R & E Grant Application
13 Biennium

Project #: 13-085

Sullivan Gulch Bottomland Restoration

Project Information

R&E Project Request: $40,000.00
Match Funding: $478,396.00
Total Project: $518,396.00
Start Date: 8/15/2014
End Date: 6/30/2015
Project Email: matt.swanson@currywatersheds.org
Project Biennium: 13 Biennium
Organization: Curry Soil and Water Conservation District

Fiscal Officer

Name: Liesl Coleman
Address: PO Box 666
Gold Beach, OR 97444
Telephone: 541-247-2755 x0
Fax: 541-247-0408
Email: liesl.coleman@currywatersheds.org

Applicant Information

Name: Matt Swanson
Address: P.O. Box 666
94181 4th St
Gold Beach, OR 97444
Telephone: 541-247-2755
Telephone 2: --
Fax: 541-247-0408
Email: matt.swanson@currywatersheds.org

Past Recommended or Completed Projects

Number	Name	Status
05-048	Cury Sm Watershed Spawning Survey	Completed
07-059	Curry Coho Spawning Surveys	Completed
09-061	South Coast Spawning Surveys	Completed
11-126	New River Tributary Fish Passage	Completed
13-027	South Langlois Creek Restoration	Approved

Project Summary

Activity Type: Habitat

Summary: This project will improve fish passage into 260 acres of overwintering habitat in the Sixes River estuary, on Cape Blanco State Park; it will also restore ½ mile of channel, create 11.2 acres of open water, place 80 wood structures, and revegetate 23.7 acres of bottomland. The project was developed by ODFW, USFWS, Curry SWCD, OR State Parks, the Coquille Indian Tribe, and others. A firm specializing in river restoration designed the project, which was funded by State Parks, OWEB, and USFWS. Federal permits have been approved, a cultural survey is complete, and over $400K has been secured for implementation.

Objectives:

(1) To restore juvenile fish passage between the Sixes River and 260 acres of high quality wetland rearing habitat located upstream of the Cape Blanco access road.

(2) To enhance and restore fish and wildlife habitat within a 40 acre project area.

(3) To preserve and stabilize the function and integrity of the 260 acres of upstream wetland habitat.

(4) To minimize project impacts on the McKenzie's livestock operation – the McKenzie Family run sheep and cattle on Cape Blanco State Park through a lease agreement.

This project is NOT part of ODFW's 25 Year Angling Plan.

Fishery Benefits:

The Sixes River is the southernmost watershed in the Oregon Coast ESU. It supports viable, intact wild populations of coho, chinook, steelhead, and coastal cutthroat, which are harvestable through a highly popular freshwater recreational fishery. Fall chinook, in particular, attract anglers and guides from around the State who travel to Curry County to fish the combined Elk River-Sixes River salmon fishery. Over 20 miles of river are accessible by boat and 5 publically owned parcels (BLM, ODFW, ODOT, State Parks) provide 4 miles of bank access. The Sixes River also contributes to a commercial salmon “bubble” fishery located off Cape Blanco that is locally important to the Port Orford fleet.

This project will benefit these salmonid populations by substantially increasing summer and winter rearing habitat. In the Sixes River rearing habitat is the limiting factor to salmon production because the watershed’s geology, coupled with relatively fast tectonic uplift rates, significantly limits the size of the estuary (~ 100 acres) and the extent of low gradient mainstem channel (head of tide is ~ 2 miles). This project will provide unimpaired access to 300 acres of seasonally inundated wetlands that provide ideal overwintering habitat for coho and large scale suckers. Summer estuarine rearing habitat will also increase by approximately 30% when the mouth of the Sixes River sands in and the project area backwaters with brackish water (see attached inundation maps); which will specifically benefit the chinook and coho juveniles that are ‘trapped’ in the estuary until the mouth opens in early winter.

Watershed Benefits:

The 260 acres of wetland located upstream of the Cape Blanco access road include multiple habitat niches that support a wide array of plant, wildlife, and fish species. The southwestern portion of the wetlands are the least disturbed, and include old growth Sitka spruce forests and two rare plant communities– a Hardstem Bulrush Marsh and a Pacific Reedgrass Fen (the only site in Oregon). The open water and seasonally inundated habitat is extensively used by migratory waterfowl, red-legged frogs, potentially western pond turtles, beaver, and native salmonids, suckers, and other fish. The area is also critical habitat for neo-tropical birds, which rely on these wetlands for shelter and food during their migrations, and the area provides refuge for a large elk herd, raptors, etc. Through this project the hydrologic conditions that produce these wetlands will be permanently safeguarded when the Sullivan Gulch ditch system downstream of the road is decommissioned and replaced with a designed stream channel.

Within the 40 acre project area 1,000 ft of the Sullivan Gulch ditch channel will be decommissioned and replaced with 2,650 ft of unconfined stream channel. The new channel will include an engineered drop-pool structure that functions to step the stream up from the existing Sullivan Gulch channel onto the contemporary Sixes River bottomlands where the new stream channel will be constructed. This drop-pool structure will provide fish passage, which is currently impeded by a series of beaver dams that are artificially “inset” within the ditch channel, and the drop-pool structure will also provide hydrologic grade control on the wetlands located upstream of the Cape Blanco access road. In addition to the new channel, 11.2 acres of backwater habitat will be created (four separate areas) for rearing and waterfowl, 80 large wood structures will be installed to increase habitat complexity, and 23.7 acres of riparian and wetland habitat will be revegetated with native species.

The project activities will dramatically increase rearing habitat in the Sixes River estuary by ensuring juvenile fish can migrate upstream into the wetlands located above the Cape Blanco access road, and by creating 12-15 acres of high quality habitat between the river and the road. Over time the planted vegetation will shade the water bodies, add cover and complexity, and increase and diversify the food web.

Current Situation:

The Sullivan Gulch bottomlands were drained in the late 19th century to convert the wetlands into pasture and cropland. In the early 1960's this area was sold to the Oregon Department of Parks and Recreation (OPRD), with a stipulation that a portion of the Park would remain in livestock production. To honor this commitment OPRD entered into a lease agreement with the McKenzie Family, which included the pastures in the Sullivan Gulch bottomlands. To preserve the integrity of those pastures the ditches dug in the 19th century were actively maintained by the McKenzie's through the late 1980's, at which point the family decided to forego the wetter ground on the south side of the Cape Blanco access road. As beaver recolonized the bottomlands in the 1990's they constructed dams across most of the ditches, which effectively restored the historic hydrology on the south side of the road. Over the last decade the wetlands have rehydrated and the pasture vegetation has begun to convert back to wetland forbes and native brush species.

Downstream of the Cape Blanco access road the two dominant ditches converge into a single, deeply incised stream channel called Sullivan Gulch. This channel, which was dug to a depth 10-15 feet below the adjacent topography, continues to dewater the adjacent wetland habitat, and beaver dams constructed in the channel often act as barriers to the upstream migration of juvenile fish because the impounded water cannot flow around the dams (as would typically occur in a natural stream channel that is unconfined). The dams also pose a significant risk to the upstream wetlands because, although they appear to be resilient, they are temporary structures that can and do washout, which results in a rapid and extensive dewatering of the upstream habitat.

Alternatives: Three sets of alternatives were considered during the development of the project plan and project design.

The first alternatives considered whether to modify the existing ditch channel or construct a new stream channel alignment. The decision was made to construct a new alignment because it would significantly increase the length of stream habitat; facilitate restoration and the construction of backwater areas; and require a smaller, cheaper fish passage-grade control structure.

The second alternatives considered whether to construct a new channel alignment without the use of grade control (i.e. built a channel with a stable slope profile). Feedback from the design firm suggested that to do so would be cost prohibitive because of the volume of excavation required to construct the required channel length, inset terraces, and the desired backwater habitat; and the channel would negatively impact the existing habitat features by lowering the bed elevation.

The third alternatives analysis compared two channel alignments with grade control. Alternative 1 is the existing project design. Alternative 2 proposed routing both the Sullivan Gulch channel and the tributary channel through a single alignment that ran along the western edge of the project's interior pasture. Alternative 1 was selected because the combined channel lengths from the primary and tributary stream channels added a significant quantity of instream habitat, and because the alignment of the primary channel utilized an existing oxbow feature and better facilitated the development of backwater habitat. (see page 1 of the design report for additional details).

Designer: Graham Matthews and Associates (GMA) and their subcontractor, Northern Hydrology and Engineering (NHE), designed the project(see attached list of qualifications). The Curry SWCD's Project Manager developed the revegetation plan.

Methods: Project construction will be awarded to a licensed construction company through a competitive bid process that takes into account price, past experience, references, availability, and equipment rates. The project bid will include the construction of the backwater areas, the fish passage - grade control structure, bridge installations, and construction of the stream channels (according to the design's standard cross-sectional profiles). Additional work, including the instream wood placements and the construction of "micro-habitat with the stream channels, will be done on a time and materials basis. The removal and reconstruction of the livestock fences will be done by the McKenzie Family.

Track driven excavators will be used to dig the backwater areas and stream channels, construct the fish passage-grade control structure, set the bridges, and build the large wood structures. Off-road and track driven dumptrucks will be used to move the excavated material to the spoils sites, which are located on-site, and bulldozers will be used to spread the spoils. The decommissioned Sullivan Gulch ditch channel will be filled with project spoils, which will be compacted to prevent erosion and possible stream recapture. The wood structures will be built using a combination of logs with and without rootwads; the logs will be partially buried into the streambanks to counter the buoyancy of the wood, and smaller diameter logs will be used to pin the structures in place.

Inspector: The Curry SWCD's Project Manager will oversee all construction activities and the revegetation component. GMA/NHE will inspect the project at 15%, 30%, and 60% completion. OPRD will monitor for cultural material.

Funding Elements: R&E funds will be used to purchase whole trees and logs for instream placement, for heavy equipment used to construct the wood placements, and for grant management and administration.

Partners: Yes

ODFW: The local Assistant and District Fish Biologists were key stakeholders during the project development process; they've assisted with pre-implementation smolt monitoring; in the design of a fish salvage plan; and they've reviewed the project designs. During implementation ODFW will oversee fish salvage operations and provide additional oversight.

OR Parks and Recreation Department: The local Natural Resource Specialist and Park Manager were key stakeholders in the development process; they provided $25,000 toward the project design; they have secured $60,000 through the North

American Wetland Conservation Act grant program (for implementation); and they have assisted in the design process. State Parks is the landowner, and they will provide cultural monitoring and additional oversight during project construction.

USFWS: The Coastal Program Manager was a key stakeholder in the project development process; provided $20,000 toward the project design; secured Federal permit approval using their programmatic Biological Opinion; and she's been involved in review of the project designs. During implementation USFWS will provide additional oversight.

Coquille Indian Tribe: The Tribe's archeologist and Cultural Program Manager were key stakeholders during the development process, and they conducted a cultural resource survey that cleared the way for construction.

McKenzie Family: The McKenzie’s were key stakeholders in the development process and they've reviewed the project designs. During implementation the McKenzie’s will remove the existing livestock fencing from the project area, move their livestock off-site during construction, and reconstruct the new fences.

Oregon Watershed Enhancement Board (OWEB): An OWEB technical assistance grant paid for the project scoping and development process, pre-implementation data collection, and for approximately 50% of the design costs. OWEB will contribute $337,945 toward project construction and revegetation.

Wild Rivers Coast Alliance (WRCA): WRCA is a philanthropic organization on the southern Oregon coast. They contributed funds for finalizing the project design and apprx. $5,000 toward project implementation.

South Coast Watershed Council: The Council assisted with the project development, and they will provide $20,000 in BLM RAC funding toward project implementation.

Existing Plan: Yes

All elements of the project are prioritized in the Sixes River Watershed Assessment and Action Plan (South Coast Watershed Council, 2002), as well as in OWEB's South Coast Regional Restoration Priorities document (2006). OPRD is also in the process of drafting a Cape Blanco Natural Resource Management Plan which will outline their management objectives and priorities for Cape Blanco State Park. Restoration and preservation of the Sullivan Gulch wetlands is a high priority for the Park, and this project will implement many of their objectives for the site.

Affected Contacted: Yes

Affected Supportive: Yes

Affected Comments: Through the stakeholder process all affected parties were invited to the table at the beginning of the scoping/development phase. The Coquille Indian Tribe helped to shape the project area and scope, and they completed the cultural resources survey. They were strongly in favor of building a channel that used grade control to step the stream up onto the contemporary Sixes River bottomlands, and they requested that culturally important plant species, such as camas and cattail, be included in the site revegetation. The Kalmiopsis Audobon Society were briefed on the project, and were generally supportive. The McKenzie Family, ODFW, and State Parks initiated the project, and have been very supportive of the development and design process. The McKenzie's requested that the project be developed to utilize the poor quality pasture for conservation/restoration while retaining the high quality pasture in livestock production. Federal and State regulatory staff visited the project site during the scoping/development phase to provide input in advance of the project design, and they've reviewed the project design at different phases of completion.

Project Schedule/Participants/Funding

Activity	Date	Participants
Finalize project design (currently at 90% complete)	6/1/2014	Curry SWCD/Design Firm
Contract for project construction	6/15/2014	Curry SWCD/Design Firm
Construct backwater areas, stream channels, and fish passage.	7/15/2014	Contractor/Curry SWCD
Install instream wood structures.	8/15/2014	Contractor/Curry SWCD
Fence livestock from project area.	9/5/2014	McKenzie/Curry SWCD
Plant 23.7 acres of bottomland with native plants, shrubs, and trees.	1/15/2015	Curry SWCD
Maintain and interplant (as needed) shrubs and trees for 3-5 years.	5/15/2015	Curry SWCD
Monitor smolt outmigration for two seasons.	3/15/2015	ODFW/Curry SWCD
Monitor migratory bird populations for two years.	4/1/2015	State Parks

Affected Species:

Chinook Salmon
Coastal Cutthroat
Coho Salmon

Large Scale Suckers
Pacific Lamprey
Steelhead

Project Permits

Name	Issued By	Secured?	Date Secured	Date Expected
Federal Biological Opinion	US Fish and Wildlife	Yes	3/15/2014	1/1/0001
Fill and Removal	US Army Corps of Engineers	Yes	3/15/2014	1/1/0001
Fill and Removal	OR Division of State Lands	No	1/1/0001	6/1/2014

Project Monitoring

Organization	Address	Activity	Frequency
Curry Soil and Water Conservation District	PO Box 666 Gold Beach, OR 97444	Plant/Tree survival and maintenance needs	Spring and fall for three to five years
ODFW	29907 Airport Way Gold Beach, OR 97444	Smolt outmigration from project area	Two or more years
OR Dept. of Parks and Recreation	89814 Cape Arago Hwy Coos Bay, OR 97420	Bird/waterfowl surveys - specifically for migratory species	Spring/fall migration for two or more years

Project Maintenance

Organization	Address	Activity	Frequency
Curry Soil and Water Conservation District	PO Box 666 Gold Beach, OR 97444	Plant/Tree watering	Average 6 times per season for 3-5 years
Curry Soil and Water Conservation District	PO Box 666 Gold Beach, OR 97444	Plant/tree release from competing vegetation	Twice per season for 3-5 years
Curry Soil and Water Conservation District	PO Box 666 Gold Beach, OR 97444	Plant/Tree interplanting	As needed over a three year period to reach full stocking density

Project Match Funding

Funding Source	Cash	In-Kind	Other	Description	Total	Secured?	Conditions?	Comments
R&E Request	$40,000.00	$0.00	$0.00		$40,000.00	No	No	Large wood placements
OWEB	$337,945.00	$0.00	$0.00		$337,945.00	Yes	No	Project implementati on
NAWCA (USFWS)	$60,000.00	$0.00	$0.00		$60,000.00	Yes	No	Backwater areas
WRCA (private)	$10,000.00	$0.00	$0.00		$10,000.00	Yes	No	Project implementati on
BLM (RAC grant)	$20,000.00	$0.00	$0.00		$20,000.00	Yes	No	Large wood placements
USFWS	$20,000.00	$800.00	$0.00		$20,800.00	Yes	No	Project implementati on
McKenzie Family	$0.00	$700.00	$0.00		$700.00	Yes	No	Livestock management
OPRD	$12,500.00	$4,000.00	$0.00		$16,500.00	Yes	No	Project implementati on
ODFW (GB District)	$0.00	$2,500.00	$0.00		$2,500.00	Yes	No	Fish salvage
Curry SWCD	$0.00	$5,000.00	$5,000.00	Materials and equipment for revegetation	$10,000.00	Yes	No	Technical assistance
				Total Match Funding:	$518,445.00			

Project Budget

Item	Item Type	Units	Unit Cost	R&E Funds	Match Funds	Total
Construction (channels, bridges, backwater areas)	Contracted Services	950	$132.80	$0.00	$126,160.00	$126,160.00
Fencing (removal/reconstruction)	Contracted Services	10000	$1.98	$0.00	$19,800.00	$19,800.00
Fiscal Administration (Curry SWCD)	Contracted Services	1	$19,688.00	$1,012.00	$18,676.00	$19,688.00
Log Placement (80K lb Excavator)	Contracted Services	130	$170.00	$19,000.00	$3,100.00	$22,100.00
Machines for Reveg (auger, pump, trimmer)	Equipment	3	$620.00	$0.00	$1,860.00	$1,860.00
Curry SWCD Project Manager	Personnel	530	$38.00	$988.00	$19,152.00	$20,140.00
Curry SWCD Staff	Personnel	2710	$26.00	$0.00	$70,460.00	$70,460.00
Engineering/Legal Services	Personnel	100	$126.25	$0.00	$12,625.00	$12,625.00
Project Partners Staff	Personnel	200	$40.00	$0.00	$8,000.00	$8,000.00
Bridge (livestock/ranch management)	Supplies/Materials /Services	2	$19,725.00	$0.00	$39,450.00	$39,450.00
Fencing (woven with barb top/offset electric)	Supplies/Materials /Services	10000	$1.77	$0.00	$17,723.00	$17,700.00
Kiosk (to inform Park visitors)	Supplies/Materials /Services	1	$600.00	$0.00	$600.00	$600.00
Pin Logs (to hold wood structures in place)	Supplies/Materials /Services	24	$540.00	$0.00	$12,960.00	$12,960.00
Revegetation (seedlings/stakes/ fuel/plugs/etc.)	Supplies/Materials /Services	25	$836.56	$0.00	$20,914.00	$20,914.00
Rock (crushed, streambed, rip rap, etc.)	Supplies/Materials /Services	3328	$22.50	$0.00	$74,880.00	$74,880.00
Whole Trees w/Rootwads (delivered to site)	Supplies/Materials /Services	120	$350.00	$19,000.00	$23,000.00	$42,000.00
Engineering Firm Per Diem	Travel	5	$180.00	$0.00	$900.00	$900.00
Mileage Reimbursement	Travel	14400	$0.57	$0.00	$8,136.00	$8,208.00
					Total Budget:	$518,445.00

Project Map

Additional Files

Click a link to view that particular file.

Budget

GMA qualifications

Letter of Support

Project design

Project design

Project design

Project design

Project design

Project design

Project design

Signature Authorization Page

I hereby make an application for financial assistance under the terms and conditions of the R&E Program as described in my project application.

I understand that if my project is approved for funding, the following will apply:

- All project sponsors must sign a grant agreement containing the terms and conditions on which funding will be released.
- Project expenses which occur before the grant agreement is signed or after the expiration date will not be paid by the R&E Program.
- Copies of all necessary permits must be submitted to the R&E Program.
- Project sponsors must certify compliance with local, state, and federal regulations and laws.
- Landowner, monitoring and maintenance agreements must be submitted to the R&E Program.
- Regular progress reports may be required, and at the end of each project a Completion Report must be submitted.
- Educational products resulting from projects are public domain.
- All information submitted to either party under this application is subject to the federal Freedom of Information Act.

Project Title: Sullivan Gulch Bottomland Restoration

Applicant: Curry Soil and Water Conservation District

Date: April 3, 2014

Fiscal Officer: Liesl Coleman

Erin Minster for Liesl Coleman EM

Signature: [redacted]

Date: 4/4/2014

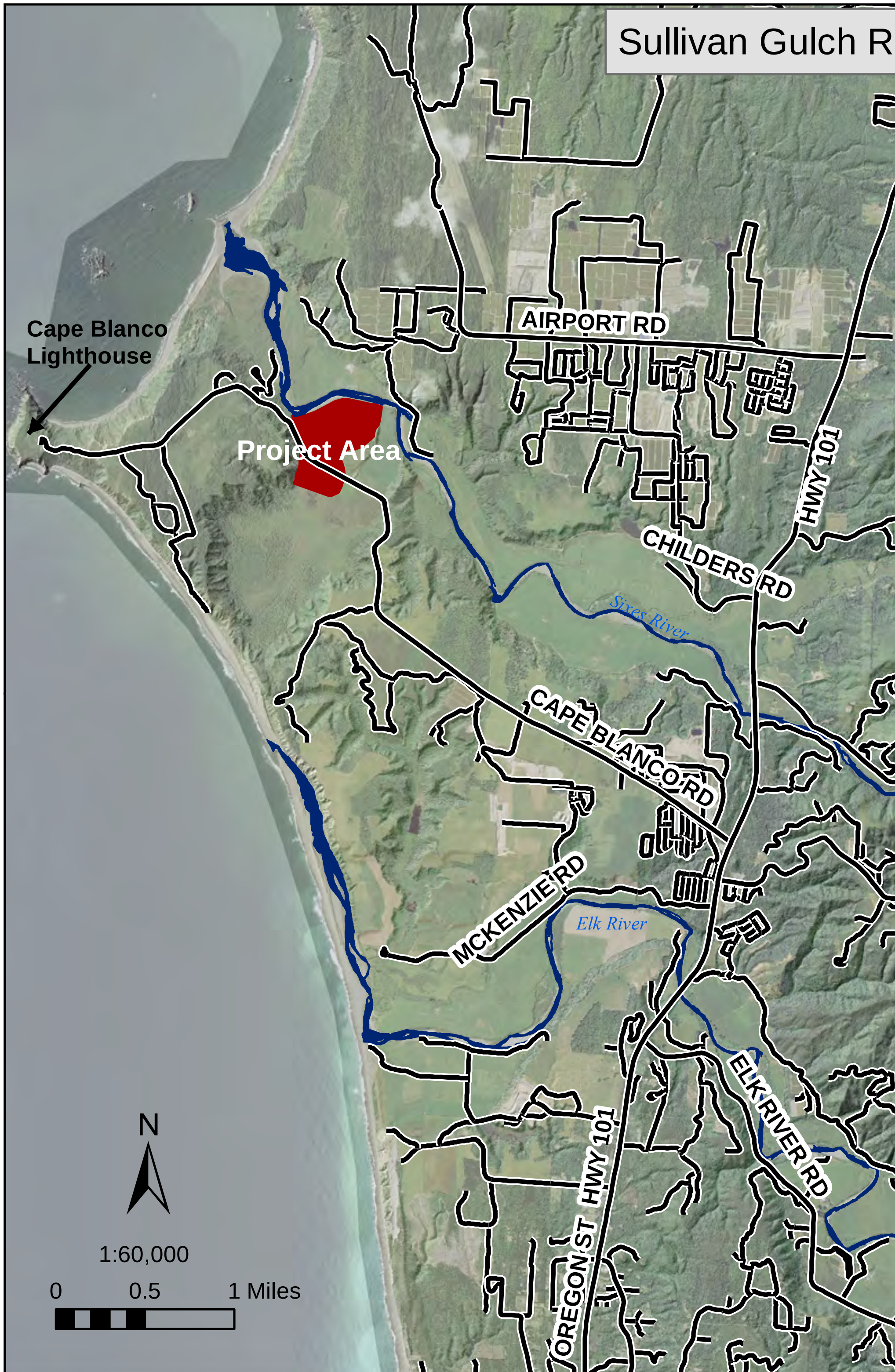
SULLIVAN GULCH BOTTOMLAND RESTORATION BUDGET

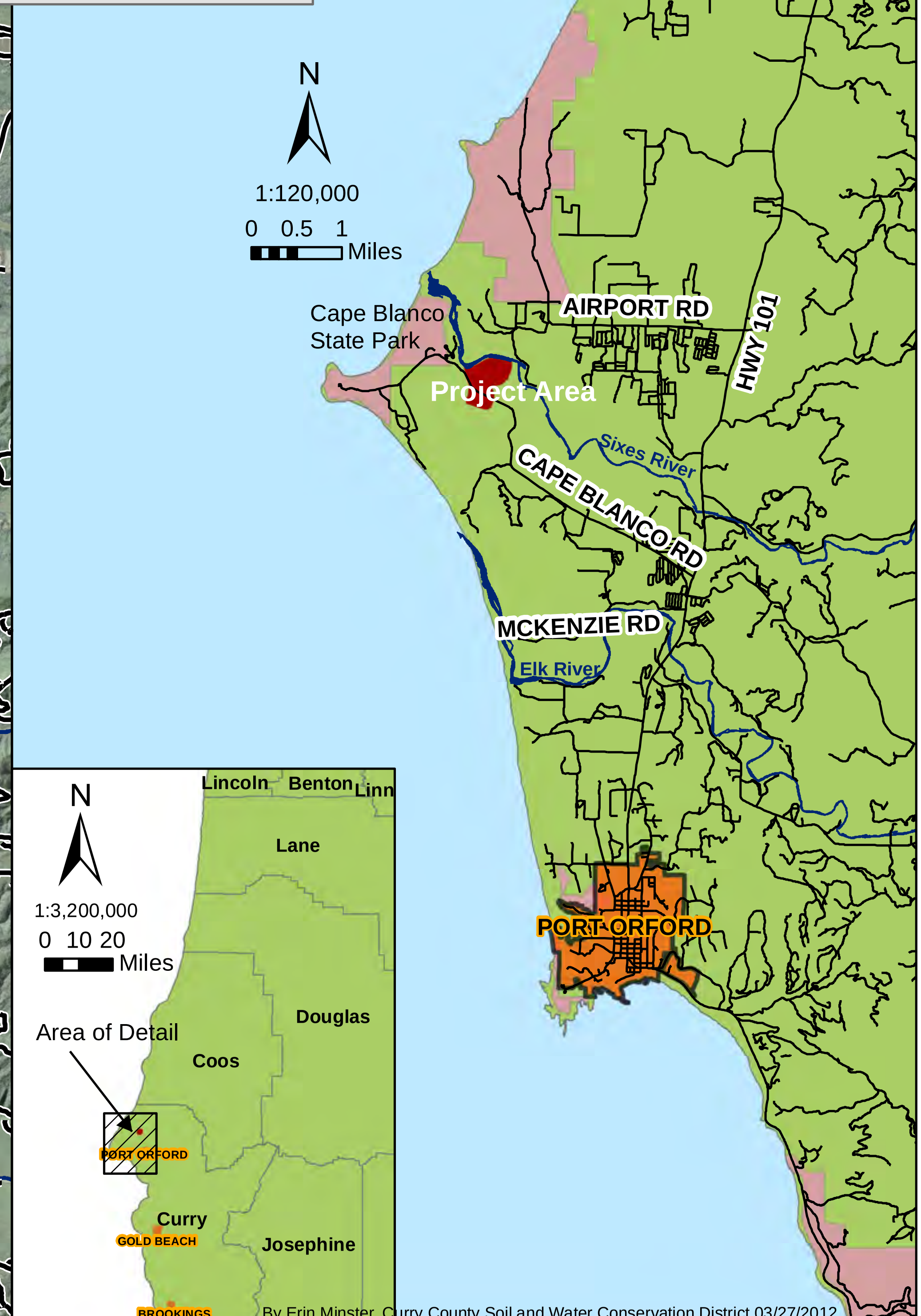
Item - Personnel	Item Description	R&E	Other	Total
GMA/NHE - Engineer/Hydrologist	92 hrs @ $125/hr	0	11500	11500
GMA/NHE - Survey/CAD Tech.	8 hrs @ $75/hr	0	600	600
Curry SWCD Project Manager	510 hrs @ $38/hr	988	19152	20140
Curry SWCD IT Specialist/Inspector	305 hrs @ $32/hr	0	9760	9760
OPRD Natural Resource Specialist	100 hrs @ $40/hr	0	4000	4000
ODFW Fish Biologist	25 hrs @ $40/hr	0	1000	1000
ODFW Fisheries Technician	60 hrs @ $25/hr	0	1500	1500
USFWS Program Manager	20 hrs @ $40/hr	0	800	800
Curry SWCD Biological Technician	60 hrs @ $27/hr	0	1620	1620
Pasture Lease Holder (McKenzie)	20 hrs @ $35/hr	0	700	700
Legal Services	3 hrs @ $175/hr	0	525	525
Curry SWCD Erosion Control Tech.	20 hrs @ $24/hr	0	480	480
Curry SWCD Veg. Mngmnt Coord.	90 hrs @ $32/hr	0	2880	2880
Curry SWCD Veg. Mngmnt Foreman	440 hrs @ $28/hr	0	12320	12320
Curry SWCD Veg. Mngmnt Tech.s	1650 hrs @ $24/hr	0	39600	39600
Curry SWCD Monitoring Coord.	100 hrs @ $38/hr	0	3800	3800
	SUBTOTAL	**988**	**110237**	**111225**

Item - Supplies/Services	Item Description	R&E	Other	Total
Coarse Aggregate	2962 yds @ $22/yd	0	65164	65164
Streambed Aggregate	338 yds @ $22/yd	0	7436	7436
Crushed Aggregate	60 yds @ $18/yd	0	1080	1080
Pit Run Aggregate	100 yds @ $12/yd	0	1200	1200
Geo-textile Fabric	1 roll @ $250/roll	0	250	250
Bridge Abutments	12 blocks @ $100/block	0	1200	1200
Railcar Bridge (89 ft)	1 bridge @ $30000/ea	0	30000	30000
Concrete Bridge (48 ft)	1 bridge @ $8000/each	0	8000	8000
Whole Trees with Rootwads (incl. logging and trucking)	120 trees @ $350/tree	19000	23000	42000
Pin Logs	24 mbf @ $540/mbf	0	12960	12960
Erosion Control Materials	LS @ $1000	0	1000	1000
Treated Wooden Fence Posts	900 posts @ $8/ea	0	7200	7200
Galvanized Class III 36" Woven Wire	30 rolls @ $250/roll	0	7500	7500
Galvanized High Tensile Barbwire	8 rolls @ $120/roll	0	960	960
Galvanized High Tensile Smoothwire	3 rolls 2 $150/roll	0	450	450
Off-set Insulators for Electric Fence	850 insulators @ $1.25/ea	0	1063	1063
Solar Fence Charger	1 charger @ $300/ea	0	300	300
Misc. Hardware: stables, spikes, etc.	LS @ $250	0	250	250
Fiberglass Rods to Mark Plantings	9550 rods @ $0.6/ea	0	5730	5730
Bareroot Conifers	3550 stems @ $.0.48/ea	0	1704	1704
Bareroot Hardwoods & Shrubs	5625 stems @ $0.55/ea	0	3094	3094
Potted Shrubs/Ferns	850 stems @ $2.25/ea	0	1913	1913
Wetland Plugs/Tubers/Bulbs	2900 plugs @ $0.32/ea	0	928	928
Wetland Seed	24 pounds @ $25/lb	0	600	600
Herbicide (Aquamaster + surfactant)	3 gallon @ $100/ga	0	300	300
RTV Rental (transport materials)	160 hrs @ $15/hr	0	2400	2400
Fuel, flagging, other misc supplies	LS @ $550	0	550	550

Auger Replacement Bits	2 bits @ $60/ea	0	120	120
Woven Wire Tree Cages (1000)	10 rolls @ $250/ea	0	2500	2500
Hoses for watering	3 hoses @ $25/ea	0	75	75
County Landuse Approval Form	1 form @ $100ea	0	100	100
Project Kiosk (to inform State Park visitors about the project)	1 Kiosk @ $600/ea	0	600	600
	SUBTOTAL	**19000**	**189627**	**208627**
Item - Travel	**Item Description**	**R&E**	**Other**	**Total**
Mileage at State Rate (80 mi round trip to site)	14,400 miles @ $0.565/mi	0	8136	8136
GMA/NHE Per Diem	5 days @ $180/day	0	900	900
	SUBTOTAL	**0**	**9036**	**9036**
Item - Equipment	**Item Description**	**R&E**	**Other**	**Total**
Gas Powered Auger for Tree Planting	1 auger @ $900/ea	0	900	900
Pump for watering trees and shrubs	1 pump @ $520/ea	0	520	520
Weedeater for releasing trees and shrubs	1 weedeater @ $440/ea	0	440	440
	SUBTOTAL	**0**	**1860**	**1860**
Item - Contracts	**Item Description**	**R&E**	**Other**	**Total**
Construction - 80K lb Excavator	360 hrs @ $170/hr	19000	42200	61200
Construction - 35K lb Excavator	80 hrs @ $155/hr	0	12400	12400
Construction - Off Road Dumptruck	480 hrs @ $110/hr	0	52800	52800
Construction - Track Dumptruck	60 hrs @ $125/hr	0	7500	7500
Construction - D8 Bulldozer	30 hrs @ $165/hr	0	4950	4950
Construction - D5 Bulldozer	30 hrs @ $140/hr	0	4200	4200
Construction - Compactor	12 hrs @ $80/hr	0	960	960
Construction - Labor	50 hrs @ $45/hr	0	2250	2250
Construction - Equipment Mobilization	LS @ $2000	0	2000	2000
Fencing - Remove Existing Fences	40 hrs @ $45/hr	0	1800	1800
Fencing - Construct New Fences	10,000 ft @ $1.8/ft	0	18000	18000
Fiscal Administration - Curry SWCD	3.9 % of Project Cost	1012	18625	19637
	SUBTOTAL	**20012**	**167685**	**187697**
	TOTAL	**40000**	**478445**	**518445**

Sullivan Gulch Restoration Project





By Erin Minster, Curry County Soil and Water Conservation District 03/27/2012

Sullivan Gulch Bottomland Restoration – R & E Proposal

Memo to File: ODFW Fish Passage Review of Project Design

April 8, 2014

The Sullivan Gulch Bottomland Restoration project design was submitted to the Restoration Review Team (RRT) for evaluation and approval when the design was at 25% and 60% completion. The RRT is a group of State and Federal resource specialists that, as I understand it, formed to review and permit complex watershed restoration projects; members include Janine Castro – USFWS/NOAA Geomorphologist; Aaron Beavers – NOAA Fish Passage Engineer; and Greg Apke – ODFW Fish Passage Coordinator. Following their review of the 25% design the RRT provided feedback specific to the fish passage – grade control structure. Graham Matthews and Associates (GMA) and Northern Hydrology and Engineering (NHE) revised the fish passage design to account for the RRT's recommendations. Those changes were resubmitted in the 60% design, which was approved by the RRT, and subsequently by NOAA Fisheries and the Army Corps of Engineers.

State approval is pending the submission of a fill/removal permit application to the Oregon Division of State Lands (DSL). That application, which is currently being drafted, will include ODFW's Fish Passage form. It is my understanding that ODFW's official approval will occur when that form is signed by Greg Apke. Since Greg has already reviewed the project as a member of the RRT (which approved the design), we anticipate that he will approve the project as designed.

For questions please contact:

Matt Swanson
Curry SWCD
Project Manager

Oregon
John A. Kitzhaber, M.D., Governor

Department of Fish and Wildlife
Gold Beach District Office
29907 Airport Way
PO Box 642
Gold Beach, OR 97444
(541) 247-7605
FAX (541) 247-2321

April 2, 2014

Matt Swanson
Curry Soil and Water Conservation District
Curry Watersheds Partnership
PO Box 642
Gold Beach, OR 97444

Re: Sullivan Gulch Bottomland Restoration

To Whom It May Concern:

The Oregon Department of Fish And Wildlife (ODFW) has reviewed your R&E application and is in full support. ODFW and Oregon State Parks and Recreation (OPRD) have been working with Mr. Swanson and other partners to develop a restoration plan for Sullivan Gulch bottomlands. ODFW feels the addition of large woody material is important to completing the project.

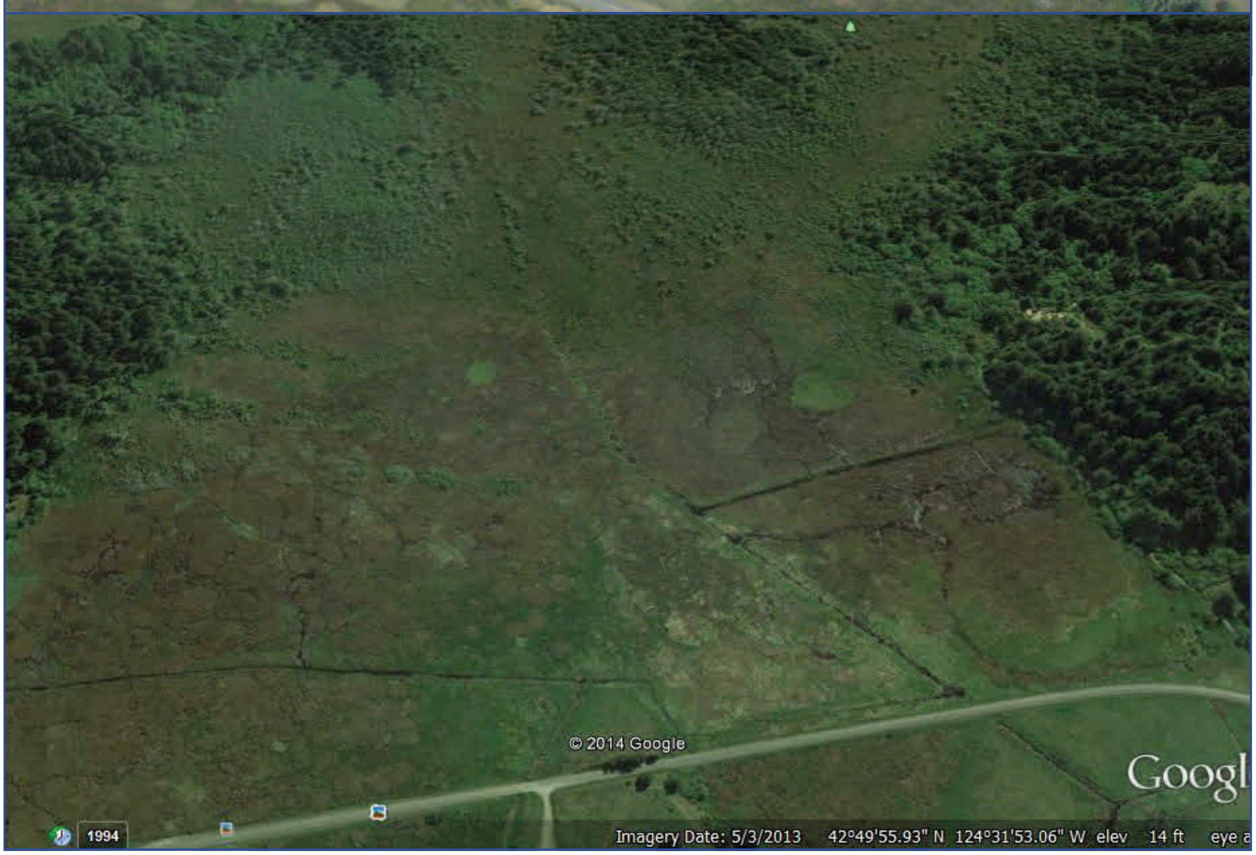
The Sullivan Gulch Bottomland Restoration project will provide over wintering habitat for listed coastal Coho a threatened species, fall chinook, coastal cutthroat, and large scale suckers. The proximity of the project to Sixes Estuary, public outreach, and partnerships, ODFW confident this project will be successful in achieving the goals outlined in the project proposal.

Sincerely,

[redacted]

Steven Mazur
Assistant District Fish Biologist

Sullivan Gulch Bottomland Restoration: The top photo is looking north at the project area (the Sixes River is in the background). The dominant ditch channel in the photo is Sullivan Gulch — most of this channel will be decommissioned and a new stream channel will be routed through the oxbow and existing depressions. The bottom photo is looking south at the wetlands located upstream of the Cape Blanco access road, which are inundated throughout the wet season. The ditches that are visible were dug in the late 19th century to convert the area to pasture, but since beaver recolonized the bottomlands in the 1990's the wetlands have rehydrated and are reverting back toward their natural state. Through this project the hydrology upstream of the road will be stabilized to prevent rapid dewatering, and access for juvenile fish will be improved.



Sullivan Gulch Bottomland Restoration: The top photo is looking at a remnant oxbow riverine feature within the project area. The new Sullivan Gulch stream channel will be routed through this feature to increase summer and rearing habitat. The bottom photo is looking at a ditched wetland within the project area that will be converted into a backwater area with open water habitat similar to the oxbow in the top photo.

Sullivan Gulch Bottomland Restoration: Both photos show portions of the project area during high flow winter conditions when the Sixes River backwaters Sullivan Gulch. In the top photo the backwatered area includes a natural segment of the Sullivan Gulch channel and on old riverine feature. Through this project wood structures will be added to this area to increase habitat complexity, and livestock will be fenced out of the wetted features. The bottom photo shows the confluence of the existing Sullivan Gulch channel and a remnant stream channel which will be incorporated into the new Sullivan Gulch alignment.

DRAFT
Sullivan Gulch Restoration Project
90% Design Report

Prepared for:
Curry Soil and Water Conservation District
P.O. Box 666
Gold Beach, OR 97444

Prepared by:
Graham Matthews & Associates
Graham Matthews, MS
P.O. Box 1516
Weaverville, CA 96093

Northern Hydrology & Engineering
Jeffrey K. Anderson, MS, PE (64540PE)
P.O. Box 2515
McKinleyville, CA 95519

FEI Testing & Inspection, Inc.
William A. Smith, MS, PE, GE
62979 NE Plateau Dr., #3
Bend, OR 97701

11 October 2013

Introduction

The Curry Soil and Water Conservation District (Curry SWCD) along with Oregon State Parks and various other state and federal agencies plan to realign and enhance approximately 1,700 feet (ft) of the Sullivan Gulch channel below Cape Blanco Road (Project). Sullivan Gulch is located in the Curry County, approximately 2.7 miles east by northeast of Sixes, Oregon on Cape Blanco Road. The project area is located in Cape Blanco State Park and encompasses approximately 130 acres.

The primary objectives of the channel realignment are to: (1) design a new channel that provides access for all life stages of salmonids between the Sixes River and the wetlands located upstream of Cape Blanco Road, (2) create and enhance complex, instream habitat, with a focus on structures and features that salmonids will utilize, (3) maintain existing pasture land downstream of Cape Blanco Road, (4) maintain the existing wetland upstream of Cape Blanco Rd, and (5) develop a design that could accommodate the replacement of the existing culverts under Cape Blanco Rd with low maintenance fish passable structure(s).

In addition to the primary objectives, several secondary objectives were identified including: (a) establishing native plant communities along the new channel alignment, (b) reducing the distribution of reed canary grass, (c) preventing the spread of invasive species, (d) maintaining and enhancing waterfowl habitat, and (e) assessing how the current hydrologic environment upstream of Cape Blanco Road is affecting several unique plant communities, fisheries habitat, and historic channel morphology.

Currently, fish passage in Sullivan Gulch is negatively affected by a series of beaver dams several hundred feet downstream of Cape Blanco Road. This project proposes to design a functioning stream channel that improves fish passage and achieves other project objectives.

Conceptual Design

Two conceptual alternatives were developed in August 2012 that primarily differed based on whether a historic oxbow feature is used as part of the design channel alignment. A second difference is whether the western culvert is directed into a new channel or combined with the eastern culvert, which has most of the flow draining the wetland complex upstream of Cape Blanco Road. Directing the design channel through the oxbow adds significant channel length and associated habitat to the project. Both alternatives use the first 700 ft of the existing channel upstream from the confluence with the Sixes and use a roughened channel or drop structure element to transition down to the existing channel elevation. Both alternatives filled the same amount of the existing incised channel. After a field meeting with Curry SWCD, Oregon State Parks, and Oregon Department of Fish & Wildlife, the alternative involving channel relocation through the oxbow was selected for further analysis and design.

Field Surveys and Project Topographic Surface

The conceptual design was developed without field checking grades of crucial infrastructure as that information was not available until after our field surveys conducted. Field surveys of the project site were conducted in August 2012 and March 2013. The new survey data also provide details of the wetted portions of the existing channel and oxbow including the effects of the multiple beaver dams, as well as defining problems that the LiDAR had with areas of dense vegetation (mostly sedges).

Once the new topography was available, we developed breaklines along channel tops, toes, and thalweg and other features. We compared our survey data with the LiDAR surface in various types of vegetation communities and found significant differences, often the LiDAR was 1-2 ft high, and in some cases, as much as 4 ft off. We adjusted the LiDAR within various vegetation polygons to match our survey data, as best we could. Finally, we developed a new surface in ArcGIS that integrates our surveys and the corrected LiDAR.

Once the revised topography was finalized, we adjusted the alignments of the existing channel and the conceptual design and developed new profiles that better fit the new surface and existing channel thalweg. The conceptual design alignment was also modified to reflect the consensus at our field walk and review of the conceptual design, to relocate the design channel into a swale to the south and east of the original concept.

Soils Investigation

Our field investigation was conducted on September 6, 2012. Field observations and sampling was conducted in 14 small test pit excavations along the proposed channel alignment. At that time, the area was mostly in use as pasture, and covered with a dense growth of grass. Field soil classification was performed at varying elevations in the test pits, and visual-manual soil classifications were recorded using the Unified Classification System (ASTM D-2488). Representative bulk samples were collected from the trench spoils and returned to our laboratory for additional testing and observations. Laboratory testing consisted of moisture content, grain size analysis, and plasticity index. (ASTM D-117/136 and D4318). The purpose of these tests was to confirm and refine the field classifications, and establish certain engineering and construction properties of the soil.

The area of interest has been mapped by the Natural Resources Conservation Service (NRCS). The predominant soil series mapped are 164A-Langlois silty clay loam, 0 to 3 percent slopes, and 128A-Gleneden silty clay loam, 0 to 3 percent slopes. Except for the sporadic inclusions of granular soils and some variation from typical profile depths, our test pits are in agreement with the NRCS classifications. Overall, the soil is slightly less clayey as test pits trend towards the existing channel on the west side of the site.

During the field investigation the test pits were examined for signs of seasonal high groundwater levels, and for current saturated conditions. Seasonal high groundwater was evidenced by oxidation reduction mottling, and was present within one foot of the ground surface throughout the investigated portions of the site. Current saturated conditions were determined by active seepage at the pit face for granular soils, and by dilatant or plastic reaction of fined grained soils. Note that saturated conditions can exist well above the phreatic surface or open water table in fine grained soils due to capillary rise, especially in silty soils, such as found on this site.

The results of the field investigation indicate that groundwater levels are likely to exist near the ground surface for some portion of the year, then recede to levels approximately as encountered. The soils intersecting the proposed channel alignment are of generally low permeability. Where coarse high permeability soils exist, such as gravelly sand, they are well below the proposed stream bed elevation. The less coarse, but still granular silty sand layers appear to be discontinuous at and above the proposed stream bed elevation. On this basis it is unlikely that rapid, or even significantly premature dewatering of the soils in surrounding areas will occur.

Analysis of Existing Channel

The following bullets provide a summary of key information that can be found in Figure 1:

1) The design channel tie-in to the existing is at elevation 3.5 to 4 ft, depending on location.
2) Invert of primary culvert outlet = 7.5 ft (constraint).
3) Existing channel Length = 1,950 ft.
4) Existing channel drop = 4.5 ft (7.5-3, assuming channel enters Sixes at about 3 ft).
5) Existing channel slope = 0.0023.
6) No head cut. Channel conforms to culvert invert well. Slight scour hole at outlet.
7) Beaver dams backwater channel and culvert. Upper beaver dam at 11.5 ft. Next downstream beaver dam at 11 ft. Lowest dam at 6 ft (which is only 1.5 feet below the invert of the culvert).

The three beaver dams completely control the water surface elevations in the existing channel. When the August 2012 survey was conducted, there was essentially zero flow and the water surface dropped 0.7 ft over Dam #1, 3.9 ft over Dam #2, and 0.7 ft over Dam #3. The Sixes was not bar bound when the survey was conducted or when the soil pits were excavated, but became bar bound later in September. This backwater completely inundated the lower channel up to Dam #2, and the water surface on either side of the dam was the same. Dam #3 completely controlled water levels in the oxbow at the time of the survey and substantially backwaters the culvert by almost 4 ft. There is no headcut as the channel conforms to the culvert with a generally gradual slope from the Sixes to the culvert, although the lower 700 feet of the existing channel are essentially flat. If the beaver dams were not controlling the water surface, the oxbow would likely be completely dry. Fish passage is affected by the beaver dams except when the Sixes is bar bound and there is flow in Sullivan Gulch, or if the Sixes is elevated enough (over 5 feet higher than low flow conditions at time of survey) during winter storms to backwater the upper two dams (certainly would not occur very often). There is no evidence that high flows have been able to remove or substantially modify the beaver dams in recent years (certainly did not happen in 2012 which was a very wet year with a large event, estimated at perhaps a 20 year recurrence interval). There is evidence from historic aerial photographs that the oxbow was mostly dry in the past, likely when the beaver dams were either not present or had been removed by human activities or high flows. One other piece of information obtained by the surveys is the presence of gravel in the culvert. This implies that some sediment transport occasionally occurs in this area, although this could have occurred when the beaver dams were not present and the culvert was not backwatered. There is no evidence, however, that the channel behind the beaver dams has substantially filled with deposited sediment, suggesting that sediment may not be a significant issue.

Clearly, much of the wetland habitat present in the project area is due to backwater conditions from beaver dams, the fill from the roadway, and vegetation upstream of the culvert. If the culvert was not backwatered, far less wetland habitat would be present, as water levels would be about 4ft lower. Thus to maintain existing wetland habitat conditions, the project design must incorporate elevations that create similar backwater conditions.

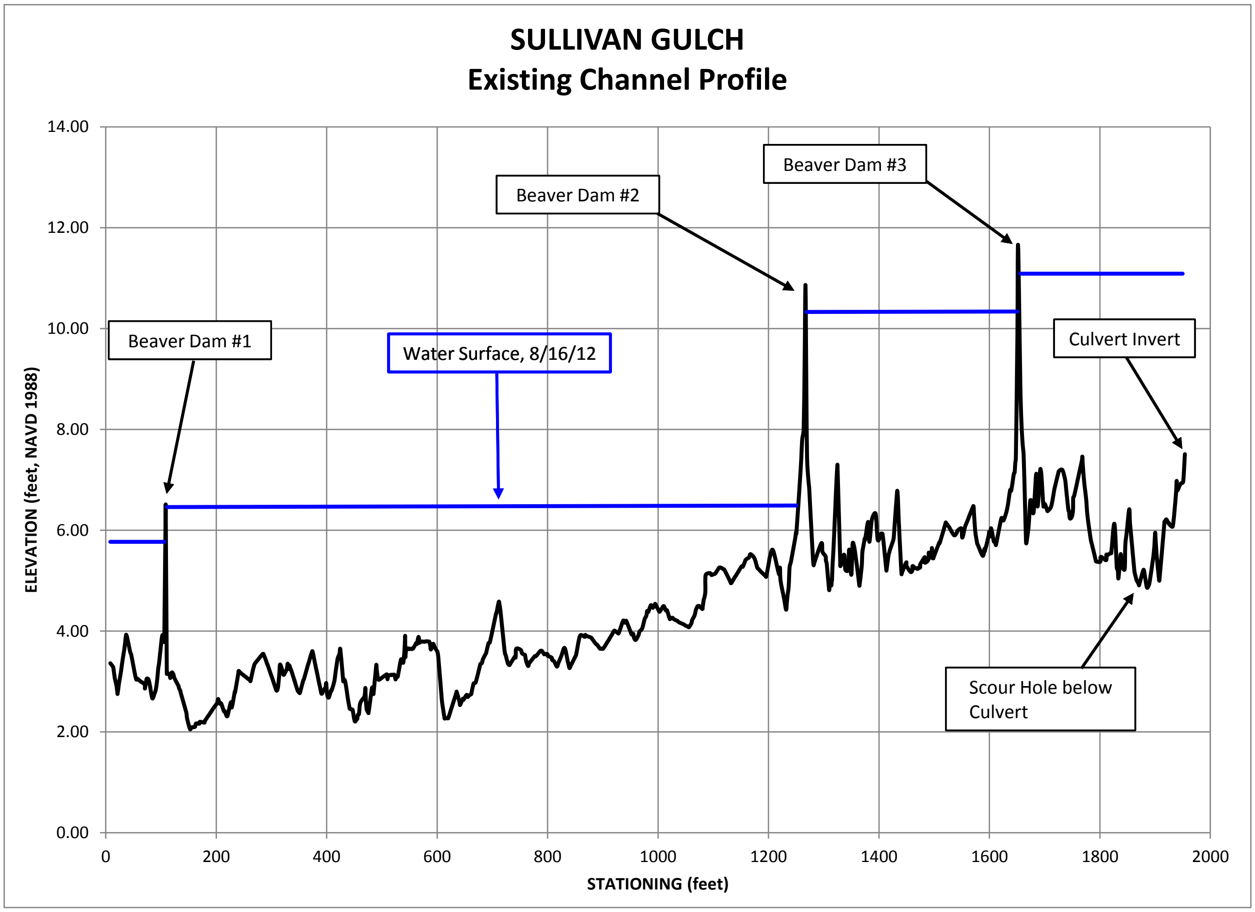


Figure 1: Existing Channel Profile at time of Field Surveys, Aug 2012.

Preliminary (25%) Design and Plans

Preliminary (25%) designs and plans of the Project were developed and submitted to Curry SWCD for review.

The following bullets provide a summary of key information that can be found in Figure 2 and in the preliminary (25%) design drawings.

1) The existing oxbow thalweg is much higher than the invert of the culvert outlet of 7.5 ft. The ground elevations from the outlet of the oxbow along the conceptual design alignment are similar to the elevation of Dam #3.
2) The preliminary design involves grading a wide (50 ft) inset floodplain from the outlet of the oxbow down to the existing channel surface. This may be wide enough to prevent beavers from damming the entire width. A smaller design channel would meander through the inset floodplain. This approach involves excavating approximately 10,100cy.
3) The design channel would meander within this inset floodplain bench with two slopes, one near the existing channel slope of 0. 2%, with a steeper grade control section at 1%.

4) This approach uses a design channel that somewhat follows the existing ground and then drops steeply back into the existing channel (red line in Figure 2). This approach would mimic existing water levels created by the beaver dams. However, constructing a design channel that backwaters the culvert by 4 ft is not good engineering practice, whereas the beaver dams could be considered either temporary features or natural occurrences. It is a different matter when a channel is designed to create that amount of backwater, as the engineer may become liable for increased flood risk, etc. State Parks has indicated that they will release the design team from liability regarding any changes induced by the project at the culvert.
5) The preliminary design shows a series of rock drop structures each with 0.5' drop that transition from the upper surface down to the existing channel. However, the specific type of transition structure (drop structures, roughened channel, or perhaps a hybrid approach) is still being determined.
6) Spoils from excavation of the inset floodplain and design channel will be used to completely fill a portion of the existing channel between the two culverts.

The preliminary design splits Sullivan Gulch into two channels. The main channel exits the primary culvert (eastern culvert) and is routed northeast through the existing oxbow feature at the eastern edge of the project area. The secondary channel exits the western culvert and is routed north crossing the current Sullivan Gulch alignment and joining back up with the main channel 1,000 ft above the confluence with the Sixes at the head of the proposed grade control structure. The alignment rejoins the existing Sullivan Gulch Alignment 700 ft above the confluence with the Sixes. Four potential off channel habitat/pond areas have been identified as part of the preliminary design.

The preliminary design channel alignment, main channel profile, and typical cross sections can be found on the Sullivan Gulch Preliminary (25%) Design Drawings. The design would create roughly 3,000 ft of new channel, combining both the primary and secondary channel lengths. The main channel, flowing from the eastern culvert, is routed through the existing oxbow feature on the project site and then utilizes existing swales to flow back west to the head of the proposed grade control structure. The main channel slopes entering and exiting the existing oxbow feature are currently at 0.2 %. Minimal to no work is proposed in the existing oxbow feature. Once the main channel reaches the proposed grade control structure, the channel slope is increased to 1.0 % for roughly 300 ft at which time the design channel joins the existing Sullivan Gulch alignment.

Preliminary design would involve excavation of approximately 10,100 cubic yards (cy) and would require roughly 9,800 cy to fill the existing Sullivan Gulch alignment. It should be noted the estimated excavation quantities do not include any cut that would be generated from the off channel habitat/pond areas. It is assumed that any additional cut material from the off channel habitat/pond areas will be used to fill the existing Sullivan Gulch alignment. In addition, by splitting the two channels, a direct path for livestock movement is possible from Cape Blanco Road to the initial floodplain grazing area.

The proposed grade control structure could be a roughened channel, drop structures, or a hybrid, although the preliminary design shows a series of rock drop structures. Each drop structure would be designed with a 0.5 ft drop (or greater if appropriate) for fish passage. Fine grained material will be incorporated into each drop structure to prevent underflow and potential dewatering over the drop structure at lower flows. The concept of a roughened channel is to provide a hydraulic environment that is similar to a natural channel at the same slope. Depending on design considerations, a roughened channel may also incorporate larger rock elements that provide velocity shelter for salmonids and stability elements for the roughened channel matrix. It is currently anticipated that the material used in a roughened channel would have to be stable for most flow conditions, as upstream sediment supply is probably limited. Fine grained material would be added to the roughened channel matrix to prevent significant subsurface flow and channel dewatering at lower flows.

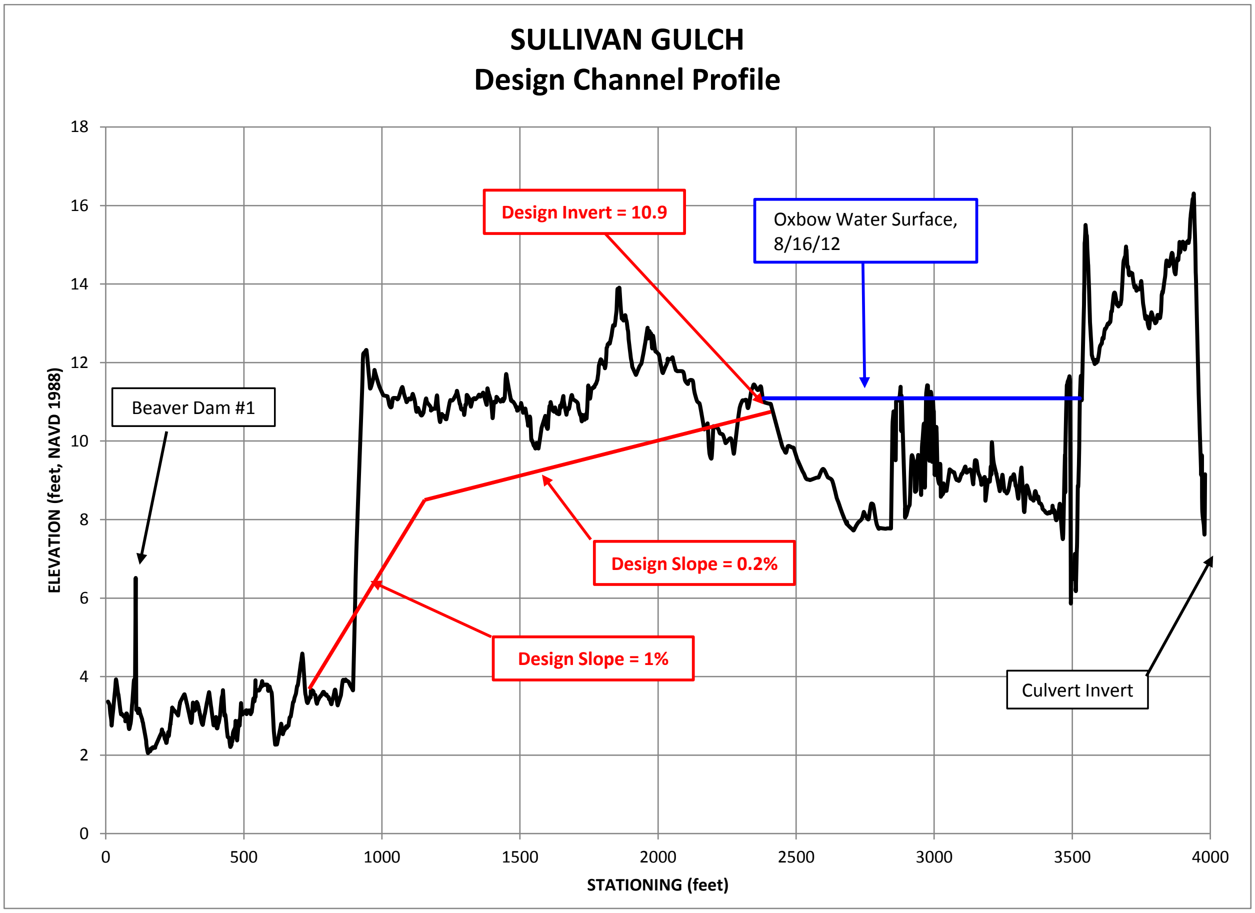


Figure 2: Design Channel invert along Preliminary Design alignment (through oxbow)

Draft (60%) Design and Plans

The Sullivan Gulch restoration project design has been completed to the 60% level. Draft (60%) plans (dated 3 July 2013) of the Project have been submitted to Curry SWCD for review and comment, and this report has been updated to represent the 60% design level. Reference to the 60% plans should be made when reviewing this document.

Based feedback and comments from SWCD and Agencies the preliminary 25% project design was updated. The following lists the key changes incorporated into the 60% designs:

1. The drop structure at the downstream end of the realigned design channel has been changed from a series of 0.5 ft rock weir drops, to a shorter chute and pool type drop structure (see Draft 60% plans). The shorter chute and pool drop structure will impact less downstream channel then the originally proposed rock weirs. The chute and pool drop structure consists of a sequence of a short, steep rock chute (essentially a short roughened channel) followed by an armored pool. The proposed chute and pool drop structure consists of two chutes and pools. The drop structure accommodates 4.7 ft of drop over approximately 155 ft, for a total drop structure slope of 0.03 (3%) over the two chute and pool sequence. Each chute drops approximately 3.5 ft over 35 ft, for an average chute slope of 0.09 (9%). Each pool is approximately 30 to 35 feet long, has no slope and backwaters the upstream chute by about 1 ft. Thus, each chute has an approximate 2.5 ft drop between pools. The 60% drop structure design is outlined in the Hydraulic Analysis section below.
2. The design channel side slopes have been changed to 1:1.5. It should be noted that the design channel bank full capacity is approximately 40 cfs, which is lower than the estimated 2-yr flood flow of 82 cfs.
3. Overall, the primary design channel has been shortened to approximately 1,750 ft. The secondary design channel of the unnamed tributary is approximately 900 ft long.
4. Pool and riffle morphology and been integrated into the 60% channel design surface.
5. A sand/gravel bed material mixture has been added to the riffle sections of the design channel.
6. Additional off-channel areas and backwater channels have been added to the 60% plans.
7. The total Project cut/fill volume been increased to approximately 18,600 cy.

Hydrologic Analysis

Introduction

This information summarizes the draft Sullivan Gulch surface water hydrology analysis conducted as part of the Sullivan Gulch Restoration Project 60% design. The purpose of the hydrologic analysis is to provide estimates of peak flow events for the evaluation of existing watershed flood conditions and channel/floodplain design flows. The peak flow estimates were determined for the Sullivan Gulch watershed above Cape Blanco Road (Figure 3). These estimates are used as upstream boundary conditions for hydraulic modeling purposes to assess existing and/or design conditions.

Peak Flood Estimates and Design Discharges

Winter high flows in Sullivan Gulch with given return intervals are required as boundary conditions for the hydraulic model to assess flood inundation on the project site, and provide design flows for channel and floodplain design. Two methods are applied and compared to estimate peak discharge for specified return intervals. These methods are the U.S. Army Corp of Engineers (COE) Hydrologic Modeling System, HEC-HMS V3.5 (COE, 2010) and the U.S. Geological Survey (USGS) regional flood frequency relations for Western Oregon (Cooper, 2005).

Methods

HEC-HMS simulates the rainfall-runoff and routing processes for both natural and anthropogenic-controlled environments, which can be used for event or continuous modeling. HEC-HMS contains a variety of internal models for simulating water losses, runoff transformations, open-channel routing, and methods for analysis and generation of meteorological input data. For this analysis, the following models/methods contained in HEC-HMS are used: (1) infiltrative losses were modeled using the Natural Resource Conservation Service (NRCS, 1986) (formally Soil Conservation Service (SCS)) curve number method, (2) NRCS unit hydrograph method using default settings was used to transform excess rainfall into surface runoff, and (3) basin wide precipitation is estimated using the NRCS (SCS) 24-hour hypothetical design storms, and 24-hour precipitation depths specified in the NOAA Atlas 2 for the Western U.S. Channel routing lag is not used in this analysis, but is incorporated into the time of concentration estimate.

Time of concentration (t_c) is estimated using the method described in the NRCS TR-55 manual (NRCS, 1986). The lag time (t_{lag}) parameter used in the NRCS method is estimated from the calculated t_c using the suggested NRCS default ($t_{lag} = 0.6t_c$). An assumed winter baseflow of 1.0 cfs is included in the flood analysis. Basin-wide precipitation input for HEC-HMS consisted of the NRCS 24-hour Type 1A synthetic storm for the Pacific Northwest Region. Precipitation depths were determined from the NOAA Atlas 2 for the Sullivan Gulch watershed upstream of Cape Blanco Road.

Sullivan Gulch watershed boundaries, areas, stream lengths and channel slopes were measured from contours generated from the available LiDAR digital elevation model (LiDAR DEM) and the 10-meter digital ortho-photo quadrangle using ArcGIS. Soil conditions were determined from the NRCS Soil Survey Geographic (SSURGO) Database, and land cover classifications were based on the 2006 National Land Cover Database. A composite curve number (CN) was determined from area-weighted land use curve numbers defined by the underlying soil drainage quality (NRCS, 1986). HEC-HMS input parameters for Sullivan Gulch above Cape Blanco Road is summarized in Table 1.

The USGS regional equations (Cooper, 2005) where applied to Sullivan Gulch above Cape Blanco Road using the USGS online StreamStats software (water.usgs.gov/osw/streamstats).

Table 1: HEC-HMS parameters for Sullivan Gulch watershed upstream of Cape Blanco Road

Parameters	Unit	Sullivan Gulch
Watershed Area	(mi^2)	0.9633
CN (Weighted)		68.66
Percent Impervious (assumed)	(%)	0.0
Initial Abstraction	(in)	0.91
Time of Concentration (T_c)	(min)	254.8
Hydrograph Lag Time (T_{lag})	(min)	152.9
Winter Baseflow (assumed)	(cfs)	1.0

Results

HEC-HMS peak flood estimates are compared to the USGS regional estimates (Table 2, Figure 4). The comparison shows that the HEC-HMS results are generally similar to the USGS regional estimates, with the HEC-HMS results being lower than the regional estimates for the 2, 5 and 10-year peak events, and higher for the remaining return interval years. Figures 5 and 6 show the HEC-HMS 2-year and 100-year precipitation and flood hydrographs, respectively, for Sullivan Gulch above Cape Blanco Road. The HEC-HMS peak flood discharge and flood hydrograph estimates were used for Sullivan Gulch design purposes.

To provide estimates of peak discharges below the 2-yr event, a log-Pearson Type III (LP3) distribution was fit to the HEC-HMS results using LP3 frequency factors developed by Chow et al. (1988) and a regional skew of -0.3 (Bulletin 17B). The LP3 fitting technique uses Excel Solver to determine the mean and standard deviation (assuming a -0.3 skew) that minimizes the difference between the HEC-HMS and LP3 peak discharges. Figure 7 shows the fitted LP3 curve and the HEC-HMS estimates. The estimated 1.11, 1.25 and 1.5-yr peak discharges for Sullivan Gulch are included in Table 2.

Table 2: Peak discharge estimates for Sullivan Gulch above Cape Blanco Road

Event[1]	Precipitation Depth[2] (in)	USGS Regional Eq. (cfs)	HEC-HMS (cfs)
1.11-yr			33
1.25-yr			45
1.5-yr			58
2-yr	4.7	85	82
5-yr	5.5	123	115
10-yr	6.0	148	138
25-yr	7.7	181	221
50-yr	8.0	206	237
100-yr	8.6	231	268
500-yr		288	

1) 1.11, 1.25 and 1.5-yr results determined from fitted LP3 curve (Figure 7).
2) Precipitation depth for Sullivan Gulch watershed from NOAA Atlas 2.

Winter Baseflow Measurements

To provide an estimate of winter baseflow, streamflow measurements were taken at the east and west culverts immediately upstream of Cape Blanco Road on 1 March 2013. The east culvert flow, which is the mainstem Sullivan Gulch, had a measured discharge of 9.8 cfs. The unnamed tributary which flows through the west culvert had a measured discharge of 0.3 cfs. These flows combine to provide a measured Sullivan Gulch winter baseflow of approximately 10 cfs. The measurements were taken immediately following a period of rainfall, so they may not be truly representative of a winter baseflow condition, which was considered in the hydraulic analysis.

Figure 3: Sullivan Gulch above Cape Blanco Road watershed/hydrology map.

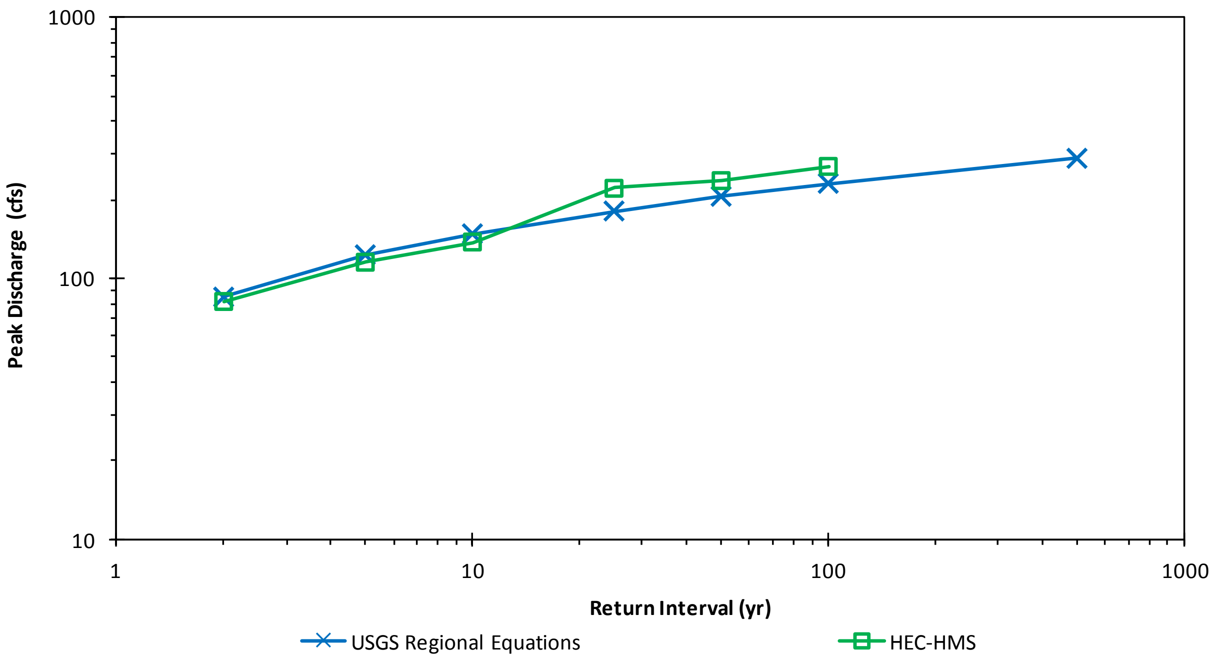


Figure 4: USGS regional equation and HEC-HMS peak flood estimates for Sullivan Gulch above Cape Blanco Road.

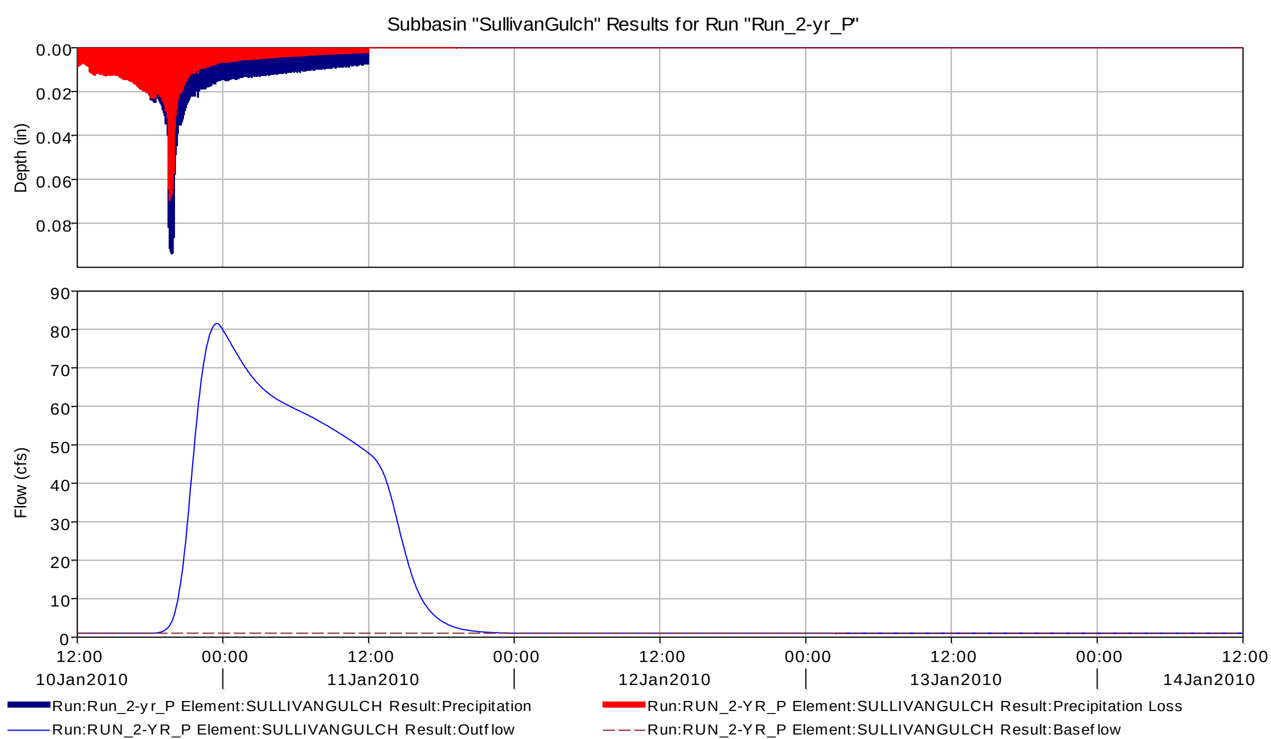


Figure 5: HEC-HMS 2-year, 24-hour precipitation and 2-year flood hydrograph for Sullivan Gulch above Cape Blanco Road.

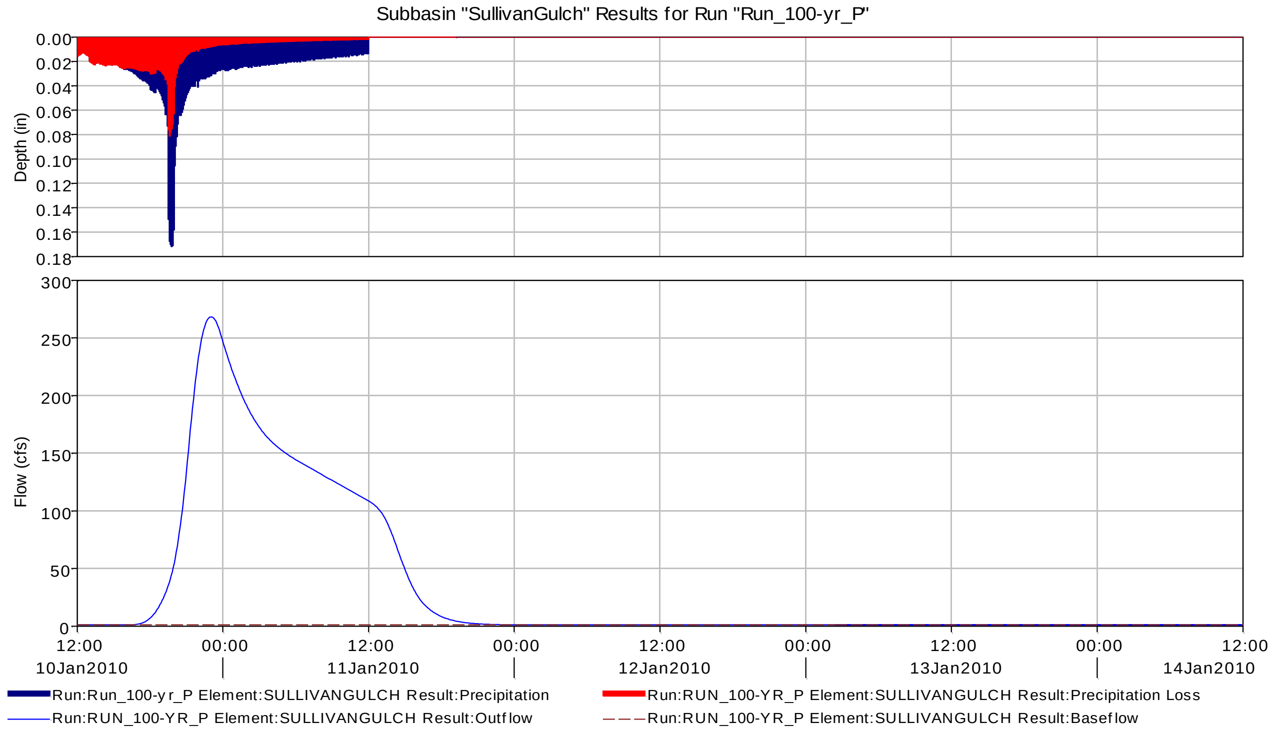


Figure 6: HEC-HMS 100-year, 24-hour precipitation and 100-year hydrograph for Sullivan Gulch above Cape Blanco Road.

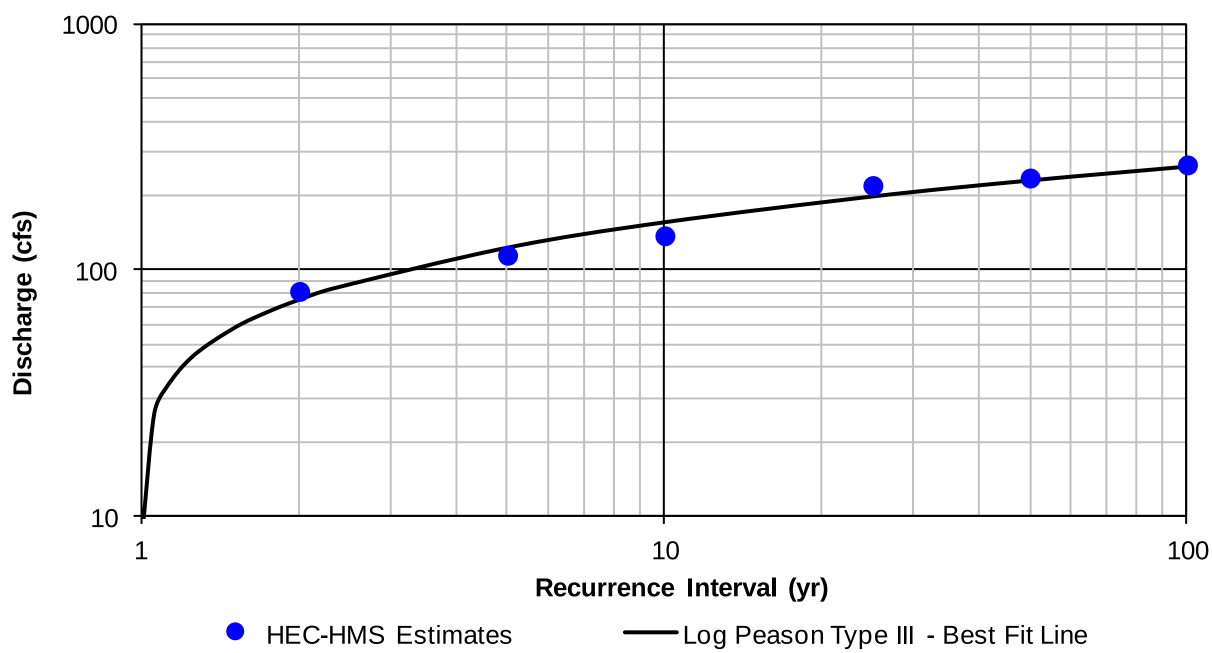


Figure 7: Log Pearson Type III fitted curve to the HEC-HMS 2, 5, 10, 25, 50 and 100-yr peak flood discharge estimates.

Hydraulic Analysis

Introduction

This information summarizes the draft Sullivan Gulch surface water hydraulic analysis conducted as part of the Sullivan Gulch Restoration Project. The conditions analyzed in this memo are existing conditions and the proposed design condition based on the 60% Sullivan Gulch Restoration Project design. The purpose of the hydraulic analysis is to provide:

- Draft water surface elevations of existing and proposed design conditions for Sullivan Gulch from the approximate confluence with the Sixes River to just upstream of Cape Blanco Road (modeling reach).
- Draft assessment of proposed project on Cape Blanco Road crossing and flooding.
- Draft channel and floodplain design dimensions.
- Draft assessment of the drop structure design, bed materials and fish passage.

Peak Water Surface Elevation Estimates

Methods

One-Dimensional Hydraulic Model

Water surface elevations within the Sullivan Gulch modeling reach were determined using a steady-state one-dimensional hydraulic model (hydraulic model) for the estimated peak floods. The hydraulic model used in this assessment was the U.S. Army Corp of Engineers (COE) River Modeling System, HEC-RAS V4.1 (COE, 2010). HEC-RAS calculates one-dimensional water surface profiles and average channel velocities for both steady gradually varied flow, and unsteady flow through a network of channels. For this preliminary analysis steady-state modeling was used to predict flood levels within the project area for different Sullivan Gulch peak flows. Reference can be made to the HEC-RAS manual for information specific to steady-state modeling.

Topographic, Bathymetric and Flow Structure Data

The topographic surface used for existing condition modeling was the Project surface developed from LiDAR and ground based surveys. The topographic surface used for design condition modeling was the existing ground topography augmented with the 60% Project design surfaces which were developed in AutoCAD. Existing flow structures (e.g. culverts) were field surveyed.

Study Area and Model Extent

The Sullivan Gulch draft modeling reach extends from approximately 150 feet upstream of the confluence with the Sixes River to just above Cape Blanco Road.

The existing condition hydraulic model (EC model) includes the existing Sullivan Gulch channel, beaver dams, and the Cape Blanco Road culvert crossing (Figure 7). The EC model includes approximately 1,850 ft of lower Sullivan Gulch represented by 23 cross-sections, extracted from the Project DEM using ArcGIS and the HEC-GeoRAS extension. Cape Blanco Road and crossing defines the upstream end of the modeling domain. Currently, field surveys of the existing channel upstream of Cape Blanco Road have not been incorporated into the EC model. The one upstream cross-section in the EC model was based on downstream channel conditions and modified based on field observations.

A design condition hydraulic model (DC model) was developed to represent the proposed project elements for the Sullivan Gulch Restoration Project based on the 60% design surface (Figure 8). The DC model was extracted from the design Project surface using ArcGIS and HEC-GeoRAS, and starts and ends at the same location in Sullivan Gulch as the EC model. The DC model includes 56 cross-sections over approximately 3,500 feet of existing and design Sullivan Gulch channel. The proposed Sullivan Gulch Project adds approximately 1,700 feet of new channel length. The one upstream cross-section in the DC model is the same cross-section used in the EC model. The primary project elements currently incorporated into the preliminary DC model include:

- Proposed inset floodplain and design channel from the existing Cape Blanco Road culvert to the existing oxbow.
- Proposed inset floodplain and design channel from the existing oxbow to the top of the drop structure.
- Drop structure geometry represented by a number of cross-sections.
- Downstream portion of existing channel from drop structure to 150 feet above Sixes River.

Since steady-state modeling is being conducted for the Project, the large backwater channels and off-channel areas have not been specifically incorporated into the DC models.

Channel Parameters

Manning' roughness coefficients (*n*) were estimated based on professional experience, and field comparison of channel conditions with published color photos, descriptive data, and computed *n* values for stream channels found in Barnes (1967). For the EC model, Sullivan Gulch channel *n* values ranged from 0.04 to 0.05 depending on location, and the DC model channel *n* values ranged from 0.04 to 0.075 with the higher values representing conditions in the restored oxbow. The overbank floodplain and wetland areas were given an *n* value of 0.1 in both the EC and DC models. Jarrett's (1984) flow resistance equation for high gradient streams was used to determine an *n* value of 0.09 for the entire drop structure, which was used in the DC model for producing water surface profiles for the total design reach.

The HEC-RAS default channel and culvert entrance and exit losses parameters of 0.1 and 0.03, respectively, were used in both the EC and DC models.

Upstream and Downstream Boundary Conditions

For steady-state modeling, upstream and downstream boundary conditions (BC) are necessary for the hydraulic models. Upstream BC consisted of the HEC-HMS estimated peak flows from the hydrologic analysis conducted for Sullivan Gulch (Table 2). Normal depth was assumed for the downstream boundary condition using a slope of 0.2%, which is approximately equal to the existing channel slope.

Results

Results from the draft EC and DC modeling show that the proposed Sullivan Gulch Restoration Project design elements raise water surface elevations for peak flood events over most of the channel design, which is caused by raising the base channel elevation above the drop structure, and the increased channel length and reduced velocities associated with reconnecting the oxbow. Table 3 lists the water surface elevations at the cross-section immediately downstream of Cape Blanco Road for EC and DC conditions. Figures 9 and 10 show modeled EC and DC water surface elevations for the 2-year and 100-year peak floods, respectively.

Table 3: Existing and design condition water surface elevations at Cape Blanco Road estimated from the draft hydraulic models

Event	Existing Condition (ft, NAVD88)	Design Condition (ft, NAVD88)
2-year	12.48	13.03
5-year	12.78	13.38
10-year	12.97	13.60
25-year	13.58	14.21
50-year	13.68	14.31
100-year	13.88	14.50

Draft Sullivan Gulch Channel Design Cross Section

The proposed inset floodplain and channel dimensions from the existing Cape Blanco Road culvert to the upstream end of the oxbow, and from the downstream end of the oxbow to the top of the drop structures were designed to provide out-of-bank flows at or below an approximate design flow of 40 cfs. The 40 cfs design flow is less than the estimated 2-year flood of 82 cfs, and represents a return interval between the 1.11 and 1.25-yr event (Table 2). Figure 11 shows a typical cross-section (XS 1646.371) of the proposed inset floodplain and channel from the DG model at the 40 cfs (1.11 to 1.25-yr event) and 82 cfs (2-yr event) flows.

Assuming a design channel *n* value of 0.05, model results indicate that the proposed design channel and inset floodplain will begin to have out-of-bank flows for discharges at or less than 30 cfs. A 30 cfs flow is less than the estimated 1.11-yr event of 33 cfs (Table 2).

Existing Sullivan Gulch Crossing at Cape Blanco Road

The existing Sullivan Gulch crossing at Cape Blanco Road is a single 6 foot diameter corrugated metal pipe, which currently overtops the road during flood events. Currently State Parks is not interested in upgrading the existing culvert crossing. Based on draft modeling results the Sullivan Gulch Restoration Project will increase water surface elevations at the Cape Blanco Road culvert and the potential for overtopping the road (Figure 12). For the 10-yr event, modeling indicates that the proposed Project design causes the road to overtop whereas overtopping does not occur for existing conditions.

Drop Structure Design and Analysis

The proposed drop structure at the downstream end of the design channel consists of a chute and pool type drop structure (refer to Draft 60% plans), which consists of a double sequence of a short, steep rock chute (essentially a short roughened channel) followed by an armored pool. The purpose of the drop structure is to stabilize the grade drop of approximately 5 feet at the transition between the design and existing channel, and provide fish passage at winter-base flows and higher.

The drop structure bottom width is approximately 10.5 ft, which is consistent with the upstream design channel width. The entire drop structure accommodates a 4.7 ft of drop over approximately 155 ft, for a total drop structure slope of 0.03 (3%). Each chute drops approximately 3.5 ft over 35 ft, for an average chute slope of 0.09 (9%). Each pool is approximately 30 to 35 feet long, has no slope and backwaters the upstream chute by about 1 ft. Thus, each chute has an approximate 2.5 ft drop between pools.

The drop structure draft 60% design, and stability and fish passage analysis follows guidelines outlined in Love and Bates (2009) and previous experience with similar type structures. The drop structure design analysis relies on a series of design equations and an iterative trial-and-error process with the HEC-RAS DG model.

Chute Stability Analysis

The stability analysis utilized the US Army Corps of Engineers (COE) steep slope riprap design equation (COE, 1994) to determine the stable D_{30} size particle for the chute. The D_{30} was then scaled following the procedure in Love and Bates (2009) to define the D_8, D_{16}, D_{50}, D_{84} and D_{100} particle sizes (Table 4) for the engineered streambed material in the drop structure chutes.

The particle gradation determined for the 25-yr event (221 cfs) was used as the 100-yr flow of 268 cfs produced excessively large particle sizes. Based on the large particle sizes and interlocking nature of the chute bed material, the proposed bed material (Table 4) should be stable for flows greater than the 25-yr event. The chute bed material has been sized so that the D_{50} and larger material is stable up to the approximate 25-yr event (~ 221 cfs) and greater, which generates the highest shear stress conditions on the chute bed.

To help seal the large bed material voids it is proposed that 5% to 8% of the bed material mix will consist of the native site soil silts and clays.

Table 4: Draft 60% engineered bed material for the drop structure chutes

Percent Finer	Particle Diameter (mm)	Particle Diameter (ft)
5	Native site soil silt/clay	Native site soil silt/clay
8	< 2 (sand, silt, clay)	< 6E-4 (sand, silt, clay)
16	128.4	0.421
50	280.8	0.921
84	702.0	2.303
100	868.7	2.850

Fish Passage Analysis

A simple fish passage analysis was conducted over a range of flow conditions for the drop structure using the DG model. Specific fish passage flows have not been determined, nor have specific fish passage depth and velocity criteria targets been indentified for the 60% design. The low flows analyzed were 1 cfs and 5 cfs, which is 50% of the measured winter base flow of 10 cfs in Sullivan Gulch as described in the Hydrologic Analysis section. The highest flows assessed where 40 cfs (~ 1.11 to 1.25-yr event), 82 cfs (2-yr) and 138 cfs (10-yr). An assessment of the energy dissipation potential of the drop structure pools has not been conducted, but the designed pools should dissipate the flow energy from the 2.5 ft chute drops between pools.

Depths and velocities at the drop structure chute were estimated with the DG model using a roughness value (*n* value) determined from the Mussetter (1989) roughness equation based on the D_{50} and D_{84} stable bed material (Table 4). Table 5 summarizes the determined *n* value, and depths and velocities across the drop structure chute for the modeled flows. Table 6 provides average drop structure pool depths and velocities from the DG model over the range of flows.

The proposed drop structure should provide fish passage for all salmonid size classes over a range of expected winter flows, particularly the lower flows around 5 cfs, as depths are greater than 0.5 ft and velocities are lower than 1 ft/s at the chutes. Passage should be provided for flows lower than 5 cfs. However, flow depths may become limiting (< 0.5 ft) for flows near 1 cfs. Fish passage should also be provided at higher flows due to the nature of the chute and pool drop structure. The large bed material and roughness elements will provide complex flow paths and lower velocity zones within the chutes. The short chute lengths and low pool velocities should allow salmonids to transverse the drop structure at higher flows.

Table 5: Estimated Manning's *n* value and average depth and velocities at the drop structure chute determined from DG model

Flow (cfs)	Manning's *n* value	Average Hydraulic Depth (ft)	Average Depth (ft)	Average Velocity (ft/s)
1 cfs (low flow)	0.44	0.3	0.4	0.4
5 cfs (~base flow)	0.35	0.6	0.8	0.7
40 cfs (~1-yr)	0.26	1.5	2.0	1.5
82 cfs (2-yr)	0.24	2.1	2.8	2.1
138 cfs (10-yr)	0.22	2.7	3.7	2.4

Table 6: Estimated average depth and velocities at the drop structure pools determined from DG model

Flow (cfs)	Average Depth (ft)	Average Velocity (ft/s)
1 cfs (low flow)	3.9	< 0.1
5 cfs (~base flow)	4.2	0.1
40 cfs (~1-yr)	5.5	0.7
82 cfs (2-yr)	6.5	1.1
138 cfs (10-yr)	7.5	1.4

Future Design Analysis

Proposed future analysis in support of the final phase of designs for the Sullivan Gulch Restoration Project may include the following, depending on Curry SWCD, stakeholder and Agency feedback on the 60% design and plans:

- Unsteady modeling of existing and design conditions to route flood hydrographs through the existing culvert and proposed large storage areas.

- Refine inset floodplain and channel dimensions based on unsteady modeling and routed peak floods.
- Further refine the drop structure design. Finalize bed material gradations based on locally available material. Assess constructability and refine final designs as necessary. For example, the 60% design and plans show a drop structure with 1-ton rock slope protection (RSP) along the channel banks. Depending on input from Curry SWCD and constructability the RSP could be reduced to approximately 1/4 to 1/2 ton in size.
- Evaluate the effect of large woody debris as added channel roughness on channel hydraulics. Finalize the number of large woody debris structures and construction technique based on input from Curry SWCD.
- Finalize channel riffle bed sand/gravel material gradation.
- Evaluate design based on Sixes River downstream conditions for flooding and lagoon water surface elevations during closure of the barrier beach.
- Develop flood inundation maps to assess if peak floods are out-flanking downstream portions of the Project near the drop structure, secondary channel and existing channel fill.
- Refine the drop structure fish passage analysis if required by Agencies.

References

Barnes, H. H. 1967. Roughness Characteristics of Natural Channels. U.S. Geological Survey Water-Supply Paper 1849, U.S. Geological Survey, Washington.

Chow, V.T., D.R Maidment and L.W. Mays, 1988. *Applied Hydrology*. The McGraw-Hill Companies, Inc. New York.

Cooper, R.M., 2005. Estimation of peak discharges for rural, unregulated streams in Western Oregon. U.S. Geological Survey Scientific Investigations Report 2005–5116, 134 p.

Interagency Advisory Committee on Water Data (Bulletin 17B). 1982. Guidelines for Determining Flood Flow Frequency, Bulletin 17B. U.S. Department of the Interior, Geological Survey, Office of Water Data Coordination, Reston, VA.

Jarrett, R. D. 1984. Hydraulics of High-Gradient Streams. Journal of Hydraulic Engineering 110(11):1519-1539.

Love, M. and K. Bates. 2009. Fish Passage Design and Implementation. Volume Two, Part XII of the California Salmonid Stream Habitat Restoration Manual, 4th Edition. California Department of Fish and Wildlife.

Mussetter, R. 1989. Dynamics of Mountain Streams. Ph.D. Dissertation. Colorado State University, Fort Collins, Colorado.

Natural Resource Conservation Service (formally Soil Conservation Service), 1986. Urban Hydrology for Small Watersheds, Technical Release 55. United States Department of Agriculture, Soil Conservation Service.

U.S. States Army Corps of Engineers (COE), 2010. HEC-RAS, River Analysis System – User's Manual and Hydraulic Reference Manual. U.S. Army Corps of Engineers, Institute of Water Resources, Hydraulic Engineering Center, Davis, California, CPD-68 and CPD-69.

U.S. Army Corps of Engineers (COE), Hydraulic Engineering Center, 2010. Hydrologic Modeling System, HEC-HMS Version 3.5, User's Manual and Technical Reference Manual. U.S. Army Corps of Engineers Hydraulic Engineering Center, Davis, California, CPD-74A and CPD-74B.

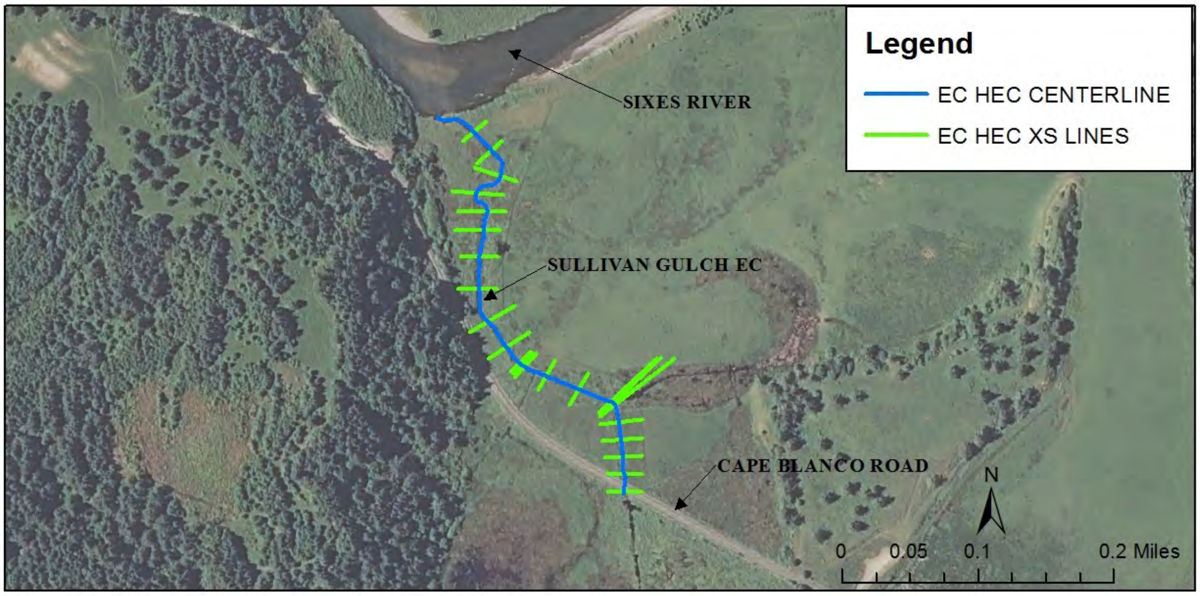


Figure 7: Draft Sullivan Gulch existing condition hydraulic model extent.

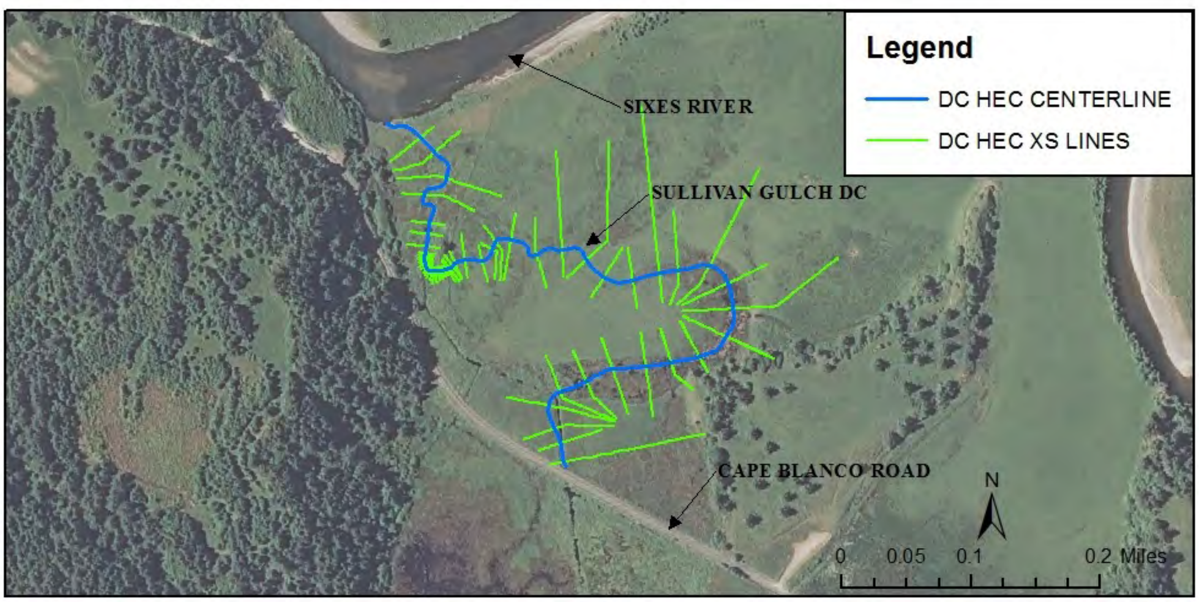
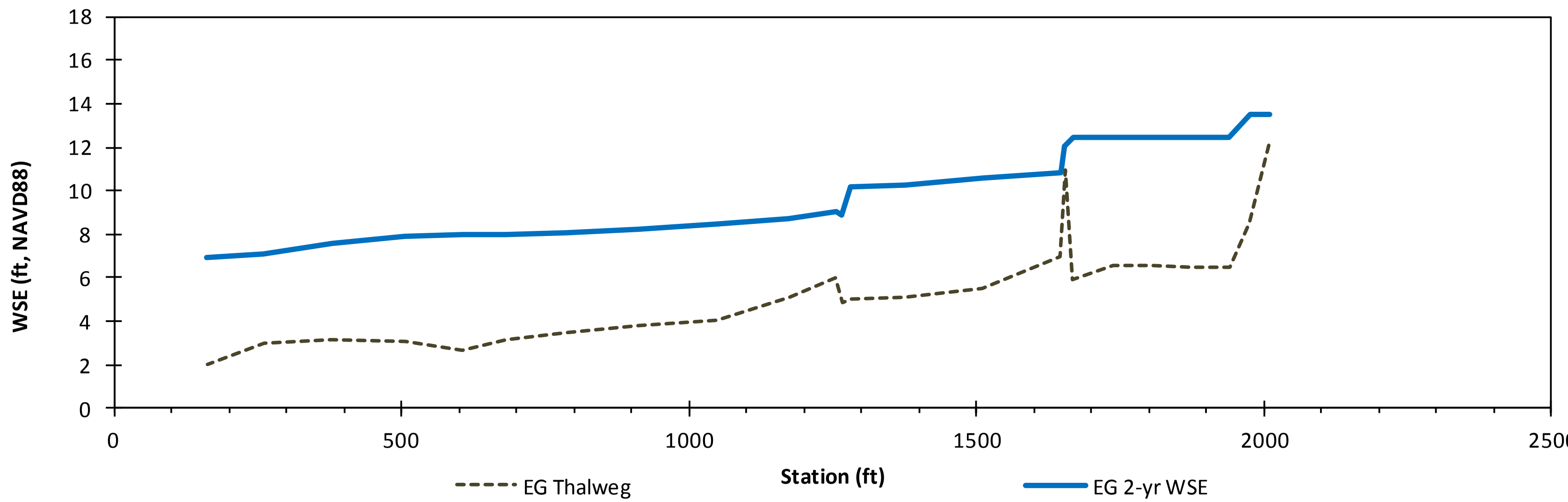


Figure 8: Draft Sullivan Gulch design condition hydraulic model extent.



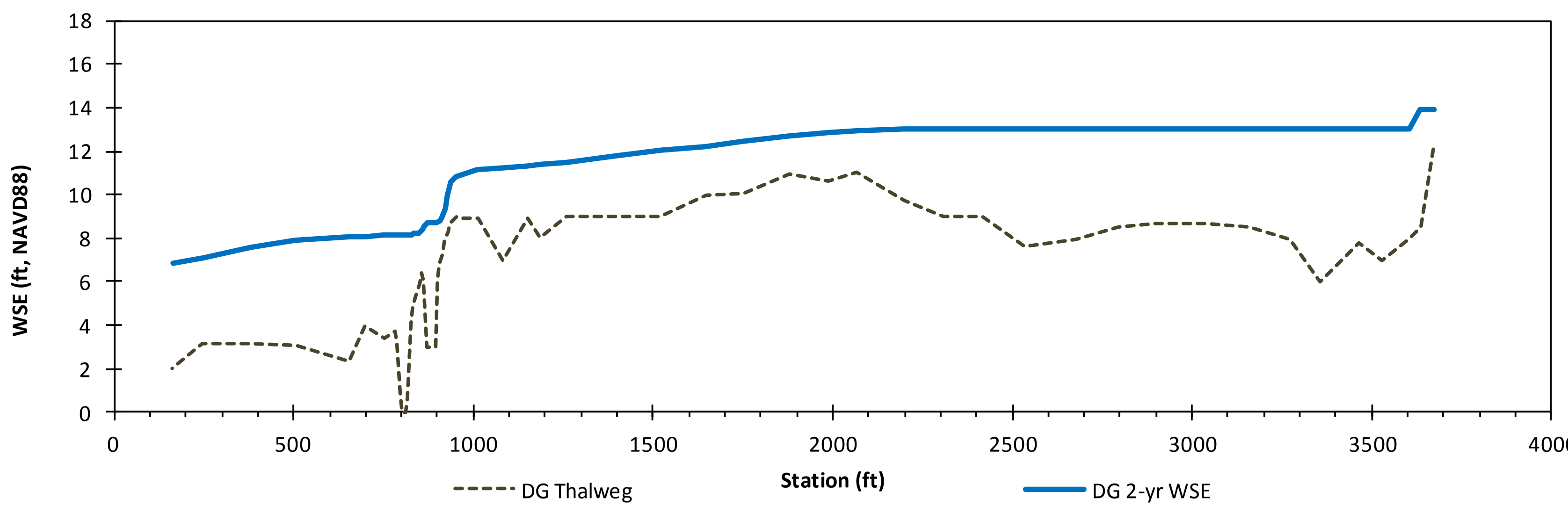
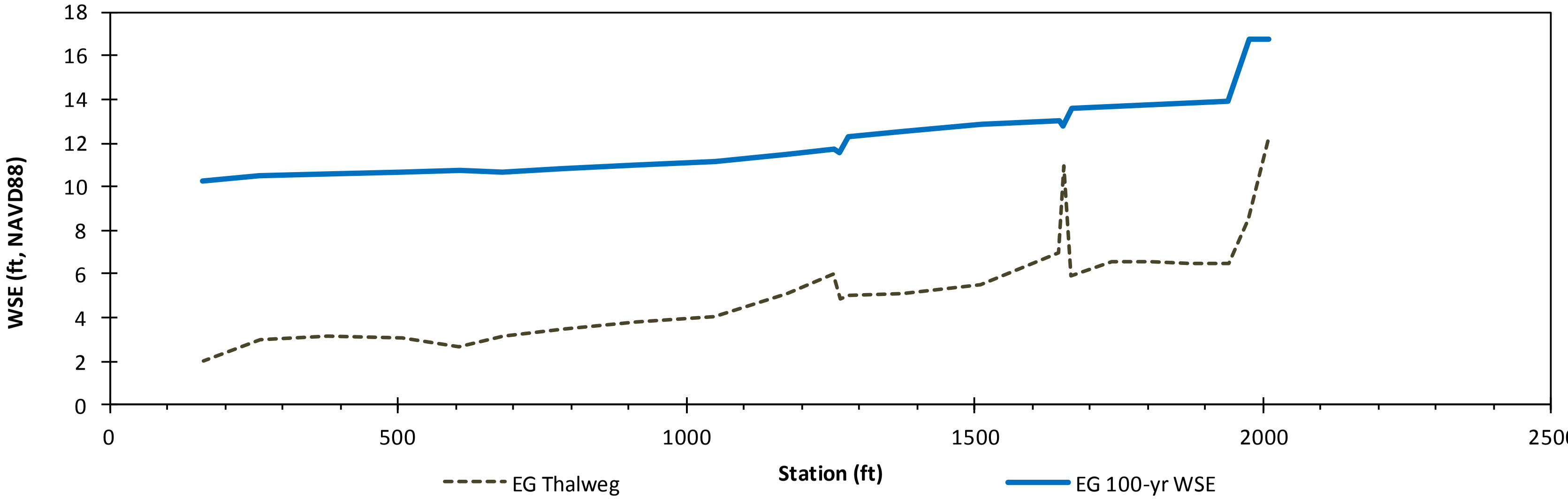


Figure 9: Sullivan Gulch preliminary hydraulic model steady state 2-yr peak water surface elevations for existing conditions (top figure) and design conditions (bottom figure).



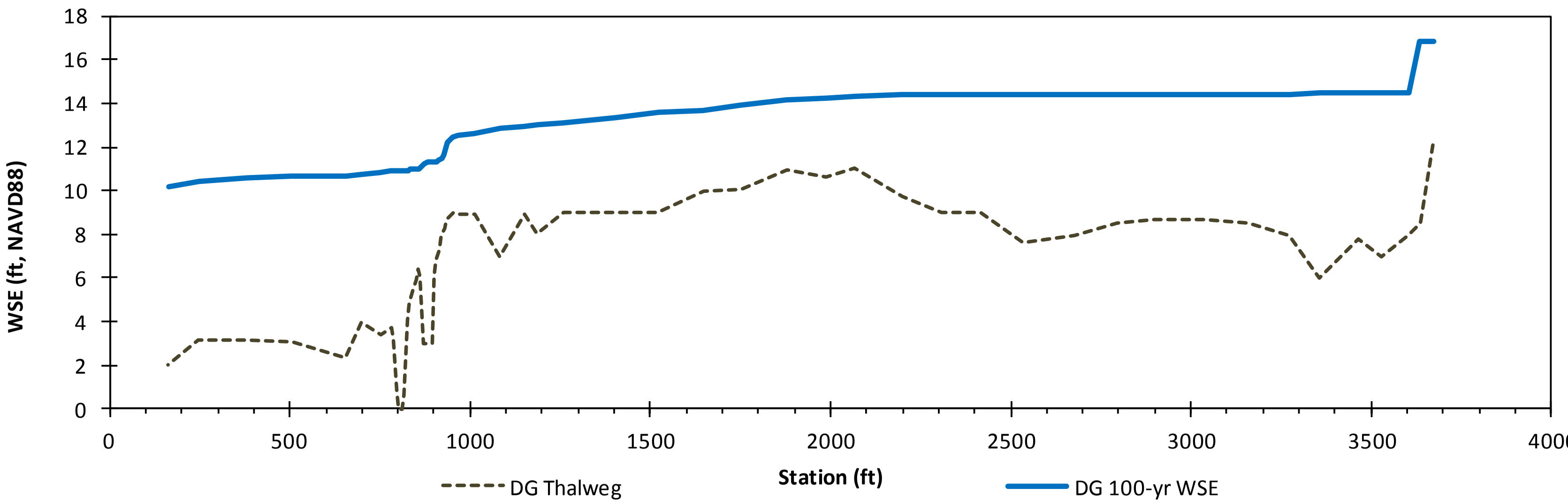


Figure 10: Sullivan Gulch preliminary hydraulic model steady state 100-yr peak water surface elevations for existing conditions (top figure) and design conditions (bottom figure).

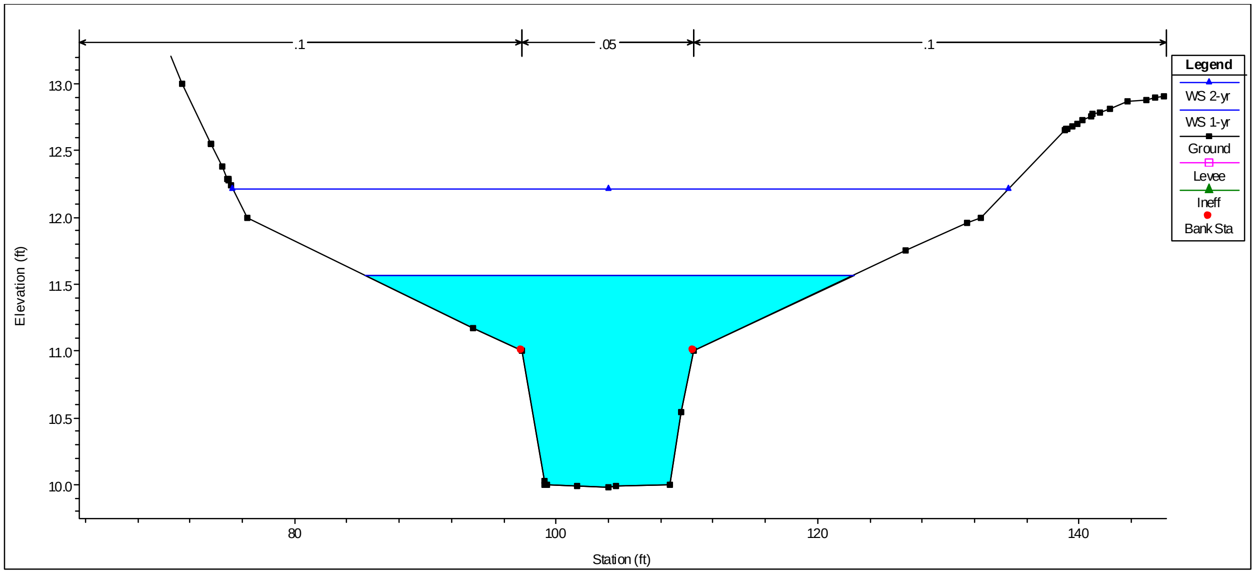


Figure 11: Preliminary Sullivan Gulch floodplain and channel design typical cross-section (DG model XS 1646.371) showing the water surface elevation at the 40 cfs design flow (approximately 1.11 to 1.25-yr event) which is depicted as the blue filled water level and denoted 1-yr, and the 82 cfs flow (2-yr event) water surface elevation which is shown as the blue line with triangle symbols.

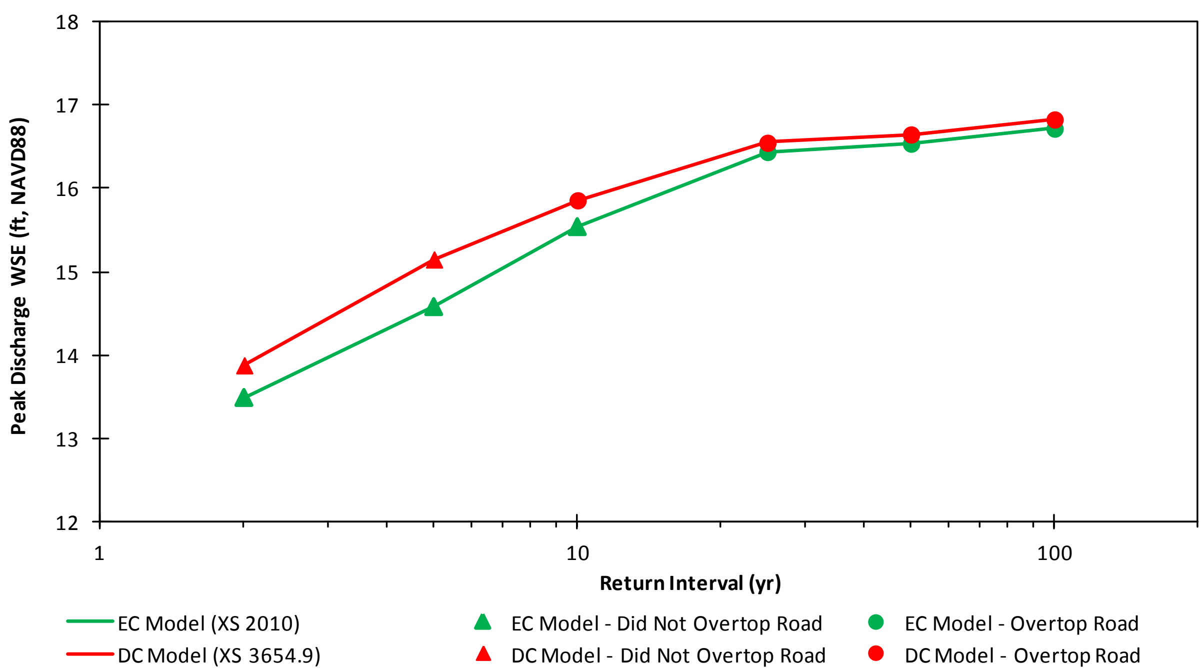
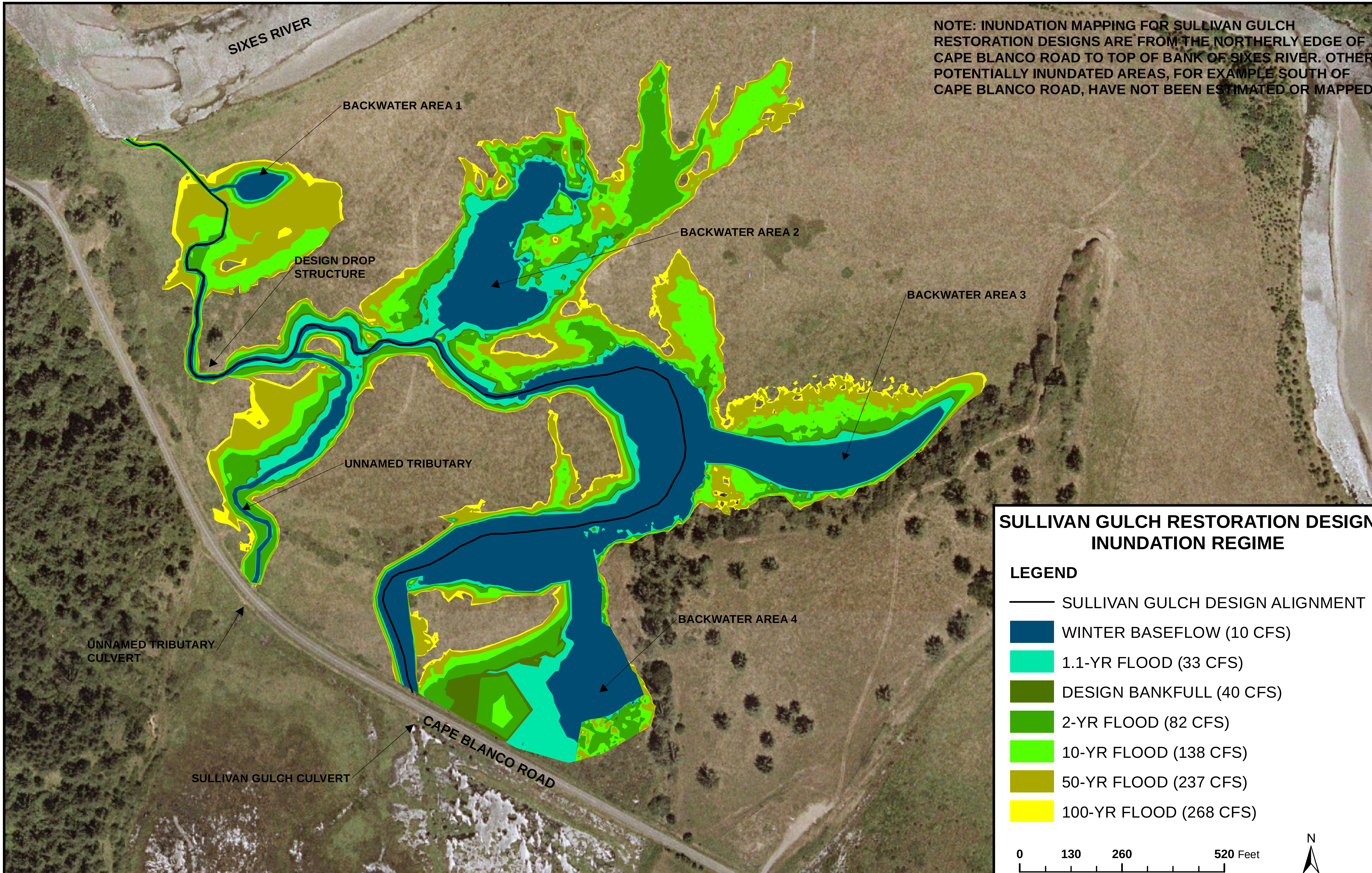
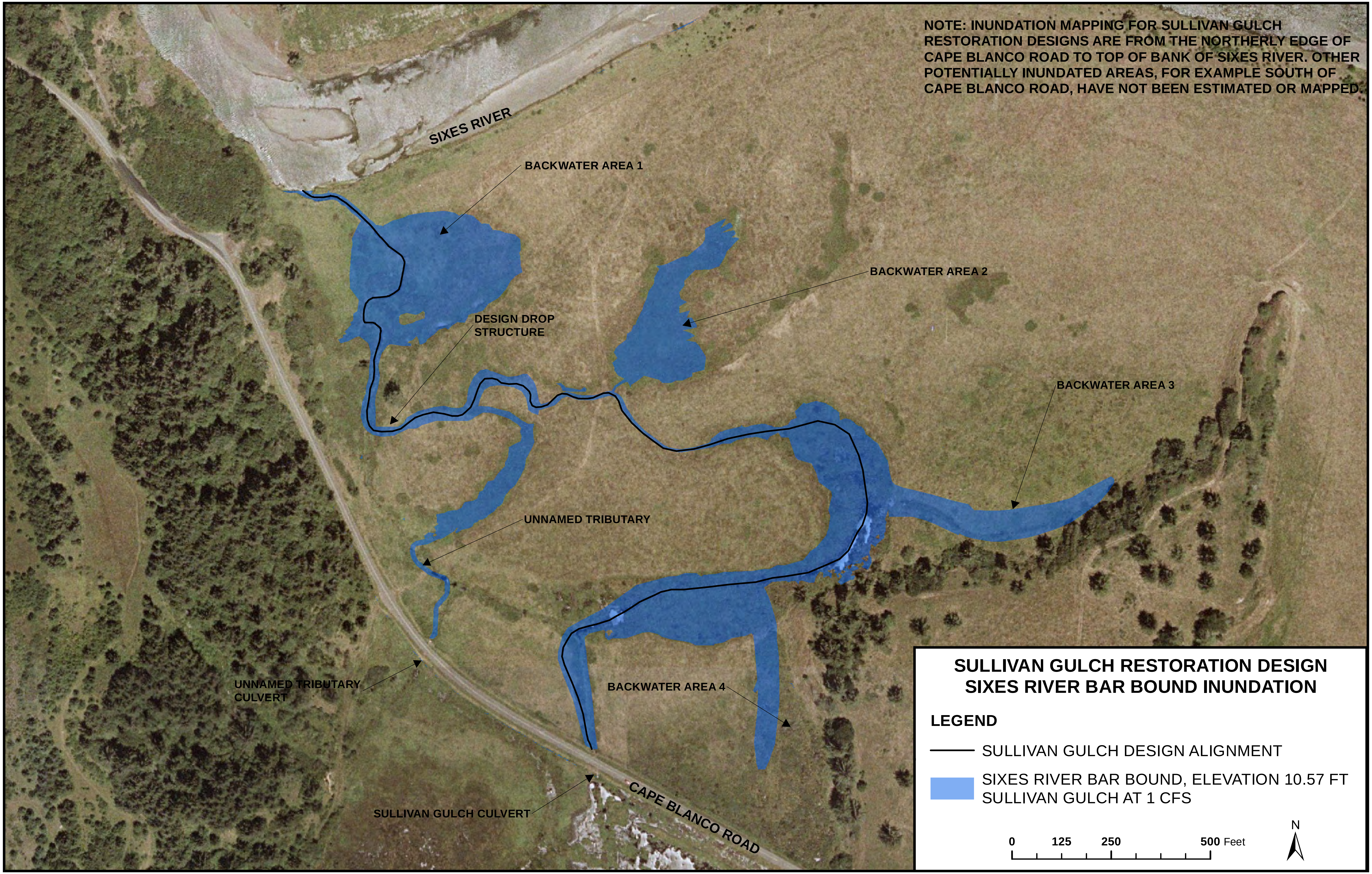


Figure 12: Sullivan Gulch hydraulic model steady state peak water surface elevations immediately upstream of existing Cape Blanco Road culvert for existing and design conditions.



SULLIVAN GULCH RESTORATION DESIGN INUNDATION REGIME
NOTE: INUNDATION MAPPING FOR SULLIVAN GULCH RESTORATION DESIGNS ARE FROM THE NORTHERLY EDGE OF CAPE BLANCO ROAD TO TOP OF BANK OF SIXES RIVER. OTHER POTENTIALLY INUNDATED AREAS, FOR EXAMPLE SOUTH OF CAPE BLANCO ROAD, HAVE NOT BEEN ESTIMATED OR MAPPED.
SIXES RIVER
BACKWATER AREA 1
BACKWATER AREA 2
BACKWATER AREA 3
BACKWATER AREA 4
DESIGN DROP STRUCTURE
UNNAMED TRIBUTARY
UNNAMED TRIBUTARY CULVERT
SULLIVAN GULCH CULVERT
CAPE BLANCO ROAD
LEGEND
SULLIVAN GULCH DESIGN ALIGNMENT
WINTER BASEFLOW (10 CFS)
1.1-YR FLOOD (33 CFS)
DESIGN BANKFULL (40 CFS)
2-YR FLOOD (82 CFS)
10-YR FLOOD (138 CFS)
50-YR FLOOD (237 CFS)
100-YR FLOOD (268 CFS)
0
130
260
520 Feet
N

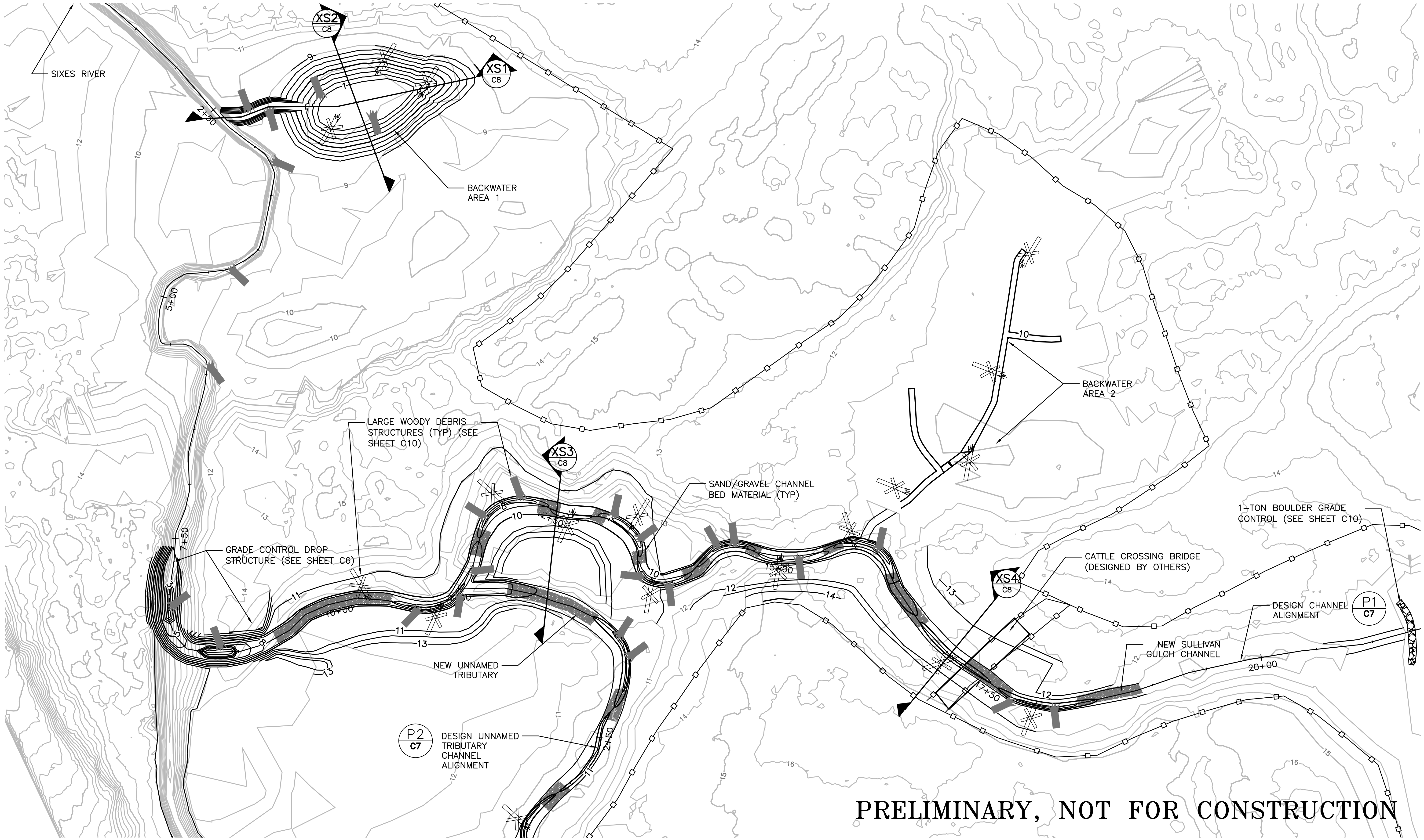

NOTE: INUNDATION MAPPING FOR SULLIVAN GULCH RESTORATION DESIGNS ARE FROM THE NORTHERLY EDGE OF CAPE BLANCO ROAD TO TOP OF BANK OF SIXES RIVER. OTHER POTENTIALLY INUNDATED AREAS, FOR EXAMPLE SOUTH OF CAPE BLANCO ROAD, HAVE NOT BEEN ESTIMATED OR MAPPED.
SIXES RIVER
BACKWATER AREA 1
BACKWATER AREA 2
BACKWATER AREA 3
BACKWATER AREA 4
DESIGN DROP STRUCTURE
UNNAMED TRIBUTARY
UNNAMED TRIBUTARY CULVERT
SULLIVAN GULCH CULVERT
CAPE BLANCO ROAD
SULLIVAN GULCH RESTORATION DESIGN
SIXES RIVER BAR BOUND INUNDATION
LEGEND
SULLIVAN GULCH DESIGN ALIGNMENT
SIXES RIVER BAR BOUND, ELEVATION 10.57 FT SULLIVAN GULCH AT 1 CFS
0
125
250
500 Feet
N

LEGEND:

— 10 — EXISTING CONTOURS
— 5 — DESIGN CONTOURS
PROPOSED FENCE LINE

150 0 150 300
SCALE OF FEET

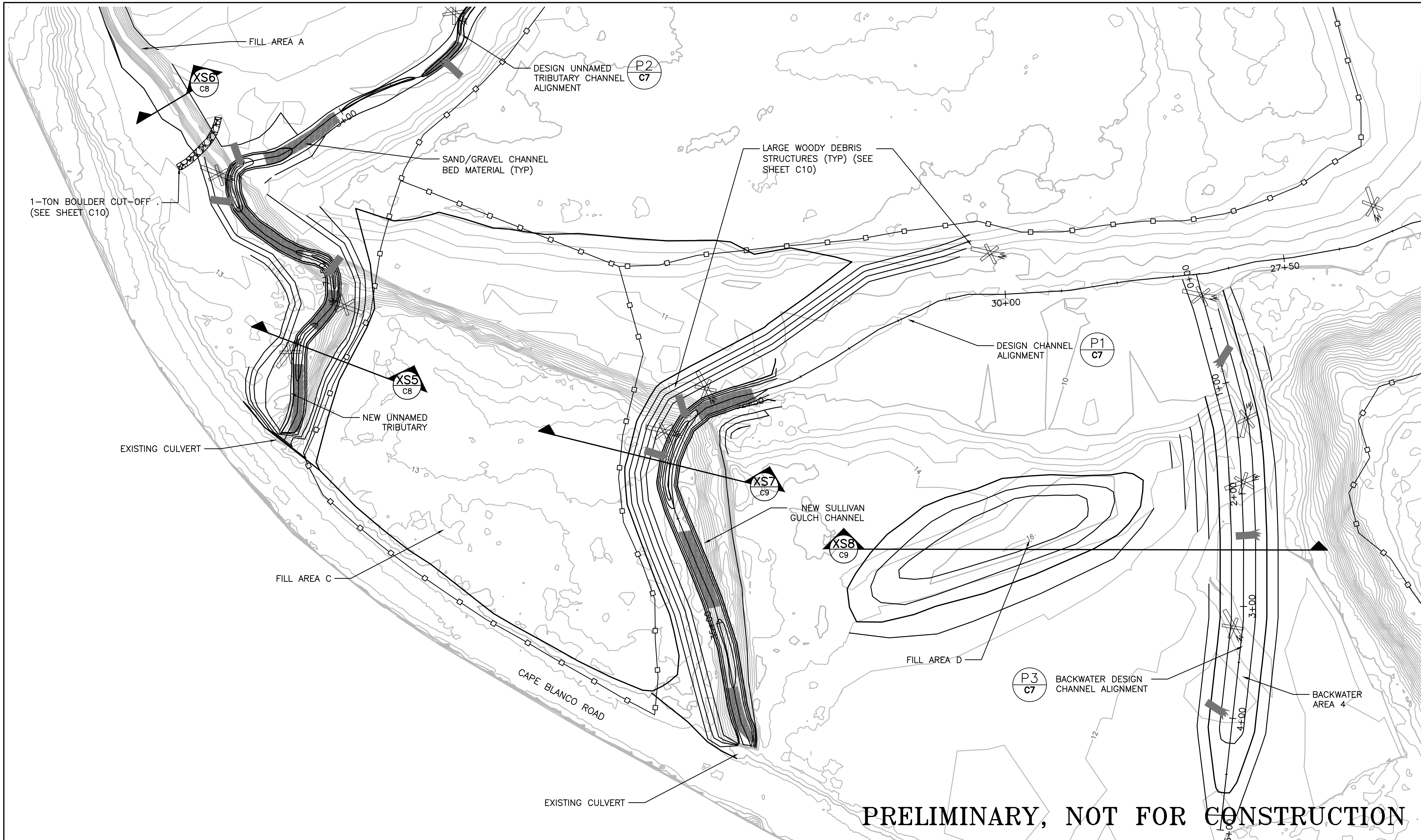
DESIGNED: GM, JKA, CP, CP CADD: CP TECH. REVIEW: JKA DATE: 10/11/2013	SUB SHEET NO. C1	TITLE OF SHEET SULLIVAN GULCH 90% RESTORATION PLAN OVERVIEW CAPE BLANCO STATE PARK OREGON	DRAWING NO. — PMIS/PKG NO. SHEET 4 OF 13



LEGEND:

10 EXISTING CONTOURS	PROPOSED FENCE LINE	LWD TYPE 1
5 DESIGN CONTOURS	RIFFLE	LWD TYPE 2

DESIGNED: GM, JKA, CP, CP	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO.
CADD: CP	C3	SULLIVAN GULCH 90% RESTORATION PLAN SITE PLAN 1	PMIS/PKG NO.
TECH. REVIEW: JKA		CAPE BLANCO STATE PARK OREGON	SHEET 6 OF 13
DATE: 10/14/2013			



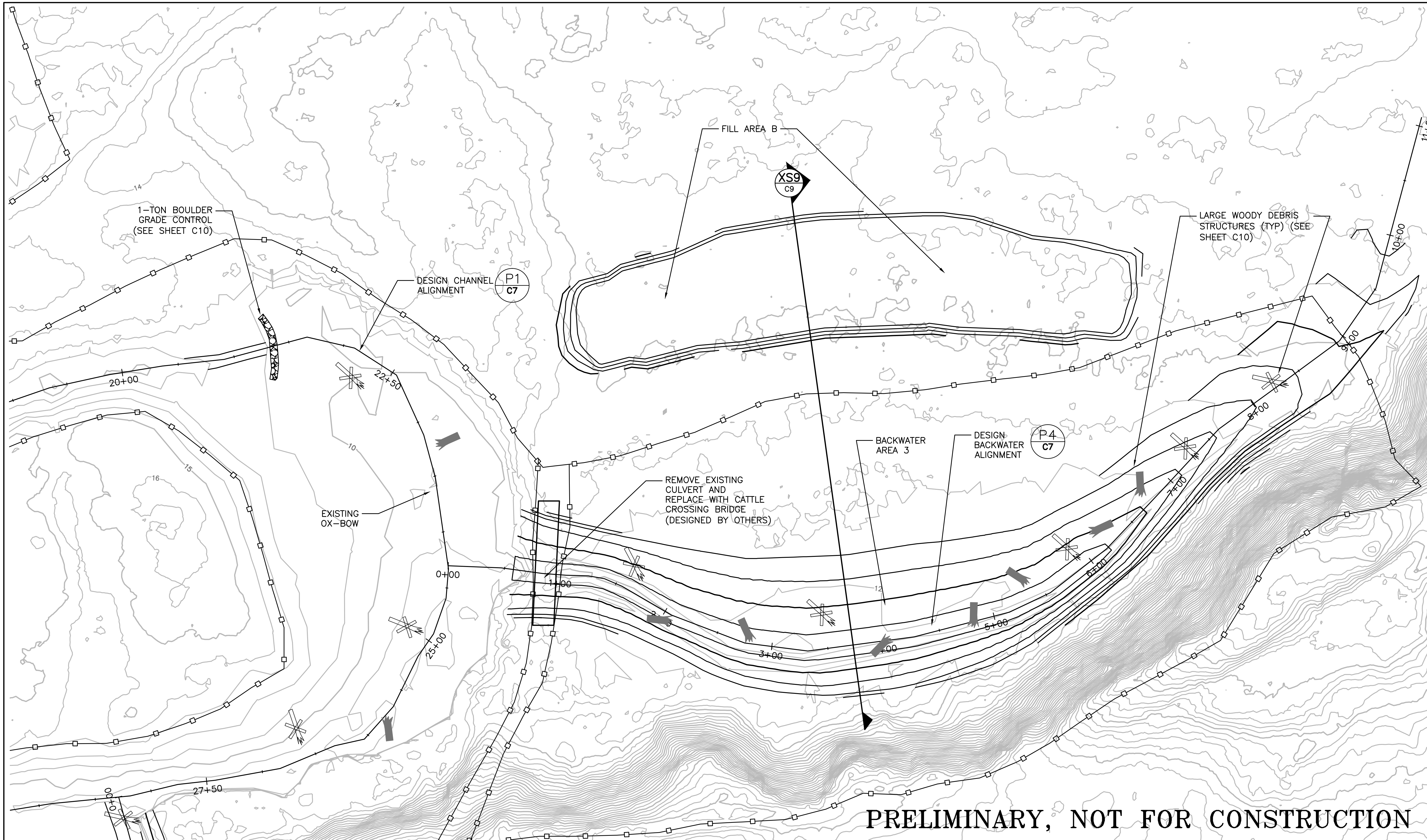
40 0 40 80

SCALE OF FEET

LEGEND:

- 10 — EXISTING CONTOURS
- 5 — DESIGN CONTOURS
- PROPOSED FENCE LINE
- RIFFLE
- LWD TYPE 1
- LWD TYPE 2

DESIGNED: GM, JKA, CP, CP; CADD: CP; TECH. REVIEW: JKA; DATE: 10/14/2013	SUB SHEET NO. C4	TITLE OF SHEET: SULLIVAN GULCH 90% RESTORATION PLAN SITE PLAN 2 CAPE BLANCO STATE PARK OREGON	DRAWING NO. —— PMIS/PKG NO. SHEET 7 OF 13



PRELIMINARY, NOT FOR CONSTRUCTION

LEGEND:

- 10 EXISTING CONTOURS
- 5 DESIGN CONTOURS
- PROPOSED FENCE LINE
- RIFFLE
- LWD TYPE 1
- LWD TYPE 2

40 0 40 80
SCALE OF FEET

DESIGNED:	SUB SHEET NO.	TITLE OF SHEET	DRAWING NO.
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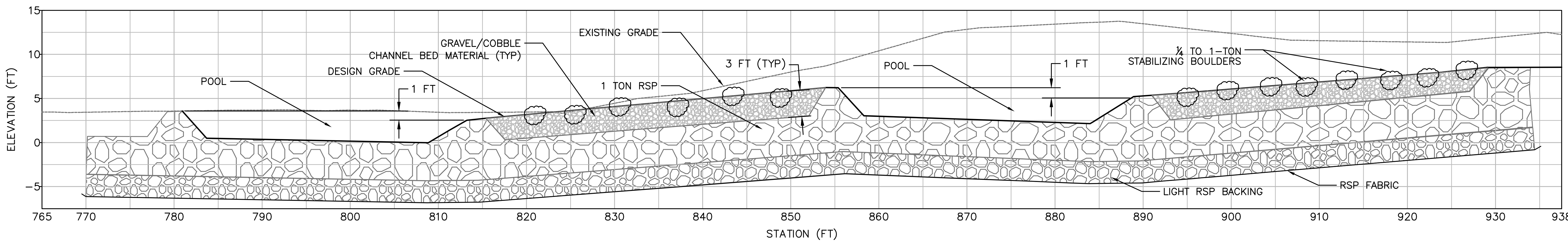
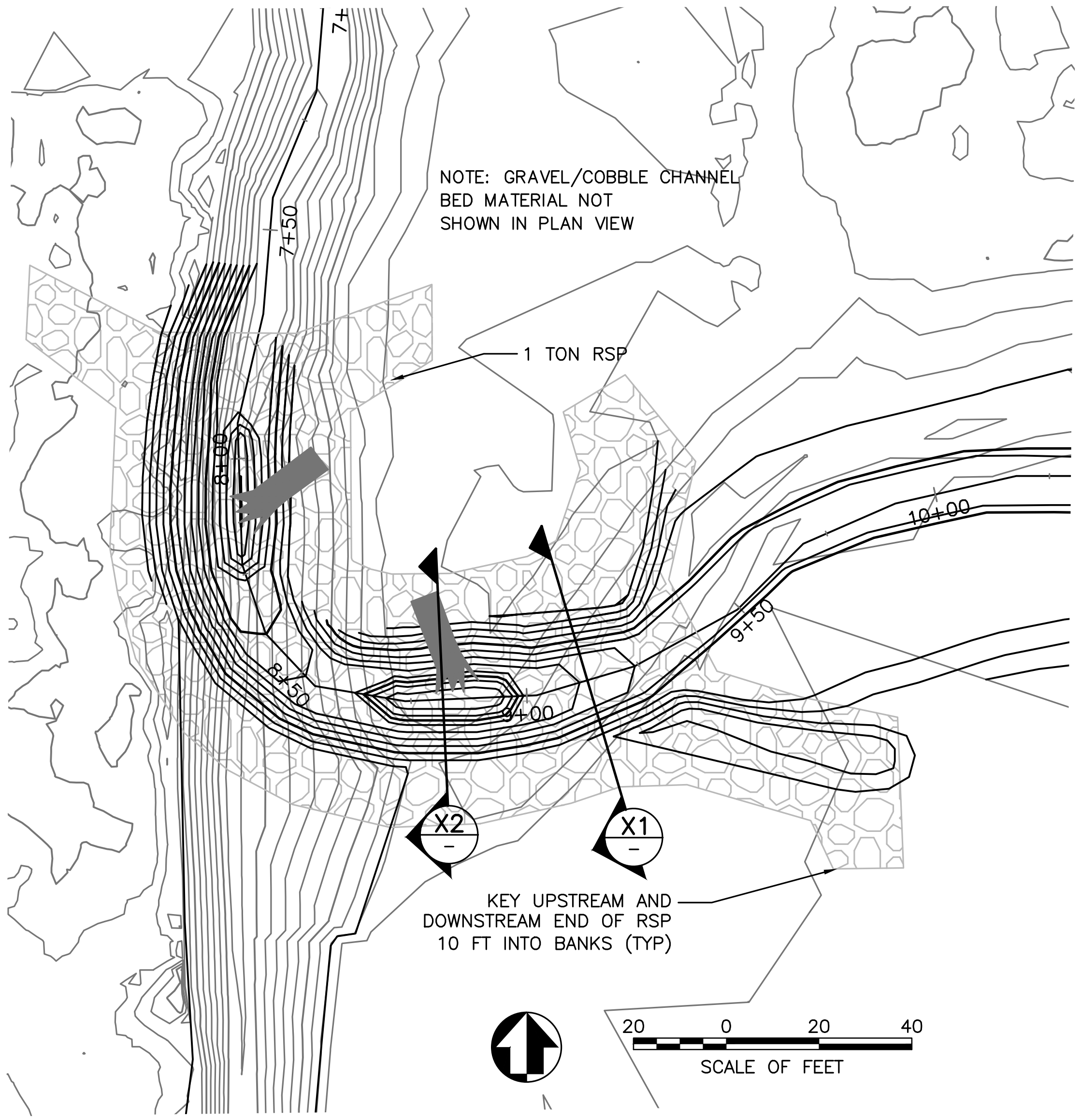
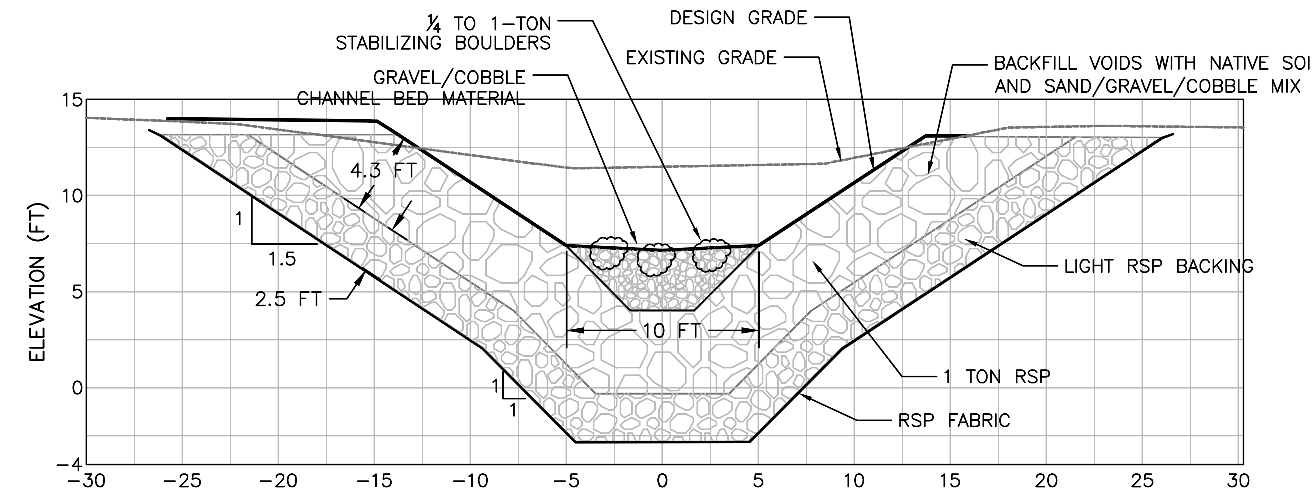
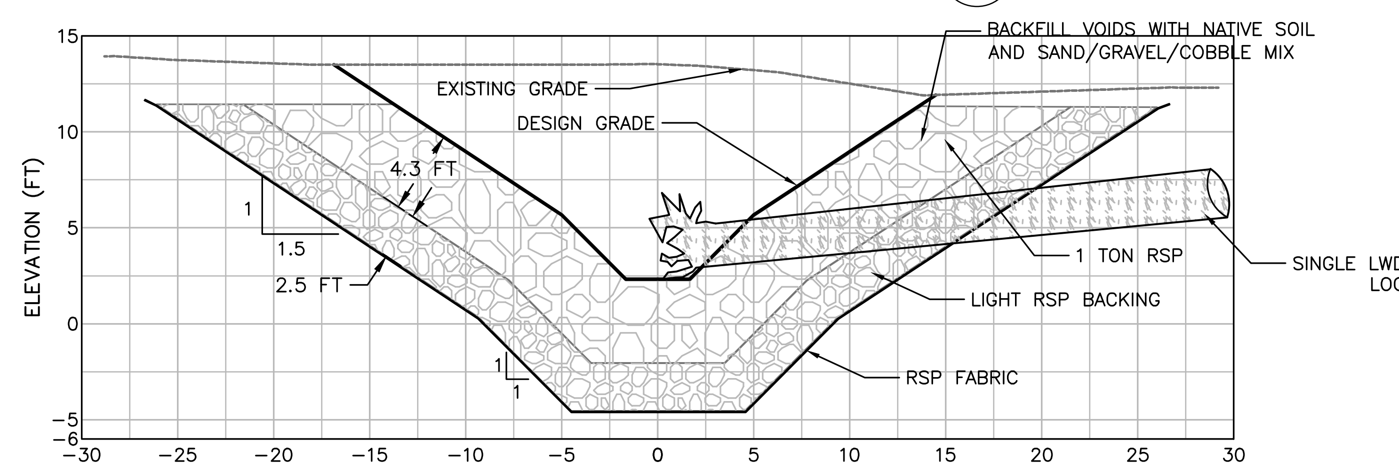


DROP STRUCTURE CHANNEL PROFILE





DROP STRUCTURE RIFFLE CROSS-SECTION X1 / –



DROP STRUCTURE POOL CROSS-SECTION X2 / –

LEGEND:
- EXISTING GROUND
- DESIGN GROUND

PRELIMINARY, NOT FOR CONSTRUCTION

DESIGNED: GM, JKA, CP, CP CADD: CP TECH. REVIEW: JKA DATE: 10/14/13	SUB SHEET NO. C6	TITLE OF SHEET SULLIVAN GULCH 90% RESTORATION PLAN DROP STRUCTURE CAPE BLANCO STATE PARK OREGON	DRAWING NO. — PMIS/PKG NO. SHEET 9 OF 13

Sullivan Gulch Bottomland Restoration: Project Design Team Qualifications and Experience

The project team has worked together on a large number of stream restoration projects over the past 16 years.

Graham Matthews & Associates (GMA) specializes in stream restoration project design and implementation involving detailed hydrologic and geomorphic data collection and analysis.

Graham Matthews, Principal Geomorphologist. has over 30 years experience in hydrology and geomorphology. He has 27 years experience in the design and construction of stream restoration projects. He was principal designer and construction manager for the Wood River Channel and Wetland Restoration Project from 1997-2003, the Williamson River Delta Restoration Project (1999-2008), the Clear Creek Floodplain Restoration Project, Phases 2a, 2b, 3a, and 3b (2002-2008), and has designed and constructed numerous restoration projects along a variety of rivers and streams throughout California, Southern Oregon, and Nevada in his professional practice. Several of these projects have received local, national, or international awards. He will provide input into the design process and will oversee the final products.

Cort Pryor, Senior Hydrologist has 12 years experience in surface water hydrology, sediment transport and surveying. Mr. Pryor specializes in the development, planning and computation of surface water and sediment transport monitoring programs. In addition, Mr. Pryor has extensive experience planning and implementing large topographic and bathymetric survey campaigns. He will be responsible for field surveys and will participate in hydraulic modeling and design preparation.

Northern Hydrology & Engineering (NHE) specializes in hydrology, hydraulics, geomorphology, water quality, water resources and stream restoration. NHE has consulted on hydrologic/hydraulic issues and stream restoration designs in California, Oregon and Nevada. NHE has experience in all aspects of water resource and restoration projects, including planning, conceptual design, data collection, design, and preparation of plans and specifications.

Jeff Anderson, Professional Engineer
Mr. Anderson is a civil engineer with more than 23 years experience, and has been an independent consultant for over 19 years. His consulting experience includes hydrology, river and open channel hydraulics, stream and wetland restoration, watershed hydrology and water quality, surface water quality studies, watershed management, urban stormwater technologies, onsite and small community wastewater systems, and wetland treatment systems. Mr. Anderson has applied and/or developed computer models for hydrologic, hydraulic, and water quality studies of rivers, estuaries, lakes and watersheds. Mr. Anderson's experience in water resources includes serving as project or principal engineer on projects in California, Oregon and Nevada for such agencies as the City of Arcata, Oregon Trout, EPA, The Nature Conservancy and the Bureau of Reclamation.

Bonnie Pryor, Fluvial Geomorphologist
Ms. Pryor has over 10 years of experience as a hydrologist and fluvial geomorphologist and

specializes in numerical and physical modeling of river systems, geomorphology, hydrology, hydraulics, river and tidal marsh restoration, sediment storage and transport.

Corin Pilkington, Water Resource Engineer
Mr. Pilkington has 5 years experience in hydrology, hydraulics, river mechanics, physical and numerical modeling, and field data collection. He has worked extensively in AutoCAD Civil 3D and ArcGIS to develop and manipulate design surfaces and produce restoration construction plans, and has modeling experience with USGS FaSTMECH (2d model) and HEC-RAS.

FEI Testing & Inspection, Inc. (FEI) is a geological testing and inspection company with offices in Corvallis, Eugene, Bend

Bill Smith, Engineering Geologist
Mr. Smith has over 20 years experience as a geotechnical engineer. He will be responsible for the soils investigation and reporting.

Experience
Graham Matthews & Associates Representative Projects

Morton Creek
Client: Curry SWCD

GMA provide hydrologic analyses, field surveys, and preliminary channel design for the Morton Creek project in Curry County, OR. GMA set stakes and provided phone and on-site construction support to Curry SWCD personnel.

Point of Contact: Matt Swanson, Projects Manager
PO Box 666
Gold Beach, OR 97444
(541) 247-2755 ext. 2#

Clear Creek Floodplain Restoration Project, Phases 2a, 2b, 3a, and 3b
Client: Western Shasta RCD and the Clear Creek Technical Team

The Clear Creek Floodplain Rehabilitation Project is a project of The Clear Creek Technical Team, a group of public agencies and private partners. Project implementation has been through the Western Shasta Resource Conservation District. Goals of the project include restoration of channel form, floodplain function, and associated riparian and aquatic habitat for almost a 3-mile reach of Lower Clear Creek within the project boundaries (all land owned by BLM) to provide improved habitat for all native species of the Clear Creek basin both terrestrial and aquatic, with a focus on threatened and endangered fisheries resources. The project area had suffered from extensive instream gravel mining which eliminated floodplain function and, after pit capture during large floods in 1983, left large warm-water pits adjacent to the channel where non-native fish preyed on native species. Lack of a functional floodplain provided many stranding opportunities and impacted the throughput of gravel movement, contributing to a gravel deficit downstream and reduced areas suitable for chinook spawning.
Since 1999, Phases 2a, 2b, 3a and 3b have been implemented. GMA and NHE have been involved with all hydraulic design of the project and have completed project engineering, including design, preparation of plans and specifications, construction review, and preparation of as-built surveys since Phase 2a. Approximately 200,000 cubic yards of old dredger mining tailings were used to fill old gravel mining pits along both side of the river and to reconstruct functional floodplains. Phase 3a was built in Fall 2002 and Phase 3b was completed in 2007. Complicated construction sequences were necessary to create and bypass 100 cfs baseflows. The project has resulted in a substantial (300-400%) increase in available spawning and rearing habitat within the project area.

Floodplain areas were revegetated with a variety of riparian species mostly from cuttings taken in the vicinity. CALFED considers Clear Creek one of 3 high priority pilot large-scale restoration projects in the Sacramento-San Joaquin System.

Project Contacts: Mary Mitchell, General Manager, (530) 365-7332, Anderson, CA and Matt Brown, USFWS, Red Bluff, (530) 10950 Tyler Road, Red Bluff, CA 96080 (530) 527-3043 x 253
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Wood River Channel and Wetland Restoration Project

Client: Oregon Trout (now the Freshwater Trust)

This project has been developed to restore form, function, and structure for the Wood River channel and adjoining wetlands. The lower 1.4 miles of the Wood River was channelized in the 1960s to allow construction of levees to convert wetlands into pasture land. Oregon Trout conceived the project and began project planning with funding from the USFWS Klamath Basin Ecosystem Restoration Program in 1996. Oregon Trout retained the design team of Graham Matthews, Robert Gearheart, Jeffrey Anderson, and Keith Barnard in October 1996 to undertake background studies and preparation of Phase 1 design documents. Major construction began in July 1998 with a local Klamath Falls contractor, Anderson's Fish and Stream Rehabilitation. Phase One and Phase Two construction was completed in October 1999. Phase Three, restoration of the Wood River Delta, was completed in 2000. GMA has provided all design, construction management, and physical monitoring of the project from 1998 to 2009. The project remained within budget and the total cost to date is approaching $2,000,000. The project was awarded the Grand Environmental Achievement Award by the International Erosion Control Association in February 2003. Remnant portions of the historic channel were connected by completely re-constructed or newly excavated stretches. 29 acres of wetlands were created by elimination of the 200-250' wide dredged channel with a 40-50' channel mimicking the historic channel. This project faced a number of significant logistical challenges during the implementation process. As the Wood River is primarily a spring-fed river, base flows at the project site almost never fall below 200 cfs. Several listed endangered species are present in the project area, and a detailed and complex construction sequence was developed to minimize impacts from project construction. Implementation challenges included construction of new streambanks in 3-10 feet of water without causing off-site turbidity, which required operation of excavators on barges and transport of all materials for streambank construction on barges. Phase 3, which included restoration of 3,000 of channel in the delta that had been eliminated by dredging of a cutoff channel in the 1960's, was completed in 2001. Phase 4 and 5 will be constructed in 2009 and 2010.

Project Contact: Andy Hamilton BLM (541) 885-4135, Klamath Falls, OR.

Williamson River Delta Restoration

Client: The Nature Conservancy

The Williamson River Restoration Project is a project of The Nature Conservancy and a number of public and private partners. Goals of the project include restoration of ecological form, function, and composition for the Williamson River Delta Preserve, including creation of over 5,000 acres of wetlands to provide improved habitat for all native species of the Upper Klamath basin both terrestrial and aquatic, with a focus on threatened and endangered fisheries resources and improved water quality for streamflow entering the lake.
Given the complexity of planning, permitting, and implementing a comprehensive restoration project on almost 8000 acres of the Williamson River delta, it was recognized that early implementation of several near-term projects could provide immediate fisheries habitat benefits, and provide feedback on how they may need to be modified for improved success as part of the overall project. Construction began in 2000 with a pilot project involving removal of 3400 feet of levee to re-create a historic meander bend with associated wetland and riparian complexes. GMA provided the project design, technical information during the environmental review and permitting process, construction management services, and as-built surveys. This was the first phase of a project that ultimately restored the lower 4 miles of the Williamson River with a total cost of $12,000,000. Approximately 100,000 cubic yards of levee materials were pushed into the river channel to narrow the dredged channel by as much as 150 feet. A turbidity barrier isolated the work area from the flowing channel. New streambanks were constructed in 5-15 feet of water and stabilized using bio-technical methods: rootwads, boulders and fabric in the upper portion, and coir fabric for remaining "low-energy" areas on the inside of the meander bend. Following that project, a master grading plan was developed by GMA and NHE principals, which involved over 2,000,000 cubic yards of grading. The project

was completed in 2007 and received the OWEB (Oregon Watershed Enhancement Board) 2007 Wetland Award.

Project Contact: Mark Stern, (503) 802-8133, Portland, OR.

Agency Creek Dam Removal and Channel Restoration Project

Client: Fort Klamath Properties, LLC

This project involved removal of an abandoned and damaged dam structure, removal of the associated impoundment and fine sediments contained within it, and restoration and modification of stream channel, wetlands, and riparian zones within and immediately upstream and downstream of the existing impoundment. The project site is located along Agency Creek, tributary to Crooked Creek and the Wood River, Klamath County, Oregon. Although the exact date is not known, a dam was constructed on Agency Creek approximately 1,200 feet above its confluence with Crooked Creek and a pond was created which was stocked with hatchery fish. As a result, approximately 1,600 feet (or 2/3rds of Agency Creek below S.R. 62) of habitat through and upstream of the dam was made inaccessible to native fish

An additional impact of the dam structure and impoundment has been the loss of 950 feet of prime spawning and rearing habitat for native fish due to sediment accumulation of up to two feet deep in portions of the historic channel within the impoundment. The remaining 650 feet of stream habitat above the impoundment lacked sufficient depth at base flows (4-6" at base flow of 8 cfs), velocity, pool and riffle features, and stream canopy cover to provide much habitat value even if the dam did not prevent native fish passage.

Construction faced a number of challenges including diversion of base flow and the volume of mucky fine grained sediment in the impoundment, which either had to be removed or stabilized in place. Project construction was completed in 2002 and the project now provides fish passage and habitat to a 1,600-foot reach of Agency Creek that was previously blocked, by removing the existing dam structure. In addition, the project re-established a natural channel grade through lower Agency Creek and created, using bio-technical methods, a narrower, more sinuous channel in place of the existing relatively straight, over-wide reaches. Specific construction techniques utilized included installation of large woody debris, boulders, spawning gravel, excavation of pools, creation of additional channel sinuosity, planting of riparian tree species, and transplanting of wetland fringe sod mats.

Project Contact: Andy Hamilton BLM (541) 885-4135, Klamath Falls, OR.

Angora Creek SEZ Restoration Project:

Client: El Dorado County Department of Transportation

The Angora Creek SEZ Restoration Project consisted of the restoration along portions of Angora Creek between Lake Tahoe Boulevard and Washoe Meadows State Park. Subdivision development surrounding Angora Creek, aged drainage structures, and other public use in the region had contributed to an increase in runoff and negative backwater impacts within the Angora Creek floodplain. A 12-foot high headcut was located 800' west of View Circle. Downstream, the creek was incised resulting in active erosion with bank heights averaging between 5 and 12 feet. The headwall and culvert at View Circle was deteriorating and areas between View Circle and Washoe Meadows State Park exhibited bank erosion and damage caused by excessive woody debris. The primary goals of this Project were (1) reduce bank and bed erosion; (2) restore stream function and riparian habitat; (3) remove barriers to fish passage; (4) improve interaction between the stream and its floodplain by increasing the number of days of over-bank flooding, and (5) protect the restoration work already in place within the Angora Creek watershed
As part of the design, a fluvial geomorphic analysis of a suitable portion of the watershed was performed to determine the most appropriate channel configuration and to evaluate the factors causing the existing channel erosion. This analysis allowed for development of a design to mitigate future erosion potential and return Angora Creek to its natural condition. The monitoring components included geomorphic, vegetation, groundwater, soils, sediment and flow monitoring. Construction activities included the following: (1) Channel reconstruction; (2) Bioengineered bank stabilization; (3) Riffle pool sequences; (4) Reestablishment and creation of fish and wildlife habitat; (5) Replacement of existing drainage facilities; (6) Removal of debris; (7) Salvaging existing native vegetation; and (8) Planting of shrubs and sod, willow stakes, seeding and mulching
Due to seasonal constraints and permit limitations, the short construction season in the Lake Tahoe Basin required

the project to occur in two phases over two construction seasons. The first phase was constructed during the 2005 season and the second phase in 2006. In December 2005, after the completion of the first construction season, a significant flood occurred with a 16-year return period. The flood caused erosion and scour within the Angora Creek channel at the headcut. The new design channel, which was not yet tied into the original channel, faired well with moderate sediment deposition evident. This flood event changed the quantities for filling the abandoned portion of the old channel, required additional dewatering and extended the completion date of the contract past October 6, 2006, as originally scheduled. The project has functioned well since completion, with rapid establishment of vegetation on the channel banks and floodplain surfaces.

Contact: Steve Kooyman, Senior Engineer, 530-573-7910

Crane Creek Restoration Project, Phases 1-3
Client: Klamath Basin Rangeland Trust

Crane Creek is a predominately spring-fed system located along the western edge of the Wood River Valley in the Upper Klamath Basin at an elevation of about 4,400 feet. The hydrology and channel form of Crane Creek were significantly impacted by excavation of nearly straight irrigation ditch and diversion of all flow into that ditch. The Crane Creek Restoration Project was developed to correct the degraded and channelized conditions by restoring historic channel morphology from Seven Mile Road to its confluence with Seven Mile Creek, approximately 3 miles downstream, in order to increase the extent of riverine wetlands adjacent to the active channel and provide for improved water quality and instream aquatic habitat. The objectives included: (1) restore channel form and function to a 9,600 foot reach of Crane Creek by creating and diverting water back into an 16,400 foot long meandering channel with pool/riffle sequences, creating an additional 6,800 feet of channel and habitat; (2) placement of spawning gravel on riffles; and (3) use bio-technical methods to stabilize new channel boundaries and create additional habitat by placement of large wood structures. A meandering channel with typical pool/riffle sequencing was designed to utilize existing channel remnants by deepening (removing accumulated muck and vegetation) them and linking them together with newly created sections of channel. Existing sinuosity of the irrigation ditch was essentially 1.0, while historic sinuosity was approximately 1.78. GMA and NHE provided all analysis, design, staking, construction management, and as-built survey services for this project, which will be completed in July 2009. Construction began in 2007 and was 95% complete by November 2008.

Project Contact: Shannon Peterson, Executive Director, 541-273-2189

Northern Hydrology & Engineering Representative Projects
Redwood Creek Restoration at Muir Beach, Marin County
Client: National Park Service, Golden Gate National Recreation Area

Northern Hydrology & Engineering worked within an interdisciplinary team of engineers, geomorphologists, aquatic biologists, landscape architects, and ecologists to restore the lower 2 km of Redwood Creek, Marin County. The restoration design includes coastal lagoon expansion and enhancement, removal of a levee that pins the channel against the lateral margin of the floodplain, re-alignment of a parking area to improve hydrologic function, relocation of approximately 2500 ft of linear feet of Redwood Creek to the topographic low of the valley to improve floodplain connectivity, installation of non-anchored large woody debris structures to provide cover for salmonids and increase topographic complexity of the channel, construction of backwater channels to serve as high flow refugia and over-winter rearing habitat for juvenile salmonids, and construction of emergent wetland for red-legged frog habitat, re-location of boardwalks and footbridges, development of new trails, removal of non-native vegetation and planting native vegetation. Stream channel, floodplain and backwater designs were developed and refined using a quasi-3D sediment transport model.

Point of Contact:
Carolyn Shoulders, Redwood Creek Park Manager
National Park Service, Golden Gate national Recreation Area
Fort Mason, Bldg 201
San Francisco, CA 94123

(415) 289-1841

Lower Freshwater Creek Estuary Rehabilitation Project

Client: Northcoast Regional Land Trust

The Freshwater Creek Estuary project was awarded in 2002 to develop conceptual designs to remove a tide gate, restore tidal hydrology, and enhance salmonid rearing at a 35 acre marsh adjacent to Freshwater Slough. A small tributary, Wood Creek, traverses the marsh. The property was purchased by the Northcoast Regional Land Trust with funds from the Coastal Conservancy, and California Department of Fish & Game funded the project implementation in 2006. Northern Hydrology & Engineering provided designs, modeling and analysis, and plans and specifications.

Point of Contact:
Ryan Wells, Projects
Northcoast Regional Land Trust
PO Box 398
Bayside, CA 95524
(707) 822-2242