Limiting Factors Assessment and Restoration Plan

Olalla Cr.

Tributary of the Yaquina Estuary

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Introduction

This document provides watershed restoration actions proposed to enhance the Coho Salmon population within the Olalla Creek subbasin in Lincoln County, Oregon. The subbasin lies in the Oregon Coast Range and contributes to the Yaquina River Basin. For purposes of this assessment, the subbasin includes Olalla Creek mainstem (Slough) and East Olalla Creek with its tributaries, but not West Olalla Creek and its tributaries.

The goal of the restoration effort has been to identify the dominant processes and habitat characteristics that currently limit the production of Coho salmon smolts in the basin, and to develop a prioritized list of actions ("prescriptions") for removing the limitations in ways that normalize landscape and stream channel function.

Restoration and assessment protocols used in developing the plan are described in "Midcoast Limiting Factors Analysis, A Method for Assessing 6th field subbasins for Restoration", available at www.midcoastwatershedscouncil.org/GIS or by contacting the Midcoast Watersheds Council. Please refer to this document for detailed information on assessment, nomenclature, prioritization rational and methodology.

Physical setting

As defined, the Olalla Creek subbasin comprises approximately 1,276 hectares in the Oregon Coast Range. Although East Olalla Creek originates in mountain valleys, a large portion of the stream and mainstem Olalla flows through lowlands with broad floodplains and very gentle gradients. This combination of mountain valley reaches and lowland habitats provides excellent potential for supporting Coho spawning and rearing through their complete freshwater life cycle.

The mountain valley portion of East Olalla Creek is about 2.9 miles long, and lies within a generally broad floodplain and low relief hillslopes. Even the uppermost reach of the Creek is characterized by valley floor widths up to five times stream width and gradients in the 1 to 2 percent range.

At river mile 6.4, the valley floor opens up into a very wide floodplain, and the stream meanders over this floodplain with a broad looping pattern until its confluence with the Yaquina River. At river mile 4.3, the West Fork Olalla Creek enters from the northwest bringing a steady supply of water from Olalla reservoir, a Georgia-Pacific water storage facility. Much of this water is imported to the reservoir from the Siletz River. At river mile 0.8, Georgia-Pacific maintains a tide gate that prevents the upstream flow of saline water from the Yaquina River. The function of the imported water and the tide gate is to secure a stable supply of fresh water for the Georgia-Pacific plant in Toledo.

These three physical features, the broadened valley, introduction of imported water from the Siletz River, and the tide gate divide East Olalla Creek and the mainstem (Olalla Slough) into four distinct ecological zones. These zones are described below, and are used as the basis for assessing the rearing capacity of the system.

Lower Olalla Slough: RM 0 to 0.8. Reach 1 of ODFW 2001 Olalla Slough survey. Lowlands. No riparian canopy. A salt water lagoon, with tidally flooded marshlands. Simple channel, no branching.

Upper Olalla Slough: RM 0.8 to 4.3. Reach 2 of ODFW 2001 Olalla Slough survey. Lowlands. Very limited riparian canopy. Freshwater marshlands, simple channel, no branching, lake-like (due to tide gate acting as a dam), wood-deprived, supplied with West Fork Olalla flow.

Lower East Olalla Creek: RM 4.3 to 6.4. Reaches 1-3 of ODFW 2000 East Olalla Creek survey. Lowlands. Very limited riparian canopy. Freshwater grass and marsh, simple channel, no branching, "pasture trench pool" habitat, wood deprived. Subject to very low flows, stagnation, temperature and oxygen restrictions.

Upper East Olalla Creek and its tributaries: RM 6.4 to 9.3. Reaches 4-9 of ODFW 2000 East Olalla Creek survey. Mountain valleys. Varied and mixed deciduous-conifer riparian canopy. The channel is simple and entrenched with little side-branching and is wood-deprived, but exhibits some meander over the floodplain.

All significant tributaries except for West Olalla Creek are located in the upper East Olalla Creek segment, above the lowlands. The Oregon Department of Fish and Wildlife conducted surveys in 2000 and 2001 that identified 14 tributaries in this segment. These streams exist in small subbasins and individually contribute modest flows to East Olalla and Creek. Because of this and generally high temperature profiles, only some of the tributaries provide important cold water temperature mitigation for East Olalla Creek.

The 2001 ODFW survey numbered the tributaries 1 to 14, while the 2000 and 2003 studies each used lettering systems. The following correlations exist between the 2000, 2001, and 2003 tributary designations:

2001	2000	2003
1		A
2		B
3	A	C
4		
5		D
6		E
7		
8		
9		F
10		
11		
12		
13		
14		

The subbasin has been extensively modified by human activities such as timber harvest, diking, culvert placement, conversion of floodplain for pasture and agricultural uses, road construction, rural residential development, water removal, and organic enrichment. The effects are seen in the commonly observed litany of channel, riparian, and water quality changes: Loss of riparian cover and instream wood, channel simplification, siltation, and elevated summer temperatures.

Despite the loss of dendritic marshland channel structure and other adverse effects of human use, the lowland segments of the subbasin continue to provide large areas of rearing habitat for juvenile salmonids. This is a result of the impoundment created by the GP water intake facility on 10th st. in Toledo.

Current status of Coho

The status of Oregon Coast Natural (OCN) Coho in the Olalla Cr subbasin was reviewed in 1999 by the Midcoast Watershed Council using the Rapid Bio-Assessment snorkel inventory. This survey observed a moderate distribution of juveniles in tributary habitats (4 of the 9 tributaries contained summer rearing Coho) and they extended high into the headwater reaches (4.6 miles from the Sturdevant Rd. crossing). The total expanded juvenile population for the 6th field subbasin in 1999 was 4,050 summer parr. Calculations of potential adult escapement utilizing an 8.8% egg/parr survival rate produces an estimate of 34 total adults (assuming a 1:1 male/female ratio). The summer parr estimates definitively underestimate the actual abundance of the summer standing crop within the 6th field because of the summer rearing that was occurring in the 3.3 miles of fresh water and salt water marsh and wetland that exists downstream from the Sturdevant Rd. crossing to the Railroad trestle near the confluence with Yaquina Bay. This zone exhibits a brackish water environment that was not included in the 1999 snorkel inventory because of poor visibility. We are however certain that summer rearing occur s here and that stream temperatures are mitigated by the cold water releases from the reservoir at Olalla Lake. The basin will be resurveyed during the summer of 2003. This data will be available by September, 2003.

Resources used in developing the plan

The following resources provided information used in the assessment:

- Oregon Department of Fish and Wildlife aquatic habitat surveys conducted on Olalla Slough in 2001 and on East Olalla Creek and three of its tributaries in 2000.

- Summer snorkel surveys of the Olalla Creek basin and its tributaries conducted in 1999. These "Rapid Bio Assay" fish inventories identify the species, age class, density and distribution of salmonids in pools (sampling frequency is every 5th pool).

- Coho habitat assessment model developed by the Oregon Department of Fish and Wildlife Research Division. This model evaluates the quantity of spawning gravel, egg deposition rates, and amount of aquatic habitat by season in order to identify which seasonal habitat and Coho life stage limit the production of smolts from a stream section (referred to as the smolt production bottleneck).

- Oregon Department of Forestry slide assessment maps, which identify failure-prone headwater slopes that are considered to be potential sources of wood and substrate to the aquatic corridor.

- Bio-Surveys Field assessment conducted on June 10-15, 2003 in conjunction with the development of this restoration plan.

General questions that guided the assessment

How well is the current system functioning for Coho production (what part does each of the habitat subdivisions play)
What temperature problems are apparent?
Where are temperature refugia located?
Where are the barriers?
What is the sedimentation state of system?
Where are the spawning areas, and how are they integrated with the summer and winter rearing sites?
What needs to be done to make the Core habitat function for all life phases, and to function at a higher level?
What work should be done in each area to facilitate a more completely functional whole?
What is the best upslope work that supports the instream work?
How are the fish currently using the system?
What problems are generated by the current habitat configuration (e.g., temperature dependant movements that expose juveniles to predation)
How and when are the greatest losses generated to the population?
Within the Core habitat, what are the dominant limiting factors?
Within the 6th field, what are the dominant limiting factors?
Within the 4th field, what are the dominant limiting factors?
Does the presence or absence of adequate winter habitat outside the spatial boundaries of the 6th field suggest or preclude the need for expanding the quantity or quality of winter habitat.

Pre-survey Mapping / Location of habitat subdivisions

Core Areas

The Core area describes the current summer distribution of juvenile Coho. The Core extends from Yaquina Bay to a point 7.8 miles up the mainstem of Olalla Cr. In addition, the Core extends up Tributaries B, C, E, and G. See habitat distribution Map.

Anchor Habitats (prioritized for greatest potential for restoration)

1) Lower 2,385 lineal ft. of the mainstem below the confluence of Trib E, current function is rated as poor but site exhibits greatest potential for the development of floodplain interaction because of low terraces, slight increase in gradient that would assist in sorting spawning gravels and its location below the most significant source of spawning gravel resource (Trib E).

2) Upper 3,000 lineal ft. of the upper mainstem to the end of Coho distribution, current function rating is moderate and trending toward recovery, the zone is a destination for spawning, contains highest level of instream wood from riparian recruitment and historical debris flow activity. Diminished habitat size restricts its potential for summer and winter rearing.

Secondary Branch Habitats

Trib A contains no significant spawning gravel resource, the tributary does however provide a cold water resource (56 deg) to the mainstem above the confluence of the WF Olalla where summer temperatures may influence the quality of mainstem rearing habitats.

Trib B contains 14 sq.m of spawning gravel and is a warm source of water (65 deg). In addition, the tributary contained 24 percent of the summer parr observed in the 1999 inventories.

Trib C contains 15 sq.m of spawning gravel and is the source of cold water (56 deg) for mitigating elevated mainstem temperatures. In addition, the tributary contained 11 percent of the summer parr observed in the 1999 inventories.

Trib E contains 93 sq.m of spawning gravel and is the source of significant summer flow and temperature (56 deg) maintenance to the mainstem. Temperature profiles may have been compromised by recent harvest activities in the tributary that are extensive. Live surface flow is common in multiple 1st order tributaries of Trib E that bisect harvest units with no vegetative buffer. The tributary contained 4 percent of the summer parr observed in the 1999 inventories.

Trib G contains 22 sq.m of spawning gravel and is a source of cold water (58 deg) to the mainstem and contained only 15 juvenile Coho during the 1999 inventory, these juveniles were probably upstream migrants from the mainstem.

Critical Contributing Areas

Overall Prioritization of critical contributing areas (considers all attributes: spawning, rearing, resource contribution, water quantity, water quality)
Trib E
Trib B
Trib C
Trib G
Trib A

Tributaries below Core Area / Anchor Sites
Trib A delivers well below an identified anchor site and into the fresh water marsh habitat just above the Sturdevant Rd. crossing. Resources recruited from this CCA would have little impact on improving ecosystem function. Its highest value is its cold water contribution and its refuge potential for upstream temperature dependant juvenile migrations. Passage for juveniles is terminated at the very beginning of the tributary by a 4"perched culvert and then higher in the system by a 16" perch.
Trib B delivers below an identified anchor site and also into a zone that would not benefit significantly from the contribution of gravel or wood resources. The tributary is very important for providing spawning habitat and was the only summer habitat seeded to capacity during the 1999 inventory.
Trib C delivers below an identified anchor site and into a zone that would not benefit significantly from the contribution of gravel and wood resources. This Tributary exhibits significant potential for spawning and temperature refuge for upstream juvenile migrants. Passage for juveniles is definitively terminated at approximately 1500 ft. by a perched culvert.
Tributaries above Core Area / Anchor Sites
Two small tributaries arranged consecutively above the confluence of Trib E on the right bank would contribute within the Core but above the lower anchor site. They contain high risk slope priorities 3 and 4. The trib containing priority slope #3 could deliver to the Core area. The trib that contains slope #4 exhibits low potential for delivery to the Core because of a Hwy 20 Rd. crossing.

Tributaries that contribute directly to Anchor Sites
Trib E delivers directly to the top end of the highest priority anchor site. It contains 88% of the spawning gravels classified as "good" (88%) for the entire drainage and 31% of the total gravel quantified in the system. It is the most significant contributor of tributary flow and delivers water at 56 deg. to the mainstem. Resource delivery from this tributary has the highest potential for improving ecosystem function. The ODF landslide risk assessment identified several high risk slopes in this tributary that would contribute to the active channel but that have a lower potential for transporting material to the Core fish bearing zone (substrate contribution from these slopes would have a greater potential for reaching the Core).
Trib D delivers directly to the lower anchor site and contains ODF's second highest priority site for slope failure. The potential for this CCA to successfully contribute to the anchor site is extremely low because of the Hwy 20 crossing that would terminate any significant debris flow.
5 consecutive no name tributaries on the left bank in the headwaters have been ranked as priority #5 for their potential to contribute directly to the Core area (see ODF Landslide Hazard Map). All 5 of these CCA's also contribute to the upper anchor site. None of these tributaries are fish bearing.

Lower Mainstem Area

The lower East Olalla Creek and Olalla Slough segments of the system lie within the lowland habitats of the Olalla Creek floodplain. These segments are therefore discussed below in the Lowland Area section of the report.

Lowland Area

The lower East Olalla Creek and Olalla Slough from RM 0-6.4 consists of three distinct habitat types: 1) Estuarine marsh habitat (0.8 mile), 2) Wetland marsh habitat (3.5 miles), and 3) Pasture trench habitat (2.0 miles). Each of these habitat types provide high quality winter habitat for juvenile salmonids.

This same 6.4 miles of lower mainstem also provides large surface areas of summer habitat that could be utilized by juvenile salmonids. However, as discussed below, the Pasture Trench habitat is characterized by low flows, low oxygen, and high temperature conditions that appear to preclude summer use.

Juvenile abundance in this region is not well documented because visibility is compromised by extensive organic decomposition during summer flow regimes.

Winter Habitat Assessment

1) Lower Olalla Slough (Estuarine Marsh Habitat)
This is the 0.8 mile reach of tidally influenced estuary habitat from the Rail Road crossing near Yaquina Bay to the Georgia Pacific fresh water pumping station at the 10th st. Rd. crossing. This habitat in particular provided substantial historical salt water marsh habitat that has been isolated by dike development. The salinity was measured at 15.7 ppt on July 29, 2003 on a low tide at 0830. Coho use is unknown in this region but is probably more significant during winter flow regimes. However, this tidal portion of the system was not included in the limiting factors analysis because of the uncertainly associated with developing useable surface area estimates (tidal fluctuations) and seasonal carrying capacity estimates for Coho.

2) Upper Olalla Slough (Freshwater Marsh Habitat)
This is the 3.5 mile reach of fresh water lake and wetland / marsh habitat above the Georgia Pacific pumping station to the confluence of the WF Olalla. This habitat exhibits variations in vegetative complexity that ranges from heavy Reed Canary grass and broad Lilly pad mats to completely canopied with mature willow. The habitats here exhibit high winter function because of the extensive floodplain interaction that is promoted by the impoundment at the GP pumping station. The average gradient through this reach is 0.2%. A very conservative estimate of winter habitat was calculated for this reach by assuming that a 2 m wide band of low velocity habitat was available on each bank as a minimum during winter flow regimes. This results in a minimum estimate of 22,548 sq.m of winter backwater habitat. Our intent is to test the hypothesis that winter habitat could be limiting by beginning with a conservative estimate of its abundance.

3) Lower East Olalla Creek (Pasture Trench Habitat)
This is the 2.0 mile section of pasture trench / wetland habitat that exists upstream from the confluence of the WF Olalla that also provides extremely high quality winter habitat. An estimate of 6,488 sq.m of winter backwater habitat was utilized for this section in the modeling exercise that assumed a 1 meter wide band of low velocity habitat exists on each side of the channel.

Summer Habitat Assessment

1) Lower Olalla Slough (Estuarine Marsh Habitat)
The estuarine habitat of Lower Olalla Slough was not evaluated for its summer rearing capacity for the reasons described above.

2) Upper Olalla Slough (Freshwater Marsh Habitat)
The fresh water marsh habitat offers extensive summer rearing potential. The obvious concerns for summer habitat are water quality issues (temperature and dissolved oxygen). The situation is unique in that the WF of Olalla contributes near the top end of this fresh water marsh habitat at the Sturdevant Rd. crossing. The WF flow is drawn off the bottom of Olalla reservoir. The WF was contributing at 15.3 deg C at the Sturdevant Rd. crossing on July 29 at 7:30 am. The flows are substantial (not quantified) and are provided by withdrawals from the Siletz river that are stored in the West Olalla Reservoir for release and delivery to the GP Mill site in Toledo. For the limiting factors analysis we utilized the summer habitat data from this reach accepting the assumption that water quality conditions would support summer rearing Coho. Coho are definitely present. Habitats within this reach are temperature stratified and exhibited dissolved oxygen concentrations that ranged from 7.3 – 7.9 (within the range considered as adequate for juvenile salmonids).

3) Lower East Olalla Creek (Pasture Trench Habitat)
The 2.0 mile section of pasture trench / wetland habitat above the confluence of the WF Olalla exhibited no potential for rearing salmonid juveniles during summer flows. This area contained dissolved oxygen concentrations ranging from 4.02 mg/l at the top of the reach to 1.00 mg/l at the confluence with WF Olalla. In addition, the morning temperatures ranged from 15.3 deg C at the top of the reach to 17.1 deg C at the bottom. The dissolved oxygen concentrations alone are lethal

and no summer rearing could be occurring in this reach at any depth. The zone exhibits limited flow and combined with extensive organic decomposition from wetland vegetation is oxygen limited.

Lake Habitat

None exists.

Location of other resources

Spawning sites
See Distribution of spawning gravel graphic
Landmarks
See General Location Map
Road crossings
See General Location Map
High risk slopes
See ODF Risk Assessment graphic
Land use
See Arial Photo sequence

Juvenile Coho

Summer distribution profile
Olalla Cr was surveyed for juvenile salmonids during the summer of 1999. This was the lowest abundance year on record for summer Coho parr in many Oregon coast basins. Coho distribution in the mainstem was extensive and probably represented maximum lineal distribution. Distribution in the tributaries was mixed with Trib B being seeded to capacity for 3,450 ft. and Trib E (probably exhibits the greatest production potential) exhibiting very low densities and only 2,000 ft of distribution. Some tributaries were not stocked at all during this low abundance year. Distribution and abundance was not determined in the first 3.3 miles from Yaquina Bay to the Sturdevant Rd. crossing because of poor visibility caused by organic decomposition.

Goal: Determine correspondence with Anchor habitat location
Coho densities peaked within the identified lower anchor site just below the confluence of Trib E. Coho were present within the upper anchor site but in densities that were lower than observed in other non anchor locations. Access to this upper anchor site could be frustrated during low winter flow regimes by the complexity and perched condition of the double culverts (#14) at unit #355

Field Assessment

Evaluate habitat quality and Coho production

Riparian vegetation
Lineal distance / location of deciduous
2.4 miles of mixed deciduous canopy between RM 5.2 and 7.8 (31% of mainstem corridor)
Lineal distance / location of coniferous
There is no significant conifer component (0% of mainstem corridor)
Lineal distance / location of open canopy
5.4 miles of open canopy from the confluence of Yaquina Bay to the end of Coho distribution (69% of mainstem corridor)
0.2 miles of this open canopy is treatable, the remainder is wetland / marsh.
Recruitment potential and time frame
No recruitment potential exists from the riparian from the confluence with Yaquina Bay to a point at RM 5.2 near the end of the lowland habitats above the Pioneer Trail crossing. These habitats are wetlands with early successional vegetation throughout the riparian.

For the remainder of the riparian from RM 5.2 to RM 7.8 there is limited short term potential because the dominant riparian component (Alder) is young. In addition the entrenched channel condition will not promote stream adjacent contribution from under cut and channel meander.

The long term potential improves slightly because of the potential for natural desiccation in Alder approx. 20 yrs out. No conifer component is present which suggests long term wood recruitment will rely heavily on deciduous species.

Potential for thermal problems
Where
There are significant concerns in the basin that riparian and upslope impacts may be having a negative effect on low summer flow temperature regimes. There are at least 5 significant issues that have a cumulative impact on summer temperatures. From the top down they are:
1) The pasture reach between the two concrete box culverts (8&9)
2) The heavily harvested slopes and tributary branches of Trib E
3) The pasture reach beginning at culvert #5 and extending upstream
4) The lake / wetland marsh reach between the GP pump station and Pioneer Trail Rd.
5) Multiple domestic water withdrawals that reduce flows and result in reductions in stream turnover rates

Why
The fundamental issues of why, are low gradient and very low summer flows (<0.5cfs above the confluence of WF Olalla). To exacerbate these natural constraints almost any solar exposure puts this aquatic corridor at risk for temperature. Trib E is a primary contributor of flow and significantly influences the mainstem. The current harvest rotation in this tributary will have a detrimental effect on temperature profiles and this is probably the most significant site to address immediately. The pasture sites are secondary but still contribute to the cumulative impacts. There was a 0.7 deg C increase in the stream temp as a result of the exposure from the agricultural zone above Culvert #5. The lake / wetland marsh habitat remains the lowest priority because temperatures there are mitigated by the artificial summer flow regime emanating from the reservoir. Water withdrawals from both the mainstem and its tributaries (Trib E) complicate the systems low summer flow profile.

Channel form and floodplain interaction
Lineal distance / location of functional anchor habitat
1) Lower 2,385 lineal ft. of the mainstem below the confluence of Trib E, current function is rated as poor but site exhibits greatest potential for the development of floodplain interaction because of low terraces, slight increase in gradient that would assist in sorting spawning gravels and its location below the most significant source of spawning gravel resource (Trib E).
2) Upper 3,000 lineal ft. of the upper mainstem to the end of Coho distribution, current function rating is moderate and trending toward recovery, the zone is a destination for spawning, contains highest level of instream wood from riparian recruitment and historical debris flow activity. Diminished habitat size restricts its potential for summer and winter rearing.

Quality, quantity and location of spawning gravel
Collected as a function of probable redd sites

Olalla Gravel Counts

Stream	Reach	Poor	Fair	Good
	Main	1		
2	43	14		
3	52	26		
4		24	2	
5		34	1	
Trib B	1	12	2	
Trib C	1	15		
Trib E	1		55	38
2	13	9	1	
Trib G	1	8	13	1
Total		143	177	43

Character and distribution of Summer Cover (lacks quantitative evaluation and relies on professional judgment)
Summer habitat complexity is abundant in the lowland section from the GP pumping station to the top of the pasture trench habitat above the Pioneer Trail crossing. However, as discussed previously, the section from the confluence of the WF Olalla to the top of the pasture trench habitat 1,000 ft above the pioneer Trail crossing (total of 1.9 miles) exhibits water quality parameters that are lethal for all salmonid juveniles during summer flow regimes. This area contained dissolved oxygen concentrations ranging from 4.02 mg/l at the top of the reach to 1.00 mg/l at the confluence with WF Olalla. In addition, the July 29th morning temperatures ranged from 15.3 deg C at the top of the reach to 17.1 deg C at the bottom. The dissolved oxygen concentrations alone are lethal and no summer rearing could be occurring in this reach at any depth. The zone exhibits limited flow and combined with extensive organic decomposition from wetland vegetation is oxygen limited. There are multiple domestic water withdrawals that are seasonal and probably related to irrigation that occur throughout the remainder of the headwaters that definitively exacerbate this condition.

Character and distribution of Winter Cover (lacks quantitative evaluation and relies on professional judgment)
Winter habitats are abundant and complex, they are available for 67% of the lineal stream distance of Olalla making them easily accessible for most subbasin residents. They can be described as fresh water marsh, wetland, or lake habitats. They are very interactive with their floodplains due to the GP impoundment and therefore provide large acreages of low velocity complex habitat. Vegetation is extensive and complex.

Locate migration barriers

Location of barriers
There were 15 culverts observed within the mainstem survey. Some of these crossings represent potential passage issues and some do not. We have included a complete list of the culverts and their pertinent issues to reduce confusion.

* There is a fish ladder at the 10th St. pumping station that terminates in a concrete box below the road crossing. Inside the concrete box is a 24" pipe with a gate valve that transports fish across the road bed and into the impounded fresh water habitat above. The upstream entrance to this pipe is 36" in dia and is necked down to the 24" gated orifice below. This configuration has the potential for increasing pipe velocities. In addition, this gate valve which was closed on July 29, 2003 may be impacting the upstream migrations of Sea Run Cutthroat that are present in the system prior to the scheduled opening of that valve.

* Culverts 1-3 at Sturdevant, Dickenson and Pioneer Trail are all undersized but are not impacting passage for juvenile or adult salmonids. Because of the undersized pipes at each of these crossings there is a high level of floodplain connectivity that is providing dramatic benefit for juvenile salmonids during winter flow regimes (see photo).

* Culvert 4 at unit #119 is an 8ft dia. corrugated pipe in good condition that does not impact adult or juvenile migrations

* Culvert 5 at unit #135 is a pair of side by side 6ft dia. corrugated pipes that are rusted through and exhibit an 8" perched condition. This crossing is a definitive barrier to upstream juvenile migrants. Because of the seasonal deterioration of water quality that has been documented in the habitats directly below this crossing, it is likely that upstream migrations of juveniles could be expected.

* Culvert 6 at unit #152 is passable for both juvenile and adult

* Culvert 7 at unit #162 is a 9 ft dia. smooth steel pipe in good condition passable for both juvenile and adult

* Culvert 8 at unit #197 is a 4x6 concrete box (see photo) with an 8" perch and a barrier to upstream juvenile migrations

* Culvert 9 at unit #210 is a 4x6 concrete box (see photo) with a 16" perch and is a definitive barrier to upstream juvenile migrations and in addition may impact adult cutthroat migrants

* Culvert 10 at unit #237 is undersized and located under Hwy 20 and is not a barrier for adults or juveniles. Exists under deep Rd. fill.

* Culvert 11 at unit #245 is undersized and located under the Pioneer Loop Rd. It is not a barrier to adult or juvenile migration but it has created a large deposition plain above and has the potential for accumulating debris and complicating passage. The crossing is currently not a barrier to adult or juvenile migrations. Exists under deep Rd. fill.

* Culvert 12 at unit #270 is a double culvert just below the VFW site that currently does not impact adult or juvenile migrations. One pipe is corrugated the other is plastic and utilized as an overflow.

* Culvert 13 at unit #316 is a corrugated pipe in good condition and does not impact adult or juvenile migrations

* Culverts 14 and 15 at unit #355 are undersized, spaced 4ft apart and definitively terminate upstream juvenile migrations and may frustrate adult passage at low winter flow regimes because of its perched condition.

Species and age class affected
Culverts 5, 8, 9, 14 all exhibit the potential for terminating upstream juvenile migrations if they occur.
Culvert 9 may also impact adult Cutthroat migrants
Culvert 14 may also impact adult Cutthroat, Coho and Steelhead during low flow regimes.

Identify potential sites for restoration work

Location
1) Culvert 5
2) Culvert 8
3) Culvert 9
4) Culvert 14
5) Pasture adjacent riparian just above confluence of Trib E
6) Lower Anchor site
7) Trib E upslope and riparian
8) GP pumping station at 10th street crossing
9) Unpermitted water withdrawals (sites not identified)
10) 350 ft pasture adjacent riparian beginning at culvert #5

Problem

1) Culvert 5 is the lowest juvenile barrier in the system and is in the most likely location for potential upstream temperature dependant migrations of juveniles. One of the parallel pipes is rusted through causing undercut and exacerbating the 8"perch.
2) Culvert 8 is just below the confluence of Trib E and also has an 8" perch that could affect upstream juvenile migrants, in addition, the perched concrete apron provides only sheet flow at moderate flows. The presence of upstream juvenile migrations is currently undetermined
3) Culvert 9 is just above the confluence of Trib E and its 16" perch is a definitive juvenile barrier and a potential barrier for older age class cutthroat
4) The back to back under sized pipes at Culvert 14 definitively terminate upstream juvenile migrations and may frustrate adult salmonid migrations at low winter flow regimes
5) Open canopy condition may negatively influence summer temperature profile
6) This site exhibits potential for floodplain interaction at winter flow regimes but the lack of roughness has simplified the zone to a point of extremely poor function during both summer and winter
7) Trib E contains the majority of the potential spawning habitat in the entire Olalla subbasin. Therefore, its water quality profile during spring incubation is extremely critical to the success of the system as a whole. The tributary corridor has been logged extensively and recently. Several 1st order corridors that converge in the zone of spawning and rearing as well as others above this zone are being directly over sprayed with herbicides during the most critical time for salmonids rearing in the basin. In addition many of these 1st order tribs with surface flow have no riparian buffer and summer temperatures are negatively impacted by this exposure.
8) The pumping station currently denies all migratory access to the habitats above and below the 10th st. crossing until September 15. This may in particular impact the unimpeded migration of fluvial or sea run Cutthroat.
9) Minimum stream flows have not been established that provide adequate summer flow to the 1.9 miles of habitat that exists above the confluence of WF Olalla. This condition has magnified the water quality issues in this zone to a point where the habitats are unutilized by salmonids. Multiple domestic water withdrawals are present during summer flow regimes. The actual quantity, frequency, location and water right status of all of these withdrawals has not been established in this assessment.
10) Open canopy condition may negatively influence summer temperature profile

Goal

1) Provide unimpeded year round access for salmonid juveniles and fluvial adult Cutthroat that may be escaping water quality limiting habitats directly downstream
2) Provide unimpeded year round access for salmonid juveniles and fluvial adult Cutthroat that may be escaping water quality limiting habitats directly downstream.
3) Provide unimpeded year round access for salmonid juveniles and fluvial adult Cutthroat that may be escaping water quality limiting habitats directly downstream
4) Provide unimpeded year round access for salmonid juveniles and fluvial adult Cutthroat that may be escaping water quality limiting habitats directly downstream. In addition, reduce the potential for impacting adult migrations during low flow regimes
5) Provide protection from solar impacts on mainstem and Trib E that are contributing to the temperature limitations downstream
6) Develop an interactive floodplain, provide roughness for spawning gravel retention directly below the key source (Trib E)
7) Accelerate riparian canopies on all first and second order contributors to Trib E. In addition, reduce chemical runoff from herbicide applications during incubation and emergence
8) Provide unimpeded access for fluvial and anadromous Cutthroat during all potential windows of migration
9) Establish minimum flows for instream water right and reduce unpermitted withdrawals that are exacerbating the water quality limitations downstream.
10) Provide protection from solar impacts on mainstem that are contributing to the temperature limitations downstream

Method

1) Propose culvert replacement that is properly sized and imbedded
2) Propose culvert replacement that is properly sized and imbedded
3) Propose culvert replacement that is properly sized and imbedded
4) Propose culvert replacement that is properly sized and imbedded
5) Propose planting for shade development and livestock exclusion fencing for protection of planting
6) Propose excavator wood placement to develop full spanning log complexes
7) Develop cooperative agreement with small private and industrial woodland owners that alters the method for reducing competitive vegetation on harvest units. Consider hand release, consider backpack applications, consider no release or application in 20 ft riparian buffer on all first and second order tributary corridors
8) Alter the current agreement between ODFW and GP to provide fish passage at the GP pumping station by July 15
9) Conduct a complete withdrawal evaluation and summer flow profile that determines minimum flow criteria for Olalla Cr. Involve Water Resources Board to review current permit status.
10) Propose planting for shade development and livestock exclusion fencing for protection of planting

Expected problems
1) Low risk, replacement would effectively address migration concerns
2) Low risk, replacement would effectively address migration concerns
3) Low risk, replacement would effectively address migration concerns
4) Low risk, replacement would effectively address migration concerns / landowner has not been interested
5) Low risk, development of maintenance plan would be critical
6) Low risk, wood contribution would need to be identified
7) Innovative restoration approach, would require complex negotiations and long term coordination commitment
8) Alters long standing agreement, may require retrofits to protect pumping facility from salt intrusion
9) Involves long term coordination and commitment of additional survey funds
10) Low risk, development of maintenance plan would be critical

Expected results
1) Restores habitat linkages that may be seasonally critical for survival
2) Restores habitat linkages that may be seasonally critical for survival
3) Restores habitat linkages that may be seasonally critical for survival
4) Restores habitat linkages that may be seasonally critical for survival and full utilization of the available spawning habitats
5) Reduction of solar exposure that contributes to cumulative negative impacts to water quality
6) Provides additional spawning resource and boosts floodplain interaction
7) Protects water quality and increases egg/fry survival rates
8) Restores habitat linkages that may be seasonally critical
9) Improves water quality and expands useable summer habitats
10) Reduction of solar exposure that contributes to cumulative negative impacts to water quality

Other restoration options considered / reason for not including
- Culverts 1-3 not included because there replacement would negatively influence the abundance of winter habitat available for juvenile salmonids, in addition, resource delivery to this fresh water marsh habitat is not crucial. Spawning does mot occur hear and complex cover is already extremely abundant.

- Culverts 1-3 on Trib A terminate juvenile migrations, landowner was not interested in replacement or providing access

- Culvert 3 on Trib C terminates juvenile migrations with radical differences observed in juvenile densities above and below the culvert (see graphic). Landowner was not interested in replacement or providing access.

- Protection of high risk slopes for future sources of wood and substrate recruitment, resource migration has been so significantly compromised by road crossings that only the slopes in Trib E have any real potential for contributing positively to the system. The slopes in Trib E have been classified by ODF as contributing only indirectly to the fish bearing Core areas.

- Dike removal and reconnection of isolated salt water marsh habitats between Yaquina Bay and the GP freshwater pumping station. This is a high priority for restoring Yaquina Basin and estuary function, it is currently not a factor limiting Coho production from the Olalla 6th field. The disruption in habitat linkages created by the GP impoundment complicates the utility of these historical habitats for juveniles of Olalla Cr. origin.

Document potential restoration sites with photos

List and rank the factors currently limiting Coho production

Include professional judgment of potential lowland habitats existing outside the boundaries of the 6th field analysis for the provision of winter habitat

A limiting factor analysis was completed utilizing Version 5.0 of the ODFW Carrying Capacity Model provided by Tom Nickelson of the ODFW Research Division. This analysis relies heavily on the summer data collected utilizing ODFW's Aquatic Habitat Inventory protocol and on inventories conducted by Bio-Surveys to assess the quantity and quality of available spawning gravel in the system. The spawning gravel surveys only measured gravels that were located in areas known to be utilized by Coho for redd development and gravels that were the appropriate size for adult Coho. Three categories of gravel quality were utilized that visually assessed the abundance of sediment and fines in the gravel. Gravel quantities in the Good category were multiplied by a coefficient of 1.0, for gravels in the Fair category we utilized a coefficient of 0.5 and for gravels in the Poor category we utilized a coefficient of 0.25. This step in the analysis adjusted the actual quantities of gravel utilized in the carrying capacity model. Consultation in the literature suggests that these coefficients are optimistic and may still tend to overestimate egg/fry survival rates in the degraded systems that dominate the Oregon Coast Range watersheds.

The results of this modeling effort are presented in the appendix. Note that two sets of life stage to smolt survival rates are presented in Table B1 and B2. These represent the vastly different ranges in life history budgeting that exist in the literature. One is the ODFW Research model which assumes a 70% egg/fry survival rate and the other is the Alsea Watershed Study model that utilizes a 42.5% grand mean for egg/fry survival.

The output tables from each of these models are presented in Tables F1 and F2 of the Olalla Smolt Capacity Excel workbook under Limiting Habitat Analysis. For the Olalla Cr system you will note that potential smolt production estimates differ between each of the models, this is to be expected given the wide range of variation between life stage survival rates that

exists between the two budgets. Regardless of the model utilized, both budgets make similar conclusions on limiting factors with the abundance of spawning gravel portrayed as the limiting life history stage.

The field assessments in this Limiting Factors analysis were designed to offer supplemental professional judgments to the mathematical representation portrayed in the modeling effort. In the case of the Olalla Cr subbasin it seems very appropriate to consider the quantity and quality of spawning substrates as a key limiting factor. Heavy sediment loading and embedded substrates are common. Well sorted gravels are only found in tributaries with higher gradients that have the hydraulic potential to clean and transport gravel substrates. Because the provision of additional high quality spawning substrate is highly dependant on channel morphology and natural recruitment, it is critical to locate and protect the quality of the gravel resources currently available to the subbasin.

Rank the list of restoration efforts

From the methods listed above, list and rank the restoration work that most effectively stabilizes the population at a higher base level and prioritizes the recovery of ecosystem function.

Short Term (prioritized)

Item #

7
6

Long Term (prioritized)

Item #

9
1
3
2
4
10
5
8

Combined prioritization

Item #

7
9
1
3
2
4
10
5
6
8

Explain how the modifications will interact and increase production

Primarily relevant to modifications that effect passage. An estimate of increased production should be developed for all habitats where access to salmonids has been denied or compromised. This will facilitate an evaluation of cost /benefit and assist in the development of prioritized culvert replacement program

None of the proposed culvert replacements definitively deny access for adult salmonids, in fact juvenile Coho were observed above each crossing. The condition being addressed in each case is the seasonal limitation to the migration of juveniles. These migrations are much more difficult to verify. However, poor water quality conditions in Olalla suggests that these upstream migrations are likely to be occurring. This is a well documented survival strategy for juvenile salmonids in the Yaquina basin and there is good reason to expect it in Olalla. If these migrations are being attempted and access has been denied by these impassable culverts then it is probably safe to assume that increases in summer parr survival would increase the production potential of the subbasin.

Assessment questionnaire

Morphology

Describe the valley form, constraint, and floodplain.

Three distinct valley forms exist:

1) The intertidal marsh and associated wetlands from Yaquina Bay to the GP fresh water pumping station (RM 0-0.6), broad valley, currently confined by extensive diking and isolated from the full extent of the historical floodplain

2) The fresh water lake and associated wetlands from The GP pumping station to a point 1,000 ft above the Pioneer Trail crossing (RM 0.6-5.2), broad valley form, limited confinement and an expansive active floodplain that is rated as functioning at a high level during winter flow regimes.

3) The riverine section of Olalla Cr. from the top of the lowland habitat to the end of Coho distribution in the headwaters (RM-5.2-7.8), moderate valley widths, Channel is currently deeply incised, confined by road and residential development, there is no significant floodplain interaction for the provision of supplemental winter habitat.

Assess the potential for the development of meander, braiding, side channel, alcove, backwater channel forms.
1) There is tremendous potential existing for the reclamation of saltwater marsh habitats that have been isolated by diking. These areas would provide complex braided backwaters and associated off channel habitats. These projects have not been included in the restoration prescriptions because they don't address the habitat factors that currently limit Coho production from the Olalla 6th field. However, they are important recovery sites for returning natural function to the Yaquina basin as a whole.
2) The habitat in this reach is impounded, consequently the habitats function similar to a lake environment during summer flows and similar to a dam pool in the winter. There is high quality backwater and side channel development during winter flows.
3) The habitats in this reach are deeply entrenched and confined with limited potential for the development of meander or backwater channel forms. This condition is not likely to be altered because of the extensive use of the available floodplain for municipal and residential pursuits.

What is the current status of development of these channel forms? Include a description of entrenchment as the alternate state.
1) The channel form could only be improved from its current condition with the reconnection of isolated salt water terraces
2) The channel form is being artificially controlled by the influence of the impoundment at the GP pumping station. This condition is unlikely to be altered unless the impoundment is removed or low terraces are diked, drained or filled. The current condition provides exceptionally high quality habitats for juvenile Coho and Cutthroat. Entrenchment is not likely with the impoundment at 10th st in place
3) These habitats have been trending toward deeper entrenchment because of the lack of channel roughness. Some future deciduous recruitment will impact the channel in a positive direction when riparian canopies mature (20 yrs.) There is currently limited short term potential for developing complex channel characteristics or floodplain interaction.

What proportion of the system's Coho production appears to be provided by this zone? Describe in terms of spawning, incubation, summer rearing, and winter rearing ability.
1) The intertidal reach provides no spawning or incubation and the summer and winter production is unknown. It would be more likely to be providing some level of winter habitat than summer, but in high abundance years it may also provide limited summer potential.
2) The lake / wetland section provides no spawning or incubation. There are large surface areas available for summer and winter habitat and the water quality parameters suggest that rearing could be successful but no information is available to assess or quantify the zones current status for the production of Coho.
3) The upper riverine reach and its tributaries contain all of the spawning and incubation potential (the majority in Trib E) for the subbasin. The current estimates of summer abundance all come from this 2.6 mile zone. This zone however, exhibits a very poor potential for the provision of winter habitat.

List and rank the factors currently limiting the development of channel complexity.
Rural residential ownerships that suppress potential for meander
Young riparian deciduous canopy that is contributing at a low rate
Confinement by road network

Are these factors addressable through restoration work?
Item #2 addresses the wood contribution rates that could be increased by the prescription of instream large wood placements

Riparian corridor

Describe the riparian corridor and its potential to provide wood. How long before recruitment?
The riparian from the confluence to Yaquina Bay to a point 1,000 ft. above the Pioneer Trail crossing (RM5.2) is dominated by early seral stage vegetation. There is no significant potential for the recruitment of wood either short term or long term. The remaining 2.6 miles of riparian to the end of Coho distribution is dominated by a young stand of mixed deciduous species. Its ability to contribute is limited in the short term and poor even with maturation of the riparian canopy. Some of this is due to the lack of channel meander as discussed previously.

To what degree would land use and ownership allow restoration work?
Riparian restorations proposed in this review would only impact 0.2 miles of the riverine component of the watershed. Attempts to encourage a large conifer component in the remainder of the riparian would probably not significantly impact the long term recovery of function in the subbasin. Current land ownership is most significant in identified Critical Contributing areas that are primarily under private industrial forest management plans. The short rotations on these hill slopes and the resultant water quality issues that are associated with harvest will subject the subbasin to the greatest long term risks. These conditions currently exist very acutely in Trib E.

What is the potential to increase channel complexity in the long term through natural recruitment processes, with and without restoration?
Without restoration, natural recruitment will be slow and storm driven. Complexity increasing with maturation of the dominant young riparian (20 years).
With restoration, channel complexity could be accelerated but this will not greatly influence the conditions that are currently limiting salmonid production.

Core Area

Anchor sites

Do anchor site(s) exist?
Yes

If so, describe the location, dimensions, gradients, and salient habitat features.
1) Lower 2,385 lineal ft. of the mainstem below the confluence of Trib E, current function is rated as poor but site exhibits greatest potential for the development of floodplain interaction because of low terraces, slight increase in gradient that would assist in sorting spawning gravels and its location below the most significant source of spawning gravel resource (Trib E).
2) Upper 3,000 lineal ft. of the upper mainstem to the end of Coho distribution, current function rating is moderate and trending toward recovery, the zone is a destination for spawning, contains highest level of instream wood from riparian recruitment and historical debris flow activity. Diminished habitat size restricts its potential for summer and winter rearing.

Describe how the site contributes to spawning, incubation, summer rearing and winter rearing.
1) 47 sq.m of spawning gravel identified, after attributing gravel quality coefficients there are only 15 sq.m of gravel utilized in the limiting factors model. Gravels are small (pea size) and exhibit heavy fine sediment loading. Winter rearing in the anchor is currently rated as very poor. The site does however, exhibit some potential for the development of floodplain connectivity with the addition of wood complexity.
2) 61 sq.m of spawning gravel identified, after attributing gravel quality coefficients there are only 32 sq.m of gravel utilized in the limiting factors model. Gravels are more appropriate size for Coho high in the system but they still contain high levels of sediment loading. The site contains some winter rearing potential because of the increased abundance of wood and low terraces. The site does not provide great potential for restoration because of diminished habitat size and inaccessibility.

What proportion of the system's summer Coho production appears to be provided by this site?
Summer abundance appears to peak in this lower anchor site. The probable reason is the location of this anchor site just below the most significant accumulation of spawning gravel in Trib E.
Summer abundance (measured in 1999 only) was wide spread but occurred in low densities in this upper anchor site. Some of this could be attributed to inadequate passage at culvert crossing #14

Rank the site in terms of each of these functions (abundance of pool surface area, spawning gravel, % of summer production).
1
2

Which function(s) limits the site's production potential, and what causes this limitation?
Anchor site 1 is probably limited by it's obvious lack of pool complexity (no scour, no cover)
Anchor site 2 is probably limited by its diminished habitat surface area (full seeding could only summer rear small numbers)

List and rank the restoration work at this site that would most effectively increase survival within the Anchor site and stabilize the core population at a higher base level.
Wood placement to encourage scour, aggradation and provide cover
Maintain riparian canopies on all Critical Contributing tributaries for protection of water quality (temperature)

Secondary Branch sites

Do secondary branch site(s) exist?
Yes

If so, describe the location, dimensions, gradients, and salient habitat features.
1) Trib A contains no significant spawning gravel resource, the tributary does however provide a cold water resource (56 deg) to the mainstem above the confluence of the WF Olalla where summer temperatures may influence the quality of mainstem rearing habitats.

2) Trib B contains 14 sq.m of spawning gravel (4 sq.m effective) and is a warm source of water (65 deg). In addition, the tributary contained 24 percent of the summer parr observed in the 1999 inventories.

3) Trib E contains 93 sq.m of spawning gravel (65 sq.m effective) and is the source of significant summer flow and temperature (56 deg) maintenance to the mainstem. Temperature profiles may have been compromised by recent harvest activities in the tributary that are extensive. Live surface flow is common in multiple 1st order tributaries of Trib E that bisect harvest units with no vegetative buffer. The tributary contained 4 percent of the summer parr observed in the 1999 inventories

4) Trib G contains 22 sq.m of spawning gravel (9 sq.m effective) and is a source of cold water (58 deg) to the mainstem and contained only 15 juvenile Coho during the 1999 inventory, these juveniles were probably upstream migrants from the mainstem

Describe how the site contributes to spawning, incubation, summer and winter rearing
Provides important spawning and incubation, summer and winter rearing limited by diminished habitat surface area
Provides important spawning and incubation, summer and winter rearing limited by diminished habitat surface area
Provides majority of basins high quality spawning habitat also capable of significant summer rearing, winter potential is limited by diminished habitat surface area and lack of floodplain interaction
Provides important spawning and incubation, summer and winter rearing limited by diminished habitat surface area

What proportion of the system's summer Coho production appears to be provided by this site(s)?
24 % of 1999 summer production residing in tributary
11 % of 1999 summer production residing in tributary
4 % of 1999 summer production residing in tributary
0.4 % of summer production residing in tributary
* These % contributions do not factor in the production that may have been occurring in the lowland habitats that were not inventoried because of poor visibility

Rank the site in terms of each of these functions (abundance of pool surface area, spawning gravel, % of summer production).
3
1
2
4

Which function(s) limits the site's production potential, and what causes this limitation?
Trib B is only limited by small habitat surface areas. The 1999 production estimate of 955 Coho was seeded to capacity and represents top end production
Trib C is limited by small habitat surface areas and by complex passage (culverts) that terminate upstream juvenile migrations
Trib E is limited by reductions in water quality that may negatively impact incubation
Trib G is limited by small habitat surface areas

List and rank the restoration work at this site that would most effectively increase survival and stabilize the Core population.
Protect upslope riparian corridors (1st, 2nd order) for maintaining current level of water quality
Protect upslope riparian corridors (1st, 2nd order) for maintaining current level of water quality
Develop recovery strategy that deals immediately with herbicide applications and protection of 1st order vegetation
Protect upslope riparian corridors (1st, 2nd order) for maintaining current level of water quality
Protect upslope riparian corridors (1st, 2nd order) for maintaining current level of water quality

Critical contributing areas

Do Critical contributing areas exist?
Yes

If so, describe the location, dimensions, gradients, and salient habitat features. How is each CCA related spatially to the Core and its Anchor sites?
Trib A delivers well below an identified anchor site and into the fresh water marsh habitat just above the Sturdevant Rd. crossing. Resources recruited from this CCA would have little impact on improving ecosystem function. It's highest value is it's cold water contribution and it's refuge potential for upstream temperature dependant juvenile migrations. Passage for juveniles is terminated at the very beginning of the tributary by a 4"perched culvert and then higher in the system by a 16" perch.

Two small tributaries arranged consecutively above the confluence of Trib E on the right bank would contribute within the Core but above the lower anchor site. They contain high risk slope priorities 3 and 4. The trib containing priority slope #3 could deliver to the Core area. The trib that contains slope #4 exhibits low potential for delivery to the Core because of a Hwy 20 Rd. crossing.

Trib D delivers directly to the lower anchor site and contains ODF's second highest priority site for slope failure. The potential for this CCA to successfully contribute to the anchor site is extremely low because of the Hwy 20 crossing that would terminate any significant debris flow.

5 consecutive no name tributaries on the left bank in the headwaters have been ranked as priority #5 for their potential to contribute directly to the Core area (see ODF Landslide Hazard Map). All 5 of these CCA's also contribute to the upper anchor site. Non of these tributaries are fish bearing.

Lowlands outside the 6th field subbasin

Do lowland habitats exist that could function as potential winter habitat for Coho?
Yes. Because the Olalla 6th field empties directly into Yaquina Bay there are additional winter habitat opportunities within the Yaquina estuary that have not been factored into this limiting habitat analysis. To do so would potentially overestimate the abundance of winter habitat and not properly test its potential to be limiting in the modeling exercise. For this reason, we have elected to recognize that these supplemental habitats exist and that there may even be a unique life history strategy that is expressed in these habitats but to not incorporate these habitats in our evaluation of 6th field limiting factors.

If so, describe the location, dimensions, gradients, and salient habitat features.
Not applicable
What is the spatial relationship of the lowland habitat to spawning and incubation sites in the watershed?
6 miles

What are the problems associated with the abundance, location or condition of these lowlands?
Many of the historical saltwater marsh habitats remain isolated from tidal influence by dikes and drains.

What are the obvious lowland issues to consider for future planning activities within the watershed?
There are many additional lowland issues that have not been dealt with in this review. Part of this is because Olalla represents a very unusual and highly altered ecosystem with the additional flow contributed from the Siletz River basin. Without this supplemental flow and / or the GP impoundment that actually creates extensive lowland habitat, the diked and drained wetlands below the GP pumping station to the confluence with Yaquina Bay would be a high priority long term recovery item. There are many other reasons to recover these saltwater marsh habitats that have not been included in this review of salmonids. Not the least of them being the potential they offer for salmonids from other portions of the Yaquina basin and a long list of other species that require that niche to abound. Any long term planning that drains, dikes or fills any portion of the fresh water marsh above the GP impoundment also may have a distinct negative impact on the winter rearing potential that currently exists.