 220580.GPJ April 8, 2024



Hanson Ponds Restoration - 220580

Geotechnical Exploration Log

Project Address & Site Specific Location

Coordinates (Lat, Lon WGS84)

Exploration Number

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

47.1864, -120.9202 (est)

AB-02

Contractor
Western States Soil
Conservation, Inc.

Equipment
Geoprobe 8150LS Drill
Rig

Sampling Method
Autohammer; 140 lb hammer; 30" drop

Ground Surface Elev. (NAVD88)
1888' (est)

Operator

Exploration Method(s)

Work Start/Completion Dates

Top of Casing Elev. (NAVD88)

Depth to Water (Below GS)

Alex

Sonic

10/30/2023

NA

6.25' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot Water Content (%)						Blows/6"	Tests	Material Type	Description	Depth (ft)			
				0	10	20	30	40	50								
31	1857		S10							3			KITTITAS DRIFT - INDIAN JOHN SUBDRIFT LACUSTRINE DEPOSITS (Qkil) SILT (ML); stiff, wet, brown; non-plastic to low plasticity; slow dilatency; fine sand; oxidized laminations; 0.5-to-3-inch-thick clay beds. (continued)	31			
32	1856									4						GRAVEL WITH SILT (GP-GM); medium dense, wet, gray brown; fine to coarse sand; fine to coarse, subrounded to subangular gravel.	32
33	1855									6							
34	1854															SILTY SAND WITH GRAVEL (SM); medium dense, wet, gray brown; subangular to angular, medium to coarse sand; fine to coarse, rounded to subrounded gravel.	
35	1853		S11							4			SILT WITH SAND (ML); stiff, wet, blue gray; non-plastic to low plasticity; fine sand; laminated silt and sand with clay beds.				35
36	1852									4						SILT WITH GRAVEL (ML); stiff, wet, blue gray; non-plastic to low plasticity; laminated silt with clay beds; little, gray brown, subrounded to subangular, fine to coarse gravel beds.	36
37	1851									10							
38	1850																
39	1849		S12							4			Bottom of exploration at 41.5 ft. bgs.				39
40	1848									4							40
41	1847									7							
42	1846																
43	1845											43					
44	1844														44		

Legend

No Soil Sample Recovery

Split Barrel 2" X 1.375" (SPT)

Plastic Limit ——— Liquid Limit

Water Level

See Exploration Log Key for
explanation of symbols

Logged by: MRH
Approved by: JG

**Exploration
Log
AB-02**

Sheet 3 of 3



Hanson Ponds Restoration - 220580

Project Address & Site Specific Location

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

Geotechnical Exploration Log

Coordinates (Lat, Lon WGS84)

47.1861, -120.9185 (est)

Exploration Number

AB-03

Contractor
Western States Soil
Conservation, Inc.

Equipment
Geoprobe 8150LS Drill
Rig

Sampling Method
Autohammer; 140 lb hammer; 30" drop

Ground Surface Elev. (NAVD88)
1884' (est)

Operator

Alex

Exploration Method(s)

Sonic

Work Start/Completion Dates

10/31/2023

Top of Casing Elev. (NAVD88)

NA

Depth to Water (Below GS)

6.25' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot					Blows/6"	Tests	Material Type	Description	Depth (ft)
				0	10	20	30	40	50				
1	1883	Boring backfilled with 3/8-inch, hydrated bentonite chips.										TOPSOIL WOODY DEBRIS; loose, slightly moist, dark brown; abundant organic material.	1
2	1882											LEVEE FILL SILTY SAND WITH GRAVEL AND COBBLES (SM); very dense, slightly moist, light brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; little rounded to subrounded cobbles.	2
3	1881		S1							12 27 28			3
4	1880	Blow counts may be overstated where gravel and cobbles are present.											4
5	1879		S2							3 25 24		Becomes dense at 5 feet bgs.	5
6	1878	10/31/2023										Becomes wet at 6.25 feet bgs.	6
7	1877												7
8	1876		S3							10 19 21	PS FC=1.8%	ALLUVIUM OF YAKIMA RIVER (Qy) GRAVEL WITH SAND AND COBBLES (GW); dense, wet, gray brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; few rounded to subrounded cobbles.	8
9	1875												9
10	1874		S4							27 31 24		Becomes very dense at 9.5 feet bgs.	10
11	1873											SILTY GRAVEL WITH SAND AND COBBLES (GM); very dense, wet, brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; rounded to subrounded cobbles; slight iron-oxide staining.	11
12	1872												12
13	1871											KITTITAS DRIFT - INDIAN JOHN SUBDRIFT LACUSTRINE DEPOSITS (Qkil) SILT WITH SAND (ML); very stiff, wet, brown; non-plastic to low plasticity; slow dilatency; fine sand with silt and clay laminations.	13
14	1870												14

Legend

□ No Soil Sample Recovery

■ Split Barrel 2" X 1.375" (SPT)

Plastic Limit — Liquid Limit

▽ Water Level ATD

Water
Level

See Exploration Log Key for
explanation of symbols

Logged by: MRH

Approved by: JG

**Exploration
Log
AB-03**

Sheet 1 of 3

Hanson Ponds Restoration - 220580

Project Address & Site Specific Location

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

Geotechnical Exploration Log

Coordinates (Lat, Lon WGS84)

47.1861, -120.9185 (est)

Exploration Number

AB-03

Contractor

Western States Soil Conservation, Inc.

Equipment

Geoprobe 8150LS Drill Rig

Sampling Method

Autohammer; 140 lb hammer; 30" drop

Ground Surface Elev. (NAVD88)

1884' (est)

Operator

Alex

Exploration Method(s)

Sonic

Work Start/Completion Dates

10/31/2023

Top of Casing Elev. (NAVD88)

NA

Depth to Water (Below GS)

6.25' (ATD)

Legend

No Soil Sample Recovery

Split Barrel 2" X 1.375" (SPT)

Plastic Limit

→ Liquid Limit

Water Level

See Exploration Log Key for explanation of symbols

Logged by: MRH

Approved by: JG

Exploration Log

AB-03

Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINT\PROJECTS\HANSON PONDS TEST PITTS - 220580.GPJ April 8, 2024

Hanson Ponds Restoration - 220580

Project Address & Site Specific Location

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

Geotechnical Exploration Log

Coordinates (Lat, Lon WGS84)

47.1861, -120.9185 (est)

Exploration Number

AB-03

Contractor

Western States Soil Conservation, Inc.

Equipment

Geoprobe 8150LS Drill Rig

Sampling Method

Autohammer; 140 lb hammer; 30" drop

Ground Surface Elev. (NAVD88)

1884' (est)

Operator

Alex

Exploration Method(s)

Sonic

Work Start/Completion Dates

10/31/2023

Top of Casing Elev. (NAVD88)

NA

Depth to Water (Below GS)

6.25' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot					Blows/6"	Tests	Material Type	Description	Depth (ft)	
				0	10	20	30	40						50
31	1853		S8							2			SILT (ML); stiff, wet, brown; non-plastic to low plasticity; slow dilatency; trace fine sand; 0.05- to 1.25-inch-thick, blue-gray clay beds; oxidized laminations. (continued)	31
32	1852									4				
33	1851									5				
34	1850													
35	1849		S9							0		Becomes medium stiff at 33.5 feet bgs.	35	
36	1848									1				
37	1847									3				
38	1846													
39	1845		S10							2		Bottom of exploration at 41.5 ft. bgs.	39	
40	1844									3				
41	1843									5				
42	1842													
43	1841												43	
44	1840												44	

Legend

No Soil Sample Recovery

Split Barrel 2" X 1.375" (SPT)

Plastic Limit

Liquid Limit

Water Level

Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: MRH

Approved by: JG

Exploration Log

AB-03

Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINT\PROJECTS\HANSON PONDS TEST PITTS - 220580.GPJ April 8, 2024



Hanson Ponds Restoration - 220580

Geotechnical Exploration Log

Project Address & Site Specific Location

Coordinates (Lat, Lon WGS84)

Exploration Number

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

47.1852, -120.9180 (est)

AB-04

Contractor
Western States Soil
Conservation, Inc.

Equipment
Geoprobe 8150LS Drill
Rig

Sampling Method

Sonic core

Ground Surface Elev. (NAVD88)

1885' (est)

Operator

Exploration Method(s)

Work Start/Completion Dates

Top of Casing Elev. (NAVD88)

Depth to Water (Below GS)

Adonis

Sonic

11/6/2023

NA

10' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot Water Content (%)					Blows/6"	Tests	Material Type	Description	Depth (ft)
				0	10	20	30	40					
1	1884	Boring backfilled with 3/8-inch, hydrated bentonite chips.	S1									LEVEE FILL GRAVEL WITH SILT, SAND, AND COBBLES (GP-GM); medium dense, slightly moist, light brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; little rounded to subrounded cobbles.	1
2	1883												2
3	1882												3
4	1881	Blow counts may be overstated where gravel and cobbles are present.	S2									SILTY GRAVEL WITH SAND AND COBBLES (GM); medium dense to dense, moist, brown to gray brown; fine to coarse sand; rounded to subangular, fine to coarse gravel; few to little rounded to subrounded cobbles; trace organic material.	4
5	1880												5
6	1879												6
7	1878	ALLUVIUM OF YAKIMA RIVER (Qy) GRAVEL WITH SILT, SAND, AND COBBLES (GP-GM); dense, moist, gray brown; fine to coarse sand; rounded to subangular, fine to coarse gravel; few rounded to subrounded cobbles.	S3									Becomes with more silt at 9 feet bgs. Becomes wet at 10 feet bgs.	7
8	1877												8
9	1876												9
10	1875	11/6/2023	S4									SILTY GRAVEL WITH SAND (GM); dense, wet, orange brown; fine to coarse sand; rounded to subangular, fine to trace coarse gravel; few rounded to subrounded cobbles.	10
11	1874												11
12	1873												12
13	1872	KITTITAS DRIFT - INDIAN JOHN SUBDRIFT LACUSTRINE DEPOSITS (Qkil) SILT WITH SAND (ML); medium stiff, brown, wet; non-plastic to low plasticity; slow dilatency; fine sand; laminated silt, sand and clay; slight iron oxide staining.										Becomes blue gray at 14.5 feet bgs.	13
14	1871												14

Legend

Grab sample

Plastic Limit — Liquid Limit

Water Level ATD

See Exploration Log Key for
explanation of symbols

Logged by: MRH
Approved by: JG

**Exploration
Log
AB-04**

Sheet 1 of 3

Hanson Ponds Restoration - 220580

Project Address & Site Specific Location

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

Geotechnical Exploration Log

Coordinates (Lat,Lon WGS84)

47.1852, -120.9180 (est)

Exploration Number

AB-04

Contractor

Western States Soil Conservation, Inc.

Equipment

Geoprobe 8150LS Drill Rig

Sampling Method

Sonic core

Ground Surface Elev. (NAVD88)

1885' (est)

Operator

Adonis

Exploration Method(s)

Sonic

Work Start/Completion Dates

11/6/2023

Top of Casing Elev. (NAVD88)

NA

Depth to Water (Below GS)

10' (ATD)

Legend

Grab sample

Plastic Limit

Liquid Limit

Water Level

Water Level

See Exploration Log Key for explanation of symbols

Logged by: MRH

Approved by: JG

Exploration Log

AB-04

Sheet 3 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINT\PROJECTS\HANSON PONDS TEST PITTS - 220580.GPJ April 8, 2024

Aspect CONSULTING		Hanson Ponds Restoration - 220580					Geotechnical Exploration Log			
Contractor Western States Soil Conservation, Inc.		Equipment Geoprobe 8150LS Drill Rig		Sampling Method Autohammer; 140 lb hammer; 30" drop		Coordinates (Lat, Lon WGS84) 47.1839, -120.9130 (est)		Exploration Number AB-05		
Operator Adonis		Exploration Method(s) Sonic		Work Start/Completion Dates 11/7/2023		Ground Surface Elev. (NAVD88) 1888' (est)		Depth to Water (Below GS) 10' (ATD)		
Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot	Water Content (%)	Blows/6"	Tests	Material Type	Description	Depth (ft)
1	1887	Boring backfilled with 3/8-inch, hydrated bentonite chips.							TOPSOIL GRAVEL WITH SILT AND SAND (GP-GM); loose, moist, gray brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; few cobbles; little woody debris and rootlets.	1
2	1886								LEVEE FILL GRAVEL WITH SILT, SAND, COBBLES, AND BOULDERS (GP-GM); medium dense, moist, gray brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; cobbles; boulders; little woody debris.	2
3	1885									3
4	1884	Blow counts may be overstated where gravel and cobbles are present.	S1							4
5	1883									5
6	1882									6
7	1881									7
8	1880									8
9	1879								ALLUVIUM OF YAKIMA RIVER (Qy) GRAVEL WITH SAND AND COBBLES (GP); medium dense, wet, light brown; medium to coarse sand; fine to coarse, rounded to subangular gravel; few cobbles.	9
10	1878	11/7/2023								10
11	1877									11
12	1876									12
13	1875									13
14	1874		S2						Becomes slightly oxidized at 14 feet bgs.	14

Legend
 Grab sample
 Split Barrel 2" X 1.375" (SPT)

Plastic Limit ——— Liquid Limit
 Water Level ATD

See Exploration Log Key for explanation of symbols

Logged by: MRH
Approved by: JG

Exploration Log AB-05
Sheet 1 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINT\PROJECTS\HANSON PONDS TEST PITTS - 220580.GPJ April 8, 2024

Aspect CONSULTING		Hanson Ponds Restoration - 220580				Geotechnical Exploration Log					
Contractor Western States Soil Conservation, Inc.		Project Address & Site Specific Location Hanson Ponds Park, Cle Elum, WA, See Figure 2.				Coordinates (Lat, Lon WGS84) 47.1839, -120.9130 (est)		Exploration Number AB-05			
		Equipment Geoprobe 8150LS Drill Rig		Sampling Method Autohammer; 140 lb hammer; 30" drop		Ground Surface Elev. (NAVD88) 1888' (est)					
Operator Adonis		Exploration Method(s) Sonic		Work Start/Completion Dates 11/7/2023		Top of Casing Elev. (NAVD88) NA		Depth to Water (Below GS) 10' (ATD)			
Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot	Water Content (%)	Blows/6"	Tests	Material Type	Description	Depth (ft)	
16	1872		S3	5		11			SILTY SAND WITH GRAVEL AND COBBLES (SM); dense, wet, brown; medium to coarse, angular sand; fine to trace coarse, rounded to subangular gravel; few cobbles.	16	
17	1871										17
18	1870										18
19	1869										19
20	1868		S4						SILTY GRAVEL WITH SAND AND COBBLES (GM); medium dense to dense, wet, light gray brown; medium to coarse, angular sand; fine to coarse, rounded to subangular gravel; few cobbles.	20	
21	1867										21
22	1866										22
23	1865										23
24	1864		S5						KITTITAS DRIFT - INDIAN JOHN SUBDRIFT LACUSTRINE DEPOSITS (Qkil) SILT (ML); very stiff, wet, brown; non-plastic to low plasticity; medium dilatency; trace fine sand; oxidized laminations; 0.25-to-2-inch-thick clay interbeds. Becomes blue gray at 26.5 feet bgs.	24	
25	1863										25
26	1862										26
27	1861										27
28	1860		S6							28	
29	1859										29

Legend
 Grab sample
 Split Barrel 2" X 1.375" (SPT)

Plastic Limit ——— Liquid Limit
 Water Level ATD

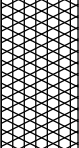
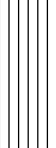
See Exploration Log Key for explanation of symbols

Logged by: MRH
Approved by: JG

Exploration Log AB-05
Sheet 2 of 3

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINT\PROJECTS\HANSON PONDS TEST PITTS - 220580.GPJ April 8, 2024

NEW STANDARD EXPLORATION LOG TEMPLATE P:\GINT\PROJECTS\HANSON PONDS TEST PITTS - 220580.GPJ April 8, 2024

		Hanson Ponds Restoration - 220580				Geotechnical Exploration Log				
		Project Address & Site Specific Location Hanson Ponds Park, Cle Elum, WA, See Figure 2.				Coordinates (Lat,Lon WGS84) 47.1839, -120.9130 (est)		Exploration Number AB-05		
Contractor Western States Soil Conservation, Inc.		Equipment Geoprobe 8150LS Drill Rig		Sampling Method Autohammer; 140 lb hammer; 30" drop		Ground Surface Elev. (NAVD88) 1888' (est)				
Operator Adonis		Exploration Method(s) Sonic		Work Start/Completion Dates 11/7/2023		Top of Casing Elev. (NAVD88) NA				
Operator Adonis		Exploration Method(s) Sonic		Work Start/Completion Dates 11/7/2023		Top of Casing Elev. (NAVD88) NA		Depth to Water (Below GS) 10' (ATD)		
Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot	Water Content (%)	Blows/6"	Tests	Material Type	Description	Depth (ft)
31	1857		S7	▲	●	2			KITTITAS DRIFT - INDIAN JOHN SUBDRIFT LACUSTRINE DEPOSITS (Qkil) SILT (ML); very stiff, wet, brown; non-plastic to low plasticity; medium dilatency; trace fine sand; oxidized laminations; 0.25-to-2-inch-thick clay interbeds. (continued)	31
32	1856								Bottom of exploration at 31.5 ft. bgs.	
33	1855									33
34	1854									34
35	1853									35
36	1852									36
37	1851									37
38	1850									38
39	1849									39
40	1848									40
41	1847									41
42	1846									42
43	1845									43
44	1844									44
Legend		Plastic Limit — Liquid Limit		▽ Water Level ATD		See Exploration Log Key for explanation of symbols				Exploration Log AB-05 Sheet 3 of 3
Sample Type	 Grab sample	Water Level				Logged by: MRH Approved by: JG				



Hanson Ponds Restoration - 220580

Project Address & Site Specific Location

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

Geotechnical Exploration Log

Coordinates (Lat, Lon WGS84)

47.1836, -120.9087 (est)

Exploration Number

AB-06

Contractor
Western States Soil
Conservation, Inc.

Equipment
Geoprobe 8150LS Drill
Rig

Sampling Method
Autohammer; 140 lb hammer; 30" drop

Ground Surface Elev. (NAVD88)
1882' (est)

Operator

Adonis

Exploration Method(s)

Sonic

Work Start/Completion Dates

11/7/2023

Top of Casing Elev. (NAVD88)

NA

Depth to Water (Below GS)

10' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot Water Content (%)					Blows/6"	Tests	Material Type	Description	Depth (ft)
				0	10	20	30	40	50				
1	1881	Boring backfilled with 3/8-inch, hydrated bentonite chips.										TOPSOIL GRAVEL WITH SILT, SAND, AND COBBLES (GP-GM); loose, moist, brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; rounded to subrounded cobbles to 4-inches-diameter; little organic debris	1
2	1880											LEEVE FILL GRAVEL WITH SILT, SAND, AND COBBLES (GW-GM); medium dense, slightly moist, brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; few cobbles; little organic debris.	2
3	1879	Blow counts may be overstated where gravel and cobbles are present.										Becomes light brown at 3 feet bgs.	3
4	1878												4
5	1877												5
6	1876											Becomes very dense and brown to gray brown at 5 feet bgs.	6
7	1875												7
8	1874												8
9	1873											ALLUVIUM OF YAKIMA RIVER (Qy) SILTY SAND WITH GRAVEL (SM); very dense, slightly moist, brown to gray brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; rounded to subrounded cobbles to 6-inches-diameter; rip-up clasts of hard silt and fine sand.	9
10	1872	11/7/2023											10
11	1871											GRAVEL WITH SILT, SAND, AND COBBLES (GW-GM); very dense, wet, gray brown; medium to coarse, angular sand; fine to coarse, rounded to angular gravel; rounded to subrounded cobbles to 8-inches-diameter.	11
12	1870												12
13	1869												13
14	1868												14

Legend

☐ No Soil Sample Recovery

▣ Split Barrel 2" X 1.375" (SPT)

▢ Grab sample

Plastic Limit ——— Liquid Limit

▽ Water Level ATD

Water
Level

See Exploration Log Key for
explanation of symbols

Logged by: MRH

Approved by: JG

**Exploration
Log
AB-06**

Sheet 1 of 3



Hanson Ponds Restoration - 220580

Project Address & Site Specific Location

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

Geotechnical Exploration Log

Coordinates (Lat, Lon WGS84)

47.1836, -120.9087 (est)

Exploration Number

AB-06

Contractor
Western States Soil
Conservation, Inc.

Equipment
Geoprobe 8150LS Drill
Rig

Sampling Method
Autohammer; 140 lb hammer; 30" drop

Ground Surface Elev. (NAVD88)
1882' (est)

Operator

Adonis

Exploration Method(s)

Sonic

Work Start/Completion Dates

11/7/2023

Top of Casing Elev. (NAVD88)

NA

Depth to Water (Below GS)

10' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot Water Content (%)					Blows/6"	Tests	Material Type	Description	Depth (ft)
				0	10	20	30	40					
16	1866		S4						16 34 31	PS FC=6.4%		GRAVEL WITH SILT, SAND, AND COBBLES (GW-GM); very dense, wet, gray brown; medium to coarse, angular sand; fine to coarse, rounded to angular gravel; rounded to subrounded cobbles to 8-inches-diameter. (continued)	16
17	1865		S5									KITTITAS DRIFT - INDIAN JOHN SUBDRIFT LACUSTRINE DEPOSITS (Qkil)	17
18	1864											SILT WITH SAND (ML); very stiff, wet, brown; non-plastic to low plasticity; medium dilatancy; fine sand; 0.5 to 2-inch-thick tan clay interbeds.	18
19	1863											Becomes blue gray at 19 feet bgs.	19
20	1862		S6						5 8 14			6-inches medium dense, gray brown sand with silt and gravel at 20 feet bgs.	20
21	1861											SILT WITH GRAVEL (ML); very stiff, wet, blue gray; non-plastic; low dilatancy; trace fine sand; 0.5 to 2-inch-thick interbeds of gray brown fine gravel with sand.	21
22	1860		S7										22
23	1859											SILT (ML); very stiff, wet, blue gray; non-plastic to low plasticity; fine sand; laminated.	23
24	1858												24
25	1857		S8						6 10 17			Becomes with trace medium sand at 25 feet bgs.	25
26	1856												26
27	1855											Becomes stiff at 27 feet bgs.	27
28	1854												28
29	1853												29

Legend

☐ No Soil Sample Recovery

▣ Split Barrel 2" X 1.375" (SPT)

▤ Grab sample

Plastic Limit ——— Liquid Limit

▽ Water Level ATD

See Exploration Log Key for
explanation of symbols

Logged by: MRH

Approved by: JG

**Exploration
Log**

AB-06

Sheet 2 of 3



Hanson Ponds Restoration - 220580

Geotechnical Exploration Log

Project Address & Site Specific Location

Coordinates (Lat, Lon WGS84)

Exploration Number

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

47.1843, -120.9140 (est)

ATP-01

Contractor

Equipment

Sampling Method

Ground Surface Elev. (NAVD88)

Mass X Construction

CAT 308 Excavator

Grab

1885' (est)

Operator

Exploration Method(s)

Work Start/Completion Dates

Top of Casing Elev. (NAVD88)

Depth to Water (Below GS)

Craig

Backhoe or trackhoe

10/24/2023

NA

9' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot Water Content (%)					Blows/6"	Tests	Material Type	Description	Depth (ft)
				0	10	20	30	40					
1	1884	Test pit backfilled with excavated material.										TOPSOIL GRAVEL WITH SILT, SAND, AND COBBLES (GW-GM); medium dense, slightly moist, brown; fine to coarse sand; fine to coarse, rounded to subrounded gravel; little rounded to subrounded cobbles; few rootlets.	1
2	1883		S1									LEEVE FILL GRAVEL WITH SILT, SAND, COBBLES, AND BOULDERS (GP-GM); medium dense, slightly moist, light brown; little fine to coarse sand; rounded to subrounded, fine to coarse gravel; few rounded to subrounded cobbles; boulders to 18-inches-diameter; few roots.	2
3	1882												3
4	1881												4
5	1880		S2									SILTY GRAVEL WITH SAND AND COBBLES (GM); medium dense, moist, gray brown; fine to coarse sand; fine to coarse, rounded to subrounded gravel; few rounded to subrounded cobbles; slight iron-oxide staining.	5
6	1879												6
7	1878		S3									ALLUVIUM OF YAKIMA RIVER (Qy) GRAVEL WITH SILT AND SAND (GP-GM); medium dense, moist, gray brown; medium to coarse, subangular sand; fine to trace coarse, rounded to subangular gravel.	7
8	1877												8
9	1876	10/23/2023										Becomes wet at 9 feet bgs.	9
10	1875											Bottom of exploration at 10 ft. bgs.	10
11	1874												11
12	1873												12
13	1872												13
14	1871												14

Legend

Grab sample

Plastic Limit — Liquid Limit

Water Level

See Exploration Log Key for
explanation of symbols

Logged by: MRH
Approved by: JG

**Exploration
Log
ATP-01**

Sheet 1 of 1



Hanson Ponds Restoration - 220580

Project Address & Site Specific Location

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

Geotechnical Exploration Log

Coordinates (Lat, Lon WGS84)

47.1836, -120.9103 (est)

Exploration Number

ATP-02

Contractor

Mass X Construction

Equipment

CAT 308 Excavator

Sampling Method

Grab

Ground Surface Elev. (NAVD88)

1885' (est)

Operator

Craig

Exploration Method(s)

Backhoe or trackhoe

Work Start/Completion Dates

10/24/2023

Top of Casing Elev. (NAVD88)

NA

Depth to Water (Below GS)

7' (Seep)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot Water Content (%)					Blows/6"	Tests	Material Type	Description	Depth (ft)
				0	10	20	30	40	50				
1	1884	Test pit backfilled with excavated material.	S1									TOPSOIL SILTY SAND WITH GRAVEL (SM); loose, slightly moist, brown; fine to coarse sand; fine to coarse, rounded to subrounded gravel; few rounded to subrounded cobbles; abundant rootlets.	1
2	1883											LEVEE FILL SAND WITH SILT, GRAVEL, AND COBBLES (SP-SM); loose, slightly moist, brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; little rounded to subrounded cobbles to 12-inches-diameter; few roots.	2
3	1882		S2										3
4	1881												4
5	1880												5
6	1879		S3									WOODY DEBRIS; loose, moist, dark brown; fine to medium sand; abundant woody debris; trace charcoal fragments.	6
7	1878	10/23/2023	S4									ALLUVIUM OF YAKIMA RIVER (Qy) SAND (SP); loose, wet, blue gray; medium to coarse, angular sand; few fine to coarse, rounded to subangular gravel; slight oxidation.	7
8	1877											SILTY SAND (SM); loose, wet, blue gray; fine to coarse sand; trace woody debris; interbedded fine sand, silt and coarse sand.	8
9	1876											GRAVEL WITH SILT, SAND, COBBLES, AND BOULDERS (GP-GM); loose, wet, gray brown; fine to coarse sand; fine to coarse, rounded to subrounded gravel; few rounded to subrounded cobbles; boulders to 16-inches-diameter. Bottom of exploration at 9 ft. bgs.	9
10	1875												10
11	1874												11
12	1873												12
13	1872												13
14	1871												14

Legend

Grab sample

Plastic Limit — Liquid Limit

Water Level (Seepage)

See Exploration Log Key for
explanation of symbols

Logged by: MRH
Approved by: JG

**Exploration
Log
ATP-02**

Sheet 1 of 1



Hanson Ponds Restoration - 220580

Geotechnical Exploration Log

Project Address & Site Specific Location

Coordinates (Lat, Lon WGS84)

Exploration Number

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

47.1836, -120.9067 (est)

ATP-03

Contractor

Equipment

Sampling Method

Ground Surface Elev. (NAVD88)

Mass X Construction

CAT 308 Excavator

Grab

1880' (est)

Operator

Exploration Method(s)

Work Start/Completion Dates

Top of Casing Elev. (NAVD88)

Depth to Water (Below GS)

Craig

Backhoe or trackhoe

10/24/2023

NA

10' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot Water Content (%)					Blows/6"	Tests	Material Type	Description	Depth (ft)
				0	10	20	30	40					
1	1879	Test pit backfilled with excavated material.	S1									TOPSOIL SILTY SAND WITH GRAVEL AND COBBLES (SM); loose, slightly moist, light brown; fine to coarse sand; fine to coarse, subrounded to subangular gravel; few subrounded to subangular cobbles; abundant rootlets.	1
2	1878											LEVEE FILL GRAVEL WITH SILT, SAND, AND COBBLES (GP-GM); medium dense, slightly moist, light brown; fine to coarse sand; fine to coarse, rounded to subrounded gravel; little subrounded to subangular cobbles to 12-inches-diameter; trace woody debris and roots.	2
3	1877												3
4	1876												4
5	1875											Becomes brown at 5 feet bgs.	5
6	1874											Becomes with more sand at 6 feet bgs.	6
7	1873												7
8	1872		S2								PS FC=37.1%	SILTY SAND WITH GRAVEL (SM); loose, very moist, dark brown; fine to coarse sand; fine to coarse, subrounded to subangular gravel; abundant woody organics; slight odor.	8
9	1871											SANDY SILT (ML); soft, very moist, gray brown; non-plastic; fine to coarse sand; abundant organics.	9
10	1870	10/23/2023	S3									ALLUVIUM OF YAKIMA RIVER (Qy) SAND WITH SILT, GRAVEL, AND COBBLES (SP-SM); medium dense, very moist, gray; medium to coarse, angular sand; fine to coarse, subrounded to subangular gravel; few subrounded cobbles; blue gray silt interbeds.	10
11	1869											Bottom of exploration at 10.5 ft. bgs.	11
12	1868												12
13	1867												13
14	1866												14

Legend

Grab sample

Plastic Limit Liquid Limit

Water Level ATD

See Exploration Log Key for
explanation of symbols

Logged by: MRH
Approved by: JG

**Exploration
Log
ATP-03**

Sheet 1 of 1



Hanson Ponds Restoration - 220580

Geotechnical Exploration Log

Project Address & Site Specific Location

Coordinates (Lat, Lon WGS84)

Exploration Number

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

47.1852, -120.9181 (est)
Ground Surface Elev. (NAVD88)

ATP-04

Contractor

Equipment

Sampling Method

Mass X Construction

CAT 308 Excavator

Grab

Operator

Exploration Method(s)

Work Start/Completion Dates

Top of Casing Elev. (NAVD88)

Depth to Water (Below GS)

Craig

Backhoe or trackhoe

10/24/2023

NA

8.25' (Seep)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot					Blows/6"	Tests	Material Type	Description	Depth (ft)
				0	10	20	30	40					
1	1885	Test pit backfilled with excavated material.	S1									TOPSOIL GRAVEL WITH SILT AND SAND (GP-GM); loose, slightly moist, brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; little roots.	1
2	1884											LEVEE FILL GRAVEL WITH SILT, SAND, AND COBBLES (GP-GM); medium dense, slightly moist, brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; few rounded to subrounded cobbles.	2
3	1883		S2										3
4	1882											GRAVEL WITH SAND, COBBLES, AND BOULDERS (GW); medium dense, slightly moist, brown; fine to coarse sand; fine to coarse, rounded to subangular gravel; little rounded to subangular cobbles; boulders to 2-feet-diameter.	4
5	1881	10/23/2023	S3										5
6	1880									PS FC=2%			6
7	1879		S3									ALLUVIUM OF YAKIMA RIVER (Qy) GRAVEL WITH SILT AND SAND (GP-GM); medium dense, moist, dark gray brown; fine to coarse, angular sand; fine to trace coarse, rounded to subrounded gravel; few rounded to subrounded cobbles.	7
8	1878											Becomes wet at 8.25 feet bgs.	8
9	1877											Bottom of exploration at 8.5 ft. bgs.	9
10	1876												10
11	1875												11
12	1874												12
13	1873												13
14	1872												14

Legend

Plastic Limit ——— Liquid Limit

Water Level (Seepage)

Sample
Type

Grab sample

Water
Level

See Exploration Log Key for
explanation of symbols

Logged by: MRH
Approved by: JG

**Exploration
Log
ATP-04**

Sheet 1 of 1



Hanson Ponds Restoration - 220580

Geotechnical Exploration Log

Project Address & Site Specific Location

Coordinates (Lat, Lon WGS84)

Exploration Number

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

47.1839, -120.9130 (est)

ATP-05

Contractor

Equipment

Sampling Method

Ground Surface Elev. (NAVD88)

Mass X Construction

CAT 308 Excavator

Grab

1888' (est)

Operator

Exploration Method(s)

Work Start/Completion Dates

Top of Casing Elev. (NAVD88)

Depth to Water (Below GS)

Craig

Backhoe or trackhoe

10/24/2023

NA

9' (ATD)

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot Water Content (%)					Blows/6"	Tests	Material Type	Description	Depth (ft)
				0	10	20	30	40					
1	1887	Test pit backfilled with excavated material.										TOPSOIL SAND WITH SILT AND GRAVEL (SP-SM); loose, slightly moist, brown; fine to coarse sand; fine to coarse, rounded to subrounded gravel; few roots and organics. LEVEE FILL GRAVEL WITH SILT, SAND, AND COBBLES (GP-GM); medium dense, slightly moist, brown; fine to coarse sand; fine to coarse, rounded to subrounded gravel; few to little cobbles to 12-inches-diameter; trace woody debris.	1
2	1886												2
3	1885												3
4	1884												4
5	1883												5
6	1882												6
7	1881		S1										7
8	1880	10/23/2023										ALLUVIUM OF YAKIMA RIVER (Qy) GRAVEL WITH SILT AND SAND (GW-GM); medium dense, moist, gray brown; fine to coarse sand; fine to coarse, rounded to subrounded gravel; few woody debris. GRAVEL WITH SAND AND COBBLES (GP); medium dense, wet, gray brown; medium to coarse, angular sand; fine to coarse, rounded gravel; few rounded to subrounded, flat cobbles.	8
9	1879		S2							PS FC=1.4%			9
10	1878												10
11	1877												11
12	1876												12
13	1875												13
14	1874												14
												Bottom of exploration at 10 ft. bgs.	

Legend

Plastic Limit — Liquid Limit

Water Level

Grab sample

See Exploration Log Key for
explanation of symbols

Logged by: MRH
Approved by: JG

**Exploration
Log
ATP-05**

Sheet 1 of 1



Hanson Ponds Restoration - 220580

Geotechnical Exploration Log

Project Address & Site Specific Location

Coordinates (Lat, Lon WGS84)

Exploration Number

Hanson Ponds Park, Cle Elum, WA, See Figure 2.

47.1818, -120.9035 (est)

ATP-06

Contractor

Equipment

Sampling Method

Ground Surface Elev. (NAVD88)

Mass X Construction

CAT 308 Excavator

Grab

1876' (est)

Operator

Exploration Method(s)

Work Start/Completion Dates

Top of Casing Elev. (NAVD88)

Depth to Water (Below GS)

Craig

Backhoe or trackhoe

10/24/2023

NA

No Water Encountered

Depth (feet)	Elev. (feet)	Exploration Notes and Completion Details	Sample Type/ID	Blows/foot Water Content (%)					Blows/6"	Tests	Material Type	Description	Depth (ft)
				0	10	20	30	40					
1	1875	Test pit backfilled with excavated material.	S1							PS FC=3.9%		TOPSOIL SANDY SILT WITH GRAVEL (ML); loose, slightly moist, brown; non-plastic; fine to coarse sand; fine to coarse, rounded to subangular gravel; abundant organics.	1
2	1874											LEVEE FILL GRAVEL WITH SAND, COBBLES, AND BOULDERS (GW); medium dense, slightly moist, light brown to gray brown; fine to coarse sand; mostly fine to coarse, rounded to subrounded gravel; little rounded to subrounded cobbles; boulders to 2-feet-diameter; trace woody debris.	2
3	1873												3
4	1872												4
5	1871												5
6	1870												6
7	1869											Becomes moist at 6.75 feet bgs.	7
8	1868											Bottom of exploration at 7 ft. bgs.	8
9	1867												9
10	1866												10
11	1865												11
12	1864												12
13	1863												13
14	1862												14

Legend

Grab sample

Plastic Limit — Liquid Limit

No Water Encountered

Water
Level

See Exploration Log Key for
explanation of symbols

Logged by: MRH
Approved by: JG

**Exploration
Log
ATP-06**

Sheet 1 of 1

APPENDIX C

Laboratory Testing Results



Moisture Content

ASTM D-2216

Project Number: 08-175 / 220580

Received Date: 12/13/2023

Project Name: Hanson Ponds Restoration

Start Date: 12/14/2023

Lab Number: 8735

Finish Date: 12/20/2023

Technician: AD

NEW BORING ID	HMA Lab #	OLD Boring ID	Sample	Depth (ft)	Weight of Moist Soil + Tare (g)	Weight of Dry Soil + Tare (g)	Tare Weight (g)	Moisture Content (%)
AB-03	8735	AB-08	S-3	7.5	1863.5	1789.7	195.3	4.6
AB-03	8735	AB-08	S-6	20	462	354.3	12.6	31.5
AB-06	8735	AB-11	S-4	15	913.4	824.8	12.7	10.9
AB-02	8735	AB-12	S-2	5	906.5	887.2	12.6	2.2
AB-02	8735	AB-12	S-4	10	2461.8	2388.4	231.2	3.4
AB-02	8735	AB-12	S-7	17.5	60.3	47.7	20	45.5
AB-01	8735	AB-13	S-1	2.5	422.2	403.4	16.1	4.9
AB-01	8735	AB-13	S-4	10	3035.2	2938.3	234.9	3.6
AB-01	8735	AB-13	S-11	40	415.4	318	12.9	31.9
ATP-03	8735	ATP-03	S-2	7.5	1819.7	1453	272.5	31.1
ATP-06	8735	ATP-04	S-1	2	4388.5	4320.3	621.1	1.8
ATP-04	8735	ATP-09	S-2	5.5	4474.9	4413.1	598.8	1.6
ATP-05	8735	ATP-10	S-2	9	3696.4	3546.1	595.9	5.1

Minus No. 200 Wash

ASTM C117

Method: A

Project Number: 08-175 / 220580

Technician: AD

Project Name: Hanson Ponds Restoration

Received: 12/13/2023

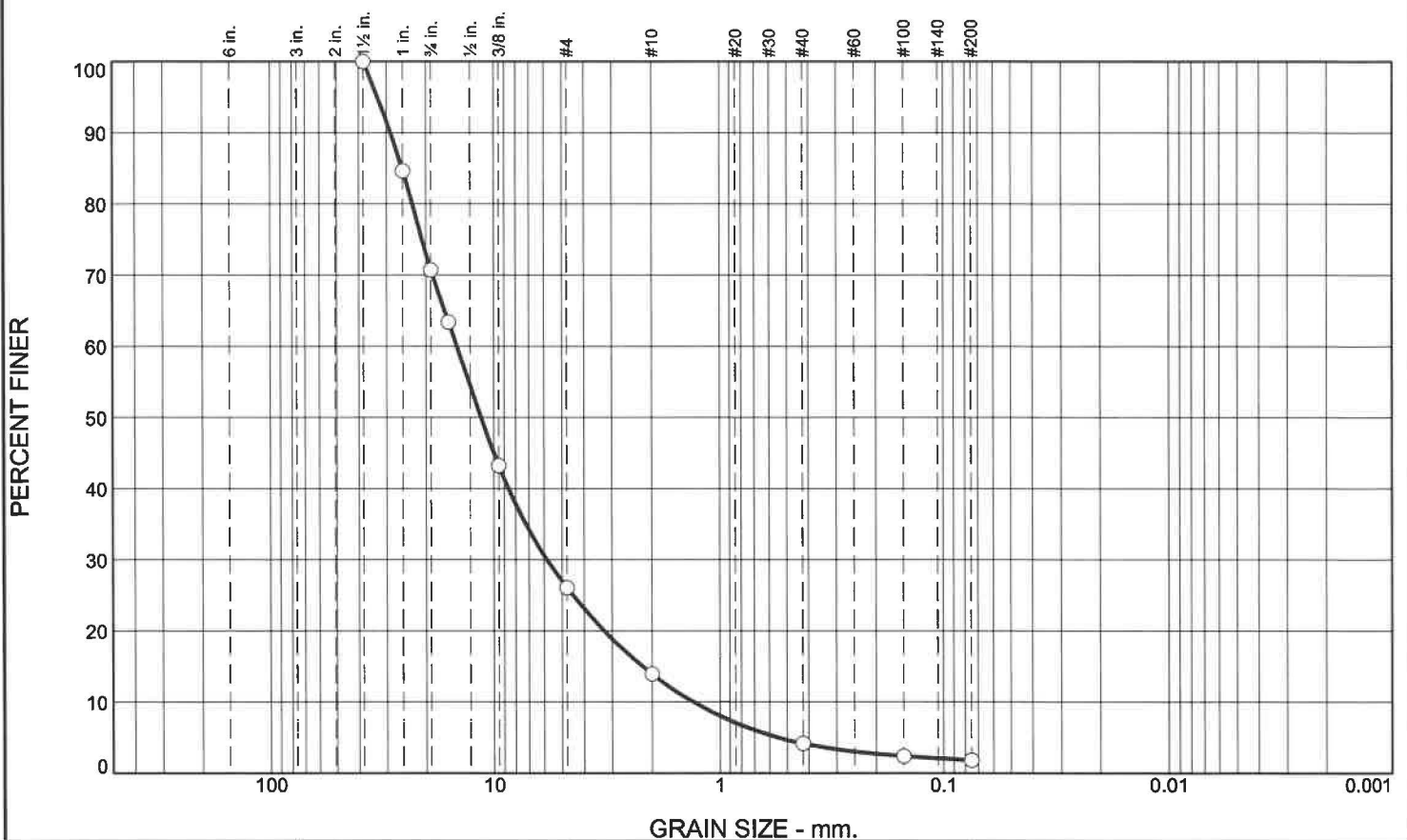
Lab Number: 8735

Start Date: 12/14/2023

Finish Date: 12/20/2023

	HMA LAB NO	Boring No	Sample Number	Depth (ft)	Tare Weight (g)	Tare+Dry Weight Before Wash (g)	Tare+Dry Weight After Wash (g)	% Retained	% PASSING
AB-03	8735	AB-08	S-6	20	12.6	354.3	28.8	4.7	95.3
AB-01	8735	AB-13	S-1	2.5	16.1	403.4	330.3	81.1	18.9
AB-01	8735	AB-13	S-11	40	12.9	318	36.4	7.7	92.3

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	29.3	44.6	12.1	9.8	2.4	1.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	84.7		
3/4"	70.7		
5/8"	63.4		
3/8"	43.2		
#4	26.1		
#10	14.0		
#40	4.2		
#100	2.4		
#200	1.8		

* (no specification provided)

<u>Soil Description</u>		
Well graded GRAVEL with sand		
<u>Atterberg Limits</u>		
PL=	LL=	PI=
<u>Coefficients</u>		
D ₉₀ = 28.7845	D ₈₅ = 25.5894	D ₆₀ = 14.5676
D ₅₀ = 11.3996	D ₃₀ = 5.8268	D ₁₅ = 2.1988
D ₁₀ = 1.3039	C _u = 11.17	C _c = 1.79
<u>Classification</u>		
USCS= GW	AASHTO=	
<u>Remarks</u>		

Source of Sample: AB-03 / S-3
Sample Number: 8735

Depth: 7.5

Date: 12/20/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Hanson Ponds Restoration

Project No: 08-175 / 220580

Figure

Tested By: AD

Checked By: JAM

GRAIN SIZE DISTRIBUTION TEST DATA

12/20/2023

Client: Aspect Consulting

Project: Hanson Ponds Restoration

Project Number: 08-175 / 220580

Location: AB-03 / S-3

Depth: 7.5

Sample Number: 8735

Material Description: Well graded GRAVEL with sand

Date: 12/20/23

USCS Classification: GW

Tested by: AD

Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 1761.30

Tare Wt. = 195.30

Minus #200 from wash = 1.8%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
1789.70	195.30	0.00	1.5"	0.00	100.0
			1"	244.60	84.7
			3/4"	466.60	70.7
			5/8"	583.10	63.4
			3/8"	905.00	43.2
			#4	1178.50	26.1
			#10	1371.80	14.0
			#40	1527.80	4.2
			#100	1556.10	2.4
			#200	1565.40	1.8

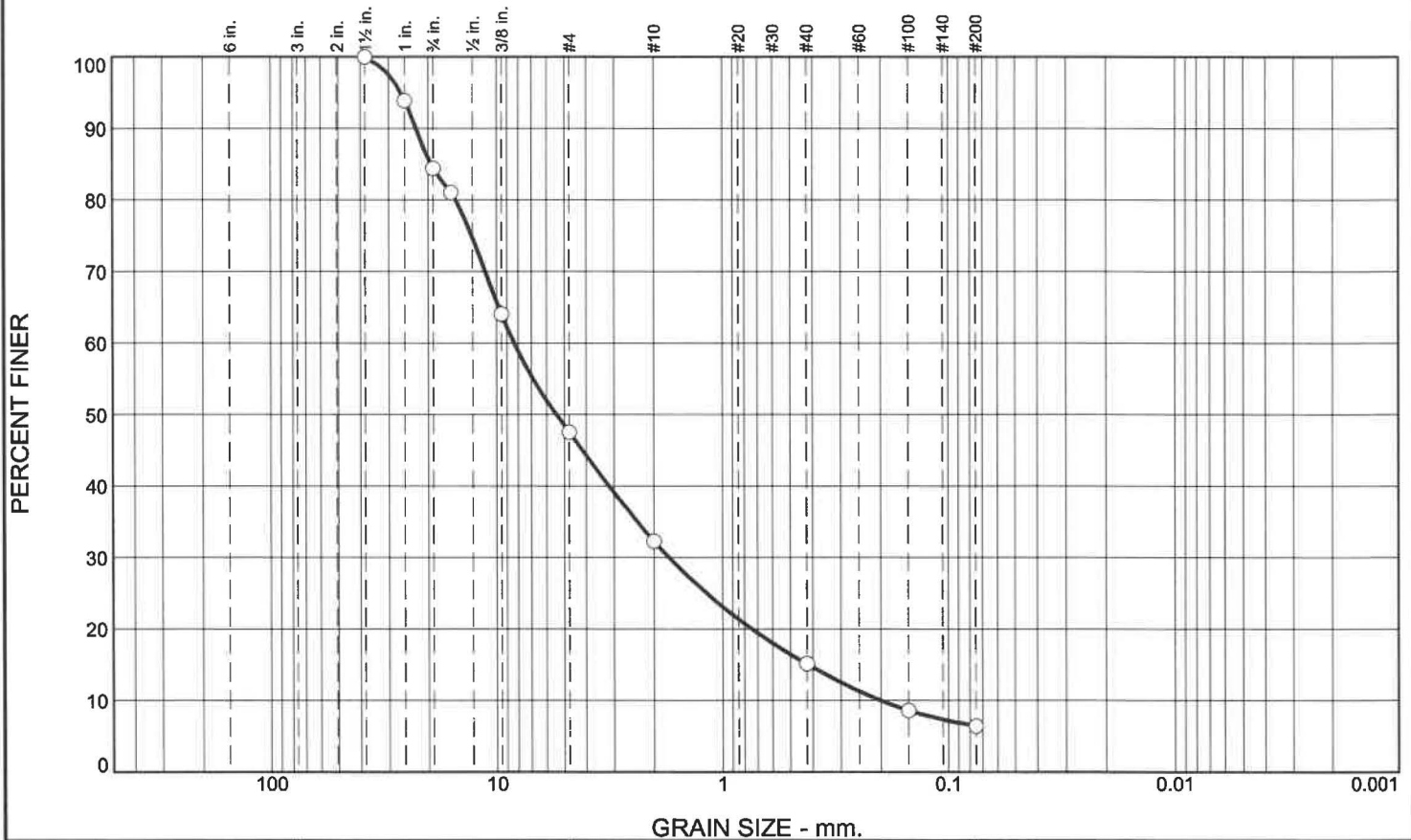
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	29.3	44.6	73.9	12.1	9.8	2.4	24.3			1.8

D ₅	D ₁₀	D ₁₅	D ₂₀	D ₃₀	D ₄₀	D ₅₀	D ₆₀	D ₈₀	D ₈₅	D ₉₀	D ₉₅
0.5440	1.3039	2.1988	3.2520	5.8268	8.6334	11.3996	14.5676	23.0680	25.5894	28.7845	32.9204

Fineness Modulus	C _u	C _c
6.24	11.17	1.79

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	15.6	36.9	15.2	17.2	8.7	6.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	93.9		
3/4"	84.4		
5/8"	81.0		
3/8"	64.0		
#4	47.5		
#10	32.3		
#40	15.1		
#100	8.6		
#200	6.4		

(no specification provided)

Soil Description
Well graded GRAVEL with silt and sand

Atterberg Limits
PL= LL= PI=

Coefficients
D₉₀= 22.6346 D₈₅= 19.4890 D₆₀= 8.3748
D₅₀= 5.4241 D₃₀= 1.7147 D₁₅= 0.4179
D₁₀= 0.1997 C_u= 41.94 C_c= 1.76

Classification
USCS= GW-GM AASHTO=

Remarks

Source of Sample: AB-06 / S-4
Sample Number: 8735

Depth: 15

Date: 12/20/23

Hayre McElroy & Associates, LLC

Client: Aspect Consulting
Project: Hanson Ponds Restoration

Redmond, WA

Project No: 08-175 / 220580

Figure

Tested By: AD

Checked By: JAM

GRAIN SIZE DISTRIBUTION TEST DATA

12/20/2023

Client: Aspect Consulting

Project: Hanson Ponds Restoration

Project Number: 08-175 / 220580

Location: AB-06 / S-4

Depth: 15

Sample Number: 8735

Material Description: Well graded GRAVEL with silt and sand

Date: 12/20/23

USCS Classification: GW-GM

Tested by: AD

Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 774.60

Tare Wt. = 12.70

Minus #200 from wash = 6.2%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
824.80	12.70	0.00	1.5"	0.00	100.0
			1"	49.50	93.9
			3/4"	126.60	84.4
			5/8"	154.00	81.0
			3/8"	292.00	64.0
			#4	426.30	47.5
			#10	549.80	32.3
			#40	689.20	15.1
			#100	742.20	8.6
			#200	760.00	6.4

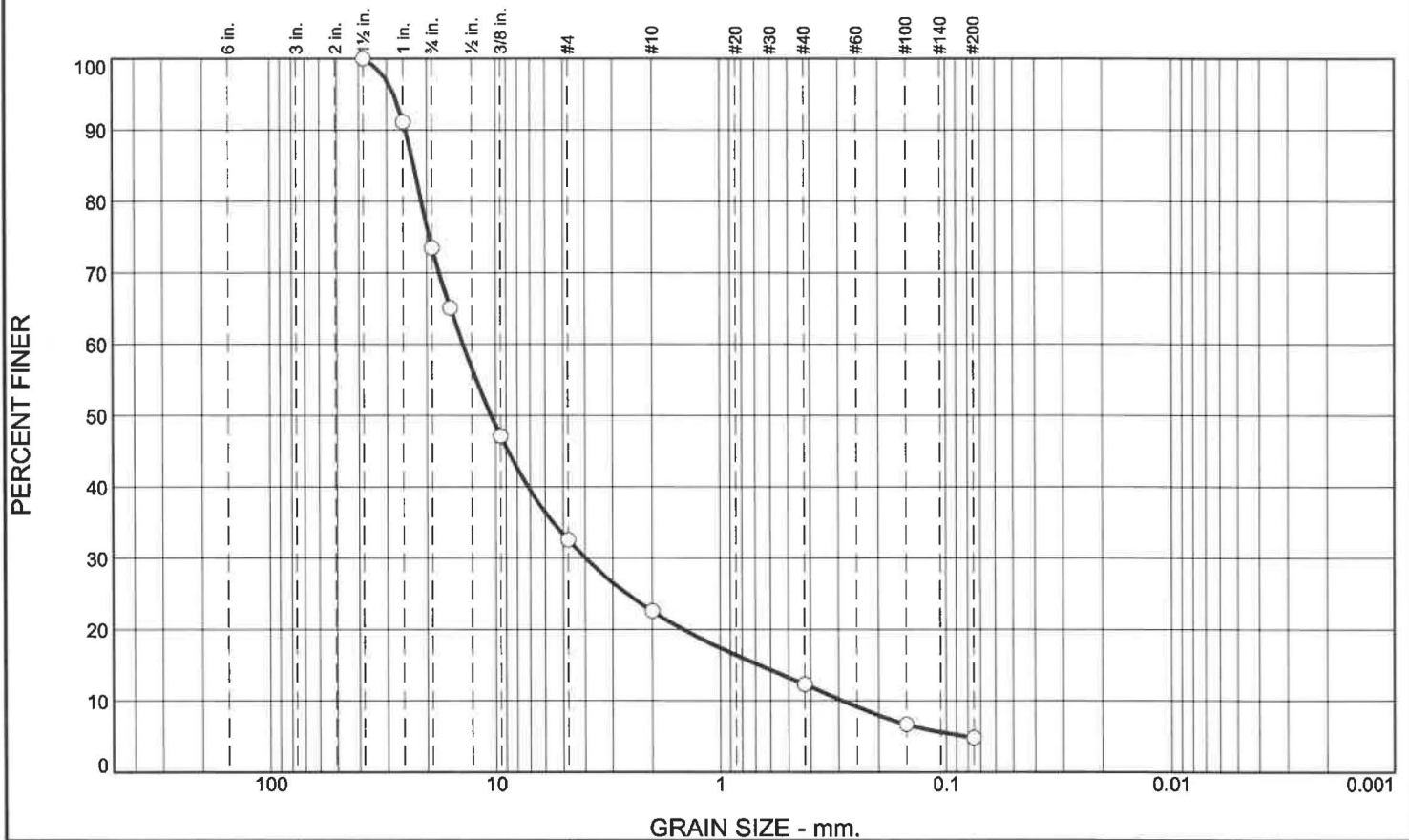
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	15.6	36.9	52.5	15.2	17.2	8.7	41.1			6.4

D ₅	D ₁₀	D ₁₅	D ₂₀	D ₃₀	D ₄₀	D ₅₀	D ₆₀	D ₈₀	D ₈₅	D ₉₀	D ₉₅
	0.1997	0.4179	0.7403	1.7147	3.1580	5.4241	8.3748	15.1554	19.4890	22.6346	26.4309

Fineness Modulus	C _u	C _c
5.05	41.94	1.76

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	26.5	40.9	10.0	10.3	7.5	4.8	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	91.2		
3/4"	73.5		
5/8"	65.1		
3/8"	47.1		
#4	32.6		
#10	22.6		
#40	12.3		
#100	6.7		
#200	4.8		

* (no specification provided)

Soil Description
Poorly graded GRAVEL with sand

Atterberg Limits
 PL= LL= PI=

Coefficients
 D₉₀= 24.8376 D₈₅= 22.8303 D₆₀= 13.9479
 D₅₀= 10.4733 D₃₀= 3.9711 D₁₅= 0.6705
 D₁₀= 0.2875 C_u= 48.51 C_c= 3.93

Classification
 USCS= GP AASHTO=

Remarks

Source of Sample: AB-02 / S-2
Sample Number: 8735

Depth: 5

Date: 12/20/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Hanson Ponds Restoration

Project No: 08-175 / 220580

Figure

Tested By: AD

Checked By: JAM

GRAIN SIZE DISTRIBUTION TEST DATA

12/20/2023

Client: Aspect Consulting

Project: Hanson Ponds Restoration

Project Number: 08-175 / 220580

Location: AB-02 / S-2

Depth: 5

Sample Number: 8735

Material Description: Poorly graded GRAVEL with sand

Date: 12/20/23

USCS Classification: GP

Tested by: AD

Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 846.90

Tare Wt. = 12.60

Minus #200 from wash = 4.6%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
887.20	12.60	0.00	1.5"	0.00	100.0
			1"	77.40	91.2
			3/4"	231.50	73.5
			5/8"	305.30	65.1
			3/8"	462.30	47.1
			#4	589.80	32.6
			#10	677.10	22.6
			#40	766.70	12.3
			#100	816.00	6.7
			#200	832.50	4.8

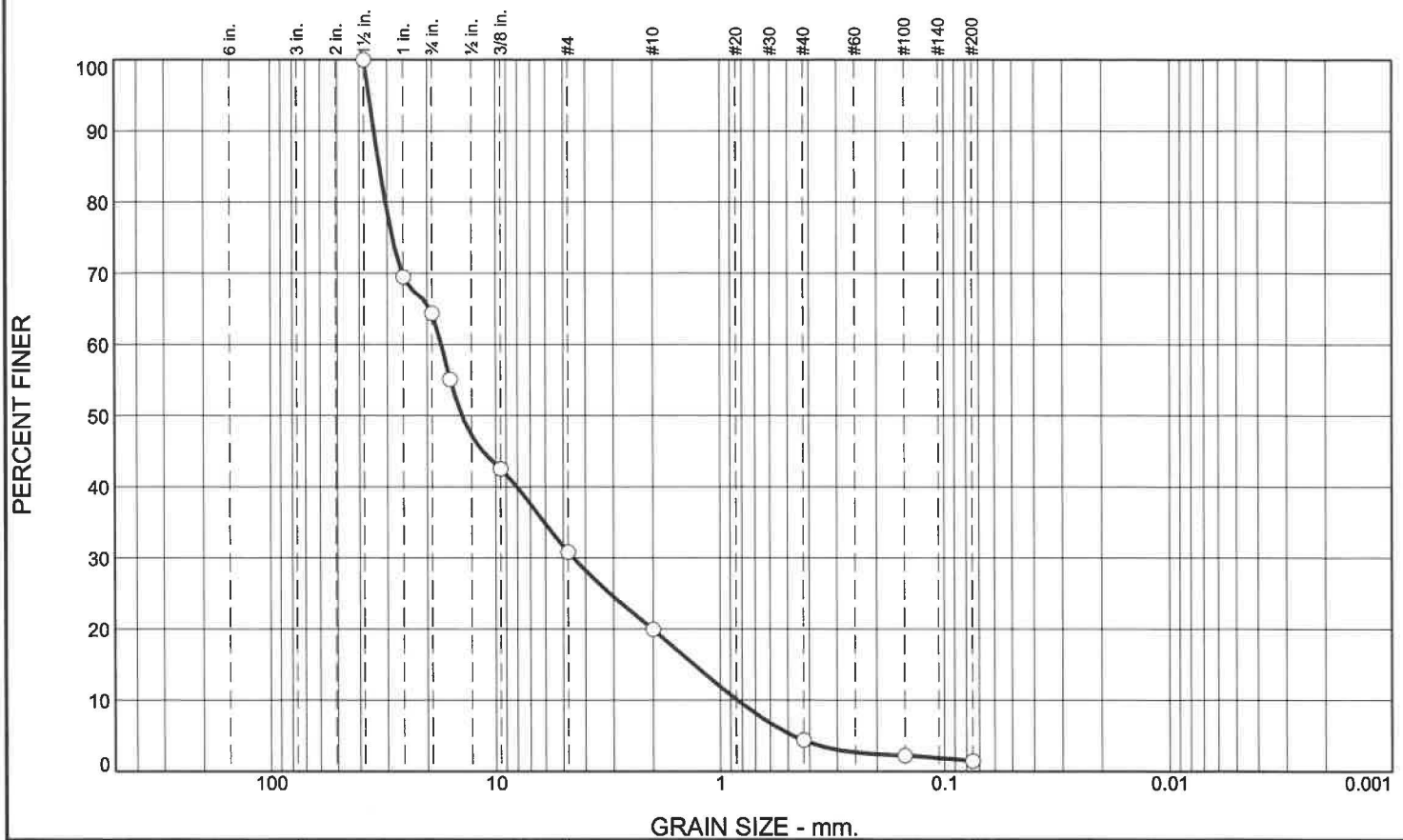
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	26.5	40.9	67.4	10.0	10.3	7.5	27.8			4.8

D ₅	D ₁₀	D ₁₅	D ₂₀	D ₃₀	D ₄₀	D ₅₀	D ₆₀	D ₈₀	D ₈₅	D ₉₀	D ₉₅
0.0818	0.2875	0.6705	1.4512	3.9711	7.1644	10.4733	13.9479	21.1461	22.8303	24.8376	27.9468

Fineness Modulus	C _u	C _c
5.73	48.51	3.93

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	35.6	33.6	10.9	15.5	2.9	1.5	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	69.5		
3/4"	64.4		
5/8"	55.1		
3/8"	42.5		
#4	30.8		
#10	19.9		
#40	4.4		
#100	2.2		
#200	1.5		

* (no specification provided)

Soil Description		
Well graded GRAVEL with sand		
Atterberg Limits		
PL=	LL=	PI=
Coefficients		
D ₉₀ = 34.3083	D ₈₅ = 32.4502	D ₆₀ = 17.3579
D ₅₀ = 14.0634	D ₃₀ = 4.5117	D ₁₅ = 1.3102
D ₁₀ = 0.8389	C _u = 20.69	C _c = 1.40
Classification		
USCS= GW	AASHTO=	
Remarks		

Source of Sample: AB-02 / S-4
Sample Number: 8735

Depth: 10

Date: 12/20/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Hanson Ponds Restoration

Project No: 08-175 / 220580

Figure

Tested By: AD

Checked By: JAM

GRAIN SIZE DISTRIBUTION TEST DATA

12/20/2023

Client: Aspect Consulting

Project: Hanson Ponds Restoration

Project Number: 08-175 / 220580

Location: AB-02 / S-4

Depth: 10

Sample Number: 8735

Material Description: Well graded GRAVEL with sand

Date: 12/20/23

USCS Classification: GW

Tested by: AD

Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 2358.70

Tare Wt. = 231.20

Minus #200 from wash = 1.4%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
2388.40	231.20	0.00	1.5"	0.00	100.0
			1"	658.10	69.5
			3/4"	768.40	64.4
			5/8"	968.70	55.1
			3/8"	1239.90	42.5
			#4	1492.60	30.8
			#10	1727.20	19.9
			#40	2062.50	4.4
			#100	2109.60	2.2
			#200	2125.60	1.5

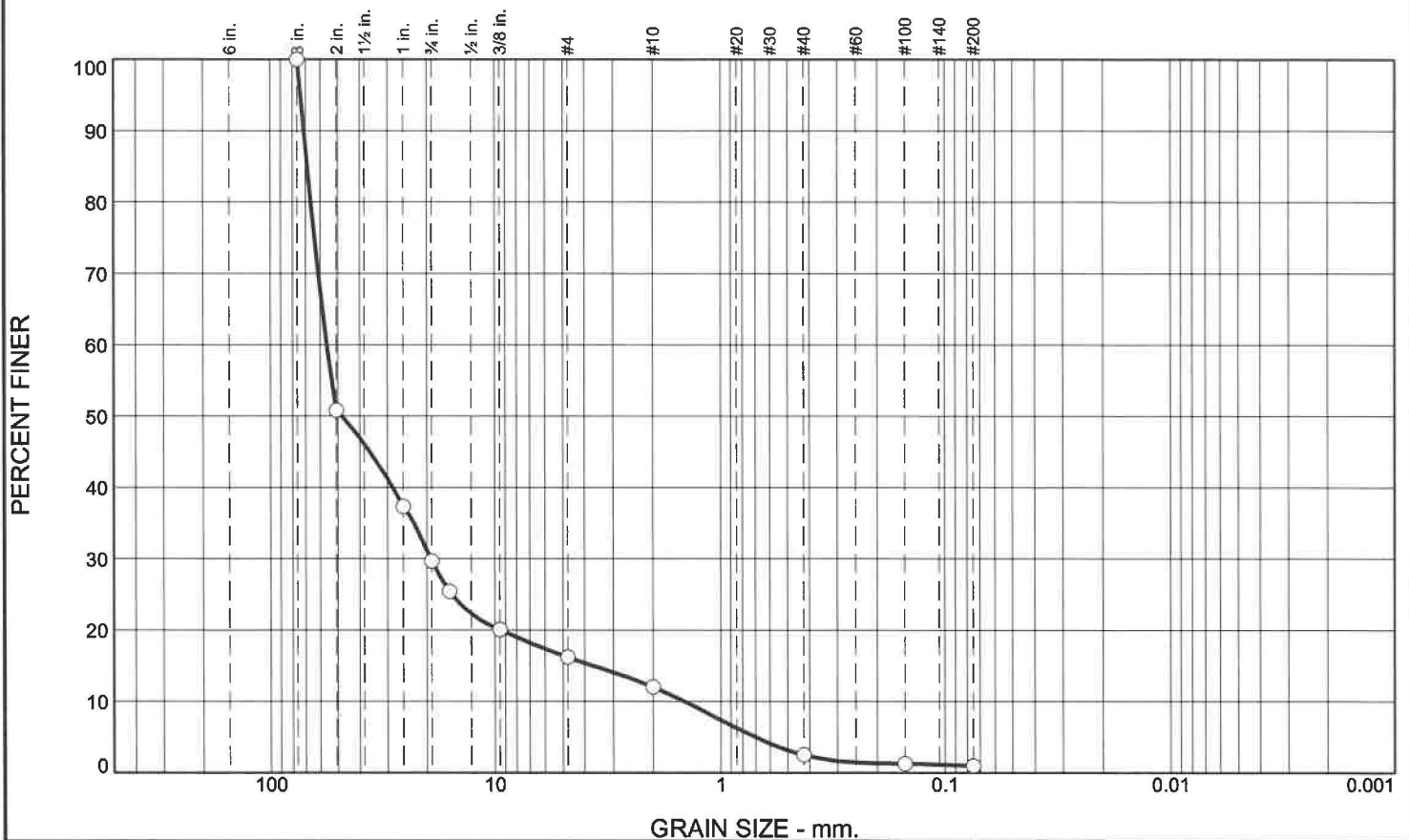
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	35.6	33.6	69.2	10.9	15.5	2.9	29.3			1.5

D ₅	D ₁₀	D ₁₅	D ₂₀	D ₃₀	D ₄₀	D ₅₀	D ₆₀	D ₈₀	D ₈₅	D ₉₀	D ₉₅
0.4711	0.8389	1.3102	2.0118	4.5117	8.0709	14.0634	17.3579	30.5388	32.4502	34.3083	36.1759

Fineness Modulus	C _u	C _c
6.15	20.69	1.40

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	70.3	13.5	4.2	9.5	1.5	1.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	50.8		
1"	37.3		
3/4"	29.7		
5/8"	25.4		
3/8"	20.1		
#4	16.2		
#10	12.0		
#40	2.5		
#100	1.3		
#200	1.0		

* (no specification provided)

Soil Description		
Poorly graded GRAVEL with sand		
Atterberg Limits		
PL=	LL=	PI=
Coefficients		
D ₉₀ = 71.0362	D ₈₅ = 68.5445	D ₆₀ = 56.1104
D ₅₀ = 48.0601	D ₃₀ = 19.2651	D ₁₅ = 3.6651
D ₁₀ = 1.4493	C _u = 38.72	C _c = 4.56
Classification		
USCS= GP	AASHTO=	
Remarks		

Source of Sample AB-01 / S-4
Sample Number: 8/55

Depth: 10

Date: 12/20/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Hanson Ponds Restoration

Project No: 08-175 / 220580

Figure

Tested By: AD

Checked By: JAM

GRAIN SIZE DISTRIBUTION TEST DATA

12/20/2023

Client: Aspect Consulting

Project: Hanson Ponds Restoration

Project Number: 08-175 / 220580

Location: AB-01 / S-4

Depth: 10

Sample Number: 8735

Material Description: Poorly graded GRAVEL with sand

Date: 12/20/23

USCS Classification: GP

Tested by: AD

Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 2912.90

Tare Wt. = 234.90

Minus #200 from wash = 0.9%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
2938.30	234.90	0.00	3"	0.00	100.0
			2"	1329.50	50.8
			1"	1694.10	37.3
			3/4"	1901.00	29.7
			5/8"	2015.50	25.4
			3/8"	2160.60	20.1
			#4	2265.40	16.2
			#10	2378.00	12.0
			#40	2635.40	2.5
			#100	2669.20	1.3
			#200	2677.50	1.0

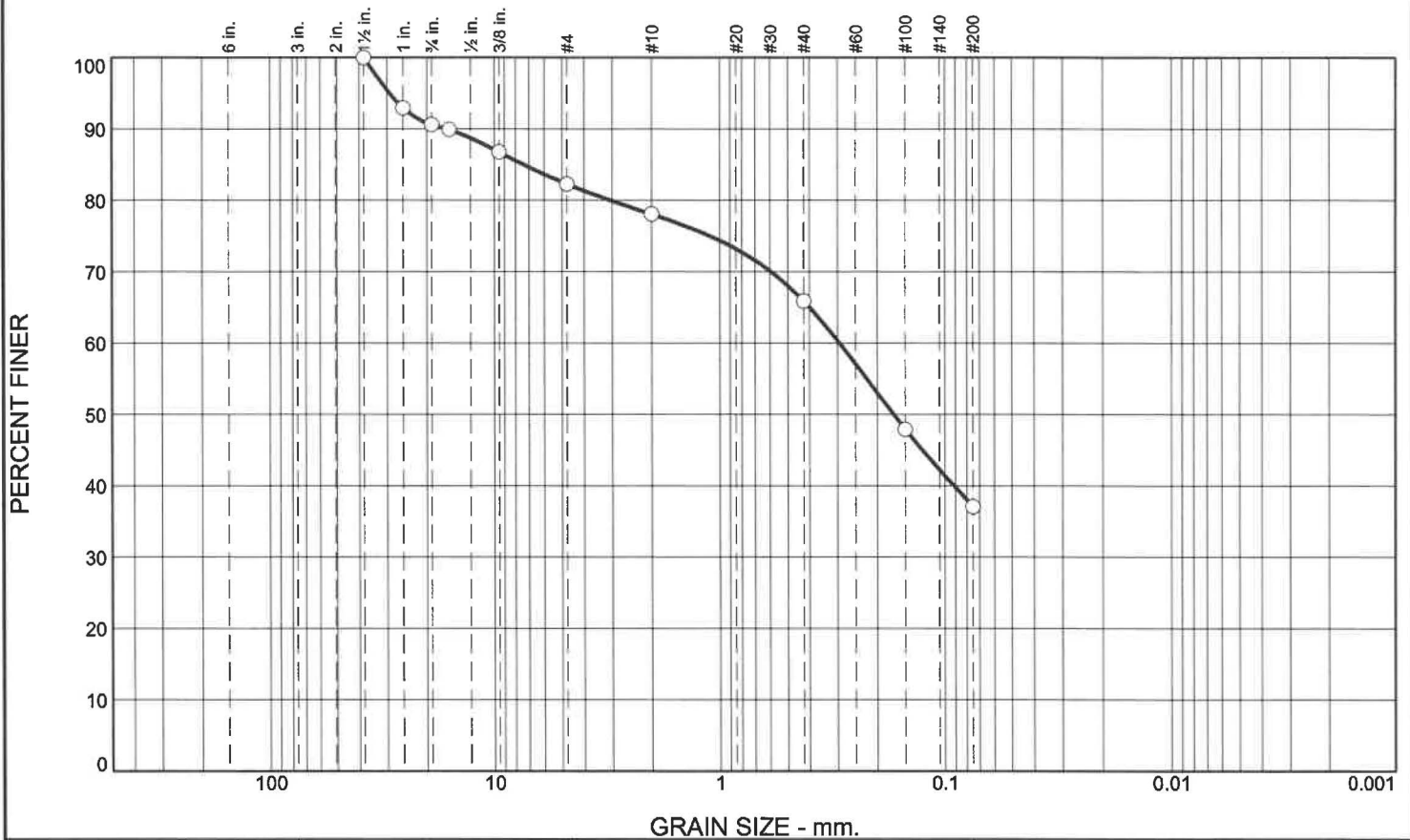
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	70.3	13.5	83.8	4.2	9.5	1.5	15.2			1.0

D ₅	D ₁₀	D ₁₅	D ₂₀	D ₃₀	D ₄₀	D ₅₀	D ₆₀	D ₈₀	D ₈₅	D ₉₀	D ₉₅
0.6964	1.4493	3.6651	9.4055	19.2651	28.4253	48.0601	56.1104	66.0874	68.5445	71.0362	73.5817

Fineness Modulus	C _u	C _c
7.59	38.72	4.56

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	9.4	8.3	4.2	12.2	28.8	37.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	92.9		
3/4"	90.6		
5/8"	89.9		
3/8"	86.8		
#4	82.3		
#10	78.1		
#40	65.9		
#100	47.9		
#200	37.1		

* (no specification provided)

Soil Description		
Silty SAND with gravel		
Atterberg Limits		
PL=	LL=	PI=
Coefficients		
D ₉₀ = 16.1319	D ₈₅ = 7.3539	D ₆₀ = 0.2940
D ₅₀ = 0.1690	D ₃₀ =	D ₁₅ =
D ₁₀ =	C _u =	C _c =
Classification		
USCS= SM	AASHTO=	
Remarks		

Source of Sample: ATP-03 / S-2
Sample Number: 8735

Depth: 7.5

Date: 12/20/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Hanson Ponds Restoration

Project No: 08-175 / 220580

Figure

Tested By: AD

Checked By: JAM

GRAIN SIZE DISTRIBUTION TEST DATA

12/20/2023

Client: Aspect Consulting

Project: Hanson Ponds Restoration

Project Number: 08-175 / 220580

Location: ATP-03 / S-2

Depth: 7.5

Sample Number: 8735

Material Description: Silty SAND with gravel

Date: 12/20/23

USCS Classification: SM

Tested by: AD

Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 1067.20

Tare Wt. = 272.50

Minus #200 from wash = 32.7%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
1453.00	272.50	0.00	1.5"	0.00	100.0
			1"	83.30	92.9
			3/4"	110.60	90.6
			5/8"	118.80	89.9
			3/8"	156.10	86.8
			#4	208.90	82.3
			#10	258.80	78.1
			#40	402.60	65.9
			#100	614.80	47.9
			#200	742.80	37.1

Fractional Components

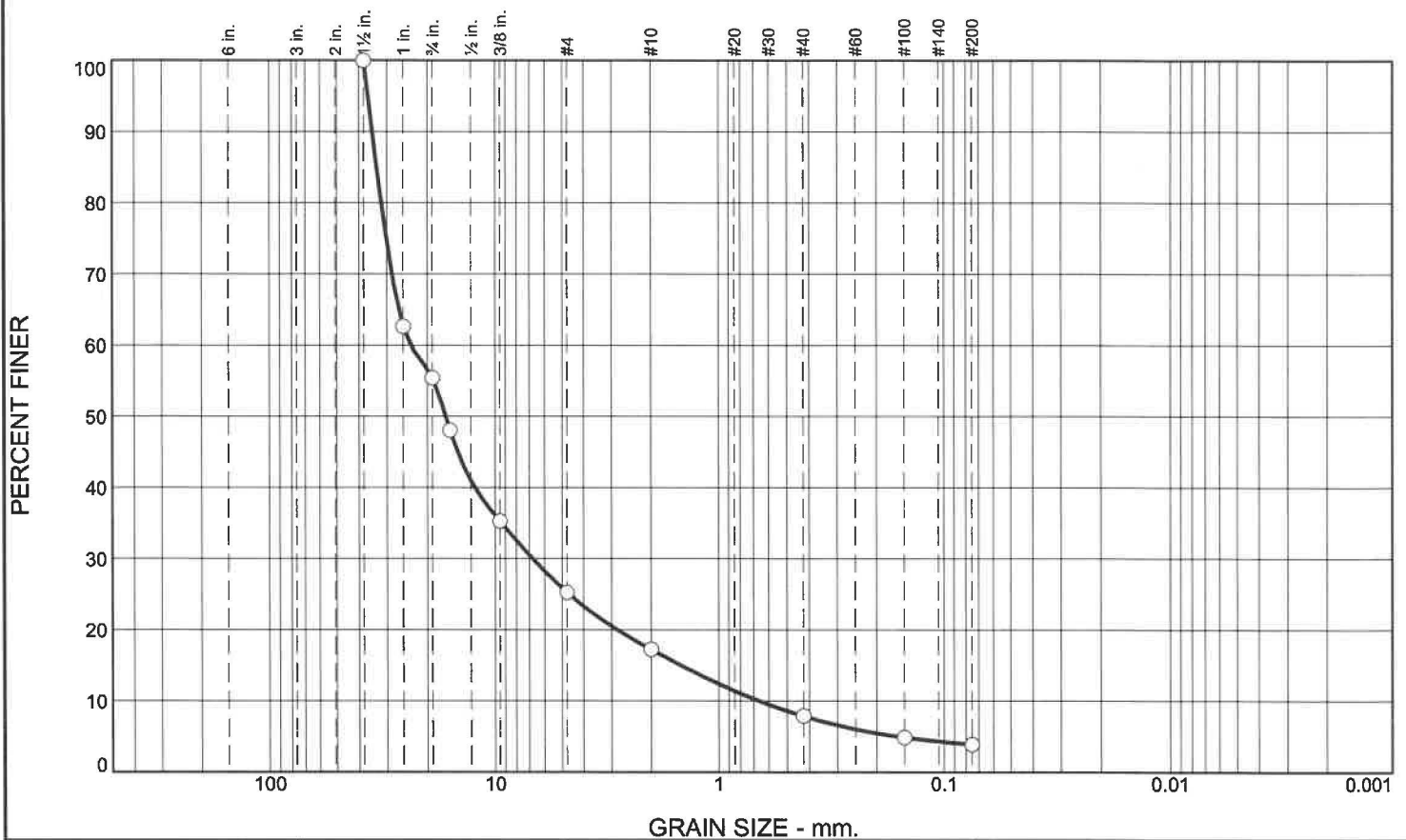
Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	9.4	8.3	17.7	4.2	12.2	28.8	45.2			37.1

D ₅	D ₁₀	D ₁₅	D ₂₀	D ₃₀	D ₄₀	D ₅₀	D ₆₀	D ₈₀	D ₈₅	D ₉₀	D ₉₅
					0.0912	0.1690	0.2940	3.0326	7.3539	16.1319	29.2106

Fineness
Modulus

2.08

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	44.6	30.2	7.9	9.4	4.0	3.9	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5"	100.0		
1"	62.6		
3/4"	55.4		
5/8"	48.0		
3/8"	35.3		
#4	25.2		
#10	17.3		
#40	7.9		
#100	4.9		
#200	3.9		

* (no specification provided)

<u>Soil Description</u>		
Well graded GRAVEL with sand		
<u>Atterberg Limits</u>		
PL=	LL=	PI=
<u>Coefficients</u>		
D ₉₀ = 34.8923	D ₈₅ = 33.3368	D ₆₀ = 23.6313
D ₅₀ = 16.6221	D ₃₀ = 6.7761	D ₁₅ = 1.4676
D ₁₀ = 0.6579	C _u = 35.92	C _c = 2.95
<u>Classification</u>		
USCS= GW	AASHTO=	
<u>Remarks</u>		

Source of Sample: ATP-06' S-1
Sample Number: 8735

Depth: 2

Date: 12/20/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Hanson Ponds Restoration

Project No: 08-175 / 220580

Figure

Tested By: AD

Checked By: JAM

GRAIN SIZE DISTRIBUTION TEST DATA

12/20/2023

Client: Aspect Consulting

Project: Hanson Ponds Restoration

Project Number: 08-175 / 220580

Location: ATP-06 / S-1

Depth: 2

Sample Number: 8735

Material Description: Well graded GRAVEL with sand

Date: 12/20/23

USCS Classification: GW

Tested by: AD

Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 4183.70

Tare Wt. = 621.10

Minus #200 from wash = 3.7%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
4320.30	621.10	0.00	1.5"	0.00	100.0
			1"	1382.20	62.6
			3/4"	1650.60	55.4
			5/8"	1922.30	48.0
			3/8"	2393.60	35.3
			#4	2765.20	25.2
			#10	3060.80	17.3
			#40	3406.60	7.9
			#100	3519.10	4.9
			#200	3555.30	3.9

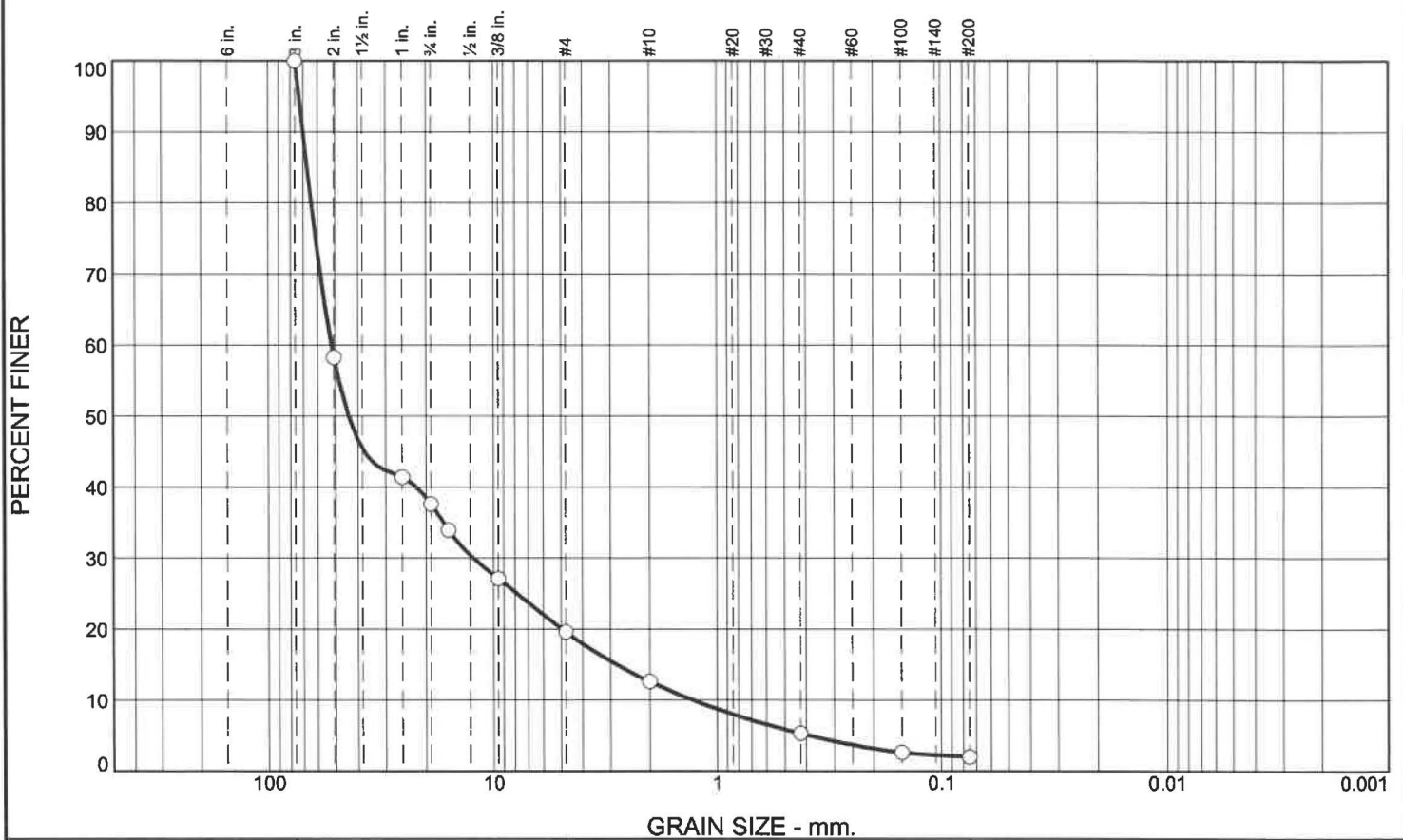
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	44.6	30.2	74.8	7.9	9.4	4.0	21.3			3.9

D ₅	D ₁₀	D ₁₅	D ₂₀	D ₃₀	D ₄₀	D ₅₀	D ₆₀	D ₈₀	D ₈₅	D ₉₀	D ₉₅
0.1608	0.6579	1.4676	2.8216	6.7761	12.2554	16.6221	23.6313	31.7786	33.3368	34.8923	36.4721

Fineness Modulus	C _u	C _c
6.31	35.92	2.95

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	62.4	18.0	7.0	7.3	3.3	2.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	58.3		
1"	41.4		
3/4"	37.6		
5/8"	34.0		
3/8"	27.1		
#4	19.6		
#10	12.6		
#40	5.3		
#100	2.6		
#200	2.0		

* (no specification provided)

<u>Soil Description</u>		
Well graded GRAVEL with sand		
<u>Atterberg Limits</u>		
PL=	LL=	PI=
<u>Coefficients</u>		
D ₉₀ = 69.9883	D ₈₅ = 67.0115	D ₆₀ = 51.9902
D ₅₀ = 43.9558	D ₃₀ = 12.3029	D ₁₅ = 2.8015
D ₁₀ = 1.2760	C _u = 40.74	C _c = 2.28
<u>Classification</u>		
USCS= GW	AASHTO=	
<u>Remarks</u>		

Source of Sample: ATP-04 / S-2
Sample Number: 8735

Depth: 5.5

Date: 12/20/23

Hayre McElroy & Associates, LLC

Client: Aspect Consulting
Project: Hanson Ponds Restoration

Redmond, WA

Project No: 08-175 / 220580

Figure

Tested By: AD

Checked By: JAM

GRAIN SIZE DISTRIBUTION TEST DATA

12/20/2023

Client: Aspect Consulting

Project: Hanson Ponds Restoration

Project Number: 08-175 / 220580

Location: ATP-04 / S-2

Depth: 5.5

Sample Number: 8735

Material Description: Well graded GRAVEL with sand

Date: 12/20/23

USCS Classification: GW

Tested by: AD

Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 4339.50

Tare Wt. = 598.80

Minus #200 from wash = 1.9%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
4413.10	598.80	0.00	3"	0.00	100.0
			2"	1591.80	58.3
			1"	2235.30	41.4
			3/4"	2378.60	37.6
			5/8"	2519.20	34.0
			3/8"	2780.00	27.1
			#4	3067.00	19.6
			#10	3332.20	12.6
			#40	3611.00	5.3
			#100	3713.50	2.6
			#200	3737.10	2.0

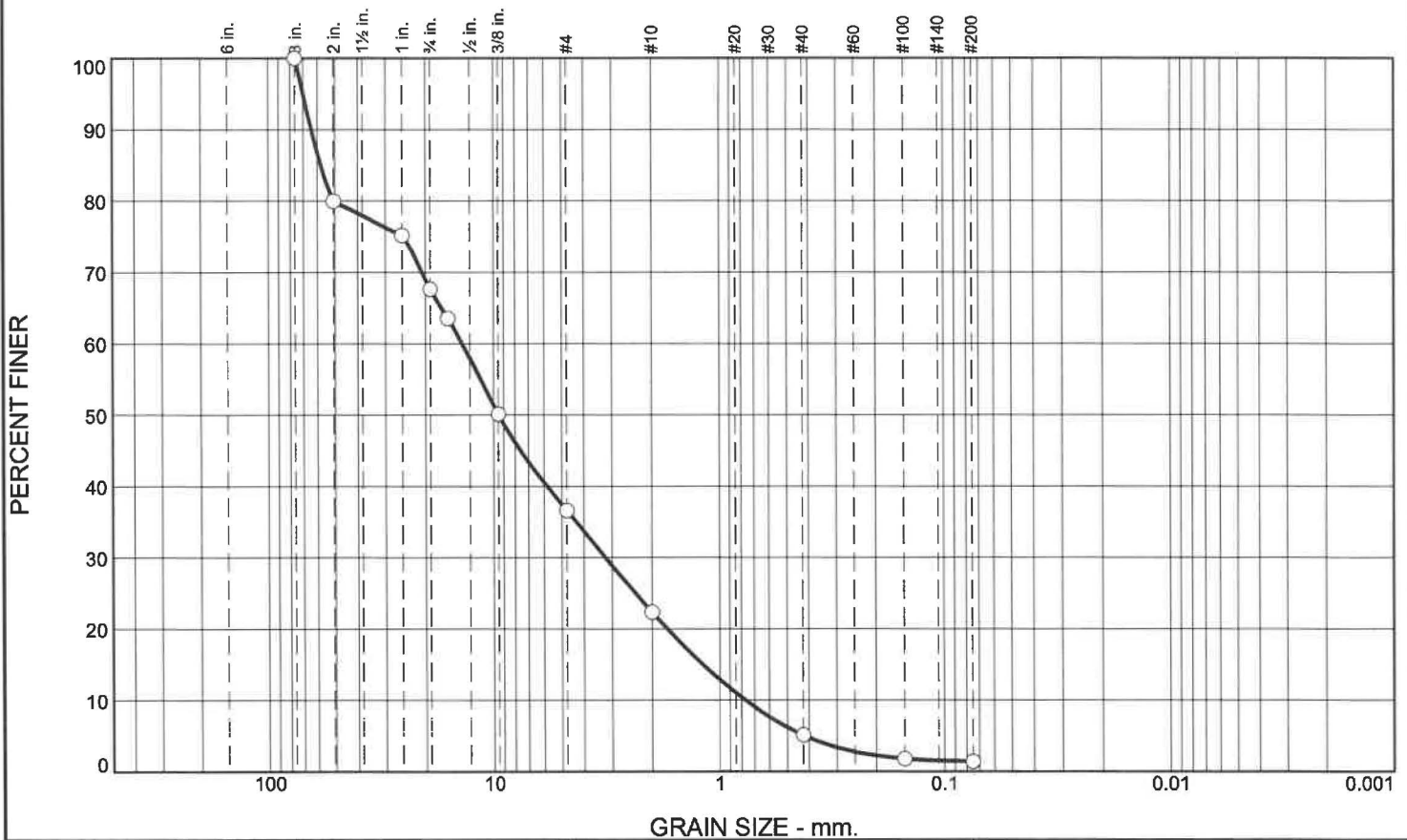
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	62.4	18.0	80.4	7.0	7.3	3.3	17.6			2.0

D ₅	D ₁₀	D ₁₅	D ₂₀	D ₃₀	D ₄₀	D ₅₀	D ₆₀	D ₈₀	D ₈₅	D ₉₀	D ₉₅
0.3852	1.2760	2.8015	4.9471	12.3029	22.1099	43.9558	51.9902	64.0820	67.0115	69.9883	73.0415

Fineness Modulus	C _u	C _c
7.34	40.74	2.28

Particle Size Distribution Report



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	32.4	31.0	14.2	17.3	3.7	1.4	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
3"	100.0		
2"	80.0		
1"	75.2		
3/4"	67.6		
5/8"	63.6		
3/8"	50.1		
#4	36.6		
#10	22.4		
#40	5.1		
#100	1.8		
#200	1.4		

* (no specification provided)

Soil Description Poorly graded GRAVEL with sand		
PL=	Atterberg Limits LL=	PI=
D ₉₀ = 64.1275 D ₅₀ = 9.4799 D ₁₀ = 0.7676	Coefficients D ₈₅ = 58.0569 D ₃₀ = 3.2074 C _u = 17.90	D ₆₀ = 13.7380 D ₁₅ = 1.1863 C _c = 0.98
USCS= GP	Classification AASHTO=	Remarks

Source of Sample ATP-05 / S-2
Sample Number: 8/55

Depth: 9

Date: 12/20/23

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting
Project: Hanson Ponds Restoration

Project No: 08-175 / 220580

Figure

Tested By: AD

Checked By: JAM

GRAIN SIZE DISTRIBUTION TEST DATA

12/20/2023

Client: Aspect Consulting

Project: Hanson Ponds Restoration

Project Number: 08-175 / 220580

Location: ATP-05 / S-2

Depth: 9

Sample Number: 8735

Material Description: Poorly graded GRAVEL with sand

Date: 12/20/23

USCS Classification: GP

Tested by: AD

Checked by: JAM

Sieve Test Data

Post #200 Wash Test Weights (grams): Dry Sample and Tare = 3506.50

Tare Wt. = 595.90

Minus #200 from wash = 1.3%

Dry Sample and Tare (grams)	Tare (grams)	Cumulative Pan Tare Weight (grams)	Sieve Opening Size	Cumulative Weight Retained (grams)	Percent Finer
3546.10	595.90	0.00	3"	0.00	100.0
			2"	590.90	80.0
			1"	732.60	75.2
			3/4"	954.60	67.6
			5/8"	1075.20	63.6
			3/8"	1471.60	50.1
			#4	1869.80	36.6
			#10	2290.60	22.4
			#40	2798.70	5.1
			#100	2897.30	1.8
			#200	2908.10	1.4

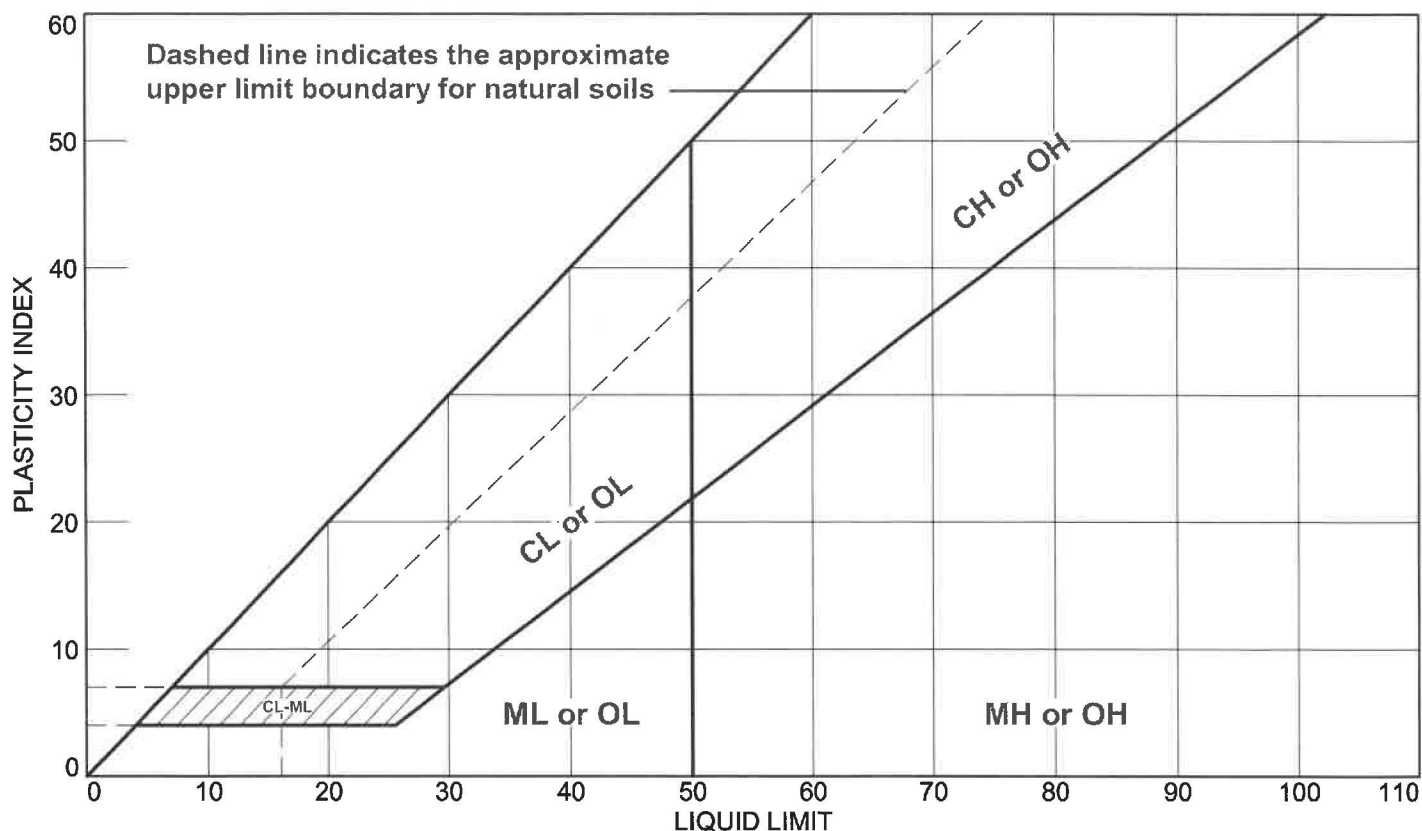
Fractional Components

Cobbles	Gravel			Sand				Fines		
	Coarse	Fine	Total	Coarse	Medium	Fine	Total	Silt	Clay	Total
0.0	32.4	31.0	63.4	14.2	17.3	3.7	35.2			1.4

D ₅	D ₁₀	D ₁₅	D ₂₀	D ₃₀	D ₄₀	D ₅₀	D ₆₀	D ₈₀	D ₈₅	D ₉₀	D ₉₅
0.4157	0.7676	1.1863	1.7089	3.2074	5.7999	9.4799	13.7380	50.8519	58.0569	64.1275	70.0503

Fineness Modulus	C _u	C _c
6.15	17.90	0.98

LIQUID AND PLASTIC LIMITS TEST REPORT



SOIL DATA

	SOURCE	SAMPLE NO.	DEPTH	NATURAL WATER CONTENT (%)	PLASTIC LIMIT (%)	LIQUID LIMIT (%)	PLASTICITY INDEX (%)	LIQUIDITY INDEX	USCS
•	AB-02 / S-7	8735	17.5	45.5	NP	NV	NP		ML

Hayre McElroy & Associates, LLC

Redmond, WA

Client: Aspect Consulting

Project: Hanson Ponds Restoration

Project No.: 08-175 / 220580

Figure

Tested By: AD

Checked By: JAM

LIQUID AND PLASTIC LIMIT TEST DATA

12/20/2023

Client: Aspect Consulting

Project: Hanson Ponds Restoration

Project Number: 08-175 / 220580

Location: AB-02 / S-7

Depth: 17.5

Sample Number: 8735

Material Description: SILT

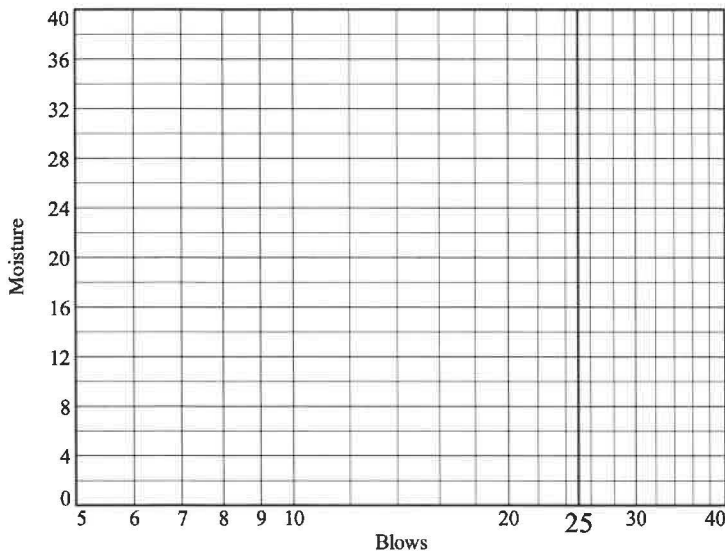
USCS: ML

Tested by: AD

Checked by: JAM

Liquid Limit Data

Run No.	1	2	3	4	5	6
Wet+Tare						
Dry+Tare						
Tare						
# Blows						
Moisture						



Liquid Limit= NV
 Plastic Limit= NP
 Plasticity Index= NP
 Natural Moisture= 45.5

Plastic Limit Data

Run No.	1	2	3	4
Wet+Tare				
Dry+Tare				
Tare				
Moisture				

Natural Moisture Data

Wet+Tare	Dry+Tare	Tare	Moisture
60.3	47.7	20	45.5

Hayre McElroy & Associates, LLC

APPENDIX D

Report Limitations and Guidelines for Use

REPORT LIMITATIONS AND GUIDELINES FOR USE

Geoscience is Not Exact

The geoscience practices (geotechnical engineering, geology, and environmental science) are far less exact than other engineering and natural science disciplines. It is important to recognize this limitation in evaluating the content of the report. If you are unclear how these "Report Limitations and Guidelines for Use" apply to your project or property, you should contact Aspect Consulting, LLC (Aspect).

This Report and Project-Specific Factors

Aspect's services are designed to meet the specific needs of our clients. Aspect has performed the services in general accordance with our agreement (the Agreement) with the Client (defined under the Limitations section of this project's work product). This report has been prepared for the exclusive use of the Client. This report should not be applied for any purpose or project except the purpose described in the Agreement.

Aspect considered many unique, project-specific factors when establishing the Scope of Work for this project and report. You should not rely on this report if it was:

- Not prepared for you;
- Not prepared for the specific purpose identified in the Agreement;
- Not prepared for the specific subject property assessed; or
- Completed before important changes occurred concerning the subject property, project, or governmental regulatory actions.

If changes are made to the project or subject property after the date of this report, Aspect should be retained to assess the impact of the changes with respect to the conclusions contained in the report.

Reliance Conditions for Third Parties

This report was prepared for the exclusive use of the Client. No other party may rely on the product of our services unless we agree in advance to such reliance in writing. This is to provide our firm with reasonable protection against liability claims by third parties with whom there would otherwise be no contractual limitations. Within the limitations of scope, schedule, and budget, our services have been executed in accordance with our Agreement with the Client and recognized geoscience practices in the same locality and involving similar conditions at the time this report was prepared.

Property Conditions Change Over Time

This report is based on conditions that existed at the time the study was performed. The findings and conclusions of this report may be affected by the passage of time, by events such as a change in property use or occupancy, or by natural events, such as floods,

earthquakes, slope instability, or groundwater fluctuations. If any of the described events may have occurred following the issuance of the report, you should contact Aspect so that we may evaluate whether changed conditions affect the continued reliability or applicability of our conclusions and recommendations.

Geotechnical, Geologic, and Environmental Reports Are Not Interchangeable

The equipment, techniques, and personnel used to perform a geotechnical or geologic study differ significantly from those used to perform an environmental study and vice versa. For that reason, a geotechnical engineering or geologic report does not usually address any environmental findings, conclusions, or recommendations (e.g., about the likelihood of encountering underground storage tanks or regulated contaminants). Similarly, environmental reports are not used to address geotechnical or geologic concerns regarding the subject property.

We appreciate the opportunity to perform these services. If you have any questions, please contact the Aspect Project Manager for this project.

Appendix D : Outfall Evaluation Materials

1. Wastewater Outfall Relocation Evaluation Memo
2. Reasonable Potential Analysis for Outfall Relocation

Hanson Ponds Restoration Project - Wastewater Outfall Evaluation and Selection

Date: January 12, 2024
Attention: Melissa Babik, KCT Restoration Director
Client: Kittitas Conservation Trust
Contributors: Jennifer Bader, Sr. Biologist; Nicole Ogan, Biologist;
Allan Evans, Sr. Civil Water Conveyance Engineer/Jacobs
Pollyanna Lind, PhD, Sr. Geomorphologist and Project Manager/Inter-Fluve, Inc.

1. Introduction

1.1 Background and Purpose

The City of Cle Elum (City) and Kittitas Conservation Trust (KCT) are proposing the Hanson Ponds Restoration Project (Project) to improve ecologic function of the area and to address the existing infrastructure risks associated with a previously identified eroding bank on the Yakima River adjacent to the Hanson Ponds (Northwest Hydraulic Consultants Inc. 2015). Based on the 2015 report findings, the City and KCT are concerned that continued bank erosion and overbank flooding will result in the ponds, which are abandoned gravel pits, capturing the full flow of the Yakima River.

These risks are related to several potential negative outcomes to both habitat and infrastructure in the area, including:

1. Ecological impacts associated with pond capture of the channel (e.g., warm water conditions in open ponds, lack of riparian buffer, notably decreased habitat complexity).
2. Damaging the City's wastewater outfall that is currently located under the Upper Pond's upstream border levee and a constructed inlet channel.
3. Abandonment of the existing outfall location by the Yakima River prior to its relocation.
4. Potential erosion to Interstate 90 (I-90), especially the southbound on- and off-ramps at Exit 85.

KCT, in partnership with the City, contracted Inter-Fluve, Inc. (Inter-Fluve) to assess site conditions and provide appropriate restoration alternatives that could potentially meet both the ecologic and infrastructure goals for the Project area. In collaboration with a technical working group, a community advisory group, and the City's special advisory group (CCE), four concept alternatives were developed and reviewed.

For background and details on the stakeholder working groups and the review process, see Section 5 (Alternatives Development & Review) in the Concept Basis of Design Report (**Attachment 1**). Part of the review process that the stakeholder groups collectively underwent included evaluating the feasibility and benefits of each alternative. Descriptions, maps, and

evaluation of the four concept alternatives are provided in **Attachment 1**. The feasibility matrix is included as **Attachment 2**. The stakeholder groups jointly recommended Alternative 4 as the preferred approach. The assessment, concept alternatives, cost and benefit evaluation of the alternatives, and recommendations from the stakeholder groups were provided to the City Council in November 2022. On November 28, 2022, the four concept alternatives were presented to the City Council, who voted to select concept Alternative 4 as the preferred approach. Alternative 4 requires that the City's treated wastewater outfall pipe be relocated from its current location. Preliminary wastewater outfall relocation options were originally developed by Inter-Fluve and KCT in collaboration with the CCE and based on criteria expressed by the CCE.

Jacobs was added to KCT's design and permitting team in 2023. Jacobs' tasks include leading the outfall relocation evaluation, supporting the civil engineering aspects of the outfall relocation design, and taking on a sizeable portion of the Project's permitting requirements. This memorandum summarizes how Alternative 4 meets the goals and objectives of the Project and thus is expected to also benefit salmon. This memorandum describes the evaluation process of the three wastewater outfall relocation options (Option A, Option B, and Option C) related to concept Alternative 4, along with the process of investigating and refining each of the outfall relocation options.

The goal of the outfall relocation evaluation process is to collaboratively identify the preferred option that meets the goals and design criteria of the Project while also being permittable and constructable for a reasonable cost. The evaluation has included communication with permitting agencies, onsite tours, preliminary desktop analysis, developing selection criteria, permit constraints assessment, and comparison of the wastewater outfall relocation options in accordance with the objectives of the design relative to the costs.

1.2 Project Location

The Project is located approximately 2 miles southeast of Cle Elum, Washington, adjacent to the Yakima River. The approximately 50-acre Project area is within the northwest and northeast quarters of Section 36, Township 20 North, Range 15 East, Willamette Meridian (see Figure 1 in **Attachment 1** for a location map).

Alternative 4: Project Goals and Benefits

2.1 Project Goals and Expected Design Outcomes

The overarching goals and objectives of the Project are to improve anadromous salmonid habitat, maintain and protect critical infrastructure (prioritizing the City's sewer outfall and I-90), improve floodplain connection and function, and provide recreational opportunities, where appropriate. Specific goals and objectives of the Project are outlined below.

2.1.1 Goal 1: Increase the quantity and quality of accessible off-channel rearing habitat for juvenile spring Chinook salmon, coho, and steelhead and spawning habitat for spring Chinook salmon in the Yakima River.

- Objective 1.1: Upon implementation of the design, set back or remove approximately 4,800 feet of levee bank.
- Objective 1.2: Upon implementation of the design, place 15 to 20 large wood structures in existing side channels to provide cover and high flow refuge.
- Objective 1.3: Upon implementation of the design, improve fish passage at 5 existing rock weirs.
- Objective 1.4 Upon implementation of the design, place 25 to 30 large wood structures in newly created side channels to create habitat complexity.

Goal 1 and its associated objectives will be met no matter which of the three wastewater outfall relocation options are selected. These objectives are specific to the proposed restoration concepts in Alternative 4. The concept was developed to increase the quantity and quality of accessible off-channel rearing salmonid habitat. The Project will address concerns associated with warm water temperatures and predation within the ponds by eliminating the ponds and creating complex side and off-channel habitat. The ponds will be transformed into a functioning floodplain with side channels that include installation of large wood structures to improve habitat and native riparian vegetation. The Project will also improve fish passage over at least five existing rock weirs in an existing side channel and 4,800 feet of levee will be removed.

2.1.2 Goal 2: Improve riverine and floodplain function and the quantity and quality of habitats they provide for juvenile spring Chinook salmon, coho, and steelhead.

- Objective 2.1: Upon implementation of the design, create approximately 22 acres of new riverine floodplain (fill islands) with approximately 6,600 feet of off-channel habitat that will serve as refuge for juvenile salmon and steelhead.

Goal 2 and its associated objective will be met no matter which of the three wastewater outfall relocation options are selected as these objectives are specific to proposed restoration concepts in Alternative 4. Each of the three options will allow for the creation of approximately 22 acres of new riverine floodplain (fill islands) and approximately 6,600 feet of created off-channel habitat.

2.1.3 Goal 3: Enhance recreational opportunities.

- Objective 3.1: Upon implementation of the design, construct 2.8 miles of recreational trails with interpretive signs and year-round access for hiking, wildlife viewing, and fishing.

Goal 3 and its associated objective will be met no matter which of the three wastewater outfall relocation options are selected through enhancing recreation opportunities at the restoration site. All three options will allow for approximately 2.8 miles of recreational trails with interpretive signs and year-round access for hiking, wildlife viewing, and fishing.

2.1.4 Goal 4: Reduce flood risk to critical regional sewer outfall and I-90 infrastructure.

- Objective 4.1: Upon implementation of the design, either fortify the sewer outfall site or relocate the outfall to a more suitable location.
- Objective 4.2: Upon implementation of the design, protect I-90 infrastructure from flood risk by establishing a setback levee approximately 5,100 feet in length.

Goal 4 and its associated objectives will be met no matter which of the three wastewater outfall relocation options are selected, since design of each will aim to reduce flood risk impacts to the critical regional sewer outfall and I-90 infrastructure.

2.2 Salmonid Benefits of Alternative 4

The *Hanson Ponds Restoration Alternatives & Concepts Designs, Basis of Design Report* (BDR) (Inter-Fluve 2022) describes design criteria, site conditions, Project area goals and objectives, potential construction impacts, infrastructure constraints, property owner concerns, and feasibility associated with the four concept alternatives (**Attachment 1**). The preliminary design criteria specific to salmonid habitat are presented in the BDR (**Attachment 1**) and listed below. These preliminary criteria were developed in collaboration with KCT, Inter-Fluve, and the technical working group.

Habitat Criteria:

- Improve quality and/or quantity of rearing habitat and maintain or improve migration for steelhead, Chinook, coho, sockeye, and bull trout.
- Improve side channel and off-channel habitat quality and quantity, where possible.
- Reduce risk of predation to salmon and steelhead juveniles by warm water fish, where possible.
- Address existing risk of habitat degradation as a result of ponds capturing the mainstem river.

To construct the preferred concept (Alternative 4), which maximizes the potential uplift benefits to salmonid habitat within the constraints of anthropogenic limitations, the existing outfall location needs to be relocated. In this manner, all wastewater outfall relocation options support Alternative 4 and thus support actions that benefit salmonids by addressing the habitat criteria.

Wastewater Outfall Relocation Options Considered

This section describes the three wastewater outfall relocation options (Option A, Option B, and Option C) associated with preferred concept Alternative 4. **Attachment 1** provides additional information on all concept alternatives. The concept Alternative 4 options and preliminary information about each were presented to the City Council on July 10 and 24, 2023.

3.1 Option A

The original concept for Option A would move the outfall from the existing location, in a scour hole at the downstream end of a constructed riffle in the mainstem Yakima River, to the left bank of the proposed relocated mainstem channel, as shown in concept Alternative 4 (Figure 3 in **Attachment 3**; Photographs 1 and 2 in **Attachment 4**).

The proposed mainstem channel relocation would be more consistent with the historic mainstem location prior to gravel mining and the development of Hanson Ponds, which included levee construction to separate the ponds from the river and to protect I-90. This option would consist of cutting the existing 24-inch ductile iron pipe at the appropriate length and removing a portion; retrofitting the pipe to 16-inch diameter, similar to the existing outfall, or a full-sized exit from the existing 24-inch pipe; installing new valves and pipe fittings; and installing a new outfall mouth. It is assumed that the outfall would be a reinforced concrete structure and outlet to the river perpendicular to flow. The remainder of the 24-inch ductile iron pipe south of the new structure would either be removed or filled with grout or sand and capped (if not removed). The original concepts for Option A were designed to daylight the outfall for maintenance purposes (in accordance with the City's request) at the bank of the relocated mainstem.

Coordination with the Washington State Department of Ecology (Ecology) has indicated that changing the outfall to a side bank discharge with no mixing prior to outletting to the mainstem channel would require a desktop mixing zone study (costing approximately \$50,000 to \$70,000) to confirm if mixing the newly designed outfall is equivalent with existing conditions. Ecology indicated that side bank discharges are often less effective at mixing compared to the existing subsurface outfall. They also indicated that results of the mixing zone study could lead to more stringent permit limits within the National Pollutant Discharge Elimination System (NPDES) Waste Discharge permit. Changes to the permit limits could be very costly for the City as it would require upgrades to the treatment facility to treat waste more effectively prior to discharge.

Given the costs of a mixing zone study and potential changes to City infrastructure, Option A was evaluated at the same location, but with a similar configuration to existing conditions, in a scour pool in the proposed relocated mainstem channel. Like existing conditions, this configuration of Option A would be a submerged outfall and would require scuba divers for maintenance inspections. However, this would not increase costs associated with a mixing zone study and potential treatment plant improvements.

3.2 Option B

Option B proposes to relocate the outfall from its existing location in a scour pool downstream from a constructed riffle in the mainstem Yakima River to the initiation point of a floodplain tributary on the south side of I-90, as shown in concept Alternative 4 (Figure 3 in **Attachment 3**; Photograph 3 in **Attachment 4**). Similar to Option A, Option B would consist of cutting the existing 24-inch ductile iron pipe at the appropriate length; retrofitting the pipe to 16-inch diameter, similar to the existing outfall, or a full-sized exit from the existing 24-inch pipe; installing new pipe fittings; and installing a new outfall structure. It is assumed that the outfall would be a reinforced concrete structure and outlet to a newly constructed floodplain tributary designed to flow into the Yakima River.

Option B would discharge into a constructed floodplain tributary that would be designed to flow into the mainstem Yakima River. The outlet was originally conceived as a side bank discharge. In this configuration, Option B would be daylighted, allowing for easy inspection of the outfall. A split outfall is proposed to allow maintenance on one side while the other side continues to discharge. Each side could be sized for full flow or could be sized down if desired, requiring coordination between maintenance activities and peak flow times. Fish barrier screens would be added to the front of the structure, and grating would be added to the top of the structure for safety purposes. The remainder of the 24-inch ductile iron pipe south of the new structure would either be removed or filled with grout or sand and capped, depending on permitting requirements.

As mentioned above in Option A, a side bank discharge would require a mixing zone study for Ecology and potential wastewater treatment facility upgrades. If the study shows mixing is less effective than existing conditions, then treatment plant upgrades may be required. There is the potential a side channel may be constructed to pull water from the Yakima River mainstem channel into the constructed floodplain tributary to allow mixing within the constructed channel prior to discharge to the mainstem Yakima River. KCT is currently working with Ecology to determine if there is a specific flow rate requirement for the side channel to decrease the likelihood that more stringent permit limits associated with the NPDES Waste Discharge permit would apply to this configuration. If this option is pursued, additional coordination will be needed with the permitting agencies to confirm if this is permissible and cost effective.

3.3 Option C

Option C proposes routing the treated wastewater through a pipe in or next to an existing ditch (Town Ditch) to an outfall location along the north side of I-90. This route goes under Exit 85 through an existing 6-foot-diameter, rebar-reinforced concrete culvert, along the north side of another gravel pit pond, and into the mainstem Yakima River downstream of the I-90 bridge (Appendix B in **Attachment 1**; Photograph 4 in **Attachment 4**).

The relative cost for this option assumed it would require approximately 2,700 feet of new buried pipe and potentially a new, larger culvert to handle increased flow capacity, as well as new pipe fittings and an outfall mouth. This option may include constructing an additional stilling pond or wetland pond for the wastewater treatment process. The outfall would be located in the mainstem Yakima River. There would be discussion about structure depth and sediment buildup in the pipeline, depending upon the result of a survey.

Two additional configurations were considered for Option C: (1) a daylight channel that would flow into Town Ditch or (2) discharging to a wetland east of the existing wastewater treatment ponds before flowing into Town Ditch (Appendix B in **Attachment 1**; Photograph 4 in **Attachment 4**). All configurations of Option C would result in either a side bank discharge to the Yakima River or an in-channel discharge.

Outfall Relocation Agency Coordination

Agency coordination has been integral to developing the selection criteria and informing the preferred outfall relocation evaluation and recommendations. Site tours involving KCT, the City, Veolia Water (wastewater facility contractor), HLA Engineering and Land Surveying, Inc. (City engineer), Kittitas County, National Marine Fisheries Service, U.S. Fish and Wildlife Service, Federal Highway Administration, Washington Department of Fish and Wildlife (WDFW), and Jacobs were conducted on June 20 and 27, 2023, to discuss wastewater outfall relocation options and identify potential effects to aquatic resources, potential permitting restraints, restoration potential, and the City maintenance and operations.

Four follow-up meetings occurred in 2023 via Microsoft Teams. Meetings were held with Ecology on July 25 and September 27, with the Washington State Department of Transportation (WSDOT) on October 17, and with the Washington State Department of Natural Resources (DNR) on October 23. The City was informed throughout this process by attending the site visits and attending the September 27 meeting with Ecology. Additional phone and email communications with all agencies mentioned in this section, including correspondence with U.S. Army Corps of Engineers, who were unable to attend the site visits, has also occurred throughout this process.

The conceptual relocation options were developed with the assumption that abandoned portions of the wastewater outfall pipe could be left in place. DNR confirmed during a meeting with KCT, Inter-Fluve, and Jacobs on October 23, 2023, that all three wastewater outfall relocations options will require removing the abandoned sections of existing wastewater outfall pipe as part of the Project. If the pipe is not removed, the City will be required to pay an annual storage fee to DNR for leaving the abandoned pipe in place at an estimated cost range of \$1,000 to \$10,000 a year. DNR has also confirmed the lease for the existing pipe expired in 2020 and recommended that the City coordinate with DNR on renewing that lease for the existing infrastructure.

Option A would likely require renewal of this lease whether the abandoned pipe is removed or left in place. Option B would occur on City-owned property in the uplands and is likely outside of DNR jurisdiction; however, further discussions are warranted with DNR to confirm this.

Refer to **Attachment 5** for Recreation and Conservation Office Comments and Responses on the draft Wastewater Outfall Evaluation and Selection memorandum.

Selection Criteria

Selection criteria considered for each of the outfall relocation options included how well each met the goals and objectives of the Project (see Section 2.4); aquatic resource impacts vs. restoration potential; permitting and monitoring requirements; public perception; infrastructure maintenance, cost, and operation (current vs. proposed); and feasibility. As part of this process, the following outfall relocation objectives were developed and evaluated for each outfall relocation option.

Outfall Relocation Objectives:

- Does not reduce benefits of Alternatives 4 for salmonids and other aquatic species.
- Potential to contribute to ecological uplift.
- Permittable, constructable, and cost effective.
- Reduce risk to existing wastewater outfall infrastructure.
- Designed to capacity for future wastewater outfall needs.
- Long-term maintenance and function.

Evaluation

6.1 Aquatic Resource Impacts vs. Ecologic Uplift Potential

Options A and B are expected to have less wetland impacts during construction than Option C because the configuration of Option C puts the outfall flow through an existing wetland complex to the east of the wastewater treatment facility. Option B has a slightly higher ecologic uplift potential compared to Option A; however, both of these options would be beneficial compared to existing conditions.

Option C would provide the most benefit as it would relocate the outfall to a more suitable location that would not require fortification; however, Options A and B and their associated configurations can also be designed to meet Project Objective 4.1 through fortifying infrastructure associated with those options. KCT and the design team are coordinating with WSDOT to confirm the Project is designed to protect I-90 infrastructure from flood risk. WSDOT

has requested this be completed through designed grade control and scour protection. WSDOT will review the hydraulic model and provide input on each level of design.

Given the new request from DNR that the discontinued portion of pipe be removed, all three options would require some amount of discontinued pipe removal that includes deconstructing the existing grade control riffle in the mainstem channel to do so. Option A (submerged configuration) would require the least amount of discontinued pipe be removed from the floodplain.

6.2 Permitting and Monitoring Requirements

6.2.1 Existing Conditions

This section provides an environmental background review of existing conditions to inform potential permitting requirements for relocating the wastewater outfall.

Federal- and State-Listed Species and State Priority Species

According to the Statewide Washington Integrated Fish Distribution (SWIFD) online mapper, Middle Columbia River summer-run steelhead (*Oncorhynchus mykiss*), Columbia River bull trout (*Salvelinus confluentus*), Middle Columbia River Chinook salmon (*Oncorhynchus tshawytscha*), upper Columbia River summer- and fall-run Chinook salmon (*O. tshawytscha*), rainbow trout (*O. mykiss*), mountain whitefish (*Prosopium williamsoni*), eastern brook trout (*Salvelinus fontinalis*), Westslope cutthroat trout (*Oncorhynchus clarkii lewisi*), and red side shiner (*Richardsonius balteatus*) all occur within the Yakima River (Northwest Indian Fisheries Commission n.d.).

The Hanson Ponds restoration elements will trigger Endangered Species Act Section 7 consultation for bull trout, steelhead, bull trout critical habitat, and steelhead critical habitat with each of the wastewater outfall relocation options (U.S. Fish and Wildlife Service n.d.-a, n.d.-b; National Oceanic and Atmospheric Administration n.d.).

There are no WDFW Priority Habitats or Species occurrence points or habitat polygons at the locations of any of the options (2023). Several shrub-steppe polygons occur in the general area, but none are in the immediate vicinity of any of the wastewater outfall relocation options. No state-listed rare plants have been documented in the general vicinity of the wastewater outfall relocation options (Washington Natural Heritage Program 2021). The nearest documented populations are over 3 miles to the south and include sticky goldenweed (*Pyrrocoma lucida*) and Knoke's desert-parsley (*Lomatium knokei*).

Wetlands

The National Wetlands Inventory (NWI) does not map any wetlands at the locations of Options A or B; however, it does map the freshwater pond that is adjacent to the east of these options. The *Wetlands and Stream Report – Hanson Ponds Project* describes the wetlands found in the study area (GG Environmental 2020). Wetland Unit 5 and Wetland Unit 7 may be impacted by

construction associated with Options A and B. NWI maps Town Ditch (location of Option C) as an existing ditch mapped as a riverine intermittent streambed, a seasonally flooded diked/impounded (R4SBC) wetland, and a riverine perennial unconsolidated bottom (R5UBH) wetland with one palustrine emergent semi permanently flooded (PEM1F) wetland mapped along the existing ditch. No aquatics assessment has occurred within Option C. If this option were to move forward, an aquatics assessment would be required to determine impacts to wetlands.

Hydrology

The National Hydrology Dataset (NHD) maps perennial ponds adjacent (east and west) of Options A and B (U.S. Geological Survey n.d.). Option C is considered an existing ditch mapped by NHD as an intermittent stream along the north side of the treatment ponds that transitions to a perennial pond, where an unnamed stream from the north flows into the ditch.

Options A and B are completely within Tier 1 Channel Migration Zone (Kittitas County Code 17A.02.150). Options A and B are completely within the 100-year floodplain of the Yakima River. Option C would occur within the floodplain near where Town Ditch outlets to the Yakima River. Only Options A and B are within the floodway. Total Maximum Daily Load (TMDL) and 303(d) listings are the same for each option (Ecology n.d.-c). The nearest 303(d)-listed waterbody is the Yakima River, for polychlorinated biphenyls over 10 miles downstream. These options are within three TMDLs: Upper Yakima River Watershed dichlorodiphenyltrichloroethane (DDT) and total suspended solids TMDL (approved); Yakima River Basin toxics TMDL (in development); and Upper Yakima River tributaries temperature TMDL (approved).

In Kittitas County, shoreline jurisdiction (RCW 90.58.030(2)) includes all shorelines of the state, upland areas (shorelands) within 200 feet of the ordinary high water mark of those waters, associated wetlands and river deltas, and floodways and contiguous floodplain areas landward 200 feet from such floodways (Kittitas County 2021b). Options A and B are within the shorelines of the Yakima River.

Ecology Facilities and Sites

There are no Environmental Protection Agency or Ecology facilities or sites of concern in the general area of any of the options (Ecology n.d.-a, n.d.-b, n.d.-c; U.S. Environmental Protection Agency n.d.-a, n.d.-b). Ecology indicates nearby facilities and sites include: (1) Sand and Gravel permit (Gibson & Son Cle Elum Pit) east of I-90 interchange, near Option C, (2) Water treatment plant, (3) CSWGP for WSDOT for Oaks Ave. from 2014; and (4) Cle Elum Drums hazardous waste generator from the 1990s, located to the west of the treatment facility and north of I-90.

6.2.2 Comparison of Permitting and Monitoring Requirements

Restoration elements of the Project for all three wastewater outfall relocation options require Clean Water Act Section 401 and Section 404 approvals, a WDFW Hydraulic Project Approval and

local permits. The Clean Water Act approvals will require Section 106 compliance, triggering the need for a cultural assessment within the Project disturbance limits and Endangered Species Act Section 7 formal consultation for federally listed fish species. Option C would require additional efforts associated with these permits as it would significantly increase the size of the disturbance limits, meaning more costs would be associated with cultural and aquatic resource surveys. Impacts within this larger footprint have the potential for additional impacts to wetlands that could trigger the need for additional mitigation associated with those impacts. Similarly, an increased mitigation area could increase the costs associated with monitoring requirements.

Ecology will likely allow the daylight channel to be considered an extended mixing zone for Option B; however, Ecology indicated this is not possible for the longer section of Town Ditch if Option C were chosen. This means Option C would trigger more stringent requirements to the NPDES Waste Discharge permit, which makes it not permittable. Option A (side bank discharge configuration) and Option B have the potential to trigger more stringent requirements to the NPDES Waste Discharge permit depending on the results of the mixing zone study Ecology will likely require. Option A (submerged configuration) has additional permitting, similar to existing conditions (e.g., DNR aquatics easement, NPDES Waste Discharge permit) and is therefore the preferred option from a permitting standpoint.

6.3 Public Perception

Concern has been raised that public perception of a side bank discharge configuration of treated wastewater may be mixed and potentially negative. Option C would relocate the wastewater outfall away from a public recreation site and Option A (submerged configuration) would keep it submerged under the mainstem Yakima River where it is out of public view. Option A (side bank discharge configuration) and Option B have the potential for negative public perception as recreation (e.g., walking paths and swimming areas) would be adjacent to a daylight wastewater outfall. These concerns regarding negative public perception could be offset by using thick, native vegetation such as willows (*Salix* sp.), and/or a fence to screen and decrease access to the outfall location. If a side bank discharge outfall is selected, this concern will need to be considered and addressed with design, public outreach, and educational information.

6.4 Infrastructure Cost, Maintenance, and Operation

The wastewater facility manager has requested the Project be designed to decrease maintenance costs and improve ease of inspection by daylighting the outfall, which would make it easier to observe and maintain outfall infrastructure. Existing conditions require hiring a scuba diver to perform inspections every 5 years and any maintenance that may be needed would also require additional costs for work on a pipe that is currently in the wetted mainstem channel of the Yakima River. However, daylighting the outfall pipe will require the City to pay more upfront costs that will likely be associated with the need for a mixing zone study that, in turn, could lead to more stringent NPDES Waste Discharge permit requirements. If Ecology were to change the permit

limits (e.g., reduce allowed ammonia levels), this could lead to additional costs to the City as they may need to retrofit the current wastewater treatment plant to meet more stringent requirements.

Option A would require more armoring during construction compared to the other options. Option B could also have this concern; however, to a lesser extent as it is located adjacent to I-90 away from the mainstem Yakima River.

Option C wastewater outfall would not require additional armoring as it would discharge to Town Ditch instead of the Yakima River. Additionally, one configuration of Option C included digging out another lagoon at the wastewater treatment plant, which could be a source of material to fill ponds. However, these benefits of Option C are offset by the cost associated with rerouting the existing outfall around the facility, so it goes toward Town Ditch instead of the Yakima River. Rerouting the outfall also has the potential to cause impacts to the facility during construction. Finally, there are several unknowns associated with Option C, including not knowing the capacity of the ditch during storm events, the condition and potential need for maintenance of the ditch downstream of the facility, whether increased flows in Town Ditch could erode where it outflows to the Yakima River, and the condition of the culvert that passes under the I-90 interchange, which has lateral cracking (Photograph 5 in **Attachment 4**).

Options A and B already have infrastructure in place and would be cheaper to retrofit compared to Option C. Option A (submerged configuration) is likely cheaper to construct compared to Option B given DNR is requiring the abandoned section of pipe be removed or an annual storage fee be paid by the City, and this option would leave more of the pipe operation so less would have to be removed. While Option A (submerged configuration) is not preferred from an outfall maintenance standpoint, it is likely the most cost-effective option, it is consistent with existing conditions, and it would limit the amount of disturbance within the floodplain associated with removing the discontinued section of pipe.

6.5 Feasibility

Option A and Option B are both feasible for relocating the wastewater outfall based on information presented throughout Section 6.

While Option C was initially preferred by the City when Alternative 4 was chosen in 2022, further investigation has revealed several factors that have decreased the feasibility of Option C. These include various unknowns about Town Ditch:

- A lack of flow rate data in the ditch during storm events, which makes it difficult to determine if it has the carrying capacity to also transport wastewater.
- No information on the condition of the ditch between the wastewater plant and river.

- Not knowing how discharging wastewater to this ditch could affect downstream residential wells.
- Whether or not the WSDOT culvert associated with Exit 85 on I-90 needs replacing given the observed lateral cracking that was noticed during a recent site visit.

Option C is estimated to be considerably more expensive than Options A and B. Given the unknowns of Options A vs. B (e.g., mixing zone study) and the unknowns of Option C (e.g., culvert condition), updated cost estimates have yet to be generated for each option. For a general comparison, initial cost estimates developed in 2021 were anticipated to be approximately \$32,500 for Option A (estimate does not include a mixing study or pipe removal from the mainstem), \$45,500 for Option B (estimate does not include a mixing study or pipe removal from the mainstem), and \$5,125,000 for Option C.

Option C would be difficult to access for geotechnical investigation and construction due to a lack of access roads and NWI mapped wetlands in the area. Ecology staff communicated to KCT and the design team in July 2023 that Option C could not be permitted as an extended mixing zone, which would in turn increase the cost of Option C beyond what is feasible for the Project.

6.6 Evaluation of Outfall Relocation Objectives

6.6.1 Benefit Salmonids and Other Aquatic Species

All options will benefit salmonids and other aquatic species as the Project is being designed to improve instream and riparian habitat as well as improve ecological function within the Yakima River floodplain. Option B has the potential for including a floodplain tributary as off-channel habitat. Option C would decrease the need for additional armoring to protect the outfall compared to Options A and B; however, all options will have an overall benefit to aquatic species and therefore this potential need for additional armoring is negligible compared to the overall benefit of the Project.

6.6.2 Ecological Uplift

All options provide the potential for ecological uplift associated with the Project. Option C would have completely removed the wastewater infrastructure from the restoration area and would allow the most flexibility in design; however, it has the potential for the greatest amount of wetland impacts, is difficult to permit, and is costly. Options B and C would require relatively high disturbance to the entire existing outfall pipe compared to Option A because more pipe would be removed for these options unless the City is willing to pay an annual storage fee to abandon it in place. Options A and B allow for some flexibility in design; however, floodplain and channel bed reinforcement to protect the new wastewater outfall location and sustain its connection to the mainstem channel will impose a constructed grade control and some channel confinement at the upstream end of the Project.

6.6.3 Permittable and Constructable

The permit requirements and unknowns associated with Option C, as described in Sections 6.2.2 and 6.5, respectively, result in this being the least desirable option. Based on projected installation costs and an inability to permit without extensive additional costs, Option C will not be recommended. All configurations of Options A and B will utilize existing infrastructure. Option A (submerged configuration) will likely be the easiest and cheapest to permit and construct as it will mimic the currently permitted outfall and will likely satisfy Ecology as having a mixing zone similar to existing conditions.

6.6.4 Reduce Risk to Wastewater Outfall Infrastructure

Option C would remove the wastewater outfall from the active floodplain of the Yakima River. Option B reduces risk to the existing wastewater outfall infrastructure by relocating it closer to I-90 at a side channel designed to have less exposure (duration and frequency) to erosive hydraulic flows. Option A reduces risks to the existing wastewater outfall infrastructure by relocating the mainstem channel in an alignment expected to reduce bank erosion and by reinforcing the floodplain and outfall to withstand very large flood events.

6.6.5 Designed for Future Capacity

The wastewater facility manager has indicated the current capacity of the existing wastewater outfall infrastructure is sufficient to account for future needs and has requested the outfall be designed to provide the same capacity of existing conditions. All three options can easily be designed to accommodate this request.

6.6.6 Long-term Maintenance and Function

Option A (side bank discharge configuration), Option B, and Option C all daylight the outfall, which allows for easier inspections and maintenance. Option A (submerged configuration) provides function most similar to existing conditions, which will make it easier to permit and likely cheaper to construct. All configurations will be designed for public safety and can be designed with materials expected to withstand very large flood events.

Rationale for Preferred Option(s) Recommendations

KCT staff presented the three wastewater outfall relocation options (Option A, Option B, and Option C) to the City Council on July 10 and 24, 2023. **Attachment 3** illustrates figures and the pros and cons of the proposed wastewater outfall alternatives that were presented. The City Council selected Option B as their preferred option on July 24, 2023 (Table 1 in **Attachment 3**). This decision was based on the benefits it is expected to provide and assumption at that time that costs were relatively equivalent for Options A and B. Option C was not selected by the City due to relative costs and the newly acquired information that Ecology cannot permit it without more

stringent operating limits of the wastewater treatment plant, which would add additional costs to this option.

Since that meeting, follow-up conversations have occurred with Ecology and DNR. A mixing zone study for Option A (side bank discharge configuration) and Option B would likely be required for permitting. The estimated cost for a mixing zone study in this area is approximately \$50,000 to \$70,000. The additional cost of doing a mixing zone study may shift the preference to Option A if the City does not want to fund the mixing zone study. In addition to costs, the City will need to consider that the study could result in more stringent permit limits to the NPDES Waste Discharge permit that may have additional costs associated with any retrofits to the wastewater treatment plant.

KCT is currently exploring the requirements with Ecology regarding supplemental side channel flows if Option B is selected. The question posed to Ecology is if supplemental flows can mitigate concerns about mixing requirements associated with transitioning from the existing submerged outfall within the mainstem Yakima River to a side bank discharge in a created floodplain tributary. Unfortunately, Ecology has not been able to provide a clear response yet on whether this would limit the need for a mixing zone study, which has not been funded. At this time Option A (submerged configuration) is the most likely to be recommended, unless the City is willing to take on the extra estimated costs associated with Option B and/or Ecology can provide guidance that would allow for Option B to be designed without changes to the NPDES Waste Discharge permit.

Other considerations for preferred outfall relocation options: Option A (submerged configuration) has existing infrastructure and obtainable permit requirements, is expected to have lower permitting costs and lower costs associated with removing abandoned pipe within the floodplain (due to less pipe to remove).

Salmonid Benefits of Preferred Options A and B

The Salmon Recovery Funding Board developed *Manual 18: Salmon Recovery Grants*, Appendix G: Benefit and Certainty Criteria, to ensure benefits to fish and the success of projects (Washington State Recreation and Conservation Office 2023). Each criterion is ranked as a high benefit (completely addresses criteria), medium benefit (fulfills some but not all limiting factors of criteria), and low benefit (does not address the criteria). As described throughout the BDR (**Attachment 1**), the Alternatives for the Project, including the three wastewater outfall relocation options assessed in this memorandum, were developed to meet these criteria (Inter-Fluve 2021). Benefit criteria is identified and prioritized by the outfall relocation option using the following criteria areas:

- Watershed Processes and Habitat Features – Option A would decrease impacts associated with removing the decommissioned existing outfall pipe; however, Option B may provide

slightly more flexibility in restoration design if the floodplain tributary configuration is permittable.

- Areas and Actions – Options A and B are within a high-priority geographic region (Yakima River Basin) and have equal benefits based on these criteria.
- Scientific – Several assessments have identified the benefits of Alternative 4, which include outfall relocation Options A and B (**Attachment 1**).
- Species – Options A and B are equivalent in comprehensively addressing multiple species of fish and fish habitat improvement treatments.
- Costs – when considering the cost of a mixing zone study and the potential treatment plant upgrades that could result from more stringent permit conditions, Option A (submerged configuration) has lower costs associated with the Project elements compared to Option A (side bank discharge configuration) and Option B.

All wastewater relocation configurations of Options A and B meet the goals and objectives of the Project, when compared to the Salmon Recovery Funding Board Benefit and Certainty Criteria. However, the uncertainty in costs associated with Option A (side bank discharge configuration) and Option B may outweigh the benefits, unless the City is wanting to assist with funding a mixing zone study and the results from that study are sufficient to allow that design to move forward. Without this funding assistance, Option A (submerged configuration), is the most likely to meet the Benefit and Certainty Criteria, given it will provide similar function as the other options yet does not have the additional costs associated with it.

Limitations

This memorandum was prepared for the exclusive use of the KCT, and their representatives. Jacobs and Inter-Fluve prepared the findings and conclusions documented in this report for specific application to the Hanson Ponds Restoration Project. The conclusions and recommendations presented in this report are the professional opinions based on interpretation of information currently available and made within the operational scope, budget, and schedule constraints of this Project. No warranty, expressed or implied, is made.

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Attachment 1. Hanson Ponds Restoration Alternatives and Concept Designs – Basis of Design Report



Hanson Ponds Restoration Alternatives & Concept Designs

Basis of Design Report

SUBMITTED TO



Hanson Ponds Restoration Alternatives & Concept Designs

Basis of Design Report



SUBMITTED TO

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1. Introduction

This basis of design report provides relevant background information and analysis that support the concept-level alternatives designs for the Hanson Ponds project area along the Yakima River (RM 185.7-187.1). Kittitas Conservation Trust (KCT) contracted Inter-Fluve in 2020 to assess and develop concept-level restoration treatment alternative designs for the project area. The site assessment evaluated the existing geomorphic, hydrologic, hydraulic and ecologic processes of the project area (Inter-Fluve, 2021). The assessment provided an understanding of the existing conditions at the site as well as the foundation for developing concept alternatives that are site-appropriate and compatible with the goals for restoration.

1.1 GOALS

KCT is partnering on this project with the City of Cle Elum and a set of regional and local stakeholders. The identified restoration goals of the project are to:

- Improve anadromous salmonid habitat
- Improve floodplain connectivity and function
- Maintain and protect critical infrastructure (prioritizing the City of Clem Elum sewer outfall and I-90).
- Provide recreational opportunities for the public, where appropriate.

1.2 RESTORATION CONCEPT CRITERIA

The design criteria are a compilation of known site conditions, project area objectives, engineering considerations, infrastructure constraints, property owner concerns, and probable feasibility. The purpose of these criteria is to:

- 1) document and communicate specific project objectives and constraints,
- 2) help inform and guide the design process so that objectives are met, and
- 3) provide a basis for future performance monitoring.

The below criteria were developed by KCT and its technical review team.

Habitat

- Improve quality and/or quantity of rearing habitat and maintain or improve migration for steelhead, chinook, coho, sockeye, and bull trout.
- Improve side channel and off-channel habitat quality and quantity, where possible.
- Reduce risk of predation to salmon and steelhead juveniles by warm water fish, where possible (ponds).
- Address existing risk of habitat degradation as a result of ponds capturing the mainstem river.

Improve System Function

- Improve the quantity and quality of floodplain habitats (aquatic, avian, terrestrial).
- Increase geomorphic and ecologic complexity throughout the channel and floodplain, where possible.
- Uplift wetlands in the project area, especially where it can improve ESA aquatic habitat.

Recreation

- Maintain or improve public access.
- Include boater/floater safety in mainstem channel treatment options.
- Retain Kiwanis Pond, if possible

Engineering Considerations

- Ecologic interdependence and function – within the existing managed hydrograph
- Geomorphic channel evolution and long-term expectations
- Available area for utilization and habitat improvements
- Habitat condition and utilization by non-focal native species (avian, terrestrial, aquatic)
- Permitting requirements, feasibility, and schedule
- Existence and location of public utilities within the project area (i.e., under or along I-90)
- Likelihood that materials will be available to construct
- Access and public safety (during and after installation)
- Inclusion of ongoing research and data collection throughout design development
- Due-diligence in site survey and analysis to support design development
- Constructability within site conditions and permissible actions
- Funding for implementation
- Communication with the public
- Sequencing or Phasing
- Protect City of Cle Elum wastewater outfall, including the existing eroding bank at RM 186.95 river left. Consider a range of approaches that include, but are not limited to outfall reinforcement or relocation.
- Do not increase flood risk to I-90. Comply with applicable regulations.
- Do not increase flood risk to adjacent private land owners without consent. Comply with applicable regulations.

2. Project Area

2.1 SITE DESCRIPTION

The Hanson Ponds project area is located near the town of Cle Elum, on the eastern flanks of the Cascades Mountains in central Washington (Figure 1). The site includes the mainstem Yakima River and a set of abandoned gravel pit ponds located on the floodplain that were mined in the past to generate materials to construct the I-90 road prism. The ponds are separated from the mainstem river by a set of constructed riprap rock and earthen levees and dikes that confine the channel within a fraction of its historical floodplain. In 2004 all but one of the ponds were reconnected to the mainstem Yakima River via a constructed inlet channel located at the upstream end of the Upper Pond and an enhanced outlet channel at the downstream Lower Ponds. Spill channels were constructed to connect the Upper, Middle, and Lower Ponds. The upstream most pond, Kiwanis Pond, receives surface water input from the floodplain and ditches upstream of it but it is not perennially connected to the mainstem channel. During large flood events the mainstem channel overtops its banks at the upstream end of the project area (near RM 186.95), instigating surface flow that connects Kiwanis to the mainstem channel and the Upper Pond.

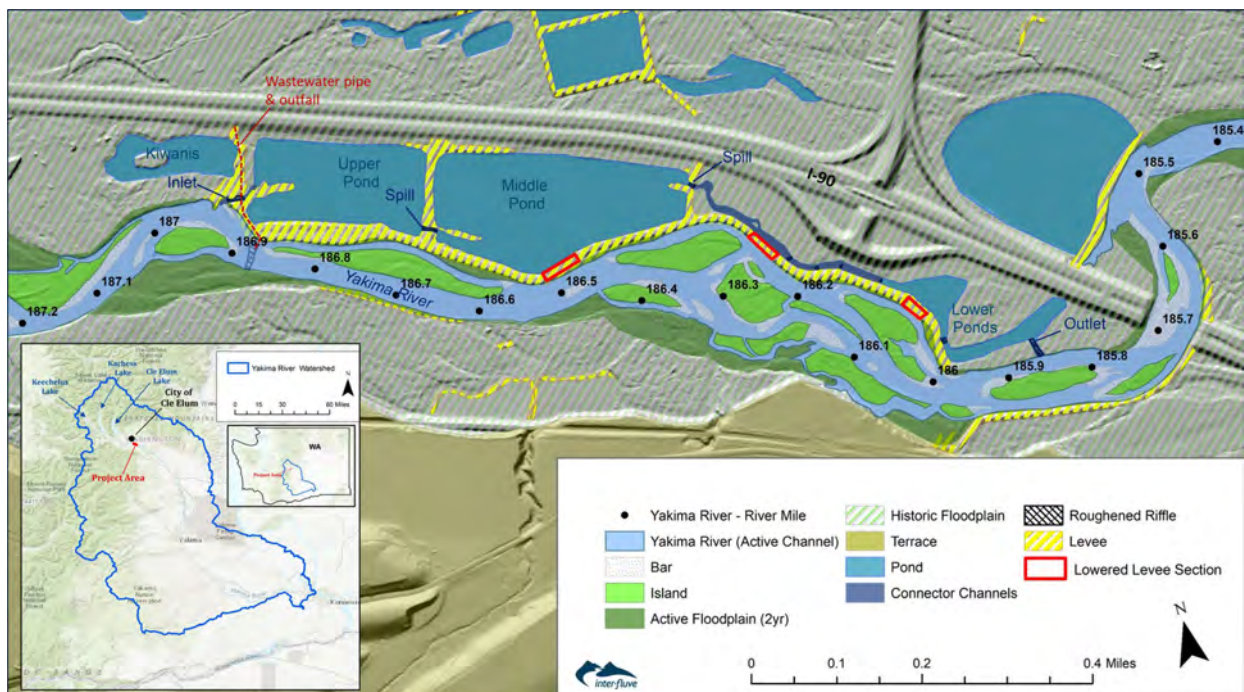


Figure 1. Hanson Ponds project area map.

The mainstem Yakima River is laterally eroding into the river left bank at RM 186.95, immediately upstream of the inlet channel. Current conditions at this location have increased the risk of potential channel avulsion or migration into the ponds. If the channel occupies a flow path through the ponds it will result in further degraded habitat for salmonids as well as a reported risk of compromising

east bound lanes and the on/off ramp intersection of I-90 as well as the City of Cle Elum’s sewer outfall buried between the Kiwanis Pond and Upper Pond are of concern (Reichmuth et al., 2002).

The seasonal hydrograph for the Yakima River at the Hanson Ponds project site is distorted from natural regimes by upstream dam releases for downstream irrigation requirements. The combination of anthropogenic impacts and water management have resulted in diminished aquatic habitat conditions for ESA listed salmonids, loss of floodplain connectivity and function, and reduced overall geomorphic complexity (Inter-Fluve, 2021).

2.2 GEOLOGY & GEOMORPHOLOGY

Periods of glacial extension and recession deposited glacial till that is evidenced today by remnants of lateral terraces and moraines within the broad U-shaped valley (Kauffman et al., 2003; Porter, 1976; Riedel, 2017). The modern upper Yakima River and its tributaries, over time, carved through the glacial till and outwash deposits to establish an inset floodplain of reworked alluvium that is today bordered by glacial till terraces (Haugerud & Tabor, 2009; Reichmuth et al., 2002; Tabor, et al., 2000). The alluvium at the site is classified as xerofluent floodplain and terrace soils (NRCS, 2010) that are somewhat “excessively” well drained and composed of extremely cobbly sand at 60 inches depth that fines upward to gravely sand, loamy sand with moderately decomposed plant material in the top 0-2 inches (Figure 2). A summary review of the floodplain’s classified channel migration zone and federal 100-year flood inundation zone map with an analysis of the site’s relative surface elevations to the channel, modeled flow hydraulics, and field surveys used to delineate the modern active flood floodplain are available in the 2021 assessment (Inter-Fluve).

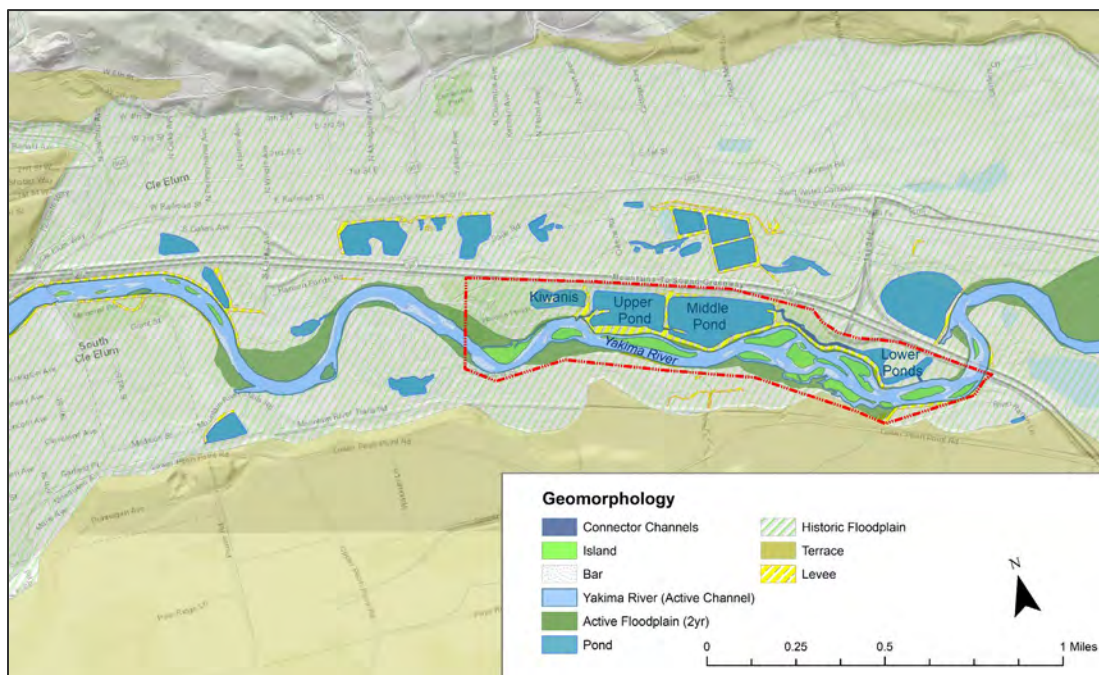


Figure 2. Geomorphic features of the Yakima River RM 185 – 189. (Basemaps: FEMA 2011 LiDAR, ESRI Topographic map)

Excavation of gravel to construct I-90 removed a large volume of material from the floodplain and left the bottom of Hanson ponds slightly lower in places than the modern incised channel. If the channel shifts to occupy the pond area, channel evolution responses such as head-cut migration, exaggerated lateral migration and bar development at the site, and downstream degradation due to sediment capture are potential, depending on the scenario and configuration of channel realignment (Northwest Hydraulic Consultants Inc, 2015; Reichmuth et al., 2002). The potential for the Yakima River to avulse or migrate into the ponds at the upstream end of the project area during a large flood event has been identified as an infrastructure risk (Reichmuth et al., 2002; Washington State Department of Natural Resources (WaDNR), 2004). The infrastructure identified at risk are the buried wastewater outfall pipe and sections of I-90, including the east interchange at exit 85.

The hydraulic model results and field survey completed in the 2021 assessment (Inter-Fluve) concur that there is currently potential for the Yakima River to eventually occupy Hanson Ponds at the upstream end of the project site. Capture of the mainstem channel by avulsion during a single flood event instead of gradually via lateral bank erosion is another identified possibility at the upstream end of the Hanson Ponds project area. Risk of mainstem channel capture as a result of overland flood flow (at >50'yr flood event) from upstream of the project area was also expressed in the hydraulic model. This indicates that long-term risk of channel capture at Hanson Ponds is not a singularly localized issued associated with the identified eroding bank. It is an issue related to gravel pit mines located within the available floodplain – an issue of concern throughout the Yakima River basin (WaDNR, 2004).

Modern sediment supply and exchange in the Yakima River at the site is expected to be notably reduced compared to historical conditions due to channel confinement: which limits natural lateral channel migration, floodplain development and sediment storage, and reduces overall planform and bed form complexity. The channel bed and bars are composed primarily of sandy gravel with cobbles. Per the scope of work, a sediment study has not been performed yet. Instead, sediment transport analysis is planned for the design phase of the preferred alternative and will be included in future design reports.



Figure 3. Example of cobble, gravel, and sand on an active mid-channel bar (RM 186.5). Photo: 9/24/2020

2.1 HYDROLOGY

At the project site, near Cle Elum, Washington, the Yakima's upstream drainage area is approximately 501 square miles. The headwaters of the Yakima are fed primarily by snowmelt supported tributaries whose contributions to the Yakima River are regulated and managed for seasonal downstream irrigation. The flow at the project reach is currently dictated by flow management for the following downstream irrigation target flows (U.S. Bureau of Reclamation (USBR), 2011):

- 400 – 800 cfs from September 10th to October 20th (Enacted 2002)
- 200 – 300 cfs from October 21st – March 31st (Enacted 2002)
- Ramp flows down starting July 1 to 1,000 cfs by late August (Enacted 2011)
- Every several years, provide channel-spanning pulse flows in the spring and winter (Enacted 2011)

In current regulated conditions, the highest daily discharges occur in the summer months as a result of irrigation releases from the upstream dams for downstream usage. Regulated flows are then ramped down by late August to 1000 cfs to provide better flow conditions for migrating fish life stages and to begin the process of storing surface water behind the headwater reservoirs for next year's irrigation season. Based on the median flows (USBR Hydromet – retrieved 2021), the 400 - 800 cfs target flow is met between September 10th to October 20th, and the minimum target flows of 200-300 cfs from October 21st through March are exceeded. USBR estimates what discharge would be at the Cle Elum gage if flows were not regulated by upstream dam management (2017-2021) – see Figure 4. The unregulated discharge is estimated to be notably higher than regulated flows through the fall, winter and spring, with storm event peaks in the fall and a snow-melt influenced high-flows in the spring (April – June). Under current regulated conditions, median high-flow discharges are maintained at approximately 4,000 cfs and they occur during irrigation season (late June – late August) when the system's discharge would naturally be decreasing. In summary, current flow regulation mutes historical seasonal fluctuations caused by storm events, alters the timing of high-flow, and greatly reduces the size, duration and frequency of high-flow.

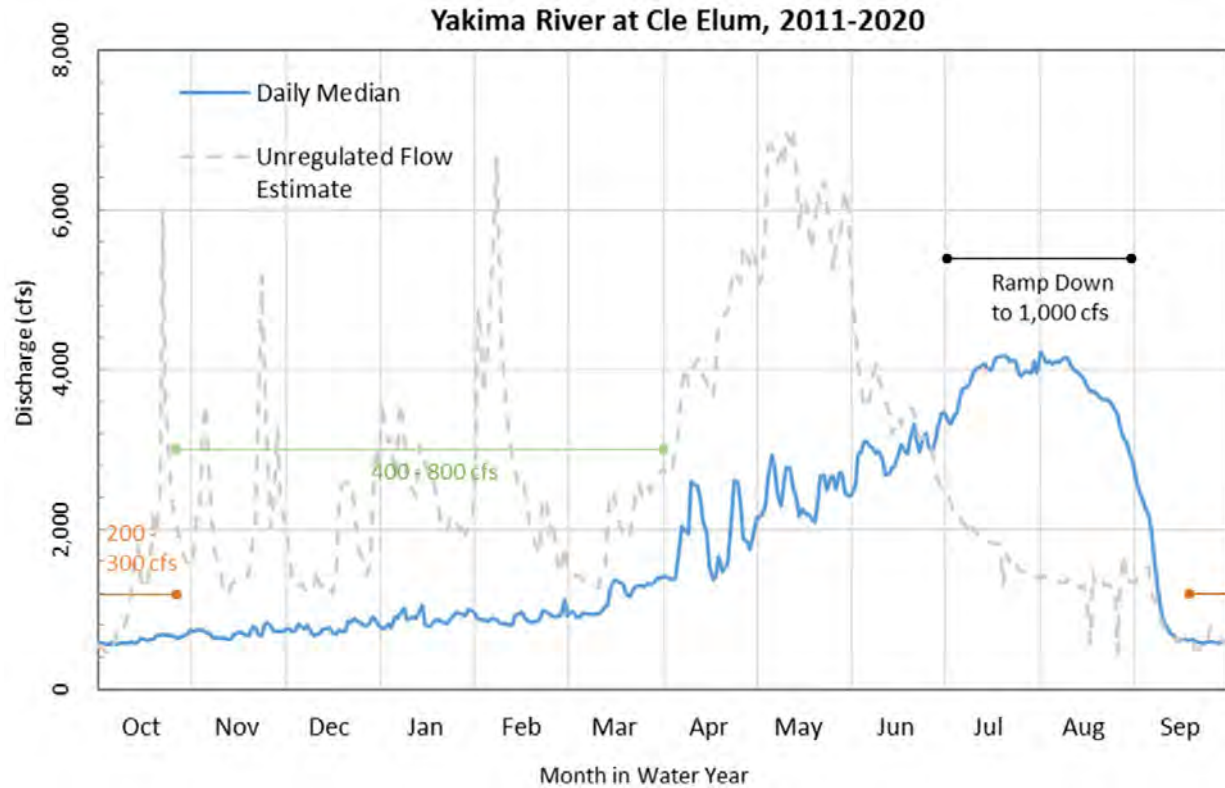


Figure 4. Median regulated discharge of the Yakima River at Cle Elum (2011-2020) and unregulated discharge estimate (USBR Hydromet data).

Peak flow data available at the Cle Elum, WA gage from 1934 to the present were used to estimate the discharge and recurrence frequency for the 2, 10, 25, 50 and 100-Year flood events. Annual Peak Flow reported from USGS was used from 1934 (the year that the final upstream dam was built) until 1978. Instantaneous data from USBR from 1985 to the present was used to determine the peak discharge value in each water year. Inter-Fluve performed a Log-Pearson Type III statistical distributional analysis using annual peak flood events to estimate flood frequency discharges using the USGS PeakFQ software, which uses the Bulletin 17C analysis (England, 2019). The peak flood estimates for the project area from the analysis are shown in Table 1.

Table 1: Yakima River at Cle Elum, WA estimated discharge for peak flood events.

Flood Return Interval	Estimated Peak Discharge (cfs)
2-Year	5,915
5-Year	8,336
10-Year	10,020
25-Year	12,220
50-Year	13,920
100-Year	15,670

2.2 CLIMATE

The climate of the Upper Yakima Watershed generally consists of warm, relatively dry summers and cold, wet winters. The majority of the precipitation throughout the basin is received October–April. (Figure 5) show the seasonal variability in the historical and 1991-2020 monthly precipitation and temperature averages at the project site as well as 1991-2020 data for the headwaters.

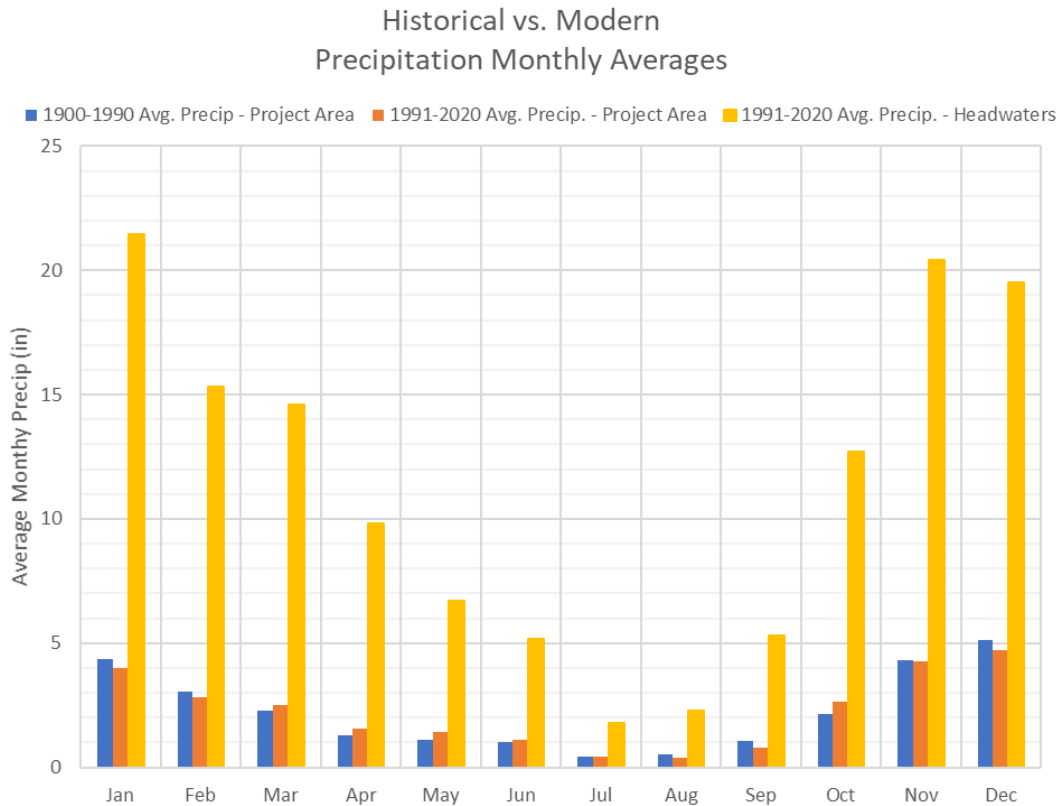


Figure 5: Historical and modern monthly averaged precipitation for the Upper Yakima watershed in the headwaters and at the Project Area. (PRISM, 2021)

Average daily air temperatures within the project area (elevation of 2,150 ft) typically fluctuate seasonally between 30°F in January to 65°F in July (PRISM, 2021).

Global climate models used to accurately capture the 1.4°F warming measured in the Pacific Northwest over the 20th century have been applied to predict future climate trends (Srinivasan et al., 2007). These models predicted an average increase in annual temperature in the region of 2.0° F by the 2020s, 3.2° F by the 2040s, and 5.3°F by 2080 (Mote & Salathé, 2010). Climate simulations indicate precipitation and streamflow in the Pacific Northwest will respond to a changing climate through increased intensity of winter storm events. Warmer temperatures are expected to result in higher winter seasonal streamflow, and decreased summer precipitation resulting in longer periods of low, and decreased rates of streamflow (Dittmer, 2013; Elsner et al., 2010; Groffman et al., 2014; Mantua et

al., 2009; Tohver, 2015). These changes are predicted to have the most substantial implications for watersheds like the Yakima River that are mixed rain-snow watersheds.

2.3 ANTHROPOGENIC FEATURES

The Yakima River has been manipulated by anthropogenic alternations for over 150 years. Railway, roads, homes, and agricultural now occupy large portions of the historical floodplain. In addition to the anthropogenic features that occupy its floodplain, upstream dams managed for irrigation have altered the river's seasonal hydrograph. Today, the upper Yakima River, including at the Hanson Ponds project area, is able to access only a portion of its historical (Holocene) floodplain as a result of a sequence of human-constructed encroachments that gradually confined the river into a narrower floodplain.

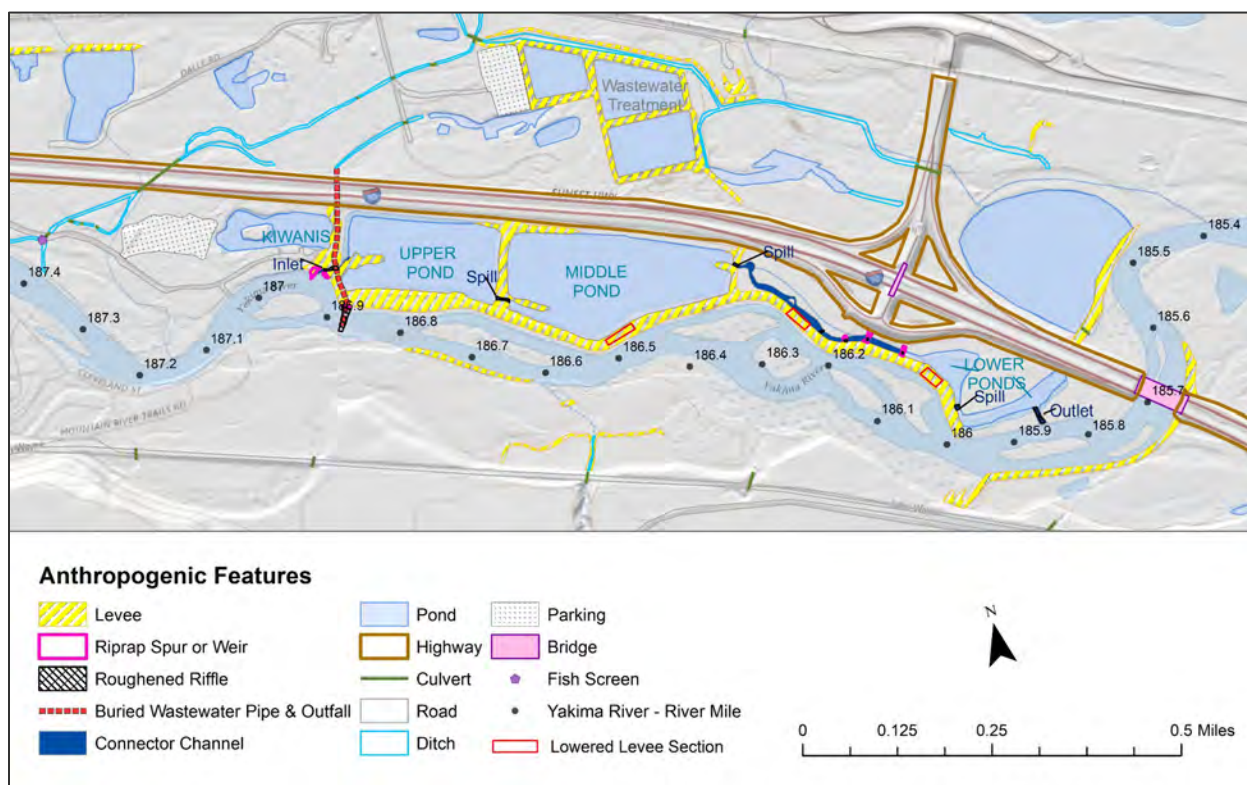


Figure 6. Primary existing anthropogenic features in the Hanson Ponds project area.

The construction of the Northern Pacific Railroad (NPRR) in 1884 disconnected a large portion of the Holocene-aged floodplain and paved the way for agricultural, industrial, and municipal development behind it. Diking, road building, and the development of South Cle Elum disconnected and converted additional floodplain between 1916 and 1964. The construction of Interstate-90 (I-90) and associated gravel mining in the late 1960s substantially reduced the amount of remaining floodplain, further confining the Yakima River. The total area of the historical Holocene floodplain reported loss to encroachment between 1884 and 2002 is 60-80% (Eitemiller et al., 2002).

The levees and dikes associated with Hanson Ponds are constructed to be stable structures on the landscape designed to separate the mainstem channel from the ponds. They have persisted in place since their installation in the late 1960s. Today, almost all of the levee banks along the river are reinforced with riprap boulders (Figure 7). Wide enough and once passable by vehicle, the top of the levee is currently a public access recreational trail.



Figure 7. Riprap reinforced levee at RM 186.51. Middle Hanson Pond on the left side of the levee and mainstem Yakima River on the right side – 8/7/2020.

The buried wastewater pipe outfall for the City of Cle Elum is located in the bed of the mainstem river under a constructed roughened boulder riprap riffle that extends across the width of the channel Figure 6. The riffle both protects the outfall pipe and provides a reinforced grade control feature to the mainstem channel (Figure 8). To reach the outfall location the pipe passes under I-90 and then is buried under the levee and dike located between the Kiwanis and Upper Ponds. A rock spur extends off the corner of the levee, reinforcing the stability of the levee to the roughened riffle. Where the pipe crosses under the inlet connector channel into the Upper Pond, it is buried under a roughened boulder riffle with riprap channel banks that protect the pipe from vertical incision and hold the grade of the inlet.



Figure 8. Aerial image with annotated anthropogenic features near the upstream end of the Hanson Ponds Project area, RM 186.85 – 186.95. Image collected by KCT 10/19/2020.

The existing anthropogenic features within the project area notably constrict the channel's capacity to laterally migrate and limit floodplain connectivity. Roads, bridges, levees, dikes railroads, etc. confine the channel, exaggerating channel simplification and down-cutting. The existing anthropogenic features make it currently impossible to fully restore the Yakima River and its floodplain in the Hanson Ponds project area. However, there are several opportunities to improve the health of the river, it's floodplain, and the resources they are able to provide.

3. Focal Species

A variety of aquatic, avian, and terrestrial species utilize the Yakima River. Within the project area, native fish species include mid-Columbia River steelhead trout, Columbia River bull trout, mid-Columbia River spring Chinook salmon, potentially upper Columbia River summer/fall run Chinook salmon, Coho salmon, resident rainbow trout, mountain whitefish, and redbside shiner (Figure 6). Northern pikeminnow and non-native bass species, often predators of juvenile salmonids, have also been found in the ponds located within the project area (D. B. Parrish, 2005). Steelhead and bull trout are both listed as threatened under the Endangered Species Act and are focal species for this project. Mid-Columbia spring Chinook, Sockeye salmon, and Coho salmon are not listed in the Yakima subbasin but are also considered focal species for this project. Sockeye and Coho salmon were extirpated from the Upper Yakima in the mid-twentieth century but have been reintroduced to the watershed.

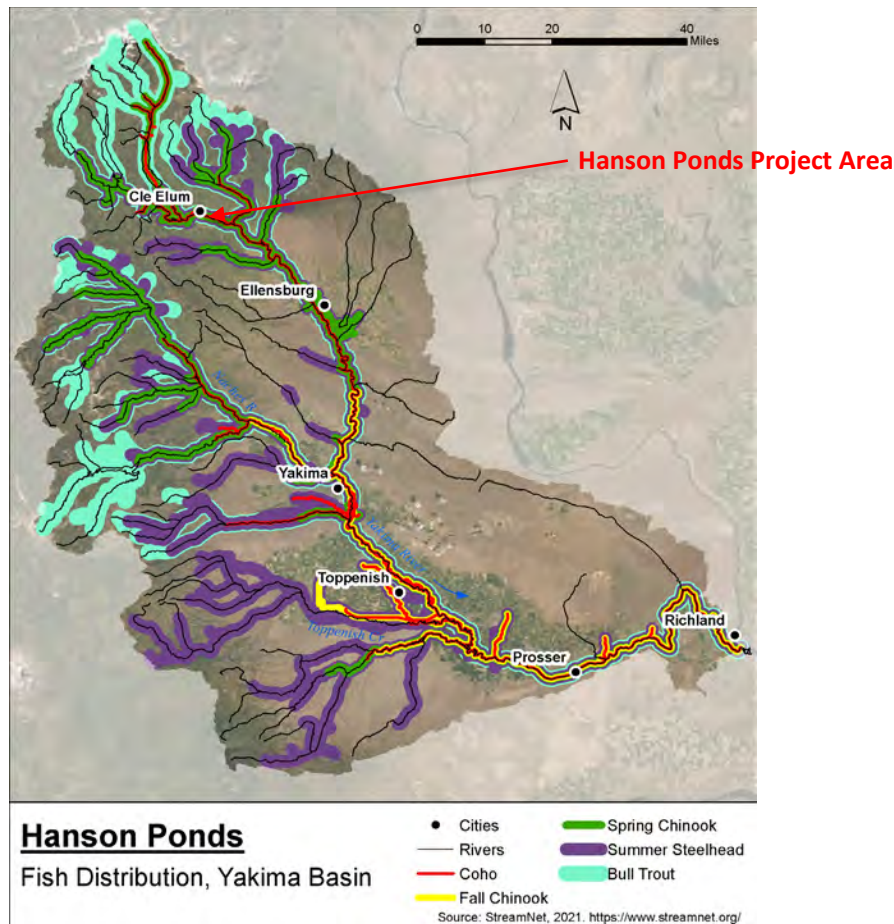


Figure 9. Distribution of focal fish species in the Yakima Basin. Hanson Pond project area near the city of Cle Elum is identified with map annotation (red locator arrow).

3.1.1 Steelhead

Current estimates of natural-origin mid-Columbia steelhead trout spawners counted annually at Roza Dam range from less than 50 individuals to over 400 (Temple et al., 2015), a fraction of the estimated 25,000-75,000 spawners historically (Yakama Nation, 2019). Steelhead spawn and rear in the project area (Washington Department of Fish and Wildlife (WDFW), 2018). Sampling within the mainstem and in Hanson Ponds found juvenile steelhead/rainbow trout to be one of the most common species rearing in the study area (D. B. Parrish, 2005).

Yakima Basin steelhead are classified as summer steelhead based on the timing of their return from the ocean to the Columbia River (Yakama Nation, 2019). Most steelhead from the Yakima basin pass through the lower Columbia River by August and slowly migrate up into the Yakima River to spawning grounds in the winter and early spring of the following year (Figure 7). Almost all steelhead enter into the Upper Yakima (past Roza Dam) in March, April and May (Yakama Nation 2019). Most steelhead spawn in tributaries to the Yakima River, although the distribution of redds throughout the basin is highly variable from year to year and significant amounts of mainstem

spawning are known to occur (Yakama Nation, 2019). Juvenile steelhead have been observed throughout the Upper Yakima River and within the project site (Temple et al., 2019).

Eggs incubate through the late spring and early summer, and though hatching time varies depending on environmental conditions, fry emergence typically occurs around mid-June to late July in the Upper Yakima mainstem (Yakama Nation, 2019). Juvenile steelhead typically spend from one to three years in tributary and mainstem reaches throughout the Yakima Basin, until they begin to smolt and migrate out to the ocean. Age-0 juveniles spend their first year primarily in shallow riffle habitats, feeding on invertebrates and utilizing overhanging riparian vegetation and undercut banks for cover (Moyle, 2002). Age-0 steelhead use slower, shallower water than Chinook salmon, preferring small boulder and large cobble substrate (Hillman & Miller, 1989). Older juveniles prefer faster moving water including deep pools and runs over cobble and boulder substrate.

3.1.2 Chinook

Historically, spring Chinook comprised one of the largest anadromous fish runs in the Yakima River basin. Currently, mid-Columbia spring Chinook salmon in the Yakima basin are not listed as threatened or endangered under the ESA, although numbers are substantially depressed relative to historic population figures (Entrix, 2002). Spring Chinook spawning has been documented in the project reach. Upper Columbia summer/fall run Chinook are also presumed to use the project area (Washington Department of Fish and Wildlife (WDFW), 2018), though are primarily found in lower portions of the Yakima basin (Figure 6; Yakama Nation, 2019).

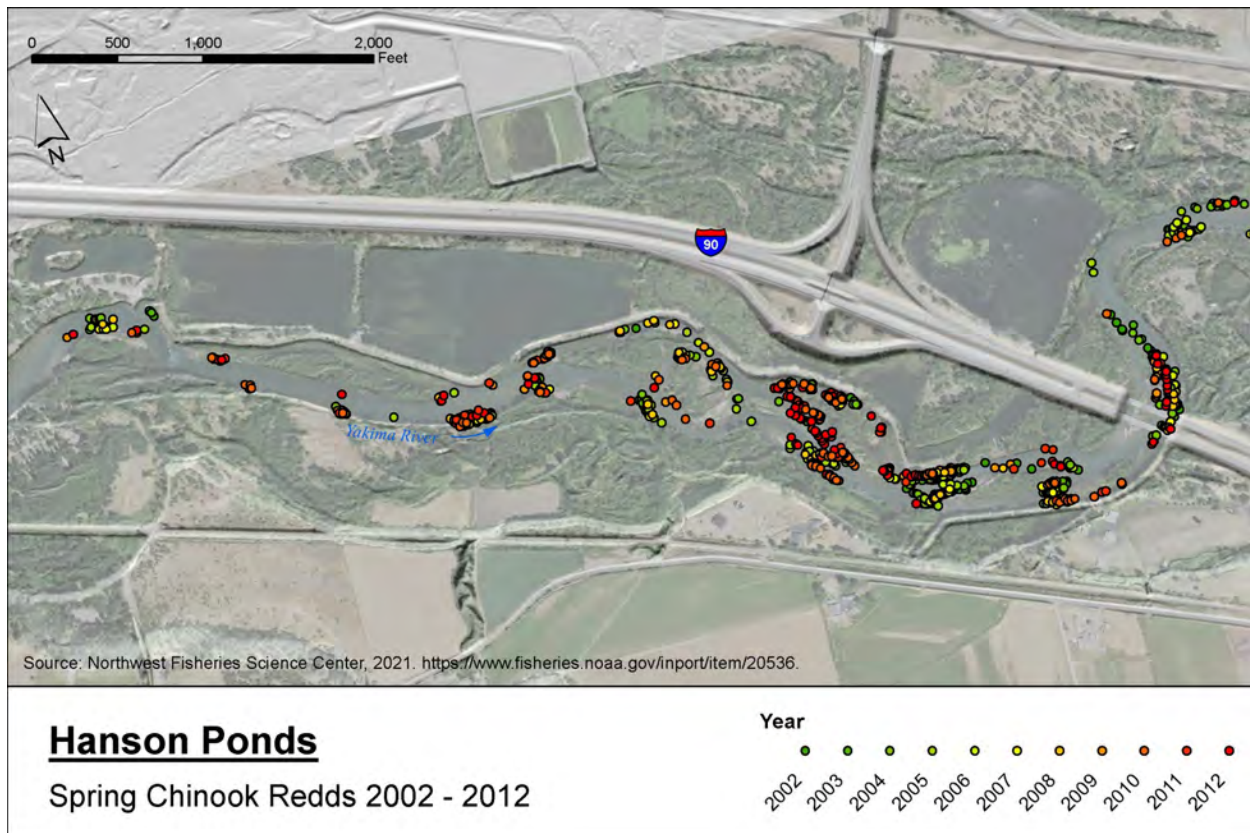


Figure 10. Spring Chinook redds observed in the project area between 2002 – 2012, compiled from various sources by the Northwest Fisheries Science Center and retrieved in February of 2021.

Middle Columbia River spring-run Chinook adults migrate to spawning areas in April and May (see Figure 7), holding in deep pools under available overhead cover until spawning occurs. Spawning typically begins in late August and extends through late September (Yakama Nation, 2019). Emergence occurs in early spring, from February to May, and often coincides with the rising spring snow-melt hydrograph. During higher flows, juveniles seek backwater or margin areas with lower velocities, dense cover, and abundant food (Quinn, 2005). Fry are vulnerable in these systems when they emerge, because their swimming ability is poor and flows are high. Near-shore areas with eddies, large woody debris, undercut tree roots, and other cover are very important for post-emergent fry (Healy, 1991; Hillman & Miller, 1989). Older juveniles utilize deeper pools with resting cover in mainstem habitats more than post-emergent individuals. Middle Columbia River spring-run Chinook exhibit a yearling life history, spending the first summer and winter in fresh water before out-migrating to the estuary and ocean (Yakama Nation, 2019). Low numbers of spring Chinook juveniles have been observed in the mainstem Yakima River near the Hanson Ponds project area (Temple & Webster, 2018; J. Romine, pers. comm., 2021).

3.1.3 Bull Trout

The Upper Yakima basin has a few distinct small populations of Columbia River bull trout. There are four populations upstream of the project area (Box Canyon, Kachess, Gold, and Upper Yakima River), all with very low population numbers (*i.e.*, less than 20 redds; Reiss et al. 2012; USFWS 2010).

More recently, the Upper Yakima has not been considered a historically separate population, instead it is used by the tributary populations for foraging, migration, and overwintering habitats when they occupy the channel (A. Conley, pers. comm., 2021). A recent survey of bull trout distribution in the tributaries to the Upper Yakima River using eDNA sampling techniques found that there are very few, if any, functional bull trout populations remaining in the Upper Yakima Basin besides the well documented populations in Gold Creek, Box Canyon and Kachess River (C. Parrish, 2017). Within the Hanson Ponds study area, bull trout presence has been documented (Washington Department of Fish and Wildlife (WDFW), 2018). Bull trout likely use the study area for migration and overwintering.

Bull trout express both resident and migratory life history strategies (Rieman & McIntyre, 1993). Populations in the upper Yakima and tributaries may primarily express resident adfluvial life history strategies as a result of fish passage barriers. Resident forms of bull trout complete their entire life cycle within the tributary (or nearby) streams in which they spawn and rear. Migratory bull trout spawn in tributary streams, where juvenile fish rear for 1 to 4 years before migrating to either a lake (adfluvial form) or larger river (fluvial form) (Fraley & Shepard, 1989).

Bull trout can live for 10 or more years and can spawn repeatedly during their lifetime (Reiss et al. 2012; USFWS 2010). Bull trout typically spawn during periods of decreasing water temperatures in the fall, and most Yakima stocks migrate to their spawning grounds between June and July for spawning between early-September to mid-October (Figure 7). Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley & Shepard, 1989). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz, 1989; Rieman & McIntyre, 1993). Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Reiss et al. 2012; USFWS 2010).

Bull trout have some of the most specific habitat requirements of salmonids (Rieman & McIntyre, 1993), including cold water temperatures, very clean stream substrates, complex stream habitat including deep pools, overhanging banks and large woody debris, and connectivity between spawning and rearing areas and downstream foraging, migration, and overwintering (FMO) habitats. Though bull trout depend on cold streams, individual fish have been found in larger, warmer river systems throughout the Columbia River basin (Reiss et al. 2012; USFWS 2010). Bull trout are opportunistic feeders, with food habits being primarily a function of size and life history strategy. Adult and juvenile bull trout prey on terrestrial and aquatic insects, macro-zooplankton, and small fish including other juvenile salmonids (Reiss et al. 2012; USFWS 2010).

3.1.4 Coho

Historically, it is likely that the Yakima supported considerable runs of wild Coho salmon (*O. kisutch*). Early records and reports suggest Coho spawned in the upper Yakima above the Cle Elum confluence as well as numerous smaller tributaries to the Yakima (Yakama Nation Fisheries Resource Management (YNFRM), 2017). However, the indigenous population of Coho salmon were

extirpated from the Mid-Columbia basin throughout the 20th century, with major population declines between 1850 and 1900, reportedly from irrigation management and water diversions. Subsequently, the population slowly dwindling until about 1980, when Coho likely became extinct in the Yakima River (Yakama Nation Fisheries Resource Management (YNFRM), 2017). A Coho reintroduction program has been established by the Yakama Nation in the Mid and Upper Columbia watersheds and a small population of Coho salmon now return to the Yakima subbasin. Because the indigenous stock of Coho salmon was extirpated in the upper Columbia River system, Coho returning to the Yakima subbasin are not included under the ESA (Yakama Nation Fisheries Resource Management (YNFRM), 2017).

Adult Coho migrate back into the Yakima River in early September through late November. Adults spawn in the tributaries between mid-October and late December (YNFRM, 2017; Figure 7). Eggs incubate over the winter and fry typically emerge from the gravels in April and May. As with other salmonid species, Coho egg survival is highly sensitive to intra-gravel flow, siltation, high-flow scour, and dewatering or freezing (Peven, 2003; YNFRM, 2017). Compared to steelhead and Chinook, juvenile Coho tend to seek off-channel habitats and tributaries with lower velocities and more overhanging cover. Most juvenile Coho salmon rear in their natal tributaries for approximately a year before migrating downstream, though a portion may migrate downstream in the fall of their first year, likely seeking overwintering habitat in the larger riverine systems (YNFRM, 2017). Coho spawn in the mainstem Yakima near the Hanson Ponds project area and some downstream tributaries that have accessible habitat (YNFRM, 2017). As part of reintroduction efforts, juvenile Coho are acclimated and placed in several tributaries to the Upper Yakima River upstream of the project area (YNFRM, 2017). Juvenile Coho parr released into Hanson Ponds between 2005 – 2007 showed some increased survival to downstream migration compared to parr released in the Yakima River adjacent to the ponds (T. Newsome, pers. comm., 2020).

3.1.5 Sockeye

Sockeye in the mid-Columbia River historically inhabited the lakes of the Upper Yakima basin, but construction of impassable dams, flow management for irrigation, hydropower operations, and overfishing led to significant population declines and ultimately, extirpation of Sockeye within the Yakima watershed. The historical total run size of Yakima River sockeye salmon has been estimated between 100,000 and 200,000 (Yakima Subbasin Fish and Wildlife Planning Board, 2004). Sockeye returning to the Wenatchee and the Okanogan Rivers are the last two remaining viable stocks in the Columbia River (Yakima Subbasin Fish and Wildlife Planning Board, 2004). A reintroduction program by Yakama Nation and partners is working to increase juvenile downstream fish passage at the tributary dams in the Yakima River (e.g., Cle Elum dam) and have transplanted thousands of adult Sockeye from Priest Rapids Dam on the Columbia River to Lake Cle Elum since 2009. Successful spawning by the transplanted Sockeye has resulted in hundreds of natural-origin returns since 2013 (Johnston et al., 2008) that migrate through the project area. However, because the indigenous stock of Sockeye salmon was extirpated in the Yakima River system, Sockeye returning to the Yakima subbasin are not included under the ESA.

Sockeye salmon are the anadromous form of kokanee (resident or adfluvial) salmon. Adult Sockeye typically return to the Yakima basin between mid-June and early August (University of Washington 2021; Figure 7). Both sockeye and kokanee utilize lakeshores, headwater streams, outlet streams (including nearby tributaries), and inter-lake streams for spawning. As with other salmonids, egg incubation is highly dependent on temperature and intra-gravel flow. After emerging from the redd in the late winter and early spring, they move upstream or downstream into a nursery lake or estuary. Fry outmigration to the freshwater rearing areas occurs for both sockeye and kokanee from mid-April to late June. Sockeye typically rear for one or two years in freshwater (usually a lake, but for some stocks it may be in major rivers), followed by one to four years in the ocean. Sockeye smolt outmigration occurs from April to June. There is no documentation of historical Yakima sockeye smolt outmigration timing but it can be assumed that it is similar to the Wenatchee stock since the rearing environments are similar (Yakima Subbasin Fish and Wildlife Planning Board, 2004).

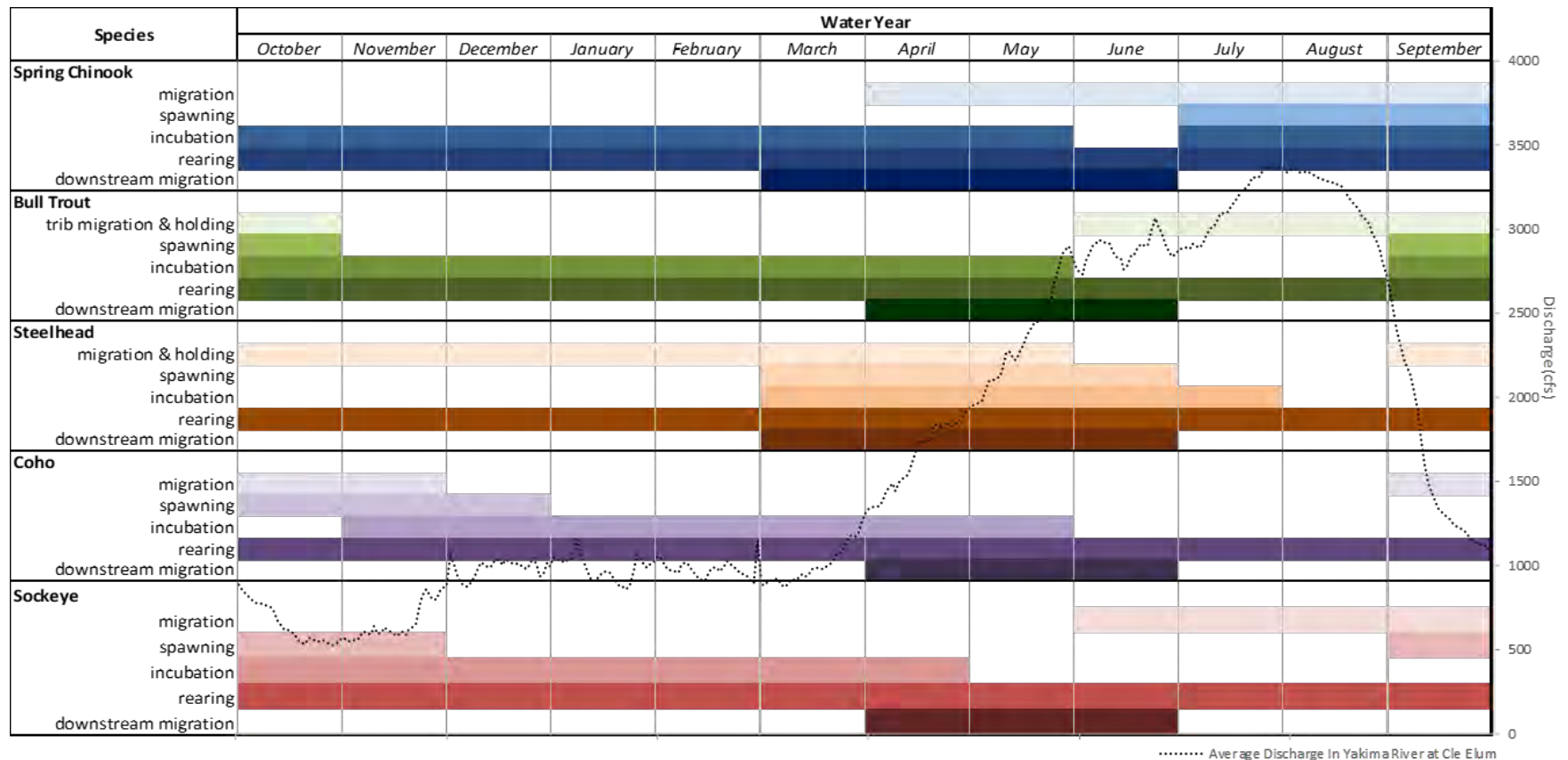


Figure 11. Life history timing for Hanson Ponds focal species overlaid with the average daily discharge in the Yakima River at Cle Elum. Not all life stages represented in this figure are present in the Hanson Ponds project area.

Aquatic habitat conditions in the study area have been negatively impacted by historical and on-going land uses, including logging and agricultural land uses, construction of interstate highway I-90 and the associated gravel mining pits, levee(s) built in the floodplain and along the river, and alterations to natural hydrological regimes. These activities have decreased channel mobility, the amount of high-quality complex aquatic habitat available in the reach, altered water quality (temperature), and have decreased the amount of large wood in the stream, notably old growth trees. Please see the 2021 assessment report for detailed information (Inter-Fluve).

In addition to undesirable physiological effects warm water temperatures may have on salmonids, elevated water temperatures combined with slow water velocities and relatively shallow water depths – such as those found in Hanson Ponds – provide habitat conditions attractive to native and non-native piscivorous species such as largemouth bass or northern pikeminnow that prey on juvenile salmonids. Largemouth bass (*Micropterus* spp., presumed *salmoides*) and northern pikeminnow have both been observed in Hanson Ponds (Entrix, 2002; J. Romine, pers. comm. 2020).

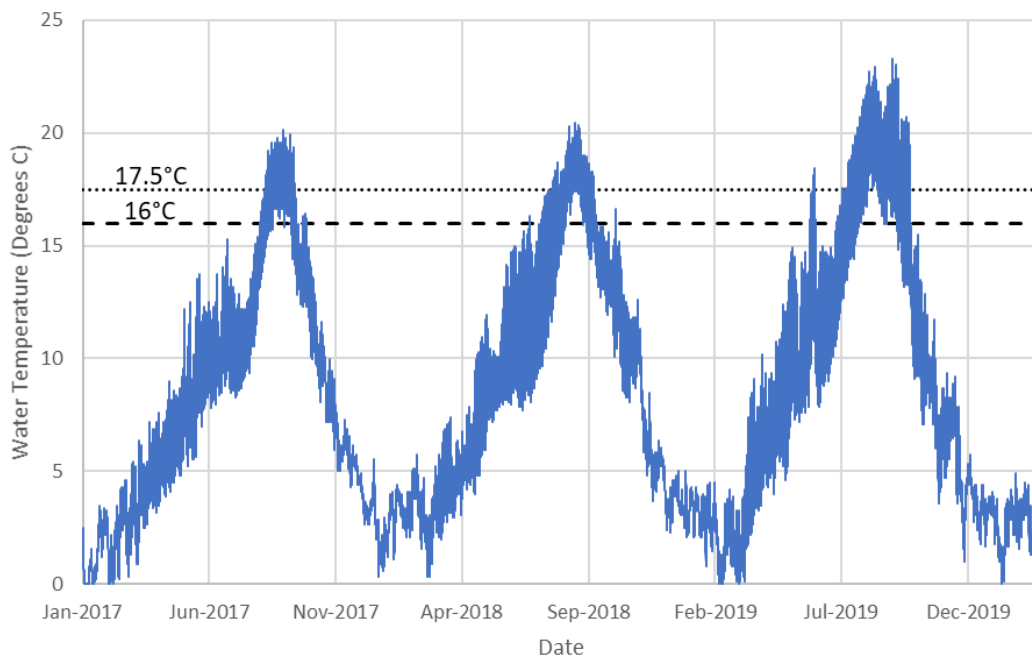


Figure 12. Water temperature recorded from January 1, 2017 – February 20, 2020 in the Yakima River. Data collected and provided by WDFW, 2021.

4. Survey and Analysis

The development of viable treatment alternatives to improve, enhance, and/or restore channel and floodplain function at the Hanson Ponds project area required field survey and multiple desktop analysis, combined with existing data and model review. Field survey and mapping were completed by Inter-Fluve science staff August and September of 2020 with subsequent site visits in 2021. Surveys included topographic and bathymetric survey with RTK GPS, geomorphic surface mapping, vegetation mapping, and a rapid aquatic habitat assessment. Analysis included, but were not limited to: hydrology, flow hydraulics; relative elevation modeling/analysis; aquatic habitat suitability, and water temperature. A description of these survey and analysis efforts are provided in the 2021 site assessment report and related appendices (Inter-Fluve). Wetland delineation was completed by GG Environmental in 2020.

The hydraulic analysis was conducted using a two-dimensional (2D) hydraulic model developed for existing conditions within the U.S. Army Corps of Engineers HEC-RAS 6.0 software (USACE, 2020). 2D hydraulic computations are typically superior to one-dimensional (1D) computations when detailed analysis of river systems with multiple channels or flow paths is required. Given the multi-threaded nature of sections of the Yakima River, along with the relatively complex interactions between the river, ponds, and surrounding floodplain, 2D computations were chosen for this project model. The existing conditions model was then refined to represent concept-level proposed alternative designs for the two primary concepts of preference. A description of the model(s) and model results are provided in Appendix A.

5. Alternatives Development & Review

The initial design criteria for developing concept alternatives required that the mainstem channel remain in its existing location to meet Washington State Department of Ecology permit requirements for the City of Cle Elum's treated wastewater discharge. Under this premise Inter-Fluve developed three different draft alternative treatments (Alternatives 1, 2, 3a & 3b) to address the goals of the project with general cost estimate for each and a feasibility to construct assessment.

The initial alternatives were reviewed by KCT and its stakeholder groups to provide technical feedback and collaboratively recommend a preferred alternative to the City of Cle Elum City Council. As the primary property owner and manager of the project area, City Council members and the Mayor of the City of Cle Elum have decision-making control on final selection of the preferred alternative(s).

KCT's Hanson Ponds regional stakeholders are a Technical Advisory Group (TAG) and a Community Advisory Group (CAG). The TAG is composed of over thirty regional experts representing Yakama Nation, agencies (state and federal), and conservation organizations – including US Bureau of Reclamation, WA Department of Transportation, US Fish and Wildlife Service, WA Department of Natural Resources, WA Recreation and Conservation Office, Kittitas and

Yakima County, NOAA, WA Department of Fish and Wildlife, Mid-Columbia Fisheries Enhancement Group, WA Department of Ecology, Kittitas County, Yakima Basin Fish and Wildlife Recovery Board, and US Army Corps of Engineers and the City of Cle Elum. KCT's local Community Advisory Group (CAG) includes two adjacent landowners, City of Cle Elum Mayor, City of Cle Elum Planning Commission, and local conservation and recreation proponents. FEMA also provided separate review of the alternatives due to infrastructure elements.

Restoration alternatives review meetings were held September 23, 2021 (TAG), November 9, 2021 (Mayor of Cle Elum), November 16, 2021 (FEMA), December 6, 2021 (CAG), and December 14, 2021 (TAG). Comments received throughout the review process were compiled and used to refine the draft alternatives and feasibility assessment. CAG provided important guidance on community prioritization, design considerations, how to quantify and predicted social impacts and recreational opportunities for the community in the feasibility assessment. TAG provided data and material to support design development and technical review and comments of design elements and considerations that were integrated, where possible, into the concept-level alternatives. In December 2021, all advisory groups concluded that Alternative 3 (a or b) is the recommended alternative. Inter-Fluve pursued modeling and analysis of concept-level alternative 3A.

However, at the December 2021 TAG review, it was agreed upon that KCT/Inter-Fluve would further pursue researching the potential to move the City's wastewater outfall location to maximize channel function and reduce infrastructure risk/maintenance required if the outfall was kept in the same location. If it was possible, an additional alternative(s) relating to a new outfall location was to be developed. The design criteria to include the option to relocate the outfall was updated. The newly installed wastewater outfall into a side channel at the city of Yakima, WA was suggested as an example.

KCT engaged the City of Cle Elum engineer, planner, and the wastewater treatment manager as a specialized advisory group (CCE) to support this effort. Inter-Fluve created three options for relocating the existing wastewater outlet, targeting options areas with potential to provide comparable or what is presumed to be better outfall conditions than what exist today. After the options were reviewed together with CCE and it was clear that moving the outfall location was a possibility and preferred, KCT set up a meeting with the engineer at the city of Yakima (June 2022) to learn about their recent upgrade to an outfall into a side channel and the process they have undertaken to with the Department of Ecology to permit it. Inter-Fluve then created a restoration alternative (4) that included moving the outfall and altering the mainstem flow route and location to alleviate bank erosion and pond capture risk. This prompted the stakeholders to recommend Alternative 4 as the preferred alternative. Inter-Fluve pursued modeling and analysis of Alternative 4 as the new preferred alternative. Model results for Alternative 4 (preferred alternative) are provided in Appendix A (Hydraulic Modeling).

6. Concept Design Elements

Plan-view concept drawings of Alternatives 1, 2, 3B, 3A, and 4 (**preferred alternative**) are provided in Appendix B (Concept Design Drawings). A description and evaluation of the design elements for each alternative as well as existing site conditions are included in Appendix B.

7. Cost Estimate of Preferred Concept

A concept-level cost estimate is provided below for **Alternatives 4 (preferred alternative)**. The cost opinion estimate has been developed based on review of current construction costs for similar items on other projects, consultation with construction contractors and material suppliers, and applicable reference cost data. The actual cost of implementation of the project may vary from the cost opinion based on a number of factors including; construction timing and phasing, variations in the heavy construction market, and other unforeseen factors.

Alternative 4 (Preferred Alternative) – Preliminary Cost Estimate

No.	Item	Unit	Quantity	Unit Cost	Cost
1.00	General Requirements / Project Initiation				\$ 466,000
2.00	Construction Erosion Prevention, Environmental Protection and Sediment Control				\$ 176,200
3.00	Earthwork				\$ 5,770,000
4.00	Large Wood Structures				\$ 1,050,000
5.00	Reinforced Bank				\$ 590,000
6.00	Recreational Improvements				\$ 326,000
7.00	Riparian Management (Wetland, Riparian, Upland Revegetation)				\$ 821,800
8.00	Relocate outfall along existing pipeline				\$ 25,000
9.00	Permitting				\$ 250,000
10.00	Design				\$ 614,000
11.00	Engineering support during construction and quality assurance oversight				\$ 90,000
	Construction Sub-Total				\$ 10,179,000
	20% Contingency (rounded to nearest hundred)				\$ 2,035,800
	Construction Total (including 20% Contingency)				\$ 12,214,800

Notes

- Contingencies account for variability in project design and construction costs, rounded up.
- Costs are in dollars as of 2022.
- Basic survey work required for construction (e.g. layout staking, grade setting, etc.) is included in this opinion. Additional survey work not included in this opinion:
- In providing opinions of probable construction cost, the Client understands that the Consultant has no control over the cost or availability of labor, equipment or materials, or over market condition or the Contractor's method of pricing, and the Consultant's opinions of probable construction costs are made on the basis of the Consultant's professional judgment and experience. The Consultant makes no warranty, expressed or implied that the bids or the negotiated cost of the Work will not vary from the Consultant's opinion of probable construction cost.

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Appendix A : Hydraulic Model Description & Results

Hydraulic Model and Analysis

The hydraulic analysis was conducted using a two-dimensional (2D) hydraulic model that was developed for existing and proposed conditions within the U.S. Army Corps of Engineers HEC-RAS 6.2 software (USACE, 2022). 2D hydraulic computations are typically superior to one-dimensional (1D) computations when detailed analysis of river systems with multiple channels or flow paths is required. Given the multi-threaded nature of the Yakima River through the project reach, along with the complex interactions between the river, ponds, and surrounding floodplain, 2D computations were chosen for this project model.

Several proposed concept alternatives have been developed in order to address the lack of habitat in Hanson Ponds. Two alternatives, Alternative 3A and Alternative 4, were chosen to be evaluated using a two-dimensional hydraulic model. Alternative 3A consists of removing existing levees, filling the existing ponds, and creating side flow channels with large wood. Alternative 4 also includes removal of existing levees and filling of most of the existing ponds, but it would create a new designed mainstem of the Yakima River in addition to smaller side channels in the filled pond area with large wood. An existing conditions model was also created to provide a comparison to the two proposed models.

1.1 MODEL GEOMETRY

1.1.1 Digital Terrain Model

The existing model geometry is based on an existing conditions digital terrain model (DTM) that was developed using a combination of aerial LiDAR acquired in 2011 and 2014 (DNR Lidar Portal) and ground/bathymetric survey data collected by Inter-Fluve staff in the fall of 2020, channel bathymetry data were collected via ground survey in wadable sections of the river along the project reach, in combination with a single-beam echo sounder equipped with an RTK GPS unit attached to a single-person pontoon raft. The floodplain topography primarily consists of LiDAR data supplemented with select ground survey data. Channel bathymetry data upstream and downstream of the project area were extrapolated using interpolated cross-section data from the FEMA model for the Yakima River Basin that was provided to Inter-Fluve in 2020 (FEMA, 2018).

Proposed condition DTMs for Alternative 3A and Alternative 4 were developed at a conceptual level, using a combination of AutoCAD Civil 3D and HEC-RAS terrain modification tools. AutoCAD Civil 3D was used to fill the existing ponds and remove high ground features, whereas HEC-RAS was used to grade side channels.

1.1.2 Computational Domain

The computational domain for the hydraulic models extends from approximately 6,600 feet downstream of the I-90 bridge to just upstream of the S. Cle Elum Way bridge. The width of the computational domain along the project reach spans between I-90 to the north and the upper terrace along the south side of the valley. An overview of the extent of the 2D model computational domain is provided in Figure 1. The computational domain was the same for the existing and proposed models.

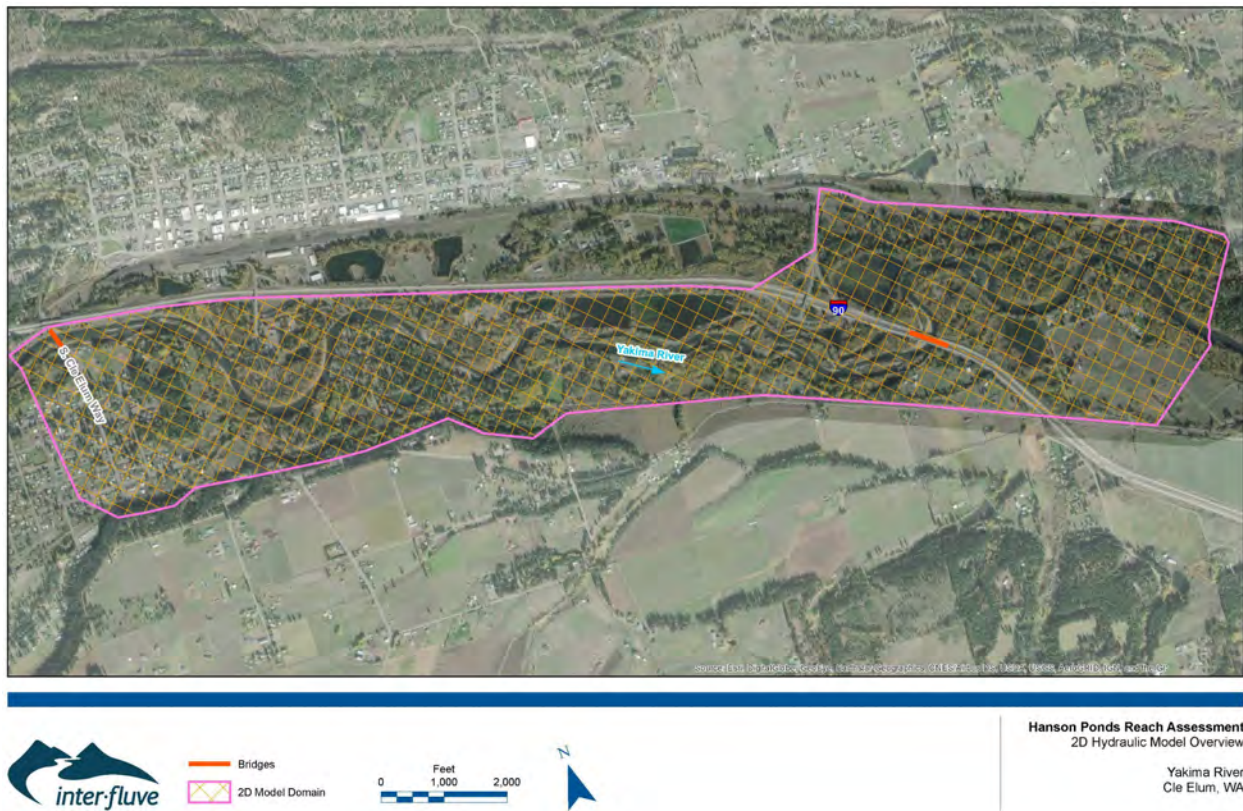


Figure 1. Overview of the 2D hydraulic model computational domain. Note: Hatching is graphical depiction and does not represent computational domain.

The model domain consists of a computational grid with average cell spacing ranging between 20 ft within the active channel to 50 feet in the floodplain. The resolution of the grid was adjusted based on terrain complexity and areas of interest, with smaller cell sizes applied to areas where higher resolution results were desired. Break lines were added along the tops of banks, levee tops, channel alignments, and various high ground features to further refine the computational mesh where needed. Additional mesh refinements were made in the proposed models where needed to represent proposed changes in topography.

1.2 INPUT PARAMETERS

1.2.1 Boundary Conditions

2D hydraulic models require boundary conditions at locations where flow is expected to enter or exit the computational domain. The inflow hydrograph is based on the hydrology estimates discussed in the 2021 assessment report (Inter-Fluve – Section 5.1) and the discharges of interest listed in Table 2. These discharges were incorporated into a synthetic quasi-steady state hydrograph with periods of steady flow (at the discharges of interest and other intermediate discharges) connected by smooth transition

periods to create a stair-step like pattern. A representative quasi-steady flow hydrograph is depicted in Figure 2. The periods of steady flow allow the model to come to a quasi-steady state condition, which facilitates the interpretation of hydraulics at specific discharges. This approach does not allow for analysis of the receding limb of the hydrograph, and likely provides conservatively high results with respect to large floods, as floodplain storage areas are allowed to fill completely to allow the model to reach a steady state.

Table 1. Summary of flows used in hydraulic modeling

Flow Recurrence Interval	Flow (cfs)
October Median Flows ¹	615
January Median Flows ¹	980
April Median Flows ¹	1,600
July Median Flows ¹	3,660
2-year Flood	5,915
5-year Flood	8,336
10-year Flood	10,020
25-year Flood	12,220
50-year Flood	13,920
100-year Flood	15,670
100-year Flood – FEMA ²	19,828
¹ Median Flows are for water years 2000-2020	
² The FEMA 100-year flood was taken directly from the FEMA model (FEMA, 2018)	

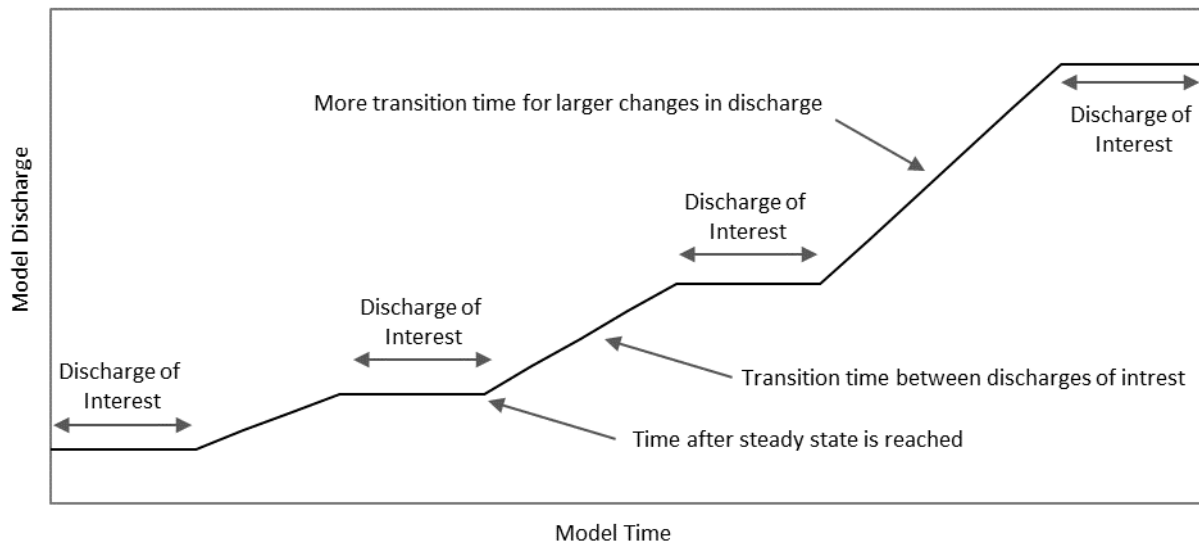


Figure 2. Demonstrative quasi-steady flow model input hydrograph.

The downstream boundary condition consists of assumed normal flow depth at a friction slope estimated from the average channel slope (0.002 feet per foot) near the downstream end of the model domain. Both the upstream and downstream boundary conditions were placed a significant distance away from the project area, to dampen the effects of any potential uncertainties associated with boundary condition assumptions, or the extrapolated bathymetric terrain data.

1.2.2 Bridges

The I-90 bridge was included in the model using the 2D model internal bridge routine tools available in HEC-RAS. The input data for the bridge was approximated based on the data included in the FEMA model (FEMA, 2018). The S. Cle Elum Way bridge near the upstream end of the model domain (Figure 41) was not included in the 2D model, as the bridge crossing is located a substantial distance upstream of the project area and adding bridge computations to the upstream extent of the model would likely introduce model instabilities.

1.2.3 Hydraulic Roughness

A spatially varying hydraulic roughness (Manning's n) layer was created by hand-digitizing regions with similar land cover throughout the model domain in ArcGIS software. In general, roughness coefficients were applied to these regions based on field observations, aerial photos, and professional judgement. Vegetation heights from the 2014 LiDAR data were also used as a basis for land cover classification where feasible, although the data only cover a small portion of the project reach. Roughness values for each landcover region were based on published guidelines of one-dimensional roughness coefficients (Arcement & Schneider, 1989) for corresponding channel types and vegetation conditions, with the understanding that 2D roughness values can often vary substantially from those published for 1D models (Robinson et al., 2019). Table 2 summarizes the roughness coefficients used in the existing and proposed conditions model.

Alternative 3A contains two different types of proposed channels: a mainstem split flow route connecting to the mainstem Yakama river and secondary flow routes in the filled pond areas. The mainstem split flow has an average bottom width of 50 feet while the secondary flow routes have a bottom width of 15 feet. Both channels will contain designed large wood structures (LWS). Since the secondary flow routes are smaller, the wood will take up a larger percentage of the conveyance area, therefore the manning's n value of the secondary flow routes is higher. Reinforced banks are proposed along I-90 and upstream of the existing riffle in the mainstem channel. The remaining areas in Alternative 3A that will be pond fill or excavated levees (such as Fill Islands and Low Floodplain Areas) are considered misc grading and have a Manning's n Value of 0.1

Alternative 4 contains the same manning's n value secondary flow routes, reinforced banks, and misc grading as Alternative 3A. Alternative 4 contains a large, 200 foot wide, designed mainstem with LWS, which was given a Manning's n value of 0.045. There are areas in Pond 1 and Pond 2 that are not being filled, and are categorized in the Proposed – Pond land use. Lastly, the three LWS upstream of the designed mainstem grading are in the Proposed – Large Wood Structure land use with a manning's n of 0.2. The rest of the LWS roughness was incorporated into the manning's n value of the Main Split Flow Route, Secondary Flow Routes, and Designed Mainstem. However, there is not any grading located with these three LWS, so they needed their own roughness category to accurately represent how they would affect the flow entering the Designed Mainstem in the Alternative 4 model.

Table 2: Roughness coefficients used in the 2D model

Land Cover Region Description	Manning's n Value
Active Main River Channel (typical gravels)	0.028
Active Side Channel	0.042
Vegetated Bar	0.07
Woody Debris	0.2
Riprap Weir	0.1
Pond	0.02
Connector Channels	0.08
Levee	0.055
Bare Ground/Gravel Parking Areas	0.035
Miscellaneous Vegetation	0.065
Wetland	0.1
Riparian	0.1
Dense Riparian	0.12
Very Dense Riparian	0.15
Light Understory	0.07
Medium Understory	0.085
Vegetation (8-30 ft) ¹	0.1

Vegetation (30-80 ft) ¹	0.08
Vegetation (50-80 ft) ¹	0.075
Residential	0.085
Residential- Forested	0.09
Residential- Landscaped	0.05
Proposed – Secondary Flow Route	0.08
Proposed – Main Split Flow Route (Alt 3A)	0.06
Proposed – Designed Mainstem (Alt 4)	0.045
Proposed – Reinforced Bank	0.15
Proposed – Pond (Alt 4)	0.02
Proposed – Log Wood Structure (Alt 4)	0.2
Proposed – Misc Fill & Grading	0.1

¹Vegetation heights are visually approximated from a canopy height raster derived from the 2014 LiDAR data that only partially covers the project site.

1.2.4 Calibration and Validation

The existing model was calibrated to surveyed water surface elevation points collected during the topographic and bathymetric surveys in 2020. The flow at the Yakima River at Cle Elum gage (USBR gage “YUMW”) during the survey ranged between 813 and 865 cfs, and a single average flow of 840 cfs was used for model calibration. Calibration was achieved by adjusting the Manning’s n values until a reasonable level of agreement was achieved between modeled and surveyed water surface elevations for the 840 cfs simulation. The calibration results for the main channel are displayed in Figure 3, and the mean residual between modeled and surveyed data is approximately 0.3 ft. Given the absence of reliable high flow calibration data, additional model validation at higher flows was based on professional judgement, field observations, anecdotal observations provided by stakeholders whom are familiar with the project reach, and limited surrogate data such as the ordinary high water (OHW) survey of the vegetation line along the channel banks.

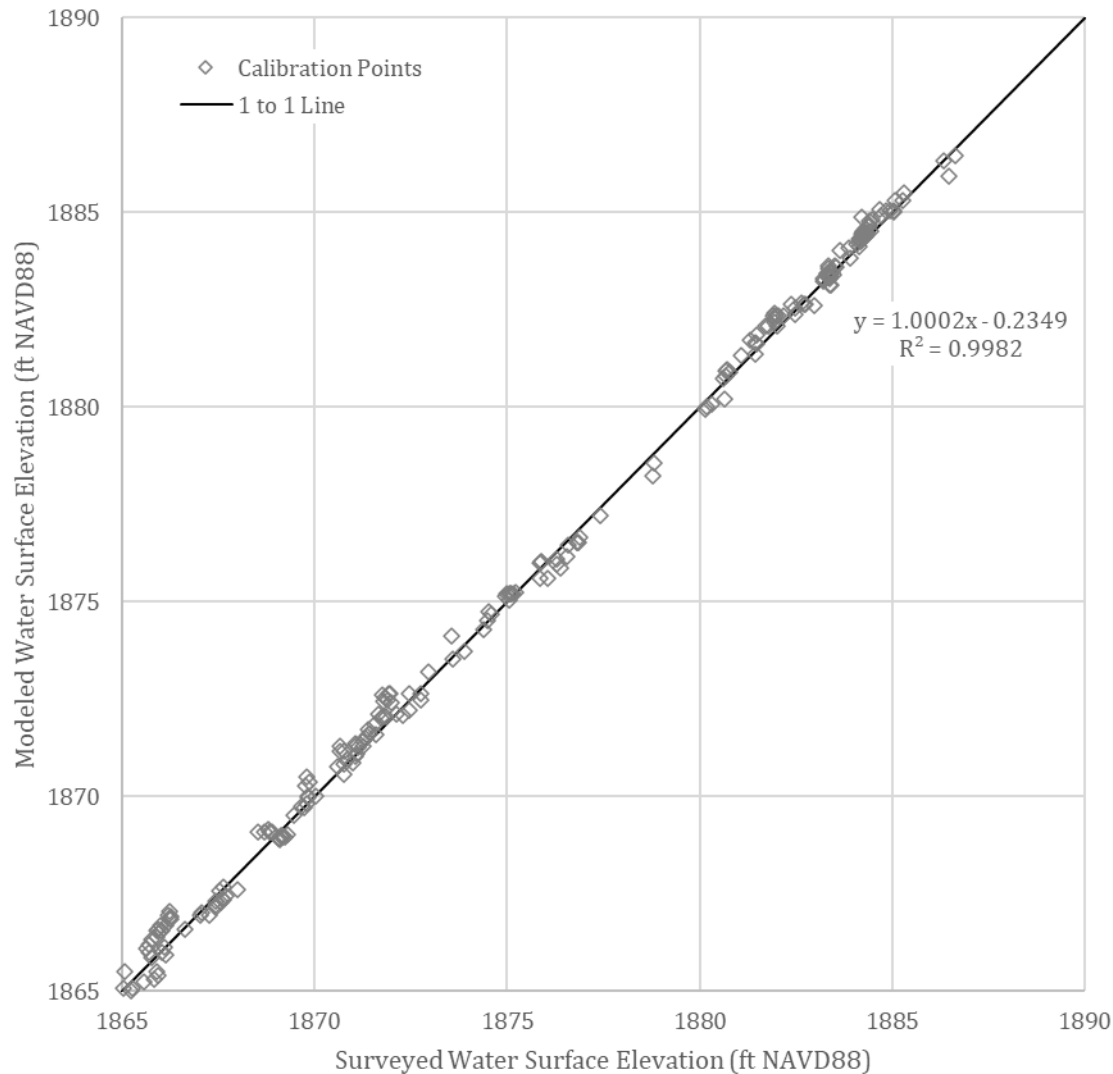


Figure 3. Model calibration results for a modeled flow of 840 cfs.

Water level loggers were installed throughout the pond network within the project area during the September 2020 survey. Limited data were downloaded from the water level loggers in early March of 2020, and these data were used to perform validation checks on water surface elevations for various model simulations. The average differences for these “spot checks” are summarized in Table 3. The average differences are generally within 0.5 feet, which is reasonable given the potential influence of additional processes such as hyporheic flow and evaporation. These processes are not explicitly represented in the 2D hydraulic model and further refinement to model parameters to reflect these processes may be necessary as additional data become available. Logger R2 is meant to collect water surface elevations in the river; however, the logger is situated in the pond outlet channel rather than the main river channel. As such, the water surface is affected by backwater from the river, as well as outflow from the ponds. A longer data set is needed to better understand the interactions between the river and the ponds at this location.

Table 3. “Spot Check” comparisons between modeled and recorded water surface elevations at the installed water level loggers.

Approximate River Flow (cfs)	Difference in Modeled and Recorded Water Surface Elevations (ft)				
	R1	HP1	HP2	HP3	R2*
865	0.2	-0.4	0.2	0.5	0.7
1327	-0.6	-0.2	-0.8	0.0	1.0
1194	-0.8	-0.4	-0.9	0.3	0.8
1504	-0.5	-0.5	-0.7	-0.1	1.0
Average	-0.4	-0.4	-0.5	0.2	0.9
*Logger R2 is directly affected by backwater from the Yakima River					

1.3 MODEL RESULTS

Outputs from the hydraulic model were used in various capacities to assess the hydraulic conditions at various discharges. These results are described below.

1.3.1 Existing Model Results

In general, the existing model results highlight that flow is distributed between multiple channels at seasonal flows, and the overall inundation extents remain relatively constrained within the active channel corridor as flows increase up to the 100-year flood. The model results show that the levee separating the ponds and main channel begins to overtop at some of the previous breach locations at approximately the 5-year flood. Modeled velocities at the 100-year flood are generally in the 8 to 12 ft/second range in the main channel, with the highest velocities through the ponds in the 6 to 10 ft/second range. Modeled depths and velocities for a range of flows are provided in Appendix A.

Despite the multi-threaded nature of the active channel, particularly downstream of the ponds, the model results demonstrate that hydraulic complexity at seasonal (i.e., monthly median) flows is somewhat lacking. Depths at these flows are relatively uniform throughout the project reach, with the exception of a few isolated pools. During the median flows for the spring months, off channel low velocity areas do exist; however, these areas are relatively shallow with the exception of the ponds. At larger flood events, the off-channel low velocity areas are generally confined to the ponds, which lack diverse habitats.

1.3.2 Alternative 3A Model Results

In Alternative 3A, the side channels are wetted at the lowest, October median flows. The low floodplain begins to activate at the July median flow and the fill islands are covered by the 2-Year Flow. In all modeled flows, the velocity in the mainstem channel is reduced compared to the existing model, due to the side channels taking additional flow compared to the existing conditions. Modeled velocities at the

100-Year Flood are generally in the 8 to 10 ft/ second range in the main channel and in the 2-6 ft/ second range in the side channel/floodplain areas.

1.3.3 Alternative 4 Model Results

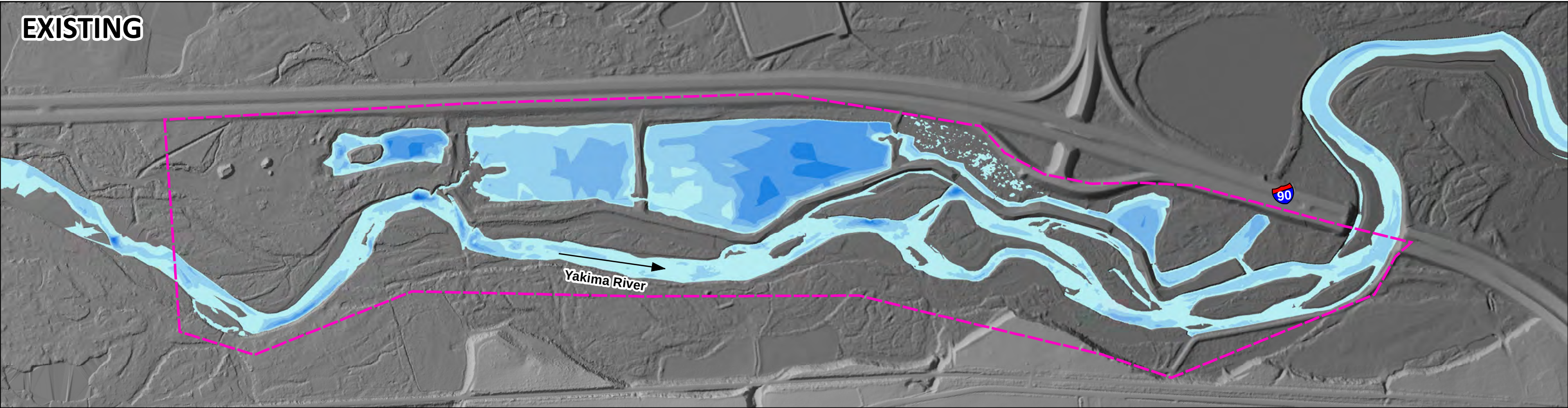
In Alternative 4 the majority of flow is directed into the designed mainstem. Similar to Alternative 3A, the low floodplain begins to activate at the July median flow and the fill islands are covered by the 2-Year Flow. In all flows, the velocity in the new designed mainstem is lower than the velocity in the mainstem in the existing conditions model. However, there are increased velocities at the beginning of the designed mainstem channel as it passes through the old levee location – this is a result of model surface configuration that will be addressed at future design phases. Modeled velocities at the 100-Year flood are over 12 ft/ second at the upstream end of the designed mainstem, and are in the 4 to 6 ft/ second range in the rest of the designed mainstem and old mainstem channel.

Further refinement to both the Alternative 3A and Alternative 4 grading will be done in subsequent design phases

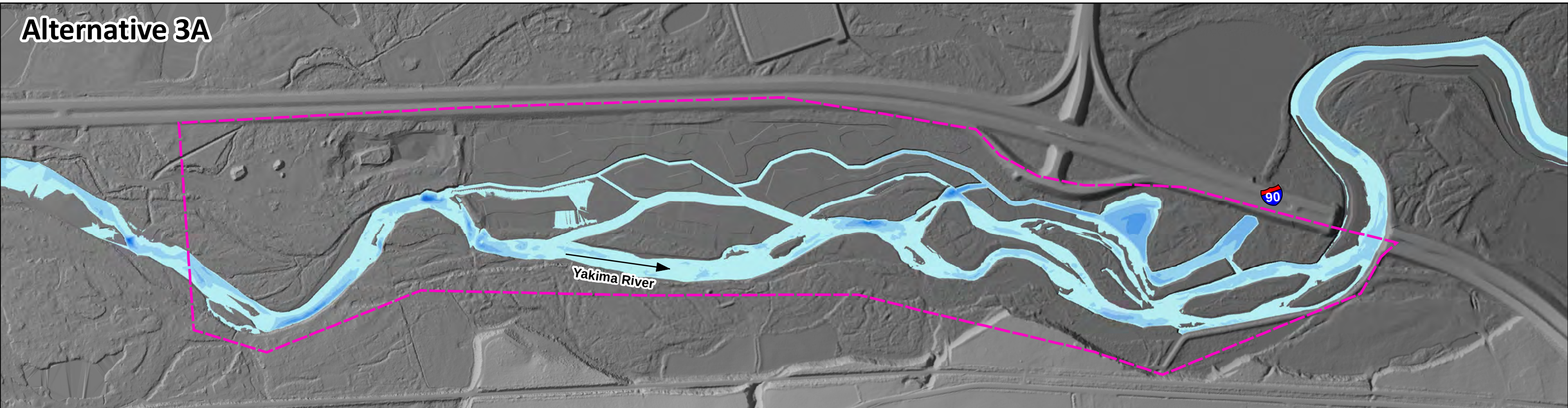
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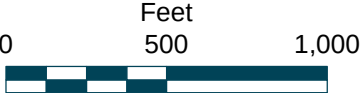
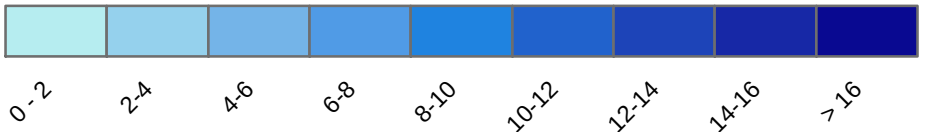


Alternative 3A



 Project Area

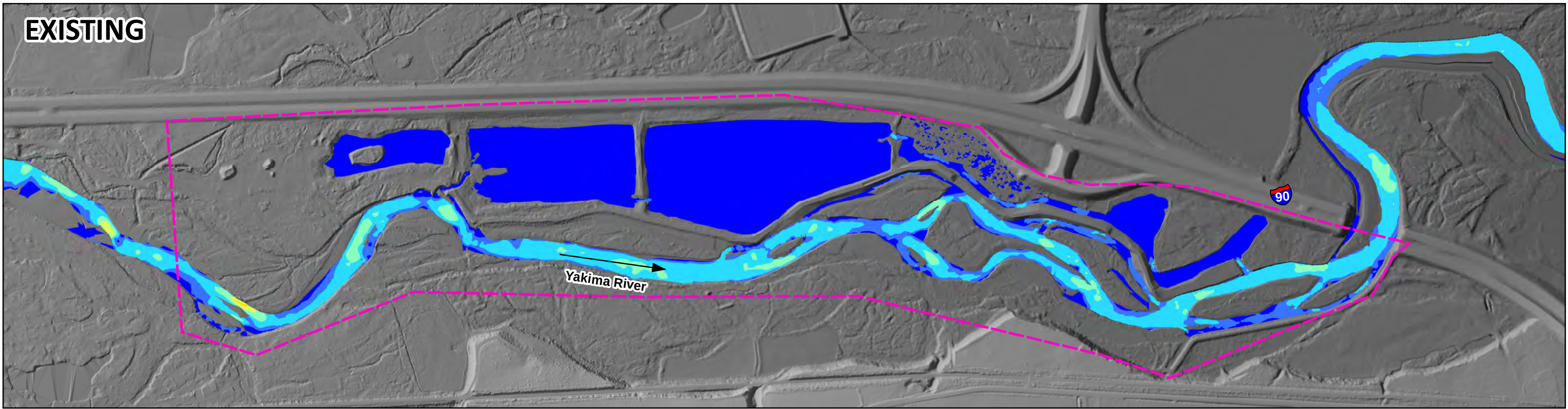
Modeled Depth (ft)



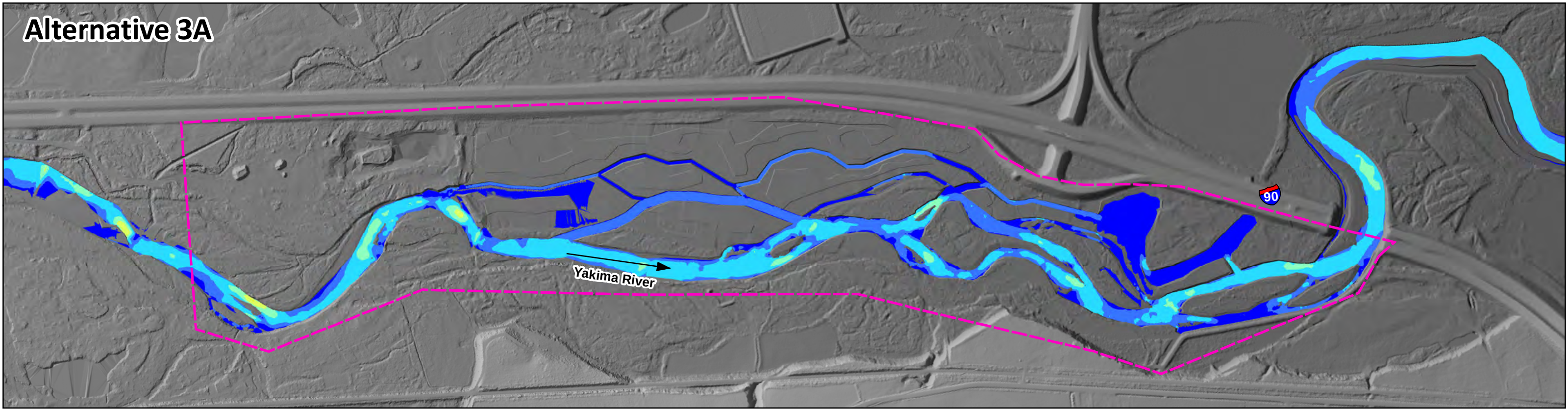
Hanson Ponds Reach Assessment

Median October Flow (615 cfs)

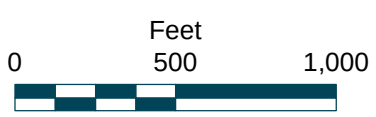
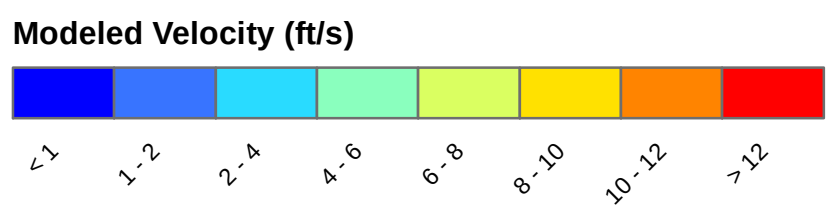
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Alternative 3A



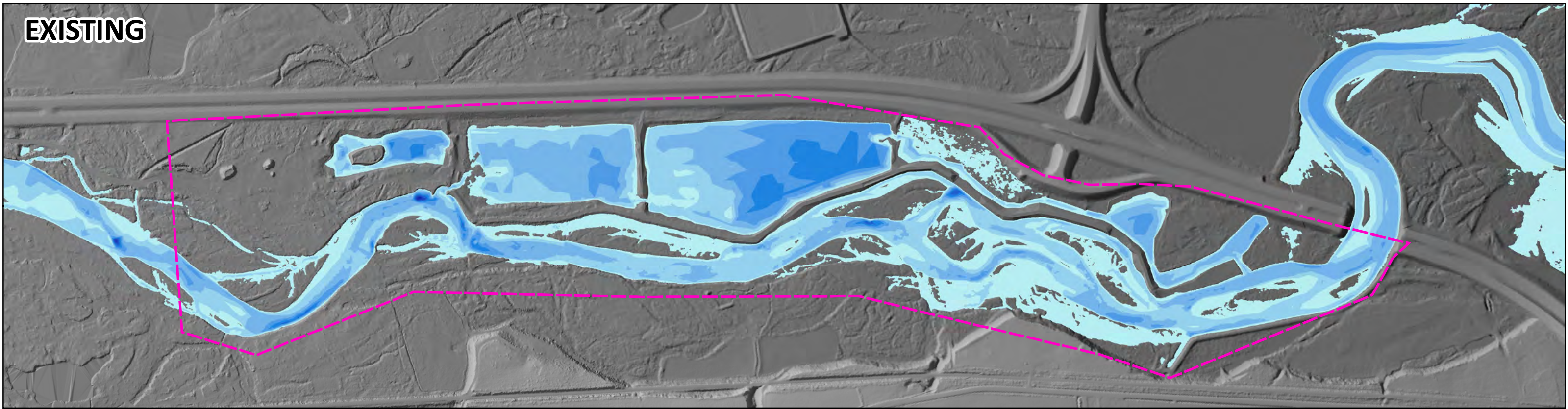
 Project Area



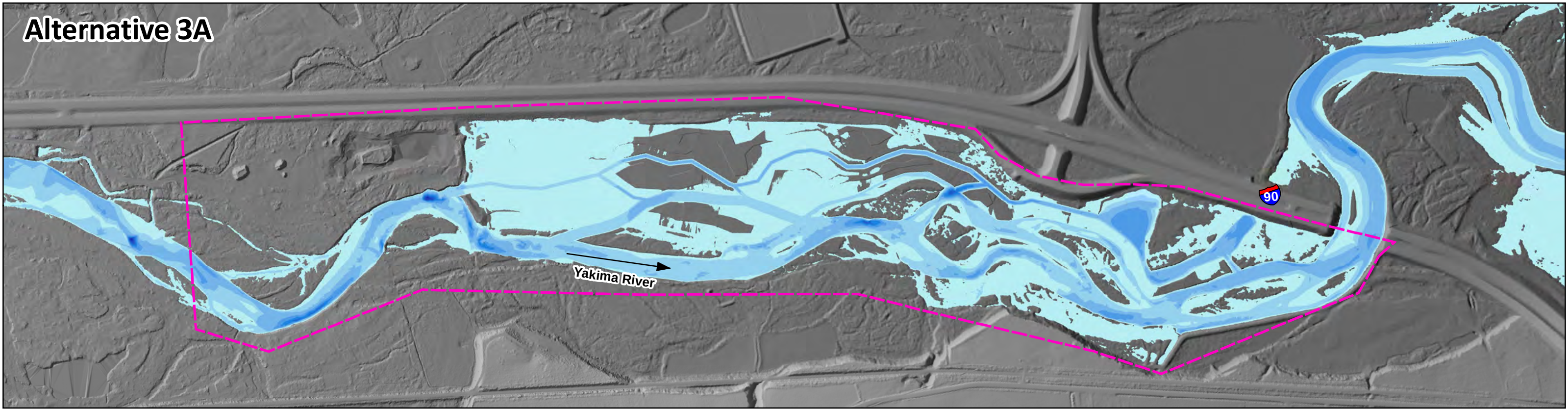
Hanson Ponds Reach Assessment

Median October Flow (615 cfs)

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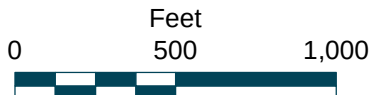
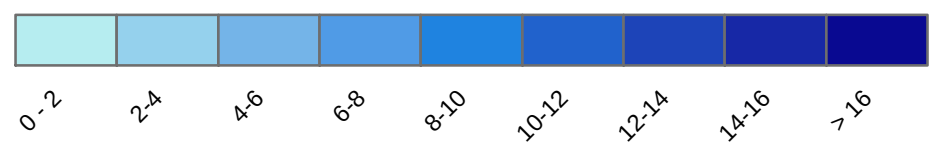


Alternative 3A



 Project Area

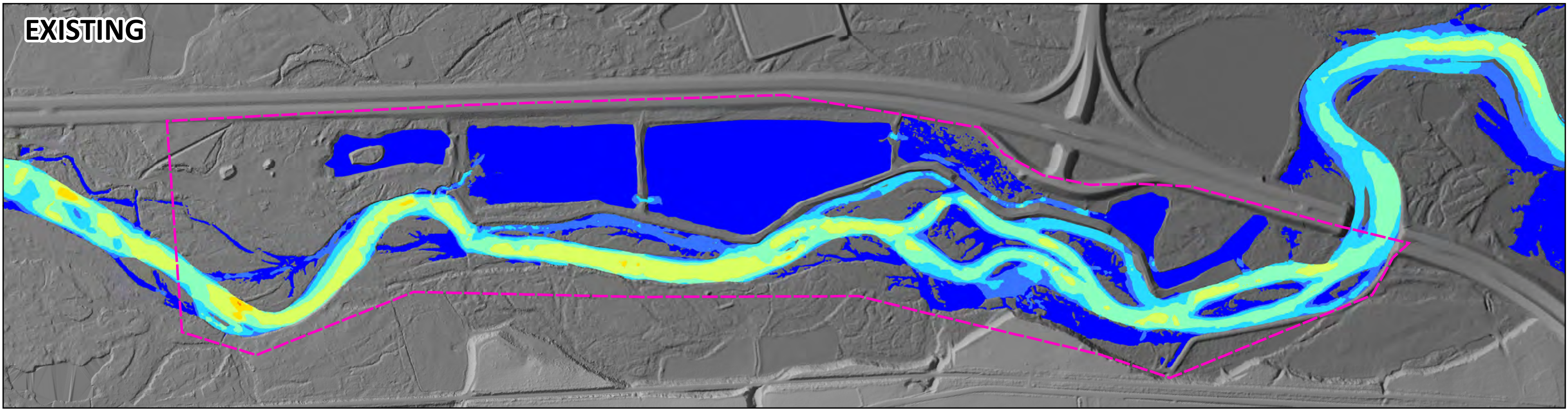
Modeled Depth (ft)



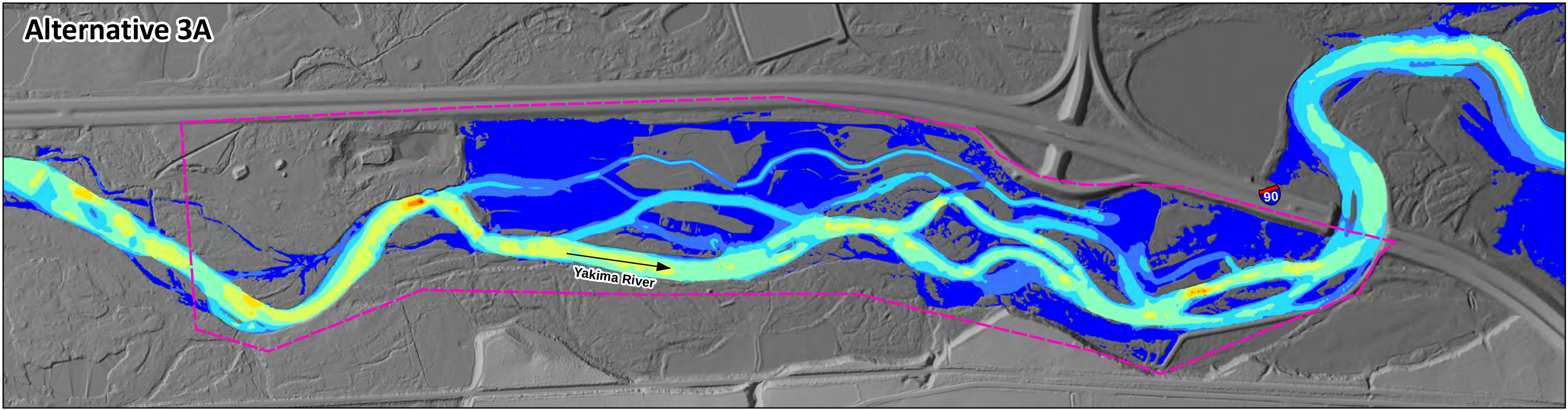
Hanson Ponds Reach Assessment

Median July Flow (3,660 cfs)

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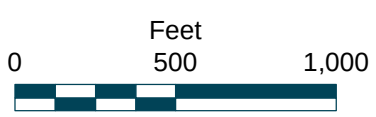
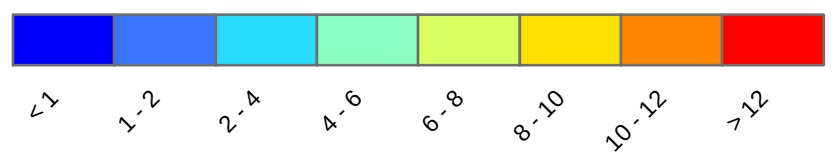


Alternative 3A



 Project Area

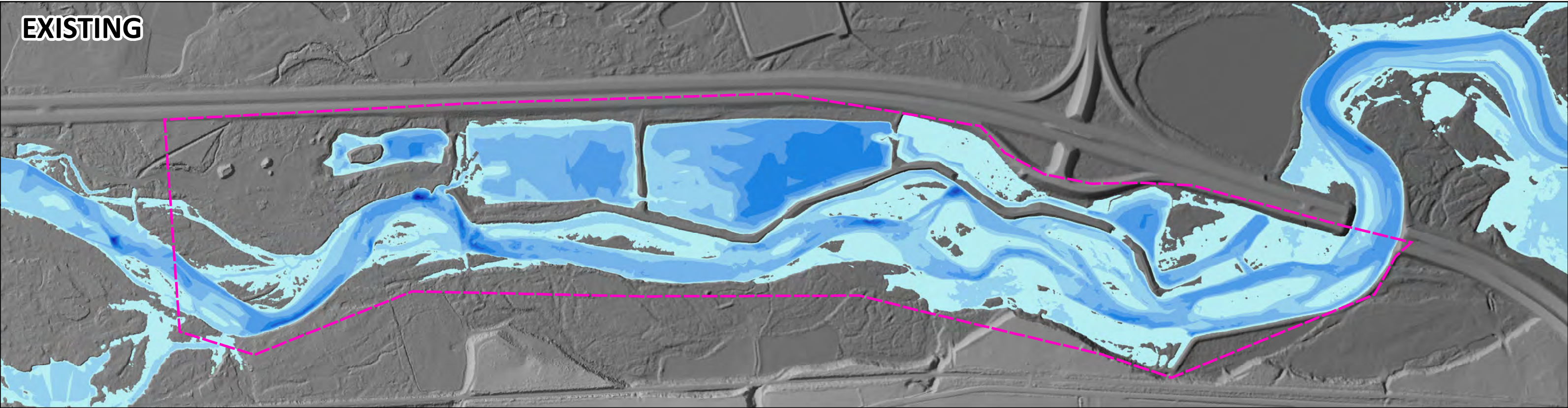
Modeled Velocity (ft/s)



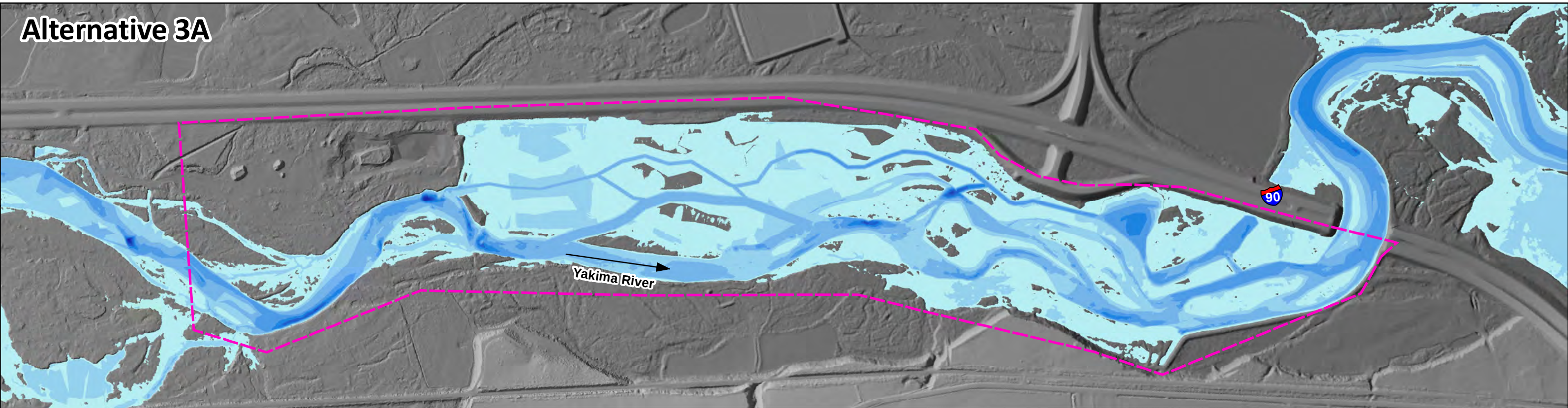
Hanson Ponds Reach Assessment

Median July Flow (3,660 cfs)

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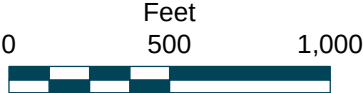
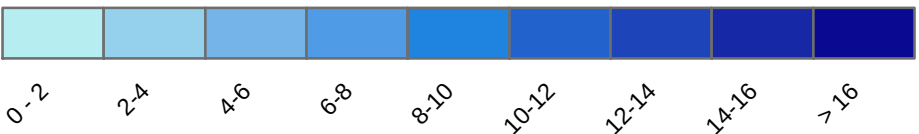


Alternative 3A



 Project Area

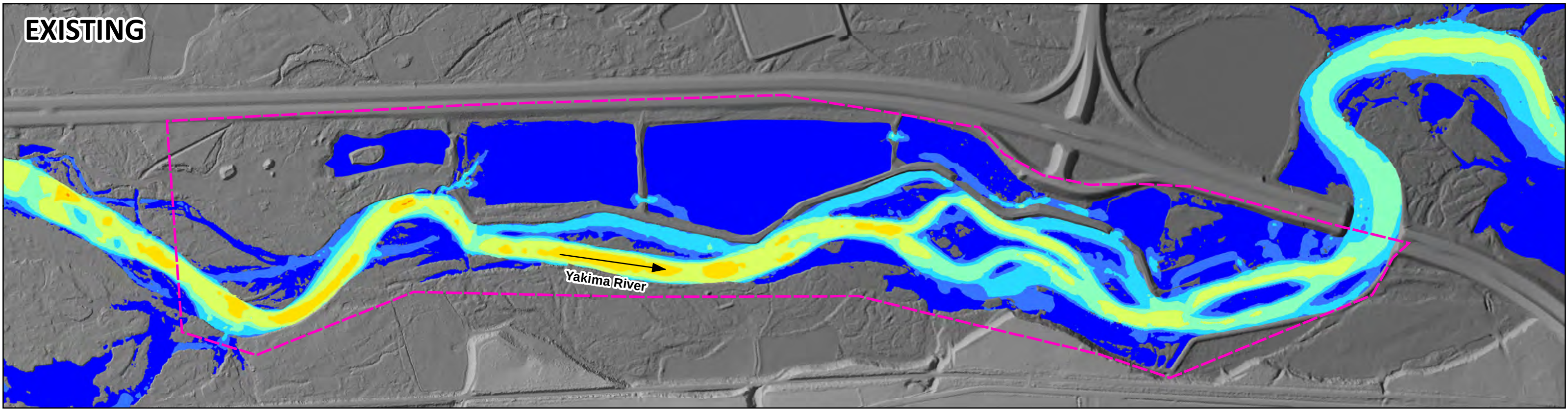
Modeled Depth (ft)



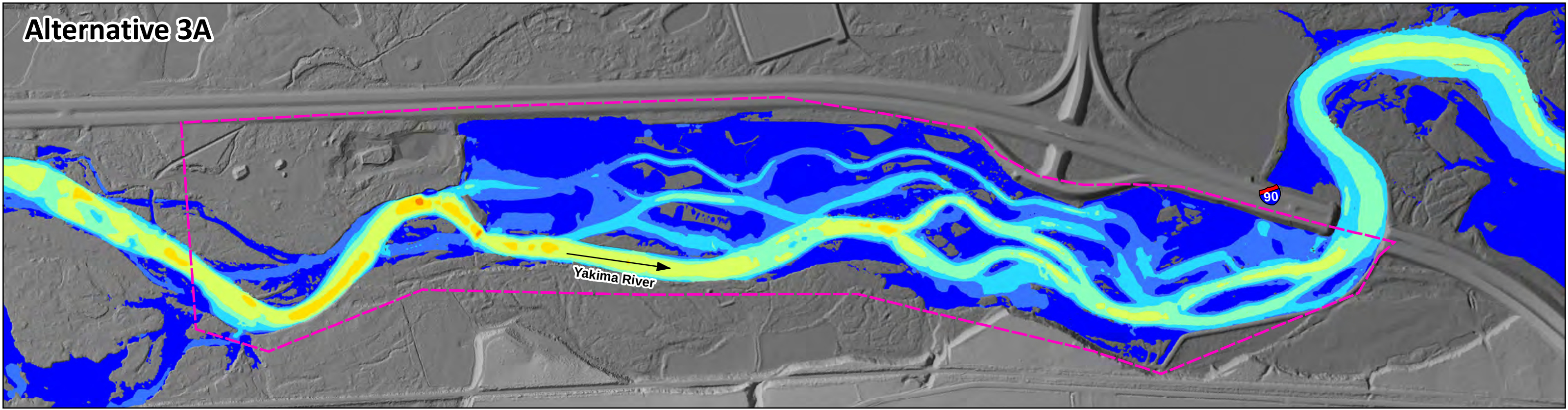
Hanson Ponds Reach Assessment

2-year Flood (5,915 cfs)

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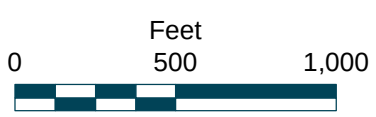
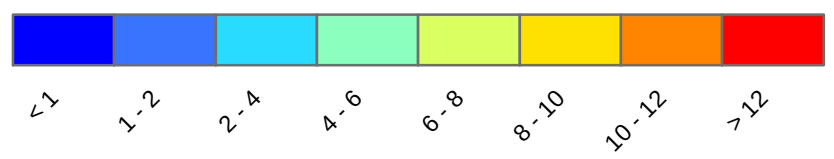


Alternative 3A



 Project Area

Modeled Velocity (ft/s)

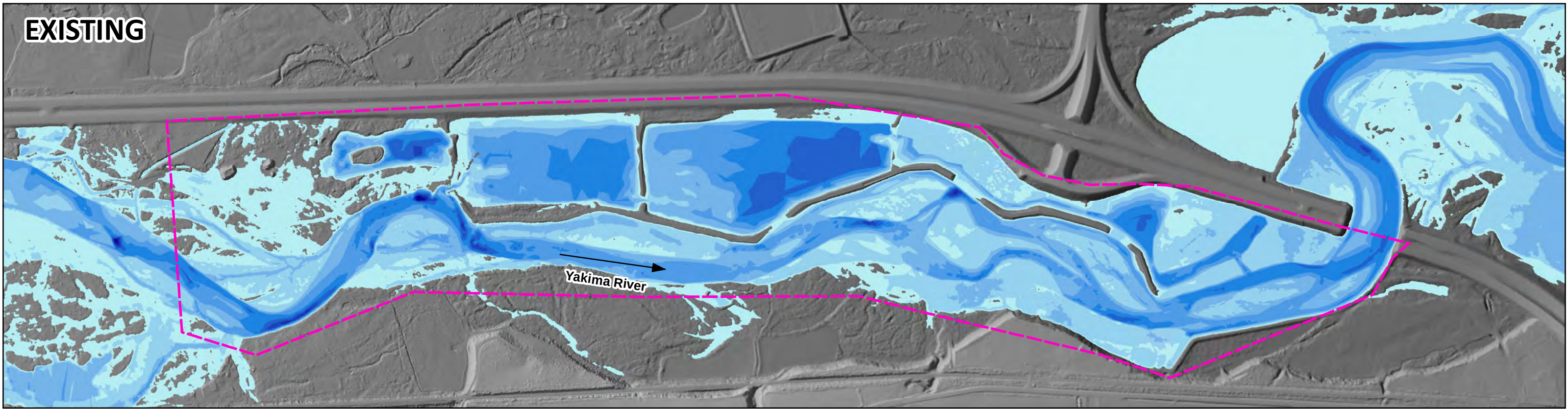


Hanson Ponds Reach Assessment

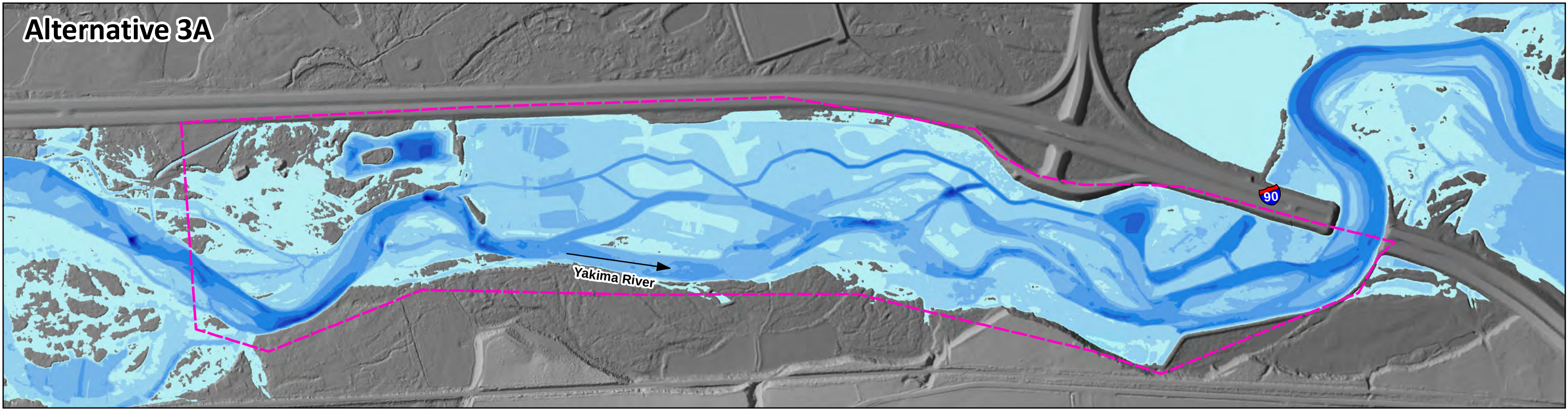
2-year Flood (5,915 cfs)

Yakima River
Cle Elum, WA
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EXISTING

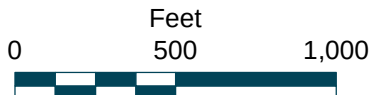
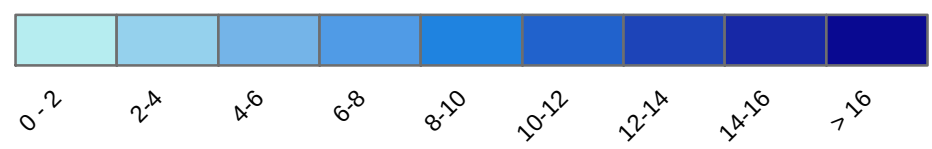


Alternative 3A



 Project Area

Modeled Depth (ft)

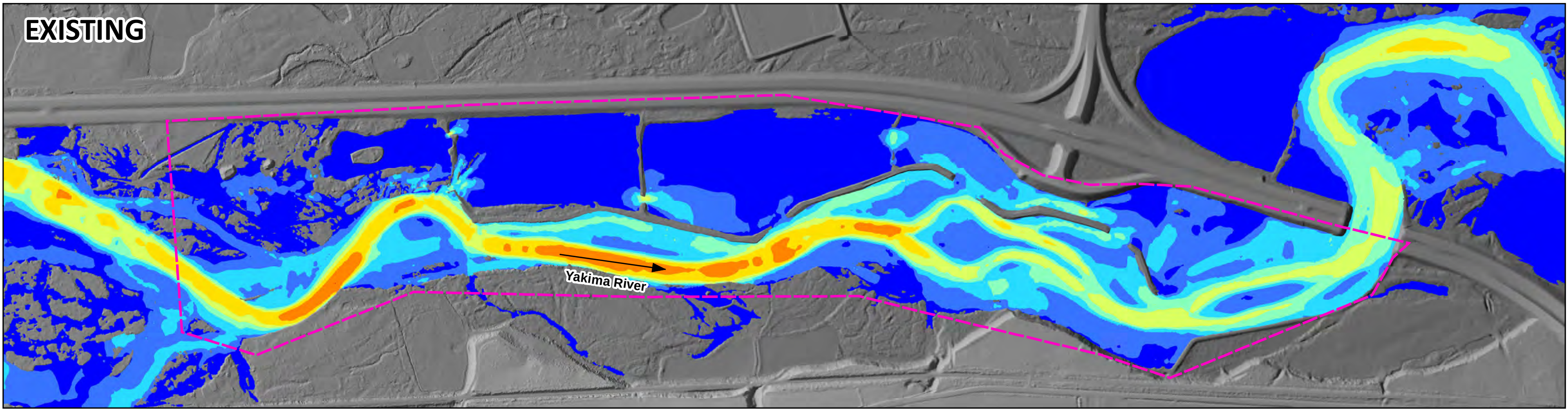


Hanson Ponds Reach Assessment

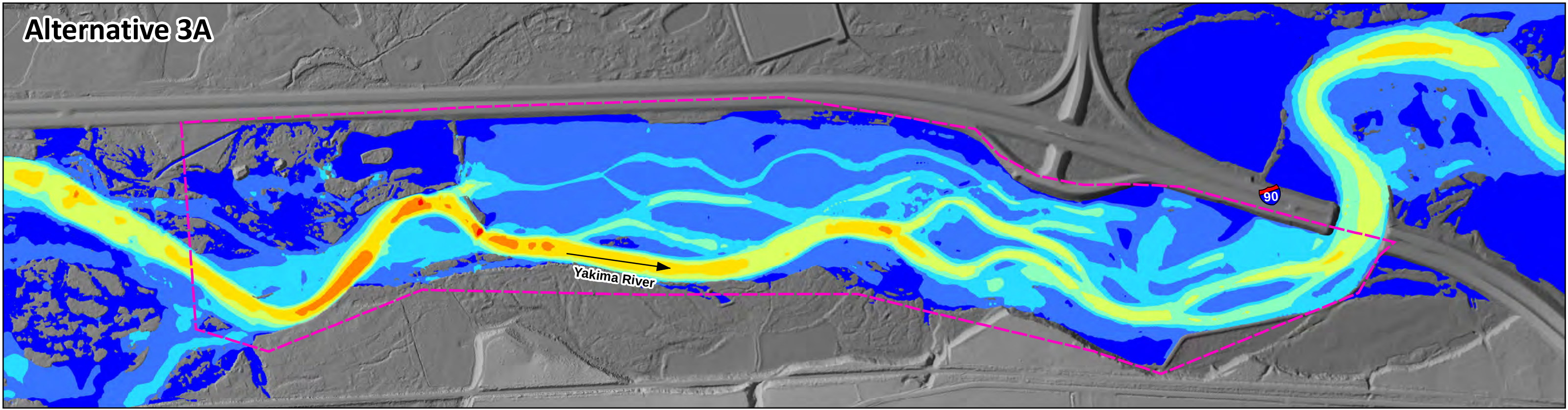
25-year Flood (12,220 cfs)

Yakima River
Cle Elum, WA

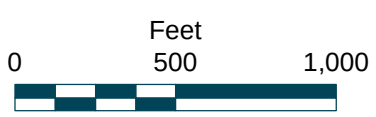
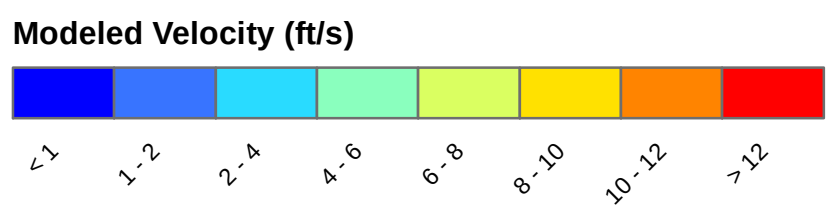
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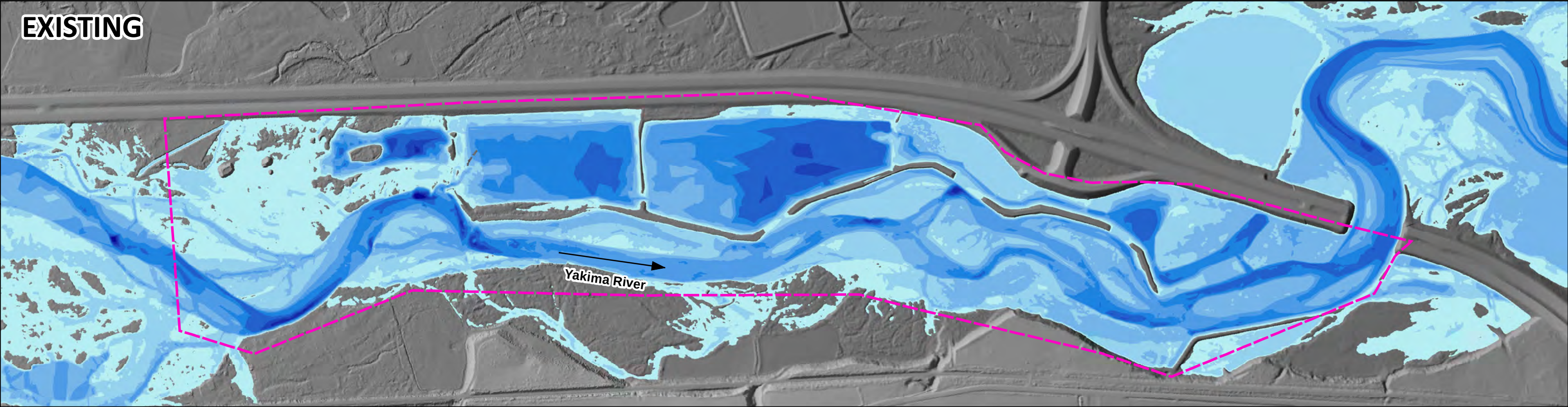
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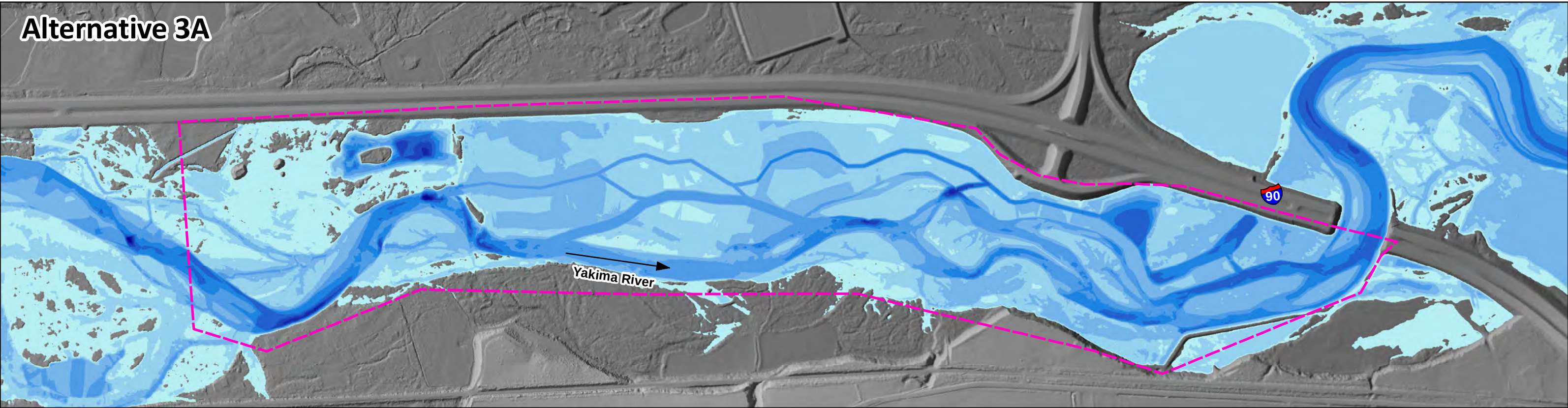
Hanson Ponds Reach Assessment

25-year Flood (12,220 cfs)

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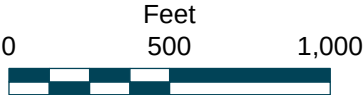
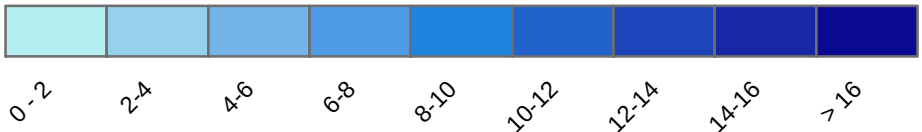


Alternative 3A



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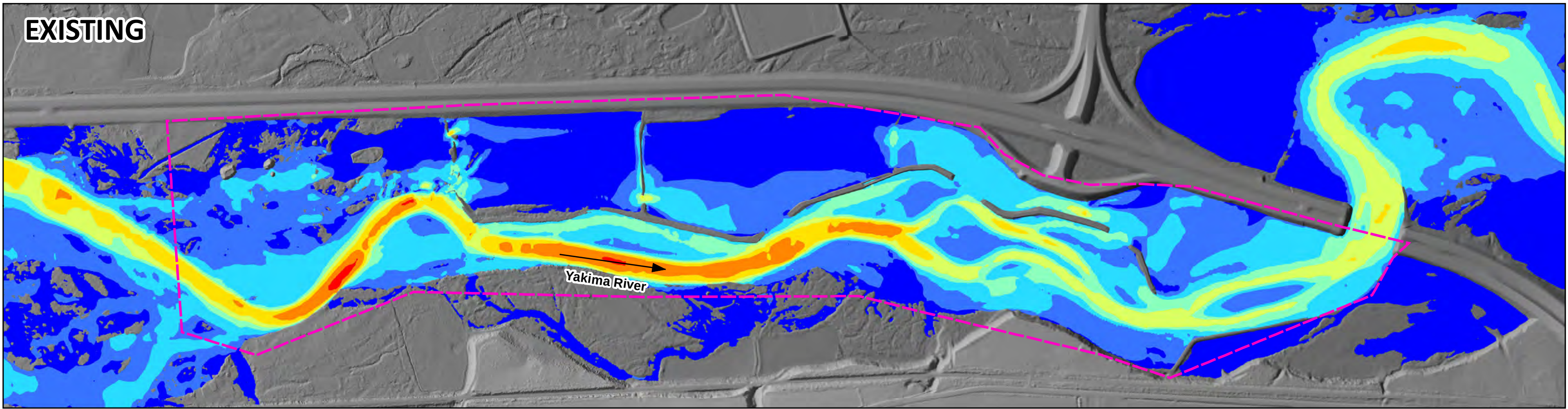
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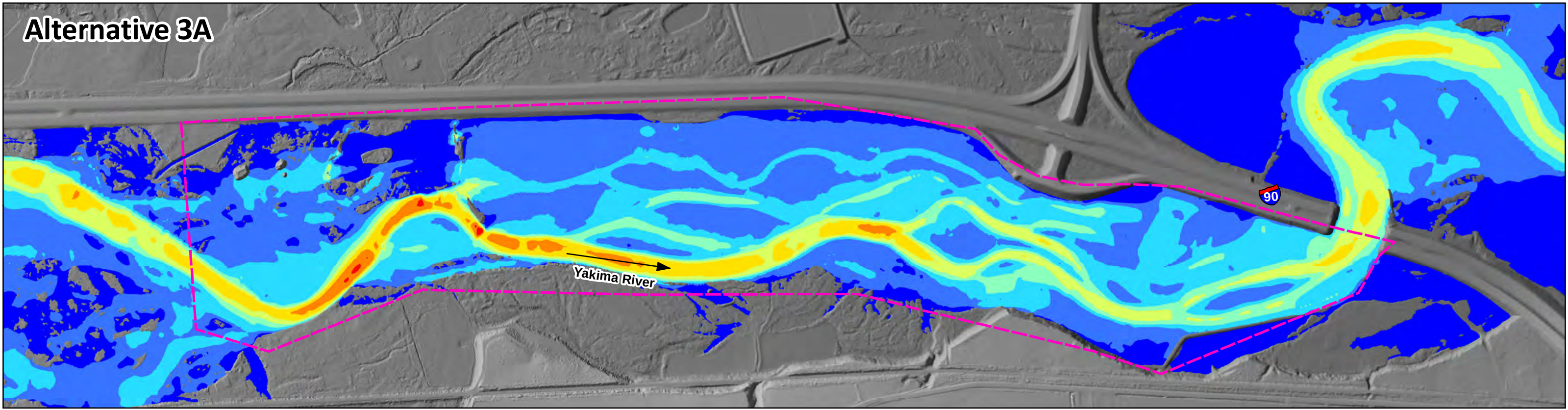
Hanson Ponds Reach Assessment

100-year Flood (15,670 cfs)

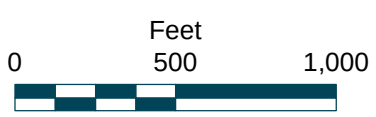
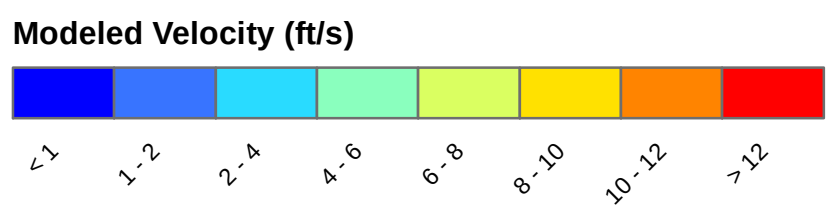
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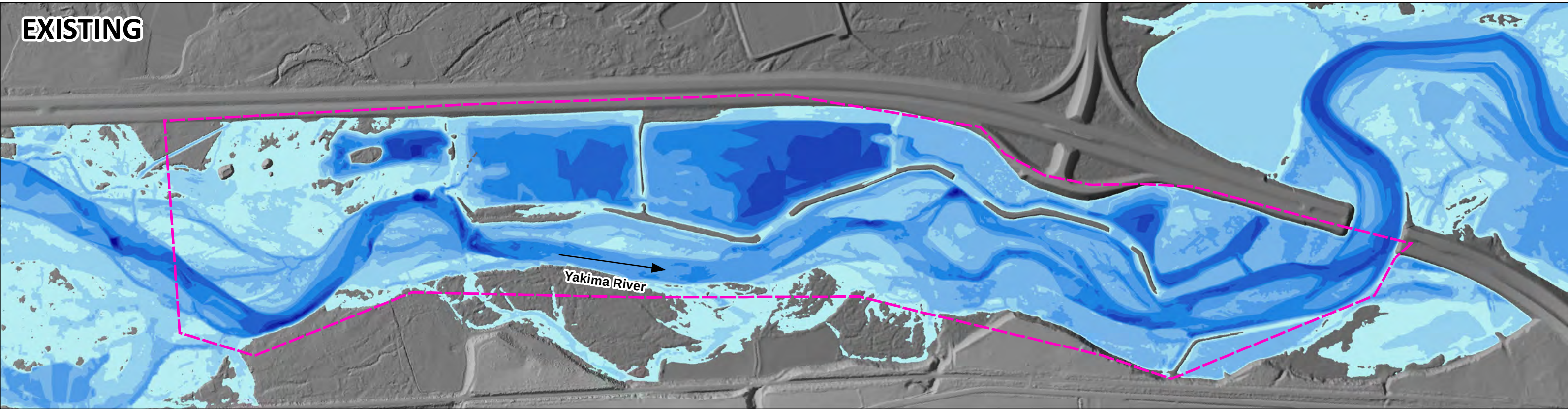
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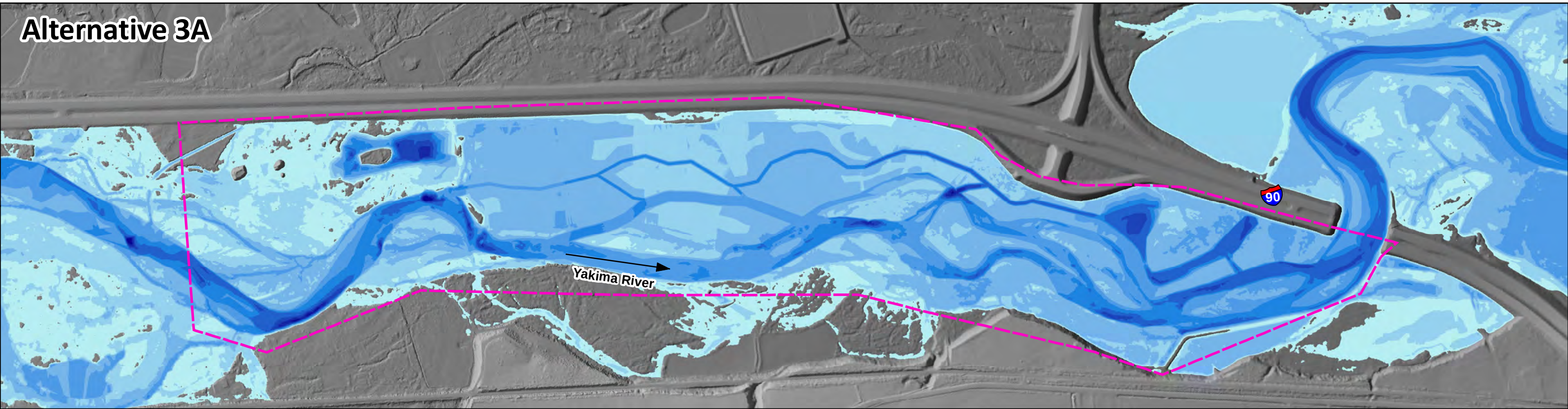
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100-year Flood (15,670 cfs)

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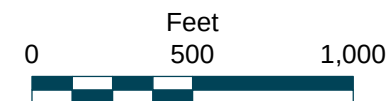
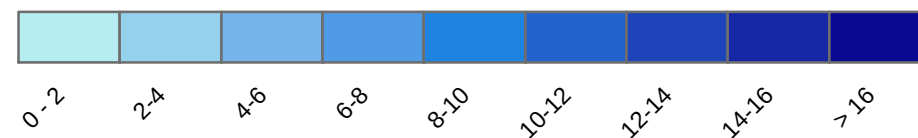


Alternative 3A



 Project Area

Modeled Depth (ft)

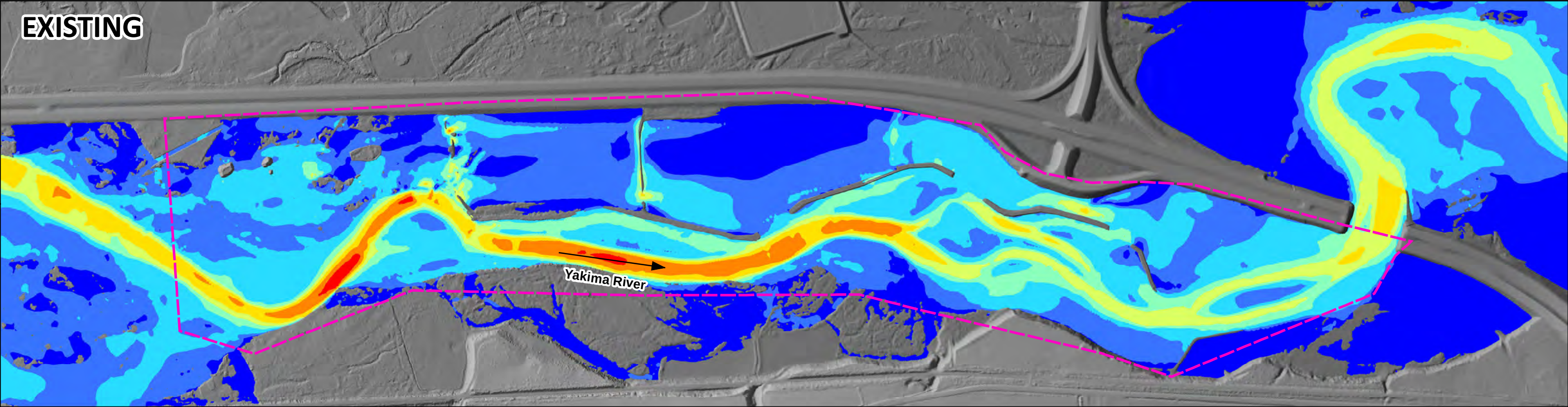


Hanson Ponds Reach Assessment

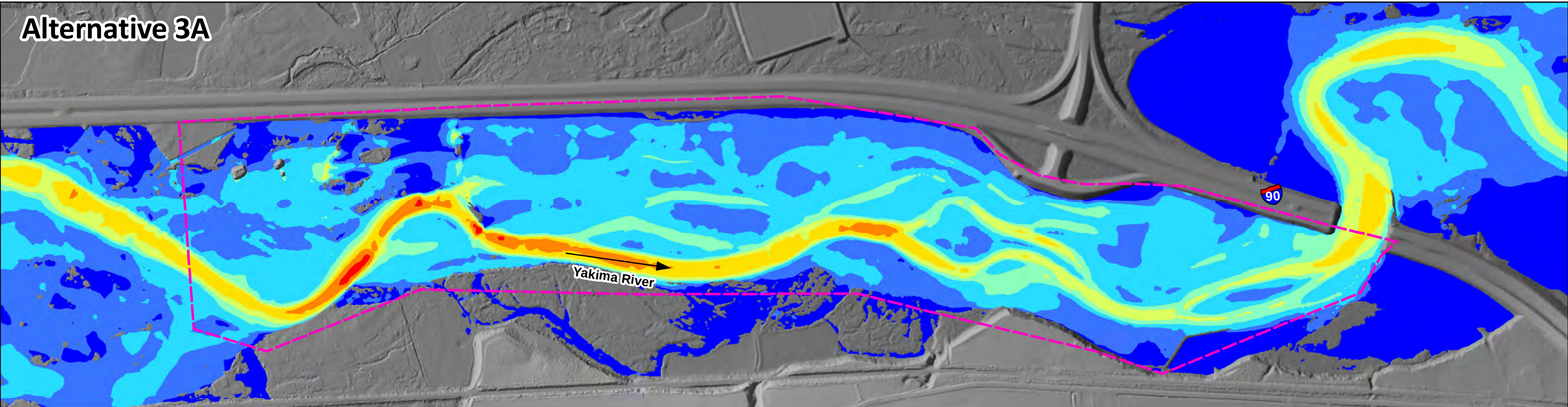
FEMA 100-year Flood (19,828 cfs)

Yakima River
Cle Elum, WA
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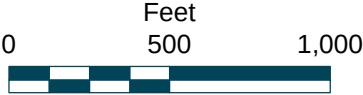


Alternative 3A



Project Area

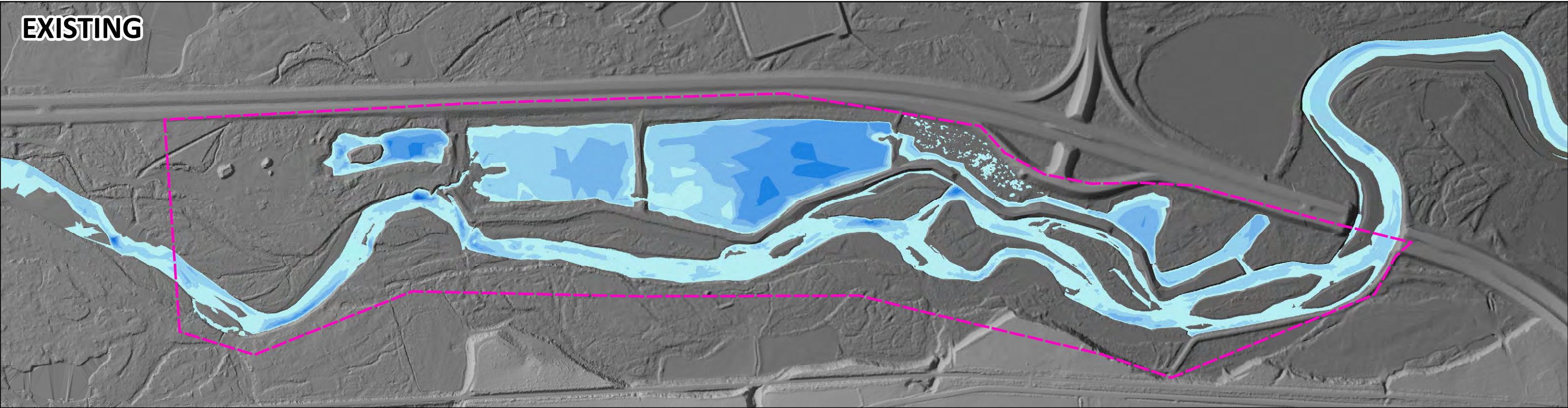
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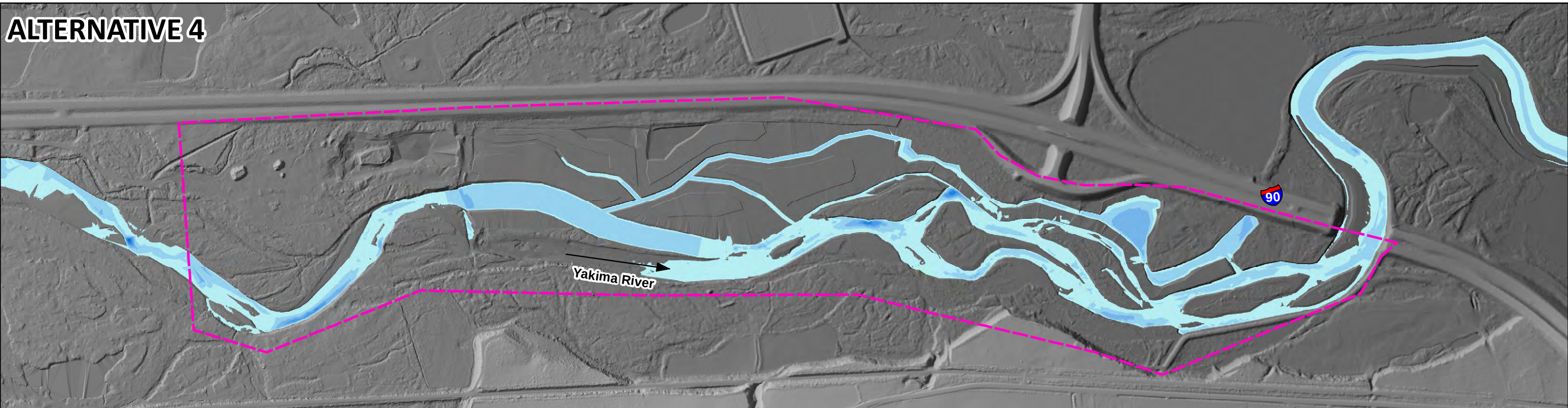
Hanson Ponds Reach Assessment

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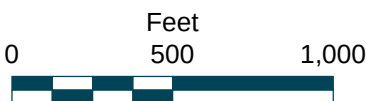
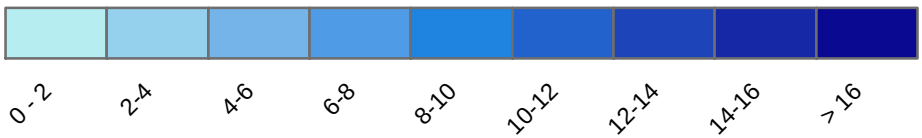


ALTERNATIVE 4



 Project Area

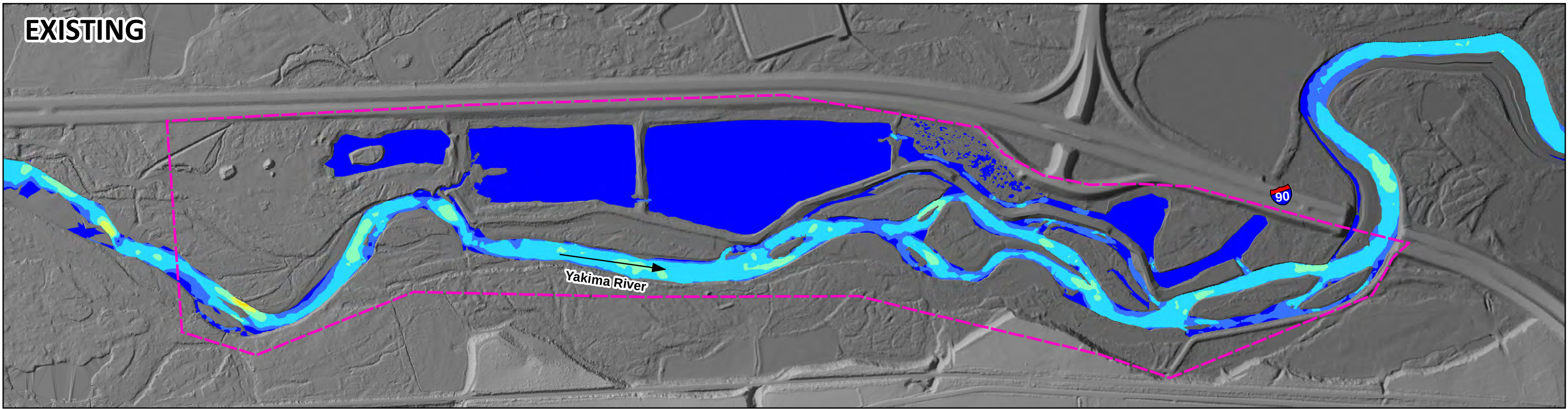
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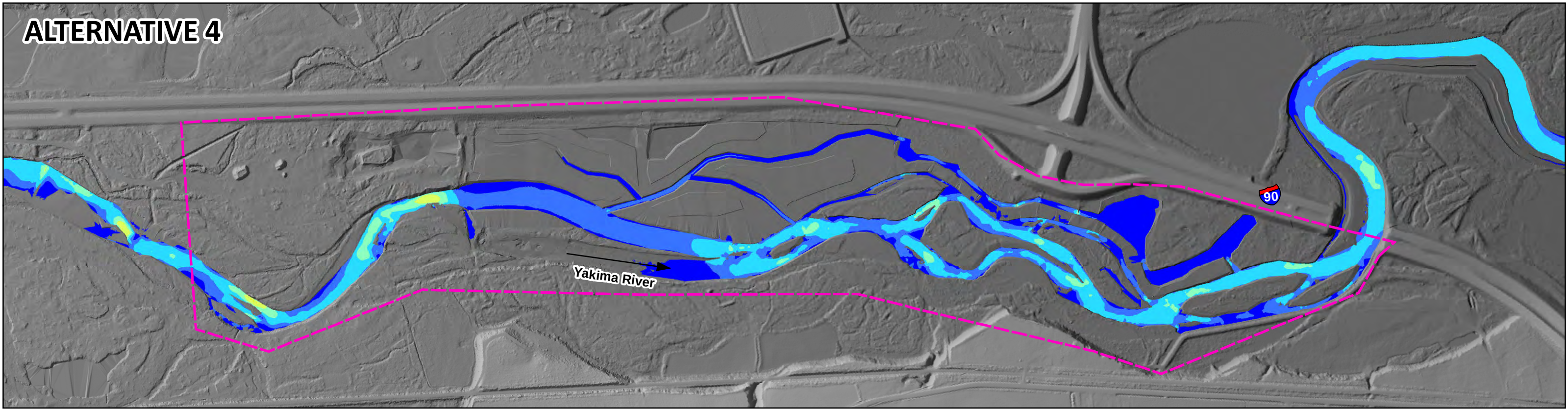
Hanson Ponds Reach Assessment

Median October Flow (615 cfs)

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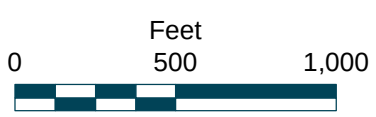
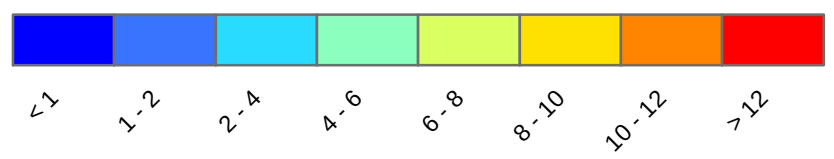


ALTERNATIVE 4



 Project Area

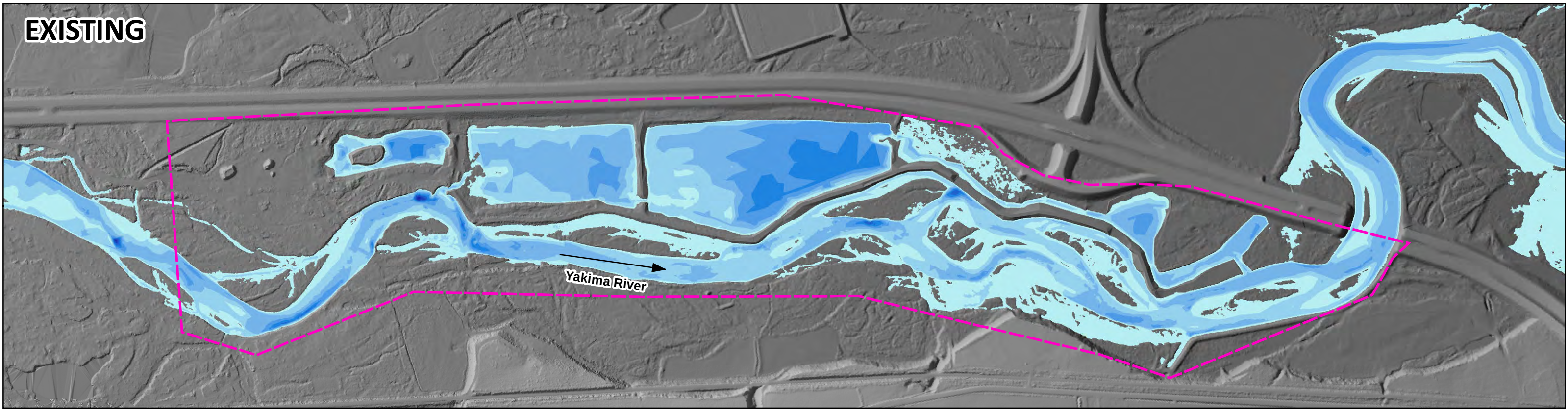
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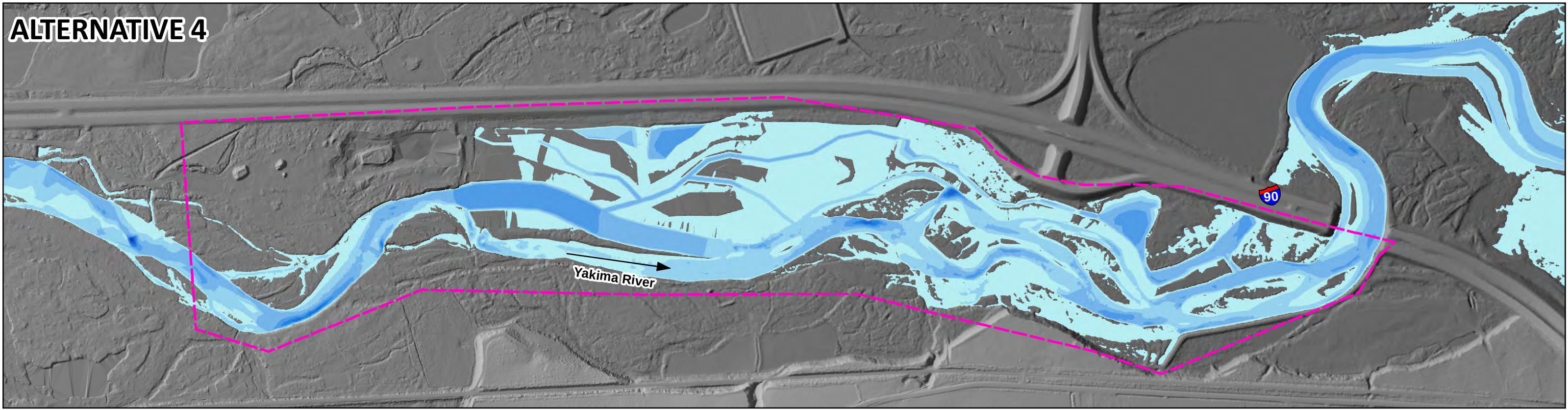
Hanson Ponds Reach Assessment

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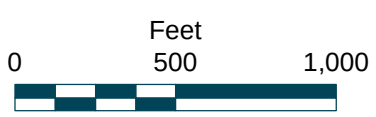
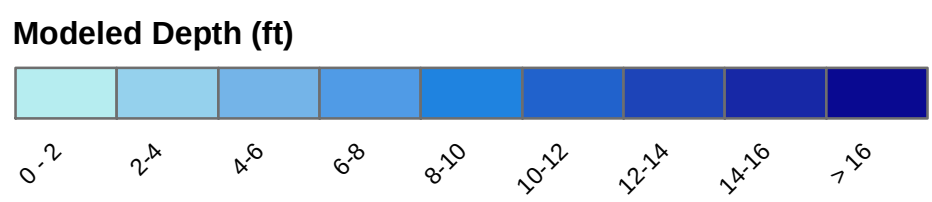
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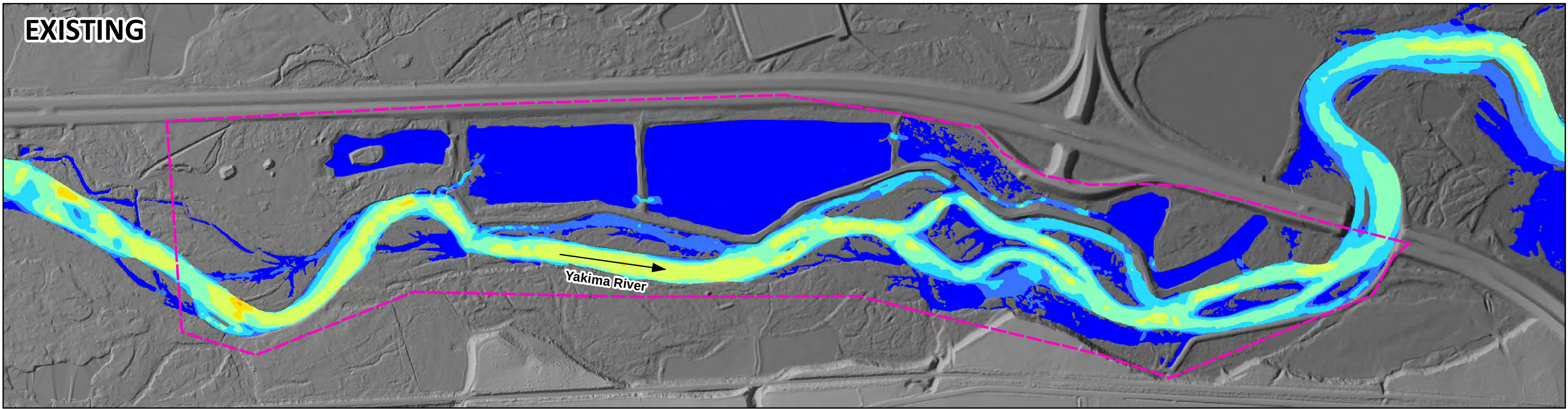
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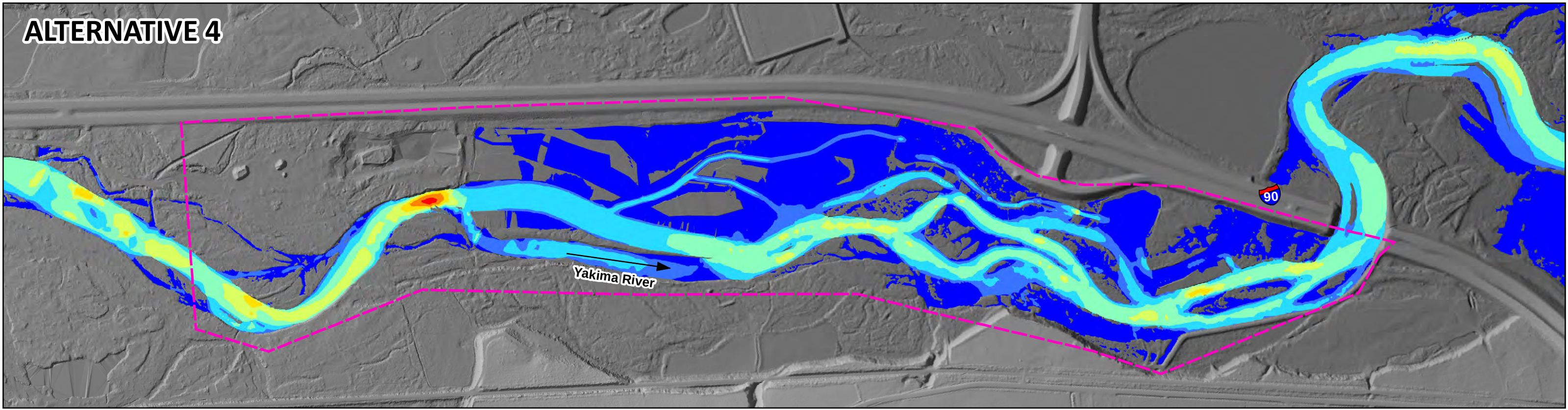
Hanson Ponds Reach Assessment

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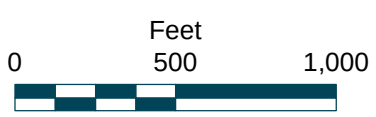
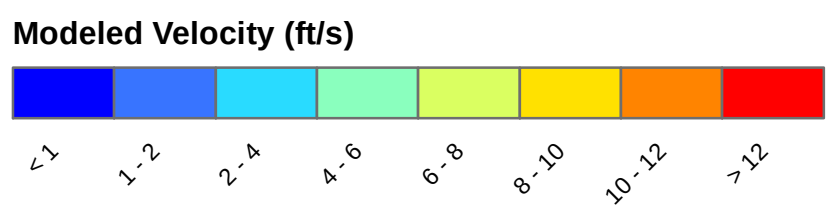
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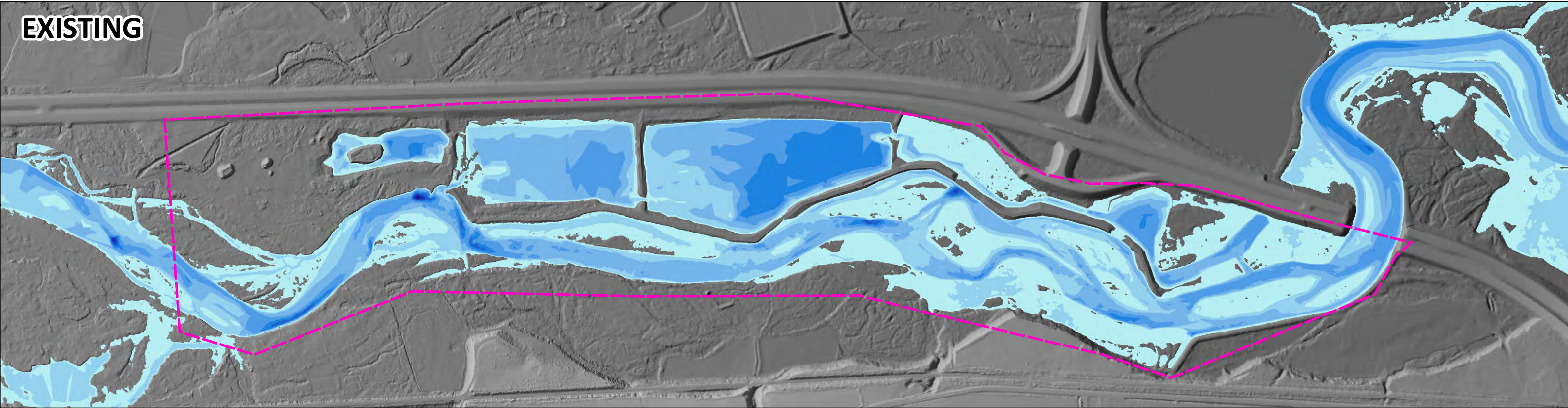
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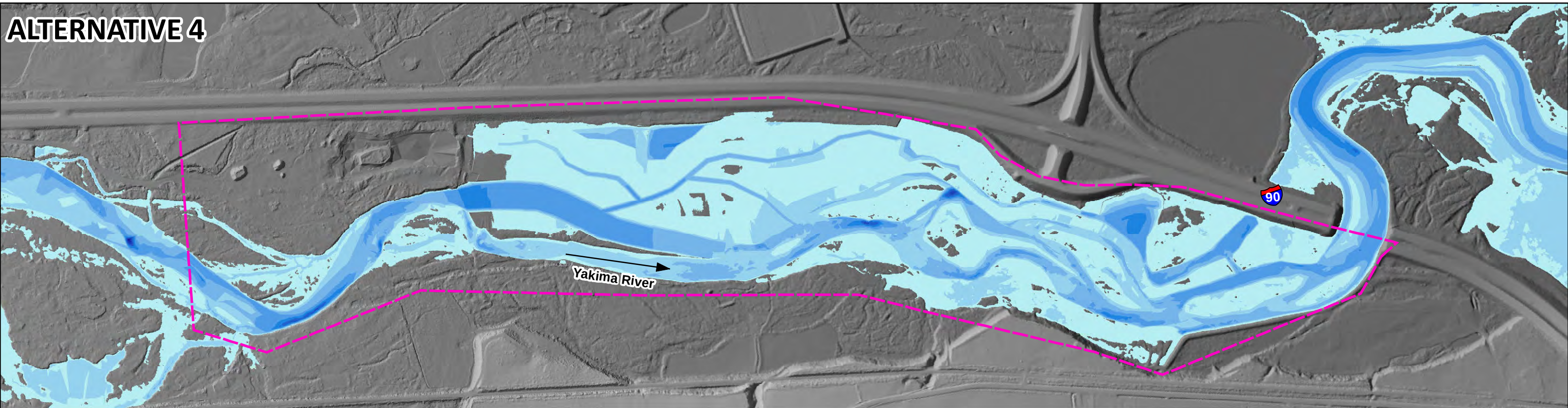
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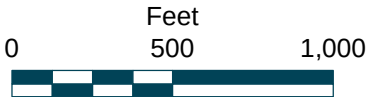
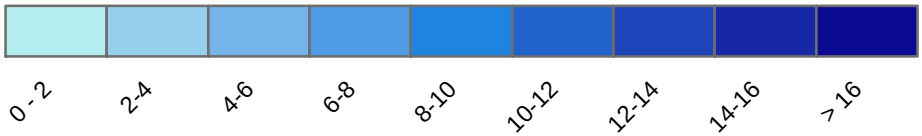


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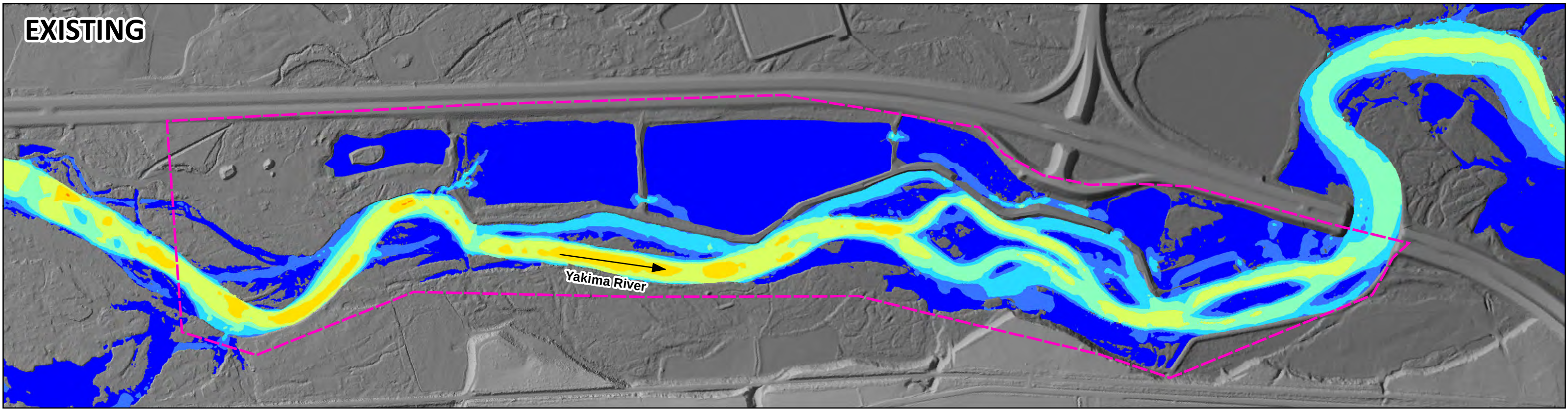
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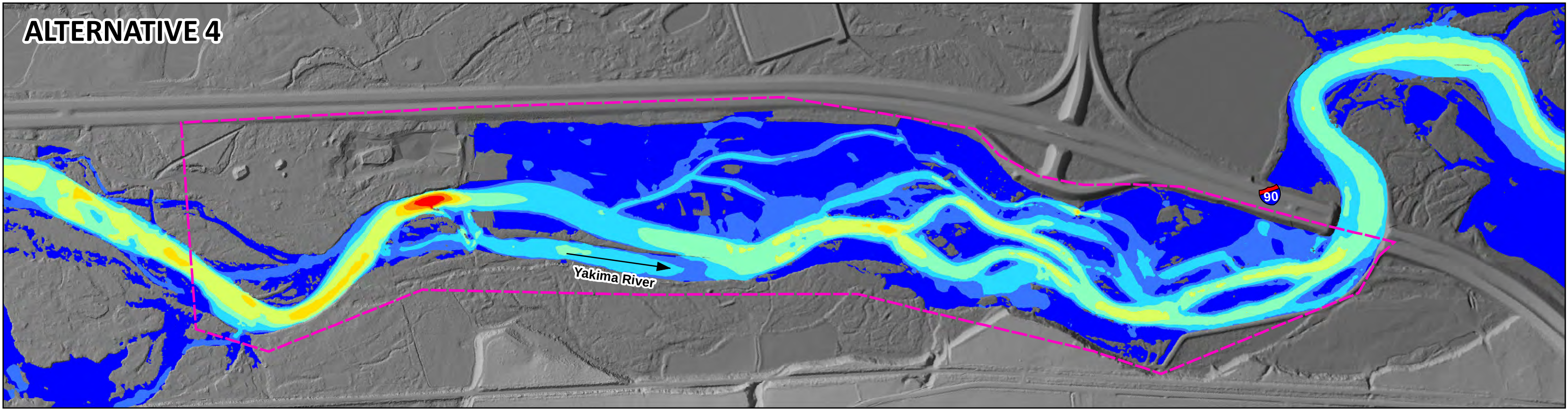
Hanson Ponds Reach Assessment

2-year Flood (5,915 cfs)

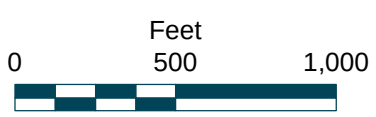
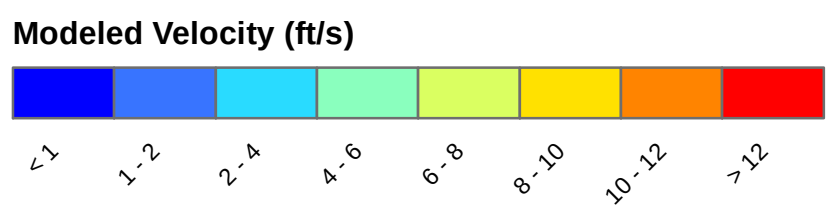
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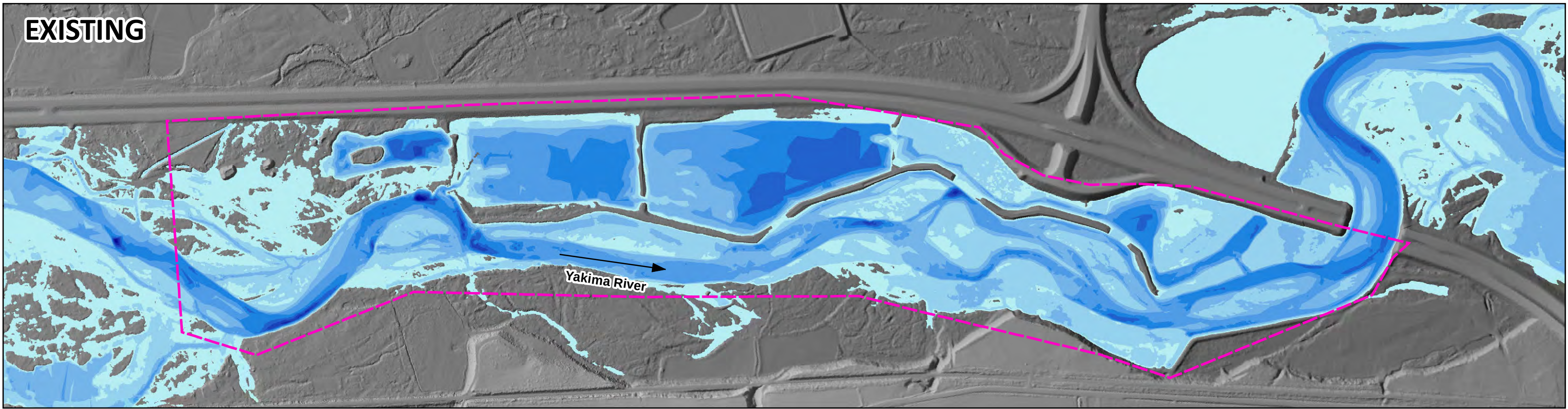
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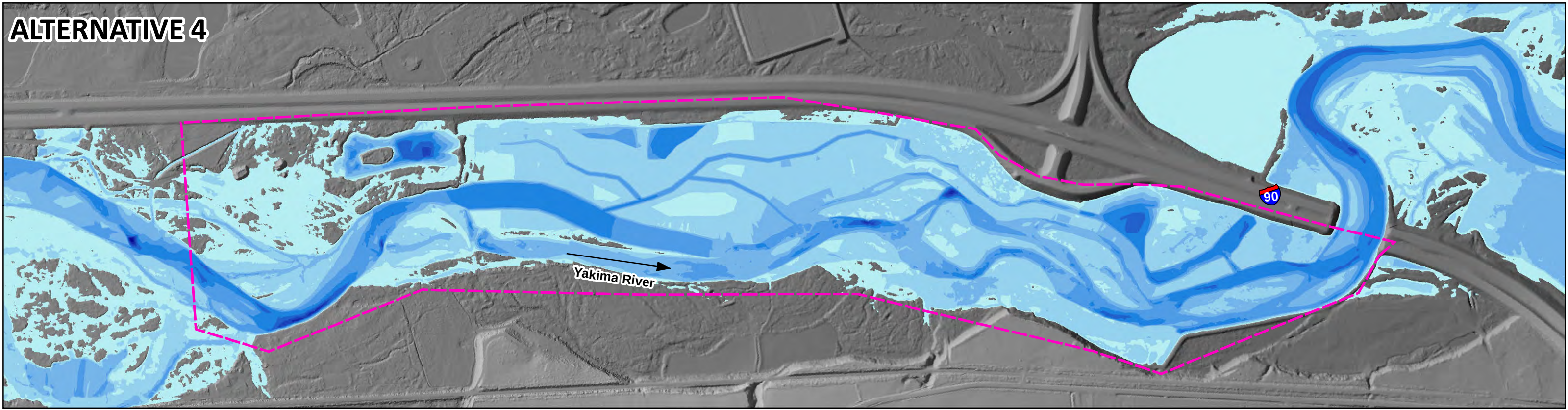
Hanson Ponds Reach Assessment

2-year Flood (5,915 cfs)

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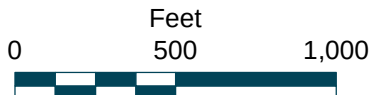
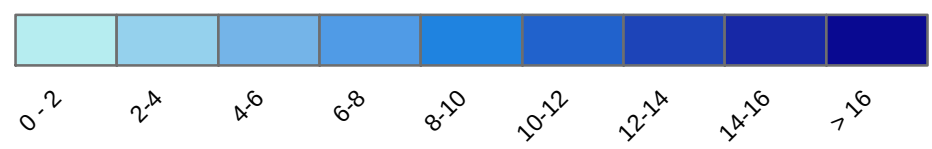


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 Project Area

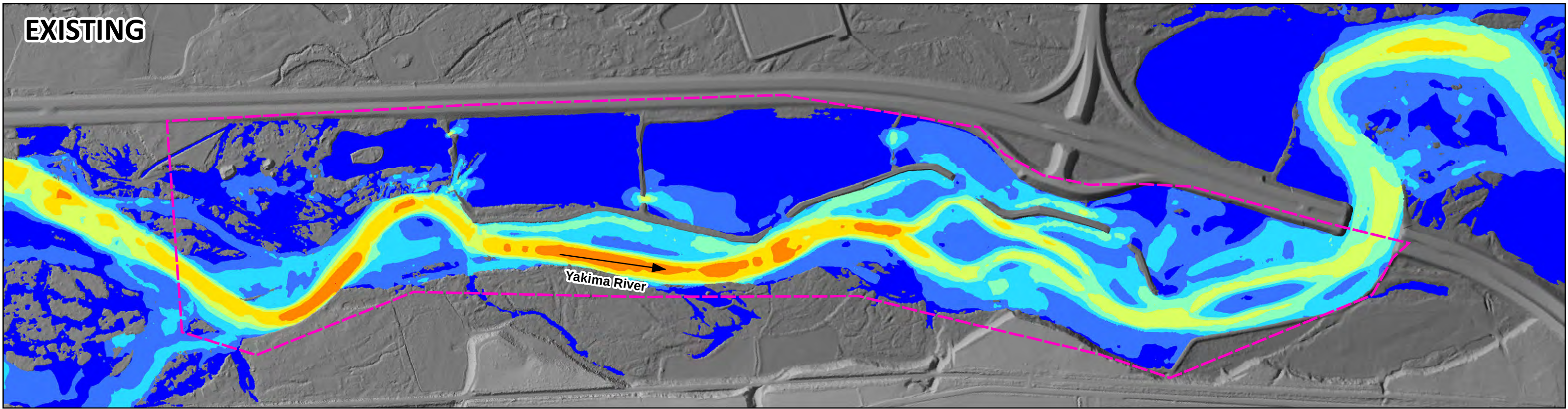
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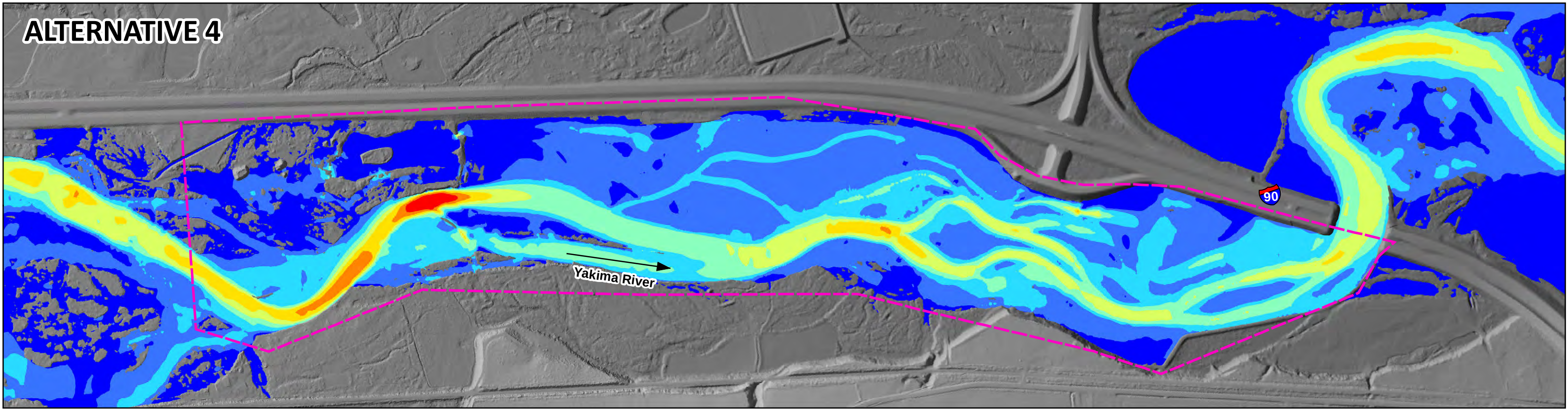
Hanson Ponds Reach Assessment

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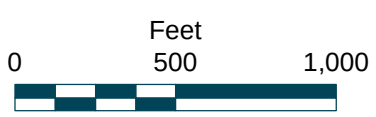
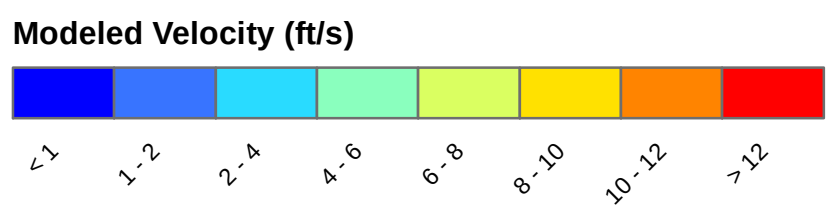
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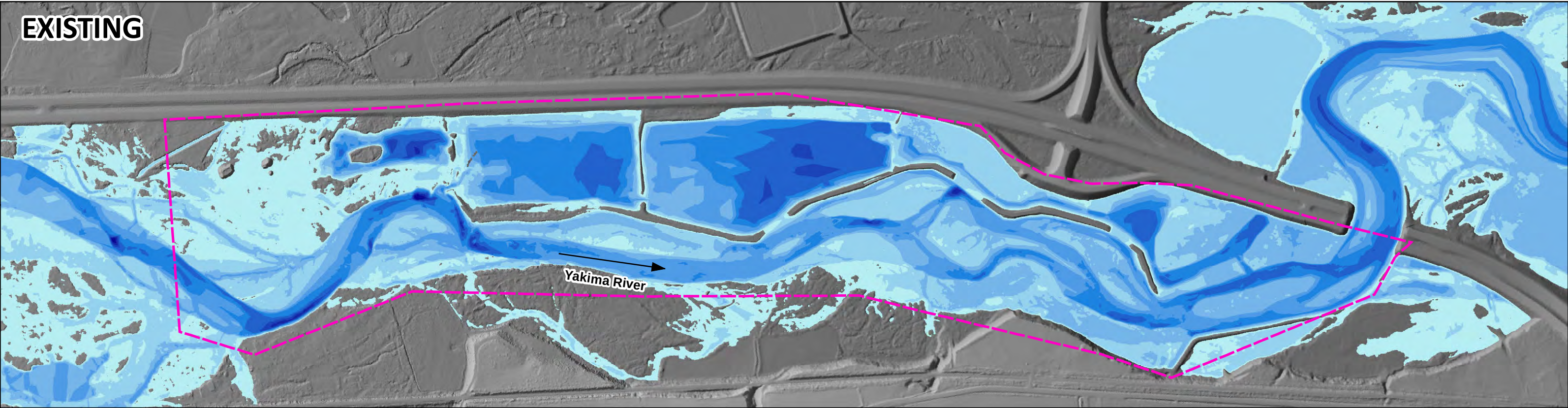
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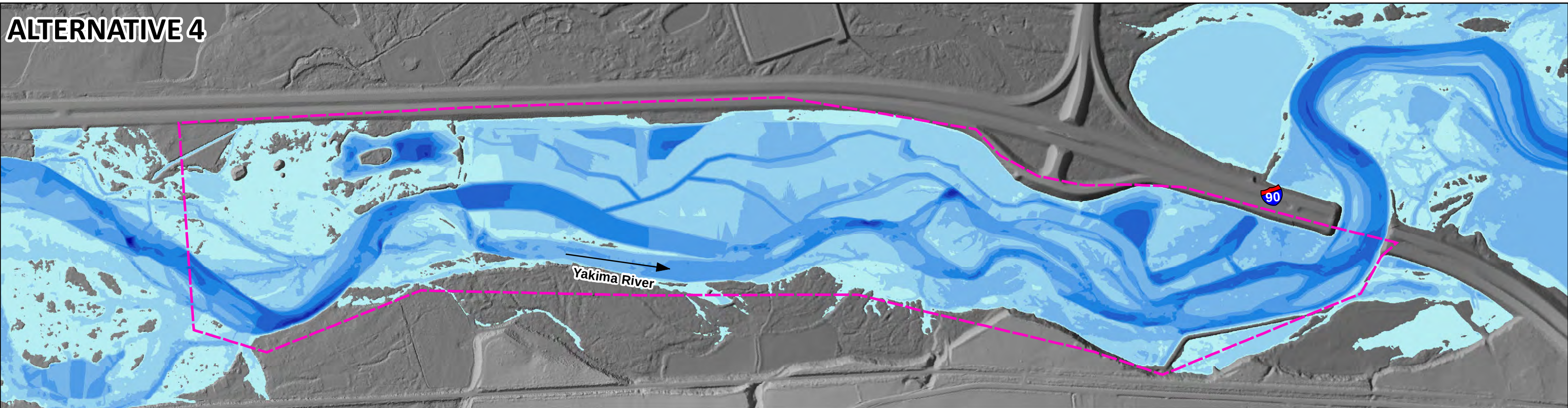
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25-year Flood (12,220 cfs)

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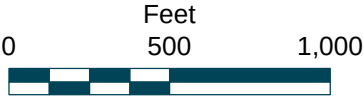
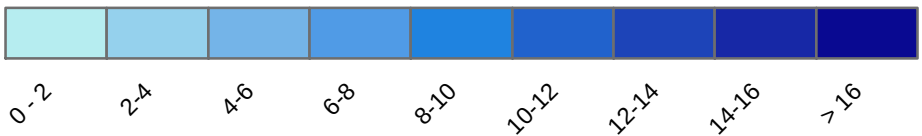


ALTERNATIVE 4



Project Area

Modeled Depth (ft)

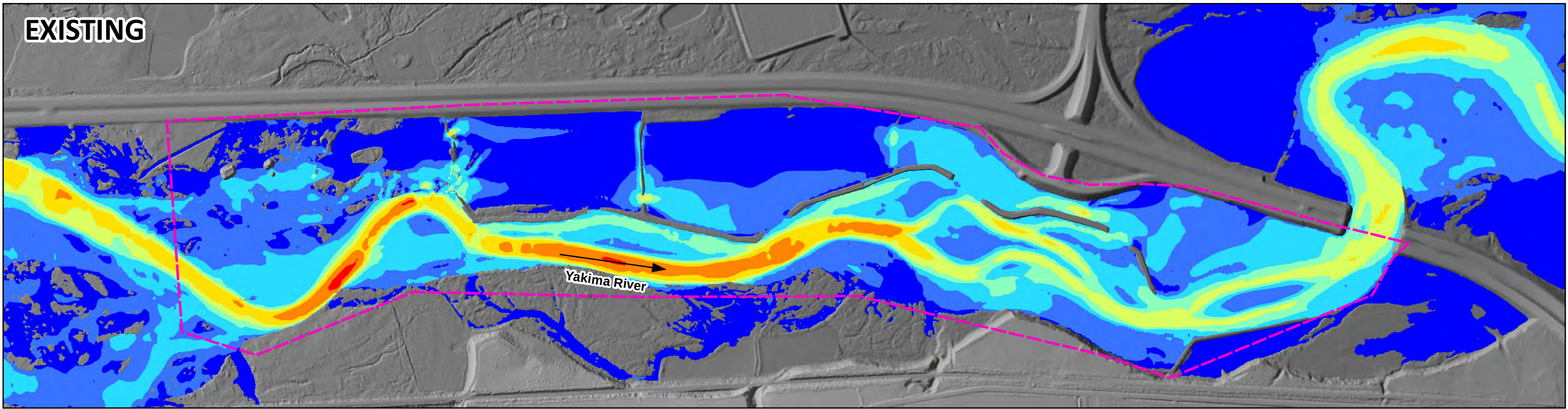


Hanson Ponds Reach Assessment

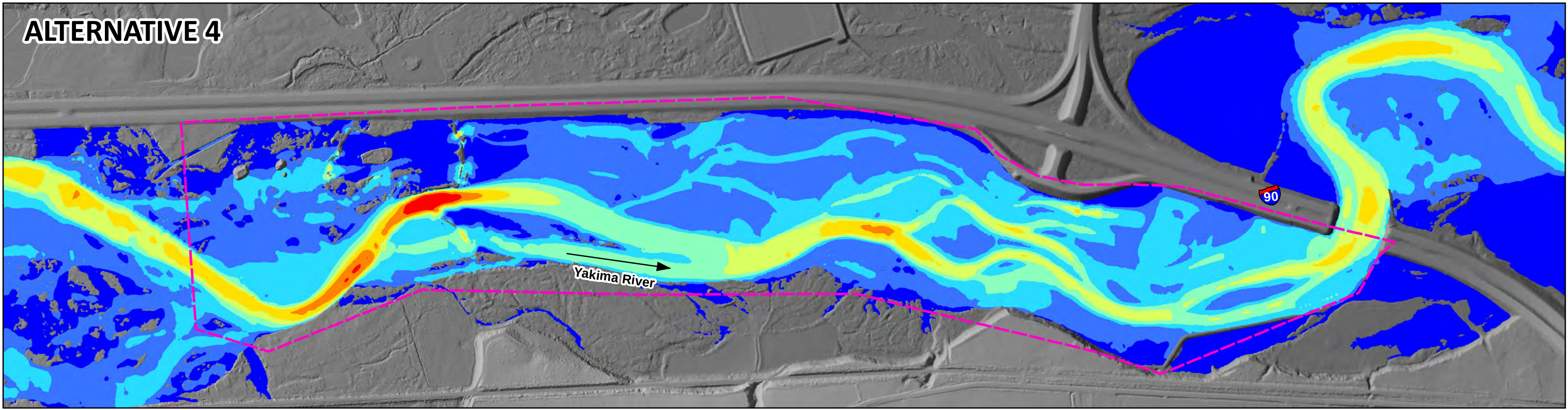
100-year Flood (15,670 cfs)

Yakima River
Cle Elum, WA
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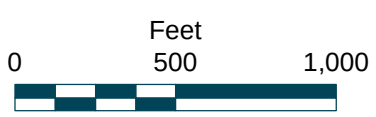
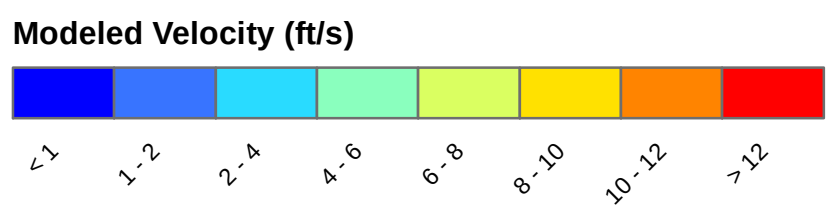
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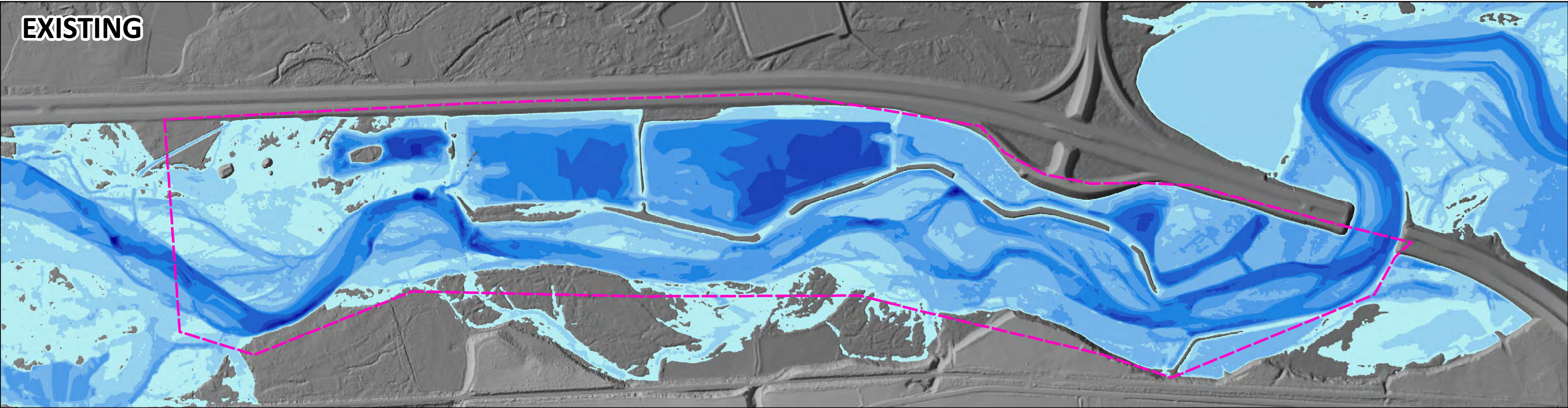
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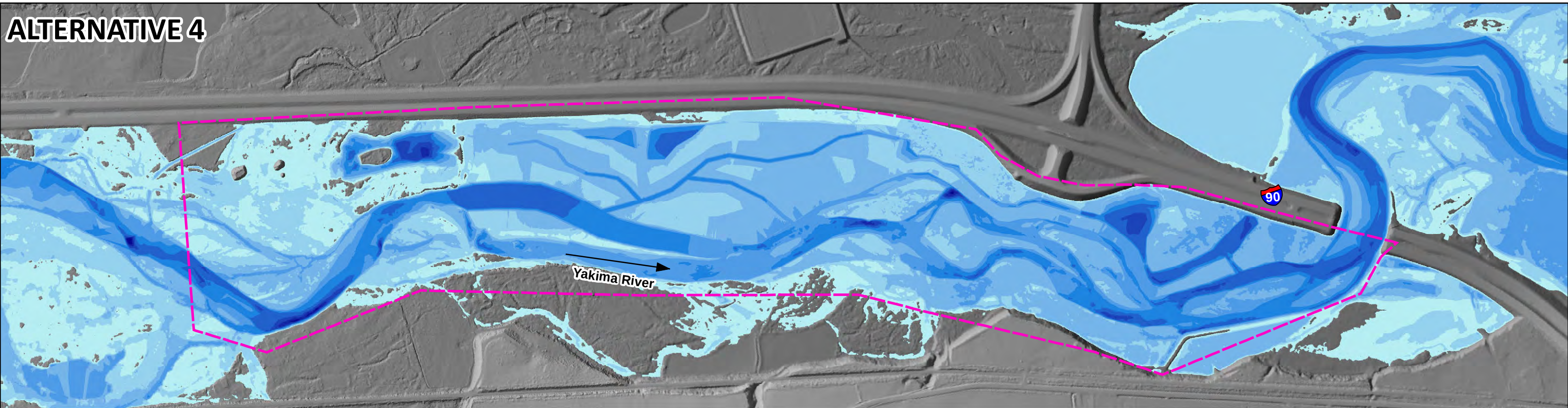
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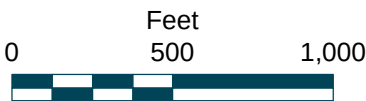
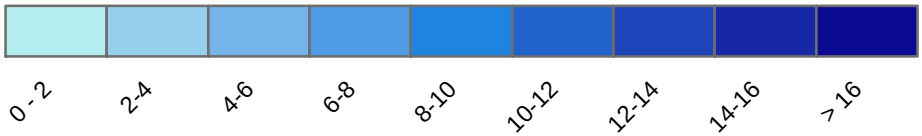


ALTERNATIVE 4



 Project Area

Modeled Depth (ft)

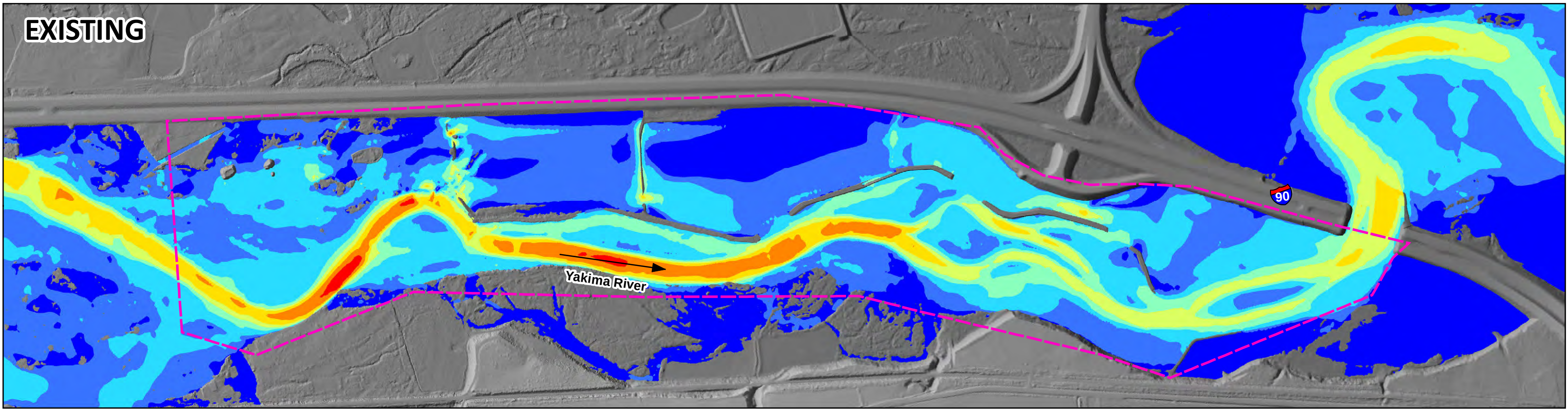


Hanson Ponds Reach Assessment

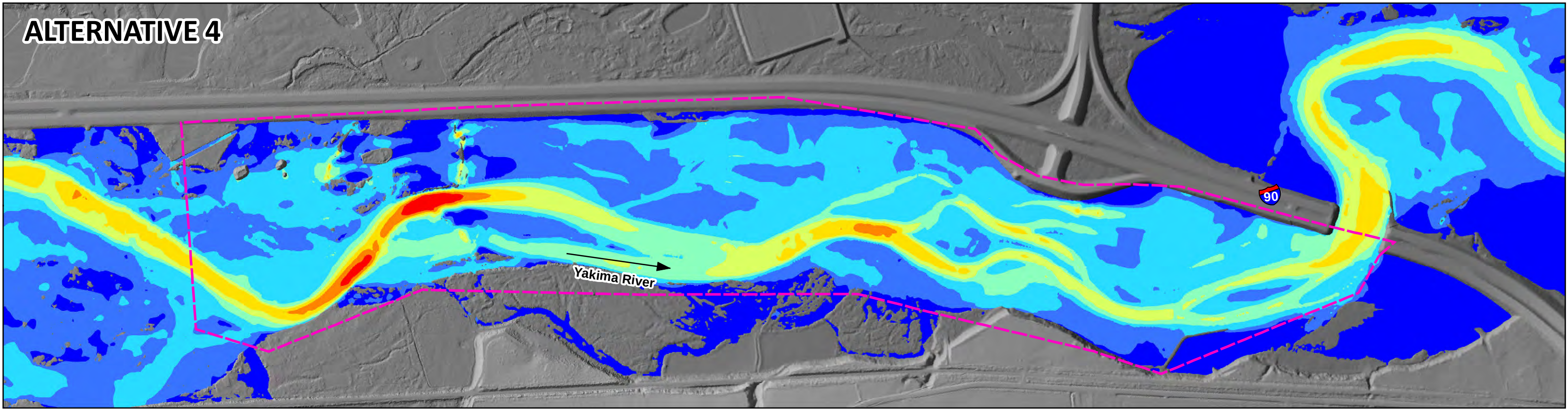
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Yakima River
Cle Elum, WA

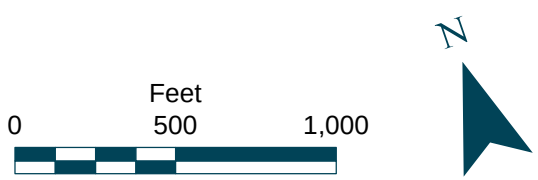
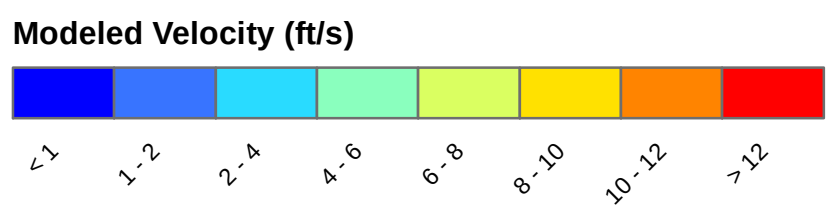
EXISTING



ALTERNATIVE 4



Project Area



Appendix B : Alternative Concept Drawings & Descriptions

Hanson Ponds

Concept Alternatives

SUBMITTED TO

Kittitas Conservation Trust
102 W. Pennsylvania Ave #202
Roslyn, WA 98941



PREPARED BY

Inter-Fluve, Inc.
501 Portway Ave., Suite 101
Hood River, OR 97031

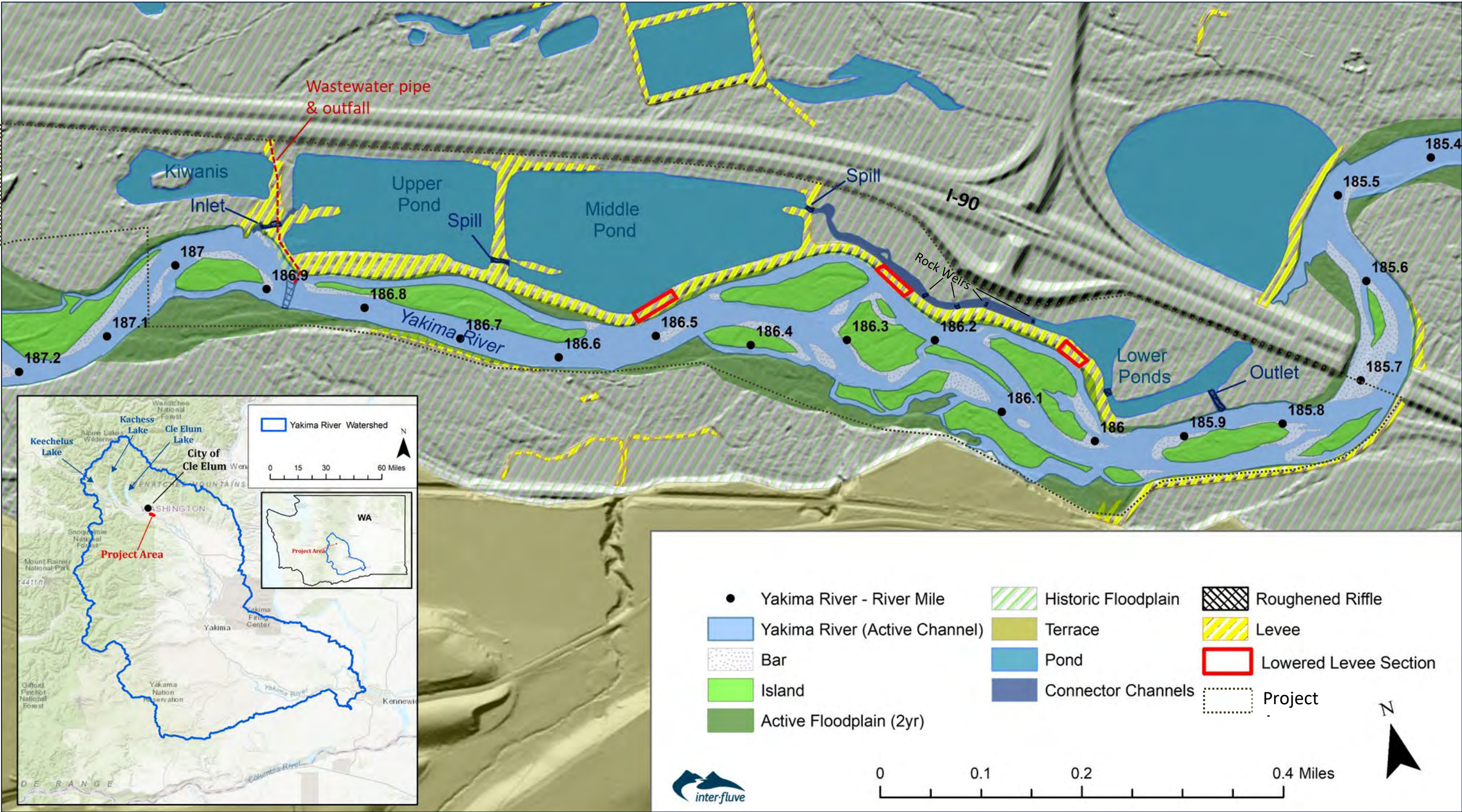


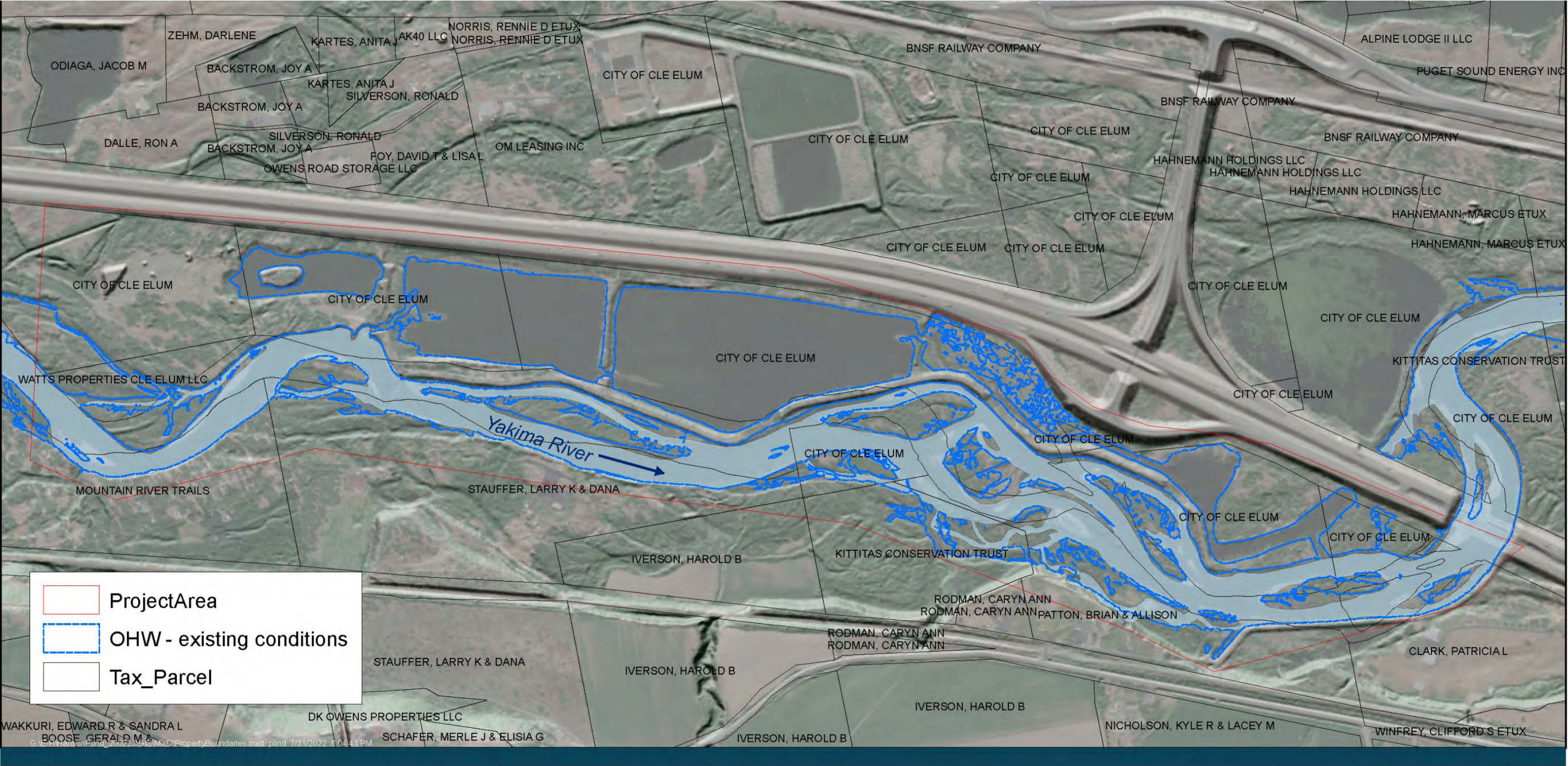
July 2022

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2	Concept Alternatives.....	3

1 Existing Conditions:

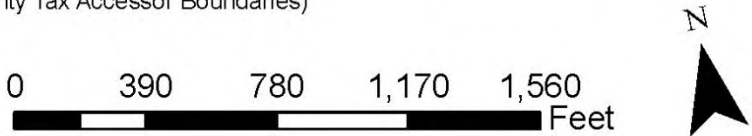




501 Portway Ave, Suite 101
Hood River, Oregon 97031
www.interfluve.com
541.386.9003

Hanson Ponds Project Area -- Property Boundaries
(County Tax Accessor Boundaries)

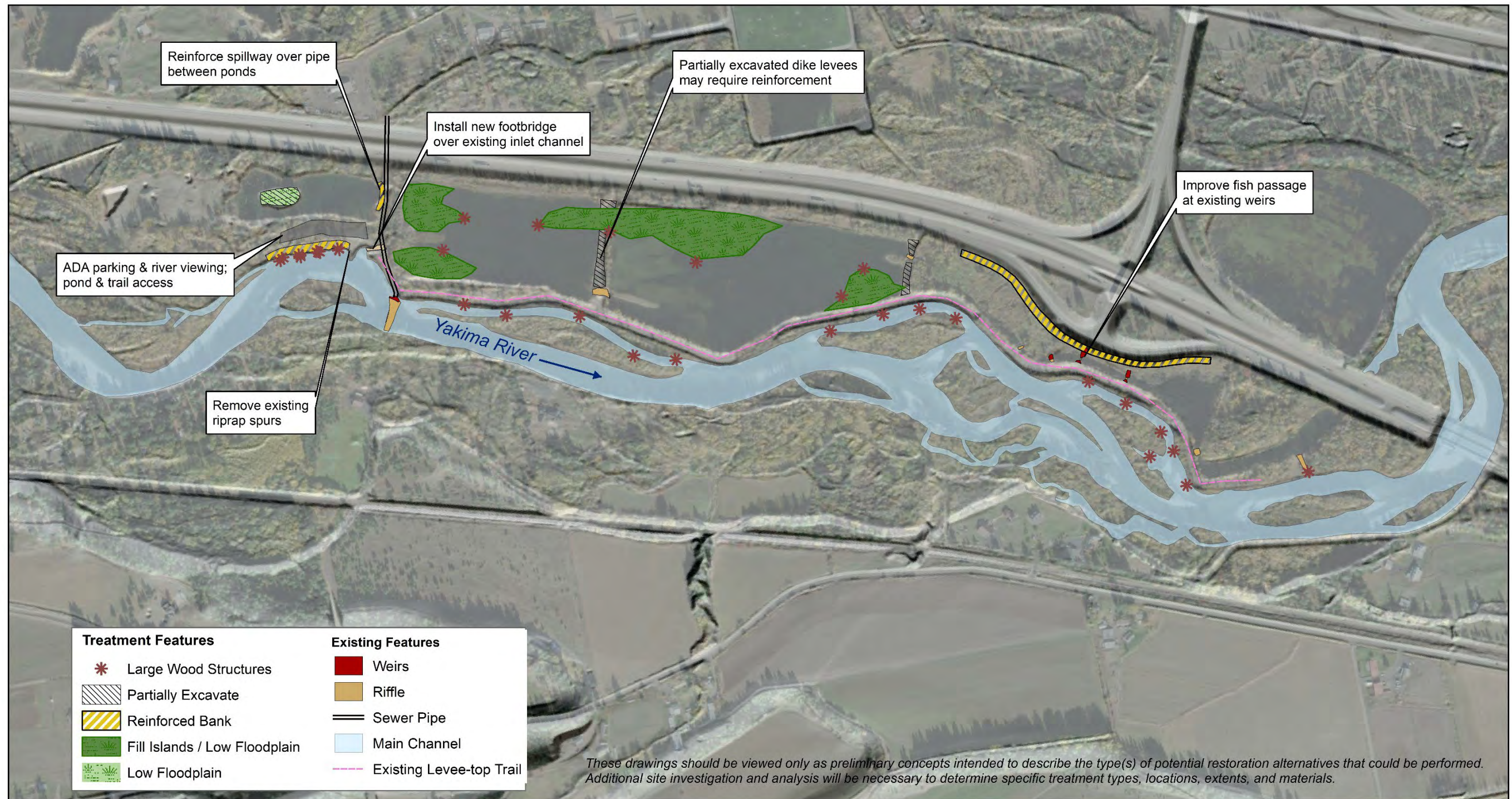
Coordinate System: NAD 1983
State Plane Washington South FIPS 4602
Vertical Datum: NAVD88



Hanson Ponds Park
Cle Elum, WA
Existing Conditions

2 Concept Alternatives

	Treatment Summary Description	Considerations
Alternative 1 Improve Existing Conditions	Concept Alternative 1 leaves the existing levees and ponds in place and focuses treatments on reinforcing areas of erosion risk while proposing to improve the existing poor-habitat conditions in the ponds and low-habitat complexity along the mainstem channel. Reinforced bank(s) and reinforced flood routing zones at erosion-prone areas are reinforced to address the existing risk(s) to the City’s wastewater outfall and I-90. Installation of Large Wood Structures to the existing side channels and the Lower Pond outlet channel mouth is included to improve the quantity and quality of off-channel and refugia habitat available to native fish without adding recreational safety impediments to the mainstem channel. Large Wood installation is an option at the reinforced eroding bank to provide habitat along the stabilized bank. Safety signage for boaters may be recommended in association with the reinforced bank, with or without habitat large wood inclusion. The existing riprap spur that is one of the factors currently promoting bank erosion at the upstream end of the project area may need to be removed or redesigned to support bank protection design and pond inlet channel persistence. Reinforcement of the current flood-routing spillway over the City’s wastewater outfall pipe at the levee between Kiwanis Pond and the Upper Pond is recommended. Partial excavation of the Kiwanis Pond Island and potentially two of the levee dikes is included in Alternative 1 to create low-floodplain areas within the ponds that support riparian vegetation and increase shore-line habitat complexity. Size and distribution of the fill islands/low floodplains will be determined by the quantity of site-generated and otherwise available adequate materials. Large Wood Structure installation to increase habitat complexity (type and condition of aquatic and avian) in the ponds is an option – depending on pond water temperature considerations. Improving fish passage at the existing weirs could improve access to off-channel refugia. However, warm water temperature issues in the ponds are not expected to be fully resolved by this alternative. Installation of a new footbridge over the Pond Inlet channel is included to restore access to existing levee-top trail route. Features Summary: • Reinforce the eroding bank – option to add large wood as habitat feature to reinforced bank. • Remove or redesign the existing riprap spur & utilize existing spur material. • Improve ADA parking and river viewing at reinforced eroding bank wall. • Install new footbridge across inlet channel for levee trail access (5,320 feet (1 mile) of existing trail) • Install Large wood structures in existing side channels of the mainstem. • Install Large wood at downstream end of outlet channel in backwater zone (off-channel habitat). • Partially excavate Kiwanis Pond Island and dike levees of Middle Pond to increase riparian areas. • Create low floodplain fill islands (riparian vegetation) in the existing ponds with the option to install Large Wood habitat structures • Reinforce I-90 bank, where needed. • Reinforce dike levee or create armored riffle over wastewater pipe between Kiwanis and Upper Pond. • Improve fish passage conditions at existing weirs in connector channel. • Native riparian vegetation re-establishment on disturbed areas and new low floodplains.	Wastewater permit requires a specific quantity of river water and flow hydraulics for mixing and dilution at the outfall. Public and adjacent landowner aesthetic and usage needs. Maintain public access and recreation. Not all site-generated or site-available materials may not be sufficient for required design fill material quantity and quality. Thus, import of fill material may be required. Identify source location(s) for appropriate floodplain and fill island material – communicate with and evaluate City, WA DOT, and other partner entities projected potential to generate appropriate material from other projects. Evaluate potential for partnering with WA DOT on I-90 modifications. Design and installation sequencing option to address eroding and wastewater outfall pipe risks in Phase I. Maintains reinforced grade control across the available floodplain at the wastewater outfall.



501 Portway Ave, Suite 101
Hood River, Oregon 97031
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Concept Alternative #1

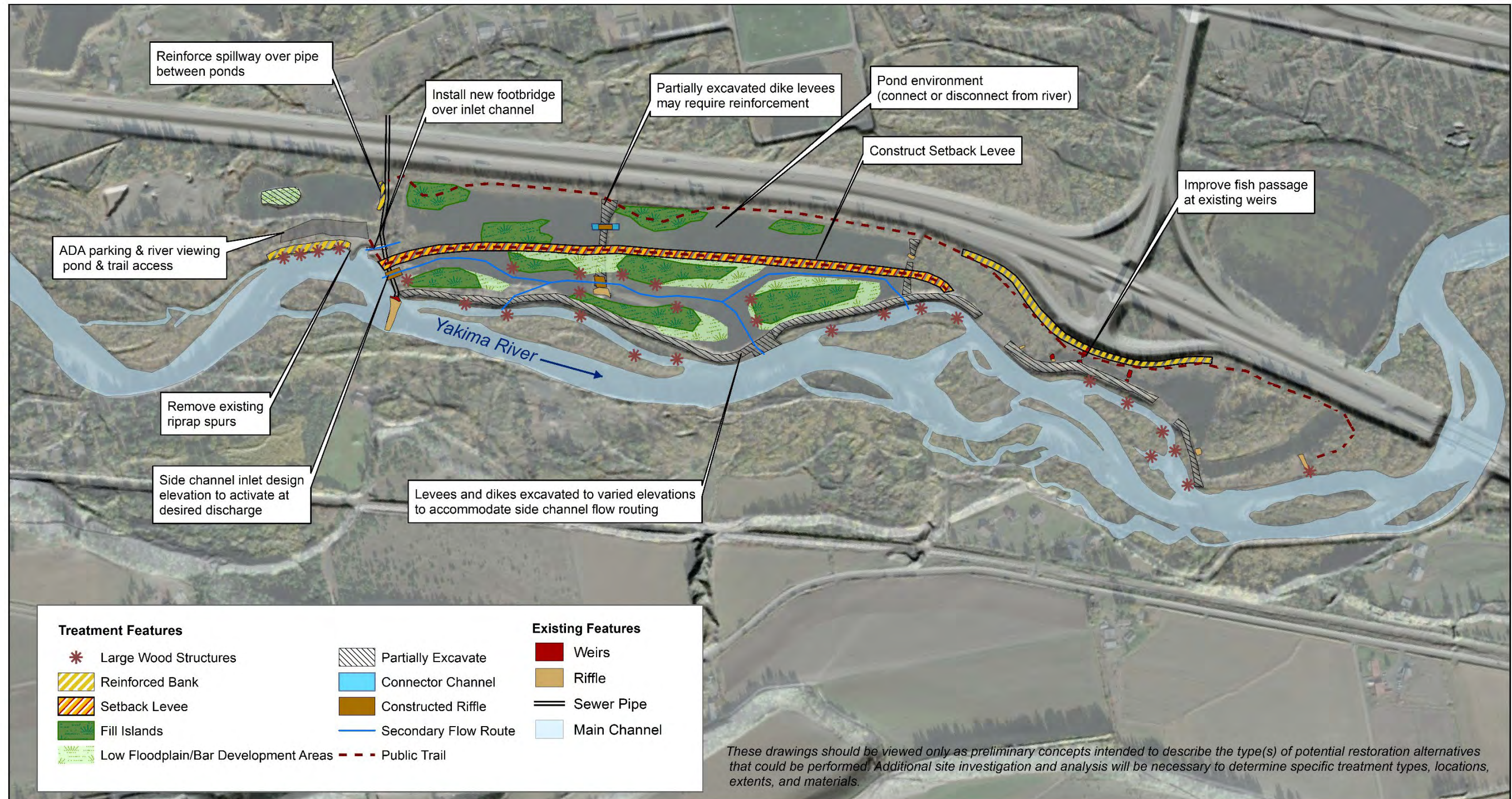
Coordinate System: NAD 1983
State Plane Washington South FIPS 4602
Vertical Datum: NAVD88

0 375 750 1,125 1,500 Feet



Hanson Ponds Park
Cle Elum, WA
Concept Alternatives

	Treatment Summary Description	Considerations
Alternative 2 Partially Reopen Floodplain +Setback Levee+	Concept Alternative 2 reinforces the existing eroding bank and reopens over half of the currently excluded floodplain area for river function and habitat while providing a setback levee designed to protect I-90 infrastructure and maintain pond features. Removal of the existing levee provides opportunity to create side channels, off-channel habitat, and vegetated floodplain islands. Reinforce the eroding bank at the upstream end. Large Wood installation is an option at the reinforced eroding bank to provide habitat. Safety signage for boaters may be recommended in association with the reinforced bank, with or without habitat large wood inclusion. The existing riprap spur at the upstream end of the project area may need to be removed or redesigned to support bank protection design and pond inlet channel persistence. Reinforcement of the current flood-routing spillway over the City’s wastewater outfall pipe between Kiwanis Pond and the Upper Pond is recommended. Installation of Large Wood Structures to the existing and newly created side channels and the Lower Pond outlet channel mouth is included to support island formation and improve the quality and quantity of off-channel and refugia habitat available to native fish, without adding recreational safety impediments to the mainstem channel. Partial excavation of the Kiwanis Pond Island and potentially two of the remaining pond levee dikes to create low-floodplains areas within the ponds that support riparian vegetation and increase shore-line habitat complexity. Additional fill island / low-floodplains and Large Wood Structure installation in the ponds is an option (see Alt 1). Improving fish passage at the existing weirs could improve access to off-channel refugia. However, warm water temperature issues in the ponds are not expected to be fully resolved by this alternative. Installation of a new footbridge over the Pond Inlet channel is included to establish access to the top of the newly constructed setback levee for optional trail route. Features Summary: • Reinforce the eroding bank – option to add large wood as habitat feature to reinforced bank. • Remove or redesign the existing riprap spur. • Improve ADA parking and river viewing at reinforced bank wall. • Install new footbridge across pond inlet channel and develop up to 9,000 feet of trail (1.7 miles). • Install Large wood at downstream end of outlet channel in backwater zone (off-channel habitat). • Partially excavate Kiwanis Pond Island and dike levees of Middle Pond to increase riparian areas. • Construct Setback Levee to widen available floodplain area and reduce warm-water pond area. • Provide area on or along setback levee for trail development. • Construct new connector channel riffle between Upper and Middle Pond. • Create secondary flow route side channel(s) in reopened floodplain. ○ Construct reinforced riffle at inlet over wastewater treatment outfall, to be activated at defined discharge. ○ Construct Fill Islands in reopened floodplain area. Design to support bar and floodplain development. ○ Install large wood structures on fill islands along secondary flow route. • Retains off-channel pond habitat and functioning wetlands between Middle and Lower Ponds. • Reinforce I-90 bank, if/as needed. • Reinforce dike levee or constructed flood event armored riffle over wastewater outfall pipe between Kiwanis and Upper Pond. • Improve fish passage conditions at existing weirs in connector channel. • Native riparian vegetation re-establishment on disturbed areas and new low floodplains.	Wastewater permit requires a specific quantity of river water and flow hydraulics for mixing and dilution at the outfall. Public and Adjacent landowner aesthetic and usage needs. Increase public access and use potential. Not all site-generated or site-available materials will be sufficient for required design fill material quantity and quality. Thus, import of fill material may be required. Identify source location(s) for appropriate floodplain and fill island material – communicate with and evaluate City, WA DOT, and other partner entities projected potential to generate appropriate material from other projects. Evaluate potential for partnering with WA DOT on I-90 modifications. Size and distribution of the fill islands/low floodplains will be determined by the quantity of site-generated and otherwise available adequate materials. Channel evolution and potential sediment aggradation in response to reopened side channels and floodplain islands. Initial and long-term downstream channel change and potential need to evaluate bridge piling scour. Geo-tech levee removal and setback levee construction Design and installation sequencing option to address eroding and wastewater outfall pipe risks in Phase I. Maintains reinforced grade control across the available floodplain at the wastewater outfall.



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Concept Alternative #2

Coordinate System: NAD 1983
State Plane Washington South FIPS 4602
Vertical Datum: NAVD88

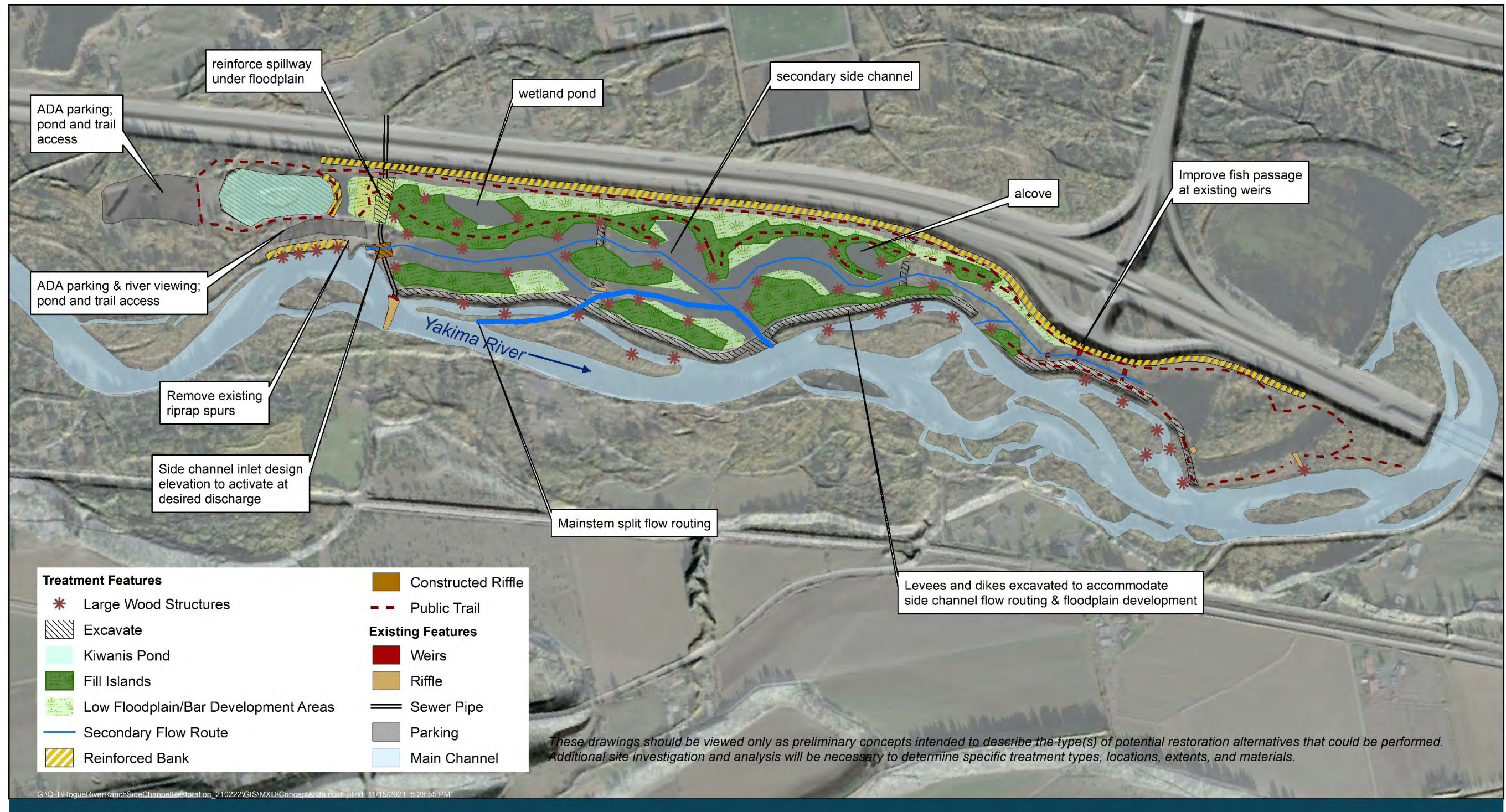
0 375 750 1,125 1,500 Feet



Hanson Ponds Park
Cle Elum, WA
Concept Alternatives

	Treatment Summary Description	Considerations
	Concept Alternative 3a reopens and reactivates the available floodplain area downstream of the wastewater outfall and south of I-90 for maximum function and habitat, while providing a means of protecting the existing infrastructure of concern. Alternative 3a includes reinforcement of the existing eroding bank with the option of including habitat Large Wood installation (similar to Alt 2). Reinforcement of the road prism bank will be extended as needed so as not to increase risk to I-90. The existing riprap spur at the upstream end of the project area will likely need to be removed or redesigned. Reinforcement of the City’s wastewater outfall pipe under the floodplain and flow routing areas is recommended. Install Large Wood Structures in the existing and newly created side channels to support island formation and improve the quality and complexity of off-channel and refugia habitat available to native fish without adding recreational safety impediments to the mainstem channel. Safety signage for boaters may be recommended to guide users toward the mainstem flow route. Reconstruct a Kiwanis Pond west of its existing location to reduce current capture and erosion risks and to generate needed fill-island material. Utilize excavated materials to create islands and low-floodplain areas that support riparian vegetation. Improve fish passage at the existing weirs to support up and downstream migration potential in the side channels and off-channel refugia areas. Construction of an ADA trail around Kiwanis Pond to support recreational use. Potential for future development of a nature trail along the north side reopened floodplain. Features Summary: • Reopen floodplain ○ Remove and/or partially excavate designated levee and dikes • Create mainstem split flow, secondary flow route side channel(s), and off-channel alcoves in reopened floodplain ○ Construct reinforced riffle at inlet over wastewater treatment outfall, to be activated at defined discharge. ○ Construct mainstem split-flow conditions via design levee excavation and fill-island placement downstream of wastewater outfall mixing zone ○ Construct Fill Islands in reopened floodplain area. Design to support bar and floodplain development ○ Install large wood structures on fill islands along secondary flow route • Install Large wood structures in existing side channels of the mainstem Yakima and at downstream end of outlet channel in backwater zone (off-channel habitat) • Reinforce I-90 bank as needed • Reinforce dike levee or constructed flood event armored riffle over wastewater pipe under floodplain and side-channel inlet • Improve fish passage conditions at existing weirs in connector channel • Native riparian vegetation re-establishment on new low floodplains • Reinforce the eroding bank – option to add large wood as habitat feature to reinforced bank • Remove the existing riprap spur • Reconstruct Kiwanis Pond west of its existing placement to reduce capture risk and to generate fill island material. • Create new ADA parking at west side of Kiwanis Pond for access to pond and trailhead – trail around Kiwanis Pond • Increase public access and uses. Potential for 15,000 feet of trail (2.8 miles).	Wastewater permit requires a specific quantity of river water and flow hydraulics for mixing and dilution at the outfall. Public and Adjacent landowner aesthetic and usage needs. Increase public access and use potential Not all site-generated or site-available materials will be sufficient for required design fill material quantity and quality. Thus, import of fill material may be required. Identify source location(s) for appropriate floodplain and fill island material – communicate with and evaluate City, WA DOT, and other partner entities projected potential to generate appropriate material from other projects. Evaluate potential for partnering with WA DOT on I-90 modifications. Size and distribution of the fill islands/low floodplains will be determined by the quantity of site-generated and otherwise available adequate materials. Channel evolution and potential sediment aggradation in response to reopened side channels and floodplain islands. Initial and long-term downstream channel change and potential need to evaluate bridge piling scour. Geo-tech levee removal and setback levee construction Design and installation sequencing option to address eroding and wastewater outfall pipe risks in Phase I. Maintains reinforced grade control across the available floodplain at the wastewater outfall.

Alternative 3a
Reopen Floodplain



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Concept Alternative #3a

Coordinate System: NAD 1983
State Plane Washington South FIPS 4602
Vertical Datum: NAVD88

0 375 750 1,125 1,500 Feet

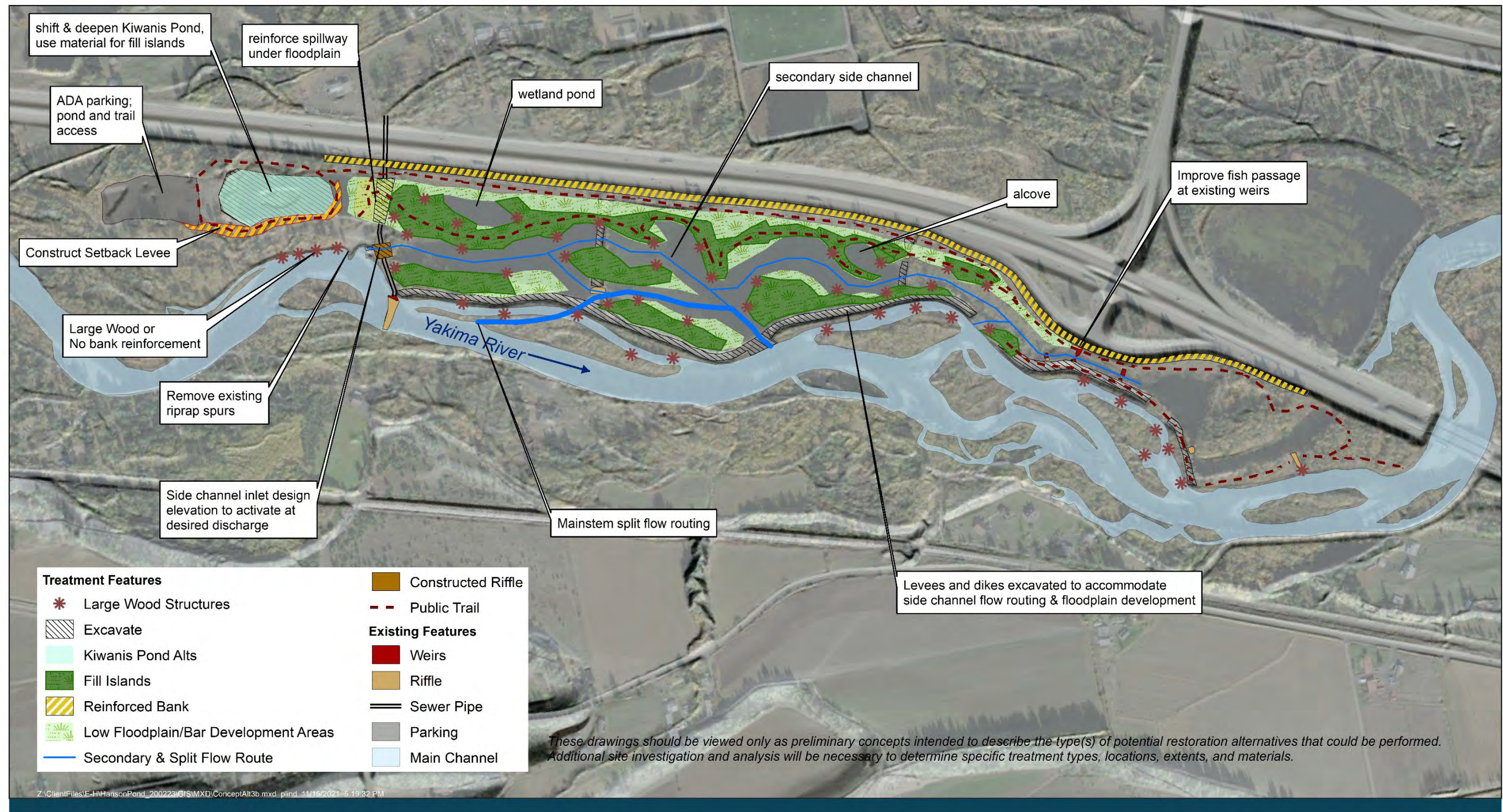


Hanson Ponds Park
Cle Elum, WA

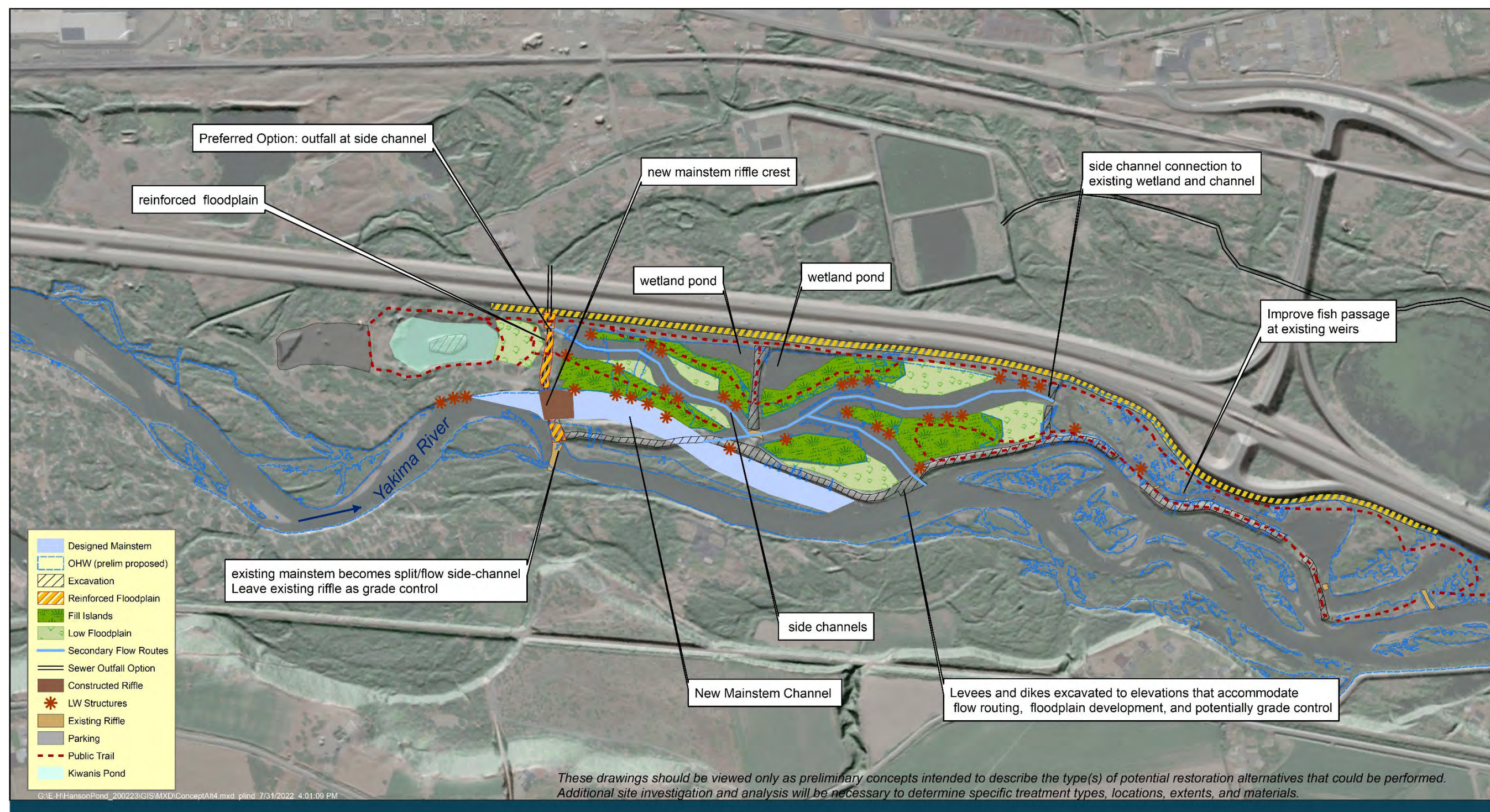
Concept Alt

	Treatment Summary Description	Considerations
	Concept Alternative 3 reopens and reactivates the available floodplain area south of I-90 for maximum function and habitat, while providing a means of protecting the existing infrastructure of concern Alternative 3b protects the Kiwanis Pond with a newly constructed low-elevation levee along the pond’s southern border. This approach includes removal and/or partial excavation of the existing levees and riprap spur(s) to maximize the opportunity for side channels, off-channel habitat, and vegetated floodplain islands. Reinforcement of the I-90 road prism bank will be designed so as to not increase risk. The existing riprap spur at the upstream end of the project area will be removed. Reinforcement of the City’s wastewater outfall pipe under the floodplain and at designed flow routes is included. Alternative 3b allows for the option of keeping the outfall in its current location or relocating it, in conjunction with shifting the mainstem route for permit mixing requirements. Install Large Wood Structures in the existing and newly created side channels to support island formation and improve the quality and complexity of off-channel and refugia habitat available to native fish without adding recreational safety impediments to the mainstem channel. Safety signage for boaters may be recommended to guide users toward the mainstem flow route. Reconstruct a Kiwanis Pond west of its existing location to reduce current capture and erosion risks and to generate needed fill-island material. Utilize excavated materials to create islands and low-floodplain areas that support riparian vegetation. Improve fish passage at the existing weirs to support up and downstream migration potential in the side channels and off-channel refugia areas. Construction of an ADA trail around the new Kiwanis Pond to support recreational use. Potential for future development of a nature trail along the north side reopened floodplain. Features Summary: • Reopen floodplain ○ Remove and/or partially excavate designated levees, dikes, and spurs • Create mainstem split flow, secondary flow route side channel(s), and off-channel alcoves in reopened floodplain ○ Construct reinforced riffles at flow routes over wastewater treatment outfall. ○ Construct mainstem split-flow conditions downstream of wastewater outfall mixing zone via designed levee excavation and fill-island placement. ○ Construct Fill Islands in reopened floodplain area. Design to support bar and floodplain development ○ Install large wood structures on fill islands along secondary flow route • Install Large wood structures in existing side channels of the mainstem Yakima and at downstream end of outlet channel in backwater zone (off-channel habitat) • Improve fish passage conditions at existing weirs in connector channel • Native riparian vegetation re-establishment on new low floodplains • Reinforce I-90 bank as needed • Construct protective levee along southern border of Kiwanis Pond (Alternative 3b). • Remove the existing riprap spur • Reinforce armored riffle over wastewater pipe under floodplain flow routes. • Reconstruct Kiwanis Pond west of its existing placement to reduce capture risk and to generate fill island material. • Create new ADA parking at west side of Kiwanis Pond for access to pond and trailhead – trail around Kiwanis Pond • Increase public access and uses. Potential for 15,000 feet of trail (2.8 miles).	Wastewater permit requires a specific quantity of river water and flow hydraulics for mixing and dilution at the outfall. Public and Adjacent landowner aesthetic and usage needs. Increase public access and use potential Not all site-generated or site-available materials will be sufficient for required design fill material quantity and quality. Thus, import of fill material may be required. Identify source location(s) for appropriate floodplain and fill island material – communicate with and evaluate City, WA DOT, and other partner entities projected potential to generate appropriate material from other projects. Evaluate potential for partnering with WA DOT on I-90 modifications. Size and distribution of the fill islands/low floodplains will be determined by the quantity of site-generated and otherwise available adequate materials. Channel evolution and potential sediment aggradation in response to reopened side channels and floodplain islands. Initial and long-term downstream channel change and potential need to evaluate bridge piling scour. Geo-tech levee removal and setback levee construction 3b design and installation sequencing option to address identified infrastructure issues with reinforced wastewater outfall and I-90 bank reinforcement. Maintains reinforced grade control across the available floodplain at the wastewater outfall.

Alternative 3b
Reopen Floodplain



Alternative 4 Outfall Relocate PREFERRED ALTERNATIVE	Treatment Summary Description	Considerations
	Concept Alternative 4 moves the mainstem flow route to alleviate lateral erosion issues at the upstream eroding bank and address unplanned pond capture of the mainstem. The location of the wastewater outfall is moved towards I-90 along its existing alignment to mitigate existing risk of damage due to pond capture or bank erosion. The wastewater will discharge into a designed side channel prior to reaching the mainstem. Alt 4 relocates the mainstem channel to the middle of the available floodplain to maximize floodplain and channel function within the available floodplain area south of I-90, while providing a means of protecting the existing infrastructure of concern. This approach includes removal and/or partial excavation of the existing levees and riprap spur(s) to maximize the opportunity for mainstem realignment, converting the existing mainstem route into a secondary or side channel, creating side channel and off-channel habitat, and vegetated floodplain islands. Reinforcement of the I-90 road prism bank will be designed so as to not increase risk. The existing riprap spur at the upstream end of the project area will be removed. Install Large Wood Structures in the existing and newly created channels to support island formation and improve the quality and complexity of off-channel and refugia habitat available to native fish without adding unnecessary recreational safety impediments to the mainstem channel. Safety signage for boaters may be recommended to guide users. Reconstruct a Kiwanis Pond west of its existing location to reduce current capture and erosion risks and to generate needed fill-island material. Utilize excavated materials to create islands and low-floodplain areas that support riparian vegetation. Improve fish passage at the existing weirs to support up and downstream migration potential in the side channels and off-channel refugia areas. Construction of an ADA trail around the new Kiwanis Pond to support recreational use. Potential for future development of a nature trail along the north side reopened floodplain. Features Summary: • Design mainstem to middle of the floodplain and constructed roughened riffle at the upstream end to maintain it as primary flow route • Relocate outfall to edge of floodplain, to discharge into constructed side channel (assumes DOE approves discharge permit changes) • Reopen floodplain ○ Remove and/or partially excavate designated levees, dikes, and spurs • Create mainstem split flow, secondary flow route side channel(s), and off-channel alcoves in reopened floodplain ○ Construct reinforced riffles at flow routes over wastewater treatment outfall. ○ Construct mainstem split-flow conditions downstream of wastewater outfall mixing zone via designed levee excavation and fill-island placement. ○ Construct Fill Islands in reopened floodplain area. Design to support bar and floodplain development ○ Install large wood structures on fill islands along secondary flow route • Install Large wood structures in existing side channels of the mainstem Yakima and at downstream end of outlet channel in backwater zone (off-channel habitat) • Improve fish passage conditions at existing weirs in connector channel • Native riparian vegetation re-establishment on new low floodplains • Reinforce I-90 bank as needed • Construct protective levee along southern border of Kiwanis Pond (Alternative 3b). • Remove the existing riprap spur • Reconstruct Kiwanis Pond west of its existing placement to reduce capture risk and to generate fill island material. • Create new ADA parking at west side of Kiwanis Pond for access to pond and trailhead – trail around Kiwanis Pond • Increase public access and uses. Potential for 15,000 feet of trail (2.8 miles).	Wastewater permit requirements for discharging into side or tributary channel Public and Adjacent landowner aesthetic and usage needs. Increase public access and use potential Not all site-generated or site-available materials will be sufficient for required design fill material quantity and quality. Thus, import of fill material may be required. Identify source location(s) for appropriate floodplain and fill island material – communicate with and evaluate City, WA DOT, and other partner entities projected potential to generate appropriate material from other projects. Evaluate potential for partnering with WA DOT on I-90 modifications. Size and distribution of the fill islands/low floodplains will be determined by the quantity of site-generated and otherwise available adequate materials. Channel evolution. Initial and long-term downstream channel change and potential need to evaluate bridge piling scour. Geo-tech levee removal and setback levee construction design and installation sequencing option to address identified infrastructure issues with relocated wastewater outfall and I-90 bank reinforcement. Maintain reinforced grade control across the available floodplain at the new mainstem and wastewater outfall.



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Concept Alternative #4

Coordinate System: NAD 1983
State Plane Washington South FIPS 4602
Vertical Datum: NAVD88

0 390 780 1,170 1,560 Feet



Hanson Ponds Park
Cle Elum, WA
Concept Alternatives

Attachment 2. Concept Alternatives Feasibility Evaluation Matrix

Hanson Ponds

Concept Alternatives: Feasibility Evaluation Matrix

Completed by Inter-Fluve and Kittitas Conservation Trust, with input and review from the Hanson Ponds Technical Advisory Group and Community Advisory Group (9/28/22).

1 Feasibility

1.1 BENEFITS, COSTS, AND CONSIDERATIONS

		Alternative 1	Alternative 2	Alternative 3	Alternative 4
Ecologic/Biologic Uplift	Rating	Low	Moderate-High	High	High
	Rational/ Assumption	No new riverine Low floodplain area created. Small Low floodplain areas in ponds create localized riparian habitat improvement.	New riverine Low floodplain at fill islands and excavated levees (approximately 9 acres) for improved riparian habitat & function.	New riverine Low floodplain at fill islands and excavated levees (approximately 22 acres) for improved riparian habitat & function.	New riverine Low floodplain at fill islands and excavated levees (approximately 25 acres) for improved riparian habitat & function.
Aquatic Habitat Uplift/Impact	Rating	Low	Moderate - High	High	High
	Rational/ Assumption	Large Wood Structures in existing side channels will improve quality of existing off-channel and refugia habitat in the mainstem. Large Wood Structures in ponds at new low floodplains to increase localized habitat complexity. Improve fish passage at existing weirs.	New side channel(s) with approximately 3,800 feet of additional available habitat . Large Wood Structures for High-quality aquatic habitat complexity. Improve fish passage at existing weirs. Option to disconnect warm water pond environment.	New side channel(s) with approximately 6,600 feet of additional available habitat . Large Wood Structures for High-quality aquatic habitat complexity. Improve fish passage at existing weirs. Warm water pond environment eliminated.	New side channel(s) with approximately 7,000 feet of additional available habitat . Large Wood Structures for High-quality aquatic habitat complexity. Improve fish passage at existing weirs. Warm water pond environment eliminated.
FEMA Issues Addressed (Eroding bank failure, wastewater outfall, I-90)	Rating	Moderate-High	Moderate-High	High	High
	Rational/ Assumption	Eroding bank reinforced. Buried wastewater pipe reinforced between Kiwanis and Upper Pond. Reinforced bank along I-90 off ramp.	Eroding bank reinforced. Buried wastewater pipe reinforced between Kiwanis and Upper Pond. Reinforced bank along I-90 off ramp.	3a: Eroding bank reinforced. 3b: Reinforce infrastructure Reinforce buried wastewater pipe. Extend reinforced bank along I-90 within project area.	Mainstem channel pathway reduces lateral bank erosion risks. Relocation of wastewater outfall reduces risk. Extended reinforced bank along I-90 within project area.
Potential Permitting Requirements	Rating	High	High	High	High
	Rational/ Assumption	See expected permitting requirements table			
Long Term Inspection & Potential Maintenance	Rating	High	High	High	Moderat-High
	Rational/ Assumption	Armored eroding bank, armoring over wastewater outfall between Kiwanis & Upper Pond; inspection and maintenance likely similar to existing conditions	New setback levee, armored eroding bank, armoring over wastewater outfall; more project elements and complexity provides opportunity for additional inspection need & potential maintenance.	Reinforced bank along I-90, armored eroding bank or Kiwanis set-back levee, armoring over wastewater outfall; more project elements and complexity provides opportunity for additional inspection & potential maintenance.	Reinforced bank along I-90, protection for relocated outfall; more project elements and complexity provides opportunity for additional inspection & potential maintenance.
Probable Construction Costs	Rating	Moderate	Moderate-High	High	High
	Rational/ Assumption	The most economical alternative due to smallest amount of excavation and fill. Preliminary estimate: \$3-5 million.	Additional cost primarily because of greater earthwork quantities. Preliminary estimate: \$4-6 million.	High cost alternative because of large earthwork quantities. Preliminary estimate: \$7-9 million.	High cost alternatives because of large earthwork quantities. Preliminary estimate: \$8-12 million.
Implementation Engineering/ Technical - Construction Feasibility	Rating	Low	Moderate	Moderate	Moderate
	Rational/ Assumption	Equipment will need to travel across existing levees to place fill in ponds.	Partial Filling of existing ponds and mainstem channel equipment access	Partial Filling of existing ponds and mainstem channel equipment access	Partial filling of existing ponds, relocation of mainstem channel, equipment access.
River Recreationists Safety Concerns	Rating	Low	Low	Low	Low
	Rational/ Assumption	Large Wood installed in existing side channels or ponds pose minimal increased risk to mainstem users - addressable through signage. New footbridge for safe trail access.	Large Wood installed in existing and new side channels pose minimal increased risk to mainstem users - addressable through signage and design. New footbridge for safe trail access.	Large Wood installed in existing and new side channels pose minimal increased risk to mainstem users - addressable through signage and design. New extended access trails	Large Wood installed in existing and new side channels pose minimal increased risk to mainstem users - addressable through signage and design. New extended access trails
Social Impact*	Rating	Moderate	Moderate	High	High
	Rational/ Assumption	There are some additional benefits and access. It stays away from the freeway. Buffered against the freeway.	Almost the same as Alternative 1; improves river hydraulics and increases the riparian area; doesn't activate entire available floodplain	Improves access; increases system function and ecosytem services.	Improves access, increases system function and ecosytem services.
Recreational Opportunities*	Rating	Moderate	Moderate - High	High	High
	Rational/ Assumption	maintains 1 mile of existing trail. Option to improve river viewing. Reestablishes year-round foot access to existing levee for fisherman. Levee trail provides access to all ponds.	1.7 miles of trail; option to improve parking and river viewing; establishes year-round levee-top trail access	2.8 miles of trail; option to improve parking and river viewing; better interpretative opportunities and wildlife viewing; recreational opportunities offsite; maximize off-channel habitat function (supports fish production) which will benefit fishing opportunities overall	2.9 miles of trail; option to improve parking and river viewing; better interpretative opportunities and wildlife viewing; recreational opportunities offsite; maximize off-channel habitat function (supports fish production) which will benefit fishing opportunities overall
Ability to meet project objectives*	Rating	Low	Moderate	Mod-High	High
	Rational/ Assumption	Short term infrastructure solution; provides minimal improvements to fish and wildlife habitat	Protects infrastructure; improves only 1/2 of the potential habitat at the site; allows for the I-90 expansion	Protects infrastructure; maximize available floodplain; improves habitat; protects infrastructure.	Protects infrastructure; maximize available floodplain, improves habitat; reduces long-term risk to infrastructure; protects infrastructure.
Feasibility	Designation	Moderate	High	High	High

*Evaluated and rated by Hanson Ponds Advisory Groups.

1.2 EXPECTED PERMITTING

Permit		Alternative 1	Alternative 2	Alternative 3	Alternative 4
Wetland		Yes	Yes	Yes	Yes
Water Quality		Yes	Yes	Yes	Yes
FEMA/ Floodplain		Yes	Yes	Yes	Yes
Endangered Species		Yes	Yes	Yes	Yes
Cultural Resources		TBD	TBD	TBD	TBD
WA Dept of Trans		Yes	Yes	Yes	Yes
Utilities		TBD	TBD	TBD	Yes
Land Use (City of Cle Elum)		TBD	TBD	TBD	TBD
Permitting Requirement Ranking		High	High	High	High

2 Concept Alternative Ranking Guide

The benefit, cost, and construction considerations are ranked to support comparison and selection of the Concept Alternatives. A description of the method for relative ranking used for each of the categories is provided here. Each alternative is ranked as low, moderate, or high for the following 12 categories.

Ecologic/Biologic Uplift

- Low** – Maintains existing ecologic and biologic functions in the project area with minimal overall improvement.
- Moderate** – Increases some ecologic and biologic function overall.
- High** – Adds relatively the most amount of ecologic and biologic function within the project area.

Aquatic Habitat Uplift/Impact

- Low** – Maintains the existing aquatic habitat areas with little to no improvement.
- Moderate** – Adds some wood structures to improve aquatic habitat.
- High** – Adds both wood structures and significant amount of new side channels for aquatic habitat.

FEMA Issues Addressed (eroding bank failure, wastewater outfall, I-90)

- Low** – not all identified issues are addressed
- Moderate** – identified issues are addressed to required standards – but some risk of future failure under current hydrologic regime exists.
- High** – identified issues are addressed to required standards – minimal risk of future failure under current hydrologic regime

Probable Construction Costs

The cost ranking reflects the relative cost of each Alternative based on permitting, construction implementation, and projected materials needs. This is a relative cost, not an absolute cost, so the scale of the project is NOT factored into this ranking. The relative cost ranking ranges from 1 to 3, with 1 reflecting a relatively lower cost alternative. For this ranking, it is assumed that implementation occurs in one phase, not multiple phases.

- High** relative cost
 - Requires construction techniques and equipment costs that are relatively high
 - Extensive excavation, onsite utilization of spoils but potential for long-distance hauling of needed import material
 - Need for import materials or prefabricated elements (i.e. trail bridge)
 - Complicated permitting (multi-agency) and geo-technical support requirements
 - Extensive planting or invasive weed control
 - Limited, difficult, or remote access
 - Intensive de-watering requirements
- Moderate** relative cost
 - Requires construction techniques and equipment costs that are relatively moderate
 - Moderate excavation, onsite utilization of spoils but potential for long-distance hauling of needed import material
 - Need for import materials or prefabricated materials (i.e. trail bridge)
 - Typical planting or invasive weed control
 - Moderate access conditions
 - Standard de-watering requirements
- Low** relative cost
 - Requires construction techniques and equipment costs that are relatively low-cost
 - Minimal excavation and minimal hauling distance of spoils or needed materials
 - Minimal planting or weed control and volunteer labor for installation and maintenance
 - Easy access conditions
 - No or minimal de-watering required.

Potential Permitting Requirements

The Potential Permitting Requirements are broken down into eight sub-categories based on permit type: Wetland, Water Quality, Floodplain, Endangered Species, Cultural Resources, Highway, Utilities and the City of Cle Elum Land Use. It is expected that required permits for implementation are attainable within 5 years or less after final designs are in hand.

- High** – Requires 6 or more permit types
- Moderate** – Requires 3-5 permit types
- Low** – Requires 2 or less permit types

Long Term Inspection & Potential Long-Term Maintenance

- High** – Large project size with high number of elements and complexity of elements related to infrastructure.
- Moderate** -- Intermediate project size with intermediate number of elements and complexity of elements related to infrastructure.
- Low** – Small project size with low number of elements and minimal complexity of elements related to infrastructure.

Implementation Engineering/ Technical - Construction Feasibility

- High** – Includes new or difficult construction techniques, may include construction or permitting risk, requires geo-technical support, and high potential for utilities or infrastructure management. Neighboring landowner access, usage, and aesthetics satisfied.
- Moderate** – Includes previously used and permitted construction techniques, requires geo-technical support, and moderate potential for utilities or infrastructure management. Neighboring landowner access, usage, and aesthetics satisfied.
- Low** – Includes previously used and permitted construction techniques and low potential for utilities or infrastructure management. Neighboring landowner access, usage, and aesthetics not satisfied.

River Recreationists Safety

- High** – Extreme risk to river recreationists that would require them to no longer be able to recreate near the project area.
- Moderate** – Imposes structures with the potential to somewhat increase risk that can be mitigated through signage or otherwise.
- Low** – Minimal to no increased risk to river recreationists.

Social Impact, Recreational Opportunities and Ability to Meet Project Objectives

(Hanson Ponds Advisory Groups)

Considerations:

- Ecosystem services provided to the public users
- Inclusiveness – equity of access to community (ADA, age differences, diversity of cultural resource)
- Support native and indigenous access (plants, fish, cultural resource, and hatchery inputs)
- Safety to the public day-use users (fishermen, ADA, hikers, birders, pet walkers, wildlife watchers)
- Maintains neighboring landowner property function, usage and aesthetics.
- Diversity of trails for diversity of users
- Does it integrate Cle Elum Complete Streets walkability plan and Yakima River Greenway plan, Cle Elum River Walk goals.
- Parking and river viewing (ADA option, bike rack, proximity to garbage and restroom)
- Costs & responsibility for maintenance and “policing” (City of Cle Elum) – have a closable day-use gate and signage.
- Aesthetics
- DOT planning
- Kiwanis Pond for stocked fishing maintained
- Interpretive signs along the trails – large kiosk entrance: safety, information (nature and history), project goals.
- Access road (maintenance, easement): City of Cle Elum responsibility
- Assess if existing restroom facilities are adequate – improve as necessary.
- Picnic tables and other user amenities.
- Reduced water depth at riffle crossings in mainstem for boat users.

Social Benefits (rating rational):

- Low** – Does not provide or maintain existing access to ecosystem services. Increase risk to users. Impacts neighboring landowners
- Moderate** - Maintains existing access to ecosystem services for diverse “users.” Does not increase risk to users. Interpretive/educational signage. Does not negatively impact neighboring landowners.
- High** – Increases access to ecosystem services for more users. Does not increase risk to users. Interpretive/educational signage. Does not negatively impact neighboring landowners.

Recreational Opportunities (rating rational):

- Low** – Reduced water depth in mainstem channel at low flow; limit seasonal access to parking area (no snow plow); Does not provide for multiple user opportunities; reduces existing trail miles;
- Moderate** – Sufficient water depth at low flow in mainstem (boat access); year-round access to parking area (snow plow); provides opportunities for multiple users, including ADA; maintains existing trail miles and uses.
- High** - Sufficient water depth at low flow in mainstem (boat access); year-round access to parking areas (snow plow); provides opportunities for multiple users, including ADA; increases existing trail miles and uses.

Ability to Meet Project Objectives (rating rational):

- Low** – Does not meet identified goals and objective. Does not increase system resilience.
- Moderate** – Meets identified goals and objectives for a long period of time. Improves function and resilience but will require maintenance.
- High** – exceeds initial identified goals and objectives for a long period of time. Builds resilience into the system. Builds resilience into the system with only minor future maintenance expected.

Feasibility Designation

The feasibility designation is the overall likely feasibility of being able to implement the project within a 5-10-year timeframe. This is based on landownership, as well as economic, funding, regulatory, political, social, permitting, or other considerations that are known to impact the feasibility of conducting projects within a reasonable timeframe. **The feasibility designation is not used as part of the project rating because feasibility issues may change over time and it is desirable to evaluate project benefits independent of feasibility.** The designations include the following:

High feasibility

- Minimal to no feasibility issues
- Adjacent landowner(s) has already indicated support

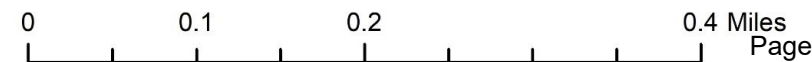
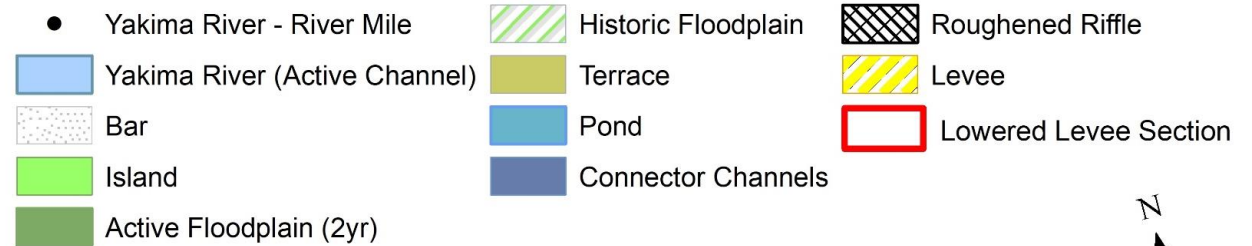
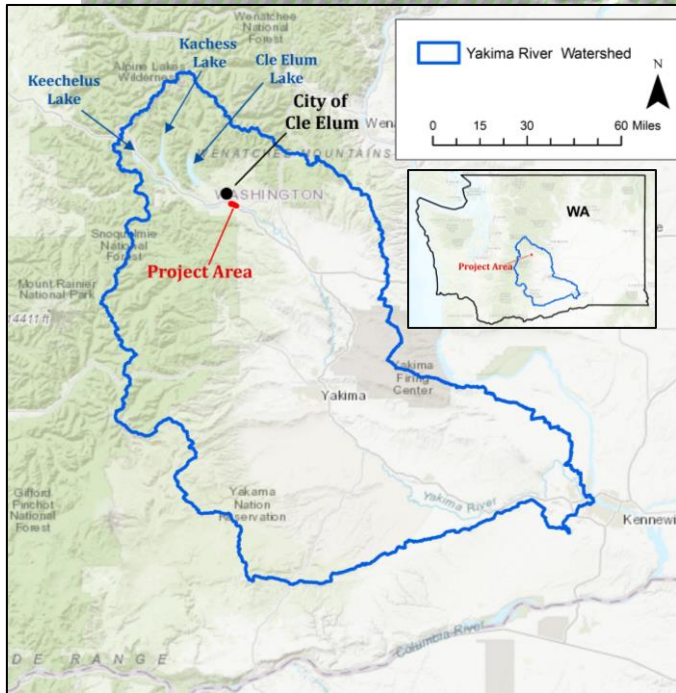
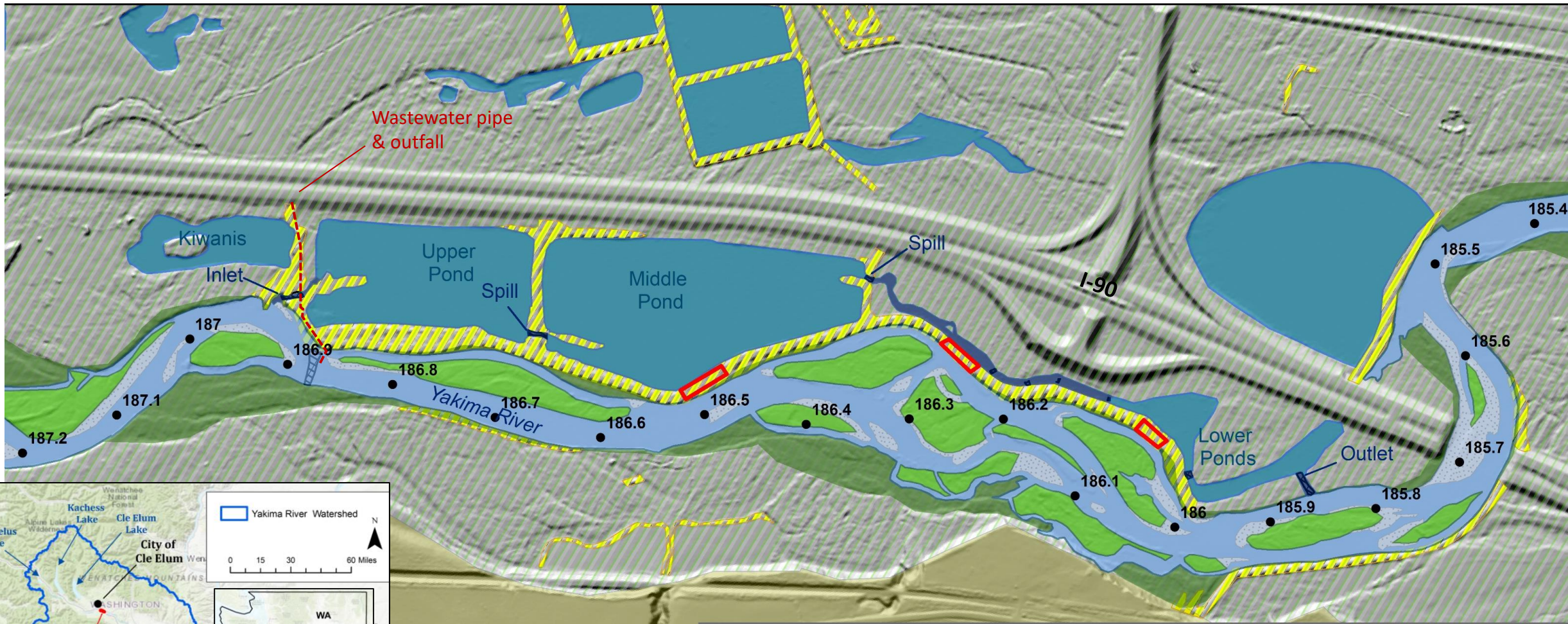
Moderate feasibility

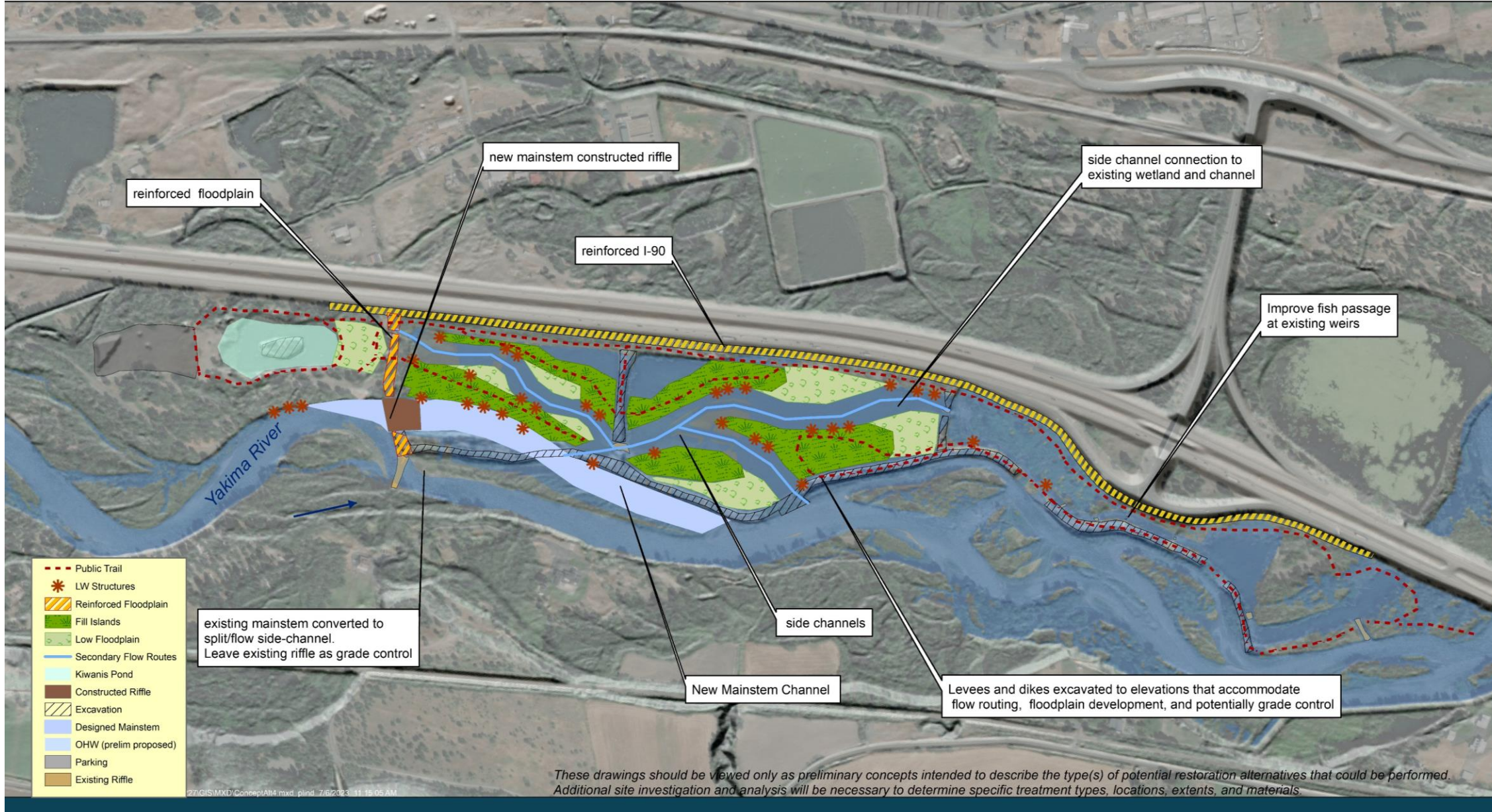
- There are potential feasibility constraints that could affect the likelihood of project implementation within a 5-10-year timeframe
- Adjacent landowner(s) is likely to support

Unlikely feasibility

- There are known feasibility constraints that would be expected to limit the ability to implement the project within a 5-10-year timeframe
- Adjacent landowner(s) does not support

Attachment 3. July 23, 2023, Cle Elum City Council Presentation





501 Portway Ave, Suite 101
Hood River, Oregon 97031
www.interfluve.com
541.386.9003

Selected Concept Alternative

Coordinate System: NAD 1983
State Plane Washington South FIPS 4602
Vertical Datum: NAVD88

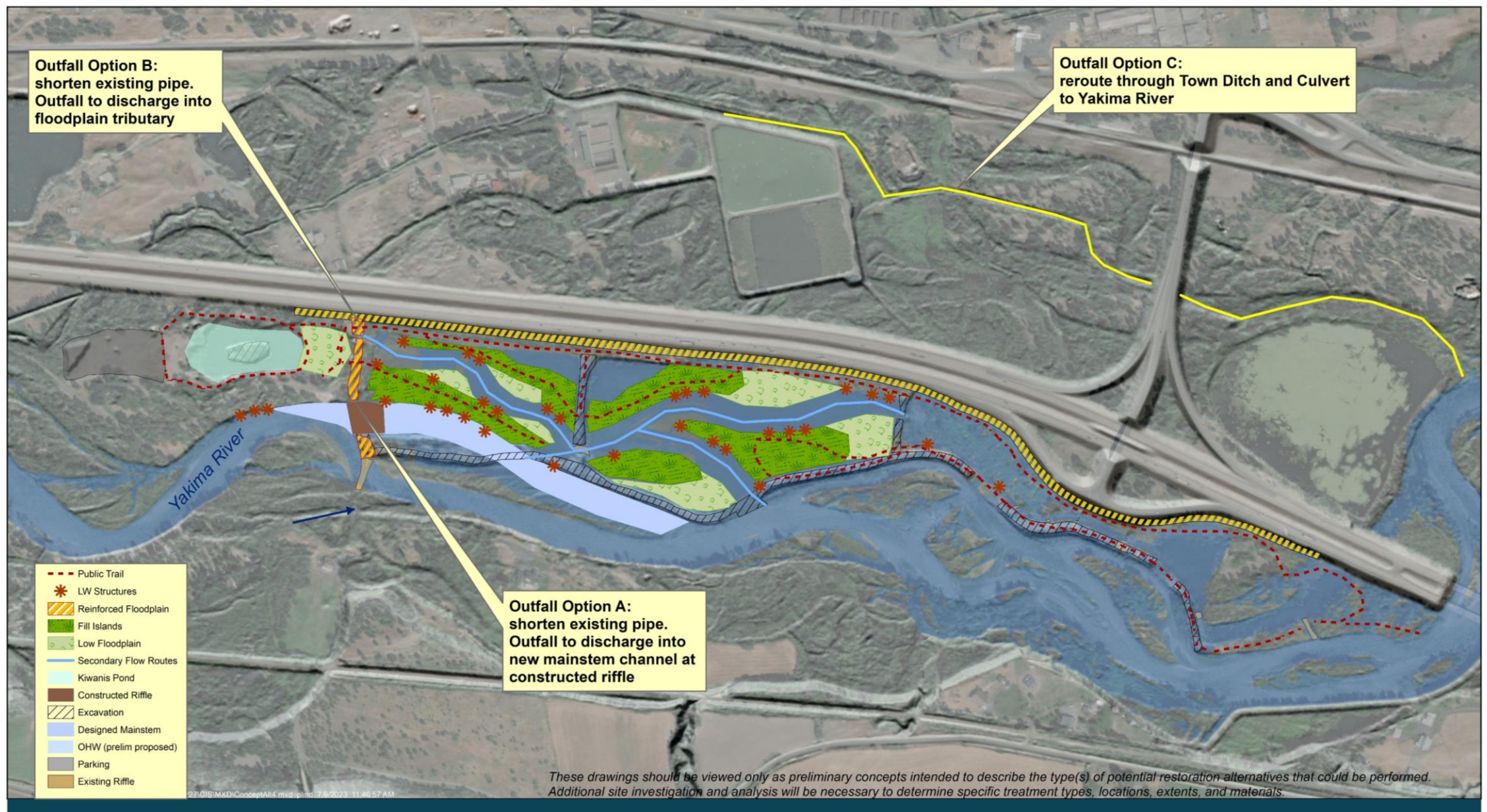
0 350 700 1,050 1,400
Feet



**Hanson Ponds Park
Cle Elum, WA**

Concept Alternatives

Figure 2
Page 284 of 414



501 Portway Ave, Suite 101
Hood River, Oregon 97031
www.interfluve.com
541.386.9003

Selected Concept Alternative: Wastewater Outfall Options

Coordinate System: NAD 1983
State Plane Washington South FIPS 4602
Vertical Datum: NAVD88

0 350 700 1,050 1,400
Feet



Hanson Ponds Park
Cle Elum, WA

Concept Alternatives

Figure 3
Page 285 of 414

Table 1. Comparison of the Pros and Cons of Options A, B, and C.

	Option A	Option B	Option C
Pro	Infrastructure in place, reducing cost compared to Option C	Infrastructure in place, reducing cost compared to Option C	Potential for cooler water entering river <i>IF</i> it infiltrates the lagoon
	Permitting similar to existing (e.g., DNR aquatics easement, NPDES wastewater permit).	Permitting similar to existing (e.g., DNR aquatics easement, NPDES wastewater permit).	Digging out old lagoon could be a source of material to fill Hanson ponds as part of floodplain restoration.
	Potential decreases in wetland impacts compared to what could be associated with Option C, but more impacts than Option B	Potential decreases in wetland impacts compared to what could be associated with Option C	Public perception no longer an issue with outfall removed from recreation site
		Daylighting into tributary decreases expenses for maintenance (scuba)	Daylighting into Town Ditch decreases expenses for maintenance (scuba)
Con	Potential future erosion issues similar to the current erosion just upstream of the outfall could cause maintenance concerns	Potential future erosion issues if the main stem of the river migrates closer to I-90 - less likely than Option A given the location of this option	Will change NPDES permit requirements- City Manager states it is a non-starter
	Negative public perception of an outfall at a recreation site	Negative public perception of an outfall at a recreation site	Very costly to re-route outfall to Town Ditch. City of Cle Elum responsible for funding.
	May limit floodplain/habitat restoration options	Mixing zone study will be required for DOE permitting for an additional cost of \$50-70k.	Potential to impact facility operations during the construction.

	Option A	Option B	Option C
	Requires expensive scuba divers for inspection and maintenance		Potential for increased wetland impacts.
			Unknown maintenance costs of Town Ditch.
			May require Option B infrastructure for releases when facility is at capacity during storm events
			Unknown carrying capacity of Town Ditch.
			Unknown condition of the ditch between wastewater plant and river.
			WSDOT culvert has lateral cracking – recommend assessment and may need replacement.
			Downstream houses are on wells – extra permitting may be needed (if even allowed)

Attachment 4. Photographs



Photograph 1. Constructed riffle in Yakima River where outfall currently exists. View is from left bank. Flow is from right to left.



Photograph 2. Side channel to mainstem Yakima River where proposed mainstem channel would be relocated and Option A would outfall. Existing outfall pipe runs under this channel.



Photograph 3. Option B approximate outfall location.



Photograph 4. Wetland east of wastewater treatment ponds that has potential to be impacted by on of the Option C configurations.



Photograph 5. Inlet of concrete I-90 culvert showing lateral cracking.

Attachment 5. Agency Comments and Responses

ATTACHMENT 5. Agency Comments and Responses

From: Jeanette Smith <jetsmith19@gmail.com>
Sent: Friday, December 22, 2023 4:14 PM
To: Butler, Elizabeth (RCO) <elizabeth.butler@rco.wa.gov>
Subject: Re: Draft memo for Hanson Ponds 22-1523

Well, this is an interesting outcome. They are really thinking though how they can get to a solution that works for all. I am pleased about the hybrid option as long as Option B stays in the forefront of the project as it moves forward on the design and funding pathways. Option B is a much better solution for fish, but Option A is much better than what is there now.

At this point, I am good with them moving forward on preliminary design for Alternative 4. I would like the questions that I posed for design in the second half of the memo to be part of the record and fully addressed as preliminary design moves forward. Mel provided some good information regarding these issues and where they are heading, but they are likely to come up for discussion again as the design moves forward.

Please let them know how much we appreciate their quick response!

Jeanette

JE Smith Consulting - 206.390.1925
jetsmith19@gmail.com
To clarify her requests:

Please incorporate the Technical Review Memo with KCT responses (attached in PRISM on 12/21/2023, named "22-1523 Hanson Ponds Outfall Alt Rev Memo_MB_JB_PL.docx") into the Basis of Design Report as part of the Stakeholder Review Comments addendum (where comments from the other partners will also be documented).

Then, as you proceed with Alternative 4 design, please address these questions and comments in the Basis of Design report.

Reinforced Floodplain and Fill Islands

As the design moves forward it needs to be clear how features critical for protecting sewer outfall and highway infrastructure affect or limit/not limit natural channel processes and salmonid habitat.

Provide a better explanation of "Reinforced Floodplain."

For example:

- Does this mean buried riprap or other hardened structure that prevents the channel from shifting location?
- What does this mean for the long-term condition of habitat downstream of the reinforced floodplain i.e. will side channels have a tendency to down cut or shift away from this hard point?

- Are the fill islands hardened in anyway? Are they intended to be permanent or allowed to shift and change?
- Minimize armoring on the fill islands to allow for some natural floodplain and channel processes.

Trails

Consider habitat function when establishing trail design standards and locations. Choose trail locations farther away from the unconfined channel to improve natural channel processes in the long run. Locate permanent trails outside of the channel migration zone to minimize protection measures that may be needed due to natural channel migration.

For Example: There is a trail located at the head of the constructed riffle and moving along one of the fill islands which may be contraindicated for improving floodplain and channel processes at this location. Building a trail here may work with Sewer outfall Option A, but is contradictory to moving infrastructure away from this area as presented in Option B. The trails farther away are less likely to affect channel processes in the long run.

We are primarily concerned that if the project establishes new trails along the channel margin, they will choose to protect and harden the channel edge instead of allowing it to shift and change and erode. This project will need to balance measures needed to protect infrastructure for the sewer outfall and measures needed to improve salmonid habitat and channel processes.

Overall, the BOD will need to clearly define where the project is creating permanent protection and where they are allowing/expecting channel change in the future. At this point in the design, the Review Panel feels it would be detrimental to salmon recovery to establish additional trail infrastructure that forces the city/county to protect those trails at the expense of natural channel processes.

I hope this will help you get the best outcome for Salmon, possible. Please let me know if you have any questions and best wishes as you proceed with your design work!

And hope you have a lovely end to 2023 and start to 2024!

With gratitude,

Elizabeth

Elizabeth Butler | Salmon Recovery Grants Manager
Washington State Recreation and Conservation Office
C 360-867-8650 | TDD call 711 | <https://rco.wa.gov>
PRISM Help: PRISMSupport@rco.wa.gov 360-902-3086

From: mbabik@kittitasconservationtrust.org <mbabik@kittitasconservationtrust.org>
Sent: Thursday, December 21, 2023 3:32 PM
To: Butler, Elizabeth (RCO) <elizabeth.butler@rco.wa.gov>
Cc: mlong@kittitasconservationtrust.org; myoung <myoung@kittitasconservationtrust.org>
Subject: RE: Hanson Ponds SRFB Review Panel Condition for Alternatives Assessment Review
Hi Elizabeth,

We did the best we could in answering the questions. I understand where Ms. Smith is coming from but there is still a lot we don't know until we start the design. Hopefully these answers were sufficient.

Please let me know if she needs further clarification.

Thank you!

MEL

Mel Babik

Restoration Director
Kittitas Conservation Trust
mbabik@kittitasconservationtrust.org
509-649-2951 (o)
830-776-3060 (c)

From: Butler, Elizabeth (RCO) <elizabeth.butler@rco.wa.gov>
Sent: Friday, December 15, 2023 1:58 PM
To: mbabik <mbabik@kittitasconservationtrust.org>
Subject: Hanson Ponds SRFB Review Panel Condition for Alternatives Assessment Review
Hi Mel,

Thanks for your help with this!

Here is the memo from Jeanette on the Hanson Ponds Alternatives Assessment.

She does have a few questions that I hope you can respond to in the body of the memo – maybe with a different color font...

I'm here next week if it would be good to chat further. And let me know if there's any additional clarification needed –

Hope you have a lovely weekend!

With deep gratitude,

Elizabeth

Elizabeth Butler | Salmon Recovery Grants Manager
Washington State Recreation and Conservation Office
C 360-867-8650 | TDD call 711 | <https://rco.wa.gov>
PRISM Help: PRISMsupport@rco.wa.gov 360-902-3086

Memorandum attachment provided via email by Mel Babik
(mbabik@kittitasconservationtrust.org) on December 21st at 3:32pm

MEMORANDUM

Date: December 15 2023

To: Elizabeth Butler

From: Jeanette Smith

Re: Condition Review for the Hanson Ponds Sewer Outfall Alternative Analysis (#22- 11523)

The Kittitas Conservation Trust (KCT) received Salmon Recovery Funding Board (SRFB) (#22-1523) to design a largescale floodplain restoration project of a set of abandoned gravel pit ponds connected to the Yakima River near Cle Elum, WA. KCT undertook an alternative analysis for the restoration project in 2021-22 with Interfluve. Three alternatives were developed and a preferred chosen for further development. Subsequently an opportunity arose to modify the city of Cle Elum's sewer outfall at the site. The location of the sewer outfall within the pond system and Yakima River Corridor impacts restoration options. KCT, the design team and City believe that if the outfall could be altered or relocated, more opportunities could be available for improved habitat, floodplain and channel processes at the site. A similar type of decision was made for the Yakima River Gap to Gap project downstream at the city of Yakima. KCT asked Interfluve to develop a 4th alternative and 3 options for restructuring or relocating the outfall.

The Review Panel asked to review the alternatives analysis for the outfall prior to the overall project design moving forward as the outcome of this analysis could determine the feasibility of the 4th alternative and the subsequent benefits to salmonids.

KCT, their investigation team and the working group on the Hanson Ponds project have employed a fairly thorough alternatives development and analysis process for both the initial project alternatives and now the possible alternatives for changing the sewer outfall within the preferred alternative 4 chosen in 2023. It appears that two of the three alternatives (A & B) are feasible and permittable while alternative C, which would provide the greatest flexibility for project design is not. Options A & B both allow for Restoration Alternative 4 to be fully implemented to improve salmonid habitat and floodplain processes though Option B (currently chosen as the preferred alternative) moves the outfall farther away from the mainstem Yakima potentially allowing greater flexibility in design and less hardened protection measures for the outfall. The Review Panel agrees on the selection of Option B for providing the most potential for salmonid benefits given that Option C is not feasible for permitting and implementation.

At this stage, it appears that the certainty of being able to modify the sewer outfall is moderately high for option B and A. However, information regarding requirements for mixing zone studies and changes to NPDES requirements and permits are still not fully available and the City may prefer to shift the preferred alternative choice to Option A.

In general, the Review Panel is in favor of the Restoration Alternative 4 moving forward towards preliminary design with Sewer Outfall Option B, but there are a few questions and some information that needs to be provided. The RP would prefer that all information regarding the implementation of a mixing zone study and potential NPDES Waste Discharge permit issues be available and a final option chosen prior to moving forward with design, but in this case the majority of the design is similar between the options and the next design steps should be able to begin without a final decision.

Agency Questions and Responses

Several pieces of information and questions are required to move the project forward at this time:

Is there any chance that the project cannot proceed with Alternative 4 given the lack of clarity on the NPDES issues? **No.** It is our goal to replace the outfall with similar NPDES requirements. Option A will have similar NPDES requirements as the current outfall. Option B would likely require a mixing zone study which would inform design. The City contractors most recently suggested a hybrid option where Option A is constructed now with a "Y" for Option B that is not built out. This would ensure the outfall is constructed under the current NPDES requirements while adding the flexibility of adaptive management/emergency response in the future. This hybrid option allows for the City to plan for the costs associated with a future mixing zone study and construction of the Option B outfall in the future once they can fund this option. Option A would remain in place once Option B is operational as a backup for emergencies. The design team is looking at the potential to build the outfall channel associated with Option B as part of this hybrid option; however, the outfall infrastructure would be installed at a later date when the City is able to fund the mixing zone study and address any changes that may be required per that study. Until Option B is build out, the potential outfall channel would function as side channel habitat for juvenile salmonids seeking refugia. Modifications would need to occur later to ensure proper mixing. If so, what is the back-up preferred alternative and how are benefits to fish compromised in making this selection? **Not applicable**

Provide a timeframe for deciding to move forward with Option B, a mixing zone study and NPDES permit consultation. Timeframe for implementing a mixing zone study, if it can be funded, and how does this effect the design pathway. **KCT will be presenting the Hybrid option to City Council on January 8, 2024.** We anticipate that City Council will prefer this option. It provides flexibility for future management/emergencies while working under known NPDES limits. It will also eliminate the need for a costly mixing zone study associated with the current restoration project.

How if at all does the design of the reinforced floodplain and constructed main channel riffle differ between Option A & B? What are the ramifications to proposed side channel and main channel habitat conditions? Attachment 3 indicates no difference in structure/function at the concept level. **Differences in reinforced floodplain and mainstem channel construction will be determined through the design process via modeling and analysis.** The side channel and mainstem habitat conditions will also be shaped through the design process to maximize habitat function within design stability and known infrastructure limitations.

How could Option B sewer outfall discharging into a side channel affect juvenile salmonids if at all? Are there effects on water temperature that benefit predators like what is experienced in the current ponds? **The effects to juvenile salmonids would be unknown at this time.** The mixing zone study is meant to predict these types of issues. Based on the results of the mixing zone study, discharge requirements to minimize temperature and other related water quality issues would be addressed through project design and wastewater treatment requirements.

Questions related to Alternative 4 as the design moves forward:

A better explanation of "Reinforced Floodplain" is required. Does this mean buried riprap or other hardened structure that prevents the channel from shifting location? What does this mean for the long-term condition of habitat downstream of the reinforced floodplain i.e. will side channels have a tendency to down cut or shift away from this hard point? **The "reinforced floodplain" concept does include buried**

or partially buried large material (potentially riprap) that both holds the mainstem channel in a designed location (and bed elevation) and provides protection from erosion across the FEMA designated floodway. Holding mainstem at a designated location will be required to maintain the wastewater outfall conditions. Designed side channels will flow perpendicular and downstream of the “reinforced floodplain” feature thus, it’s influence on laterally shifting side channels towards or away from the “hard point” it creates is expected to be minimal.

Are the fill islands hardened in anyway? Are they intended to be permanent or allowed to shift and change? Fill islands are expected to have some stability structure built into them which will be designed to promote bar/island development downstream of them. This is expected to be an evolutionary process. The amount and composition of the fill island’s structure is not yet known. Potential materials may include large wood structures or boulders or salvaged riprap from the existing levee. These details will be determined through the design process.

What is the design standard for the recreational trails? Are they intended to be permanent and therefore require protection? A secondary goal of this project is to enhance recreational opportunities when feasible. Trails will not require armoring or protection. They will be designed to work with a functioning floodplain and there may be areas of only seasonal use. Maintenance by the City of Cle Elum is expected to be required over the long-term. There is a trail located at the head of the constructed riffle and moving along one of the fill islands which may be contraindicated for improving floodplain and channel processes at this location. Building a trail here may work with Sewer outfall Option A, but is contradictory to moving infrastructure away from this area as presented in Option b. The trails farther away are less likely to affect channel processes in the long run. Trail locations will be designed and finalized in coordination with the city of Cle Elum.



Reasonable Potential Analysis for Outfall Relocation

Version: 1.2

Inter-Fluve

Hanson Ponds Restoration
May 24, 2024

Reasonable Potential Analysis for Outfall Relocation

Client name:	Inter-Fluve		
Project name:	Hanson Ponds Restoration		
Client reference:	N/A	Project no:	D3761100
Document no:	Hanson Ponds Restoration	Project manager:	Jennifer Bader
Version:	1.2	Prepared by:	Juan Gattorno
Date:	May 24, 2024	File name:	Reasonable potential Analysis for Outfall Relocation_V1.1_JB

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Appendix 1 – PermitCalc Workbook Calculations for Cle Elum WWTP

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ACRONYMS AND ABBREVIATIONS

1DMa	1-day maximum temperature
30Q5	30-day low flow period with a recurrence interval of 5 years
7DADMAX	7-day average of the daily maximum temperatures
7Q10	7-day low flow and high flow periods with a recurrence interval of 10 years
DMR	Discharge Monitoring Report
Ecology	Washington State Department of Ecology
LP3	log-Pearson Type III
MGD	million gallons per day
NTU	Nephelometric turbidity unit
RPA	reasonable potential analysis
WAC	Washington Administrative Code
WWTP	Cle Elum Regional Wastewater Treatment Plant

1. Introduction

This report assesses the potential impact of relocating the Cle Elum Regional Wastewater Treatment Plant (WWTP) outfall on the Yakima River. A key factor is whether the effluent has a reasonable chance of exceeding water quality standards for aquatic life and human health in current and future conditions. Washington State Department of Ecology (Ecology) guidelines and tools (PermitCalc Excel® Workbook) were used to evaluate this risk. Attachment 1 provides a printed version of the Ecology Excel permit calculations worksheets for the Cle Elum WWTP.

Section 2 of this report establishes critical flow conditions for both the effluent discharge and the Yakima River. Section 3 examines the water quality of the effluent and the receiving water. Finally, Section 4 analyzes the dilution of the effluent in the river and the reasonable potential for exceeding water quality standards under current and future river conditions. Results from this analysis are presented in tables throughout the report.

2. Design Flows

2.1 Critical Receiving Water Flow Conditions

The critical period for receiving water toxicity occurs when the coinciding conditions of water inflow and effluent discharge create the greatest potential for toxic effects on aquatic life and human health in the receiving water body. This scenario typically arises during low flow conditions within a water body, thereby reducing its capacity to dilute discharged effluent. As outlined in the Water Quality Program Permit Writer's Manual (Key 2018) chapters 3 and 7, the following critical design flow conditions for water quality-based permitting are employed to determine dilution requirements for aquatic life and human health criteria:

Table 1: Design Conditions for Aquatic Life Criteria

Parameter	Mixing Zone	Critical Design Condition
Receiving Water	Acute and Chronic Freshwater	7Q10: The 7-day low flow and high flow periods with a recurrence interval of 10 years (7Q10 by the appropriate statistical method). The diffuser depth is defined as the depth at the 7Q10 low flow period.

Table 2: Design Conditions for Human Health Criteria

Parameter	Mixing Zone	Critical Design Condition
Receiving Water	Carcinogen - Freshwater	The harmonic mean flow for the representative period of record. The diffuser depth is defined as the depth at the harmonic mean flow.
	Noncarcinogen - Freshwater	30Q5: The 30-day low flow period with a recurrence interval of 5 years (30Q5) if available or at 7Q10. The diffuser depth is defined as the depth at the 30Q5 or 7Q10 low flow period.

2.1.1 7Q10, 30Q5 and Harmonic mean flow estimation

2.1.1.1 Data processing

Streamflow data was obtained from the Bureau of Reclamation's Hydromet system for the period January 1, 2011, to December 31, 2023 (Reclamation n.d.). The data encompasses a

thirteen-year period, from January 1, 2011, to December 31, 2023, and is associated with station "Yakima River At Cle Elum" (YUMW). This data set consisted of daily 15-minute discharge measurements which were used to aggregate into daily average flows using Microsoft Excel. Subsequently, a data validation process for each year was completed to ensure the integrity of the results. This involved the identification and removal of outliers (e.g., 300,000 cubic feet per second (cfs)) which exceed maximum characteristics values that can be observed for each year.

2.1.1.2 Calculations and results

Following data processing, the Surface Water Toolbox (SWToolbox) software was employed to calculate the critical low flow statistics (Kiang et al., 2018). The Surface Water Toolbox (SW Toolbox) is a desktop application which offers a comprehensive suite of statistical tools for analyzing streamflow time series data and computing n-day frequency statistics, such as 7Q10 which is the 7-day minimum flow with a 10-year recurrence interval.

Some of the SWToolbox functionalities to support water quantity and quality modeling efforts are:

- Biologically based design flow calculations, flow-duration statistics generation, computation of various annual, monthly, and seasonal statistics such as the mean, minimum, and maximum value, for a selected time series.
- Deriving annual n-day time series:
 - Transforming daily streamflow data into annual n-day series by averaging consecutive n-day periods within a year or season.
- Annual low-flow series analysis:
 - Identifying and estimating of the lowest average flow periods within a year or season over the entire period of record. Streamflow time series for full years are typically constructed based on the climatic year, which spans from April 1st through March 31st of the next year.
- Frequency analysis:
 - Employing the log-Pearson Type III (LP3) distribution, commonly used for n-day minimum flow analysis, to estimate the likelihood of streamflow not exceeding specific levels in a given year.
 - Calculating the confidence interval using the expected moments algorithm with associated confidence intervals for LP3 distribution fitting, as described by Cohn et al. (2001).

Utilizing the functionalities above, an analysis of streamflow data for the Yakima River near Cle Elum was conducted. The analysis focused on n-day frequency statistics particularly in the critical low flow statistics necessary to estimate the dilution requirements.

Table 3 presents the calculated annual series of the lowest 7-day and 30-day average low flows for each year. Due to data inconsistency within the August 2019 record, the 2019-2020 climatic year was excluded from the analysis.

Table 3: Annual Series of Lowest Average Flow

Year	7Q10 (cfs)	Rank	30Q5 (cfs)	Rank
2012	487.7	8	415.8	6
2013	468.33	7	451.34	8
2014	253.22	2	150.23	1
2015	466.37	6	437.28	7
2016	241.04	1	239.21	3
2017	405.15	4	380.96	4
2018	418.43	5	412.13	5
2019	610.65	9	605.56	9
2021	828.7	11	818.36	11
2022	638.89	10	635.16	10
2023	271.72	3	224.09	2

Additionally, **Table 4** summarizes the critical low flow statistics computed for the analyzed period 2011 – 2023 using the LP3 distribution. The calculated 7Q10 value is 258.4 cfs, meaning that there's a 10% probability that an average flow over seven consecutive days of this size could occur in any one year. To visualize this, the annual non-exceedance probability curve produced in SW Toolbox, which is shown in **Figure 1** along with the parameters and interval confidence for the 7Q10 flow in **Table 5**.

Table 4: Low Flow Statistics

Flow Statistic	Flow Value (cfs)
7Q10	258.4
30Q5	452.94
Harmonic Mean	1,118.10
Harmonic Mean, Adjusted	1,114.30

Table 5: Parameter Values at 10% Probability

Non - Exceedance Probability	Recurrence Interval	Parameter Value	Variance of Estimate	95% Confidence Intervals	
				Lower	Upper
0.100	10	258.4	1.009	148.79	339.22

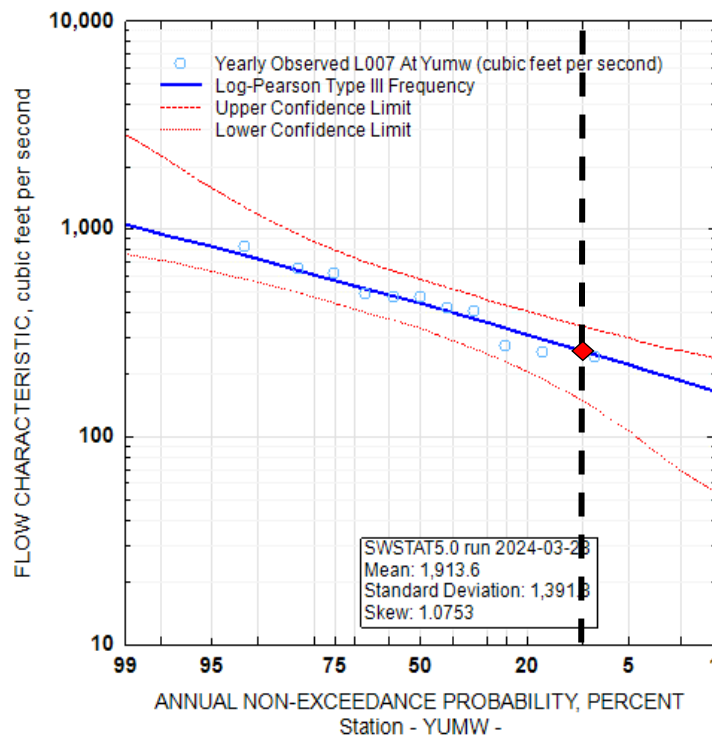


Figure 1: Annual Non-Exceedance Probability Curve (Percentage)

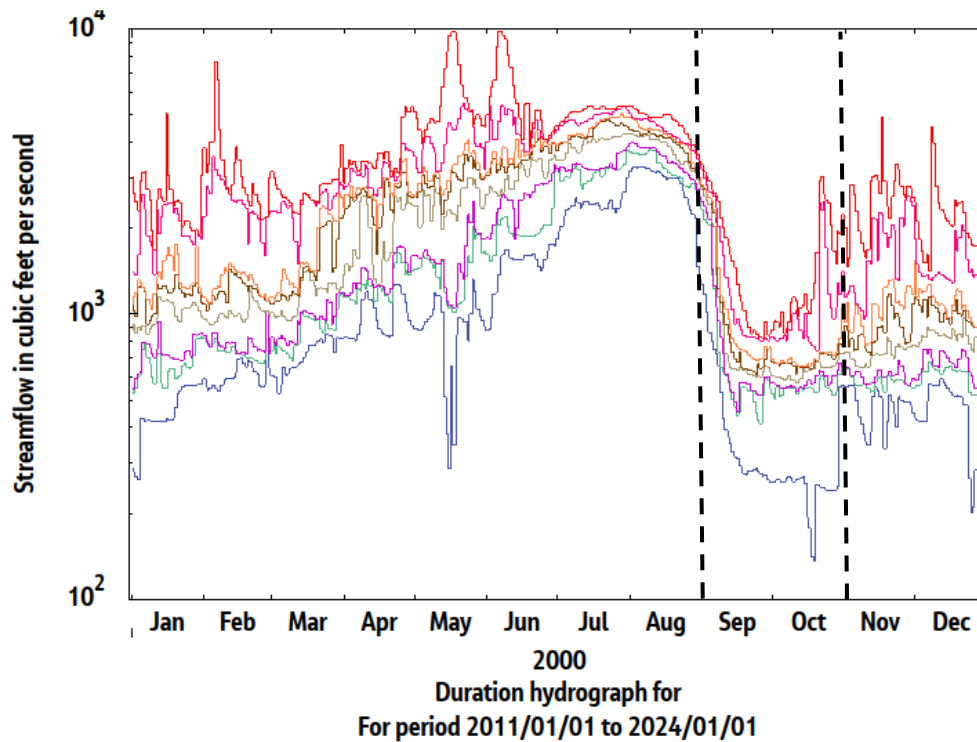


Figure 2: Duration Hydrograph for 2011-2023 Time Series

Furthermore, analysis of the data sets suggests that **critical low flow periods in the Yakima River tend to occur frequently between September and October**. This information is corroborated by the duration hydrograph presented in Figure 2.

2.2 Critical Facility Effluent Flow Conditions

To ensure adequate dilution and protect aquatic life and human health during the critical low flow periods, chapters 3 and 7 of the Water Quality Program Permit Writer's Manual establish the critical design effluent flow conditions for water quality-based permitting for aquatic life and human health criteria outlined in **Table 6 and 7**. These conditions will be applied in the sections 2.2.1.1 and 2.2.1.2.

Table 6: Design Conditions for Aquatic Life Criteria

Parameter	Mixing Zone	Critical Design Condition
Plant Effluent Flow – Municipal	Acute	If the facility is operating at less than 85% of the dry weather design flow during the critical period, is defined as the highest daily maximum plant effluent flow for the past three years during the critical flow or when the critical condition is likely to occur. If the facility is operating between 85 and 100% of dry weather design flow during the critical period, then use a peaking factor applied to dry weather design to determine acute design flow. The peaking factor is a ratio of daily maximum to monthly average flows derived from actual plant data during critical period.
	Chronic	If the facility is operating at less than 85% of design flow during the critical period, the critical plant effluent flow is defined as the highest monthly average plant effluent flow for the past three years during the critical flow or when the critical condition is likely to occur. If the facility is operating between 85 and 100% of design during the critical period, defined as the dry weather design flow

Table 7: Design Conditions for Human Health Criteria

Parameter	Mixing Zone	Critical Design Condition
Plant Effluent Flow – Municipal	Carcinogen - Freshwater	The design effluent flow is defined as the annual average flow based on the engineering report, permit application or DMR analysis. Use equivalent annual flow for intermittent discharges.
	Noncarcinogen - Freshwater	The design effluent flow is defined as the highest monthly average plant effluent flow for the past three years during the critical flow or when critical condition is likely to occur. If plant effluent flows are expected to increase during the life of the permit, the highest average monthly flow must be estimated. Use equivalent monthly average flow for intermittent discharges.

2.2.1 Critical Effluent Flow Estimation

2.2.1.1 Current Effluent Flow

Ecology guidelines (**Tables 7 and 8**) require the design capacity of the WWTP to be considered when determining the critical effluent flow for dilution analysis in the mixing zone. This critical flow reflects the WWTP's operational level relative to its design capacity. The municipal National Pollutant Discharge Elimination System permit (permit number WA0021938) specifies a maximum monthly design flow of 3.6 million gallons per day (MGD) for the WWTP. The guidelines set a threshold of 85% design capacity to determine the appropriate flow rate.

An analysis of Discharge Monitoring Reports (DMRs) reveals an average maximum monthly flow of 1.501 MGD during for the last six years (see Table 8). This translates to a current average operating factor of approximately 42% (1.501 MGD / 3.6 MGD). Since the WWTP operates below 85% capacity, the design conditions outlined in **Table 9** apply.

Table 8: Average Maximum Monthly Flow

Year	Monthly Maximum (MGD)
2018	1.592
2019	1.096
2020	2.375
2021	1.490
2022	1.503
2023	0.950
Average	1.501

As identified in Section 2.1.1.2, the critical low flow period for the receiving water body occurs between September and October. This period is used for estimating the WWTP flow rates during critical conditions. **Table 9** presents these flow rates, derived from data in the DMRs for the period 2018-2023. The table shows that the maximum daily flow over a 24-hour period recorded between September and October for the 2018-2023 period was 1.0 MGD, occurring on September 1st, 2019. The annual average flow for this period is estimated at 0.875 MGD. Additionally, **Table 10** presents the monthly average flow during the critical period, indicating that the highest monthly average value during this period is 0.627 MGD.

Table 9: Design Conditions and Flow Rates

Parameter	Mixing Zone	Design Condition	Flow (MGD)
Current WWTP Flow	Acute	Highest daily maximum plant effluent flow during the critical period	1.00
	Chronic	Highest monthly average plant effluent flow during the critical period	0.627
	Carcinogen - Freshwater	Annual average flow	0.875
	Noncarcinogen - Freshwater	Highest monthly average plant effluent flow during the critical period	0.627

Table 10: Monthly Average Flow During the Critical Period for WWTP

Average Flows During the Critical Period (MGD)							
Month	2018	2019	2020	2021	2022	2023	Total
September	0.514	0.627	0.603	0.508	0.508	0.495	0.543
October	0.422	0.539	0.571	0.426	0.391	0.331	0.447
Monthly Average	0.468	0.583	0.587	0.467	0.452	0.413	0.495

2.2.1.2 Future Effluent Flow

A future effluent flow scenario utilizes the year 2040 flow projections outlined in the General Sewer Plan (HLA, 2023) as presented in **Table 11**. Using the design rating established by Ecology in Permit No. WA0021938, the WWTP is projected to operate at 83% of its maximum monthly design flow (2.98 MGD out of a capacity of 3.6 MGD). Since the WWTP operates below 85% capacity, the design conditions show in **Table 12** apply.

To estimate the future highest daily maximum flow during the critical season, a two-step approach was employed. First, the projected monthly average flow for the critical period is determined by multiplying the ratio of the current critical season monthly average flow to the current annual average flow with the projected future annual flow. Secondly, a peaking factor, derived from DMRs data (refer to **Table 13**), which represents the typical increase in daily

maximum flow compared to the monthly average during the critical season, is applied to the projected monthly average flow to estimate the future highest daily maximum flow.

Table 11: Future Flow Projections from General Sewer Plan

Year	Annual Average Low (MGD)	Maximum Monthly Flow (MGD)
2025	1.06	1.66
2030	1.28	2.00
2035	1.56	2.43
2040	1.91	2.98

Table 12: Projected Flows for Critical Season in the Year 2040

Parameter	Mixing Zone	Design Condition	Flow (MGD)
Current WWTP flow	Acute	Highest daily maximum plant effluent flow during the critical period	1.810
	Chronic	Highest monthly average plant effluent flow during the critical period	1.193
	Carcinogen - Freshwater	Annual average flow	1.910
	Noncarcinogen - Freshwater	Highest monthly average plant effluent flow during the critical period	1.193

Table 13: Peaking Factor for Current Daily Max/Monthly Max Flow During Critical Period

Year	Daily Maximum (MGD)	Monthly Maximum (MGD)	Monthly Average (MGD)	PF (Daily)	PF (Monthly)
2018	0.757	0.514	0.468	1.62	1.1
2019	1.003	0.627	0.583	1.72	1.08
2020	0.896	0.603	0.587	1.53	1.03
2021	0.704	0.508	0.467	1.51	1.09
2022	0.732	0.508	0.452	1.62	1.12
2023	0.845	0.495	0.413	2.05	1.2
Average Peaking Factor				1.67	1.1

PF = Peaking factor

Similarly, to estimate the future highest monthly average plant effluent flow during the critical period, a comparable process was followed. The projected monthly average flow for the critical period is multiplied by a peaking factor (**Table 13**), which represents the typical increase in monthly maximum flow compared to the monthly average during the critical season.

2.2.1.3 Summary of Effluent Design Flow Conditions

Table 14 summarizes the effluent flow rates used to compute the dilution factor for both the current and future scenarios.

Table 14: Effluent Flows for Dilution Estimation

Scenario	Mixing Zone	Flow (MGD)
Current WWTP Flows	Acute	1.00
	Chronic	0.627
	Carcinogen - Freshwater	0.875
	Noncarcinogen - Freshwater	0.627
Future WWTP Flows	Acute	1.810
	Chronic	1.193
	Carcinogen - Freshwater	1.910
	Noncarcinogen - Freshwater	1.193

3. Water Quality Design Conditions

3.1 Receiving Water Quality Conditions

Similar to the flow rates, the Yakima River ambient water quality data for this analysis was obtained from three sources: the Yakima River at Cle Elum (YUMW) Hydromet station, and stations 39A090 and 39A080 from the Environmental Information Management System from the Department of Ecology. The design background conditions were extracted from the Water Quality Program Permit Writer's Manual, and the values were estimated from daily time series and discrete data. **Table 15** presents these estimated values.

Table 15: Yakima River Background Water Quality

Parameter	Design Background Condition	Unit	Value
Temperature	90 th percentile annual maximum 7DADMax, or 90 th percentile of annual maximum 1DMax; whichever matches the criterion. For acute and chronic mixing zones.	°C	21.10 ¹
Dissolved Oxygen	10 th percentile during the critical period recommended as a reasonable worst case.	mg/L	8.44 ²
pH	Minimum and maximum pH values during the critical period	s.u.	7.3-7.9 ³
Fecal Coliform	95 th percentile during the critical period recommended	#/100 mL	38.60 ⁴
Total Ammonia-N (Toxics Criteria)	90 th Percentile Concentration recommended	mg/L	0.011 ⁵
Alkalinity	Average concentration during critical period	mg/L as CaCO ₃	26.18 ⁶
Hardness	Average concentration during critical period	mg/L CaCO ₃	26.0 ⁷
Total Suspended Solids	Average concentration during critical period	mg/L	1.5 ⁸
Turbidity	Average concentration during critical period	NTU	2.5 ⁹

Reasonable Potential Analysis for Outfall Relocation

1. Estimated using data for the 2011-2023 period from the Yakima River at Cle Elum (YUMW) Hydromet station.
2. Estimated using data from 2015 and 2019 period from station 39A090.
3. Minimum/maximum observed values from 2015 and 2019 from stations 39A090 and 39A080.
4. Estimated using discrete data between 2000 and 2023 from station 39A090.
5. Estimated using discrete data between 2013 and 2023 from station 39A090.
6. Estimated using discrete data from 2019 from station 39A090.
7. Estimated using discrete data between 2007-2012 from station 39A090.
8. Estimated using discrete data between 2000-2022 from station 39A090.
9. Estimated using discrete data between 2010-2022 from station 39A090.

mg/L = milligrams per liter

DO = dissolved oxygen

s.u. = standard unit

3.2 Effluent Water Quality Conditions

Effluent water quality data for the WWTP was estimated using data from the Ecology Permitting and Reporting Information System for the period 2018-2023. This data was obtained from the DMRs. **Table 16** presents these estimated values.

Table 16: WWTP Effluent Water Quality

Parameter	Design Background Condition	Unit	Value ¹
Temperature	<i>Chronic mixing zone:</i> 95 th percentile (0.05 probability) of 7DADMax, or 95 th percentile of 1DMax; whichever matches the criterion.	°C	19.92
	<i>Acute mixing zone:</i> 99 th percentile (0.05 probability) of 7DADMax, or 95 th percentile of 1DMax; whichever matches the criterion	mg/L	20.06
Dissolved Oxygen	10 th percentile during the critical period recommended as a reasonable worst case.	mg/L	3.38
pH	Minimum – Maximum pH values during the critical period	s.u.	6.24-7.50
Fecal Coliform	95 th percentile during the critical period recommended	#/100 mL	51.8
Total Ammonia-N	95 th Percentile Concentration during critical period	mg/L	1.20 ³
Alkalinity	Average concentration during the critical period	mg/L as CaCO ₃	72.50 ²
Hardness	Average concentration during the critical period	mg/L CaCO ₃	64
Total Suspended Solids		mg/L	4.78

Reasonable Potential Analysis for Outfall Relocation

1. Except where indicated all values were estimated using 6 years of data from 2018-2023 from the DMRs from the WWTP.
2. Estimated using data from 2021-2023 from the DMRs provided by WWTP operation team.
3. The data used for the estimation consisted of 110 samples with a mean of 0.6914, standard deviation of 0.7544 and coefficient of variation of 1.09.

4. Reasonable Potential Analysis Results

To determine the reasonable potential, the following specific water quality standards that apply to the discharge from the WWTP into the Yakima River will be employed:

Temperature Criteria: The temperature of the water discharged from the WWTP is regulated to protect salmon in the Yakima River. Washington Administrative Code (WAC) 173-201A-200(1)(c) and a water quality atlas designate this section of the Yakima River as critical for salmon spawning, rearing, and migration. To ensure a suitable habitat, the maximum temperature of the water near the discharge point cannot exceed 17.5°C.

Dissolved Oxygen Criteria: Minimum oxygen levels are mandated by WAC 173-201A-200(1)(d). For this discharge, the lowest 1-day minimum dissolved oxygen concentration for salmonid spawning, rearing, and migration habitat category is 8 milligram per liter (mg/L).

pH Criteria: WAC 173-201A-200(1)(g) also specifies the acceptable pH range for the water. For salmonid spawning, rearing, and migration habitat, the pH should be within the range of 6.5 to 8.5 with a human-caused variation outside the above range of less than 0.5 units.

Turbidity Criteria: WAC 173-201A-200(1)(e) sets limits on the allowed increase in turbidity which depends on the natural level (background turbidity) in the river. The maximum turbidity criteria for salmonid spawning, rearing, and migration habitat shall not exceed:

- 10 NTU over background when the background is 50 NTU or less; or
- A 20 percent increase in turbidity when the background turbidity is more than 50 NTU.

Fecal Coliform Bacteria Criteria: WAC 173-201A-200(2)(b) establish that Fecal coliform organism levels must not exceed a geometric mean value of 100 colonies per 100 ml, with no more than 10 percent of all samples (or any single sample when less than ten sample points exist) obtained for calculating the geometric mean value exceeding 200 colonies per 100 ml. Using PermitCal, compliance will be demonstrated showing that technology-based effluent limit on fecal coliform of 400 per 100 ml with simple mixing meets the lower WQ standard of 100 per 100 ml (fresh).

Toxics Criteria: The WWTP monitors one toxicant, ammonia. The acceptable level of ammonia in the effluent is calculated using formulas in WAC 173-201A-240 which are applied in PermitCalc software.

4.1 Dilution Factors and Reasonable Potential Analysis for Current River Condition

Table 17 presents the dilution factors generated by the PermitCal modeling spreadsheet. These factors account for the current and future flow rates of the WWTP and the Yakima River design condition with a 7Q10 of 258.4 cfs and parameters from **Table 4**.

Table 17: Dilution Factors for Current and Future WWTP Scenario and Current River Condition

Parameter	Mixing Zone	Maximum Dilution Factor Allowed
Current WWTP Flows	Acute	5.2
	Chronic	67.6
	Carcinogen - Freshwater	207.5
	Noncarcinogen - Freshwater	117.7
Future WWTP Flows	Acute	3.3
	Chronic	36.0
	Carcinogen - Freshwater	95.6
	Noncarcinogen - Freshwater	62.4

To determine if water quality based effluent limits are required, a reasonable potential analysis (RPA) is completed to assess the potential for the discharge to violate water quality standards for aquatic life and human health. Factors such as effluent composition, river mixing, and existing water quality are considered. Ecology's PermitCalc spreadsheets this evaluation. Using the parameters estimated in the previous sections as an input, the results from this analysis are presented in **Table 18**.

The analysis using current and future WWTP flows indicates that maintaining the outfall's current location wouldn't necessitate revising existing permit limits. Fecal coliform was previously identified as having reasonable potential for exceeding water quality standards, and its limit will therefore be retained in the permit.

Table 18: RPA for Current Yakima River Condition and Outfall Location

Parameter	Description	Unit	Value Output PermitCalc		Reasonable Potential (Yes/No)
			Current WWTP Flow	Future WWTP Flow	
Temperature	Temperature at chronic mixing zone boundary	°C	21.08	21.07	No
	Incremental temperature increase or decrease	°C	-0.02	-0.03	
	Maximum allowable incremental temperature increase:	°C	0.3	0.3	

Reasonable Potential Analysis for Outfall Relocation

Parameter	Description	Unit	Value Output PermitCalc		Reasonable Potential (Yes/No)
			Current WWTP Flow	Future WWTP Flow	
	Maximum allowable temperature at ixing zone boundary	°C	17.5	17.5	
Dissolved Oxygen	DO at Mixing Zone Boundary, mg/L	mg/L	8.37	8.30	No
	DO decrease caused by effluent at chronic boundary, mg/L	mg/L	0.07	0.14	
pH	pH change at Mixing Zone Acute	s.u.	0.42	0.51	No
	pH change at Mixing Zone Chronic		0.07	0.11	
Fecal Coliform	At Mixing Zone Boundary Difference between mixed/Ambient	#/100 mL	44 5	49 10	Yes
Total Ammonia-N	Maximum concentration at edge of Acute	ug/L	0.241	0.371	No
	Maximum concentration at edge of Chronic		0.0286	0.0440	
	Aquatic Life Criteria Acute	ug/L	11,375	11,375	
	Aquatic Life Criteria Chronic		1,373	1,373	
Turbidity/Total Suspended Solids	Turbidity shall not exceed 10 NTU	mg/L	N/A	N/A	No

ug/L = microgram per liter

4.2 Dilution Factors and Reasonable Potential Analysis for River Condition with Lowest Estimated 7Q10

Table 19 presents the dilution factors generated by the PermitCal modeling spreadsheet for the design condition with a 7Q10 of 148.79 which represents the lowest 7Q10 within the confidence interval. For this scenario the 30Q5 and harmonic mean have been estimated using the guidelines in PermitCal.

Table 20 shows that adopting the lowest 7Q10 river flow estimated and modelling this with both scenarios, current and future WWTP flows, wouldn't necessitate revising existing permit limits. Fecal coliform was previously identified as having reasonable potential for exceeding water quality standards, and its limit will therefore be retained in the permit.

Table 19: Dilution Factors for Current and Future WWTP Scenario and Lowest 7Q10 River Condition

Parameter	Mixing Zone	Maximum Dilution Factor Allowed
Current WWTP Flows	Acute	3.4
	Chronic	39.3
	Carcinogen - Freshwater	83.4
	Noncarcinogen - Freshwater	54.7
Future WWTP Flows	Acute	2.3
	Chronic	21.2
	Carcinogen - Freshwater	29.2
	Noncarcinogen - Freshwater	81.6

Table 20: RPA for Lowest 7Q10 Yakima River Condition

Parameter	Description	Unit	Value Output PermitCalc		Reasonable Potential (Yes/No)
			Current WWTP Flow	Future WWTP Flow	
Temperature	Temperature at Chronic Mixing Zone Boundary	°C	21.07	21.04	No
	Incremental Temperature Increase or decrease	°C	-0.03	-0.06	
	Maximum Allowable Incremental Temperature Increase:	°C	0.3	0.3	
	Maximum Allowable Temperature at Mixing Zone Boundary	°C	17.5	17.5	
Dissolved Oxygen	DO at Mixing Zone Boundary, mg/L	mg/L	8.31	8.20	No
	DO decrease caused by effluent at chronic boundary, mg/L	mg/L	0.13	0.24	
pH	pH change at Mixing Zone Acute	s.u.	0.50	0.58	No
	pH change at Mixing Zone Chronic		0.11	0.17	
Fecal Coliform	At Mixing Zone Boundary Difference between mixed/ambient	#/100 mL	48 9	56 17	Yes
Total Ammonia-N	Max concentration at edge of Acute	ug/L	0.360	0.522	No
	Max concentration at edge of Chronic		0.0412	0.0672	
	Aquatic Life Criteria Acute	ug/L	11,375	11,375	
	Aquatic Life Criteria Chronic		1,373	1,373	
Turbidity/Total Suspended Solids	Turbidity shall not exceed 10 NTU	mg/L	N/A	N/A	No

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**APPENDIX 1 – PERMITCALC WORKBOOK CALCULATIONS FOR CLE ELUM
WWTP**

Dilution Factor Calculations and Receiving Water Critical Conditions (Design condition with a 7Q10 of 258.4 cfs)

Step 1: Enter Waterbody Type

Water Body Type	Freshwater
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Facility Name	Cle Elum WwTP
Receiving Water	Yakima River

Step 2: Enter Dilution Factors -OR- Calculate DFs by entering Facility/Receiving Water Flow Data

Do you want to enter dilution factors -or- flow data?	Flow Data
---	-----------

Current WWTP Flow

	Annual Average	Max Monthly Average	Daily Max
Facility Flow, MGD	0.875	0.627	1.000
Facility Flow, cfs (calculated)	1.35	0.97	1.55

	Condition	Receiving Water Flow, cfs	Allowable % of river flow	Max Dilution Factor Allowed
<u>Aquatic Life - Acute</u>	7Q10	258.4	0.025	5.2
<u>Aquatic Life - Chronic</u>	7Q10	258.4	0.25	67.6
<u>HH-Non-Carcinogen</u>	30Q5	452.94	0.25	117.7
<u>HH-Carcinogen</u>	Harmonic Mean	1118.1	0.25	207.5
<u>Whole river at 7Q10</u>	7Q10	258.4	1	267.4

Step 3: Enter Critical Data

	Effluent	Receiving Water
Temp, °C	19.92	21.1
pH, s.u.	6.9	7.6
Alkalinity, mg/L as CaCO3	72.5	26.18
Hardness, mg/L CaCO3	64	26
Salinity, psu		
Receiving water TSS, mg/L (leave blank if unknown)		1.5
If TSS is annual data, enter 'A'; if from critical period, enter 'S'; If no TSS, leave blank		A

Step 4: Specify if using 'Mixed' values for hardness, temperature, and pH

	Use 'Mixed Hardness' (Y/N)	Use 'Mixed Max Temp' (Y/N)	Use 'Mixed pH (Y/N)
	N	N	N
Acute Zone Boundary	33.3	20.9	7.2
Chronic Zone Boundary	26.6	21.1	7.5
Whole river at 7Q10	26.1	21.1	7.6

Reasonable Potential Calculation

Facility	Cle Elum WwTP
Water Body Type	Freshwater
Rec. Water Hardness	26 mg/L

Dilution Factors:		Acute	Chronic
Aquatic Life		5.2	67.6
Human Health Carcinogenic			207.5
Human Health Non-Carcinogenic			117.7

Pollutant, CAS No. & NPDES Application Ref. No.		AMMONIA, Criteria as Total NH3										
Effluent Data	# of Samples (n)	101										
	Coeff of Variation (Cv)	1.09	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Effluent Concentration, ug/L (Max. or 95th Percentile)	1.20										
	Calculated 50th percentile Effluent Conc. (when n>10)											
Receiving Water Data	90th Percentile Conc., ug/L	0.011										
	Geo Mean, ug/L											
Water Quality Criteria	Aquatic Life Criteria, Acute ug/L	11,375										
	Chronic	1,373										
	WQ Criteria for Protection of Human Health, ug/L	-										
	Metal Criteria Acute	-										
	Translator, decimal	-										
	Carcinogen?	N										

Aquatic Life Reasonable Potential

Effluent percentile value	0.950
s $s^2 = \ln(CV^2 + 1)$	0.885
Pn $Pn = (1 - \text{confidence level})^{1/n}$	0.971
Multiplier	1.00
Max concentration (ug/L) at edge of...	Acute 0.241
	Chronic 0.0286
Reasonable Potential? Limit Required?	NO

Aquatic Life Limit Calculation

# of Compliance Samples Expected per month	
LTA Coeff. Var. (CV), decimal	
Permit Limit Coeff. Var. (CV), decimal	
Waste Load Allocations, ug/L	Acute
	Chronic
Long Term Averages, ug/L	Acute
	Chronic
Limiting LTA, ug/L	
Metal Translator or 1?	
Average Monthly Limit (AML), ug/L	
Maximum Daily Limit (MDL), ug/L	

Human Health Reasonable Potential

s $s^2 = \ln(CV^2 + 1)$	
Pn $Pn = (1 - \text{confidence level})^{1/n}$	
Multiplier	
Dilution Factor	
Max Conc. at edge of Chronic Zone, ug/L	
Reasonable Potential? Limit Required?	

Human Health Limit Calculation

# of Compliance Samples Expected per month	
Average Monthly Effluent Limit, ug/L	
Maximum Daily Effluent Limit, ug/L	

Comments/Notes:

References: WAC 173-201A,
 Technical Support Document for Water Quality-based Toxics Control, US EPA, March 1991, EPA/505/2-90-001, pages 56/99

Override formatting & show Aq. Life Limit Calc?	N	N	N	N	N	N	N	N	N	N	N	N
Override formatting & show HH Limit Calc?	N	N	N	N	N	N	N	N	N	N	N	N

Freshwater Un-ionized Ammonia Criteria Calculation

Based on Chapter 173-201A WAC, amended November 20, 2006

		mixed @ Acute Boundary	mixed @ Chronic Boundary	mixed @ Whole River
INPUT				
1. Receiving Water Temperature (deg C):	21.1	20.9	21.1	21.1
2. Receiving Water pH:	7.6	7.2	7.5	7.6
3. Is salmonid habitat an existing or designated use?	Yes	Yes	Yes	Yes
4. Are non-salmonid early life stages present or absent?	Present	Present	Present	Present
OUTPUT				
Using mixed temp and pH at mixing zone boundaries?	no			
Ratio	15.631	25.204	17.106	16.029
FT	1.400	1.400	1.400	1.400
FPH	1.305	2.127	1.387	1.326
pKa	9.368	9.375	9.368	9.368
Unionized Fraction	0.017	0.006	0.014	0.016
Unionized ammonia NH3 criteria (mg/L as NH ₃)				
Acute:	0.232	0.156	0.000	0.229
Chronic:	0.028	0.011	0.024	0.027
RESULTS				
Total ammonia nitrogen criteria (mg/L as N):				
Acute:	11.375	20.164		11.705
Chronic:	1.373		1.371	1.372

Data source:

Calculation of Fecal Coliform/E. Coli/Enterococci at Chronic Mixing Zone

INPUT	
Chronic Dilution Factor	67.6
Receiving Water [bacteria indicator], #/100 ml	39
Effluent [Bacteria indicator] - worst case, #/100 ml	400
Surface Water Criterion, #/100 ml	14
OUTPUT	
[bacteria indicator] at Mixing Zone Boundary, #/100 ml	44
Difference between mixed and ambient, #/100 ml	5
Conclusion: At design flow, the discharge has a reasonable potential to violate water quality standards for fecal coliform.	

Calculation of Dissolved Oxygen at Chronic Mixing Zone

INPUT	
Chronic Dilution Factor	67.6
Receiving Water DO Concentration, mg/L	8.4
Effluent DO Concentration, mg/L	3.4
Effluent Immediate DO Demand (IDOD), mg/L	
Surface Water Criteria, mg/L	8
OUTPUT	
DO at Mixing Zone Boundary, mg/L	8.37
DO decrease caused by effluent at chronic boundary, mg/L	0.07
Conclusion: At design flow, the discharge has no reasonable potential to violate water quality standards for dissolved oxygen.	

References: EPA/600/6-85/002b and EPA/430/9-82-011

Freshwater Temperature Reasonable Potential and Limit Calculation

Based on WAC 173-201A-200(1)(c)(i)--(ii) and the Water Quality Program Guidance. All data inputs must meet WQ guidelines.

	Core Summer Criteria	Supplemental Criteria
INPUT	July 1-Sept 14	Sept 15-July 1
1. Chronic Dilution Factor at Mixing Zone Boundary	67.6	67.6
2. 7DADMax Ambient Temperature (T) (Upstream Background 90th percentile)	21.1 °C	21.1 °C
3. 7DADMax Effluent Temperature (95th percentile)	19.9 °C	19.9 °C
4. Aquatic Life Temperature WQ Criterion in Fresh Water	17.5 °C	17.5 °C
OUTPUT		
5. Temperature at Chronic Mixing Zone Boundary:	21.08 °C	21.08 °C
6. Incremental Temperature Increase or decrease:	-0.02 °C	-0.02 °C
7. Maximum Allowable Incremental Temperature Increase:	0.3 °C	0.3 °C
8. Maximum Allowable Temperature at Mixing Zone Boundary:	17.5 °C	17.5 °C
A. If ambient temp is warmer than WQ criterion		
9. Does temp fall within this warmer temp range?	YES	YES
10. If YES - Use TMDL-based or performance-based limit - Do Not use this spreadsheet		
B. If ambient temp is cooler than WQ criterion but within $28/(T_{amb}+7)$ of the criterion		
11. Does temp fall within this Incremental temp. range?	---	---
12. Temp increase allowed at mixing zone boundary, if required:	---	---
C. If ambient temp is cooler than $(WQ\ criterion - 28/(T_{amb}+7))$		
13. Does temp fall within this Incremental temp. range?	---	---
14. Temp increase allowed at mixing zone boundary, if required:	---	---
RESULTS		
15. Do any of the above cells show a temp increase?	NO	NO
16. Temperature Limit if Required?	NO LIMIT	NO LIMIT

Calculation of pH of a Mixture of Two Flows

Based on the procedure in EPA's DESCON program (EPA, 1988. Technical Guidance on Supplementary Stream Design Conditions for Steady State Model
Office of Water, Washington D.C.)

INPUT		
	@ Acute Boundary	@ Chronic Boundary
1. Dilution Factor at Mixing Zone Boundary	5.2	67.60
2. Ambient/Upstream/Background Conditions		
Temperature (deg C):	21.10	21.10
pH:	7.60	7.60
Alkalinity (mg CaCO3/L):	26.18	26.18
3. Effluent Characteristics		
Temperature (deg C):	19.92	19.92
pH:	6.90	6.90
Alkalinity (mg CaCO3/L):	72.50	72.50
4. Aquatic Life Use Designation	Char spawning & rearing and/or core summer habitat	
OUTPUT		
1. Ionization Constants		
Upstream/Background pKa:	6.37	6.37
Effluent pKa:	6.38	6.38
2. Ionization Fractions		
Upstream/Background Ionization Fraction:	0.94	0.94
Effluent Ionization Fraction:	0.77	0.77
3. Total Inorganic Carbon		
Upstream/Background Total Inorganic Carbon (mg CaCO3/L):	28	28
Effluent Total Inorganic Carbon (mg CaCO3/L):	95	95
4. Conditions at Mixing Zone Boundary		
Temperature (deg C):	20.87	21.08
Alkalinity (mg CaCO3/L):	35.09	26.87
Total Inorganic Carbon (mg CaCO3/L):	40.58	28.73
pKa:	6.38	6.37
5. Allowable pH change	NA	0.20
RESULTS		
pH at Mixing Zone Boundary:	7.18	7.53
pH change at Mixing Zone Boundary:	0.42	0.07
Is permit limit needed?	NO	NO

Dilution Factor Calculations and Receiving Water Critical Conditions (Design condition with a 7Q10 of 258.4 cfs)

Step 1: Enter Waterbody Type

Water Body Type	Freshwater
-----------------	------------

Facility Name	Cle Elum WwTP
Receiving Water	Yakima River

Step 2: Enter Dilution Factors -OR- Calculate DFs by entering Facility/Receiving Water Flow Data

Do you want to enter dilution factors -or- flow data?	Flow Data
---	-----------

Future WWTP Flow

	Annual Average	Max Monthly Average	Daily Max
Facility Flow, MGD	1.910	1.193	1.810
Facility Flow, cfs (calculated)	2.95	1.85	2.80

	Condition	Receiving Water Flow, cfs	Allowable % of river flow	Max Dilution Factor Allowed
<u>Aquatic Life - Acute</u>	7Q10	258.4	0.025	3.3
<u>Aquatic Life - Chronic</u>	7Q10	258.4	0.25	36.0
<u>HH-Non-Carcinogen</u>	30Q5	452.94	0.25	62.4
<u>HH-Carcinogen</u>	Harmonic Mean	1118.1	0.25	95.6
<u>Whole river at 7Q10</u>	7Q10	258.4	1	141.0

Step 3: Enter Critical Data

	Effluent	Receiving Water
Temp, °C	19.92	21.1
pH, s.u.	6.9	7.6
Alkalinity, mg/L as CaCO3	72.5	26.18
Hardness, mg/L CaCO3	64	26
Salinity, psu		
Receiving water TSS, mg/L (leave blank if unknown)		1.5
If TSS is annual data, enter 'A'; if from critical period, enter 'S'; If no TSS, leave blank		A

Step 4: Specify if using 'Mixed' values for hardness, temperature, and pH

	Use 'Mixed Hardness' (Y/N)	Use 'Mixed Max Temp' (Y/N)	Use 'Mixed pH (Y/N)
	N	N	N
Acute Zone Boundary	37.5	20.7	7.1
Chronic Zone Boundary	27.1	21.1	7.5
Whole river at 7Q10	26.3	21.1	7.6

Reasonable Potential Calculation

Facility	Cle Elum WwTP
Water Body Type	Freshwater
Rec. Water Hardness	26 mg/L

Dilution Factors:	Acute	Chronic
Aquatic Life	3.3	36.0
Human Health Carcinogenic		95.6
Human Health Non-Carcinogenic		62.4

Pollutant, CAS No. & NPDES Application Ref. No.		AMMONIA, Criteria as Total NH3										
Effluent Data	# of Samples (n)	101										
	Coeff of Variation (Cv)	1.09	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Effluent Concentration, ug/L (Max. or 95th Percentile)	1.20										
	Calculated 50th percentile Effluent Conc. (when n>10)											
Receiving Water Data	90th Percentile Conc., ug/L	0.011										
	Geo Mean, ug/L											
Water Quality Criteria	Aquatic Life Criteria, Acute ug/L	11,375										
	Chronic	1,373										
	WQ Criteria for Protection of Human Health, ug/L	-										
	Metal Criteria Acute	-										
	Translator, decimal	-										
	Carcinogen?	N										

Aquatic Life Reasonable Potential

Effluent percentile value	0.950
s $s^2 = \ln(CV^2 + 1)$	0.885
Pn $Pn = (1 - \text{confidence level})^{1/n}$	0.971
Multiplier	1.00
Max concentration (ug/L) at edge of...	Acute 0.371
	Chronic 0.0440
Reasonable Potential? Limit Required?	NO

Aquatic Life Limit Calculation

# of Compliance Samples Expected per month	
LTA Coeff. Var. (CV), decimal	
Permit Limit Coeff. Var. (CV), decimal	
Waste Load Allocations, ug/L	Acute
	Chronic
Long Term Averages, ug/L	Acute
	Chronic
Limiting LTA, ug/L	
Metal Translator or 1?	
Average Monthly Limit (AML), ug/L	
Maximum Daily Limit (MDL), ug/L	

Human Health Reasonable Potential

s $s^2 = \ln(CV^2 + 1)$	
Pn $Pn = (1 - \text{confidence level})^{1/n}$	
Multiplier	
Dilution Factor	
Max Conc. at edge of Chronic Zone, ug/L	
Reasonable Potential? Limit Required?	

Human Health Limit Calculation

# of Compliance Samples Expected per month	
Average Monthly Effluent Limit, ug/L	
Maximum Daily Effluent Limit, ug/L	

Comments/Notes:

References: WAC 173-201A,
 Technical Support Document for Water Quality-based Toxics Control, US EPA, March 1991, EPA/505/2-90-001, pages 56/99

Override formatting & show Aq. Life Limit Calc?	N	N	N	N	N	N	N	N	N	N	N	N
Override formatting & show HH Limit Calc?	N	N	N	N	N	N	N	N	N	N	N	N

Freshwater Un-ionized Ammonia Criteria Calculation

Based on Chapter 173-201A WAC, amended November 20, 2006

		mixed @ Acute Boundary	mixed @ Chronic Boundary	mixed @ Whole River
INPUT				
1. Receiving Water Temperature (deg C):	21.1	20.7	21.1	21.1
2. Receiving Water pH:	7.6	7.1	7.5	7.6
3. Is salmonid habitat an existing or designated use?	Yes	Yes	Yes	Yes
4. Are non-salmonid early life stages present or absent?	Present	Present	Present	Present
OUTPUT				
Using mixed temp and pH at mixing zone boundaries?	no			
Ratio	15.631	27.083	18.210	16.370
FT	1.400	1.400	1.400	1.400
FPH	1.305	2.426	1.456	1.345
pKa	9.368	9.379	9.369	9.368
Unionized Fraction	0.017	0.005	0.013	0.016
Unionized ammonia NH3 criteria (mg/L as NH ₃)				
Acute:	0.232	0.138	0.000	0.227
Chronic:	0.028	0.009	0.022	0.026
RESULTS				
Total ammonia nitrogen criteria (mg/L as N):				
Acute:	11.375	22.124		11.990
Chronic:	1.373		1.371	1.372

Data source:

Calculation of Fecal Coliform/E. Coli/Enterococci at Chronic Mixing Zone

INPUT	
Chronic Dilution Factor	36.0
Receiving Water [bacteria indicator], #/100 ml	39
Effluent [Bacteria indicator] - worst case, #/100 ml	400
Surface Water Criterion, #/100 ml	14
OUTPUT	
[bacteria indicator] at Mixing Zone Boundary, #/100 ml	49
Difference between mixed and ambient, #/100 ml	10
Conclusion: At design flow, the discharge has a reasonable potential to violate water quality standards for fecal coliform.	

Calculation of Dissolved Oxygen at Chronic Mixing Zone

INPUT	
Chronic Dilution Factor	36.0
Receiving Water DO Concentration, mg/L	8.4
Effluent DO Concentration, mg/L	3.4
Effluent Immediate DO Demand (IDOD), mg/L	
Surface Water Criteria, mg/L	8
OUTPUT	
DO at Mixing Zone Boundary, mg/L	8.30
DO decrease caused by effluent at chronic boundary, mg/L	0.14
Conclusion: At design flow, the discharge has no reasonable potential to violate water quality standards for dissolved oxygen.	

References: EPA/600/6-85/002b and EPA/430/9-82-011

Freshwater Temperature Reasonable Potential and Limit Calculation

Based on WAC 173-201A-200(1)(c)(i)--(ii) and the Water Quality Program Guidance. All data inputs must meet WQ guidelines.

	Core Summer Criteria	Supplemental Criteria
INPUT	July 1-Sept 14	Sept 15-July 1
1. Chronic Dilution Factor at Mixing Zone Boundary	36.0	36.0
2. 7DADMax Ambient Temperature (T) (Upstream Background 90th percentile)	21.1 °C	21.1 °C
3. 7DADMax Effluent Temperature (95th percentile)	19.9 °C	19.9 °C
4. Aquatic Life Temperature WQ Criterion in Fresh Water	17.5 °C	17.5 °C
OUTPUT		
5. Temperature at Chronic Mixing Zone Boundary:	21.07 °C	21.07 °C
6. Incremental Temperature Increase or decrease:	-0.03 °C	-0.03 °C
7. Maximum Allowable Incremental Temperature Increase:	0.3 °C	0.3 °C
8. Maximum Allowable Temperature at Mixing Zone Boundary:	17.5 °C	17.5 °C
A. If ambient temp is warmer than WQ criterion		
9. Does temp fall within this warmer temp range?	YES	YES
10. If YES - Use TMDL-based or performance-based limit - Do Not use this spreadsheet		
B. If ambient temp is cooler than WQ criterion but within $28/(T_{amb}+7)$ of the criterion		
11. Does temp fall within this Incremental temp. range?	---	---
12. Temp increase allowed at mixing zone boundary, if required:	---	---
C. If ambient temp is cooler than $(WQ\ criterion - 28/(T_{amb}+7))$		
13. Does temp fall within this Incremental temp. range?	---	---
14. Temp increase allowed at mixing zone boundary, if required:	---	---
RESULTS		
15. Do any of the above cells show a temp increase?	NO	NO
16. Temperature Limit if Required?	NO LIMIT	NO LIMIT

Calculation of pH of a Mixture of Two Flows

Based on the procedure in EPA's DESCON program (EPA, 1988. Technical Guidance on Supplementary Stream Design Conditions for Steady State Model
Office of Water, Washington D.C.)

INPUT		
	@ Acute Boundary	@ Chronic Boundary
1. Dilution Factor at Mixing Zone Boundary	3.3	36.00
2. Ambient/Upstream/Background Conditions		
Temperature (deg C):	21.10	21.10
pH:	7.60	7.60
Alkalinity (mg CaCO3/L):	26.18	26.18
3. Effluent Characteristics		
Temperature (deg C):	19.92	19.92
pH:	6.90	6.90
Alkalinity (mg CaCO3/L):	72.50	72.50
4. Aquatic Life Use Designation	Char spawning & rearing and/or core summer habitat	
OUTPUT		
1. Ionization Constants		
Upstream/Background pKa:	6.37	6.37
Effluent pKa:	6.38	6.38
2. Ionization Fractions		
Upstream/Background Ionization Fraction:	0.94	0.94
Effluent Ionization Fraction:	0.77	0.77
3. Total Inorganic Carbon		
Upstream/Background Total Inorganic Carbon (mg CaCO3/L):	28	28
Effluent Total Inorganic Carbon (mg CaCO3/L):	95	95
4. Conditions at Mixing Zone Boundary		
Temperature (deg C):	20.74	21.07
Alkalinity (mg CaCO3/L):	40.22	27.47
Total Inorganic Carbon (mg CaCO3/L):	47.98	29.59
pKa:	6.38	6.37
5. Allowable pH change	NA	0.20
RESULTS		
pH at Mixing Zone Boundary:	7.09	7.49
pH change at Mixing Zone Boundary:	0.51	0.11
Is permit limit needed?	NO	NO

Dilution Factor Calculations and Receiving Water Critical Conditions (Design condition with lowest 7Q10 of 148.79 cfs)

Step 1: Enter Waterbody Type

Water Body Type	Freshwater
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Facility Name	Cle Elum WwTP
Receiving Water	Yakima River

Step 2: Enter Dilution Factors -OR- Calculate DFs by entering Facility/Receiving Water Flow Data

Do you want to enter dilution factors -or- flow data?	Flow Data
---	-----------

Current WWTP Flow

	Annual Average	Max Monthly Average	Daily Max
Facility Flow, MGD	0.875	0.627	1.000
Facility Flow, cfs (calculated)	1.35	0.97	1.55

	Condition	Receiving Water Flow, cfs	Allowable % of river flow	Max Dilution Factor Allowed
Aquatic Life - Acute	7Q10	148.79	0.025	3.4
Aquatic Life - Chronic	7Q10	148.79	0.25	39.3
HH-Non-Carcinogen	30Q5	208.306	0.25	54.7
HH-Carcinogen	Harmonic Mean	446.37	0.25	83.4
Whole river at 7Q10	7Q10	148.79	1	154.4

Step 3: Enter Critical Data

	Effluent	Receiving Water
Temp, °C	19.92	21.1
pH, s.u.	6.9	7.6
Alkalinity, mg/L as CaCO3	72.5	26.18
Hardness, mg/L CaCO3	64	26
Salinity, psu		
Receiving water TSS, mg/L (leave blank if unknown)		1.5
If TSS is annual data, enter 'A'; if from critical period, enter 'S'; If no TSS, leave blank		A

Step 4: Specify if using 'Mixed' values for hardness, temperature, and pH

	Use 'Mixed Hardness' (Y/N)	Use 'Mixed Max Temp' (Y/N)	Use 'Mixed pH' (Y/N)
	N	N	N
Acute Zone Boundary	37.2	20.8	7.1
Chronic Zone Boundary	27.0	21.1	7.5
Whole river at 7Q10	26.2	21.1	7.6

Reasonable Potential Calculation

Facility	Cle Elum WwTP
Water Body Type	Freshwater
Rec. Water Hardness	26 mg/L

Dilution Factors:		Acute	Chronic
Aquatic Life		3.4	39.3
Human Health Carcinogenic			83.4
Human Health Non-Carcinogenic			54.7

Pollutant, CAS No. & NPDES Application Ref. No.		AMMONIA, Criteria as Total NH3										
Effluent Data	# of Samples (n)	101										
	Coeff of Variation (Cv)	1.09	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Effluent Concentration, ug/L (Max. or 95th Percentile)	1.20										
	Calculated 50th percentile Effluent Conc. (when n>10)											
Receiving Water Data	90th Percentile Conc., ug/L	0.011										
	Geo Mean, ug/L											
Water Quality Criteria	Aquatic Life Criteria, Acute ug/L	11,375										
	Chronic	1,373										
	WQ Criteria for Protection of Human Health, ug/L	-										
	Metal Criteria Acute	-										
	Translator, decimal	-										
	Carcinogen?	N										

Aquatic Life Reasonable Potential

Effluent percentile value		0.950
s	$s^2 = \ln(CV^2 + 1)$	0.885
Pn	$Pn = (1 - \text{confidence level})^{1/n}$	0.971
Multiplier		1.00
Max concentration (ug/L) at edge of...	Acute	0.360
	Chronic	0.0412
Reasonable Potential? Limit Required?		NO

Aquatic Life Limit Calculation

# of Compliance Samples Expected per month		
LTA Coeff. Var. (CV), decimal		
Permit Limit Coeff. Var. (CV), decimal		
Waste Load Allocations, ug/L	Acute	
	Chronic	
Long Term Averages, ug/L	Acute	
	Chronic	
Limiting LTA, ug/L		
Metal Translator or 1?		
Average Monthly Limit (AML), ug/L		
Maximum Daily Limit (MDL), ug/L		

Human Health Reasonable Potential

s	$s^2 = \ln(CV^2 + 1)$	
Pn	$Pn = (1 - \text{confidence level})^{1/n}$	
Multiplier		
Dilution Factor		
Max Conc. at edge of Chronic Zone, ug/L		
Reasonable Potential? Limit Required?		

Human Health Limit Calculation

# of Compliance Samples Expected per month		
Average Monthly Effluent Limit, ug/L		
Maximum Daily Effluent Limit, ug/L		

Comments/Notes:

References: WAC 173-201A,
Technical Support Document for Water Quality-based Toxics Control, US EPA, March 1991, EPA/505/2-90-001, pages 56/99

Override formatting & show Aq. Life Limit Calc?	N	N	N	N	N	N	N	N	N	N	N	N
Override formatting & show HH Limit Calc?	N	N	N	N	N	N	N	N	N	N	N	N

Freshwater Un-ionized Ammonia Criteria Calculation

Based on Chapter 173-201A WAC, amended November 20, 2006

		mixed @ Acute Boundary	mixed @ Chronic Boundary	mixed @ Whole River
INPUT				
1. Receiving Water Temperature (deg C):	21.1	20.8	21.1	21.1
2. Receiving Water pH:	7.6	7.1	7.5	7.6
3. Is salmonid habitat an existing or designated use?	Yes	Yes	Yes	Yes
4. Are non-salmonid early life stages present or absent?	Present	Present	Present	Present
OUTPUT				
Using mixed temp and pH at mixing zone boundaries?	no			
Ratio	15.631	26.967	18.021	16.308
FT	1.400	1.400	1.400	1.400
FPH	1.305	2.406	1.444	1.341
pKa	9.368	9.379	9.369	9.368
Unionized Fraction	0.017	0.005	0.013	0.016
Unionized ammonia NH3 criteria (mg/L as NH ₃)				
Acute:	0.232	0.139	0.000	0.227
Chronic:	0.028	0.009	0.022	0.026
RESULTS				
Total ammonia nitrogen criteria (mg/L as N):				
Acute:	11.375	22.000		11.938
Chronic:	1.373		1.371	1.372

Data source:

Calculation of Fecal Coliform/E. Coli/Enterococci at Chronic Mixing Zone

INPUT	
Chronic Dilution Factor	39.3
Receiving Water [bacteria indicator], #/100 ml	39
Effluent [Bacteria indicator] - worst case, #/100 ml	400
Surface Water Criterion, #/100 ml	14
OUTPUT	
[bacteria indicator] at Mixing Zone Boundary, #/100 ml	48
Difference between mixed and ambient, #/100 ml	9
Conclusion: At design flow, the discharge has a reasonable potential to violate water quality standards for fecal coliform.	

Calculation of Dissolved Oxygen at Chronic Mixing Zone

INPUT	
Chronic Dilution Factor	39.3
Receiving Water DO Concentration, mg/L	8.4
Effluent DO Concentration, mg/L	3.4
Effluent Immediate DO Demand (IDOD), mg/L	
Surface Water Criteria, mg/L	8
OUTPUT	
DO at Mixing Zone Boundary, mg/L	8.31
DO decrease caused by effluent at chronic boundary, mg/L	0.13
Conclusion: At design flow, the discharge has no reasonable potential to violate water quality standards for dissolved oxygen.	

References: EPA/600/6-85/002b and EPA/430/9-82-011

Freshwater Temperature Reasonable Potential and Limit Calculation

Based on WAC 173-201A-200(1)(c)(i)--(ii) and the Water Quality Program Guidance. All data inputs must meet WQ guidelines.

	Core Summer Criteria	Supplemental Criteria
INPUT	July 1-Sept 14	Sept 15-July 1
1. Chronic Dilution Factor at Mixing Zone Boundary	39.3	39.3
2. 7DADMax Ambient Temperature (T) (Upstream Background 90th percentile)	21.1 °C	21.1 °C
3. 7DADMax Effluent Temperature (95th percentile)	19.9 °C	19.9 °C
4. Aquatic Life Temperature WQ Criterion in Fresh Water	17.5 °C	17.5 °C
OUTPUT		
5. Temperature at Chronic Mixing Zone Boundary:	21.07 °C	21.07 °C
6. Incremental Temperature Increase or decrease:	-0.03 °C	-0.03 °C
7. Maximum Allowable Incremental Temperature Increase:	0.3 °C	0.3 °C
8. Maximum Allowable Temperature at Mixing Zone Boundary:	17.5 °C	17.5 °C
A. If ambient temp is warmer than WQ criterion		
9. Does temp fall within this warmer temp range?	YES	YES
10. If YES - Use TMDL-based or performance-based limit - Do Not use this spreadsheet		
B. If ambient temp is cooler than WQ criterion but within $28/(T_{amb}+7)$ of the criterion		
11. Does temp fall within this Incremental temp. range?	---	---
12. Temp increase allowed at mixing zone boundary, if required:	---	---
C. If ambient temp is cooler than $(WQ\ criterion - 28/(T_{amb}+7))$		
13. Does temp fall within this Incremental temp. range?	---	---
14. Temp increase allowed at mixing zone boundary, if required:	---	---
RESULTS		
15. Do any of the above cells show a temp increase?	NO	NO
16. Temperature Limit if Required?	NO LIMIT	NO LIMIT

Calculation of pH of a Mixture of Two Flows

Based on the procedure in EPA's DESCON program (EPA, 1988. Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling. USEPA Office of Water, Washington D.C.)

INPUT		
	@ Acute Boundary	@ Chronic Boundary
1. Dilution Factor at Mixing Zone Boundary	3.4	39.30
2. Ambient/Upstream/Background Conditions		
Temperature (deg C):	21.10	21.10
pH:	7.60	7.60
Alkalinity (mg CaCO3/L):	26.18	26.18
3. Effluent Characteristics		
Temperature (deg C):	19.92	19.92
pH:	6.90	6.90
Alkalinity (mg CaCO3/L):	72.50	72.50
4. Aquatic Life Use Designation	Char spawning & rearing and/or core summer habitat	
OUTPUT		
1. Ionization Constants		
Upstream/Background pKa:	6.37	6.37
Effluent pKa:	6.38	6.38
2. Ionization Fractions		
Upstream/Background Ionization Fraction:	0.94	0.94
Effluent Ionization Fraction:	0.77	0.77
3. Total Inorganic Carbon		
Upstream/Background Total Inorganic Carbon (mg CaCO3/L):	28	28
Effluent Total Inorganic Carbon (mg CaCO3/L):	95	95
4. Condtions at Mixing Zone Boundary		
Temperature (deg C):	20.75	21.07
Alkalinity (mg CaCO3/L):	39.80	27.36
Total Inorganic Carbon (mg CaCO3/L):	47.38	29.44
pKa:	6.38	6.37
5. Allowable pH change	NA	0.20
RESULTS		
pH at Mixing Zone Boundary:	7.10	7.49
pH change at Mixing Zone Boundary:	0.50	0.11
Is permit limit needed?	NO	NO

Dilution Factor Calculations and Receiving Water Critical Conditions (Design condition with lowest 7Q10 of 148.79 cfs)

Step 1: Enter Waterbody Type

Water Body Type	Freshwater
-----------------	------------

Facility Name	Cle Elum WwTP
Receiving Water	Yakima River

Step 2: Enter Dilution Factors -OR- Calculate DFs by entering Facility/Receiving Water Flow Data

Do you want to enter dilution factors -or- flow data?	Flow Data
---	-----------

Future WWTP Flow

	Annual Average	Max Monthly Average	Daily Max
Facility Flow, MGD	1.910	1.193	1.810
Facility Flow, cfs (calculated)	2.95	1.85	2.80

	Condition	Receiving Water Flow, cfs	Allowable % of river flow	Max Dilution Factor Allowed
Aquatic Life - Acute	7Q10	148.79	0.025	2.3
Aquatic Life - Chronic	7Q10	148.79	0.25	21.2
HH-Non-Carcinogen	30Q5	208.306	0.25	29.2
HH-Carcinogen	Harmonic Mean	446.37	0.25	38.8
Whole river at 7Q10	7Q10	148.79	1	81.6

Step 3: Enter Critical Data

	Effluent	Receiving Water
Temp, °C	19.92	21.1
pH, s.u.	6.9	7.6
Alkalinity, mg/L as CaCO3	72.5	26.18
Hardness, mg/L CaCO3	64	26
Salinity, psu		
Receiving water TSS, mg/L (leave blank if unknown)		1.5
If TSS is annual data, enter 'A'; if from critical period, enter 'S'; If no TSS, leave blank		A

Step 4: Specify if using 'Mixed' values for hardness, temperature, and pH

	Use 'Mixed Hardness' (Y/N)	Use 'Mixed Max Temp' (Y/N)	Use 'Mixed pH' (Y/N)
	N	N	N
Acute Zone Boundary	42.3	20.6	7.0
Chronic Zone Boundary	27.8	21.0	7.4
Whole river at 7Q10	26.5	21.1	7.5

Reasonable Potential Calculation

Facility	Cle Elum WwTP
Water Body Type	Freshwater
Rec. Water Hardness	26 mg/L

Dilution Factors:	Acute	Chronic
Aquatic Life	2.3	21.2
Human Health Carcinogenic		38.8
Human Health Non-Carcinogenic		29.2

Pollutant, CAS No. & NPDES Application Ref. No.		AMMONIA, Criteria as Total NH3										
Effluent Data	# of Samples (n)	101										
	Coeff of Variation (Cv)	1.09	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
	Effluent Concentration, ug/L (Max. or 95th Percentile)	1.20										
	Calculated 50th percentile Effluent Conc. (when n>10)											
Receiving Water Data	90th Percentile Conc., ug/L	0.011										
	Geo Mean, ug/L											
Water Quality Criteria	Aquatic Life Criteria, Acute ug/L	11,375										
	Chronic	1,373										
	WQ Criteria for Protection of Human Health, ug/L	-										
	Metal Criteria Acute	-										
	Translator, decimal	-										
	Carcinogen?	N										

Aquatic Life Reasonable Potential

Effluent percentile value	0.950
s $s^2 = \ln(CV^2 + 1)$	0.885
Pn $Pn = (1 - \text{confidence level})^{1/n}$	0.971
Multiplier	1.00
Max concentration (ug/L) at edge of...	Acute 0.522
	Chronic 0.0672
Reasonable Potential? Limit Required?	NO

Aquatic Life Limit Calculation

# of Compliance Samples Expected per month	
LTA Coeff. Var. (CV), decimal	
Permit Limit Coeff. Var. (CV), decimal	
Waste Load Allocations, ug/L	Acute
	Chronic
Long Term Averages, ug/L	Acute
	Chronic
Limiting LTA, ug/L	
Metal Translator or 1?	
Average Monthly Limit (AML), ug/L	
Maximum Daily Limit (MDL), ug/L	

Human Health Reasonable Potential

s $s^2 = \ln(CV^2 + 1)$	
Pn $Pn = (1 - \text{confidence level})^{1/n}$	
Multiplier	
Dilution Factor	
Max Conc. at edge of Chronic Zone, ug/L	
Reasonable Potential? Limit Required?	

Human Health Limit Calculation

# of Compliance Samples Expected per month	
Average Monthly Effluent Limit, ug/L	
Maximum Daily Effluent Limit, ug/L	

Comments/Notes:

References: WAC 173-201A,
Technical Support Document for Water Quality-based Toxics Control, US EPA, March 1991, EPA/505/2-90-001, pages 56/99

Override formatting & show Aq. Life Limit Calc?	N	N	N	N	N	N	N	N	N	N	N	N
Override formatting & show HH Limit Calc?	N	N	N	N	N	N	N	N	N	N	N	N

Freshwater Un-ionized Ammonia Criteria Calculation

Based on Chapter 173-201A WAC, amended November 20, 2006

		mixed @ Acute Boundary	mixed @ Chronic Boundary	mixed @ Whole River
INPUT				
1. Receiving Water Temperature (deg C):	21.1	20.6	21.0	21.1
2. Receiving Water pH:	7.6	7.0	7.4	7.5
3. Is salmonid habitat an existing or designated use?	Yes	Yes	Yes	Yes
4. Are non-salmonid early life stages present or absent?	Present	Present	Present	Present
OUTPUT				
Using mixed temp and pH at mixing zone boundaries?	no			
Ratio	15.631	28.390	19.611	16.870
FT	1.400	1.400	1.400	1.400
FPH	1.305	2.691	1.555	1.373
pKa	9.368	9.384	9.369	9.368
Unionized Fraction	0.017	0.004	0.011	0.015
Unionized ammonia NH3 criteria (mg/L as NH ₃)				
Acute:	0.232	0.125	0.000	0.223
Chronic:	0.028	0.007	0.019	0.025
RESULTS				
Total ammonia nitrogen criteria (mg/L as N):				
Acute:	11.375	23.540		12.412
Chronic:	1.373		1.371	1.372

Data source:

Calculation of Fecal Coliform/E. Coli/Enterococci at Chronic Mixing Zone

INPUT	
Chronic Dilution Factor	21.2
Receiving Water [bacteria indicator], #/100 ml	39
Effluent [Bacteria indicator] - worst case, #/100 ml	400
Surface Water Criterion, #/100 ml	14
OUTPUT	
[bacteria indicator] at Mixing Zone Boundary, #/100 ml	56
Difference between mixed and ambient, #/100 ml	17
Conclusion: At design flow, the discharge has a reasonable potential to violate water quality standards for fecal coliform.	

Calculation of Dissolved Oxygen at Chronic Mixing Zone

INPUT	
Chronic Dilution Factor	21.2
Receiving Water DO Concentration, mg/L	8.4
Effluent DO Concentration, mg/L	3.4
Effluent Immediate DO Demand (IDOD), mg/L	
Surface Water Criteria, mg/L	8
OUTPUT	
DO at Mixing Zone Boundary, mg/L	8.20
DO decrease caused by effluent at chronic boundary, mg/L	0.24
Conclusion: At design flow, the discharge has no reasonable potential to violate water quality standards for dissolved oxygen.	

References: EPA/600/6-85/002b and EPA/430/9-82-011

Freshwater Temperature Reasonable Potential and Limit Calculation

Based on WAC 173-201A-200(1)(c)(i)--(ii) and the Water Quality Program Guidance. All data inputs must meet WQ guidelines.

	Core Summer Criteria	Supplemental Criteria
INPUT	July 1-Sept 14	Sept 15-July 1
1. Chronic Dilution Factor at Mixing Zone Boundary	21.2	21.2
2. 7DADMax Ambient Temperature (T) (Upstream Background 90th percentile)	21.1 °C	21.1 °C
3. 7DADMax Effluent Temperature (95th percentile)	19.9 °C	19.9 °C
4. Aquatic Life Temperature WQ Criterion in Fresh Water	17.5 °C	17.5 °C
OUTPUT		
5. Temperature at Chronic Mixing Zone Boundary:	21.04 °C	21.04 °C
6. Incremental Temperature Increase or decrease:	-0.06 °C	-0.06 °C
7. Maximum Allowable Incremental Temperature Increase:	0.3 °C	0.3 °C
8. Maximum Allowable Temperature at Mixing Zone Boundary:	17.5 °C	17.5 °C
A. If ambient temp is warmer than WQ criterion		
9. Does temp fall within this warmer temp range?	YES	YES
10. If YES - Use TMDL-based or performance-based limit - Do Not use this spreadsheet		
B. If ambient temp is cooler than WQ criterion but within $28/(T_{amb}+7)$ of the criterion		
11. Does temp fall within this Incremental temp. range?	---	---
12. Temp increase allowed at mixing zone boundary, if required:	---	---
C. If ambient temp is cooler than $(WQ\ criterion - 28/(T_{amb}+7))$		
13. Does temp fall within this Incremental temp. range?	---	---
14. Temp increase allowed at mixing zone boundary, if required:	---	---
RESULTS		
15. Do any of the above cells show a temp increase?	NO	NO
16. Temperature Limit if Required?	NO LIMIT	NO LIMIT

Calculation of pH of a Mixture of Two Flows

Based on the procedure in EPA's DESCON program (EPA, 1988. Technical Guidance on Supplementary Stream Design Conditions for Steady State Modeling. USEPA Office of Water, Washington D.C.)

INPUT		
	@ Acute Boundary	@ Chronic Boundary
1. Dilution Factor at Mixing Zone Boundary	2.3	21.20
2. Ambient/Upstream/Background Conditions		
Temperature (deg C):	21.10	21.10
pH:	7.60	7.60
Alkalinity (mg CaCO3/L):	26.18	26.18
3. Effluent Characteristics		
Temperature (deg C):	19.92	19.92
pH:	6.90	6.90
Alkalinity (mg CaCO3/L):	72.50	72.50
4. Aquatic Life Use Designation	Char spawning & rearing and/or core summer habitat	
OUTPUT		
1. Ionization Constants		
Upstream/Background pKa:	6.37	6.37
Effluent pKa:	6.38	6.38
2. Ionization Fractions		
Upstream/Background Ionization Fraction:	0.94	0.94
Effluent Ionization Fraction:	0.77	0.77
3. Total Inorganic Carbon		
Upstream/Background Total Inorganic Carbon (mg CaCO3/L):	28	28
Effluent Total Inorganic Carbon (mg CaCO3/L):	95	95
4. Condtions at Mixing Zone Boundary		
Temperature (deg C):	20.59	21.04
Alkalinity (mg CaCO3/L):	46.32	28.36
Total Inorganic Carbon (mg CaCO3/L):	56.78	30.89
pKa:	6.38	6.37
5. Allowable pH change	NA	0.20
RESULTS		
pH at Mixing Zone Boundary:	7.02	7.43
pH change at Mixing Zone Boundary:	0.58	0.17
Is permit limit needed?	NO	NO

Appendix E : Draft 30% Outfall Basis of Design Memo (Jacobs)

DRAFT

Regional Wastewater Outfall Mitigation and Yakima River & Floodplain Reconnection

Date: June 27, 2024
Attention: Pollyanna Lind, PhD, Sr. Geomorphologist and Project Manager
Client: Inter-Fluve, Inc.
Contributors: John Nelson, Intake and Fisheries Engineer Subject Matter Expert
Allan Evans, Sr. Civil Water Conveyance Engineer

1. Purpose

This Draft Basis of Design Report (BODR) for the Regional Wastewater Outfall Mitigation and Yakima River & Floodplain Reconnection presents the design development for the civil, structural, and hydraulic design associated with the replacement of the City of Cle Elum's Upper Kittitas County Regional Wastewater Treatment effluent outfall and a portion of the associated conveyance pipeline (Hanson Ponds Outfall and Conveyance Piping).

The existing outfall is located approximately 800 ft south of Interstate 90 (I-90), on the downstream face of an engineered riprap drop structure and is constructed in the center of the main channel of the Yakima River. The existing outfall has limited accessibility, has been previously damaged, and is susceptible to bank erosion during large flooding events and as the Yakima River migrates.

The overall intent of the Regional Wastewater Outfall Mitigation and Yakima River & Floodplain Reconnection is to replace the aging outfall infrastructure with a similar outfall discharge configuration. The new outfall will discharge in an engineered scour hole located on the left bank of the new main river channel which is being designed to improve the river salmonid habitat while removing non-native predator habitat. This new outfall location reduces risks to the existing wastewater outfall infrastructure by relocating the mainstem channel in an alignment expected to reduce bank erosion and by reinforcing the floodplain and outfall to withstand very large flood events. The memorandum is organized as follows:

- General Design Criteria
- Survey Control
- Applicable Codes, Standards, Regulation, and Design Criteria
- Permitting Support

2. General Design Criteria

The following table presents the general design parameters and criteria associated with replacing the City of Cle Elum's Upper Kittitas County Regional Wastewater Treatment effluent outfall and a portion of the conveyance pipeline (Table 1).

Table 1. General design criteria for the replacement of the City of Cle Elum's Upper Kittitas County Regional Wastewater Treatment effluent outfall

	Parameter	Criteria
1	Design Flow Rate Monthly Average Flow Rate 3.5 MGD (5.43 cfs), Peak Instantaneous Flow Rate 10.5 MGD (16.28 cfs)	Confirm existing pipe size and positive discharge into the river.
2	Conveyance Pipe Working Pressure (Surge Pressure)	Match "in-kind" the working pressure of the existing pipe and fittings. Confirm pressure minimum EQ Basin water surface and maximum Yakima River water surface.
3	Conveyance Pipe Alignment, Invert Elevations and Pipe Slope	Match "in-kind" existing 24" Ductile Iron (DI) pipeline both the invert elevation of the tie -in to the and existing DI pipe slope. Verify pipe alignment, invert and conveyance pipe slope at several locations along the pipeline
4	Conveyance Cleanout	Provide new 24" diameter DI cleanout with blind flange
5	Locate Outfall	Replace "in-kind" both DI fittings and invert elevation in the new main Yakima River channel design.
6	Outfall Anchor	Maximum Scour depth

3. Survey Control

Horizontal Datum: Washington State SPC (Southern Zone)

Vertical Datum: North American Vertical Datum 1988 abbreviated to *NAVD 88*

Grid System: Washington State Plane, Southern Zone

Geoid Model: Geoid03 Conus (Conterminous United States)

Units: United States Survey Feet abbreviated to FT

Elevation Factor: City of Cle Elum's Upper Kittitas County Regional Wastewater Treatment As built's are in NGVD29. NGVD29 conversion to NAVD88, add 3.79 ft to NGVD29 elevations.

Scale Factor: Pending

Combined Factor: Pending

4. Applicable Codes, Standards, Regulations, and Design Criteria

- American Water Works Association (AWWA)
- American Society of Civil Engineers (ASCE)
- City of Cle Elum Building Code
- Kittitas County Code, Title 13 / Water and Sewers
- Washington Administrative Code (WAC) WAC173-240-060 Engineering Report for replacing existing wastewater outfall
- Washington Department of Transportation (WSDOT) Standard Specifications

5. Permitting Support

Jacobs will assist in coordination with permitting agencies as needed to streamline the permitting and documentation process, including the City of Cle Elum, Kittitas County, US Fish and Wildlife Service, National Marine Fisheries Service, Washington Department of Fish and Wildlife, Department of Ecology US Army Corps of Engineers, and other agencies. Coordination items include project introductions, determining which outfall alternatives are permissible and requirements for each alternative, permit needs analysis and verification, pre-BA site visit, pre-submittal coordination for permit packages, constructability and plans reviews, and general impact analysis and streamlining efforts. Permits and approvals Jacobs anticipates the project will require which Jacobs will provide support for include:

- WDFW Hydraulic Project Approval
- US Army Corps of Engineers Clean Water Act (CWA) Section 404 Permit. If this project will qualify for a Nationwide Permit (NWP) 27 for restoration. Endangered Species Act (ESA) formal consultations with NMFS and USFWS
- Department of Ecology CWA Section 401 verification.
- NPDES Construction General Stormwater Permit (Section 402)
- County Floodplain Development Permit

6. Grading and Drainage

Criteria for regrading of the riverbank beyond IF's design limits, impacted areas due to the conveyance pipeline replacement back to the toe of Interstate Highway I-90 are:

Unpaved cut and fill slopes –

- Fill slopes: 3:1 maximum, 10:1 minimum, 6:1 normal
- Cut slopes: 3:1 maximum, 4:1 normal

The conveyance alignment will be graded so stormwater runoff will sheet flow off the disturbed surfaces. Because this area is so small, no stormwater controls will be used in this design.

DRAFT

Appendix F : RCO Conditions Review for the Hanson Ponds Sewer Outfall Alternative Analysis (#22-11523)

MEMORANDUM

Date: December 15 2023

To: Elizabeth Butler

From: Jeanette Smith

Re: Condition Review for the Hanson Ponds Sewer Outfall Alternative Analysis (#22- 11523)

The Kittitas Conservation Trust (KCT) received Salmon Recovery Funding Board (SRFB) (#22-1523) to design a largescale floodplain restoration project of a set of abandoned gravel pit ponds connected to the Yakima River near Cle Elum, WA. KCT undertook an alternative analysis for the restoration project in 2021-22 with Interfluve. Three alternatives were developed and a preferred chosen for further development. Subsequently an opportunity arose to modify the city of Cle Elum's sewer outfall at the site. The location of the sewer outfall within the pond system and Yakima River Corridor impacts restoration options. KCT, the design team and City believe that if the outfall could be altered or relocated, more opportunities could be available for improved habitat, floodplain and channel processes at the site. A similar type of decision was made for the Yakima River Gap to Gap project downstream at the city of Yakima. KCT asked Interfluve to develop a 4th alternative and 3 options for restructuring or relocating the outfall.

The Review Panel asked to review the alternatives analysis for the outfall prior to the overall project design moving forward as the outcome of this analysis could determine the feasibility of the 4th alternative and the subsequent benefits to salmonids.

KCT, their investigation team and the working group on the Hanson Ponds project have employed a fairly thorough alternatives development and analysis process for both the initial project alternatives and now the possible alternatives for changing the sewer outfall within the preferred alternative 4 chosen in 2023. It appears that two of the three alternatives (A & B) are feasible and permittable while alternative C, which would provide the greatest flexibility for project design is not. Options A & B both allow for Restoration Alternative 4 to be fully implemented to improve salmonid habitat and floodplain processes though Option B (currently chosen as the preferred alternative) moves the outfall farther away from the mainstem Yakima potentially allowing greater flexibility in design and less hardened protection measures for the outfall. The Review Panel agrees on the selection of Option B for providing the most potential for salmonid benefits given that Option C is not feasible for permitting and implementation.

At this stage, it appears that the certainty of being able to modify the sewer outfall is moderately high for option B and A. However, information regarding requirements for mixing zone studies and changes to NPDES requirements and permits are still not fully available and the City may prefer to shift the preferred alternative choice to Option A.

In general, the Review Panel is in favor of the Restoration Alternative 4 moving forward towards preliminary design with Sewer Outfall Option B, but there are a few questions and some information that needs to be provided. The RP would prefer that all information regarding the implementation of a mixing zone study and potential NPDES Waste Discharge permit issues be available and a final option chosen

prior to moving forward with design, but in this case the majority of the design is similar between the options and the next design steps should be able to begin without a final decision.

Several pieces of information and questions are required to move the project forward at this time:

Is there any chance that the project cannot proceed with Alternative 4 given the lack of clarity on the NPDES issues?

No. It is our goal to replace the outfall with similar NPDES requirements.

Option A will have similar NPDES requirements as the current outfall.

Option B would likely require a mixing zone study which would inform design.

The City contractors most recently suggested a hybrid option where Option A is constructed now with a "Y" for Option B that is not built out. This would ensure the outfall is constructed under the current NPDES requirements while adding the flexibility of adaptive management/emergency response in the future. This hybrid option allows for the City to plan for the costs associated with a future mixing zone study and construction of the Option B outfall in the future once they can fund this option. Option A would remain in place once Option B is operational as a backup for emergencies. The design team is looking at the potential to build the outfall channel associated with Option B as part of this hybrid option; however, the outfall infrastructure would be installed at a later date when the City is able to fund the mixing zone study and address any changes that may be required per that study. Until Option B is built out, the potential outfall channel would function as side channel habitat for juvenile salmonids seeking refugia. Modifications would need to occur later to ensure proper mixing.

If so, what is the back-up preferred alternative and how are benefits to fish compromised in making this selection?

Not applicable

Provide a timeframe for deciding to move forward with Option B, a mixing zone study and NPDES permit consultation. Timeframe for implementing a mixing zone study, if it can be funded, and how does this effect the design pathway.

KCT will be presenting the Hybrid option to City Council on January 8, 2024. We anticipate that City Council will prefer this option. It provides flexibility for future management/emergencies while working under known NPDES limits. It will also eliminate the need for a costly mixing zone study associated with the current restoration project.

How if at all does the design of the reinforced floodplain and constructed main channel riffle differ between Option A & B? What are the ramifications to proposed side channel and main channel habitat conditions? Attachment 3 indicates no difference in structure/function at the concept level.

Differences in reinforced floodplain and mainstem channel construction will be determined through the design process via modeling and analysis. The side channel and mainstem habitat conditions will also be shaped through the design process to maximize habitat function within design stability and known infrastructure limitations.

How could Option B sewer outfall discharging into a side channel affect juvenile salmonids if at all? Are there effects on water temperature that benefit predators like what is experienced in the current ponds?

The effects to juvenile salmonids would be unknown at this time. The mixing zone study is meant to predict these types of issues. Based on the results of the mixing zone study, discharge requirements to minimize temperature and other related water quality issues would be addressed through project design and wastewater treatment requirements.

Questions related to Alternative 4 as the design moves forward:

A better explanation of “Reinforced Floodplain” is required. Does this mean buried riprap or other hardened structure that prevents the channel from shifting location? What does this mean for the long-term condition of habitat downstream of the reinforced floodplain i.e. will side channels have a tendency to down cut or shift away from this hard point?

The “reinforced floodplain” concept does include buried or partially buried large material (potentially riprap) that both holds the mainstem channel in a designed location (and bed elevation) and provides protection from erosion across the FEMA designated floodway. Holding mainstem at a designated location will be required to maintain the wastewater outfall conditions. Designed side channels will flow perpendicular and downstream of the “reinforced floodplain” feature thus, its influence on laterally shifting side channels towards or away from the “hard point” it creates is expected to be minimal.

Are the fill islands hardened in anyway? Are they intended to be permanent or allowed to shift and change?

Fill islands are expected to have some stability structure built into them which will be designed to promote bar/island development downstream of them. This is expected to be an evolutionary process. The amount and composition of the fill island’s structure is not yet known. Potential materials may include large wood structures or boulders or salvaged riprap from the existing levee. These details will be determined through the design process.

What is the design standard for the recreational trails? Are they intended to be permanent and therefore require protection?

A secondary goal of this project is to enhance recreational opportunities when feasible. Trails will not require armoring or protection. They will be designed to work with a functioning floodplain and there may be areas of only seasonal use. Maintenance by the City of Cle Elum is expected to be required over the long-term.

There is a trail located at the head of the constructed riffle and moving along one of the fill islands which may be contraindicated for improving floodplain and channel processes at this location. Building a trail here may work with Sewer outfall Option A, but is contradictory to moving infrastructure away from this area as presented in Option b. The trails farther away are less likely to affect channel processes in the long run.

Trail locations will be designed and finalized in coordination with the city of Cle Elum.



Hanson Ponds: Regional Wastewater Outfall Mitigation & Yakima River and Floodplain Reconnection

DRAFT - Preliminary (30%)
Basis of Design Report

SUBMITTED TO



Hanson Ponds: Regional Wastewater Outfall Mitigation & Yakima River and Floodplain Reconnection

DRAFT Preliminary (30%)

Basis of Design Report



SUBMITTED TO

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DRAFT

1. Introduction

This basis of design report provides relevant information to support the DRAFT Preliminary (30%) Designs for the Hanson Ponds project area along the Yakima River (RM 185.7-187.1) – See Appendix A. Kittitas Conservation Trust (KCT) contracted Inter-Fluve’s design team to develop the designs for the project area. KCT undertook the project at the request of the City of Cle Elum. Inter-Fluve completed a site assessment (Inter-Fluve, 2021) that compiled previous studies and evaluated the existing geomorphic, hydrologic, hydraulic and ecologic processes of the project area. The assessment provided an understanding of the existing conditions at the site as well as the foundation for developing a site-appropriate restoration approach that is compatible with the goals and limitations of the project.



Figure 1. Actively eroding bank at upstream end of project area (March 2021).

1.1 PROJECT GOALS

The identified goals of the project are to:

- Protect critical infrastructure (specifically City outfall, Kiwanis Pond, I-90)
 - Reconfigure wastewater outfall to a location that reduces risk to the City’s infrastructure and provides the greatest ecological uplift, while maintaining NPDES permit standards.
- Improve anadromous salmonid habitat
- Restore floodplain connection and function.
- Provide recreational opportunities within the project site, if/where appropriate.

2. Project Area

2.1 SITE DESCRIPTION

The Hanson Ponds project area is located near the town of Cle Elum, on the eastern flanks of the Cascades Mountains in central Washington (Figure 2). The project is entirely within property owned and managed by the City of Cle Elum. The site includes the existing regional wastewater outfall infrastructure (pipe, levee, and constructed riffle) and a set of abandoned gravel pit ponds (Hanson Ponds) located on the floodplain. The ponds are abandoned gravel pits that resulted from material excavation for the construction of the I-90 road prism. The ponds are separated from the mainstem river by a set of constructed and reinforced levees and dikes that confine the modern channel to a fraction of its historical floodplain. In 2004 the Upper Pond, Middle Pond, and Lower Ponds were reconnected via surface water to the mainstem Yakima River at levee breaches for an inlet and an outlet channel at the downstream end and two spill channels that connect the Upper, Middle, and Lower Ponds. Three small sections of the levee adjacent to the mainstem were also lowered to facilitate high-water condition exchange between the ponds and the channel. The upstream most pond, Kiwanis Pond, receives surface flow during large flood events from upstream. Currently, during large flow events the mainstem channel also overtops the eroding bank near RM 186.95, resulting in surface water inputs to Kiwanis. The overflow from Kiwanis Ponds currently pours over the existing regional wastewater outfall pipe and reinforced floodplain surface into the Upper Pond.

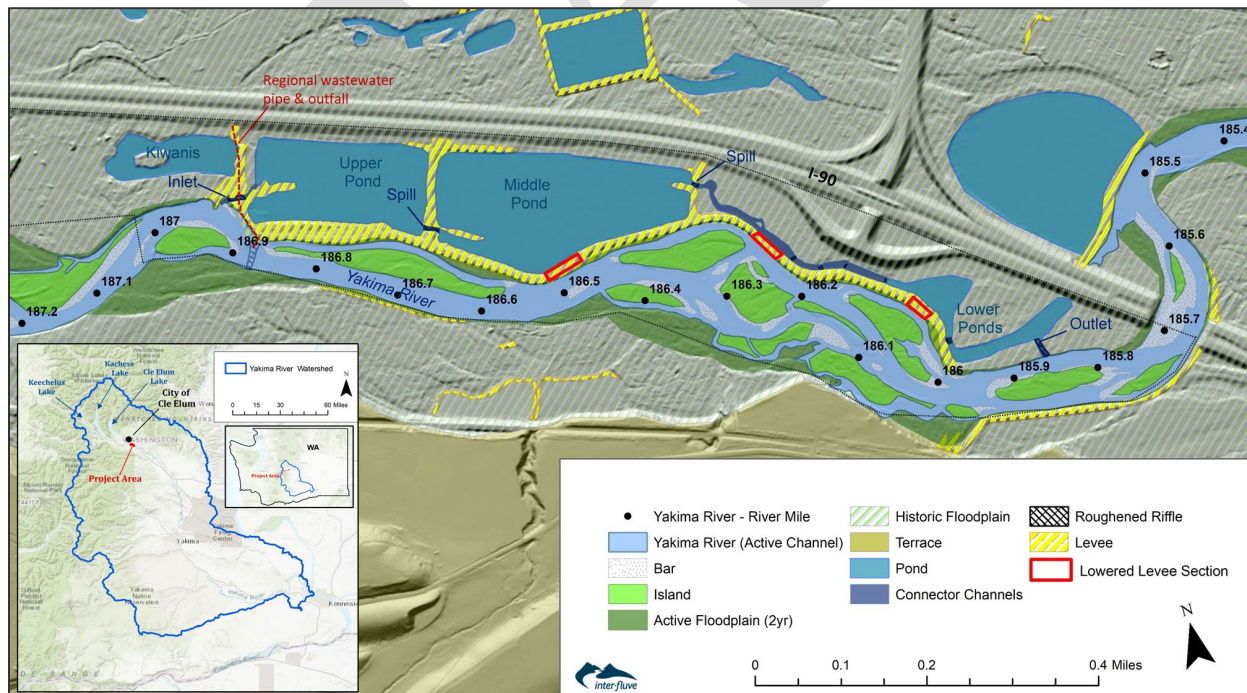


Figure 2. Hanson Ponds project area map (dotted line denotes general project boundary).

The mainstem Yakima River is actively laterally eroding into its river left bank at RM 186.95 (Figure 3). The eroding bank was reinforced with material between 1996-1998 with material excavated from the floodplain, creation of Kiwanis Ponds, due to concerns of risks and flood impacts associated with the lateral migration. Riprap barbs were included in the bank reinforcement. City of Cle Elum reported (2020 conversations) that “other” bank and potentially floodplain (at downstream side of Kiwanis Pond) reinforcement maintenance in that area has been done but no details were provided. Continued lateral erosion and overbank flooding into Kiwanis Ponds at the RM 186.95 location retain potential of risk of the channel avulsing or migrating into the ponds, if no action is taken. If the channel were to occupy a flow path through the ponds and behind the existing levee, it is expected to result in the previously reported risk of compromising the I-90 east bound lanes, the on/off ramp intersection of I-90, and the regional wastewater outfall buried between the Kiwanis Pond and Upper Pond (Reichmuth et al., 2002).



Figure 3. Photo of the eroding bank of concern with riprap spur visible at the downstream end of the bank (a person standing on spur). (Photo: 8/7/ 2020).

The combination of local anthropogenic impacts and regional water management have resulted in diminished aquatic habitat conditions for ESA listed salmonids, loss of floodplain connectivity and function, and reduced overall geomorphic complexity in the project area. The levees and dikes confine the channel and disconnect it from its available floodplain. The seasonal hydrograph for the Yakima River is notably altered from natural regimes by irrigation storage and withdrawal timing managed with upstream dam releases. A summary of some of the existing and forcing conditions at the site are provided in this report and more information is combined in the 2021 reach assessment (Inter-Fluve).

2.2 GEOLOGY & GEOMORPHOLOGY

Periods of glacial extension and recession deposited glacial till that is evidenced today in the remnants of lateral terraces and moraines along the borders of the broad U-shaped valley of the Yakima River (Kauffman et al., 2003; Porter, 1976; Riedel, 2017). The modern upper Yakima River and its tributaries, over time, carved through the glacial till and outwash deposits to establish an inset floodplain of reworked alluvium that is today bordered by the glacial till terraces (Haugerud & Tabor, 2009; Reichmuth et al., 2002; Tabor, et al., 2000). The alluvium at the project site is classified as xerofluvent floodplain and terrace soils (NRCS, 2010) that are somewhat “excessively” well drained and composed of extremely cobbly sand at 60 inches depth that fines upward to gravely sand, loamy sand with moderately decomposed plant material in the top 0-2 inches (Figure 4). A summary review of the floodplain’s classified channel migration zone and federal 100-year flood inundation zone map with an analysis of the site’s relative surface elevations to the channel, modeled flow hydraulics, and field surveys used to delineate the modern active flood floodplain are available in the 2021 assessment (Inter-Fluve).

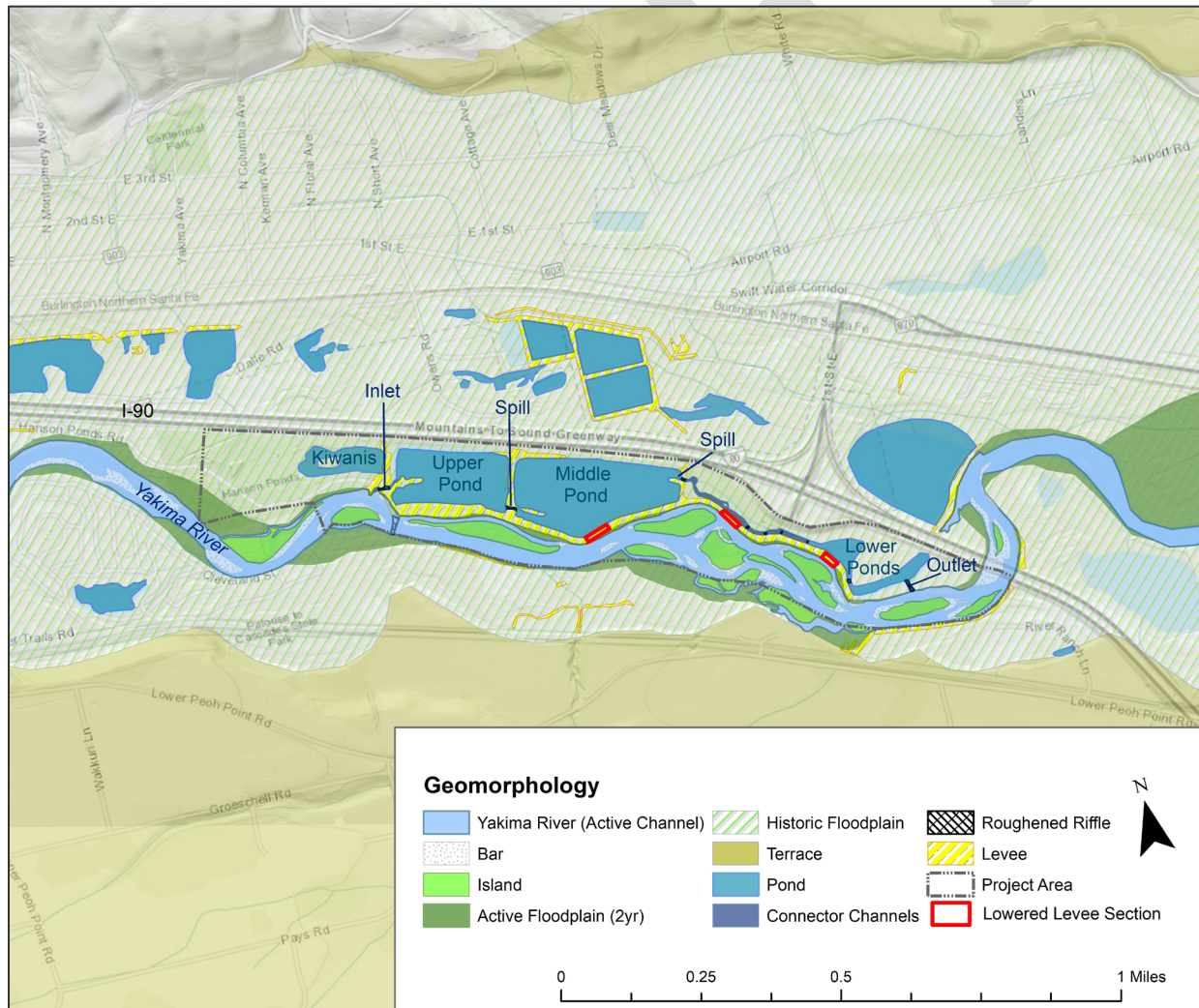


Figure 4. Geomorphic features of the Yakima River RM 185 – 189. (Basemaps: FEMA 2011 LiDAR, ESRI Topographic map)

Excavation of gravel from the floodplain to construct I-90 removed a large volume of material and left the bottom of Hanson Ponds lower in places than the modern incised channel. If the channel shifts to occupy the pond area, channel evolution responses such as head-cut migration, exaggerated lateral migration and bar development at the site, and downstream degradation due to sediment capture are potential, depending on the scenario and configuration of channel realignment (Northwest Hydraulic Consultants Inc, 2015; Reichmuth et al., 2002). The potential for the Yakima River to avulse or migrate into the ponds at the upstream end of the project area during a large flood event was identified as an infrastructure risk (Reichmuth et al., 2002; Washington State Department of Natural Resources (WaDNR), 2004). The infrastructure identified at risk are the buried wastewater outfall pipe and sections of I-90, including the east interchange at exit 85. Some level of reinforcements (no as-built plans provided) were installed during the 2004 pond inlet and outfall pipe construction, but the issues and infrastructures risks related to continued bank erosion and capture of the mainstem channel by the ponds remains.

The existing conditions hydraulic model results and field surveys (2021, 2023) completed by Inter-Fluve concur that there remains potential for the Yakima River to eventually occupy Hanson Ponds at the upstream end of the project site, if no action is taken. Capture of the mainstem channel by avulsion during a single large flood event instead of gradually via lateral bank erosion is an identified possibility at the upstream end of the Hanson Ponds project area. Risk of mainstem channel capture as a result of overland flood flow (at >50'yr flood event) from upstream of the project area was also expressed in the hydraulic model. This indicates that long-term risk of channel capture at Hanson Ponds is not a singularly localized issued associated with the identified eroding bank. It is an issue related to gravel pit mines located within the available floodplain – an issue of concern throughout the Yakima River basin (WaDNR, 2004).

2.1 HYDROLOGY SUMMARY

At the project site, near Cle Elum WA, the Yakima River's upstream drainage area is approximately 501 square miles. The headwaters of the Yakima are fed primarily by snowmelt supported tributaries whose contributions to the Yakima River are regulated and managed for seasonal downstream irrigation. The flow at the project reach is currently dictated by flow management for the following downstream irrigation target flows (U.S. Bureau of Reclamation (USBR), 2011):

- 400 – 800 cfs from September 10th to October 20th (Enacted 2002)
- 200 – 300 cfs from October 21st – March 31st (Enacted 2002)
- Ramp flows down starting July 1 to 1,000 cfs by late August (Enacted 2011)
- Every several years, provide channel-spanning pulse flows in the spring and winter (Enacted 2011)

In current regulated conditions, the highest daily discharges occur in the summer months (Figure 5). This is due to irrigation releases from the upstream dams for downstream usage. Regulated flows are then ramped down by late August to 1000 cfs to provide better flow conditions for migrating fish

life stages and to begin the process of storing surface water behind the dams for next year's irrigation season. Based on the median flows (USBR Hydromet – retrieved 2021), the 400 - 800 cfs target flow is regularly met between September 10th to October 20th, and the minimum target flows of 200-300 cfs from October 21st through March are exceeded. The US Bureau of Reclamation (USBR) estimates for what unregulated discharge would be at the Cle Elum gage if flows were not controlled by upstream dam management (2017-2021) are also provided (dashed grey line) in with the managed annual hydrograph in Figure 5.

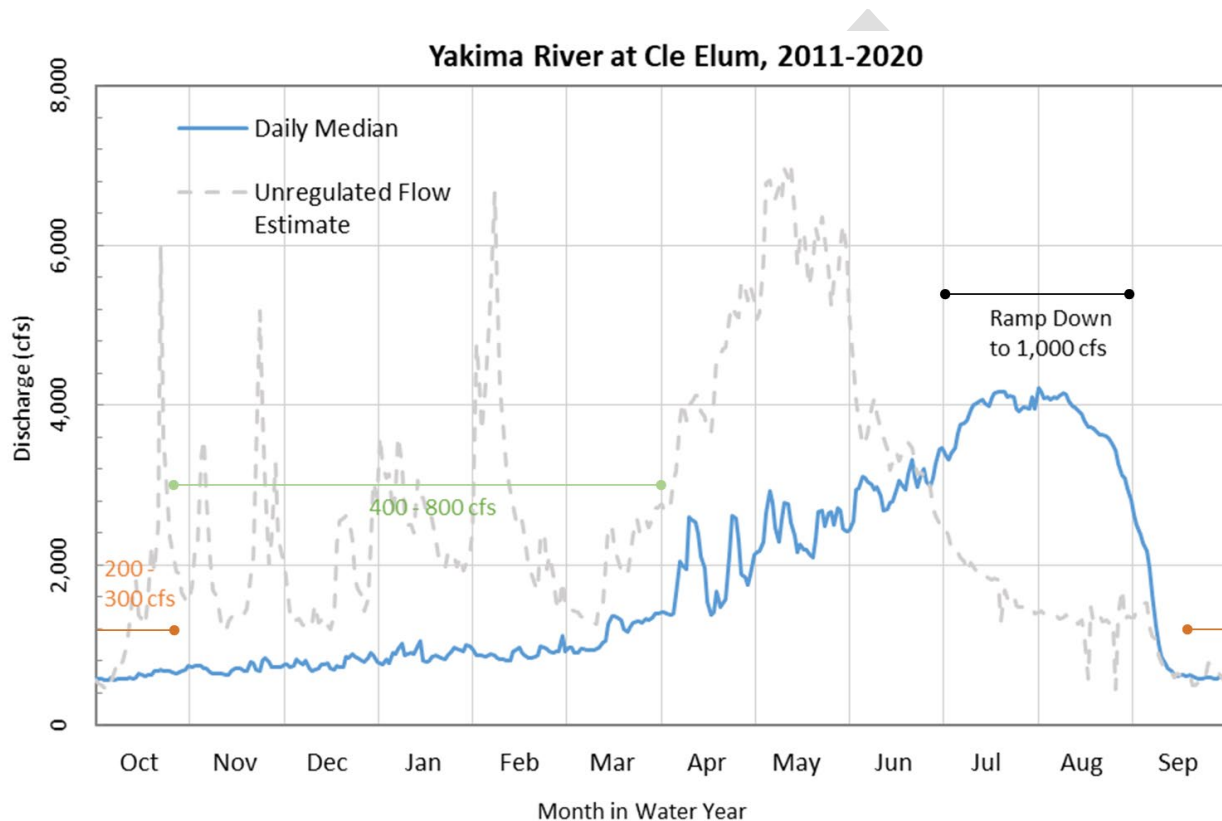


Figure 5. Median regulated discharge of the Yakima River at Cle Elum (2011-2020) and unregulated discharge (flow) estimate (USBR Hydromet data).

The unregulated discharge is estimated to be notably higher than regulated flows through the fall, winter and spring, with storm event peaks in the fall and a snow-melt influenced high-flows in the spring (April – June). Under current regulated conditions, median high-flow discharges are maintained at approximately 4,000 cfs and they occur during irrigation season (late June – late August) when the system's discharge would naturally be decreasing. In summary, current flow regulation mutes historical seasonal fluctuations caused by storm events, alters the timing of high-flow, and greatly reduces the size, duration and frequency of high-flow discharge events.

Peak flow data available at the Cle Elum, WA gage from 2011 to the present were used to estimate the discharge and recurrence frequency for seasonal flows and flood events for the 2, 10, 25, 50 and 100-Year flood events. Instantaneous data from USBR from 1985 to the present was used to determine the peak discharge value in each water year. Inter-Fluve performed a Log-Pearson Type

III statistical distributional analysis using annual peak flood events to estimate flood frequency discharges using the USGS PeakFQ software, which uses the Bulletin 17C analysis (England, 2019). The seasonal and peak flood estimates for the project area from the analysis are shown in Table 1.

Table 1: Yakima River at Cle Elum, WA estimated discharge for seasonal and peak flood events.

Flow Recurrence Interval	Flow (cfs)
7Q10	260
October Median Flows ¹	615
January Median Flows ¹	980
April Median Flows ¹	1,600
June Median Flows ¹	2,743
July Median Flows ¹	3,660
2-year Flood	5,915
5-year Flood	8,336
10-year Flood	10,020
25-year Flood	12,220
50-year Flood	13,920
100-year Flood	15,670
100-year Flood – FEMA ²	19,828

¹Median Flows are for water years 2000-2020

² The FEMA 100-year flood was taken directly from the FEMA model (FEMA, 2018)

2.2 CLIMATE

The climate of the Upper Yakima Watershed generally consists of warm, relatively dry summers and cold, wet winters. The majority of the precipitation throughout the basin is received October –April. Figure 6 shows the seasonal variability in the historical and 1991-2020 monthly precipitation and temperature averages at the project site as well as 1991-2020 data for the headwaters.

Historical vs. Modern Precipitation Monthly Averages

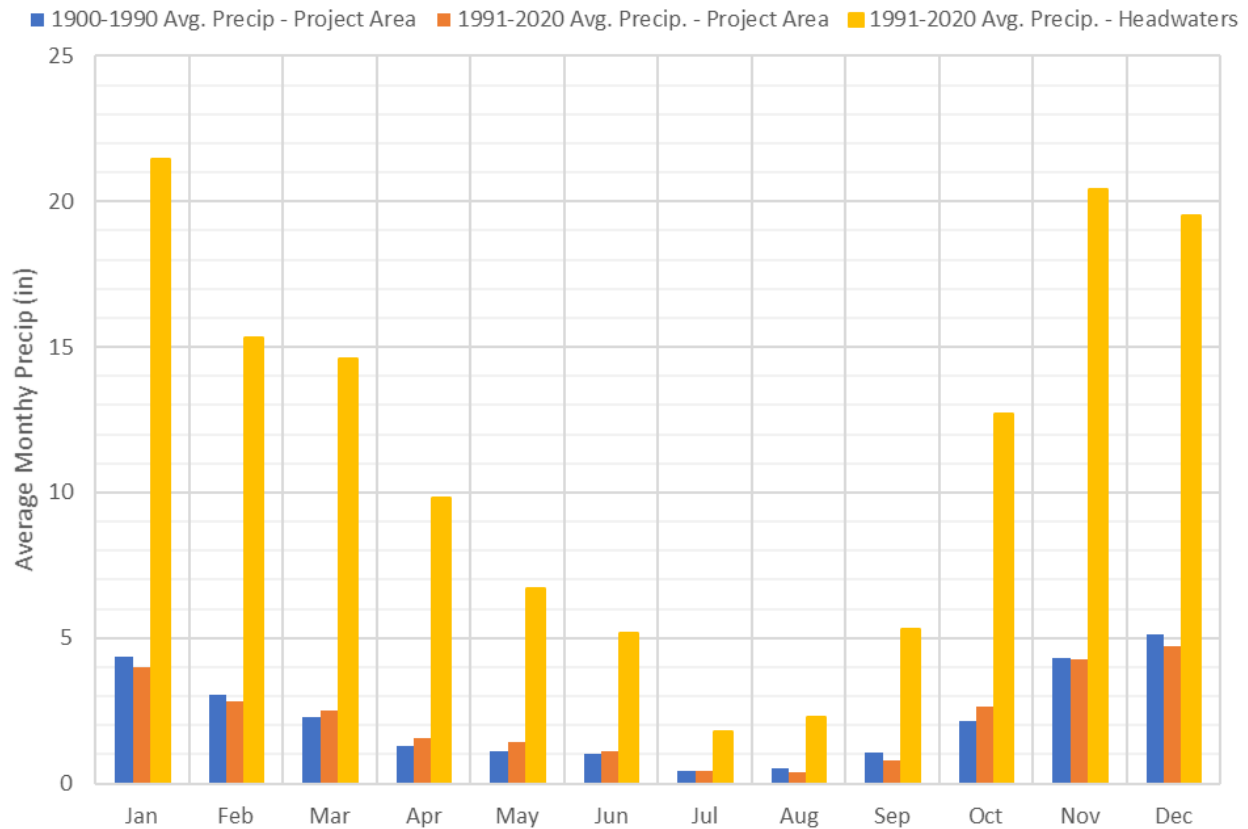


Figure 6: Historical and modern monthly averaged precipitation for the Upper Yakima watershed in the headwaters and at the Project Area. (PRISM, 2021)

Average daily air temperatures within the project area (elevation of 2,150 ft) typically fluctuate seasonally between 30°F in January to 65°F in July (PRISM, 2021).

Global climate models used to accurately capture the 1.4°F warming measured in the Pacific Northwest over the 20th century have been applied to predict future climate trends (Srinivasan et al., 2007). These models predicted an average increase in annual temperature in the region of 2.0° F by the 2020s, 3.2° F by the 2040s, and 5.3°F by 2080 (Mote & Salathé, 2010). Climate simulations indicate precipitation and streamflow in the Pacific Northwest will respond to a changing climate through increased intensity of winter storm events. Warmer temperatures are expected to result in higher winter seasonal streamflow, and decreased summer precipitation resulting in longer periods of low, and decreased rates of streamflow (Dittmer, 2013; Elsner et al., 2010; Groffman et al., 2014; Mantua et al., 2009; Tohver, 2015). These changes are predicted to have the most substantial implications for watersheds like the Yakima River that are mixed rain-snow watersheds.

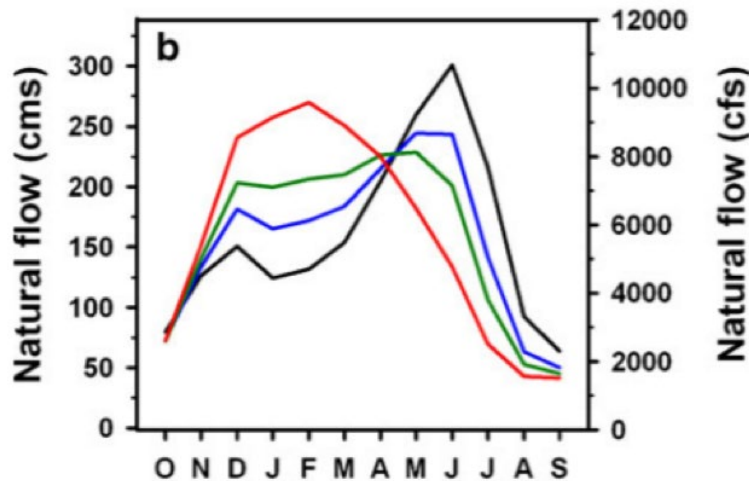


Figure 7. Predicted waterflow of Yakima River, October to September. Black = historic average, Blue = 2020 – 2040, Red = 2080. Source: Vano et al., “Climate Change Impacts on Water Management and Irrigated Agriculture in the Yakima River Basin, Washington, USA.”

2.3 ANTHROPOGENIC FEATURES

The Yakima River has been manipulated by anthropogenic alternations for over 150 years. Railway, roads, homes, and agricultural now occupy large portions of the historical floodplain (Figure 8). In addition to the anthropogenic features that occupy its floodplain, upstream dams managed for irrigation have altered the river’s seasonal hydrograph. Today the upper Yakima River, including at the Hanson Ponds project area, is able to access only a portion of its historical (Holocene) alluvial floodplain as a result of a sequence of human-constructed encroachments that gradually confined the river into a narrower floodplain.

The construction of the Northern Pacific Railroad (NPRR) in 1884 disconnected a large portion of the Holocene-aged floodplain and paved the way for agricultural, industrial, and municipal development behind it (north side of the tracks). Diking, road building, and the development of South Cle Elum disconnected and converted additional floodplain between 1916 and 1964. The construction of Interstate-90 (I-90) and associated gravel mining in the late 1960s again substantially reduced the amount of remaining floodplain, further confining the Yakima River. The total area of the historical Holocene floodplain reported loss to anthropogenic encroachment between 1884 and 2002 is 60-80% (Eitemiller et al., 2002).

The levees and dikes associated with Hanson Ponds are constructed to be stable structures on the landscape designed to separate the mainstem channel from the ponds. They have persisted in place since their installation in the late 1960s, with maintenance. Today, almost all of the levee banks along

the river are reinforced with riprap boulders (Figure 9). Wide enough and once passable by vehicle, the top of the levee is currently a public access recreational trail.

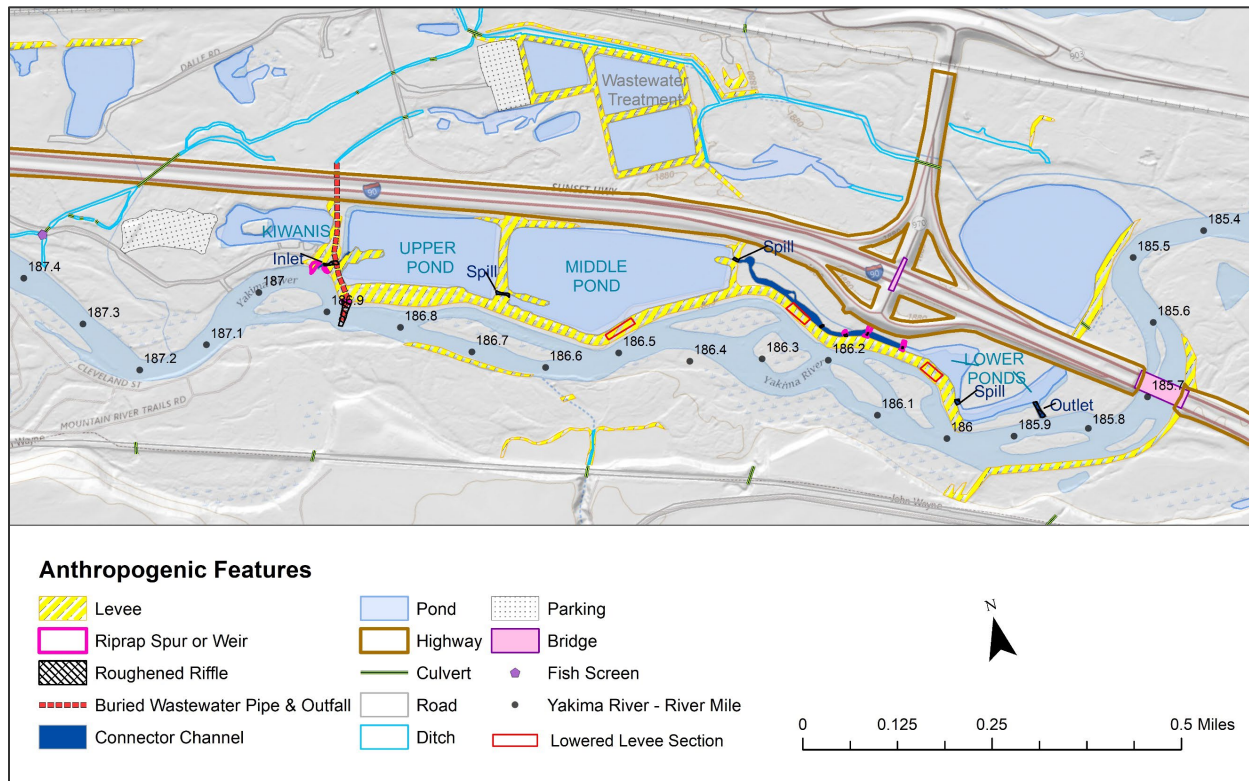


Figure 8. Primary existing anthropogenic features in the Hanson Ponds project area.



Figure 9. Riprap reinforced levee at RM 186.51. Middle Hanson Pond on the left side of the levee and mainstem Yakima River on the right side – 8/7/2020.

The buried wastewater pipe outfall for the City of Cle Elum is located in the bed of the mainstem river under a constructed roughened boulder riprap riffle that extends across the width of the channel (Figure 8). The riffle both protects the outfall pipe and provides a reinforced grade control feature to the mainstem channel (Figure 10). To reach the outfall location at the riffle the pipe passes under I-90 and then is buried under the levee and dike located between the Kiwanis and Upper Ponds. A rock spur extends off the corner of the levee, reinforcing the stability of the levee to the roughened riffle. Where the pipe crosses under the inlet connector channel into the Upper Pond, it is buried under a roughened boulder riffle with riprap channel banks meant to protect the pipe from vertical incision and hold the grade of the inlet.



Figure 10. Aerial image with annotated anthropogenic features near the upstream end of the Hanson Ponds Project area, RM 186.85 – 186.95. Image collected by KCT 10/19/2020.

The existing levees and armored banks downstream of the constructed riffle notably constrict the channel's capacity to laterally migrate and drastically limits floodplain connectivity. Roads, bridges, levees, dikes railroads, etc. confine the channel, exaggerating channel simplification and flow hydraulics.

2.4 VEGETATION

The existing riparian vegetation in the project area occurs in narrow strips along the various ponds, as vegetated gravel bars and islands, and in seasonal side channels, or as wetland/riparian vegetation along the connector channel and Lower Ponds. Along the Yakima River mainstem, the riparian zone is limited to a narrow corridor, characterized by mature alder (*Alnus spp.*), Red Oiser dogwood (*cornus sericea*), and cottonwood (*Populus balsamifera*) with minimal shrub and emergent

vegetation (Figure 11). The top and armored banks of the existing levees are sparsely vegetated with grasses and occasional shrubs.



Figure 11. Alder and cottonwood trees with minimal shrub and emergent vegetation in riparian corridor along Yakima River mainstem (9/28/23 – low flow conditions, with irrigation flows turned off)

The restricted riparian zone along the mainstem is attributed to seasonally high flow velocities associated with dam-controlled irrigation hydrology. The highest flows at the site are during the growing season (June-August) which limits the riparian vegetation from establishing at lower elevations. In seasonally slower-moving, shallow areas with less gradient, the existing riparian zone is broader, and the riparian vegetation is more diverse. The riparian zone in these areas is characterized by alder (*Alnus spp.*) and cottonwood (*Populus balsamifera*) trees, willow (*Salix spp.*) and cottonwood (*Populus balsamifera*) shrubs, and sedges and rushes in the emergent fringe (Figure 12). The invasive reed canary grass (*Phalaris arundinacea*) is also prevalent at the site in the emergent zone.



Figure 12. Fringe emergent, shrubs, and trees in the riparian zone on an island of the Yakima River that backwaters at high flows (9/28/23 – low flow conditions, with irrigation flows turned off)

Along the ponds, the riparian zone is restricted to the pond edges, the lower banks of the levees, and the I-90 prism. The riparian vegetation in these areas ranges from an emergent fringe, dominated by reed canary grass (*Phalaris arundinacea*), sedges and rushes, to a riparian forested zone, dominated by alder (*Alnus spp.*), cottonwood (*Populus balsamifera*), and willow (*Salix spp.*). Where the levee has been breached in the past and conditions provide, riparian vegetation is also establishing.

The wetland located downstream of Middle Pond and adjacent to the I-90 pyramid, is dominated by cattail (*Typha latifolia*) with scattered clumps of riparian shrubs and trees, including alder (*Alnus spp.*), cottonwood (*Populus spp.*), and willow (*Salix spp.*).

3. Focal Species

A variety of aquatic, avian, and terrestrial species utilize the Yakima River. Within the project area, native fish species include Mid-Columbia River steelhead trout, Columbia River bull trout, Mid-Columbia River Spring Chinook salmon, potentially Upper Columbia River summer/fall run Chinook salmon, Coho salmon, resident rainbow trout, mountain whitefish, and redbelly shiner (Figure 13). Northern pikeminnow and non-native bass species, often predators of juvenile salmonids, have also been found in the ponds located within the project area (D. B. Parrish, 2005). Steelhead and bull trout are both listed as threatened under the Endangered Species Act and are focal species for this project. Mid-Columbia Spring Chinook, Sockeye salmon, and Coho salmon are not listed in the Yakima subbasin but are also considered focal species for this project. Sockeye and Coho salmon were extirpated from the Upper Yakima in the mid-twentieth century but have been reintroduced to the watershed.

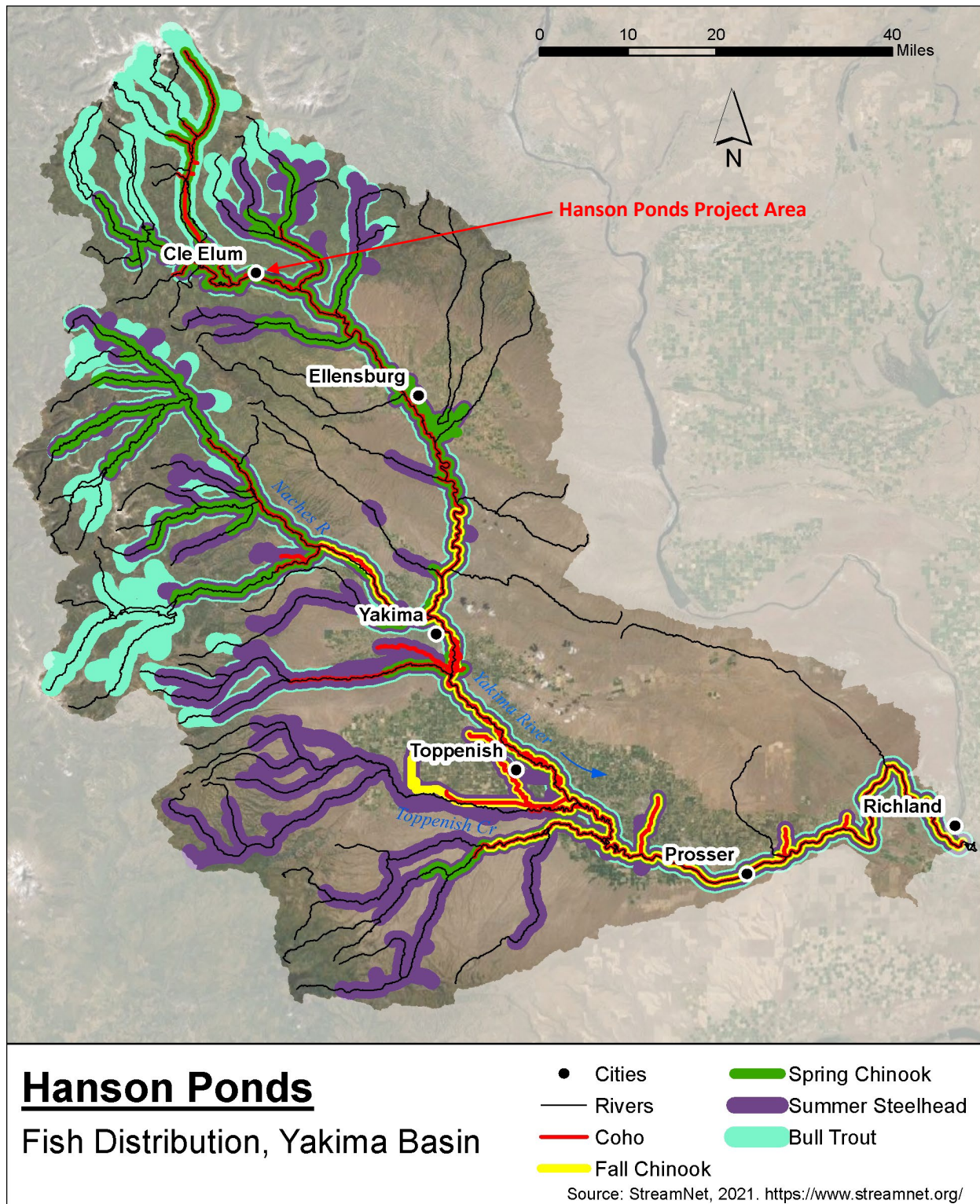


Figure 13. Distribution of focal fish species in the Yakima Basin. Hanson Pond project area near the city of Cle Elum is identified with map annotation (red locator arrow).

3.1.1 Steelhead

Current estimates of natural-origin Mid-Columbia steelhead trout spawners counted annually at Roza Dam range from less than 50 individuals to over 400 (Temple et al., 2015), a fraction of the estimated 25,000-75,000 spawners historically (Yakama Nation, 2019). Steelhead spawn and rear in the project area (Washington Department of Fish and Wildlife (WDFW), 2024). Sampling within the mainstem and in Hanson Ponds found juvenile steelhead/rainbow trout to be one of the most common species rearing in the study area (D. B. Parrish, 2005).

Yakima Basin steelhead are classified as summer steelhead based on the timing of their return from the ocean to the Columbia River (Yakama Nation, 2019). Most steelhead from the Yakima basin pass through the lower Columbia River by August and slowly migrate up into the Yakima River to spawning grounds in the winter and early spring of the following year (Figure 15). Almost all steelhead enter into the Upper Yakima (past Roza Dam) in March, April and May (Yakama Nation 2019). Most steelhead spawn in tributaries to the Yakima River, although the distribution of redds throughout the basin is highly variable from year to year and significant amounts of mainstem spawning are known to occur (Yakama Nation, 2019). Juvenile steelhead have been observed throughout the Upper Yakima River and within the project site (Temple et al., 2019).

Eggs incubate through the late spring and early summer, and though hatching time varies depending on environmental conditions, fry emergence typically occurs around mid-June to late July in the Upper Yakima mainstem (Yakama Nation, 2019). Juvenile steelhead typically spend from one to three years in tributary and mainstem reaches throughout the Yakima Basin, until they begin to smolt and migrate out to the ocean. Age-0 juveniles spend their first year primarily in shallow riffle habitats, feeding on invertebrates and utilizing overhanging riparian vegetation and undercut banks for cover (Moyle, 2002). Age-0 steelhead use slower, shallower water than Chinook salmon, preferring small boulder and large cobble substrate (Hillman & Miller, 1989). Older juveniles prefer faster moving water including deep pools and runs over cobble and boulder substrate.

3.1.2 Chinook

Historically, spring Chinook comprised one of the largest anadromous fish runs in the Yakima River basin. Currently, mid-Columbia spring Chinook salmon in the Yakima basin are not listed as threatened or endangered under the ESA, although numbers are substantially depressed relative to historic population figures (Entrix, 2002). Spring Chinook spawning has been documented in the project reach. Upper Columbia summer/fall run Chinook are also presumed to use the project area (Washington Department of Fish and Wildlife (WDFW), 2024), though are primarily found in lower portions of the Yakima basin (Figure 14; Yakama Nation, 2019).

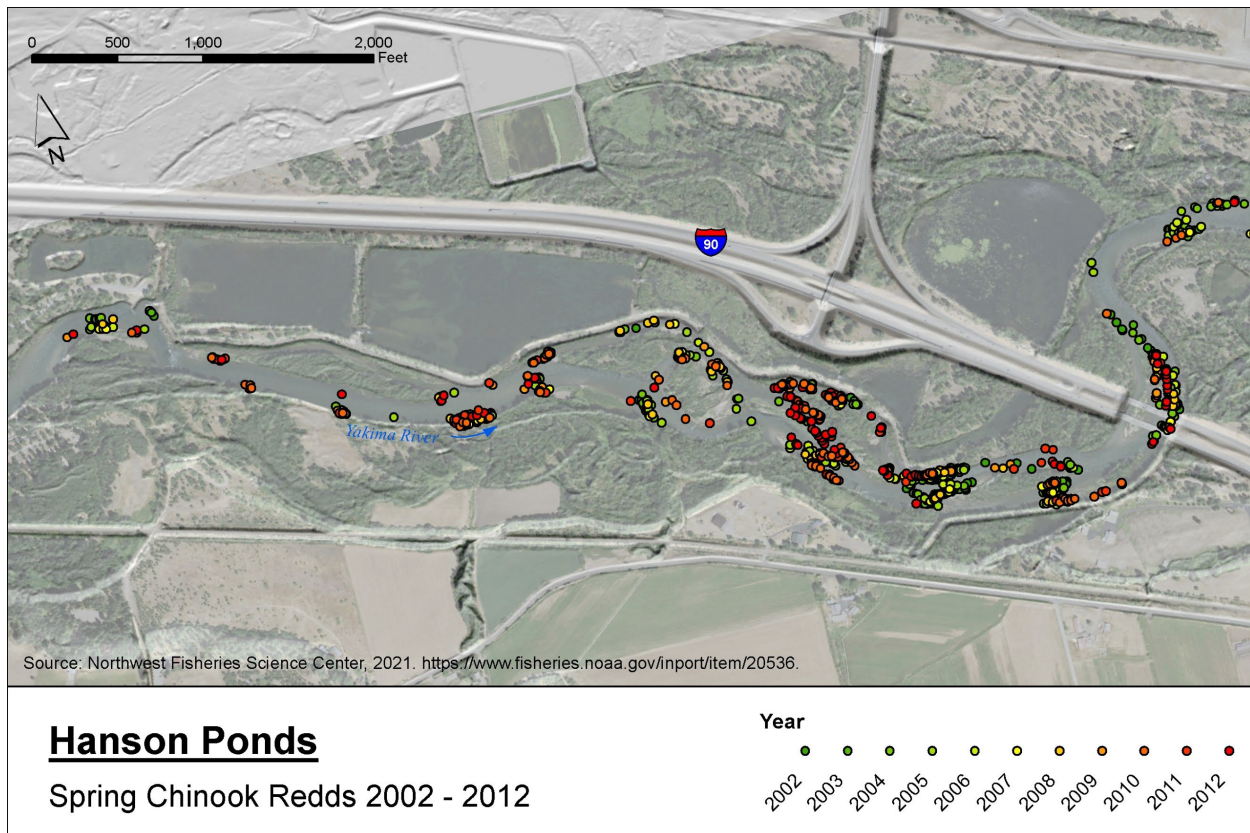


Figure 14. Spring Chinook redds observed in the project area between 2002 – 2012, compiled from various sources by the Northwest Fisheries Science Center and retrieved in February of 2021.

Middle Columbia River spring-run Chinook adults migrate to spawning areas in April and May (see Figure 15), holding in deep pools under available overhead cover until spawning occurs. Spawning typically begins in late August and extends through late September (Yakama Nation, 2019). Emergence occurs in early spring, from February to May, and often coincides with the rising spring snow-melt hydrograph. During higher flows, juveniles seek backwater or margin areas with lower velocities, dense cover, and abundant food (Quinn, 2005). Fry are vulnerable in these systems when they emerge, because their swimming ability is poor and flows are high. Near-shore areas with eddies, large woody debris, undercut tree roots, and other cover are very important for post-emergent fry (Healy, 1991; Hillman & Miller, 1989). Older juveniles utilize deeper pools with resting cover in mainstem habitats more than post-emergent individuals. Middle Columbia River spring-run Chinook exhibit a yearling life history, spending the first summer and winter in fresh water before out-migrating to the estuary and ocean (Yakama Nation, 2019). Low numbers of spring Chinook juveniles have been observed in the mainstem Yakima River near the Hanson Ponds project area (Temple & Webster, 2018; J. Romine, pers. comm., 2021).

3.1.3 Bull Trout

The Upper Yakima basin has a few distinct small populations of Columbia River bull trout. There are four populations upstream of the project area (Box Canyon, Kachess, Gold, and Upper Yakima River), all with very low population numbers (*i.e.*, less than 20 redds; Reiss et al. 2012; USFWS 2010).

More recently, the Upper Yakima has not been considered a historically separate population, instead it is used by the tributary populations for foraging, migration, and overwintering habitats when they occupy the channel (A. Conley, pers. comm., 2021). A recent survey of bull trout distribution in the tributaries to the Upper Yakima River using eDNA sampling techniques found that there are very few, if any, functional bull trout populations remaining in the Upper Yakima Basin besides the well documented populations in Gold Creek, Box Canyon and Kachess River (C. Parrish, 2017). Within the Hanson Ponds study area, bull trout presence has been documented (Washington Department of Fish and Wildlife (WDFW), 2024). Bull trout likely use the study area for migration and overwintering.

Bull trout express both resident and migratory life history strategies (Rieman & McIntyre, 1993). Populations in the Upper Yakima and tributaries may primarily express resident adfluvial life history strategies as a result of fish passage barriers. Resident forms of bull trout complete their entire life cycle within the tributary (or nearby) streams in which they spawn and rear. Migratory bull trout spawn in tributary streams, where juvenile fish rear for 1 to 4 years before migrating to either a lake (adfluvial form) or larger river (fluvial form) (Fraley & Shepard, 1989).

Bull trout can live for 10 or more years and can spawn repeatedly during their lifetime (Reiss et al. 2012; USFWS 2010). Bull trout typically spawn during periods of decreasing water temperatures in the fall, and most Yakima stocks migrate to their spawning grounds between June and July for spawning between early-September to mid-October (Figure 15). Preferred spawning habitat consists of low-gradient stream reaches with loose, clean gravel (Fraley & Shepard, 1989). Redds are often constructed in stream reaches fed by springs or near other sources of cold groundwater (Goetz, 1989; Rieman & McIntyre, 1993). Fry normally emerge from early April through May, depending on water temperatures and increasing stream flows (Reiss et al. 2012; USFWS 2010).

Bull trout have some of the most specific habitat requirements of salmonids (Rieman & McIntyre, 1993), including cold water temperatures, very clean stream substrates, complex stream habitat including deep pools, overhanging banks and large woody debris, and connectivity between spawning and rearing areas and downstream foraging, migration, and overwintering (FMO) habitats. Though bull trout depend on cold streams, individual fish have been found in larger, warmer river systems throughout the Columbia River basin (Reiss et al. 2012; USFWS 2010). Bull trout are opportunistic feeders, with food habits being primarily a function of size and life history strategy. Adult and juvenile bull trout prey on terrestrial and aquatic insects, macro-zooplankton, and small fish including other juvenile salmonids (Reiss et al. 2012; USFWS 2010).

3.1.4 Coho

Historically, it is likely that the Yakima supported considerable runs of wild Coho salmon (*O. kisutch*). Early records and reports suggest Coho spawned in the upper Yakima above the Cle Elum confluence as well as numerous smaller tributaries to the Yakima (Yakama Nation Fisheries Resource Management (YNFRM), 2017). However, the indigenous population of Coho salmon were

extirpated from the Mid-Columbia basin throughout the 20th century, with major population declines between 1850 and 1900, reportedly from irrigation management and water diversions. Subsequently, the population slowly dwindling until about 1980, when Coho likely became extinct in the Yakima River (Yakama Nation Fisheries Resource Management (YNFRM), 2017). A Coho reintroduction program has been established by the Yakama Nation in the Mid and Upper Columbia watersheds and a small population of Coho salmon now return to the Yakima subbasin. Because the indigenous stock of Coho salmon was extirpated in the upper Columbia River system, Coho returning to the Yakima subbasin are not included under the ESA (Yakama Nation Fisheries Resource Management (YNFRM), 2017).

Adult Coho migrate back into the Yakima River in early September through late November. Adults spawn in the tributaries between mid-October and late December (YNFRM, 2017; Figure 15). Eggs incubate over the winter and fry typically emerge from the gravels in April and May. As with other salmonid species, Coho egg survival is highly sensitive to intra-gravel flow, siltation, high-flow scour, and dewatering or freezing (Peven, 2003; YNFRM, 2017). Compared to steelhead and Chinook, juvenile Coho tend to seek off-channel habitats and tributaries with lower velocities and more overhanging cover. Most juvenile Coho salmon rear in their natal tributaries for approximately a year before migrating downstream, though a portion may migrate downstream in the fall of their first year, likely seeking overwintering habitat in the larger riverine systems (YNFRM, 2017). Coho spawn in the mainstem Yakima near the Hanson Ponds project area and some downstream tributaries that have accessible habitat (YNFRM, 2017). As part of reintroduction efforts, juvenile Coho are acclimated and placed in several tributaries to the Upper Yakima River upstream of the project area (YNFRM, 2017). Juvenile Coho parr released into Hanson Ponds between 2005 – 2007 showed some increased survival to downstream migration compared to parr released in the Yakima River adjacent to the ponds (T. Newsome, pers. comm., 2020).

3.1.5 Sockeye

Sockeye in the mid-Columbia River historically inhabited the lakes of the Upper Yakima basin, but construction of impassable dams, flow management for irrigation, hydropower operations, and overfishing led to significant population declines and ultimately, extirpation of Sockeye within the Yakima watershed. The historical total run size of Yakima River sockeye salmon has been estimated between 100,000 and 200,000 (Yakima Subbasin Fish and Wildlife Planning Board, 2004). Sockeye returning to the Wenatchee and the Okanogan Rivers are the last two remaining viable stocks in the Columbia River (Yakima Subbasin Fish and Wildlife Planning Board, 2004). A reintroduction program by Yakama Nation and partners is working to increase juvenile downstream fish passage at the tributary dams in the Yakima River (e.g., Cle Elum dam) and have transplanted thousands of adult Sockeye from Priest Rapids Dam on the Columbia River to Lake Cle Elum since 2009. Successful spawning by the transplanted Sockeye has resulted in hundreds of natural-origin returns since 2013 (Johnston et al., 2008) that migrate through the project area. However, because the indigenous stock of Sockeye salmon was extirpated in the Yakima River system, Sockeye returning to the Yakima subbasin are not included under the ESA.

Sockeye salmon are the anadromous form of kokanee (resident or adfluvial) salmon. Adult Sockeye typically return to the Yakima basin between mid-June and early August (University of Washington 2021; Figure 15). Both sockeye and kokanee utilize lakeshores, headwater streams, outlet streams (including nearby tributaries), and inter-lake streams for spawning. As with other salmonids, egg incubation is highly dependent on temperature and intra-gravel flow. After emerging from the redd in the late winter and early spring, they move upstream or downstream into a nursery lake or estuary. Fry outmigration to the freshwater rearing areas occurs for both sockeye and kokanee from mid-April to late June. Sockeye typically rear for one or two years in freshwater (usually a lake, but for some stocks it may be in major rivers), followed by one to four years in the ocean. Sockeye smolt outmigration occurs from April to June. There is no documentation of historical Yakima sockeye smolt outmigration timing but it can be assumed that it is similar to the Wenatchee stock since the rearing environments are similar (Yakima Subbasin Fish and Wildlife Planning Board, 2004).

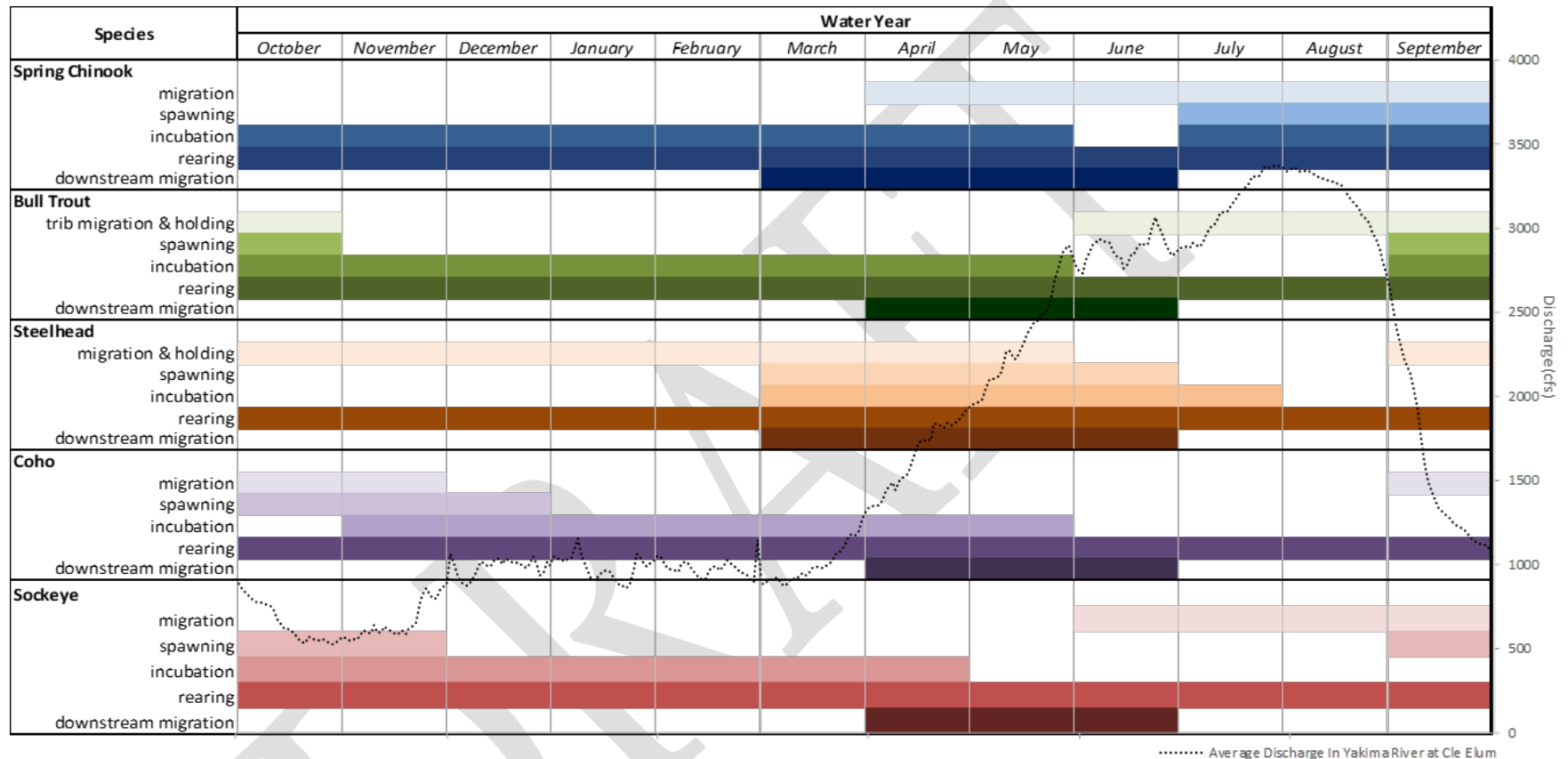


Figure 15. Life history timing for Hanson Ponds focal species overlaid with the average daily discharge in the Yakima River at Cle Elum. Not all life stages represented in this figure are present in the Hanson Ponds project area.

Aquatic habitat conditions in the study area have been negatively impacted by historical and on-going land uses, including logging and agricultural land uses, construction of interstate highway I-90 and the associated gravel mining pits, levee(s) built in the floodplain and along the river, and alterations to natural hydrological regimes. These activities have decreased channel mobility, the amount of high-quality complex aquatic habitat available in the reach, altered water quality (temperature), and have decreased the amount of large wood in the stream, notably old growth trees. Please see the 2021 assessment report for detailed information (Inter-Fluve).

In addition to undesirable physiological effects warm water temperatures may have on salmonids, elevated water temperatures combined with slow water velocities and relatively shallow water depths – such as those found in Hanson Ponds – provide habitat conditions attractive to native and non-native piscivorous species such as largemouth bass or northern pikeminnow that prey on juvenile salmonids. Largemouth bass (*Micropterus* spp., presumed *salmoides*) and northern pikeminnow have both been observed in Hanson Ponds (Entrix, 2002; J. Romine, pers. comm. 2020). Water temperature data collected in the ponds is available in the Assessment (Inter-Fluve, 2021).

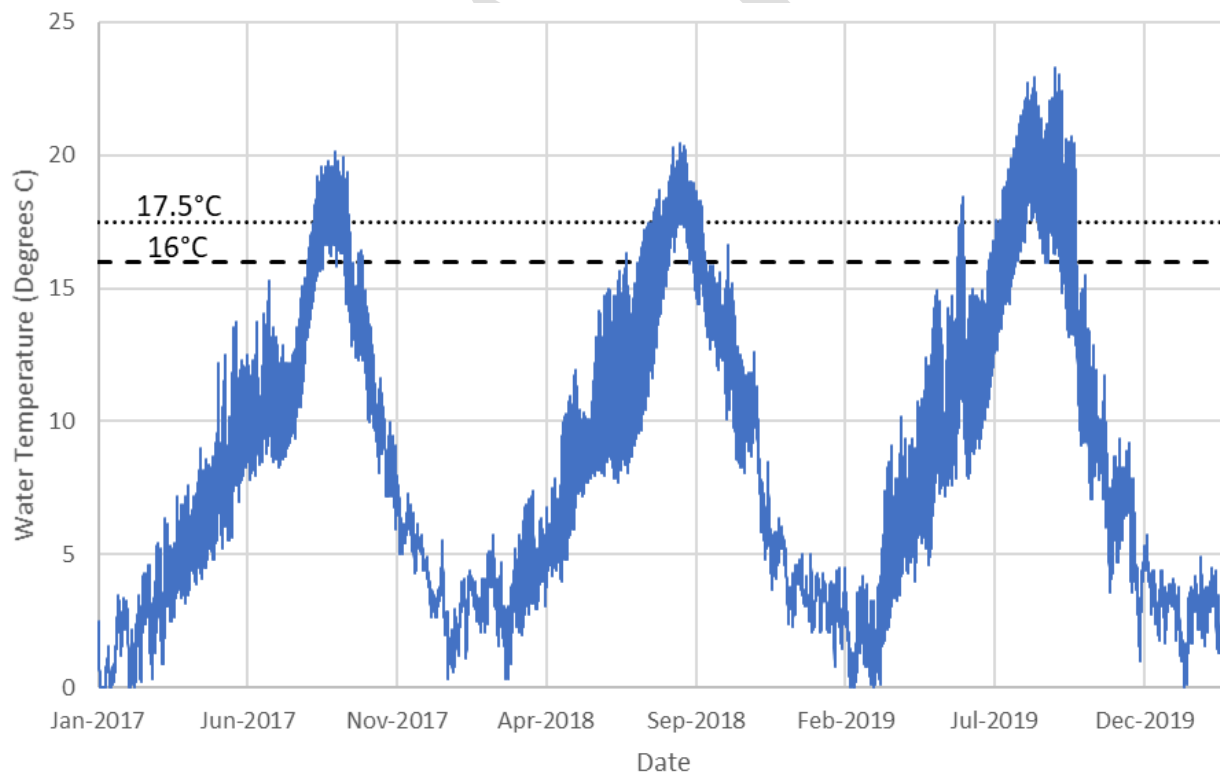


Figure 16. Water temperature recorded from January 1, 2017 – February 20, 2020 in the Yakima River. Data collected and provided by WDFW, 2021.

4. Survey and Analysis

4.1 ASSESSMENT AND SURVEY

Assessment, analysis and design of the Hanson Ponds project area required field survey and multiple desktop analysis, combined with existing data and model review. Field survey and mapping were completed by Inter-Fluve science staff August and September of 2020 and September of 2023. The 2020 surveys included topographic and bathymetric survey with RTK GPS, geomorphic surface mapping, vegetation mapping, and a rapid aquatic habitat assessment. A description of the 2020 survey and analysis efforts are provided in the 2021 site assessment report and related appendices (Inter-Fluve). Wetland delineation was completed by GG Environmental in 2020. The 2023 surveys included additional topographic and bathymetric survey, features survey (levee, pipe cleanouts, etc.), representative sediment grain size sampling, and riparian vegetation zone mapping. Two site visits in 2023 supported the evaluation for relocation of the regional wastewater outfall with City of Cle Elum and permitting stakeholders. Additional analysis completed after the 2023 field survey to support design efforts include additional hydrologic analysis, hydraulic modeling; geo-technical investigations; potential permittable outfall discharge evaluation, and preliminary sediment analysis.

4.2 HYDRAULIC MODELING

Preliminary hydraulic analysis was conducted using a two-dimensional (2D) hydraulic model that was developed for existing and preliminary proposed conditions within the U.S. Army Corps of Engineers HEC-RAS 6.4.1 software (USACE, 2023). 2D hydraulic computations are typically superior to one-dimensional (1D) computations when detailed analysis of river systems with multiple channels and floodplain inundation sequencing is required. Given the conditions of the Yakima River through the project reach, along with the complex interactions between the river, ponds, and surrounding floodplain, 2D computations were chosen for this project model. An existing conditions 2D hydraulic model was developed to assess the current channel/floodplain dynamics as well as assess the overall impacts of a wide range of flows on the existing landscape. In addition, a preliminary proposed conditions 2D hydraulic model was created and several iterations completed for the Draft 30% design and used to assess the functionality of each design element and evaluate the relative changes between existing and the preliminary proposed condition hydraulics within the project reach. The preliminary hydraulic model will be used to guide design development. A description of the model(s) and model results are provided in Appendix B.

4.3 GEO-TECHNICAL INVESTIGATION

Aspect Engineering completed geo-technical investigations in the project area of sub-surface floodplain and levee composition to guide design and analysis. The preliminary geo-technical report is provided as Appendix C as a separate document. The science team is prepped to complete additional geo-technical investigation along I-90, if requested by Washington Department of

Transportation after they review the 30% Draft Design Documents and hydraulic model. If WSDT makes this request, the geo-technical report will be updated to include the additional findings before it is finalized.

4.4 SEDIMENT

The channel bed and bars are composed primarily of sandy gravel with cobbles. In September of 2023, five bedload pebble-counts were completed (Wolman, 1954) at representative riffle crests and bars in the mainstem channel. The location and grain size distribution of those surveys are provided in Figure 17.

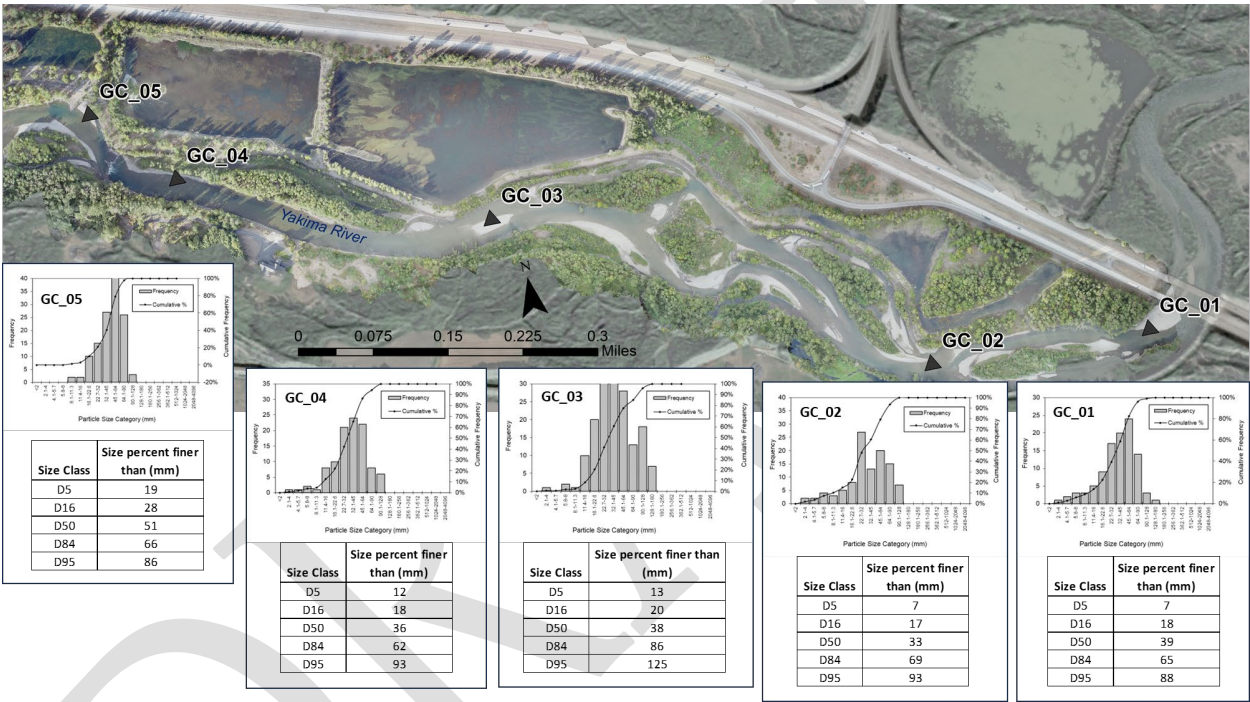


Figure 17. Gravel count locations and material grain size distribution (Sept 2023).

Sediment distribution and transport capacity is being analyzed for the project area to guide design of channel and floodplain geometry, slope, and preferred discharge distribution. Results of the analysis will be used to develop conditions with the potential to support floodplain development, bar maintenance, and geomorphic complexity. Preliminary analysis of sediment capacity for existing conditions at select locations in the channel that represent desired conditions (analogue areas - split flow and bar regeneration) and undesired conditions (single-thread transport reach) has been completed. The initial results guided the Draft 30% design development. Sediment capacity analysis will be completed for proposed conditions at the next stage of design. That analysis will accompany the future design documents.

5. Approach Development and Selection

Kittitas Conservation Trust developed and coordinated technical, community, and City of Cle Elum stakeholder groups that provide technical feedback, public interest input, review, and guidance toward developing the approach for the site, including recommendations to the City Council. The Inter-Fluve team provides the science and engineering expertise and experience to evaluate and design a site-appropriate approach to address the project goals and design criteria. The project is on property owned and managed by the City of Cle Elum. As such, the City of Cle Elum City Council makes decisions on approach selection.

KCT's Hanson Ponds regional stakeholders include a Technical Advisory Group (TAG), a Community Advisory Group (CAG), and the City Engineer and Manager Group (CCE). The TAG is composed of over thirty regional experts representing Yakama Nation, agencies (state and federal), and conservation organizations. Members include staff representing the US Bureau of Reclamation, WA Department of Transportation, US Fish and Wildlife Service, WA Department of Natural Resources, WA Recreation and Conservation Office, Kittitas and Yakima County, NOAA, WA Department of Fish and Wildlife, Mid-Columbia Fisheries Enhancement Group, WA Department of Ecology, Kittitas County, Yakima Basin Fish and Wildlife Recovery Board, and US Army Corps of Engineers and the City of Cle Elum. KCT's local Community Advisory Group (CAG) includes adjacent landowners, City of Cle Elum Mayor, City of Cle Elum contracted engineer, and local conservation and recreation proponents. CAG provides recreation usage, resource conservation, and aesthetic requests to be considered in the design criteria. KCT engaged the City of Cle Elum engineer, planner, and the wastewater treatment manager as a specialized advisory group (CCE) to support the effort of evaluating if, and if yes where, a relocated outfall location would function. FEMA also provided a separate review of the alternatives due to infrastructure-related elements and funding.

5.1 CONCEPT ALTERNATIVES

The initial design criteria created by TAG and CAG included, along with several infrastructure, ecologic, and recreational criteria, the requirement that the existing regional wastewater outfall pipe remain in its existing location within the mainstem channel to meet Washington State Department of Ecology permit requirements. Under this premise Inter-Fluve developed three alternative treatment approaches (Alternatives 1, 2, 3a & 3b) to address the goals of the project (Section 1.1) and the initial design criteria. The alternatives were accompanied by a general cost estimate and a preliminary feasibility to construct assessment.

The three alternatives were reviewed by KCT and its stakeholder groups multiple times through their development. Alternatives review meetings were held September 23, 2021 (TAG), November 9, 2021 (Mayor of Cle Elum), November 16, 2021 (FEMA), December 6, 2021 (CAG), and December 14, 2021 (TAG & some CAG members). Comments received throughout the review process were compiled and used to refine the design criteria, draft alternatives, and feasibility assessment. CAG

provided important guidance on community prioritization, design considerations, how to quantify and predicted social impacts and recreational opportunities for the community in the feasibility assessment. TAG provided data and material to support design development and technical review and comments of design elements and considerations that were integrated, where possible, into the concept-level alternatives.

At the Dec 14, 2021 meeting, the group members provided technical feedback and collaboratively recommend Alternative 3 as the preferred alternative because it had the potential to provide the most ecologic uplift. At that same meeting, the stakeholder groups also collaboratively gave direction to evaluate if the location of the wastewater outfall could be moved and, if yes, to develop another alternative that allowed for all or some of the wastewater pipe and outfall to be removed from the floodway and improve potential for ecologic uplift at the site. If the evaluation indicated that the outfall could be moved, the advisory groups directed KCT and Inter-Fluve to develop an additional alternative(s) relating to a new outfall location. The design criteria were updated to include the desire to relocate the outfall from its existing location, if possible.

KCT engaged the City of Cle Elum engineer, planner, and the wastewater treatment manager as a specialized advisory group (CCE) to support the effort of evaluating if, and if yes where, a relocated outfall location could function. Based on initial information and assessment, Inter-Fluve created a conceptual alternative (4) that included removing some or all of the existing outfall pipe from the floodway and routing the mainstem to alleviate bank erosion and pond capture risk. The three alternatives targeted relocation options with comparable or what is presumed to be better and/or preferred outfall conditions than what exist today. The Alternative 4 outfall relocation options include Option A: removing a portion of the existing pipe from the floodplain and moving the mainstem channel to that location; Option B: remove most of the existing pipe from the floodplain and designing a side channel that initiated at the new outfall location that the treated wastewater would discharge into; and Option C: removing all of the existing pipe from the floodway, route the outfall/pipe approximately 2,700 ft into an existing ditch north of I-90 and through a culvert to discharge into the mainstem downstream of the project area at an already reinforced pond levee. After the options were reviewed together with CCE and it was clear that moving the outfall location was a possibility and preferred by all members of the CCE, evaluation of those relocation options began. Preliminary evaluation included the design team and CCE meeting with the engineer at the city of Yakima (June 2022) to learn about their recent upgrade to an outfall into a side channel and the process they have undertaken with the Department of Ecology to beginning the process of permitting it. After review of Alternative 4, the TAG and CCE (Sept 2022) recommended Alternative 4 as the preferred alternative to the City of Cle Elum. The City Council agreed and directed KCT to pursue outfall relocation evaluation to identify the optimal configuration for the Alternative 4 (Nov 14, 2022).

Inter-Fluve provided the conceptual alternative documents and concept-level basis of design report in August of 2022 to KCT. KCT submitted those documents to Washington State's Recreation and Conservation Office (RCO) for review. RCO supported KCT pursuing the Alternative 4 outfall relocation evaluation prior to beginning the design process of Alternative 4. To address this project

need, KCT and Inter-Fluve took steps (funding and contracting) to expand the design team to include geo-technical expertise, civil engineering expertise, and permitting support. By the spring of 2023, the design team included Inter-Fluve, Aspect Engineering, and Jacobs. Once the team was established, evaluation of the three outfall relocation options was initiated.

5.2 WASTEWATER OUTFALL RELOCATION EVALUATION

The regional wastewater outfall relocation evaluation was completed June – December of 2023. Multiple meetings and two site visits with the City of Cle Elum engineer and the wastewater treatment manager (CCE) as well as TAG members and permitters were undertaken to gather information for the evaluation. The process, findings, and conclusion of the evaluation are provided in the Hanson Ponds Restoration Project – Wastewater Outfall Evaluation and Selection technical memo produced by Jacobs and Inter-Fluve (1/12/2024) – See Appendix D Outfall Evaluation Materials. In summary: Option C was determined to be not permissible; Option B with discharge into a side channel, was determined to be too costly for the City of Cle Elum and the Wastewater Treatment Facility to meet required facility upgrades; and Option A, with in-kind outfall conditions, was determined to be the most feasible for the City to permit and it met most of the outfall criteria requests of the CCE. This information was shared with the City Council of Cle Elum in January of 2024 and they supported further pursuit of developing design criteria and gathering information regarding permit requirements and costs for the outfall options from permitters (i.e. Washington State Department of Ecology and Department of Natural Resources) and the project’s technical advisors. An additional meeting with the TAG and CCE to provide the update on the outfall evaluation process was held on the 23rd of January 2024. The TAG and CCE agreed upon the priority criteria for the project. The Science Advisory Review Panel from Washington State’s Recreation and Conservation Office also provided review and written comments of the evaluation. The memo states that the Review Panel is “in favor of the Restoration Alternative 4 moving forward towards preliminary designs...” with questions and information requests about the outfall options and decisions throughout the design process. The RCO Review Panel memo with responses (December 2023) is provided separately as Appendix F.

The next step was to evaluate probable dilution discharge requirements at the new outfall location with Washington State’s Department of Ecology (DOE) staff to determine the design criteria for seasonal flow at the outfall point. Several meetings (5) between February 1st and May 6th were held with DOE staff to work through this process. DOE provided the design team with their Dilution Factor Calculation sheets and worked with the project design team to complete the evaluation. The evaluation is provided in The Reasonable Potential Analysis for Outfall Relocation memo produced by Jacobs (April 2024), approved by the DOE (May 6, 2024) and finalized on May 24, 2024 – See Appendix D – Outfall Evaluation Materials. In summary, the analysis concluded that split flow conditions that provide a minimum of 260 cfs at the outfall location will likely be permissible. The design criteria were updated to include this detail.

5.3 DESIGN APPROACH & SELECTION

The project design team then developed a concept-level design approach for Alternative 4, Option A that addresses the updated design criteria priorities and considers all other listed criteria. The approach considers channel processes, ecological uplift potential, and infrastructure risk. On May 6th, 2024 the conceptual design approach for Alt 4 Opt A was presented to the TAG, CCE, and CAG

members. After review and comments, all members present approved of the conceptual approach for Alternative 4 Opt A and collaboratively recommended it to the City Council as the preferred approach. On May 14th 2024, the conceptual approach for Alt 4, Opt A was presented to the City Council of Cle Elum. After review and comments, the Council approved the design approach at the meeting. The design criteria were finalized, and the project design team initiated the preliminary analysis and design process.

5.4 DRAFT PRELIMINARY 30% - DESIGN

These DRAFT 30% Preliminary Designs, completed on June 28, 2024, are meant to be a pre-cursor to the 30% Preliminary Design Documents. The draft documents provide a review opportunity by the TAG, CCE, and CAG during the design process. Technical review will include a separate evaluation of the 2-D hydraulic model and designs by WSDT engineers, to provide input on the I-90 design requirements for the 30% designs. Comments will be received and integrated appropriately into the Preliminary 30% Design Documents, slated to be completed in August of 2024, and provided to the City of Cle Elum for comment.

6. Design Criteria and Elements

This section of the report provides summary descriptions of the main elements included in the Draft preliminary-level designs. The elements and their intent are guided by the design criteria, assessment and analysis.

6.1 DESIGN CRITERIA

The design criteria incorporate site conditions, project area objectives, construction impacts, infrastructure constraints, property owner considerations, recreationists and adjacent property owner requests, and feasibility. Design criteria serve three primary purposes:

- 1) to clearly document and communicate specific project objectives and constraints,
- 2) to help inform and guide the design process so that objectives are met, and
- 3) provide a basis for future performance monitoring.

Priority Criteria:

- Minimize the amount of regional wastewater infrastructure in the floodway.
- Design to protect, as much as possible, infrastructure in and adjacent to the floodway within the project area.
- Maximize ecologic uplift.

INFRASTRUCTURE CRITERIA

- Minimize the amount of infrastructure (regional wastewater outfall) that exists within the floodway.
- Design to protect new outfall location for estimated 100-yr flood event.
- Design to retain some version of Kiwanis Pond.
- Create a new parking area at the west side of Kiwanis Pond, near the existing restroom and with clear new recreational trail access.
- Do not disturb the ground on the west side of Kiwanis Pond (buried dump).
- Do not increase existing flood risk to I-90. Comply with applicable regulations and WSDOT requirements.
- Do not increase existing flood risk or erosion potential to adjacent private landowners without consent. Comply with applicable regulations.
- Outfall location to meet preliminary DOE estimated discharge and mixing requirements. Estimated minimal allowable discharge at wastewater outfall point is 260 cfs (based on Allowable Discharge Analysis approved by DOE 5/6/24).
- Remove existing outfall infrastructure (pipe / constructed riffle) obsolete for wastewater discharge and grade control.



Figure 18. Existing constructed riffle at existing wastewater outfall discharge point (Photo: Sept 2024)

ENVIRONMENTAL CRITERIA

- Reestablish floodplain function and reconnection to channel processes within the project area.
- Restore meandering mainstem channel form with multi-threaded, perennial and seasonal side channel complexity.

- Improve quality and/or quantity of spawning and rearing habitat, and maintain or improve migration for steelhead, Chinook, coho, sockeye, and bull trout.
- Reduce risk of warm water predation on salmon and steelhead juveniles, by eliminating Hanson Ponds or reducing access to them.
- Consider the potential for improvements in habitat diversity and function for native aquatic, avian, and terrestrial flora and fauna throughout the project area.
- Increase geomorphic and ecologic complexity, where appropriate, to support channel and floodplain function.
- Uplift and create functional fringe wetlands along channels.
- Enhance and expand riparian areas.

RECREATION CRITERIA

- Maintain or improve existing public access to Kiwanis Pond and available floodplain.
 - Develop a trail network around Kiwanis Pond with the ability to connect to available floodplain within the project area. The floodplain trails will be informal and deformable (dirt), appearing “user built” and with no added surface materials that alter the flow regime.
 - Consider reshaping or deepening Kiwanis Pond, as needed, for enhanced recreational fishing and to accommodate other project goals.
- Include boater/floater safety considerations in mainstem channel treatment options.
- Interpretive signage and possibly hazard signage for floaters -
- If consistent within project goals, design for some perennial flow along the current RR banks for private property owner aesthetic request.

6.2 DESIGN ELEMENTS

This section provides summary descriptions of the primary design elements included in the selected approach. Additional information and specifics will be included in future documents as the review and design process of analysis, assessment, and refinement move forward.

6.2.1 Regional Wastewater Outfall

Draft description of purpose, intent, and design considerations of the relocated regional wastewater outfall is provided in the attached memo produced by Jacobs - Appendix E – Regional Wastewater Outfall Design Elements

6.2.2 Reconstruct Channel Planform – Mainstem and Side Channels

Location, geometry, and planform to be refined through the design process.

Intent

- Reduce infrastructure risk from continued bank erosion and infrastructure risk of potential river capture behind existing pond levees.

- Recreate or mimic channel's historical meander planform and split-flow conditions – naturalize hydraulics.
- Distribute moderate -- high flow events across restored floodplain area.
- Produce hydraulics that maintain permittable outfall conditions.

Design Considerations

- Location of the existing wastewater outfall pipe buried under the floodplain – relative to new outfall location.
- Minimize the amount of pipe remaining in the floodway while sufficiently buffering Kiwanis Ponds and I-90.
- Comparable or improved maintenance and access requirements for the City of Cle Elum and wastewater managers.
- Recreate historical and existing meander wavelengths (distance of one meander to the next along the down-valley axis) to naturalize and reduce lateral erosion trends: based on historical photos, channel scars, and existing functional meanders.
- Mimic channel form and gradient of analogue reach with floodplain width similar to that being restored at the site.
- Channel geometry to support desired hydraulics – floodplain and channel function.
- Split-flow conditions to support desired hydraulics – floodplain and channel function.
- Flow hydraulics at outfall point – maintain scour and helicoidal flow conditions at meander bend
- Appropriately sized and naturalized composition of channel bed and bank materials.
- Constructed channel beds and banks in areas of required stability – material sizing and geometries to be determined through design process.
- Side-channel redundancy to support annual channel wetting throughout the project area, including in front of across-the-river landowner home –habitat complexity and requested aesthetic element
- Available materials: composition and quantity requirements (excavated from levees, in existing channel and ponds, and/or imported).
- Sediment flux potential and desired hydraulic conditions – floodplain and channel function.
- Diverse and complex habitats supported.
- Recreational user safety and routing options.

6.2.3 Reinforced Banks and Set-Back Berm

Location, geometry, and material composition to be refined through the design process.

Intent

- Provide stability to banks in specified locations, where required for infrastructure protection.
- Provide grade control in channel and floodplain in specified/identified locations, where required to protect infrastructure.
- Maintain mainstem connection at wastewater outfall location – designed hard-point intended to hold the mainstem channel at the designated outfall location.
- Design for assumed permittable flow requirements at outfall location.
- Retain use and function of some configuration of Kiwanis Pond.
- Minimize areas of hardened banks, where possible, to support channel and floodplain processes downstream of the wastewater outfall.

Design Considerations

- Wastewater outfall protection requirements.

- Location of existing infrastructure and Kiwanis Pond.
- Size and composition of appropriate materials for the 100-yr flood event – to be determined. Set-back berm material may require large boulders or rip-rap and/or buried sheet pile. Reinforced banks material may require coarse alluvium, boulders, or rip-rap, depending on flow hydraulics.
- Potential channel evolution scenarios. Design to support channel and floodplain processes downstream of waste-water outfall location.
- Existing floodplain substrate and depth of sub-grade requirements based on potential scour calculations (geo-technical).
- Location of existing reinforced banks.
- Available quantity, size, and composition of material to be excavated from levees and dikes (geo-technical).
- Recreational user safety.

6.2.4 Reconnect and Create Floodplain

Elevations, distribution, and material composition to be refined through the design process

Intent

- Maximize connected floodplain area available to the channel between I-90 and the across-river (river right) landowner.
- Dissipate flood-flows across a broad area that can support diverse wetland and riparian vegetation.
- Provide complex habitat (aquatic and terrestrial) inputs and support to ecosystem function.
- Disconnect or remove (fill) poor-quality warm-water conditions currently present at Upper, Middle, and Lower Hason Ponds.
- Support/maintain desired split-flow conditions that support habitat/geomorphic complexity.
- Develop conditions that support channel and floodplain evolution downstream of the wastewater outfall.

Design Considerations

- Quantity of material needed to fill floodplain voids or create fill-islands and what should that material be composed of to provide sufficient structure as well as conditions for evolution.
- Frequency of expected/desired floodplain surfaces inundation.
- Flow hydraulics and surface erosion potential.
- Floodplain surface roughness and vegetation establishment.
- Desire to provide varied habitats (wetland, riparian, transitional) and purpose of each.
- Quantity and composition of material required to create floodplain and/or fill islands.
- Sediment flux potential and desired floodplain development/maintenance.
- Design to support channel and floodplain evolution processes.

6.2.5 Uplift and Create Wetlands

Extent and location to be refined through the design process.

Intent

- Maintain or increase the acreage of functioning wetlands on the sites.
- Diversify types of wetlands on the site.
- Promote diversity of species supported by or complementary to wetlands, including beaver.
- Build resilience into the site (geomorphic, ecologic, and hydrologic)

Design Considerations

- Inundation frequency.
- Floodplain elevation above water surface elevation – seasonal.
- Flow hydraulics immediately and overtime as plantings establish.

- Native species – appropriate and diverse.
- Culturally significant species.
- Vegetation installation and establishment sequencing.
- Contribution to floodplain roughness

6.2.6 Improve Habitat Conditions and Diversity

Areas and installations to be refined through the design process.

Intent

- Increase quantity of aquatic habitats available to support multiple (appropriate) life stages of native species of interest.
- Increase quality and complexity of available aquatic habitat.
 - Increase diversity of habitat types (pools, riffles, off-channel, side-channels, etc)
 - Increase in-channel cover and immediate nutrient inputs – [large wood installation \(6.2.5\)](#).
- Increase quality and quantity of avian and terrestrial habitats – wetlands and floodplain features.

Design Considerations

- Distribution and flow routing to increase quantity and types of aquatic habitats available.
- Flow hydraulics diversity throughout the site to support diverse habitats – scour and deposition complexity.
- consider area as a diverse riparian corridor for wildlife.
- Potential to support beaver populations.
- Potential to improve and create wetland and riparian diversity.

6.2.7 Large Wood Installation

Locations, size, structure, and distribution to be refined through the design process.

Intent

- Increase quality of in-channel habitats.
- Provide in-channel nutrients and cover.
- Instigate and/or maintain scour or deposition or deflection (depending on position and structure).
- Instigate and/or maintain split-flow conditions.
- Provide additional bank complexity, if/where appropriate to reinforced banks (6.2.1).
- Provide roughness and flow routing on floodplains during over-bank flow – especially while vegetation is establishing on new surfaces.

Design Considerations

- Appropriate location(s) and size regarding geomorphology and hydraulics.
- Habitat complexity and goals for each structure.
- Ability to install (access) and potential disturbance.
- Structural stability and ballasting.
- Land-owner (City of Cle Elum) access and maintenance routes and safety.
- Recreational user safety – structure design and identify mainstem boater route and potential signage.

6.2.8 Native Plant Revegetation

A revegetation planting plan with site appropriate native vegetation is being developed in collaboration with KCT for all areas disturbed during construction. A plant and seed list are provided on the Draft 30% Design Phase, for review and refinement with KCT and appropriate stakeholders. Four planting zones are proposed: Emergent Fringe (Zone 1), Riparian (Zone 2),

Transitional (Zone 3), and Upland (Zone 4). Locations of planting zones will be identified in later phases of design. Species were selected based on the following criteria: native according to the USDA plant database, dominant at Hanson Ponds, tolerant of transplanting, rapid establishment, and species diversity.

The **Emergent Fringe** zone is proposed for side channels, islands, and floodplain where water is shallow and lower in velocity. Plantings of hydrophytic sedges, rushes, and grasses are proposed for the Emergent Fringe. Fast establishment of plantings in the Emergent Fringe is critical to minimize colonization by reed canary grass.

The **Riparian** zone is proposed for the channel banks and floodplain approximately at or above ordinary high water. Container plantings, live cuttings, and seeds of facultative and facultative wetland species are proposed for the Riparian zone. The Riparian zone will stabilize the constructed banks and provide shade to improve aquatic habitat.

The **Transitional** zone is proposed for areas of disturbance that are higher in elevation than the Riparian zone including: the disturbed banks of levees and the I-90 prism, construction accesses, and the informal parking area. Container plantings and seeds of facultative species are proposed for the Transitional zone.

The **Upland** zone is proposed for areas of disturbance on the upper banks and top of levees and the I-90 prism. Container plantings and seeds of facultative upland and upland species are proposed for the Upland zone.

6.2.9 Recreation

Features, locations, and grading to be refined during the design process.

Intent

- Retain a version of Kiwanis Pond for public access and recreation– shape, depth, and access to be refined through the design process.
- Parking that supports similar informal multi-access use of Kiwanis Pond as exists today but move the parking to be near existing toilet.
- Include public viewing potential for Kiwanis and the channel.
- Informational signage for public information about the site.
- Design to support a trail around Kiwanis Pond.
- Identify potential informal walking routes throughout the project area, where appropriate, to provide public access.

Design Considerations.

- Public use of Kiwanis Pond.
- Orientation of parking area for viewing, traffic routing, and access to toilets and trailhead.
- Viewing areas with varied access and uses.
- Verbage and content of informational signage – to be developed collaboratively with the city.
- Informal trails through the project area are meant to morph or be adjusted over time to the evolving channel/floodplain conditions/locations.
- Access and maintenance potential.

7. Cost Estimate – DRAFT 30%

The below Opinion of Probable Construction Cost (OPCC) is preliminary and not recommended for use of budgeting or contracting. The DRAFT 30% OPCC has been developed based on review of current construction costs for similar items on other projects, consultation with construction contractors and material suppliers, and applicable reference cost data. However, at this stage it does not include cost estimates for elements of the project that have either not been designed yet (i.e. Revegetation, Recreation) or elements that need further design prior to warranting a cost estimate. The OPCC will be refined through each stage of design development and review.

Engineer's Opinion of Probable Construction Costs June 2024 - DRAFT Preliminary (30%)						
No.	Item	Unit	Quantity	Unit Cost	Cost	Notes
1.00 General Requirements / Project Initiation						
					\$ 809,800	Subtotal (rounded up to nearest hundred)
1.01	Bonds	L.S.	1	\$ 141,300	\$ 141,300	Calculated as 1.3% of overall construction cost.
1.02	Insurance	L.S.	1	\$ 173,900	\$ 173,900	Calculated as 1.6% of overall construction cost.
1.03	Safety program and implementation	L.S.	1	\$ 27,200	\$ 27,200	Calculated as 0.25% of overall construction cost.
1.04	Mobilization/demobilization	L.S.	1	\$ 217,400	\$ 217,400	Calculated as 2% of overall construction cost.
1.05	Permitting	L.S.	1	\$ 250,000	\$ 250,000	
2.00 Construction Erosion Prevention, Environmental Protection and Sediment Control						
					\$ 218,200	Subtotal (rounded up to nearest hundred)
2.01	Erosion and Sediment Control Plan and Implementation	L.S.	1	\$ 53,300	\$ 53,300	Includes development, submittal, approval, and implementation of plan BMPs. Calculated as 0.5% of direct costs.
2.02	Aquatic Environment Protection Plan and Implementation	L.S.	1	\$ 53,300	\$ 53,300	Includes development, submittal, approval, and implementation of plan BMPs. Calculated as 0.5% of direct costs.
2.03	Traffic Control	L.S.	1	\$ 5,000	\$ 5,000	Temporary signage along roads during mobilization/demobilization and hauling.
2.04	Temporary access road improvements	L.S.	1	\$ 53,300	\$ 53,300	Access road impv. and placement of quarry spalls over geotextile in sensitive areas to minimize impacts. Calculated as 0.5% of direct construction costs.
2.05	Temporary staging area improvements	L.S.	1	\$ 53,300	\$ 53,300	Staging area impv. and placement of quarry spalls over geotextile in sensitive areas to minimize impacts. Calculated as 0.5% of direct construction costs.
3.00 Earthwork						
					\$ 8,867,100	Subtotal (rounded up to nearest hundred)
3.01	Excavation	C.Y.	1,000	\$ 50	\$ 50,000	Miscellaneous unsuitable material hauled and disposed of off site
3.02	Excavation and Replace on Site	C.Y.	102,839	\$ 10	\$ 1,028,390	Excavation of native material, and filled on site. Assumes no bedrock excavation.
3.03	Imported Fill	C.Y.	203,990	\$ 35	\$ 7,139,650	Fill of islands, low floodplain and setback levee, incl. off-site purchase as necessary
3.04	Roughened channel: main stem riffle near Kiwanis Ponds	C.Y.	6,490	\$ 100	\$ 649,000	Imported substrated sized for channel stability
4.00 Large Wood Structures						
					\$ 1,620,000	Subtotal (rounded up to nearest hundred)
4.01	Large Wood Structure - Head of Island	EACH	4	\$ 60,000	\$ 240,000	each: 55ft face width
4.02	Large Wood Structure - Bank Buried	EACH	10	\$ 61,000	\$ 610,000	600-lineal feet of bank.
4.03	Large Wood Structure - Floodplain Roughness	EACH	70	\$ 11,000	\$ 770,000	one structure per 15,600 square feet
5.00 Reinforced Bank						
					\$ 160,000	Subtotal (rounded up to nearest hundred)
5.01	Set-back Berm along Kiwanis pond	L.F.	600		\$ -	To be included in the permit-level design plan set
5.02	Riprap lined bank	C.Y.	1,600	\$ 100	\$ 160,000	Riprap lining along Kiwanis Pond
5.03	new wastewater outfall	TBD				To be included in the permit-level design plan set
6.00 Recreational Improvements						
					\$ -	Subtotal (rounded up to nearest hundred)
6.01	Trail Creation	L.F.	TBD			To be included in the permit-level design plan set
7.00 Riparian Management						
					\$ -	Subtotal (rounded up to nearest hundred)
7.01	Wetland Revegetation	AC	TBD			To be included in the permit-level design plan set
7.02	Upland Revegetation	AC	TBD			To be included in the permit-level design plan set
Construction Sub-Total					\$ 11,675,100	Assumptions and undetermined costs listed above.
30% Contingency (rounded to nearest hundred)					\$ 3,502,500	Calculated on Construction Sub-Total
Construction Total (including 30% Contingency)					\$ 15,177,600	
Notes						
- Source of earthworks and large wood have yet to be determined. Haul costs may vary greatly. - Contingencies account for variability in project design and construction costs, rounded up. - Costs are in dollars as of 2024. - Basic survey work required for construction (e.g. layout staking, grade setting, etc.) is included in this opinion. Additional survey work not included in this opinion: - Pre-construction conditions survey - Full as-built topographic survey - In providing opinions of probable construction cost, the Client understands that the Consultant has no control over the cost or availability of labor, equipment or materials, or over market condition or the Contractor's method of pricing, and the Consultant's opinions of probable construction costs are made on the basis of the Consultant's professional judgment and experience. The Consultant makes no warranty, expressed or implied that the bids or the negotiated cost of the Work will not vary from the Consultant's opinion of probable construction cost.						
Abbreviations						
AC - acre, C.Y. - cubic yard, Dia. - diameter, impv. - improvement, incl. - includes, L.F. - linear foot, L.S. - lump sum						

8. References

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DRAFT

7.4 PONDS

Hanson Ponds is a set of floodplain gravel mine pit ponds separated from the upper Yakima River by constructed levees and dikes between RM 185.8 and 187. The ponds are currently connected to the mainstem and to each other via spill channels constructed through the levees originally designed to separate the features. An additional pond known as Kiwanis Pond is also included in the project area. Kiwanis Pond was created 30 years after Hanson Ponds and is located upstream of the Upper Pond on the river-left (north) floodplain. At flood conditions, Kiwanis Pond has an undesigned spill route that temporarily connects surface water contributions from Kiwanis into the Upper Pond. A longitudinal profile of the Upper, Middle, and Lower Ponds with the connecting spill channels labeled is provided below in Figure 39 (Kiwanis Pond no included).

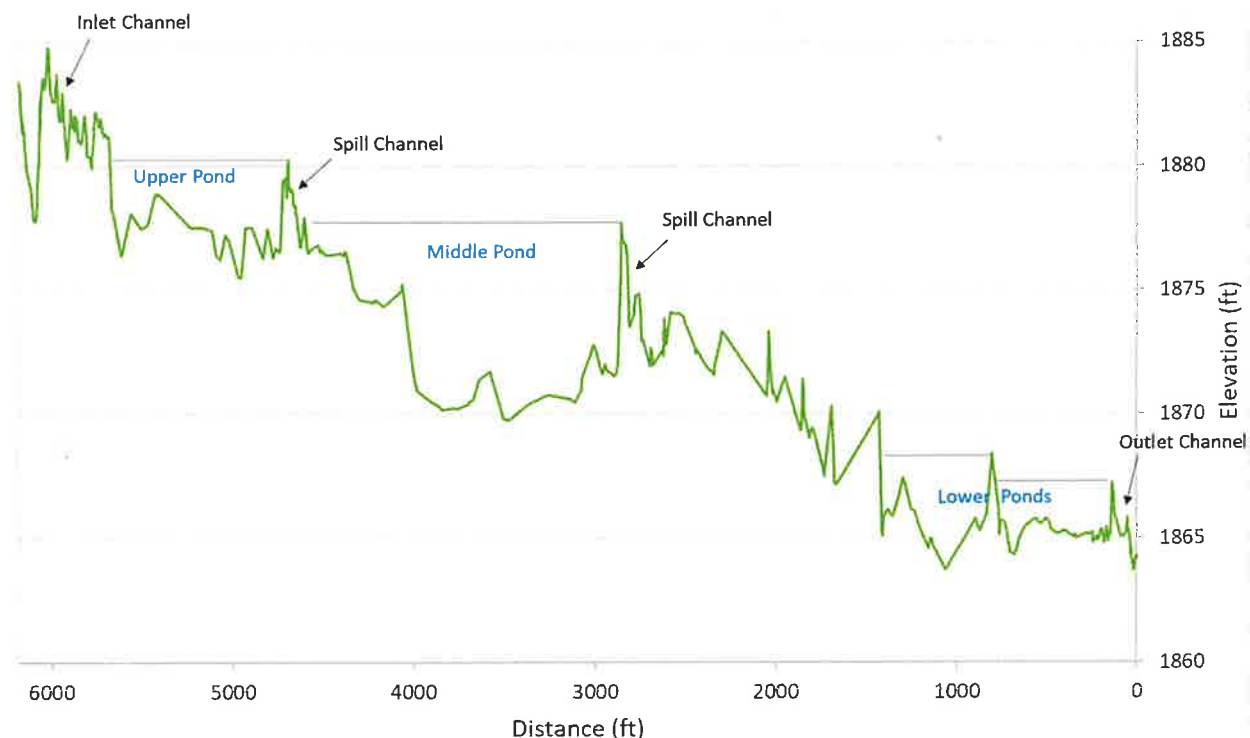


Figure 39. Centerline longitudinal profile along constructed connector channels and through ponds.

The riffle crest of each spill channel controls the water surface elevation in the pond upstream from it, at normal flow conditions. This creates a stair-step in water surface elevations of the ponds. It also results in water surface elevation at the downstream end of the ponds being higher than water surface elevation in the Yakima River on the other side of the levee.

The Relative Elevation Model shows the variability in pond depth and how it relates to the elevation of the channel (Figure 40) with bed topography shown at three cross sections. Water surface in the graphs is represented by the modeled annual high flow discharge (2420 cfs). The relative elevation model and cross sections confirm that the bed of the Upper Pond is slightly lower in elevation compared to the channel (XS01). The bed of the Middle Pond is lower than the mainstem channel at mid-section (XS 02) with a higher water surface elevation. At XS 03 the channel's bed is lower in elevation than the Middle Pond water surface remains higher in the pond.

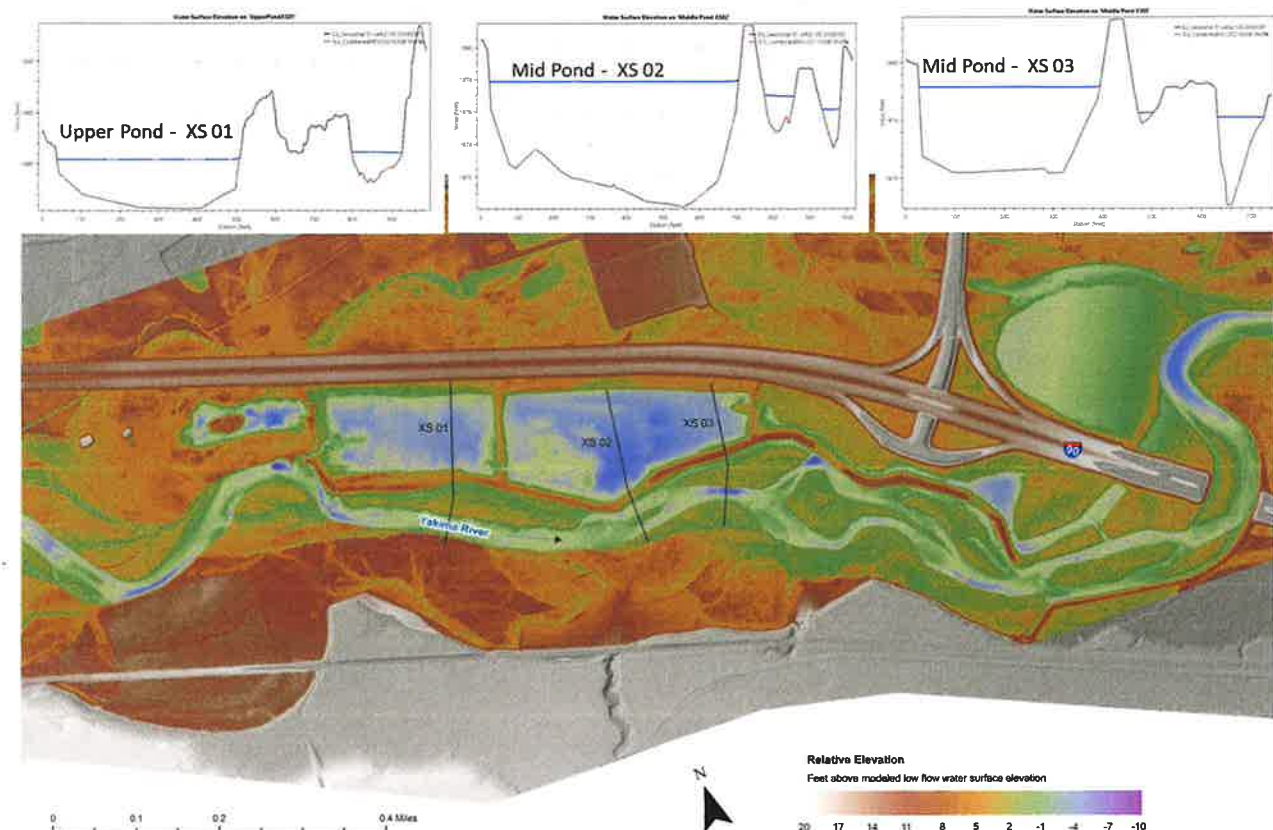


Figure 40. Relative elevation of topography modeled from low-flow water surface elevation of mainstem channel. Cross sections extracted from Hydraulic model results for annual high-flow (2420 cfs).

At larger flood events, the off-channel low-velocity areas are generally confined to the ponds, which lack diverse habitats and present predation and temperature issues (see Section 3.2 – Aquatic Habitat).

7.4.1 Channel Capture Potential

Excavation of gravel to construct I-90 removed a large volume of material from the floodplain and left the bottom of Hanson ponds slightly lower in places than the modern incised channel. If the channel shifts to occupy the pond area, channel evolution responses such as head-cut migration, exaggerated lateral migration and bar development at the site, and downstream degradation due to sediment capture are potential, depending on the scenario and configuration of channel realignment (Northwest Hydraulic Consultants Inc, 2015; Reichmuth et al., 2002). These variables will and need to be considered in the development and design of restoration alternatives for the site.

In its current condition, the potential for the Yakima River to avulse or migrate into the ponds during a large flood event has been identified as an infrastructure risk (Reichmuth et al., 2002; Washington State Department of Natural Resources (WaDNR), 2004). The infrastructure identified at risk are the buried wastewater outfall pipe and sections of I-90, including the east interchange at exit 85.

The hydraulic model results (see Appendix A) and field survey generated as part of this assessment concur that there is currently potential for the Yakima River to eventually occupy Hanson Ponds at the upstream end of the project site. The current planform of the channel directs flow towards the bank on the outside of a meander bend at the upstream end of the Hanson Ponds project area – resulting in lateral bank erosion (Figure 41). The curvature of the meander is exaggerated due to constructed riprap spurs and the alignment of the west side Upper Pond levee. The meander bend flow hydraulics are locally amplified by the riprap boulder spurs that were constructed in 1999 as an emergency response to flood-induced bank erosion (Reichmuth et al., 2002). The riprap spurs currently promote bank erosion at normal annual flow discharges that is expected to continue. A sequence of historical aerial images from 1994 (prior to Kiwanis Pond, emergency rock spurs, and bank extension construction in 1999), 2003 (prior to inlet channel construction in 2004), 2005, 2006, 2013, 2018) shows the changes in lateral bank location over time. Lateral bank erosion at this location is also expected to continue with the potential to erode past and around the spurs, potentially eventually reaching the lower elevation floodplain surface next to the Kiwanis Ponds area. This scenario is expected to result in an increased frequency of overbank flooding thus increasing the rate of bank erosion toward or into Kiwanis Pond and/or the Upper Pond. If the ongoing process of lateral migration erodes around and/or undermines the constructed spurs that are currently deflecting mainstem flow away from the inlet channel into the Upper Pond, the risk of channel capture by the pond via the inlet channel is likely to increase.

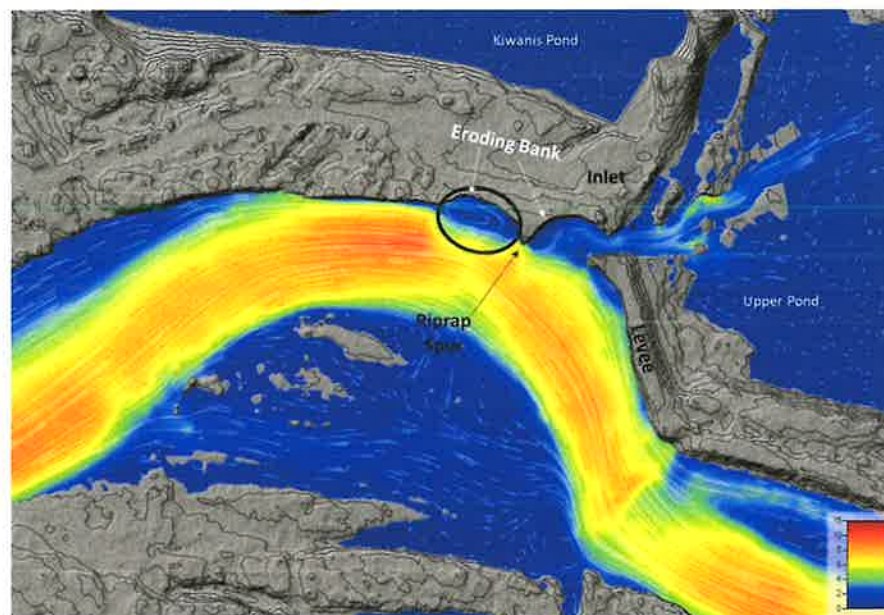


Figure 41. Hydraulic model velocity (ft/sec) results of 2-yr modeled discharge at existing conditions, with particle trace routing to show flow directed at bank in meander bend, high velocity conditions where the channel drops into scour pool at upstream side of the eroded bank promoting up-bank lateral erosion, and planform control of riprap spur and levee.



Figure 42. Sequence of aerial photos (1994, 2003, 2005, 2006, 2013, 2018). Yellow line delineates channel bank location in 2003 photo. Annotation identifies features and eroding bank of concern. (Photos: GoogleEarth)

Capture of the mainstem channel by avulsion during a single flood event instead of gradually via lateral bank erosion is another identified possibility at the upstream end of the Hanson Ponds project area. The existing conditions 2-D hydraulic model created as part of this assessment (see Section 7.5 and Appendix A) confirms that at approximately the 5-year modeled flood discharge, the mainstem channel begins to overtop the armored bank separating the river from the ponds at the upstream end and at the constructed levee breaches. The hydraulic model results for a 25-yr flood event produces floodplain inundation and flow hydraulics (velocity) with the potential of initiating surface erosion and headcuts that could instigate channel avulsion at the meander bend. Of note is that between the 50-yr and 100-yr modeled flow event, risk of mainstem channel capture as a result of overland flow from upstream of the project area occurs. This indicates that long-term risk of channel capture at Hanson Ponds is not a singularly localized issue associated with the identified eroding bank. It is an issue related to gravel pits mines located within the available floodplain – an issue of concern throughout the Yakima River basin (WaDNR, 2004).

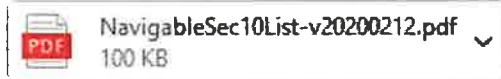
RE: [Non-DoD Source] Navigable waters



Churchill, Jenae N CIV USARMY CENWS (USA) <Jenae.N.Chu
To mbabik@kittitasconservationtrust.org



Mon 4:55 PM



Hello Mel,

Please see the enclosed pdf for guidance on navigable water limits. Under Section 404 of the Clean Water Act the Corps regulates the discharge of dredged or fill material into waters of the U.S. Under Section 10 of the Rivers and Harbors Act the Corps regulates any work in or over navigable waters of the U.S.

Please let me know if you have any follow up questions.

Jenae Churchill

Navigable Waters of the United States in Washington State

Originally listed 19 December 1986, revised 31 Dec 2008

Waterway Name	Navigable length (miles)	Miles under Federally authorized project	Approximate location of the upstream limit of navigation		Remarks
			Latitude	Longitude	
Abernathy Creek	0.3	None			Originally entered 12/19/1986; modified 5/5/2000, revised 2/12/2020
Bachelor Island Slough	2.5	None			Tributary of the Columbia River near Stella, WA. Tidal Influence for 0.3 mile to the rapids (*see Portland Dist public notice dated 1 Aug 1975).
Baker Bay (Ilwaco Channel)	4.5	4.5			Tributary of Columbia River, Mouth 14 miles south of Vancouver, Washington.
Baker Bay (West Channel)	3.4	3.4			Part of the Columbia River estuary. Chinook to Ilwaco, Washington.
Bear River	4	None			Tributary of Lower Columbia River at Ilwaco, Washington.
Bingen Channel	0.3	0.3			Flows into Willapa Bay. Navigable to head of tidewater, approx. 4 miles above mouth.
Birnie Slough	3	None			Tributary to Bonneville Pool. At Bingen, Washington.
Black River	15	None			Tributary of Columbia River. 1 mile south of Cathlamet, WA.
Brooks Slough	1	None			Flows into Chehalis River near Rochester, WA. Navigable to 15 miles above mouth.
Burke Slough	2	None			Tributary of Skamokawa Creek. Mouth at Skamokawa, WA.
Camas Slough	3	None			from Kalama, WA.
Carrolls Channel	5	None			Side channel of Columbia River at Camas, WA.
Cathlamet Channel	8	2			Side channel of Columbia River. Downstream end at Longview, WA.
Cedar River	1	None			Side channel of Columbia River at Cathlamet, WA.
Chehalis River	68	14			Flows into Lake Washington at Renton, WA. Navigable to N.P.R.R. bridge, approx. 1.25 miles above mouth.
Chinook River	1	None			Flows into Grays Harbor. Project mileage begins at Union Pacific Railway bridge at Aberdeen, WA. Navigable to 68.5 miles above mouth, near Chehalis, WA.
Coal Creek Slough	6	None			Flows into Baker Bay. Mouth 3 miles east of Ilwaco, WA.
Columbia River	215	215.6			Tributary of Columbia River. Mouth 10 miles downstream of Longview, WA.
Columbia River	93	93			From Baker Bay to NWP upstream limit at River Mile 216. The boundary between OR & WA contains Bonneville Lock (RM 145.5) and the Dalles Lock (RM 192.5). See State of Oregon also.
Columbia River					From River Mile 216. John Day Dam to River Mile 309, which is the Oregon-Washington state line, (left blank) 17 miles above McNary Dam. Also listed under the State of Oregon.

Navigable Waters of the United States in Washington State

Originally listed 19 December 1986, revised 31 Dec 2008

Waterway Name	Navigable length (miles)	Miles under Federally authorized project	Approximate location of the upstream limit of navigation		Remarks
			Latitude	Longitude	
Columbia River	45	45			From River Mile 309 to River Mile 354, which is 16 miles upstream from Richland, WA, Seattle/Walla Walla District boundary.
Columbia River	392	242			Navigable length shown is from the boundary of the Seattle-Walla Walla Districts upstream to the Canadian border. The authorized project extends from Wenatchee to Kettle Falls. There are 7 dams, all without locks, across the river within Seattle District. Bays within pools created by the dams are considered navigable to normal full pool elevations. Spokane River from mouth to Little Falls, WA also is considered navigable.
Coweman River	4	None			Tributary of Cowlitz River. Mouth at Longview, WA.
Coweman River Sloughs (includes Marys Slough)	-	-			Three tributaries entering Coweman River left bank within 0.8 mile of its mouth (*see Portland Dist public notice dated 8/1/1975).
Coweman Sloughs	4	None			Tributary of Cowlitz River. Mouth at Longview, WA.
Cowlitz River	35.5	35.5			Tributary of Columbia River. Normally only the first 5 miles are maintained. Mouth at Longview, WA.
Crooked Creek	2.6	-			Tributary of Grays Bay (Columbia River).
Dakota Creek	2	None			Flows into Drayton Harbor near Blaine, WA. Navigable to head of tidewater, about 2 miles above mouth.
Deep River	6	6			Tributary of Lower Columbia. Mouth 7 miles NE of Astoria, OR.
Dickey River	1	None			Flows into Quillayute River near La Push, WA. Navigable to head of tidewater, about 1 mile above mouth.
Drano Lake	1	None			In Bonneville pool - 3 miles from Hood River, OR, across Columbia River. Mouth of Little White Salmon River.
Duwamish River	10	5			River mouth is considered the head of West Waterway, Seattle Harbor, about 0.3 miles downstream of Spokane Street bridge. Head of navigation is the mouth of Black River, former outlet of Lake Washington. This is also the approx. head of the tide, and the point where the Duwamish River becomes the Green River.
Elochoman River	2.2	None			Tributary to Elochomon Slough.
Elochomon Slough	3.5	1.5			Tributary of Columbia River. Mouth at Cathlamet, WA.
Fisher Island Slough	3	None			Side channel of Columbia River. Downstream end 6 miles downstream from Longview, WA.

Navigable Waters of the United States in Washington State

Originally listed 19 December 1986, revised 31 Dec 2008

Waterway Name	Navigable length (miles)	Miles under Federally authorized project	Approximate location of the upstream limit of navigation		Remarks
			Latitude	Longitude	
Grays Harbor	22	24			Originally entered 12/19/1986; modified 5/5/2000, revised 2/12/2020
Grays River	8	8			The navigable length shown is for the main channel from the UPPR bridge of Aberdeen to the seaward end of the bar channel as of 1965. Mileage shown under authorized project includes this main channel plus Bay City Channel and Westhaven Cove entrance. All bays and sloughs in the harbor are considered navigable to the elevation of MHW.
Hama Hama River	1	None			Tributary of Lower Columbia River. Mouth 7 miles NE of Astoria, OR.
Hoh River	1	None			Flows into Hood Canal near Eldon, WA. Navigable to head of tidewater, approx. 1 mile above mouth. (*see 13 Jan 83 DF from Engineering Division).
Hoko River	1	None			Flows into Pacific Ocean near Forks, WA. Navigable to head of tidewater, approx. 1 mile above mouth.
Hoquiam River	8	2.5			Flows into Strait of Juan De Fuca near Sekiu, WA. Navigable to head of tidewater, approx. 1 mile above mouth.
Hoquiam River (East Fork)	6	None			Flows into Grays Harbor at Hoquiam, WA. Navigable to approximately 8 miles above mouth.
Humplulips River	3	None			Flows into Hoquiam River at Hoquiam, WA. Navigable to approximately 6 miles above mouth to dam.
Johns River	4	None			Flows into Grays Harbor near Hoquiam, WA. Navigable to 3.5 miles above mouth.
Kalama River	4	None			Flows into Grays Harbor near Markham, WA. Navigable to head of tidewater, approx. 4 miles above mouth.
Klickitat River	1	None			Kalama, WA.
Lake Chelan	55	None			Tributary to Bonneville Pool, Columbia River. Mouth at Lyle, WA.
Lake River	11	3			1,100 ft. (N.G.V.D.) Entire Lake
Lake Sammamish	8	None			Tributary of Columbia River. Mouth 1 mile east of St. Helens, OR. Originates in Vancouver Lake.
Lake Union	1	None			Mileage shown is from outlet of lake on north shore to most southern point in lake. OHW elevation = 27.0' NGVD 1929
					Mileage shown is from the Lake Washington Ship Canal sailing course to the south end of Lake Union. Navigable to upper regulated level. OHW elevation = 21.8' COE datum

Navigable Waters of the United States in Washington State
Originally listed 19 December 1986, revised 31 Dec 2008

Waterway Name	Navigable length (miles)	Miles under Federally authorized project	Approximate location of the upstream limit of navigation		Remarks Originally entered 12/19/1986; modified 5/5/2000, revised 2/12/2020
			Latitude	Longitude	
Lake Washington	20	None			Navigable length is shown from Webster Point, the easterly end of Lake Washington Ship Canal, to the north end of the Lake near Kenmore, and to the south end of the Lake near Renton. Navigable to upper regulated level. OHW elevation = 21.8 feet COE datum.
Lake Washington Ship Canal	8	8			Length shown is from the 34-foot depth curve in Shilshole Bay to the 30-foot depth curve in Lake Washington at Webster Point.
Lewis River	18	0.18			Tributary of Columbia River. Across Columbia River from St. Helens, OR. Normally only first 2 miles maintained.
Lewis River (East Fork)	3	2.5			Tributary of Lewis River. (Inactive part of Federal project). Upper end at LaCente, WA.
Little Hoquiam River	2	None			Flows into Hoquiam River near Hoquiam, WA. Navigable to head of tidalwater, approx. 2 miles above mouth.
Martin Island Slough	2	None			Side channel of Columbia River 4 miles upstream from Kalama, WA.
Naselle River	14	None			Flows into Willapa Bay near Naselle, WA. Navigable 14 miles above mouth.
Nooksack River	26	None			Flows into Bellingham Bay near Bellingham, WA. Navigable 26 miles above mouth to Everson.
North Nemah River	1	None			Flows into Willapa Bay near Nemah, WA. Navigable 0.5 miles above mouth, to State Highway bridge.
North River	5	None			Flows into Willapa Bay near South Bend, WA. Navigable to falls 5 miles above mouth.
Okanogan River	50	None			Flows into Columbia River near Brewster, WA. Navigable from mouth to McLaughlin Falls, approx. 50 miles above mouth near Riverside.
Palix River	4	None			Flows into Willapa Bay near Bay Center, WA. Navigable from mouth to head tidal influence, which is undetermined, but is assumed to be approx. 4 miles above mouth.
Pend Oreille River	72	None			Mileage shown is from the Canadian boundary at Mile 16, to the Washington-Idaho State line at Mile 88. Box Canyon Dam in this reach has no locks. Above Box Canyon the river is considered navigable to normal full pool elevation. (See also under Idaho).

Navigable Waters of the United States in Washington State

Originally listed 19 December 1986, revised 31 Dec 2008

Waterway Name	Navigable length (miles)	Miles under Federally authorized project	Approximate location of the upstream limit of navigation		Remarks
			Latitude	Longitude	
Puget Sound	97	15			Originally entered 12/19/1986; modified 5/5/2000, revised 2/12/2020 Waters included are those described in Chapter 13, United States Coast Pilot 7, Ninth (1963) Edition. All are navigable to the line of MHW. Length of main channel is sailing course from Port Townsend to Olympia. No project channels are involved in this course except 2.5 miles at Olympia. Miles shown under authorized project are the aggregate length of the waterway connecting Port Townsend Bay and Oak Bay; East Waterway at Everett; Port Gamble, East and West Waterways at Seattle; Port Orchard; Hylebos, Port Industrial and City Waterways at Tacoma; Hammersley Inlet; and Olympia. Lengths of authorized small boat harbors at Port Townsend, Lake Crockett and Shilshole Bay are not included.
Puyallup River	3	3			Flows into Commencement Bay at Tacoma, WA. Navigable 3 miles above mouth.
Pysht River	2	None			head of tidewater, 2.5 miles above mouth.
Queets River	1	None			Flows into Pacific Ocean near Queets, WA. Navigable approx. 1 mile above mouth.
Quillayute River	2	1			Flows into Pacific Ocean at La Push, WA. Navigable 2.5 miles above mouth.
Rock Creek	1	None			In Bonneville Pool Columbia River at Stevenson, WA.
Samish River	4	None			Flows into Samish Bay near Edison, WA. Navigable 4 miles above mouth.
Sammamish River	15	15			Flows out of Lake Sammamish into Lake Washington near Seattle, Washington. Navigable throughout.
Sauk River	40	None			Tributary to the Skagit River. Navigable up to Bedal.
Seal Slough	1.9	-			Tributary to Corays River. Tidal influence for a distance 1.9 miles from its mouth to Kendall Road crossing (see Portland District public notice dated 1 Aug 1975).
Sekiu River	1	None			Flows into Strait of Juan De Fuca near Sekiu, WA. Navigable 4,000 feet above mouth.
Skagit River (North Fork)	7	None			Flows out of Skagit River at about Mile 9.5 near Mt. Vernon, into Skagit Bay.
Skagit River (Including South Fork)	77	9.5			Flows into Skagit Bay near Stanwood, WA. Mileage shown is from outboard end of training dike, at entrance to the South Fork, to Ranger Station at Marblemount, WA.
Skamokawa Creek	1	0.4			Tributary of Columbia River. Mouth at Skamokawa, WA.

Navigable Waters of the United States in Washington State

Originally listed 19 December 1986, revised 31 Dec 2008

Waterway Name	Navigable length (miles)	Miles under Federally authorized project	Approximate location of the upstream limit of navigation		Remarks
			Latitude	Longitude	
Skokomish River	3	None			Flows into Hood Canal near Union, WA. Navigable 3 miles above mouth to head of tidewater. (*see 13 Jan 86 DF from Engineering Division).
Skykomish River	12	None			At point of confluence with Snoqualmie River forms the Snohomish River near Monroe, WA. Navigable to Sultan, WA., approx. 12 miles above mouth.
Snake River	36	36			From Lewiston, ID - Clarkston, WA, Highway Bridge to the Washington-Oregon state line at Corlin Creek. Also listed under the State of Idaho.
Snake River	140	140			From its confluence with the Columbia to Lewiston, ID - Clarkston, WA, Highway Bridge.
Snohomish River	23	6			Formed by confluence of Skykomish and Snoqualmie near Monroe, WA. Flows into Port Gardner at Everett, WA. Navigable throughout. Mileage shown is from south end of training dike in Everett Harbor.
Snohomish River (Ebey Slough)	11	None			Flows out of Snohomish River near Mile 10 at Everett, WA, into Port Gardner. Mileage shown is from head to I-5 highway bridge near mouth.
Snohomish River (Steamboat Slough)	5	None			Flows out of Snohomish River near Mile 6 at Everett, WA, into Port Gardner. Mileage shown is from head to GN Ry bridge near mouth.
Snohomish River (Union Slough)	4	None			Flows out of Snohomish River near Mile 6 at Everett, WA, into Port Gardner. Mileage shown is from head to GN Ry bridge near mouth.
Snoqualmie River	20	None			At point of confluence with Skykomish River, forms the Snohomish River Monroe, WA. Navigable to Carnation, WA approx. 20 miles above mouth.
Steamboat Slough	2	0.5			Side channel of Columbia River. Mouth at Skamokawa, WA.
Silliguanish River	8	2.5			Flows into Port Susan near Stanwood, WA. Navigable approx. 8 miles above mouth to head of Hat Slough.
Silliguanish River (Hat Slough)	2	None			Flows out of Silliguanish River near Mile 8. Mileage shown is from head to mouth in Port Susan.
Straits of Georgia and Juan de Fuca	124	13			Waters included are those described in Ch. 12, United States Coast Pilot 7, Ninth (1963) Edition. All are navigable to the line of M-HW. Length of main channel is sailing course from Cape Flattery to Bellingham. No project canals are involved in this course except 1.2 miles of Wharrior Creek Waterway of Bellingham. Miles shown under authorized project are the aggregate length of Squallicum and Wharrior Creek; Waterways of Bellingham, Capesante Waterway at Anacortes, and Swinomish Channel. Lengths of authorized small boat harbors at Neah Bay, Port Angeles, Blaine, Bellingham, and Anacortes are not included.

Navigable Waters of the United States in Washington State

Originally listed 19 December 1986, revised 31 Dec 2008

Waterway Name	Navigable length (miles)	Miles under Federally authorized project	Approximate location of the upstream limit of navigation		Remarks
			Latitude	Longitude	
Suittale River	11.5	None			Originally entered 12/19/1986; modified 5/5/2000, revised 2/12/2020
Vancouver Lake	-	-			Tributary to the Sauk River. Navigable to the Boundary Bridge.
Wallacut River	0.5	None			In its entirety. Lake River originates at north end.
Walla Walla River	13	10			Flows into Baker Bay. Mouth 1 mi. NE of Ilwaco, WA.
Washougal River	0.5	None			This is from original mouth before McNary Pool was formed to the State Highway 12 Bridge.
Welcome Slough	1.4	None			Tributary to the Columbia River. Tidal influence for a distance of 0.5 miles from its mouth on Camas Slough (*See Portland Dist public notice dated 1 Aug 1975).
White Salmon River	1	None			Tributary of Columbia River. 2 mi. south of Cathlamet, WA.
Willapa River	7	6			Tributary to Bonneville Pool - Columbia River. Mouth 2 miles downstream from White Salmon, WA.
Willapa River (North Fork)	14	2			Formed by confluence of North and South Forks at Raymond, WA. Flows into Willapa Bay near South Bend, WA. River is navigable throughout
Willapa River (South Fork)	3	2			At confluence with South Fork, forms Willapa River at Raymond, WA. Navigable 14 miles above mouth to Willapa City.
Willapa River (Skidmore Slough)	1	None			At confluence with North Fork, forms Willapa River at Raymond, WA. Navigable to head if tidal influence, estimated at 3 miles above mouth.
Wind River	1	None			Flows into Willapa River near South Bend, WA. Navigable to 2,000' above mouth, but closed to navigation by NP Railway culverts 1,000' above mouth.
Wishkah River	11	None			Tributary to Bonneville Pool - Columbia River. Mouth 4 mi. upstream from Stevenson, WA.
Yakima River	8.4	6			Flows into Chehalis River at Aberdeen, WA. Navigable approx. 11 miles above mouth, to head of tide water at Forks.
					This is from original mouth before McNary Pool was formed to the Van Geisen Street Bridge.

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