APPENDIX 1

REARING AND BROOD CAPTURE SITE DESCRIPTIONS

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1. Summary

For the natural production phases of the project, the program plans to rely on existing adult traps as close to spawning habitat as possible. Several tributary traps have been discussed by other fishery agencies but do not yet exist. These are shown as "Proposed" on Figure 1-1. The Yakama Nation does not plan on constructing any additional, permanent trapping facilities for the coho program.

The emphasis for hatchery rearing is proposed to be on existing facilities—Winthrop National Fish Hatchery (NFH), Willard NFH, and Cascade Fish Hatchery (FH)—that have reared MCCRP coho in the past (Figure 1-2). A small hatchery is proposed for the Dryden site. If Dryden is not a feasible location for the proposed new hatchery, the George site would be used as an alternate location.

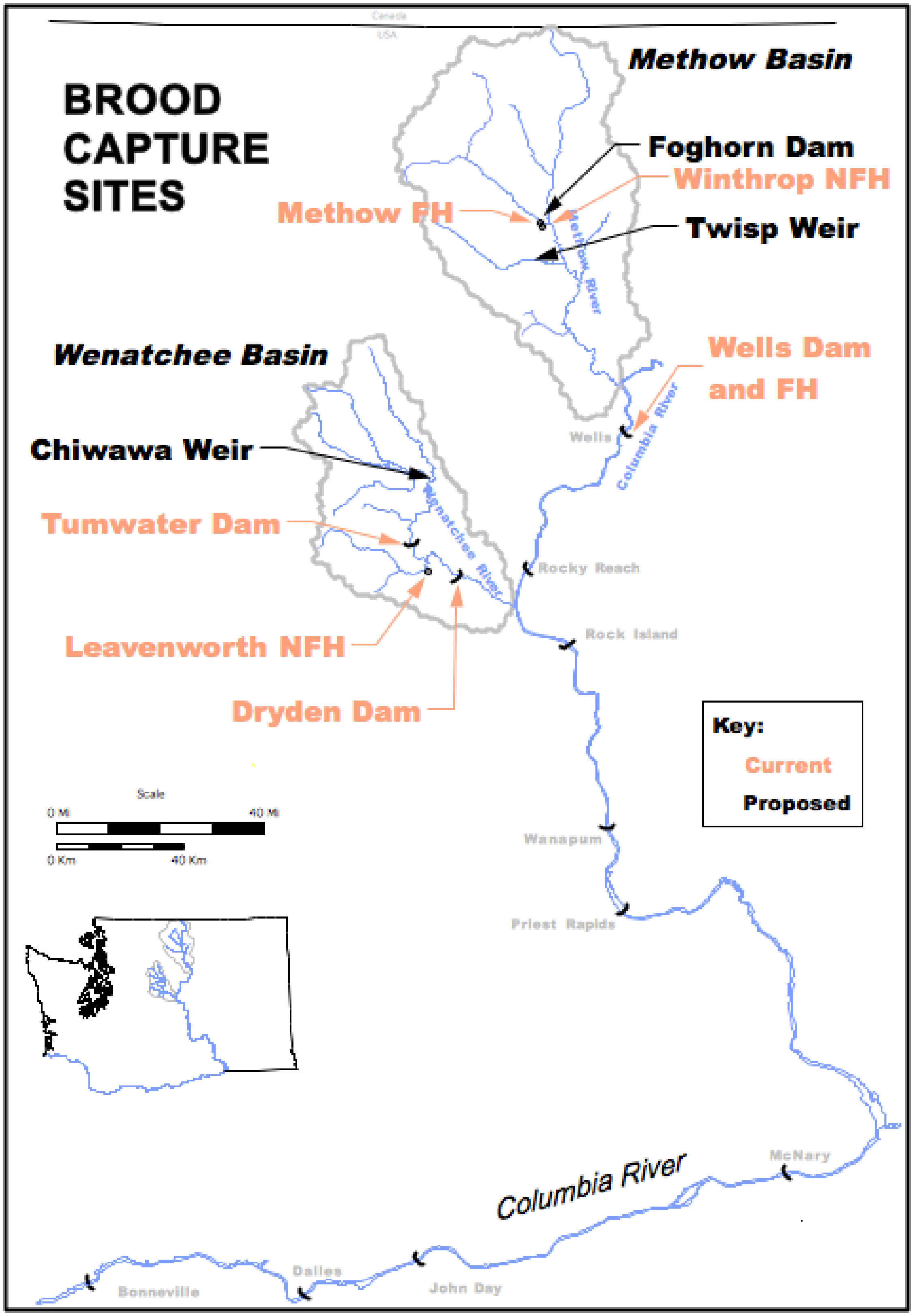

Figure 1-1. Brood Capture Site Map

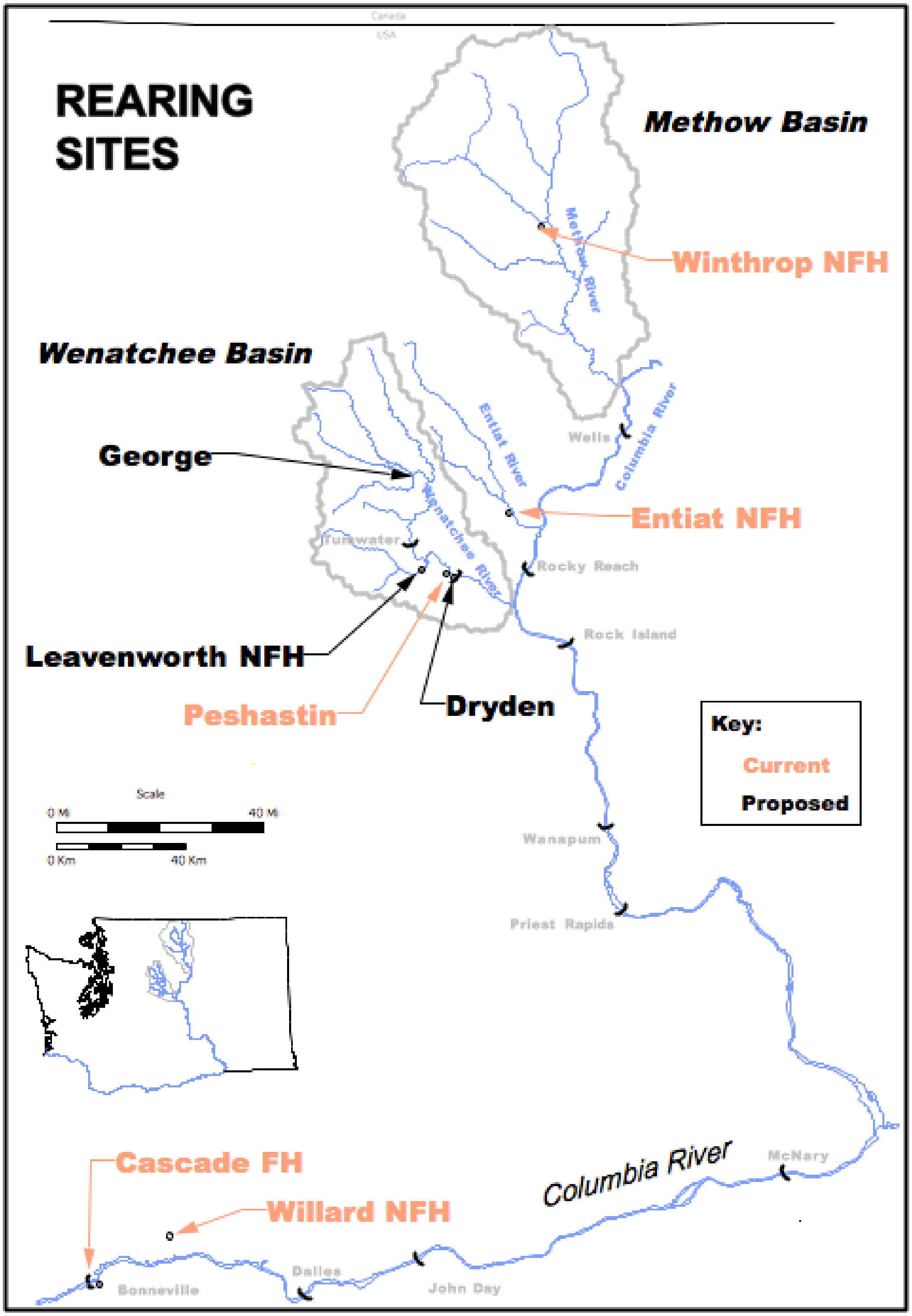

Figure 1-2. Rearing Site Map

Construction is proposed only at Dryden. A surface water intake at Dryden Dam, an infiltration gallery or wells, a hatchery building, rearing units, and an effluent treatment system are planned.

Project construction impacts are summarized in Table 1-1 below.

Table 1-1. Brood Capture and Rearing Construction Impacts at Dryden

Rearing	Dryden
Snow plowing for fish delivery (ft)	No
New road construction (ft)	No
New intake construction	Yes
Surface water removal distance (ft)	0
New groundwater supply	Yes
Existing well	No
Volume excavated (ft^3/1000) - new hatchery construction	131
Volume excavated (ft^3/1000) - existing pond	No
Surface disturbance (acres) - new hatchery construction	1.5
Surface disturbance (ft^2) - water systems, intakes	0
Surface disturbance (ft^2) - water systems, open channel	0
Buried water pipelines (ft)	1,500
Buried power lines (ft)	500
Surface disturbance (acre) - total	4
Period of operation (mo.)	12
Generator	Yes

2. Site Descriptions – Brood Capture

The project proposes to use broodstock capture facilities that currently exist or are planned for future development by other agencies. Trap operation protocols for the existing facilities may need to change to meet broodstock collection goals for the coho program.

Broodstock Development Phase 1 (BDP1) emphasized adult capture at locations low in the watersheds, such as at Dryden and Wells dams (Figure 1-1). As the program transitioned to Broodstock Development Phase 2 (BDP2) and the natural production phases, trapping locations closer to spawning habitat increased in importance.

2.1. Wenatchee

The primary locations for capture of adults during the BDP1 were Dryden Dam and Leavenworth NFH in the Wenatchee watershed. The primary BDP2 and natural production adult capture facilities are proposed to be Tumwater Dam and the Chiwawa Weir. Leavenworth NFH and Dryden Dam would continue to be used during both the broodstock development and natural production phases as needed, acting as back-up locations if collection goals are not met at the primary capture facilities.

Other trapping facilities, such as tributary weirs, have been recommended for other species. These collection facilities have been proposed by fisheries agencies in the region but may not be built. If the facilities are constructed, the MCCRP project would likely use them, particularly those being considered for Nason Creek and White River.

2.1.1. Dryden Dam

The Dryden Dam collection facility is located at river mile (rm) 17.4 on the Wenatchee River. This facility is owned and maintained by Chelan County Public Utility District (CCPUD). YN and WDFW are co-operators collecting steelhead, summer Chinook and coho broodstock for various supplementation and reintroduction programs. Dryden has been a key site for coho broodstock collection since the program's inception.

There are two trapping facilities within the Dryden Dam structure: left bank and right bank. The left bank trap is located on the north shore of the river and operates passively. As fish enter the trap, a series of ladders provide upstream passage into the collection area. Once through the ladder system, an in-line, V-trap weir collects fish in the holding area. While in operation, the left bank trap is checked at least once a day to provide brood collection and/or upstream passage of adult fish. Past years have required multiple daily checks at this facility due to large numbers of summer Chinook and coho encountered.

Dryden right bank is located across and upstream of the left bank facility and is also a passive trap. A small concrete apron spans approximately half the Wenatchee River. An expandable/retractable, water-filled bladder is positioned atop the apron to provide blockage for migrating fish. This bladder is monitored daily and adjusted to account for changing flow regimes encountered during the trapping seasons. Fish entering the right bank facility are shunted into a holding area via a V-trap weir. When it is operating, the trap is checked daily to either pass or collect fish.

On non-operating days, holding areas are closed to provide unimpeded, upstream movement through the facilities. Collection efficiencies during operation depend on Wenatchee River flows. Higher flows result in reduced trapping efficiencies due to an accessible portion of river located between the right bank and left bank traps.

Figure 2-1. Dryden Dam Aerial

2.1.2. Leavenworth NFH

The Leavenworth NFH volunteer ladder would be used for broodstock collection on Icicle Creek when trapping goals at other locations are not met. This collection facility is owned and operated by the US Fish and Wildlife Service (USFWS) and is located at Icicle Creek km 2.8 on the left bank shore. Broodstock migrate through a series of ladders until they enter a V-trap weir downstream of the hatchery adult holding ponds. This trap allows coho to be collected while juvenile spring Chinook are being reared in the adult holding ponds. If needed, the Leavenworth NFH ladder trap could operate 7 days a week, 24 hours a day, October through the end of November.

Figure 2-2. Leavenworth NFH Adult Ladder

2.1.3. Tumwater Dam

Tumwater Dam is located at rm 30.4 on the Wenatchee River. The facility is owned and maintained by CCPUD; YN and WDFW are co-operators. Tumwater Dam can be actively or passively operated, depending on fish numbers and available personnel. In 2004, YN entered into a cost-share with CCPUD to modify and update the trapping facility. These modifications improved functionality for multiple species.

Passive trapping operations allow migrating fish to move through a series of ladders and enter a holding facility. Once in the holding facility, fish migrate up a steep pass Denil ladder where they are shunted into a holding chamber. Prior to working up the fish, the chamber is de-watered and a hopper hauls fish out of the holding area where they are sorted, identified, and either kept for broodstock or passed upstream. YN and/or WDFW check the trap at least once a day during passive operation.

Active operation follows the same procedures except that once fish move up the steep pass Denil, staff are present to shunt fish to various holding tanks. During large salmon runs, it is necessary to actively trap at Tumwater Dam to prevent overloading the hopper/holding area. For non-trapping days, Tumwater Dam is opened for passage while a video monitoring system records all migrating fish species.

In the Wenatchee subbasin, BDP1 is complete. During BDP2, fish could be trapped at Tumwater Dam up to 7 days a week, 16 hours a day from mid-September through mid-December, which is an increase from current practice (3 days a week, 16 hours a day) and with the understanding that appropriate permitting would be in-place. Tumwater Dam is currently operating under the extended trapping periods through WDFW's steelhead/spring Chinook adult management programs. During trap operations, YN personnel would check the trap at least once a day.

Figure 2-3. Tumwater Ladder

2.1.4. Chiwawa Weir

The Chiwawa weir is located adjacent to the Chiwawa Acclimation Facility on the Chiwawa River (rm 1.2). It is currently being operated by Washington Department of Fish and Wildlife (WDFW) for multiple supplementation programs. This tributary trap would be important for collections during natural production phases because it selects adults that have traveled nearly the full distance back to the spawning grounds.

The weir spans the entire width of the river. It is angled slightly to move migrating fish towards the right-bank shore where a holding facility is located. Operation is proposed for up to 7 days a week, 24 hours a day, with YN personnel checking the trap a minimum of once a day. Multiple checks per day would be warranted if large numbers of coho return and would be coordinated with on-station hatchery staff. Trapping would begin in September and run through the middle of December.

Figure 2-4. Chiwawa Weir

2.1.5. Nason Weir (proposed)

The Nason Creek adult trap being proposed is a semi-permanent, floating weir near the mouth of Nason Creek. If constructed, this facility would be funded by Grant County Public Utility District (GCPUD) as a part of their spring Chinook mitigation obligations. Preferred operations, if used for coho, would be 7 days a week, 16 hours a day from September to the middle of December but would depend on permitting.

2.1.6. White Trap (proposed)

The White River adult trap is another proposed facility that may be located somewhere in the lower two kilometers of the river. The trapping method, location, and operation are undetermined at this time. This weir or trap would also be funded by GCPUD.

2.2. Methow

The primary facilities used for adult capture during BDP1 in the Methow subbasin were Wells Dam and the Winthrop NFH. The primary BDP2 and natural production adult capture facilities are proposed to be Winthrop NFH, the Twisp Weir, and Wells Dam.

Additional Methow trapping facilities have been proposed by other fisheries agencies in the region but may not be built. If they are constructed, the MCCRP project would likely use them, particularly those being considered on the mainstem Methow at Foghorn Dam and on the Chewuch River.

2.2.1. Wells Dam

Wells Dam is located at rm 515.7 on the Columbia River. Unlike the Wenatchee subbasin, the Methow does not have a lower river trapping facility, so this Columbia River mainstem location is used to supplement collections at Winthrop NFH and to collect naturally produced adults.

Initial dam trapping operations begin in late September for 3 days a week, up to 16 hours a day, until mid-October. The reduced trapping effort prior to mid-October is intended to minimize impacts to steelhead adults migrating through the system. After mid-October, YN has the ability to trap 7 days a week, up to 16 hours a day, through November 30. Trapping duration would depend on the number of swim-ins encountered at Winthrop NFH.

There are three trapping facilities at Wells Dam, the east and west fish ladders and the volunteer ladder. All facilities are owned and maintained by Douglas County Public Utility District (DCPUD) and are operated by WDFW and YN.

For the west ladder, adults negotiate a chute where they are either shunted into a holding area at Wells FH or bypassed back to the ladder on the upstream side of the collection point. Coho are removed from the holding area daily and the WDFW removes and samples steelhead on a daily basis. Once sorted, adult coho are either placed directly into a transport truck and sent to Winthrop NFH or placed into net pens for temporary holding until a transport truck is available.

Fish using the east ladder trap ascend a series of pools to the trap. Fish negotiate a steep-pass Denil, then swim down a chute where they are either passed to an anesthetic tank or returned to the ladder. Fish collected in the tank are identified, baseline biological information is collected, and then they are placed in a transport truck for delivery to Winthrop NFH. On non-trapping days, the trapping weirs are closed and gates that block the ladder passage are re-opened.

Wells Fish Hatchery (FH) is situated adjacent the Wells Dam west ladder. This hatchery, funded by DCPUD and operated by WDFW, raises summer Chinook and steelhead for mitigation and restoration purposes. Wells FH has also been contracted by YN in the past to acclimate coho juveniles. This production has been viewed as a supplemental brood source if needed in low return years. The volunteer trap is located at the lower portion of the facility and is the primary brood collection source for Wells summer Chinook. This trapping facility has been discussed by WDFW and YN as a supplemental trapping location, if other trapping locations fail to produce sufficient collection numbers. This trap would be operated on an as-needed basis during the months of October and November.

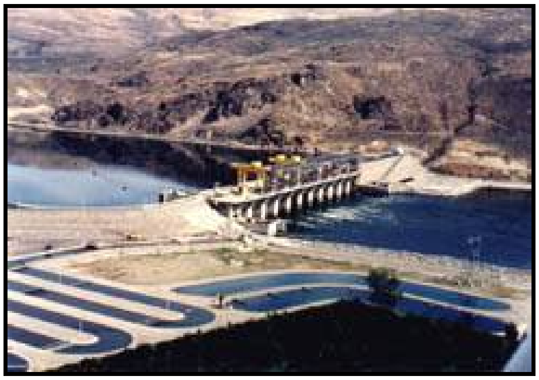

Figure 2-5. Wells Dam

2.2.2. Twisp Weir

The adult weir is located at rm 3.7 on the Twisp River. Beginning with BDP2, trap operations are proposed to be 7 days a week, 16 hours a day from September to mid-December; however, effects on steelhead and bull trout spawning migration would need to be evaluated. Bi-weekly quotas would be developed in annual broodstock protocol documents, written by June 30 each year, in cooperation with DCPUD and the members of the HCP Hatchery Committee. Shortfalls at this and other tributary trap locations would require increased collections at Wells Dam and/or Winthrop NFH.

The Twisp River weir is funded by DCPUD and operated by WDFW. Improvements to the weir were made in 2007 to improve trapping efficiency at all flow conditions.

Figure 2-6. Twisp Weir Trap

2.2.3. Winthrop NFH

Winthrop NFH is located at rm 49.7 on the Methow River and is operated by the USFWS. Fish volitionally enter the hatchery adult pond through Spring Creek, a tributary to the Methow River. A secondary collection source, a temporary weir trap, may also be used for broodstock collections. The weir trap is installed within the outlet infrastructure of the back-channel acclimation pond, adjacent to the entrance of the hatchery ladder. Adults collected in the weir are transported to the hatchery holding pond. Coho collected at both locations are held until spawning. Trap operations would be 7 days a week, 24 hours a day, mid-September through mid-December.

Figure 2-7. Winthrop NFH Adult Ladder

2.2.4. Methow Fish Hatchery

Terms of the Wells hydropower Habitat Conservation Plan guide activities at the Methow Fish Hatchery and daily operation is conducted by WDFW. Some adult coho straying from the Winthrop NFH outfall attempt to enter the Methow Hatchery. A V-notch weir structure exists on the hatchery discharge that can be lowered into place in order to trap fish. Douglas PUD and WDFW have offered to provide the YN access to this collection weir. Trapped coho will be transported to the Winthrop NFH for ripening and spawning.

2.2.5. Foghorn Dam

Foghorn Dam is a rock structure dam just above the Methow Valley Fish Hatchery on the Methow mainstem at rm 50.3. It has been ineffective at collecting spring Chinook broodstock for other mitigation programs. Should improvements be made that allow more efficient trapping at the current right bank trap, this location may also be suitable for adult coho collection.

2.2.6. Chewuch Weir (proposed)

The Chewuch River Weir is a trap proposed for spring Chinook supplementation that may be funded by DCPUD. It is currently undergoing feasibility evaluations.

3. Site Descriptions – Primary Rearing Sites

The plan emphasizes the use of existing hatcheries due to cost considerations. Hatcheries that would continue to provide long-term rearing (eyed-egg to pre-smolt) through the natural production phases are Cascade FH and Willard NFH on the lower Columbia River, as well as Winthrop NFH in the Methow subbasin. A new facility with adult holding, incubation, and rearing capabilities is proposed for the Wenatchee subbasin at Dryden Dam.

3.1. Early Incubation

In addition to the rearing facilities described below, early incubation (from green to eyed) would continue to occur at the Peshastin Incubation Facility and the Leavenworth NFH. The Dryden hatchery would take over the majority of this function after it is built, although either or both facilities may be used into the future for back-up purposes. After eying at Peshastin and/or Leavenworth, eggs are transferred to Lower Columbia River (LCR) facilities for rearing.

Peshastin Incubation Facility

This Wenatchee basin facility was set up as a temporary facility for the Mid-Columbia Coho Feasibility Studies on property owned by Peshastin Hi-Up, a fruit cooperative in the town of Peshastin. The water source is non-chlorinated city water from Peshastin Water District, one of the only cities in the region where water does not need chlorination. Supplemental groundwater is available through Peshastin Hi-Up and has been used in the past as a back-up water supply. Incoming water is run through charcoal and crushed coral filter beds for conditioning. Three deep-trough incubation systems can rear eggs to the eyed stage.

Facility Production

- Incubation: up to 800,000 to the eyed stage.

Site Information

- Location, elevation: Near the town of Peshastin at Wenatchee rm 20.5; in T24N, R18E, SE ¼ of S17 in Chelan County; elevation 310 meters.
- Ownership: Peshastin Hi-Up.
- Flood designation: Above the 100 year flood elevation.
- Land use: The incubation room is inside an existing fruit storage warehouse.
- Access: Plowed, paved roads.

Water Supply

- Groundwater: Up to 20 gallons per minute (gpm) is available from the City of Peshastin and an existing well inside the warehouse is a back-up supply.

Figure 3-1. Peshastin Incubation Facility

Leavenworth NFH

An isolated incubation area in the existing hatchery building is dedicated to coho. Twelve vertical stack incubators with approximately 5 gpm running through each stack were available for incubation. To alleviate fish health concerns of spreading disease, splash curtains were installed in addition to a UV treatment system and regular formalin treatments. This system was renovated in 2010 to accommodate the transition of the coho program from Entiat NFH to Leavenworth NFH.

Facility Production

- Incubation: up to 750,000 to the eyed stage.

Site Information

- Location: Leavenworth NFH
- Ownership: U.S. Fish and Wildlife Service, funded by Bureau of Reclamation.
- Flood designation: Above the 100 year flood elevation.
- Land use: The incubation room is inside the existing hatchery building designated for egg incubation/early juvenile rearing.
- Access: Plowed, paved roads.

Water Supply

- Groundwater: Up to 70 gpm of chilled well water is available during egg incubation.

3.2. Cascade FH

The Cascade FH is used to rear coho destined for release in the Wenatchee subbasin. It is operated by the Oregon Department of Fish and Wildlife (ODFW) and is located on Eagle Creek, near Bonneville Dam. The number of coho proposed for rearing at Cascade changes throughout the life of the program.

Cascade FH was authorized under the Mitchell Act and began operating in 1959 as part of the Columbia River Fisheries Development Program. The hatchery is supplied with surface water from Eagle Creek and has full rearing capability, with the following facilities (IHOT 1996):

- Adult holding: 1 concrete adult holding pond - 22,500 cubic feet
- Incubation: vertical stack incubators
- Raceways: 30 concrete raceways at 16 feet by 78 feet by 2.5 feet deep; 3,120 cubic feet each.

In 2006, production goals for Cascade FH were 700,000 coho for the MCCRP, 1,000,000 coho for the Confederated Tribes of the Umatilla Nation, and 600,000 coho for the Clatsop Economic Development Commission. The MCCRP proposed future production from Cascade FH will remain consistent with current production levels (up to 700,000).

Water is supplied through a gravity-fed system from Eagle Creek. The total water right is 20,200 gpm at 45 cubic feet per second (cfs) with an actual average water usage of about 7,000 gpm (16 cfs). Eagle Creek water temperatures typically fluctuate between 2° C in December/January to 17° C in July/August. High summer temperatures create some disease problems but the large natural fluctuations may help produce smolts that survive to adulthood in increased numbers.

Predicted fish sizes for the February/March transport dates for the MCCRP are 23-25 fish/lb, depending on release location and rearing strategy. Volume densities in the raceways will range from 0.6 - 0.7 pounds per cubic feet (ft^3).

In 2005, a predator net system consisting of wires and netting enclosing the coho raceways allocated for the YN program was constructed. This structure has reduced avian predation significantly (pers. comm., Mark Traynor, ODFW, 2007).

Figure 3-2. Cascade Hatchery

3.3. Willard NFH

Willard NFH would be used to rear coho destined for release in both Wenatchee and Methow subbasins. The proposed numbers of fish produced at Willard NFH would change throughout the life of the program.

Willard NFH is located on the Little White Salmon River near Cook, Washington. It was authorized by the Mitchell Act in 1946 and constructed in 1952. The facility was originally planned as a fall Chinook hatchery but changed to spring Chinook and coho because of cold water temperatures, and then switched completely to coho in the mid-1960s. Currently, this facility has reverted back to rearing coho, spring and fall Chinook. It operates on surface water and has full rearing capability, with the following facilities (IHOT 1997):

- 24 vertical stack incubation trays (16 trays per stack, 384 trays total)
- Early rearing: 52 concrete starter tanks - 91 cubic feet each
- Raceways: 50 concrete raceways – 8 feet by 73 feet by 2.4 feet; 1,408 cubic feet each

The 1997 hatchery production goal was 2,500,000 coho smolts, or 166,600 pounds. Current production is much lower and is focused on supporting tribal programs. In 2007, the hatchery reared approximately 500,000 coho for the MCCRP. In 2009 and 2010, production was closer to 650,000 for the Wenatchee and Methow programs. This production is expected to rise to 1,000,000 during the NPIP phase, if space is available.

The Willard NFH concrete raceways are narrow and shallow, which may have a negative impact on smolt quality. A-frame, overhead covers were installed in 2005 in order to provide effective shade, predator control, and crew working space. The general condition of the hatchery is good. A recent intake rebuild has improved water supply reliability.

The hatchery is exempt from a National Pollutant Discharge Elimination System (NPDES) discharge permit because the effluent disappears into porous lava before reaching the Little White Salmon River. Cold water disease has been an issue in the past but has recently been controlled with improved fish culture techniques. As with Cascade FH, fish produced from Willard NFH need to be trucked long distances to acclimation sites on the Wenatchee and Methow rivers.

Figure 3-3. Willard NFH

3.4. Dryden

A small, new hatchery is proposed on the Wenatchee River, to be operational by 2013. This facility would provide a centrally located site for handling and spawning local broodstock, incubating eggs, and rearing some juveniles.

The benefits of having an in-basin facility include reduced inter-watershed disease transmission, improved logistics, reduced transportation stress, additional program control, and added in-basin juvenile imprinting.

The preferred location for this facility is near Dryden Dam at the mouth of Peshastin Creek. The potential availability of both ground and surface water supplies and low environmental impacts make this an attractive hatchery location. However, the land near the proposed hatchery has been determined to be contaminated with lead from a nearby gun club. Environmental surveys will evaluate the extent of contamination and will help guide clean-up efforts. The site is owned by the Washington State Department of Transportation (WSDOT).

Design guidelines, basic site data, and the draft design are described below.

Facility Production

- Adult holding: 1,300.
- Incubation: 1,400,000 to the eyed stage.
- Fish production: 200,000 pre-smolts.

Site Information

- Location, elevation: Near the mouth of Peshastin Creek at Wenatchee rm 18.6; in T24N, R18E, SW ¼ of S22 in Chelan County; adjacent to Dryden Dam; elevation 300 meters.
- Ownership: The 24-acre Washington State Department of Transportation (WSDOT) property is lot number 241822745006, zoned Commercial Agricultural Lands (AC).
- Flood designation: Zone X500 (between 100- and 500-year floods).
- Land use: Used in the past by WSDOT for storage of highway sand. The site currently provides access to Dryden Dam and Fishway, portage for river rafters, and fishermen's access to the Wenatchee River.
- Access: Plowed, paved roads.
- Utilities: 3-phase power is available at the nearby Dryden right bank ladder facility.

Water Supplies

- Groundwater availability: Drill logs for nearby wells and the geology of the site suggest productive groundwater conditions. Historic gravel deposition at the Peshastin alluvial fan may have left layers of clean gravel.
- Groundwater withdrawal: Shallow wells near the river are proposed, minimizing impacts to deeper wells in the vicinity and producing water with a temperature variation closer to that of the river than deep groundwater. The production goal is 3.3 cfs (including a 50% safety factor).
- Surface water supply: Wenatchee River water is proposed to be pumped from the Dryden fishway. An intake would be built into the existing concrete structure, at location A on the drawing below. This location allows water to be pumped at all river flow conditions without impacting fishway

operation and does not require excavation in the river bank for construction. Water would be delivered to the hatchery in an 850' long buried pipeline. The hatchery model shown below estimates that a minimum flow of 3.1 cubic feet per second (cfs) is needed. Applying a 50% safety factor results in a water requirement of 4.7 cfs.

- Water Return. The option of returning water (and fish) upstream of the removal location in Peshastin Creek, at the dam, or just downstream of the dam would be possible by installing various return pipelines.

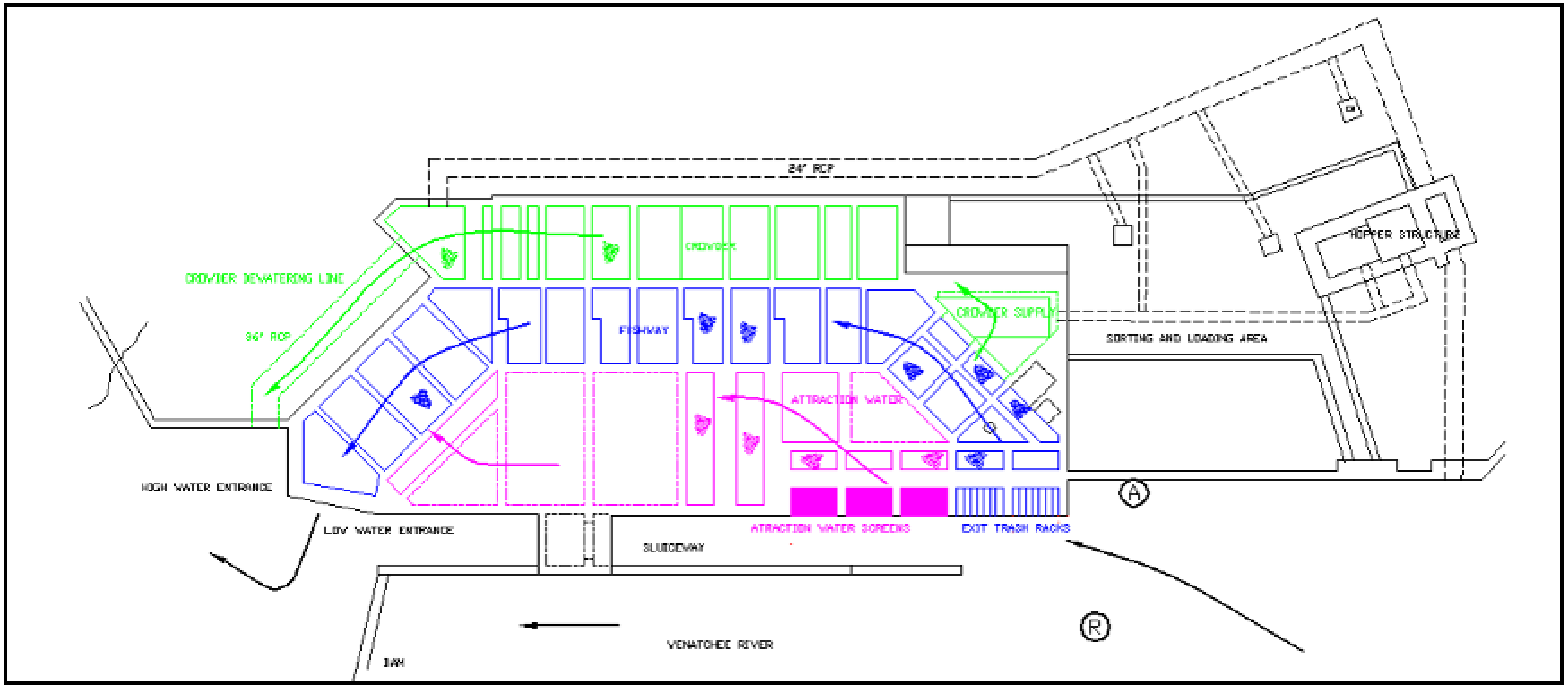

Figure 3-4. Dryden Surface Water Intake

Period	Rearing Unit	Water Source	Water Temp. (^0F)	Mort. #/mo.	Removed/ Released	Number at Hatchery	Fish Size lbs	Fish Size #/lb	Fish Size inch	Flow Density lbs/gpm	Volume Density lbs/cft	Total Weight lbs	Min. Flow gpm	Min. Flow cfs	Min. Volume cft	Rearing Units
Sep	Adult	Ground	47	81		1,085							1,085	2.4	10,847	3
Oct	Adult	Ground	42	76		1,009							1,009	2.2	10,090	3
Nov	Inc	Ground	42	49,733		1,375,938							174	0.4		29
Dec	Inc	Ground	42	47,935		1,326,205							168	0.4		28
Jan	Inc	Ground	42	20,955		1,278,270							162	0.4		27
Feb	Inc	Ground	42	20,612	1,000,000	1,257,315							162	0.4		27
Mar	RW	Ground	42	1,568		236,703	0.0010	1000	1.50	1.5	0.2	237	158	0.4	1,262	1
Apr	RW	Ground	43	1,557		235,135	0.0018	556	1.83	1.8	0.2	423	232	0.5	1,855	1
May	RW	Surface	45	1,547		233,578	0.0030	333	2.16	2.2	0.27	701	324	0.7	2,590	1
Jun	RW	Surface	49	1,537		232,031	0.0049	204	2.55	2.5	0.32	1,137	446	1.0	3,569	2
Jul	RW	Surface	57	1,526		230,495	0.0064	156	2.79	2.8	0.35	1,475	530	1.2	4,236	2
Aug	RW	Surface	62	1,516		228,968	0.0088	114	3.10	3.1	0.39	2,015	650	1.4	5,203	2
Sep	Pond	Surface	61	1,506		227,452	0.0159	63	3.77	3.8	0.23	3,616	959	2.1	15,975	2
Oct	Pond	Surface	51	1,496		225,946	0.0238	42	4.32	4.3	0.26	5,380	1,246	2.8	20,771	2
Nov	Pond	Surface	45	1,486	110,000	224,449	0.0290	34	4.61	4.6	0.28	6,509	1,412	3.1	23,533	2
Dec	Pond	Surface	40	748		112,963	0.0320	31	4.76	4.8	0.29	3,615	759	1.7	12,647	1
Jan	Pond	Surface	38	743		112,215	0.0330	30	4.81	4.8	0.29	3,703	769	1.7	12,824	1
Feb	Pond	Surface	37	738		111,472	0.0340	29	4.86	4.9	0.29	3,790	780	1.7	12,995	1
Mar	Pond	Surface	40	733	110,000	110,733	0.0370	27	5.00	5.0	0.30	4,097	819	1.8	13,658	1
Apr	Pond	Surface	43	0		0	0.0420	24	5.22	5.2	0.31	0	0	0.0	0	0
May	Pond	Surface	45	0		0	0.0500	20	5.53	5.5	0.33	0	0	0.0	0	0
Jun						0										
					1,220,000											

SPREADSHEET INPUTS:

ADULTS

Adult mortality:	15%	
Adult mortality/mo.:	7.5%	
Eggs per female:	3,000	
Adult vol. density:	10	ft^3/adult
Adult flow density:	1	gpm/adult
Adult pond volume:	3,500	cft

INCUBATION

Fert. to eyeing mort.:	15%	
Fert. to eyeing mort./mo:	3.8%	
Eyed to ponding mort.:	5%	
Eyed to ponding mort./mo.:	1.7%	
Eggs/Heath tray:	3,000	
Eggs/stack:	45,000	
Water flow/full stack	6	gpm

REARING

Pond. to release mort.:	10%	
Pond. to release mort./mo.:	0.7%	
Raceway density index:	0.125	lbs/ft^3/in
Pond density index:	0.06	lbs/ft^3/in
Flow density index:	1.00	lbs/gpm/in
Raceway volume:	3,500	cft
Pond volume:	14,400	cft

Figure 3-5. Dryden Hatchery Model

Proposed Hatchery Design

Draft site plans are shown on the following figures.

- Adult holding: Four concrete raceways (100 ft by 10 ft by 4 ft), with multiple divisions in the raceways to allow sorting.
- Incubation: Vertical stack incubators and deep troughs inside a hatchery building would be fed with aerated, chilled ground water.
- Rearing: The four concrete raceways would be used for fish production when adults are not present. Also, two ponds measuring 40 ft by 120 ft by 3' deep would add low density rearing space.
- Predator control, cover: The site would be fenced and an overhead net system installed over the rearing units.
- Waste treatment: Discharge water treatment would likely require a high degree of nutrient removal to meet conditions of the Total Maximum Daily Load restrictions in place for the Wenatchee River. Two treatment systems are being proposed. An off-line treatment tank measuring 10' by 20' by 4' will hold and settle wastes vacuumed from the rearing units. Water from the hatchery will be directed to a 2 acre constructed wetland for additional nutrient removal.
- Support systems: A 3,000 square-foot (ft^2) hatchery building will enclose the incubators, rearing troughs, offices, and a small shop. Generators will provide back-up power. Parking will be provided for up to 10 vehicles.
- Site footprint: The hatchery site will require 1.5 acres of land. The full hatchery facility, including pipelines, water supply construction, the constructed wetland, and hatchery facilities, will require that a total of 4 acres of land will be disturbed during construction.

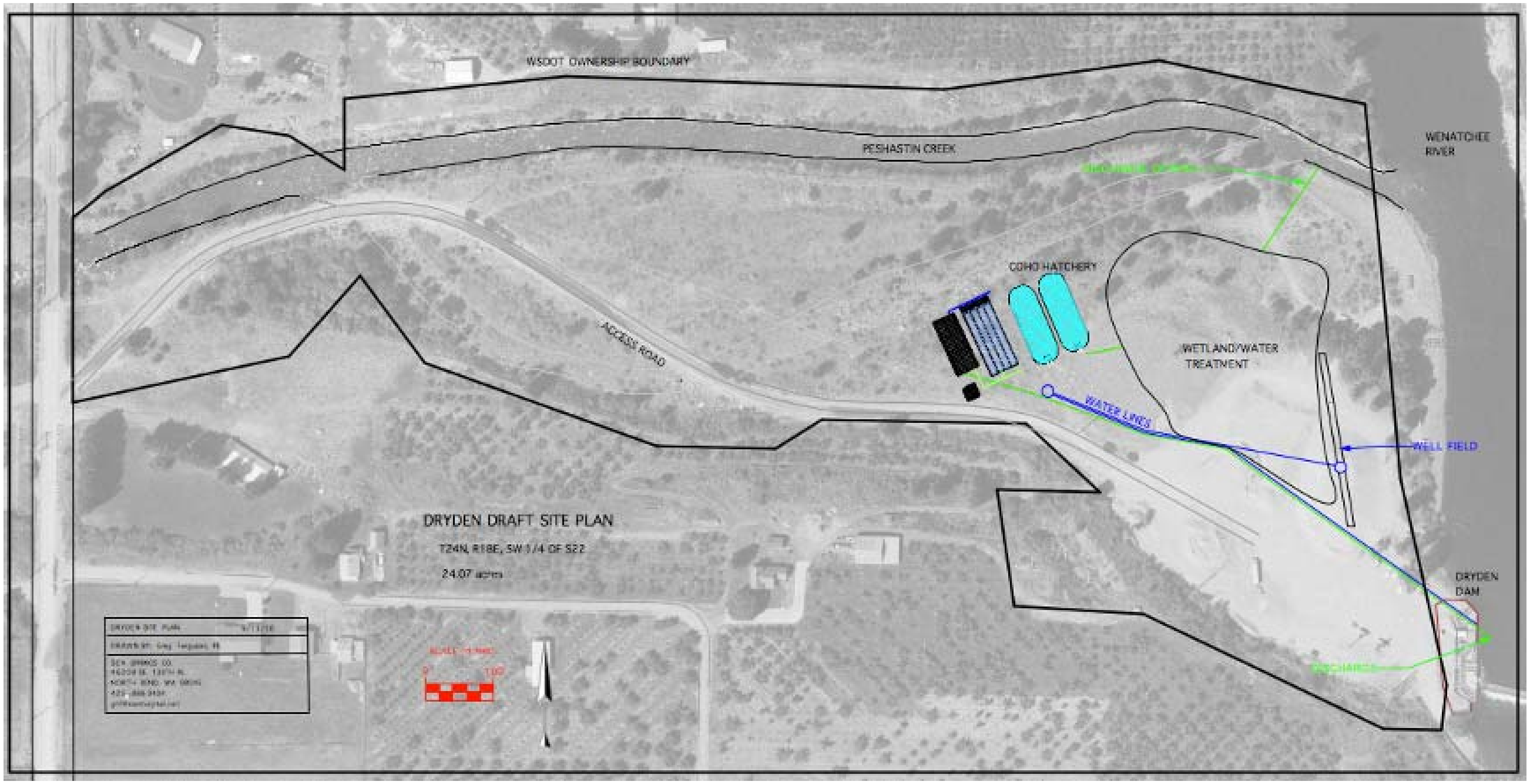

Figure 3-6. Dryden Draft Site Plan with Aerial Photo

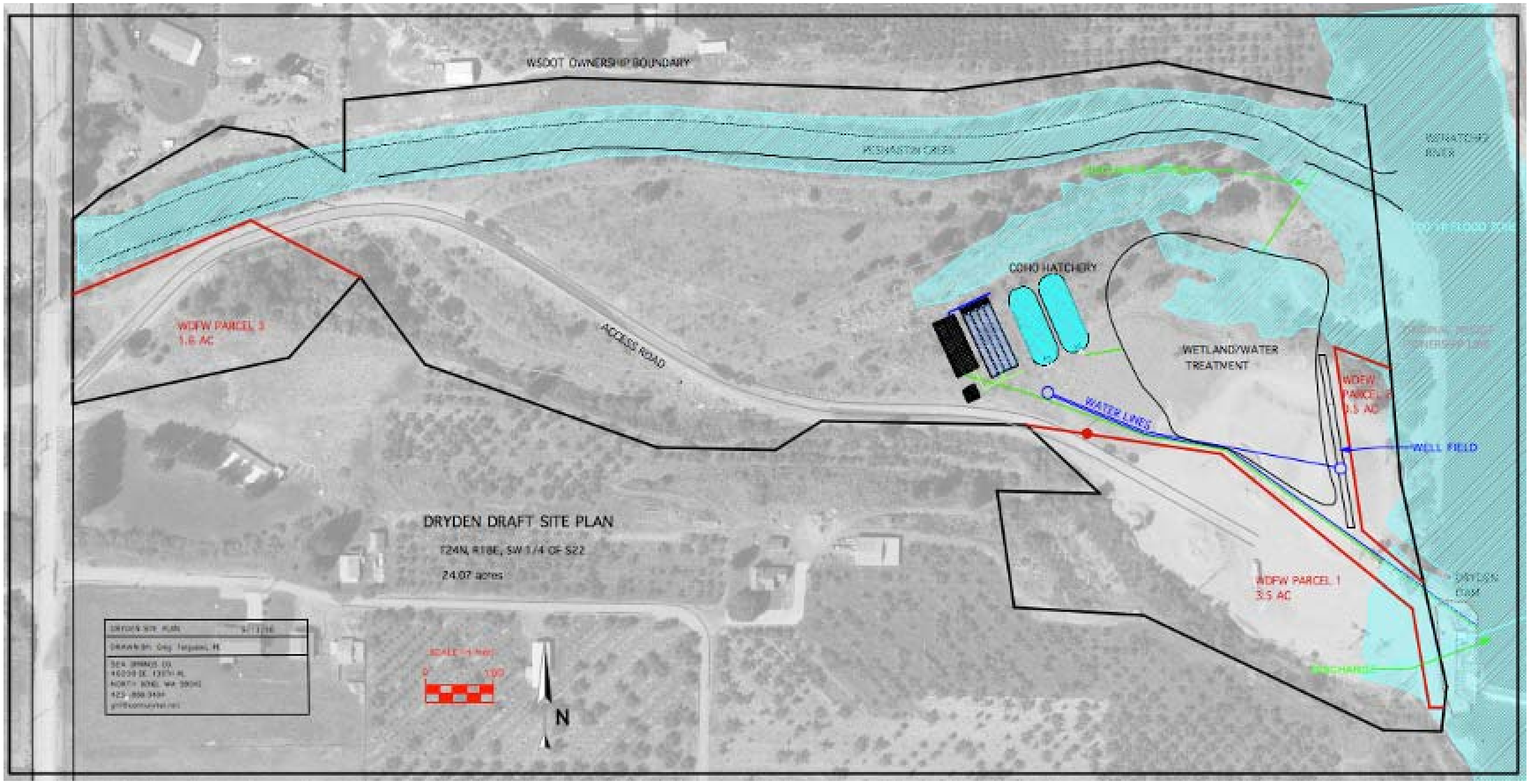

Figure 3-7. Dryden Draft Site Plan with Flood Boundaries

3.5. Winthrop NFH

The proposed plan calls for the continued production of 300,000 - 350,000 pre-smolts from the Winthrop NFH (approximately 250,000 on-station and 100,000 in the hatchery back-channel), starting with BDP2. Plans also call for Winthrop NFH to hold all captured Methow broodstock. With minor modifications planned by the USFWS to the water delivery system, adult holding area, and incubation system, this facility would hold a maximum of 1,300 adults and 1,300,000 eggs. A large proportion of the eggs would be transferred to lower river hatcheries at the eyed stage.

Winthrop NFH was originally authorized as part of the Grand Coulee Fish Maintenance Project. It began operation in 1942 to compensate for fish losses in the upper Columbia River drainage caused by the construction of Grand Coulee Dam. The funding agency is the U.S. Bureau of Reclamation and the operating agency is the USFWS.

The following information is from Integrated Hatchery Operations Team (IHOT 1998) and the Hatchery and Genetics Management Plan (HGMP 2002) and represents current conditions at the hatchery. The hatchery has water rights totaling 29,930 gpm from the Methow River, Spring Branch Spring, and two infiltration galleries (6,000 gpm). Water use ranges from 8,500 to 27,700 gpm. Rearing systems include:

- Adult Holding Ponds: 2 concrete ponds at 25,000 ft^3 each that currently are unused.
- Incubation: 150 iso buckets, 150 vertical stack trays, and bulk incubators.
- Early Rearing Tanks: 34 fiberglass, 16 feet x 2 feet x 2.8 feet.
- Raceways: 30 at 80 feet x 8 feet x 2.3 feet — 1,470 ft^3 each (design flow of 300 gpm).
- Raceways: 7 at 100 feet x 12 feet x 1.8 feet — 2,200 ft^3 each (design flow of 350 gpm).
- Foster-Lucas Ponds: 7 at 2,750 ft^3 each (design flow of 350 gpm), currently not used for fish production.

Figure 3-8. Winthrop NFH

4. Site Descriptions – Back-up Rearing Sites

An alternative to the Dryden hatchery is being evaluated. It has the same facility production requirements and same water and space needs.

4.1. George

Site Information

- Location, elevation: Downstream of Lake Wenatchee at Wenatchee rm 51.6; T27N, R17E, NW ¼ of S26 in Chelan County; elevation 570 meters.
- Ownership: The 150 acre parcel is currently in private ownership. The Yakama Nation is considering buying the site for habitat restoration.
- Flood designation: Most of the site is in Zone A3, in the 100 year flood hazard area. The Base Flood Elevation near the proposed hatchery site is 1,875'.
- Land use: The site is undeveloped and has been logged in the past. It is zoned RR20, rural residential with a minimum lot size of 20 acres.
- Access: Unpaved, primitive roads provide limited access.
- Utilities: 3-phase power is 4,000 ft away.
- Soils: The Natural Resources Conservation Service classifies soils on the site as adfluvial (NRCS, 2010).

Proposed Facilities

- Rearing units: Four 100' by 10' by 4' concrete raceways for adult holding and rearing, egg incubators with a capacity for 1,400,000 eggs, early rearing troughs, and two rearing ponds measuring 120' by 40' by 3' are proposed.

- Support systems: A 3,000 ft^2 hatchery building will enclose the incubators, rearing troughs, offices, and a small shop. Generators will provide back-up power. Parking will be provided for up to 10 vehicles.
- Discharge treatment: An off-line treatment tank measuring 10' by 20' by 4' will hold and settle wastes vacuumed from the rearing units. Water from the hatchery will be directed to a large, disconnected side channel for additional treatment and nutrient removal prior to reaching the Wenatchee. Water would be removed from the mainstem Wenatchee for a distance of 3,800 ft.
- Site footprint: Hatchery facilities will require 1.5 acres of land. An additional 1.0 acres will be disturbed by power conduit and pipeline burial.

Water Supply

- Groundwater supply: A preliminary evaluation of the potential for developing groundwater on the site is planned. Two or more wells are proposed to produce the required 3.3 cfs.
- Surface water supply: 4.7 cfs of surface water will be pumped from the Wenatchee River. A submerged intake screen will be built into an existing rock barb in the river.
- Pipelines: Surface and ground water will be delivered to the hatchery in separate pipelines that will be approximately 1,500 ft long.

Proposed Hatchery Design

- Adult holding: Four concrete raceways (100 ft by 10 ft by 4 ft).
- Incubation: Vertical stack incubators and deep troughs inside a hatchery building would be fed with aerated, chilled ground water.
- Rearing: The four concrete raceways would be used for fish production when adults are not present. Also, two ponds measuring 40 ft by 120 ft by 3' deep would add low density rearing space.
- Predator control, cover: The site would be fenced and an overhead net system installed over the rearing units.
- Waste treatment: Discharge water treatment would likely require a high degree of nutrient removal to meet conditions of the Total Maximum Daily Load restrictions in place for the Wenatchee River. An off-line treatment tank measuring 10' by 20' by 4' will hold and settle wastes vacuumed from the rearing units. Treated water from the hatchery will be directed to the existing, 5,600 ft long, side channel on the site for further nutrient removal

prior to entering the Wenatchee River.

- Support systems: A 3,000 ft^2 hatchery building will enclose the incubators, rearing troughs, offices, and a small shop. Generators will provide back-up power. Parking will be provided for up to 10 vehicles.
- Site footprint: Hatchery facilities will require 1.5 acres of land. Including pipelines, water supply construction, and hatchery facilities, a total of 2.5 acres of land will be disturbed.

Figure 4-1. George Draft Site Plan

5. References

HGMP (Hatchery and Genetics Management Plan), Spring Chinook. 2002. Winthrop National Fish Hatchery, Leavenworth Hatchery Complex.

IHOT (Integrated Hatchery Operations Team). 1996. Hatchery Evaluation Report, Cascade Hatchery – Coho. December 1996.

IHOT. 1997. Hatchery Evaluation Report, Willard Hatchery – Coho. February 1997.

IHOT. 1998. Hatchery Evaluation Report Summary for Winthrop NFH – Spring Chinook, Summer Steelhead. February, 1998.

NRCS (Natural Resources Conservation Service). 2010. Web Soil Survey (http://websoilsurvey.nrcs.usda.gov/app/).

APPENDIX 2

WENATCHEE ACCLIMATION SITE DESCRIPTIONS

Prepared by: Greg Ferguson, Sea Springs Co.

May, 2011

Table of Contents

List of Figures

1. Summary

The proposed alternative for the Wenatchee Natural Production Implementation Phase includes releases at up to 14 locations (see Fig 1-1). Ten of the locations have existing natural or semi-natural ponds, one has artificial ponds, one utilizes adult plants, and two require new pond construction. Back-up acclimation sites and methods have also been identified. Three back-up sites that do not require construction and two that do are described.

Large releases relative to habitat capacity are planned for Icicle Creek from the Leavenworth National Fish Hatchery (NFH) during Broodstock Development Phase 1 and 2 (BDP1 and BDP2). These large releases are for continued development of the local broodstock.

The proposed Chiwawa sites are important parts of the Wenatchee program, with approximately 30% of the proposed releases for the entire Wenatchee basin occurring in this one watershed. However, the majority of high quality habitat that lies within the upper watershed is inaccessible during winter months by wheeled vehicle. The uppermost acclimation locations, Chikamin and Minnow, would be managed by snowmobiles prior to snow being cleared.

The Little Wenatchee River also has winter access problems. Acclimation is proposed in the more accessible lower part of the watershed.

Winter access to some of the high quality habitat in the White River is feasible by a road that is plowed up to Tall Timber Ranch. An alternative reintroduction strategy, adult plants, has been proposed for one site on the White River. Coho would be trucked from adult collection and holding facilities to a small tributary, Dirty Face Creek, and confined there through the spawning season.

Nason Creek has an existing site at the upper end of the low gradient section of the watershed that is capable of winter operation. The purpose of the Rohlfing site is to disperse adults into downstream areas. The Coulter site is further downstream and discharges into a large wetland complex that is expected to be productive rearing habitat. The Coulter and Butcher Creek sites are very close and are planned to be used in alternating years. This may reduce in-pond losses by disrupting predator feeding patterns.

Small tributary sites and alternative acclimation strategies may be evaluated in the future for releases. Feedback from the Monitoring and Evaluation program would help determine the value of potential habitat. Techniques used to target other sites may include adult plants or in-river acclimation, along with pond acclimation.

Site activities at acclimation ponds include fish delivery, feeding, predator hazing, sampling, and release monitoring. Sites would be visited one or more times per day to conduct these activities. Large truck access is required once at the start of acclimation at each site for fish delivery. Daily access could occur by small vehicle, foot, or snowmobile.

Proposed construction at the primary acclimation sites includes the creation of two new ponds, excavation of accumulated material in one existing pond and a new well at one site. The total area expected to be disturbed during construction is 0.7 acres.

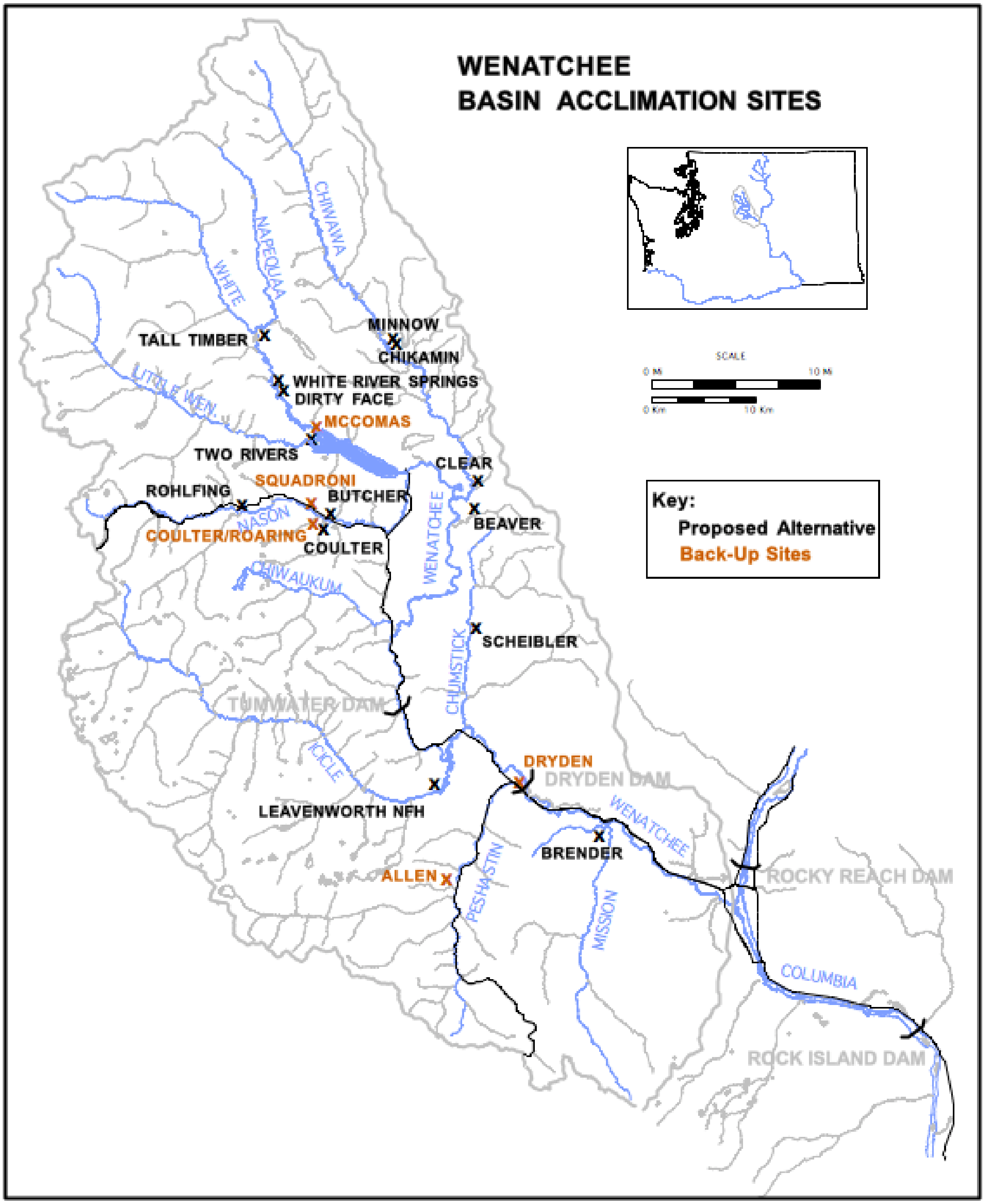

Figure 1-1. Wenatchee Subbasin Acclimation Site Map

2. Site Details

2.1. Information Tables

The tables below include specific details for each proposed Wenatchee acclimation site.

	GENERAL				LOCATION								LAND USE,/ZONING			FLOOD
	Release (1,000s)	Overwinter	Adult Trap	Previously used	Distance to Wen. mouth (rkm)	Township	Range	Section	1/4 section	Elevation (m)	Latitude	Longitude	Zoning (Comp. Plan)	Shoreline MP designation	Landuse	FEMA flood designation
Wenatchee Acc.																
Rohlfing	105	Y	T	Y	109	26	16	5	NE	685	47'08"	52'42	RR5	Co	Vacation home	None
Coulter	105		T	Y	103	26	16	11	SE	660	45'52"	48'10"	RR5	Co	Vacation home	None
Butcher	105	Y	T	Y	102	26	16	11	NE	658	46'13"	48'05"	RR5	Co	Vacation home	100 yr
Tall Timber	110		T		112	28	16	18	SW	589	55'24"	53'37"	RR20	Co	Guest ranch	NM
White River Springs	50	Y	T		108	28	16	32	SE	573	53'12"	52'21"	RR10	N	Rural residential	100 yr
Two Rivers	120	Y	T	Y	96	27	16	15	SW	575	50'10"	50'30"	RR20	N	Gravel mine	100 yr
Chikamin	100		T		99	28	17	21	SW	740	54'33"	43'12"	FC	Co	Private forestry	NM
Minnow	100		T		99	28	17	21	SW	740	54'40"	43'10"	FC	Co	Private forestry	NM
Clear	150	Y	T		80	27	18	31	NE	610	47'56"	37'48"	RRR	N	Private campground	None
Beaver	100		T	Y	75	26	17	12	NE	586	46'04"	38'58"	RR5	N	Guest ranch	None
Scheibler	65		D		51	26	18	31	SE	499	42'24"	38'15"	RR5	N	Farming	NM
Brender	50		N		18	23	19	5	NE	243	31'16"	28'58"	UGA	UGA	Urban	None
Leavenworth NFH	100	Y	L	Y	47	24	17	26	NE	344	33'31"	40'20"	P	Co	Public hatchery	None
Adult Plants																
Dirty Face			T		107	28	16	32	SE	573	52'40"	52'12"	RR10	Na	Wildlife	100 yr
Acc. Back-ups																
Coulter/Roaring	105		T		104	26	16	11	SE	659	45'59"	48'35"	RR5	Co	Vacation home	100 yr
Squadroni	105		T		106	26	16	3	SE	661	46'33"	49'27"	RR5	Co	Vacation home	100 yr
McComas	50	Y	T		96	27	16	10	SW	578	50'55"	49'56"	RR20	Na	Acclimation ponds	100 yr
Allen (Peshastin)	50		D		40	23	17	13	SE	501	28'57"	39'21"	RRR	N	Rural residential	None
Dryden	100	Y	D		29	24	18	22	NW	303	33'24"	34'25"	AC	Co	Gravel storage	None
Other																

Figure 2-1. General, Location, and Land Use Details

Key, Figure 2-1:

- Release (thousands). The proposed peak number of coho smolts to be released during the Natural Production Implementation Phase
- Overwinter. Does the site have a reasonable potential for over-winter acclimation? This requires a source of groundwater and reliable access.
- Adult Trap. The nearest downstream collection facility. T = Tumwater, D = Dryden, L = Leavenworth NFH, N = none.
- Previously used. Has the site been used by the coho reintroduction program in past years?
- Distance to mouth (rkm). The distance from the mouth of the Wenatchee to the acclimation site in river kilometers.
- Zoning. Zoning designations match the Chelan County Comprehensive Plan. RR5 = rural residential with a limit of one dwelling per 5 acres, RR10 = rural residential with a limit of one dwelling per 10 acres, RR20 = rural residential with a limit of one dwelling per 20 acres, RRR = rural residential/resource, FC = commercial forest, UGA = urban growth area, AC = commercial agriculture, P = public. Data from Chelan County.
- Shoreline Master Plan Designation. Co = Conservancy, Na = Natural, UGA = urban growth area N = None. Data from Chelan County, 2009.
- Land use. The predominant use of land surrounding the acclimation site.
- FEMA flood designation. 100 Yr. = 100 year floodplain None = not in an identified flood zone, NM = not mapped. Data from FEMA, 2009.

	MISC		WATER			SURFACE WATER		GROUND WATER		SPACE						ACCLIMATON PONDS		
	Power	Road access	New water right	Water reqrt. (cfs)	Water available (cfs)	Surface stream name	WDNR stream type	Overwinter tempering	GW needed (cfs)	Required space (cft/1000)	Required pond area (acre)	Existing space (cft/1000)	Existing pond area (acre)	New pond area added (acre)	Acclimation area/Existing pond aarea	Pond type	Free passage allowed	Pond confinement method
Wenatchee Acc.																		
Rohlfing	1P	Unsurf.	G	1.6	4.0	Unnamed	F	Y	0.3	22	0.17	22	0.17		100%	Existing man-made		Barrier
Coulter	1P	Unsurf.		1.6	>1.6	Coulter	F			22	0.17	48	0.37		100%	Existing beaver		Barrier
Butcher	3P	Surf.	G	1.6	2.0	Butcher	F	Y	0.5	22	0.17	73	0.56		100%	Existing beaver		Barrier
Tall Timber	1P	Unsurf.	S	1.7	>1.7	Napeequa	S			23	0.18	31	0.28	0.61	0%	Existing side channel	Y	Seine
White River Springs	N	Unsurf.		0.8	1.5	Unnamed	F			10	0.08	9.6	0.07		100%	Existing beaver		Barrier
Two Rivers	N	Unsurf.		1.9	1.9	None				25	0.19	23	0.17		100%	Existing man-made	Y	Screens
Chikamin	N	Unsurf.	S	1.5	>1.5	Chikamin	F			21	0.16	0	0.00	0.16	0%	New acclimation	Y	Screens
Minnow	N	Unsurf.		1.5	>1.5	Minnow	F			21	0.16	0	0.00	0.16	0%	New acclimation	Y	Seine
Clear	3P	Surf.		2.3	>2.3	Clear	F			31	0.24	68	0.52		46%	Existing man-made	Y	Seine
Beaver	N	Unsurf.		1.5	>1.5	Beaver	F			21	0.16	31	0.24		100%	Existing man-made		Screens
Scheibler	3P	Unsurf.		1.0	>1.0	Chumstick	F			14	0.10	4.5	0.03	0.10	0%	Existing man-made	Y	Seine
Brender	3P	Unsurf.		0.8	>.08	Brender	F			10	0.08	35	0.27		30%	Existing man-made	Y	Seine
Leavenworth NFH	3P	Surf.		1.5	>1.5	Icicle	S			21	0.16	>21	>.16		100%	Existing hatchery	Y	Screens
Adult Plants																		
Dirty Face	N	Surf.				Dirty Face	F									None	Y	Pickets
Acc. Back-ups																		
Coulter/Roaring	1P	Unsurf.		1.6	>1.6	Coulter,Roaring	F			22	0.17	637	5.8		3%	Existing beaver	Y	Seine
Squadroni	3P	Surf.	G	1.6	0.0	Nason	F	Y	1.6	22	0.17	0	0.00	0.17	0%	New acclimation		Screens
McComas	1P	Surf.		0.8	>0.8	White		Y		10	0.08	0	0.00	0.08	0%	New acclimation	Y	Screens
Allen	3P	Surf.		0.8		Allen	F			10	0.08	94	0.72		11%	Existing man-made	Y	Seine
Dryden	3P	Unsurf.	G,S	1.5	>1.5	Wenatchee	S	Y	0.2	21	0.16	0	0.00	0.16	0%	New hatchery	Y	Screens
Other																		

Figure 2-2. Water and Space Detail

Key, Figure 2-2:

- Power. N = None, 1P = single phase, 3P = three phase.
- Road access. Asphalt surfaced or unsurfaced (gravel).
- New water right. G = new ground water right needed, S = new surface water right needed.
- Water required (cfs). Minimum water requirements for each site are based on a flow density of 9 pounds of fish per gallon/minute (flow density index of 1.5 lbs/gpm/inch). This is an average minimum value based on approximate spring-time water temperatures and fish sizes. Actual flow rates would be higher to provide a safety margin, with the amount of margin depending on the reliability of the water supply at each site.
- Water available (cfs). The expected low flow during the acclimation period.
- Surface stream name. The name of the stream supplying water to the acclimation site.
- WDNR stream type. Washington Department of Natural Resources stream type designation, from http://fortress.wa.gov/dnr/app1/fpars/viewer.htm.
    - Type "S" = Shoreline. Streams and waterbodies that are designated “shorelines of the state”.
    - Type "F" = Fish. Streams and waterbodies that are known to be used by fish, or meet the physical criteria to be potentially used by fish.
    - Type "Np" = Non-Fish Perennial.
    - Type "Ns" = Non-Fish Seasonal.
- Overwinter tempering. Is ground water needed to control ice formation on surface water intakes?
- GW (ground water) needed (cfs).
- Required space (cft/1000). Space requirements are calculated using 0.3 pounds of fish per cubic foot of water (a volume index of 0.03 lbs/cft/inch). Sites that rely on pumped supplies without backup would require more space.
- Required pond area (acre). The pond area is calculated from the space requirement by assuming an average water depth of 3 ft.
- Existing space (cft/1000). Space is calculated by multiplying the existing pond surface area by a 3 ft assumed average depth.
- Existing pond area (acre). The total existing pond area, actual area may be less if seine nets are used.
- New pond area (acre). The amount of new area that is proposed to be added by expanding existing ponds or building new ones.

- Acclimation area/Existing pond area. The ratio of area that is proposed to be used by coho during the acclimation period to the existing pond area. The calculation is made only for existing pond area, if new pond area is built and blocked, the ratio is 0%. For barrier nets, 100% is blocked and for seine nets, some part of the existing area is blocked.
- Pond type.
- Free passage allowed. Does the presence of small ESA listed fish require that free up and downstream passage be allowed by the coho confinement net?
- Pond confinement method. A barrier net (see section 2.2) confines coho and does not allow free passage of any fish past it during acclimation. A seine net encloses a portion of a pond and allows passage around it. The seine net separates coho and other fish species during acclimation. Screens are rigid devices placed in outlet structures and pickets prevent downstream adult movement.

	Plowing for fish delivery (ft)	New road construction (ft)	New intake construction	Removal distance (ft)	New well	Existing well	Volume excavated (cft/1000) - new pond	Volume excavated (cft/1000) - existing pond	Surface disturbance (acre) - pond construction	Surface disturbance (sft) - water systems, intakes	Surface disturbance (sft) - water systems: wells, open channel	Buried water pipe line (ft)	Total area disturbed (acre)	Period of operation (mo.)	Generator
Wenatchee Acc.															
Rohlfing						Y								5	Y
Coulter														1.5	
Butcher					Y						900		0.02	5	Y
Tall Timber	250		Y	1,700						800		800	0.20	1.5	
White River Springs														5	
Two Rivers														5	Y
Chikamin			Y	380			30		0.2	800	1300	200	0.29	1.5	
Minnow	600	600					30		0.2				0.20	1.5	
Clear														5	
Beaver	1,000													1.5	
Scheibler								8						1.5	
Brender														1.5	
LNFH						Y								5	
Adult Plants															
Dirty Face														2	
Back-ups															
Coulter/Roaring														1.5	
Squadroni					Y		30		0.2		900		0.22	1.5	Y
McComas														5	
Allen														1.5	
Dryden			Y		Y		30		0.2		3500	700	0.44	5	Y
TOTALS-PRIMARY	1,850	600	2	2,080	1	2	60	8	0.4	1,600	2,200	1,000	0.72	43	3
TOTALS-BACK-UP			1		2		60		0.4	-	4,400	700	0.66	17	2

Figure 2-3. Construction and Operation Impacts

Key, Figure 2-3:

- Plowing. Roads at some sites require snow removal at least once per season to allow fish transport trucks to access acclimation ponds.
- Removal distance. The stream length impacted by new water withdrawals.
- New well. Some sites would require that new wells be drilled and developed.

- Surface disturbance – pond construction. The area impacted by new pond construction. This does not include the surface area temporarily disturbed by fill deposition.
- Surface disturbance – water systems, intakes. Excavation and installation of intake structures would involve disturbance of the work area.
- Surface disturbance – water systems: wells, open channels. Water would be delivered to and discharged from some ponds in rock-lined channels. It is assumed that a 10’ wide strip of land would be disturbed during construction of the channels. Well construction would require truck access and staging areas.
- Buried water pipe line. Underground piping would deliver water to some ponds. It is assumed that a 10’ wide strip of land will be disturbed during pipeline excavation. This is a temporary disturbance; the lines will be re-vegetated after work completion.
- Total area disturbed. The sum of all the area impacted by construction.
- Pond operation. The expected yearly duration of operation.
- Generator. Main or back-up power would be provided by electrical generators with automatic transfer switches. At locations where generators are the main source of power, two generators are proposed.

See Appendix 1, Brood Capture and Rearing Site Descriptions for a discussion of the Dryden Hatchery construction impacts. Impacts that would result if acclimation only were conducted on the site are listed above.

Leavenworth NFH is an existing facility and no changes are proposed by the MCCRP. The environmental impacts of the facility operation have been reviewed through past permitting processes.

The McComas site is proposed by Grant County Public Utility District and the impacts of constructing and operating the site will be analyzed during separate permitting processes.

These details are approximate and are based on schematic designs. They are for the purpose of evaluating potential environmental impacts.

2.2. Net Confinement Systems

Net systems would be used to confine coho during the acclimation period at most sites. They can be configured in one of two ways. Where loss of habitat and/or coho interaction with listed fish species is not expected to have negative impacts;

nets which fully block fish passage in the ponds (barrier nets) could be installed. They are placed perpendicular to the flow (see the figure below).

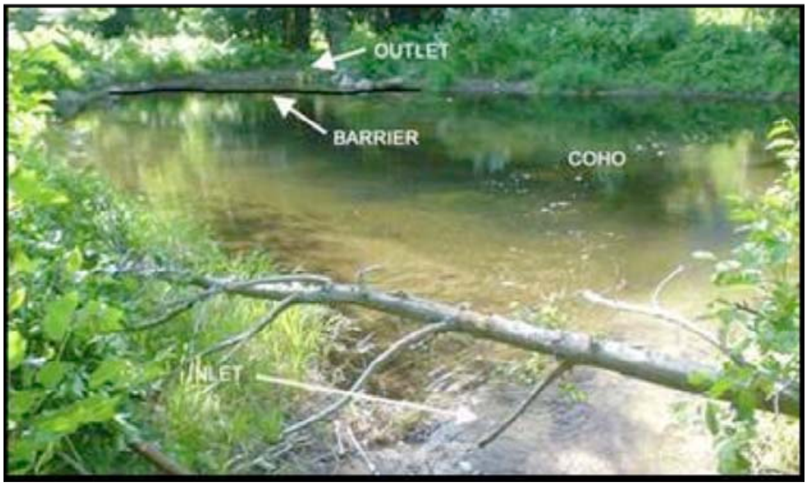

Figure 2-4. Barrier Net Example

Where impacts may be significant and free passage of fish up and downstream is required; nets that form an enclosed impoundment (seine nets) of only a portion of the pond could be used.

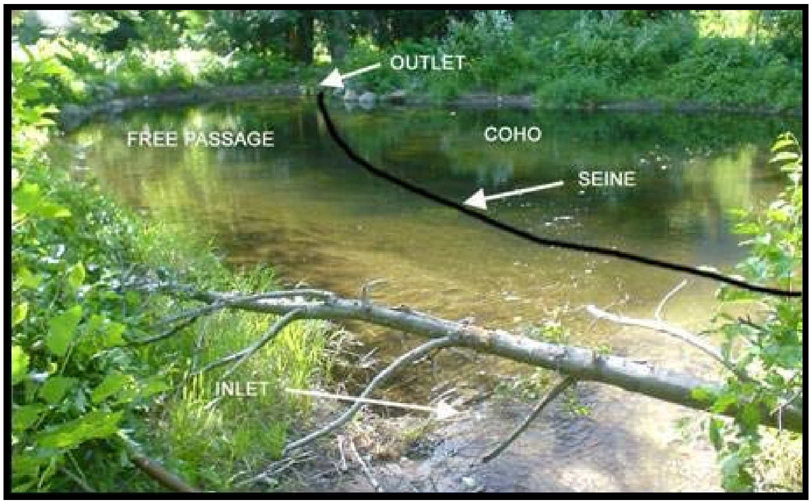

Figure 2-5. Seine Net Example

In both cases the net systems are temporary and are in place only during acclimation. They will be designed to minimize premature escape and will include jump barriers and double lead lines (see below).

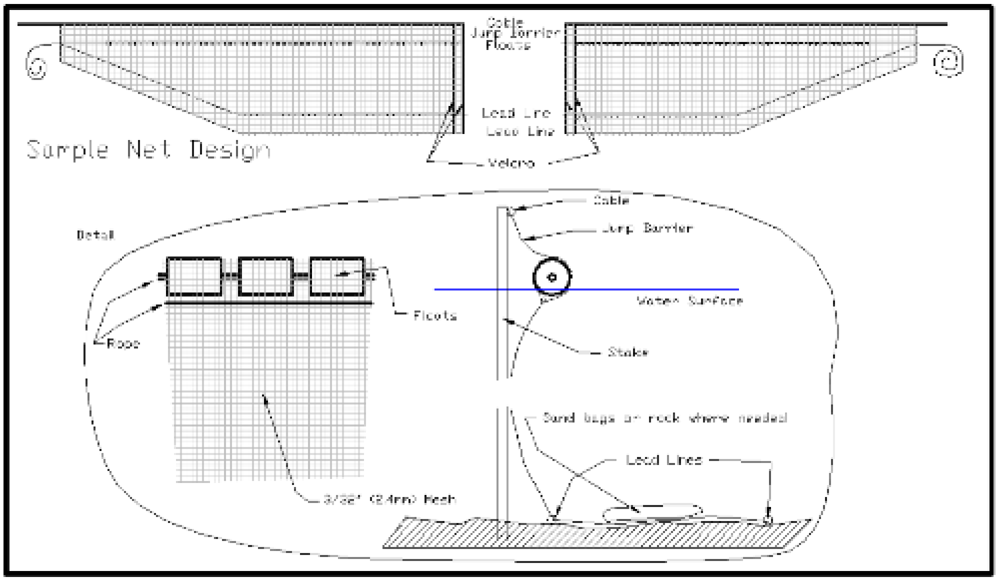

Figure 2-6. Example Net System Design

2.3. Other Site Design Features

Water effluent treatment systems outside of the acclimation ponds themselves are not planned for the small, natural sites. Relatively small numbers of fish would be held at low densities in large ponds at these locations. The minimum retention time for water flowing through the ponds be 2.5 hours and in most cases will be much longer than this. Fish waste will settle at low densities in the ponds.

The ponds are relatively effective at limiting the amount of Total Phosphorous (TP) that is being introduced in the form of fish feed to be discharged through the water supply. Fish feed rates and the amount of TP in the feed are known, along with the amount of TP leaving the pond in the discharge water (see Appendix 6) and in the fish. This data was used to perform the calculation below that estimates that 80% of the TP fed was not discharged from two of the acclimation ponds in 2009.

Rohlfing - 2009

	# of Fish	Fish Size	Total Fish Weight	Fish Feed Rate	TP Feed Rate	P not absorbed by fish
		grams	*grams*	*grams/day*	*grams/day*	*g/day*
Start	101,000	20.1	2,028,938	20,289	288	176
End	101,000	28.0	2,830,494	28,305	402	245

Average rate that TP added to pond (after fish absorbtion):	210	grams/day
Number of days of acclimation	56	days
Total TP not removed by fish through the acclimation season:	11,786	grams
TP load rate exiting pond as determined by measurement (see Section 3.2.1.1):	37.5	grams/day
Total TP exiting pond as determined by measurment:	2,100	grams
Pond P removal efficiency:	82%	

Butcher - 2009

	# of Fish	Fish Size	Total Fish Weight	Fish Feed Rate	TP Feed Rate	P not absorbed by fish
		grams	*grams*	*grams/day*	*grams/day*	*g/day*
Start	136,700	20.1	2,746,097	27,461	390	238
End	136,700	27.2	3,716,275	37,163	528	322

Average rate that TP added to pond (after fish absorbtion):	280	grams/day
Number of days of acclimation	57	days
Total TP not removed by fish through the acclimation season:	15,674	grams
TP load rate exiting pond as determined by measurement (see Section 3.2.3.1):	52.0	grams/day
Total TP exiting pond as determined by measurment:	2,964	grams
Pond P removal efficiency:	81%	

Spreadsheet Inputs	**Value**	**Source**
Fish feed rate (gram feed/gram fish/day)	1.0%	Silver Cup Feeds
Concentration of P in fish feed	1.42%	Skretting Nutra Fry diet
Amount of P in feed absorbed by fish	39%	From Flimlin, G, Sugiura, S., and Ferraris, P., 2003.

Figure 2-7. Pond Phosphorous Removal Efficiency

Avian and mammalian predation is a major consideration for remote acclimation sites. At some locations, physical barriers may be installed if predation becomes severe. Temporary fencing and overhead bird netting may be necessary. Deterrence of predation through human presence has been used effectively at sites currently operated by the MCCRP as well as at federal and state hatcheries; this technique is planned to be employed at most locations.

Many of the ponds at proposed sites could become inundated during major floods. Because spring is the natural migration period, the unplanned release of fish during snow-melt floods would be allowed and no special flood control measures will be taken.

3. Site Descriptions – Proposed, With Construction

Construction would involve the creation of new ponds and excavation of accumulated material in some existing ponds. The ponds have natural bottoms and construction includes the removal of cut material and the spreading and revegetation of fill. Fill areas have not been located, but material would be spread where environmental impacts are minimized under the conditions of construction permits.

Several wells are proposed be drilled to supply water to several sites. They would be located where high yields are most likely, near power sources, and where disturbance to existing vegetation is minimized. Water would be delivered from the wells to the ponds in buried pipelines and in rock-lined channels that will aerate the ground water. Generators provide both primary and back-up power to well pumps. They will be sized after well tests determine pump motor requirements.

North is up in all the following aerial photos, drawings, and maps unless otherwise denoted.

3.1. Butcher

This site is currently being used by the MCCRP for coho acclimation. Plans call for up to 105,000 coho to be acclimated and released every other year (alternating with the Coulter site) during the NPIP phase.

- Location: In an area of potential coho habitat on Nason Creek.
- Surface water supply: Butcher Creek flows directly into the acclimation pond.
- Ground water supply: A new well is proposed that would allow operation of the pond over the winter.
- Acclimation space: An existing pond that measures approximately 270' long by 90' wide has been created by beaver activity in a historic Nason Creek channel.
- Enclosure system: A temporary barrier net at the beaver dam is installed during acclimation to prevent premature downstream migration by coho pre-smolts.
- Land use: A vacation home is located near the pond.
- Access: A surfaced road from Highway 2 is plowed in the winter.
- Construction: The well is proposed to be located near existing roads and near Butcher Creek or the pond. The exact location will be determined with the help of geotechnical experts and with input from landowners. Water from the well would be delivered through a 50 ft. long rock-lined open

channel. Pumps would be powered by line power and a back-up generator is proposed.

Figure 3-1. Butcher Aerial

Figure 3-2. Butcher Pond

3.2. Tall Timber

Plans call for a disconnected side channel to be supplied with water from a new surface water intake.

- Location: In high quality salmon spawning habitat on the Napeequa near the confluence with the White River.
- Surface water supply: An intake on the Napeequa is proposed. A buried pipeline would deliver water by gravity-flow from the intake to an existing historic side channel. Soils encountered during excavation are expected to be Aquic cryumbrepts (NRCS, 2009).
- Ground water supply: None.
- Acclimation space: The existing, disconnected side channel is 1,000’ long and averages 60’ wide. Approximately 40,000 sft of the side channel would be covered by water when the intake is in operation. When not in operation, the water surface area in the channel varies depends on local conditions but will typically occupy about 8,000 sft.
- Enclosure system: A seine net in the channel would be installed during acclimation to confine coho pre-smolts while allowing movement of other fish occupying the channel. The net would be removed at release.
- Land use: Tall Timber Ranch is operated as a church camp.
- Access: The White River Road is plowed all winter.
- Construction: A screened, surface water intake is planned to be prefabricated and installed in the bank of the Napeequa. The intake structure would conform to the existing bank profile and would not impede river flow or impact flood storage capacity. It will use a fixed, sloped screen with an air or water backwash system to flush debris off the screen face and will meet agency screen criteria for sweeping flow, approach velocity, and mesh size. 800’ of buried pipeline would transport water from the intake to the existing side channel. It would include a large, below grade, sand trap near the intake and several manholes for maintenance. No excavation is expected in the side channel. The existing culvert outlet may be adequate to return flow to the Napeequa with the addition of dam boards for elevation control on the culvert inlet.

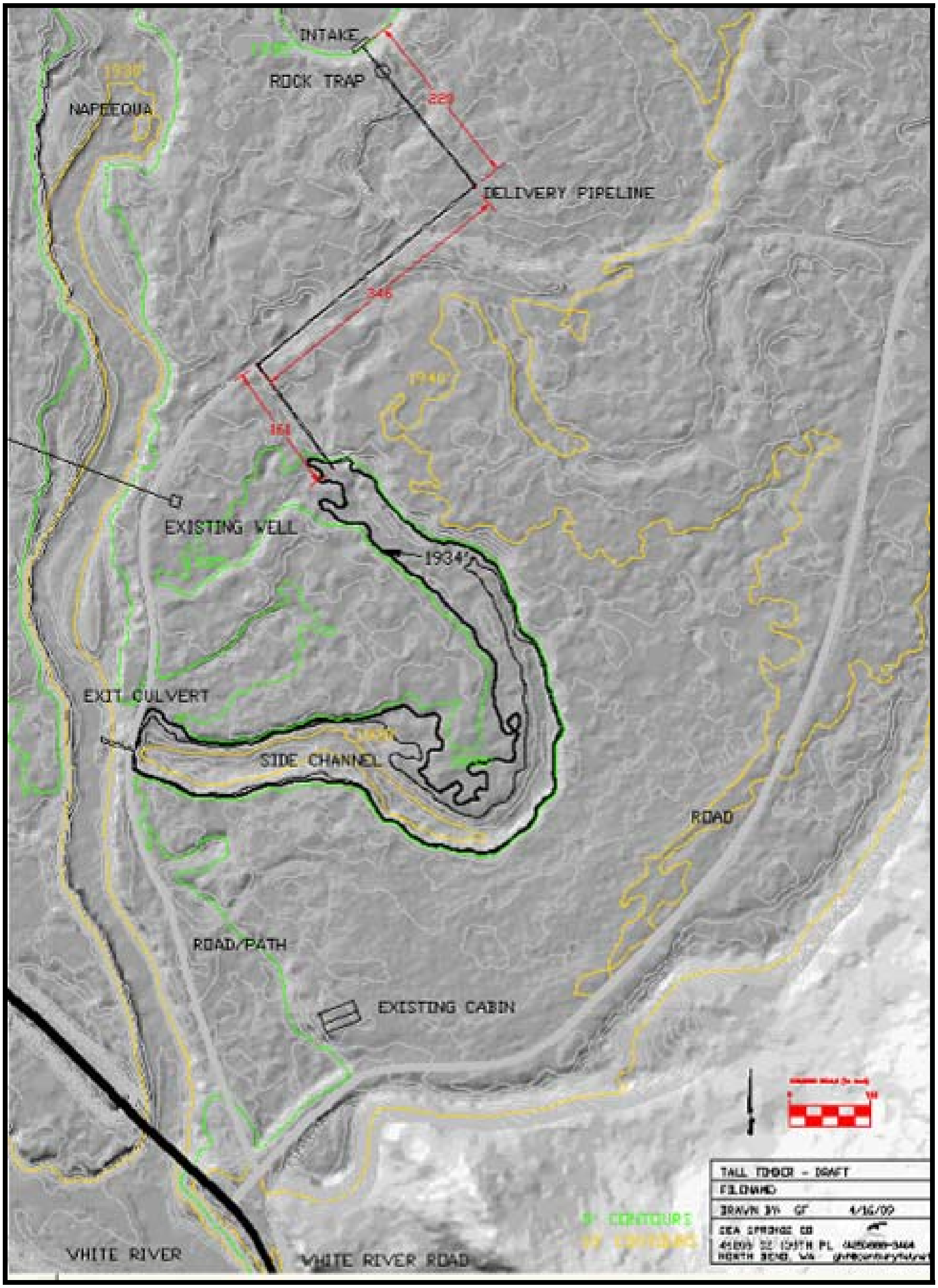

Figure 3-3. Tall Timber Site Plan

Figure 3-4. Tall Timber Pond

3.3. Chikamin

Two acclimation ponds are proposed on a single ownership; one using Chikamin Creek water and the other using Minnow Creek water (see Section 3.4). A new pond and new river intake is proposed for the Chikamin site.

- Location: This site would release fish into an area of high quality habitat in Chikamin Creek and in the middle section of the Chiwawa River.
- Surface water supply: An intake on Chikamin Creek would supply water by pipe to a constructed pond.
- Ground water supply: None.
- Acclimation space: The pond would be earthen bottom with an irregular shape. It would have inlet and outlet screens in place during acclimation to prevent other fish species from entering the rearing area. The pond would be approximately 120 ft. long and 80 ft. wide. Soil expected to be encountered during pond excavation is Kladnick cobbly fine sandy loam (NRCS, 2009).
- Land use: Timber has been harvested from the property.
- Access: The Chiwawa River Road is not plowed in winter. It is maintained for winter recreation and normally is not opened to the Chikamin site until May 1. Daily maintenance access to the acclimation site would need to be by snowmobile.
- Water supply construction: An intake structure is planned to be prefabricated and placed in the Chikamin stream bank. It would conform to the existing bank profile and would not impede river flow or impact flood storage capacity. The intake uses a fixed, sloped screen with an air or water

backwash system to flush debris off the screen face and will meet agency screen criteria for sweeping flow, approach velocity, and mesh size. Pipe (120 ft.) would be buried from the intake to a pond constructed alongside Chikamin Creek. A 70 ft. long discharge channel would return water from the pond to the creek. It would be rock lined to prevent erosion.

- Pond construction: The pond would be constructed by excavating material from a flat bench near the creek. A typical crossection through the pond is shown in Figure 3-7. Areas A and B would be cut from the existing ground contour and the fill would be spread elsewhere. No pond berms will be constructed. Although no flood elevation data is available for the area, it is likely in the 100 year flood plain, although out of the floodway. Because the pond will be below existing grade and material will be removed from the flood plain, pond construction will increase flood storage capacity (area A in Figure 3-7).

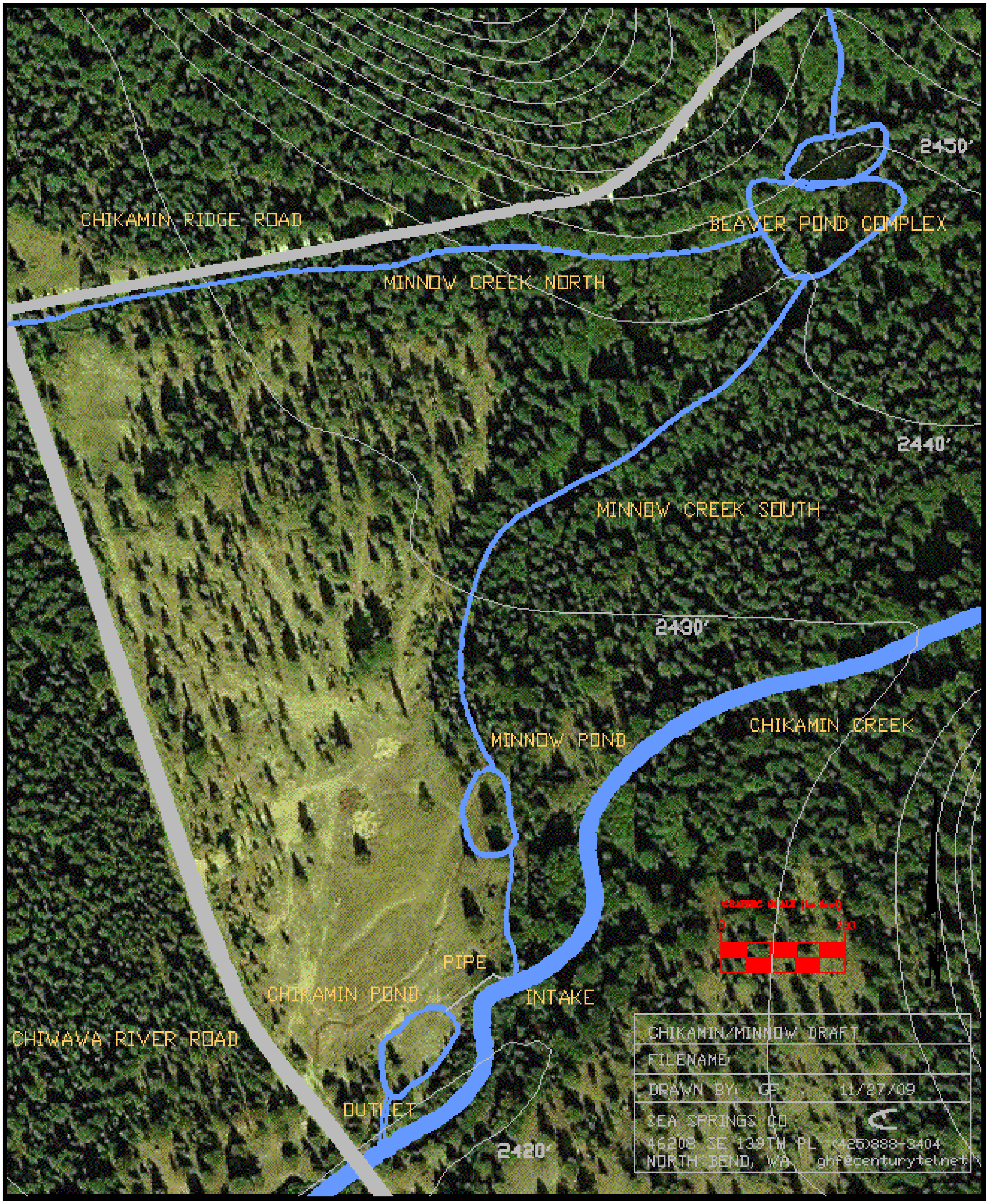

Figure 3-5. Chikamin and Minnow Site Plan

Figure 3-6. Chikamin Pond Location

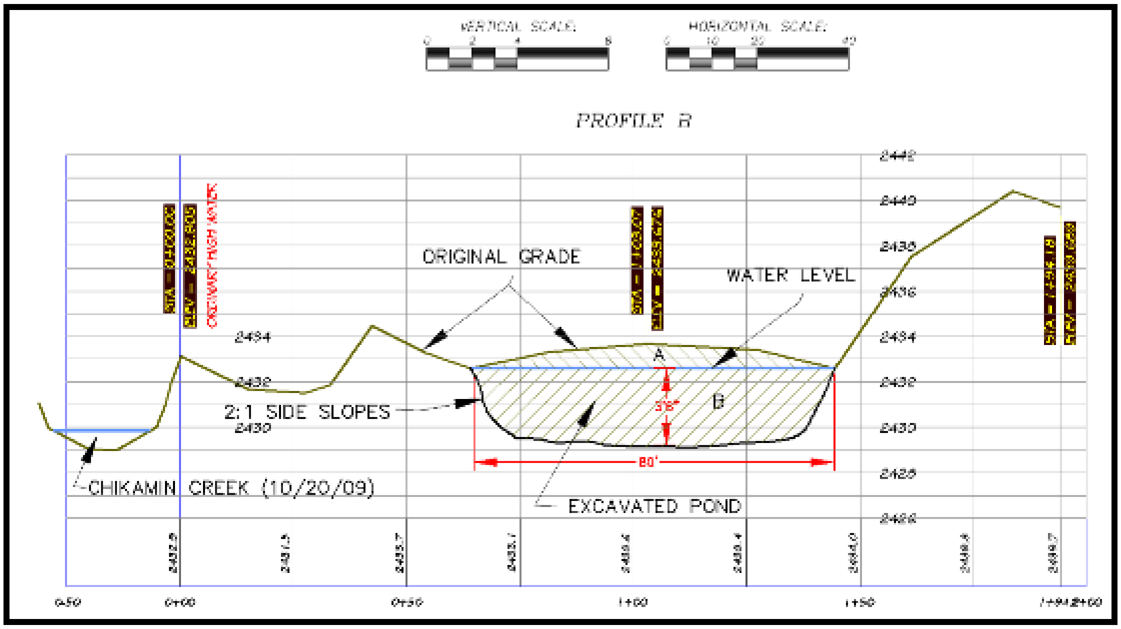

Figure 3-7. Chikamin Pond Crossection

3.4. Minnow

The Minnow pond is proposed to be constructed in the creek channel.

- Location: This site would release fish into an area of high quality habitat in Minnow Creek, a tributary of Chikamin Creek.
- Surface water supply: Minnow Creek water would flow directly into and out of a constructed pond. No water intake or diversion is planned.
- Ground water supply: None.
- Acclimation space: An earthen bottom with an irregular shape would be built in the Minnow Creek channel. Coho would be contained in pond during acclimation by temporary seines. Free passage up and downstream

by other fish would be maintained. The pond would be approximately 120 ft. long and 80 ft. wide. Soil expected to be encountered during pond excavation is Kladnick cobbly fine sandy loam (NRCS, 2009).

- Land use: Timber has been harvested from the property.
- Access: The Chiwawa River Road is not plowed in winter. It is maintained for winter recreation and normally is not opened to Chikamin until May 1. Daily maintenance access to the acclimation site would need to be by snowmobile.
- Construction: A pond would be excavated next to the current Minnow Creek stream channel (see the aerial photo in Section 3.3). After completion and stabilization of the pond bottom, Minnow Creek would be diverted into the completed pond. The pond would be constructed by excavating and removing material and would be located in the 100 year floodplain and floodway. Because the pond will be below existing grade and material will be removed from the flood plain, pond construction will increase flood storage capacity. The pond would be rock lined to prevent erosion.

Figure 3-8. Minnow Pond Location

3.5. Scheibler

An impoundment in the Chumstick Creek channel was built at some point in the past, forming a pond.

- Location: The site is located 13.0 km up Chumstick Creek, above some areas that may become coho spawning habitat. Several culverts throughout the lower and middle sections of Chumstick Creek have been removed, vastly improving salmonid passage.

- Surface water supply: Chumstick Creek flows directly into the existing pond.
- Ground water supply: None.
- Acclimation space: The existing pond is 100' long and 15' wide. With landowner permission, expansion of the pond will be proposed. Increasing the capacity by 14,000 cft would require the removal of 350 cubic yards of material.
- Seine net system: A temporary seine net would enclose a part of the pond. It would be positioned to allow free access to the inlet, outlet, and part of the pond habitat by other fish. The net would be removed at release.
- Land use: The surrounding property is used for farming.
- Access: The surfaced Chumstick Road provides year round access to a point close to the ponds. Three-phase power is on the property and near the pond.
- Construction: Excavation and enlargement of the existing pond would increase room for coho acclimation and would provide rearing space for other fish in the Chumstick Creek. Excavation will occur during low flow and the creek will be piped around the work area during construction. Material cut from the pond will be spread at approved areas, as dictated by permit conditions.

Figure 3-9. Scheibler Aerial

Figure 3-10. Scheibler Photo

4. Site Descriptions – Proposed, No Construction

The sites listed below would require no construction activities that result in earth-moving activities or permanent changes. Existing ponds and water supplies would be used for acclimation.

4.1. Coulter

Site function: This site is currently being used by the MCCRP for coho acclimation. Plans call for up to 105,000 coho to be acclimated and released every other year (alternating with the Butcher Creek site) during the NPIP phase. No overwinter acclimation is planned.

- Location: In an area of potential coho habitat on Nason Creek. Fish migrate down Coulter Creek from the pond into a large wetland complex owned by the Yakama Nation before entering Nason Creek.
- Surface water supply: Coulter Creek flows directly into the acclimation pond.
- Ground water supply: None.
- Acclimation space: An existing pond that measure approximately 200’ wide by 80’ long has been created by beaver activity.
- Enclosure system: A temporary barrier net at the beaver dam is installed during acclimation to prevent premature downstream migration by coho pre-smolts.
- Land use: A vacation home is located near the pond.
- Access: An unsurfaced road from Highway 2 is plowed in the winter, providing adequate access throughout the year.

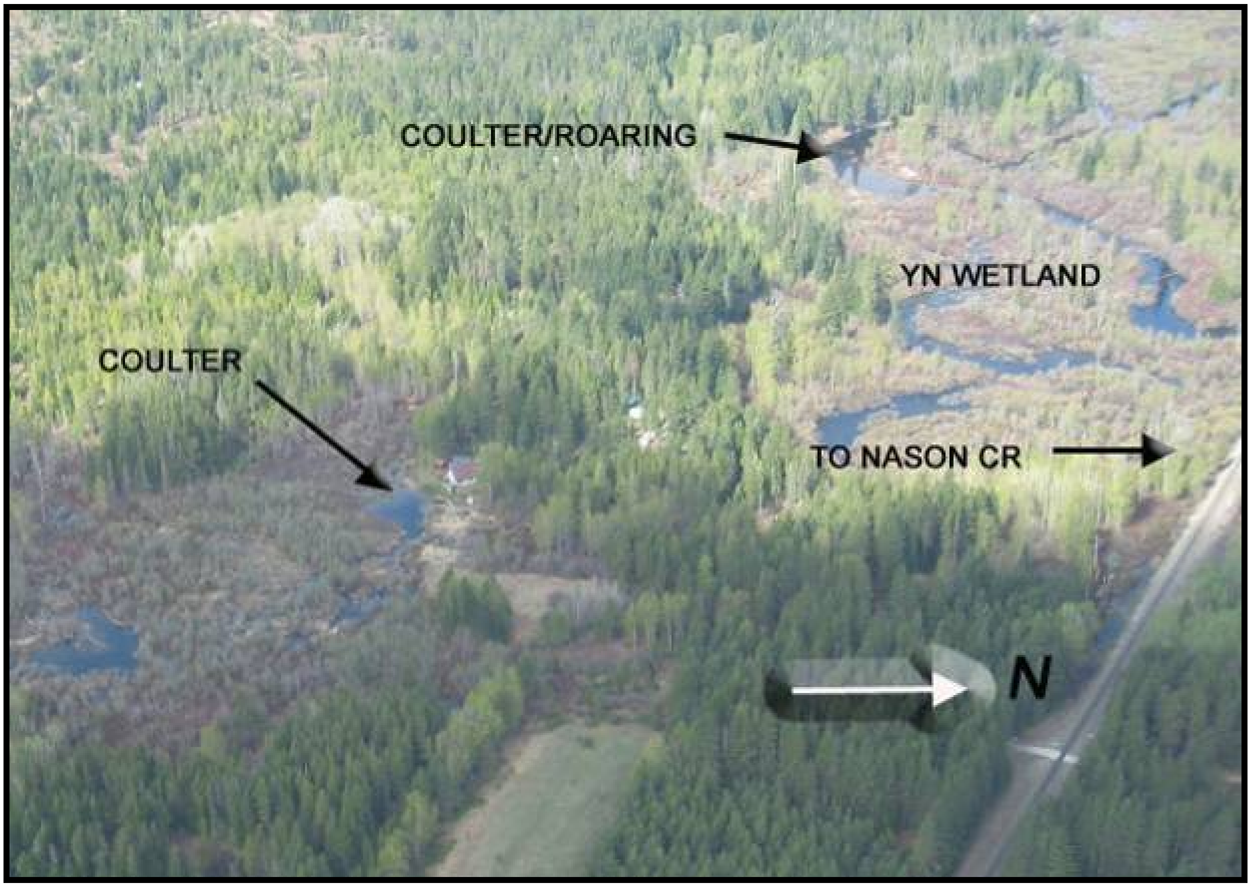

Figure 4-1. Coulter Aerial

Figure 4-2. Coulter Photo

4.2. Rohlfing

This site is currently being used by the MCCRP for coho acclimation.

- Location: Near the upstream end of accessible coho habitat on Nason Creek.
- Surface water supply: An unnamed, seasonal stream flows at over 1-4 cfs in the spring directly into the acclimation pond. Low stream flows during the

fall adult migration period may encourage coho to distribute to suitable spawning habitat in Nason Creek.

- Ground water supply: An 8” well was dug in 2003 that is estimated to produce 130 gpm (Williamson, 2003). Plans call for piping to be installed in 2010 that would deliver this water to the pond. Ground water would allow the Rohlfing site to be used for overwinter acclimation.
- Acclimation space: An existing pond was expanded in 2004. It currently measures approximately 90’ long by 50’ wide with an average depth of 4’. A barrier net at the pond outlet is installed during acclimation to prevent premature downstream migration by coho pre-smolts. The net is removed at release.
- Land use: A vacation home is located near the pond.
- Access: Whitepine Road is an unsurfaced US Forest Service road which is plowed in the winter, providing adequate access throughout the year. It is one mile from Highway 2 to the Rohlfing Pond. Single phase, underground power is currently in place.

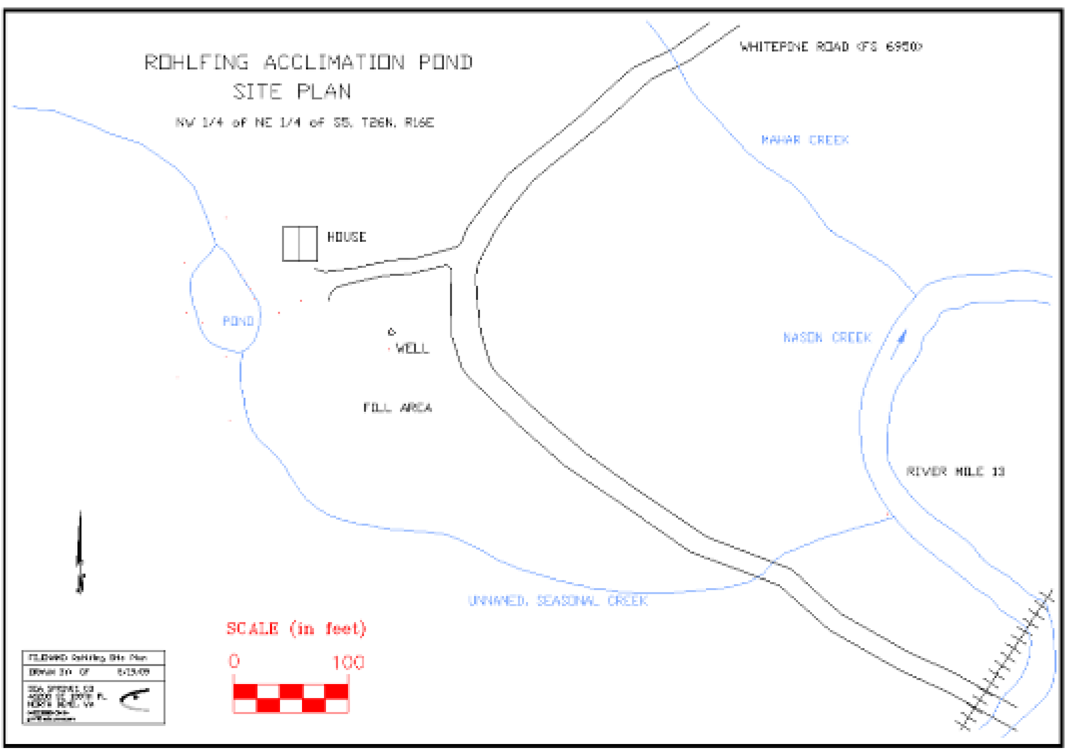

Figure 4-3. Rohlfing Site Plan

Figure 4-4. Rohlfing Photo

4.3. White River Springs

Two springs originating from talus slopes on Dirty Face Mountain combine and flow into a system of beaver ponds.

- Location: In a very low gradient section of the White River. Adults would need to migrate past the release location or into tributaries on the lower White to find suitable spawning habitat.
- Water supply: The combined springs flow is 1.5 cfs at the head of the channel during the spring period. Flow entering the White River is reduced by water leaking from the channel into the cleared field and from seepage and dispersion that result from beaver dams. It may be possible to overwinter acclimate with the temperate spring water supplies.
- Acclimation space: Existing ponds are formed by beaver dams between the cleared property and the White River. Their size depends on the location and condition of the dams.
- Enclosure system: A temporary barrier net at a beaver dam would be installed during acclimation to prevent premature downstream migration by coho pre-smolts. The net is removed at release.
- Land use: A residence is located on the property.
- Access: The surfaced White River Road is plowed in the winter.

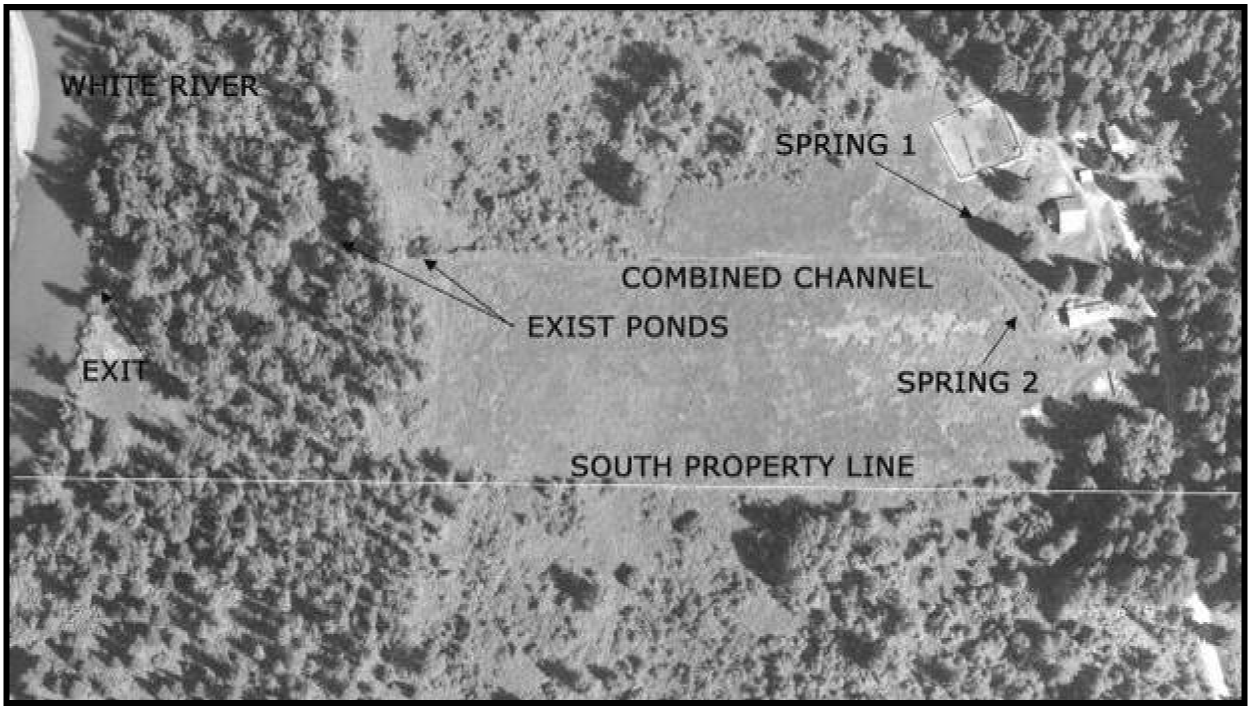

Figure 4-5. White River Springs Aerial

Figure 4-6. White River Springs Pond Photo

4.4. Dirty Face

Spring water flows through a flat, open field and then into the White River. The mouth is on publicly owned land, where adult plants are proposed.

- Location: In a very low gradient section of the White River. Adults would need to migrate past the release location or into tributaries to find suitable spawning habitat.
- Water supply: A spring originating from talus slopes on Dirty Face Mountain.
- Acclimation space: None. A temporary weir would be placed near the mouth of the creek and adults would be planted behind the weir. When spawning is completed, the weir would be removed.
- Land use: The mouth of the creek is in the Chelan Wildlife Area - White River Unit and is owned and managed by the Washington Department of Fish and Wildlife. A vacation home is located on adjacent property.
- Access: The surfaced White River Road is plowed in the winter.

Figure 4-7. Dirty Face Aerial

Figure 4-8. Dirty Face Photo

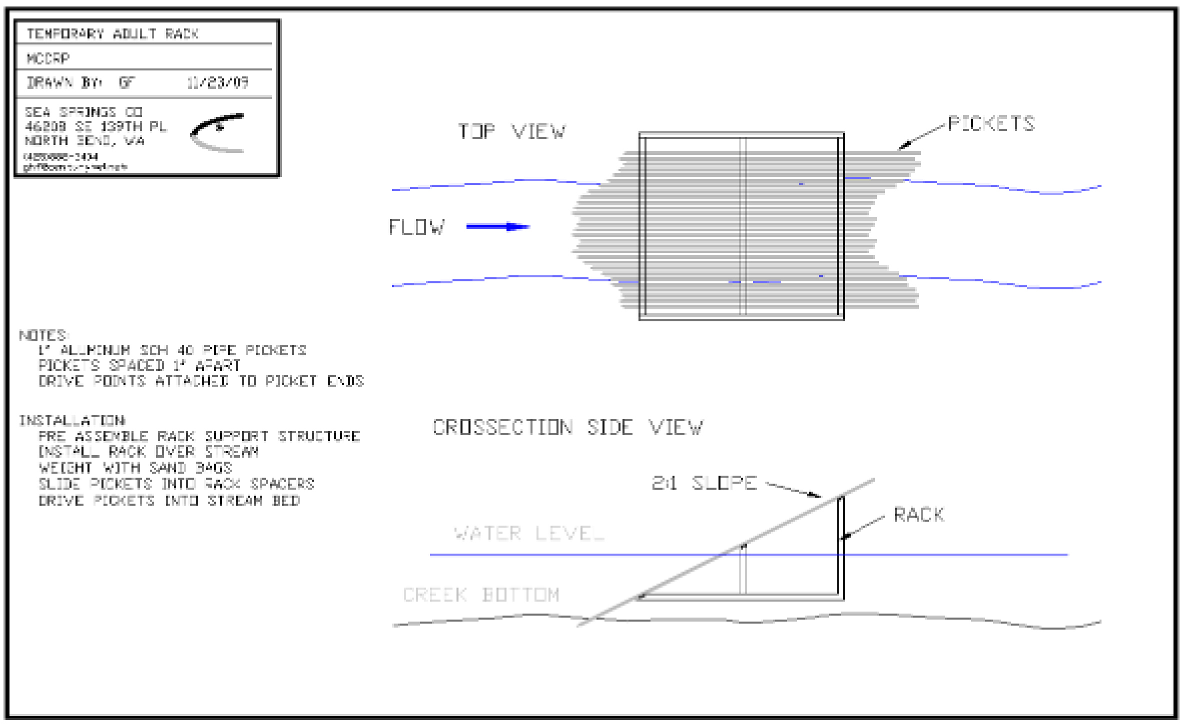

Figure 4-9. Sample Adult Barrier

4.5. Two Rivers

This site has been used in the past for coho acclimation and is on the Two Rivers gravel mine.

- Location: The site is located in the lower section of the Little Wenatchee River. Adults would need to migrate past the release location to find suitable spawning habitat.
- Surface water supply: None.
- Ground water supply: Water is pumped from a lake formed by the gravel mine to an existing acclimation pond. Gravel excavation through the winter and spring creates relatively high turbidity in the lake. To minimize sediment discharge, water is returned to the lake rather than to the Little Wenatchee River.
- Acclimation space: The existing acclimation pond is 500' long and 15' wide. An existing screened outlet structure confines the fish during acclimation.
- Land use: Gravel mining.
- Access and power: The surfaced Little Wenatchee River Road is plowed in the winter to the mine, providing adequate access throughout the year. Public power does not extend to the site and main power is produced by generators.

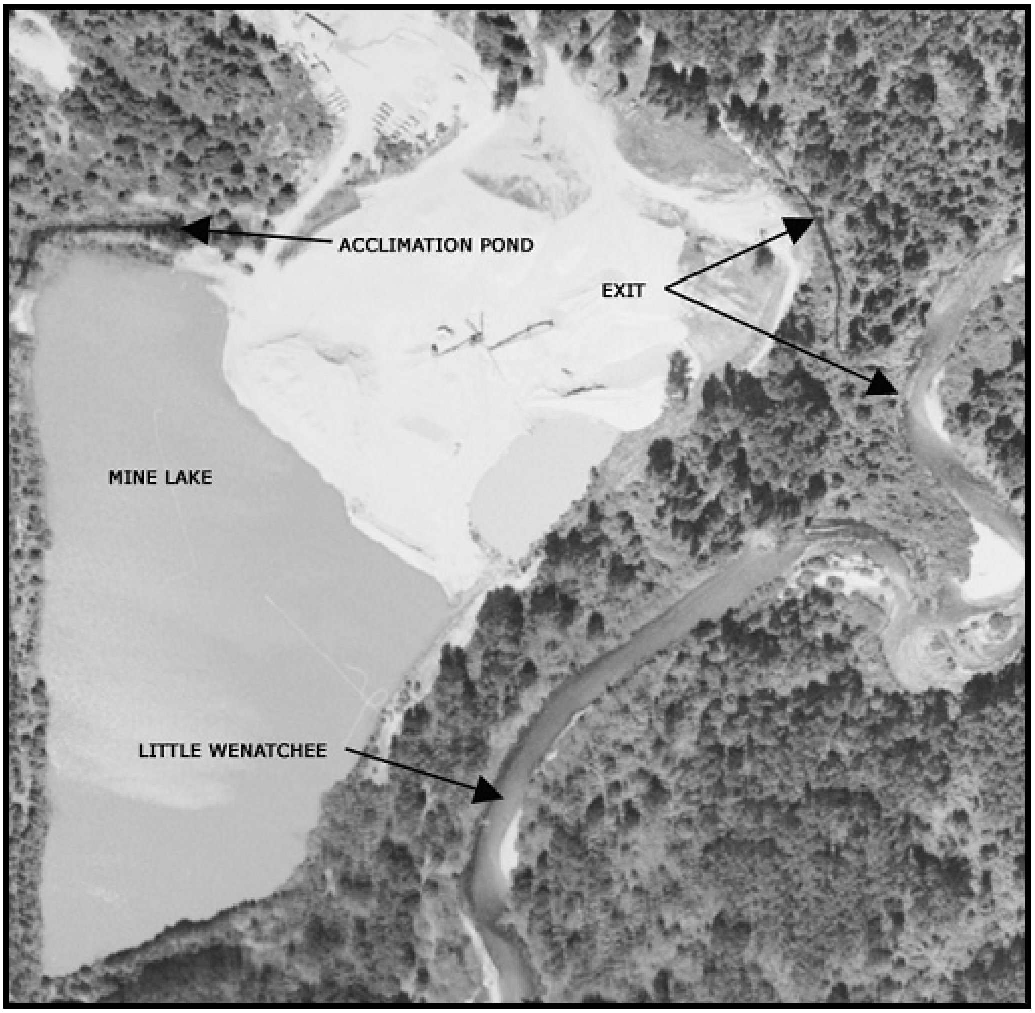

Figure 4-10. Two Rivers Aerial

Figure 4-11. Two Rivers Pond

4.6. Clear

Several man-made ponds exist on a private campground site.

- Location: In the lower section of the Chiwawa River.
- Water supply: Clear Creek is a spring influenced water supply. It has a relatively stable flows and temperatures which may allow overwinter acclimation. Clear Creek flows into and out of the acclimation pond.
- Acclimation space: There are three ponds connected in series. The upstream pond has been proposed for coho acclimation.
- Enclosure system: A temporary seine net would enclose a part of the pond. It would be positioned to allow free access to the inlet, outlet, and to part of the pond habitat by other fish. The net would be removed at release.
- Land use: The ponds are on a Thousand Trails private campground.
- Access: Surfaced, plowed roads provide adequate access.

Figure 4-12. Clear Creek Aerial

Figure 4-13. Clear Creek Pond

4.7. Beaver

This site has been used in the past for coho acclimation.

- Location: Beaver Creek is a small direct tributary of the Wenatchee River. Coho habitat exists in the creek but to date no spawning activity has been documented. A passage barrier at the mouth may prevent coho from accessing the creek.
- Surface water supply: An existing intake on Beaver Creek diverts flow into the pond.
- Ground water supply: None.
- Acclimation space: The existing acclimation pond is 115' in diameter. Bird predation is limited to some extent by the surrounding mature tree cover, but otters are present. An existing screened outlet structure confines the fish during acclimation.
- Enclosure system: The screen prevents free passage of naturally produced fish in Beaver Creek during coho acclimation.
- Land use: The pond is owned by Mountain Springs Lodge, a recreation-oriented guest facility.
- Access: An unsurfaced road extends 1,000' from the Lodge to the pond.

Figure 4-14. Beaver Aerial

Figure 4-15. Beaver Pond

4.8. Brender

This site is the lowest and most accessible to returning adults in the Wenatchee basin. Mission and Brender creeks have low-gradient, small-stream habitat that might be used by coho. Habitat degradation is an impediment to reintroduction in these watersheds.

- Location: The site is located on Brender Creek, a tributary to Mission Creek, which in turn flows into the Wenatchee near the town of Cashmere.
- Surface water supply: Brender Creek flows directly into the existing pond.
- Ground water supply: None.
- Acclimation space: The existing acclimation pond is approximately 130’ in diameter.
- Seine net system: A temporary seine net would enclose a part of the pond. It would be positioned to allow free access to the inlet, outlet, and to part of the pond habitat by other fish. The net would be removed at release.
- Land use: The area includes some light industry, retail stores, and residences.
- Access: Surfaced roads provide adequate access and power is nearby.

Figure 4-16. Brender Aerial

Figure 4-17. Brender Pond

4.9. Leavenworth NFH

This USFWS hatchery on Icicle Creek is currently being used by the MCCRP for acclimation and release. Coho are held in second-use water in old Foster-Lucas concrete raceways. Smolts are released from the raceways and then passed through the hatchery ladder into Icicle Creek. The main purpose of the site has been for broodstock development; releases would continue during natural production phases to provide a back-up broodstock source. The hatchery might also be used in the future as an intermediate acclimation location between lower river hatcheries and upriver release sites.

5. Site Descriptions – Back-up, With Construction

5.1. Squadroni

Squadroni would be used if the other primary Nason Creek sites are not.

- Location: In an area of potential coho habitat on Nason Creek.
- Surface water supply: An existing ditch that flows seasonally would be connected to the pond. There will be some surface water flow during snow melt and rain events.
- Ground water supply: A new well is proposed.
- Acclimation space: A new pond is proposed pond that would have an earthen bottom and irregular shape. The pond would be approximately 120 ft. long and 90 ft. wide. Soil expected to be encountered during pond excavation is Aeric Fluvaquents (NRCS, 2009).
- Enclosure system: The pond would have inlet and outlet screens in place during acclimation.
- Land use: A vacation home is located near the pond.
- Access: Highway 2.
- Construction: The well is proposed to be located near existing roads, the exact location would be determined with the help of geotechnical experts and with input from landowners. Water from the well would be delivered through a 50 ft. long rock-lined open channel. Pumps would be powered by line power and back-up generators. The pond would be constructed by excavating material from a pasture area. Because it will be below existing grade and material will be removed from the flood plain, pond construction will increase flood storage capacity. A 20 ft. long discharge channel would return water from the pond to the ditch. It would be rock lined to prevent erosion.

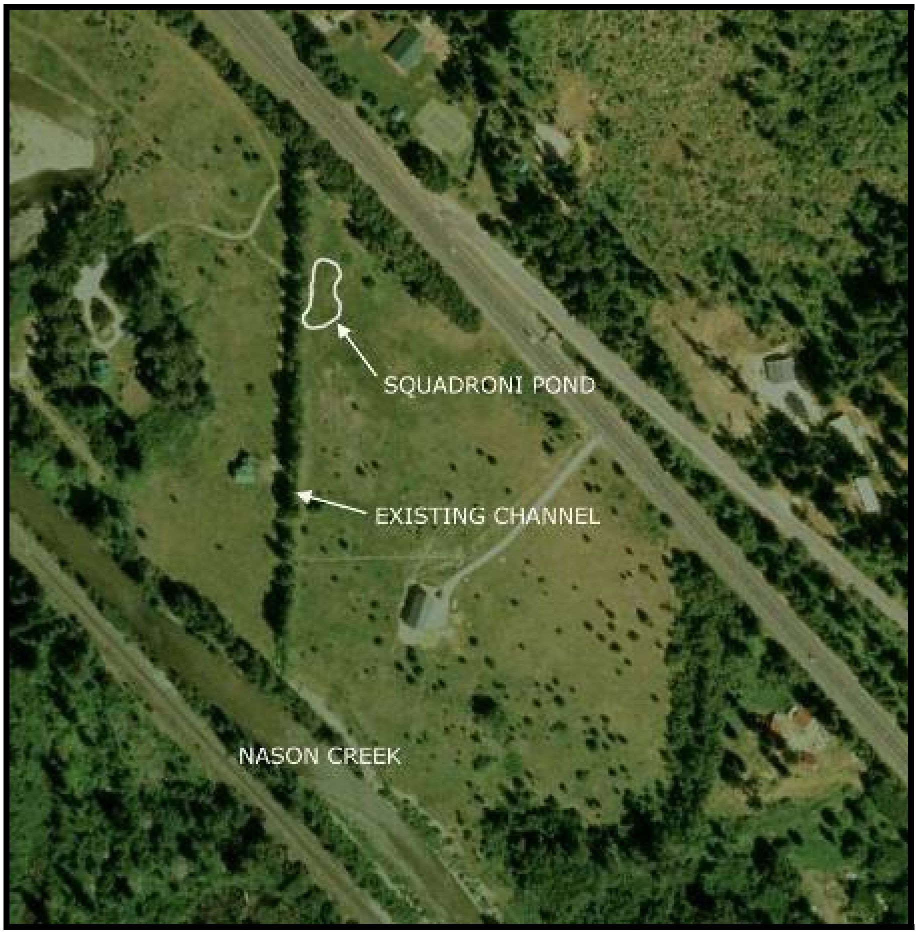

Figure 5-1. Squadroni Aerial

5.2. Dryden

This site is a proposed hatchery (see the Adult Capture and Rearing Site Descriptions for site details). Smolt releases may also occur for several purposes. Releases above Dryden Dam may provide an alternative broodstock source, release into Peshastin Creek may help seed that stream, and releases directly into the Wenatchee may help distribute coho throughout the lower river. Facility designs would allow releases to occur in Peshastin Creek or in the Wenatchee above Dryden Dam as well as potentially provide intermediate rearing for juveniles destined for the upper watershed.

6. Site Descriptions – Back-up, No Construction

6.1. Allen

The Allen pond is used for recreation by the Valley Hi community.

- Surface water supply: A diversion from Allen Creek feeds the pond.
- Ground water supply: None.
- Acclimation space: The pond measures approximately 200’ in diameter.
- Land use: Recreation.
- Access: Year-round paved roads provide access to Valley Hi from Highway 97.

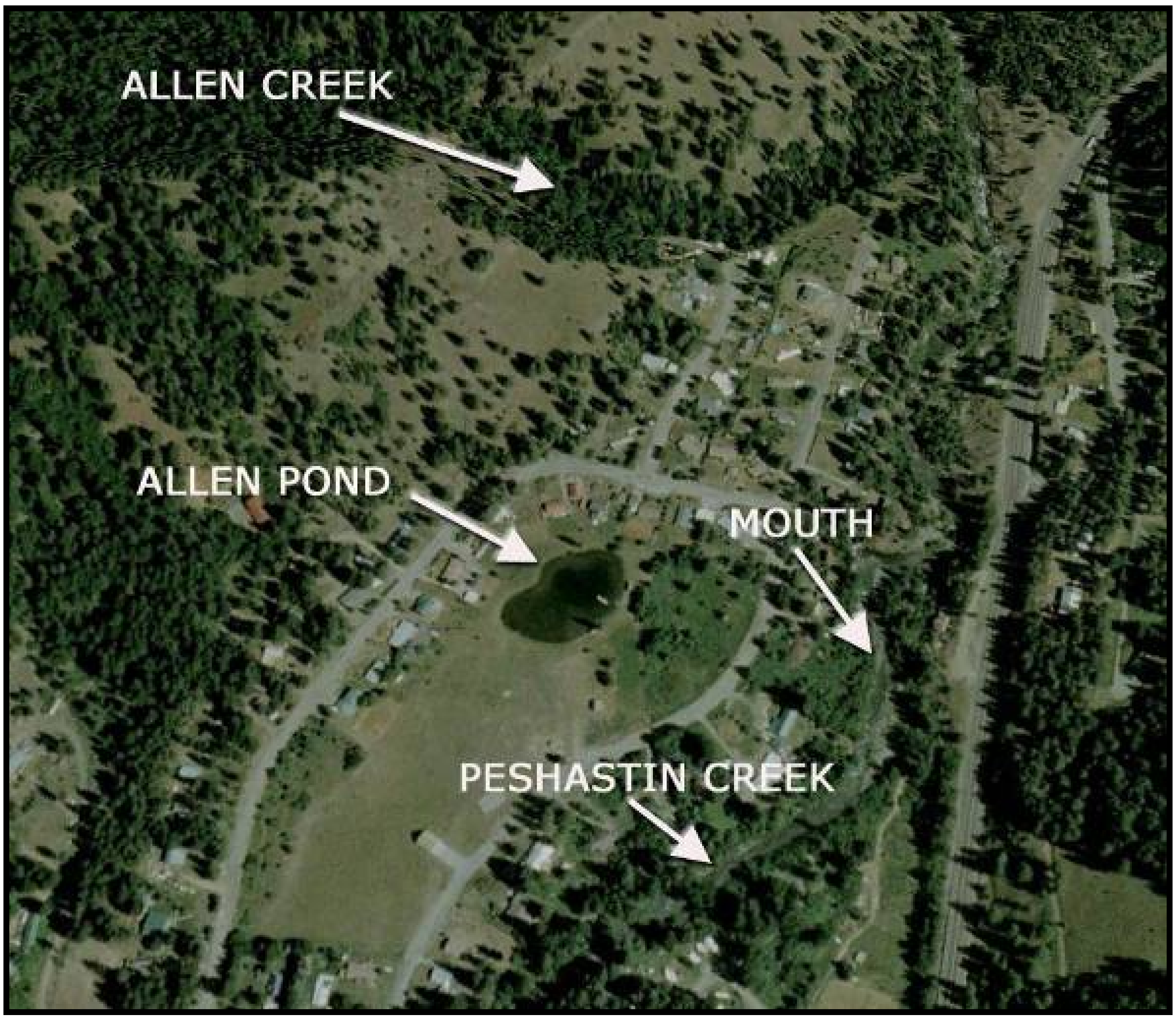

Figure 6-1. Allen Aerial

6.2. Coulter/Roaring

The Coulter/Roaring wetland is owned by the Yakama Nation, although access to potential sites is through private property. Several large ponds are formed in the wetland by beaver dams. A seine in part of a pond would allow acclimation to occur.

- Location: In an area where small tributaries may be seeded and where a wetland complex may provide rearing habitat. Smolts would migrate from the acclimation area, through the wetland, and then in to Nason Creek.
- Surface water supply: Coulter and Roaring creeks.
- Ground water supply: None.
- Acclimation space: A large beaver pond.
- Land use: Habitat preservation, recreation, and rural residential.
- Access: A gravel road from Hwy 2 is plowed in the winter.

See the aerial photo in Section 4.1.

6.3. McComas

Grant Public Utility District has proposed developing the McComas site for spring Chinook acclimation in the White River. Some coho could be acclimated at the site as a back-up to the upriver sites on the White River.

- Location: Low in the White watershed, below coho spawning habitat.
- Surface water supply: White River.
- Ground water supply: Wells.
- Acclimation space: Large, constructed ponds.
- Land use: Habitat preservation and rural residential.
- Access: The paved, plowed Little Wenatchee Road.

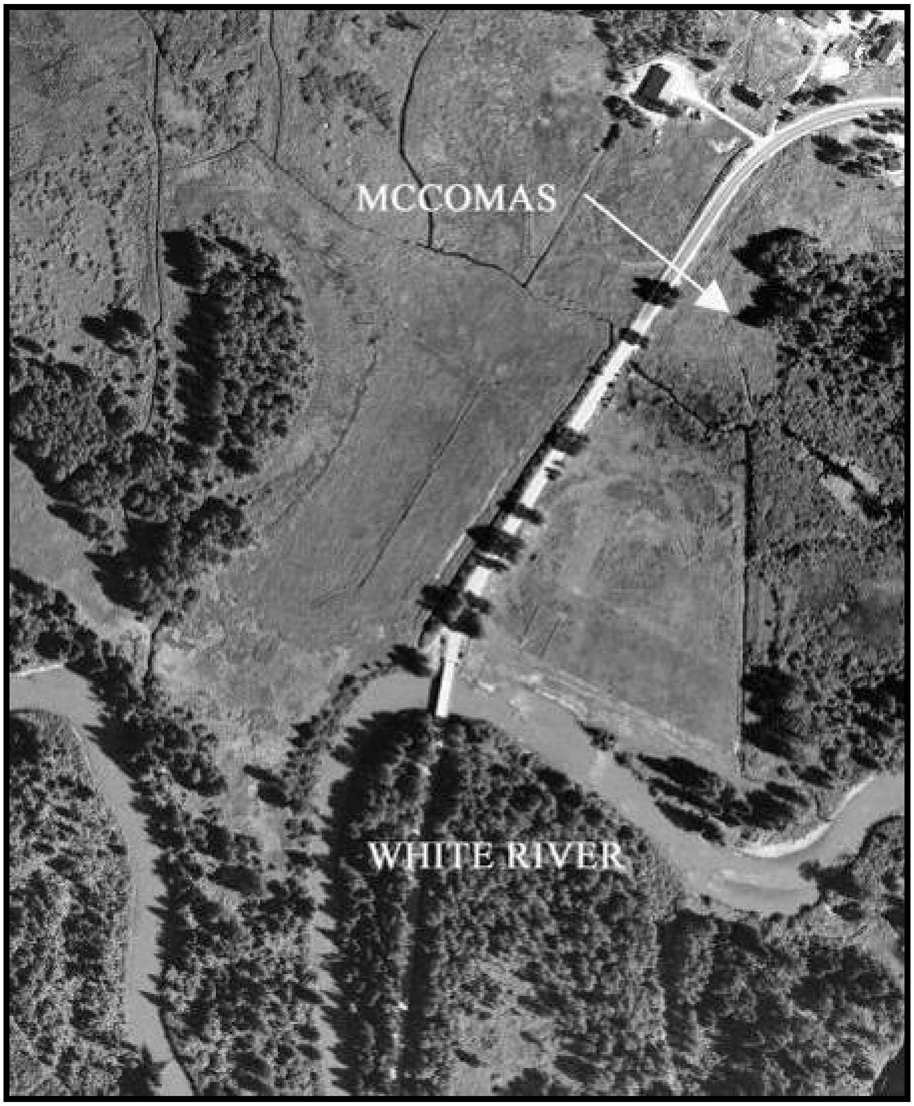

Figure 6-2. McComas Aerial

7. Other Locations and Methods

Areas where ponds do not currently exist and where pond construction is not possible may be targeted for adult plants. Procedures would be similar to those described for Dirty Face above, using a temporary adult weir to confine fish to targeted areas during spawning.

Acclimation and release of coho at existing and planned facilities that are developed for other species may also be considered in the future. Mixing coho with spring chinook and or steelhead, or acclimating in separate rearing units on the same site, may be possible.

8. References

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APPENDIX 3

METHOW ACCLIMATION SITE DESCRIPTIONS

Prepared by: Greg Ferguson, Sea Springs Co.

May, 2011

Table of Contents

List of Figures

1. Summary

The proposed alternative for the Methow Natural Production Implementation Phase (NPIP) includes smolt releases at up to 12 locations in the Methow watershed (see Fig 1-1). Back-up acclimation sites and methods have also been identified.

Tributary sites where releases occur upstream of traps will be important as they would initiate production in areas where returning natural origin adults will be available for broodstock collection. Continued releases from the Winthrop National Fish Hatchery (Winthrop NFH) on the mainstem Methow have a dual purpose: 1) to distribute spawning adults throughout the Methow basin and 2) to serve as a back-up brood source.

The proposed Chewuch sites are a large part of the Methow program, with approximately 30% of the proposed releases for the Methow basin occurring in this watershed. Three primary acclimation sites and two back-ups have been identified in the Chewuch, with Methow State Wildlife Area (MSWA) Eightmile and Mason adjacent to each other and located as far upstream as access allows.

The Lincoln site on the Twisp River is at the upper end of the low gradient habitat preferred by coho salmon. It is capable of over winter operation. The Twisp weir site also releases fish above the existing trap on the Twisp River.

Two sites on the mainstem, Heath and Hancock, are located on large springs that may be productive coho spawning habitat. The Hancock location does not have a pond and adult plants would be the reintroduction technique used.

Other acclimation sites and procedures may be evaluated in the future. Small streams with potential coho habitat may be targeted for reintroduction. Feedback from the Monitoring and Evaluation program would help determine the value of such tributary habitat. Along with adult plants and pond acclimation, in-river acclimation may be tested as an alternative reintroduction strategy.

Site activities at acclimation ponds include fish delivery, feeding, predator hazing, sampling, and release monitoring. Sites would be visited one or more times per day to conduct the routine activities. Large truck access is required once at the start of acclimation at each site for fish delivery. Daily access could occur by small vehicle, foot, or snowmobile.

Proposed construction at the primary sites includes the excavation of one new pond, one new intake, excavation of accumulated material in two existing ponds and new wells at four sites. A total of 0.9 acres is expected to be disturbed by construction activities.

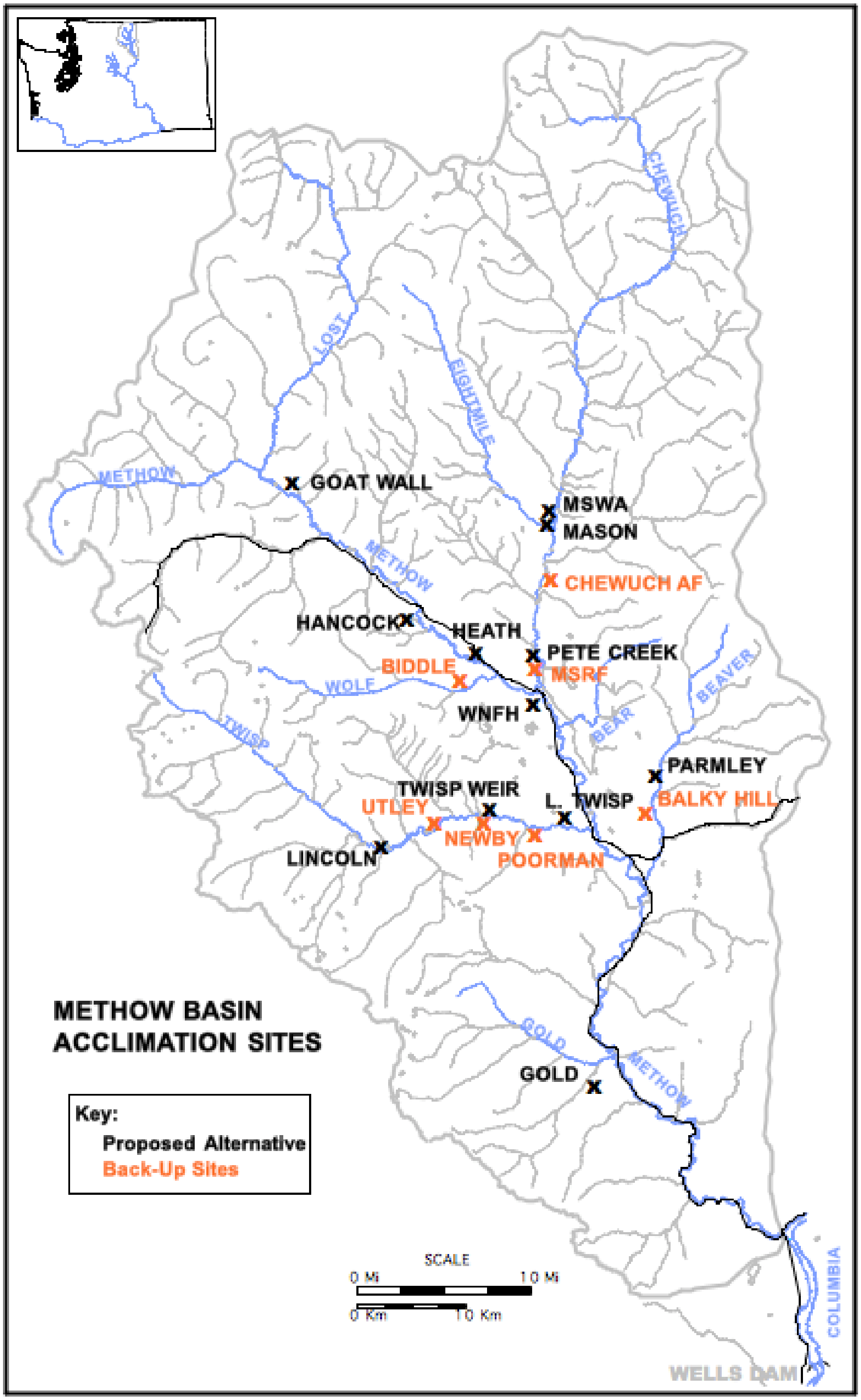

Figure 1-1. Methow Subbasin Acclimation Site Map

2. Site Details

2.1. Information Tables

The tables below include specific details for each proposed Methow acclimation site.

	GENERAL				LOCATION								LAND USE/ZONING					FLOOD
	Release (1,000s)	Overwinter	Adult trap	Previously used	Distance to Methow mouth (rkm)	Township	Range	Section	1/4 section	Elevation (m)	Latitude	Longitude	Zoning	Comprehensive Plan	Shoreline MP designation	Conservation Easement	Landuse	FEMA flood designations
Methow Acc.																		
MSWA (Eightmile)	88		W		99	36	21	24	NW	646	36'33"	09'46"	A20	FL	N	Y	Wildlife (public)	NM
Mason (Eightmile)	88	Y	W	Y	98	36	21	23	SE	652	36'18"	09'58"	R20	RL	N	Y	Vacation home	NM
Pete Creek	125		W		86	35	21	22	SE	570	30'57"	11'20"	R5	RM	RE		Rural estate	100 Yr
Goat Wall	50		W		112	36	19	9	SE	690	37'59"	28'03"	RR5	SUA	CE	Y	Rural residential	NM
Heath	100	Y	W		87	35	21	30	SW	557	30'10"	15'09"	RR5	SUA	RE	Y	Rural residential	100 Yr
Parmley	50		W		69	34	22	35	NE	711	24'28"	02'21"	A20	AL	ND		Vacation home	NM
Lincoln	110	Y	T		89	33	20	17	SE	710	21'12"	22'15"	R5	RM	N	Y	Farming/Conservation	100 Yr
Twisp Weir	110	Y	T		75	33	21	8	NW	609	22'49"	14'42"	R5	RM	N		Fish acclimation	100 Yr
Lower Twisp	30	Y	W	Y	66	33	22	18	NW	496	21'58"	08'09"	R5	RM	T		Wildlife	100 Yr
Gold	50		W		38	31	22	20	NW	470	10'47"	07'08"	R20	RL	ND		Rural Residential	NM
Winthrop NFH	100	Y	WH	Y	80	34	21	3	SE	530	28'24"	11'12"	R1	UGA	RE		Public hatchery	100 Yr
Adult Plants																		
Hancock			W		94	35	20	15	SE	590	32'02"	19'48"	RR5	SUA	CE		Ranching	100 Yr
Acc. Back-ups																		
Poorman	83		W		69	33	21	14	NW	540	22'07"	10'60"	R5	RM	N		Rural residential	100 Yr
Newby	83		T		76	33	21	8	NW	622	22'43"	15'9"	R5	RM	N		Rural residential	NM
Utley	83	Y	T		81	33	20	11	SE	664	22'18"	18'14"	R5	RM	N		Rural residential	100 Yr
Biddle	50		W	Y	86	35	21	32	SW	581	29'18"	14'47"	RR5	SUA	RE		Vacation home	NM
Balky Hill	50		W		66	33	22	2	SE	630	23'01"	02'55"	A20	AL	RE		Ranching	NM
Chewuch A.F.	125		W		93	36	21	2	NW	602	33'53"	10'33"	R5	RM	RE		Rural residential	None
MSRF - Chewuch	125	Y	W		85	35	21	27	NE	563	30'40"	11'17"	R5	RM	RE		Wildlife	100 Yr

Figure 2-1. General, Location, and Land Use Details

Key, Figure 2-1:

Release (thousands). The proposed peak number of coho smolts to be released during the Natural Production Implementation Phase.

Overwinter. Does the site have a reasonable potential for over-winter acclimation? This requires a source of groundwater and reliable access.

Adult Trap. The nearest downstream collection facility: W = Wells, T = Twisp Weir, WH = Winthrop NFH.

Previously used. Has the site been used by the coho reintroduction program in past years?

Distance to mouth (rkm). The distance from the mouth of the Wenatchee to the acclimation site in river kilometers.

Zoning. C= City, R1 = Rural 1 acre, R5 = Rural 5 acre, R20 = Rural 20 acre, RR5 = Rural residential 5, AG20 = Agriculture 20. Data from Okanogan County, 2009b.

Comprehensive Plan. SUA = Sub-Unit-A, RL = Rural Low, RM = Rural Medium, FL = Forest Lands, AL = Agricultural Lands, UGA = Urban Growth Area. Data from Okanogan County, 2009a.

Shoreline Master Plan Designation. CE = Conservancy Environment, NE = Natural Environment, N = None, RE = Rural Environment, T = Towns, ND = No Designation. Data from Okanogan County Shorelines Designations Map, 12/26/01.

Land use. The predominant use of land surrounding the acclimation site.

FEMA flood designation. 100 Yr. = 100 year floodplain, None = not in an identified flood zone, NM = not mapped. Data from FEMA, 2009.

	MISC		WATER			SURFACE WATER			GROUND WATER		SPACE						ACCLIMATION PONDS		
	Power	Road access	New water right	Water rqrt. (cfs)	Water available (cfs)	Surface stream name	New surface water intake	WDNR stream type	Overwinter tempering	GW needed (cfs)	Required space (cft/1000)	Required area (acre)	Existing space (cft/1000)	Existing pond area (acre)	New pond area added (acre)	Acclimation area/Existing pond area	Pond type	Free passage allowed	Pond confinement method
Methow Acc.																			
MSWA (Eightmile)	N	Unsurf.	G	1.4	0.5	Chewuck		F		1.8	18	0.14	84	0.64		22%	Existing side channel	Y	Seine
Mason (Eightmile)	1P	Unsurf.	G	1.4		Eightmile		F	Y	0.5	18	0.14	28	0.22		65%	Existing man-made	N	Screen
Pete Creek	3P	Surf.		1.9		Chewuck		F			26	0.20	30	0.23		87%	Existing side channel	Y	Seine
Goat Wall	N	Surf.		0.8		Cold		U			10	0.08	10	0.08		100%	Existing stream channel	Y	Seine
Heath	N	Unsurf.		1.5		Heath		F			21	0.16	95	0.72		22%	Existing man-made	Y	Seine
Parmley	1P	Surf.		0.8		Beaver		S			10	0.08	14	0.11		72%	Existing man-made	Y	Seine
Lincoln	1P	Unsurf.	G	1.7		Twisp		U	Y	2.6	23	0.18	41	0.31		57%	Existing side channel	Y	Seine
Twisp Weir	3P	Surf.	S,G	1.7		Twisp	Y	F	Y	0.5	23	0.18	0	0.00	23	0%	New pond	N	Screen
Lower Twisp	3P	Surf.	G	0.5		Twisp		U	Y	0.5	6	0.05	18	0.14		100%	Existing man-made	N	Barrier
Gold	1P	Unsurf.		0.8		S. Fork Gold		F			10	0.08	13	0.10		79%	Existing man-made	Y	Seine
Winthrop NFH	3P	Surf.		1.5		Methow		F			21	0.16	21	0.16		100%	Existing hatchery	N	Screen
Adult Plants																			
Hancock		Unsurf.				Hancock		F									None	Y	Pickets
Acc. Back-ups																			
Poorman		Unsurf.		1.4		Twisp		F			23	0.18	94	0.72		100%	Existing man-made	N	Barrier
Newby		Unsurf.	S	1.4		Newby	Y	F			23	0.18	0	0	23	0%	New pond	Y	Screen
Utley		Unsurf.		1.4		Spring		U			23	0.11	29	0.14		82%	Existing man-made	Y	Seine
Biddle		Unsurf.		0.8		Wolf		S			10	0.08	24	0.17		48%	Existing man-made	Y	Seine
Balky Hill		Surf.		0.8		Beaver					10	0.08	12	0.09		100%	Existing man-made	N	Barrier
Chewuch A.F.		Surf.		1.4		Chewuch		F			26	0.20	0	0.00	26	0%	New pond	N	Screen
MSRF Chewuck		Surf.	G	1.4		None		F	Y	1.4	26	0.20	0	0.00	26	0%	New pond	N	Screen

Figure 2-2. Water and Space Details

Key, Figure 2-2:

- Power. N = None, 1P = single phase, 3P = three phase.
- Road access. Asphalt surfaced or unsurfaced (gravel).
- New water right. G = new ground water right needed, S = new surface water right needed.
- Water requirement (cfs). Minimum water requirements for each site are based on a flow density of 9 pounds of fish per gallon/minute (flow density index of 1.5 lbs/gpm/inch). This is an average minimum value based on approximate springtime water temperatures and fish sizes. Actual flow rates would be higher to provide a safety margin, with the amount of margin depending on the reliability of the water supply at each site.
- Water available (cfs). The expected low flow during the acclimation period.
- Surface stream name. The name of the stream supplying water to the acclimation site.
- New surface water intake. Would a water intake structure need to be constructed?
- WDNR stream type. Washington Department of Natural Resources stream type designation, from FPARS ARCIMS viewer: http://fortress.wa.gov/dnr/app1/fpars/viewer.htm.
    - Type "S" = Shoreline. Streams and waterbodies that are designated “shorelines of the state”.
    - Type "F" = Fish. Streams and waterbodies that are known to be used by fish, or meet the physical criteria to be potentially used by fish.
    - U = Unknown
- Overwinter tempering. Is ground water needed to control ice formation on surface water intakes?
- New well construction. Would new wells need to be built to meet water requirements?
- GW needed (cfs).
- Required space (cft x 1000). Space requirements are calculated using 0.3 pounds of fish per cubic foot of water at sites (a volume index of 0.03 lbs/cft/inch). Sites that rely on pumped supplies without backup will require more space.
- Required pond area (acre). The pond area is calculated from the space requirement by assuming an average water depth of 3 ft.
- Existing space (cft x 1000). Space is calculated by multiplying the existing pond surface area by a 3 ft assumed average depth.

- Existing pond area (acre). The total existing pond area, actual area used may be less if seine nets are used.
- New pond area (acre). The amount of new area that is proposed to be added by expanding existing ponds or building new ones.
- Acclimation area/Existing pond area. The ratio of area that is proposed to be used by coho during the acclimation period to the existing pond area. The calculation is made only for existing pond area, if new pond area is built and blocked, the ratio is 0%. For barrier nets, 100% is blocked and for seine nets, some part of the existing area is blocked.
- Pond type.
- Free passage allowed. Does the presence of small ESA listed fish require that free up and downstream passage be allowed by the coho confinement net?
- Type of net. A barrier net (see section 2.2) confines coho and does not allow free passage of any fish past it during acclimation. A seine net encloses a portion of a pond and allows passage around it. The seine net separates coho and other fish species during acclimation.

	Plowing for fish delivery (ft)	New road construction (ft)	New intake construction	Removal Distance (ft)	New well	Existing well	Volume excavated (cft/1000) - new pond	Volume excavated (cft/1000) - existing pond	Surface disturbance (acre) - pond construction	Surface disturbance (sft) - water systems, open channel	Buried water pipeline (ft)	Buried power line (ft)	Total area disturbed (acre)	Period of operation (mo.)	Generators
Methow Acc.															
MSWA (Eightmile)	3,000				Yes					500		450	0.11	1.5	Yes
Mason (Eightmile)					Yes	Yes				250			0.01	5	Yes
Pete Creek														1.5	
Goat Wall														1.5	
Heath														1.5	
Parmley (Beaver)														1.5	
Lincoln	3,000				Yes			20		500	600	900	0.36	5	Yes
Twisp Weir		20	Yes	300	Yes		23		0.18	400	500	400	0.40	5	Yes
Lower Twisp						Yes								5	
Gold								5						1.5	
Winthrop NFH														5	
Adult Plants															
Hancock														2	
Acc. Back-ups															
Poorman (Twisp)														1.5	
Newby			Yes	220			23		0.18	400	350		0.27	1.5	
Utley	1,200									800				1.5	
Biddle (Wolf)														1.5	
Balky Hill														1.5	
Chewuch A.F.					Yes	Yes	26		0.20		300	50	0.28	1.5	
MSRF Chewuch					Yes		26		0.20	1,000		100	0.25	5	Yes
TOTALS-PRIMARY	6,000	20	1	300	4	2	23	25	0.18	1,650	1,100	1,750	0.88	36	4
TOTALS-BACK-UP	1,200	-	1	220	2	1	75	-	0.58	2,200	650	150	0.80	14	1

Figure 2-3. Construction and Operation Impacts

Key, Figure 2-3:

- Plowing. Roads at some sites would require snow removal at least once per season to allow fish transport trucks to access acclimation ponds.
- New well. Some sites would require that new wells be drilled and developed.
- Surface disturbance – pond construction. The area permanently impacted by new pond construction. This does not include the surface area temporarily impacted by fill deposition.
- Surface disturbance – water systems, open channels. Water would be delivered to and discharged from some ponds in rock-lined channels.
- Buried water pipeline. Underground piping would deliver water to some ponds.

- Generator. Main or back-up power would be provided by electrical generators with automatic transfer switches. At locations where generators are the main source of power, two generators are proposed.

Winthrop NFH is an existing facility and no changes are proposed by the MCCRP. The environmental impacts of the facility operation have been reviewed through past permitting processes.

These details are approximate and are based on schematic designs. They are for the purpose of evaluating potential environmental impacts.

2.2.   Net Confinement Systems

Net systems would be used to confine coho during the acclimation period at most sites. They would be configured in one of two ways. Where loss of habitat and/or coho interaction with listed fish species is not expected to have negative impacts, the nets fully block fish passage in the ponds - **barrier** nets. They would be placed perpendicular to the flow (see the figure below).

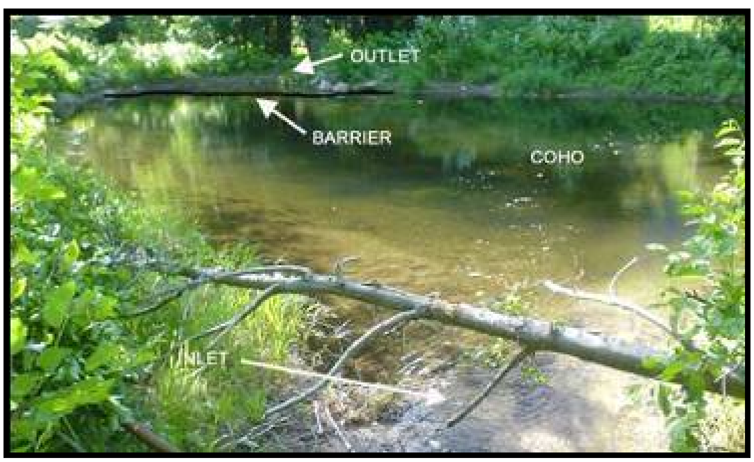

Figure 2-4. Barrier Net Example

Where impacts may be significant and free passage of fish up and downstream is required, the nets would form an enclosed impoundment - **seine** nets - of only a portion of the pond.

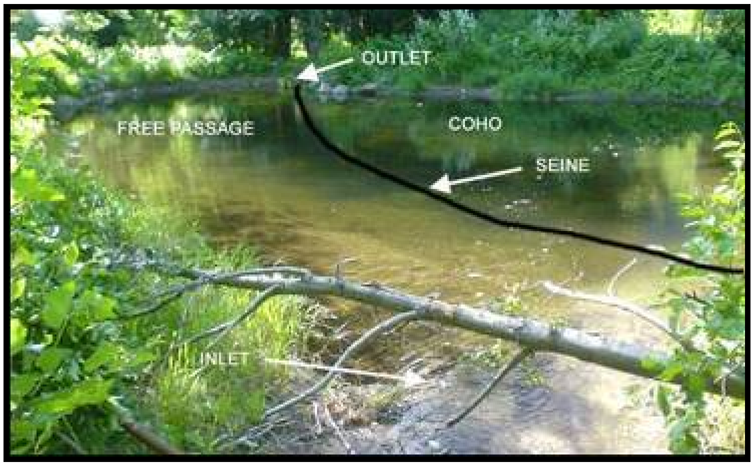

Figure 2-5. Seine Net Example

In both cases the net systems are temporary and are in place only during acclimation. They will be designed to minimize premature escape and will include jump barriers and double lead lines (see below).

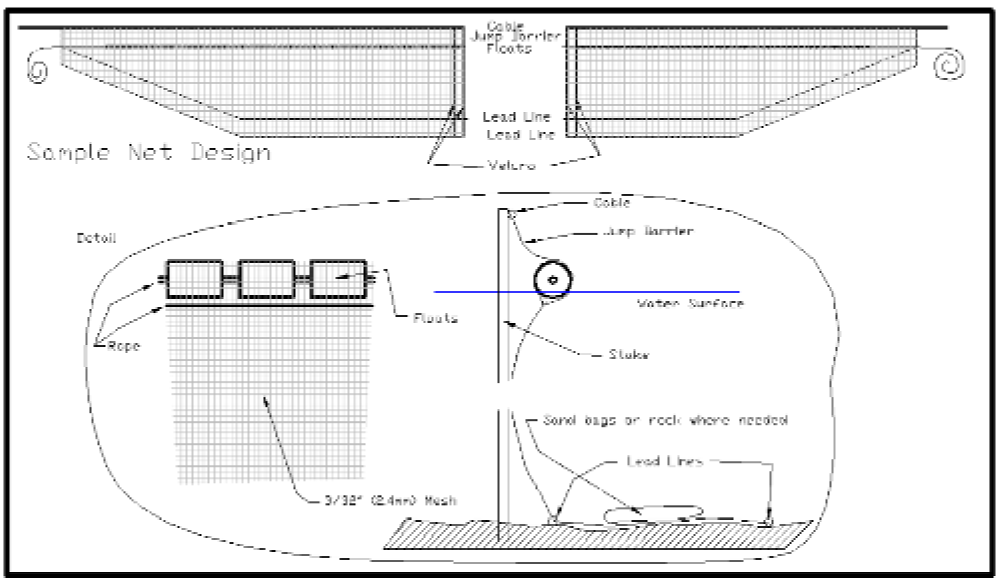

Figure 2-6. Example Net System Designs

2.3. Other Site Design Features

Water effluent treatment systems outside of the acclimation ponds themselves are not planned for the natural sites. Relatively small numbers of fish would be held at low densities in large ponds at these locations. The minimum retention time for water flowing through the pond will be 2.5 hours and in most cases will be much longer than this. Fish waste will settle at low densities in the ponds and will be effectively treated during the long periods of time through the summer and fall when coho are not being acclimated.

The ponds are relatively effective at limiting the amount of Total Phosphorous (TP) being discharged into receiving waters. Fish feed rates and the amount of TP in the feed are known, along with the amount of TP leaving the pond in the discharge water (see Appendix 6) and in the fish. This data was used to perform the calculation below that estimates that over 75% of the TP fed was not discharged from the two of the acclimation ponds in 2009.

Rohlfing - 2009

	# of Fish	Fish Size	Total Fish Weight	Fish Feed Rate	TP Feed Rate	P not absorbed by fish
		grams	*grams*	*grams/day*	*grams/day*	*g/day*
Start	101,000	20.1	2,028,938	20,289	288	176
End	101,000	28.0	2,830,494	28,305	402	245

Average rate that TP added to pond (after fish absorbtion):	210	grams/day
Number of days of acclimation	56	days
Total TP not removed by fish through the acclimation season:	11,786	grams
TP load rate exiting pond as determined by measurement (see Section 3.2.1.1):	37.5	grams/day
Total TP exiting pond as determined by measurment:	2,100	grams
Pond P removal efficiency:	82%	

Butcher - 2009

	# of Fish	Fish Size	Total Fish Weight	Fish Feed Rate	TP Feed Rate	P not absorbed by fish
		grams	*grams*	*grams/day*	*grams/day*	*g/day*
Start	136,700	20.1	2,746,097	27,461	390	238
End	136,700	27.2	3,716,275	37,163	528	322

Average rate that TP added to pond (after fish absorbtion):	280	grams/day
Number of days of acclimation	57	days
Total TP not removed by fish through the acclimation season:	15,674	grams
TP load rate exiting pond as determined by measurement (see Section 3.2.3.1):	52.0	grams/day
Total TP exiting pond as determined by measurment:	2,964	grams
Pond P removal efficiency:	81%	

Spreadsheet Inputs	**Value**	**Source**
Fish feed rate (gram feed/gram fish/day)	1.0%	Silver Cup Feeds
Concentration of P in fish feed	1.42%	Skretting Nutra Fry diet
Amount of P in feed absorbed by fish	39%	From Flimlin, G. Sugiura, S., and Ferraris, P. 2003

Figure 2-7. Pond Phosphorous Removal Efficiency

Avian and mammalian predation is a major consideration for remote acclimation sites. At some locations, physical barriers may be installed if predation becomes severe. Temporary fencing and overhead bird netting may be necessary. Deterrence of predation through human presence has been used effectively at sites currently operated by the MCCRP as well as at federal and state hatcheries; this technique would be employed at most locations.

Many of the ponds at proposed sites could become inundated during major floods. Because spring is the natural migration period, the unplanned release of fish during snowmelt floods would be allowed and no special flood control measures would be taken.

3. Site Descriptions – Primary, With Construction

Construction is proposed to involve the creation of new ponds and excavation of accumulated material in some existing ponds. The ponds have natural bottoms and construction would include the removal of cut and the spreading and revegetation of fill. Fill areas have not been located, but material would be spread where environmental impacts are minimized under the conditions of construction permits.

Wells would be drilled to supply water to several sites. They would be located where high yields are most likely, near power sources, and where disturbance to existing vegetation is minimized. Water would be delivered from the wells to the ponds in buried pipelines and in rock-lined channels that will re-aerate the ground water. Generators would provide both primary and back-up power to well pumps. They will be sized after well tests determine pump motor requirements.

North is up in all the following aerial photos, drawings, and maps unless otherwise denoted.

3.1. MSWA Eightmile

This site is an existing, disconnected side channel on the Chewuch River. It is the farthest upstream site that is easily accessible in the late winter on the Chewuch.

- Location: Upstream of the mouth of Eightmile creek in an area of potential mainstem coho spawning habitat.
- Surface water supply: Seepage through the side channel provides some flow (less than ½ cfs).
- Ground water supply: A well is proposed near the side channel on private land to supplement the existing surface flow.
- Acclimation space: The full side channel measures approximately 400' x 70'.
- Confinement system: A temporary seine-style net would be placed in the side channel that would allow continued use of most of the channel and full passage

by other fish species. The net would be removed at release. The area near the arrow in the aerial photo below is proposed for acclimation.

- Land use: The side channel is part of the MSWA owned by the Washington Department of Fish and Wildlife (WDFW) and managed for wildlife conservation and public recreation.
- Access: Winter plowing stops ½ mile from the site on the West Chewuch River Road. Access to the side channel from the road is another 1,000’ on an unsurfaced MSWA road.
- Construction: A well would be drilled just east of the side channel on private property. A rock lined open channel from the well to the side channel would deliver water while aerating it. A generator would be required to power the well pump. The soil materials in the area are Boesel fine sandy loam (NRCS, 2009).

Figure 3-1. MSWA and Mason Aerial

Figure 3-2. MSWA Side Channel

3.2. Mason (Eightmile)

The Mason site was used in 1998 for coho acclimation. It consists of three man-made ponds in series fed by water from an irrigation intake.

- Location: Near the mouth of Eightmile Creek.
- Surface water supply: An irrigation diversion on Eightmile Creek.
- Ground water supply: A domestic well exists near the ponds. Aquifer conditions may be favorable for developing more ground water.
- Acclimation space: The lowest pond measures 100' x 30', the second pond measures 70' x 40', and the third pond measures 80' by 45'.
- Confinement system: The ponds have fish proof outlet screens and natural origin fish are prevented from entering the pond system by the irrigation fish screens at the diversion intake.
- Land use: A vacation home is located adjacent to the ponds.
- Access: Winter plowing stops on the West Chewuch River Road at the site.
- Construction: A new well may be constructed to supplement Eightmile Creek water. Water would be delivered to the ponds through a rock-lined channel.

Figure 3-3. Mason Ponds

3.3. Lincoln

Two ponds are connected in series adjacent to the Methow River. A rock gabion berm separates the ponds from the river. The property includes a conservation easement, purchased by the Methow Conservancy, which divides the land into several zones. The acclimation pond and one well are proposed in the conservation zone.

- Location: Relatively high in the Twisp system, in potential coho spawning habitat and above the Twisp weir. Adults returning to the Lincoln site can potentially be captured for broodstock and for management purposes in general at the weir.
- Surface water supply: A perched culvert supplies water to the ponds at Twisp River flows greater than 200 cfs.
- Ground water supply: New drilled wells would provide ground water when the existing culvert is not flowing. Two wells would be constructed near the ponds approximately 400' apart. Water from Well 2 would be piped to Well 1 in a buried line located under an existing road. Water from both wells would be delivered to the upper pond through an open, rock-lined channel.
- Power supply. Line power and back-up generators would be needed to power the pumps. Buried lines in the existing road would deliver power from the service entrance and generators to the well pumps.
- Acclimation space: The existing Pond 2. The pond has silt, sand, gravel, and rock deposits that would be excavated to provide adequate water depths for acclimation. Approximately 10,000 cft of material is proposed to be removed.
- Enclosure system: A seine net in the pond.
- Land use: A rural home and farm are adjacent to the ponds.
- Access: The Twisp River Road is plowed in the winter to within 1/2 mile of the Lincoln site.

- Soils: Boesel fine sandy loam (NRCS, 2009).
- Construction: New wells may be drilled, water and electrical pipelines buried, the pond excavated, and generators installed.

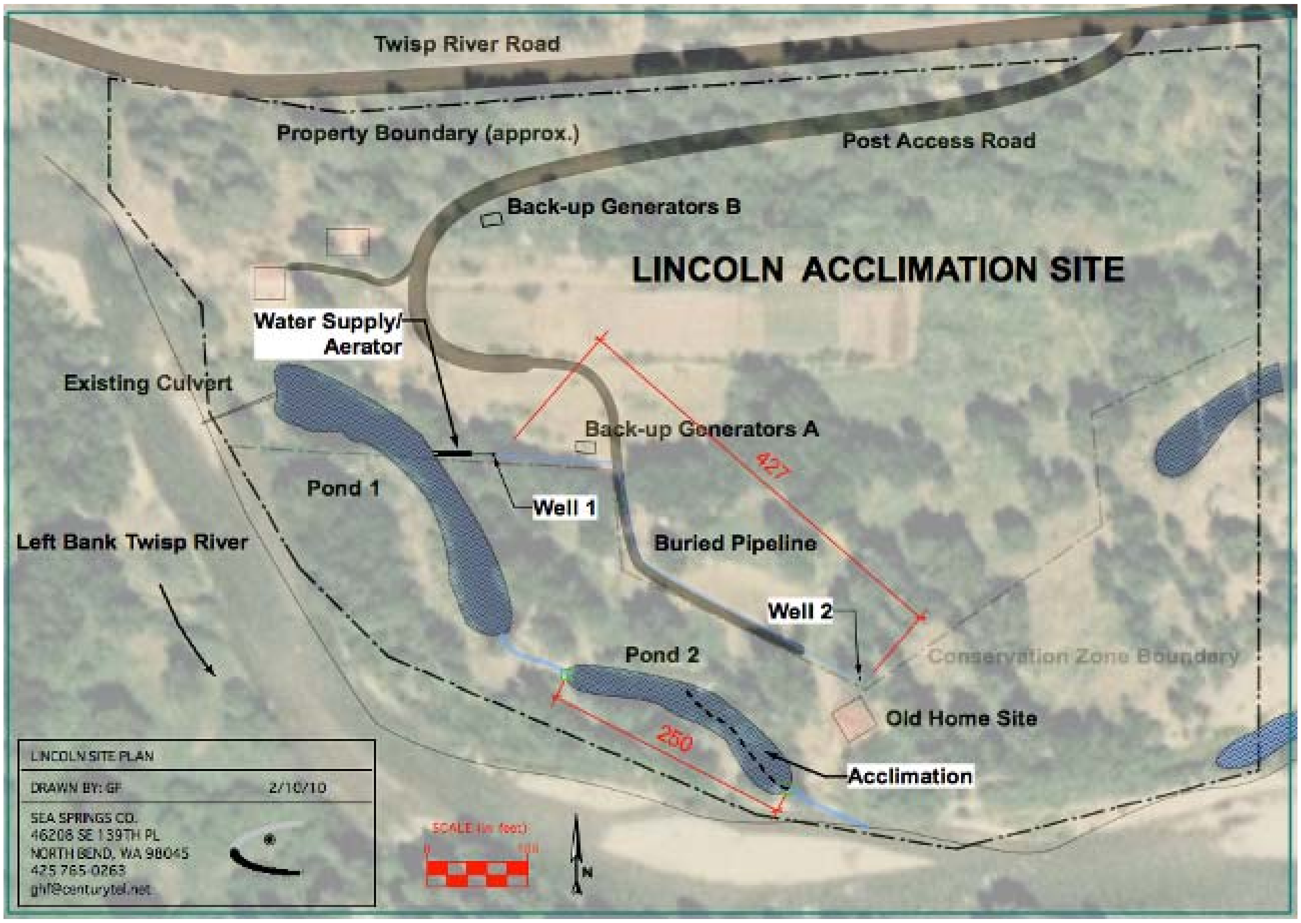

Figure 3-4. Lincoln Site Plan

Figure 3-5. Lincoln Pond 2

3.4. Twisp Weir

The Twisp Acclimation Facility has an existing pond operated by WDFW for spring Chinook acclimation. The pond is fed by Twisp River water diverted from an irrigation intake. It is proposed that a separate coho pond be constructed adjacent to the existing facility.

- Location: At the Twisp weir. Fish would be released upstream of the weir.
- Surface water supply: An upstream irrigation system diverts water from the Twisp into a ditch. A new intake, fish screen, and pipeline will remove water from the irrigation ditch and direct it to the coho pond. Another buried pipeline will return water to the Twisp. Water would be removed from the river 300 ft upstream of the point where it is returned.
- Ground water supply: Wells are proposed to be dug near the Twisp shoreline.
- Acclimation space: A 140 ft long, 50 ft wide, 3.5 ft deep, constructed, earthen pond, occupying approximately 0.2 acres. The pond will have a screened outlet structure to confine fish during acclimation.
- Confinement system: The ponds would have fish proof inlet and outlet screens.
- Land use: Part of the site is occupied by the Twisp Acclimation Facility and part is rural residential.
- Access: Roads to the site are plowed all winter.
- Soils: Boesel fine sandy loam (NRCS, 2009).
- Construction: An intake will be constructed, a pond excavated, and pipelines buried. Because the pond will be below existing grade and material will be removed from the flood plain, pond construction will increase flood storage capacity.

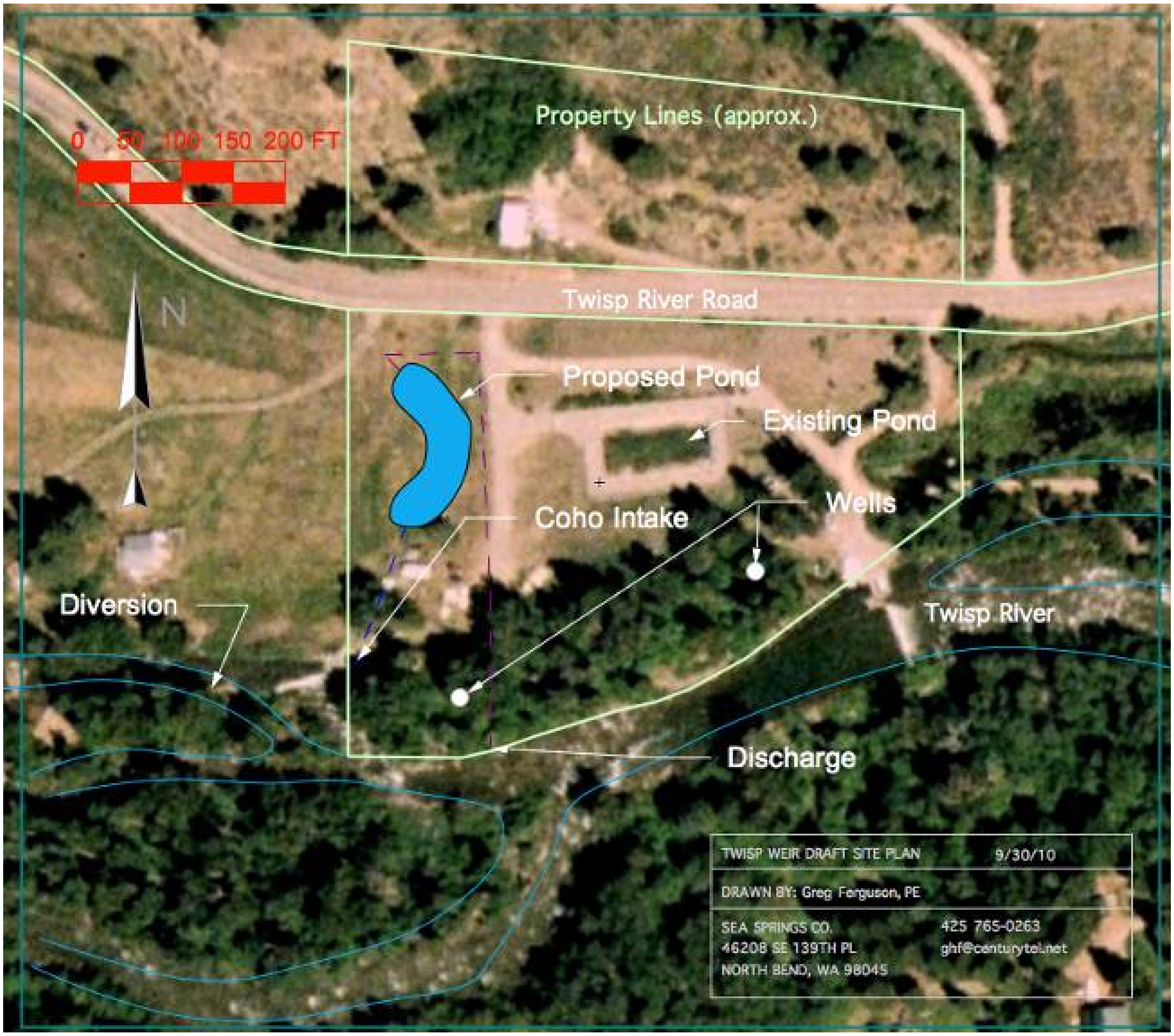

Figure 3-6. Twisp Weir Draft Site Plan

Figure 3-7. Twisp Weir Site

3.5. Gold

A series of small man-made ponds were dug adjacent to South Fork gold Creek.

- Location: Near the mouth of South Fork Gold Creek, in potential coho spawning habitat.
- Surface water supply: An unscreened diversion on South Fork Gold Creek.
- Ground water supply: None.
- Acclimation space: The existing ponds. They have silt, sand, and gravel deposits that would be excavated to provide adequate water depths for acclimation. Approximately 7,000 cft of material is proposed to be removed.
- Enclosure system: Seine nets in the ponds.
- Land use: Several residences are adjacent to the ponds.
- Construction: Silt, gravel, and rock that have accumulated in the ponds would be removed to increase effective rearing area.

Figure 3-8. Gold Aerial

Figure 3-9. Gold Ponds

4. Site Descriptions – Primary, No Construction

The sites listed below would require no construction activities that result in earth-moving activities or permanent changes. Existing ponds and water supplies would be used for acclimation.

4.1. Goat Wall

A disconnected side channel system on the Methow includes a pond near the mouth.

- Location: Downstream of the mouth of the Lost River. The site is in the river reach that periodically has no surface flow during some fall and winter months. The ability of coho to manage this flow regime will be carefully evaluated before and during test releases from this site.
- Surface water supply: Water from the adjacent Gate Creek is diverted into the pond.
- Ground water supply: Natural ground water seepage (Cold Creek) through the side channel provides flow at high Methow river levels.
- Acclimation space: A natural, existing pond formed in the cold Creek channel.
- Enclosure system: A temporary seine net system.
- Land use: A residence is adjacent to the pond.
- Access: The Lost River road is plowed in the winter.

Figure 4-1. Goat Wall Aerial

Figure 4-2. Goat Wall Pond

4.2. Pete Creek

Several ponds are part of a Methow River disconnected side channel system.

- Location: Returning adults from this site in the lower Methow would distribute to nearby tributary streams, and the mainstem Methow. Some spawning may occur in the discharge channel.
- Surface water supply: Future Methow Salmon Recovery Foundation plans call for reconnecting the side channel, which would result in Methow River water flowing through the acclimation pond. Pete Creek, a seasonal stream flows into the system and it may also be possible to deliver Twisp River irrigation water to the pond.
- Ground water supply: Natural ground water seepage through the side channel provides approximately 0.5 cfs of flow.
- Acclimation space: A natural pond.
- Enclosure system: A temporary seine net system would allow passage by other fish species in the side channel system.
- Land use: A large, rural estate with a 9-hole golf course is adjacent to the side channel complex.
- Access: 800’ of gravel road provides access from the West Chewuch River Road.

Figure 4-3. Pete Creek Aerial

Figure 4-4. Pete Creek Photo

4.3. Heath

A series of large springs originate in the Methow valley floor. Ponds were constructed in the past to impound this water for irrigation purposes. Habitat restoration efforts are underway to provide fish passage into and past the ponds. The spring channels may provide the low gradient, small stream, spawning habitat preferred by coho and completion of the restoration work will allow access to more of this habitat.

- Location: The pond proposed for coho acclimation is the lowest in the Heath springs complex. The general site location is downstream of the section of the Methow that periodically de-waters. Returning adults would distribute to nearby small tributaries, the mainstem, and return to the Heath springs.
- Ground water supply: All the flow in the proposed acclimation pond consists of spring water.
- Acclimation space: The pond measures approximately 450' x 70'.
- Enclosure system: A temporary seine net system would allow passage by other fish species in the spring system.
- Land use: The pond is on rural residential land. The adjacent upstream property is owned by WDFW; the Big Valley Unit of the Methow Valley Wildlife Area is managed for riparian habitat protection and wildlife conservation.
- Access: 800' of existing gravel road provides access from SR 20.

Figure 4-5. Heath Aerial

Figure 4-6. Heath Pond

4.4. Parmley

A farm pond was dug in the past, adjacent to Beaver Creek.

- Location: Upper Beaver Creek, in potential coho spawning habitat.
- Surface water supply: An unscreened diversion on Beaver Creek.
- Ground water supply: None.
- Acclimation space: The 80' diameter, existing pond.
- Enclosure system: A seine net system.
- Land use: A rural vacation home overlooks the pond.
- Access: The Beaver Creek road provides reliable year round access.

Figure 4-7. Parmley Aerial

Figure 4-8. Parmley Pond

4.5. Lower Twisp

The Methow Salmon Recovery Foundation owned site includes several ponds in series, some of which are used for steelhead acclimation. The lowest pond in the series was used for coho acclimation starting in 2009.

- Location: The lower Twisp River.
- Surface water supply: An unscreened intake on the Twisp provides a controllable amount of water to the ponds.
- Ground water supply: An existing well can be used a back-up supply and as winter tempering water.
- Acclimation space: Coho are acclimated in the lowest pond, downstream of steelhead.
- Confinement system: A temporary barrier net is placed across the pond near the exit.
- Land use: The property is managed for salmon recovery purposes.
- Access: The Twisp River road provides reliable year-round access.

Figure 4-9. Lower Twisp Aerial

Figure 4-10. Lower Twisp Pond

4.6. Hancock

A large spring originates 1.3 km from the Methow River. Recent Yakama Nation restoration projects have replaced a road culvert, improved fencing, added woody debris, and improved flow patterns in the spring channel. It is now more accessible to salmonids and has habitat that should be attractive to spawning coho. Adult plants in the spring channel are proposed.

- Location: Upstream of Winthrop in an area where steelhead and Chinook now spawn.
- Ground water supply: Hancock Spring has the relatively stable temperature and flow patterns typical of other springs.
- Enclosure system: A temporary rack in the spring channel would hold adults while redds are constructed and spawning occurs. The rack is proposed to be pre-assembled and installed in early October. It would be held in place with sand bags and rock (see diagram below) and removed in mid-November each year.
- Land use: Farming.
- Access: The Wolf Creek road provides good access to an area near the spring mouth.

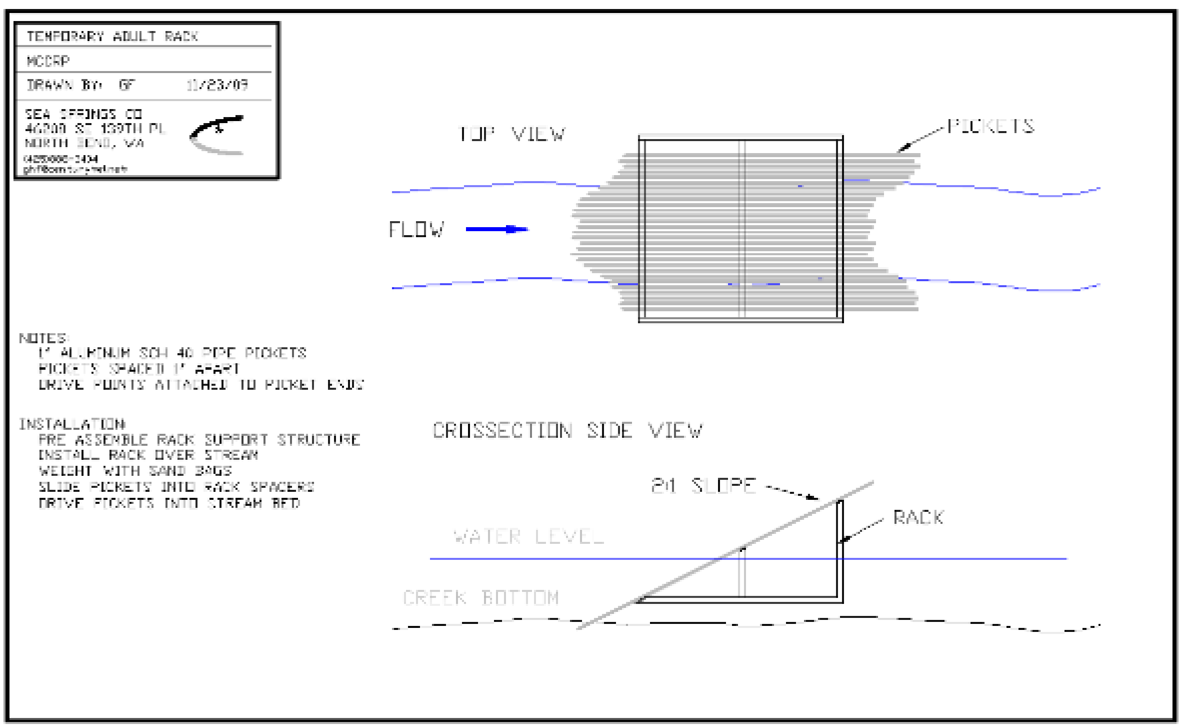

Figure 4-11. Sample Adult Barrier

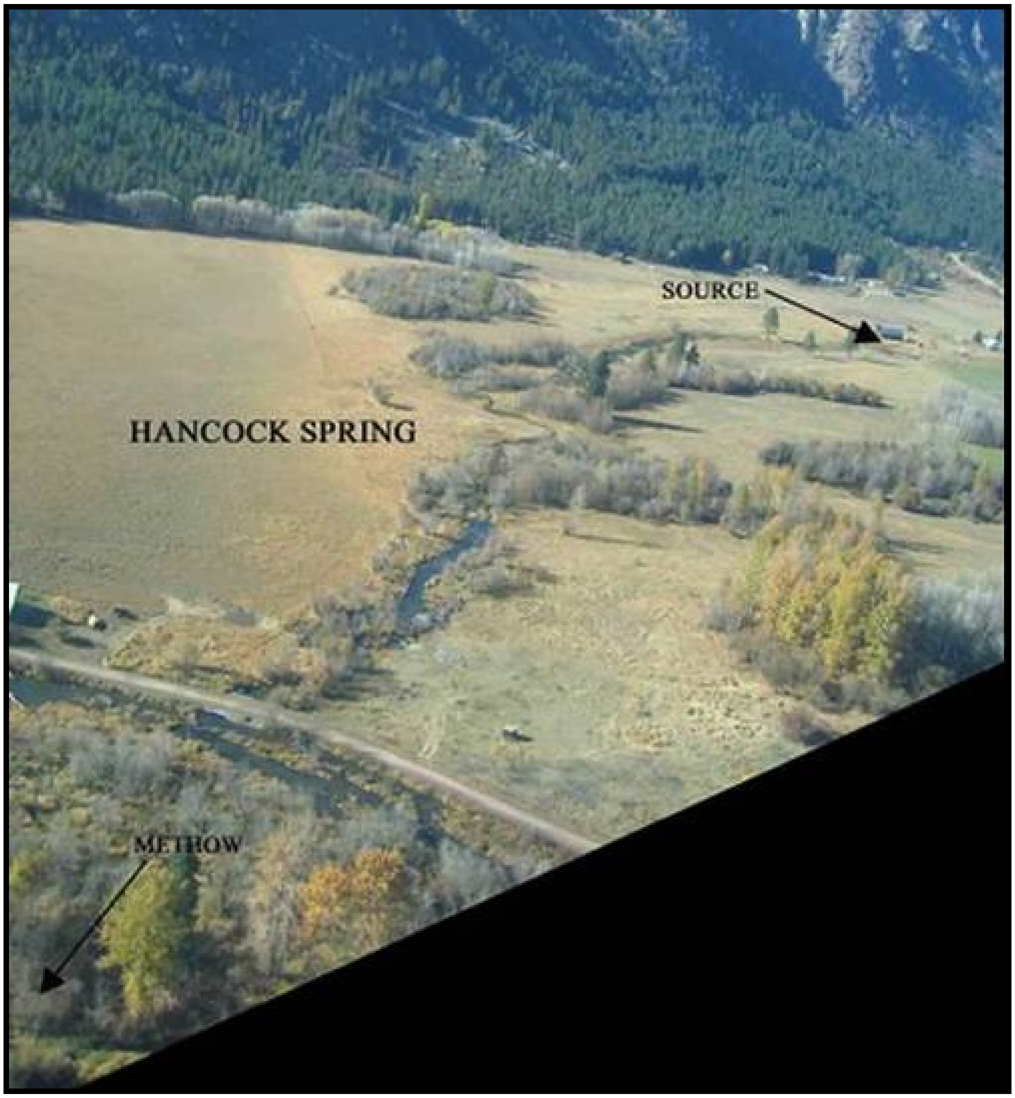

Figure 4-12. Hancock Spring Aerial

Figure 4-13. Hancock Spring

4.7. Winthrop NFH

The Winthrop NFH is operated by the US Fish and Wildlife Service. Production goals are established by the Columbia River Fisheries Management Plan and include commitments in support of tribal trust responsibilities.

- Location: Returning adults from this site in the Methow near Winthrop would distribute to nearby tributary streams, and the mainstem Methow. Adults returning to the hatchery can be trapped and used for broodstock.
- Surface water supply: Surface water is diverted from the Methow and delivered to the hatchery in an irrigation channel.
- Ground water supply: Infiltration galleries.
- Acclimation space: A pond formed in the hatchery back channel.
- Enclosure system: Fish screens in fixed outlet structures confine smolts.
- Land use: A large, public hatchery.

Figure 4-14. Winthrop NFH Aerial

Figure 4-15. Winthrop NFH Back Channel

5. Site Descriptions – Back-up, With Construction

5.1. MSRF Chewuch

The Methow Salmon Recovery Foundation (MSRF) owns a site on the lower Chewuch River that includes an existing well.

- Location: Returning adults from this site in the lower Chewuch River would distribute to nearby tributary streams, and the mainstem Chewuch River.
- Surface water supply: There is no surface water supply.
- Ground water supply: The existing well would be developed and would be the main water source. If pump tests determine that the well will not produce the required flow, another well would be built.
- Acclimation space: A 150 ft long, 50 ft wide, 3.5 ft deep, constructed, earthen pond (see figure below), occupying approximately 0.2 acres.
- Enclosure system: The pond would include outlet structures with removable screens.
- Land use: The MSRF mission is to enhance and preserve salmon habitat.
- Access: The West Chewuch road provides reliable year round access.
- Construction: A new pond would be required, along with a rock lined channel delivering water from the well(s) and another discharging water to the Methow. A back-up generator would also need to be installed on the site. The pond would be constructed by excavating material from a flat area near the creek. Because the pond will be below existing grade and material will be removed from the flood plain, pond construction will increase flood storage capacity.

Figure 5-1. MSRF Chewuch Site Plan

Figure 5-2. MSRF Chewuch Pond Site

5.2. Chewuch AF

The Chewuch Acclimation Facility (AF) is an existing pond operated by WDFW for spring Chinook acclimation. The pond is fed by Chewuch River water diverted from an irrigation intake. It is proposed that a separate coho pond be constructed downstream of the existing facility.

- Location: At the Eastside Chewuch road bridge midway between the Eightmile sites and the Lower Chewuch/Pete Creek Pond sites.
- Surface water supply: An irrigation diversion on the Chewuch River.
- Ground water supply: None.
- Acclimation space: A 150 ft long, 50 ft wide, 3.5 ft deep, constructed, earthen pond, occupying approximately 0.2 acres.
- Confinement system: The ponds would have fish proof outlet screens and natural origin fish are prevented from entering the pond system by screens on the diversion intake.
- Land use: A trailer park exists on the land proposed for pond construction.
- Access: Roads to the site are plowed all winter.
- Construction: An earthen bottom pond is proposed for the site. Water delivery pipelines from the fish screens on the irrigation intake to the pond and from the pond back to the river would also be installed. The pond is proposed to be constructed by excavating material from flat ground in the trailer park. Because the pond will be below existing grade and material will be removed from the flood plain, pond construction will increase flood storage capacity. The soils in the area are Winthrop loamy sand (NRCS, 2009).

Figure 5-3. Chewuch AF Site Plan

Figure 5-4. Chewuch AF

5.3. Utley

A large pond fed by spring water adjacent to the Twisp River.

- Location: The Utley pond is 6 km upstream of the Twisp weir. It would be used as a backup if the primary Twisp sites are not used.
- Water supply: Spring water that originates in the pond.
- Acclimation space: A large, natural pond.
- Enclosure system: A temporary seine net system or outlet structures with fish screens would confine coho during acclimation.
- Land use: A rural home is adjacent to the ponds.
- Access: The Twisp River road is plowed and there is a 1,200 ft gravel road from it to the pond.
- Construction: A 80 ft long, 3 ft wide channel from the pond to the Twisp is proposed to allow released smolts access to the Twisp River. The pond currently drains into a large swampy area and there is no direct return to the river.

Figure 5-5. Utley Site Plan

Figure 5-6. Utley Ponds

5.4. Newby

Newby is a high gradient, small tributary to the Twisp.

- Location: Newby Creek will be inaccessible to coho adults. Returnees would distribute to nearby tributary streams and the mainstem Twisp. The site is just upstream of the Twisp trap, which could be used to capture adults released from the site.
- Surface water supply: An intake constructed on Newby Creek.
- Acclimation space: A 140 ft long, 50 ft wide, 3.5 ft deep, constructed, earthen pond (see figure below), occupying approximately 0.2 acres. The pond will have a screened outlet structure to confine fish during acclimation.
- Enclosure system: The pond would include outlet structures with removable screens. The water intake system would prevent fish from entering the pond.
- Land use: The site is recreation property.
- Access: The Twisp River Road and the Newby Creek Road are plowed during winter.
- Soils: Sandy loam (NRCS, 2009).
- Construction: An earthen bottom pond and an intake on Newby Creek are proposed for the site. Buried water delivery pipelines from the intake to the pond and from the pond back to the river would also be installed. The intake would be located just upstream of a road culvert and water would be withdrawn from Newby for a distance of 220 ft.

Figure 5-7. Newby Site Plan

Figure 5-8. Newby

6. Site Descriptions –Back-up, No Construction

6.1. Poorman

Four large ponds were constructed on private land in the Twisp River valley.

- Location: Poorman is 3.4 kilometers upstream of the Lower Twisp ponds on the Twisp River. It would be used as a backup if the primary Twisp sites are not used.
- Surface water supply: Twisp River water is diverted from an irrigation intake to the ponds.
- Ground water supply: None.
- Acclimation space: Large, natural ponds.
- Enclosure system: A temporary seine net system or outlet structures with fish screens would confine coho during acclimation.
- Land use: A rural home is adjacent to the ponds.
- Access: The Twisp River road is plowed.

Figure 6-1. Poorman Ponds

6.2. Biddle

Two existing ponds are fed by a creek diversion.

- Location: Wolf Creek, in the relatively high gradient lower reach.

- Surface water supply: A diversion on Wolf Creek.
- Ground water supply: None.
- Acclimation space: One of the two existing ponds.
- Enclosure system: An outlet structure in the pond with removable screens.
- Land use: A rural vacation home overlooks the pond.
- Access: The Wolf Creek road provides reliable year round access.

Figure 6-2. Lower Biddle Pond

6.3. Balky Hill

A pond fed by groundwater was built in the past on farm property.

- Location: Balky Hill pond is on Beaver Creek. It would be used as a backup if the Parmley site is not used.
- Surface water supply: None.
- Ground water supply: Spring water collects at the base of a hill and flows into the pond.
- Acclimation space: One earthen pond.
- Enclosure system: A temporary barrier net would prevent premature coho migration.
- Land use: A farm is adjacent to the ponds.
- Access: The Beaver Creek road is plowed.

Figure 6-3. Balky Hill Pond

6.4. Other

Acclimation and release of coho at existing and planned facilities that are developed for other species may be considered in the future. Mixing coho with spring Chinook and or steelhead, or acclimating in separate rearing units on the same site, may be possible.

Areas where ponds do not currently exist and where pond construction is not possible may be targeted for adult plants. Procedures would be similar to those described for Hancock above, using a temporary adult weir to confine fish to targeted areas during spawning.

7. References

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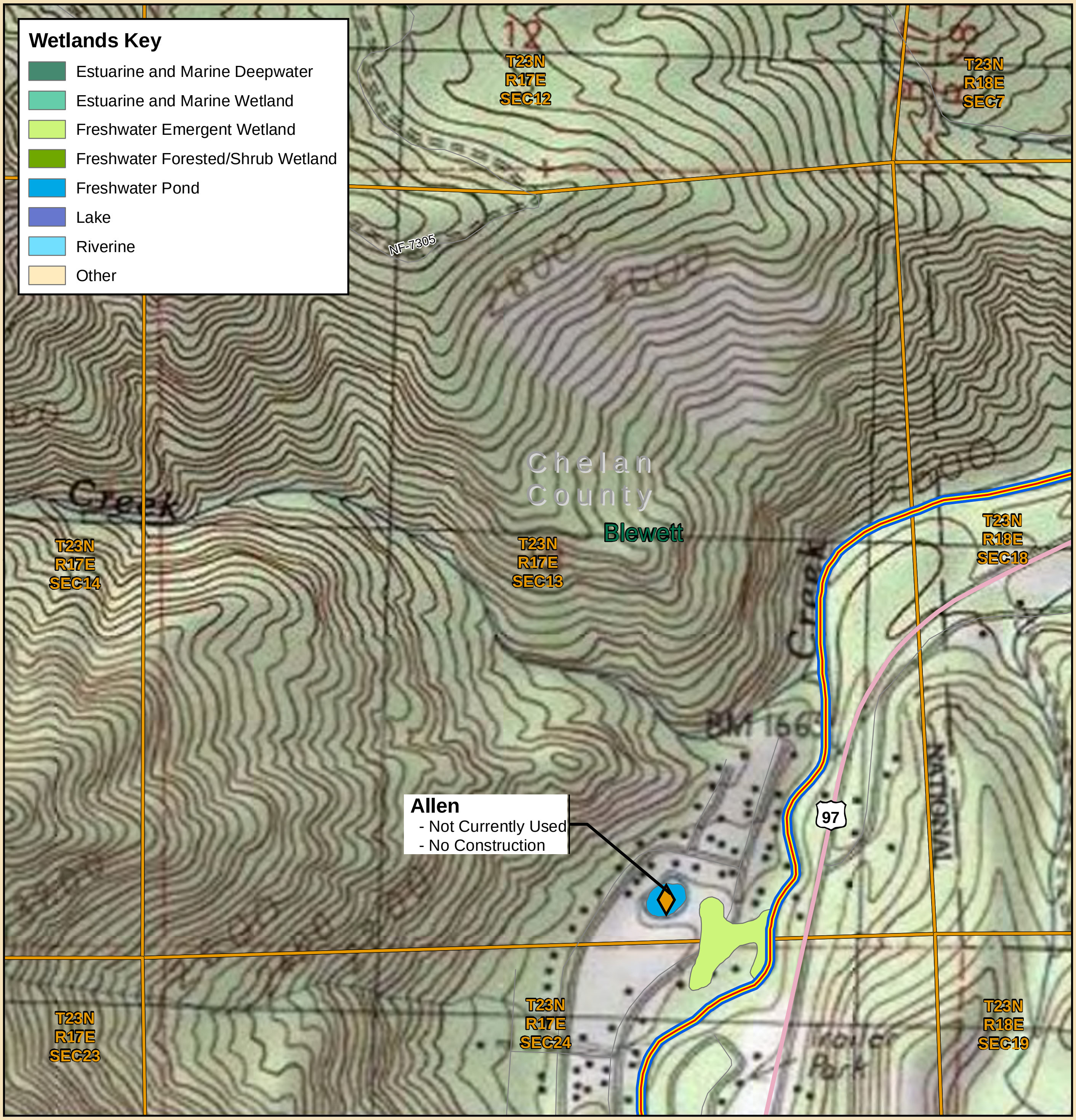


Figure 10a - Allen

Blewett Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

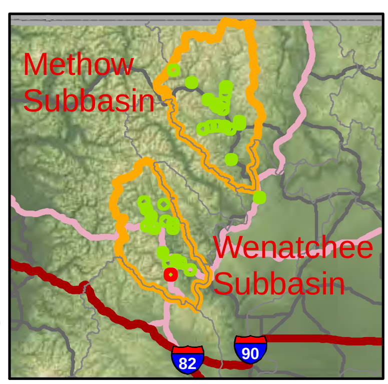
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



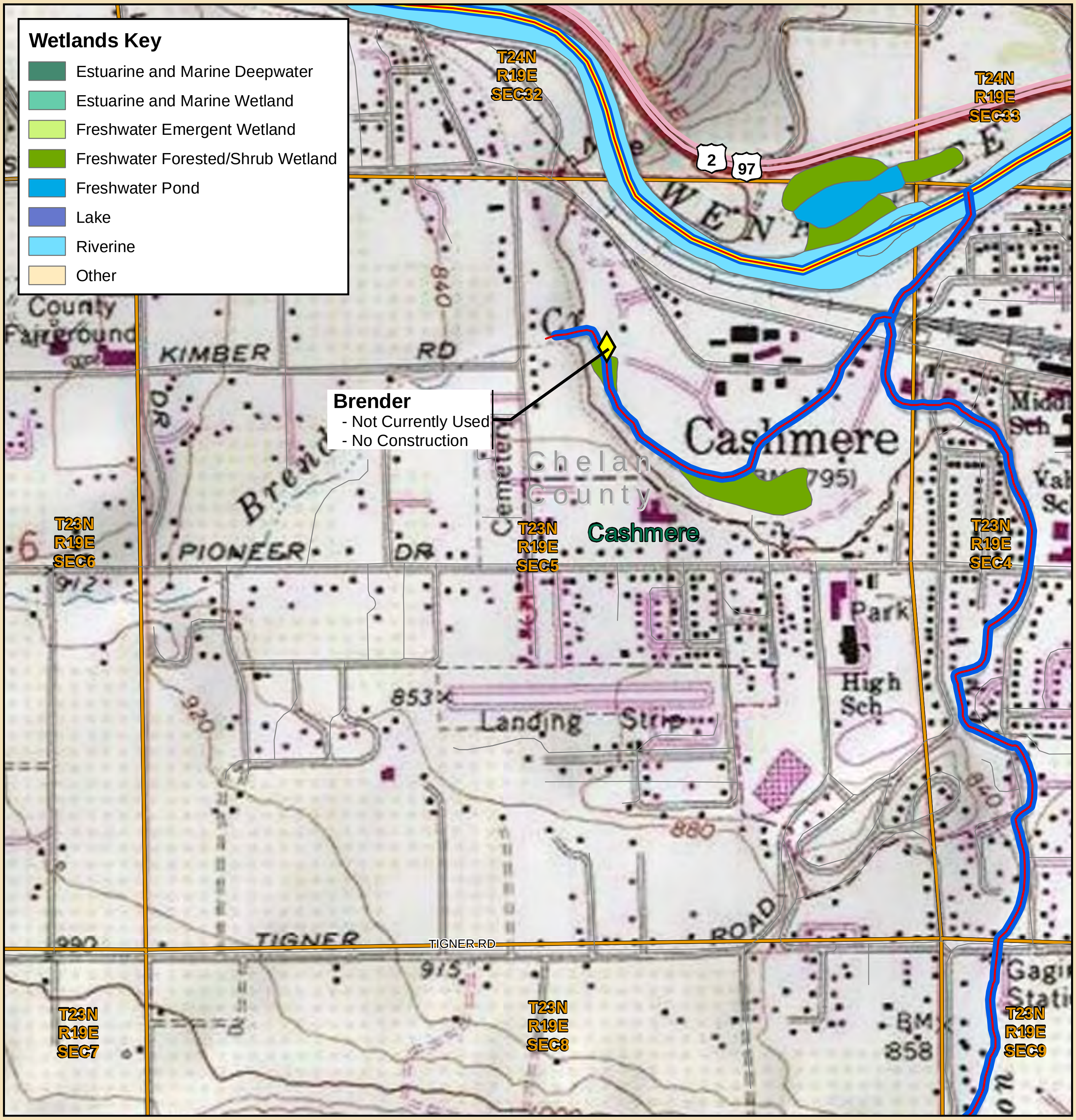


Figure 10b - Brender

Cashmere Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

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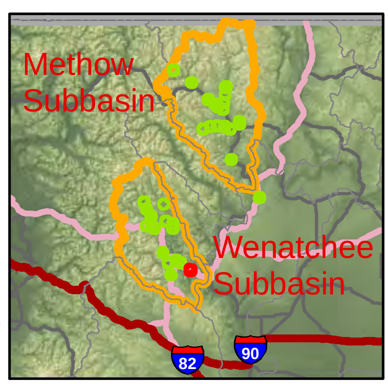


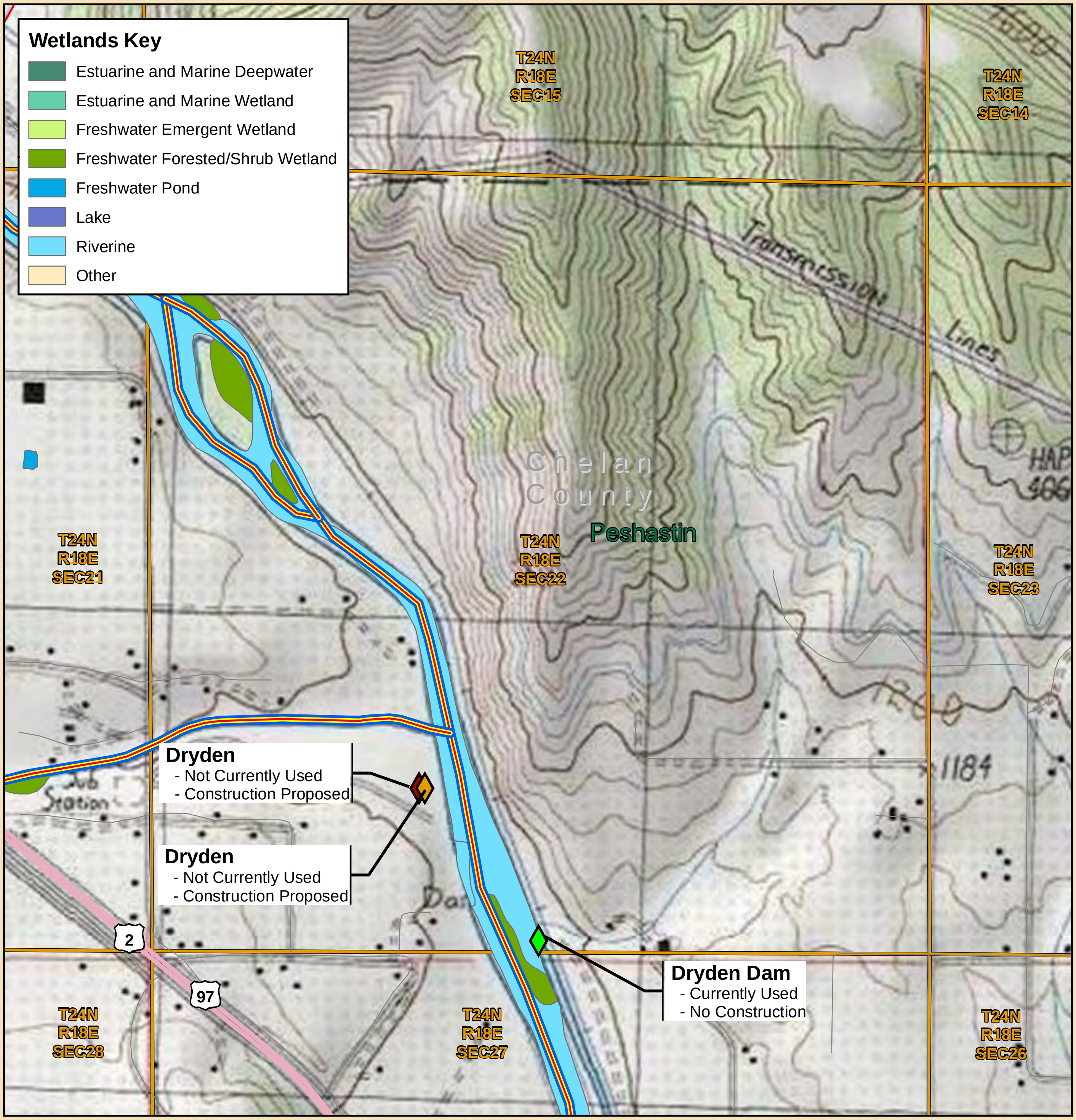


Figure 10c - Dryden and Dryden Dam

Peshastin Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

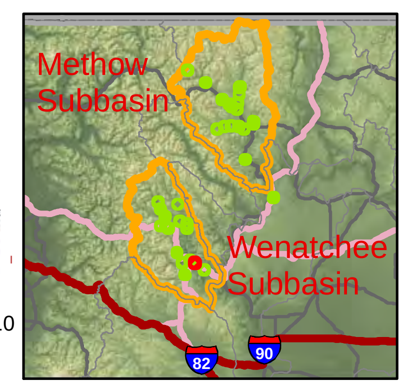
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



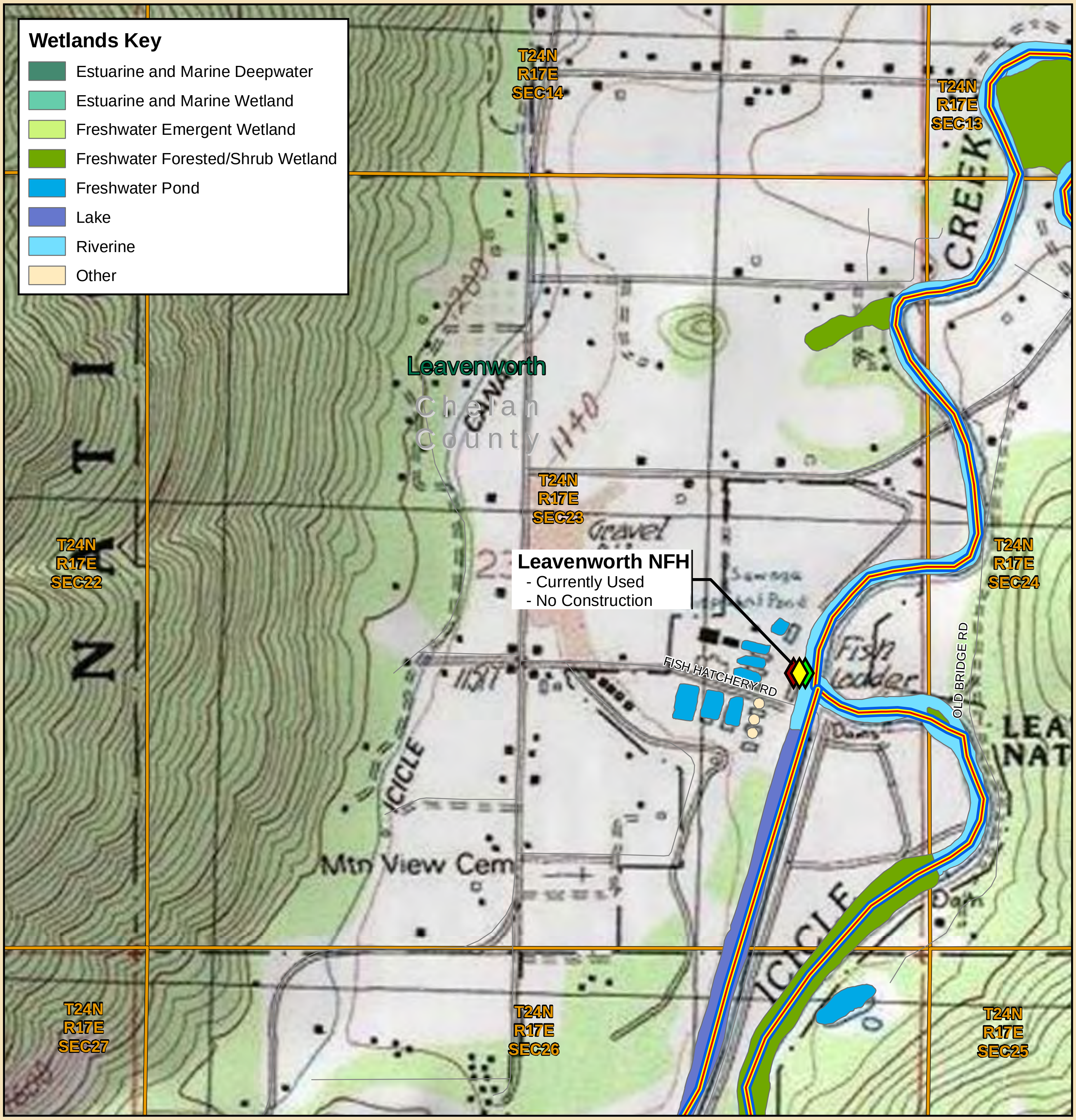


Figure 10d - Leavenworth NFH

Leavenworth Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

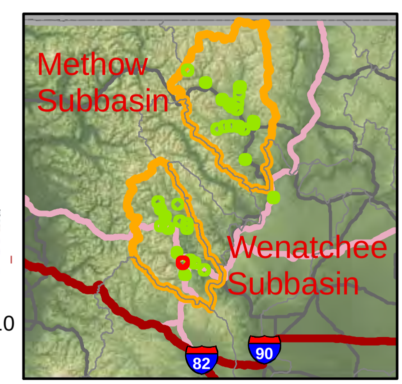
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



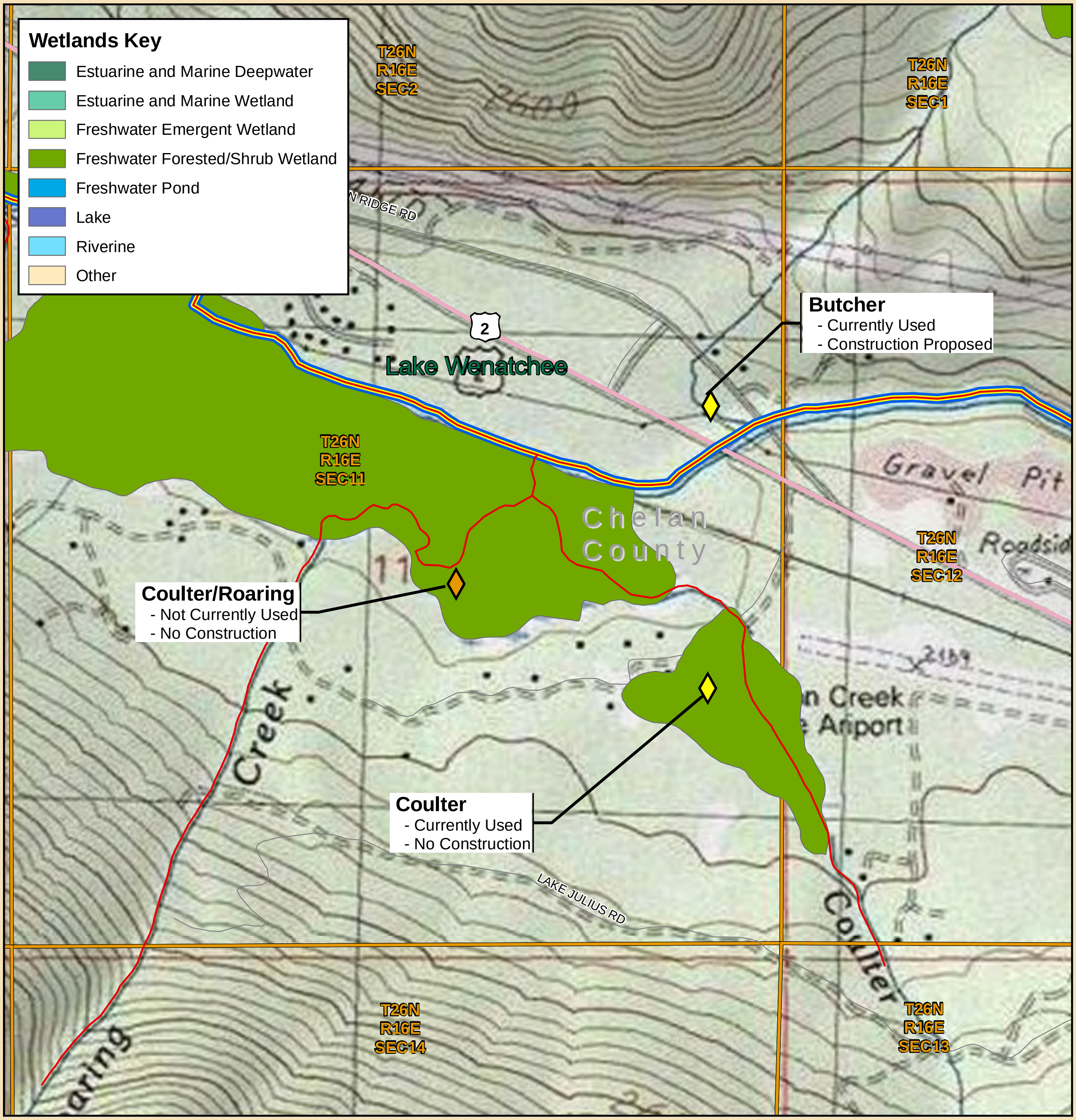


Figure 10e - Coulter, Butcher, and Coulter/Roaring

Lake Wenatchee Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

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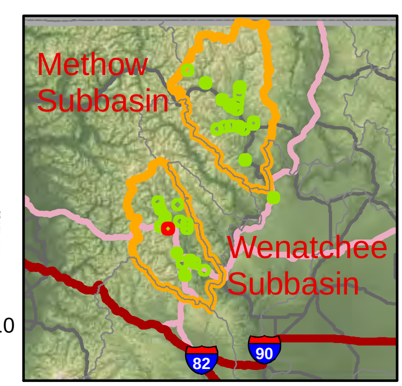


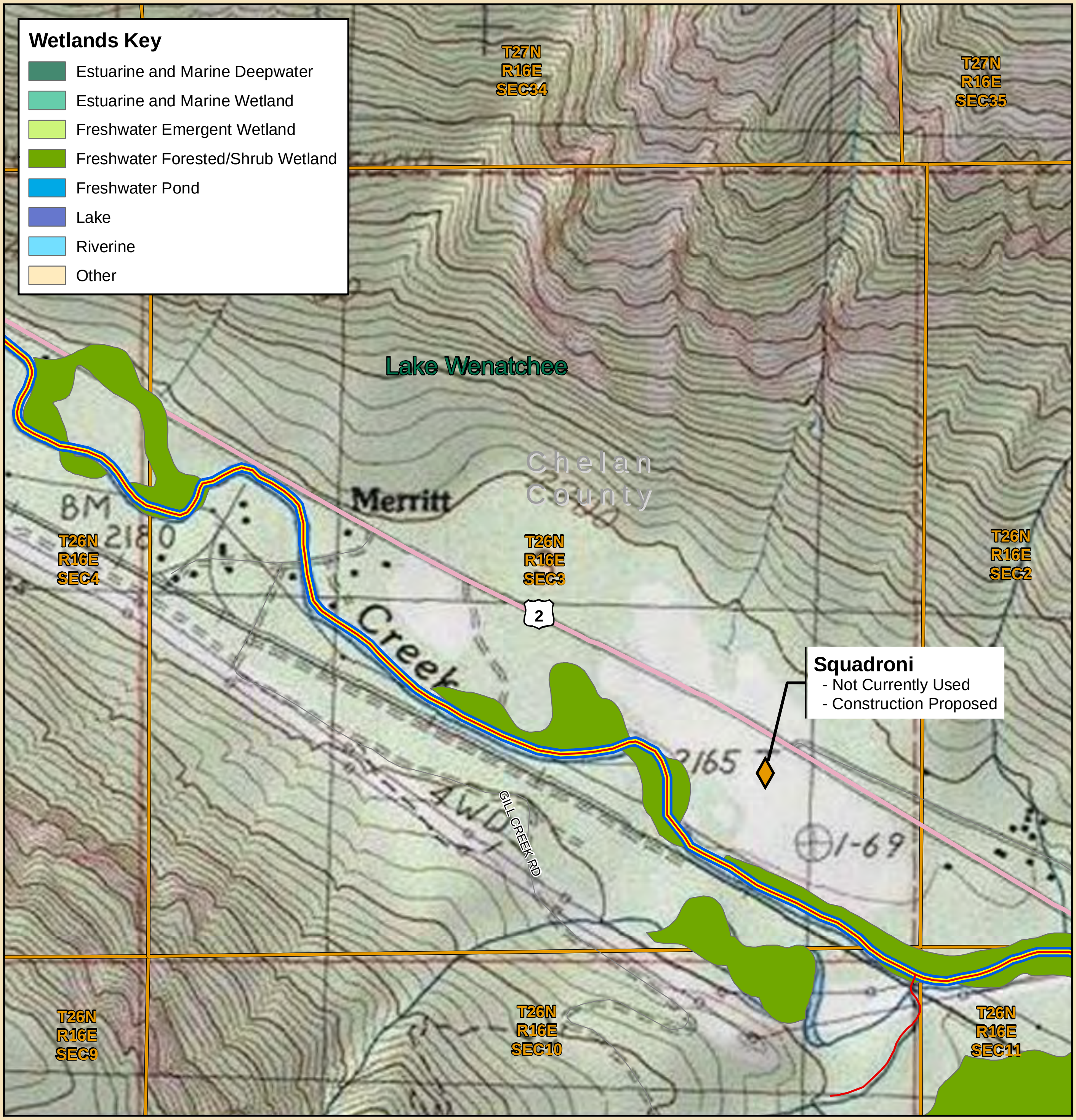


Figure 10f - Squadroni

Lake Wenatchee Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

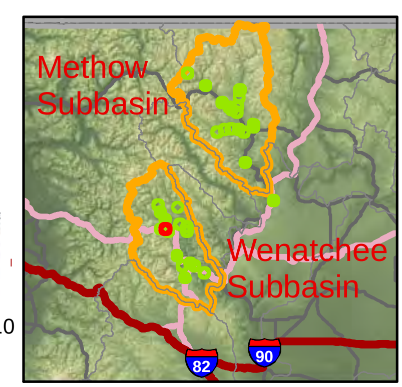
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



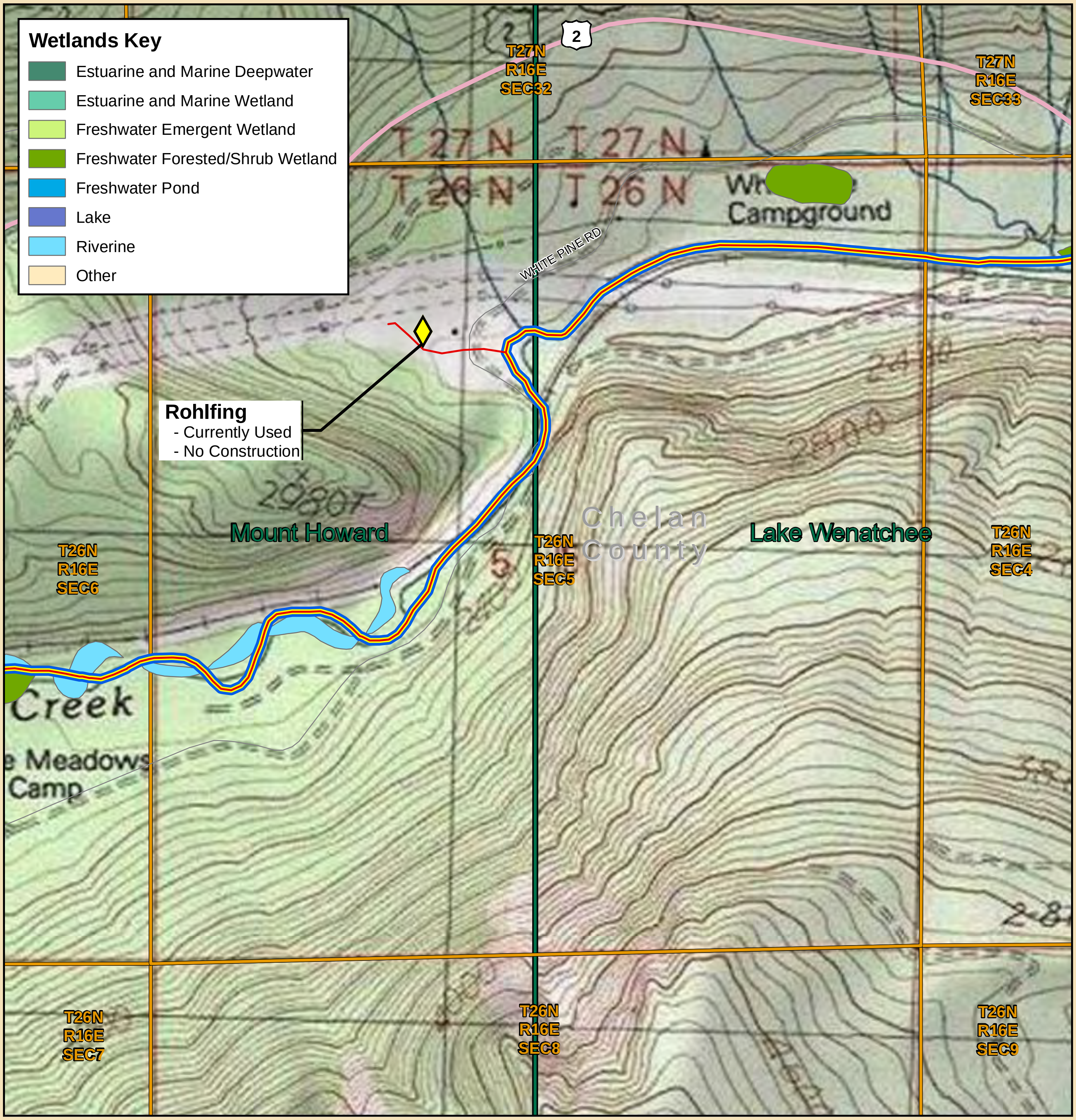


Figure 10g - Rohlfing

Lake Wenatchee Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

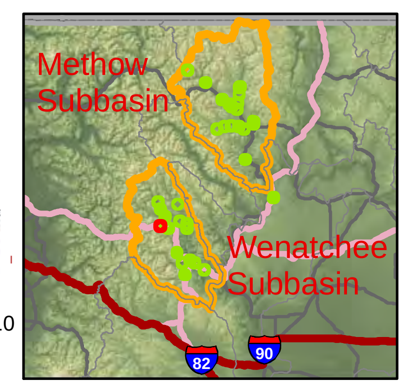
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



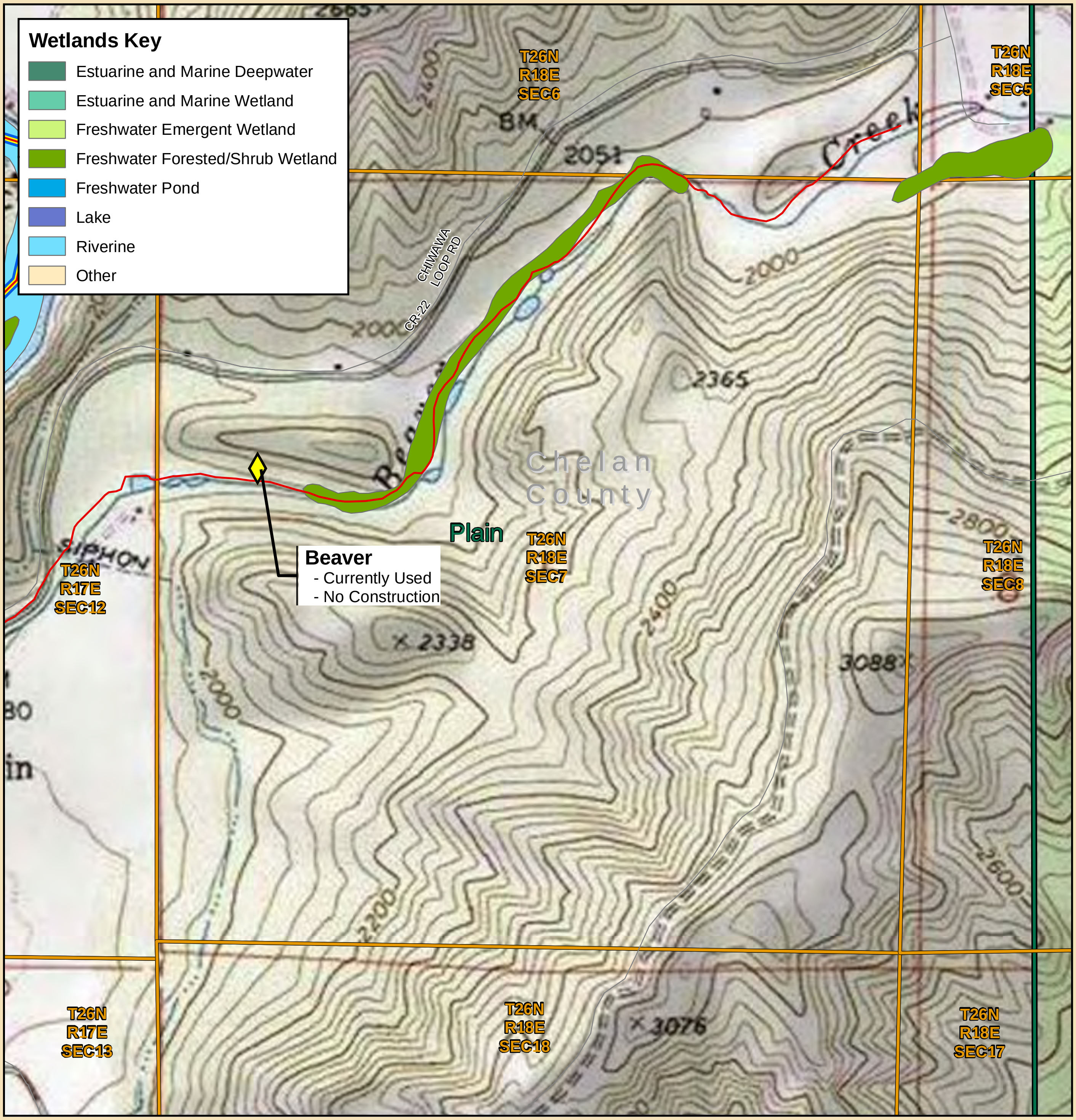


Figure 10h - Beaver

Plain Quadrangle

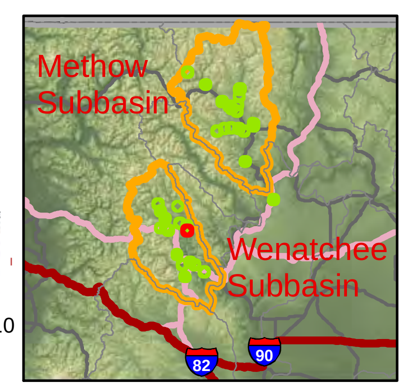
Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



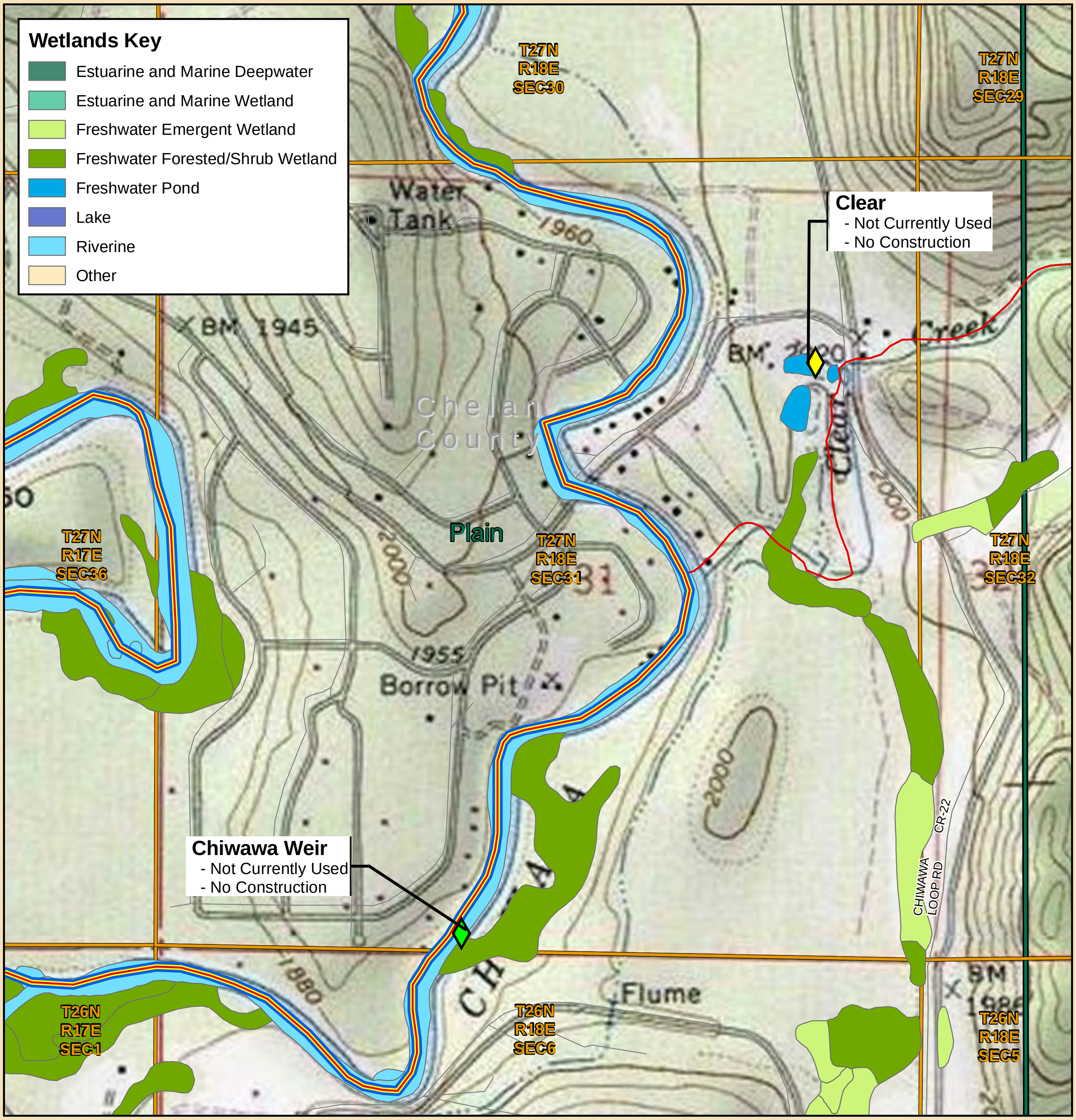


Figure 10i - Clear and Chiwawa Weir

Plain Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

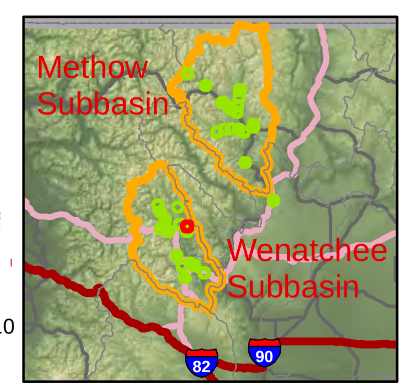
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE POWER ADMINISTRATION

November 1, 2010

0 500 1,000 2,000 Feet



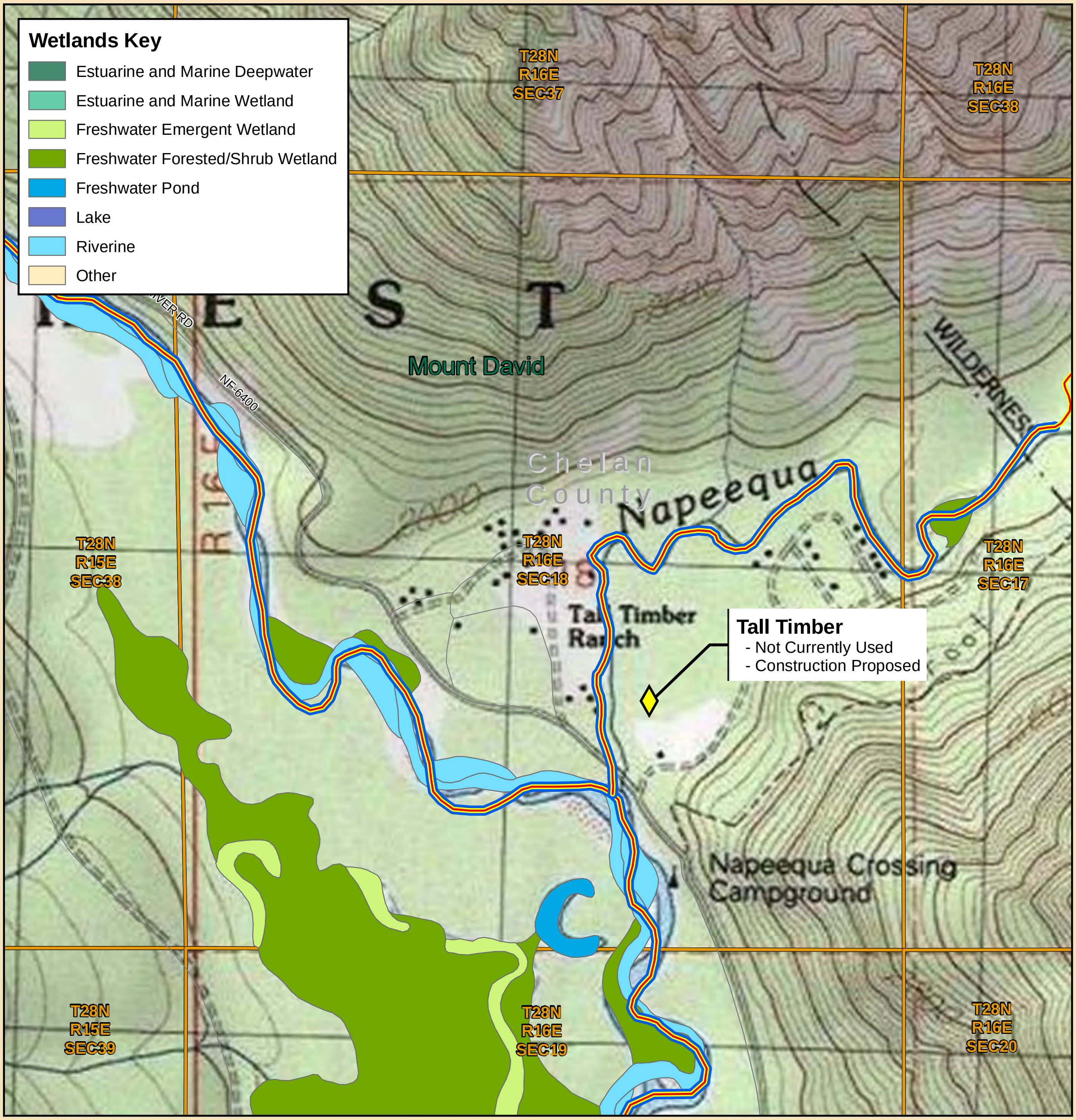


Figure 10j - Tall Timber

Mount David Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

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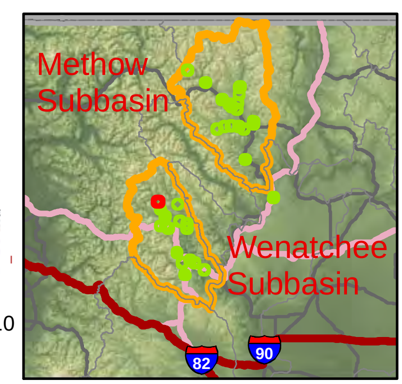


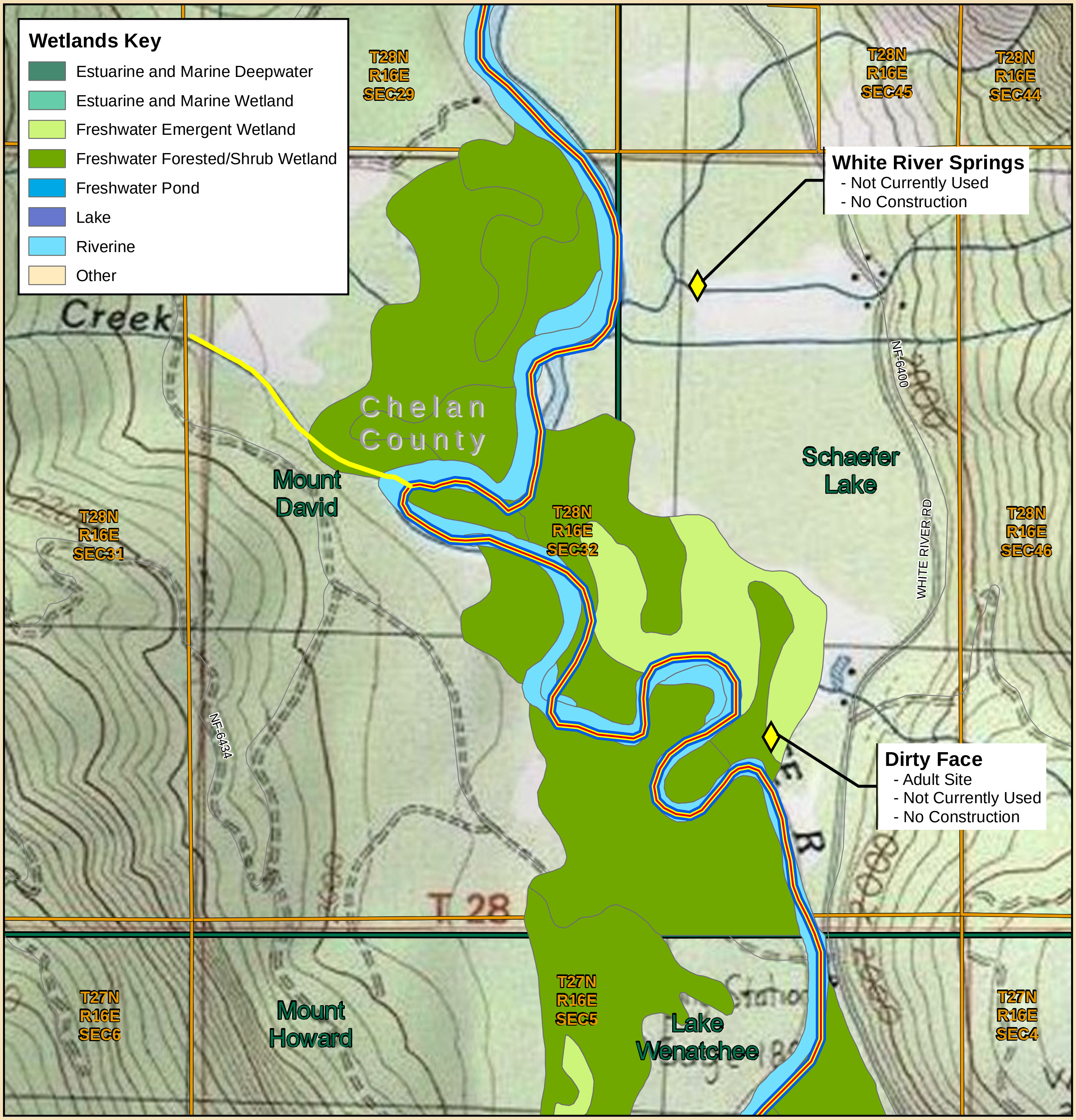


Figure 10k - White River Springs

Shaefer Lake Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

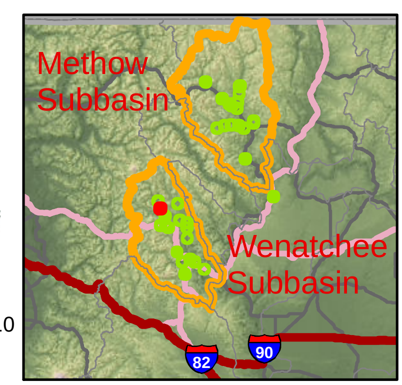
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



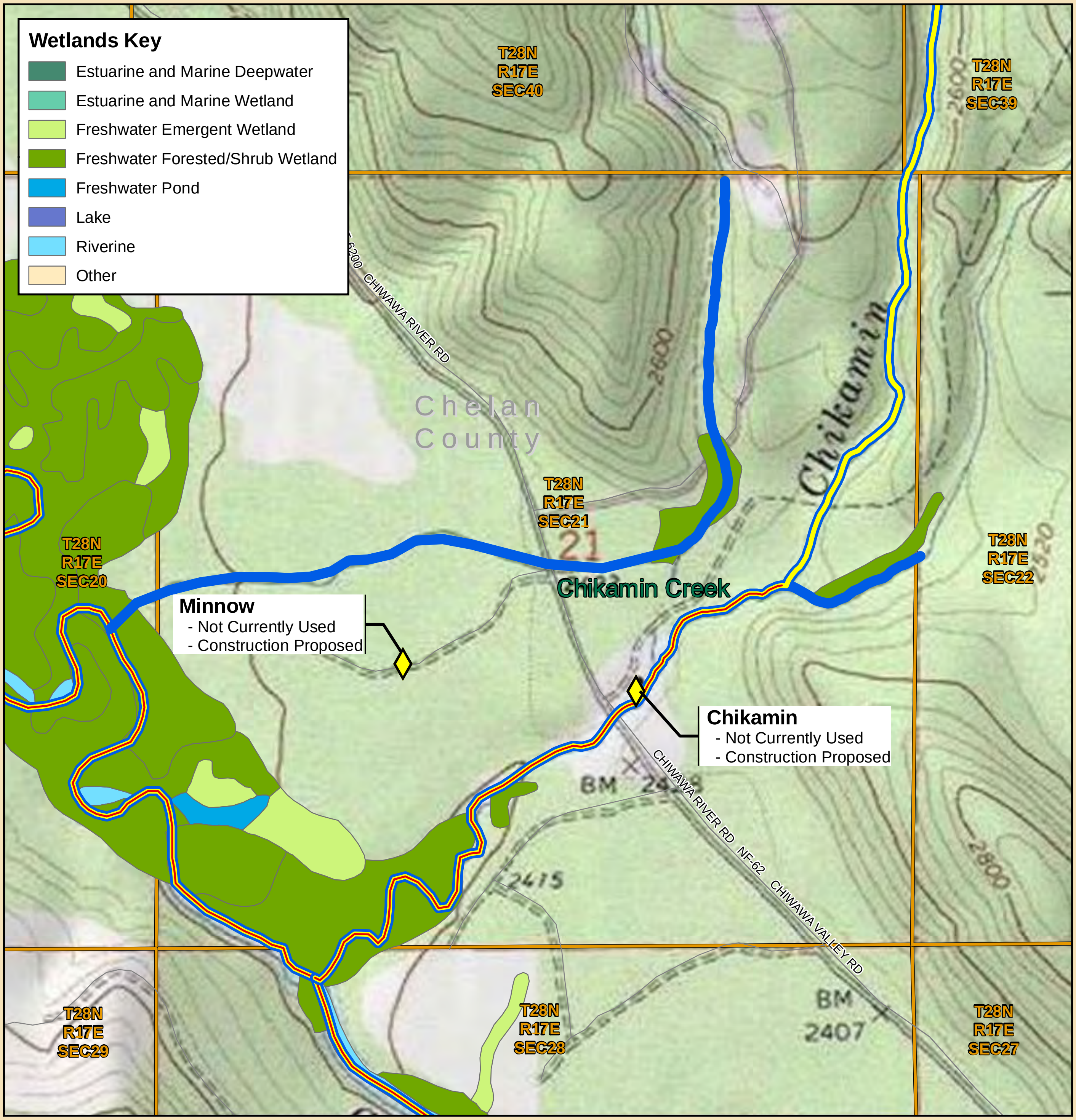


Figure 10l - Minnow and Chikamin

Chikamin Creek Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

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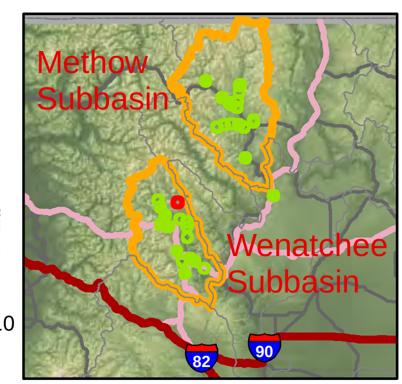


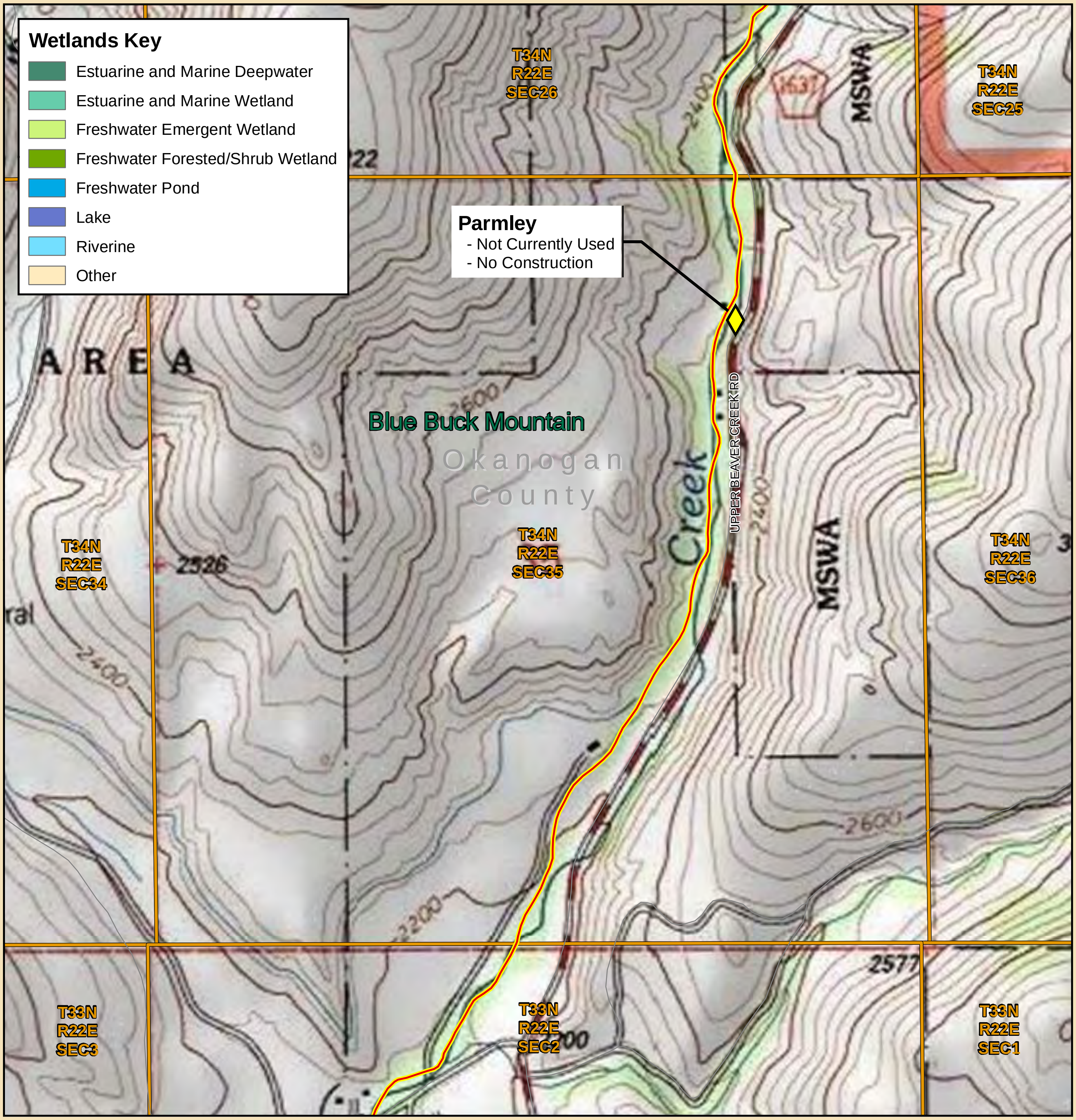


Figure 10m - Parmley

Blue Buck Mountain Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

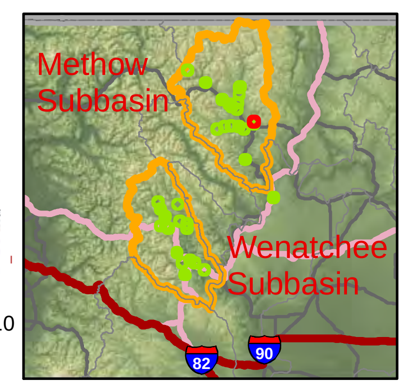
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



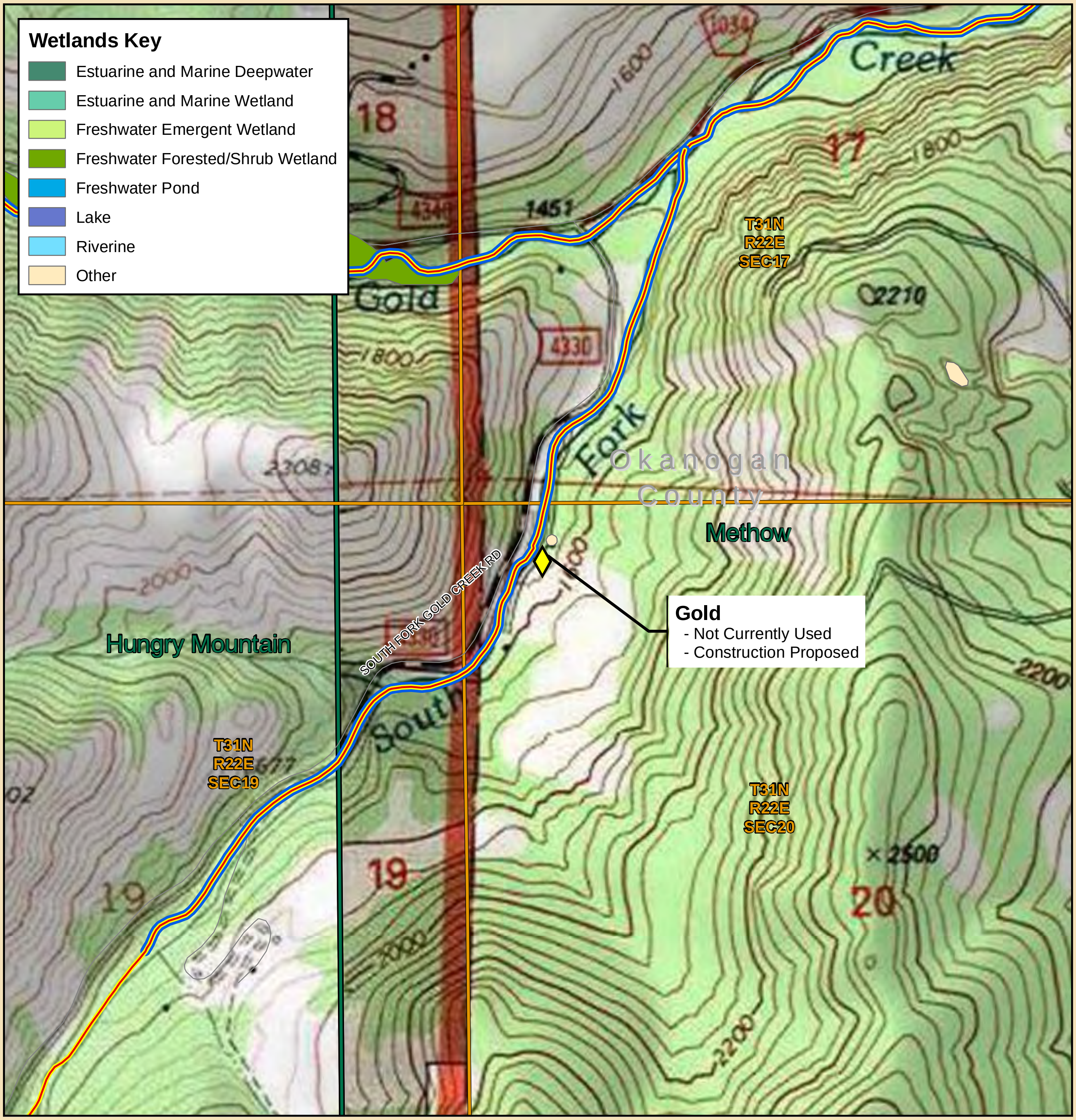


Figure 10n - Gold

Methow Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

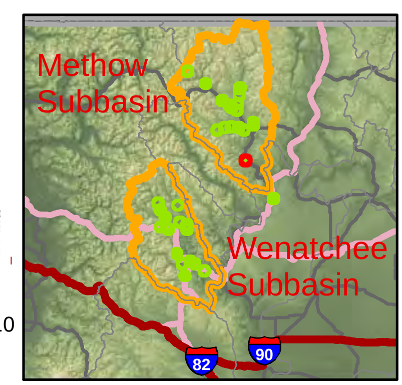
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



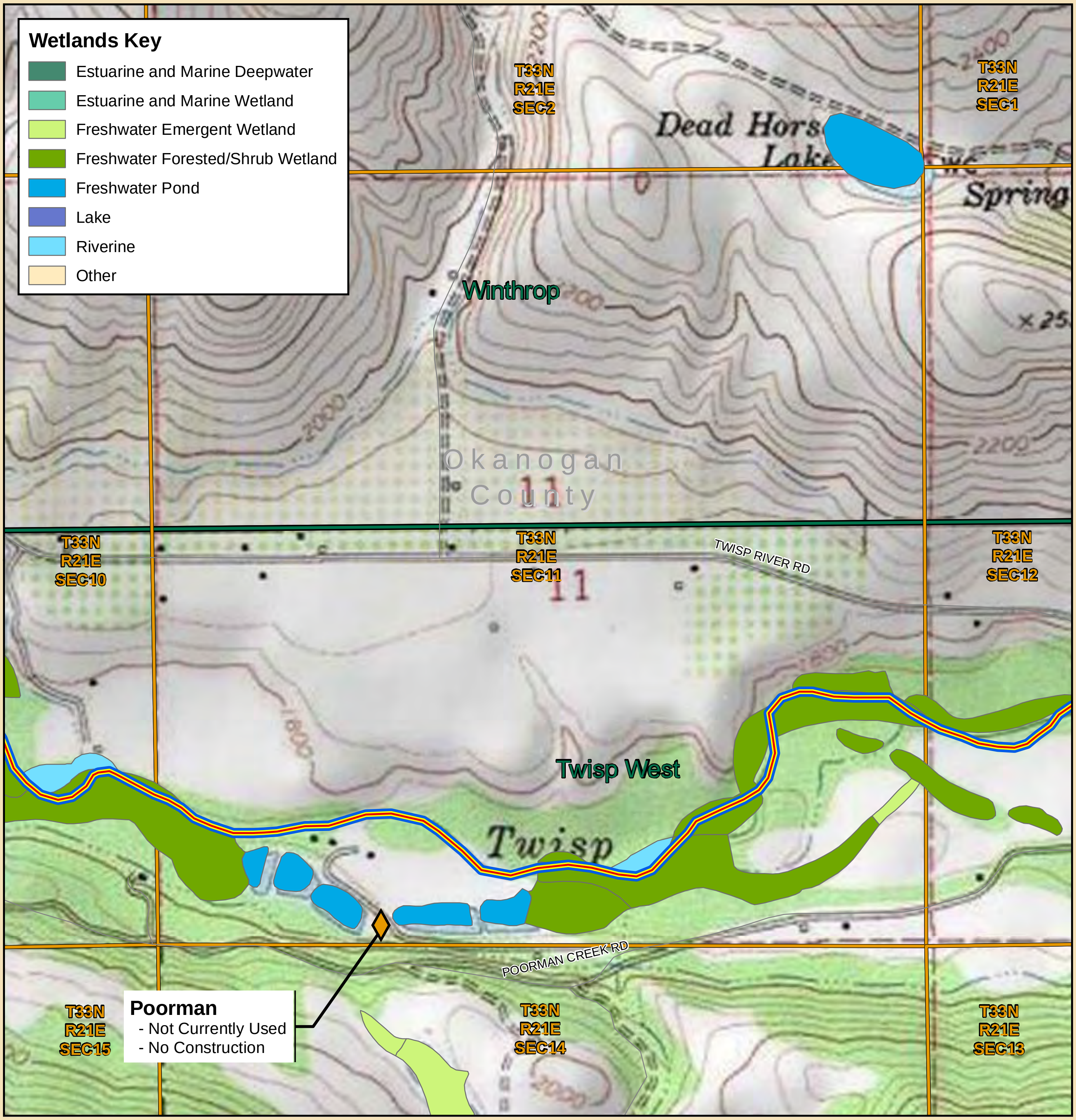


Figure 10o - Poorman

Winthrop Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

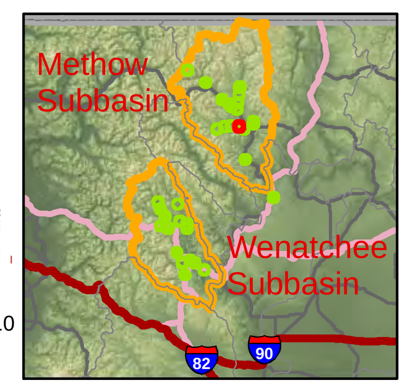
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



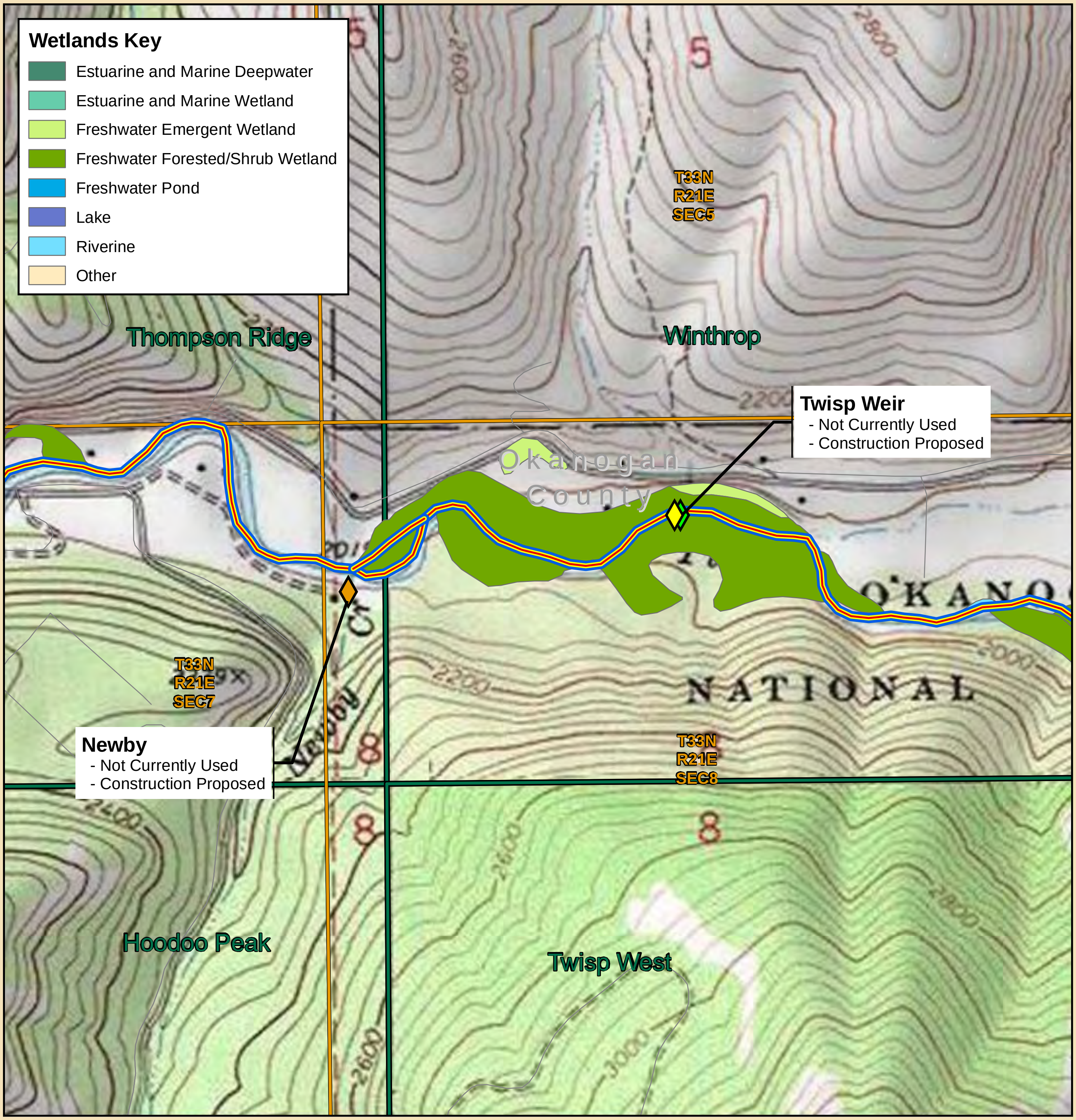


Figure 10p - Newby and Twisp Weir

Thompson Ridge Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

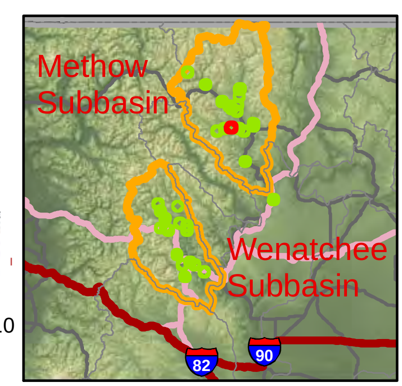
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



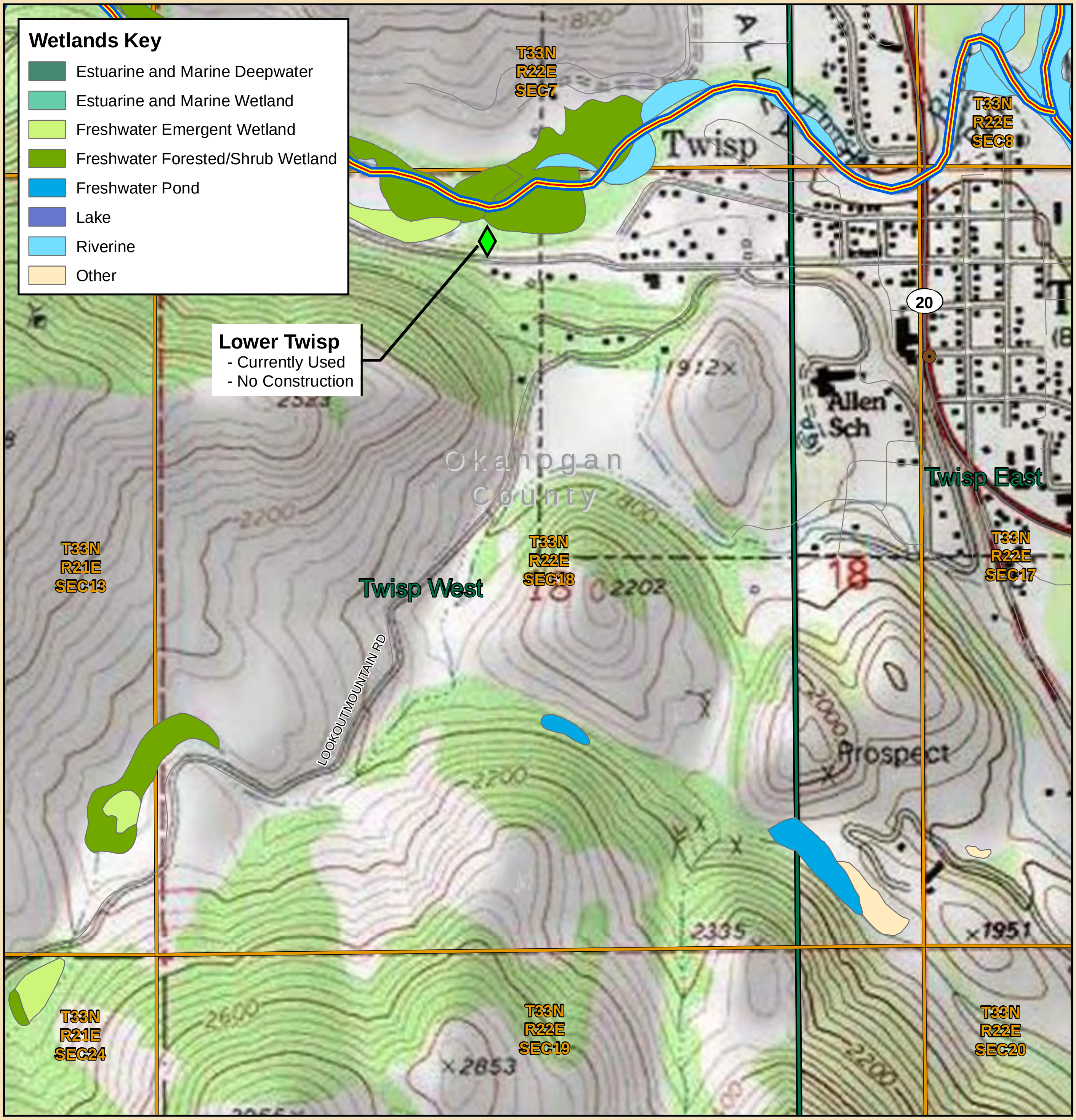


Figure 10q - Lower Twisp

Twisp West Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

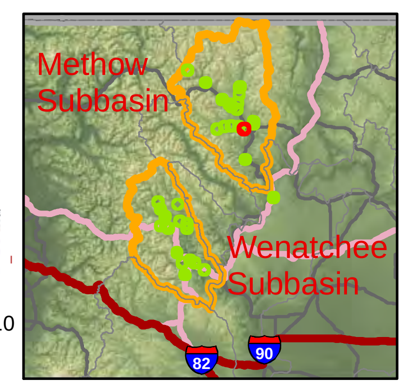
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE POWER ADMINISTRATION

November 1, 2010

0 500 1,000 2,000 Feet



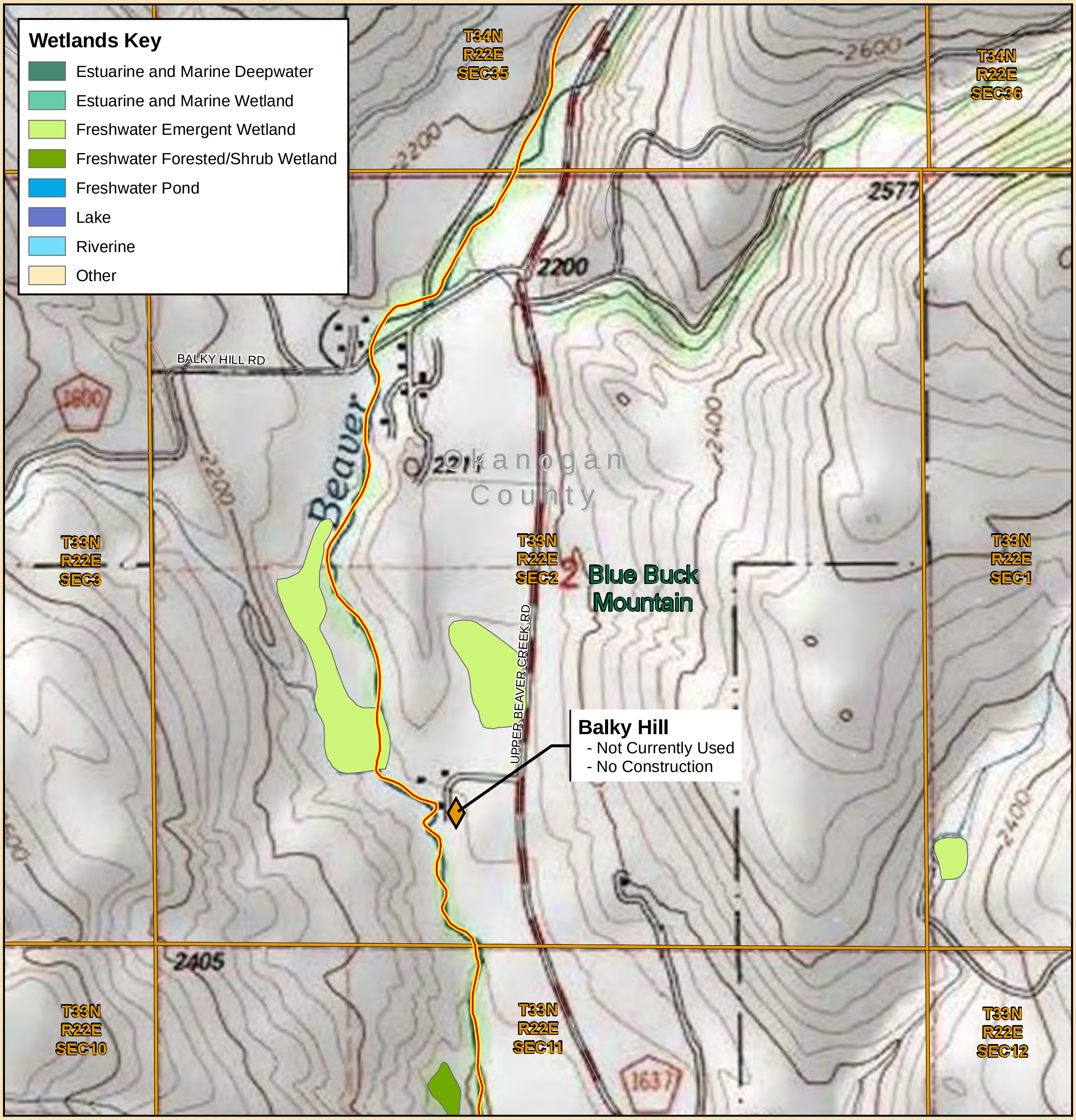


Figure 10r - Balky Hill

Blue Buck Mountain Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

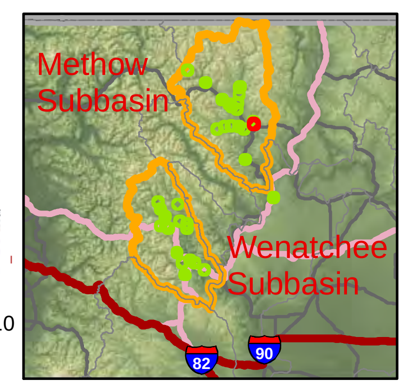
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



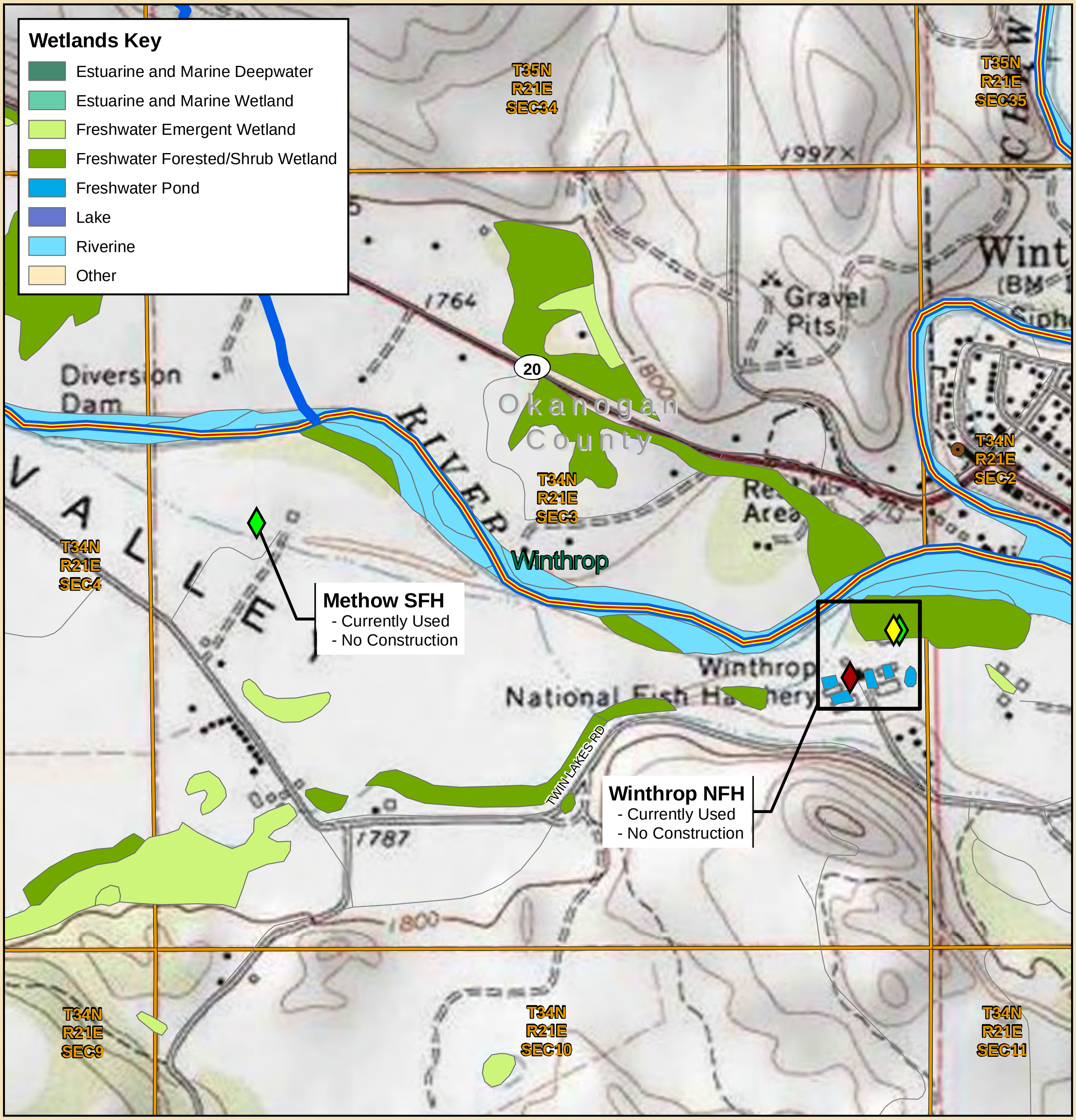


Figure 10s - Winthrop NFH and Methow SFH

Winthrop Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

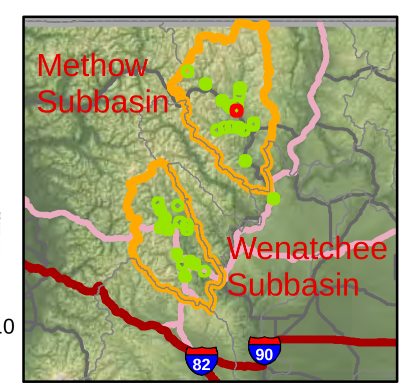
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



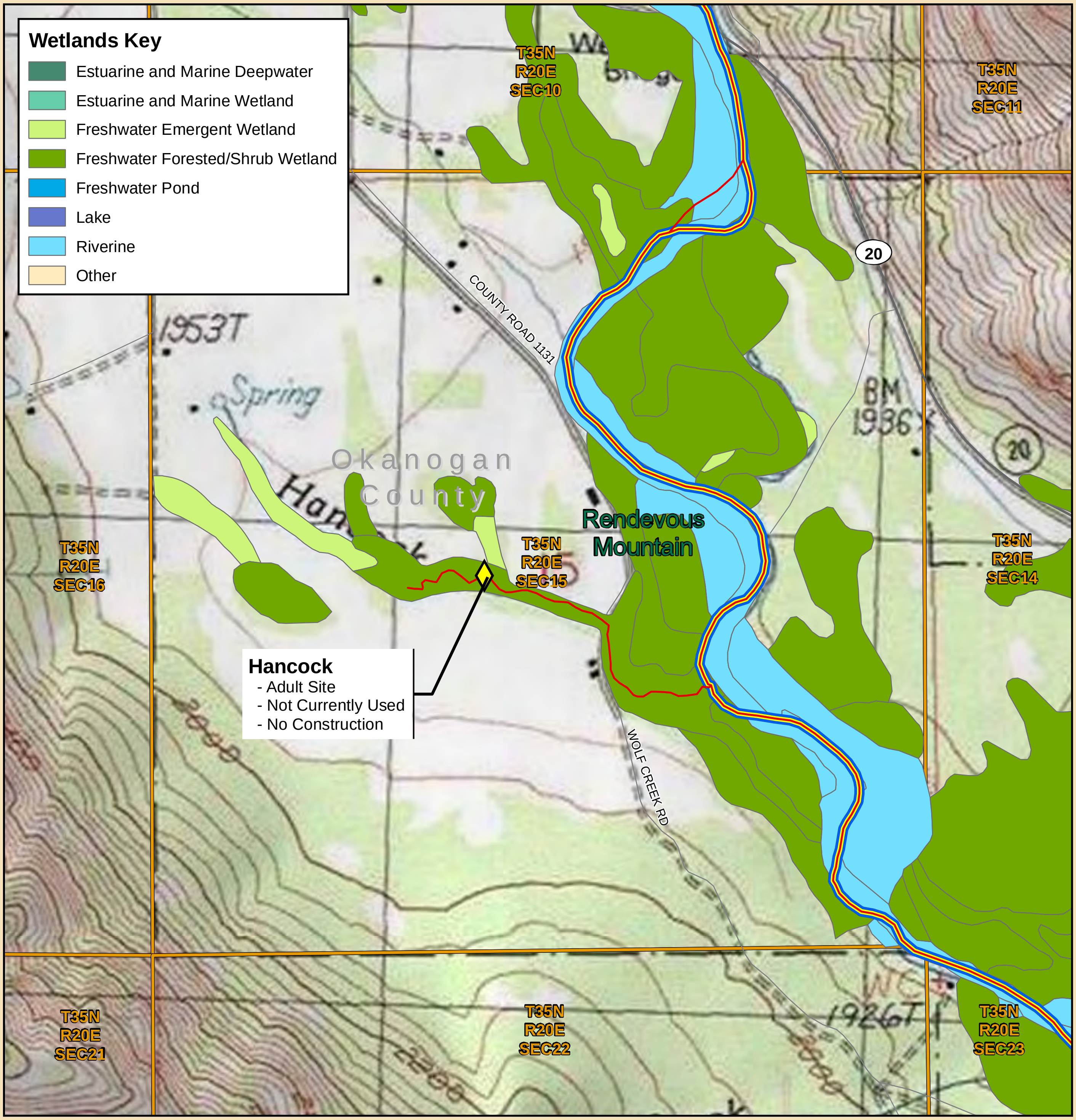


Figure 10t - Hancock

Rendevous Mountain Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

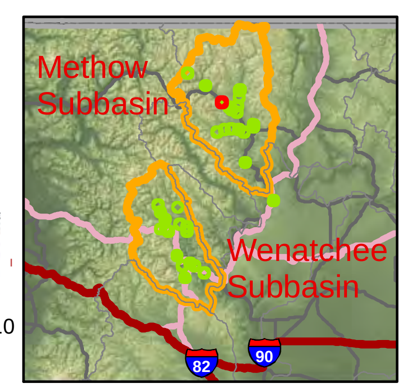
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



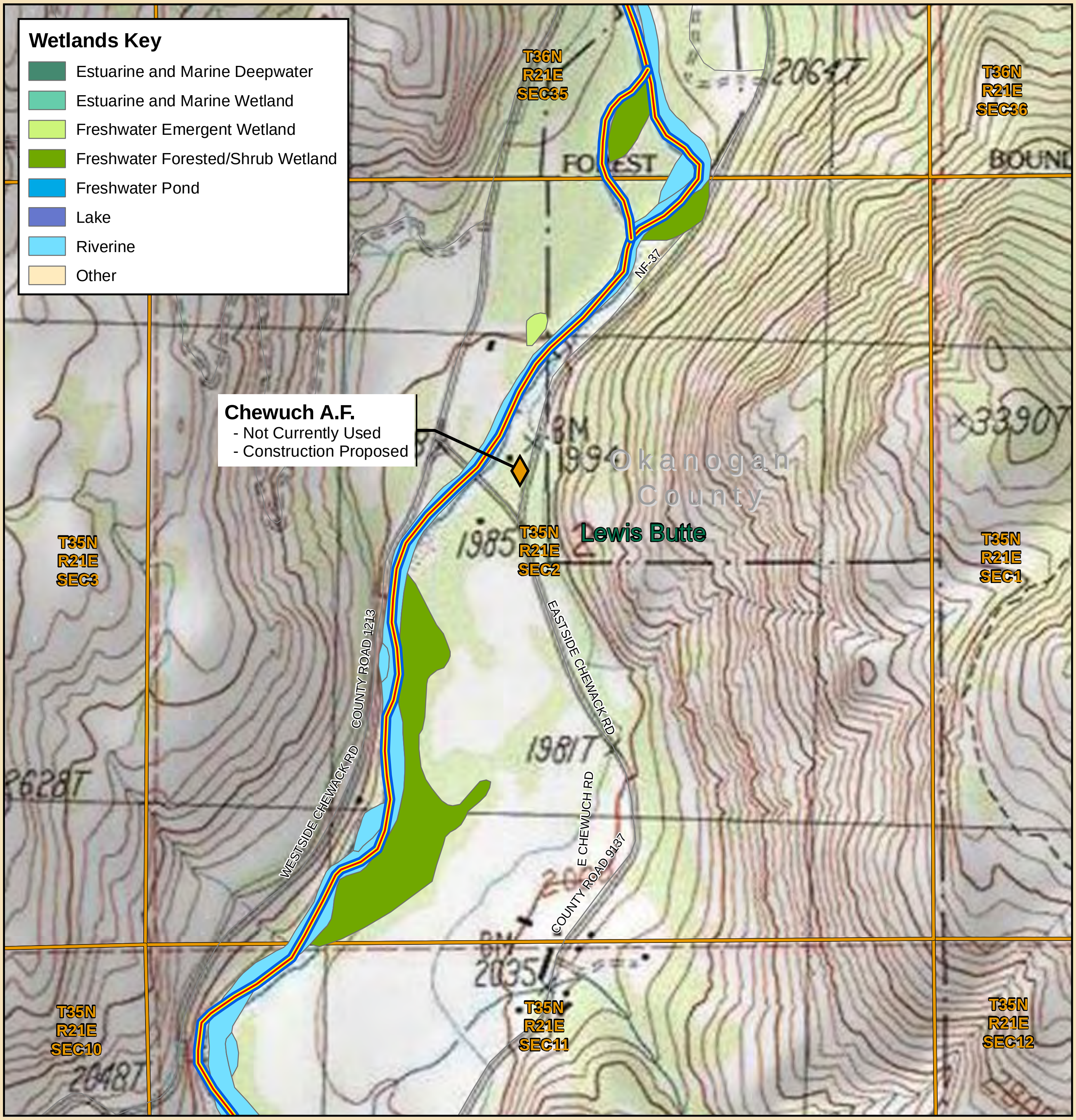


Figure 10u - Chewuch A.F.

Lewis Butte Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

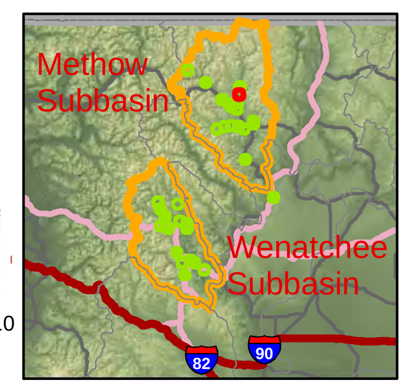
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE POWER ADMINISTRATION

November 1, 2010

0 500 1,000 2,000 Feet



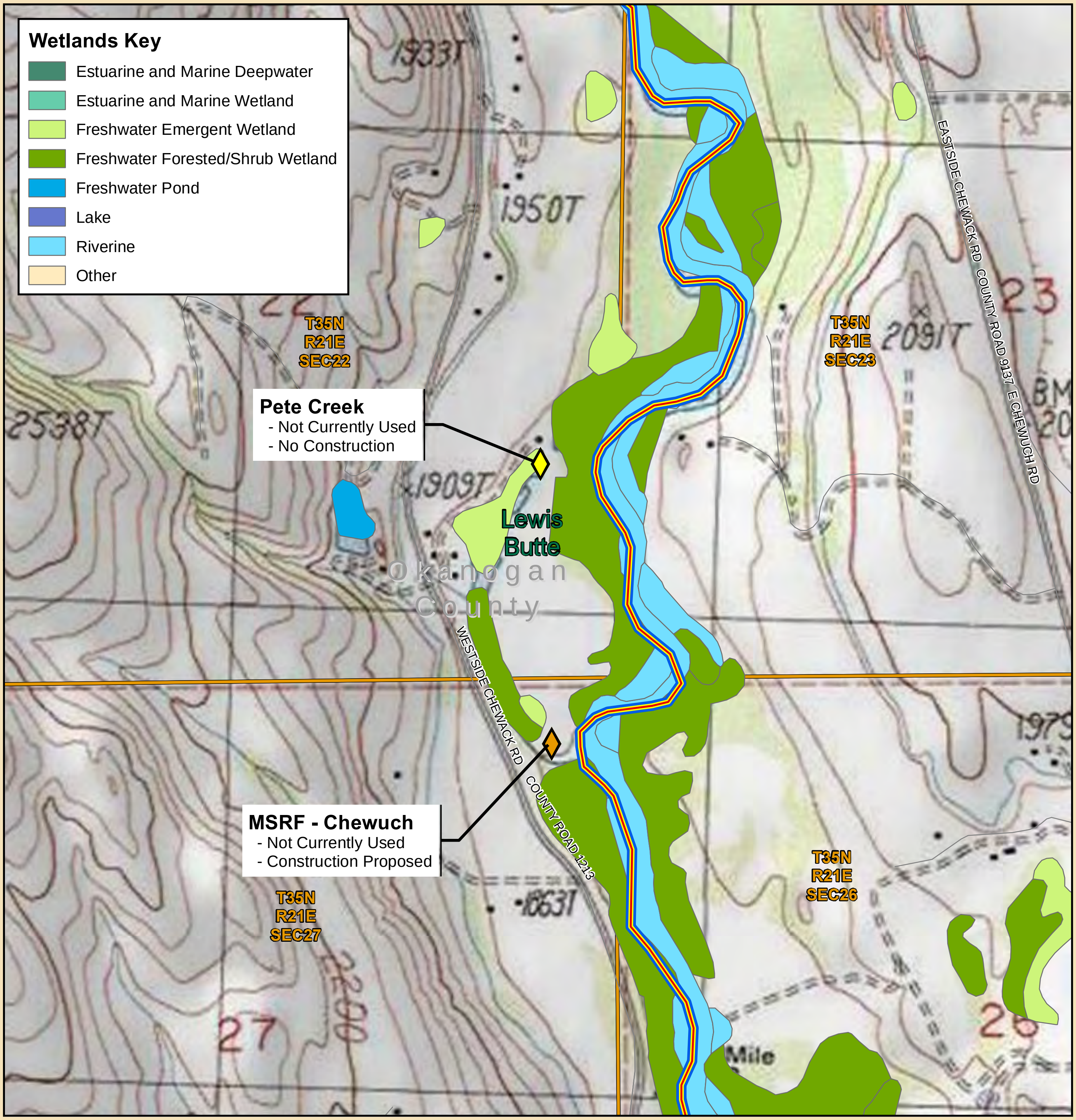


Figure 10v – MSRF Chewuch and Pete Creek

Lewis Butte Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

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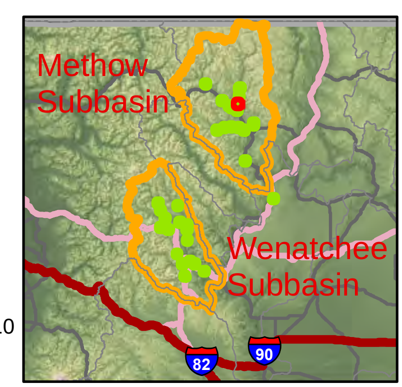


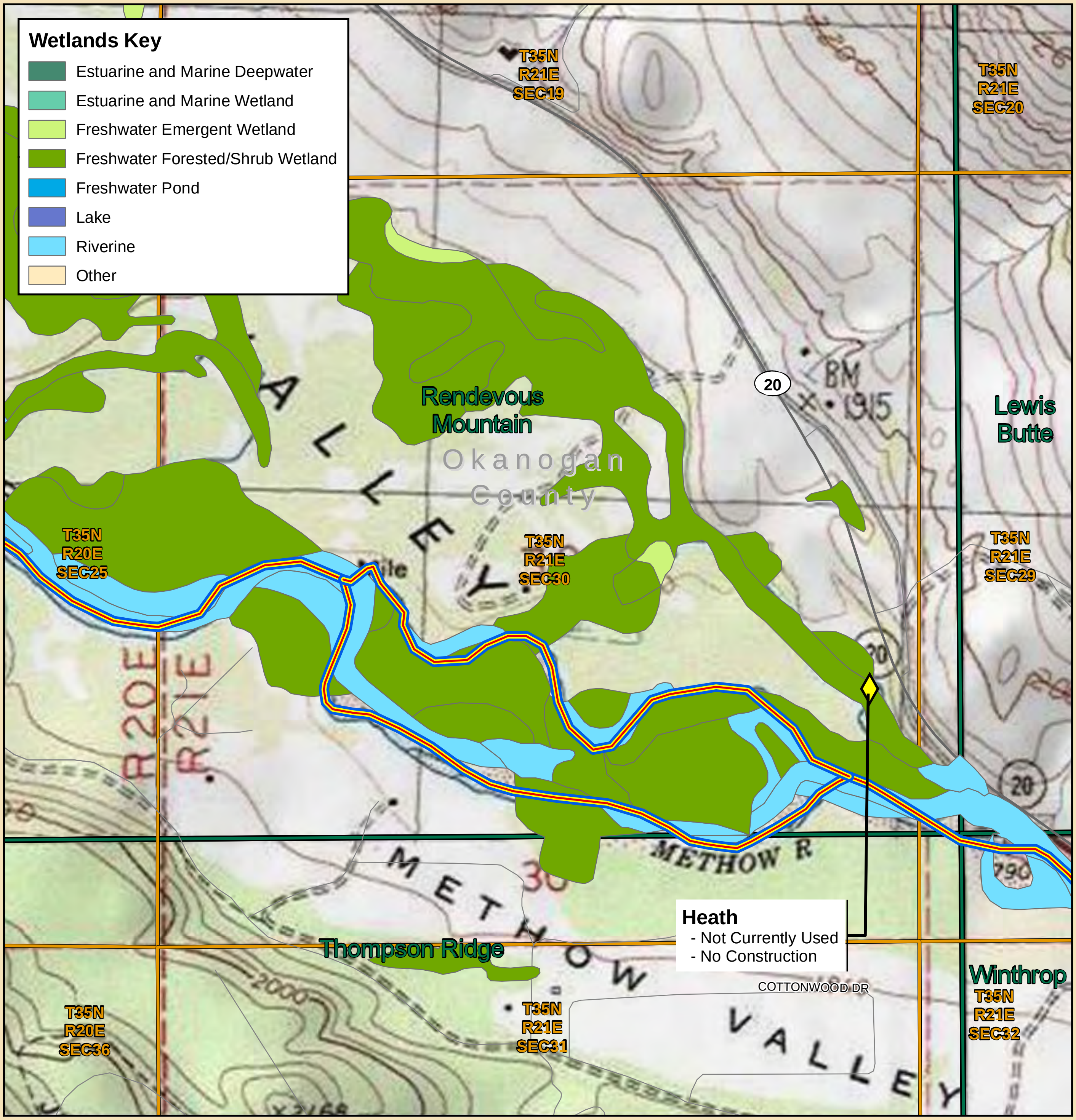


Figure 10w - Heath

Rendevous Mountain Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

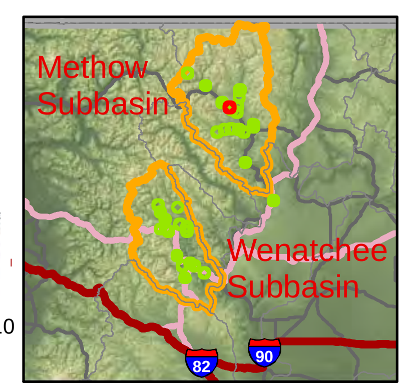
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



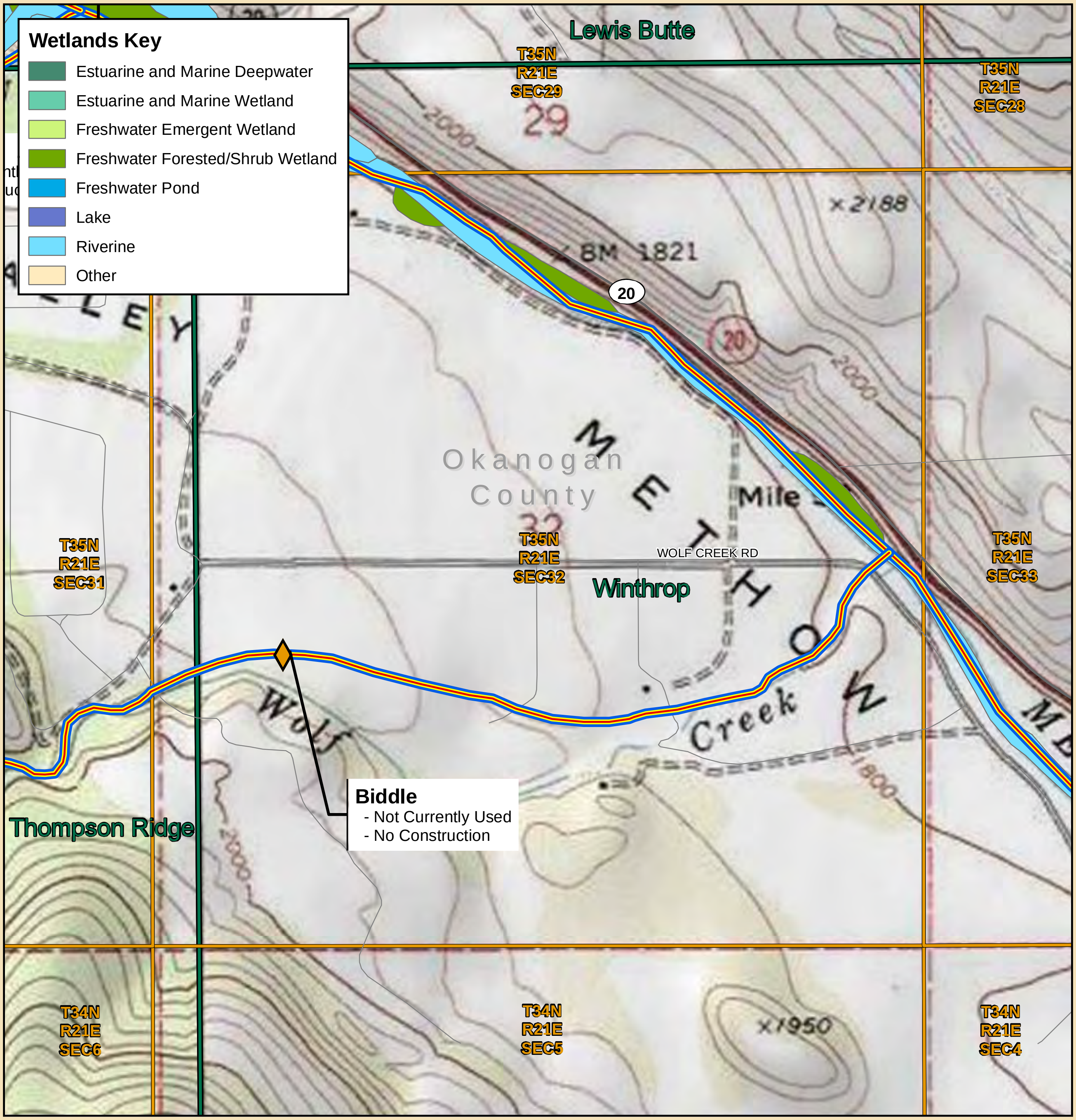


Figure 10x - Biddle

Winthrop Quadrangle

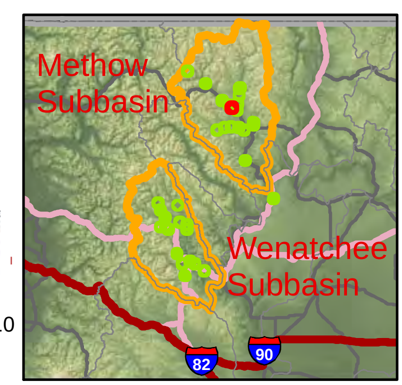
Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



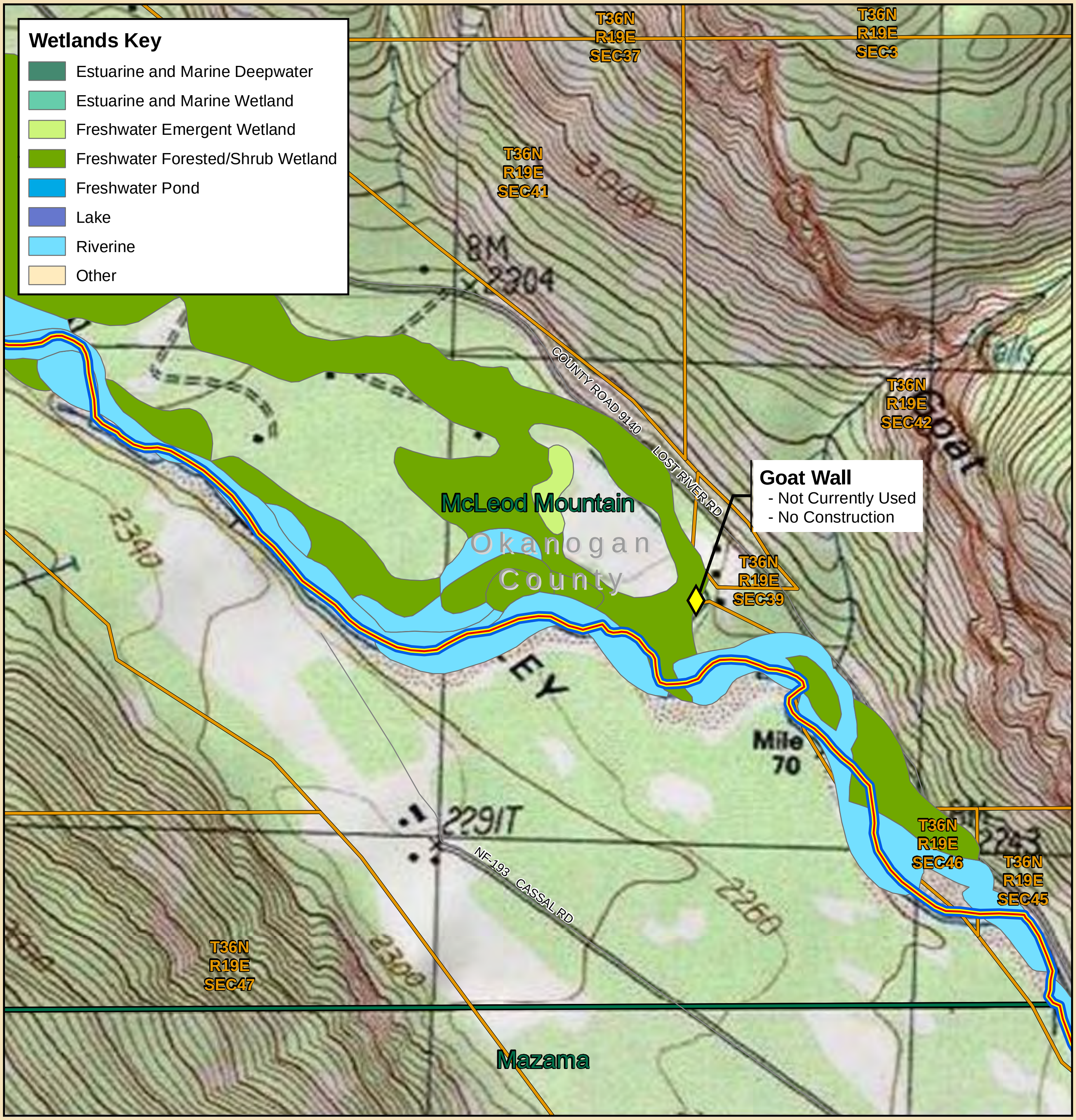


Figure 10y - Goat Wall

McLeod Mountain Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

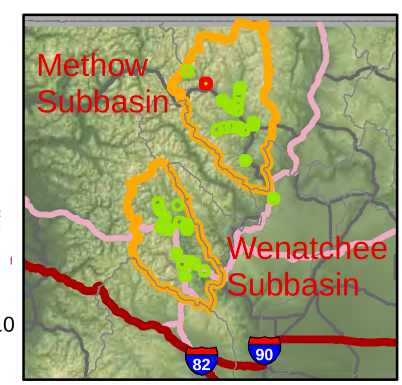
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE POWER ADMINISTRATION

November 1, 2010

0 500 1,000 2,000 Feet



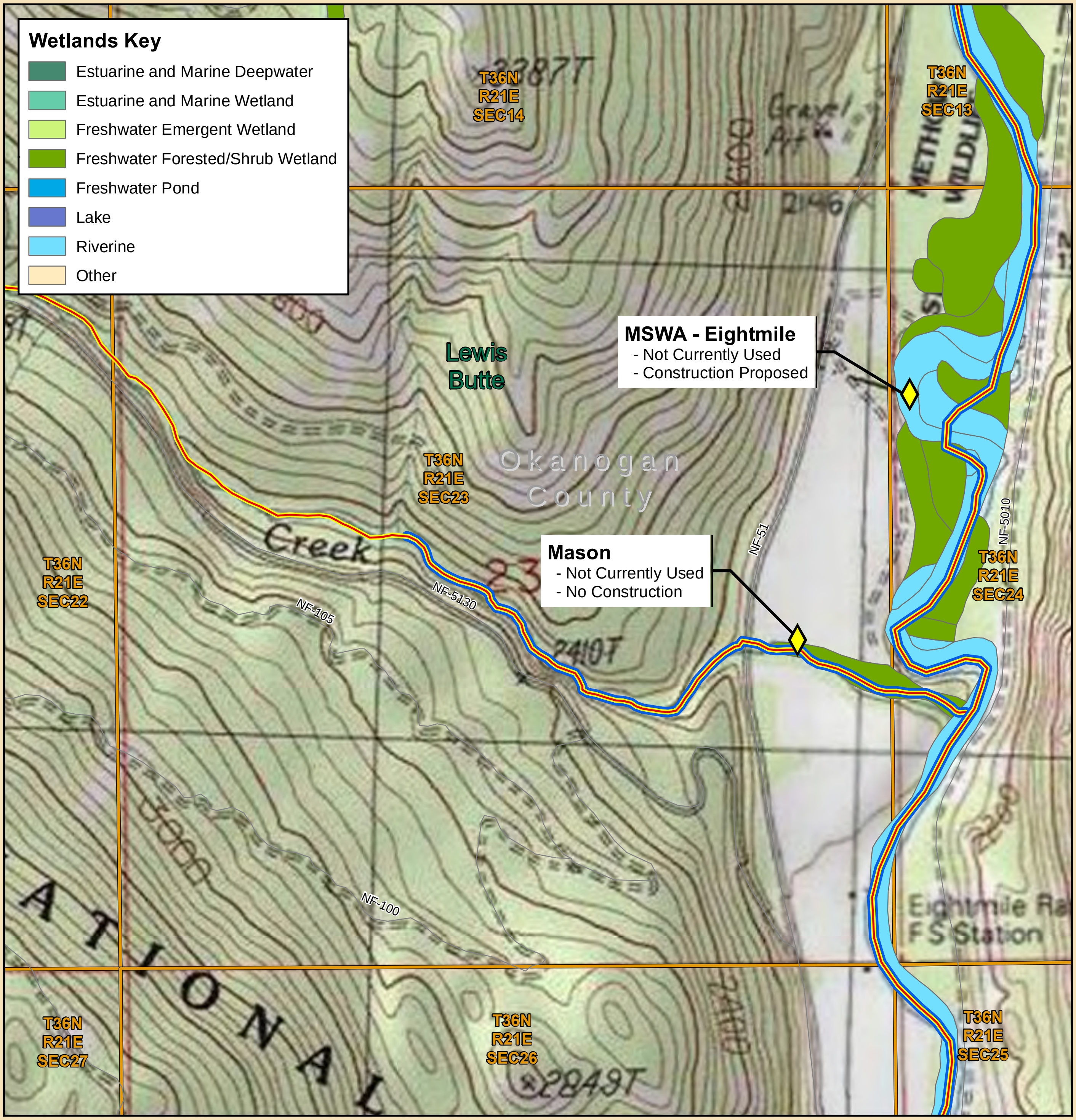


Figure 10z – Mason and MSWA Eightmile

Lewis Butte Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

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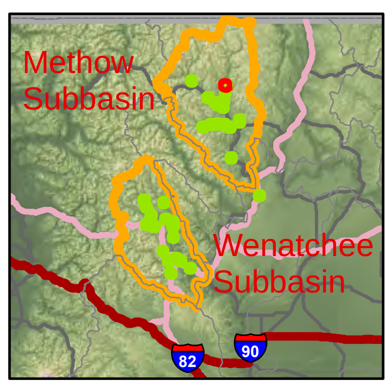
November 1, 2010

0 500 1,000 2,000 Feet



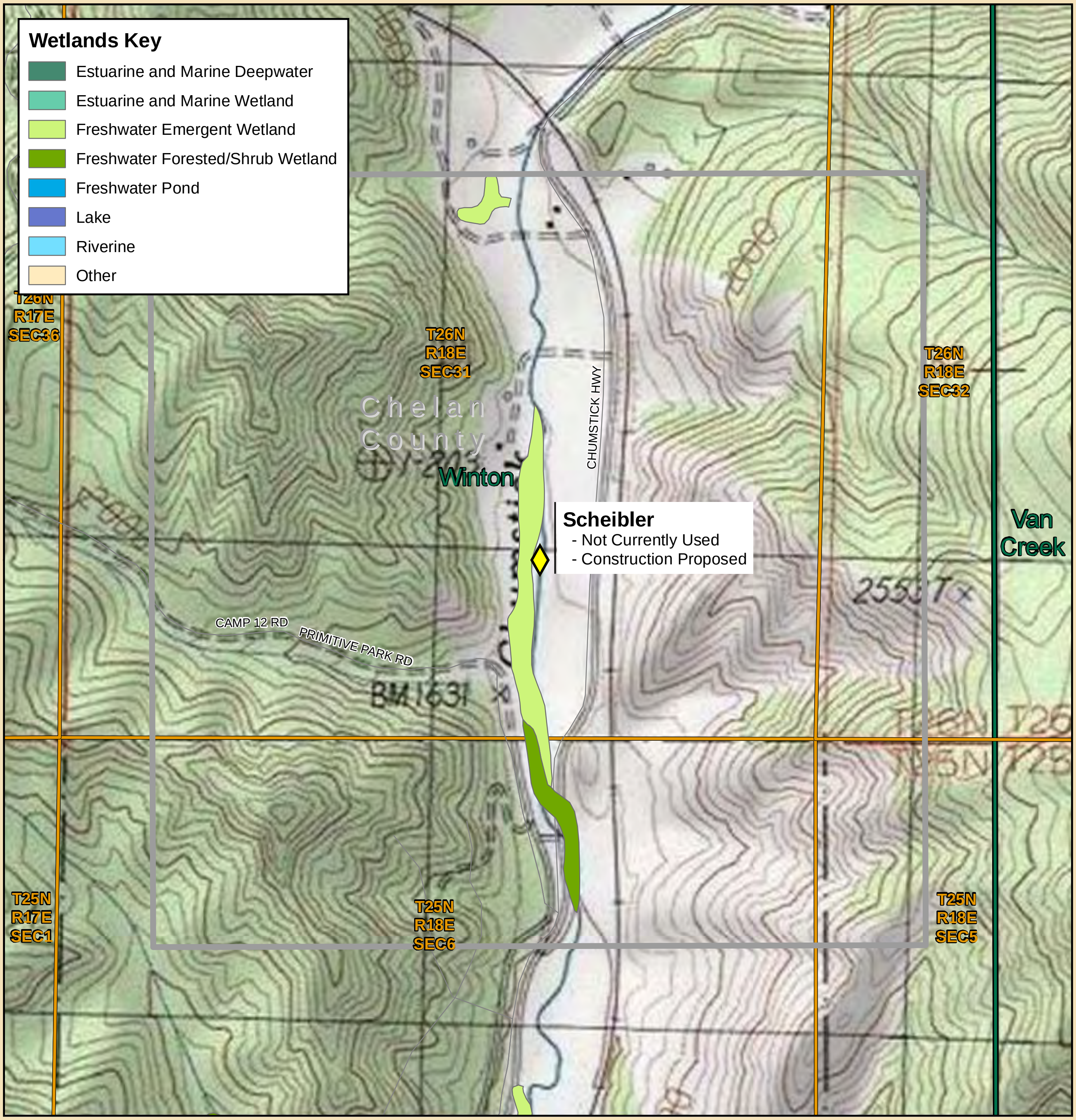


Figure 10ab - Scheibler

Slate Peak Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

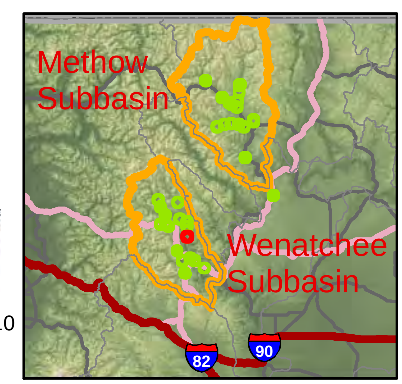
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



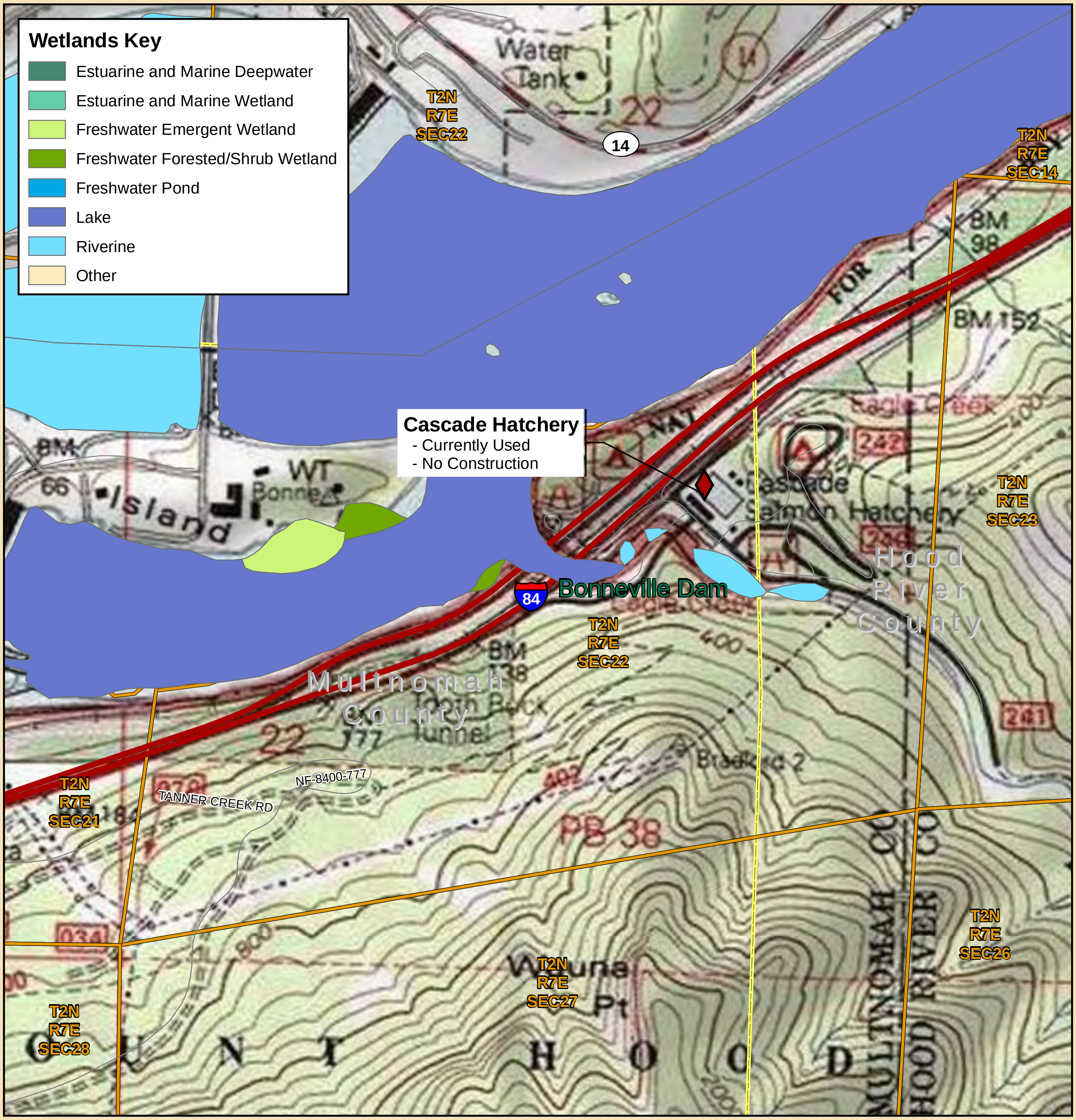


Figure 10ac - Cascade Hatchery

Bonneville Dam Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet

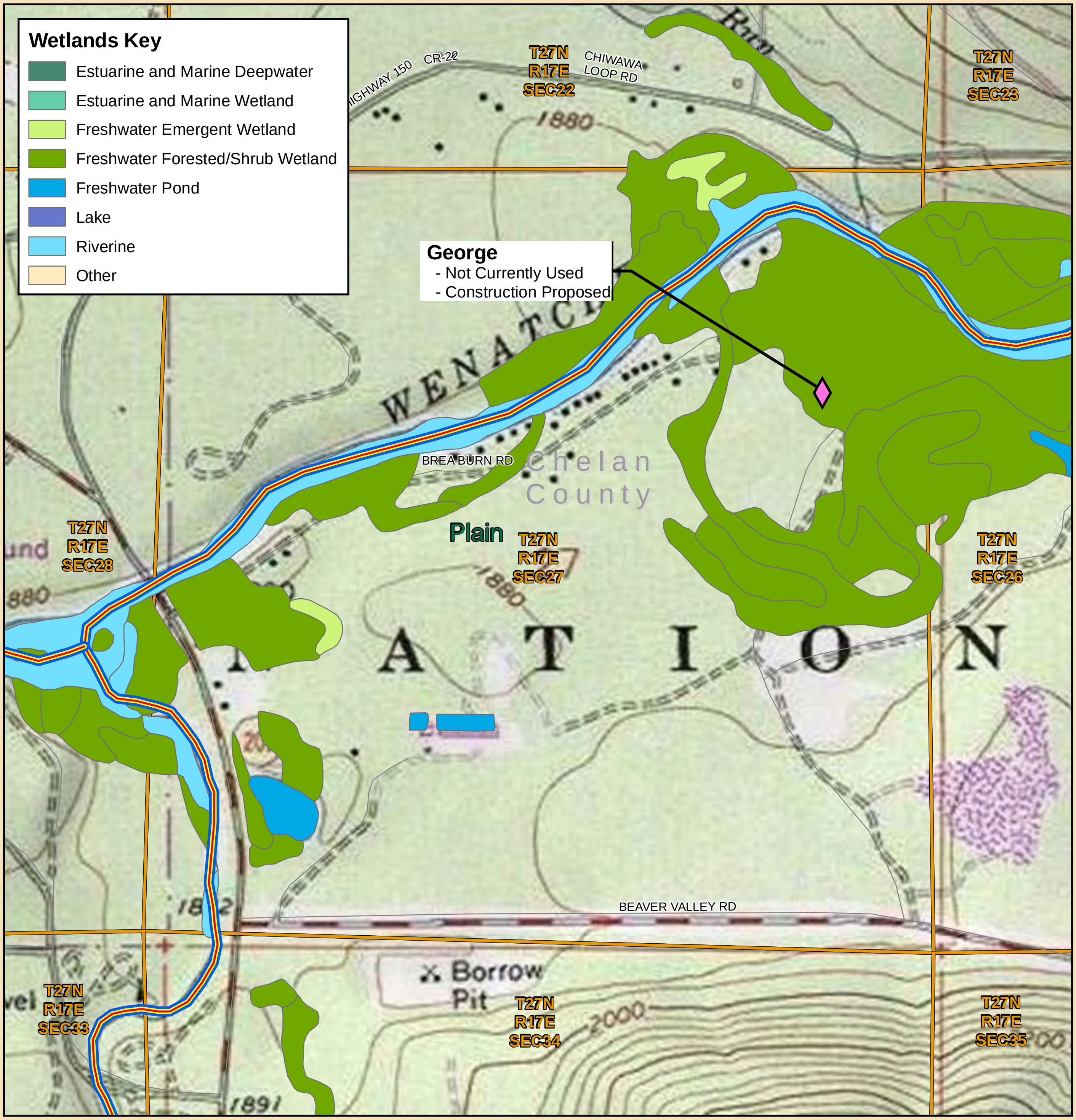


Figure 10ad - George

Plain Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

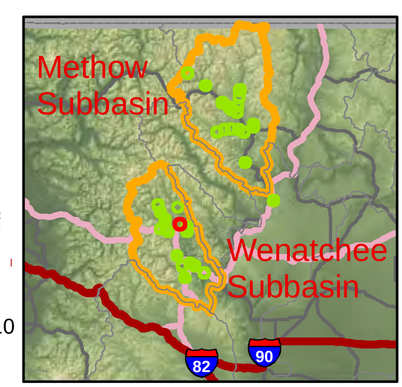
Primary Acclimation Site
Backup Acclimation Site
Broodstock Capture Site
Primary Incubation and Rearings Site
Alternative Incubation and Rearings Site

Summer Steelhead
Dolly Varden/Bull Trout
Spring Chinook
Township/Range/Section (PLSS)
Quad Name and Boundary

N

November 1, 2010

0 500 1,000 2,000 Feet



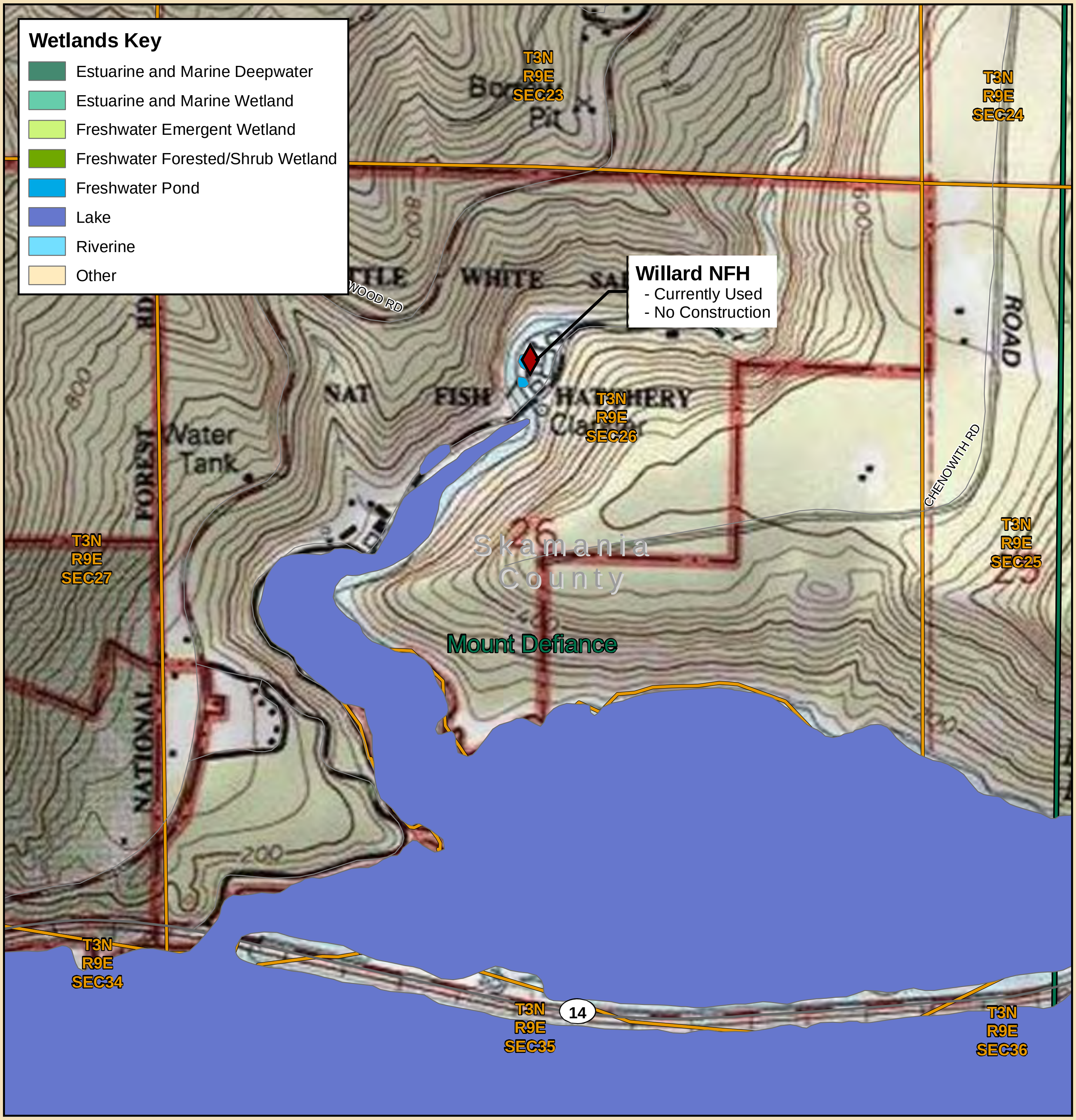


Figure 10ae - Willard NFH

Mount Defiance Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

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BONNEVILLE POWER ADMINISTRATION

November 1, 2010

0 500 1,000 2,000 Feet

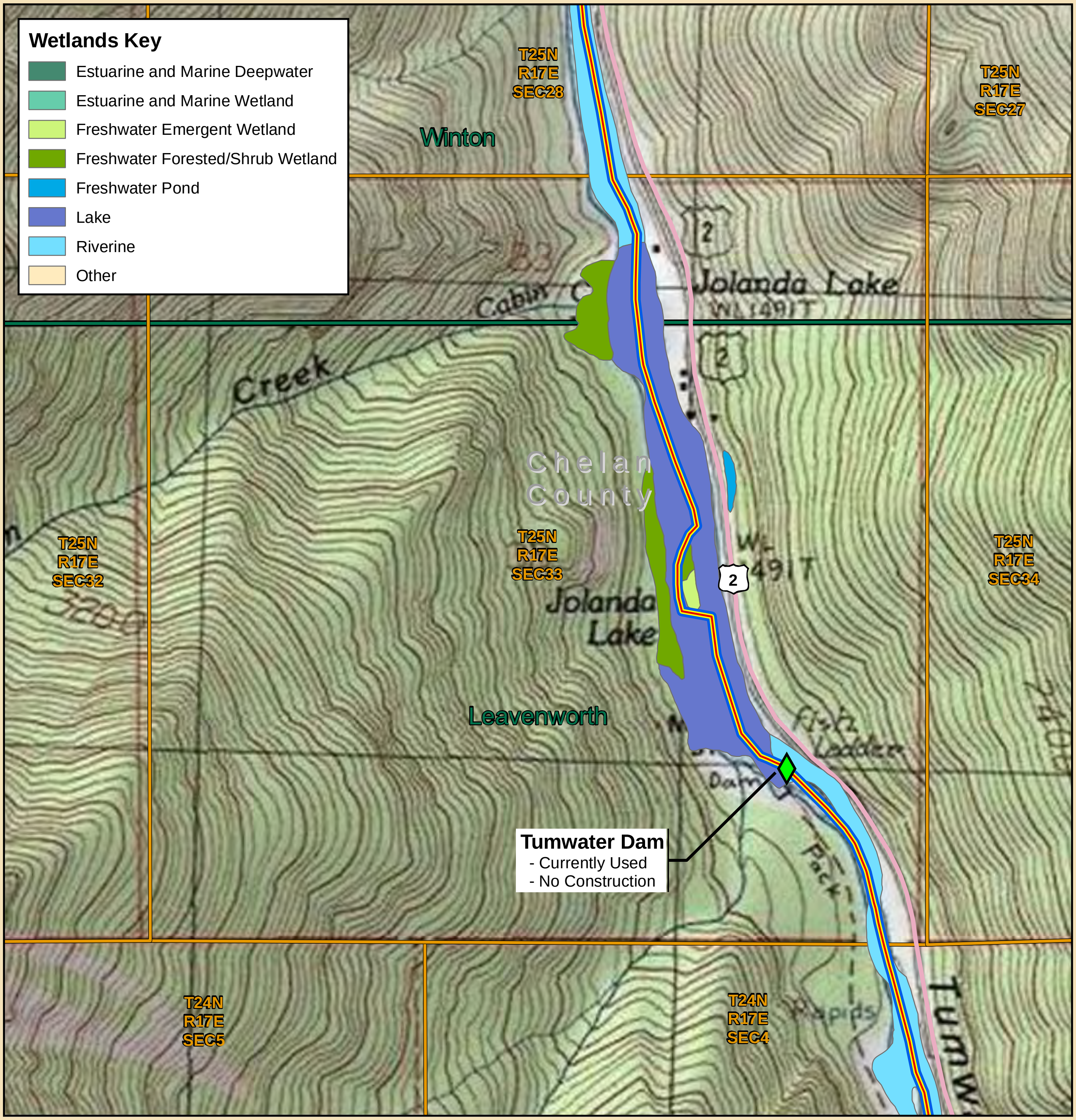

Figure 10af - Tumwater Dam

Leavenworth Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

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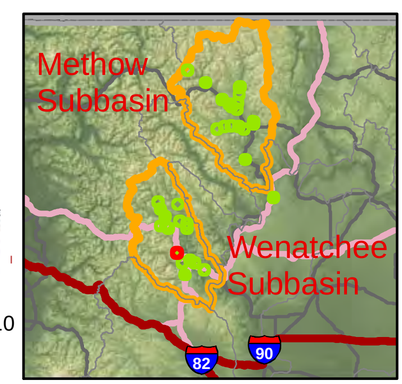
BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



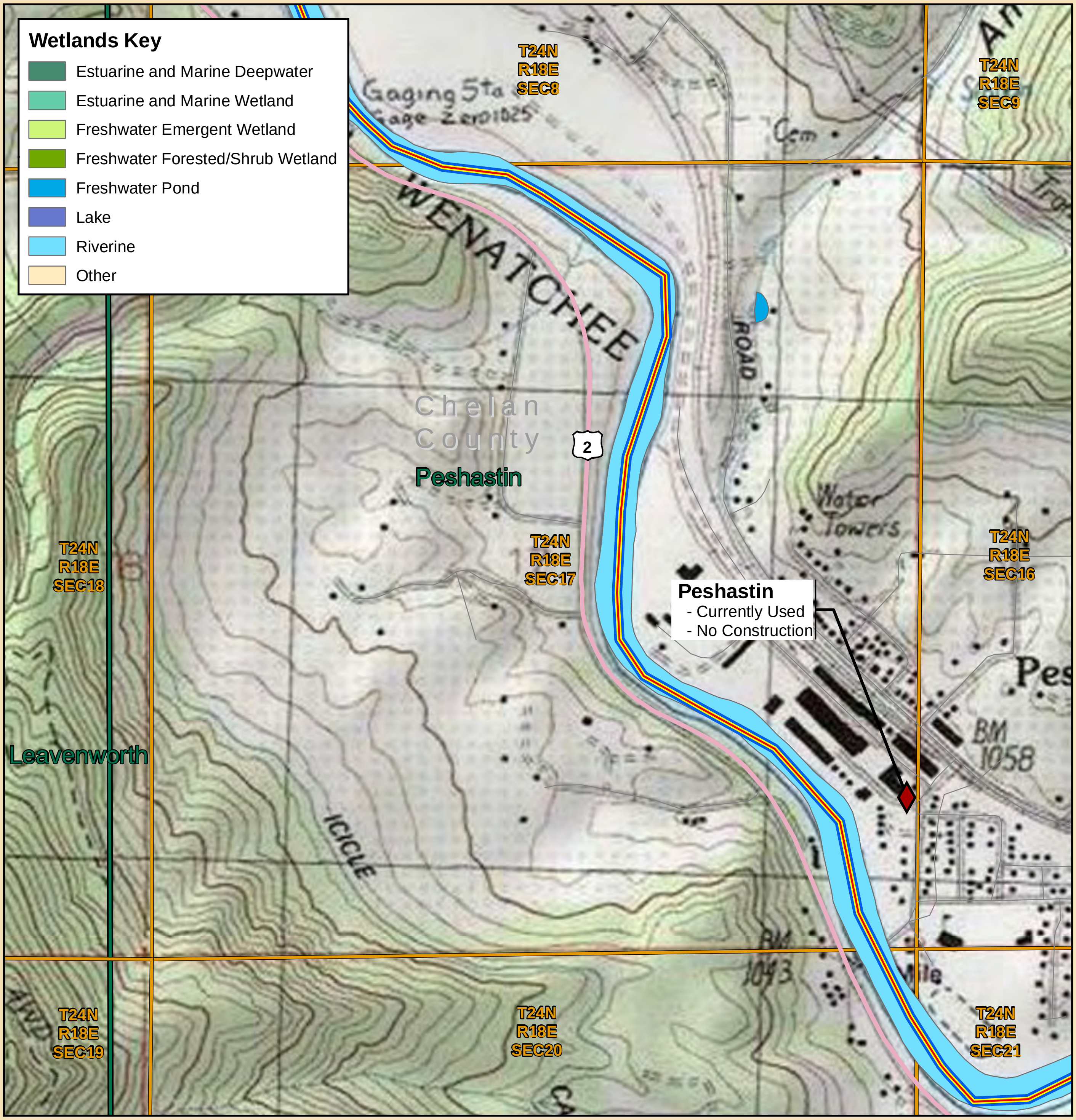


Figure 10ag - Peshastin

Peshastin Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

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BONNEVILLE

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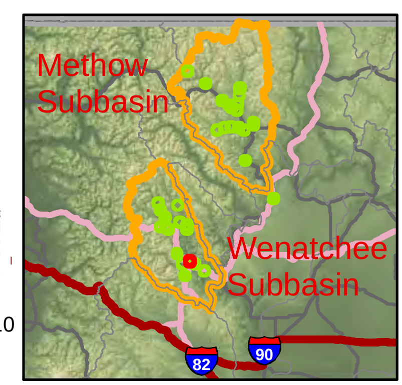
0 500 1,000 2,000 Feet



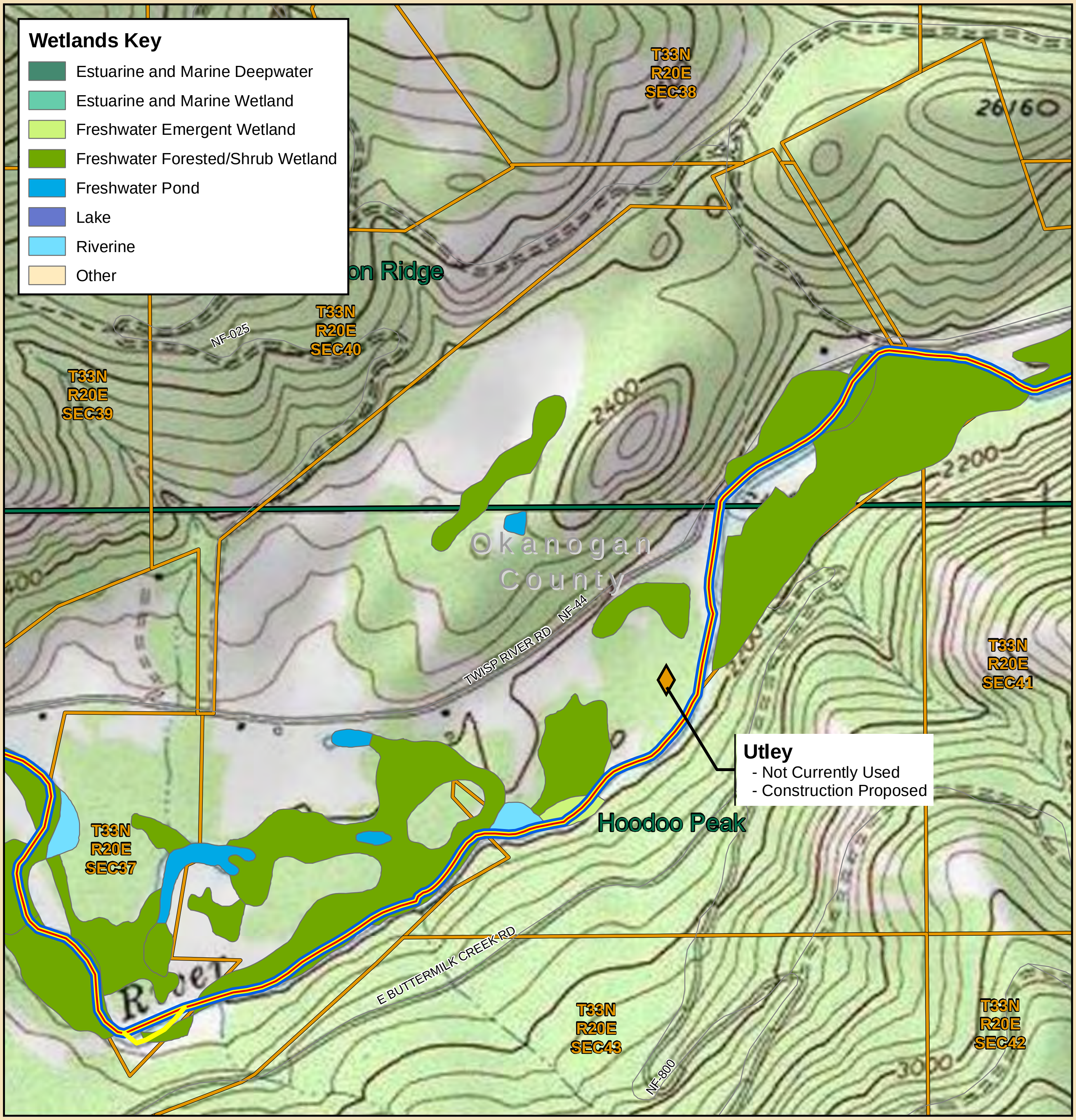


Figure 10ah - Utley

Hoodoo Peak Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

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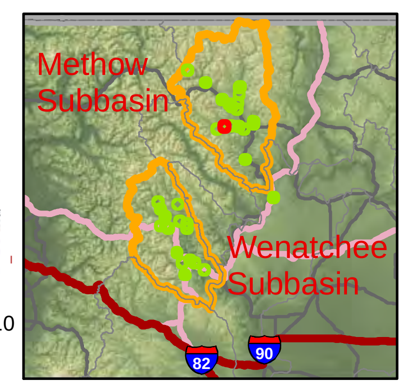
BONNEVILLE

November 1, 2010

0 500 1,000 2,000 Feet



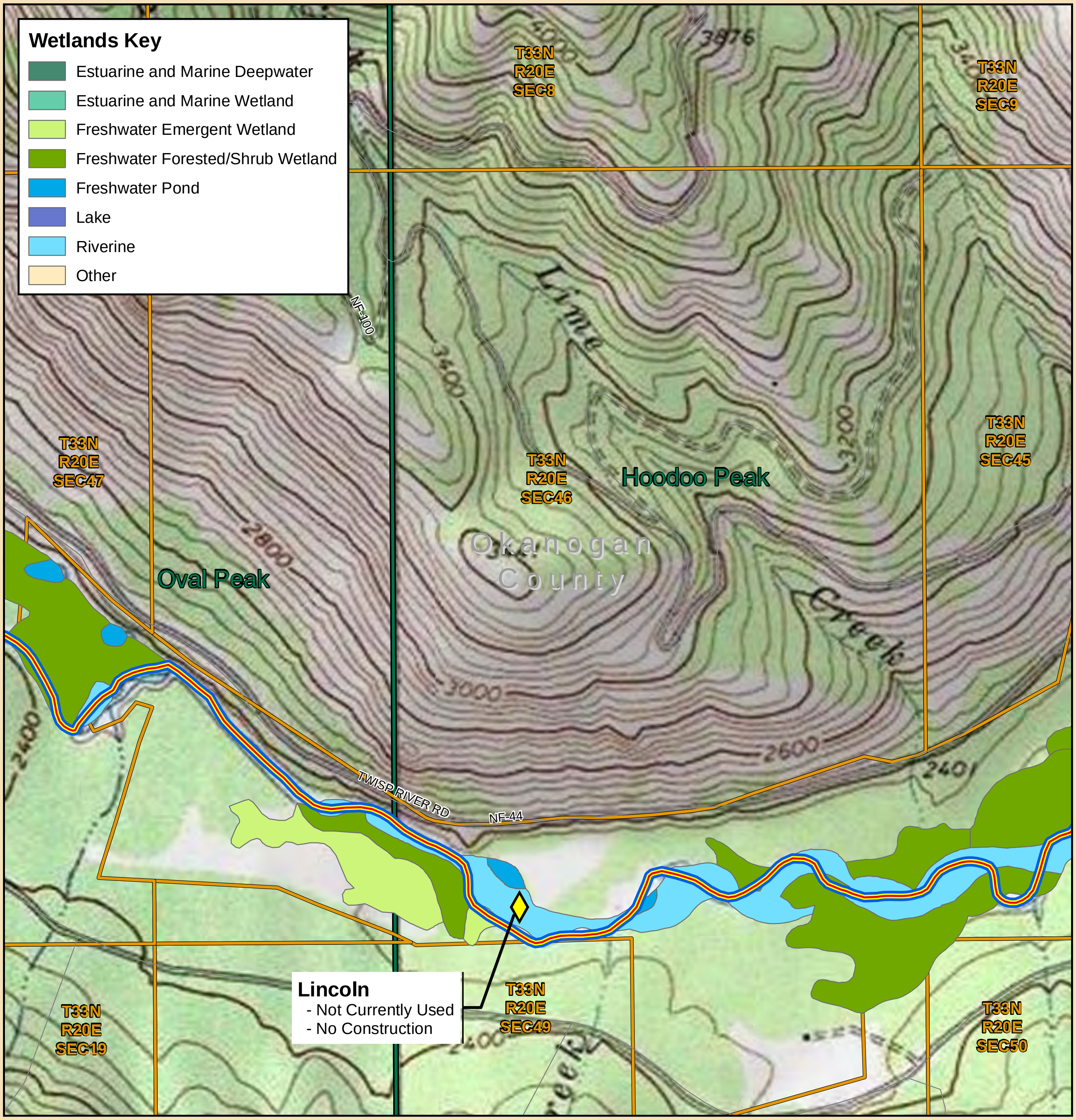


Figure 10ai - Lincoln

Hoodoo Peak Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

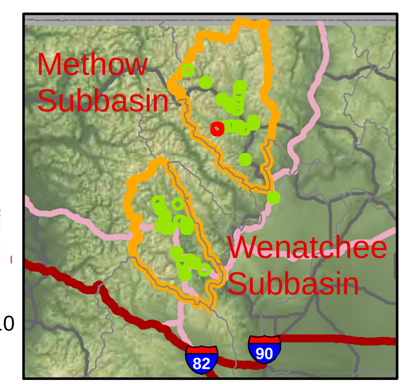
- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE POWER ADMINISTRATION

November 1, 2010

0 500 1,000 2,000 Feet



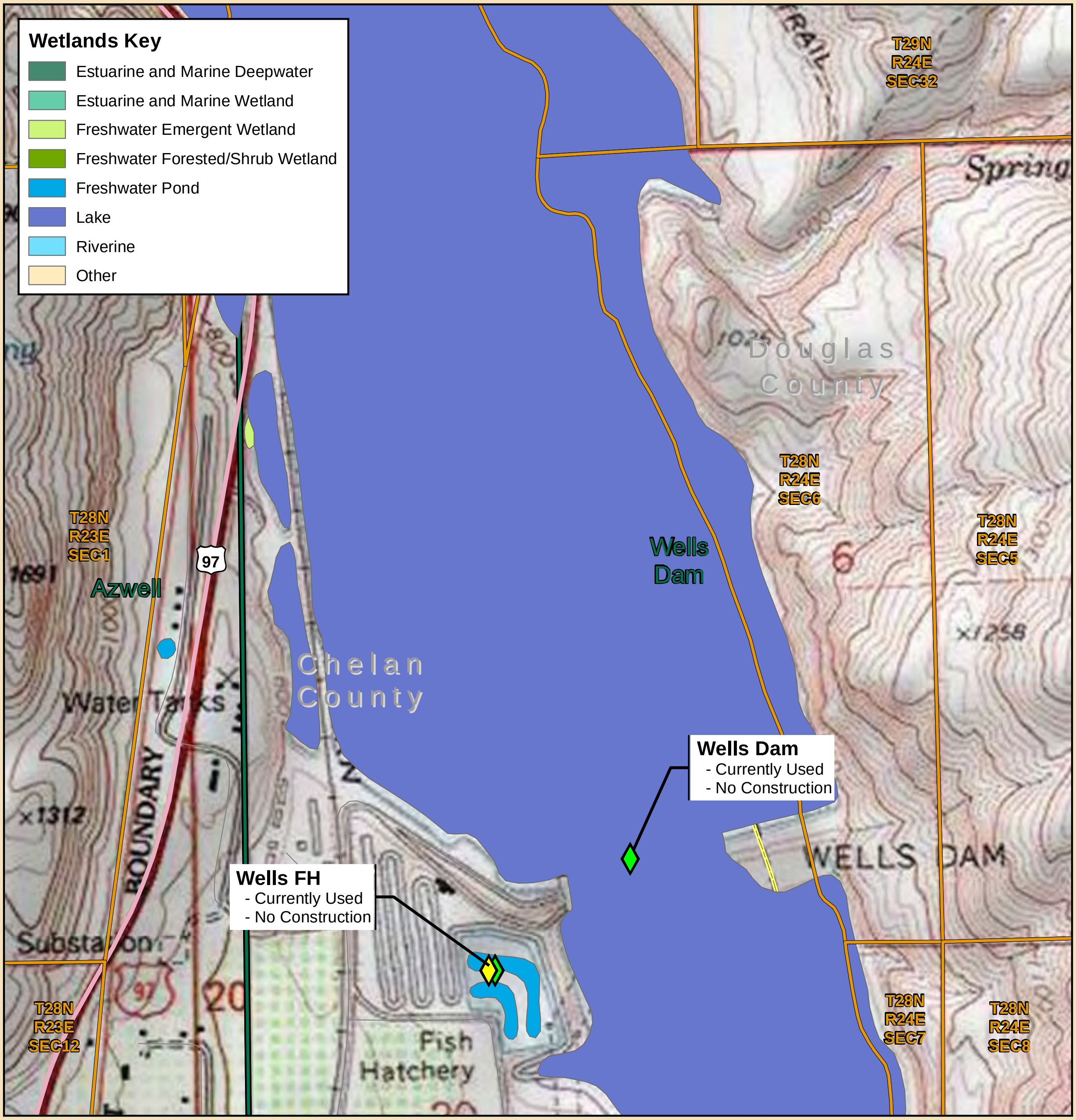


Figure 10aj - Wells Dam and Fish Hatchery

Wells Dam Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE POWER ADMINISTRATION

November 1, 2010

0 500 1,000 2,000 Feet

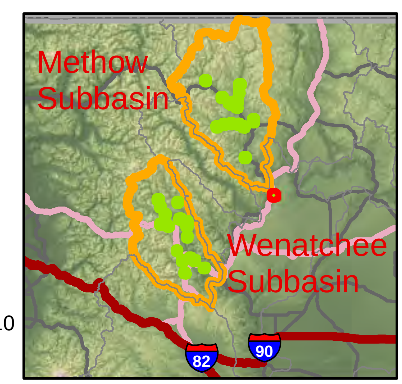


Figure 10ak - Two Rivers

Lake Wenatchee Quadrangle

Mid-Columbia Coho Restoration EIS - Proposed Action

- Primary Acclimation Site
- Backup Acclimation Site
- Broodstock Capture Site
- Primary Incubation and Rearings Site
- Alternative Incubation and Rearings Site

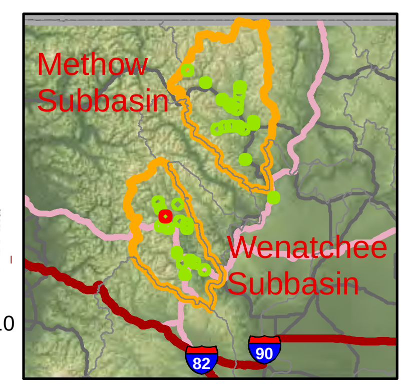
- Summer Steelhead
- Dolly Varden/Bull Trout
- Spring Chinook
- Township/Range/Section (PLSS)
- Quad Name and Boundary

N

BONNEVILLE POWER ADMINISTRATION

November 1, 2010

0 500 1,000 2,000 Feet



Appendix 5. Monitoring and Evaluation Program

Note: This section has been adapted from the Mid-Columbia Coho Restoration Master Plan (YN 2010). For further information and for a list of cited references, see the Master Plan.

Summary

Table 7-1 summarizes the M&E plan. References to activities for BDP1 are left in the table to show the monitoring that was done for that phase, which is now completed in both basins, and the continuity of program monitoring.

Table 5-1. Summary of M&E activities

M&E Activity	Indicator Measured	Strategy	Restoration Phases	Coordinated with other programs?
Release-to-McNary survival	Project Performance	PIT tags	BDP1, BDP2, NPIP, NPSP[1]	No
In-pond survival	Project Performance	PIT tags Predation control	BDP1, BDP2, NPIP, NPSP[1]	No
Pre-release fish condition	Project Performance	Physical examination	BDP1, BDP2, NPIP, NPSP	No
Volitional release run-timing and tributary residence	Project Performance / Species Interaction	PIT tags Smolt trapping	BDP1, BDP2, NPIP, NPSP[1]	Yes: Integrated Status & Effectiveness Monitoring Program (ISEMP) (BPA project #2003-017-00); CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
Spawning escapement and distribution	Project Performance	Redd counts Carcass recovery Radio-telemetry CWT	BDP1, BDP2, NPIP, NPSP	No
Natural smolt production	Project Performance	Smolt trapping CWT	BDP1, BDP2, NPIP, NPSP[2]	Yes: ISEMP; CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
Egg-to-emigrant survival	Project Performance	Smolt trapping Redd counts CWT	BDP1, BDP2, NPIP, NPSP[2]	Yes: ISEMP; CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
Adult-to-adult survival	Project Performance	Adult trapping Redd counts Carcass recovery CWT	BDP1, BDP2, NPIP, NPSP	No
Adult-to-adult productivity	Project Performance	Adult trapping Carcass recovery CWT Scale analysis	NPIP, NPS	No

[1] PIT tags will be used during NPSP if smolt-to-adult rates are not meeting program goals and further investigation into survival is warranted.

[2] Natural smolt production and egg-to-emigrant survival estimates will be specific to release tributaries during NPIP and NPSP, and basin-wide during BDP1 and BDP2.

Table 5-1 (continued)

M&E Activity	Indicator Measured	Strategy	Restoration Phases	Coordinated with other programs?
Harvest rates	Project Performance	CWT Scale analysis Database queries	BDP1, BDP2, NPIP, NPSP	Yes: Coordinated with harvest management agencies
NTTOC – Size structure	Species Interactions	Smolt trapping	BDP1, BDP2, NPIP, NPSP[3]	Yes: ISEMP; CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
NTTOC – Abundance and survival	Species Interactions / Status of NTTOC	Smolt trapping Underwater observation	BDP1, BDP2, NPIP, NPSP[3]	Yes: ISEMP; CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
NTTOC – Distribution	Species Interactions / Status of NTTOC	Redd counts Underwater observation	BDP1, BDP2, NPIP, NPSP[3]	Yes: ISEMP; CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
Competition	Species Interactions / Mechanisms of Interaction	Underwater observation Enclosures Size and growth	NPIP	No
Predation by naturally produced coho on spring Chinook fry	Species Interactions / Mechanisms of Interaction	Smolt trapping Emergence and emigration timing	NPIP	Yes: ISEMP; CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
Morphometrics and life history traits	Genetic Adaptability	Adult trapping Redd counts Carcass recovery Smolt trapping CWT	BDP1, BDP2, NPIP, NPSP	Yes: ISEMP; CCPUD/ DCPUD HCP Hatchery Programs; GCPUD Hatchery Programs
Genetic monitoring	Genetic Adaptability	Genetic sampling CWT	BDP1, BDP2, NPIP, NPSP	No
Reproductive Success	Genetic Adaptability	Genetic sampling	BDPII, NPIP, NPSP	No

[3] Baseline NTTOC monitoring during BDP1 and BDP2, effects monitoring during NPIP and NPSP.

M & E Plan Details

The goal of the M&E program is to monitor and evaluate the results of reintroduction so that operations can be adaptively managed to optimize hatchery and natural production while minimizing any negative ecological impacts. Pursuing this goal, research data collection and analysis endeavors to: 1) demonstrate when the reintroduction program is meeting the established phased restoration goals; 2) determine whether a change in status of sensitive species is occurring and whether it is a result of coho reintroduction; and 3) provide science-based recommendations for management consideration.

The M&E plan is organized into three distinct categories: Project Performance Indicators, Species Interactions, and Genetic Adaptability. Project performance indicators are intended to evaluate how well reintroduced hatchery fish and the resulting naturally produced fish are surviving and adapting, whether certain reintroduction or hatchery practices can be modified to improve benefits achieved, and whether harvest levels threaten project success. Monitoring of project performance indicators will allow for adaptive management and evaluation of project progress toward successful reintroduction. Species interaction evaluations include monitoring the status of non-target taxa of concern (NTTOC) and investigating mechanisms of interaction (i.e., predation and competition). The species interactions evaluations described in this plan expand on issues examined during the feasibility phase and are integrated with other species monitoring ongoing or proposed in the two basins. Monitoring of genetic adaptability to local conditions is designed to determine whether the project is successfully creating a local broodstock distinct from lower Columbia River stocks in terms of genetic divergence and life history traits; and to determine the biological significance of the changes.

M&E results and plan objectives will be reviewed and revised every six years (two generations) to allow for modification of actions and adaptive management. NTTOC monitoring will continue until program termination, 5 generations (15 years) after starting the natural production phases.

Note: We have left references to Broodstock Development Phase 1 in the text, even though BDP1 has been completed in both subbasins, to show the continuity of the M&E program throughout the project.

5.1 Project Performance Indicators

5.1.1 Release-to-McNary Smolt Survival

Objective: To estimate smolt-smolt survival (release to McNary Dam) for hatchery coho released in mid-Columbia tributaries.

***Metric**:* Smolt-to-smolt survival index (Neeley 2004)

$$\text{Smolt-to-Smolt Survival Index to McNary} = \frac{\sum_{\text{Strata}} \text{Estimated Number of tagged Fish passing McNary during stratum}}{\text{Number of Fish tagged or released}}$$

Rationale: Mullan et al. (1992) and Chapman et al. (1994a; 1994b; 1995a; 1995b) recognize that a central limitation to building self-sustaining populations of anadromous fish in Wenatchee and Methow subbasins is the high smolt and adult mortalities incurred at the numerous hydropower facilities on the mainstem Columbia River. Mortalities related to hydropower facilities can severely reduce the escapement numbers. Salmon abundance is also heavily influenced by ocean conditions. Freshwater conditions reflect variability within a broader spectrum of population abundance that is largely controlled by ocean conditions (Mullan et al. 1992; Nickelson 1986). Therefore, we feel it is important to monitor survival of hatchery juveniles in freshwater to help partition smolt-to-adult survival of hatchery reared program fish into the components of freshwater and marine mortality.

Smolt-to-smolt survival rates will be used to compare the "quality of smolt" produced by different rearing strategies, acclimation sites, acclimation duration, and time of release. Smolt-to-smolt survival indices will be used to evaluate rearing strategies and rearing facilities, to include current and proposed facilities, evaluations of growth rates, acclimation length, and smolt size. Knowing how rearing and environmental conditions affect smolt survival allows researchers to adaptively manage the reintroduction effort to maximize survival. Smolt-to smolt survival indices will be used to parse out that portion of mortality that is occurring during emigration.

Restoration Phases: BDP1, BDP2, NPIP. Smolt-to-smolt survival rates will be measured during the Support Phases if smolt-to-adult rates are not meeting program goals and further investigation into survival is warranted.

Methods: Groups of juvenile coho, ranging from 3,500 to 8,000 individuals, depending upon release location, will be PIT-tagged 3-6 months prior to release. PIT-tagged coho will be released from a minimum of one upper Wenatchee River acclimation site, LNFH, and Methow River site. PIT groups will also be released from ponds which have not previously been used for coho acclimation and from sites where smolt-to-adult survival rates are below expectations. All PIT tagging will follow protocols described in the PIT TAG Marking Procedures Manual (CBFWA 1999). When possible, volitional releases will be monitored for PIT tags. Survival estimates will be calculated based on subsequent PIT detections at McNary, John Day, and Bonneville Dams following methods described in Neeley 2007.

5.1.2 In-Pond Survival

Objective: To estimate in-pond (transport-to-release) survival of hatchery coho.

Metric: In-pond survival estimate based on PIT tag releases (Neeley 2007) or predator and mortality observations (Kamphaus and Murdoch 2008).

Rationale: In-pond survival estimates will increase the accuracy of smolt-to-adult and smolt-smolt survival estimates. In-pond survival estimates will be used to evaluate the success of acclimation ponds and predator control strategies, allowing researchers to maximize survival through adaptive management.

***Restoration Phases*:** All phases.

Method: Groups of approximately 3,500 to 8,000 juvenile coho will be PIT tagged 3-6 months prior to release (see **Section 7.1.1 Release-to McNary Smolt Survival**). In-pond survival estimates based on PIT tags are possible only in ponds with monitored releases. In-pond survival based on PIT tags will be calculated following methods described in Neeley 2007. In-pond survival rates from acclimation sites that do not have PIT tag detection capability will be estimated based on moribund fish, numbers of predators observed, and predator consumption rates (Kamphaus and Murdoch 2008).

5.1.3 Pre-Release Fish Condition

Objective: To provide a comparative measure of fish condition and stage of smoltification prior to release.

Metric: Stage of smoltification will be measured as the proportion of fish which, upon visual examination, appear to be smolts, transitional (in the process of becoming a smolt), or parr. Fish condition will be assessed not only on size and growth accrued during acclimation but also on morphological and physiological measures such as overall condition of fins and eyes; of internal organs (e.g., kidney, liver, spleen, etc.); and of mesenteric fat levels and blood components (% volume of red and white blood cells, plasma protein levels).

Rationale: Pre-release fish condition examinations are intended to assess the normality or overall health of the population. These examinations will allow researchers to compare fish condition between ponds and between years as a measure that may affect survival.

Restoration Phases: All phases.

Methods: A random sample of 100 fish from each acclimation pond will be used to measure stage of smoltification and growth weekly until release. The pre-release fish condition assessment will be done once within 72 hours of release. Detailed methods describing how stage of smoltification is determined and how pre-release fish condition examinations are conducted can be found in Kamphaus and Murdoch 2008.

5.1.4 Volitional Release Run-Timing and Tributary Residency

Objective: To describe volitional release patterns, peak migration from acclimation ponds, duration of time spent in tributaries post-release, and run timing to McNary Dam.

Metric: Run timing, in hours, calculated from PIT tag detections during monitored releases to recapture in tributary traps (i.e., smolt traps), in-stream PIT tag arrays, and Columbia River PIT detection facilities.

Rationale: Knowing tributary residence time will enable researchers to better understand the potential for interaction between hatchery coho and listed and sensitive species (see **Section 7.2 Species Interactions**). We will examine the relationship between volitional exit date and tributary residence time, allowing for programmatic changes to minimize potential negative interactions. The correlation between volitional exit date and smolt-smolt survival may also enable researchers to maximize survival of hatchery fish by releasing hatchery coho at an optimal time.

Run timing is a life history attribute which may change with the development of a local broodstock (see **Section 7.3.1 Morphometrics and Life History Traits**). As natural production increases during the NPIP and Support Phases, run timing will be measured for both naturally produced and hatchery coho based on the distribution of migrating naturally produced coho captured in tributary smolt traps.

Method: Using the same groups of 3,500 to 8,000 PIT-tagged juvenile coho as described in **Section 7.1.1 Release-to-McNary Smolt Survival**, tributary residence time will be calculated from ponds with PIT tag detection capabilities (e.g., Butcher Creek Pond, Rohlfing's Pond, Beaver Creek Pond Coulter Creek Pond, Winthrop NFH back-channel and Lower Twisp Ponds). Dates and times of reported recaptures in tributary traps and Columbia River PIT tag interrogation facilities will be used to calculate residence time and run timing.

5.1.5 Spawning Escapement and Distribution

***Objective*:** To estimate in-basin spawning escapement and distribution for both hatchery origin returns (HORs) and natural-origin returns (NORs).

Metric: Annual redd counts, escapement estimates and spawning ground composition.

***Purpose*:** Redd counts will provide an estimate of spawning escapement and distribution of reintroduced coho salmon. The counts, along with spawning composition (pNOS and pHOS) and distribution, will allow researchers and managers to determine the efficacy of the reintroduction effort, collect empirical productivity data and determine whether spawning ground composition goals for each phase are being met.

Hypotheses:

- Implementation Phase – H_o: pHOS ≤ 90%
- Support Phase (1) – H_o: pHOS ≤ 75%
- Support Phase (2) – H_o: pHOS ≤ 65%

Restoration Phases: All phases.

Method: Spawning escapement and distribution will be evaluated in terms of redd counts and an estimate of fish per redd (based on sex ratio observed at in-basin trapping facilities). Spawning ground surveys will be conducted in all tributaries where juvenile coho have been released and other tributaries that have coho spawning attributes such as low gradient, adequate winter flow and small gravel (about 25 mm) (Quinn 2005). Radio-telemetry or PIT tagging techniques could be used, particularly during the natural production phases, to identify previously unknown coho spawning locations, to ensure that all spawning reaches are surveyed, and to identify spawning locations of straying coho. A description of protocols for both spawning ground surveys and radio telemetry can be found in Murdoch et al. 2005.

5.1.6 Natural Smolt Production

Objective: To provide a population estimate of naturally produced coho smolts emigrating from the Wenatchee and Methow rivers.

Metric: Population estimates of both spring and fall emigrating coho with 95% confidence intervals.

Rationale: Natural smolt production estimates are a measure of productivity. Smolt production estimates will be used to evaluate program progress and success in terms of egg-to-emigrant survival rates and smolt-to-adult survival rates. Natural smolt population estimates during all phases are essential to accurately measure key project performance indicators, such as smolt-to-adult survival rates.

While the broodstock development phases primarily focus on the development of a local broodstock rather than on natural production, some natural production will occur during these early phases, likely in a geographically limited area. Fish trapping facilities at Dryden Dam are not 100% efficient, presumably resulting in some natural production on a limited geographical scale. It is important to collect data regarding natural production during the broodstock development phases because early measures of productivity (e.g., smolts per spawner, egg-to-emigrant survival, etc.) on a basin-wide scale will provide a rough baseline measure of the success of natural spawners prior to the natural production phases.

Restoration Phases: All Phases.

Methods: Operation of rotary smolt traps, protocols for fish handling, and data analysis will proceed as described in Murdoch et al. (2005) and Hillman (2004). Traps will be operated annually between March 1 and November 30.

Broodstock Development Phases: During broodstock development phases we will coordinate with ongoing monitoring activities to reduce duplication of activities.

Currently in the Wenatchee basin, WDFW operates a rotary smolt trap near the town of Monitor. Through a cooperative effort, this trap will be used to provide population estimates for naturally produced coho as it was during the feasibility phase. The YN-operated smolt trap in Nason Creek will provide a tributary-specific population estimate. Similar coordination with WDFW in the Methow basin should provide a basin-wide coho population estimate for the Methow.

Natural Production Phases: All monitoring efforts, including population estimates during the natural production phases, will be coordinated with other co-managers and recovery processes to avoid unnecessary duplication of efforts and cumulative handling effects. In tributaries currently without means of estimating smolt production, the YN proposes to operate either a rotary smolt trap or other sampling equipment during the spring and fall emigration periods to estimate the number of natural coho emigrants.

5.1.7 Egg-to-Emigrant Survival Rates

Objective: To estimate egg-to-emigrant survival rates for naturally produced coho salmon in mid-Columbia tributaries.

Metric: Egg-to-Emigrant Survival (S) will be expressed as the ratio of the estimated number of emigrant coho (C_e) and the estimated number of eggs deposited (E_d).

$$S = C_e/E_d$$

Rationale: The egg-to-emigrant survival rate will provide data to determine which tributaries are most productive for coho production. The relationship between egg-to-emigrant survival and seeding level will assist researchers in developing tributary-specific empirically derived estimates of carrying capacity.

We assume that the freshwater productivity (expressed as an egg-to-emigrant survival rate) will increase as domestication selection is reduced, local adaptation is emphasized and habitat improvement projects are implemented.

Hypothesis:

- H_o: Egg-to-Emigrant Survival $_{\text{Broodstock Development Phases}}$ ≥ Egg-to-Emigrant Survival $_{\text{Implementation Phase}}$ ≥ Egg-to-Emigrant Survival $_{\text{Support Phase}}$

Restoration Phases: Egg-to-emigrant survival rates will be calculated on a basin-wide scale during the broodstock development phases (i.e., total number of redds vs. total number of emigrants). During the natural production phases we will calculate egg-to-emigrant survival independently in each tributary of reintroduction.

Methods: The number of emigrant coho will be estimated from tributary trap data as described in **Section 7.1.6 Natural Smolt Production**. The number of eggs deposited will be calculated from the number of redds observed (see **Section 7.1.5 Spawning Escapement and Distribution**). Both basin-wide and tributary specific estimates will be calculated.

5.1.8 Smolt-to-Adult Survival (SAR)

Objective: To measure smolt-to-adult survival for hatchery and natural origin coho.

Metric: Smolt-to-adult survival will be calculated as follows:

$$S_{\text{smolt-adult}} = \text{Adults and Jacks}_{\textbf{broodyear X}} / \text{Smolts}_{\textbf{broodyear X}}$$

Where $S_{smolt\text{-}adult}$ is the estimated smolt-to-adult survival rates; Adults and Jacks $_{\textbf{broodyear } X}$ is the number of adult coho to return from broodyear *X* ; Smolts $_{\textbf{broodyear } X}$ is the population of emigrating smolts.

Rationale: For hatchery fish, smolt-to-adult survival will be used to test the premise that SARs will increase with the development of a local broodstock. SARs will also be used to compare the "quality of smolt" produced by different rearing strategies, acclimation sites, acclimation duration, and time of release. Knowing how smolt-to-adult survival indices correlate with rearing and environmental conditions will allow researchers to adaptively manage the reintroduction effort to maximize survival. The SARs will be used to evaluate rearing strategies and rearing facilities to maximize survival. Evaluations will include facility comparisons (currently ongoing), comparisons of growth rates, smolt size, and acclimation length (currently ongoing).

We assume that the survival of Wenatchee and Methow coho will increase as domestication selection is reduced, local adaptation is emphasized and habitat improvement projects are implemented.

Hypothesis:

- H_o: Smolt-to-Adult Survival $_{\text{Broodstock Development Phases}}$ ≥ Smolt-to-Adult Survival $_{\text{Implementation Phase}}$ ≥ Smolt-to-Adult Survival $_{\text{Support Phases}}$

Methods: SARs will be calculated for both naturally and hatchery produced coho. We plan to mark 100% of the hatchery fish released under this program with CWTs. CWTs will be used to calculate SARs from each release group and location, and will be used to distinguish hatchery from natural fish (no CWT). Pre-release CWT retentions will be used to estimate the number of fish with CWTs released. To verify origin, scale samples will be taken from all adult coho that do not have a CWT. During the broodstock development phases, SARs for hatchery and naturally produced coho will be calculated based upon the number of smolts released (hatchery), smolt emigration estimates from WDFW's Methow and Wenatchee river smolt traps, and CWTs recovered from hatchery and naturally produced coho collected at Dryden Dam for broodstock. During the natural production phases, tributary-specific SARs may be based on carcass recovery and tributary population estimates, in addition to the basin-wide metric described above.

5.1.9 Adult-to-Adult Productivity

Metric: Adult productivity will be measured in the Wenatchee and Methow broodstock collection facilities and on the spawning grounds (through carcass recovery) for naturally spawning fish. Adult-to-adult survival will be calculated as follows:

$$P_{adult} = S_2/S_1$$

Where P_{adult} is the estimated adult-to-adult survival; S_2 is the number of returning adults (including jacks); and S_1 is the number of adults from the parent brood year producing the S_2 returning adults. A P_{adult} value that averages greater than 1.0 over several generations indicates that the population is increasing.

Rationale: The adult-to-adult survival rate measures the productivity of reintroduced coho, providing an overall indicator of project success. During the NPIP, P_{adult} may indicate which tributaries are the most productive.

We assume that the productivity of Wenatchee and Methow river coho salmon will increase as domestication selection is reduced, local adaptation is emphasized and habitat improvement projects are implemented.

Hypothesis:

- H_o: $P_{\text{Broodstock Development Phases}} \geq P_{\text{Implementation Phase}} \geq P_{\text{Support Phases}}$

Restoration Phases: Natural Production Phases

Methods: Coho collected for broodstock and naturally spawning coho carcasses will be interrogated for the presence of CWTs. Scales will be taken from coho that are not marked with a CWT to confirm origin. These data will be used in calculations described under ***Metric***.

5.1.10 Harvest Rates

Objective: Estimate out-of-basin harvest rates of program fish in order to determine if harvest rates are likely to limit project success.

Rationale: Harvest may have been a significant factor in the disappearance or reduced number of coho in both the distant and recent past. Currently, the majority of coho in the Columbia River are produced and released below Bonneville Dam. The historical intent of this production was to supply coho for the 80-90% exploitation rate by ocean and lower Columbia River fisheries. However, since the period 1988-1993, harvest rates of coho (commercial ocean troll and recreational) have decreased by approximately 25% (PFMC 1999). Harvest reductions were the result of mixed stock fishery issues related to the Endangered Species Act. Coho released under this project are subject to the following fisheries: ocean commercial troll fisheries, ocean recreation fisheries, Buoy 10 recreational fisheries, lower Columbia River commercial fisheries, lower Columbia River recreational fisheries, Zone 6 (Bonneville to McNary dams) Treaty Indian commercial fisheries, and above-Bonneville Dam recreational fisheries. All recreational fisheries and the ocean commercial troll fisheries are selective for adipose-fin-clipped fish. Harvest mortality for project fish in these fisheries will primarily be limited to incidental mortality, so we have no ability to recover CWTs from these fisheries. The Columbia River commercial coho fisheries (Buoy 10 to Bonneville Dam) do intercept both adipose-clipped and non-clipped fish. All coho captured in this fishery are examined for the presence of a CWT, with an approximate sampling rate of 20%. Presently, harvest monitoring of Treaty Indian fisheries does not include recovery of CWT. Although the total harvest rate on adipose-clipped fish could be as high as 50-60%, the total harvest rate on non-adipose-fin-clipped fish is substantially lower (20-25%) due to the selective fisheries that are likely to remain in place for many years as a result of ESA constraints.

Restoration Phases: All phases.

Methods: We will coordinate with agencies responsible for harvest management (WDFW, ODFW, USFWS, CRITFC, etc.) to estimate the harvest rates of target stocks by querying existing databases that may contain harvest or stray information for program fish.

5.2 Species Interactions

During the feasibility phase, the YN completed several studies to evaluate predation and competition by hatchery coho with listed and sensitive species (Dunnigan 1999; Murdoch and

Dunnigan 2002; Murdoch and LaRue 2002; Murdoch et al. 2004; Murdoch et al. 2005). Results of these studies indicate low predation rates and species-specific habitat segregation (see **Chapter 3**). Stream dwelling salmonids that have evolved in sympatry have developed mechanisms to promote coexistence and to partition the available habitat. Studies with coho salmon and steelhead trout (Hartman 1965; Johnson 1967; Fraser 1969; Allee 1974), Chinook salmon and steelhead trout (Everest and Chapman 1972), Chinook salmon and coho salmon (Lister and Genoe 1970; Stein et al. 1972; Murphy et al. 1989), coho salmon and cutthroat trout (Bjornn 1971; Bustard and Narver 1975; Sabo and Pauley 1997) and coho salmon and dolly varden (Dolloff and Reeves 1990) all support this statement.

Mechanisms to measure negative interactions between hatchery fish and other species have been studied by others (Larkin 1956; Fraser 1969; Stein et al. 1972; Glova 1986; Marnell 1986; Cannamela 1993; Riley et al. 2004), but impacts to non-target species in terms of abundance, distribution and size have not been conclusively measured (Fresh 1997, Pearsons et al. 2004) on a basin-wide scale. Interactions between reintroduced coho and listed and sensitive species will be evaluated through an integrated NTTOC monitoring program. A basin-wide NTTOC monitoring program has been implemented in the Yakima River (Busak et al. 1997, Hubble et al. 2004; Pearsons et al. 2004).

NTTOC status monitoring (**Section 7.2.1**) answers the question "Are there adverse changes in the status of NTTOC in tributaries where coho have been introduced?" NTTOC status monitoring does not answer questions of whether coho caused the changes in NTTOC status or the mechanism of change (e.g., predation, competition, etc.). The studies outlined in **Section 7.2.2** address those causal questions.

Species interaction monitoring will continue for a minimum of six years (two coho generations) during the Support Phases, but may continue longer pending results.

5.2.1 Status of Non-Target Taxa of Concern (NTTOC)

During the feasibility phase of the Mid-Columbia Coho Reintroduction Program, the HGMP (YN et al. 2002) and the mid-Columbia Coho Technical Workgroup (TWG) identified a number of critical uncertainties associated with coho reintroduction and species interactions. Studies implemented during the feasibility phase (see Chapter 3) answer many of those uncertainties, including the rates of predation by hatchery coho on spring Chinook fry and on sockeye fry. One main question remains unanswered, that of the predation rate of naturally produced coho on spring Chinook fry. As stated in Chapter 3, numbers of naturally producing coho were not sufficient to undertake a meaningful study (Murdoch et al. 2005). The study described in **Section 7.2.2.2** proposes to address this remaining question.

With most of the critical uncertainties answered, the proposed NTTOC monitoring plan is designed to integrate the coho reintroduction effort with other ongoing programs to monitor the status of listed and sensitive species. The non-target taxa monitoring program will focus on the status and freshwater residence of spring Chinook and steelhead, but data on all other species encountered, such as bull trout, cutthroat trout, lamprey and sockeye, will also be collected.

We define status as the interaction of abundance, distribution, and size. A change in status is the deviation from baseline conditions. **A change in status does not indicate causation, but if coho reintroduction has a negative impact on listed and sensitive species, decline in status**

would occur. If a decline in status is detected, further investigations into the mechanism of interaction and source of decline are warranted (see **Section 7.2.2**).

To provide baseline data for evaluating effects of coho reintroduction, monitoring will begin during the broodstock development phases when the hatchery coho are released on a geographically limited scale and numbers of naturally spawning coho in tributaries containing spring Chinook and steelhead will be minimal. Baseline monitoring will be done in most tributaries proposed for future coho releases during the natural production phases. Monitoring of changes in tributaries with no previous coho release will occur during the Implementation Phase. The study design will include both a temporal and spatial control. Baseline data collected prior to coho reintroduction will function as a temporal control from which to compare any change in NTTOC status.

The NTTOC monitoring plan builds on, and will be coordinated with, ongoing monitoring efforts in the Wenatchee, Entiat and Methow basins, thus avoiding duplication of efforts and minimizing cumulative handling effects and costs. Existing programs currently collecting data that may be used to help determine a change in status for NTTOC include the Chelan and Douglas County PUD HCP hatchery compensation monitoring and evaluation programs, the developing Grant County PUD hatchery monitoring and evaluation program, and the Integrated Status and Effectiveness monitoring program (ISEMP) (BPA project # 200301700).

This NTTOC monitoring program is designed to provide data to measure the effects of both Type I and Type II interactions. Type I interactions are those that occur between hatchery fish and wild fish, while Type II interaction may occur between NTTOC and the naturally produced offspring of hatchery fish (Pearsons and Hopley 1999).

5.2.1.1 NTTOC Risk Assessment

As one part of the Monitoring and Evaluation Plan for HCP Hatchery Compensation programs (Murdoch and Peven 2005; DCPUD 2005) and the Monitoring and Evaluation Plan for Grant PUD Salmon and Steelhead Supplementation programs (GCPUD 2009), coho salmon will be included in a NTTOC risk assessment. An expert panel will conduct the assessment to evaluate risks associated with potential effects of supplemented Plan Species (including coho salmon) on non-target taxa using an approach similar to that used in the Yakima Basin (Ham and Pearsons 2001). The process is intended to focus on assessing the risks to NTTOC and on identifying interactions, the actions that could be taken to minimize risks, and the level of uncertainty. Both positive and negative species interactions are included in the assessment; a list of interactions and species considered is shown in Table 7-1. The list of species was decided upon by consensus of the Chelan and Douglas County PUD HCP Hatchery Committees.

Table 7-1. List of species and interactions to be considered in the NTTOC risk assessment

NTTOC	Negative Interactions Considered	Positive Interactions Considered
Spring Chinook Steelhead Sockeye	Competition Behavioral anomalies Pathogenic Predation	Prey Nutrient Enhancement

5.2.1.2 Reference Stream Comparisons

For a spatial control, we propose to use the Entiat River as a reference population of Chinook and steelhead from which any observed changes in abundance (as measured through egg-to-emigrant survival rates), distribution, or size can be gauged.

The Entiat River has been proposed by the resource managers (NOAA, WDFW, YN, USFWS, Colville Tribe), Chelan PUD and Douglas PUD as a potential reference stream for both spring Chinook and steelhead, to measure the success of the PUDs' HCP hatchery programs (Murdoch and Peven 2005). As such, analysis to determine the ultimate suitability of the Entiat River as a reference stream for spring Chinook and steelhead, along with the data required to compare changes in size, abundance and distribution would be collected by the HCP monitoring activities funded by CCPUD and DCPUD hatchery compensation programs (Murdoch and Peven 2005). Reference stream suitability criteria have been adapted from the Chelan and Douglas HCP hatchery compensation program M&E plan (Murdoch and Peven 2005) and include the following:

- No recent (within the last 5-10 years) hatchery releases directed at target species
- Similar information of hatchery contribution on the spawning grounds
- Similar fluvial-geomorphologic characteristics
- Similar out-of-subbasin effects
- Similar historic records of productivity
- Appropriate scale for comparison
- Similar in-basin biological components, based upon analysis of empirical information.

The USFWS generates population estimates of juvenile salmonids through rotary trap operation, uses underwater observation techniques to estimate juvenile rearing distribution, and conducts spawning ground surveys for spring Chinook, summer Chinook, and steelhead in the basin. The use of the Entiat River as a potential reference stream for steelhead and spring Chinook precludes the release of these species in the Entiat basin, making the Entiat River similarly a reference stream to gauge potential NTTOC interactions as a result of coho reintroduction in the Wenatchee and Methow.

The continued status of the Entiat River as a reference from which to gauge changes in the status of NTTOC in the Wenatchee and Entiat rivers is currently unknown. Spring Chinook spawning habitat is upstream of the ENFH, and the USFWS rotary smolt trap used to calculate population abundance is located near the facility. A portion of the steelhead production and likely all bull trout production also are upstream of the ENFH.

Use of the Entiat River as a reference stream may also be complicated due to the intensive habitat restoration that is currently ongoing and planned. The ISEMP is testing the effectiveness of habitat restoration actions in the Entiat River. The ISEMP is supporting an accelerated schedule for the implementation of 75-80 in-stream habitat actions defined in Entiat Watershed Plan (CCCD 2004) within a short time frame (goal of 5 years). In relation to the size of the Entiat basin, this is a substantially faster rate of habitat improvement than will take place in the Wenatchee or Methow basins, potentially resulting in a population increase that could preclude the use of the Entiat River as a reference stream.

If it is later determined that the Entiat River is not suitable as a spatial reference, we may need to rely solely on the temporal control to gauge changes in NTTOC status.

5.2.1.3 Status of NTTOC

We define a change in status of NTTOC as a change in size, abundance, or distribution. The following sections describe how we plan to monitoring any change in status of NTTOC as we proceed with coho restoration in the Wenatchee and Methow basins.

The Integrated Status and Effectiveness Monitoring Program (ISEMP), BPA project #2003-017-00, is a statistically robust intensive monitoring framework that builds on current status and trend monitoring infrastructures in the upper Columbia. The intent of the ISEMP project is to efficiently collect data to address multiple management objectives over a broad range of scales, including evaluating the status and trends for anadromous salmonids in their habitat. Since 2004, ISEMP in the Wenatchee and Entiat basins has focused on the design and implementation of a sampling regime and status and trend monitoring program with 67 monitoring indicators (Hillman 2004). This monitoring project targets salmon and steelhead populations and habitat and is implemented in collaboration with the Upper Columbia Regional Technical Team.

Data collected in this intense Status, Trend, and Effectiveness monitoring program will give statistically robust status updates for spring Chinook and steelhead on 5-year intervals. By coordinating with the ISEMP program, we minimize a duplication of sampling effort.

Size Structure

Objective: To monitor size (growth and K-factor) of NTTOC and juvenile coho in all tributaries proposed for coho reintroduction.

***Rationale*:** The size, condition, and growth of NTTOC and juvenile coho, combined with abundance and distribution data, will be used to evaluate the effect, if any, of coho reintroduction. Baseline monitoring during the broodstock development phases will establish trends in size, abundance and distribution of NTTOC prior to the natural production phases. Baseline monitoring in all tributaries with proposed coho releases will provide a temporal control in which to evaluate any changes in NTTOC size.

Hypotheses:

- H_o: NTTOC Size $_{\text{before reintroduction}}$ < NTTOC Size $_{\text{after reintroduction}}$
- H_o: NTTOC Size $_{\text{treatment stream}}$ < NTTOC Size $_{\text{reference stream}}$

***Restoration Phases*:** Baseline monitoring during broodstock development phases; change monitoring during the natural production phases.

Methods: The importance of monitoring size and growth of NTTOC in both the treatment and reference streams prior to reintroduction of coho is emphasized. Because seeding levels and intra-specific competition can influence the size structure of each population, a careful analysis of the relationship between seeding levels, survival, and growth should be established in each tributary (treatment and reference) in order to gauge the change.

We will collect size and condition factor information from the various smolt traps operating within the Wenatchee, Entiat and Methow basins (Nason Creek, Chiwawa River, White River, Upper Wenatchee River, Entiat River, Twisp River and Methow

River). Currently the Nason Creek smolt trap is operated by the YN as a cost-sharing effort between two BPA projects (Project # 1996-040-00 and #2003-017-00) and Grant County PUD. The White River smolt trap is operated by the YN and funded by Grant County PUD. The Chiwawa River trap is operated by WDFW. In the Methow basin, the Twisp and Methow rivers traps are both operated by WDFW. The USFWS operates two rotary smolt traps in the Entiat River (reference populations). Additional baseline and post-reintroduction data will be provided through the ISEMP status and trend monitoring program.

Abundance and Survival

Objective: To measure the abundance and corresponding survival rates for NTTOC in target tributaries.

Rationale: See **Size Structure** above. Abundance of NTTOC, in-terms of population size and survival rates (egg-to-emigrant survival), will be used to evaluate the effect, if any, of coho reintroduction. Baseline monitoring during the broodstock development phases will establish trends in abundance and survival prior to the natural production phases. Abundance and survival monitoring for spring Chinook and steelhead in Nason Creek, Chiwawa River, White River, Wenatchee River, Twisp River, Methow River, and Entiat River are currently on-going or proposed under other programs. We propose to continue this monitoring as baseline and effect monitoring throughout the broodstock development and natural production phases.

Baseline monitoring in all tributaries with proposed coho releases will provide a temporal control. Inclusion of the Entiat River in the monitoring plan will allow for a spatial control or reference stream.

Hypotheses:

- H_o: NTTOC Egg-to-Emigrant Survival $_{\text{before reintroduction}}$ < Egg-to-Emigrant Survival $_{\text{after reintroduction}}$
- H_o: NTTOC Egg-to-Emigrant Survival $_{\text{treatment stream}}$ < NTTOC Egg-to-Emigrant Survival $_{\text{reference stream}}$

Methods: It is important to monitor NTTOC abundance in terms of egg-to-emigrant survival in both the treatment and reference streams before reintroduction of coho. Currently, such monitoring is ongoing in Nason Creek, Chiwawa River, White River, Peshastin Creek, Twisp River, Methow River, and Entiat River. Because seeding levels and intra-specific competition directly influence the egg-to-emigrant survival rate (stock-recruitment curve) of each population, a careful analysis of the relationship between seeding levels, survival, and growth should be established in each tributary (treatment and reference) in order to gauge the change.

Current on-going smolt trapping programs in Nason Creek, Chiwawa River, White River, Wenatchee River, Twisp River, Chewuch River, Methow River and Entiat River will form the basis for the NTTOC abundance and survival estimates. Similar traps on the Little Wenatchee may be proposed for coho natural production monitoring during the natural production phases and will also be used to collect abundance and survival data for the NTTOC monitoring program.

In addition, ISEMP has implemented a PIT tagging program for natural origin juvenile spring Chinook and steelhead in the Wenatchee and Entiat basins. All Chinook and steelhead longer than 60 mm captured at all smolt traps are currently being PIT tagged. Parr rearing in the tributaries captured either by seine nets, electro-fishing, or hook and line are also being PIT tagged. This intensive tagging effort is expected to provide life-stage-specific survival rates for spring Chinook and steelhead rearing in tributary streams over time.

Smolt trap operation for emigrant population analysis will proceed as described in Hillman (2004) and Prevatte and Murdoch (2004). We will follow protocols for underwater observation as described in Thurow (1994) and for electro-fishing in Temple and Pearsons (2004). The same index sites will be monitored annually. Any correlation between egg-seeding level, indexed rearing density, egg-to-emigrant survival, and emigrant population estimates will be analyzed using multiple regression techniques (Zar 1999).

In order to avoid duplication of efforts, NTT abundance and survival monitoring will be closely coordinated with ongoing monitoring and evaluation programs in the Wenatchee and Methow basins, including but not limited to BPA project #2003-017-000 (ISEMP) and M&E activities funded by the mid-Columbia PUDs.

Restoration Phases: Baseline monitoring will proceed as described above during the broodstock development phases in all tributaries proposed for future coho releases. Monitoring of changes will be done during the natural production phases. Any change in NTTOC status during this monitoring will be closely evaluated in subsequent studies such as those described Section 7.2.2, to determine if the coho reintroduction efforts are causing the observed change or if other factors may be involved.

Distribution of NTTOC

Objective: To evaluate the status of NTTOC in terms of their distribution throughout each basin.

Rationale: Data on the distribution of NTTOC and juvenile coho, in combination with abundance and size data, will enable researchers to evaluate changes in NTTOC status during the coho reintroduction process.

Baseline monitoring in all tributaries with proposed coho releases will provide a temporal control. Inclusion of the Entiat River in the monitoring plan will allow for a spatial control or reference stream.

Hypotheses:

- H_o: NTTOC Distribution $_{\text{before reintroduction}}$ < NTTOC Distribution $_{\text{after reintroduction}}$
- H_o: NTTOC Distribution $_{\text{treatment stream}}$ < NTTOC Distribution $_{\text{reference stream}}$

Restoration Phases: Same as for size and abundance monitoring.

Methods: It is important to monitor NTTOC spawning and rearing distribution in both the treatment and reference streams before reintroduction of coho. Currently NTTOC monitoring is ongoing in Nason Creek, Chiwawa River, White River, Peshastin Creek, Twisp River, Methow River, and Entiat River. A careful analysis of the relationship between seeding levels, survival, and distribution should be established in each tributary (treatment and reference) in order to gauge the change.

Distribution will be evaluated in terms of adult spawning distribution (adult spawning distribution data are collected by WDFW and CCPUD) and juvenile rearing distribution, through the annual snorkel and electro-fishing surveys conducted under ISEMP.

5.2.2 Mechanism of Interaction

5.2.2.1 Competition

***Objective*:** To continue to evaluate competition for space and food between naturally produced coho and NTTOC.

Rationale: If the status of NTTOC is determined to have declined, continued investigations into competition between reintroduced coho and NTTOC will help determine the cause of the decline and, if necessary, programmatic changes that can be made to minimize negative interactions between coho (hatchery and/or natural) and NTTOC.

Hypotheses: Possible hypotheses to investigate include the following:

- H_o: NTTOC microhabitat $_{\text{with coho}}$ = NTTOC microhabitat use $_{\text{without coho}}$
- H_o: NTTOC growth $_{\text{with coho}}$ = NTTOC growth $_{\text{without coho}}$
- H_o: Coho microhabitat use = NTTOC microhabitat use

Methods: Competitive interactions between species are often investigated using two general techniques: controlled field studies or laboratory investigations (using aquaria or enclosures). Field studies can lack statistical power but are seldom criticized for lacking relevance to actual conditions. Studies in aquaria or enclosures more easily achieve statistical power through replication, but the natural conditions which closely parallel the stream ecosystem are difficult to duplicate.

To investigate competition, a combination of approaches may be used, including field studies similar to those conducted during the feasibility phase (Murdoch et al. 2004, Murdoch et al. 2005) or direct measures of competition such as growth and condition of NTTOC in small-scale enclosures with varying abundance of competitors under differing habitat and environmental conditions. Together competition studies may help ascertain conditions under which competition may have a negative effect on NTTOC.

5.2.2.2 Predation by Naturally Reared Coho on Spring Chinook Fry

Objective: To quantify predation rates by naturally produced coho on spring Chinook fry.

Rationale: The extent to which naturally produced coho may prey upon NTTOC in the Wenatchee and Methow rivers is largely unknown. Preliminary investigations during the feasibility phase documented that some naturally produced coho smolts will consume fry-sized fish. Due to the low numbers and abundance of naturally produced coho in areas of ESA-listed spring Chinook production during the feasibility phase, it was not possible to accurately measure incidence of predation (Murdoch et al. 2005).

Restoration Phases: Predation evaluations will occur during the NPIP. The tributary(s) chosen for the predation evaluation(s) will be based on the natural production rates and resources for fish capture.

Methods: A study to determine the incidence of predation and an estimate of the total number of spring Chinook fry consumed will follow methods described in Murdoch et al. (2005). The study may be replicated in more than one tributary as deemed necessary to adequately assess the extent that predation may occur.

5.3 Genetic Adaptability

Few opportunities in the Columbia Basin exist to investigate the local adaptation process required for a species reintroduction project to be completely successful. This coho reintroduction plan presents such an opportunity to understand the natural selection intensities on naturalized coho. Success of this coho reintroduction program relies on the use of hatchery fish to develop naturalized spawning populations. Until recently the project has relied entirely upon the transfer of lower Columbia River hatchery coho to produce adult coho returns. If a viable self-sustaining population of coho is to be re-established in the Wenatchee and Methow basins, parent stocks must possess sufficient genetic variability to allow the newly founded population to respond to differing selective pressures between environments of the lower Columbia River and the mid-Columbia region. Some changes in the life history characteristics of the introduced broodstock are likely, due to multiple factors such as longer migration distance, differing environmental conditions of inland rivers, and historical artificial selection on donor stocks. Several of the life history characteristics that might be expected to differ could be endurance, run timing, sexual maturation timing, fecundity, egg size, length at age, juvenile migration timing, sex ratio, and allele frequencies of non-neutral loci. Therefore, a long-term monitoring effort will be continued to track changes over several generations.

Implementation of the proposed study plan would be a valuable contribution to the science of salmon recovery by quantitatively addressing the following questions:

1) Is divergence at neutral and adaptive SNP (Single Nucleotide Polymorphism)[1] loci a useful measure of reproductive isolation and adaptation?

2) Is phenotypic divergence (if observed) a useful proxy for local adaptation, or are observed differences simply the result of phenotypic plasticity?

3) What is the biological significance to perceived local adaptation/naturalization?

4) What is the mechanism leading to local adaptation, and how quickly can stocks react to alternative natural selection regimes?

5.3.1 Morphometrics and Life History Traits

Metric: We will measure traits such as fecundity, body morphometry, run timing, maturation timing, length-at-age and spawn timing.

Rationale: Because conditions in mid-Columbia tributaries are likely to be different from coastal streams and the lower Columbia River where the broodstock used for reintroduction originated, life history characteristics of reintroduced coho are likely to change. For one, the migration distance is much greater between the ocean and the mid-Columbia than, for example, between the ocean and Cascade Fish Hatchery. Optimal maturation rates and spawn timing are likely to be different between these two areas. In order to determine if the

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[1] SNP – Single nucleotide polymorphism: an alteration of one base in the genome of an organism (e.g., A⇔G or C⇔T).

stock used has adequate genetic variance and phenotypic plasticity to adapt to local conditions, the life history characteristics of the coho broodstock should be monitored over the length of the program.

Monitoring life history traits and morphometrics of mid-Columbia coho will contribute to answering broader questions about the rate of genetic drift when a broodstock is established in a subbasin.

Methods: Through sampling efforts in the Wenatchee and Methow basins, we will collect morphometric and life history data from the reintroduced population. From adult coho captured for broodstock (HORs and NORs) we will collect data from phenotypic traits such as fecundity, body morphometry and maturation timing. Similar data will be collected from HORs and NORs recovered on the spawning grounds. Trend monitoring will be used to ascertain changes in life history or morphometry for each generation.

5.3.2 Phenotypic Traits at Tumwater and Dryden Dams

Metric: We will measure traits such as lipid levels, run timing, state of maturation (measured by hormone levels), fish size, fish shape, and gender.

Rationale: In addition to tracking any changes in phenotypic traits over time for the population as a whole, during Broodstock Development Phase 2 (BDP2) we plan to assess whether there is any measurable difference in phenotypic traits between coho salmon that are able to ascend Tumwater Canyon and those that cannot. Knowledge of any potential phenotypic difference between fish that can ascend the canyon and those that cannot, could be used to revise our broodstock collection efforts if we are unsuccessful in completing BDP2 as described in Section 5.2 of this Master Plan. However, because targeting broodstock collection for certain traits would reduce genetic diversity and could also result in the inadvertent selection for deleterious traits, such measures would be a last resort.

Hypotheses: Possible hypotheses to investigate include the following:

- H_o: Lipid Levels $_{\text{successful coho}}$ = Lipid Levels $_{\text{unsuccessful coho}}$
- H_o: State of Maturation $_{\text{successful coho}}$ = State of Maturation $_{\text{unsuccessful coho}}$
- H_o: Run Timing $_{\text{successful coho}}$ = Run Timing $_{\text{unsuccessful coho}}$
- H_o: Morphometrics $_{\text{successful coho}}$ = Morphometrics $_{\text{unsuccessful coho}}$

Methods: Coho smolts released upstream of Tumwater Dam will be marked with a blank wire in the adipose fin. Upon return, adults headed upstream of Tumwater Dam will be identifiable at downstream trapping sites. During broodstock collection efforts at Dryden Dam, all coho destined for the upper Wenatchee basin will be scanned for a PIT tag; if no PIT tag is found, a tag will be applied. Phenotypic data described above will be collected. Fish that successfully ascend Tumwater Canyon to the dam will either be re-collected or detected on the antenna arrays (2) within the fishway. Data from phenotypic data from fish that have arrived at Tumwater Dam will then be compared to the data collected from the fish that did not successfully ascend the canyon.

5.3.3 Genetic Monitoring

Objective: To determine whether the project is successfully creating a local broodstock distinct from lower Columbia River coho salmon stocks; to measure the rate of divergence at neutral markers, and to determine the biological significance of local adaptation.

Metric: We will measure the rate and direction of divergence in neutral and adaptive allele frequencies of coho stocks that are used for reintroduction in mid-Columbia rivers.

Rationale: A sound understanding of the genetic structure of the species is a prerequisite for the assessment of the genetic impacts of human activities such as introductions, transfers, or stock enhancement on natural populations. A measure to assess the impact of human activities on natural populations is the degree to which the population structure responds to applied management action. This can be done by measuring the frequencies of alleles at specific loci through time in a population (Allendorf and Phelps 1981; Utter 1991; Allendorf 1995). Such a database permits the determination of temporal and geographic (degree of isolation) variance components.

Within the body of peer-reviewed literature, scientific views remain mixed regarding the scale and biological significance of perceived local adaptations (Taylor 1991b; Purdom 1994). Utilizing both neutral and adaptive SNP loci provides the opportunity to evaluate the biological significance of genetic differentiation among stocks. The coho reintroduction effort in the mid-Columbia provides an ideal framework for studying rates of genetic and phenotypic divergence.

Restoration Phases: Broodstock development phases will focus on collecting genetic samples from hatchery returns to measure the rate of divergence. Genetic analysis during natural production phases will include naturally spawning coho as described above.

Methods: We propose to measure genetic divergence using 35 SNP markers. To do so, we intend to sample tissue from a minimum of 60 adult coho from each of four study groups: 1) adults destined for natural spawning; 2) adults collected for broodstock; 3) naturally produced smolts; and 4) hatchery origin smolts. Over time the data will allow us to estimate three types of genetic drift:

1) Changes in allele distribution between parent and progeny life history stages (e.g., drift occurring between the adult spawning population and their progeny) relative to the amount of genetic divergence expected to result from genetic sampling error attributed to reproductive events (Weir 1996). In addition, by measuring changes in composite haplotype[2] frequencies we can quantify variation in reproductive success on a very broad scale. These data will be used to scale the relevance of statistical tests of genetic differentiations (e.g., genetic sampling error will be included as a component of variance when assessing differentiation between hatchery and natural-origin adults and progeny).

2) Genetic variation present in the hatchery broodstock compared to the naturally spawning population component. This will allow us to determine whether broodstock collection methods are effectively achieving a representative sample of returning adults. These data will be helpful in optimizing broodstock collection protocols.

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[2] Haplotype: The composite genotype of multiple loci that can provide a "fingerprint" for various lineages, populations, or individuals.

3) Over time, as broodstock development progresses, we will be able to determine the length of time necessary to genetically recognize mid-Columbia coho salmon as a distinct spawning population from the lower river source populations.

5.3.4 Reproductive Success

Objective: To measure changes in reproductive success over generations as an indicator of local adaptation.

Metric: Individual recruits per spawner as assessed through parental assignment.

Rationale: Initially we expect the reproductive success of reintroduced coho salmon do be low because a domesticated hatchery stock was used for the reintroduction. This Master Plan describes a phased approach to first develop a local broodstock and then to focus on natural production and local adaptation to the natural environment (rather than hatchery environment). As we proceed with the phased reintroduction effort, we would expect the reproductive success of the population to improve. Because the program is designed to be an integrated hatchery program, we would not expect the reproductive success to be different between natural and hatchery produced fish; however, as our reliance on hatchery production diminishes in the NPS phases, we would expect an increase in reproductive success for the population.

Hypotheses: Possible hypotheses to investigate include the following:

- H_o: Reproductive Success $_{\text{BDPII (baseline)}}$ = Reproductive Success $_{\text{NPS2 (locally adapted)}}$

Restoration Phases: During the broodstock development phases, we will focus on collecting baseline reproductive success data which would be compared to the reproductive success of reintroduced coho at the conclusion of the Natural Production Phases.

Methods: The reproductive success of reintroduced populations is a CRITFC-sponsored evaluation (Accord Project #200900900). We plan to coordinate with CRITFC researchers for the implementation of this study. A small fin clip will be taken from all coho ascending Tumwater Dam (and possibly Wells Dam). Genetic profiles acquired for each fish will be compared to the profiles for adults in its respective brood year to permit parentage assignment.

Individual productivity (R/S) estimates will be calculated for each adult within brood years as well as average productivity and relative reproductive success among parental types. We will then compare the reproductive success of hatchery and naturally produced coho during the broodstock development phases (baseline) to data collected near the completion of the natural production phases.

References

YN (Yakama Nation Fisheries Resource Management). 2010. Mid-Columbia Coho Restoration Master Plan. Prepared for the Northwest Power and Conservation Council. 199 pages.