Draft 2.0

Appendix B: Guidelines for Off-Channel Routine Effectiveness Evaluation

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WORKING DRAFT – Off-Channel REE Guidelines

This is a working draft of the Watershed Restoration Program's (WRP's) Routine Effectiveness Evaluation Guidelines. Your comments and suggestions on ways to improve these guidelines are welcome. Please complete the comment sheet provided in Appendix B-1 at the back of this technical circular and forward it to us.

Background

The WRP was established in 1994 under the auspices of Forest Renewal BC. As of 1999, the key five-year target of the WRP is to protect and restore high priority water quality and fisheries resources in 20% of the province's Priority Key watersheds by 2004. Since its inception, the WRP has invested considerable time and effort in restoring habitat and water quality in many watersheds throughout the province. A standardised effectiveness evaluation procedure is required to ensure that WRP activities are:

1. successful at achieving watershed objectives as defined in Restoration Plans (RP's);
2. conducted in a cost-effective manner;
3. adjusted to best meet restoration objectives based on lessons learned from successes and failures in the field through an adaptive management process.

A framework for conducting effectiveness evaluations for all WRP components (up-slope, stream and riparian) was developed to provide a rationale for undertaking effectiveness evaluations throughout the province (Gaboury and Wong, 1999). The framework breaks effectiveness evaluations into three levels based on statistical rigor and scope. The most basic level of evaluation defined in the framework is Routine Effectiveness Evaluations (REE), while intensive effectiveness evaluation (IEE) and operational techniques refinement (OTR) are more focussed at addressing specific questions or issues in watershed restoration.

While the effectiveness evaluation framework applies to all WRP components, each component requires specific procedures be undertaken to determine the overall component effectiveness. This document describes the REE procedures to be implemented for the off-channel restoration component of watershed restoration work.

Objective

Routine effectiveness evaluations provide a low intensity, standardised procedure for determining the success of WRP stream and riparian restoration projects at a broad scale, and low cost. The intent of the REE procedure is to examine all off-channel sites within restoration projects to determine, at a qualitative level, if physical and biological objectives at the site, component and watershed level are being met satisfactorily (see Gaboury and Wong, 1999 for objective definitions).

The outputs of REE are:

1. recommendations for site-specific maintenance or remedial works;
2. documentation of unexpected and instructive site-specific successes and failures;
3. a statement of progress towards component restoration completion including a time frame for additional evaluation and;
4. recommendations (if any) for potential IEE and OTR projects stemming from REE findings.

The REE outputs will be used to both determine restoration component completion in eligible watersheds by feeding information back to Restoration Plans (RP's), as well as being rolled up on an annual basis to summarise province-wide REE findings in an annual compendium. Recommendations from the annual REE compendium form a component of an adaptive management loop that will be used to adjust WRP delivery, and where warranted government policy and legislation.

A limitation of REE is that it inherently is directed at a component and particularly at a site level. Thus it is not well suited for identifying restoration gaps at a watershed level or providing recommendations for watershed completion. These aspects are covered off via an audit of restoration plans. REE confirms that completed works achieve, at a site level, the objectives of the prescriptions, and provide limited feedback regarding the overall appropriateness of prescriptions at a site level.

Off-Channel REE Methods

The off-channel REE methodologies have been adopted from the methods of Koning et al. (1998). The methods have been altered to emphasise off-channel restoration biological objectives and physical condition. A field form for entering off-channel REE information is included as Appendix B-2.

The off-channel REE methodology includes two components, requiring a single form (Appendix B-2). The first component is an evaluation of the overall off-channel project as it pertains to biological performance objectives (are the habitats present in the project available in suitable quantity and quality for the target species and lifestage). The second component examines the physical condition of the off-channel project and the cover elements that may have been installed (is the project still structurally sound, are cover elements still present and functional).

The site objectives for off-channel restoration vary by species and life stages identified as targets for restoration. As such, it is important that the watershed level objectives, as defined in the RP, be reviewed to determine the nature and intent of off-channel restoration projects prior to undertaking an off-channel REE. Otherwise, restoration works successful at providing coho rearing habitat could be identified as failing to create sockeye spawning habitat and remedial actions recommended to improve the function of the project.

The REE plan, updated as required following the annual construction period, must include a submission of a completed REE form indicating the objectives of each restoration structure (see Appendix B-3). This is accomplished by placing a circle in the appropriate columns for biological performance objectives for each off-channel construction site as per the methodology of Koning et al. (1998). The task of the REE methodology is to contrast the planned biological performance with the realised biological performance of the site.

Timing for conducting off-channel REE projects will need to be considered prior to the survey. If the site objectives all pertain to high flow conditions, REE should be timed for freshet. If objectives are better observed at low flow, then REE should be conducted at low flows. Selection of REE timing, by activity, will be outlined in the regionally derived Authorisation Documents or Schedule A.

General Information

MYA / AA Holder No.
Enter the MYA or AA holder name and FRBC MYA / AA number.

FRBC Activity No.
Enter the FRBC Activity number for the restoration work being evaluated.

Project Name
Enter the name of the watershed restoration project on which the REE is being conducted.

Watershed
Identify the name of the watershed or watershed group in which the in-stream restoration was completed, as referenced in the Regional Resource Management Plan.

Sub-watershed
Identify the sub-watershed in which the restoration works were completed.

Date
Enter the day, month and year that the REE was completed.

Survey Crew
Enter the initials of the survey crew and the organisation with which they are affiliated.

Weather
Enter the weather and flow conditions on the date of the REE survey (very high – greater than bankfull, high – bankfull, moderate – intermediate flow less than bankfull, low – low flow, typical of late summer). Note, the REE should be conducted in a flow that is suitable for assessing the performance of structures. As such, very high and high flows are excessive for the majority of REE, and should be avoided.

Forest District
List the Ministry of Forests forest district in which the REE is being completed.

REE Interval
Enter the period for which the REE is being completed (e.g. one, three or five years following construction, or following a 1 in 20 year or greater discharge event).

Other Components Surveyed
Identify what other WRP components are being evaluated within the watershed (e.g. upslope, riparian, fish access and in-stream). Listing this information will facilitate the compilation of all REE summaries in a provincial REE compendium.

Restoration Activities Complete
If all restoration activities for the off-channel component have been implemented and evaluated, and there are no requirements for remedial works or follow-up REE, enter that the off-channel component of the RP is complete. If off-channel work is on-going, remedial works are identified, or follow up REE is recommended, enter that the off-channel restoration component is not complete.

Project Specific Information for Off-Channel Projects

These definitions apply to the off-channel project evaluation criteria for the REE field form (Appendix B-2):

Stream and or Project Name
List the particular stream and or project name within the watershed that is being evaluated.

Reach
List the stream reach containing the off-channel restoration project.

Distance and UTMs
Measure the distance from the start of the reach to the off-channel site being evaluated. Determine the UTMs for the off-channel outlet using a handheld GPS unit.

Site ID #
Individual off-channel sites must be entered as separate line items and identified in a consistent fashion with REE plans, as-built reports and other REE documents.

Off-channel Type
Enter the appropriate code for the off-channel site being evaluated. Use the code that best describes the structure being evaluated. If an off-channel type is not listed, use the "other" category and supply a list describing the additional codes. There are primarily two types of Off-Channel habitat constructed under WRP: surface fed channels (SF) and groundwater fed (GF) channels.

Site Objective
The site objective of a particular off-channel project is a simplified and generic statement of purpose that parallels the site-specific objective. For a groundwater fed side channel, the intended function could be to provide coho salmon overwintering habitat. The intended function will come from restoration summaries, REE plans developed at the prescription development phase or previous REE reports.

Targets

Species
Enter the target species for the off-channel restoration project, using species definitions found in Appendix B-4. If multiple species are targeted at a given site, list all species abbreviations.

Life Stage
List all lifestages for which the particular off-channel area was designed to provide habitat.

Biological Performance Objectives

The data collected at the level of performance objectives allows for the systematic review of biological performance objectives to determine if off-channel restoration sites are adequately meeting site and component objectives.

All performance objectives are scored on a 4-point scale to indicate how well a restoration site is, or is not meeting an objective. In all cases, a score of 4 indicates the site is exceeding expectations for that particular attribute, and a score of 1 represents a failure to achieve the site or component objective. **Half point scoring is allowed to provide a greater degree of discretion to REE implementers.** The following definitions, modified from Koning et al. (1998), apply for off-channel component REE activities:

4. site conditions resulting from works are exceeding expectations and objectives;
3. site conditions resulting from works are meeting expectations and objectives.
2. site conditions resulting from works are failing to meet expectations or objectives;
1. site conditions resulting from works have failed to meet objectives. Expectations have not been met.

For each of the biological objectives, a series of scoring definitions are provided to guide the evaluation of structure performance. Site objectives and on-site conditions must be considered when evaluating off-channel site performance. It is acknowledged that the scoring definitions do not apply to all projects or site objectives. If additional definitions are required for unique or non-standard sites or projects, summarise the definitions used in the REE report.

Overwinter
One of the most critical fish habitats compromised by streamside forest harvesting is overwinter habitat. The effectiveness of off-channel restoration sites that have an emphasis on overwintering habitat needs to be evaluated in terms of stable pool habitat with abundant cover. Off-channel habitats often have deep pools excavated at the time of construction. These must be reviewed to ensure they have not filled in or been otherwise compromised.

4. Stable, deep pools have been maintained throughout the off-channel area. There is no evidence of in filling or collapse following construction at any sites throughout the channel length. Abundant cover in the form of LWD and overhanging vegetation has been maintained at all pool sites and new cover elements have been recruited following construction.

3. Stable deep pools have been maintained throughout the majority of the off-channel area. Cover has been maintained but there is little or no increase in cover quantity or quality following construction.

2. The majority of deep pool areas have partially filled in; LWD has been lost from pools. Little habitat diversity remains in deep pool areas following construction.

1. Almost all pools have filled in, and there has been a substantial loss of habitat and cover features throughout excavated pools. Little overwinter habitat has been maintained following construction.

Rearing
Juvenile rearing habitat differs for various species and lifestages. The overall effectiveness of restoration for all target species rearing must be evaluated.

4. Abundant rearing habitat has been maintained throughout the off-channel area. Rearing habitat has increased following construction as additional habitat components have been recruited to the off-channel area.

3. Adequate rearing habitat has been maintained at the off-channel site following construction. The LWD and boulder elements placed in the off-channel area during construction have been maintained but there is little or no increase in rearing habitat or cover following construction.

2. Insufficient rearing habitat has been maintained at the off-channel site. Rearing habitat elements such as LWD or boulders have been buried or flushed from the system.

1. The off-channel area has failed to provide rearing habitat. Habitat elements have been buried, flushed from the channel or otherwise compromised following construction.

Spawning
Off-channel areas often are designed with the objective of supplementing or providing spawning habitat for the target species. Chum salmon and sockeye salmon spawning channels have been very successful at increasing production throughout the species distribution in the province. In unstable watersheds, off-channel areas may provide the only source of stable, long-term habitat suitable for the target species spawning requirements. The quantity and quality of spawning habitat must be assessed in terms of both physical and spatial criteria (e.g. does gravel exist, is it the right size, is there enough of it, is it clean, is it at a suitable location to be conducive for spawning?), whether it has been placed in the channel or is naturally occurring.

4. Stable, clean, non-compacted spawning gravel suited for use by the target species has been maintained in all placement locations in the off-channel site. Additional spawning habitat has developed following construction and there is evidence of spawning (e.g. adult spawners, carcasses and or redds) in the channel.

3. Stable, clean, non-compacted spawning gravel suited for use by the target species has been maintained in most placement locations in the off-channel site. There is evidence of spawning (e.g. adult spawners, carcasses and or redds) in the channel.

2. Little spawning gravel has been maintained in the off-channel area. Gravel has filled in with fines, dewaters in low flows or otherwise compromises the success of the project objective. Little evidence of use by target species spawners.

1. Little or no quality spawning gravel remains in the placement areas of the off-channel project. There is no evidence of use by target species spawners.

Incubation
Off-channel restoration projects need to provide more than just spawning gravel. For the project to be successful, eggs must be successfully incubated throughout their gestation period. Thus, off-channel restoration projects with the objective of providing spawning habitat also need to be evaluated in terms of the potential for incubation success.

4. No evidence of hydrological redd scour throughout the off-channel area. Spawning substrate is located in stable areas, is free of fines, not compacted, has suitable substrate size and water flows for the target species incubation requirements and there is no evidence of the channel dewatering during the incubation period.

3. There is little evidence of redd scour throughout the off-channel area. Spawning gravel is present in appropriate locations and appears to be stable, free of fines, not compacted and has sufficient flow for the target species.

2. There is some evidence of redd scour in the off-channel area. Incubation success has been compromised because of spawning gravel partially washing out or filling in with fines. Gravel is compacted and flows are not sufficient to ensure incubation success for the target species.

1. Incubation success is very poor as a result of extensive redd scour, gravel washing out, filling in compaction and insufficient or excessive flows.

Overall Rating
Review performance for all biological performance ratings that pertain to site objectives. List the overall biological performance rating as the lowest value identified as an off-channel objective (e.g. ignore unexpected successes). Once all objectives have been evaluated, plot the mean and standard deviation of the biological performance for all off-channel projects in the watershed. See Appendix B-5 for model figures

Physical Condition

Physical condition variables apply to all off-channel projects. As such, they do not represent objectives as above, but relate to measures of physical performance that may require maintenance, regardless of the overall side channel objectives.

As opposed to biological performance objectives, where off-channel projects are reviewed only in terms of relevant objectives, all physical condition variables pertinent to a project are reviewed for off-channel restoration projects (e.g. if a berm was constructed, evaluate the physical performance of the berm, if no berm was constructed, ignore and move on to the next parameter).

Dissolved Oxygen
The ultimate success of any off-channel watershed restoration project relates to the presence of dissolved oxygen. Surface water fed channels are not limited in the same way as ground water channels as the mixing of surface waters prior to entering the off-channel area is sufficient to

ensure well oxygenated water is available to support the target species. However, groundwater fed side channels may be seasonally limited in the amount of oxygen they contain. As such, oxygen levels in ground water fed off-channel projects need to be determined during REE. To account for the difference in water temperature, dissolved oxygen must be considered in terms of percent saturation. Methods for determining dissolved oxygen levels may be through the use of a titration procedure (e.g. Winkler titration), kit (e.g. Haach Kit), or probe (e.g. Y.S.I. dissolved oxygen probe). Appendix B-6 provides a summary of dissolved oxygen requirements for various salmonids and lifestages (see Bjorn and Reiser (1991) for a review of dissolved oxygen requirements for salmonids).

It is essential that the time of year D.O. is evaluated correspond with the off-channel project objectives (e.g. off-channel ponds designed to provide coho overwinter habitat must be evaluated for dissolved oxygen suitability in winter).

4. Dissolved oxygen levels are above optimal for target species in the watershed.

3. Dissolved oxygen levels are optimal for target species.

2. Dissolved oxygen levels are between optimal and lower lethal for target species.

1. Dissolved oxygen levels are approximating lower lethal for the target species.

Nutrients
Off-channel areas may be limited in their success if there are insufficient nutrients available to support rearing species. As this may prevent the project from fulfilling its objectives, the nutrient levels of off-channel restoration areas need to be verified at a qualitative level.

4. There is abundant periphyton production, benthic invertebrates are prevalent on substrate and there is an abundance of leaf/needle litter in the channel. The whole channel appears productive.

3. Adequate amount of periphyton on substrate surface. Some benthic invertebrates are visible on substrate. Sufficient leaf/needle litter is available as food source for invertebrates. Production appears adequate for supporting target species and lifestages.

2. There is only patchy evidence of primary and secondary production and little in the way of leaf or needle litter entering the channel. There does not appear to be sufficient periphyton or benthic invertebrate production for the target species and lifestage.

1. The channel appears sterile. There is little or no evidence of periphyton or invertebrate production and no leaf or needle litter associated with the side channel.

Intake Integrity / Function
Surface water fed off-channel areas require intake structures to supply water to the side channel area. These intakes are often engineered structures that may or may not require manual operation to regulate flows to the off-channel area. Intake structures must be evaluated at the time of REE to ensure function identify maintenance concerns.

4. The intake is functioning in excess of expectations. Scour around the intake is preserving function, long-term flow is available to off-channel system.

3. The intake function is working to expectations. There is no evidence of substrate filling in around intake or obstructing flow into the off-channel area. No erosion is visible around intake.

2. Intake has partially filled in with sediment, bank erosion visible around pipe, some debris hanging up on restoration structure. Channel shifting is threatening to isolate intake.

1. Intake structure has failed. The intake has filled in with substrate or otherwise been compromised. Debris has damaged intake, rendering non-functional. Channel movement has isolated intake.

Flow
Insufficient flow may reduce the capability of off-channel pond areas for both surface water and ground water fed channels. Flows must be evaluated at the time of year most relevant to the fulfilment of site objectives (spawning channels must be evaluated during periods of spawning and incubation, overwintering channels must be visited during winter months, etc.).

4. Flow is excellent for the off-channel pond objectives. There is no evidence of high flow in the channel damaging function, or low flow stranding or isolating fish or otherwise compromising the off-channel function.

3. Flow is adequate for the off-channel objectives. Some evidence of flow fluctuation that may lead to compromised performance, but within the natural range of variability.

2. Low flow periods cause localised dewatering of the off-channel project. Some evidence of high flow alteration of channel function. Fish may be isolated in pools but are not at high risk of being stranded (e.g. totally de-watered)

1. Flow routinely insufficient for objectives of off-channel area. Flow is frequently subsurface, or excessive flows render habitat unsuitable to fulfil of-channel objectives. Fish are routinely isolated and stranded.

Outlet Integrity / Function
Off-channel areas must be evaluated in terms of the outlet function. Outlets may erode, agrade, or otherwise change in such a way that fish access is not possible. Alternatively, the mainstem channel may be laterally migrating, which could threaten the continued function of the off-channel project either from erosion or isolation. If the target fish species and lifestage can not access the off-channel area, the project is failing to achieve its site, component or watershed level objectives.

4. The off-channel outlet is functioning well. No evidence of outlet erosion or excess sediment deposition, the area well revegetated. No evidence of lateral mainstem channel migration eroding or isolating the outlet area. Excellent access for target species and lifestages at all flows of main channel.

3. The outlet is functioning as planned, minimal erosion of banks, ample access for target species and lifestages at most main-channel flows.

2. The outlet has eroded or aggraded but is still marginally functional and fish can still access the side channel. Insufficient flows periodically prevent access for the target species and lifestage. Lateral mainstem channel migration threatens outlet function.

1. The outlet has failed. Erosion is widespread and the structural integrity of the project has been compromised. Flows prevent use of the off-channel area by the target species. Lateral channel migration has eroded or isolated the outlet, causing the off-channel project to fail.

Berm Stability
Off-channel areas often rely on constructed safe-fail berms to prevent high mainstem river flows from destroying constructed off-channel habitats. It is necessary to examine the condition of berms and ensure they are not threatened with failure. Undermining, vegetative piping and overtopping all may reduce the effectiveness of a berm structure. As such berms must be evaluated to determine their condition.

4. There is no evidence of the berm being eroded or breached, post-construction revegetation has increased the integrity of the berm. High flows have been prevented from disturbing the off-channel area. There is no evidence of leakage or piping through the berm.

3. The berm is functioning adequately. There is no unexpected improvement in berm integrity following construction. Only minimal undermining or erosion of the berm is evident.

2. There was a partial failure of the berm during high flows. Some leakage or piping of water threatens the longevity of the structure. Evidence of erosion and undermining of berm

1. There was a substantial failure of the berm. Berm overtopped in less than expected return flood. Collapse of berm due to undermining and erosion.

Mainstem Stability
A vital component of the off-channel evaluation is a determination of the stability of the mainstem channel in the proximity of the off-channel project. Off-channel projects are often constructed in areas where mainstem conditions preclude in-stream works because of channel instability. A risk in these situations is that the mainstem can avulse and destroy an off-channel project. Thus it is important at a routine level to walk the mainstem channel associated with the off-channel project to determine if conditions have changed following construction that can now endanger the short to long-term success of the project. Starting at a point upstream of the off-channel project on the mainstem channel, the channel should be walked to note changes in overall stability since construction that may serve as a warning for the continued success of the project.

4. Overall channel stability unchanged or improved since construction of side channel. Gravel bars vegetating, no evidence of lateral channel migration.

3. Channel stability has not changed since construction. Little evidence of lateral channel migration, gravel bars have not changed.

2. Fresh erosion scars along streambanks and newly formed gravel bars are evident in mainstem channel. Indications of recent lateral channel migration are evident that may threaten off-channel project.

1. Evidence of rapid channel migration towards off-channel project. Complete wash out of off-channel project due to instability of mainstem channel.

Cut-Slope Stability
The third stability consideration with respect to off-channel projects is the stability of cut slopes. Off-channel projects are often constructed in areas of unconsolidated soils that can slough or slump into the off-channel area. This can have minor or serious implications for the physical success of the project depending on the extent and location of the cut-slope failure in the project.

4. Off-channel cut-slope is revegetating or has revegetated over the total excavation area. There is no evidence of cut-slope erosion or sloughing into the wetted area of the off-channel project.

3. An adequate amount of revegetation has established following excavation. There is some localised areas of sloughing or erosion that have since stabilised.

2. There is a poor amount of revegetation in the excavated area. A substantial amount of erosion or sloughing is evident from the cut-slope into off-channel area. There is no evidence of cut-slope stabilisation.

1. No revegetation is evident on the cut-slopes. Sloughing and erosion are evident throughout the off-channel area, compromising the functional integrity of the off channel project.

Revegetation
Off-channel areas are often revegetated following construction. The objectives of this may be to minimise erosion, provide cover and or to provide allochthonous carbon input to the off-channel area. While wildlife browsing is a natural process, if it threatens the survival and compromises the success at revegetating a site, maintenance may be required (e.g. deployment of browse prevention devices).

When evaluating revegetation it is important to consider the goals and objectives of any revegetation prescription relative to that of the whole off-channel project. While a thick mat of grass may be excellent for controlling erosion, it will be of limited use if it is choking out conifers or shrub species planted to provide cover over the mid- to long-term. Thus, both erosion control and tree and shrub regeneration/survival need to be considered when scoring this category. If trees and shrubs will not become established, and that was an objective of the revegetation prescription, score success lower, regardless of the erosion protection afforded by the results of grass seeding

4. Complete revegetation of off-channel site. No evidence of erosion or infilling from overland flow of water. Nearly all whips are viable and seedlings and plugs have high survival. No evidence of browse damage.

3. Some areas remain unvegetated, but overall high level of success. Some browse damage evident and high levels of planting survival.

2. Substantial areas remain unvegetated following construction. Evidence of erosion from overland flow. Many seedlings browsed to the point of threatening viability and there is low survival of plantings.

1. The revegetation treatment has failed. Much of off-channel area remains unvegetated. There is substantial evidence of erosion affecting the off-channel area. A very high level of mortality is evident among seedlings, whips and plugs.

Cover Elements
Off-channel projects often contain cover elements to increase the quantity and quality of habitat. These cover elements can range from large woody debris placements to riffles to boulder clusters, depending on the size and type of off-channel project. When evaluating an off-channel project it is important to consider the overall physical performance of these cover elements. An off-channel project may contain many diverse applications of cover, and as such this variable will represent the overall physical condition of cover elements. If a single structure has failed, a lower score is warranted, but maintenance may be a lesser priority than if many structures failed and the overall physical condition of the off-channel was compromised.

Have the cover elements moved? Are they providing cover as intended? Are they causing any inadvertent impacts to the off-channel project (e.g. bank erosion, scour, flow diversion etc.)? Are the cover elements still structurally sound?

4. Cover elements are exceeding physical objectives. Cover has increased following construction and become more stable as a result of new material inputs or other means.

3. Cover elements are adequately meeting physical objectives. Little movement, in-filling, erosion or structural decay has occurred.

2. Cover elements are not adequately meeting physical objectives. Cover elements have moved, in-filled, caused bank erosion or otherwise been compromised and in their present configuration are not able to meet physical performance objectives.

1. Cover elements are failing to meet physical condition objectives. Structures have failed through collapse or in-filling and may threatening the overall structural integrity of the off-channel project.

Overall Rating
Review the physical condition ratings and list the overall physical condition rating as the lowest value identified. Once all off-channel sites have been evaluated, plot the mean and standard deviation of the physical condition for the watershed. See Appendix B-5 for model figures

General

Maintenance
A recommendation for maintenance or remedial works is required for each off-channel area evaluated under REE. Does the off-channel site meet its site objectives? Are remedial works warranted? Will remedial works or maintenance help achieve component and watershed level objectives?

4. No repairs of maintenance required.

3. Minor repairs or remedial works could be undertaken but are not required. Repairs / remedial works were undertaken at the time of REE survey and no follow-up is required.

2. Repairs are required to return the site to a functioning state. However, the works are minor, or do not require immediate action (can be completed within a year).

1. Major repairs are required using the existing or new prescriptions or plans. Works are required as a priority and must be undertaken within a short time frame (e.g. less than six moths).

Photos
Enter the number and roll of all photographs taken of the structure.

Photographs are required as a component of REE. As the REE compendium is limited to four pages, few photographs will be incorporated. Emphasis for photographs should be placed on those off-channel areas that demonstrate opportunities for learning. Unexpected successes and failures should be documented, as well as areas/sites recommended for remedial works. Other noteworthy photographs should be included at the discretion of the REE project supervisor.

Comments

Any comments regarding the function or failure of off-channel restoration sites, or anything else worth noting that will help with understanding why a site is meeting, exceeding, or failing its objectives should be included on the form.

Detailed REE Requirements

At the Ministry representative's discretion, additional data may be required under REE. This is called Detailed REE and is required to ensure sufficient information is collected on top of the basic REE methodology outlined above to ensure that effectiveness of restoration works at a routine level is achieved.

Pre- and Post-Restoration Photopoints
Detailed REE requirements may include establishing pre-restoration photopoints and obtaining photographs at photopoints whenever REE is undertaken. As pre-restoration photopoints must be established prior to construction, the Ministry Representative will identify particulars of photopoints and include them in the construction Schedule A.

Fish Sampling
Fish sampling is not a requirement of the basic REE methodology. Observation and professional judgement are to be used to determine if fish are present and or using the off-channel area in a manner in accordance with the site objectives.

With detailed REE, fish sampling can be expanded to include adult counts, smolt trapping, snorkel surveys, electroshocking, G-trapping, angling or seining. Details of fish sampling including level of rigour (presence versus population estimates), timing and requirements for obtaining and analysing age structures will be determined in consultation with the Ministry Representative.

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Appendix B-1. REE Feedback Form

This document is intended as a working draft. Changes/edits and release of this document in its final form is scheduled for spring 2001. The Watershed Restoration Program Provincial Co-ordination Team would appreciate any feedback on information presented in these guidelines, including content and format of the document, subjects that may require further clarification and additional topics that should be considered for inclusion.

Comments can be sent to Andrew.Wilson@gems4.gov.bc.ca.

All feedback will be forwarded to the WRP Provincial Co-ordination Team for their consideration. Please reference the appropriate page number when providing comments, as well as your name, phone/fax number and email address if applicable.

Appendix B-2. Field Form for Off-Channel REE

Form 1. Routine Effectivness Evaluation Restoration Summary - Off-Channel Component

MYA /AA Holder No._____ Watershed _____ Survey Crew _____ REE Interval _____

FRBC Activity No._____ Sub-watershed_____ Weather / Flow _____ Watershed Classification _____

Project Name _____ Date _____ Forest District _____ Off-Channel Works Complete? Y/N

						Targets		Biological Performance Objectives					Physical Condition											General		Comments
Stream	Reach	Distance	Site ID #	Off-Channel Type	Site Objective	Species	Lifestage	Overwinter	Rearing	Spawning	Incubation	Overall Rating	Dissolved Oxygen	Nutirents	Intake Integrity / Function	Flow	Outlet Integrity / Function	Berm Stability	Mainstem Stability	Cut-Slope Stability	Revegetation	Cover Elements	Overall Rating	Maintnenance	Photos	

Appendix B-3. Example Entry for Off-Channel REE Field Form

Form 1. Routine Effectivness Evaluation Restoration Summary - Off-Channel Component

MYA /AA Holder No.: OPAXXXXX
FRBC Activity No.: 712355
Project Name.: Zappa Creek Rehab.

Watershed: Frank River
Sub-watershed: Zappa Creek
Date: September 15, 2001

Survey Crew: ZZ/EE
Weather / Flow: Overcast / Low
Forest District: Squamish

REE Interval: 1 year following construction
Other Components: In-stream, riparian
Off-Channel Works Complete? Yes

						Targets		Biological Performance Objectives					Physical Condition											General		
Stream	Reach	Distance	Site ID #	Off-Channel Type	Site Objective	Species	Lifestage	Overwinter	Rearing	Spawning	Incubation	Overall Rating	Dissolved Oxygen	Nutrients	Intake Integrity / Function	Flow	Outlet Integrity / Function	Berm Stability	Mainstem Stability	Cut-Slope Stability	Revegetation	Cover Elements	Overall Rating	Maintenance	Photos	Comments
Zappa	2	2+340	OFF2	SF	RB rearing	RB	JUV	(4)	(4)			4	4	2	3	3	1	4	3	3	3	3	2.9	1		outlet failed, more work needed

Note: Values enclosed in circles represent original Biological Performance Objectives. Unanticipated biological performance objectives are marked without circling.

Appendix B-4. Fish Species Definitions to be Used in REE.

CODE	COMMON NAMES	LATIN NAMES
Salmonids (Salmon, Trout, Char)		
SA	Salmon (General)	*Oncorhynchus spp., Salmo salar*
AO	All Salmon	*Oncorhynchus spp., Salmo salar*
AS	Atlantic Salmon	*Salmo salar*
GB	Brown Trout	*Salmo trutta*
AGB	Anadromous Brown Trout	*Salmo trutta*
CM	Chum Salmon, Dog Salmon	*Oncorhynchus keta*
CH	Chinook Salmon, Spring Salmon, King Salmon, Tyee	*O. tshawytscha*
PK	Pink Salmon, Humpback Salmon	*O. gorbuscha*
CO	Coho Salmon	*O. kisutch*
SK	Sockeye Salmon	*O. nerka*
KO	Kokanee	*O. nerka*
CT	Cutthroat Trout (General)	*O. clarki*
ACT	Anadromous Cutthroat Trout	*O. clarki*
CCT	Coastal Cutthroat Trout	*O. clarki clarki*
WCT	Westslope Cutthroat Trout, Yellowstone Cutthroat Trout	*O. clarki lewisi*
RB	Rainbow Trout, Kamloops Trout	*O. mykiss*
ST	Steelhead	*O. mykiss*
AC	Arctic Char	*Salvelinus alpinus*
BT	Bull Trout	*S. confluentus*
DV	Dolly Varden, Dolly Varden Char	*S. malma*
ADV	Anadromous Dolly Varden	*S. malma*
EB	Brook Trout, Eastern Brook Trout	*S. fontinalis*
AEB	Anadromous Eastern Brook Trout	*S. fontinalis*
SPK	Splake	*Salvelinus fontinalis x namaycush*
LT	Lake Trout, Lake Char	*S. namaycush*
Sturgeon		
SG	Sturgeons (General)	*Acipenser spp.*
GSG	Green Sturgeon	*A. medirostris*
WSG	White Sturgeon	*A. transmontanus*
Cod		
BB	Burbot, Freshwater Ling Cod, Ling, Loche, Lawyer	*Lota lota*
Whitefish		
WG	Whitefish (General)	*Prosopium* spp., *Coregonus* spp., *Stenodus* sp.
PW	Pygmy Whitefish, Coulter's Whitefish	*Prosopium coulteri*
GPW	Giant Pygmy Whitefish	*P*. sp., poss. subspecies of *Prosopium coulteri*
MW	Mountain Whitefish, Rocky Mountain Whitefish	*P. williamsoni*
RW	Round Whitefish	*P. cylindraceum*
LW	Lake Whitefish, Common Whitefish, Humpback Whitefish	*Coregonus clupeaformis*
HW	Humpbacked Whitefish	*C. pidschian*
BW	Broad Whitefish, Round-nosed Whitefish, Sheep-nose Whitefish	*C. nasus*
SQ	Squanga	*C*. sp.
CS	Least Cisco	*C. sardinella*
CA	Arctic Cisco	*C. autumnalis*
CL	Lake Cisco	*C. artedii*
IN	Inconnu, Sheefish, "Conny"	*Stenodus leucichthys*
Grayling		
GR	Arctic Grayling	*Thymallus arcticus*

Appendix B-5. Model Figures for Summarising REE Performance Data

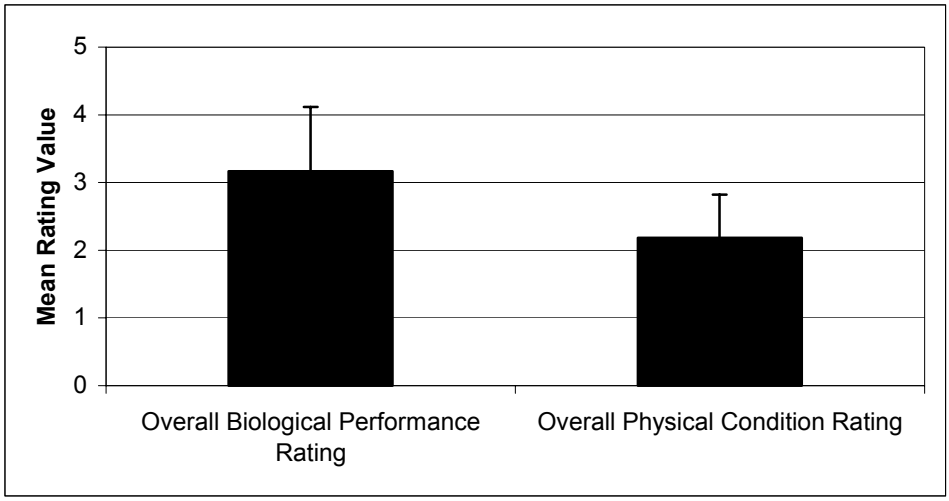

Figure 1. Summary of performance and condition ratings for the Unnamed Watershed groundwater fed side channel (± one standard deviation).

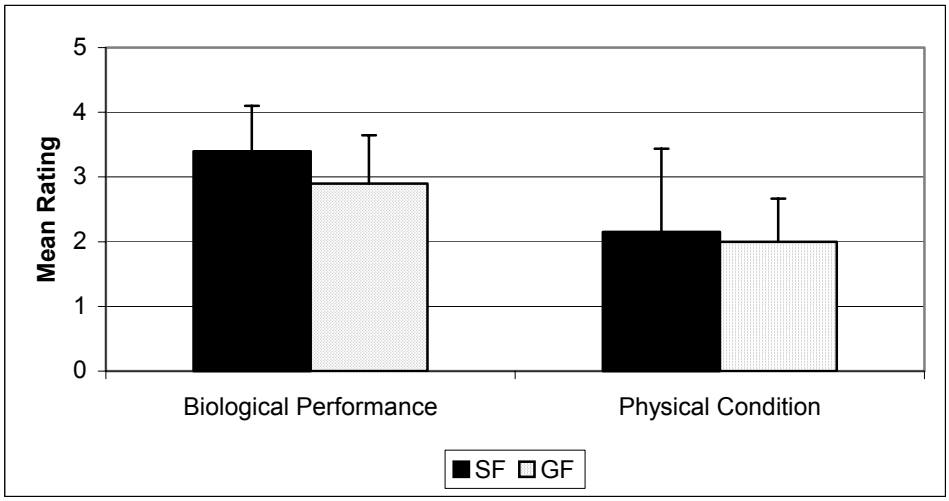

Figure 2. Summary of performance ratings for surface water fed (SF) and groundwater fed (GF) off-channel sites in the Unnamed Watershed (± one standard deviation).

Table 1. Summary of remedial works recommended for the Unnamed Watershed off-channel projects.

Priority	Watershed	Distance	Site Id	Maintenance Score	Problem / Fix	Estimated Cost of Work	Person Days Required	Materials and Equipment Required	Prescription Required
1	Unnamed Creek Reach 1	0+240	SF1	1	Berm failure. Rebuild berm	$10,000	5	Large capacity excavator	Yes
2	Unnamed Creek Reach 1	0+80	SF1	1	Intake failure. Replace intake with modified structure. Protect with LWD jams	$7,500	3	Spyder, 10-1000kb boulders, 5 LWD, cable, epoxy	Yes
3	Unnamed Creek Reach 2	1+120	GW1	2	Cable LWD to prevent shifting in high flows.	$1,500	3	30 m cable, 10 tubes epoxy	No
4	Unnamed Trib 1	0+300	GW2	3	Re-seed off-channel project to stabilise exposed soil	$250	0.25	10 kg bag Coastal reclamation mix grass seed	No
5	Unnamed Trib 2	0+90	SF4	3	Re-seed off-channel project to stabilise exposed soil	$250	0.25	10 kg bag Coastal reclamation mix grass seed	No

Appendix B-6. Dissolved Oxygen Requirements for Salmonids

Adapted from Bjornn and Reiser (1991).

Spawning salmonids minimum dissolved oxygen requirement:

- 80% saturation and a minimum of 5 $mg \cdot L^{-1}$.

Incubating salmonids minimum dissolved oxygen requirement:

- At or near saturation.

Rearing salmonids minimum dissolved oxygen requirement:

- Adequate: 76%-93% saturation and a minimum of 8 $mg \cdot L^{-1}$.
- Poor: 57-72% saturation and a minimum of 6 $mg \cdot L^{-1}$.
- Very poor: 38-51% and a minimum of 4 $mg \cdot L^{-1}$.

Appendix B-7. Model REE Deliverable