Washington Department of FISH and WILDLIFE

CAPS Cover Sheet

TITLE:	Pilot General Hydraulic Project Approval for Fish Passage Structures	**WDFW NUMBER:**	09-1838
PERIOD:	01/12/2010 to 01/31/2020	**STATUS:**	Active
CONTRACTOR:	Green Diamond Resource Company	**NUMBER OF AMENDMENTS:**	0
CONTRACTOR CONTACT:	Eric Beach (360) 427-4790	**WDFW MANAGER:**	Jeff Davis (360) 902-2527
CONTRACT TYPE:	No Cost, MOA/LOA	**PROGRAM:**	Habitat
STAFF TYPE:	WDFW	**DIVISION:**	Environmental Services
		CFDA NUMBER:	
		AWARD NUMBER:	
		RFQQ/RFQ/RFP/IFB NUMBER:	

SUMMARY PROJECT DESCRIPTION:
Memorandum of Agreement to implement and issue a pilot regional general Hydraulic Project Approval for water crossing structures on Green Diamond Resource Company lands in Western Washington.

INTERNAL CONTACTS:

Name	Role	Work Phone
Dianna Neiswanger	Contract Staff	(360) 902-2438
Jeff Davis	Project Manager	(360) 902-2527
Jennifer Evans	Budget Approver	(360) 902-2196

Distribution
From: Dianna N.

Date:
01/20/2010

TO: Jeff Davis: HP

Memorandum of Agreement

on

Pilot General Hydraulic Project Approval (HPA) for Fish Passage Structures

By and Between the

Washington Department of Fish and Wildlife

and the

Green Diamond Resource Company

This Memorandum represents a commitment on the part of the GREEN DIAMOND RESOURCE COMPANY, hereafter referred to as GDRCo and the WASHINGTON DEPARTMENT OF FISH AND WILDLIFE, hereafter referred to as WDFW to acknowledge the critical interests and needs of forest management, fish protection and salmon recovery solely in association with the replacement or new installation of culverts or bridges, and road abandonment for the purposes of implementing a road management strategy which provides/restores fish passage at road crossings on Type F streams.

Recitals

Whereas, WDFW is responsible for the protection, perpetuation, and management of fish life in the State of Washington. Fish life means all fish species, including but not limited to food fish, shellfish, game fish, and other non-classified fish species and all stages of development of those species.

Whereas, GDRCo is responsible for the protection and enhancement of aquatic resources on the GDRCo Habitat Conservation Plan (HCP) lands.

Whereas, GDRCo operates under multiple statutory requirements and regulatory direction that provides a substantial amount of protection to aquatic resources.

Objectives

1. Work cooperatively to ensure that GDRCo projects protect fish life, and ensure the consistent and efficient administration of Chapter 77.55 RCW (Construction Projects in State Waters), Chapter 220-110 WAC (Hydraulic Code Rules) for forest management related projects.

2. Work cooperatively to develop and implement a pilot general Hydraulic Project Approval (HPA) for no slope and stream simulation design culverts, full span bridge crossings, and road abandonment in a manner that adequately protects fish life.

3. Work cooperatively to ensure properly designed culverts and bridges are installed and maintained to provide fish passage for the life of the project and that project impacts will be adequately mitigated.

4. Work cooperatively to provide compliance assessments, effectiveness monitoring and perform timely corrective actions for culverts, bridges and abandoned road crossings completed under this Memorandum of Agreement (MOA) for the life of the MOA.

Scope

The purpose of this MOA is to establish and promote mutual agreement of the needs and mandates of GDRCO and WDFW; and to develop and implement a pilot general Hydraulic Project Approval (HPA) for "no slope and "stream simulation" culverts, full spanning bridges, and abandoned road crossings in Type F streams on GDRCo ownership in Mason, Grays Harbor, Pacific, and Lewis Counties. The MOA will also facilitate the consistent and efficient administration of HPAs for projects under Chapter 77.55 RCW (Construction Projects in State Waters), Chapter 77.57 RCW (Fishways, Flow, and Screening), and Chapter 220-110 WAC (Hydraulic Code Rules).

Statement of Mutual Benefits and Interests

The WDFW was established by the laws of the State of Washington to provide for the management and protection of fish and aquatic resources of the state, and for the protection, maintenance, and enhancement of viable habitat for the perpetuation of these species.

The GDRCO and WDFW share a common objective to protect and maintain, water, fish, and aquatic resources, and recognize their mutual desire to continue a long-standing working relationship.

Therefore, in consideration of the above premises, the parties agree to work in a cooperative spirit while carrying out their respective programs for the good of fish, water, and aquatic resources as follows:

GDRCO AGREES:

To coordinate and collaborate with WDFW on compliance assessments and effectiveness monitoring reviews of the hydraulic projects covered under this MOA.

To replace/correct any structures installed under the pilot general HPA found, via effectiveness monitoring, to not meet the compliance standard (fish passage) within two years of identification.

To relieve WDFW of any cost-sharing obligations for projects completed under this HPA found to not meet the effectiveness standards identified within this MOA.[1]

[1] Forest and Fish Report April 29, 1999 Appendix D II. D.1(d)(iv). , "Culverts which were legally installed, properly maintained, and which are capable of passing fish will not be required to be replaced and brought up to new standards until the end of such culvert's functional life unless otherwise recommended by WDFW. If WDFW recommends removal of such culverts, the cost of such removals will be paid through a public-private cost-sharing program."

IT IS MUTUALLY AGREED AND UNDERSTOOD BY GDRCO AND WDFW THAT:

1. Both GDRCo and WDFW possess expertise in fish and fish habitat, engineering, and hydraulic project design and implementation.

2. GDRCo's objective is to meet or exceed the intent of WDFW's standards and guidelines for the design, construction, and maintenance of all GDRCo hydraulic projects to ensure the protection of fish life.

3. This is a 5-year pilot HPA program between GDRCo and WDFW that will only be expanded if the program can demonstrate significant HPA processing efficiencies and GDRCo can demonstrate satisfactory compliance with HPA requirements.

4. GDRCo will submit a Joint Aquatic Resource Permit Application (JARPA) to WDFW to initiate the HPA issuance process. The MOA will be attached to the JARPA.

5. GDRCo and WDFW will implement the following Forest Practices Application (FPA) related HPA review, concurrence and compliance process:
    a. GDRCo will apply for pilot general HPA coverage by submitting a FPA to DNR, noting in "additional comments" that HPA coverage is intended to be under the pilot general HPA and including the WDFW HPA log control number on the applicable Forest Practices Application.

       Note: For the pilot program all FPAs will be Class III.

    b. The complete FPA will include the following plans and information:
        i. Complete Plans that convey enough project/site information to reviewers to understand the nature and expected outcome of projects. The level of requisite detail in a plan is dependent on the project complexity such that several types of plans are appropriate to cover the spectrum of activities addressed by the HPA (Appendix A, Table 2).

        ii. Existing and proposed conditions shall be included on the plan sheets to document the critical physical parameters associated with the site. This information will be used to determine eligibility. Key elevations stated and referenced to an on-site bench mark may be required on some projects.

        iii. Where necessary, material specifications must be stated on the plans.

6. GDRCo submittal of this information shall be the only communication required to trigger review by WDFW.

7. WDFW may
    a. Accept the project proposal, or;
    b. Consult with GDRCo about the project, or;

c. Reject coverage under the pilot general HPA and require a standard individual HPA for the project.

8. Within 10 days of notification to WDFW through the Forest Practices Application Review System (FPARS) of DNR's receipt of a FPA submitted by GDRCo, WDFW may:
    a. Contact GDRCo to inquire about project eligibility, or;
    b. Request a consult or field review with GDRCo personnel.

9. Within 30 days of notification to WDFW through FPARS of DNR's receipt of FPA submitted by GDRCO, WDFW must:
    a. Notify GDRCO in writing (email or letter) that the project is approved under the pilot general HPA, or;
    b. Notify GDRCO in writing (email or letter) that the project is approved under the pilot general HPA if GDRCO makes minor modifications to the project that are satisfactory to both GDRCO and WDFW, or;
    c. Notify GDRCO in writing (email or letter) that the project is disapproved under the pilot general HPA. Notification shall include an explanation of why coverage in not being authorized and that the project will be considered for approval under a standard individual HPA.

10. Rejection for project coverage under the general HPA does not mean the project itself is denied. Coverage rejection simply means that the proposal requires coverage under a standard individual HPA for the project. The standard individual HPA will have separate informal and formal appeal rights. There will be no dispute resolution process for the disapproval of coverage under the pilot general HPA. The standard individual HPA will allow full appeal rights under WAC 220-110-340 and WAC 220-110-350 to GDRCO. Elements that may trigger a "no coverage" call include; inadequate survey effort or detail to understand the site relative to the project, inadequate plans to provide necessary detail for project impact assessment, disagreement on site conditions relating to design parameters

11. GDRCO will apply for a standard HPA by submitting a complete FPA to DNR, noting in "additional comments" that HPA coverage is intended to be under a standard individual HPA. WDFW will process the application and will issue or deny a HPA within 45 days of receipt of a complete application.

12. Disputes regarding hydraulic projects within the scope of this MOA shall be resolved at the field level in a cooperative and professional manner. In the event that issues cannot be resolved by field personnel in consultation with technical experts within the two parties, the parties agree to elevate the issues of concern through equivalent levels of each organization until the conflict is resolved.

COMPLIANCE, EFFECTIVENESS AND CONTINGENCY PROCESS

WDFW and GDRCO recognize the importance of designing fish passage structures to withstand the 100-year flood event with consideration for associated debris and sediment. To ensure that replacement and new structures continue to pass fish through time, a compliance assessment will be documented and effectiveness monitoring will be conducted.

Fish passage structures shall pass all fish at all life stages that would be expected in the reach where the project is found. In degraded habitat, upstream of man-made barriers, or in streams where fish have been extirpated, passage is provided in anticipation of habitat and fish recovery. Fish passage structures should maintain the stream channel functions and values within the stream reach where the crossing is found. Fish passage structures designed and constructed according to the principles and methods found in Design of Road Crossings for Fish Passage, WDFW, 2003, or as subsequently amended, are assumed to meet the above requirements.

"As-Built" and Compliance Assessment

A compliance assessment will be accomplished to insure that projects are constructed according to the plans and the provisions contained within the approved HPA. Fish passage projects will either have been designed according to a specific plan, a template plan or criteria established in the general permit and MOA.

A compliance assessment of each project permitted under the regional general permit is conducted within the year following a project's completion. Project compliance will be documented and submitted as a report to the WDFW prior to the annual December RMAP meeting.

The Compliance Assessment provides sufficient information such that a determination may be made that the project was completed as per the submitted plans and the provisions contained within the general HPA:

* Stream Simulation and no-slope culverts meets WDFW guidelines
* Bridge Abutments, piers, piling, sills, approach fills, etc. are placed outside the average bankfull width of the stream.
* Road Dormancy and decommissioning sites have imported fill material removed to the angle of repose or a slope similar to the natural valley walls
* GDRCo's Best Management Practices for slope stability, sediment and erosion control are implemented

The assessment also documents departures/modifications from the original plans. The deliverable from the Compliance Assessment will be an "As-built" plan drafted to the same standards as the project plan (i.e. specific plan, template, narrative). Attributes necessary for inclusion in the "as-built" and compliance evaluation are in Figure 1 and include:

Channel Width; Average bankfull width of natural channel at a representative location upstream out of the influence of the structure.

Countersunk; Depth of substrate over the bottom of road crossing structure at the downstream end.

Hydraulic Drop; Change in water surface elevation between the bottom of the road crossing structure and the water surface elevation immediately downstream of the culvert.

Length; Horizontal length of stream crossing structure measured from downstream edge to upstream edge

Slope (%); Change in elevation from the downstream top edge to the upstream top edge of the road crossing structure, divided by Length.

Span/Diameter; of road crossing structure (Maximum)

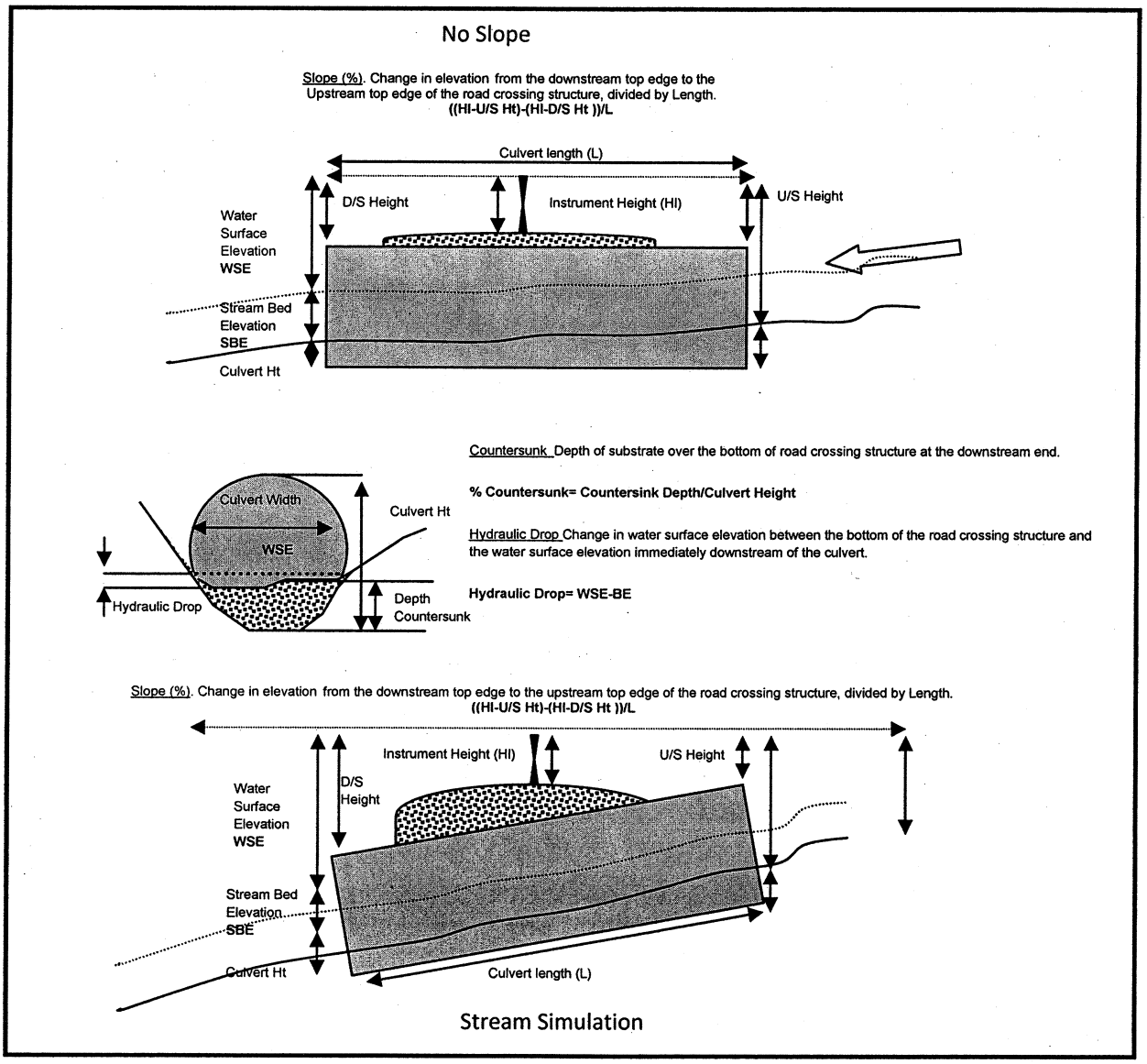

Figure 1. "As built" /compliance monitoring measurement points for Culvert Installations

Field Methods

A self-leveling rotary laser is set up on a tripod on the road at the mid-point of the water crossing structure. Two reference points are established next to the road to allow the instrument to be installed at the same location/height at each visit. The measurements are;

- Length of structure
- Total distance from the lowermost to uppermost point of the survey (i.e. three bankfull widths downstream to three bankfull widths upstream of the structure).
- Stream gradient and culvert gradient will be calculated.
- Culvert measurements; the elevations of
    * The top and bottom of the culvert, water surface and stream bed taken at both ends of the culvert. (water surface elevation (WSE) and bankfull depth (BFD) at upstream extent of bridge structure)
    * The downstream end will include a measurement of the hydraulic drop, if present.
    * The elevations of the thalweg and water surface, as well as bankfull width and bankfull depth measured at three channel widths upstream and downstream of the culvert or bridge[2].

Other measurements to be taken include

- Dominant substrate upstream and downstream (i.e. sand, fine gravel, coarse gravel, cobble, boulder, bedrock),
- Culvert dimensions or bridge span
- Distance and azimuth to reference points

Site photographs and notes will be taken on the day of the survey and then included in a summary report of field measurements.

[2] Moving three channel widths from the culvert allows measurements to be outside of the influence of the culvert.

EFFECTIVENESS MONITORING

Effectiveness monitoring is conducted three years post-construction and includes an assessment of fish passage characteristics and the stream channel function using the same methods as compliance monitoring. GDRCo will work cooperatively with the State and the tribal co-managers in evaluating effectiveness of structures and adaptively manage stream crossings over the life of the permit; *i.e.* build on the existing knowledge through structure evaluation during the effectiveness monitoring phase of the project. Monitoring results will be reported to WDFW at the annual RMAP meeting held each December.

Performance Measures

To be effective, performance measures and standards must be measurable, meaningful, and achievable. A direct connection must also be evident between these performance criteria and the goals and objectives of the mitigation project. The structure;

1. Will pass fish per level A assessment i.e. natural stream bed throughout culvert, culvert span>75% of stream width at second riffle downstream of structure or outfall drop < 0.24 m, culvert slope < 1%
2. Maintain channel function(s) consistent with in-stream conditions in adjacent upstream and downstream reaches to include;
   a. Gradient: the structure does not function as nick point or initiate head-cutting.
   b. Confinement consistent with channel condition prior to construction or does not cause increased confinement when compared to upstream reach- i.e. does not create a backwater exceeding the requirements in WAC 220-110-070(1)(h).
   c. Substrate particle size distribution is consistent between upstream, structure and downstream stream reaches (given the pre-project condition was a consistent gradient and channel width throughout the upstream, project and downstream reach)
3. Surrounding areas will have been reclaimed per BMP's
   a. Vegetation on disturbed sites established per WAC
   b. Banks and shorelines stabilized, no active erosion
   c. Fill areas pulled back to angle of repose/natural grade

A fish passage structure shall be deemed effective if it meets criteria set forth in the following section, and ineffective if it fails any single criteria; however GDRCo and WDFW may jointly agree that a project passes fish (i.e. is effective) even though one or more criteria are not met.

No-slope Culvert Performance Measures

1. Streambed fill depths at the inlet and outlet ends of the culvert $\leq$40% (or 50% per plans) streambed elevation at the inlet
2. $\geq$20% streambed fill at the outlet (within +/- 5% of rise),
3. The absolute difference between the inlet and outlet crown elevation divided by the length is $\leq$1%.

4. Elevation where specified by plan, culvert crown elevation must be within +/- 0.5 feet of plan elevation.
5. ≤ 3 feet of unintended regrade
6. For wetland-type crossings, the countersink may be measured by the backwatered elevation measured during low flow periods.

Stream Simulation Culvert Performance Measures

1. Project area has a stream bed character similar to natural up and downstream reaches.[3]
2. Culvert bed cross section is similar to the natural stream cross section
3. Culvert bed slope is ≤ 1.25 times the average upstream channel slope.
4. Inlet and outlet countersink is >30% and< 50% of culvert rise (+/- 5%).
5. Upstream channel regrade results in no persistent water surface drops >1.5 feet or exposure of bedrock >100 feet.

Bridge Performance Measures

1. Bridge components that are within the flood prone width or the channel migration zone, may not affect stream function. Any affects to stream function will be mitigated. Evidence of affected stream function is as follows:
    a. Bed scour to depths in excess of average pool depth.
    b. Bank scour in excess of prevailing bank scour.
    c. Signs of undercutting infrastructure.
2. No appreciable increase (i.e. < 0.2 feet) in backwater elevation[4]
3. The bottom cord of bridge must be above a calculated 100 year flood elevation with consideration for debris likely to be encountered
4. Bridges and their approach fills must not deliver fine sediment directly to the stream such that water quality standards are exceeded

Road Dormancy & Decommissioning

1. Imported fill material removed to the angle of repose or a slope similar to the natural, valley bottom and walls and upstream and downstream bank and channel widths.
2. Fill slopes do not exhibit signs of instability. Channel condition within project area consistent with upstream and downstream reaches.
3. Exposed or disturbed riparian areas are revegetated with native species per Forest Practices Rules WAC 222-34 on road decommissioning projects.
4. Exposed soils within dormant road crossings are covered with grass and/or natural vegetation.

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[3] Median particle size is +/- 1 phi class of median particle size in the natural stream bed outside the influence of the crossing. In most cases a visual examination of channel form and bed characteristics will suffice. Photographic evidence may meet this requirement

[4] calculated at the 100-year flood

Contingency Actions

If, during the effectiveness monitoring a project is found to not meet the effectiveness standards and is not exempted during consultation with DFW and tribe(s), it will be subject to a contingency action. Contingency actions may include maintenance, retrofit, or replacement as appropriate to the site specific condition. The specific management action will be designed in consultation with DFW. GDRCo shall mitigate any ineffective structures within two years following the identification of a non-effective condition (i.e. within 5 years of construction).

Mitigation

Mitigation is an integral part of a stream crossing project i.e. the purpose of upgrading a stream crossing installation is to increase habitat values thus placing the structure is a mitigation activity. Regarding new construction; these BMPs provide for natural processes with structure design; restoration and enhancement, are not objectives of stream crossing structures permitted under the general HPA. Compensatory mitigation for loss of ecological services available to the stream channel, e.g. large woody debris (LWD) recruitment potential from right-of-ways is based on site specific requirement and the proposed mitigation will be part of the project plan submittal. The mitigation actions will be documented in the compliance monitoring.

Annual Report

An annual report will be distributed to WDFW and other stakeholders prior to the annual RMAP meeting held in December. The report summarizes the status of all projects permitted each year under the general HPA and includes: The list of sites with Forest Practice ID Numbers, RMAP ID (Road Number and Station), Latitude/Longitude, Activity, and any notable deviations from plan as well as the Compliance status of each of above sites.

Also included in the annual report will be effectiveness monitoring results for sites 3 years old.

ADDITIONAL PROVISIONS

1. No conditions contained within this MOA shall limit the authority of WDFW to enforce applicable statutes and rules.

2. Timely communication and collaboration between GDRCO and WDFW regarding GDRCO hydraulic projects will be critical to the successful implementation of this MOA. GDRCO personnel and WDFW biologists are encouraged to discuss GDRCO projects, and to work cooperatively on reviewing and documenting compliance and effectiveness for completed projects.

3. Instream work periods for GDRCO hydraulic projects in this MOA will be described within the associated general HPA (WDFW log control #).

4. GDRCO shall submit an annual report to WDFW summarizing the GDRCO hydraulic projects that were completed under this MOA within the preceding calendar year a minimum of 30-days prior to the annual December RMAP meeting.

5. Adaptive management is an important part of this process. The set of BMPs in this MOA will be evaluated on a continual basis during the effectiveness monitoring process. Modifications and improvements to the BMPs will be an agenda item at the annual meeting. Changes to the BMPs that are acceptable to WDFW and GDRCo will not become effective until this MOA is modified as described in Provision 9 below.

6. This MOA is executed as of the last signature and is effective for a 10-year period or until the effectiveness monitoring and any necessary work to correct issues identified during the effectiveness monitoring has been completed for all project constructed under this pilot general HPA, at which time it will expire unless extended according to Provision 8 below.

7. GDRCo and WDFW will discuss the future of this general approach at a meeting to be held no later than 6 months prior to the expiration of the pilot general HPA. .

8. Modifications within the scope of the MOA shall be made by mutual consent of the parties, by issuance of a written modification, signed and dated by all parties, prior to any changes being performed.

9. Either party, in writing, may terminate this MOA in whole, or in part, at any time before the date of expiration by providing written notice of termination to the other party which shall become effective thirty (30) days after receipt of the notice of termination.

The principal contacts for this MOA are:

Assistant Director
Habitat Program
Washington Department of Fish and Wildlife
600 Capitol Way North
Olympia, WA 98501-1091
(360) 902-2534

Timberland Services Manager
Northwest Timberlands Division
Green Diamond Resource Company
215 North Third St.
P.O. Box 9001
Shelton, WA 98584-0931
(360) 427-4790

Signatures

The Parties hereto have executed this agreement:

Eric Beach, Timberland ~~Services~~ Manager
Green Diamond Resource Company

1/20/10
Date

Lee Rolle, Chief Financial Officer
~~Director~~, Washington Department of Fish and Wildlife

1/20/10
Date

APPENDIX A

Green Diamond Resource Co. NW Timberlands
Best Management Practices for Type F Stream Crossings

Scope

Green Diamond Resource Company (GDRCo) is a privately-held timberland management company with a long tradition of stewardship. GDRCo conducts land management activities within the Ordinary High Water Mark (OHWM) of fish-bearing streams under permit approval from Washington Department of Natural Resources (DNR) and the Washington Department of Fish and Wildlife (WDFW). In collaboration with the WDFW, GDRCo is seeking a General Hydraulic Project Approval (HPA) to cover most types of water crossings required for industrial forestry operations. GDRCo relies on engineering principles and quantitative evaluation to design projects and construct crossings. These Best Management Practices (BMPs) are based on established physical and biological criteria. This submittal describes in detail the BMPs that will be in place during stream crossing work covered by the General HPA.

Covered under this General Permit are projects on fish bearing waters (Type F streams and wetlands) including:

1. Installation of No-Slope and Stream Simulation Culverts,
2. Bridges,
3. Road Abandonment (Dormant or Decommission) activities,
4. And the maintenance of these structures.

The General Permit will be for GDRCo lands located in western Washington found within the jurisdictional boundaries of WDFW Region 5 & 6. This will include the ~280,000 acres within the HCP area as well as ~ 12,000 acres located west of Highway 101 in the North and Johns River drainages and ~18,000 in Lewis County in the Chehalis basin.

Although two different HCP's (Olympic Tree Farm and FFR) regulate land management on the permit area, GDRCo road management and associated road stream crossing BMP's are consistent across the ownership. The meteorological conditions are generally consistent across this landscape; cool wet winters, dry summers. Dominant land cover is evergreen conifer forest. Geologies are marine sediments and Crescent basalts as well as areas at the southern terminus of the last glacial advance. The prescriptions within this document are appropriate for these environmental conditions.

THE DESIGN PROCESS

Prior to the design phase of a project all stream crossing alternatives are considered (e.g. road relocation, abandonment, alternate access) and the watershed position of the stream crossing is evaluated in order to prevent disruptions of meanders/channel migration, ensure that the structure will not impact natural channel bed form or sediment transport/deposition processes .

1. Select the solution type appropriate to site conditions and road use level. We use a matrix of recommended solutions based on short-term and long-term needs (Table 1)

Table 1. Stream Crossing Activity Matrix

Short-Term Road Use	Long-Term Road Use		
	None	Management-only	Heavy
None	Decommission	Dormant with future Temporary Culvert, or Culvert/Bridge	Dormant now, then Culvert/Bridge or Temporary Culvert/Bridge
Heavy	Decommission after use, or Temporary Culvert	Culvert/Bridge	Culvert/Bridge

2. Examine/quantify site-specific characteristics.
   - Channel Bankfull Width (BFW), Valley Width/Confinement Ratio, 100 year flood area, Stream Gradient
   - Characterize stream bed material, habitat quality and seasonality, upstream head cut potential, debris risks
   - Properly designed up- and downstream transitions
   - Crossing skew; use LWD to reduce skew or redirect flow

3. Select the appropriate structure. Recommendations:
   - Permanent Crossing
     * Gradient < 3% and BFW <10': No Slope culvert
     * Gradient > 3% and BFW < 10' : Stream Simulation culvert
     * BFW > 10': Consider installing a bridge
   - Temporary Crossing
     * BFW < 5' and Gradient < 5%: Consider permanent culvert.
     * Otherwise weigh Temporary Culvert vs. Temporary Bridge

4. Design and construct crossing using the standards and guidelines within these BMP's.

PLAN TYPES

Plans should convey enough project/site information to reviewers to understand the nature and expected outcome of projects. The level of requisite detail in a plan is dependant on the project complexity such that several types of plans are appropriate to cover the spectrum of activities addressed by the HPA (Table 2).

Table 2. Plan Types

Plan Type	Culvert Installation	Bridge Installation	Road Abandonment
Narrative	N/A	N/A	Fill Height ≤ 5' & BFW ≤ 5' & Outfall ≤ 2
Template/ Sketch	Stream Gradient ≤ 3% & BFW ≤ 10' & Outfall ≤ 2'	BFW ≤ 25' & Entrenchment Ratio <2	All Others
Formal	All others	All others	N/A

Narrative

Use on simple sites that easily accommodate the desired activity type *e.g.* removing a low road fill on a small stream crossing or culvert maintenance work. A narrative plan includes;

a) Description of the site: stream size, gradient, and confinement.

b) Explanation of proposed work; width of removed fill, revegetation plans.

c) Benchmarks establishing elevation control.

Template/Sketch

Use on low risk, non-complex sites. Includes GDRCo "Typical Sketches" based on various project types, site specific sketches may be included to better depict conditions. Information recorded on the template includes

a) Stream gradient, BFW and confinement/entrenchment, culvert size,

b) Stream flow and structure sizing calculations.

c) Existing structures indicated on templates or sketches.

d) Benchmarks establishing elevation control.

Formal

Use for more complex sites. Plans include a longitudinal stream profile and a site survey, including benchmarks. Individual site designs with design details noted on the plan, including existing structures.

SIZING STREAM PARAMETERS

Measuring Channel Parameters

Conditions upstream and downstream of the crossing may be significantly different. Unless the disturbance downstream of the crossing is traveling upstream, e.g. nick point migration or lateral migration of an adjacent meander, then the conditions downstream will be unlikely to affect the crossing. More emphasis should be placed on the upstream conditions.

To adequately assess the channel conditions at a project site, the engineer should walk should ~ 20 channel widths (CW) or 200' upstream and downstream as necessary from the crossing location.

Bankfull width will be established by taking channel widths upstream of the location of the planned structure at 5 regularly spaced intervals (e.g. spaced the length of 2 channel widths) over a length of stream equal to 10 BFW

Estimating Bankfull Width at Wetlands

When the BFW cannot be determined in the field (due to a wetland or linear-wetland channel), use the regression model below to approximate a BFW. This value is termed the Estimated Bankfull Width (EBFW).

When designing a project using EBFW, apply an additional factor of safety

- No slope culverts and bridges: 1' or +10% (i.e. design BFW = EBFW + 1' or 10%)
- Road abandonments: 2' or +20%.

Estimating Bankfull Width by Basin Area Regression

A number of regression formulas have been created that use precipitation and basin area. We have evaluated these models as well as GDRCo data specific to the Olympic Tree Farm. The Standard USGS[5] equation for determining flows approximating bankfull discharge[6] at ungaged sites in Regions 1 and 2 in Washington State are:
Region 1 (SW WA and Olympics): $\mathbf{Q_2 = 0.350A^{0.923}P^{1.24}}$
Region 2 (Puget Sound, West Slope Cascades): $\mathbf{Q_2 = 0.090A^{0.877}P^{1.51}}$

Contributing drainage area (A), in square miles,
Mean annual precipitation (P), in inches,

The GDRCo regression for calculation of Estimated Bankfull Width (EBFW in feet) i.e. $Q_{1.5}$, includes basin area (A) in acres. Annual Average Precipitation (in inches per year) was not found to be a significant variable in any of the models examined.

An equation of the form; $\mathbf{Q_{1.5} = 4.678 + 0.0203A}$ provides the highest R^2 with a p of <<0.001, an approach that favors simplicity. Specific coefficients will be identified on a basin specific basis and will be evaluated, refined and expanded over the life of the permit.

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[5] http://pubs.usgs.gov/fs/fs-016-01/

[6] Bank Full Discharge is ~1.5 yr return interval- i.e. $Q_{1.5}$ (Dunne and Leopold 1978). USGS regression formulas provide a Q_2 equation which is sufficient accuracy for the purpose of this estimation.

CALCULATING 100 YEAR FLOOD AREA

All water crossing structures shall be designed and constructed to pass the 100-year peak flow with consideration of debris likely to be encountered. Fill associated with all water crossing structures shall be protected from erosion to the 100-year peak flow.

Professional engineering judgment is used to select the appropriate design value although one or more methods may be used to estimate the 100 year flood area for a particular site. The critical value, which ever method is used, is the area of opening required at a culvert inlet (A_{100}) that correlates to culvert diameter (Table 4).

Table 4. 100 year flood area and the equivalent culvert diameter; inches (feet).

100 YEAR FLOOD AREA (SQFT)	EQUIVILENT ROUND CULVERT DIAMETER
3.1	24" (2')
4.9	30" (2.5')
7.1	36" (3')
9.6	42" (3.5')
12.6	48" (4')
15.9	54" (4.5')
19.6	60" (5')
23.8	66" (5.5')
28.3	72" (6')
38.5	84" (7')
50.2	96" (8')
63.6	108" (9')
78.5	120" (10')
95.0	132" (11')
113.1	144" (12')

Physical Stream Area Method

We use the 100 year flood area to design dimensions of culverts for stream crossings (Figure 2). The Formula for 100 year Flood Area is:

$A_{100} = H * (W1 + W2)$

Where; W1 is active channel width or OHWM, W2 is BFW, and H is BFD

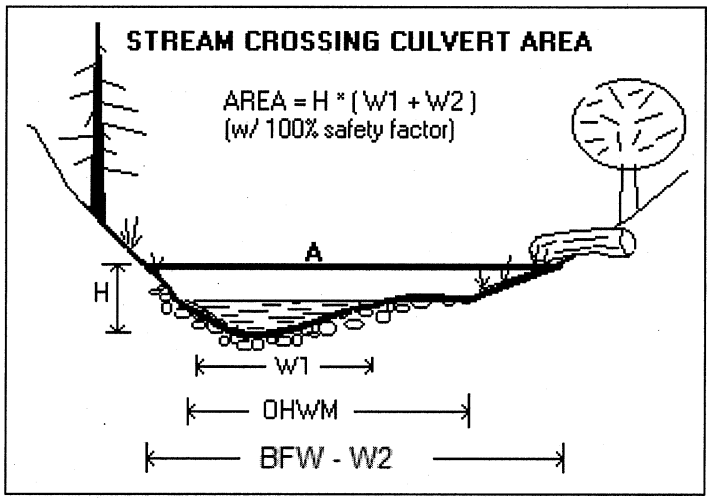


***Figure 1**. Physical measurements necessary for planning a stream crossing project*

Talbot Formula

The Talbot formula uses basin area and a terrain coefficient to estimate the required waterway area to pass a 100 year flood.

$A_{100} = C (M)$ ^3/4

Where A is area of pipe (ft^2), M is drainage area (acres) and C is terrain coefficient (Table 5)

Table 5. Quantitative vs. Qualitative values of the terrain coefficient C and Typical Litho-Topo Units representative of each value.

C	1	2/3	½	1/3	1/5
Terrain	Steep & rocky	Rough & hilly	Uneven valleys	Rolling ground	Flat, no water
Typical LTU's	CUP	CIS, SIG	AGL	ROP	ROP

Basin Rainfall Intensity

Uses basin area and instantaneous run off from a large precipitation event, assumptions include;

- Precipitation of 1 inch per hour (1"/hr) equates to a 100 year storm event (based on past rainfall records, represents the greatest intensities during heavy storms in the area).
- 100% saturation conditions so that 100% of this rainfall runs off instantly and collects at the project site.
- Does not account for infiltration or time-lag issues; leads to an overestimation of flow rate; results in conservative values.

These assumptions lead to an overestimation of predicted flow. This flow is then converted to an effective area of opening (A_{100}) based on the nomograph in the DNR board manual (Figure 3) via their recommended culvert size, using a HW/D ratio of 0.8.

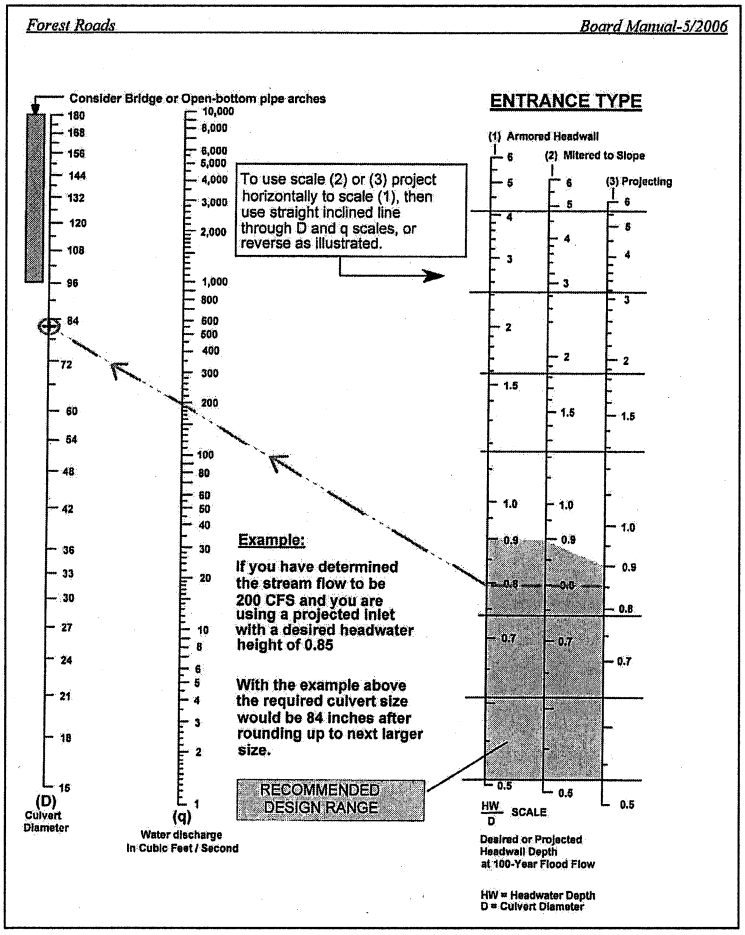
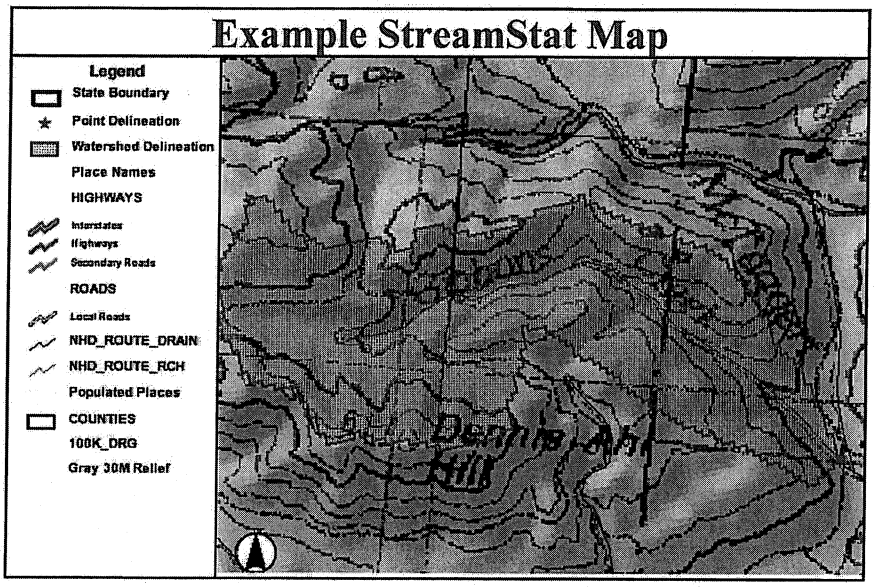


***Figure 2**. Nomograph for relating 100 year flow (Q_{100}) to culvert size (A_{100})*

Stream-Stats

The web site (http://water.usgs.gov/osw/streamstats/Washington.html) contains interactive tools that allow users to find 100 year flood flows. Stream-stats is very effective and accepted method for larger basins (typically >640 acres), but may not be appropriate for sizing culverts in small basins catchments. The results present a Q_{100}, which is then converted to A_{100} through the DNR nomograph. It is important to confirm the basin represented in Stream-Stats is accurate.

Streamstats Report



Streamflow Statistics Report

Peak Flow Basin Characteristics			
100% Region 2 (1.056 mi2)			
Parameter	Value	Min	Max
Drainage Area (square miles)	1.056	0.08	3020
Mean Annual Precipitation (inches)	103	23	170

Streamflow Statistics					
Statistic	Flow (ft^3/s)	Standard Error (percent)	Equivalent years of record	90-Percent Prediction Interval	
				Minimum	Maximum
Peak-Flow Statistics					
PK2	103	56	1		
PK10	195	53	1		
PK25	246	53	2		
PK50	293	53	2		
PK100	332	54	3		
PK500	446				

Figure 3. *StreamStat example output*

Final Selection of 100 year flood area Design A_{100}

The results for A_{100} from the above methods may vary by ~ 1 pipe size, thus engineering judgment plays an important factor in selecting the appropriate value to use in design. We use a spreadsheet (Figure 5) for calculation and display of these values. A conservative approach selects the largest area indicated, which may be appropriate in high-debris streams, rain-on-snow basins, etc. It is experience and sound engineering judgment that ultimately selects the appropriate design A_{100}.

CULVERT SIZING CALCULATIONS

PROJECT: 1750/1760

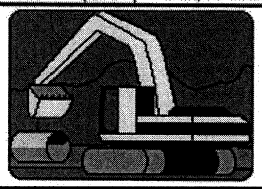
Road / Stream Crossings				Required Culverts			100 year area formula					Talbot Equation			DNR Board Manual		
Road #	Station	Stream	Stream Type	Selected Culvert Diameter	Culvert Length	Stream Gradient	CDZ W1 (ft)	100 yr W2 (ft)	BFD H (ft)	yr flood Area	Culv D	Basin Acres	Talbot Area*	Culv D	DNR** cfs	DNR Entrance	Culv D
										0			0.0		0.0	0.8	
1750	3+25		F	108"	40'	8%	4.5	5.5	1	10	48"	42	8.2	42"	42.4	0.8	48"
				stream-sim, c.s. 40%=3.6'			4.1	5.6	1.0	9.87			0.0		0.0	0.8	
1760	5+00	POND	F	60"	30'	0%				0		24.7	5.5	36"	24.9	0.8	36"
				c.s. 30%, set flat						0			0.0		0.0	0.8	
										0			0.0		0.0	0.8	

*Talbot C Value= 1/2 (Uneven valleys)
**Storm Rainfall= 1 in/hr

NUMBER OF CULVERTS AND LENGTHS

18" CPP _____
24" CMP/CPP _____
36" CMP/CPP _____
48" CMP _____
60" CMP _____
72" CMP _____
____" CMP/CPP _____
____" CMP/CPP _____
BRIDGE/LENGTH _____

Talbot C	LTU	Terrain
1	CUP	Steep & rocky
2/3	CIS	Rough & hilly
2/3	SIG	Rough & hilly
1/2	AGL	Uneven valleys
1/2	LEW	Uneven valleys
1/3	ROP	Rolling ground
1/5	ROP	Flat, no water



100 Yr Area	*Min Culv D*
3.1	24"
4.9	30"
7.1	36"
9.6	42"
12.6	48"
15.9	54"
19.6	60"
23.8	66"
28.3	72"
38.5	84"
50.2	96"
63.6	108"
78.5	120"

Figure 4. Example culvert Sizing worksheet

However, the A_{100} may not play a significant role in determining culvert size for fish passage culverts. The requirement for exceeding stream bankfull width at countersunk depth typically leads to culvert sizes where the inlet area remaining above countersinking is many times larger than that required to pass the 100 year flood.

CULVERTS

General Guidelines

Culverts in fish-bearing streams shall be designed, installed, and maintained to provide passage for all fish species and all life stages that are likely to be encountered at the site.

Set culvert in line with natural stream flow. Avoid constricting the channel into the culvert.

The culvert shall be installed and maintained to avoid inlet scouring and to prevent erosion of stream banks downstream of the project.

Survey/measure lengths and elevations as necessary to ensure proper culvert placement. Set elevations relative to benchmarks when noted on plans.

Clear any loose debris upstream that may plug culvert.

Permanent crossings require stabilization of material within the 100 year flow, with rip-rap, hydro-seeding, etc.

No installation of culverts in spawning areas. If this condition cannot be met, then mitigation must be provided to fully replace the impacted habitat.

Temporary Culverts

Temporary culverts are allowed for one-season installation. Culverts may be placed at the start of the hydraulics window (defined in "Timing" section below) and will be removed before the end of the hydraulics window of the same year.

Culverts will be sized to pass the largest summer storms anticipated in the area. They are not required to pass fish or the 100 year flood, because of their short duration of installation and lack of storm flows during the summer.

No Slope Culvert Design

No slope culvert designs shall meet the guidelines in WDFW's "Design of Road Culverts for Fish Passage" manual.

Typically, no slope culverts will be installed on streams less than 10' wide (BFW) and less than 3% stream gradient. Culverts shall be designed and installed at a slope of no greater than 0.5% (Figure 6).

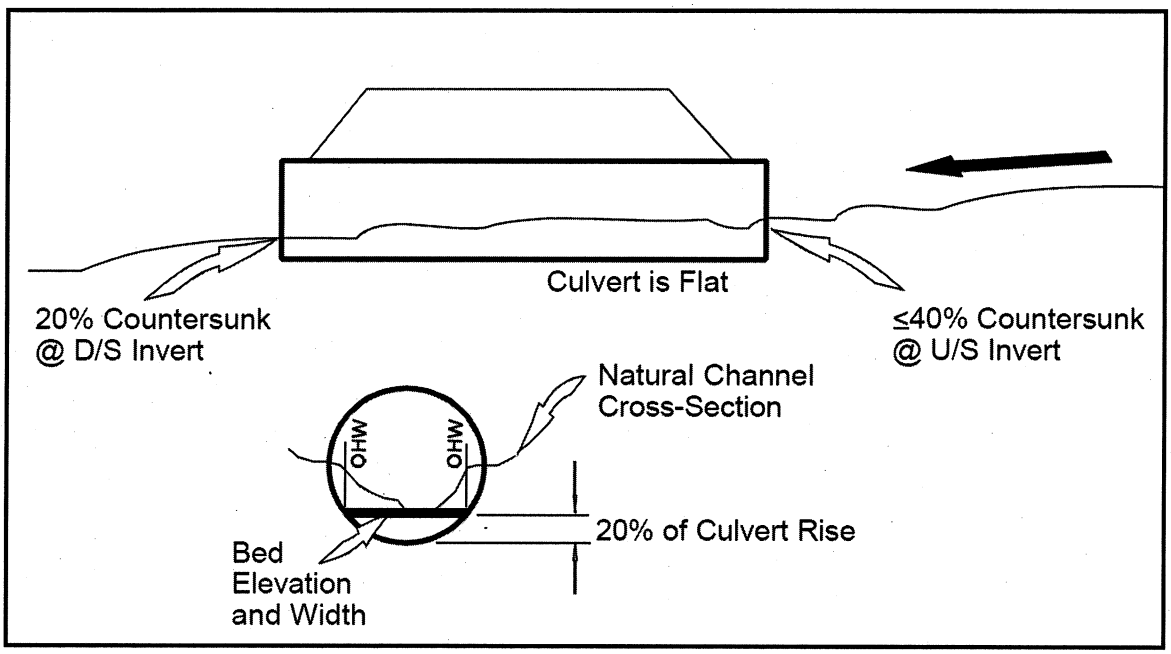


Figure 5. Diagram of No Slope Culvert

The natural/ideal stream gradient at the outlet of the culvert will be countersunk at least 20% of the culvert rise. This elevation shall be established and clearly benchmarked for post-project review prior to commencing any excavation for the project.

The width of the stream bed at 20% outlet countersink will be as wide as the average bankfull width of the streambed. The formula for this leads to:

- Minimum Culvert Diameter = 1.25 * BFW; conversely
- Width at 20% countersink = 0.8 * Culvert Diameter

The natural/ideal stream gradient at the inlet of the culvert will be countersunk at least 20%, typically at 40%, and sometimes as much as 50%, of the culvert rise. Inlet countersink design greater than 40% is allowed under certain situations, such as wetlands or wetland channels, on steeper streams (>3%), or where head cut is anticipated that will flatten the stream gradient at the culvert.

The area at the inlet remaining open (above countersinking) shall provide enough opening to pass the 100 year flood with consideration for debris likely to be encountered (Figure 7).

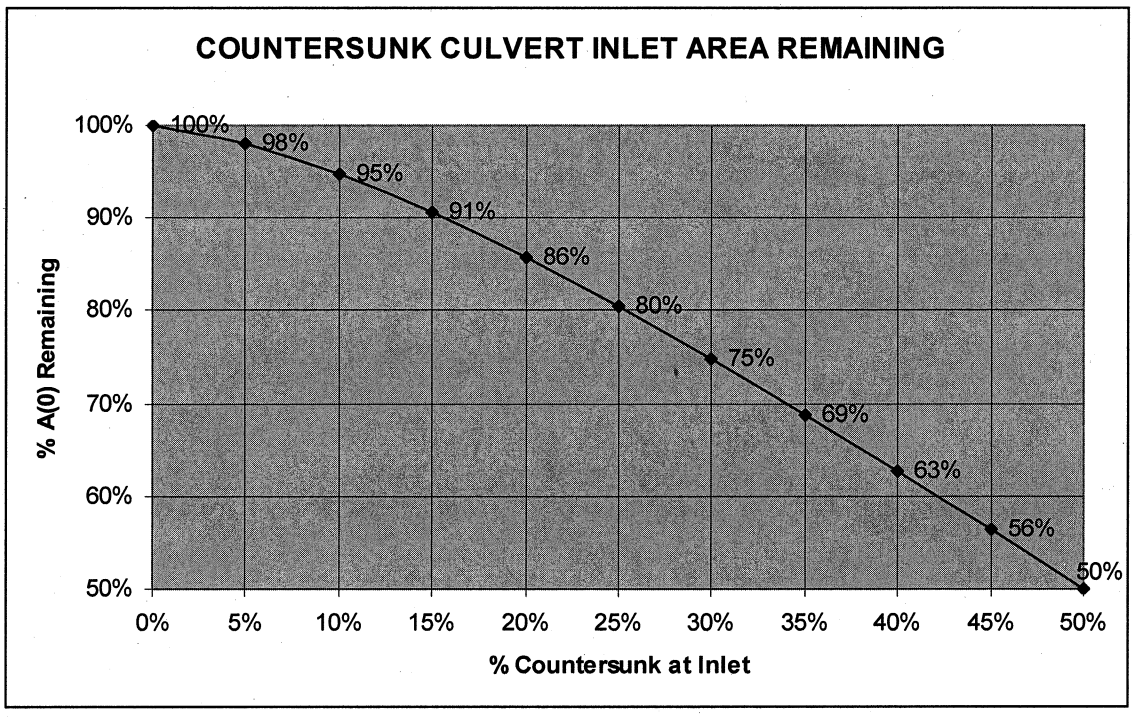


Figure 6. Culvert Inlet Area Remaining versus Percent of Countersink

Experience with No Slope culverts indicates that a culvert set lower (c.s. > 20%) have the greatest possibility to meet project objectives of fish passage over the long term. Consider designing from the top-down (i.e. start at c.s. 40%/50% at inlet, so that outlet c.s. is maximized >20%)

Culverts are filled with well-graded material consistent with the surrounding channel characteristics when natural processes are not expected to fill the culvert within 2 years (i.e. no significant wedge of material upstream of crossing). In wetland situations, no filling is required because the culvert will naturally backwater when set at proper elevations, which will provide pool habitat for fish species.

Pipe arches (*aka* squashed pipes) will be sized and designed to meet the above guidelines using the "Handbook of Steel Drainage & Highway Construction Products" from the American Iron and Steel Institute, 1994 edition, for geometry, sizing, and flow calculations.

Stream-Simulation Culverts

Stream simulation occurs when physical conditions in the culvert look and function similarly to those in the adjacent natural channel. These conditions imply acceptable passage for fish and wildlife.

Typically, stream-simulation culverts will be installed on streams less than 10' wide (BFW) and greater than 3% stream gradient.

Stream simulation projects shall be surveyed, designed and constructed in a manner consistent with the WDFW Design of Road Culverts for Fish Passage, Chapter 6 - Stream Simulation Design Option (Figure 8).

Typically, culverts are set along the natural stream gradient, countersunk 40%, filled with a range of streambed gravel sized to match the naturally occurring, ambient substrate, resist scour, and sized to a diameter of D=1.2*BFW+2'.

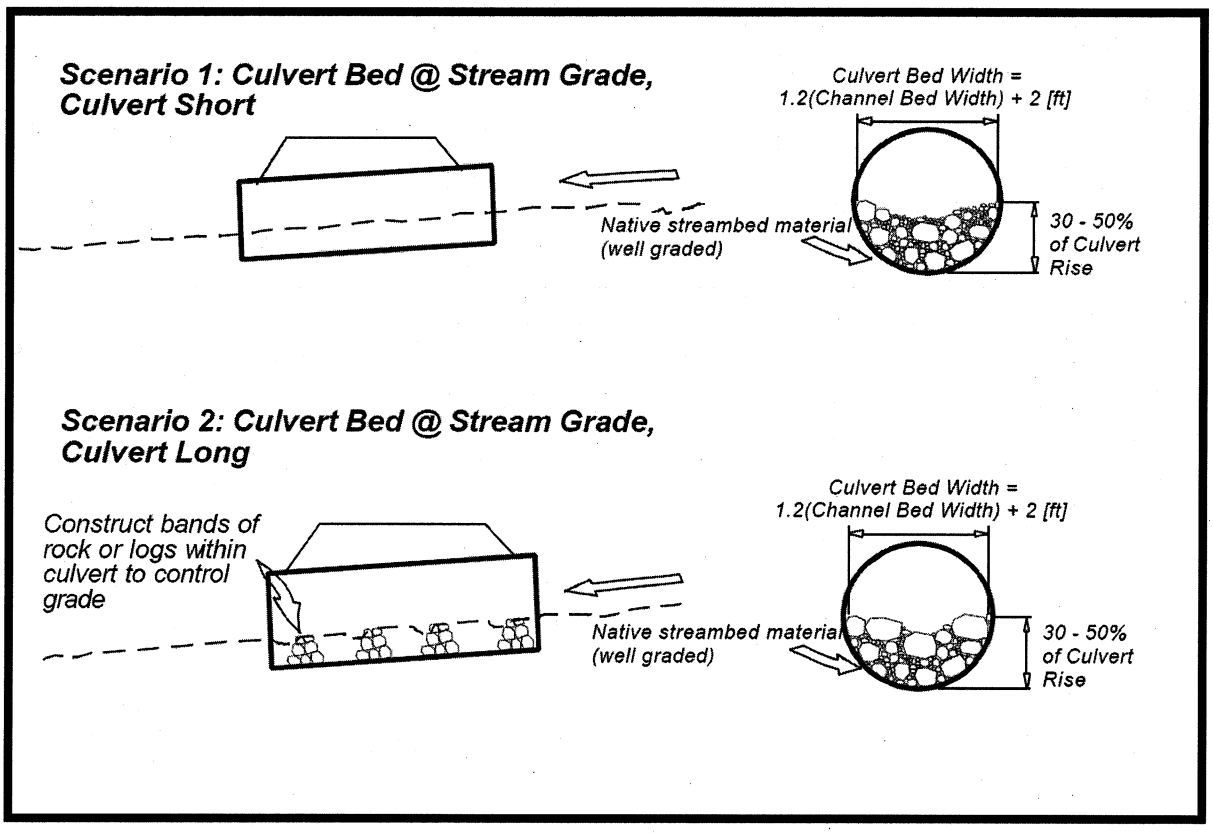


Figure 7. Diagram of stream simulation culvert

BRIDGES

Installation of single span bridges with piers outside of the bankfull channel

General Guidelines

The toe width under bridge project will equal or exceed the natural stream bankfull width, with an ideal toe width between rip-rap to stream BFW ratio of 1.2. All structures (abutments, piers, piling, sills, approach fills, etc) are placed outside of the bankfull width of the stream.

The stream channel bed through the project site will conform to the original location and equivalent to up and downstream width and gradient and shall be aligned to cause the least effect on the hydraulics of the stream. When placing structures within the flood prone width, effects on natural stream function must be considered and weighed as factors to designed toe width. Riprap materials used for structure protection shall be clean, angular rock, which shall be installed to withstand the 100-year peak flow. Set the bottom chord of the bridge at an elevation that exceeds the calculated 100 year flood elevation with consideration for debris likely to be encountered

When possible, slope road approaches away from the bridge to eliminate delivery of fine sediment to the stream. If unavoidable, road drainage shall be disconnected via cross drains or other measures and all appropriate measures must be taken to reduce potential sediment delivery (catch basins, quality road surfacing material, etc).

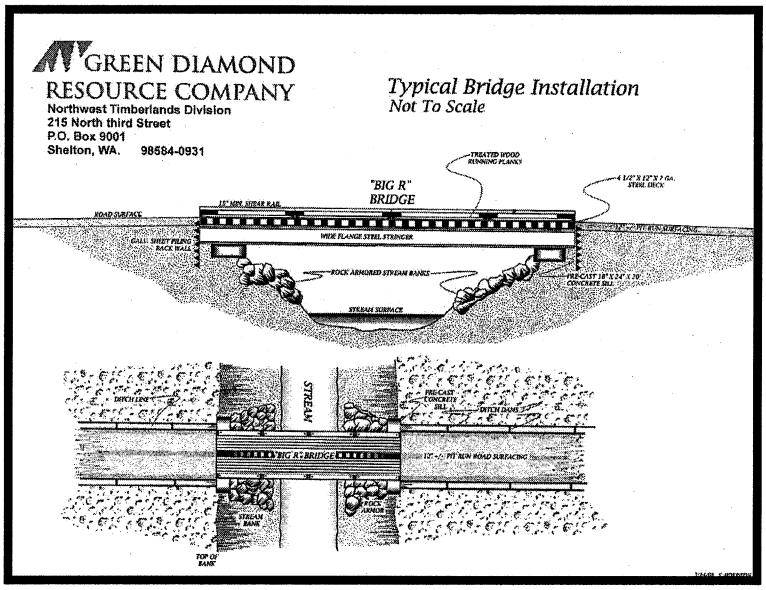


Figure 8 – Typical bridge installation

Temporary Bridges at New and Replacement Sites

Installation of temporary bridges is the preferred environmental choice for seldom-used roads crossing fish streams. Temporary bridge crossings will be constructed following all other general bridge guidelines.

These sites are established with permanent sills and abutments, where the bridge structure can be easily removed and/or replaced as needed. No additional in-stream work is required to remove or reinstall the bridge when a crane is used, but generally will require 1 equipment water crossing.

New Construction

Minimize disturbance of streambed and banks; locate the bridge with appropriate alignment so that the toe width and gradient are similar to the natural channel characteristics.

Excavation for and placement of the foundation and superstructure shall be outside the ordinary high water line or bank full width or completely separated from the stream by placing the footings landward of the top of the bank.

Culvert Replacement Sites

Stream width established under the bridge is equal to the natural BFW in the project vicinity as established by measured stream cross sections as described in previous sections

Removal of an Existing Bridge Structure

The bridge deck shall be cleaned of aggregate or earth materials prior to bridge removal. Material shall be disposed of so it will not re-enter the stream.

Large, sound, untreated wood stringers, abutments or cribbing removed in association with a water crossing project shall be incorporated into the stream channel downstream from the project as mitigation for project impacts.

As much of the bridge identified for removal will be dismantled and mechanically removed. Bridge parts that cannot be mechanically removed may be broken into large sections and dropped into the stream. These sections shall be as large as can safely be handled and shall be removed immediately after they have been dropped. Removal shall be accomplished by mechanical means.

ROAD CROSSING ABANDONMENT

Road Abandonment Guidelines

The objective is to re-establish the natural bankfull width, with the streambed as close to the original location as possible and consistent with up and downstream width, bank, and gradient characteristics. On applications for abandonment activities on FPAs, GDRCo shall submit a typical sketch (e.g. Figure 10) or other more detailed sketch as needed, and include the bankfull width (bfw), confinement ratio and proposed pulled toe width of fill material, as well as the existing height of fill over the stream and natural stream gradient in the project vicinity.

Erosion control measures are implemented on exposed soils upon project completion or in advance of anticipated rain events, using wheat straw blankets, hydro-mulch, vegetation, or other means. This typically includes grass seed and straw; installing catch basins, surface bars, and other structures.

Approaches are blocked to vehicular traffic.

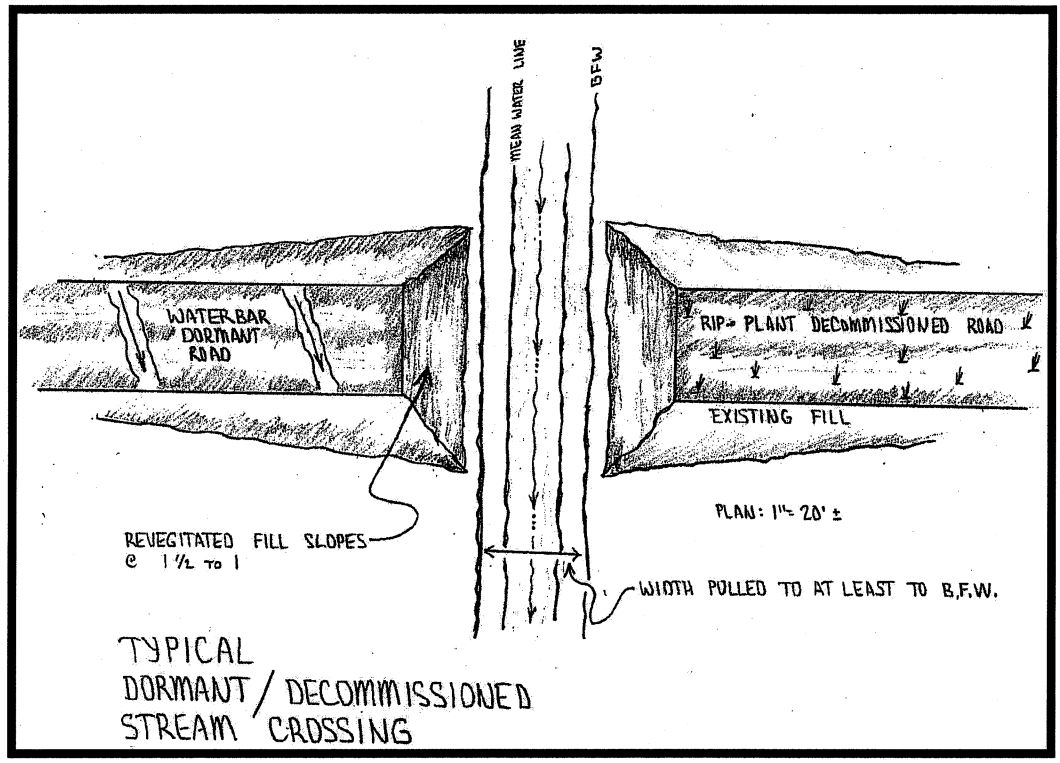


Figure 9. Typical Dormant/Decommissioned Site Plan

Structure Removal

The existing structure (culvert, bridge or puncheon) will be removed from the stream channel and moved to a suitable disposal site outside of the active floodplain. All material removed for the project shall be placed in a stable location that will not deliver to typed waters or wetlands.

Large, sound, untreated wood stringers, abutments or cribbing removed in association with a water crossing project shall be incorporated into the stream channel downstream from the project as mitigation for project impacts.

Road Dormancy Fill Removal

The toe of remaining fill slope shall be pulled to a width equal to stream BFW + 2' or BFW * 1.2, whichever is greater.

All remaining fill slopes shall be reshaped to a stable angle (not to exceed 1.5:1 unless into bedrock).

Road Decommissioning Fill Removal

In highly confined settings (VW < 2 * BFW), the fill slopes shall be pulled back to a width approximately equal to the valley width and sloped to match to the natural valley bottom and walls and upstream and downstream bank and channel widths.

In unconfined settings (VW > 2 * BFW), the toe width of remaining fill shall be equal to the flood prone width; VW at 2xBFD (Figure 11).

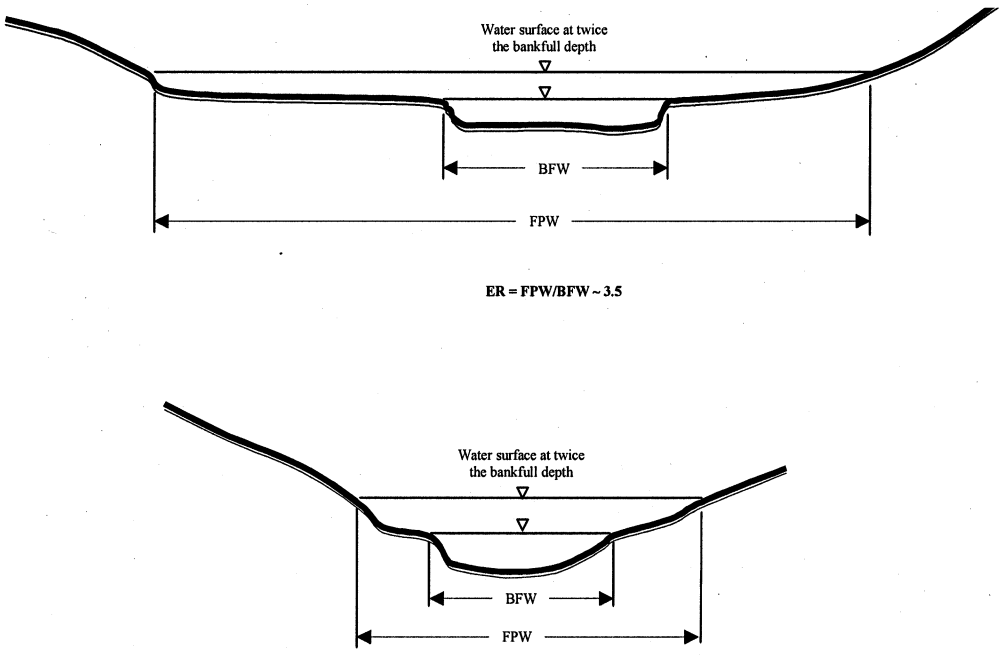


Figure 10. Illustration of Flood Prone width in relation to BFW and BFD

Wetlands are site-specific and bottom and toe width are included in submitted plans for WDFW review. Typically, short fills (<25' road length) are "pulled all across wetland", longer fills (>50') must be considered for pulling all or punching holes to hydrologically reconnect wetland functions.

All remaining fill slopes shall be reshaped to the angle of repose or a slope similar to the natural valley bottom and walls and upstream and downstream bank and channel widths (not to exceed 1.5:1 unless into bedrock).

Tree planting, when appropriate (i.e. areas >1/2 acre or further than 80m from mature shade tolerant conifer) will be completed during the next available planting season. Exposed or disturbed riparian areas shall be revegetated with native tree species per Forest Practices Rules WAC 222-34.

GENERAL CONSTRUCTION PRACTICES

Guidelines

All Type F water crossings are designed for unimpeded migration of fish species. This condition is assumed to be met when a natural stream bed that is similar in channel width, gradient and substrate composition to the upstream and downstream channel and habitat conditions is present throughout the project site.

All crossings shall be designed and constructed to pass a 100 year peak flow with consideration of debris likely to be encountered.

Have diversions in place before excavating, or at least before removing existing culverts.

Establish a competent culvert bed. Compact fills in 2 foot lifts. Manual compaction may be required adjacent to culverts to ensure proper strength and prevent water infiltration. Fill over culvert will be equal to at least half pipe diameter but never less than 1 foot.

Install erosion control and sediment reduction measures on exposed soils upon project completion or in advance of anticipated rain event.

Alteration or disturbance of the bank and vegetation shall be limited to that necessary to construct the project. Affected bed and bank areas outside the project vicinity shall be restored to pre-project condition following project completion e.g.

- Regrade to natural contours
- Clean up and revegetate storage and access points
- Remove unnecessary fill, revegetate remaining fill slopes with native vegetation
- Control invasive species
- Restore wood loading of the channel consistent with reach conditions

Construction Timing

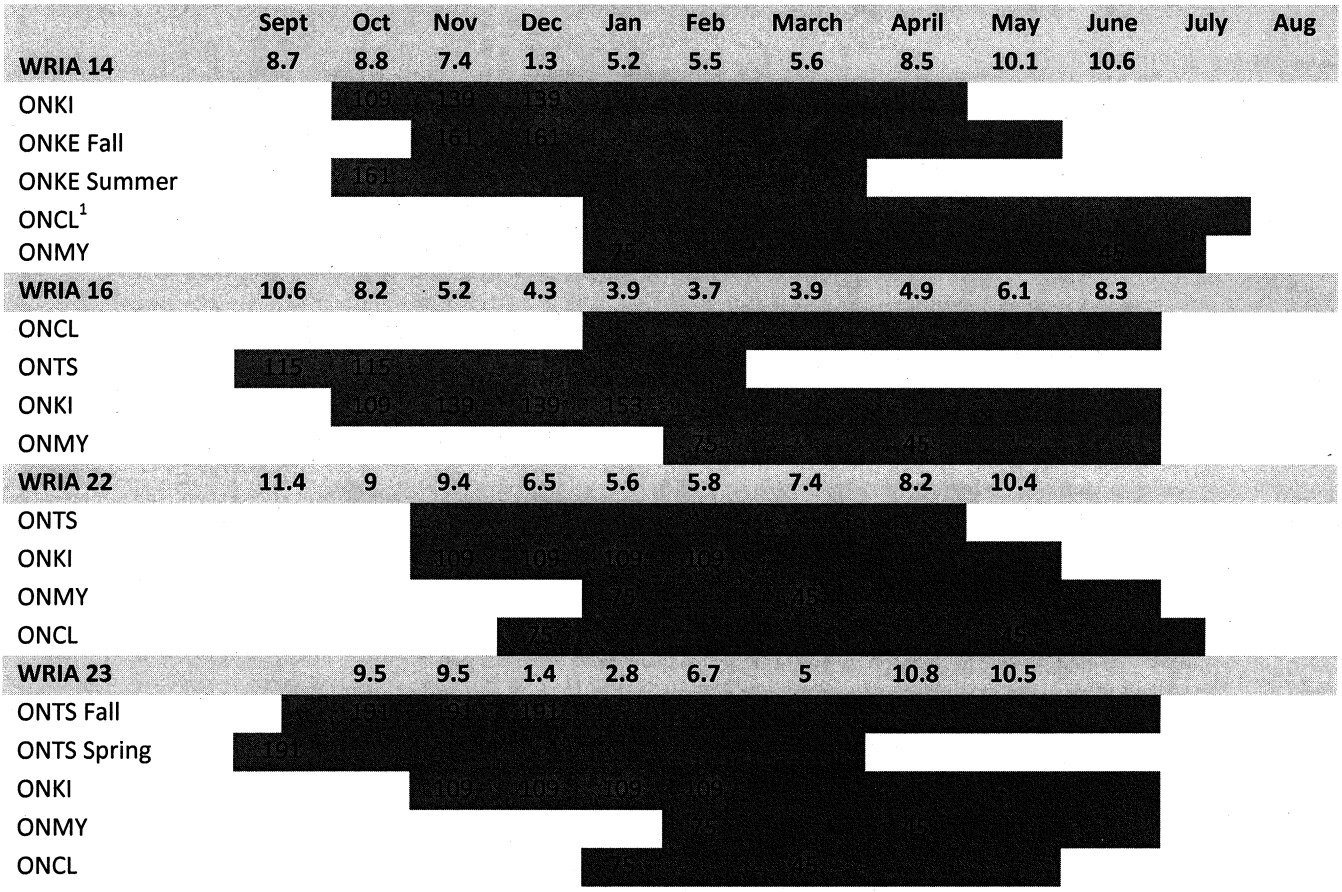
In-stream work on perennial streams conducted during the spawning-emergence windows of salmonids found in each WRIA (Table 6). We determined the period of time that in-stream work could take place as the portions of the year where no salmonid species were found in the gravels of the stream bed (Table 7).

Table 6[1] Allowable dates for in-stream work within the General Permit Area

WRIA	Mainstem	Tributary	Non-Anadromous
14	July 15 -Sep 15	July 15- Sep 15	July 15-Nov 1[2]
16	July 1- Sep 15	July 15 -Oct 1	July 1- Nov 1
22	July 1- Oct 1	July 1 - Oct 1	July 1- Nov1
23	July 15-Sep 15	July1 - Nov 1	July 1- Nov 1

[1] WRIA 14, 16 & 22 dates revised to reflect comments by D. Naur; WDFW & S. Haque; Squaxin Tribe

Table 7. Water temperature by WRIA vs. incubation time by species; red fill indicated eggs or alevin are in gravel.



[1] WRIA 14,16 & 22 dates Revised to reflect comments by D.Naur; WDFW & S. Haque; Squaxin Tribe

[2] In-stream work will be finished by November 1 in all WRIA's even if fish or eggs are not present. This is due to the likely onset of winter rains.

To calculate this period we use the peak spawning time indicated by the mean of a Gaussian distribution as the beginning of the timing until emergence from gravel (Figure 11).

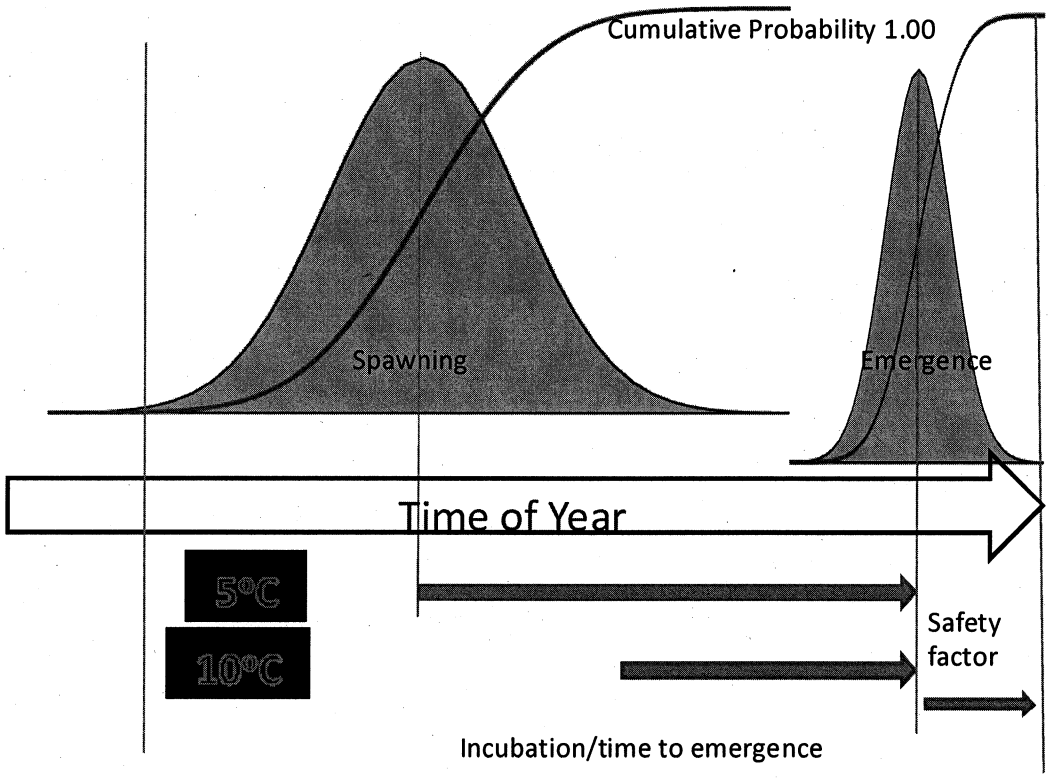


Figure 11. Conceptual diagram of fry emergence analysis.

We obtained the dates of spawning and length of incubation/time to emergence specific to each WRIA covered by this permit from a variety of sources in the public domain (Table 8) dependent on the time of year in the gravel, time intervals are assigned. *i.e.* data from the DOE gauging stations within representative streams in each WAU provide monthly mean temperatures. That temperature is assigned to each population at the time of peak spawning. The cumulative density line demonstrates that the combination of longer incubation at the beginning of the spawning period with shorter incubation times over the course of the reproductive season results in effective protection of fry if the in-stream window is set at the peak spawning time plus the 5°C incubation time. We add a safety factor based on the incubation time under increased water temperatures that would be found later in the season to ensure the later cohorts of a population are protected while in the gravel.

Table 8. Salmon runs present on GDRCo lands covered by the regional general permit. The timing of spawning and emergence from gravels bound the HPA fish window

WRIA ESU	Species	Spawning (Peak)	Emergence
14 Puget Sound	Cutthroat ONCL Resident	Dec-May[1]	March-June w/ peak in April[7]
	Steelhead ONMY Winter Mainstem spawner	Hamersley Inlet Early Feb.-Early April[8]	Hamersley: March-Mid June[9]
	Coho ONKI Tributary Spawner	Late Oct.-Mid Dec[10]	Mid Feb-Mid May
	Chum ONKE Tributary Spawner	Goldsborough Dec- Early Feb [2&4] Totten: Nov [2&4]	May-mid June[11 12] Mid April-Mid May
16 Puget Sound	Cutthroat ONCL Resident	Dec-May[1]	March-June
	Chinook ONTS Fall Mainstem spawner	Sept-Oct[4]	March-Mid May[13]
	Coho ONKI Tributary Spawner	Late Oct-Mid Jan[2]	Feb-Early July[6,7]
	Steelhead ONMY Winter Mainstem spawner	Feb-April[14]	Mid April-Mid June[7]

[7] http://www.nwfsc.noaa.gov/publications/techmemos/tm15/cutthroat.html
[8] http://wdfw.wa.gov/fish/sassi/1992_sassi_appendices/1992_sassi_apndx_1_sps.pdf
[9] Pennell et al. 1996
[10] 1992 Washington State Salmon and Steelhead Stock Inventory
[5] http://www.ecy.wa.gov/apps/watersheds/riv/ WRIA 14
[12] Quinn 2005.
[13] http://waterdata.usgs.gov/wa/nwis/monthly site 2056500
[14] http://www.nwfsc.noaa.gov/assets/25/4245_06172004_122523_steelhead.pdf

WRIA ESU	Species	Spawning (Peak)	Emergence
22 SW WA	Cutthroat ONCL Resident	February-Mid March[15]	March-Late May[16]
	Chinook ONTS Fall Mainstem spawner	Oct-Nov[9]	Mid Feb-Mid April[6 17]
	Steelhead ONMY (Winter) Mainstem spawner	Mid Feb-Mid June[9] (peak April-May[1])	April-July[7]
	Coho ONKI Tributary Spawner	Late Oct.-Mid Feb.[9]	Mid Feb-Mid June[6,10]
23	Chinook ONTS Fall Spring Mainstem spawner	Mid October- Dec[9] Late September	April-Early July.[18] April
	Coho ONKI Tributary Spawner	Nov.-Feb.[9]	Mid Feb.-Mid June.
	Steelhead ONMY Winter	Mid Feb- Mid June[9]	May-July[3]
	Cutthroat ONCL Resident	Feb-Mid March[9]	Mid March-Late May[3]

[15] http://www.chehalisbasinpartnership.org/cbp_salmon_habitat_restoration_work_plan_2007.pdf

[16] http://www.nwrc.usgs.gov/wdb/pub/hsi/hsi-005.pdf

[17] http://www.ecy.wa.gov/apps/watersheds/riv/station.asp?theyear=&tab=prelim_data&scrolly=300&showhistoric=true&sta=22H070

[18] http://www.ecy.wa.gov/apps/watersheds/riv/station.asp?theyear=&tab=prelim_data&scrolly=349&showhistoric=true&wria=23&sta=23A170

Equipment Limitations

Machinery and equipment used during maintenance work will be serviced, fueled, and maintained on uplands in order to prevent contamination to surface waters. Fueling areas will be provided with adequate spill containment.

Equipment used for a project will be free of external petroleum-based products while working around the channel. Equipment will be checked daily for leaks and any necessary repairs will be completed prior to commencing work activities along the channel. No petroleum products, hydraulic fluid, fresh cement, sediments, sediment-laden water, chemicals, or any other toxic or deleterious materials are allowed to enter or leach into waters of the state. Isolate concrete, paint, adhesives until cured. There will be no visible sheen from petroleum products in the receiving water as a result of the activity

Accumulation of soils or debris will be removed from the drive mechanisms (wheels, tires, tracks, etc.) and undercarriage of equipment prior to its working below the OHWM

Equipment used for a project will typically operate stationed on the roadway, shoulder or bank. Equipment crossings will be limited to the minimum necessary to complete the project LWD will be placed on crossing route(s) to minimize disturbance to the channel bed.

Equipment crossings will be compliant with the following guidelines;

- Minimize bank disturbance- find low-gradient/low bank site to cross, protect and revegetate disturbed soils
- Minimize bed disturbance- set LWD in stream to cross on, where appropriate leave LWD in stream.

Best Management Practices will be implemented during all phases of the project to ensure that entry of sediment-laden water to waters of the state is minimized. Water discharged back to the receiving water shall comply with state surface water quality standards.

If flow conditions occur that may cause siltation during a project, work will stop until the flow subsides.

All material excavated from channelized streams or for culvert maintenance and replacement activities will be completely removed and disposed of at an upland location, unless suitable material is incorporated into the project (ex. culvert stream-sim gravel). No material shall be side cast into adjacent wetlands, or other waters of the state, unless authorized by WDFW for stream habitat improvement.

Dewatering Construction Sites

In the event that only hand tools (come-along, chain saw winch, etc.) are used to conduct the activity, or the stream channel is dry during construction, no dewatering or bypass is necessary.

Dewatering of the construction site itself is typically necessary because culverts are installed below the normal water table at the site. It is critical to keep these sites dry so the culvert bed can be surveyed and compaction assured along the culvert. For culvert installation sites, divert stream flows around the project site when working within the wetted perimeter. Slowly drain wetlands prior to commencing construction. Work in wetlands may be accomplished without dewatering or diversion. For new bridge installation sites and where no in-channel work is required, no dewatering is required.

For culvert removal sites where the culverts is not "on grade" (i.e. has an outfall drop) and flow exceeds 1 cfs, divert stream flows around the project site when working within the wetted perimeter. . Otherwise, no diversion is required due to the short duration of in-water work and the low risk of deleterious sediment effects.

When diversion is required, a temporary bypass to divert flow around the work area will be in place prior to initiation of work in the wetted perimeter. Sandbagging and hard pipe flumes or pumping will be the approved diversion method. Other methods may be utilized if a positive separation can be maintained between the work area and waters of the state (Figure 12.)

Figure 12. Diversion Pipe method of dewatering for stream crossing construction on GDRCo roads

Keep clean water clean by diverting before the stream enters the construction site. Discharge clean diverted water back into the channel downstream as close as possible to keep flows at normal levels, hence reducing fish collection efforts.

Construction site dewatering (i.e. "wastewater") is typically dirty water that cannot be discharged directly into state waters. Place pump outlets at a sufficient distance from the stream channel to allow natural vegetation to filter sediments before water reaches the channel.

The diversion relief and de-watering discharge point will be designed and operated so as not to cause erosion or scour in the stream channel, banks or vegetation. Prior to releasing the water flow to the project area, all bank protection or armoring will be completed. Upon completion of the project, all material used in the temporary bypass will be removed from the site and the site returned to pre-project or improved conditions.

Reintroduction of water to the channel will be done gradually and in stages so as to minimize the mobilization of sediments and fines into downstream waters. Wastewater pumps shall remain in place and active to filter the first flush at the downstream end of the project.

Fish Removal and Screening

The permittee will capture and safely move fish from the job site when dewatering. The permittee will have fish exclusion, fish capture, and transportation equipment ready and on the job site including properly designed upstream and downstream block nets[19]. Captured fish will be immediately and safely transferred to free-flowing water downstream of the project site. Any device used for diverting water from a fish-bearing stream will be equipped with a fish guard to prevent passage of fish into the diversion device pursuant to RCW 75.20.040 and RCW 77.16.220. The pump intake will be screened with 3/32-inch mesh to prevent fish from entering the system. The screened intake will consist of a facility with enough surface area to ensure that the velocity through the screen is less than 0.4 feet per second. Screen maintenance will be adequate to prevent injury or entrapment to juvenile fish and the screen will remain in place whenever water is withdrawn from the stream through the pump intake.

Sediment Removal

No more than 50 cubic yards of material per project per year will be removed without separate written approval from WDFW and will not be conducted in fish spawning areas. Sediment removal will be limited to restoring the channelized stream to as-built condition with a gradual taper of the ground line to meet the native stream channelized stream by starting at the upstream end of the project boundary and working downstream. After project completion, disturbed stream banks and lakeshores shall be revegetated with site-appropriate vegetation to maintain soil stability and provide shade and future sources of large wood.

Beaver Prevention Methods

Use larger sized culverts (Figure 13), or bridges, where appropriate. Place obstructions upstream to allow beavers to construct and maintain their pools upstream, without plugging the culvert. For example, rock bands are installed in an arc upstream of the culvert, or LWD is placed in an upstream V to help establish the base of a new dam, or a "picket fence" of logs is set in a ring around the culvert inlet (1-2' space between pickets so fish can pass).

Figure 13. Miter culvert inlet. The inlet area above the miter along the miter should project to be the same area as the area of the culvert

Cleaning Beaver-Plugged Infrastructure

Where possible, cleanout will be accomplished by hand methods. Remove blocking dams gradually so the impounded water drains slowly. Marking culvert inlets with plastic PCV pipe risers is recommended.

[19] http://www.wsdot.wa.gov/Maintenance/pdf/Guidelines/AppE.pdf