ANNEX F
Restoration Planting Guidelines

R.087575.004 Reay Creek Remediation – Victoria Airport Lands
1640 Electra Boulevard, Sidney, BC
SLR Project No.: 205.03892.00004

British Columbia Ministry of Environment
Riparian Restoration Guidelines (2008)

R.087575.004 Reay Creek Remediation – Victoria Airport Lands

BRITISH COLUMBIA
The Best Place on Earth

March 2008

Riparian Restoration Guidelines

Riparian Restoration Plans should be prepared and supervised by an appropriately qualified professional. The riparian restoration plan should be sufficiently detailed to allow for monitoring for conformity to the plan as well as plant survival rates.

Planting Guidelines:

A list of recommended tree and shrub species is provided on page 2.

[1] d = dry, m = moist, w = wet

♦ denotes fruit-bearing species

- All riparian plantings should be based on 1 tree or shrub per 1 square metre density.
- All tree/shrub species should be of guaranteed nursery stock.
- The botanical name should be used when ordering stock to ensure that the desired native species is being purchased. Each specimen should be tagged with the botanical name and the tag should be left attached after planting.
- Stock planted during the fall (Sept. - Oct.) and spring (March - April) has the greatest likelihood of surviving. Regular watering may be required until the plants are established. Additional advice on proper planting procedures should be obtained from the nursery supplying the stock.
- Coniferous trees should comprise not less than 10% nor more than 25% of the tree stock planted.
- Tree stock should be a minimum of 1.2 m (4 ft) in height when purchased and planted 1.5 to 2 m apart.
- Planting on a given area being enhanced must be successful to an 80% take. If more than 20% die over one year, replanting is required.
- A minimum of 50% of trees and shrubs planted should be fruit-bearing species.

Structural Guidelines

Wherever a development site will result in land clearing activities, the opportunity exists to salvage and translocate structural materials (i.e. downed wood, stumps, mossy rocks, vascular plants, non vascular plants) into the remaining environmentally sensitive areas. These key forest floor features provide a diversity of habitats for both invertebrates and vertebrate species.

- Salvaged large woody debris and stumps from the development site should be placed in previously damaged riparian areas to provide structural habitat features for small wildlife and amphibians.
- Mossy rocks and herbs can be salvaged from the development site to help 'seed' the restored area with native groundcover species.
- Large projects are well suited to the creation or translocation of wildlife trees within the area undergoing restoration/enhancement.

Ministry of Environment
Environmental Stewardship
Lower Mainland Region
Mailing/Location Address:
10470-152 Street
Surrey BC V3R 0Y3
Telephone: (604) 582-5222
Facsimile: (604) 930-7119
http://www.gov.bc.ca/
http://www.gov.bc.ca/env/

Recommended Native Plant Species for Riparian Fish and Wildlife Habitat

Deciduous Trees

	Botanical Name	Common Name	Mature Height (m)	Best Growth Conditions[1]
	Acer circinatum	vine maple	to 7	m-w
	Acer glabrum var. douglasii	Douglas maple	to 10	d-m
	Acer macrophyllum	broadleaf maple	to 35	d-m
	Alnus rubra	red alder	to 25	m
	Betula papyrifera var. commutata	western white birch	to 30	m-w
♦	*Crataegus douglasii*	black hawthorn	to 10	m
	Populus balsamifera or P.trichocarpa	black cottonwood	to 50	m-w
♦	*Prunus emarginata*	bitter cherry	2-15	m
	Rhamnus purshiana	cascara	to 10	d-w
	Salix lucida ssp. lasiandra	Pacific willow	to 12	w

Coniferous Trees

Botanical Name	Common Name	Mature Height (m)	Best Growth Conditions[1]
Picea sitchensis	Sitka spruce	up to 70	m
Pinus monticola	western white pine	to 40	m-d
Pseudotsuga menziesii	Douglas-fir	to 70	d
Thuja plicata	western red cedar	to 60	m-w
Tsuga heterophylla	western hemlock	to 60	d-w

Shrubs

	Botanical Name	Common Name	Mature Height (m)	Best Growth Conditions[1]
	Alnus crispa ssp. sinuata	Sitka alder	1-5	m
♦	*Amelanchier alnifolia*	saskatoon	1-5	d-m
♦	*Cornus sericea or C. stolonifera*	red-osier dogwood	1-6	m
♦	*Corylus cornuta var. californica*	beaked hazelnut	1-4	m
	Holodiscus discolor	oceanspray	to 4	d-m
	Physocarpus capitatus	Pacific ninebark	to 4	w
♦	*Prunus virginiana*	choke cherry	1-4	d
♦	*Rosa nutkana*	Nootka rose	to 3	d-m
♦	*Rosa gymnocarpa*	baldhip or dwarf rose	to 1.5	d-m
♦	*Rubus parviflorus*	thimbleberry	0.5-3	m
♦	*Rubus spectabilis*	salmonberry	to 4	m-w
	Salix hookeriana	Hooker's willow	to 6	w
	Salix lucida spp. lasiandra	Pacific willow	to 12	w
	Salix scouleriana	Scouler's willow	2-12	m
	Salix sitchensis	Sitka willow	1-8	m-w
♦	*Sambucus caerulea or S. glauca*	blue elderberry	-	d-m
♦	*Sambucus racemosa var. arborescens*	red elderberry	to 6	m
♦	*Sorbus sitchensis*	Sitka mountain ash	1-4	m
♦	*Symphoricarpos albus*	snowberry	0.5-2	d-m
♦	*Vaccinium parvifolium*	red huckleberry	to 4	m

Ministry of Environment
Environmental Stewardship
Lower Mainland Region
Mailing/Location Address:
10470-152 Street
Surrey BC V3R 0Y3
Telephone: (604) 582-5222
Facsimile: (604) 930-7119
http://www.gov.bc.ca/
http://www.gov.bc.ca/env/

British Columbia Ministry of Environment
Riparian Restoration Standards (2006)

R.087575.004 Reay Creek Remediation – Victoria Airport Lands

BRITISH COLUMBIA

FIA Activity Standards Document

Restoration & Rehabilitation Component, Riparian Activity Area, and

Strategic Resource Planning Component, Management Unit or Watershed Level Strategies Activity Area, Watershed Restoration Plans Activity

Standards for Riparian Restoration Planning, Treatments, Treatment Effectiveness Evaluation, and Inspection and Maintenance

Ministry of Environment

Effective Date: April 1, 2006

Strategic Resource Planning Component, Management Unit or Watershed Level Strategies Activity Area, Watershed Restoration Plans Activity: This standard addresses the prioritization of sub-basins and reaches under this activity. Guidelines for these activities are available at: **[http://www.env.gov.bc.ca/wld/documents/fia_docs/wrp_guidelines_s.pdf]** and http://www.dfo-mpo.gc.ca/Library/255159.pdf

Restoration and Rehabilitation Component, Riparian Activity Area – Treatments; Treatment Effectiveness Evaluation; and Inspection and Maintenance Activities: This standard addresses all aspects of these activities. The standards have been drawn from existing guidelines that still apply, and additional guidelines have been developed. See http://www.for.gov.bc.ca/hcp/fia/landbase/r_and_r_eligible_activities.htm for web access to these guidelines.

The following standards cover (1) planning (overview assessments); (2) conducting detailed assessments of riparian condition; (3) preparing prescriptions; (4) implementing restoration treatments; (5) reporting; (6) conducting treatment effectiveness evaluations; and (7) inspecting and maintaining restoration treatments. An application for FIA funding may include any one, some or all of the above phases of riparian restoration.

CONTENTS

1.0 GOAL OF RIPARIAN RESTORATION

The goal of riparian restoration is to improve *riparian function.* Restoration treatments must be designed to improve riparian function sooner or more effectively than if no action was taken, to the benefit of both terrestrial and aquatic ecosystems.

2.0 APPROACH, EXPECTATIONS, AND ELIGIBLE ACTIVITIES

The *Recipient's* approach to riparian restoration and rehabilitation will be to address high priority areas where lack of *riparian function* is negatively affecting stream channel morphology, aquatic ecosystem integrity, or terrestrial ecosystem integrity. A successful riparian restoration project will typically include the following elements:

- **A regional and watershed perspective:** areas or watersheds will be chosen for restoration based on regional priorities, and site-level priorities will be determined in a watershed context;
- **Clear goals and objectives:** riparian restoration goals and objectives must address loss of riparian function and must be specific, achievable, and measurable;
- **Cost-effective prescriptions implemented on priority sites:** experience, historical costs, and trials that compare cost effectiveness of treatments should be considered
- **Inspection and maintenance:** a representative portion of treated areas should be inspected to determine maintenance needs; inspections and maintenance will usually be scheduled in advance and may also be based on natural events and prospective risks to the work; and
- **Treatment effectiveness evaluations (monitoring):** a representative portion of treated areas should be evaluated to determine and improve the effectiveness of the treatments.

Investments are expected to result in:

- Identification of high priority watersheds and sites for which restoration prescriptions are developed;
- Implementation of high priority and cost effective riparian restoration projects;
- Completion of inspections and maintenance to ensure benefits continue;
- Collection of monitoring (effectiveness evaluation) data/information that will improve current and future riparian restoration projects; and
- Restoration of riparian function sooner and or more effectively than if no action was taken.

Eligible work under the Riparian Activity Area includes: (1) *planning (including overview assessments to determine priority watersheds and areas if not done under Watershed Restoration Plans),* (2) *conducting detailed assessments of riparian condition in selected areas, (3) developing restoration prescriptions for priority sites, (4) implementing restoration prescriptions, (5) reporting, (6) inspecting and maintaining the treated areas, and (7) conducting treatment effectiveness evaluations (monitoring). See* (http://www.for.gov.bc.ca/hcp/fia/landbase/activities/riparian.htm)

The following standards apply to all eligible activities. The standards will be periodically updated to reflect improvements in technical and procedural guidance.

3.0 DEFINITIONS

In this document, the following words or terms are defined as follows:

Administrator administrator of the Forest Investment Account

Coordinating Registered Professional A Registered Professional Forester or Registered Professional Biologist who is the designated representative for the *Recipient*, and who is responsible for ensuring that all work and planning is done to standard

Coarse Woody Debris (CWD) sound and rotting logs and stumps that provide habitat for plants, animals, and insects and a source of nutrients for soil development

FIA Forest Investment Account

Large Woody Debris (LWD) a large tree part, conventionally a piece greater than 10 cm in diameter and 1 m in length. This term most often refers the tree parts that provide channel stability or create fish habitat diversity in a stream channel. Similar tree parts on land are usually called coarse woody debris.

Recipient a party designated by the Ministry of Forests to receive FIA funding pursuant to a Recipient Agreement

Recipient Agreement the contract between an Administrator and a Recipient for performance of the Work

Reference Ecosystem a less disturbed ecosystem similar to the one requiring restoration. For riparian restoration, reference ecosystems are usually unharvested or mature forest stands in the same biogeoclimatic zone and site series. Reference ecosystems must sometimes be inferred from stump counts or other data.

Registered Professional a member in good standing with one of the following professional associations: Association of British Columbia Forest Professions, Association of Professional Biologists of British Columbia (College of Applied Biology Act)

Riparian Function the ecological services that a riparian zone provides or can provide to the aquatic and terrestrial environments. Examples of ecological services that can be described as riparian functions include shading, large woody debris input, wildlife trees, wildlife forage, and bank stability. Riparian function is also sometimes used to refer to the overall condition of the riparian area.

Small Organic Debris small pieces of organic matter such as leaves, needles, twigs and invertebrates that become entrained in aquatic ecosystems. This organic matter input is particularly important to small streams.

Work the work described and funded under a Recipient Agreement

Work Area means individual locations, watersheds or other particular areas or locations where Work is to be undertaken or within any area of Crown Land occupied for purposes of the Work

4.0 GENERAL REQUIREMENTS

Contractual and Legal Responsibilities

4.1 The *Recipient* must carry out all work consistent with the requirements of this FIA Activity Standards Document and in compliance with the laws of Canada and British Columbia applicable to the *Work* and *Work Area*.

4.2 The Recipient must retain all data, reports, photographs and maps required to be produced by this FIA Activity Standards Document for a period of not less than three years.

4.3 The Recipient must forward all documents that are required to be produced and retained for three years to the Ministries Library at ForProdres@gov.bc.ca, within two months of the completion of the project.

4.4 Despite any Work or improvements on Crown land that may be performed or made by the Recipient, the sole ownership of all Work Areas and any improvements remains with the Province.

4.5 The *Recipient* must follow the applicable inventory and silviculoture standards for reporting when changes in tree cover are made.

Qualifications and Responsibilities of Personnel

4.6 The *Recipient's* representative must act as the *Coordinating Registered Professional* for the project. This individual will take overall responsibility and accountability for the project, which includes engaging and coordinating the appropriate team of *Registered Professionals* (i.e., Registered Forest Professionals and or Registered Professional Biologists) to be responsible for the various phases of the project, including planning, assessments, riparian prescription preparation, restoration treatments, reporting, inspections and maintenance, and effectiveness evaluations. The *Coordinating Registered Professional* and the *Registered Professional* may be the same person.

4.7 The *Registered Professional(s)* responsible for the phases of the project must comply with the FIA standards for the respective activities, as described below.

4.8 The *Registered Professional(s)* will:

(a) Maintain a current knowledge and understanding of advances in riparian restoration theory and application;

(b) Sign all riparian management prescriptions and other plans/reports for the project, and provide a statement (on the plans or in a separate letter) that the prescriptions were prepared consistent with the requirements of this FIA Riparian Activity Standards Document and all other applicable legislation.

(c) Consider the following technical references, and provide suitable acknowledgement of these or other relevant references in the planning, assessment, restoration prescriptions, restoration work, inspection and maintenance, and monitoring (treatment effectiveness evaluation) phases of the project.

Technical References

4.9 The following reference documents are sources for procedures and guidelines for the various phases of a riparian restoration project. Riparian restoration guidelines by Bancroft and Zielke (2002) (below) must be consulted when preparing restoration prescriptions, and justification should be documented if the guidelines are not being followed. The *Registered Professional* must use their professional judgement to choose methods and techniques that best serve the individual project objectives and are consistent with legislative requirements.

The *Registered Professional(s)* will consider the following references where applicable:

Planning

Holt, R. 2001. Strategic Ecological Restoration Assessments – Results of Regional Workshops. http://www.env.gov.bc.ca/wld/documents/fia_docs/sera_terp_summary.pdf (*These assessments were done for each region and provide information on high priority BEC subzones for restoration treatments)*

WRP Provincial Coordination Team. 2003. Watershed Restoration Planning and Priority Setting – An Emphasis on Fish Habitat. Produced for the Watershed Restoration Program and updated for the Forest Investment Account. (*this document helps focus riparian treatments to priority stream reaches important to fish) (*http://www.env.gov.bc.ca/wld/documents/fia_docs/wrp_guidelines_s.pdf)

BC Ministry of Fisheries, BC Ministry of Environment, Lands and Parks, Fisheries and Oceans Canada. 2001. Watershed-based Fish Sustainability Planning – Conserving BC Fish Populations and their Habitat: A Guidebook for Participants. http://www-heb.pac.dfo-mpo.gc.ca/publications/pdf/wfsp/wfsp_e.htm

Douglas, T. 2002. Ecological Restoration Guidelines for British Columbia. Biodiversity Branch, Ministry of Water, Land and Air Protection. [PDF rest_guidelines HTML rest_guidelines] (*this document provides context and tools for restoration planning).*

Assessment

Koning, C.W. [ed.] 1999. Riparian Assessment and Prescription Procedures. Watershed Restoration Technical Circular No. 6. Ministry of Environment, Lands and Parks, Victoria, BC. (*this document provides a useful assessment procedure)* http://www.env.gov.bc.ca/wld/documents/wrp/wrt6/index.html

McLennan, D. 2002. Riparian Restoration in British Columbia – Ecological Fundamentals and Future Directions. Produced for the BC Ministry of Water, Land and Air Protection, Victoria, BC. (*this document provides ecological information about riparian function and provides an ecosystem framework for riparian restoration. It is a companion document to Bancroft and Zielki (2002))*

Bancroft, B. and K. Zielke. 2002. Guidelines for Riparian Restoration in British Columbia – Recommended Riparian Zone Silviculture Treatments. Prepared for the Ministry of Forests by Symmetree Consulting Group Ltd., October 2002. http://www.for.gov.bc.ca/hfp/pubs/riparian/Riparian%20Guidelines%20Oct%2011up%20locked.pdf

Field Guides for Site Identification and Interpretation for the various regions of the province: http://www.for.gov.bc.ca/hfd/pubs/lmh.htm

Related Assessment and Management Procedures

B.C. Ministry of Forests and B.C. Ministry of Environment, Lands and Parks. 1997. Biodiversity guidebook. Victoria, B.C. http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/biodiv/biotoc.htm

B.C. Ministry of Forests. 2001. Gully Assessment Procedure Guidebook, 4th Edition, Victoria, B.C. http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/GULLY/GAPGdbk-Web.pdf

B.C. Ministry of Forests and B.C. Ministry of Environment, Lands and Parks. 1995. Riparian Management Area Guidebook. Victoria, B.C. http://www.for.gov.bc.ca/tasb/legsregs/fpc/fpcguide/riparian/rip-toc.htm

B.C. Ministry of Forests and B.C. Ministry of Environment, Lands and Parks. 1996. Channel Assessment Procedure Guidebook. Victoria, B.C. http://www.for.gov.bc.ca/tasb/legsregs/fpc/FPCGUIDE/CHANNEL/CHAN-TOC.HTM

BC Ministry of Forests and B.C. Ministry of Environment, Lands and Parks. 1999. Mapping and Assessing Terrain Stability Guidebook, 2nd Edition. Victoria, B.C http://www.for.gov.bc.ca/TASB/LEGSREGS/FPC/FPCGUIDE/terrain/

Nyberg, J.B and D.W. Janz. 1990. B.C. Ministry of Forests Special Report #5 - Deer and Elk Habitats in Coastal Forests of Soutern British Columbia.http://www.for.gov.bc.ca/hfd/pubs/Docs/Srs/Srs05.htm

Restoration Prescriptions/Silviculture Treatments

Bancroft, B. and K. Zielke. 2002. Guidelines for Riparian Restoration in British Columbia – Recommended Riparian Zone Silviculture Treatments. Prepared for the Ministry of Forests by Symmetree Consulting Group Ltd., October 2002. http://www.for.gov.bc.ca/hfp/pubs/riparian/Riparian%20Guidelines%20Oct%2011up%20locked.pdf

McLennan, D. 2002. Riparian Restoration in British Columbia – Ecological Fundamentals and Future Directions. Produced for the BC Ministry of Water, Land and Air Protection, Victoria, BC. (*this document provides ecological information about riparian function and provides an ecosystem framework for riparian restoration. It is a companion document to Bancroft and Zielki (2002))*

Machmer, M and C. Steeger. 2002. Effectiveness Monitoring Guidelines for Ecosystem Restoration. Prepared for the Habitat Branch, Ministry of Water, Land and Air Protection, by Pandion Ecological Research Ltd., Nelson, BC. (*planning for effectiveness monitoring needs to begin at the prescription development phase – the process is described in this document) [rest_effect_mon_guidelines_s.pdf]*

Treatment Effectiveness Evaluations (Monitoring)

Machmer, M and C. Steeger. 2002. Effectiveness Monitoring Guidelines for Ecosystem Restoration. Prepared for the Habitat Branch, Ministry of Water, Land and Air Protection, by Pandion Ecological Research Ltd., Nelson, BC. [rest_effect_mon_guidelines_s.pdf]

Gaboury, M. and R. Wong. 1999. A framework for conducting effectiveness evaluations of watershed restoration projects. Watershed Restoration Program Technical Circular No. 12. Ministry of Environment, Lands and Parks, and Ministry of Forests, British Columbia. http://www.env.gov.bc.ca/wld/documents/wrp/wrtc_12.pdf

5.0 PLANNING

Under the Strategic Resource Planning Component of the FIA, (http://www.for.gov.bc.ca/hcp/fia/landbase/strategic_resource_planning.htm), Land Based Investment Rationales or Sustainable Forest Management planning can identify the need to develop restoration plans for watersheds within a particular management unit. Watershed-based Fish Sustainability Planning (WFSP) (http://www-heb.pac.dfo-mpo.gc.ca/publications/pdf/wfsp/wfsp_e.htm) is another strategic planning mechanism that is an eligible activity under the FIA. A WFSP is a regional, multi-stakeholder process that identifies high priority watersheds for restoration, including areas or sites that are candidates for riparian restoration. Watershed Restoration Planning (wrp_guidelines_s.pdf) and Ecosystem Restoration Planning are more focused mechanisms for identifying sites that are high priority for riparian restoration. Watershed Restoration and Ecosystem Restoration planning should coordinate riparian restoration with aquatic and terrestrial restoration activities, including road deactivation. The overview level of the Riparian Assessment and Prescription Procedure (http://wlapwww.gov.bc.ca/wld/documents/wrp/wrtc_6.pdf) is another method of planning that can identify areas for further study.

Regardless of which planning process is used, both terrestrial and aquatic habitat values and restoration needs must be taken into account. One or more of these planning processes must be used in order to justify where to invest in riparian restoration. The following standards describe the minimum planning requirements:

Planning Requirements

5.1 The *Coordinating Registered Professional* must demonstrate that planning and prioritization has occurred at the management unit and watershed levels, prior to proceeding with detailed riparian assessments and prescription development. Data and a written rationale must document:

(a) how certain watersheds or portions of management units were prioritized for riparian restoration;

(b) which sub-basins and sites within priority watersheds/areas are high priority for further assessment, based on likelihood of treatment success and restoration goals for the management unit or watershed; and

(c) the watershed, sub-basin, and site-level restoration objectives, and potential treatments to address the loss of *riparian function*.

5.2 If the above documentation cannot be synthesised from existing information, the *Coordinating Registered Professional* must select a suitable assessment procedure and team of *Registered Professionals* to obtain the required information described above.

5.3 The *Coordinating Registered Professional* will consider the Technical References and assessment methodologies described in clause 4.7, in deciding which assessment procedures are acceptable for obtaining the required information.

5.4 The *Coordinating Registered Professional* will consider previously completed overview assessments, Watershed Assessment Procedures (WAP), assessments (or default assumptions) of fish presence, and other pertinent assessment literature to meet assessment requirements.

5.5 The *Coordinating Registered Professional* will make the planning documentation available to the *Administrator* upon request. This documentation must be held by the Recipient for a minimum of three years, and be available for auditing by the Ministry of Forests and Range or the Ministry of Environment.

6.0 RIPARIAN HABITAT ASSESSMENT

The Planning phase prioritized watersheds and sites, and recommended priority areas for more detailed assessment based on suspected impairment of *riparian function*. A riparian assessment will prioritize sites for prescription development and provide preliminary recommendations for restoration. The Riparian Assessment and Prescriptions Procedure (Koning 1999) provides an example of an acceptable field assessment procedure to quantify impacts to riparian habitat. McLennan (2002) provides an assessment example using this procedure, and Bancroft and Zielke (2002) provide more detailed information to assist in developing preliminary restoration prescriptions. (See clause 4.7 for all technical references.) The minimum requirements for carrying out an assessment are described below.

Riparian Habitat Assessment Requirements

6.1 Candidate sites identified during project planning will be assessed on the ground for their ability to supply basic riparian functions such as:

- *Large Woody Debris* (especially from coniferous trees);
- *Coarse Woody Debris* and *Small Organic Debris*;
- Stream shading;
- Stream bank and channel stability;
- Wildlife and general biodiversity attributes; and
- Filtering of fine sediment and other deleterious materials.

Different riparian functions will vary in their level of importance depending on the location in a watershed (e.g. headwaters or floodplain), stream gradient, and biogeoclimatic zone (see Chatwin et al 2000 and McLennan 2002 in Technical References, Clause 4.7). Typical data collected to determine riparian function and condition may include soils, slopes, stand and stocking information (e.g., numbers, species, average heights, average diameters, other vegetation, shrub and herb abundance), wildlife use (e.g., rubs, trails, feeding activity, nesting, wildlife trees), aspect, CWD and LWD abundance, biogeoclimatic subzones and site series, access trails and roads, general biodiversity aspects (e.g., vertical and horizontal structure, description of canopy layers, crown closure/shading), diseases, blowdown expectations, beaver activity, historic and/or presently active slides, erosion, mass wasting, bank slumps and excessive undercuts, road and bridge building impacts (present or historic), and public access and impact.

6.2 The outputs of a riparian assessment must include:

a. field data for use in prescription development, including classification and mapping of similar vegetation types or vegetation type complexes (where frequent type changes occur), into distinct polygons (detailed procedures for data collection can be found in the RAPP);
b. stream class and approximate stream gradient of adjacent waterbody;
c. a list of priority sites for prescription development, based on level of riparian function. Riparian function will be classified as low, medium, or high, based on a comparison between current conditions and expected reference conditions in a similar unharvested site;
d. preliminary recommendations for restoration options; and
e. a discussion of methods used to complete the assessment.

6.3 Riparian assessment outputs must be compiled into a report that is signed by a *Registered Professional*. This report must be available to the *Administrator* upon request. This report must be held by the *Recipient* for a minimum of three years, and be available for auditing by the Ministry of Forests and Range or the Ministry of Environment.

7.0 RIPARIAN RESTORATION PRESCRIPTIONS

The prescription development phase of riparian restoration uses data collected during the assessment and planning phases. The purpose of the prescription development phase is to prepare detailed restoration objectives and prescriptions for carrying out restoration work. This often involves further field data collection. The Riparian Assessment and Prescriptions Procedure (Koning 1999) provides an acceptable procedure for developing restoration prescriptions, and Bancroft and Zielke (2002) provide information to assist in developing restoration prescriptions. (See clause 4.7 for all technical references.) The minimum requirements for developing riparian restoration prescriptions are described below.

Prescription Development Requirements

7.1 Prescriptions must be based on assessment information collected for priority sites. Documentation is required to show how priority sites were chosen.

7.2 Prescribed treatments must be incremental to any existing obligations on the sites.

7.3 Prescribed treatments must conform to current legislation and standards where applicable.

7.4 If data collected during the assessment phase do not provide the detailed quantitative information required to develop prescriptions, more data must be collected as needed according to the proposed treatment(s). For example, ofdata on stand/stocking, and soil & biogeoclimatic assessment is often necessary for riparian treatments such as planting and stand tending.

7.5 The following must be taken into account when developing riparian prescriptions:
- a. safety issues;
- b. levels of supervision and crew training required;
- c. cost-benefit and logistics of treatments;
- d. *Reference Ecosystems* – actual or inferred – must be used to inform riparian prescriptions;
- e. aquatic and terrestrial habitat/biodiversity concerns – both aquatic and terrestrial values must be taken into account for all prescriptions;
- f. specific, measurable goals and objectives; and
- g. the design of future treatment effectiveness evaluations that relate to the goals and objectives (see section 11.0).

7.6 Riparian restoration prescriptions and accompanying documentation must include:
- a. a description of the nature of the problem - i.e., which *riparian functions* are impaired;
- b. restoration objectives for each treatment type - these objectives must be specific and measurable;
- c. a description of the *Reference Ecosystem* (actual or inferred) that was used to inform restoration objectives;
- d. maps or air photo overlays showing treatment area boundaries and points of reference (e.g., roads);
- e. recommended prescriptions for each site, site complex, stratum or vegetation type;
- f. a description of how the prescribed treatments will address the impaired riparian functions, including both terrestrial and aquatic values;
- g. Workers Compensation Board safe working practices;
- h. an estimated budget;
- i. photographs of typical pre-treatment conditions;
- j. a description of the methods used to develop the prescriptions;
- k. data describing pre-treatment conditions so that future treatment effectiveness evaluation (monitoring) can be conducted. The amount and type of data required will depend on the treatment effectiveness evaluation objectives (see section 11.0 and Machmer and Steeger (2002) in clause 4.7);
- l. proposed treatment effectiveness evaluations to determine treatment success; and
- m. any data collected to inform the prescriptions.

7.7 The restoration prescriptions and accompanying documentation must be signed by a *Registered Professional.*

7.8 Riparian restoration prescriptions and accompanying documentation must be compiled into a report. This report must be sent to the Ministries Library at ForProdres@gov.bc.ca. This report must be held by the *Recipient* for a minimum of three years, and be available for auditing by the Ministry of Forests and Range or Ministry of Environment.

8.0 RIPARIAN RESTORATION TREATMENTS

Riparian restoration treatments follow the planning, assessment, and prescription development phases (see sections 5.0, 6.0 and 7.0). The minimum requirements for carrying out riparian restoration treatments are described below.

Requirements for Riparian Restoration Treatments

8.1 All legislated approvals must be obtained before proceeding.

8.2 The *Recipient* or the *Coordinating Registered Professional* must notifying the MOE Regional Ecosystems Section Head - Environmental Stewardship of the approved *work*, at least 10 days prior to the initiation of *work*, and supply them with copy of the prescriptions upon request;

8.3 Treatments must be carried out only on high priority sites that were identified in a planning process and assessed for their loss of *riparian function* (see sections 5.0, 6.0 and 7.0 for planning, assessment and prescription development standards).

8.4 The *Coordinating Registered Professional* is responsible for ensuring that the treatments are carried out according to the riparian restoration prescriptions developed by a *Registered Professional*. Any necessary deviations from the prescriptions must be documented and justified.

8.5 A *Registered Professional* must be responsible for crew training and supervision for the duration of the treatments.

8.6 All applicable federal and provincial legislation and regulations must be complied with while carrying out the treatments.

8.7 Upon completion of the work, an 'as-treated' report must be completed to describe the work. This report must include:

a. costs per hectare for each treatment type, final project costs, and number of person days;
b. maps and descriptions of the polygons treated;
c. representative photographs for each treatment type;
d. descriptions of any departures from the restoration prescriptions, and the reasons for them;
e. descriptions of the treatments and treatment locations sufficient to allow for future inspections and maintenance (see section 10.0);
f. a suggested schedule for future inspections and maintenance; and
g. any suggestions to improve similar projects in future.

8.8 For future treatment effectiveness evaluations, the 'as-treated' report must include data on pre–treatment (see clause 7.7 k) and on conditions present immediately after treatment. The amount of detail and the type of data collected will depend on the type of treatment, and the treatment effectiveness evaluation objectives (see section 11.0). Potential treatment effectiveness evaluations and a proposed schedule for treatment effectiveness evaluation must also be included.

8.9 A Project Completion Abstract must be completed. Standards and a template for the abstract are included in section 9.0. Copies of this abstract must be provided to the Ministries Library by sending the abstract to ForProdres@gov.bc.ca.

8.10 Ministry of Forests silviculture reporting standards for ISIS must be followed when the tree species composition of the site changes.

8.11 The as-treated report must be sent to the Ministries Library at ForProdres@gov.bc.ca. This report must be held by the *Recipient* for a minimum of three years, and be available for auditing by the Ministry of Forests or the Ministry of Water, Land and Air Protection.

9.0 PROJECT COMPLETION ABSTRACT

The following is both the standard and the template for completing the Project Completion Abstract. This abstract must be completed in the same fiscal year as riparian treatments are conducted. The abstract must not be more than two pages in length. This standardized abstract will be available for public viewing on the FIA website alongside projects from this and other activity areas. The completed abstract must be emailed to the Ministries Library at For.Prodres@gov.bc.ca .

[Insert project name, watershed, and Forest Region/District here]

Objectives of the overall project

Briefly state the objectives of the project, including which *riparian functions* were addressed.

FIA Investment Schedule Number, Project Number, and Fiscal Year

For cross-reference purposes, provide the unique FIA Investment Schedule Number, Project Number, and Fiscal Year the work was completed.

Recipient Name and Division/ MoFR District/ MoFR Region

Specify the Recipient Name and Division responsible for the project and the MoF region and district where the project work was carried out.

Names/Affiliation of Registered Professionals Involved in the Project

Specify the names of the Registered Professionals involved and their professional affiliation.

Author(s) of the Project Completion Abstract

Give the author's name(s), title, affiliation, mailing address, fax number, telephone number, email address.

Name of Watershed / Sub-basin, & Location

Give the name of the watershed or management unit. Describe the geographical location of the work area, and how best to access the area. Provide the Universal Transverse Mercator (UTM) grid coordinates or longs/lats of a convenient access point or an area of particular interest.

Introduction

Provide a brief summary of the background and history that prompted development of the project. Make particular reference to the prioritization and at what level this was done (e.g., SFM planning, WFSP, etc). List the assessments that contributed to treatment decisions.

Include applicable details. Briefly describe details of any previous work that may have been carried out at the site related to restoration.

Description of Restoration Prescriptions

Provide information about the restoration prescriptions, including their objectives and a rationale for the type of treatments planned.

Description of Completed Work

Provide the start and completion dates of the work at the site.

Summarize the number of hectares treated in total and for each treatment type, and provide any relevant details regarding the work activities and treatments provided.

Cost Summary

Activity costs – provide the cost per hectare for each treatment type, including labour, equipment and materials. Provide the total cost of the work.

Post-treatment Inspections and Maintenance

State the purpose and timing of post-treatment inspections and/or maintenance.

Treatment Effectiveness Evaluations

Discuss plans and a schedule to evaluate treatment effectiveness.

Photographs

Include site photographs to show typical pre treatment and post-treatment conditions (maximum of 3 photos). Provide photo numbers and captions for all photographs provided, and make reference to the photos in the above text.

Photo 1. Caption

Photo 2. Caption

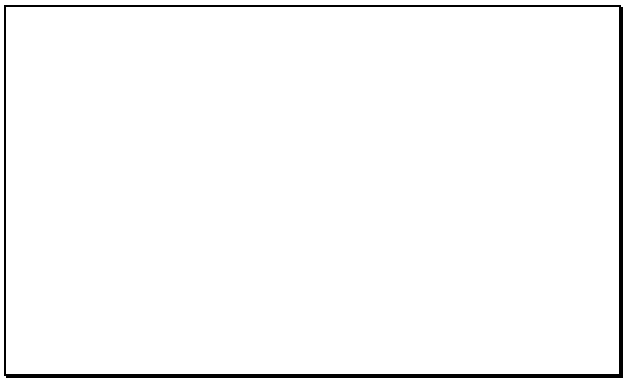

Photo 3. Caption

Note to Author:

The layout of the Project Completion Abstract should be in a two-column format (as viewed in Page/Print Layout mode).

10.0 INSPECTION AND MAINTENANCE

Inspection and maintenance are a critical aspect of riparian restoration. Without follow-up treatments, some restoration treatments will fail and others will not fully meet restoration goals. The type and frequency of inspection and maintenance will depend on the type of treatments. Some maintenance requirements will be known in advance, and others will be evident only when inspections are made. The minimum requirements for inspection and maintenance are described below. All inspections and maintenance are subject to funding, however, the inspection and maintenance of previous work must take precedence over the initiation of new work.

Requirements for Inspection and Maintenance

10.1 An inspection and maintenance schedule will be created and revised when necessary in order to meet the restoration objectives described in the restoration prescriptions (see Section 7.0).

10.2 The treated areas will be inspected according to how well they meet the restoration prescriptions. If the area no longer meets the restoration prescriptions, maintenance should be prescribed and implemented. (For example, if canopy gaps were part of the prescription but are rapidly closing in due to crown development, epicormic branching, or crowns leaning into the created opening, more overstory trees would need to be felled.)

10.3 Planted stock must be inspected periodically and maintained if necessary, until the seedlings are effectively competing with brush and other vegetation. If significant mortality occurs, new trees must be planted and or the restoration prescriptions must be revised.

10.4 A record of inspection visits and maintenance treatments must be kept by the *Recipient*, and must be sent to the Ministries Library at ForProdres@gov.bc.ca. This record must be held by the *Recipient* for a minimum of three years, and be available for auditing by the Ministry of Forests and the Ministry of Environment.

11.0 TREATMENT EFFECTIVENESS EVALUATION

Treatment effectiveness evaluation addresses the question of how successful a treatment is at restoring the ecosystem function or its component parts, relative to the initial goals and objectives. It is the process of identifying and monitoring key indicators of ecosystem response to evaluate the success of a restoration initiative.

Fundamental questions addressed by treatment effectiveness evaluations include the following:

- Is the restoration work achieving the desired objectives for the targeted ecosystem and or its component parts?
- Can restoration treatment methods and techniques (i.e., standards and guidelines) be improved to optimize recovery of the ecosystem and or its component parts?
- What modifications are possible to improve the cost-effectiveness of the work?

All restoration projects require some level of treatment effectiveness evaluation. In order to evaluate treatment effectiveness, compliance must first be confirmed. If there is any non-compliance, the treatment effectiveness evaluation may be limited or impossible to conduct. Treatment effectiveness evaluations may entail rapid, mostly qualitative data collection to compare a small number of response variables before and after treatment. For example, a project to establish or release conifers might entail rating the survival and vigour of the trees over five to fifteen years, using visual inspections in years one, five, ten and fifteen, or until the trees are competing well. Certain projects will require a more intensive level of evaluation that entails in-depth quantitative monitoring and analysis over a longer time frame. The appropriate level of treatment effectiveness evaluation will depend on the nature of the restoration project. A conceptual framework and guidelines for effectiveness evaluation are provided by Machmer and Steeger (2002). The minimum requirements for treatment effectiveness evaluation are described below:

Requirements for Treatment Effectiveness Evaluation

11.1 A treatment effectiveness evaluation must include the following key steps (discussed in more depth in Machmer and Steeger (2002) (rest_effect_mon_guidelines_s.pdf):

a. identification of the treatment effectiveness evaluation objectives. These objectives should complement the restoration objectives in scale and timeframe;
b. selection of the appropriate level of evaluation;
c. identification of key response variables (indicators) that are critical to determine whether the project was ecologically successful. Usefulness, cost-effectiveness and practicality are factors that help determine which response variables are 'critical' to monitor;
d. development of the treatment effectiveness evaluation design and monitoring protocols. Factors to take into consideration include data collection standards and protocols, and the locations, timing, frequency, and duration of data collection;
e. implementation of effectiveness evaluation. This entails pre- and post-treatment data collection for the key response variable(s), according to the design and protocols developed. All monitoring locations must be permanently marked and readily located;
f. analysis, summaries and interpretation of the collected data; and
g. application of the findings to current and future restoration projects.

11.2 Treatment effectiveness evaluation findings of any significance must be disseminated to interested individuals using forums such as conferences, workshops, peer-reviewed journals, the Streamline restoration bulletin (http://www.forrex.org/streamline/), or email listservs such as WATERSHEDEXT (http://www.forrex.org/listserv/listserv.asp). A project summary can be posted on the Natural Resources Information Network (http://nrin.siferp.org/). More detailed treatment effectiveness evaluations may be appropriate for the online Journal of Ecosystems and Management (http://www.forrex.org/JEM/).

11.3 Treatment effectiveness evaluation results must be documented. The amount of detail necessary will depend on the monitoring intensity. Evaluation results should include a description of the

restoration objectives, the treatment effectiveness evaluation objectives, the evaluation design and monitoring protocols, and key response variables. The documented results should also contain a discussion of the following:

a. a summary of monitoring data and any analyses;
b. an assessment of the short-term success of restoration treatment(s) relative to stated objectives (based on effectiveness evaluation data and other evidence gathered to date);
c. recommendations for change or refinement to the restoration project objectives, treatment prescriptions, treatment implementation, effectiveness evaluation objectives, or monitoring protocols, in order to improve overall success;
d. comments on the cost-effectiveness of the restoration treatments and any possible improvements; and
e. recommendations for continued treatment effectiveness evaluation, including more intensive evaluation, if warranted.

11.4 The treatment effectiveness evaluation results must be sent to the Ministries Library at ForProdres@gov.bc.ca. The results must be held by the *Recipient* for a minimum of three years, and be available for auditing by the Ministry of Forests or the Ministry of Water, Land and Air Protection. For scientific and future planning purposes the maps and results should be kept for a minimum of 20 years, and if possible, for the length of a forest rotation.