Cougar Proposed Special Operation
to Improve Downstream Passage & Survival

Implementation Date (approximate)

This special operation should be implemented from 01 November (or whenever water temperature control tower operation has been completed) through 31 December.

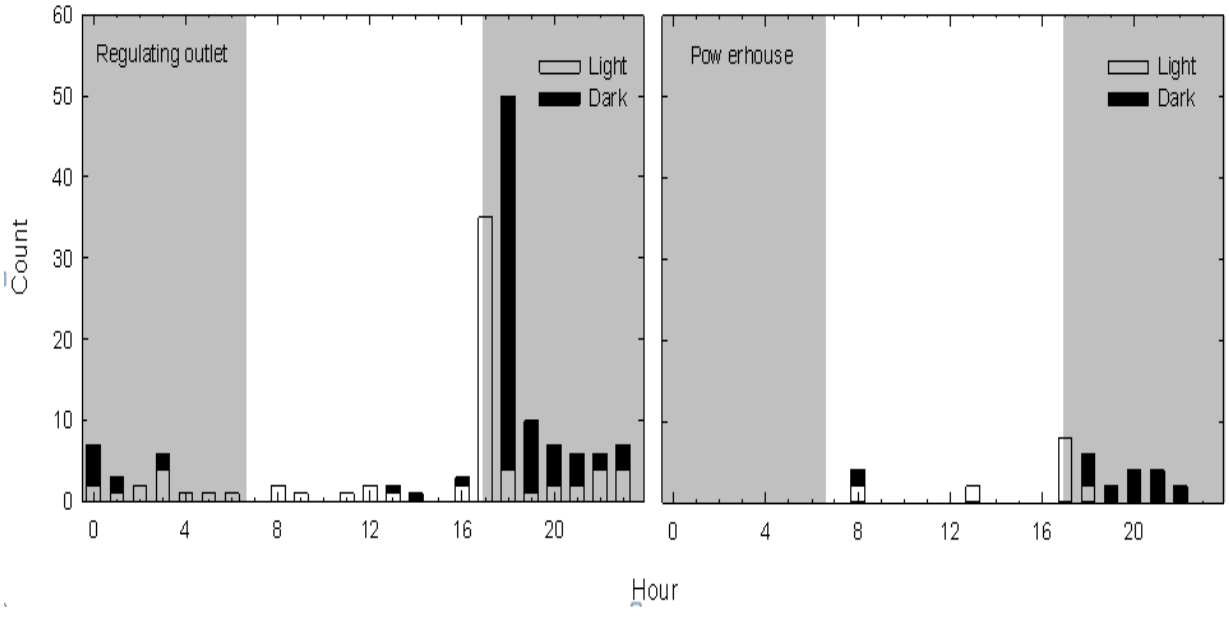
Purpose

The purpose of this proposed operation is to improve fish passage survival of juvenile ESA-listed spring Chinook salmon through Cougar Dam by prioritizing the operation of the regulating outlets (RO). Studies indicate that downstream passage through Cougar Dam is poor (ODFW 2008, Hiesey 2010, ODFW 2010, 2012, Beeman 2012, 2013). This is due to the inaccessibility of downstream passage routes during the conservation season (when the reservoir is full) combined with poor survival through these routes (turbine units) once they become available (shallower) during the flood season.

Biological Justification

Past biological studies have shown that the survival through the RO is about double that of the turbines (~70% for RO & ~35% for turbine). These studies also show that the majority (>87%) of fish pass Cougar Dam during the night (Figure 1.) rather than during the day. For this reason, priority should be given to the RO outlets as the reservoir is drawn down and held low for the winter flood control season. RO priority should be focused at night, from 1600 to 0400 hours, and should target flows of ~1000-1500 cfs through a single RO gate.

Figure 1. Diel passage timing for Radio Tagged Chinook juveniles (Beeman 2012).



Operational Details

This special operation should be implemented from approximately 01 November (or whenever WTC operation has been completed) through 31 December. Exact outflows are uncertain and will depend on inflows and hydrologic conditions. Table 1 (below) shows some potential operations for different discharge levels. This table is presented as a concept only; the actual operations will need to be developed by regulators and managed on a real-time basis, especially during times of high flows. The actual discharge rates are subject to the reservoir level, minimum gate openings, and turbine operating range.

Table 1. Hypothetical operations for juvenile RO survival test.

	NIGHT		DAY	
Mean 24hr Discharge	**RO Flow**	**Powerhouse Flow**	**RO Flow**	**Powerhouse Flow**
500	500	0	0	500
1000	1000	0	0	1000
1500	1500	0	500	1000
2000	1500	500	1000	1000
2500	1500	1000	1500	1000
3000	2000	1000	2000	1000

Research, Monitoring and Evaluation

As in previous years, ODFW will monitor passage with screwtraps. Additionally, dam passage rates and timing can be inferred by the detection of PIT tagged fish at Leaburg and Walterville dams downstream.

Potential Impacts

This operation may cause elevated levels of total dissolved gas (TDG) below Cougar Dam. Real-time information will be measured and monitored during this operation, thus this operation may be suspended or ended all together if warranted.

Daily changes in dam operations may cause possible downstream ramp rate violations, however every effort will be made to minimize these.

During periods of critical power needs, project construction and maintenance, or high flow situations, the operation may be suspended or altered.

Detroit Proposed Special Operation
Temperature Management

Implementation Timeframe (approximate)

01 June - 14 November

Purpose

The purpose of this proposed operation is to provide downstream water temperature management while enhancing downstream juvenile fish passage at Detroit and Big Cliff Dams through strategic use of the spillway, turbines and regulating outlets from 01 June through 14 November. This operation meets Reasonable and Prudent Alternative (RPAs) measures 4.8 and 5.1 of the National Marine Fisheries Service (NMFS) Biological Opinion which calls for implementation of interim operational measures to improve downstream water quality and fish passage for ESA-listed fish.

Background

The construction and operation of Detroit Dam has altered the pre-dam seasonal thermal regimes in the North Santiam River and blocked access to the majority of historic spawning and rearing habitat. During pre-2007 project operations, all water was typically routed through the powerhouse of both Detroit and Big Cliff Dams when the project discharge did not exceed the hydraulic capacity of the powerhouses. During summer months, with Detroit Reservoir at maximum conservation pool, deep (hypolimnetic) water was released through the upper ROs and turbine outlets produced downstream water temperatures 5.4° to 9.0°F cooler than inflow temperatures (June through September). During fall and winter as Detroit Reservoir was drawn down, surface (epilimnetic) water was released through the upper ROs and turbine outlets produced downstream water temperatures up to 18°F warmer than inflow temperatures. It is likely that the increase in downstream water temperatures during fall and winter was exacerbated by the removal of Detroit Reservoir's cold hypolimnetic water throughout the summer, which increased the volume of warm epilimnetic waters for release from October through December (Gore and Petts 1989). This altered temperature regime negatively affected the productivity of ESA-listed spring Chinook salmon and winter steelhead in the lower North Santiam River, and has been identified as one of the most critical limiting factors for species recovery (NMFS 2008).

During temperature operations Research Monitoring and Evaluation (RM&E) studies have found also found high rates of dam passage and survival for juvenile Chinook salmon at Detroit Dam (Beeman et al. 2012, Friesen et. al 2012). Taken together, data indicate that temperature management operations may provide some connectivity to the majority of historic spawning and rearing habitat above the dam – through providing downstream passage benefits – while also improving the seasonal thermal regimes in the North Santiam River below Big Cliff Dam.

Biological Justification for Temperature Improvements

Restoring the natural thermal regimes in the river reach directly below Detroit Dam will provide a benefit to both ESA-listed spring Chinook salmon and winter steelhead. These benefits have been realized over the past six years that water temperature management operations have been performed. Recent RM&E studies also indicate that these temperature management operations promote downstream fish passage during summer spillway operations. Priority should be given to refilling Detroit Reservoir so that both temperature management and fish passage operations can be accomplished to the fullest extent possible.

Operational Details

On 01 June, water temperature management operations will commence. A blend of spillway and turbine releases (a 60%/40% split, respectively) from Detroit Dam should be implemented in order to manage for downstream water temperatures and meet temperature targets (Table 1) throughout the summer. This operation will be carried out until Detroit Reservoir is drawn down below spillway crest.

Once below spillway crest, water temperature management operations will shift to powerhouse-only discharges until mid-October or when outflow water temperatures reach 50°F. From approximately 22 October through 14 November, a blend of powerhouse and regulating outlet flow will be discharged to meet downstream water temperature goals (Table 1). It is estimated that a 30%/70% split in RO to powerhouse discharge will be needed during this time; however, adaptive management should be used to ensure water temperatures stay below 50°F. The RO/powerhouse operation for fall water temperature management is based on water quality modeling results and operations conducted in previous years. A discussion of this modeling effort and justification for RO use in the fall can be found in Section 4.2.2 of the *Willamette Basin Annual Water Quality Report, WY 2010*.

Big Cliff will be used to moderate downstream flows so that they are consistent and meet instream tributary flow requirements. At no time will water temperature management operations be allowed to violate the current engineering and operational restrictions in place for Detroit/Big Cliff Dams and Reservoirs. Continuity of the operation is contingent upon meeting other critical operating purposes, specifically, but not necessarily limited to, flood damage reduction. Flood reduction operations would result in temporary termination of the operation. Should any flow management of dam safety concerns arise during this study, these operations will be modified or suspended.

Table 1. Water Temperature Targets for the North Santiam River below Detroit and Big Cliff Dams.

Month	Temperature Maximum/Minimum	
	°F	°F
January	40.1	40.1
February	42.1	41.0

March	42.1	41.0
April	45.1	43.2
May	49.1	46.0
June	56.1	51.1
July	61.2	54.1
August	60.3	54.1
September	56.1	52.3
October	<50.0	<50.0
November	<50.0	<50.0
December	41.0	41.0

Coordination

Coordination will occur through the Willamette Fish Passage Operations and Maintenance (W-FPOM) team.

Fall Creek Operation
Deep Drawdown to Facilitate Downstream Fish Passage

Background

The Corps' Willamette dams have blocked access to a majority of the historical habitat for ESA-listed fish. Many of these dams were built without downstream fish passage facilities and those facilities that were built have since been abandoned due to lack of functionality. Therefore, many fish are restricted to areas below the dams and subjected to altered flow and water quality conditions by dam operations. Those juvenile fish produced upstream of the dams (from adult salmon and steelhead outplanting) must pass through the dams via turbines, regulating outlets (ROs), or spillways.

Past studies indicate that downstream passage through the Willamette high-head dams is poor. This is likely due to the inaccessibility of downstream passage routes during the conservation season (when reservoirs are full) combined with poor survival through these routes once they become available during the flood season.

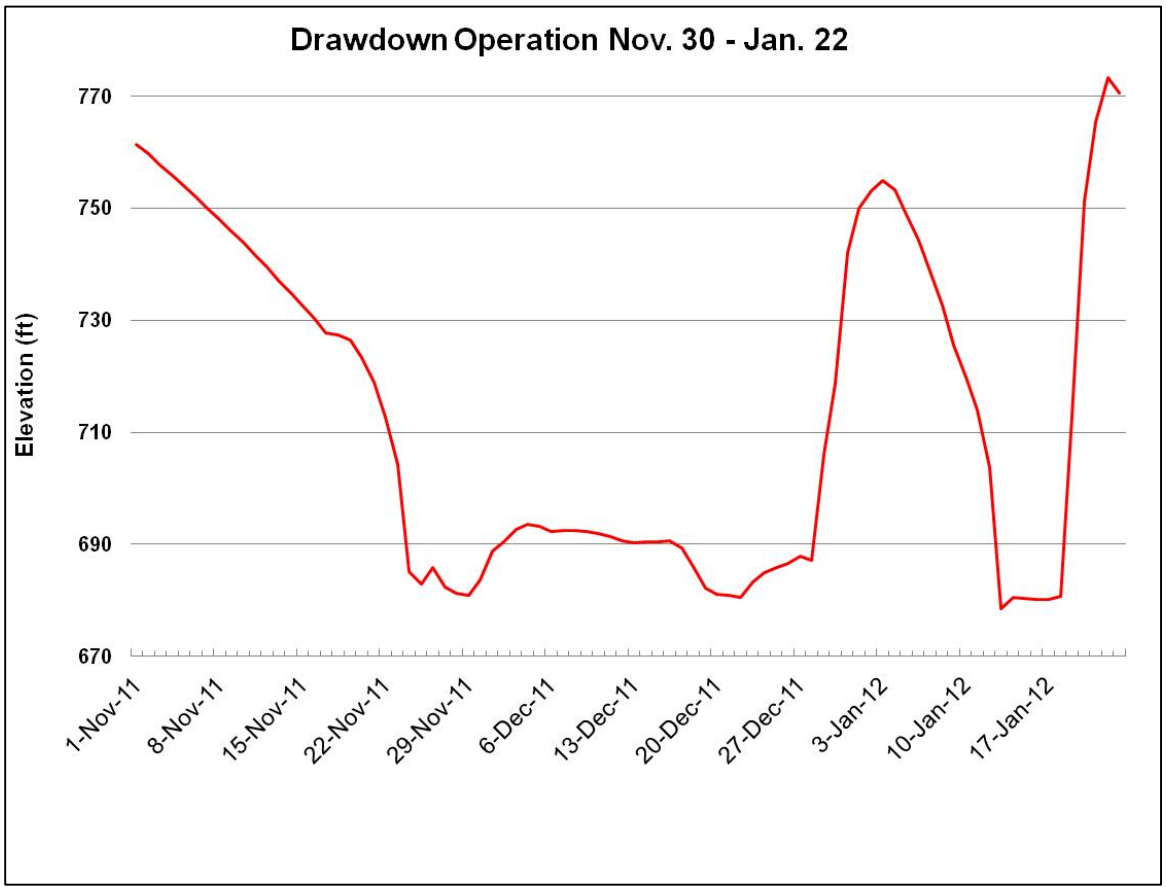
Purpose

The purpose of this proposed operation is to improve downstream volitional fish passage through a drawdown of Fall Creek Reservoir to an elevation ranged of 680 to 685 ft. This operation meets Reasonable and Prudent Alternative (RPA) 4.8 of the National Marine Fisheries Service (NMFS) Biological Opinion which calls for implementation of interim operational measures to improve downstream passage of migrants as safely and efficiently as possible.

Biological Justification

Reservoir drawdown has been shown to significantly increase the passage probability of Chinook salmon smolts at Fall Creek Dam (Taylor et al. 2012). In the winter of 2011, the Corps drew Fall Creek Reservoir down to near the target elevation of 680 ft to increase fish passage efficiency and survival of ESA-listed spring Chinook salmon. Due to varying inflows into Fall Creek Reservoir, forebay elevations ranged from 680 ft to 695 ft during the study timeframe (Figure 1). During drawdown, it was estimated that approximately 20,000 spring Chinook subyearlings were flushed from the reservoir, with the largest proportion outmigrating at the lowest reservoir elevations. Non-native fish species were also flushed from the reservoir, reducing predation and competition for food which should provide better rearing conditions for salmonids in future years.

Figure 1. Fall Creek Reservoir Elevation during Deep Drawdown Special Operation, Winter 2011.



Operational Details

Fall Creek Reservoir is typically operated at or below a water control diagram that provides guidance to the reservoir regulators on how to manage the storage in the reservoir to meet multi-purpose needs. The water control diagram for Fall Creek Dam is shown in Figure 2 below. Fall Creek Reservoir is typically drawn down (i.e., storage evacuated) in the fall to minimum conservation pool (elevation 728 ft) to provide space to store high runoff from winter rain events. In the early spring, the reservoir begins to capture some of the runoff to store water for use in the summer months. Refill back to maximum conservation pool (elevation 830 ft) typically occurs by mid-May.

Under this special operation, it is proposed that Fall Creek Reservoir be drawn down below minimum conservation pool to run-of –river - like conditions. Operations will target an elevation range of between 680 and 685 ft, or approximately 48 feet deeper than the minimum flood control pool elevation (Figure 2) for two weeks during the month of December. The goal is to hold the reservoir near elevation 680 ft. Per Hydraulic Design recommendations the RO gates should be operated between the minimum gate opening of 1 foot and the maximum gate opening is 8 feet when above elevation 682 ft. If the gate needs to be opened greater than 8 feet, it should be fully opened. Once below elevation 682 ft, the 0.65 maximum gate opening restriction should be applied. Table 1, below, gives specific gate openings that should be followed when the reservoir is drawn down below 682 ft elevation. Following

these guidelines will ensure that pressurized flow is maintained the regulating outlet conduit at all times.

Table 1. Maximum Gate Opening (ft) for Specific Low Reservoir Elevations, Fall Creek Reservoir.

Pool Elevation (ft)	Maximum Gate Opening (ft)
682	7.8
681	7.1
680	6.5
679	5.8
678	5.2
677	4.5
676	3.9
675	3.2
674	2.6
673	1.9
672	1.3

Continuity of the operation is contingent upon meeting other critical operating purposes, specifically, but not necessarily limited to, flood damage reduction. Flood reduction operations would result in temporary termination of the deviation operation.

The boat ramps to Fall Creek Reservoir are closed during the winter months by the Oregon Parks and Recreation Department so adverse impacts to recreation by implementing a deeper draft of the reservoir should not be an issue.

During drawdown and refill of Fall Creek Dam, draft and refill rates of 3ft and 5ft per/day, respectively, will be followed. All outlets will be operated within their limits to avoid cavitation and structural damage. Draft rates, ramp rates and downstream flow targets may be missed during this operation, especially if unforeseen meteorological conditions develop. The Corps will coordinate with the agencies throughout implementation of this operation to ensure good communication and transparency.

Figure 2. Fall Creek Reservoir Water Control Diagram

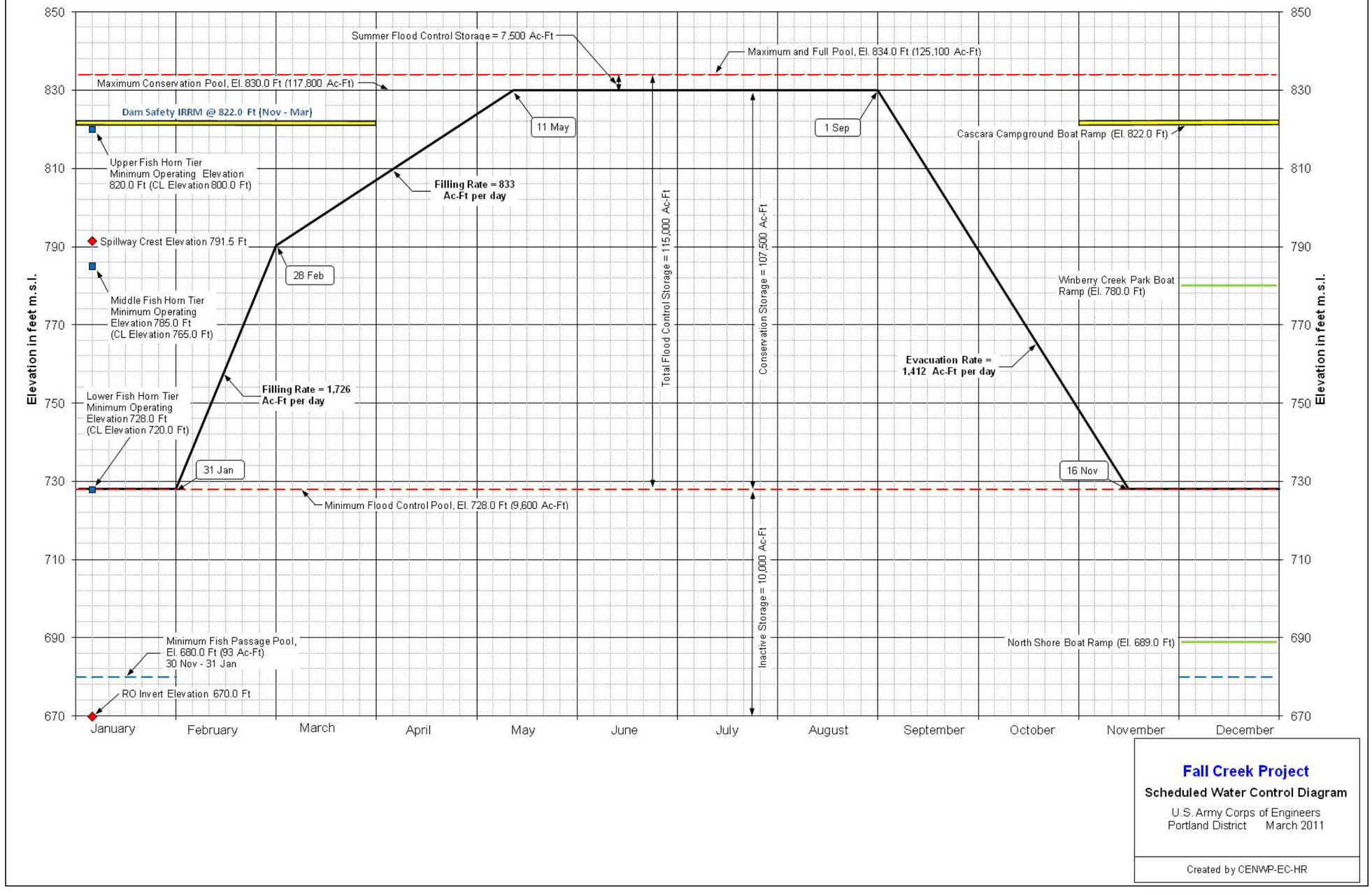
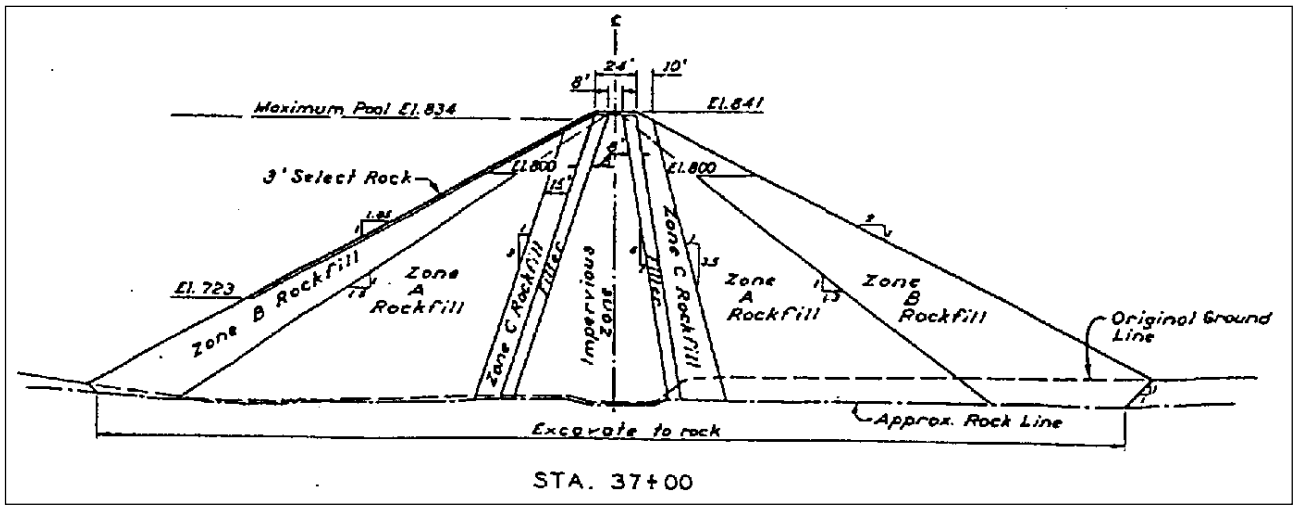


Figure 3. Fall Creek Embankment Cross Section



Coordination

This is a standard operation and will be discussed and coordinated through the Willamette Fish Passage Operations and Maintenance (W-FPOM) Team.

Foster Weir Fish Operation

Description/Intent

The Foster fish weir will be operated for fish passage and RM&E during 2016. The USACE operates the Foster fish weir from April 15th through May 15th annually around reservoir elevation 635 ft, to provide downstream fish passage primarily for emigrating juvenile winter steelhead. The operation provides spill of 0.5 to 1.5 feet (~92-238 cfs). The weir provides a more focused surface passage route which may better facilitate efficiency and survival. Steelhead kelts may also use the weir if operations overlap with their emigration for ocean re-entry. During fall and winter, woster reservoir is drawn down to elevation 616 feet in order to operate the fish weir. Discharges during this operation average 300 cfs through the weir.

Additional details will be added once the study plan is finalized.

Potential Impacts and Mitigation

Because the weir will be in a spill bay during the flood control season, an analysis of potential impacts to flood control operations is required. The project could remove the weir with a two (2) day or less notice, if required.

As a precautionary method, a checklist was developed by Foster Operations in 2013 and will be used again as guidance of when or not to operate the weir during winter months.

After about mid-November, the Project would operate the weir only when no threat of heavy river flows is predicted. That is, if any single condition on the checklist is present, the weir will not be operated and the bay will be closed. If another spill bay is out of service, then the Project will remove the weir and stop logs and return the bay to regular service. If/when we put the weir back in will be determined by all of us after reviewing the circumstances.

Additional details will be added once the study plan is finalized.

Draft Operations Plan for Leaburg Dam Trap: 2016

The purpose of this document is to describe proposed operation of the adult fish trap in the south bank ladder at Leaburg Dam in the McKenzie River in 2016. In recent years, the trap was used to remove hatchery-origin Chinook salmon as part of ODFW's efforts to reduce the proportion of hatchery-origin spawners (pHOS) in the McKenzie River wild fish sanctuary in the river reaches above the dam. We propose to continue the practice but expand the operation to begin earlier and occur more often.

Passage of Chinook salmon at Leaburg Dam is generally characterized by upstream movement of predominantly natural-origin fish, mostly in June and July, with a secondary peak usually dominated by hatchery-origin (adipose-clipped) fish in September (Figure 1). Clearly, we do not want to operate the trap during the main peak (generally in May through early July) because the bulk of the fish moving at that time are naturally-produced; the potential for delaying migration or causing injury to wild fish is greater. However, focusing the trapping operation in August and September greatly reduces the number of wild fish that will be handled.

The goal of the trapping operation is to annually remove 100 or more adipose-clipped Chinook salmon that would otherwise spawn in the wild fish sanctuary above Leaburg Dam. We propose to begin operating the trap when we estimate that > 80 % of the wild run has passed. Historically (2009 – 2014), 80% of the wild run passed in the third or fourth week of July with 90% passing by the third or fourth week of August (Figure 2). It is conceivable that the run thresholds could occur earlier in 2016 so we will use the existing continuous video monitoring of clipped and unclipped fish passing Leaburg Dam and be prepared to begin trapping as early as July 1. When the weekly total and weekly unclipped counts drop precipitously, the trap in the south bank ladder will begin operation. Note that, as shown in Figure 1, in 2013 and 2014 the unclipped count dropped but then rose again as a second pulse of unclipped fish moved upstream. In both cases the early drop in counts occurred in June. In all years, including 2013 and 2014, a drop in counts in the month of July was followed by low numbers of upstream migrants through August and a pulse of migrants in September when counts of clipped fish equaled or, usually, exceeded counts of unclipped fish.

The tentative schedule of operations is shown in Table 1. The schedule will be managed adaptively. If unclipped Chinook salmon abundance exceeds 50% of the total on <u>any</u> day, the trap will be pulled and passive monitoring of relative abundance of clipped and unclipped Chinook salmon will resume. The

trapping operation will only be reinstated when absolute numbers of unclipped fish are low and the relative abundance of clipped fish equals or exceeds that of unclipped fish. The trap will operate every weekday and will be checked at least twice daily, once in the morning and once in the late afternoon. For the morning check, if adult fish are in the trap, then they will be sorted by hand with unclipped fish immediately passed upstream. Adipose clipped fish will be hoisted into an on-site transport tank and delivered to the McKenzie Hatchery to be used for broodstock or one of the other approved uses (outplanting, donation, or sale). The afternoon check will be a visual inspection to guard against the extremely unlikely event whereby substantial numbers of adult fish enter the trap during daylight hours. We intend for the trap to be left open on weekends but are exploring the possibility of finding staff and funds to support operation of the trap on weekends.

The trap counts and timing upon which Figures 1 and 2 are based represent total counts through both the left bank and right bank ladders. It is important to note that only the left bank (south) ladder has a trap in place so there is no access to fish passing through the right bank (north) ladder. Passage through the ladders likely depends largely on flows through the three different roll gates on the dam with fish attracted to the ladder on the side with the most flow.

Reporting on trap operations to the Hatchery Management Team will at a minimum occur weekly with a daily summary of count of Chinook salmon by clip status and disposition. Any unusual outcomes such as mortalities or injuries will be reported in real time to all participants on the Hatchery Management Team.

Figure 1. Passage of clipped and unclipped Chinook salmon at Leaburg Dam, 2009 – 2014. Values are percentages of the total upstream migrant count (clipped plus unclipped fish) over biweekly intervals.

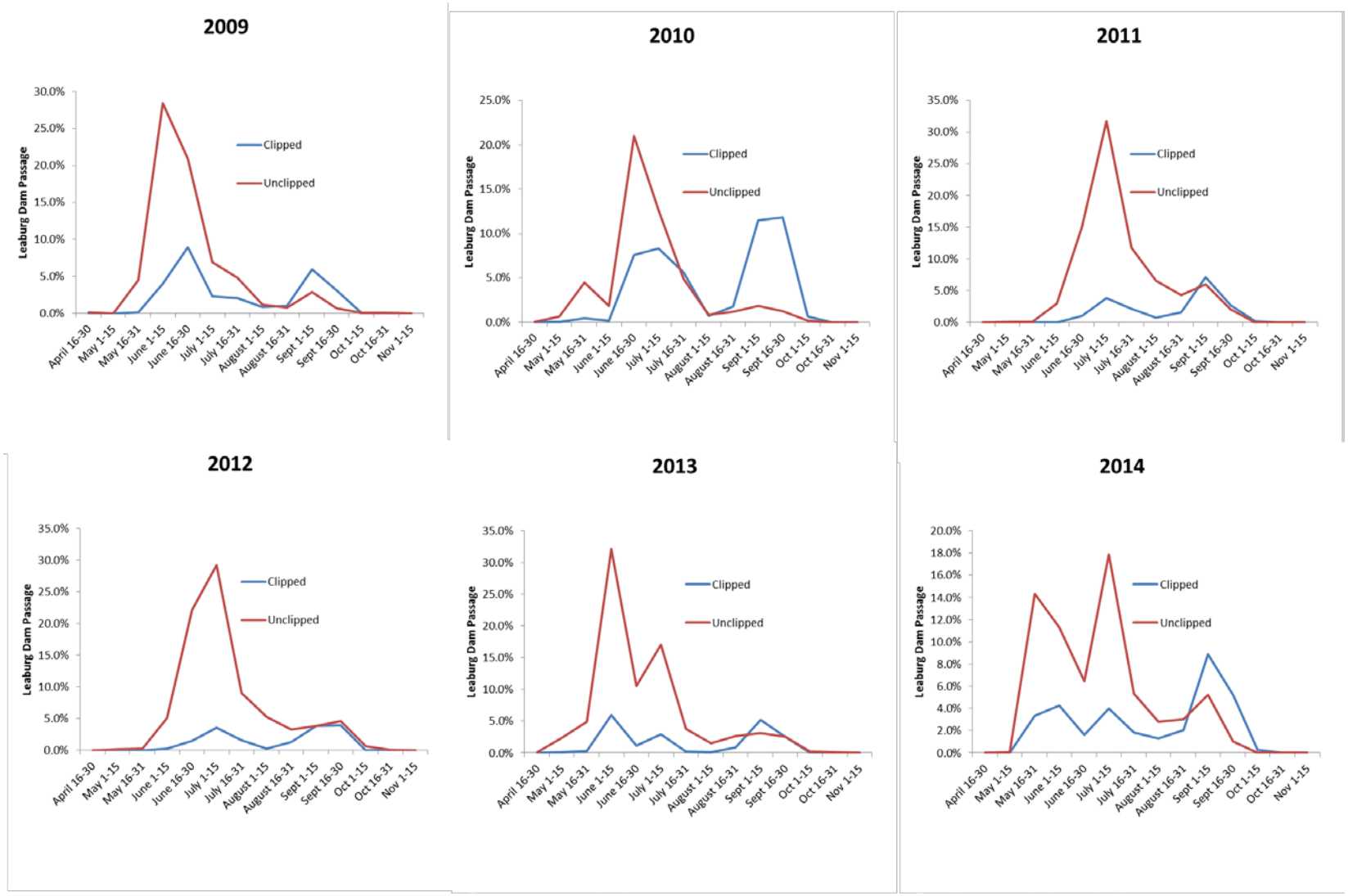


Figure 2. Average percent passage (cumulative) of clipped and unclipped Chinook salmon by two-week interval at Leaburg Dam: 2009 – 2014.

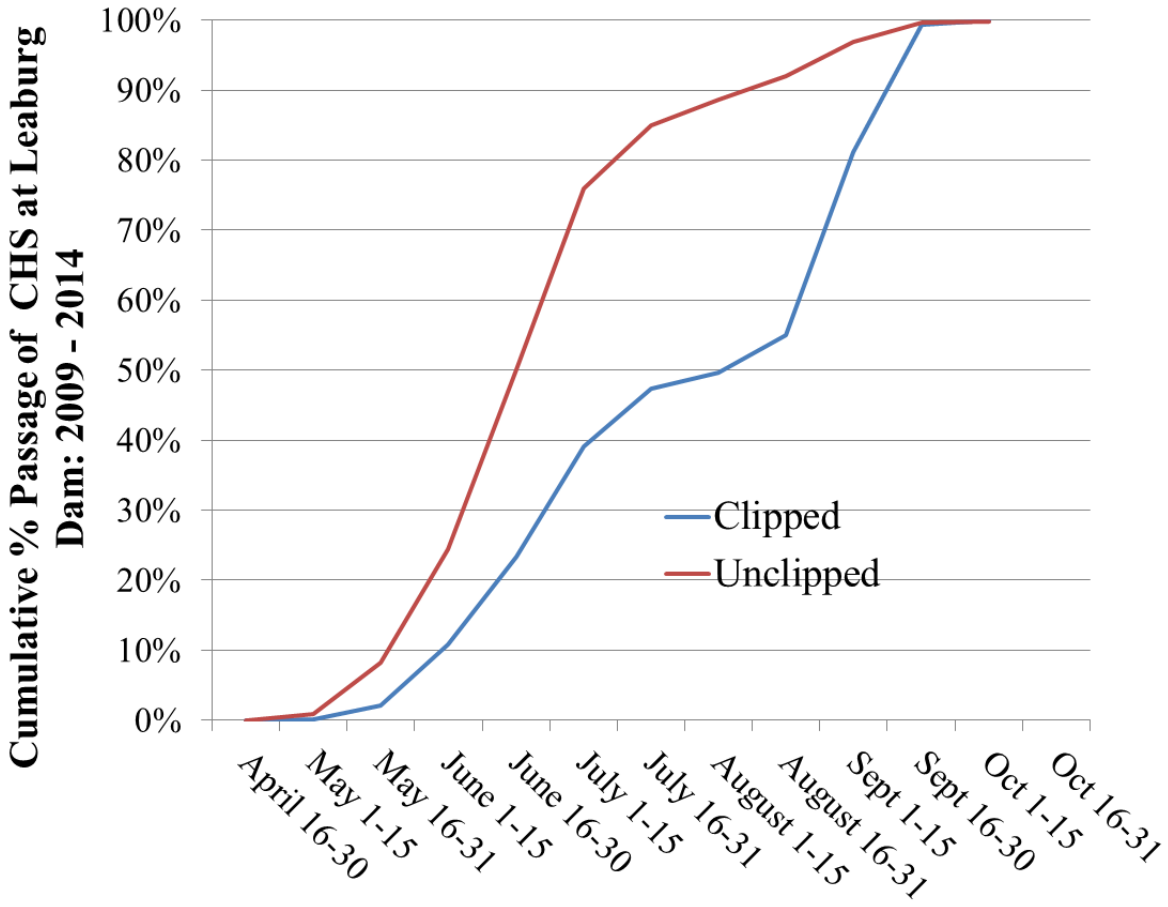


Table 1. Draft schedule for Leaburg Dam trapping operation for Chinook salmon (ChS) in 2016. Ad and NM indicate adipose clipped and non-marked fish. Draft schedule assumes that NM ChS counts drop precipitously in the third week of July. Schedule will shift if that event occurs earlier or later.

Dates			Action
1-Jul	-	10-Jul	Monitor relative abundance of Ad and NM Chinook
13-Jul	-	17-Jul	Install trap. AM and PM trap checks. Trap and transport Ad ChS to McKenzie Hatchery
20-Jul	-	2-Oct	Continue trapping. AM and PM trap checks. Trap and transport Ad ChS to McKenzie Hatchery