

Okanogan River Adult Salmon Weir

- Operational Plan -

Prepared by Colville Tribes Fish & Wildlife Department in collaboration with
Washington Department of Fish & Wildlife and NOAA Fisheries.

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1.0 INTRODUCTION

This document provides a guide to standard operating criteria and conducting the daily operations of the weir, and other supporting activities. It has been developed by the Colville Confederated Tribes (CCT) in collaboration with WDFW and NOAA Fisheries.

1.1 GOAL OF THE PILOT WEIR PROJECT

Assess the feasibility of safe and effective fish capture, handling, release, and by-pass through behavioral assessments. The weir will be operated as a live capture, live release facility and fish survival is of paramount importance. In addition, the pilot weir will be used to assess installation efficiency, structure stability, operational flexibility, and guidance effectiveness. Supporting activities will be implemented to provide environmental monitoring of the impacts of the structure on migrating fish of the Okanogan.

1.2 TECHNICAL OVERSIGHT GROUP

An informal Technical Oversight Group (TOG), comprised of representatives of the CCT, WDFW (non-listed species), and NOAA Fisheries (listed species), will collaborate to implement the adaptive management aspects of the weir program. More specifically, the TOG will evaluate impacts of the weir program on aquatic resources and may provide timely recommendations to the CCT on project modifications to safeguard aquatic resources and maintain compliance with applicable permits and authorizations. Such recommendations may include, but are not limited to, mitigation measures, termination of weir operations, resumption of weir operations, alternate approaches to accomplishing the goals of the weir project, and modification to numerical adaptive management criteria. A standard protocol for communicating, evaluating, and resolving potentially critical situations through the TOG is presented in Section 5.1. Further, the TOG will be kept abreast of regular activities including notification of weir installation, the beginning and end of trapping periods, and of general observations regarding implementation of the plan.

2.0 GENERAL SPECIFICATIONS

2.1 SPECIES AND TIMING

Target species for capture: hatchery origin Summer Chinook

Target species for by-pass: natural origin Summer Chinook, Sockeye, Steelhead, resident species

Timing: In-stream structure in place for July, August, and September (Permits covering 1 July through 30 September). Operational as a fish guidance structure 24 hrs/day for a 5-7 day period in each month. 24 hr staffing during trapping periods, and daily visits for maintenance during non-trapping periods. Non-operational periods will have sections of the weir opened up for unabated fish passage. Lighting of walkways will be implemented for safety.

Target dates:

- Post-freshet, pre-thermal barrier (approx. 15 Jul)
- Post-thermal barrier (approx. 15 Aug)

- Late run (approx. 7 Sep)

Actual dates will depend on water discharge, fish migration timing, and water temperature (see JARPA 2011 for details). Our goal is to catch and release HOR Chinook, so the timing of operations need to be based on when they are actively passing the weir location.

- Water discharge: Target installation at approximately 2kcfs. Operate to a target maximum of up to 3 kcfs. Both targets to be confirmed in the field based on the ability to safely service the weir and process fish.
- Fish migration timing: Target weir operation for trapping when summer Chinook are actively migrating up the Okanogan from the Columbia. To be determined based on catch at the purse seine, and underwater video monitoring at the weir site.
- Water temperature: Migration timing will be influenced by water temperature. Temperatures less than 21 C usually promote active migration, while higher temperatures will slow or stop their migration.

2.2 STANDARD OPERATING CONFIGURATIONS

- A. Weir covers complete wetted width of channel. Three (3) inch picket gap panels used in primary migration corridor. One (1) inch picket gap panels used on bank sides of the migration corridor. Full open gate to downstream side of trap. Trap gate closed to capture fish as they enter the trap.
- B. If active trapping spooks fish away from the weir, close the trap gate when a group of fish are in the trap.
- C. If flow refuge or less water is needed through the trap, install a strategically placed solid barrier such as a tarp or wood sheet.
- D. If additional attraction flow is needed through the migration corridor of the weir, install strategically placed solid barrier such as a tarp on the bank side panels of the weir.
- E. If additional attraction flow is needed through the trap, strategically remove pickets and/or open the upstream gate. Gates will be closed simultaneously to trap fish.
- F. If gilled/stuck fish occur in panels, decrease the gap size appropriately as based on observations. Any gilled fish will be released by pulling out adjacent pickets (rather than pushing/pulling fish through the pickets).
- G. If the number of fish approaching or holding at the weir exceeds operational capacity, remove pickets on a panel(s) in the migration corridor.

2.3 ENGINEERED WEIR PANEL FAILURE MECHANISM

Each weir picket panel is designed to support a working load of up to one foot of unbalanced hydraulic head differential, such as might occur if the pickets were clogged with debris. Manual cleaning will be the usual method of removing such debris, by raking up and over the top of the panel or by removing individual pickets as necessary until debris clears the panel. In the event that the panel cannot be accessed manually, a failure mode controlled collapse of the panel has been designed to permit the panel to

settle to the stream bed, which will sweep any remaining debris from the picket surfaces without damaging or destroying the panel itself.

The failure mode is designed into the rear leg tripod joint by means of a shear pin connection (**Appendix A Figure**). In normal operation, the shear pin is not overloaded and the panel stands as designed, with the rear leg capable of rotating upstream or downstream as needed to install the panel in a stable configuration. When the shear pin fails under excessive load, the rear leg connection will be released and the leg will be driven up and out of the connection joint by the weight of the panel and the causative hydraulic load, allowing the two front legs supporting the pickets and picket panel to settle to the stream bed. The rear leg, which is safety-chained to the two front legs, will fall out of the way, but still be attached to the panel so that recovery is straightforward and no damage to the assembly can occur. The panel would be raised back into position and secured by simply replacing the shear pin once the panel is raised and the rear support leg is repositioned under the connection joint.

3.0 DAILY ACTIVITIES

3.1 MAINTENANCE

*Purpose: Provide effective fish guidance and fish-friendly conditions at the weir, including achievement of standard operating criteria (**Appendix A**). These activities will occur daily while the weir is in the water (**Datasheet #1 in Appendix B**).*

- ✓ Inspect the structural integrity of all in-water weir components (**Appendix C**).
- ✓ Ensure adjacent panels are abutting and cable connections secure
- ✓ Ensure plastic pickets are driven into substrate and undamaged
- ✓ Ensure gravel bags are secure
- ✓ Ensure debris buildup is actively managed
- ✓ Ensure trap connections are secure and overall stability of trap is maintained
- ✓ Ensure access bridge connections are secure
- ✓ Ensure facility warning signs, buoys & lights are in place and functional
- ✓ Provide assistance to recreationalists portaging around the weir
- ✓ Record on-river person traffic (**Datasheet #2**)
- ✓ Record any gilled or impinged fish at the weir (**Datasheet #3**)
- ✓ Provide project information to recreationalists and visitors

3.2 POLLUTION CONTROL PLAN

Purpose: Protect aquatic and adjacent upland environment at the weir from deleterious substances.

At all times during installation and operation of the proposed weir and trap facility, the CCT will adhere to the water quality standards required under the WAC-173-201A Water Quality Standards for the State of Washington. Specifically, no petroleum-fueled equipment will be refueled within 100 feet of surface water on the site, and an appropriate spill kit will be provided at a prominent and convenient location where it is immediately accessible in the event of a spill. All machinery or equipment to be used near or in the water will be approved for such use, and will be maintained in proper order to prevent spills or leaks of petroleum-based fluids into surface waters. Any

heavy equipment operated within the Ordinary High Water Line or within 10 feet of the active stream channel will be provided with biodegradable hydraulic fluids, and kept in clean working order with no leaks. At the end of each workday, all petroleum-fueled equipment (except boats) will be removed from exposure to surface water to a location at least 100 feet away from the active stream channel. We do not anticipate using petroleum-fueled equipment at the site, nor will there be construction or operation liquids at the site to spill. However, training in emergency response to spill events will be provided to work crew prior to commencement of construction or trapping activities. The only waste anticipated at the site is packaging materials which will be recycled or disposed of at the local waste management facility.

The project site has no evidence of progressive erosion. The banks are composed entirely of sand, and the channel is predominantly armored cobble. The banks on the upstream and downstream sides of the weir will be stabilized with geo-textile cloth during the period of weir operation, and then removed. Gravel bags will be used to stabilize any portion of the channel affected by the weir or operations.

The sediment plume created by instream construction work shall not exceed 5 NTU's above background. If the differential exceeds the allowable range, the particular construction activity that is responsible for introducing turbidity will be terminated until mitigative measures can be developed and implemented. A daily log of turbidity measurements will be updated and maintained on site.

3.3 DEBRIS & SEDIMENT REMOVAL PLAN

Purpose: Provide a mechanism to minimize the accumulation or suspension of debris and sediment in proximity to the weir.

No sediment removal is anticipated for this project. Operation of the weir should not cause a need for sediment removal as all sediment passes through the site as fully suspended load. If hydraulic eddies form in proximity to the weir, it may be necessary to redistribute or re-suspend excessive bed sediments after high flow events (which are not anticipated to occur during the period of operation).

Macrophytes and small "beaver" branches are anticipated to be the most substantial form of debris at the weir. Vegetation impinged on the weir will be dislodged and allowed to pass downstream. Any garbage impinged on the weir will be removed and placed in a proper waste bin.

3.4 WATER TEMPERATURE ASSESSMENT

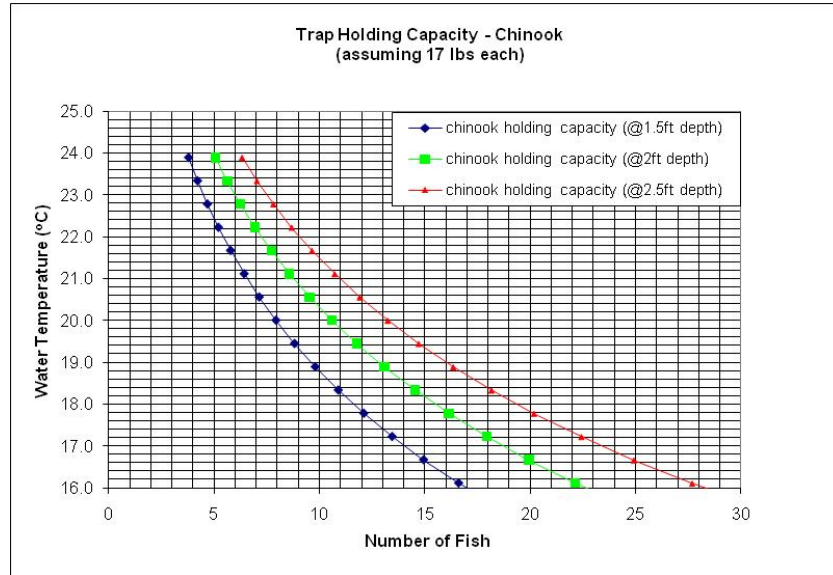
Purpose: To evaluate whether fish trapping and handling can be conducted.

Water temperature at the trap will be measured continuously during operations. The weir and trap will be operated through 22.4°C (72.3°F). When water temperature meets or exceeds 22.5°C (72.5°F), the trap will be closed and sections of the weir opened up for unabated fish passage. We will also use an assessment of fish condition and any evidence of related mortality to decide if the temperature guideline is appropriate.

3.5 TRAPPING

Purpose: Assess the feasibility of conducting effective and fish-friendly capture, handling, and release of fish. This includes behavioral assessments to decide if the operation is working appropriately.

1. Operate with upstream gate closed and downstream gate open (until, and unless trap maximum fish holding capacity is exceeded);
2. Handling trough (watered and flowing) and sanctuary dip net in stand-by;
3. Visually monitor for fish approaching the weir and entering the trap. Record general observations (e.g. species preference, behavior, etc.), (**Datasheet #4**);
4. Lower downstream gate when one or more fish have entered (**Datasheet #5**).
When relatively few fish are actively moving up to the weir, process trapped fish immediately. When relatively numerous fish are actively moving up to the weir, process trapped fish after accumulating no more than 11 Chinook in the trap if water depth is 2 ft and water temperature is less than 20° C (see Figure below). Trap holding capacity is reduced 10% with every degree °F temperature higher, so at 22.4°C, trap capacity must be reduced to no more than 5 Chinook. These capacities are lower if sockeye are also in the trap (5 sockeye = 1 Chinook);
5. Attendant 1 enters trap at downstream end to net fish or dips from the walkway. Use internal crowder as appropriate;
6. Identify Chinook as natural or hatchery origin. Identify Sockeye, Steelhead and other non-targets. The first fish to be released will include any Steelhead, bulltrout or NOR Chinook. They are to be guided out of the upstream trap gate with a crowder (without handling), or if necessary, captured with a net and immediately released upstream;
7. Transfer hatchery origin Chinook to Attendant 2 at sampling trough one at a time for processing and marking (hole punch on left pectoral fin). Classify fish condition as 1) vigorous, 2) vigorous and bleeding, 3) lethargic, 4) lethargic and bleeding, or 5) no movement/ventilation;
8. Data collection and release. Continually monitor the upstream side of the weir for impinged fish. Capture any live impinged fish in sanctuary net and walk upstream to low velocity pool, and release. Dead salmon washing up on the weir will be inspected thoroughly for spawn condition and cause-of-death assessment (**Datasheet #3**). Look for any other potential fish stress indicators such as slamming/jumping at weir panels, descaling, or gilling (**Datasheet #3**). Assess whether facilities and equipment provide adequate handling space and post-release conditions. Consider use of a fish tubes or a pen to promote recovery;
9. Reopen downstream gate to continue trapping;



3.6 TOWER OBSERVATION

Purpose: Document events that describe how fish are interacting with the weir.

- Conduct visual fish behavior assessment from tower using binoculars (**Datasheet #4**);
- 30 minute period, four times per day, during daylight hours.

3.7 SNORKEL SURVEY

Purpose: Look for patterns/trends that indicate fish are actively migrating or holding.

This method can be used as an early warning indicator to the weir operators and Project Manager.

- Conduct visual fish behavior assessment and count from weir downstream to Chilliwist Creek (**Datasheet 6**). Count carcasses and cut in half (to eliminate double counting);
- Two times per day (AM/PM), during daylight hours;
- Estimate number of fish by species.

3.8 VIDEO REVIEW

Purpose: Document events that show how fish are interacting with the weir.

- Review underwater imagery of available cameras for previous 24 hours for fish events (**Datasheet #7**);
- Conduct assessment of behavior to infer if the operation is working appropriately.

3.9 WEATHER / WATER ASSESSMENT

Purpose: Anticipate water discharge conditions that could put fish, staff or weir in jeopardy.

- Review weather forecast, looking specifically for potential rain events and high water temperatures;

- Review river discharge and temperature for USGS @ Malott and Nighthawk for pattern/trend. Record water velocities in proximity to weir (**Datasheet 8**) and the weir staff gauge;
- Notify senior staff of any concerns.

3.10 COMMUNICATIONS

Purpose: Inform all project staff and the TOG of present operations status.

- Field crew completes the standard information form and distributes it to email list on a daily basis;
- The Project Manager will be immediately informed of any observations that indicate a potential negative impact to fish health. Critical situations and observations will then be relayed to the TOG the same day.

4.0 EVALUATIONS

As the purpose of the pilot weir is to assess the feasibility of safe and effective fish capture, handling, release, and by-pass, and to assess the structural integrity and efficiency of the trap and guidance system, there are several specific questions that need to be investigated relative to the operation. These questions are partitioned into three topic areas including structural design (Table I), operational design (Table II), and fish behavior and passage (Table III). The goal is to collect data that will answer these questions, confirm adequate performance, or indicate inadequate performance. Specific data sheets will be completed for each type of activity conducted by the weir project (see **Appendix B**).

A physical site inventory of the weir site is presented in Nass et al. (2006) and includes a calculated stage-discharge curve and bathymetric profile.

I. Evaluate Structural Design

Issue Statement	Characterization or Measurement	Method / Approach	Discussion
What are the water velocities in proximity to the weir and trap? (Datasheet #8)	Measure water velocity at various points along the weir on the upstream and downstream side, and in the trap.	Electronic or hand held water velocity meter	<ul style="list-style-type: none"> • NOAA guidelines indicate 1.25 ft/sec maximum • Non-compliance would require adjustment of panel structure, or request for variance
What is the best mechanism and location to provide Free-pass conditions?	Evaluate picket removal, panel removal, gates on trap.	Direct observation	<ul style="list-style-type: none"> • Need to ID the easiest way to provide unabated passage of fish past the weir
What should the gap between pickets measure?	Install test panels of different gap and observe what works best (i.e., pass Sk, bar Ch, no gilling). 24 hrs of close observation after any major change to confirm no negative impact.	1) Underwater video 2) Tower observation	<ul style="list-style-type: none"> • NOAA guidelines indicate 1 in. • Nez Perce has used wider gap (2 in.) @ Lostine River facility to pass juveniles • WDFW used wider gaps (1.5 and 3.0 in) on several systems (NOAA approved). 1.5 gilled some fish. (E. Kinne, pers comm.) • Okanogan weir panels need to freely pass Sockeye, but guide Chinook • Have cross-member designs for 1.0, 1.5, 2.0, 2.5, and 3.0 in
Is the size of the trap appropriate for the fish abundance encountered?	Actual trapping experience – too little or too much space?	Direct observation and crew feedback	<ul style="list-style-type: none"> • Max number is 11 Chinook at 20°C, see Capacity table for details • Includes assessment of gate size • It's too small if fish are getting stressed by abundance • It's too big if we are only trapping a couple at a time

Does the picket frame assembly maintain proper tension and picket contact between adjacent frames and with bed substrate?	Observe gap between adjacent picket frame sections. Observe tension on tensioning cable system. Observe picket frame position and inclination. Observe picket base in substrate	Record observations of gap size, misalignment, etc. Record picket frame inclination if it changes over time in response to water/debris load.	<ul style="list-style-type: none"> • Adjust tensioning cable as necessary, if possible • Keep debris off pickets • Replace displaced gravel bags • Push pickets deeper into substrate
Is trap structure stable and integral? Do panels retain shape? Are structural members adequate?	Observe trap structure stability when loaded with weight of staff/fish being processed.	Note instability and identify cause, if possible	<ul style="list-style-type: none"> • Adjust or reattach structural members as necessary and if possible • Check connections between panels
Is the weir in the best hydraulic position to encourage volitional passage?	Evaluate water velocities and hydraulic transition in proximity to weir, especially downstream.	Direct observation	<ul style="list-style-type: none"> • Will require assessment over a range of flows

II. Evaluate Operational Design

Issue Statement	Characterization or Measurement	Method / Approach	Discussion
Does the weir cause passage problems for human traffic?	Observe whether signage and portage area provide safe passage around weir for recreationalists	1) Direct observation 2) Surveillance video	<ul style="list-style-type: none"> • Document No. of events and outcome • Consider results relative to a permanent weir
Does the weir cause local erosion to the substrate?	Observe for conveyance, compaction. Assess utility of gravel bags as mitigation	Direct observation	<ul style="list-style-type: none"> • Document specific locations if persistent or severe • Consider results relative to a permanent weir (partial sill? complete sill?)
Is the size & layout of the trap facilitating efficient processing of catch?	Actual trapping experience	Direct observation and crew feedback	<ul style="list-style-type: none"> • Considers trapping accessories such as dipnets, troughs, gate locations, crowders, access etc.
Can staff readily replace picket frames/pickets with panels of different spacing?	Actual experience with picket frame replacement, individual picket replacement, horizontal support replacement, etc.	Observation and notes on changeout procedure and success	<ul style="list-style-type: none"> • Consider observations in future design of improved pickets/frames, etc.
Can staff safely and effectively operate (trap, clean, monitor) the weir over the range conditions encountered?	Actual experience of safe wading and fish processing through complete 24 hr period	Direct observation and crew feedback	<ul style="list-style-type: none"> • Consider results relative to a permanent weir and what could be done to improve operations

III. Evaluate Fish Behavior, Passage and Condition

Issue Statement	Characterization or Measurement	Method / Approach	Discussion
Are upstream moving fish effectively guided along the weir to the trap?	Observation for patterns of fish moving along the downstream side of the weir.	1) Direct observation 2) Tower observation 3) Underwater video	<ul style="list-style-type: none"> • Aggregation, line ups, drifting? • Differences between species?
Do Chinook or Sockeye enter the trap?	Observation for patterns of fish moving into the trap.	1) Direct observation 2) Tower observation 3) Underwater video	<ul style="list-style-type: none"> • Document behavioral characteristics of entering and non-entering fish. • Numbers by species
Do Chinook or Sockeye use the by-pass section of the weir?	Observation for patterns of fish moving through the by-pass.	1) Direct observation 2) Tower observation 3) Underwater video	<ul style="list-style-type: none"> • Document behavioral characteristics of approaching fish. • Numbers by species. • Close monitoring continues after the weir is opened up for unabated passage to ensure use of by-pass.
What picket gap width allows Sockeye to pass through the weir, but hold up Chinook?	Observation for patterns of fish moving through the by-pass.	1) Direct observation 2) Tower observation 3) Underwater video	<ul style="list-style-type: none"> • Document behavioral characteristics of fish attempting to get through the pickets? (e.g. congregate in specific hydraulic conditions such as high/low velocity, depth, near cover, etc.).
To what extent do Chinook or Sockeye drop back after encountering the weir?	Observation of drop back movements or holding that results in pooling or pre-spawn mortality.	1) Tower observation (near field) 2) Snorkel survey (far field) to Chilliwist Creek, by section	<ul style="list-style-type: none"> • Assume there will be some drop back. • Observation from tower may provide data on No. approaches, No. passes, No. drop backs • Snorkel observation may provide data to assess No. of fish holding and mortalities in downstream pools. • Uncommonly high abundance aggregation or persistent aggregation or mortality of either species may indicate holdup.

Issue Statement	Characterization or Measurement	Method / Approach	Discussion
Do Chinook and Sockeye co-migrate to the weir in time or space?	Counts by species approaching or passing the weir. Observation of approach line.	1) Trap counts, by time 2) Free-pass counts, by time, using underwater video 3) Tower observation to map approach lines	<ul style="list-style-type: none"> • Co-migration will make separation at trap more difficult • Separated migration would make separation at trap easier • Free-pass counts with camera using white board • May vary from year to year
Within a given time frame, does the number of fish (by species) observed below the weir appear to translate into a similar number of fish passing the weir?	Number of salmon below the weir compared to number of salmon passing the weir.	Number of salmon below the weir will be estimated by snorkel survey; number passing the weir according to visual counts of by-pass and trapped	<ul style="list-style-type: none"> • A reasonable time frame for comparative purposes may be 24 hrs. • Relatively similar numbers may indicate suitable passage conditions. • Increasing numbers of fish below the weir may indicate inadequate passage conditions.
Does fish vigor at release decline with increasing water temperature?	Classify level of fish vigor after trapping and handling at trap. Watch for fish impingement on weir after release upstream.	Direction observation	<ul style="list-style-type: none"> • Use same classification scale as seine crew
Is there acute mortality of fish that have been trapped, handled and released at the weir?	Number of dead or moribund fish that impinge on the weir.	Direct observation	<ul style="list-style-type: none"> • Any fish handled at the trap will be marked with a specific hole punch to identify them as such.

5.0 ADAPTIVE MANAGEMENT

5.1 STANDARD PROTOCOL

It is possible that “critical” situations or conditions may develop in which operation of the weir as a functional trapping system needs be terminated or modified to prevent or minimize negative effects on migrating salmon or other aquatic resources. This may include data or observations that indicate the weir or its’ operations may be causing delay in passage, bodily injury or mortality to fish (**see Datasheets**). In these cases, the process of adaptive management for operation of the weir will be conducted through the TOG and guided by five primary steps:

1. Observation – field crew immediately reports a critical situation to Project Manager and provides documentation (who/what/where/when/why/how) of a potential negative impact to fish :
 - a. passage delay (e.g., approach and regress)
 - b. bodily injury (e.g., potentially through jumping, contacting, gilling)
 - c. mortality (e.g., moribund or dead fish impinged or gilled at weir)
2. Project Manager reports the critical situation to TOG that same day and provides a recommendation for mitigative action;
3. TOG Assessment – conduct review and assessment of available data and Operational Plan criteria (see Sections 5.2 – 5.4) to evaluate the impact and its severity;
4. TOG Response – decide what mitigative action to recommend. Consensus may be to:
 - a. concur with project managers’ recommended action
 - b. request additional information from the Project Manager
 - c. recommend an alternative action which could include:
 - i. no change to operation and continue monitoring
 - ii. modify operation and continue monitoring
 - iii. temporarily terminate operations, modify operation, and the resume operations with continued monitoring
 - iv. terminate the operation for the season
5. Project Manager implements TOG recommendation, monitors the situation closely for 24 hours, and provides subsequent status updates on the situation.

All available information will be considered in defining a critical situation and developing a mitigative response. Counts of salmon passing Wells Dam will be considered with respect to the potential relative impact of the weir on the population. Potential impacts to natural origin Chinook will be given priority over hatchery origin Chinook.

5.2 SITUATIONS THAT REQUIRE INITIATION OF TOG CONSULTATION

- Observation of any one Steelhead at or below the weir to Chilliwist Creek (see Steelhead below).
- 50% of fish approach the weir, but return downstream (drop back) in a 30 minute observation period (see **Datasheet #4**).
- 50% of fish that approach the weir, hold directly below the weir for an extended period of time (e.g., 12 hours) as assessed from **Datasheet #4**.
- Fish numbers increase progressively in pools downstream of the weir to 3 times the number of fish passing the weir the subsequent day (**Datasheet 6**).
- 5 cumulative fish of any species, live or dead, are impinged on weir (**Datasheet #3**). Cumulative from start – no set timeframe.
- 5 cumulative fish of any species, live or dead, are gilled/stuck between pickets of the weir (**Datasheet #3**). Based on the size class of the fish (Chinook adult, Chinook jack, large Sockeye, small Sockeye) and the specific picket spacing of panel, the TOG may recommend replacement with an alternate picket spacing. Cumulative from start – no set timeframe.
- 10 cumulative salmon mortalities in pools downstream of the weir. Note: presently, no information exists on natural mortality in this area for this time of year (**Datasheet #6**).

5.3 SITUATIONS THAT REQUIRE IMMEDIATE TERMINATION OF OPERATIONS:

Termination includes closing the trap and opening up weir panels for unabated fish passage. Any incident in this category is reported to the TOG.

- When water temperature meets or exceeds 22.5°C (72.5°F).
- Observation of numerous fish holding or pressing on the weir (overwhelming the capacity to normally process fish) (**Datasheet #4**).

Regular weir operations can be resumed subsequent to termination when recommended by the TOG.

5.4 STEELHEAD

It is possible that an adult Steelhead could be encountered at the weir. Therefore, we will anticipate and plan for this potential event(s) with the following protocol.

The emphasis will be to preempt encounters, minimize contact, and expedite passage in the direction of movement. Preemptive measures will include daily snorkel surveys below the weir during operational periods to look for approaching Steelhead, and staff will also watch the vicinity of the weir for approaching Steelhead. The TOG will be notified immediately of any Steelhead that are observed. Steelhead will be provided passage at the weir in the direction of their approach movement by opening gates or removing panels. Steelhead will not be physically handled unless it is necessary for their survival.

It is recognized that information collected on sockeye and Chinook interactions with the weir will inform the operation regarding options for Steelhead, and that the relevant data will be shared with the TOG on a continuous basis. Data will be summarized

appropriately to assist in trend analysis. Initial data may support that no change in operations is necessary.

- 2 Steelhead approach the weir and dropback in a sampling period (i.e., delay of migration by not choosing the trap or bypass route), weir operations are terminated that day. Weir operations resume the next day.
- 2 Steelhead are impinged on the weir on a day, or 3 Steelhead total during a sampling interval of 7 days, weir operations are terminated until directed otherwise by TOG.
- 2 Steelhead gilled/stuck between pickets on a day, or 3 Steelhead total during a sampling interval of 7 days, weir operations are terminated until directed otherwise by TOG.
- 1 Steelhead mortality at the weir, weir operations are terminated until directed otherwise by TOG and NOAA Fisheries.
- 10 Steelhead pass the weir in a day, weir operations are terminated that day. Weir operations resume the next day.
- 10 Steelhead pass the weir in a day for three days in a row, weir operations are permanently terminated for the year.

5.5 EXAMPLES OF NON-CRITICAL SITUATIONS

- Fish begin spawning downstream of the weir.
- Water discharge declines below 1000 cfs and tarps are used to focus flow through the trap or bypass areas of the weir.

6.0 REFERENCES

Nass, B. L., E. Zapel, and E. Rowland. A conceptual proposal for a salmon enumeration facility on the Okanogan River. Report prepared by LGL Limited, Ellensburg, WA for Confederated Tribes of the Colville Reservation, Fish & Wildlife Department, Omak, WA.

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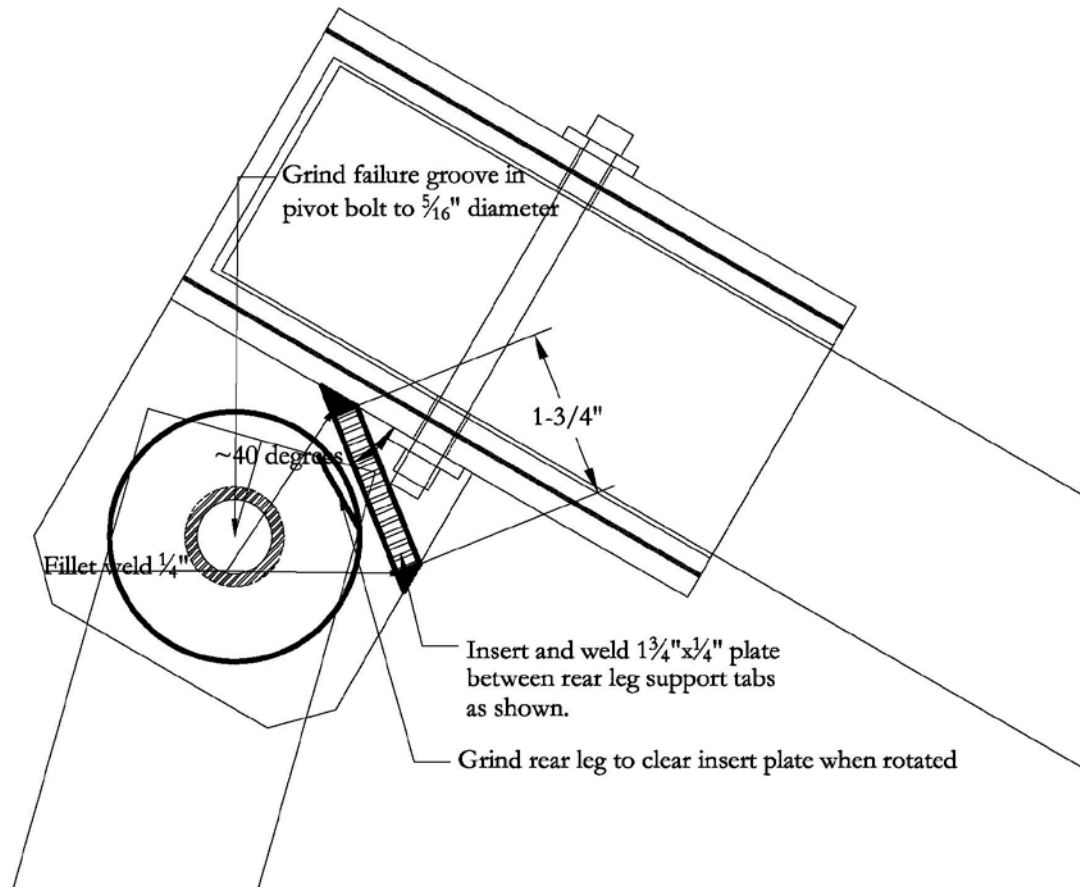
7.0 APPENDIX A – STANDARD OPERATING CRITERIA

STANDARD OPERATING CRITERIA

NOAA Criteria*	Criteria value	Okanogan River weir value	Meet Criteria Yes or No	Explanation
5.3.2.1 Picket Openings	≤ 1 inch	1 in to 3 in	No	Okanogan weir is designed to evaluate if sockeye can pass through pickets while excluding Chinook. Different gapped panels will be used.
5.3.2.2 Average Design River Velocity	<1 fps, w/ max <1.25 fps through pickets	0.9 to 3.5 fps average; 2.5 to 5.7 fps thru pickets	No	River cross section not large enough to facilitate picket area sufficient to achieve velocity criteria at design flows.
5.3.2.3 Head Differential	<0.3 ft	≤ 0.5 ft	Yes	Pickets will be cleaned regularly to maintain head loss within guidelines. Low flow situations may require water barricading adjacent to trap to maintain attraction flows.
5.3.2.4 Debris and Sediment	Plan	Plan	Yes	Debris and sediment will be controlled continuously during trapping periods. The weir will be inspected once per day during non-trapping periods, or more frequently if discharge increases substantially.
5.3.2.5 Picket Barrier Orientation	Lead fish	Angled lead	Yes	Weir designed with 10 to 20 degree lead to trap location. Also takes advantage of shallow right bank vicinity to force fish to deeper water on vicinity of trap.
5.3.2.6 Picket Freeboard	2 feet	≥ 2 feet	Yes	Pickets designed to provide at least 2 ft of freeboard at high design flow.
5.3.2.7 Submerged Depth	2 ft for at least 10% of river cross section	0<depth<3ft	Yes	Weir stretches from exposed bar at low flow to deeper thalweg at trap location. Depth depends on flow, but at lowest flow, depth at trap is at least 2 ft.
5.3.2.8 Picket Porosity	40% open area	37% @ 1" spacing, 64% @ 3" spacing	Yes	Okanogan weir is designed to evaluate if sockeye can pass through pickets while excluding Chinook. Different gapped panels will be used.
5.3.2.9	Flat, round,	ABS 1 ½" in	Yes	Pickets are 1 ½" ABS plastic pipe (black).

Picket material	aluminum, or plastic	pipe		
5.3.2.10 Picket sill	Uniform concrete or other approved	Bed stabilized with gravel bags	No	Weir designed as temporary test facility, not permanent. Permanent sill not part of design, nor part of test facility plan. Chain link will be used to stabilize bed if necessary.
6.5.1.2 Trap Capacity	0.25 cft / lb of fish @ <10°C, minus 5% every °F above	Minus 10% every °F above	Yes	Trap holding capacity dependent on water temperature and water depth in trap. Will require regular monitoring to determine holding capacity during operational periods.
6.9.2.1 Trap Volume	Equation based; or “relatively stable hydraulic conditions”	Volume changes with river stage.	Yes	Trap is porous to the river through pickets and will have similar conditions. Reduced velocity conditions can be achieved by partial blocking at upstream end of trap. Trap is 10ft wide x 15ft long with minimum depth of 18 inches.
6.9.2.1 Trap intake	Fine trash rack <7/8in	Standard 1in picket spacing	No	Trap is porous to the river through pickets and will have similar conditions.
6.9.2.1 Trap freeboard	4 ft above trap pool water surface at max design	3 ft above pool water surface at mean flows	No	Mean depth of pool will be 2 ft. Therefore, fish will not be able to jump very high. Further, trap is staffed constantly during operation to remove fish as they enter.
6.6.2.1 & 6.9.2.1 Trap surfaces	smooth	smooth	Yes	All metal edges rounded or ground smooth. Flat surfaces will be fish friendly.

* “Anadromous Salmonid Passage Facility Design”, NOAA Fisheries, 2008.



Appendix A Figure. Engineered weir panel failure mechanism.

8.0 APPENDIX B – DATASHEETS

DATASHEET #1. Daily check list to be completed everyday (including non sampling days). Task can be "✓" if completed with no additional action or an "✗" if the task does not apply for the day (i.e. no panels are in place on non sampling days). Describe the action taken if one is required. One data sheet per day.

DATE:

CREW:

Task	Observation and actions taken (if needed)
Ensure plastic pickets are driven into substrate and undamaged	
Ensure access bridge connections are secure	
Ensure minimal shoreline erosion	
Ensure facility warning signs, buoys & lights are in place and functional	
Ensure that lifesaver is in accessible location and all employees are wearing a PFD	
Ensure adjacent panels are abutting (record gap sizes)	
Ensure panel cable connections are secure	
Ensure no change in panel inclination and shape	
Ensure no debris accumulation on pickets	
Ensure gravel bags are secure	
Ensure trap connections are secure	
Provide assistance to recreationalists portaging around the weir	
Provide project information to recreationalists and visitors	
Ensure impinged fish are removed from the upstream side of the weir	
Ensure a non-detrimental weather forecast for the next day	

Datasheet #2. On-river person traffic observed. One person/group per line. **Locomotion:** Means of movement ("Blue kayak", "Walking", "White speedboat", etc). **Direction:** Moving upstream or downstream (US/DS). **Action:** What they did and if weir staff helped ("Walked around on shore", "turned back", "required assistance carrying canoe on shore", etc). Observations will be recorded as they happen and video data can be added upon review.

[illegible]

Datasheet #3. **Fish gilled or impinged on weir.** All species. One fish per line. **State:** Current state of existence. Live, dead but had been spawning, dead but had not been spawning (L/DS/DNS). **Hole punched:** Does the fish have a hole punch in their left pectoral fin (Y/N). Chinook only. **COD:** Obvious causes of death. Otherwise, leave blank.

[illegible]

Datasheet #4. **Behavior of Chinook (CH), Sockeye (SO), and Steelhead (SH) approaching the weir.** One data sheet per day. Conducted four times a day (7:00, 10:45, 14:30, 18:15) for 30 minutes with data observations being made every 5 minute. Number of fish Left of thalweg, Center, Right of thalweg. **Searching:** Spend majority of time erratically moving up, down, and/or side-to-side in an apparent attempt to pass the weir (Y/N). **Swam DS:** Immediately or eventually swims back downstream (Y/N). **Stationary:** Spend majority of time relatively stationary (Y/N). **Jump:** Number times jumping or contacting weir. **Guidance:** Guided towards the trap (Y/N). **Panel:** Passed through a weir panel (Y/N) and, if so, which one (P1/P2/P3...). **Trap:** Entered trap box (Y/N).

DATE:

CREW:

Time	Species	Left	Center	Right	Searching	Swam DS	Stationary	Jump or Contacting	Guidance	Panel	Trap
Comments:											
Comments:											
Comments:											
Comments:											
Comments:											

Datasheet #5. **Weir trap data.** All species. One data sheet per day. One fish per line. CH=chinook, SK=sockeye, SH=steelhead. **Time:** When the fish was processed. **Origin:** Need only be determined of Chinook (CH). Natural or hatchery (N/H). **Applied mark:** Hatchery origin CH will be measured (in.), have their left pectoral fin hole punched. Hole punch applied (Y/N). **Vigor:** Classify level of fish vigor after trapping and handling. 1) vigorous, 2) vigorous and bleeding, 3) lethargic, 4) lethargic and bleeding, or 5) no movement/ventilation

[illegible]

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Datasheet #6. **Chinook (CH), Sockeye (SO), and Steelhead (SH) tally between the weir and Chilliwist Creek (~1 km).** One data sheet per day. Survey will be conducted twice a day (9:00, 16:00) in 100 m transects on each by two people swimming downstream. **Live:** Number live salmon observed. **Behavior:** General behavior of live fish. **DS:** Number of dead and had been spawning. **DNS:** Number of dead and had not been spawning.

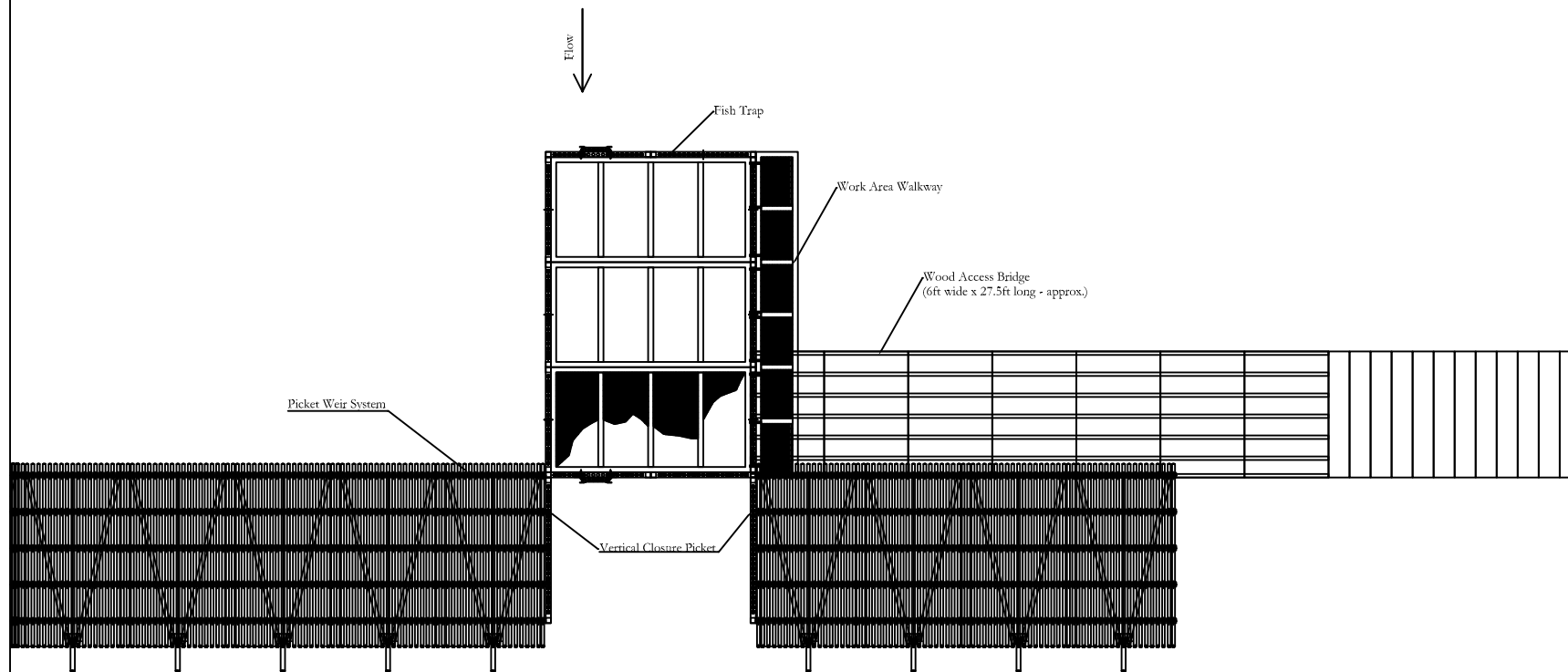
DATE:				CREW:								
Left Bank		Chinook			Sockeye			Steelhead				
Time	Transect	Live	DS	DNS	Live	DS	DNS	Live	DS	DNS	Comments	
	900-1000											
	800-900											
	700-800											
	600-700											
	500-600											
	400-500											
	300-400											
	200-300											
	100-200											
	0-100											
	900-1000											
	800-900											
	700-800											
	600-700											
	500-600											
	400-500											
	300-400											
	200-300											
	100-200											
	0-100											
Right Bank		Chinook			Sockeye			Steelhead				
Time	Transect	Live	DS	DNP	Live	DS	DNP	Live	DS	DNP	Time	
	900-1000											
	800-900											
	700-800											
	600-700											
	500-600											
	400-500											
	300-400											
	200-300											
	100-200											
	0-100											
	900-1000											
	800-900											
	700-800											
	600-700											
	500-600											
	400-500											
	300-400											
	200-300											
	100-200											
	0-100											

[illegible]

Datasheet #8. **Daily water velocity (ft/sec) measurements.** One day per line. **US1 = X. US2 = X. DS1 = X. DS2 = X.** NOAA guidelines indicate 1.25 ft/sec maximum. Non-compliance would require adjustment of panel structure, or request for variance.

[illegible]

9.0 APPENDIX C – WEIR SCHEMATICS



Fish Trap & Picket System Arrangement - Plan View

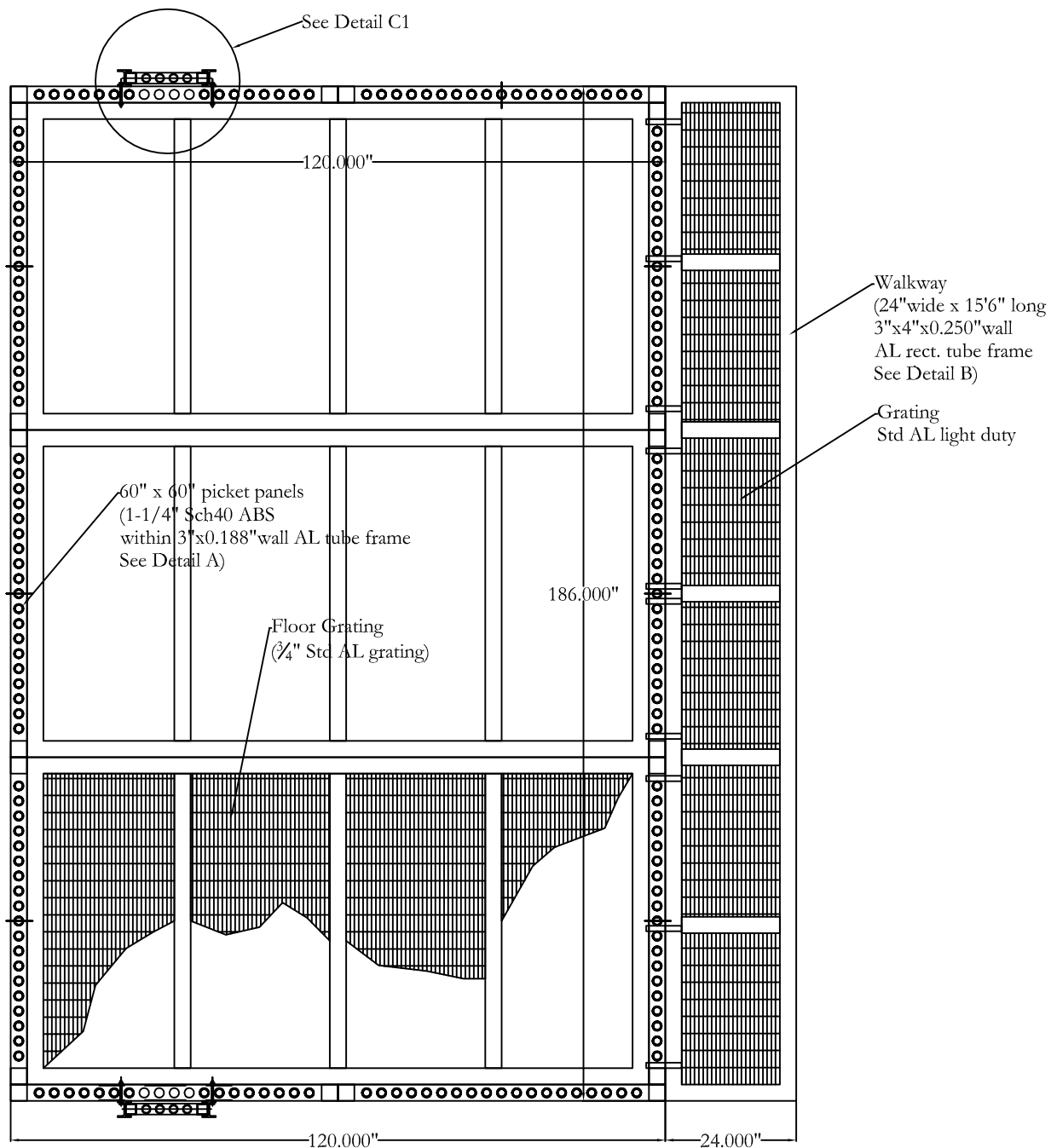
Colville Confederated Tribes
Fish & Wildlife

Okanogan River Fish Collection Weir
Malott Site 2

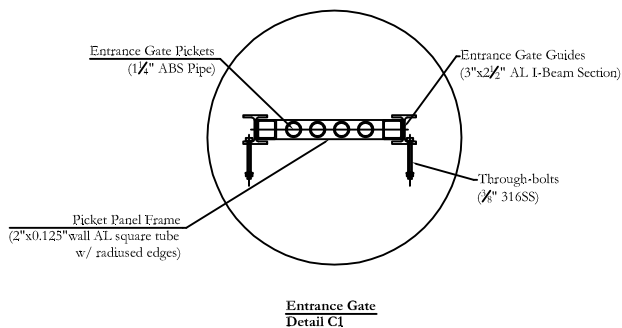
Fish Trap & Picket System
Plan View Overall
Figure 1

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Fish Trap - Top View



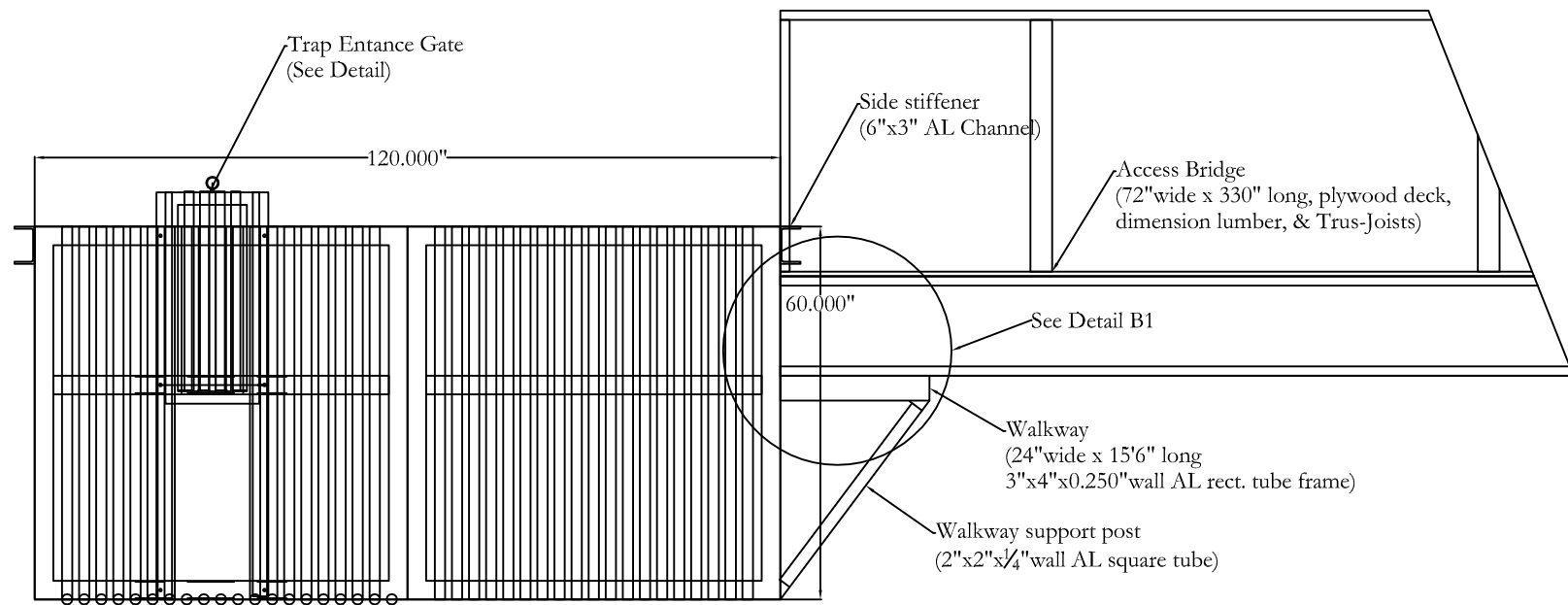
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Malott Site 2

**Fish Trap Details
Plan View
Figure 2**

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Trap
Typical Front Elevation

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Okanogan River Fish Collection Weir
Malott Site 2

Fish Trap Details
Front Elevation
Figure 3

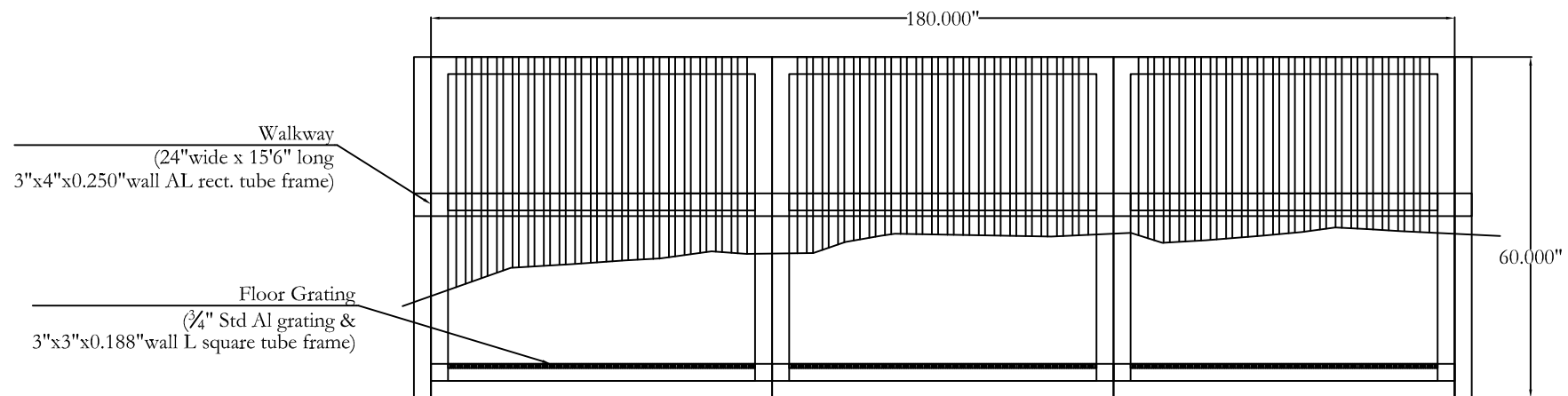
21893-1

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Trap
Typical Side Elevation

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Okanogan River Fish Collection Weir
Malott Site 2

Fish Trap Details
Side Elevation
Figure 4

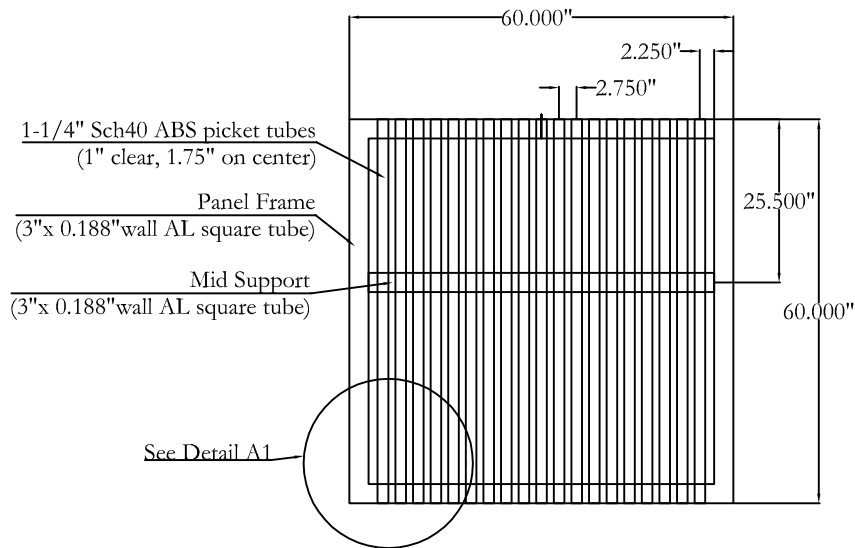
21893-1

REV. NO.: 0

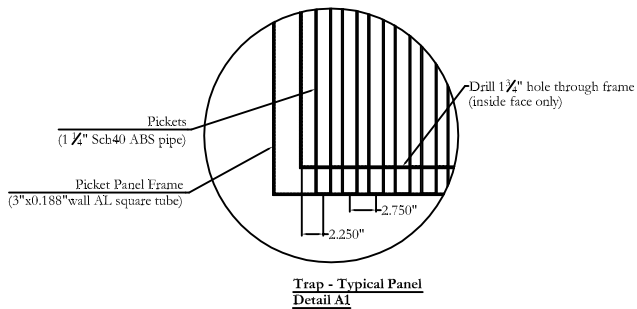
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Trap - Typical Panel
Detail A



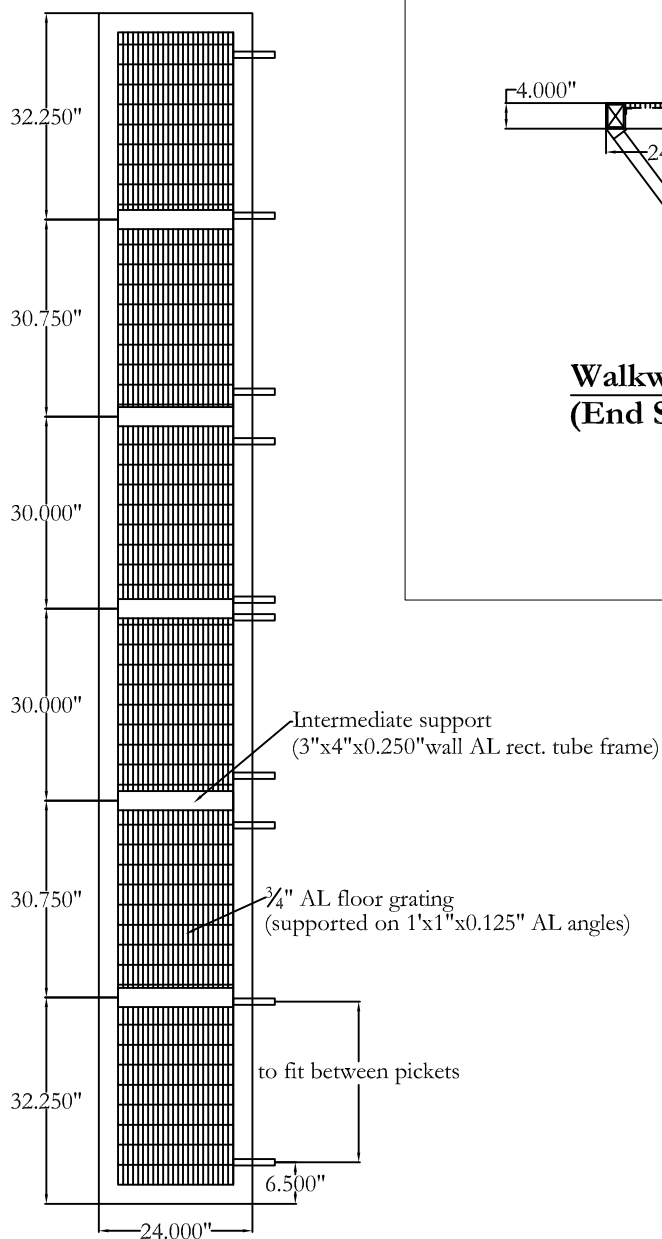
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Okanogan River Fish Collection Weir
Malott Site 2

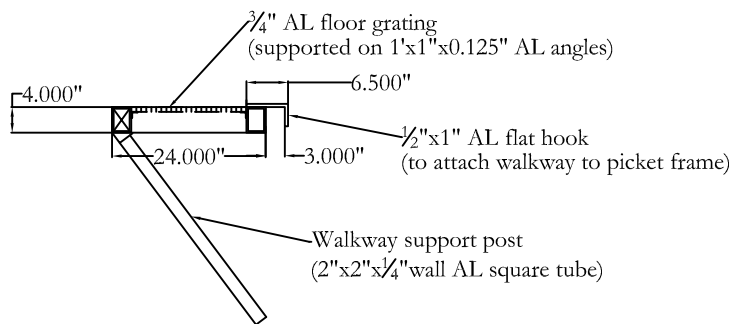
Fish Trap Details
Trap Panel Detail A (Typical)
Figure 5

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Walkway - Detail B
(Typical Plan View)



Walkway - Detail B1
(End Section)

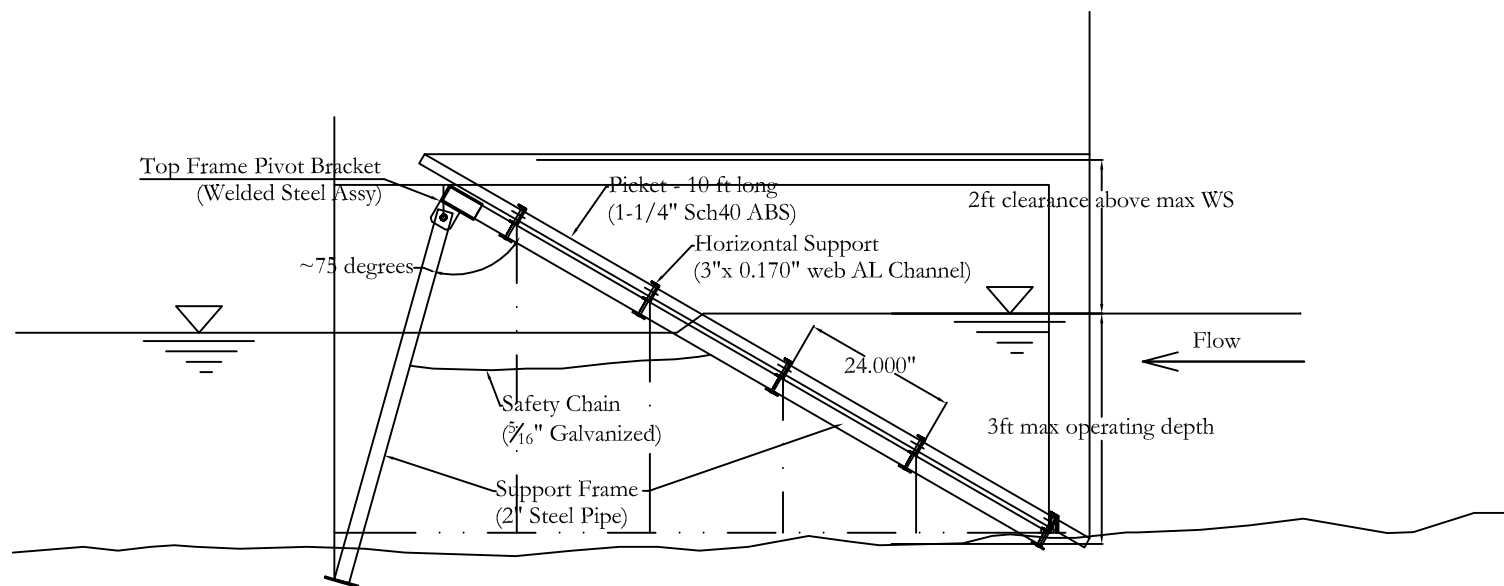
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Fish Trap Details
Walkway Detail B - Plan View
Figure 6

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Typical Side Elevation
(deployed position)

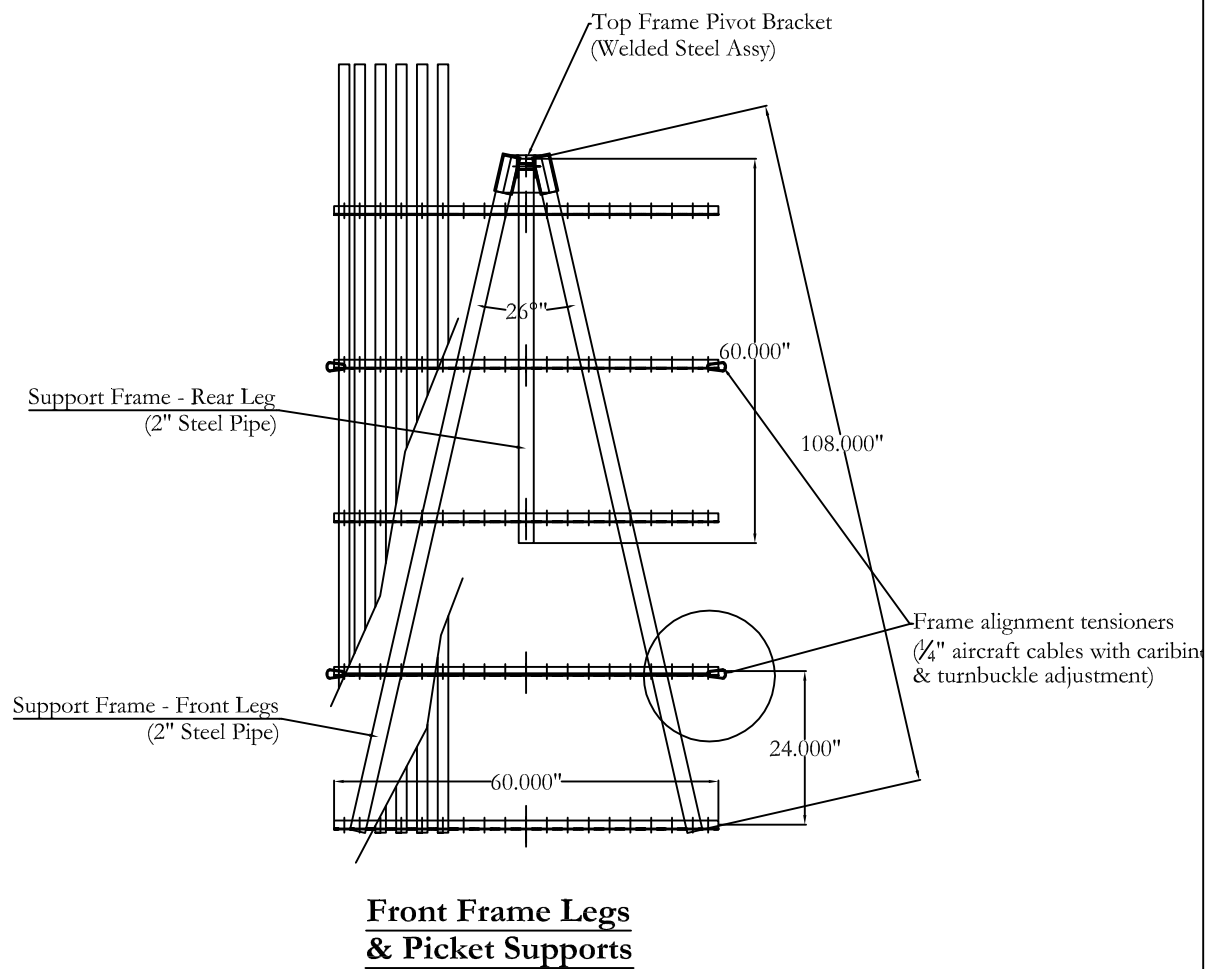
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Okanogan River Fish Collection Weir
Malott Site 2

Weir Picket Panel Details
Side Elevation - (deployed)
Figure 7

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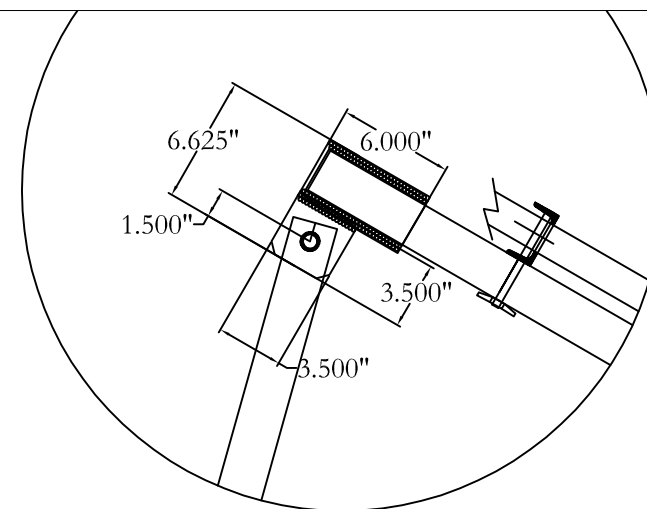
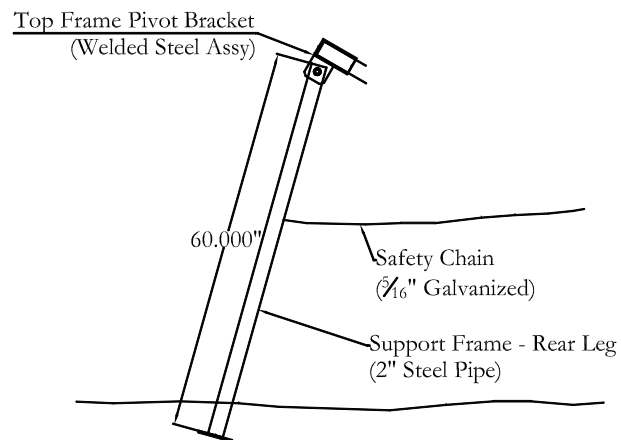
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Malott Site 2

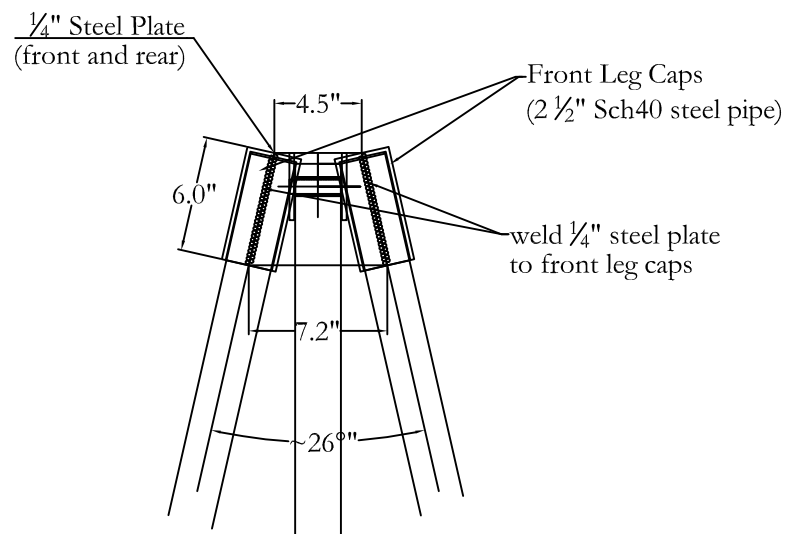
**Weir Picket Panel Details
Front Frame Legs & Picket Supports
Figure 8**

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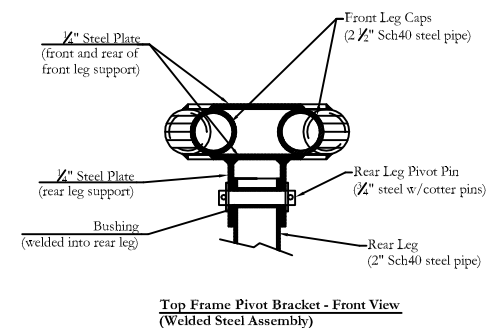
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Top Frame Pivot Bracket - Side View
(Welded Steel Assembly)



Top Frame Pivot Bracket - Front View
(Welded Steel Assembly)



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Okanogan River Fish Collection Weir
Malott Site 2

Weir Picket Panel Details
Rear Frame Leg & Top Frame Bracket
Figure 9

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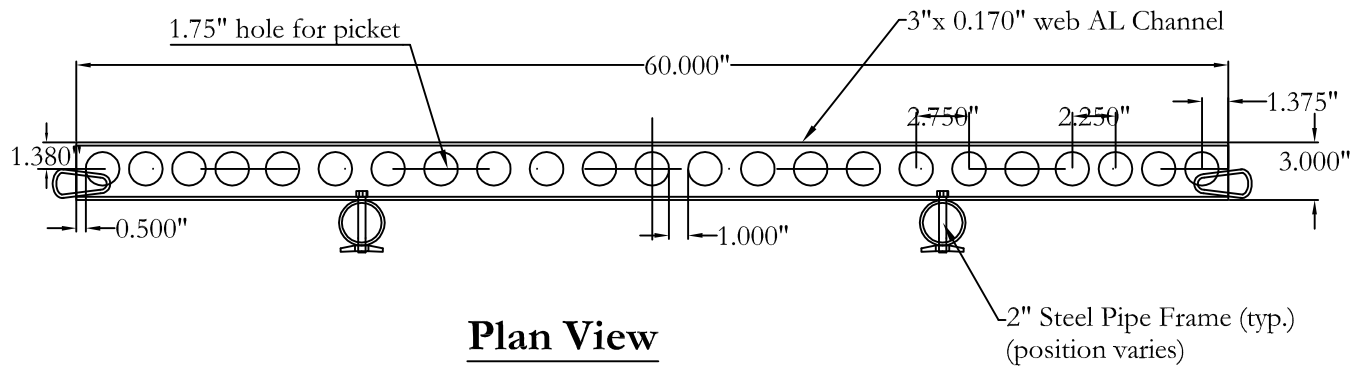
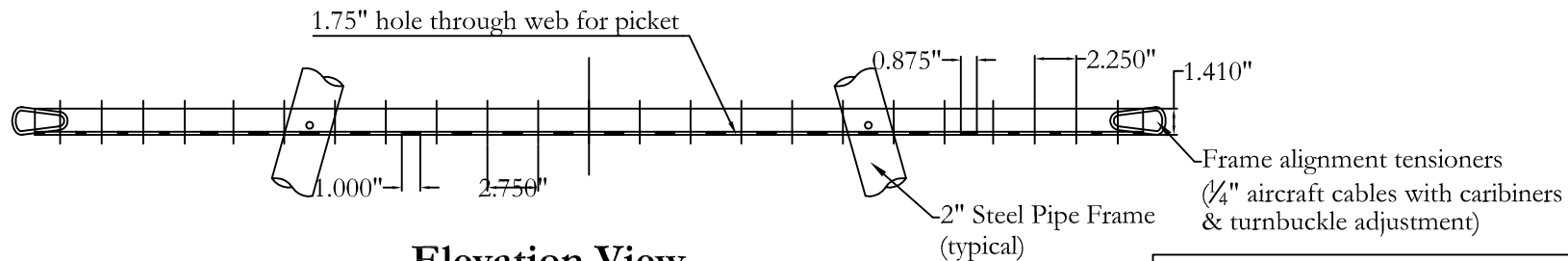
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NOTE:

lay out holes from center.

adjust end hole locations to fit as shown.

4 end holes each side 2.25" apart on center.

**Plan View****Elevation View**

Horizontal Picket Support

(For 1-1/4" PVC Typical - 1" clear)

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Malott Site 2

Weir Picket Panel Details
Picket Supports - (1.0" clear spacing)
Figure 10

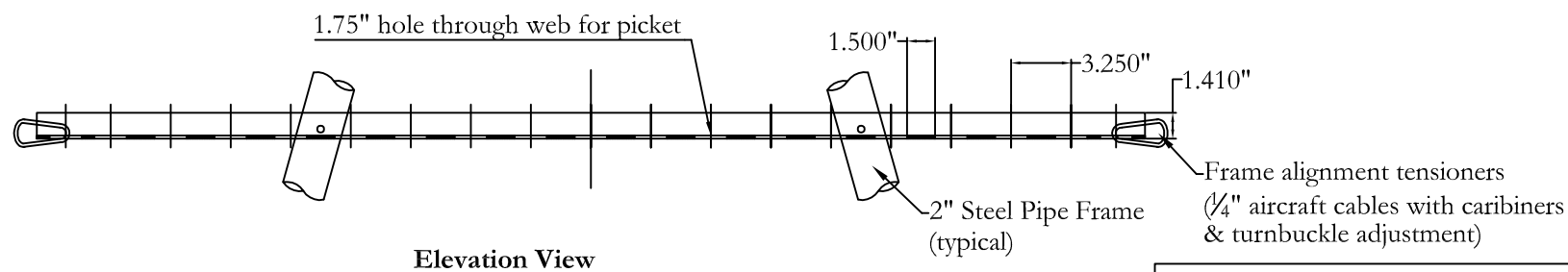
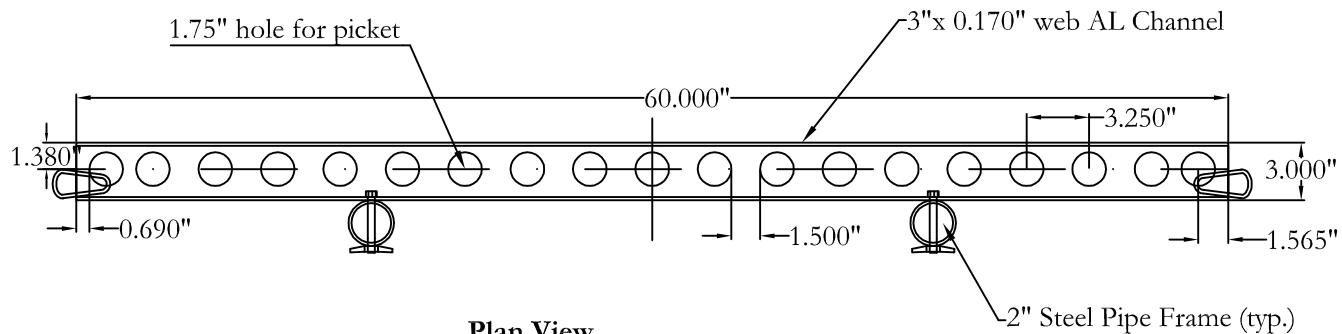
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NOTE:

lay out holes from center.

adjust end hole locations to fit as shown.



Horizontal Picket Support
(For 1-1/4" PVC Typical - 1.5" clear)

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Okanogan River Fish Collection Weir
 Malott Site 2

Weir Picket Panel Details
Picket Supports - (1.5" clear spacing)
Figure 11

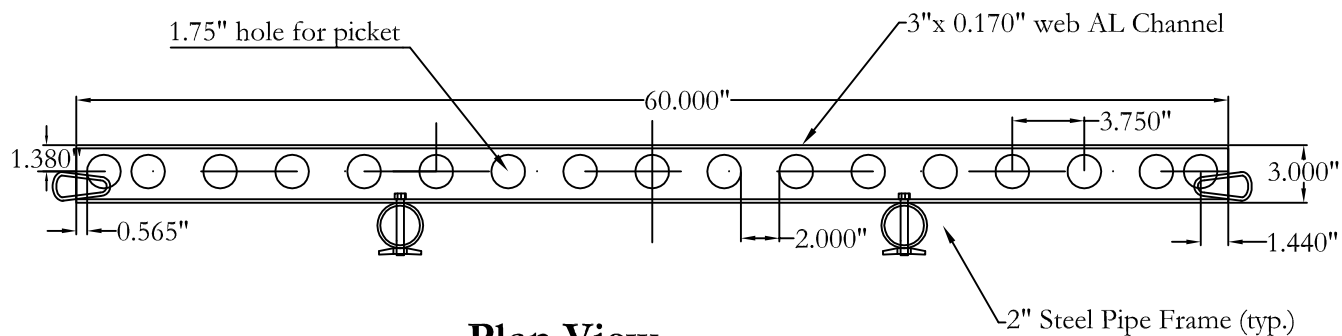
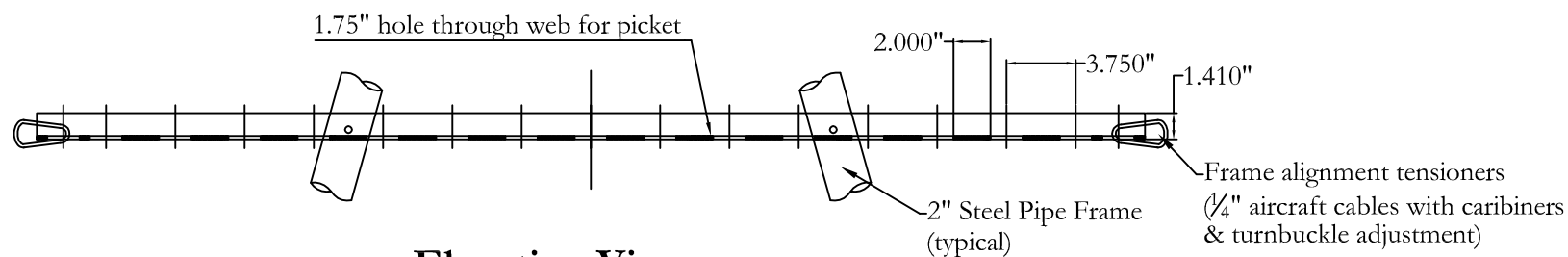
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NOTE:

lay out holes from center.

adjust end hole locations to fit as shown.

**Plan View****Elevation View**

Horizontal Picket Support (For 1-1/4" PVC Typical - 2" clear)

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Okanogan River Fish Collection Weir
Malott Site 2Weir Picket Panel Details
Picket Supports - (2" clear spacing)
Figure 12

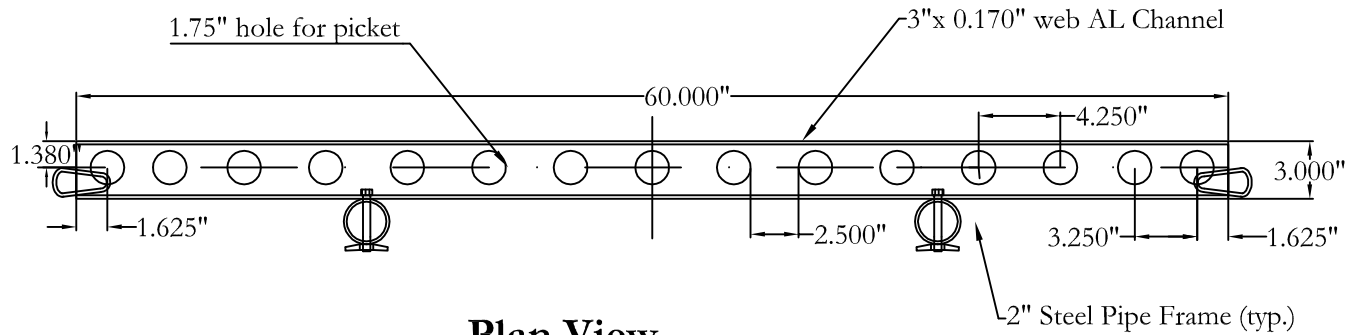
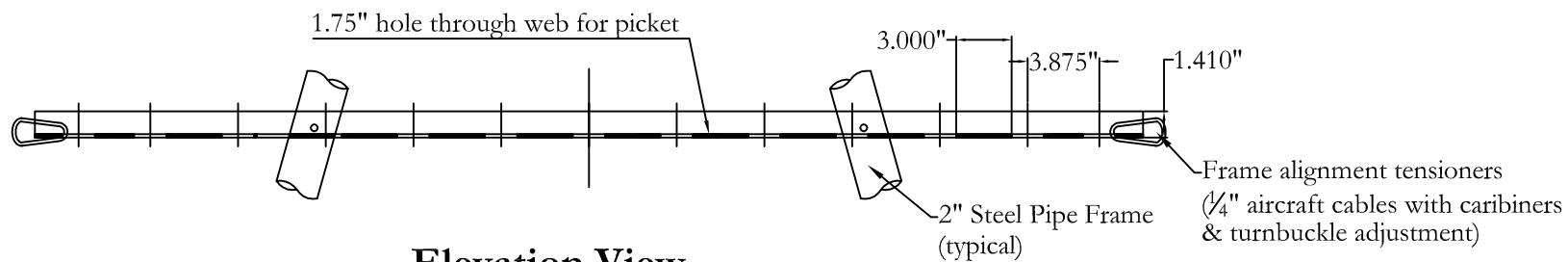
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NOTE:

lay out holes from center.

adjust end hole locations to fit as shown.

**Plan View****Elevation View**

Horizontal Picket Support

(For 1-1/4" PVC Typical - 2.5" clear)

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Malott Site 2

Weir Picket Panel Details
Picket Supports - (2.5" clear spacing)
Figure 13

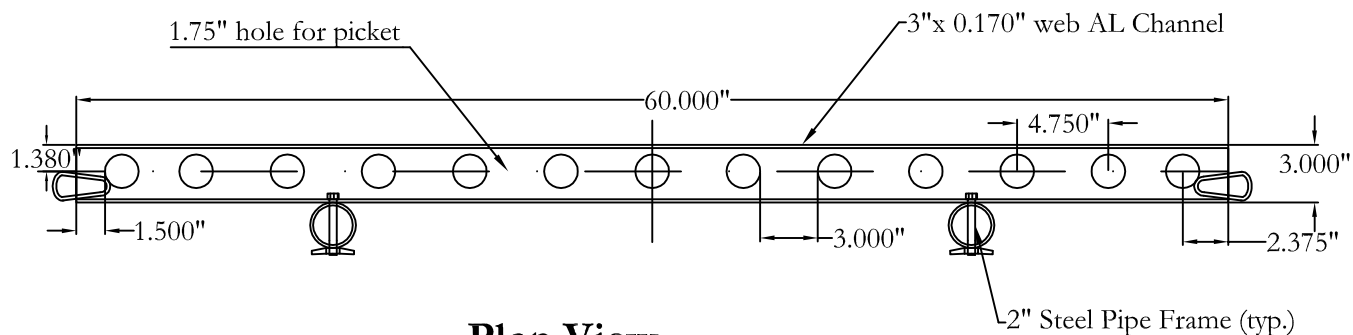
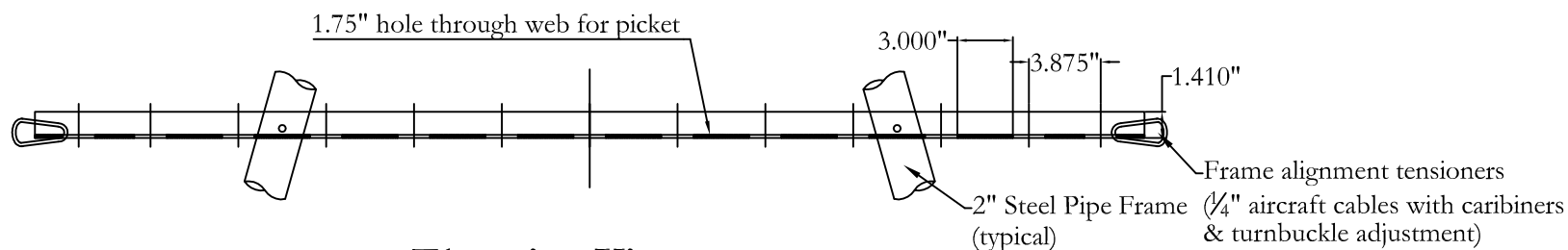
21893-1 | REV. NO.: 0 | DRN. BY: TRS | 5 May 2011

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NOTE:

lay out holes from center.

adjust end hole locations to fit as shown.

**Plan View****Elevation View**

Horizontal Picket Support (For 1-1/4" PVC Typical - 3" clear)

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Okanogan River Fish Collection Weir
Malott Site 2Weir Picket Panel Details
Picket Supports - (3" clear spacing)

Figure 14

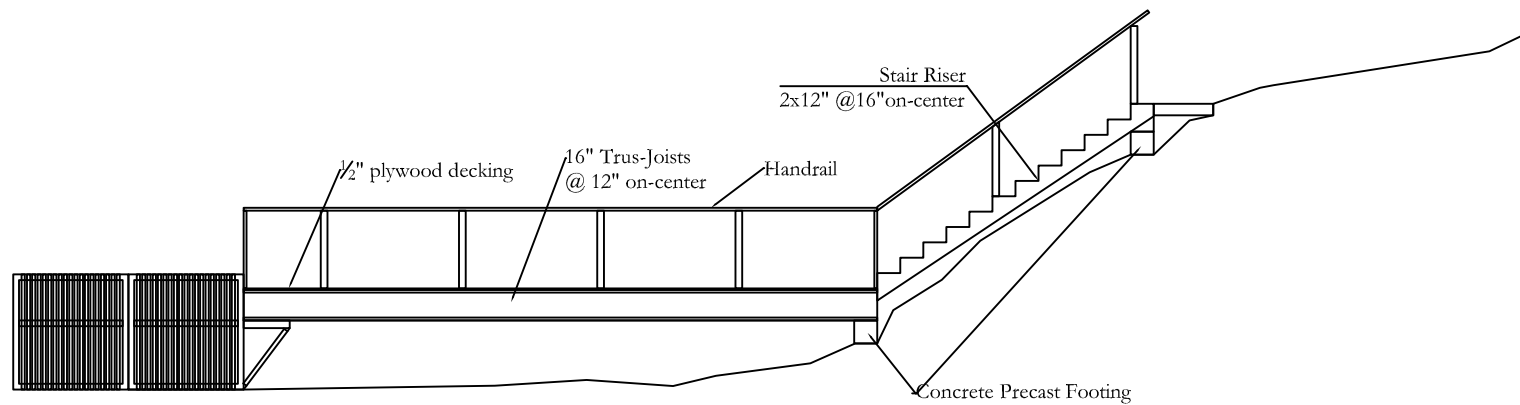
21893-1

REV. NO.: 0

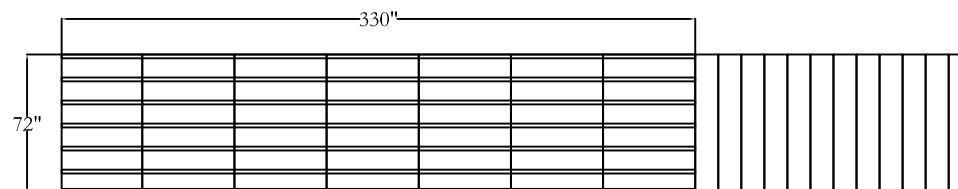
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Access Bridge & Stairway -
Side Elevation



Access Bridge & Stairway
- Plan View

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Okanogan River Fish Collection Weir
Malott Site 2

**Wood Access Bridge & Stair
Side Elevation**

Figure 15

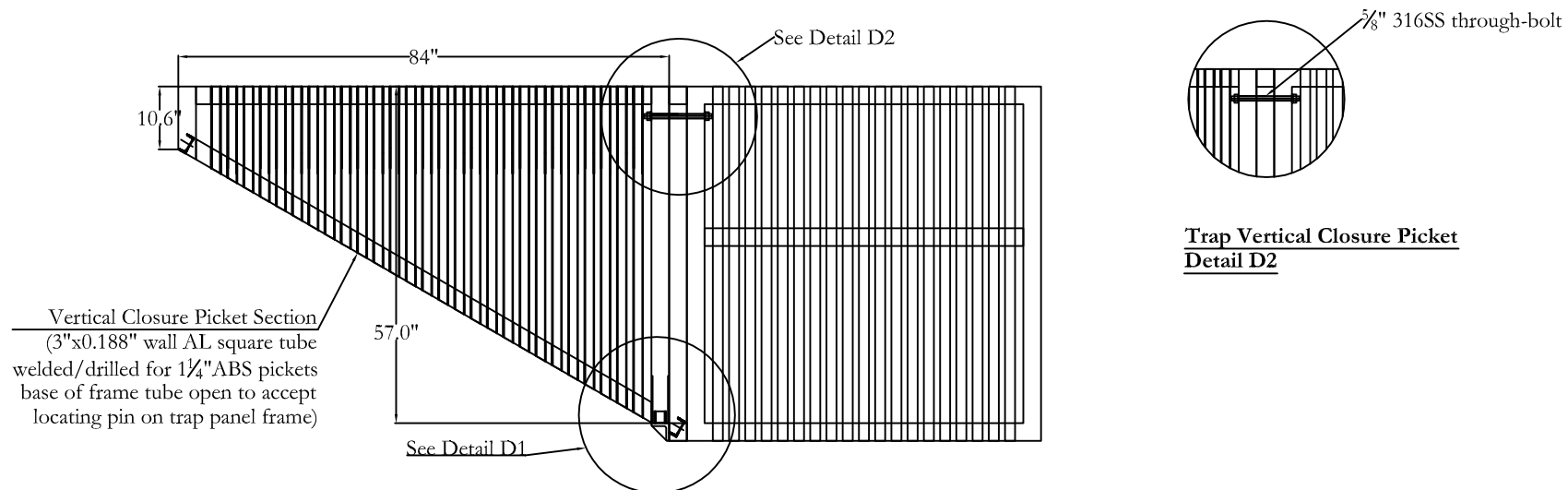
21893-1

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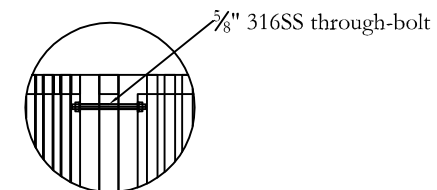
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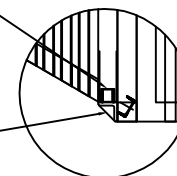
**Trap Vertical Closure Picket
Side Elevation**

2"x0.25" wall x 2" high AL Square Tube
(Short section welded to angle support to provide centering pin for closure picket section locating)

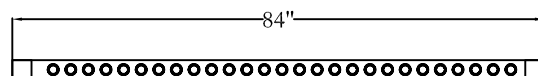
3"x3"x1/2" AL Structural Angle Section
(with 1/2" thick flange welded in for support)



**Trap Vertical Closure Picket
Detail D2**



**Trap Vertical Closure Picket
Detail D1**



**Trap Vertical Closure Picket
Top View**

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Okanogan River Fish Collection Weir
Malott Site 2

**Fish Trap Details
Picket Closure Section - Details
Figure 16**

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