



northwest hydraulic consultants

July 29, 2009

TO: Paul Levesque, Rick Klumph, Design Team-Oregon Solutions
FROM: Vaughn Collins, P.E.
CC: Dave Boatman P.E., Jeff Johnson, P.E.
RE: **Report on First Flood Control Project, Project Exodus**

Summary

This report contains recommended projects for the First Flood Control Project required in our scope of work. We have evaluated projects from the mouth of the Wilson River canyon to Tillamook Bay, and propose three projects to address flooding in the Wilson River.

The three projects together provide significant flood relief for the lower river valley, and up the Tillamook and Trask River systems a short distance.

- **Project Exodus:** This is the core project proposed that provides the greatest benefits in both flood level reduction and area over which it is effective. We propose two alternatives for consideration.
- **South Bank Wilson River Berm:** Two alternatives are presented to control flooding overtopping the south bank of the Wilson River and flowing west over 101 in the Fred Meyer store area.
- **North Bank Wilson River – Field Grading:** This alternative is a simple lowering of a portion of existing pasture that acts as a control on water levels north of the Wilson River.

While we did evaluate alternatives in the upper valley, no solutions presented themselves – either there were significant adverse impacts in one area while providing benefits in another, or the projects simply were ineffective.

There are several key decisions that must be made on project alternatives before further work can be done. This report provides the construction costs, flood benefits and real estate needs associated with each alternative in order to allow the Oregon Solutions group to make informed decisions. We also provide flood results for one set of alternatives, and are providing complete mapping in a separate document.



Project Exodus Alternatives

The largest and most important project identified is the Project Exodus alternative. The southern portion of the project consists of creating a flow corridor beginning downstream of SR101 between Hoquarten and Dougherty Sloughs and running westward to the Tillamook River. The flow corridor is created by constructing setback levees and removing existing levees within the project area. In the northern half of the Wetlands Acquisition Area further levee removals are proposed. Two versions of Project Exodus are presented. They differ in how the southern half of the Wetlands Acquisition Area is treated.

The two alternatives share mostly common features and require the same land footprint. Key differences are in the length of new levee required and the area used for unconfined conveyance open to tidal influence. Alternative 3 was presented previously to the Oregon Solutions Design Team, but Alternative 4 is a new option. The alternatives are shown on the following page.

Alternative 3

Alternative 3 consists of merging the southern flow corridor with the Modified Wetlands Acquisition Alternative recommended in the Corps Feasibility study. It continues to utilize the existing conveyance path out to the flood gates at the mouth of the Wilson River. Additional flood gates would be added to the new northern levee. The public lands within the leveed conveyance corridor would be restored to a regulated tidal wetland system designed to ensure continued effective flood conveyance to the gates.

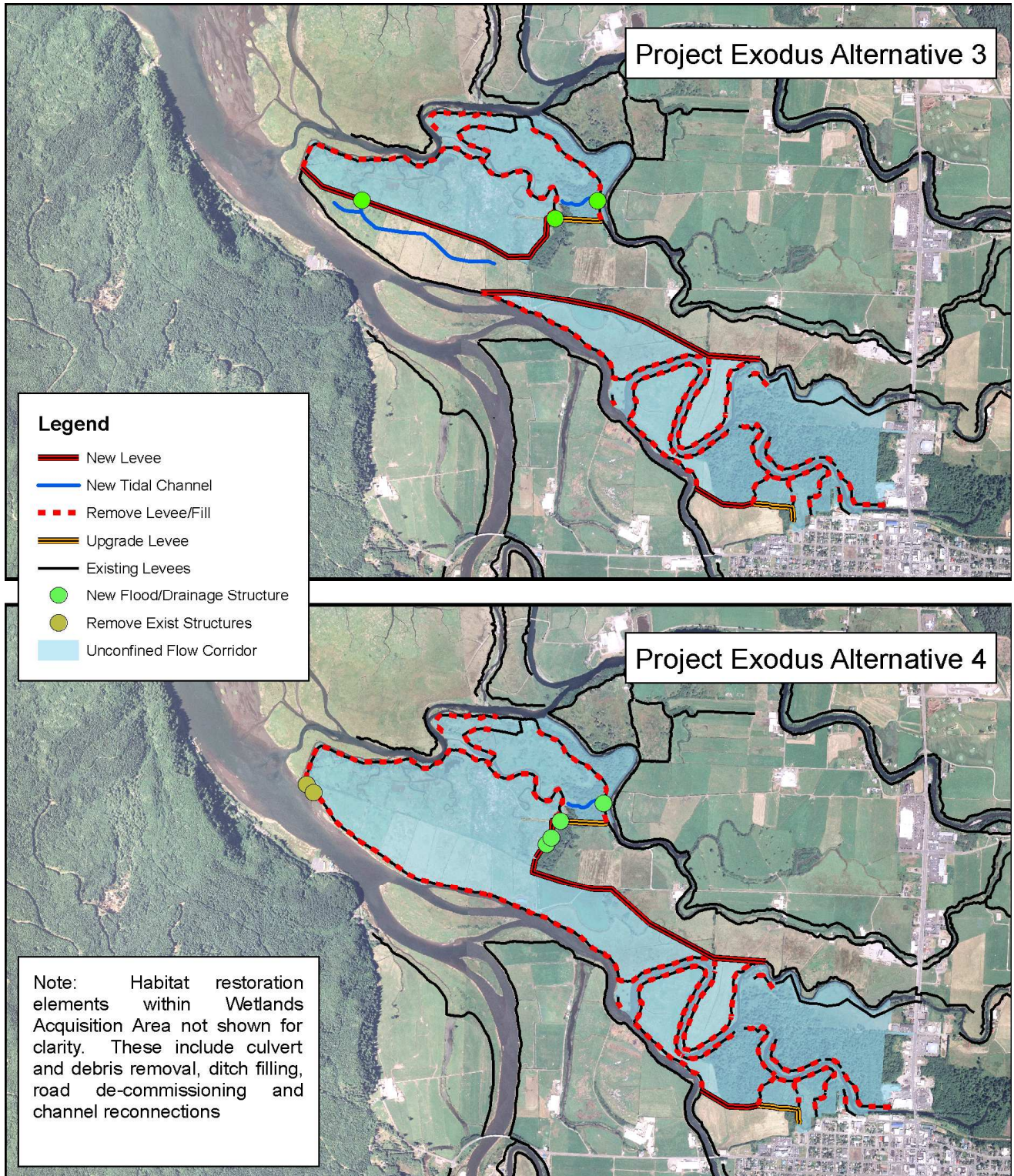
Alternative 4

This alternative combines the Project southern flow corridor with building a shorter levee system east of the current alignment. Virtually all of the Wetland Acquisition Area would be opened to flood conveyance and tidal influence. This reduces the new levee length needed substantially. It requires the removal of all the existing flood gates at the mouth of the Wilson and construction of new gates within the new levee. The proposed design would reuse all the existing gates now located at the mouth of the Wilson, but the culvert pipes and concrete structures would be removed.

Comparison of Alternatives

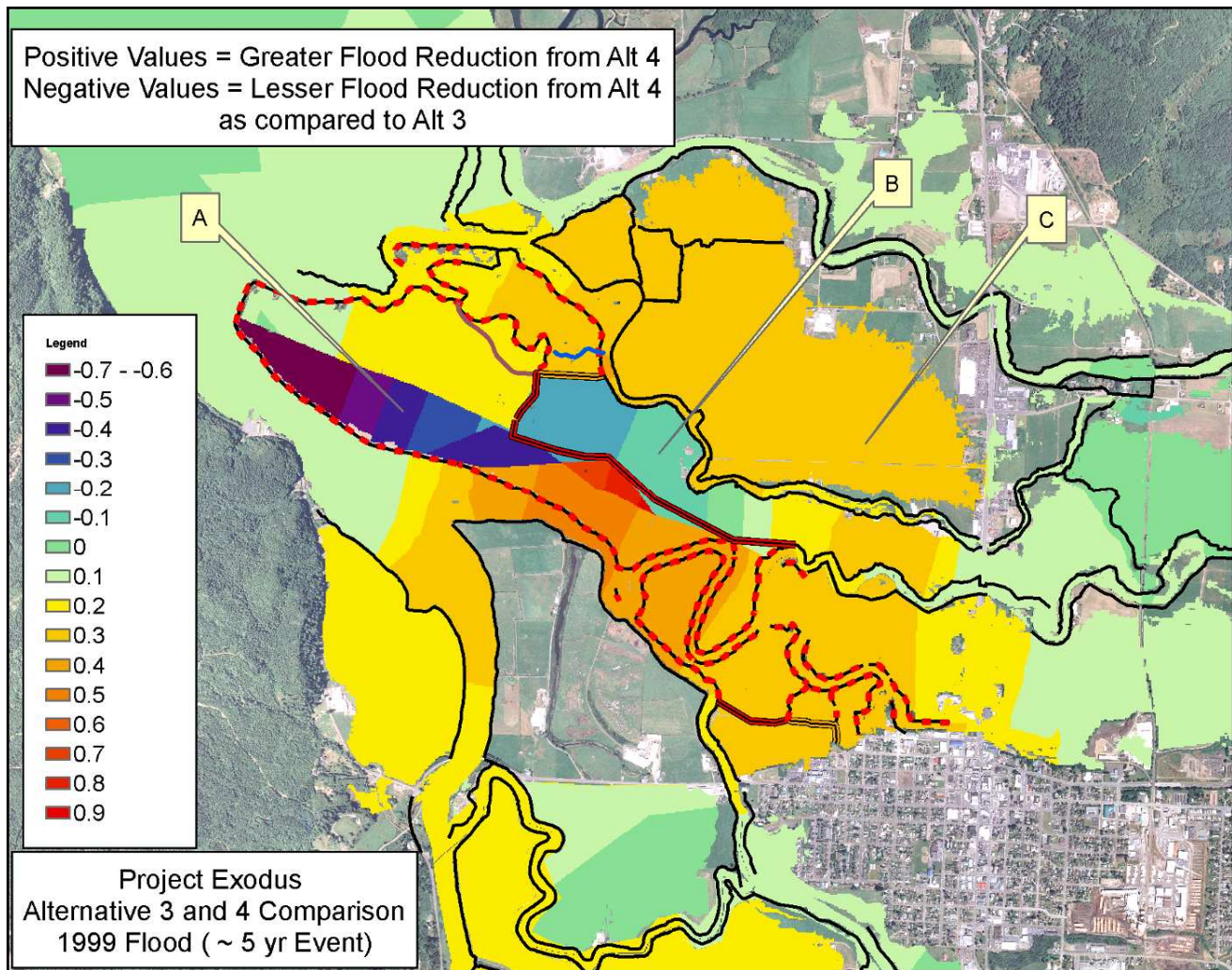
The two alternatives share many elements in common. Both the work within the southern flow corridor and within the northern half of the Wetland Acquisition Area is the same. While Alternative 4 requires more new flood gates, levee earthwork costs are much less, resulting in the lower cost estimate.

Item	Alternative 3	Alternative 4
Length of New Levee needed (ft)	14,700	9,600
Volume of new levee needed (cy)	118,000	74,000
Estimated construction costs.	\$9,250,863	\$7,173,290



Flood Reduction Benefits

Flood level changes from implementation of Alternative 4 are presented later in this report and full results for both alternatives are contained in the separate mapping document. The following figure shows the difference in water level reduction between Alternatives 3 and 4 for a 5-yr flood event, not the difference between an alternative and existing conditions. Both alternatives show good benefits throughout the lower Wilson River floodplain.



Comments: Area A differences are due to the different levee alignments here. Alternative 4 generally shows several tenths of a foot greater reduction than Alternative 3 over most of the area (C). The one area where Alternative 3 shows greater reductions is at B – here the Alt 4 levee alignment is less effective at lowering water levels.



Effect of Fuhrman Road Berm

A key change from the previous version of this alternative relates to the treatment of lower Hall Slough. Previous proposals envisioned elevating the road to the Fuhrman house and providing a bank of culverts under the road to connect Hall Slough with Blind Slough. Further analysis shows that by removing the berm that protects the road and providing a larger opening between Hall and Blind Slough further significant flood level reductions can be achieved in the south bank Wilson River. This recommendation is included in the both alternatives 3 and 4 presented.

Leaving the Fuhrman Road berm in place, but still constructing a 70 ft wide opening with a bridge has an impact on water levels as shown in the following table. The berm has the largest impact during smaller, more frequent floods when its damming function is greater. It may be possible to remove only a portion of the berm and achieve the same results. The following table shows the effects of the berm in place or removed on flood levels over 101 north of Hall Slough with the rest of Alternative 4 implemented.

Flood Run	Approx Frequency	Reduction in water level from existing conditions		Maximum Depth over SR101	
		Berm Removed	Not Removed	Berm Removed	Not Removed
100-yr	100-yr	-1.7	-1.4	1.4	1.8
1999	5-yr	-1.1	-0.4	-0.3(dry)	0.4
2001	1.5 yr	-1.4	-0.3	-1.0(dry)	0.1

Rise in 100-year water levels.

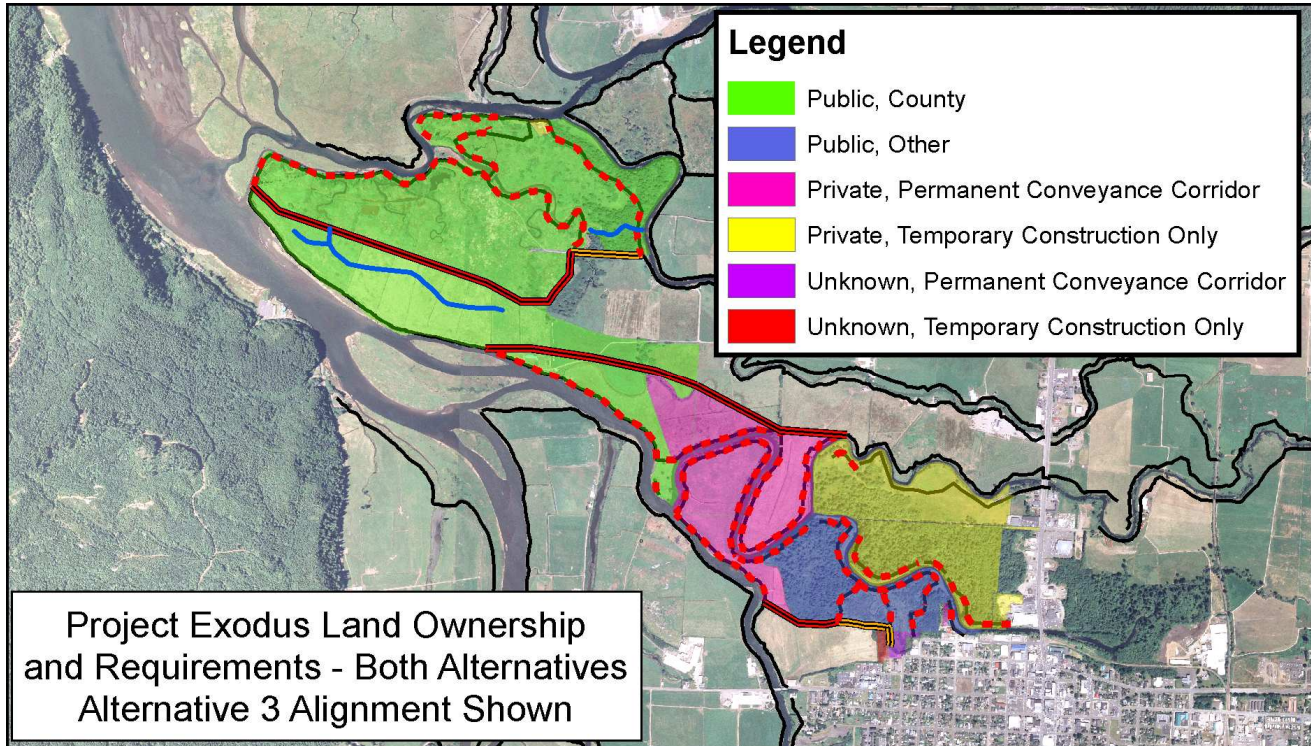
We noted at the previous meeting that a small rise in water level at the confluence of the Trask and Tillamook Rivers was predicted in all flood runs with implementation of Alternative 3 of Project Exodus. Although this area is not in the floodway, work upstream is, and basic FEMA regulations require no-rise everywhere due to work in the floodway. We investigated setting back the northern conveyance corridor levee along the Tillamook River further but the rise persisted. As this would substantially add to the project cost it was not pursued further. Project Exodus Alternative 4 does not show this same rise – we attribute this to the substantially wider conveyance width available in this area.

The federal flood code does contain a clause allowing communities to implement projects that cause rises in the floodway with appropriate public notice and other requirements. This is rarely used and guidance from the regional FEMA office on the viability of this approach is needed.

Real Estate Needs

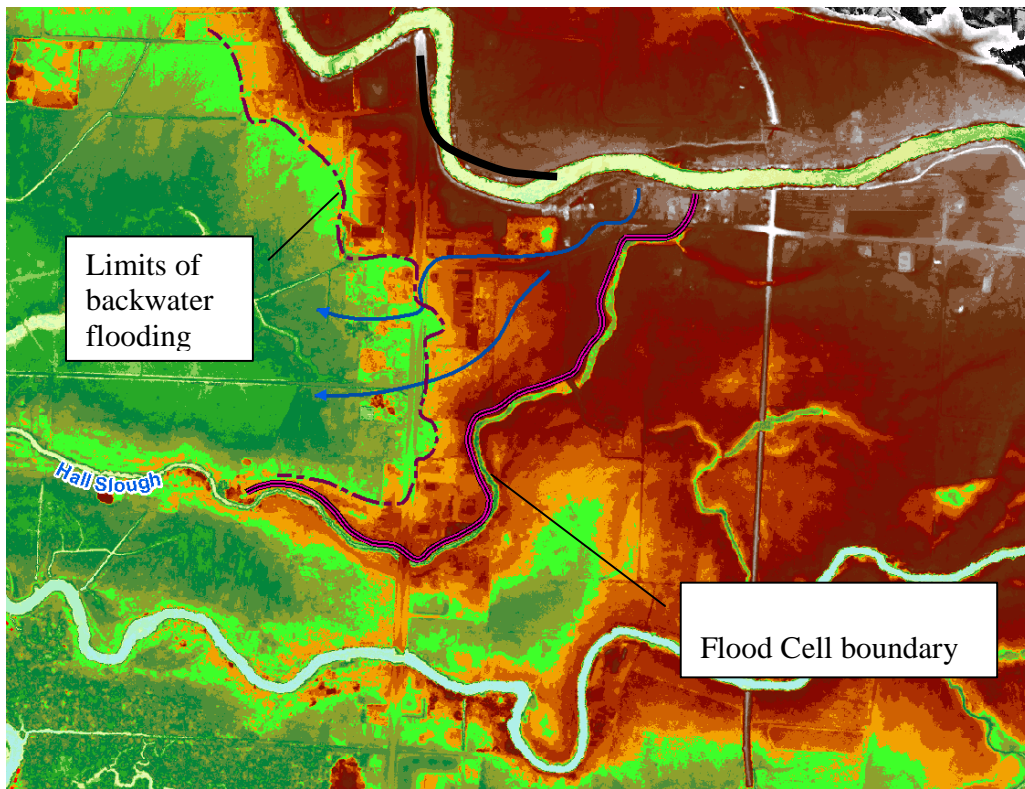
Both alternatives occupy the same overall footprint and have the same needs for the use of privately owned lands in the conveyance corridor. The following figure shows the overall land ownership and project needs. We estimate 116 acres of private lands currently in pasture will be needed for the conveyance corridor (shown in pink below). Two or three additional private parcels will need levee removal construction activities on them. Because these lands are already open to tidal influence we believe that only temporary construction access will be necessary. The remaining lands are publicly

held land owned by the County, Port of Tillamook or City of Tillamook. Please note that we have not estimated any real estate costs for these projects.



South Bank Wilson River - Hall Slough Alternatives

On the south bank of the Wilson River between the Railroad and the Shilo levee is a section with an incomplete and generally poorly constructed berm. Floods frequently overtop this area and flow south and west down through the developed area along SR101 and into the lower land to the west. The levees along the lower end of Hall Slough and the Wilson River upstream of Hall Slough are also low, so floodwaters are backed up from the Wilson River and overtop the Hall Slough levees, filling the flood cell from the west and eventually backwatering up across SR101. In somewhat larger events, overtopping of the south bank of the Wilson downstream of SR101 also contributes to this. The following two figures show this flooding pattern and the approximate division between the two flood sources. Any project here needs to address both sources in order to reduce flooding effectively.

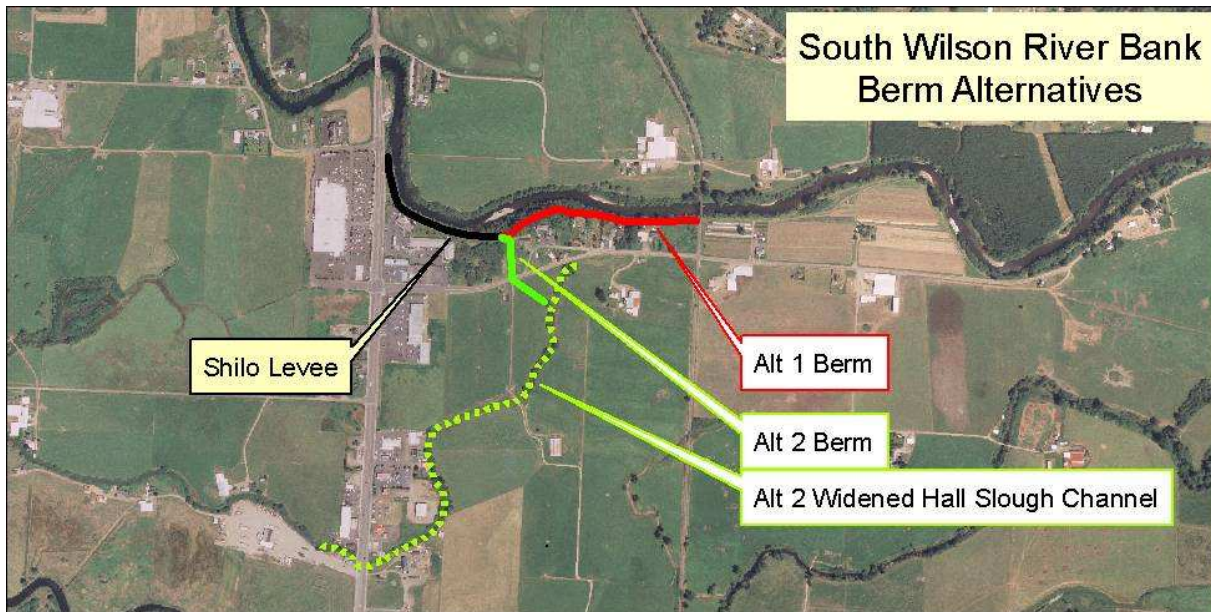




1999 Flood: Photo courtesy Don Best/Best Impressions Picture Co.

Backwater flooding from the west is addressed by the Project Exodus Alternative 3 or 4. By opening up the Wetlands Acquisition Area and providing a good connection to Hall Slough water levels will be reduced in lower Hall Slough and consequently on SR101 as described earlier.

Two berm alternatives were analyzed to address flooding coming from upstream. The first design keeps the water in the Wilson River, the second redirects the water past the area in question. Note that these are both modeled with Project Exodus Alternative 4 assumed to be constructed. The rises in flood levels discussed below will be larger and more widespread if these are constructed independently. The benefits are the same if Project Exodus Alternative 3 was to be constructed instead.



Berm Alternative 1

The first alternative is to construct a new berm tying in from the railroad grade fill downstream to the Shilo levee. The 1600 foot long berm would be engineered to resist overtopping and prevent overbank flows up to around a 5-year frequency flood. Modeling indicates this alternative is effective. However, there is still a rise of up to 0.2 ft in the Wilson River mainstem in the 100-yr flood due to the project, caused by increased flows in the river from the higher berm.

There are a series of options that can be chosen to address this rise. First, if the berm footprint is outside of the floodway, FEMA zero-rise standards do not apply, the one-foot rise standard applies. Given that (with alternative 4 or 3 implemented) flood levels are lowered throughout the floodplain where people and structures are located, the community may choose to accept a small rise in the river channel itself.

If, due to floodway rules or a community decision, the project must meet zero-rise standards there are several mitigation options that can be pursued. Initial modeling of several options was conducted to see if relatively simple projects could work to do this by pulling the added flows out of the river to restore existing condition flow rates. However, neither lowering 2000 feet of the north river berm and bank by 1-2 feet; nor sending more water south through an 8 ft diameter culvert ; or sending water south over a 100 foot wide lowered spillway were successful in reducing water levels below existing conditions.

The implication of this is that a larger, more complex project is needed to mitigate the rise. Using the south bank would require at a minimum an excavated connection to the river and a new culvert or bridge. The Corps of Engineers Feasibility Study evaluated an Hall Slough alternative consisting of reopening a connection to the Wilson River, extensive widening of Hall Slough and some setback levees and berms. It was estimated around 1000 cfs could be conveyed down this channel. We have not



evaluated flood benefits of this project. The estimated cost was around \$6 million. These costs are very large for mitigating a small rise in the Wilson River and we do not recommend this alternative from a flood control perspective.

Berm Alternative 2

The second berm alternative is to use a “guide berm” to still allow overbank flows through the area, but direct all the flow into Hall Slough rather than flowing west towards the highway. This berm would run south from the upper end of the Shilo levee and redirect flows that would otherwise flow west into Hall Slough. The upper end of the Hall Slough channel down to just past SR101 would be excavated in order to prevent a rise in water surface in this reach due to the increased flows. By the time flows in Hall Slough pass 101, the effects of implementing Project Exodus take over and further channel improvement is not needed. The roadway would be elevated where it passes over this berm. This alternative does not reduce flooding among the homes and properties north of the road, and may cause some flood level increases here that are not able to be captured by the model resolution.

Level of protection

A final alternative that can be used in combination with either of the berm alternatives is to provide a lower level of protection. This will allow more frequent flooding in the area north bank SR101 area, but cause less water surface rise elsewhere and may lead to lower mitigation costs.

Summary

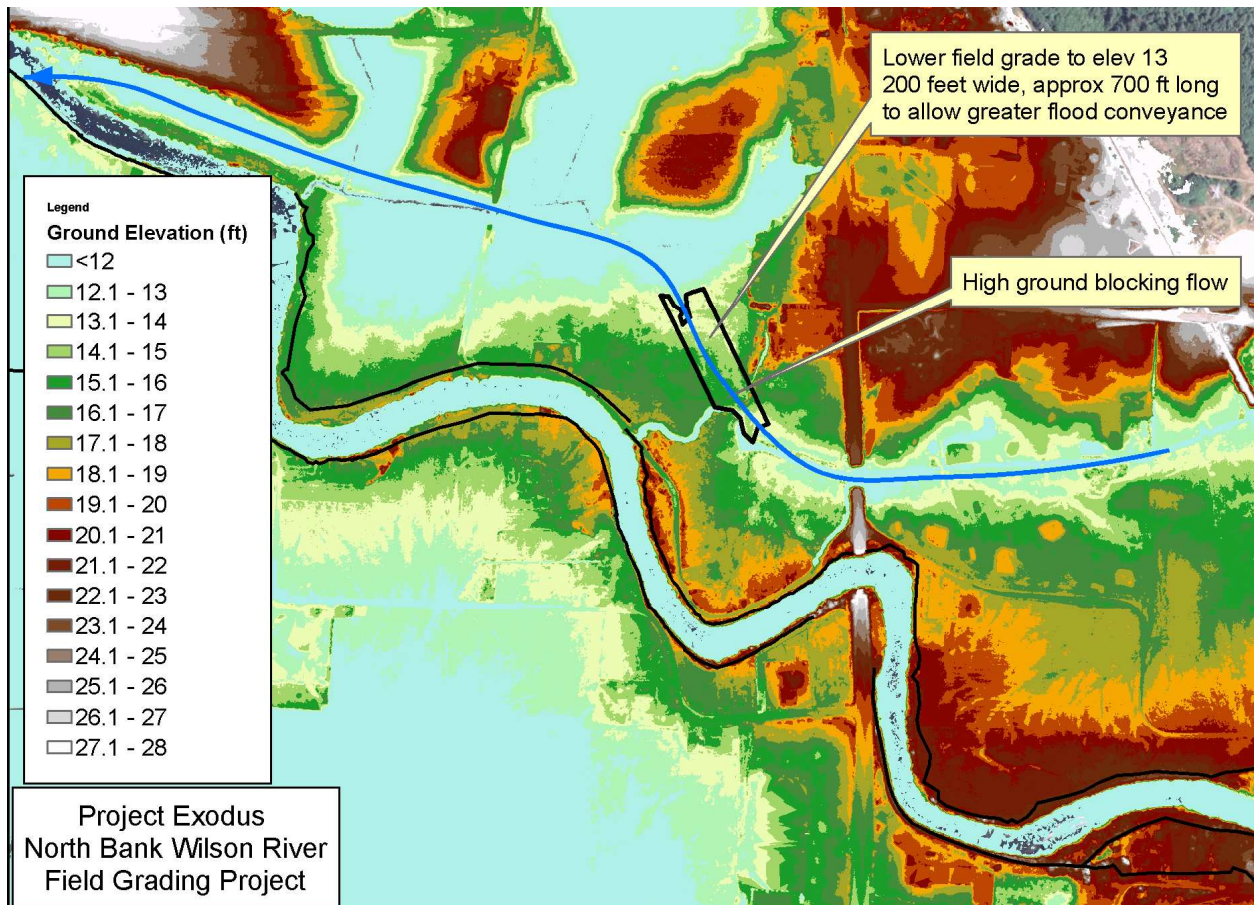
Building one of the two berm alternatives will reduce the frequency of flooding on land east of 101 and north of Hall Slough. Mitigation costs to address zero rise criteria for Alternative 1, if necessary, could be substantially larger than the berm costs itself and have not been developed yet. Implementation of the Project Exodus alternative will greatly reduce nuisance flooding on 101 itself and lands to the west. The actual extent and quality of the existing berm between the Shilo Levee and the railroad is unknown due to the dense tree and brush cover preventing accurate Lidar mapping. Field survey is recommended here prior to further design work being performed. Both alternatives will require acquisition of flood control easements from multiple landowners.

Item	Berm Alternative A	Berm Alternative B
Estimated construction costs.	\$949,163	\$856,031

North Bank Wilson Project

Floodwaters overtopping the north bank of the Wilson River beginning upstream of SR101 are routed through a relief bridge under SR101, then flow back into the river over the levees downstream or through relatively small drainage culverts. There is an area of high floodplain that divides this area in two. Modeling and flood photo inspection indicates that this “ridge” causes a backwater that extends upstream of 101 during flood conditions. This project would lower the field across this high area to increase conveyance. Topsoil would be cleared to the side, the ground underneath removed and the topsoil replaced to allow continued agricultural use. The soils could possibly be spread out onsite and tilled into the fields, used to fill low areas of nearby fields, or completely removed if necessary. Water level reductions of 1 to 2 feet are predicted by the model throughout the range of floods from annual to 100-yr events. The project is located within one parcel and would require temporary construction easements and possibly a permanent flood conveyance easement.

Estimated construction costs.	\$286,445
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Dougherty Slough Inlet

Dougherty Slough diverts significant quantities of flow from the Wilson River – on the order of 3000-4000 cfs during small to medium floods. Three alternatives have been evaluated, two of them designed to reduce flows into the slough inlet.

Keep the Existing Structure

The existing structure appears to be functioning well, metering flows by floating at higher water levels and allowing flow underneath. It is our opinion that there is no immediate need to replace the structure. It may be prudent to evaluate the estimated strength of the cables and deadman anchors that hold the jam in place if this was not done when constructed.

Augment Existing Structure

One alternative to reducing flows is to ballast the existing structure to reduce or prevent flotation at higher water levels. Steel or timber piles could be driven around and through the structure and additional wood and cabled rock ballast placed on top. With sufficient weight above water levels the structure would no longer float and the amount of flow should be reduced dramatically. Sediment ingestion would also be significantly reduced. Flow would still pass through the structure. It is possible that the structure would infill with sediment and become a complete plug at some point. Some armoring around each side may be necessary to ensure flows did not erode around the jam. Driving piles could also be used to strengthen the existing structure while still allowing it to float and operate as it does now.

Slot Structure

We evaluated replacing the existing cabled log jam with a slot inlet structure. The purpose of the structure is to limit the intake of water and sediment into the slough, allow free surface flow through a wide range of water levels for juvenile fish access and minimize maintenance costs. Several hundred feet of channel downstream of the inlet would be regraded and lowered and wood placed throughout to create a channel with good habitat value, less stranding issues and better fish passage.

Flood Benefits

Evaluation of restricting flows in the slough inlet showed little benefit for flows greater than the 5-yr level and beyond. Restricting flows causes a rise in the Wilson River. This increases overtopping depths over thousands of feet of bank, especially upstream. The net result is overbank flows downstream, and hence water levels, do not differ significantly with any of the alternatives. We have no included a project here for this reason.

Table 1

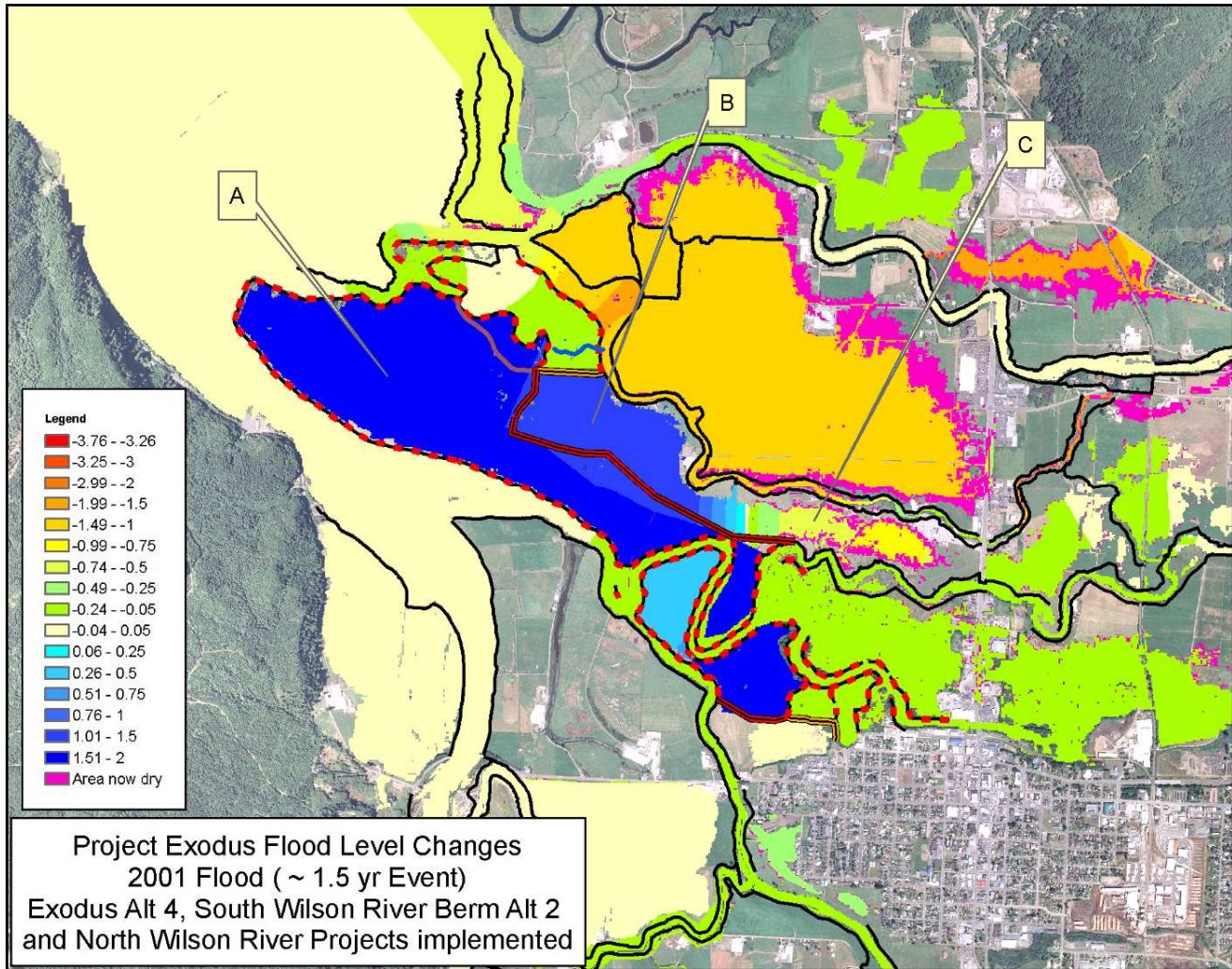
Item	Augment Exist. Structure	Slot Inlet Structure
Estimated construction costs.	\$638,085	\$1,431,783



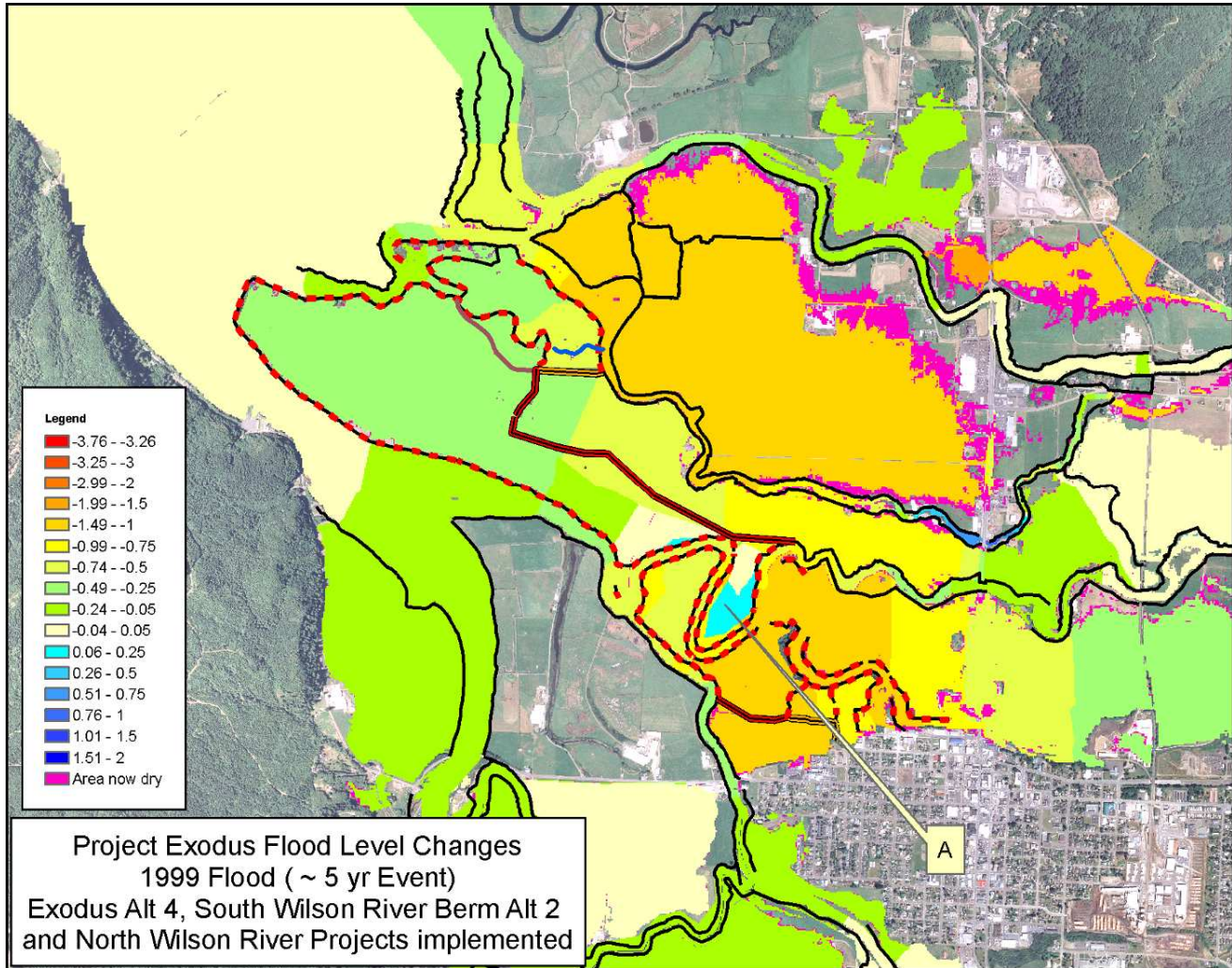
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Overall Flood Level Reduction Benefits

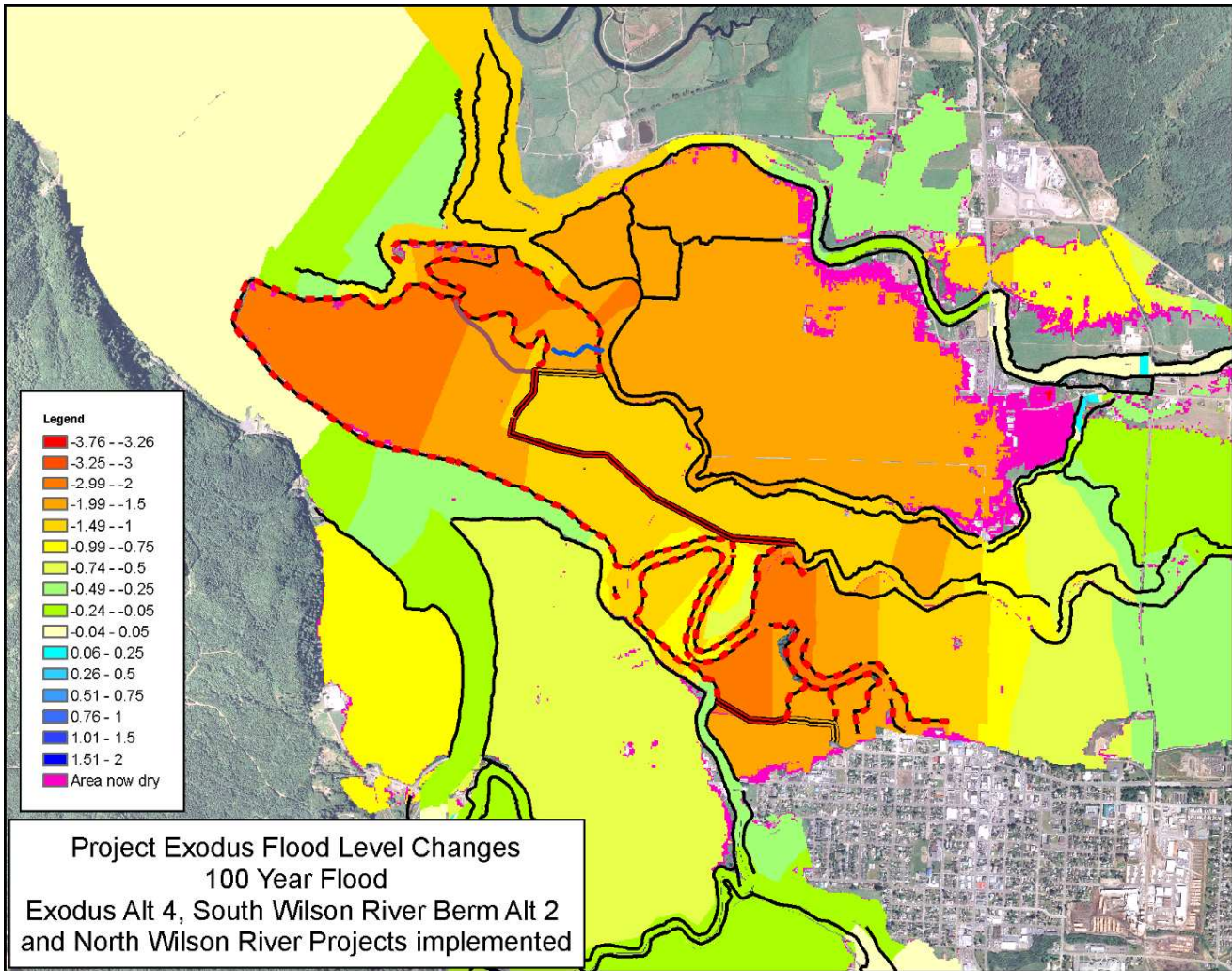
The following three figures show the difference in maximum water surface elevation predicted due to the implementation of Project Exodus Alternative 4, South Bank Wilson River Berm Alternative B, and the North Bank Wilson River Field Grading Project. The South Bank berm project primarily affects flood levels east of 101 and north of Hall Slough. The North Bank project affects only flood levels in that area. As noted previously, Alternative 3 provides similar benefits to Alternative 4, but is generally 0.2-0.4 ft less effective.



Comments: In this very small event, note the rises shown in the Wetland Acquisition Area. Areas now in the conveyance corridor (A) show large rises because the high tide now floods the land whereas before the area was protected by levees. Point B shows where the lower end of the now shortened conveyance pathway has a rise. It is in these small floods that the current configuration of the Wetlands acquisition area provides sufficient storage to keep water levels below high tide level outside the levees. Alternative 4 removes most of this storage, causing the rise in the lower end. The actual water levels are still well below any structures in the area. Also note that upstream in the same conveyance path the rise tapers out and water level reductions are achieved nearer to SR101 (C).



Comments: By a 5-yr flood, the increased conveyance benefits of Project Exodus more than compensate for the loss of flood storage in current Wetlands Acquisition Area. Flood level reductions are achieved everywhere. Point “A” is a mapping issue- water level reductions are achieved here as well.



Comments: In the 100-yr flood significant flood level reductions are achieved everywhere and small benefits extend up the Trask and Tillamook systems as well. Note that the area east of 101 and south of the Shilo levee now does not flood at all due to the South Bank Wilson River berm project. The water level reductions shown on the North Bank Wilson in this flood and the previous figures are due to the North Bank Wilson River project – Project Exodus alternatives do not provide benefits here.



Preliminary Cost Estimates

PROJECT EXODUS ALTERNATIVE 3

Item No.	Item	Unit	Quantity	Unit Price	Total Amount
1	Mobilization, Bonding, Insurance, Demobilization @ 5%	LS	1	\$62,000	\$62,000
2	Clearing & Grubbing	LS	1	\$36,000	\$36,000
3	Construction Staking	LS	1	\$24,000	\$24,000
4	Construction Compaction Testing	LS	1	\$24,000	\$24,000
5	Erosion Control Measures	LS	1	\$58,000	\$58,000
6	Filter Fabric at Levee Base	SY	73,000	\$2.60	\$189,800
7	Strip and Haul Organics Offsite from Levee Base	CY	38,000	\$14	\$532,000
8	Strip and Spread Organics on Levee Face	CY	11000	\$11	\$121,000
9	Temporary Access Road Aggregate Base Improvements	CY	8,000	\$22	\$176,000
10	Temporary Access Road Pavement Repair	TON	250	\$90	\$22,500
11	Remove Old Levee and use in New Levee Core (short haul)	CY	60,000	\$22	\$1,320,000
12	Haul Excess Material from South Levees Offsite	CY	30,000	\$14	\$420,000
13	Haul in Material for New Levee from Spoils Pile	CY	57,000	\$28	\$1,596,000
14	Construction Fencing/Protection	LF	30,000	\$3	\$90,000
15	Levee Finish Slopes	LS	All	\$60,000	\$60,000
16	Levee Roadway Aggregate Base (12" depth) (7320 lf x 12' wide)	CY	5,600	\$22	\$123,200
17	New Flood Structure	EA	2	\$400,000	\$800,000
18	Removal of Plugs/Tidegates, Disposal of Rubbish, Tires	LS	1	\$24,000	\$24,000
19	Install Woody Debris	LS	1	\$80,000	\$80,000
20	Install Organics/Fill Low Reas	LS	1	\$52,500	\$52,500
21	Construction Fencing/Protection	LF	30,000	\$3	\$90,000
22	Floating Sedimentation Fences	LS	1	\$50,000	\$50,000
23	Excavate Swale at Fuhman Road and Spread on Levee Sides	CY	1,100	\$14	\$15,400
24	Temporary Dewatering	LS	1	\$28,000	\$28,000
25	Armour Protection	CY	400	\$20	\$8,000
26	RR Flatcard Bridge on Fuhman Road	EA	1	\$120,000	\$120,000
27	Fuhman Road Upgrade for Bridge Delivery	CY	200	\$26	\$5,200
28	Excavate Tidal Wetland	CY	6,666	\$14	\$93,324
Subtotal Construction Costs					\$6,220,924
Permitting					\$60,000
Engineering, Administration, Legal @ 18%					\$1,119,766
Subtotal Project Costs					\$7,400,690
25% Contingency					\$1,850,173
Total Project Costs					\$9,250,863



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PROJECT EXODUS ALTERNATIVE 4

Item No.	Item	Unit	Quantity	Unit Price	Total Amount
1	Mobilization, Bonding, Insurance, Demobilization @ 5%	LS	1	\$62,000	\$62,000
2	Clearing & Grubbing	LS	1	\$36,000	\$36,000
3	Construction Staking	LS	1	\$24,000	\$24,000
4	Construction Compaction Testing	LS	1	\$24,000	\$24,000
5	Erosion Control Measures	LS	1	\$58,000	\$58,000
6	Filter Fabric at Levee Base	SY	42,000	\$2.60	\$109,200
7	Strip and Haul Organics Offsite from Levee Base	CY	16,000	\$14	\$224,000
8	Strip and Spread Organics on Levee Face	CY	12000	\$11	\$132,000
9	Temporary Access Road Aggregate Base Improvements	CY	8,000	\$22	\$176,000
10	Temporary Access Road Pavement Repair	TON	250	\$90	\$22,500
11	Remove Old Levee and use in New Levee Core (short haul)	CY	40,000	\$22	\$880,000
12	Haul Excess Material from South Levees Offsite	CY	10,000	\$14	\$140,000
13	Haul in Material for New Levee from Spoils Pile	CY	34,000	\$28	\$952,000
14	Construction Fencing/Protection	LF	15,000	\$3	\$45,000
15	Levee Finish Slopes	LS	All	\$40,000	\$40,000
16	Levee Roadway Aggregate Base (12" depth) (7320 lf x 12' wide)	CY	3,300	\$22	\$72,600
17	6' Diameter Culverts with Top Hinge Tidegate (70' length)	EA	10	\$40,000	\$400,000
18	6' Diameter Culverts with Reuse Tidegates	EA	10	\$30,000	\$300,000
19	New Flood Structure	EA	1	\$400,000	\$400,000
20	New Flood Structure, Reuse Flood Gates and Tide Gates	EA	1	\$300,000	\$300,000
21	Demo Existing Structure, and Culverts	LS	1	\$12,000	\$12,000
22	Removal of Plugs/Tidegates, Disposal of Rubbish, Tires	LS	1	\$24,000	\$24,000
23	Install Woody Debris	LS	1	\$70,000	\$70,000
24	Install Organics/Fill Low Reas	LS	1	\$52,500	\$52,500
25	Construction Fencing/Protection	LF	10,000	\$3	\$30,000
26	Floating Sedimentation Fences	LS	1	\$50,000	\$50,000
27	Excavate Swale at Fuhman Road and Spread on Levee Sides	CY	1,100	\$14	\$15,400
28	Temporary Dewatering	LS	1	\$28,000	\$28,000
29	Armour Protection	CY	400	\$20	\$8,000
30	RR Flatcard Bridge on Fuhman Road	EA	1	\$120,000	\$120,000
31	Fuhman Road Upgrade for Bridge Delivery	CY	200	\$26	\$5,200
Subtotal Construction Costs					\$4,812,400
Permitting					\$60,000
Engineering, Administration, Legal @ 18%					\$866,232
Subtotal Project Costs					\$5,738,632
25% Contingency					\$1,434,658
Total Project Costs					\$7,173,290



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SOUTH BANK WILSON RIVER BERM ALTERNATIVE A

No.	Item	Unit	Quantity	Unit Price	Total Amount
1	Mobilization, Bonding, Insurance, Demobilization, Traffic Control	LS	1	\$32,000	\$32,000
2	Clearing and Grubbing (Haul Offsite)	CY	7600	\$14	\$106,400
3	Construction Staking	LS	1	\$12,000	\$12,000
4	Compaction Testing	LS	1	\$12,000	\$12,000
5	Erosion Control Measures	LS	1	\$21,000	\$21,000
6	Filter Fabric at Base of Levee	SY	11500	\$2.50	\$28,750
7	Strip and Spread Organics on Levee Face	CY	4030	\$11	\$44,330
8	Temporary Access Roadway	CY	760	\$22	\$16,720
9	Gravel Road on Top of Levee	CY	630	\$22	\$13,860
10	Haul in Material for New Levee and Earthwork	CY	9600	\$28	\$268,800
11	Construction Fencing/Protection	LF	3400	\$2.50	\$8,500
12	Levee Finish Slopes	LS	1	\$16,000	\$16,000
Subtotal Construction Costs					\$580,360
Engineering, Administration, Legal @ 18%					\$104,465
Subtotal Project Costs					\$684,825
25% Contingency					\$171,206
Total Project Costs					\$856,031

SOUTH BANK WILSON RIVER BERM ALTERNATIVE B

Item No.	Item	Unit	Quantity	Unit Price	Total Amount
1	Mobilization, Bonding, Insurance, Demobilization	LS	1	\$32,000	\$32,000
2	Clearing and Grubbing, Haul Offsite	CY	1900	\$14	\$26,600
3	Construction Staking	LS	1	\$12,000	\$12,000
4	Construction Compaction Testing	LS	1	\$12,000	\$12,000
5	Erosion Control Measures	LS	1	\$8,000	\$8,000
6	Filter Fabric at Base of Levee	SY	3000	\$3	\$7,800
7	Traffic Control	LS	1	\$6,000	\$6,000
8	Raise Paved Roadway 2.5'	LS	1	\$58,500	\$58,500
9	Construction Fencing	LF	1600	\$3	\$4,800
10	Levee Finish Slopes	LS	1	\$10,000	\$10,000
11	Haul in Material for New Levee	CY	3900	\$28	\$109,200
12	Channel Excavation for Hall Slough	CY	25000	\$14	\$350,000
13	Gravel Levee Road 10' wide x 770' long x 12" deep	CY	300	\$22	\$6,600
Subtotal Construction Costs					\$643,500
Engineering, Administration, Legal @ 18%					\$115,830
Subtotal Project Costs					\$759,330
25% Contingency					\$189,833
Total Project Costs					\$949,163



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NORTH BANK WILSON RIVER FIELD GRADING PROJECT

No.	Item	Unit	Quantity	Unit Price	Total Amount
1	Mobilization, Bonding, Insurance, Demobilization	LS	1	\$10,000	\$10,000
2	Excavate underlying soil and Spread in Fields	CY	4900	\$14	\$68,600
3	Excavate and Replace Topsoil	CY	4400	\$24	\$105,600
4	Construction Staking	LS	1	\$5,000	\$5,000
5	Finish Grading and Seeding	LS	1	\$5,000	\$5,000
Subtotal Construction Costs					\$194,200
Engineering, Administration, Legal @ 18%					\$34,956
Subtotal Project Costs					\$229,156
25% Contingency					\$57,289
Total Project Costs					\$286,445

DOUGHERTY SLOUGH INLET PILING ALTERNATIVE

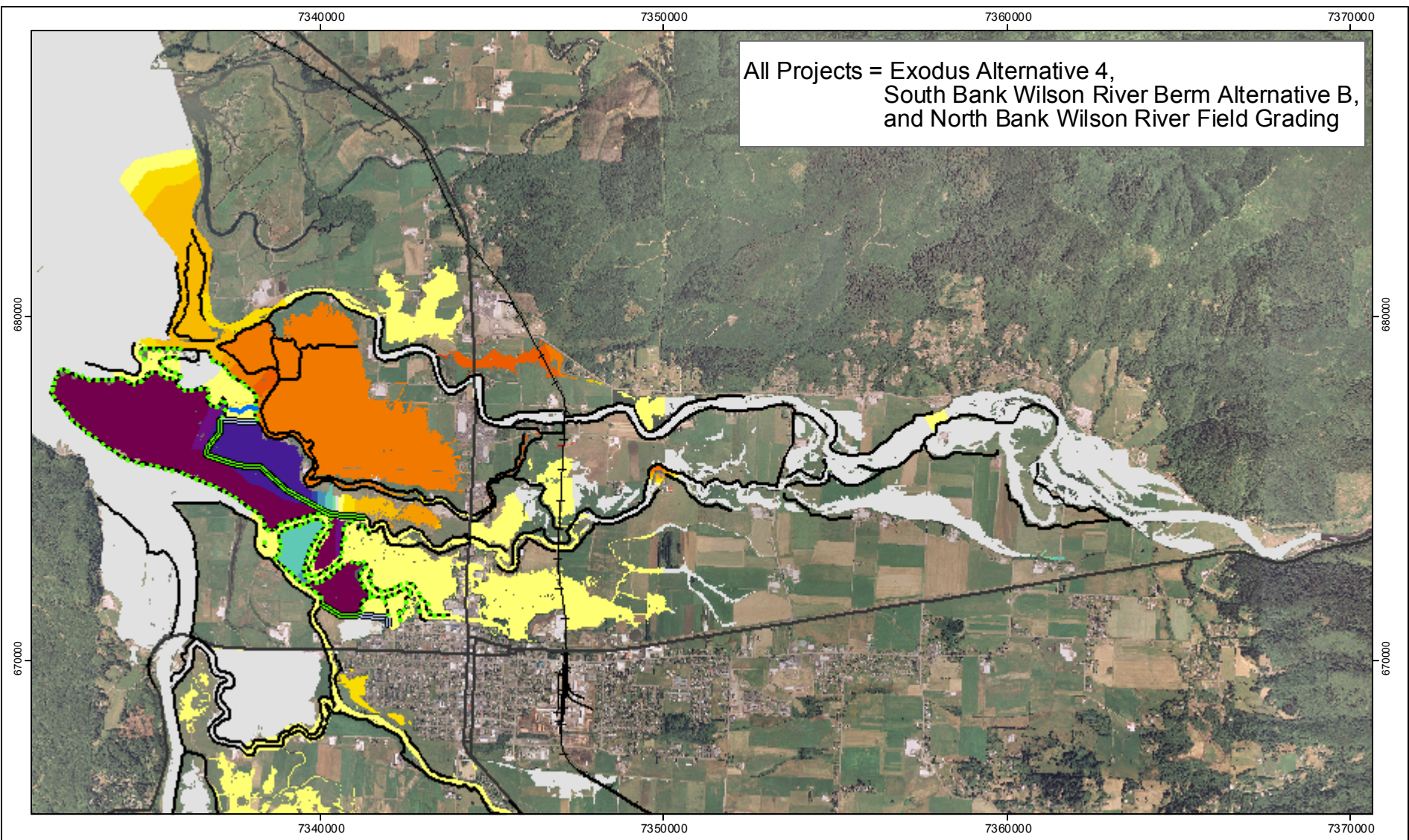
Item No.	Item	Unit	Quantity	Unit Price	Total Amount
1	Mobilization, Bonding, Insurance, Demobilization	LS	1	\$20,600	\$20,600
2	Permits	LS	1	\$5,000	\$5,000
3	Access Roadway (12' x 1,000 lf @ 12" depth)	CY	800	\$30	\$24,000
4	Grading/Earthwork for Roadway	LS	1	\$8,000	\$8,000
5	Grading of Channels/Banks for 2000 lf	LS	1	\$16,000	\$16,000
6	Installation of Additional Woody Debris	LS	1	\$25,000	\$25,000
7	Erosion Control	LS	1	\$10,000	\$10,000
8	Fish Protection	LS	1	\$20,000	\$20,000
9	Restoration	LS	1	\$30,000	\$30,000
10	Anchor Log Dam with "H" Piling	LS	1	\$260,000	\$260,000
11	Clearing and Grubbing	LS	1	\$14,000	\$14,000
Subtotal Construction Costs					\$432,600
Engineering, Administration, Legal @ 18%					\$77,868
Subtotal Project Costs					\$510,468
25% Contingency					\$127,617
Total Project Costs					\$638,085



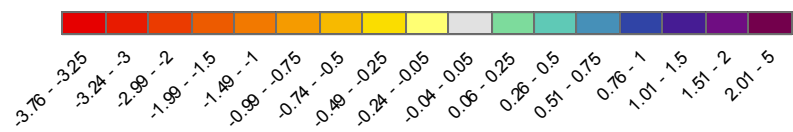
DOUGHERTY SLOUGH INLET SLOT INLET ALTERNATIVE

Item No.	Item	Unit	Quantity	Unit Price	Total Amount
1	Mobilization, Bonding, Insurance, Demobilization	LS	1	\$50,000	\$50,000
2	Permits	LS	1	\$5,000	\$5,000
3	Armourment	CY	800	\$30	\$24,000
4	Access Roadway (12' x 1,000 lf @ 12" depth)	CY	450	\$26	\$11,700
5	Grading/Earthwork for Roadway	LS	1	\$8,000	\$8,000
6	Grading of Channels/Banks for 2000 lf	LS	1	\$16,000	\$16,000
7	Installation of Woody Debris	LS	1	\$20,000	\$20,000
8	Erosion Control	LS	1	\$12,000	\$12,000
9	Fish Protection	LS	1	\$20,000	\$20,000
10	Restoration	LS	1	\$30,000	\$30,000
11	Removal of Log Dam and Cable Support	LS	1	\$60,000	\$60,000
12	Clearing and Grubbing	LS	1	\$14,000	\$14,000
13	Sheet Pile Wall with 1' Opening 120' total length, 40' tall with 40' wide opening at 30' height	LS	1	\$700,000	\$700,000
Subtotal Construction Costs					\$970,700
Permitting					
Engineering, Administration, Legal @ 18%					\$174,726
Subtotal Project Costs					\$1,145,426
25% Contingency					\$286,357
Total Project Costs					\$1,431,783

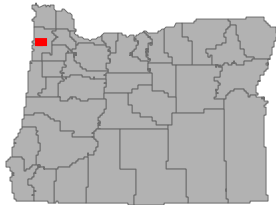
All Projects = Exodus Alternative 4,
 South Bank Wilson River Berm Alternative B,
 and North Bank Wilson River Field Grading



Water Surface Elevation Difference From Base Case



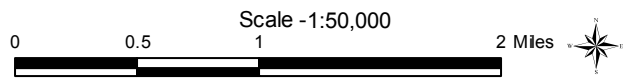
OR Reference Map



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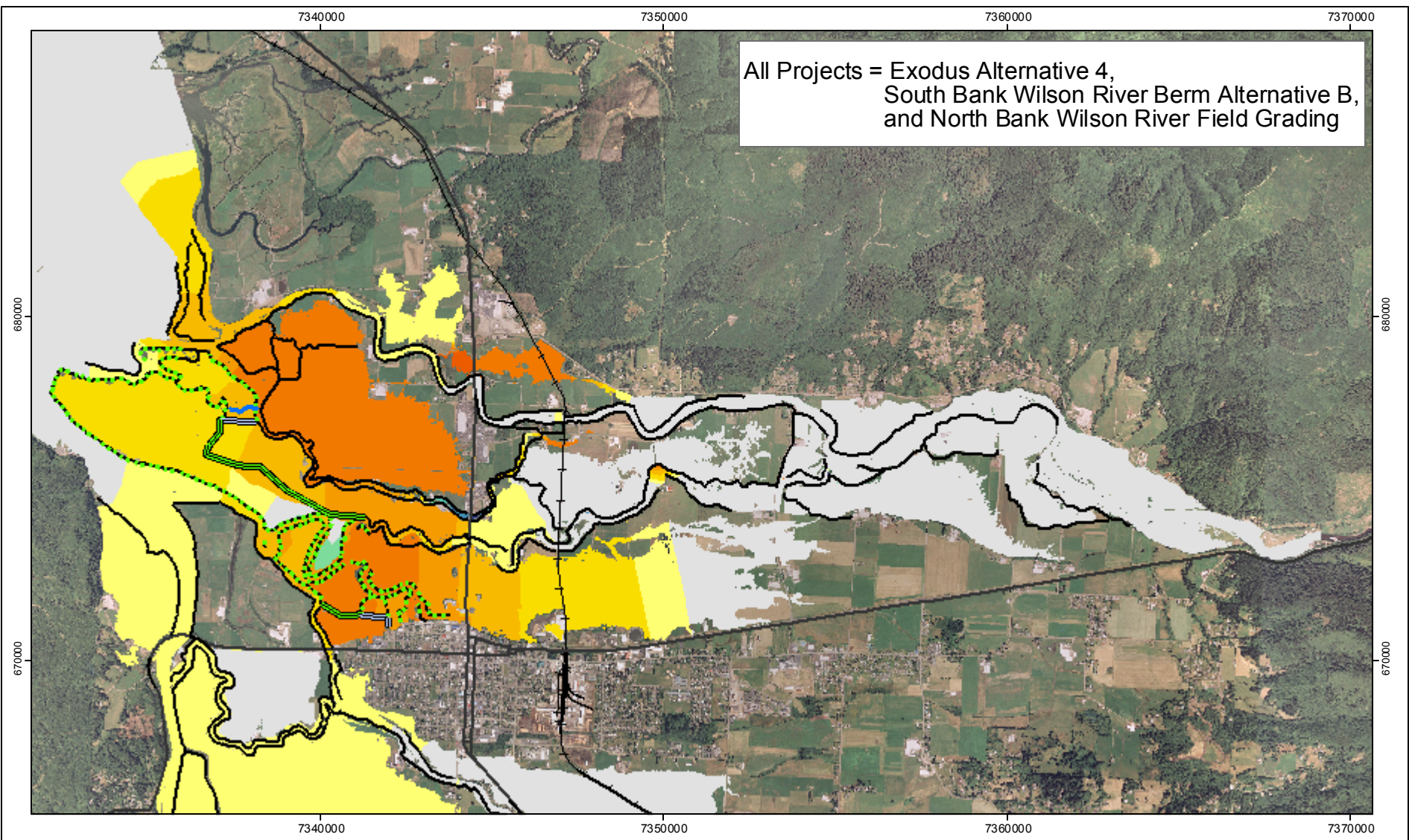
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First Flood Control Project
 All Projects 2001

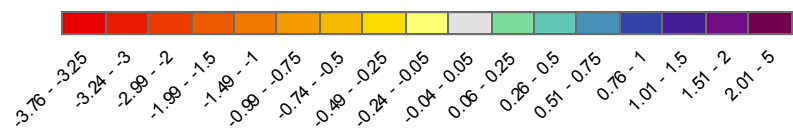


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northwest hydraulic consultants	project no. 21672	29-July-2009

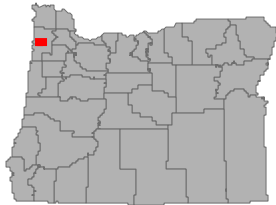
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Water Surface Elevation Difference From Base Case



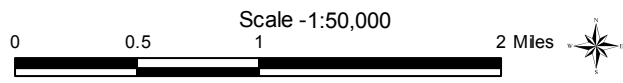
OR Reference Map



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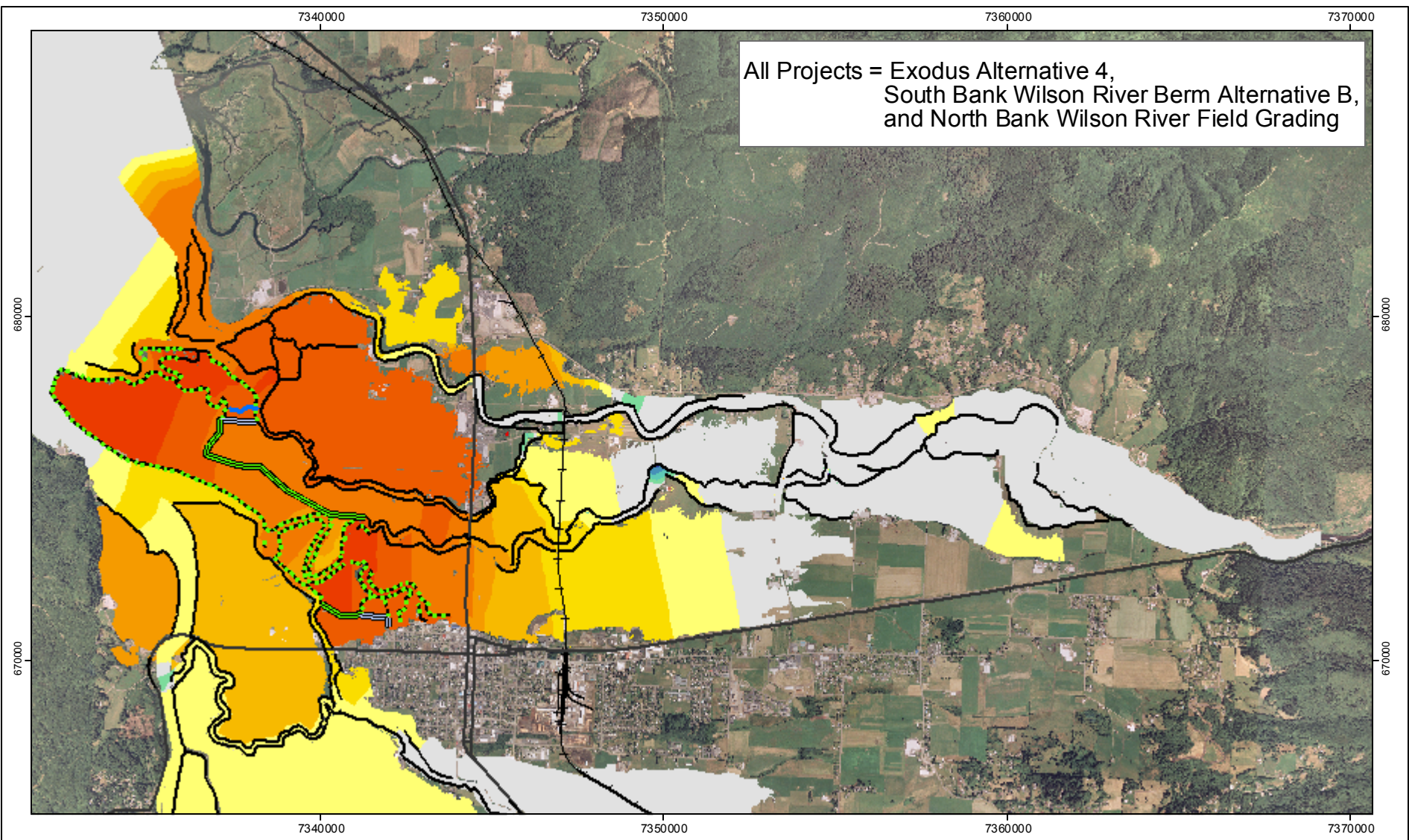
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First Flood Control Project
 All Projects 1999

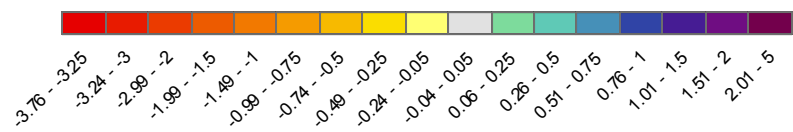


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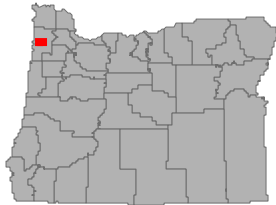
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Water Surface Elevation Difference From Base Case

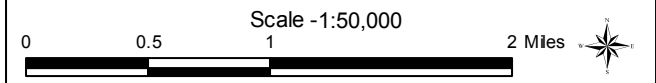


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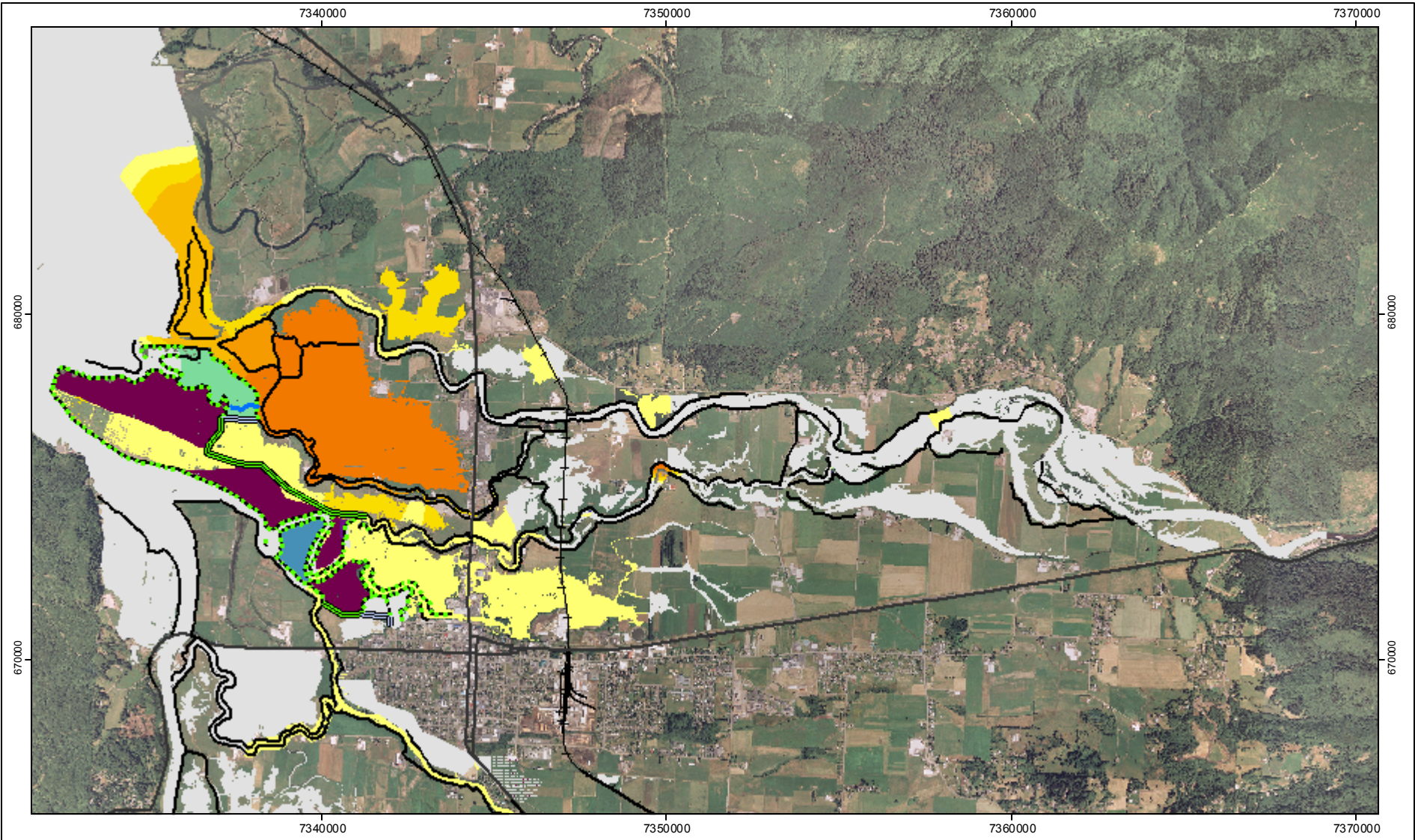


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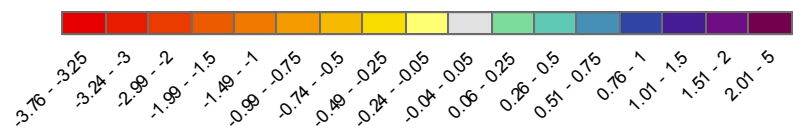
DRAFT First Flood Control Project
 All Projects 100yr



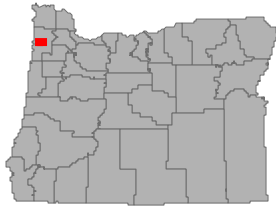
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northwest hydraulic consultants	project no. 21672	29-July-2009



Water Surface Elevation Difference From Base Case

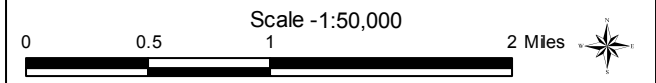


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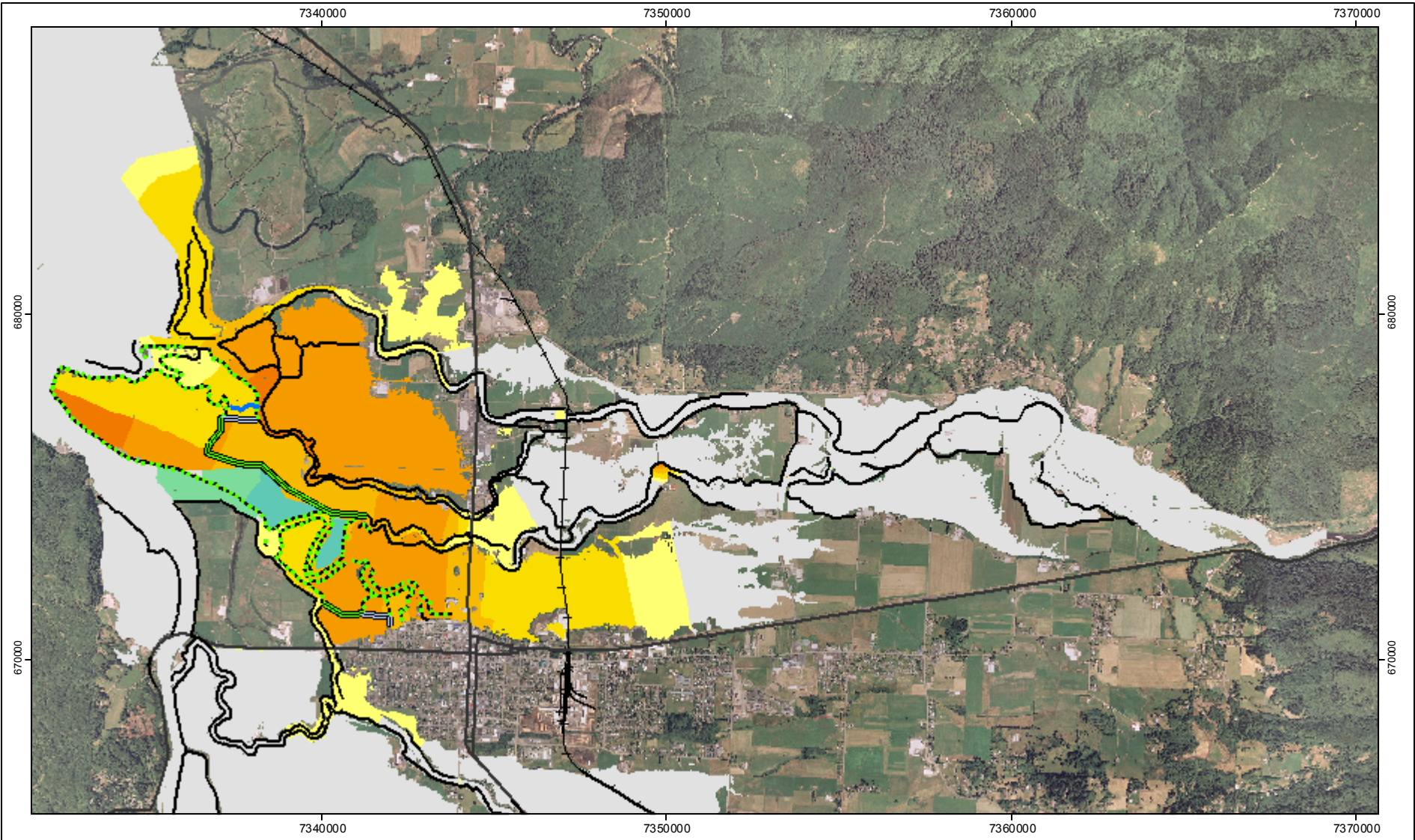


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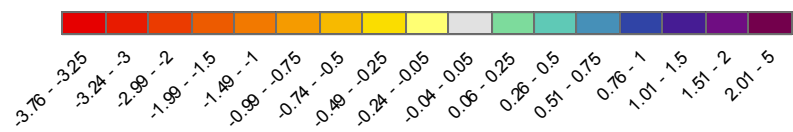
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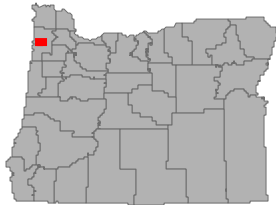
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northwest hydraulic consultants	project no. 21672	29-July-2009



Water Surface Elevation Difference From Base Case

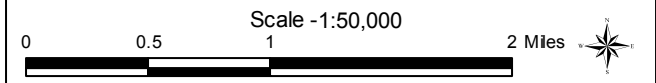


OR Reference Map

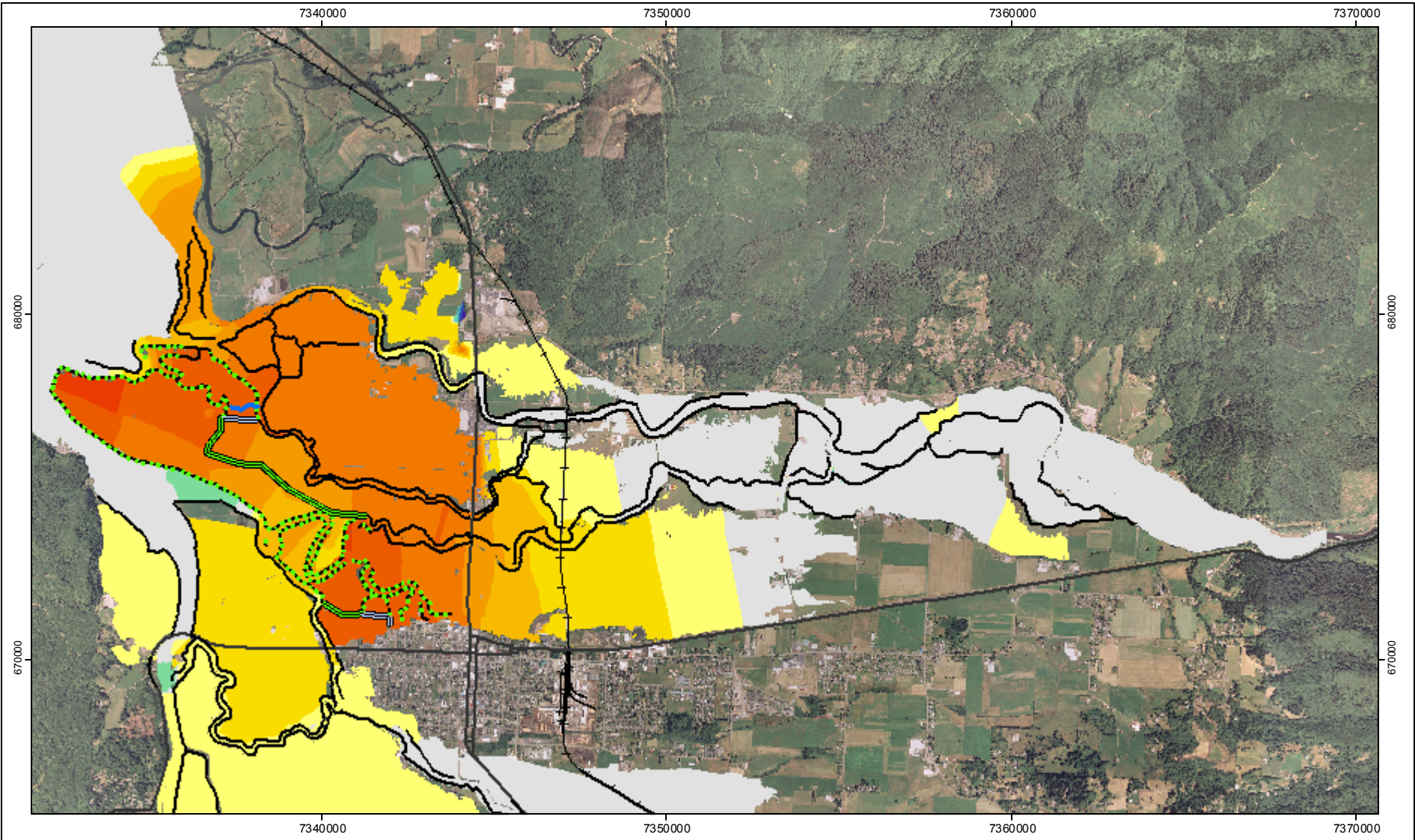


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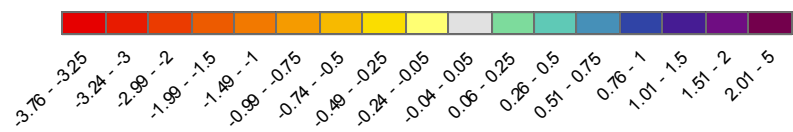
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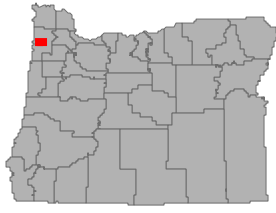
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northwest hydraulic consultants	project no. 21672	29-July-2009



Water Surface Elevation Difference From Base Case



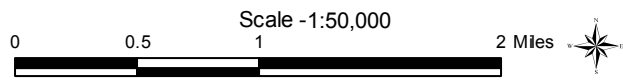
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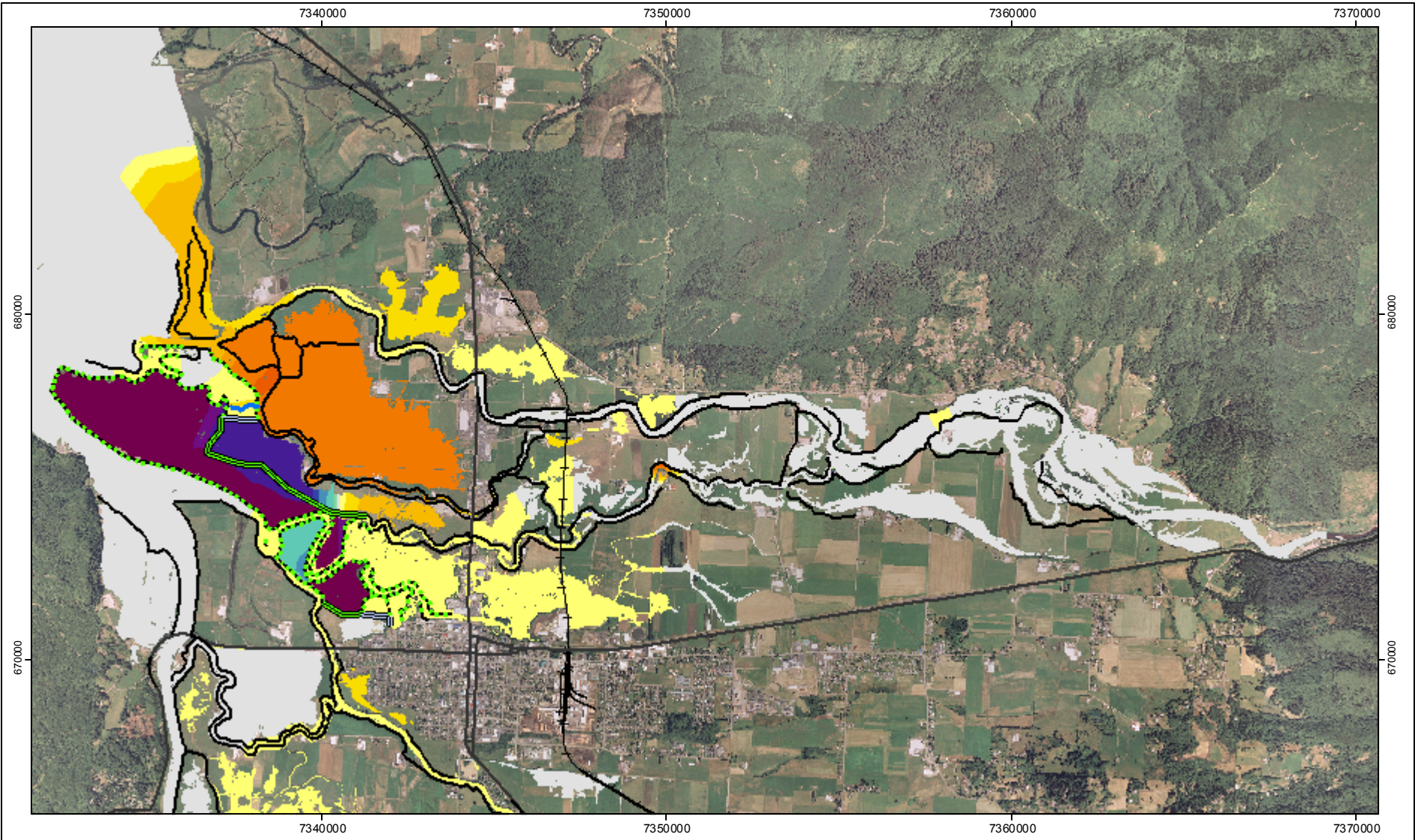
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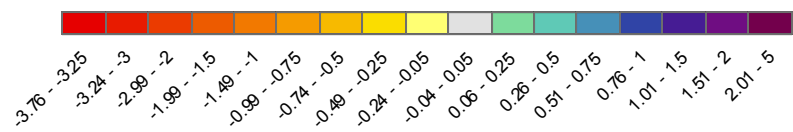
**First Flood Control Project
Exodus Alternative 3 100yr**



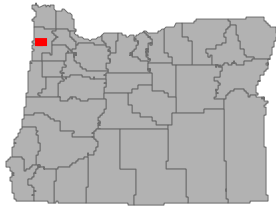
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northwest hydraulic consultants	project no. 21672	29-July-2009



Water Surface Elevation Difference From Base Case



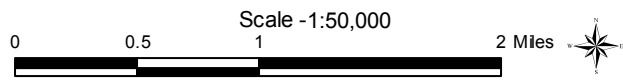
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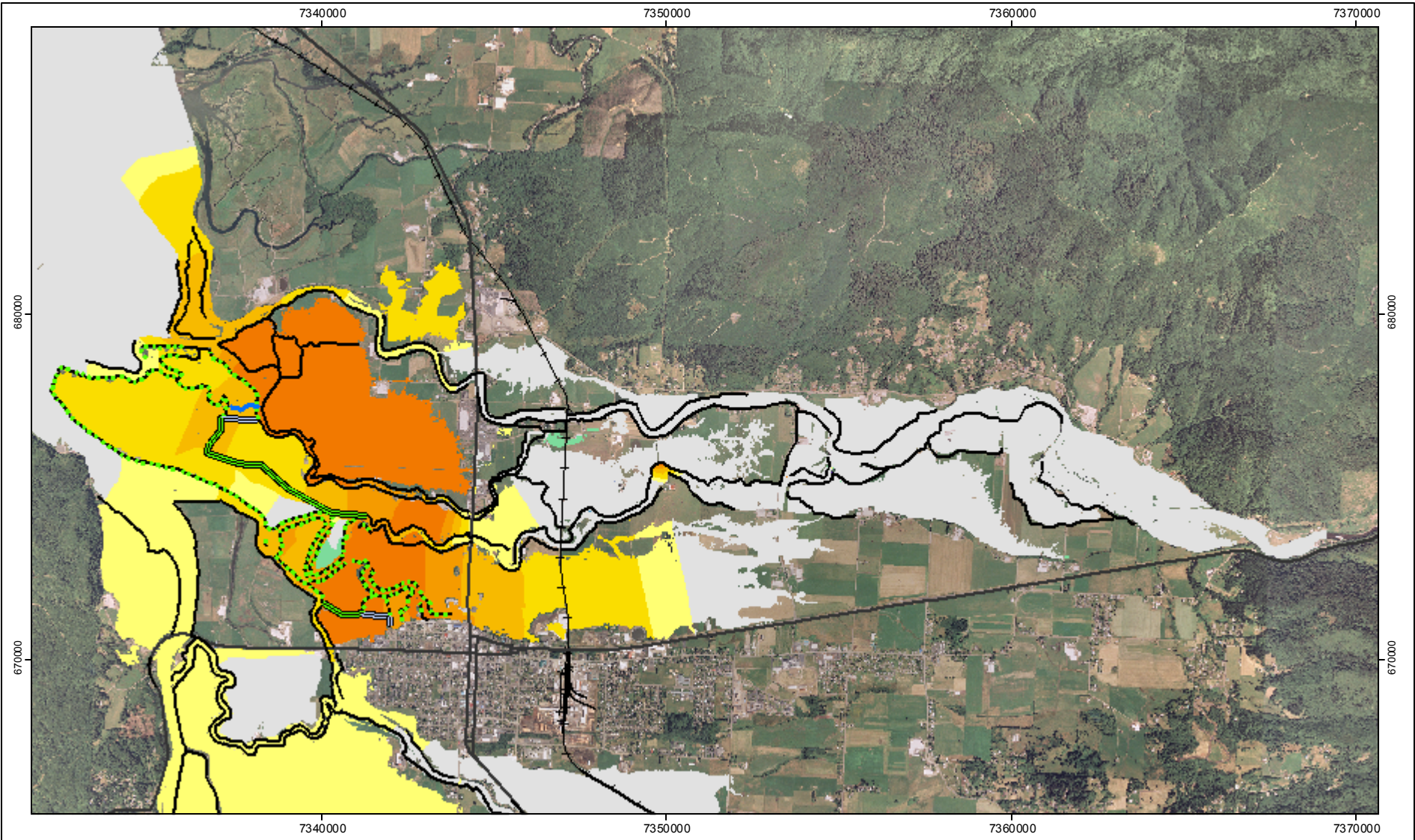
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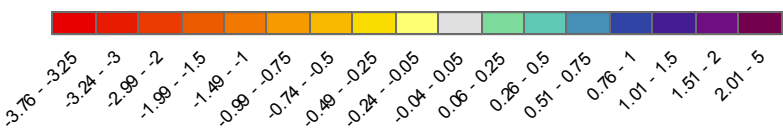
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Exodus Alternative 4 2001**



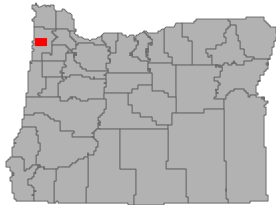
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northwest hydraulic consultants	project no. 21672	29-July-2009



Water Surface Elevation Difference From Base Case

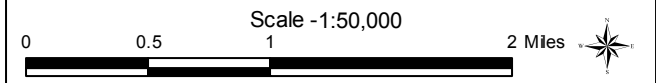


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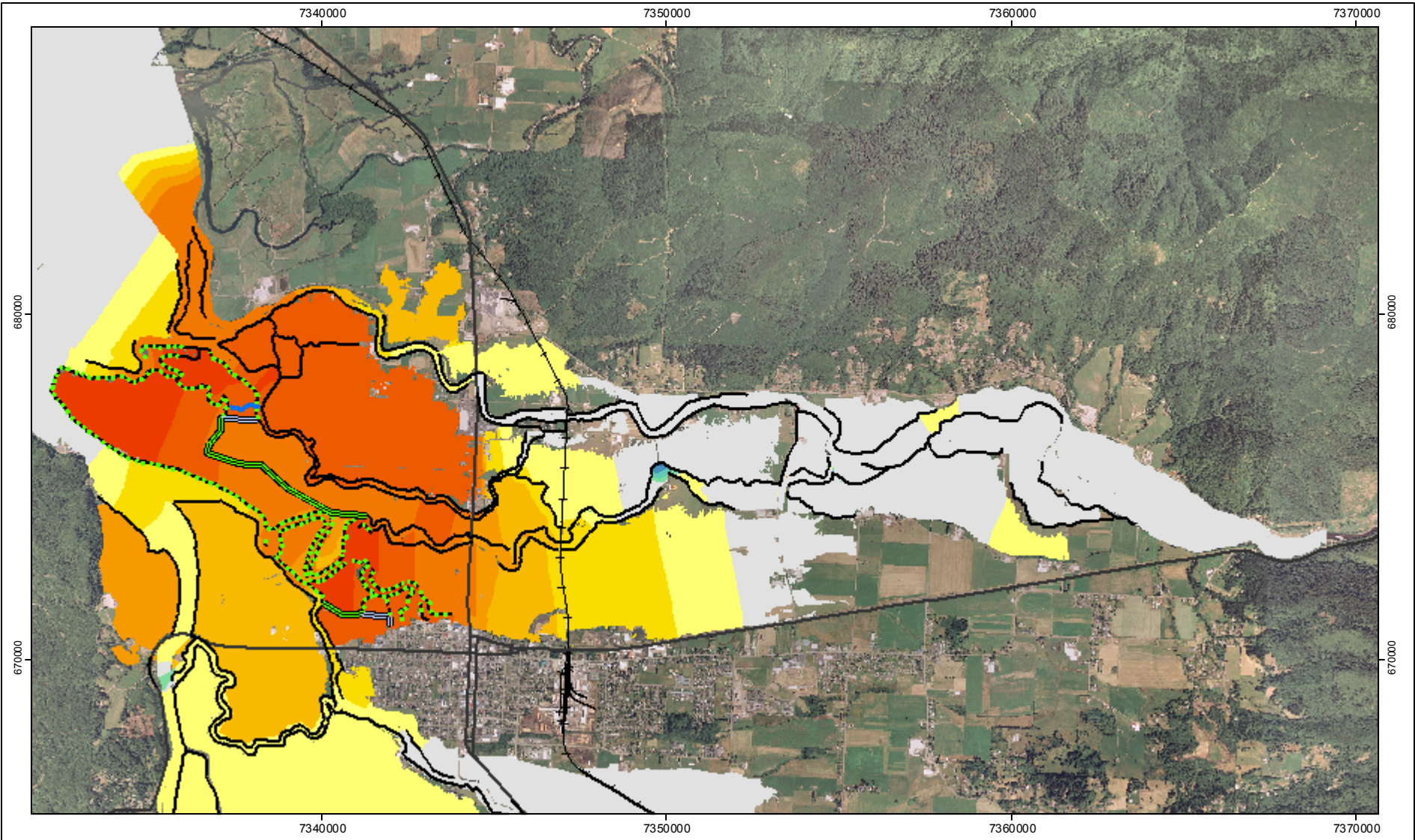


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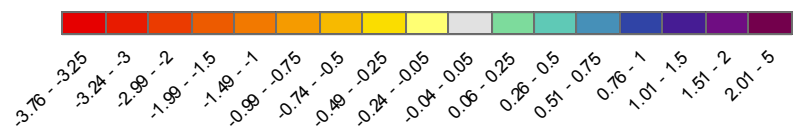
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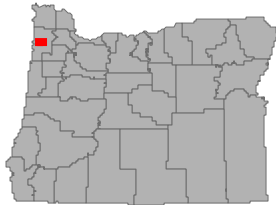
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Water Surface Elevation Difference From Base Case

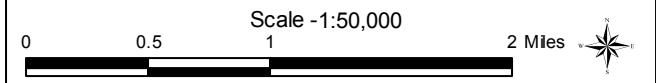


OR Reference Map



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northwest hydraulic consultants	project no. 21672	29-July-2009