Guidebook

Environmentally Sustainable Log Handling Facilities in British Columbia

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Consultation and collaboration were invaluable in the development of a clear and relevant Guidebook. Members of the steering committee met through several review cycles and contributed greatly by providing guidance, vision, opinion and technical review. Contributions of members of the steering committee and others who reviewed the document are gratefully acknowledged.

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Preface

This Guidebook was developed in response to needs identified by regulatory agencies and organizations involved in the log handling industry in British Columbia. Many acts and regulations provide a legal framework for protecting fish and wildlife, their habitat and other aspects of a healthy ecosystem. This document was created to help translate such policies into practice, and to provide clear direction on means to operate log handling facilities that prevent, limit or compensate for damage to fish and fish habitat.

The log handling industry has a long history in British Columbia and, historically, business practices often resulted in habitat disruption or damage. While recognizing the reality that, today, there is a mix of older and modern industry practices, this Guidebook stresses the requirement to meet all relevant laws and regulations and provides general direction on how to achieve this.

This Guidebook describes environmentally sustainable and sound industrial practices (called Best Management Practices or BMPs). These BMPs will guide proponents away from critical and important habitats, provide options and recommendations and describe likely outcomes. Following the Guidebook will assist in the development of proposals that adequately address environmental concerns and will have greater likelihood of approval.

In these ways, it is hoped that the goals of economically and environmentally sustainable log handling practices can be achieved together.

Caveat

This Guidebook should not be considered as or relied upon for legal advice. If proponents require legal advice on specific projects, they are urged to consult their own legal counsel.

Following this document does not preclude liability for prosecution under any federal, provincial or municipal laws. The agency and industry representatives on the steering committee, and the authors, do not make any expressed or implied warranty concerning the thoughts and ideas expressed herein, should they fail to work as planned, if utilized.

This document is intended as general guidance to assist forest companies and their consultants exercise professional and technical judgement to develop site-specific operational plans. The principles in this Guidebook regarding habitat protection and environmentally sound operational practices are based upon existing legislation, caselaw and policy. The most suitable procedure for an individual site will vary depending upon habitat type, pre-existing operations and other site-specific circumstances. This Guidebook does not preclude the use of alternative practices, so long as they are environmentally sound and consistent with provincial and federal legislation.

It is recommended that proponents check with local agencies for any site-specific requirements, changes to review processes and requirements for proposal submission.

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1.0 Introduction & Application Procedure

This *Guidebook for Environmentally Sustainable Log Handling Operations in British Columbia* has been developed to assist proponents and regulatory agency personnel in complying with environmental legislation relevant to log handling operations. A steering committee, comprised of representatives of regulatory agencies and industry, directed Guidebook development to address the needs of those involved in log handling operations.

Currently, Land and Water British Columbia Inc. (LWBC) reviews all applications for log handling operations on Crown land, which includes tenures and leases on foreshore areas. LWBC refers applications to relevant provincial and federal agencies for comment on environmental, First Nations, forestry, site-specific and other concerns. Agencies such as Fisheries and Oceans Canada (DFO), Environment Canada (EC) and Ministry of Water, Land and Air Protection (MWLAP) address environmental concerns and Canadian Coast Guard (DFO) addresses navigational concerns.

The application process, consisting of a flow chart, is presented in this section to help proponents identify regulatory requirements and assess whether proposed activities will result in environmental impacts that will be unacceptable to DFO. Using this information, the proponent may decide whether to continue developing the proposal by including mitigation or compensation strategies, relocate to a more appropriate area or abandon the proposal. Reduced costs are anticipated for industry and regulators by clarifying the application process, expediting the review process and reducing the number of proposals rejected or returned for revision. Subsequent sections provide information on types and value of aquatic habitat, log handling operations and their potential environmental impacts, relevant legislation, Best Management Practices (BMPs), monitoring and reporting requirements and cited literature. The enclosed glossary and appendices provide additional information.

Photo 1. Intertidal marsh habitat (critical habitat)

1.1 Log Handling Operations & Potential Habitat Impacts

The log handling industry in British Columbia has a long history, and in the past, business was often conducted in ways that resulted in habitat disruption or damage. While recognizing the reality that, today, there is a mix of older and modern industry practices, this guidebook stresses the requirement to meet all relevant laws and regulations and provides direction on how to achieve this.

Log handling operations are often situated in or near marine or freshwater, a consequence of the terrain, coastline and economic realities of moving wood products in the province. Environmental value of aquatic habitat (defined as *critical, important* or *marginal*) and reasons for protecting it are described in Section 2. Types of log handling

operations (initial transfer to water, sorting, booming, barging, transport, storage), and their potential impacts to fish habitat and water quality are described in Section 3. Commonly observed impacts include damage to shoreline and underwater substrate during construction or operation and deposition of wood waste, mostly bark, which can smother habitat and its inhabitants.

Photo 2. Estuarine habitat in winter (critical habitat)

1.2 Applicable Legislation & Regulatory Requirements

The federal *Fisheries Act* is the guiding legislation of this document. Section 4 describes this and other acts that may apply to log handling. For example, DFO requires that an application contain a Debris Management Plan that addresses Canadian Coast Guard (CCG) concerns on potential impacts to navigation of escaped logs and deadheads (under the *Navigable Waters Protection Act*) and Habitat and Enhancement Branch (HEB) concerns for environmental impacts of woody debris accumulation (under the *Fisheries Act*). Under the provincial *Waste Management Act*, MWLAP requires a permit for activities that involve discharge of waste (e.g., sewage, solid waste disposal by landfill or incineration, treatment of hazardous wastes). Various acts protect birds, wildlife and their habitat. Consultation with First Nations may also be required.

The *Fisheries Act* defines fish habitat as "spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes" (Section 34 [1]). The definition of habitat includes water, surrounding vegetation and substrate. Under the *Act*, no person may damage fish habitat without prior authorization (Section 35) and no person may pollute water frequented by fish (Section 36).

Harmful alteration, disruption or destruction of fish habitat (HADD) is prohibited under Section 35(1) of the *Act*. The DFO policy of net gain of habitat for Canada's fisheries resources (DFO, 1986) seeks to increase productive capacity of fish habitat through conservation, restoration and development. The conservation objective is guided by the principle of No Net Loss which can be achieved in several ways: relocating proposed developments to avoid damaging habitats of higher value; mitigating to reduce impacts of proposed developments (e.g., building around sensitive habitat, shutting down at specific times of year); and building compensatory habitat where impacts are unavoidable and the project is in the public interest.

Photo 3. Well-vegetated shore in steep and deep habitat

Photo 4. Log dump located on steeply sloped shoreline, with logs used for debris containment visible in the distance

1.3 Best Management Practices

Environmental protection practices or Best Management Practices (BMPs) are described as they apply to siting and design (Section 5), construction and operation (Section 6) and site deactivation (Section 7). These BMPs will assist the proponent to identify and follow procedures that protect the environment and can be incorporated into the *Proponent Application*. Within this approach, and with continually evolving scientific knowledge and industry practices, it is recognized that new, innovative or modified approaches may be appropriate in some circumstances and should be encouraged.

DFO has procedures for implementing the No Net Loss policy at log handling facilities. If harmful impacts cannot be fully mitigated, DFO requires that the proponent apply for an *Authorization for a HADD* pursuant to Section 35[2] of the *Fisheries Act*, which includes compensating for damage by creating new habitat (DFO, 1998).

Authorization for a HADD triggers the *Canadian Environmental Assessment Act* (CEAA), which requires an environmental assessment before issuing the *Authorization*. In many cases, DFO can conduct the environmental assessment (screening process) using a *Proponent Application* (step 5 in the flow chart). These plans, best prepared by a qualified professional, include site assessment, identification of potential environmental impacts and mitigation and/or compensation plans.

The type of mitigation or compensation required will vary with the type of operation and with habitat value. For example, compensation and mitigation measures will be less complex and costly in areas of marginal habitat than in areas of critical or important habitat.

1.4 Environmental Monitoring & Reporting

Having applied BMPs in constructing and operating the facility, the proponent may be required to evaluate how well these measures protect habitat. Has the operation succeeded in protecting the environment and achieving the objective of No Net Loss of habitat? Section 8 describes monitoring and reporting requirements and briefly describes resources for environmental assessment. Annual monitoring may

Photo 5. Extensive woody debris accumulation on intertidal habitat

be required to assess mitigation and compensation measures, use of BMPs and environmental impacts (e.g., oil sheen, bark management). If substances from the *List of Toxic Compounds* (Schedule 1 of *Canadian Environmental Protection Act,* 1999; *CEPA*) are used at the facility, a Pollution Prevention Plan may be required under Part 4 of *CEPA*. Regulatory agencies and industry may choose to monitor the effectiveness of BMPs.

1.5 Application & Review Process

The application process described in the following flow chart identifies seven steps and is designed to make requirements and the process clear to the proponent. This should enable agencies to evaluate well-prepared applications, expedite review and result in fewer rejected or revised applications.

Application Process for Log Handling Operations

1. Identify habitat and other environmental issues Evaluate habitat type and rating (Table 1, critical, important, marginal), and likelihood of approval. Is a HADD likely?	**GUIDEBOOK SECTION 2**
2. Identify proposed activities and potential negative impacts Type, size, operational time frames	**GUIDEBOOK SECTION 3**
3. Identify requirements for approval, regulatory authorities and relevant issues Crown Land tenure (LWBC) navigation issues (DFO-CCG) habitat & environmental effects (DFO-HEB, EC, MWLAP) *It may be useful to make a preliminary inquiry to LWBC and to identify site-specific or regional issues that would prevent a successful application.* Proceed to **Step 4** if a favourable outcome is anticipated.	**GUIDEBOOK SECTION 4**
4. Conduct initial habitat assessment & project review Determine habitat rating (Table 1), application requirements, any requirements for a HADD Authorization and likely outcomes. Proceed to **Step 5** if a favourable outcome is anticipated.	**REVIEW ABOVE INFORMATION**

Table 1:
Habitat Rating System for Proposed Log Handling Facilities

Category	CRITICAL STOP	IMPORTANT CAUTION	MARGINAL GO
Definition	habitat essential because of its rarity, productivity and sensitivity habitat essential to sustaining a subsistence, commercial or recreational fishery or species at risk[1]	common or widespread habitat type in the region, with a large amount of similar habitat readily available habitat used by fish for feeding, growth and migration, not deemed critical	habitat with low productive capacity and contributing only incidentally to fish production
General Indicators	presence of high-value spawning or rearing habitat areas high in primary productivity previously constructed habitat compensation	important migration corridors presence of suitable spawning habitat habitat with moderate rearing potential for the fish species present	absence of suitable spawning habitat habitat with low rearing potential sparse vegetation and macro-invertebrate distribution
Habitat Types	mudflats salt marshes some eelgrass beds kelp beds shellfish beds beach spawning areas herring spawning areas salmon and eulachon holding areas freshwater salmonid spawning habitat seabird rookeries mammal haulouts	sand and gravel beaches some eelgrass beds freshwater riparian areas freshwater littoral zones instream fish habitat migratory bird habitat wildlife habitat	"steep and deep" rock faces and cliffs some rocky foreshores old dumpsites areas already disturbed by industrial activity
Regulatory Response	Authorization for HADD **HIGHLY UNLIKELY**	Authorization **MAY BE GIVEN**, only if unmitigated HADD can be fully compensated, resulting in No Net Loss of fish habitat	Authorization **LIKELY**, provided habitat impacts are mitigated compensation for HADD required
Applicant Action	avoid through alternate siting if project is still considered, propose mitigation or compensation strategies, although likelihood of approval is very low[2].	relocate to marginal habitat if possible pursue impact mitigation options to the extent possible propose compensation for unavoidable HADD	pursue impact mitigation options to the extent possible minimize temporal habitat loss

1. See http://www.cosewicgc.ca/cosewic or http://srmwww.gov.bc.ca/atrisk/ for red-listed, blue-listed and COSEWIC listed species
2. Should a proponent wish to proceed with an application for a facility in critical habitat, the application must indicate how impacts would be mitigated and how unmitigated HADD would be fully compensated, resulting in No Net Loss of fish habitat.

5. Prepare Proponent Application

DFO typically requires the information below to evaluate habitat and navigational concerns. A qualified professional biologist or technician with adequate training and knowledge of fish habitat should prepare the application. The applicant should identify regional and site-specific requirements of LWBC, MWLAP (*Waste Management Act* permits), EC and other agencies before preparing the application.

1. Site Location

Describe site location, connectivity to surrounding environment and other site issues. Describe specific criteria potentially required by LWBC (e.g., MWLAP siting criteria, DFO Debris Management Plan). Describe precise location of site (UTMs, etc.).

2. Fisheries Resource Values

Describe in detail existing fisheries values in the area that could be affected by proposed works, including hydrologic features, water quality, species of fish that frequent the waterbody and fish habitat present. Review existing fisheries databases and conduct detailed habitat inventories and physical site surveys, including fish sampling, as necessary (see Section 8 and Appendix 4).

3. Description of Proposed Activities

Describe in detail the proposed work and the site plan (with schematic drawings). Indicate how the works are to be carried out, including machinery and materials to be used, maintenance requirements and decommissioning plans. A project time schedule that includes construction and operational activities and applicable timing windows is required.

4. Impacts to the Fisheries Resources

Discuss anticipated impacts to fisheries and habitat values. Identify nature, duration, magnitude and location of potential impacts and effects on adjacent areas. Provide justification or rationale for any changes in natural features (relocation of stream channels, filling with riprap, etc.).

5. Mitigation, Debris Management Plan, Sheen Reporting

Describe all measures (actions and contingencies) that should be taken to avoid, reduce or eliminate any anticipated impacts during construction, operation and decommissioning of the log handling facility. Describe any proposed habitat compensation works to be undertaken to achieve No Net Loss of fish habitat, as required. Provide a Debris Management Plan that describes all mitigation measures (BMPs, actions, contingencies) that will be taken to avoid, reduce or eliminate the deposition of woody debris such as bark, log chunks and slabs that may be generated from the log handling facility and pose a risk to navigation or impact fish habitat. Describe procedures for sheen or spill monitoring and response.

6. Environmental Monitoring

Describe any environmental monitoring that may be required to ensure that mitigation and/or compensation measures taken to conserve habitat values have been implemented and are functioning to the satisfaction of the environmental agencies granting approval for the works. Environmental monitors conducting the monitoring are expected to report to the appropriate regulatory agency and should act at "arms length" from the proponent and proponent's contractors.

6. Submit Proponent Application to LWBC

LWBC directs application to relevant agencies for comment

7. Await Decision of Review

If not approved, consider whether additional mitigation or compensation strategies will result in approval.
Contact agencies to discuss options for revision.

2.0 Habitat Considerations

Marine, estuarine and freshwater habitats in BC support diverse and productive biological communities, including fish stocks with high commercial, recreational and ecological value. Many physical, chemical, geophysical and human-related factors interact to influence productivity and species composition. These include currents, tides, nutrient cycling, geology, topography, habitat disturbance and harvesting rates. Log handling operations are often situated next to or in these aquatic habitats, and have the potential to create negative impacts.

Information for this section was adapted from FREMP (1991; undated), BC Nearshore Habitat Loss Work Group (2001), Swanson (2001) and MOF (2002).

2.1 Habitat Rating System for Log Handling Proposals

Although all habitat types are ecologically important, DFO assigns a higher value to some than to others, based on productivity, intensity of use, rareness, sensitivity to human exploitation or alteration and other factors considered important by society. Table 1 (Section 1) presents a habitat rating system that links habitat type to requirements for acceptance of proposals and likelihood of approval. This system was based on models used by various regulatory agencies (e.g., *Fish-Stream Crossing Guidebook*; MOF, 2002) and uses a "traffic light" approach to describe habitat as **Critical, Important** and **Marginal**.

When the proponent understands the level of effort required for approval by DFO (e.g., mitigation plans, compensation plans for an authorized HADD) in various habitat types, a decision can be made whether to proceed as planned or modify the application prior to submission. Mitigation options include minimizing footprint and other harmful effects through design modification and avoiding sensitive times of year. Compensation for any unmitigated HADD will be required, although the extent and cost is also linked to habitat quality.

Critical Habitat

Red denotes **stop** when considering where to develop, unless designated habitat features can be completely avoided. This is ***Critical*** habitat, highly productive and most sensitive biologically to disturbance. A HADD of critical fish habitat is unacceptable and it is unlikely that DFO will approve proposals sited in such habitat. The proposal should be moved to an alternative site or not considered. If a proponent wishes to make an application involving siting in ***Critical*** habitat (e.g., no alternate feasible site), the application must indicate how impacts would be fully mitigated and how unmitigated HADD would be fully compensated, resulting in No Net Loss of fish habitat.

Important Habitat

Yellow denotes proceed **with caution** in developing a proposal. This ***Important*** habitat is moderately productive or seasonally important and moderately sensitive to disturbance. It is unlikely that DFO will approve proposals that will result in a HADD, unless the proposal includes mitigation and a plan for full compensation of the unmitigated HADD so as to result in No Net Loss of fish habitat. The proponent should relocate the project to marginal habitat wherever possible or not consider the application.

Marginal Habitat

Green denotes **go**, while considering potential habitat impacts. ***Marginal*** habitat, although still productive, is the least biologically sensitive to disturbance and more suited to log handling oper-

ations. DFO is more likely to approve proposals for ***Marginal*** areas, and will likely not require a HADD authorization if any damage to fish habitat can be mitigated, but will require authorization and compensation for an unmitigated HADD.

2.2 Critical & Important Marine Habitat

Coastal habitats are among the most diverse and productive ecosystems, vital to ecological processes. Along the BC coast, mixing of Pacific Ocean seawater with in-flowing freshwater, currents, tides, wind, waves and temperature influence distribution of marine species and define habitats. Physical factors interact with biological factors, such as lifecycle stage, mobility, predation, competition and whether the organism is solitary or communal, to produce distinct distribution patterns or zonation of organisms.

Critical

- mudflats
- salt marshes
- some eelgrass beds
- kelp beds
- seabird rookeries
- mammal haulouts
- beach spawning areas
- herring spawning areas
- salmon holding areas
- eulachon holding areas
- shellfish beds

Important

- sand and gravel beaches
- some eelgrass beds
- migratory bird habitat
- wildlife habitat

Habitats in coastal and estuarine areas include rocky shorelines, shallow subtidal areas, marshes, beaches, sandflats, mudflats, eelgrass and kelp beds. They provide shelter, food and a relatively wide range of conditions for many species of fish and invertebrates, including economically important species of salmon, steelhead and cutthroat trout, herring, smelt, sturgeon, shellfish and crabs. Some areas provide habitat year-round, whereas others are used seasonally for rearing, migration, holding or spawning (e.g., juvenile salmon rearing, adult salmon migration, herring spawning). Significant seasonal use may be mitigated by temporary shutdown of operations during sensitive periods.

All five species of Pacific salmon (sockeye, coho, chinook, chum, pink) spend some time rearing in estuarine and nearshore areas, mature in the ocean and return to their natal streams to spawn and die. Depending on species and location, smolts (juveniles) may spend days to months feeding in estuaries and nearshore areas any time between late winter and early summer, feeding on rich populations of invertebrates and larval fish. Adults returning to spawn may be abundant at passes and river mouths, during which time they may be sensitive to log handling operations. Sea-run cutthroat trout and steelhead also use nearshore and estuarine habitat as juveniles and maturing adults. Sturgeon use intertidal, subtidal and river habitat at various life stages.

Migratory and indigenous mammals such as harbour seals, sea lions, killer whales, otters and mink depend on habitat provided by rocky shores, beaches, pocket coves and sheltered bays, feeding on the abundant finfish and shellfish. Seals and sea lions use nearshore rocks, reefs and estuarine sandbars for resting, giving birth and nursing. Thousands of sea lions congregate in rookeries during the summer. The Northern fur seal, Northern elephant seal and California sea lion are frequent migrants.

Seabirds include divers (loons, grebes, cormorants, alcids), waterfowl (swans, geese, ducks) and gulls.

They use a variety of coastal habitats and are most abundant from October to April. Habitat requirements vary from species to species, with most found on waters less than 10 m deep. Although seasonal and regional differences in food requirements are poorly documented, diving ducks and gulls are known to consume benthic fish and invertebrates, while grazers such as Brant and other geese feed extensively on eelgrass.

Rocky Intertidal Regions

Rocky intertidal shorelines are very common, and typically rated as important habitat. They are formed in areas of hard rock outcroppings and where strong wave and tidal action or steep rock faces prevent accumulation of sediment. Heavy surf eventually erodes soft sedimentary rock into shingle or cobble beaches. Physical and biological factors interact to produce distinct intertidal zones. Seaweeds are the most abundant vegetation and provide food and habitat for many animals. Fucus, or rockweed, is one of the more abundant, visible and widespread intertidal seaweeds. Many other species of brown, green and red algae inhabit specific depths. Surf grass, a vascular plant, often grows in tide-pools. Several species of lichen inhabit the upper intertidal and splash zones.

Photo 6. Rocky intertidal habitat

Many species of invertebrates inhabit rocky intertidal areas, including barnacles, chitons, sea stars, sea anemones, sea urchins, sea slugs, sponges, limpets, snails, worms, octopus, hermit crabs and other crabs. Mussels may be abundant on exposed shores. Small fish such as sculpins, sticklebacks, clingfishes and gunnels may be abundant in tide-pools and channels. Invertebrates and small fish are the primary food source for shorebirds and many species of fish.

Shallow Subtidal Areas

A variety of seaweeds, invertebrates and fish inhabit consolidated (rocky) or unconsolidated (sand, mud) substrates in shallow subtidal areas. These productive areas, often considered critical habitat, may be well used seasonally by juvenile salmonids, spawning and juvenile herring and migrating salmonids. They provide year-round habitat for many fish, including rockfish, surfsmelt and lingcod in rocky areas and English sole and starry flounder in sandy areas. Herring spawn on eelgrass, kelp and rockweed in intertidal and subtidal areas during early spring, with eggs hatching in a few weeks and juveniles remaining near shore for some time.

Sand & Gravel Beaches

Beaches develop from the action of waves on unconsolidated material. They can be found on exposed outer coasts, more sheltered coves and shallow bays, forming critical or important habitat. Particle size ranges from fine sand, mud and shell fragments to gravel and cobbles, depending on sediment source, distance from source and exposure to wave energy.

In exposed areas, beach substrates shift constantly in response to high wave energy, preventing much colonization or attachment by larger plants, although rockweed may be common in gravelly areas and beds of surf grass may grow in gravelly areas partially covered with sand. A variety of seaweeds may grow or accumulate in more protected areas. Microscopic diatoms are the most productive plants in beach habitats. Microscopic fauna, such as protozoans, tiny nematode and annelid worms and copepods (small crustaceans), are also abundant and important.

Larger animals live as filter feeders burrowing into sediment (e.g., Pacific razor clam, little neck clam), scavengers (e.g., sand fleas, isopods, some snails, Dungeness crabs, polychaetes) or predators (e.g., amphipods, bloodworms, moon snails). Several commercially or recreationally important species of shellfish and crustaceans are abundant in intertidal areas of sandy beaches. The Pacific oyster grows on small stones, cobbles and shells in lower intertidal flats. Adult Dungeness crabs are most abundant on lower intertidal sand and mud flats and along the delta front and continental shelf, to a depth of 90 m. Fish such as sand lance, smelt and herring lay their eggs on vegetation or sand during high spring tides. The eggs hatch when water levels later reach the same elevation. These fish provide important prey for Pacific salmon.

Sea gulls are common and abundant shorebirds, scavenging dead and dying plant and animal matter and feeding on shellfish. Less abundant are sanderlings, dunlins, western sandpipers and godwits, which probe the sand for worms and amphipods.

Estuaries & Bays

Estuaries form at river mouths that enter the sea directly or through an enclosed bay. They provide critical habitat, given that they are among the most productive and diverse environments on the earth. Large estuaries along the coast include those associated with the Fraser, Nanaimo, Campbell, Nimpkish, Bella Coola, Wannock, Skeena and Nass Rivers. Although comprising less than 3% of BC's coastline, estuaries are often associated with considerable human activity, including log handling operations.

In estuaries, freshwater flows seaward at the surface and saltier ocean water pushes in below, forming either a distinct salt wedge or a partially mixed system. Sediments settle and form deltas, mudflats and tidal marshes in areas of low current and wave action. High levels of nutrients flow into estuaries, where plankton and plants take them up. These plants and detritus formed from their degradation nourish a wide variety of animals, including small aquatic insects, shellfish and small finfish that are food for larger predatory fish (e.g., salmon), reptiles, amphibians, birds and mammals.

The outer delta of the Fraser River is the most extensive sand and mudflat habitat on the BC coast. It is a 257 sq. km area that includes Roberts Bank, Sturgeon Bank and Boundary Bay. Lower tidal and shallow subtidal areas support eelgrass beds and abundant surface-dwelling and burrowing invertebrates. Small (less than 1 mm) invertebrates are very abundant in the top centimetre of sediment (3,000 to 20,000 organisms/m^2), making these mudflats critical feeding and rearing habitat for juvenile pink, chum and chinook salmon. Other species of fish (notably Pacific herring) and large invertebrates (e.g., Dungeness crab) also breed, rear and feed here. Adult Dungeness crabs molt and mate in nearby eelgrass beds and young crab overwinter on the sandflats, reaching densities of 150 organisms/m^2 in some areas.

Photo 7. Mudflats in an estuary

Eelgrass (*Zostera marina*) meadows are particularly critical communities in shallow intertidal and subtidal areas, providing ideal rearing habitat for juvenile chum salmon and rearing or spawning habitat for approximately 60 other species of fish, notably Pacific herring. Eelgrass can form extensive stands in firm, muddy to sandy substrates, in areas of moderate salinity sheltered from surf, at an elevation of approximately +1.8 m to –6.6 m (Chart Datum). A diverse community of microscopic algae and small seaweeds living on the eelgrass often contributes at least as much productivity as the eelgrass. Eelgrass provides a major source of detritus, nutrients and habitat for many animals and a direct food source for waterfowl. Small, sediment-dwelling invertebrates are much more abundant in eelgrass meadows than in adjacent unvegetated mudflats. Among this group are harpacticoid copepods, the most important prey of juvenile chum salmon while they reside in the estuary.

Bird life is varied and abundant year-round in estuaries and nearshore ecosystems. Some arrive in spring to nest, rear young and depart in the fall, some spend the winter and many others are migrants along the Pacific Flyway. Large flocks of migrating waterfowl such as black Brant geese, Canada geese, widgeons, scoters and canvasbacks can consume enough eelgrass to create visible denuded patches and increase habitat complexity. Marsh and shore birds include waders (herons and bitterns) and smaller species (sandpipers, plovers, etc.). Many species of songbirds are widespread, particularly in areas of emergent and riparian vegetation, although their abundance and use of estuarine habitat is difficult to assess. Raptors use upper intertidal areas, meadows and fields, where prey is readily available and open areas provide easy hunting and vegetation for perching, nesting and cover. Peregrine falcons, gyrfalcons, goshawks and merlins are attracted to the abundant bird life. Owls and hawks are attracted to the abundant small rodents in the upper foreshore and nearby fields.

Kelp Beds

Large attached brown algae form extensive kelp bed and forests in subtidal areas of the open coast, contributing critical habitat. Species such as giant kelp (*Macrocystis*) and bull kelp (*Nereocystis*) grow in water 3 m to 30 m deep. These large seaweeds are so thick and well anchored to the sandy bottom that they significantly reduce wave action, helping protect beaches from erosion. Their dense canopies often reach the surface and provide habitat for giant kelpfish, striped seaperch and a small but expanding population of sea otters. Herring often spawn on *Macrocystis*. Other animals that live at the seabed include flatfish (e.g., sole and flounder), scallops, sea cucumbers, sea pens and sand dollars.

2.3 Critical & Important Freshwater Habitat

Rivers and lakes, with their associated wetlands and riparian areas, are of great ecological and economic importance. They provide critical and important habitat for many species of resident and anadromous fish, including the five species of Pacific salmon, for all or part of their lifecycles and provide important stopover habitat for migrating waterfowl and songbirds.

Critical

- spawning habitat for salmonids

Important

- riparian areas
- littoral zones of lakes
- instream fish habitat
- migratory bird habitat
- wildlife habitat

Photo 8. River habitat near the mouth of the Fraser River

Riparian & Littoral Areas

Riparian and littoral areas provide critical habitat for reptiles, amphibians, birds and mammals, as well as fish. They are typically the most diverse and productive areas within a forest. Given that most forest habitat in Canada has been allocated for logging, the potential for harvesting and large-scale non-forestry projects to impact fish, bird and wildlife habitat is great and pressures continue to grow. Maintaining healthy fish, migratory bird and wildlife populations and diversity requires an ecosystem approach to forest management that considers interrelationships of species, habitats and human activities. Proposals for log handling facilities should include assessment of potential effects on habitat of migratory birds and wildlife, as well as fish, and result in minimal habitat disruption.

Riparian areas are zones where terrestrial and aquatic environments interact directly. These areas along streams, lakes and reservoirs and within wetlands are highly diverse and productive. By connecting hillsides to streams and headwaters to valley bottoms, riparian areas provide many valuable functions. The vegetation helps form soil, stabilize shore and stream banks, prevent erosion and siltation, modify microclimate, contribute nutrients and woody debris to the water and provide wildlife habitat. Riparian areas also provide a buffer for potential effects of human activities (e.g., application of herbicides and pesticides), landslides and other sources of sediment. They provide home ranges and travel corridors for wildlife, including many species of insects, reptiles, amphibians, birds and small mammals. Coarse woody debris from snags (standing dead trees), fallen logs and limbs provides nutrients, refuge and nesting structures for wildlife. Snags and wildlife trees provide important habitat for cavity-nesting birds, raptors, otter, mink and marten. Windthrow trees (trees uprooted and felled by strong gusts of wind) expose soils for plant and fungal pioneers and create openings in the forest and edge habitat for large mammals. Riparian areas also provide large woody debris to streams, which influence habitat structure and complexity.

Littoral zones include shallow submerged areas, which are highly productive and diverse. They are often fringed by riparian vegetation or marshes, and contain abundant invertebrates that provide food for resident fish and other animals. Overhanging vegetation and crevices among rocks provide refuge and cover habitat.

Instream Fish Habitat

Streams are defined as watercourses having an alluvial sediment bed, formed when water flows between continuous definable banks. They may be perennial or intermittent, extending from headwaters to mouth, traveling through identifiable sections or reaches characterized by uniform channel pattern, gradient, substrate and degree of confinement.

Differences in water velocity, morphology, local topography and substrate size create a variety of habitats (pools, glides, riffles and cascades) within a reach. Fish use specific habitats for spawning and rearing. Pools are slower, deeper water with a con-

cave bottom, fine sediments and a low gradient water surface. These are important rearing areas for juvenile fish and holding areas for adult fish. Glides often occur at the bottom end of a pool and are fast-flowing, non-turbulent and relatively flat bottomed. They provide spawning habitat for salmonids. Riffles are turbulent, fast-flowing, relatively shallow areas, moderate in gradient, with gravel or cobble substrates and boulders projecting above the water. Gravel substrates in riffles provide essential spawning habitat for salmonids. Cascades are steep, stepped riffles of bedrock or emergent boulders.

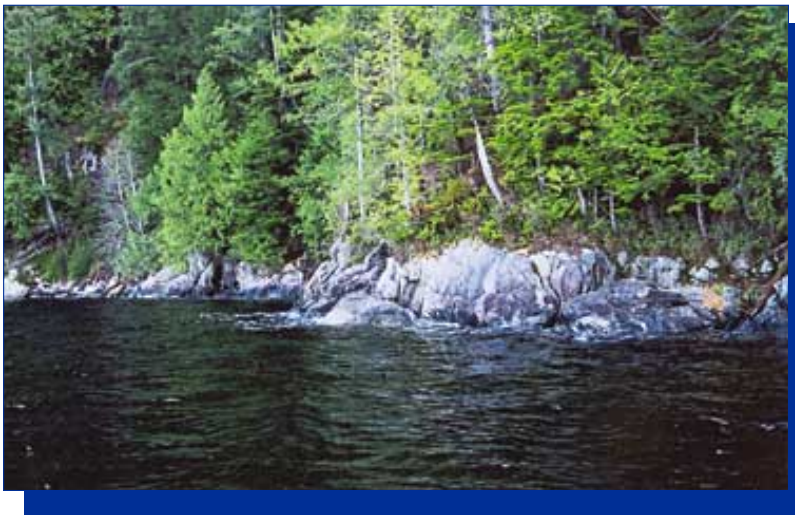

Photo 9. Rocky shoreline in steep and deep habitat

Water quality, physical structure and flow regime contribute to the value of particular habitat to fish, plants and invertebrates. Water quality is affected by temperature, turbidity, dissolved oxygen, nutrients, chemicals, light, pH and toxic compounds. Physical structures such as large woody debris, boulders, stream banks and riparian vegetation may directly alter or enhance the stream. Logging, which can reduce physical structures, may reduce habitat diversity. Flow regime is the quantity, depth, velocity and direction of water in a stream channel. Flow regime can be affected by seasonal precipitation, peak flow events and removal of vegetation, which in turn influence channel structure and available habitat.

2.4 Marginal Habitat

All habitat types are considered valuable, although some are deemed less productive than others. Marginal habitat is found in some coastal and lake areas, for example, where there are "steep and deep" rock faces and cliffs, rocky foreshore areas devoid of vegetation year-round and previously disturbed areas (e.g., old dumpsites, areas already disturbed by industrial activity).

The evaluation of "marginal" status is often made on a site-specific basis, taking into consideration habitat value of surrounding areas and the proposed activity. Proponents should strive to identify and use these areas over those possessing attributes considered "important" or "critical", while recognizing that even marginal habitat provides important habitat for some species. Given that marginal areas are favoured for log handling operations, proposals that address potential habitat impacts through mitigation and or compensation strategies are likely to be approved.

Marginal

- "steep and deep" rock faces and cliffs
- some rocky foreshores
- old dumpsites
- areas already disturbed by industrial activity

Even within this category, there is potential to create conflicts and impacts. For example, "steep and deep" rock faces may be used as feeding and migration areas by humpback and grey whales at some

times of years. Humpback whale populations, previously in decline, are now rebounding and animals are moving back into some North Coast areas. Typically, they are present between early June and mid-November. Mitigation strategies, such as monitoring whale activity at sensitive times of year and temporarily stopping activities such as helicopter logging when whales are present may be required.

The suitability of re-using old dumpsites should be assessed based on their location (e.g., avoiding estuaries), time since deactivation and ability to restore productive habitat. For example, it may be appropriate to use previously disturbed sites if habitat has already been damaged and there is potential for restoration once the proposed activity is concluded.

3.0 Log Handling Operations

This section summarizes log handling activities and their potential and observed environmental impacts and risks, based on information provided by Schaumburg (1973), Conlan (1977), Conlan and Ellis (1979), Duval *et al.* (1980), Levy *et al.* (1982), Robinson-Wilson and Jackson (1986), O'Clair and Freese (1988), Sedell *et al.* (1991), Kendall and Michelsen (1997), Kirkpatrick *et al.* (1998), Williamson *et al.* (2000), Triton (2001a, 2001b), and Picard *et al.* (2002).

Photo 10. Fine woody debris deposited in an intertidal area

Logs are transferred from land to water, transported to sorting and booming grounds, towed in booms or barges to storage areas, followed by more sorting, booming and storing, then towed to local mill storage sites and, finally, to the millpond of the processing facility. Bark and woody debris may be dispersed far beyond the site. For example, Alaska studies have documented wood debris at depths >70 m, well below the 20 m depth required for monitoring.

Facility siting is the most significant risk factor for potential environmental effects. Marginal habitat, described in Section 2, should be selected wherever possible, considering the consequences and impacts described in Table 2. Estuaries are particularly vulnerable and should be avoided. Log handling facilities may severely reduce or eliminate the productive capacity of aquatic habitats in the immediate vicinity, through deposition of wood waste, discharge of leachates and other contaminants, and facility characteristics (footprint, shading, etc.), as described in Table 3.

Canadian Coast Guard requires applicants to address potential navigation impacts, including proper notification of barging and towing activities, vessel lighting, use of marker buoys and other warning signals and concerns regarding long, unmarked towlines. Sunken logs, deadheads and improperly marked or decommissioned piles and dolphins can present navigation hazards.

Photo 11. Logs, bark and other woody debris accumulation

Photo 12. Log booms grounded at low tide.

Photo 13. Sediment plume developed from high velocity dumping of logs

Table 2: Potential Harmful Environmental Impacts of Siting & Construction

Activity	Factor	Biota Affected	Effect
siting of marine facilities	water circulation	flora & fauna	Poor circulation leads to slow debris dispersal. Rapid currents may reduce effectiveness of bark and debris control measures. Siting in estuaries may have profound negative impacts on substrate and vegetation, and reduce availability of insect prey. The impact on juvenile salmonids may be less severe in well-flushed estuaries if there are alternate food sources.
	habitat alienation	flora & fauna	The operation may severely reduce or eliminate productive capacity of aquatic habitats in the immediate vicinity, due to footprint, shading and other factors. Sites close to one another may have a cumulative impact on biota. Seal and sea lion haulouts and seabird rookeries may be affected.
siting of freshwater facilities	habitat alienation	juvenile salmonids	Facilities may disrupt rearing habitat along stream and lake shores.
		birds & large mammals	Siting facilities along riparian and littoral zones may contribute to habitat loss for birds and place stress on ungulates during calving.
foreshore construction	materials	flora & fauna	Uncured concrete may poison fish by increasing pH. Chemicals used to treat wood are highly toxic to aquatic organisms.
	timing	fish	Construction activities may disturb migrating or spawning fish.
	methods	fish	Blasting and other in-water construction may produce vibrations lethal to fish.
		general	Uncontrolled runoff may introduce sediments and toxic chemicals to the water column.

Table 3: Potential Harmful Environmental Impacts of Log Handling Operations

Factor	Biota Affected	Effect
leachates from bark	fish & invertebrates	Leachates are toxic to many organisms (insect larvae, shrimp and crab larvae, various life stages of salmonids). Bark contains higher concentrations of leachates than wood. Toxicity can be a particular problem in closed or semi-enclosed bodies of water with low flushing rates. Leaching occurs faster in freshwater than saltwater, with some compounds (e.g., terpenes and tropolenes) more bioavailable in freshwater.
physical effects of bark	benthic communities	Bark smothers benthos (significant reduction in number and diversity, virtual elimination of suspension-feeders; reduced fecundity and increased egg mortality in Dungeness crab). Layers >2.5 cm thick may have adverse effects lasting decades. Thin bark layers may lead to increased biodiversity by enhancing macrofauna number and diversity and increasing organic enrichment and habitat variability.
	fish	Bark may suffocate incubating fish eggs or interfere with habitat use. Declines in benthic invertebrates may reduce food availability. Conversely, prey may become more diverse and abundant in areas with scattered debris and higher habitat complexity.
degradation of bark	fish & invertebrates	High BOD leads to anoxic conditions and formation of toxic compounds such as sulphides (primarily marine), methane (primarily freshwater) and ammonia. Toxicity levels vary greatly among species and under various conditions.
increased turbidity	benthic microalgae & macrophytes	Particulate matter (silt, fine bark debris) may enter the water and raise turbidity, reducing light intensity and changing the spectral composition of light. This can lead to a local, short-term decrease in algal growth.
	fish	Increased turbidity can affect the ability of fish to catch prey, damage gills and interfere with respiration.
shading by log booms	benthic microalgae, macrophytes, invertebrates	Decreased light intensity may reduce primary production and growth. Simplified community structure and reduced abundance may affect invertebrate herbivores.
contact of logs with substrates (grounding)	intertidal & subtidal fauna & flora	Mechanical scouring destroys animals (including smelt and herring eggs, benthos), uproots or fragments vegetation (algae, eelgrass). Substrate in shallow, intertidal waters is most vulnerable (e.g., eelgrass beds, associated organisms); algae on vertical faces are less vulnerable. Repeated movement of lost, grounded logs on shallow, rocky beaches may crush larger suspension feeders (e.g., clams), shifting communities toward infaunal detritus feeders. Bundled logs are more likely to disturb substrates than loose logs as bundles sink deeper before floating. Inorganic debris (e.g., rafting cable and bundle fasteners) may accumulate.
tug propeller wash	all benthic organisms	Substrates may be scoured to depths of 0.5 m to 1.5 m during transport. Scoured areas generally fill with sediment. Increased suspension of sediment leads to increased water turbidity (see increased turbidity above)
	fish	Incubating eggs of smelt and herring may be destroyed

3.1 Log Dumping

The process of transferring logs to water has potential to adversely impact shoreline habitat. In recent years, new procedures have helped reduce the *Harmful Alteration, Disruption or Destruction* (HADD) of fish habitat. The most common potential impacts, as described in Table 3, arise from the following factors:

Impacts - log dumping

- leachates from bark
- physical effects of bark
- degradation of bark
- increased turbidity
- contact of logs with substrate

Dumping using skidways is the most common procedure used in BC, although skidding directly over the foreshore still occurs in some areas. Cables or machines are used to drop, slide or lower individual or bundled logs into the water. Logs striking the water and each other when dumped may disturb habitat and scour the bottom.

Skidways

Use of skidways or slides, the most common log-dumping method currently in use, requires substantial upland and foreshore development, including foreshore filling, to place the skidway as close to the water as possible (requiring a HADD authorization). DFO often stipulates use of large clean blast rock from the site rather than finer material, to reduce sedimentation and add complex surfaces and interstices, enhancing habitat for plants and animals. Modern skid surfaces are constructed of metal, can be re-used and result in less bark generation than wood skids, although wood skids are still common in some areas. Slope ranges from 30% to 75% and vertical slide distance varies from 3 m to 8 m. Logs are typically trucked to the upland area and bundled, then loaded onto skids using a front-end loader or log-stacking machine and released to slide into the water.

Photo 14. Log dumping using steel skids, skids span intertidal area

Photo 15. Log dump using steel skids on steep shoreline

Vertical Hoist Methods

Vertical hoist methods, such as cranes and A-frames, were once common along the south coast, but are expensive and some have had problems controlling debris generation. Less foreshore filling is required for vertical hoist than skidway systems. Most hoists operate efficiently through the entire tidal range so that bundles float free. Shore-based cranes lift log bundles and place them in the water. A-frames, working in conjunction with trucks, consist of a pulley system attached to two logs bound together to

form an "A" configuration. Log bundles are loaded into the A-frame, swung out over the ocean, then lowered into the water.

Photo 16. Log dumping using a vertical hoist method

Helicopter Drops

Helicopter logging is common along the north coast, comprising an estimated 20% of annual logging operations, and at some inland locations. Helicopters transport logs from the harvest area to a drop site in protected water, typically less than 2 km away. Logs are attached to the helicopter by a ground crew or the pilot using a remote control grapple system, flown to the drop zone and released, where they may also be sorted. Although helicopter operations are generally of short duration (up to two weeks), there is potential for woody debris generation.

Photo 17. Helicopter log drop, directly to a barge

Seldom Used Methods

Historically, logs were transferred to water by pulling, pushing or swinging them directly from the forest into the water. Logs may be yarded into the ocean using an A-frame and winch mounted on a large float, with cables leading back to logs on land, which are attached and pulled directly into the booming ground. Occasionally, logs may be skidded onto the beach at low tide, using tractors and rubber-tired skidders, then allowed to float with the rising tide. A tractor may push logs or log bundles into the ocean at high tide. Today, these methods are rarely used and seldom approved, given the potential for habitat damage.

3.2 Log Sorting

Until the 1990s, logs typically were sorted in water near dump sites or in central sorting grounds near processing plants. Several factors influenced the transition to dryland sorting. Sorting in water requires sheltered waters and a large annual volume of logs to be economically sustainable. Also, mill specialization has resulted in increased handling and sorting of logs for species, grade and size (seven to eight sorts in the 1960s vs. fifteen to twenty sorts currently). Increased sorting leads to increased log damage and wood waste deposition. As a result, most small coastal operations currently transport camp-run bundle or barge loads to well-equipped central sorting grounds close to processing facilities, for example in Howe Sound and the lower Fraser River.

In-Water Sorting

Loose logs or bundles are sorted using a log dozer or "sidewinder," a sturdy steel-hulled vessel with a 50 to 150 HP engine capable of 360 degree movement. The saw-toothed bow grips logs and rams between them to separate

and push them into a pocket according to requirements. Potential impacts described in Table 3 arise from the following factors:

Impacts - in-water sorting

- tug propeller wash
- contact of logs with substrate
- increased turbidity
- substrate disturbance
- debris generation
- fuel spills
- release of contaminated bilge water

Photo 18. Log booming operation

Dryland Sorting

Dryland sorting typically incorporates an upland log dump area and a nearby water transfer area. Dryland sorts generate considerable wood waste, although less that with in-water sorts. Surface runoff contaminated with leachates from wood waste is usually highly toxic. Potential environmental impacts described in Table 3 are related to the following factors:

Factors - dryland sorting

- leachates from bark
- physical effects of bark
- degradation of bark

Logs are sorted in the upland area, scaled and bundled, then dumped into the water. Alternatively, unsorted logs are bundled on land, transferred to water and towed to a central sorting facility, where bundles are broken, logs removed to land and sorted. At large facilities, logs are removed from the water using a front-end loader (individual logs) or crane (bundled logs), carried to sorting or storage areas, then sorted. Many facilities are unpaved, although large, highly mechanized dryland sorts may be paved and use a track-mounted submersible loader to transport logs from storage areas, minimizing debris generation.

3.3 Log Booming, Barging & Transport

Logs are prepared for transport by forming into booms or loading onto barges. These activities typically generate bark and wood waste, with potential harmful impacts listed in Table 3 related to the following factors:

Impacts - booming, barging & transport

- tug propeller wash
- physical effects of bark
- degradation of bark
- contact of logs with substrate
- shading by log booms

Log Booming

Booming grounds are usually located near a dump site or central sorting ground. Log dozers push bundles or individual logs into a pocket to construct a flat raft or bundle boom approximately 20 metres square. The booms are held together using boomsticks, chains and swifter-wires or logs to make them seaworthy, and towed by tugboats. The booming ground contains two or more pockets or alleys enclosed by standing booms, held in place by pilings or anchors. Log

dozers push bundles along the pocket and stow them lengthwise in the boom. As sections are completed, a swifter-line or swifter-log is pulled into position across the bundles and ends firmly secured to the outside boomstick.

Bundle booms are constructed for long distance towing (40 km or farther). Flat rafts are typically used for shorter distance transport in well-protected waters and for transporting Western red cedar. Bag booms are groups of log bundles or loose logs pushed together at random and surrounded by boomsticks chained end-to-end, used for local storage and short tows in sheltered waters. Typically, several sections are joined together for towing.

Photo 19. Bundled logs stored in a river

Photo 20. Booming in a contained area

Barging

Barges are used to transport logs long distances, across exposed waters and to foreign markets. Barges range in capacity from 1,000 to 1,500 m^3, used in smaller, protected waters, to 10,000 to 15,000 m^3, suitable for longer coastal transport. Most barges are towed by large tugs, although self-propelled carriers may also be used. Barges are typically self-loading and use onboard cranes. The amount of woody debris and numbers of lost logs entering the water is much lower for barged than boomed logs. Very little wood waste is released during transport under normal conditions. Lost logs are usually salvaged immediately by the towing company or log owners. Barge sites are usually located in protected waters close to log dumps and storage areas. Areas at least 150 m offshore, with ample water depth (at least 9 m) and sufficient maneuvering room for the tug and barge (400 m to 800 m) are required.

Logs or log bundles may be barged. At isolated logging operations, large bag booms of camp run logs are prepared and stored until the barge arrives (typically every two to six weeks). Booms are towed to the barge and loaded using a crane and grapple. Direct load-to-barge operations, using cranes or front-end loaders to move logs or log bundles from land directly to barge, are less common. Logs are moved directly from the dumpsite to the barge or stockpiled on land until the barge arrives. The most common environmental impacts are associated with shoreline filling for the loading area. There is less potential for debris production and deposition in water during transport, as logs are not stored in water. However, there is potential for debris and bark generation during loading and dumping of the barge.

Barges are dumped in sheltered waters near central sorting grounds and mills by flooding ballast tanks on one side, tipping the barge to let logs slip into the water. Any logs remaining on the barge are typically removed at the processing site using a grapple. Alternatively, some barges are unloaded rather than dumped, which also generates debris along the shoreline.

3.4 Storage

Logs are stored in sheltered water at several stages, at or near the logging operation, sorting and processing centres and intermediate tie-ups. Booms are held in place in deep water using anchors, can buoys and boom chains and in shallower water attached to dolphins. Although not recommended, due to potential damage to fish habitat, some storage areas are located in shallow intertidal regions. Potential impacts described in Table 3 relate to the following factors:

Impacts - storage

- physical effects of bark
- degradation of bark
- contact of logs with substrate
- shading by log booms

Camp storage generally requires 2 to 40 hectares of water surface. Storage sites at logging operations are often located in an estuary, sheltered bay or along a protected, steep shoreline. In an estuary, sufficient water depth to allow movement of booms without scouring of bottom or foreshore is essential. In shallow areas, booms are tied to pilings, dolphins or standing booms. In areas of steep shoreline, they are tied to a standing boom (string of boomsticks) held offshore by jill-poke sticks.

During transit in adverse weather, temporary storage sites may be needed. Several intermediate storage areas, ranging in size from 2 to 20 hectares, are located behind rocky points or within sheltered bays along the main Georgia Strait towing routes. Booms are tied up at permanent standing booms or dolphins. These sites are used for only a short period, so individual booms are not expected to generate much wood waste; however, substantial amounts of bark may accumulate over time (decades in some cases).

Large sorting grounds (e.g., Howe Sound, mouth of the Fraser River) service many incoming and outgoing booms and provide tie up at dolphin standing booms, jill-poke sticks or permanent concrete pillars. There is minimal buffeting or damage to logs at these protected sites. Large storage grounds may have programs to remove and dispose of accumulated debris, deadheads and log sinkers. The duration of log storage varies greatly, and depends on supply and demand. The industry prefers storage in lower salinity estuaries, as there is less growth of the wood-boring shipworm (*Bankia setacea*), locally referred to as "teredos."

Most mill storage areas are located in estuaries, bays or along steep, protected shorelines and provide storage for one week to two months. Most mills prefer water storage, as land storage is often not available, expensive or exposes logs to insect attack.

3.5 Retrieval at Processing Plants

Logs typically arrive at millponds in flat rafts, bag booms or bundles, where they are sorted for size, species and grade, and lifted to the mill log deck by jackladders, Peco lifts or cranes. Logs are aligned parallel to the conveyors and hoisted or pulled into position. In modern mills, bundles are broken over large trays that retain sinkers, which are later retrieved. In older mills, cranes are used periodically to recover sinkers.

Photo 21. Log retrieval at a sawmill

4.0 Relevant Legislation

This section describes legislation and regulatory agencies relevant to siting and operating log handling facilities. Appendix 1 provides additional information. Full details are available on government Internet sites. Legislation is enforced through compliance monitoring, fines, "cease and desist" orders, formal agreements, Best Management Practices Plans and other mechanisms. The federal *Fisheries Act* is particularly relevant to log handling operations.

The *Constitution Act* (1867) defines areas of legislative authority for federal and provincial governments. The federal government is responsible for "seacoast and inland fisheries", which includes the protection of fish habitat. Provincial governments, both through ownership of Provincial Land (including water lots) and legislative powers, have the ability to regulate and control many aspects of log handling operations. By administrative arrangement, the Province of BC is responsible for management and protection of freshwater fish and anadromous stocks of steelhead, cutthroat trout and Dolly Varden char. The federal government retains responsibility for management and protection of fish habitat, marine fishes and Pacific salmon.

Although both federal and provincial agencies have responsibility for protecting various aspects of the environment, both levels of government make significant efforts to work co-operatively. For example, the *Canada-British Columbia Agreement for Environmental Assessment Cooperation* was created to harmonize activities related to the Canadian and BC *Environmental Assessment Acts*. This resulted in a comprehensive process for major projects, increased efficiency and cost effectiveness, information sharing and improved communication.

4.1 The Federal Government

The federal government, primarily through Fisheries and Oceans Canada (DFO) and Environment Canada (EC), administers several Acts that apply to log handling operations. These include the *Fisheries Act*, *Oceans Act, Navigable Waters Protection Act, Migratory Birds Convention Act, Canadian Environmental Assessment Act, Canadian Environmental Protection Act, 1999, Canada Shipping Act* (Oil Pollution Prevention Regulations) and *Species at Risk Act* (Table 4).

4.2 British Columbia Government

Responsibility for environmental regulations is currently shared between the Ministry of Water, Land and Air Protection (MWLAP), Ministry of Sustainable Resource Management (MSRM) and Land and Water BC Inc. (LWBC). The Ministry of Forests (MOF) is responsible for activities related to the forest industry. Provincial legislation that may apply to log handling facilities, listed in Table 5, include the *Land Act, Water Act, Waste Manage-ment Act* and the *Forest Act* (including the Forest Practices Code).

4.3 First Nations

Concerns of First Nations and impacts on their traditional activities should also be considered when selecting appropriate sites. In some locations, First Nations concerns' will preclude placement of log handling facilities. The Provincial Guide to First Nations consultation, available on the Provincial Government website, provides a comprehensive review of this issue.

Table 4:
Federal Legislation Relevant to Log Handling Operations

Act	Mandate	Management tools	Examples of Triggers
Fisheries Act (DFO, EC)	To manage & regulate salt water & freshwater fisheries (harvesting, habitat, pollution control) and marine mammals Prohibits the harmful alteration, disruption or destruction of fish habitat (HADD) and deposition of deleterious substances in water frequented by fish	No Net Loss Policy Conservation, restoration, development Authorizations for a HADD, mitigation and compensations options	HADD Discharge of deleterious substances (e.g., leachate, silt, hydrocarbons) Deposition of bark and woody debris
Oceans Act (DFO, others)	To recognize Canada's jurisdiction over ocean areas, consistent with international law & practice	National Ocean Management Strategy Marine Protected Areas, Integrated Coastal Zone Management, Marine Environmental Quality	Activities in or near Marine Protected Areas
Navigable Waters Protection Act (DFO-CCG)	To protect the right of navigation in Canada To regulate any activity in, around, under & over navigable waters (culverts, bridges, dredging, riprap placement)	Referrals for works below the high water mark, which consults with DFO Habitat & Enhancement Branch regarding fisheries & habitat implications	Towing, booming, helicopter logging Foreshore works (e.g., docks, riprap) woody debris generation
Species At Risk Act (EC)	To prevent wildlife species from being extirpated or becoming extinct. To provide for recovery of wildlife species that are extirpated, endangered or threatened as a result of human activity.	Mandated recovery planning (Recovery Strategies, Action Plans) Procedures for listing species of concern Provision of stewardship agreements	Presence of species of concern or COSEWIC-listed species in an area proposed for log handling activities
Canada Shipping Act (Transport Canada, DFO-CCG)	To regulate activities of ships operating in waters under Canadian jurisdiction and of Canadian-registered ships outside of waters under Canadian jurisdiction	Oil Pollution Prevention Regulations prohibit discharge of oil and oily mixtures from a ship, require onboard retention facilities or oil filtering equipment on ships that carry oil as fuel or cargo, regulate fueling procedures	Use of oil as fuel on a vessel Discharge of oil or oily mixtures from a vessel
Migratory Birds Convention Act (EC-CWS)	To co-operatively manage migratory bird populations in Canada & the USA (prohibits deposition of oil and other harmful substance in waters and areas frequented by migratory birds)	Indictable and ticketable offences	Oil and other spills, oil sheen reporting Activities in areas used by migratory birds (e.g., estuaries)
Canadian Environmental Assessment Act (the responsible authority)	To require environmental assessments of certain projects involving the federal government, to ensure that environmental effects of projects are evaluated in planning stage, including effects on traditional First Nation activities	Requires DFO to conduct an environmental assessment of a project before issuing approval under the *Fisheries Act*	*Fisheries Act* HADD Authorization *NWPA* Authorization *CEPA* Disposal at Sea Permit
Canadian Environmental Protection Act, 1999 (EC)	To prevent pollution, to protect the environment & human health in order to contribute to sustainable development To regulate production & control of toxic substances	On-line registry for CEPA (regulations, orders, historic enforcement information) Pollution Prevention Plans for certain substance on the *List of Toxic Substances*	Use of toxic substances (e.g., wood preservatives, fuel) Disposal at sea (dredge spoils)

Table 5:
Provincial Legislation Relevant to Log Handling Operations

Act	Mandate	Management tools	Examples of Triggers
Land Act (LWBC)	To regulate use & disposal of Crown land within BC	Application Process, Referral Process	Application for tenure of Crown land (e.g., foreshore)
Water Act (MSRM)	To license & regulate water	Section 9 approval for work in and about a stream, protect water quality, aquatic habitat, private property	Work in or about a stream (e.g., culverts)
Waste Management Act (MWLAP)	To regulate discharge of all wastes into the environment	Permits for discharge of waste into the receiving environment, wide enforcement powers, may require protection of fish habitat, monitoring, environmental studies, contingency plans	At dryland sorts – landfilling or incineration of wood waste, runoff treatment systems
BC Environmental Assessment Act (MSRM-EAO)	To provide a single comprehensive environmental assessment process for major development projects To ensure that major projects are constructed & operated in a manner than avoids or reduces environmental impacts & provide long-term economic & social benefits To enable participation of public, proponents, First Nations, municipalities, regional districts, government agencies	The Canada/BC Agreement for Environmental Assessment Cooperation (to harmonize with CEAA) EA Prescribed Time Limit Regulations EA Reviewable Projects Regulations Applies to log handling, industrial, mining, tourism, transportation & other projects	Exceeding prescribed size threshold defined by the *Act*
Forest Practices Code of BC (MOF)	To regulate forest practices on Crown land in BC To protect habitat of threatened, endangered & regionally important species, to protect habitat of fish supporting a fishery	Province-wide regulations, guidebooks describing recommended procedures & practices Forest Practices Board oversees compliance & enforcement Riparian Management Areas, Reserve Zones around streams	Stream crossings Logging road construction and maintenance

5.0 BMPs for Siting & Design

This section describes BMPs that apply when selecting sites for new log handling facilities. They address scale, features and configuration. BMPs were consolidated from existing Canadian guidelines used by DFO and other agencies, and from applicable US sources (Toews and Brownlee, 1981; LTF-GTS, 1985; DFO and MELP, 1995; EC and DFO, 1996; BCAL and MELP, 1999; Hutton and Samis, 2000; Warrington, 2000; Adams, 2002; EC, undated; MELP, 2001; MWLAP, 2001).

Numbered statements refer to specific BMPs, with "S" referring to the siting and design stage.

5.1 Facility Siting

Careful evaluation of potential log handling sites helps minimize environmental risks and costs of site deactivation and remediation. Avoiding sensitive aquatic and wildlife habitat (Table 1) when selecting sites and designing facilities can prevent many potentially adverse effects of log handling (Table 2). Sites for in-water storage or transfer of logs should be located in available areas with the least productive intertidal and subtidal habitat and generally should be situated at least 100 m from wetlands, deltas, river and creek mouths and other critical and important habitat. The following BMPs describe how to avoid sensitive habitat during siting of log handling facilities, including dryland sorts.

These BMPs are to be considered when developing the proposal (*Proponent Application*), as they are essential to project authorization. Relevant siting issues include avoiding sensitive habitat, the role of exposure and setting in determining or mitigating potential impacts, and cumulative impacts. They apply to log handling facilities and associated float camps, mooring basins, docks and floats.

The *CEAA* process requires that cumulative effects of the proposed operation be considered in relation to existing foreshore developments in the area (e.g., marinas, abandoned canneries, other industrial operations), even though potential adverse impacts may appear minor when viewed in isolation. Proponents are encouraged, where possible, to consolidate log handling activities at one location to facilitate debris management and other mitigation efforts. Where road constraints do not permit consolidation, new log handling facilities should be situated at least 5 km from existing log handling operations.

	Avoiding Sensitive Habitat
S1.	No facilities should be developed on or adjacent to extensive tidal flats, salt marshes, kelp or eelgrass beds, seaweed-harvest areas or shellfish beds. Site-specific minimal distances will be derived from assessments.
S2.	Log dumps, helicopter log dumps and booming areas generally should be situated at least 100 m from the mouth of an anadromous fish-bearing stream.
S3.	Facilities should not be developed in areas known to be important spawning or rearing habitat for commercially or recreationally important finfish (e.g., salmonids, herring or eulachon) or shellfish.
S4.	Construction or operational activities should not occur closer than 100 m to significant wildlife trees (e.g., active raptor nests) and 300 m from heronries.
S5.	Facilities should not be sited where there is a risk that construction or operation will have an impact on protected water resources and special habitats (e.g., marine protected areas, national or provincial parks), critical or sensitive ecosystems, seabird congregating areas, marine mammal haulouts or wildlife migration paths.

Photo 22. Well contained log dumping and booming along a steep shoreline

Photo 23. Modification of an existing rocky outcrop in steep and deep habitat

Photo 24. Log handling situated away from an estuary

Avoiding Sensitive Habitat

S6.	Logs should not be dumped or stored in areas where they will ground at low tide. The minimum depth currently required by DFO is 12 m (Chart Datum) for most log storage sites and 20 m for helicopter log drops and associated temporary storage facilities.
S7.	Additional siting criteria may apply (e.g., higher level planning processes, provincial land or water use plans).

Current direction and speed should be evaluated to ensure sufficient flushing to prevent excessive debris buildup, although the proponent is required to submit a debris management plan and should not rely solely on currents to manage debris. Grounding of logs and excessive accumulation of bark and debris can be avoided by choosing appropriate sites.

Exposure & Setting Considerations for Log Transfer Facilities

S8.	Currents, tides and wind exposure should be assessed at the site to ensure worker safety for water-based activities.
S9.	Coastal facilities generally should be situated adjacent to straits, channels or deep bays with sufficient current to disperse sunken or floating wood debris. Areas to be avoided include locations adjacent to rapidly flowing waters or other turbulent water, where measures to control bark and debris cannot be effective.
S10.	Although facilities are typically sited in waters with suitable anchorage and protected from weather, blind channels, sloughs and embayments with sills should be avoided, as they lack sufficient flow to ensure adequate, regular flushing for debris dispersal.
S11.	Booming and storage facilities should be safely accessible to tugboats with log rafts at most tides and on most winter days and should be oriented to provide maximum tidal flushing and exchange by prevailing currents.

Exposure & Setting Considerations for Dryland Sort Facilities

S12.	Log storage and sorting activities must be conducted above highest high water levels (including active floodplains).
S13.	Areas with infilling wetted depressions or wetlands should be avoided.
S14.	Management of wood waste (landfilling requirements) and storm water (regional hydrology) must be considered at the site development stage.

5.2 Facility Design

Facility design should be based on the most environmentally sustainable, economically viable option. The *Fish-Stream Crossing Guidebook* (MOF, 2002) should be consulted when providing access roads across fish-bearing streams. Facilities should be situated to use existing landscape features to advantage and result in minimal excavation and recontouring. Although not environmental requirements, the amount of suitable upland working surface and grade for road access should also be considered. The rock fill and riprap structures often required to armour shorelines may, if well designed, provide substrate for colonization by plants and invertebrates, typically within one or two years. Riprap may provide refuge to a diverse population of invertebrates, fish, amphibians, reptiles and small mammals, both above and below normal high water. If anticipated adverse impacts cannot be fully mitigated, a HADD Authorization may require provision of compensatory habitat.

	Design of Fill & Revetment Structures
S15.	Fill structures should be designed and constructed to prevent erosion, pollution and structural displacement by using the largest and roughest rocks possible to maximize surface area in interstices and provide the greatest amount of habitat relative to size.
S16.	Footprint of fill structures should be minimized and the amount of fill placed on floodplains kept to a minimum to reduce potential for upstream flooding.
S17.	When riprap is used along stream banks, live stakes of willow or other easily rooted woody vegetation should be planted in the interstices to promote riparian vegetation growth and improve fish habitat quality.

Floating or pile-supported structures constructed on or over water should be designed to protect plants and animals living in the water and on the bottom. Although some species may quickly colonize the structures, habitat for other species may be destroyed unless care is taken at siting and construction stages. If anticipated adverse impacts cannot be fully mitigated, a HADD *Authorization* may require provision of compensatory habitat. When foreshore structures are designed and built to minimize environmental impacts, there may be cost savings associated with improved safety and reduced requirements for maintenance, habitat compensation and attendant assessment and monitoring.

Design & Orientation of Wharves, Docks, Piers & Floats

S18.	All docks, walkways and piers should span the intertidal zone and maintain free flow of water currents beneath, to prevent erosion and sedimentation along the shore. Where possible, floats should be oriented with currents or prevailing winds to prevent trapping surface debris and oily residue.
S19.	Piers should be elevated a minimum of 1 m above high water and built as narrow as possible to minimize shading of bottom vegetation.
S20.	Dock floats must remain afloat at the lowest tides, should not be placed over obvious areas of vegetation and should minimize shading of bottom substrates.
S21.	Piles should not be placed over significant marine or intertidal vegetation beds.
S22.	Piers or trestles supporting mechanical or refueling equipment should incorporate an impermeable deck and a spill containment and collection system for surface runoff.
S23.	Protective wear strips (e.g., high-density polyethylene) should be used on treated wood surfaces subject to abrasion. Where creosote-treated wood is exposed to high temperatures, creosote containment (e.g., pile wrapping) should be considered.
S24.	Steel piles used in saltwater should have a coal tar epoxy coating or cathodic protection. Use of creosote-treated wood piles should be avoided in saltwater.

Construction Materials & Chemical Treatment for Wharves, Docks, Piers & Floats

Construction materials directly influence applicability of the following BMPs. Appendix 2 provides an overview of preservatives used to treat wood.

S25.	Where possible, docks and float camp facilities should be constructed of pre-cast concrete, steel or plastic rather than treated wood, especially in poorly flushed areas; pre-cast concrete is preferred in areas of low current velocity and anoxic, fine-textured sediment.
S26.	Concrete support piles installed in marine environments should have coarse surfaces that enable ready attachment of encrusting organisms.
S27.	Piles constructed of untreated wood should be used at sites of limited tenure or in freshwater, where possible. A BMP certification mark (CSA O80) is required for treated wood used in or over water.
S28.	High-density or encapsulated foam is preferred to Styrofoam or foam-filled tires for floats.
S29.	Wood treated with water-based preservatives rather than creosote should be used in structures, except where there is a risk from marine borers or a demonstrated need for creosote. Creosote-treated wood should not be used in fresh water, as leaching rates for toxic compounds are greater for fresh than salt water.

The following BMPs address site-specific concerns regarding management of wood waste, stormwater runoff, landfilling and facility operation at dryland sorts and log transfer facilities. Given that issues related to management of water, refuse and petroleum products have been identified at these operations (MELP, 2001), site selection should consider the following requirements, in addition to those already described for log transfer, wharves, road construction and other activities.

BMPs Specific to Design of Dryland Sort Facilities

Site Runoff

S30.	Runoff water should be collected and diverted to treatment works for settling of solids and removal of hydrocarbons prior to discharge.
S31.	Treatment works should be designed to be capable of handling all expected discharge flows, including major storm events. Where site space is limited, treatment systems for solids and hydrocarbons may be combined.
S32.	Where engineered wetlands are used for treatment of site runoff, a thorough assessment of wetland composition and leachate (runoff) water constituents must be completed to ensure effectiveness.
S33.	Final site runoff should be released to the least sensitive portion of the receiving environment and discharged in a manner that minimizes local impact.
S34.	Surfacing material that allows for efficient, effective and regular removal of wood waste should be used (e.g., asphalt or concrete for large or high volume sites).

BMPs Specific to Design of Dryland Sort Facilities

Wood Waste Management

S35.	Site design should consider operational requirements for regular wood waste removal from high generation areas (e.g., loading bunks) and removal to appropriate storage or disposal sites.
S36.	Temporary storage areas for wood waste should be sited as far as possible from streams or other sensitive receiving environments.
S37.	Containment works or buffers for wood waste may need to be incorporated.

Landfill Siting

A Waste Management permit or approval is required for landfilling of wood waste residue. A qualified professional should design the landfill, considering water infiltration, means to minimize leachate generation and/or impact and the following BMPs:

S38.	Where landfill for wood waste residue is required, an engineering assessment of the region may be required to determine a suitable location sufficiently far from surface water, groundwater, marine environments and other sensitive habitats.
S39.	Use of existing landfills in the operating region should be considered before developing new landfill sites.
S40.	New landfills should be sited as far as feasible from streams or other sensitive environments and should incorporate appropriate buffers. MWLAP (2001) provides the following siting criteria for municipal solid waste and wood waste landfills: - 100 m from geotechnically unstable areas. - 50 m from property boundary, with 15 m vegetated buffer adjacent to boundary; - 300 m from nearest residence or residential/commercial property; - 100 m from surface water sources; and, - removed from the 200-year floodplain or having adequate flood protection.

6.0 BMPs During Construction & Operation

This section describes BMPs that apply during construction and operation of log handling facilities. Potential impacts of these activities are described in Section 3, including Tables 2 and 3. Specific BMPs will vary according to the type of facility and how long it is in use. For example, there is little or no upland development associated with helicopter dumping, whereas there is potential for blasting, excavation, road building and foreshore filling at skidway operations. The size of dryland sorts is related to the volume of material, operational timeframe and available suitable terrain. Booming, towing and barging operations have particular water-based concerns. BMPS in this section refer to management of woody debris, other waste and surface runoff and associated environmental issues.

Literature sources used to develop these BMPs include Liu *et al.* (1995), Toews and Brownlee (1981), LTF-GTS (1985), USEPA (2000), DFO and MELP (1995), Environment Canada and DFO (1996), CFLA (1997), MacMillan Bloedel Ltd. (1998), Samis *et al.* (1999), Hutton and Samis (2000), Warrington (2000), MELP (2001) and Environment Canada (undated). MOF (2002) provides BMPs applicable to construction of stream crossings along forest roads that access log handling facilities.

Numbered statements refer to specific BMPs, with "C" referring to the construction stage and "O" to the operation and maintenance stage.

6.1 Construction Practices

Many potentially adverse impacts can be avoided by timing construction for dry periods or when valued species or life stages are not present at the site. Breeding land birds, seabirds and nearshore nesters such as raptors, herons and waterfowl are particularly sensitive to disturbance from construction. General construction practices that help protect water quality should also be incorporated.

	Scheduling & General Construction Considerations
C1.	In-water construction, blasting or filling should be scheduled to limit adverse impacts (including water quality and sediment) on marine and estuarine fishery resources and marine mammals, and avoid conflicts with other user groups.
C2.	Blasting and other intrusive activities should be conducted in periods of lowest bird use of nearby upland areas (generally not during spring).
C3.	Construction should be scheduled, as much as possible, during the dry season (to minimize erosion) and to minimize the amount of land actively cleared and easily eroded at one time (some areas being revegetated, other areas not yet cleared).
C4.	Excavation should be minimized and existing soil and vegetation retained as much as possible. Trees, shrubs and soils that are to remain in their natural state should be protected from damage or compaction by construction equipment by, for example, installation of temporary snow fencing.
C5.	An approved pad with spill control and collection measures should be installed if fueling, lubricating and hydraulic top-up of equipment will occur on-site.
C6.	Wood wastes (e.g., hog fuel, sawdust, chips) should not be buried on site as they produce toxic leachates.

	Site Preparation
C7.	Bubble curtains or ground padding should be used in the water when blasting, to disrupt shock waves.
C8.	Extensive construction of floats, ramps or docks should be avoided on the foreshore.
C9.	Constructed slopes should be gradual enough to be stabilized using natural vegetation, rather than riprap or crib walls, where possible.

	Construction Materials Used in the Aquatic Environment
	Treated Wood Special care must be taken to prevent harmful chemicals used to treat wood from entering the water and sediment. The BMPs in this section are general guidelines; more detailed BMPs are described in Appendix 2.
C10.	Treated wood used in or over water is required to have a BMP certification mark (e.g., CSA 080 series).
C11.	Storage of treated wood in the water should be minimized during construction.
C12.	Debris from treated wood that enters the water must be contained and recovered.
C13.	Application of wood preservatives over the water should be avoided. Where this is not possible, an impermeable barrier (e.g., plastic sheeting) should be used to contain and prevent preservatives from entering the water.
C14.	Absorbent booms must be deployed when installing oil-based treated-wood pilings.
	Concrete Uncured concrete can kill fish by altering the pH of the water.
C15.	Pre-cast concrete should be used whenever possible, to eliminate the risk to fish.
C16.	Any required cast-in-place concrete work must be done in the dry and isolated from any water that may enter the aquatic environment for a minimum of 48 hours.

6.2 Managing Surface Runoff During Construction & Operation

This section describes procedures that should be followed to control runoff of surface water from log dumps, sort yards and storage yards. Erosion and sediment control should incorporate BMPs for each stage and manage runoff water that has potential to contain hydrocarbons or leachates. It is most efficient to minimize potential sediment sources from the beginning by minimizing extent and duration of land disturbance and protecting exposed surfaces. Next, incoming flows should be diverted and internally generated flows contained. Finally, sediment, leachate and hydrocarbons should be retained in appropriate systems (e.g., oil-grit separators), treated and/or removed.

A variety of design options are described here, although it should be noted that designs are updated periodically. These systems should be constructed to facilitate regular, proper cleaning and with the most efficient capacity to control runoff and sediment possible. Temporary sediment traps are commonly used at outlets of diversions, channels, slope drains, etc. that convey sediment-laden water. Permanent traps (e.g., swales and ponds) may be incorporated in grade stabilization. Temporary sediment barriers (e.g. fences, straw bales) may be used to control erosion and velocity of sheet flow from small disturbed areas.

Sediment traps should be designed to accommodate flows that exceed capacity. These include protecting the bank from failure caused by high runoff, incorporating non-erosive emergency bypass areas and using high length-to-width ratios to minimize potential for short-circuiting. The outlet design should be appropriate for sediment control (e.g., a stone-lined section as the low point of a pond).

Trap efficiency may be increased in a variety of ways. Inlet and/or outlet channels may be armoured (e.g., with riprap) to reduce water velocity and encourage sediment deposition. Small check dams may be constructed across the channel to reduce erosion by restricting flow velocity. Channels may be hardened with erosion-resistant linings (e.g., riprap, paving). Sediment traps constructed with concrete or with flume drop inlets and/or outlets can be protected using geo-textile or filter fabric with a barrier low enough to allow overflow into the inlet and high enough to prevent overflow bypassing the inlet to unprotected lower areas. A gravel torus or "doughnut" constructed around an inlet may be used in combination with other temporary inlet protection devices, such as fabric.

Photo 25. Runoff control (sediment settling pond)

Temporary sediment barriers (e.g., sediment or silt fences, straw bales) are designed to retain sediment from small disturbed areas by reducing the velocity of sheet flows, and are often used during construction. Fences consist of filter fabric buried at the bottom, with

ends well-anchored, stretched and supported by posts. Straw bales may be staked into the ground. These techniques can cause temporary ponding of water, so sufficient storage area and overflow outlets should be provided.

Photo 26. Poor runoff control through lack of maintenance of existing structure

Management of Surface Runoff

C17.	Working surfaces should be graded to direct runoff away from wood waste storage areas or sediment sources.
C18.	Temporary stockpiles and backfill materials should be covered with an impermeable barrier to prevent erosion and sedimentation.
C19.	Silt fences, combined with mulch or plastic cover, should be used to contain runoff from easily eroded slopes.
C20.	Runoff water should be conveyed, intercepted, collected and redirected in ways that minimize erosion and allow for collection and disposal of sediment and debris. This can be done in many ways, including construction of: - swales (grass-lined channels that convey storm water runoff to disposal locations); gravel may be placed in a ridge below an excavated swale; - diversion dikes or berms to force sheet flow around a protected area; - water bars excavated diagonally across sloping surfaces of roads or rights-of-way subject to erosion, to divert runoff into adjacent undisturbed areas for dissipation; - channels with erosion-resistant linings of riprap, paving or other structural material; - paved flumes (small concrete-lined channels) to convey water from diversions, channels or natural drainage-ways above a relatively steep slope; - temporary diversions created by excavating a channel and placing the spoil to form a dike on the down-gradient side of the channel; or - temporary slope drains (flexible tubing or conduits extending down a cut or fill slope), generally used in conjunction with diversions to convey runoff until permanent water disposal measures can be installed.

Sediment Containment & Management

C21. Sediment should be contained during construction; structures should facilitate proper clean out on a regular basis. Several design options are available:

- sediment traps (small, temporary ponding basins formed by an embankment or excavation to capture sediment from runoff); most commonly used at outlets of diversions, channels, slope drains or other runoff conveyances;
- permanent swales, ponds, wetlands or lakes included as part of a grade stabilization system; or,
- temporary barriers (e.g., sediment fences, silt fences, straw bale barriers).

The most appropriate means of improving sediment control efficiency should be employed (e.g., armouring of inlet and/or outlet channels, construction of small check dams across a drainage, hardening of the channel, protection of concrete traps inlets and outlets with geo-textile or filter fabric, construction of gravel torus around an inlet).

Release of Runoff Water to Receiving Environment

C22. Where water is directed out of a containment or diversion structure, outlets should be protected by installing:

- level spreaders (outlets designed to convert concentrated runoff to sheet flow and disperse it uniformly across a slope without causing erosion);
- riprap-lined aprons (relatively low in cost and easy to install); or
- riprap-lined basins or plunge pools (where there are drops or waterfalls at the end of the pipe or where high flows would require excessive apron length).

An oil/water separator should be installed in the outlet from a sediment pond that receives surface drainage with potential to contain oily water (e.g., sort, fuelling or equipment servicing areas). A simple baffled box structure may be used and it should be large enough to handle expected water flows, properly maintained and frequently cleaned.

Surfacing of Dryland Sort Facilities

C23. Dry land sorts should be surfaced with an appropriate material that allows for effective and regular removal of wood waste. For high-volume facilities, consideration should be given to paving the site.

C24. Paved yards must be sloped toward collection ditches that lead to appropriate sediment and oil/water separators prior to water discharge.

6.3 Facility Operation & Debris Management

Bark accumulation is a serious environmental issue, given the large amounts of waste typically generated at log handling facilities. Woody debris, particularly deadheads, can present an extreme navigation hazard. The proponent is responsible for damage and injury caused by debris escaping from its operation. DFO requires that proponents prepare a Debris Management Plan to address environmental (Habitat and Enhancement Branch, HEB) and navigation (Canadian Coast Guard, CCG) concerns. The Debris Management Plan describes BMPs to be followed to contain woody debris generated on-site, remove it from the water and dispose of it on land following approved methods, and may address other measures (e.g., sheen or oil spill reporting and containment). The plan and any required bark monitoring surveys are submitted to regional DFO staff (HEB and CCG).

	General Objectives of Wood Waste Control
O1.	Levels of bark and wood waste accumulation must be carefully monitored and measures taken to limit deposition. The best available methods should be used to control, collect and dispose of intertidal and subtidal accumulations of bark and wood debris at log handling facilities and associated upland facilities.
O2.	A Debris Management Plan describing ongoing monitoring, removal and disposal of wood waste must be developed and submitted to DFO as part of the application, and debris monitoring reports provided, where stipulated.
O3.	If bark and wood debris accumulates despite following the Debris Management Plan, the operator must submit a statement describing remedial practices to be used to minimize additional bark accumulation and immediately incorporate those practices.
O4.	Deadheads, which are navigation concerns, must be secured and collected.
O5.	Disposal options for collected wood waste include use of an approved upland landfill, controlled open burning or ocean disposal at a designated site. This is determined on a site-specific basis, after adhering to appropriate regulations and obtaining required permits. Alternatives to the use of landfills are encouraged.
O6.	Wood waste must not be deposited beyond the area described by the lease agreement.

	Shore-based Log Dumps
O7.	Appropriate measures must be taken to control and remove wood debris generated, including daily removal (to the maximum achievable) of debris that accumulates at the site and on adjacent tidelands.
O8.	Solid waste (wood, cables, metal bands, used equipment, machinery, vehicle or boat parts, metal drums, appliances, etc.) should be removed routinely and disposed of in an approved manner, not in or adjacent to any waters, wetlands or tidal areas.
O9.	Treated wood cuttings and absorbents must not be incinerated.
O10.	Logs should be bundled or sorted on land wherever possible; in-water sorting should be done within the log pocket.
O11.	Log bundles should be placed in receiving waters at a single specified point.
O12.	Log bundles should be broken on land or at a mill, not in the water, where possible.
O13.	Easy let-down devices (e.g., A-frames, stiff-legged derricks) should be used to place logs in water, wherever feasible, to reduce generation of wood debris.
O14.	Free-fall, violent dumping of logs into water is prohibited, as this is the major cause and point source of loose bark and other wood debris.
O15.	Steel skids should be used at long-term skidways to minimize bark deposition; containment of wood waste using debris nets made of flexible steel mesh is recommended to reduce entry of wood waste to the water. Nets should be installed between the steel skids and draped over the high foreshore.
O16.	Bark and wood debris that accumulates in upland traffic areas should be removed and disposed of regularly to prevent debris and leachate from entering the water.

Photo 27. Debris net in position below a metal skid

Photo 28. Containment booms in place at a skidway

Dryland Sorts

Dryland sorts are preferred, wherever possible, as amounts of wood debris and leachates entering the water are minimized.

O17.	Paving should be considered at long-term facilities, to reduce wood waste loss and erosion and to control surface runoff.
O18.	A berm must be established around the outer edge of the sort surface using rocks, logs or other suitable materials, to prevent loss of wood debris to the water.
O19.	Alternative uses of wood waste should be considered (e.g., hog fuel, shake blocks, firewood, wood chips); where feasible, wood waste may be sorted according to grade, species, level of soil contamination, etc., to increase reusability.
O20.	Potential leachate generation should be minimized by reducing contact of water with wood waste during temporary storage and disposal (e.g., at landfills).
O21.	Temporary storage of wood waste should occur in designated areas having either bulkhead or berm containment. Temporary piles should be designed to minimize exposure to precipitation (e.g., conical shape). Storage areas must incorporate surface water diversion to reduce contact of surface runoff with the waste pile.
O22.	The volume of wood waste stored temporarily on-site should be minimized. Waste should be transported as quickly as possible to the approved disposal site.
O23.	Enclosed loading belts should be used to load wood waste or residue (e.g., chips) onto scows, to reduce wind blown waste. Efforts should be made to contain and reclaim residue lost during loading.
O24.	Dredging of foreshore and its removal should be avoided through proper waste management practices in upland areas. Any dredging must comply with DFO requirements.

Landfill Design & Use

Natural control or engineered landfills may be used for disposal of wood waste. Natural control landfills use landscape features (e.g., low permeability) and engineered landfills use leachate and gas collection systems, etc., to control leachate and emissions. The following guidelines are intended for reference only and are not definitive prescriptions or BMPs. Appropriate waste management plan, leachate and emission control structures and landfill final covering should be according to specific MWLAP requirements.

Landfills should be authorized under waste management regulations, designated for specific waste, and must not receive materials such as tires and equipment. Design should include a 2 m thick layer of low permeability soil (silt or clay) lining the bottom, with the bottom at least 1.2 m above the seasonal high water table. There should be surface water collection and diversion around the landfill designed with appropriate erosion and sediment control. A 0.3 m thick layer of soil should be placed for every 3.0 m thick layer of waste for fire prevention. The landfill slope should be of 25% gradient or less to prevent erosion.

Wood Waste Incineration

In some cases, burning of wood waste may be considered acceptable, particularly where landfilling could lead to leachate problems. MWLAP *Waste Management Act* approval must be obtained for open burning. Burning must be conducted in accordance with all specified terms and conditions. These BMPs relate to protection of aquatic habitat during burning.

O25.	Wood waste stockpiled for burning should be treated similarly to temporary wood waste piles and employ all measures available to control leachate production and loss (e.g., surface runoff control).
O26.	Resulting ash should be disposed of, when cold, in an appropriate landfill.

Photo 29. Woody debris management at a paved dryland sort operation

	Booming & Storage
O27.	Foreshore and intertidal zones must be kept clear of debris (including deadheads).
O28.	Logs to be boomed should be limbed and cleaned of all debris on land; debris and chunks should not be mixed with logs.
O29.	Bundle wires must be secured tightly around logs to prevent escape, breakage or excessive shifting during handling.
O30.	If debris is not contained adequately as a result of following BMPs O28 and O29, high quality shear sticks should be used behind dolphin lines. Use of steel shear sticks and dolphins should be considered when longevity is a concern.
O31.	A low- or no-wake zone for booming boats should be established near shore and in shallow waters where wave action would cause erosion, suspend sediment or damage nests, resting grounds or feeding grounds.
O32.	Logs and log bundles that have been transferred to water should remain floating at all times and not be allowed to rest on or touch the bottom.
O33.	Logs should be rafted and stored in waters at least 12 m deep (Chart Datum), in an area with currents strong enough to disperse wood debris. The following BMPs apply to new operations and may not have been stipulated at older facilities; however, their use will be reviewed when older leases come up for renewal.
O34.	Logs or log bundles should be moved out of assembly and storage areas at the earliest possible time to minimize retention of logs in the water.
O35.	The number of logs stored in the water should be minimized; onshore log storage is preferable, where feasible.

Photo 30. The "sea rake", developed by Triumph Timber Ltd. to collect debris for disposal

Barging & Towing

O36.	High-quality, high-floating (low-density) boomsticks must be used and should be inspected regularly, particularly in areas where marine burrowers can be found; headsticks and tailsticks must be appropriate for towing.
O37.	Booms should be inspected before towing and, if necessary, repaired to meet applicable standards.
O38.	Booms should be constructed securely to prevent breakage and loss of logs and debris, using durable materials (e.g., steel bands, recycled bundling strand). Debris should be prevented from escaping when booms are being broken down or restrung. Where feasible, transport of bundled logs should be considered, as this results in less potential for wood waste generation and loss of logs than does transport of individual logs.
O39.	Towline lengths should be adjusted to prevent tug propeller wash from rinsing debris out of booms.
O40.	Barges should be loaded and unloaded in ways that do not break or damage logs within bundles or create debris that can be deposited on the barge deck. Unloading speeds should be low enough to prevent log breakage. Wood debris should be collected and properly disposed of on land.
O41.	High-quality, high-floating, double-wide catch sticks should be used to contain all debris when dumping barges, and debris collected and properly disposed of on land.
O42.	Barges and scows should be inspected and, if necessary, repaired to prevent chips, hog fuel or sawdust being lost during loading or towing.

Helicopter Log Drops

O43.	Crews must be briefed on the Debris Management Plan before operation start-up. A support vessel and crew must be on standby to frequently monitor the storage area for escaped debris between helicopter turns and collect debris.
O44.	Logs should be limbed on land as much as practical, before being transferred to water, and any debris disposed of on land.
O45.	Log should be bundled on land, not in water, where practical.
O46.	Log bundles should be placed in the water at one specified point, marked with appropriate buoys. Drop zones must be located in waters at least 20 m deep (Chart Datum). Slower drop speeds and similar or greater depths should be used in fresh water, given the different buoyancy of wood in salt and fresh water.
O47.	Double containment sticks should be used in log storage areas to control debris.
O48.	Consideration should be made of marine mammals that may be present in the area, notably humpback and grey whales. Between May 15 and Dec. 1, a crew member should watch for whales and monitor their behaviour. Work should be temporarily stopped if whales approach to within 300 m of a helicopter flight path or if marked changes in whale behaviour are exhibited.

6.4 Navigation & Vessel Maintenance Considerations

Helicopter log dumps and booming, barging and towing activities pose a significant navigation hazard. The proponent is responsible for ensuring approvals have been obtained under the *Navigable Waters Protection Act* (NWPA) and that existing works conform with approved plans. Any questions should be directed to the NWPA Officer for the region, who will review alterations or additions to the plan.

All vessels used in log handing operations must meet requirements of the *Canada Shipping Act* for vessel size, tonnage and horsepower. Vessels should be regularly maintained and checked for problems, particularly as they relate to release of fuel slicks and contaminated bilge water, which are considered deleterious substances under the *Fisheries Act*.

Navigation & NWPA Regulations

O49.	Notice to Shipping must be issued prior to operation of helicopter log dumps. Given that mariners may not be aware of the temporary operation, all efforts must be made to mark the work site.
O50.	All buoys must conform with Private Buoy Regulations (i.e., orange and white buoys for mooring barges and vessels, yellow buoys for attaching booms to anchor lines, yellow radar- and light-reflective marker buoys for helicopter drop zones).
O51.	The outside perimeter of booming grounds should conform to approved plans and be marked with radar- and light-reflective marker buoys (steel, 0.6 m in diameter or larger, painted and maintained as per Private Buoy Regulations).

Vessel Maintenance

O52.	Free water should not be allowed to accumulate in bilges.
O53.	Proper confined-space entry procedures should be followed before carrying out maintenance.
O54.	Barges should be checked for leaks and holes in the deck, which can lead to down-flooding.
O55.	Barges used as equipment ferries should be equipped with an oil spill kit.
O56.	Boom boats should be inspected regularly for leakage and water buildup while in the water (at least every two days, more frequently in wet weather). They should be equipped with two automatic bilge pumps wired to separate float assemblies.
O57.	Boom boats should be removed from the water during periods of inactivity to reduce problems associated with accidental sinking and release of fuel slicks.

6.5 Control of Hydrocarbons, Liquid Wastes & Other Residues

It is essential to know and comply with all regulations governing storage, handling and use of substances that can be deleterious to fish and fish habitat, including wood preservatives, paints, fuel, lubricants and fertilizers. Wood preservatives containing creosote, chlorophenols, zinc or copper are extremely toxic to fish and should not be used where they can enter the aquatic environment. It is particularly important to employ BMPs related to control of hydrocarbons and other residues, given their persistence in the environment and tendency to bioaccumulate in animal tissues.

The Canadian Coast Guard is the lead agency for all spills into the marine environment (and other navigable waters) from ships, oil handling facilities during transfer operations, and unknown sources. CCG works in conjunction with Environment Canada and the Provincial Emergency Program to ensure communication and response to reported spills. MWLAP (Provincial Emergency Program) is the lead agency for spills into the freshwater environment.

Handling of Hazardous Substances

Spill Response

O58.	ALL SPILLS INTO THE MARINE ENVIRONMENT MUST BE REPORTED TO THE CANADIAN COAST GUARD IMMEDIATELY. ALL SPILLS INTO FRESHWATER MUST BE REPORTED TO THE PROVINCIAL EMERGENCY PROGRAM IMMEDIATELY.
O59.	Every fuel handling facility must have an up-to-date Spill Response Kit and Spill Response Plan. Site-specific spill cleanup equipment must be on-site and properly maintained and staff must be trained in its proper use.
O60.	Site workers should be informed on proper disposal for all materials and a permitted waste handler contracted to remove wastes.
O61.	An accurate, up-to-date inventory of all stored materials should be kept, to enable cleanup crews and fire fighters to anticipate potentially hazardous combinations.
O62.	Discharges must not violate the *BC Waste Management Act*, federal *Water Act* or *Canadian Environmental Protection Act*, 1999.

	Preventative Practices
O63.	Log handling equipment should be operated and maintained in ways that minimize the risk of petroleum and lubricating products entering waters.
O64.	Volatile compounds from newly installed creosote piles near sensitive habitat areas and poorly circulated areas must be contained and absorbed.
O65.	No bark, wood debris, scum, floating solids, oily or greasy wastes and hydrocarbons, foam, or other residues should be discharged that alone, or in combination with other substances, causes: - receiving waters to be unfit or unsafe for use in water supply, recreation, growth and propagation of finfish, shellfish, other aquatic life and terrestrial wildlife, or the harvesting and consumption of raw mollusks or other aquatic life; - discolouration, film or sheen on the water surface, bottom substrate or adjoining shoreline; - leaching of toxic or deleterious substances; or - a sludge, solid, or emulsion to be deposited upon the surface of the water, within the water column, on the bottom or on adjoining shorelines.
O66.	Fueling equipment should have automatic shutoff nozzles to reduce spillage when fueling.
O67.	Impervious pavement, berms, curbs or other means of spill containment should be provided, and connected to spill collection sumps for fuel and storage tank areas.
	Containment & Storage
O68.	Storage tank containment areas should be elevated and provided with a roof to prevent storm runoff from spilling over the berm and overwhelming the collection sumps.
O69.	Underground storage tanks should not be used as they eventually corrode and leak, causing extensive ground and water pollution that is very costly to clean up.
O70.	Labeled, unbreakable, double-walled, inert storage containers with sealed lids should be used. Secondary containment should be used for large quantities. Fluid storage containers should be equipped with level ndicators to prevent overfilling and spillage.
O71.	Dykes or berms capable of holding 25% of the total stored fluids or 110% of the largest container should be installed to contain spills; in general, several smaller tanks are more economical and safer than one large container.
O72.	Fuels and other highly flammable fluids should be stored in a separate area, and in a manner that complies with local fire department regulations.

Disposal

O73.	Separate containers should be provided for disposal of waste oil, gasoline, antifreeze, diesel, kerosene and mineral spirits. Containers should be clearly labeled and colour coded or of different designs. Containers should be stored on an impervious surface and properly covered against weather in fire-resistant enclosures or fenced secure areas. Containers should not be stacked.
O74.	Liquid waste storage tanks should be equipped with overfill protection devices and situated in 110% capacity containment trays.
O75.	Drip pans and open containers should be emptied and cleaned promptly.
O76.	Oil filters should be drained before recycling.
O77.	Wastewater from an on-site oil/water separator should not be discharged to sewers or to ground unless it is demonstrated to contain less than 15 mg/L of oil.
O78.	Waste liquids should not be discharged down floor, sink or storm drains.
O79.	Storm water should be drained though a siphon from uncovered waste storage areas enclosed by berms.
O80.	Waste oil recycling tanks should be pumped out regularly to ensure ample capacity.
O81.	Valves and hose connections should be properly maintained to prevent leaks; hydraulic hoses with coupled ends should be stored in leak-proof containers.

Worker Facilities

O82.	Care should be taken to ensure that sewage disposal is adequate to prevent contamination of nearby waters. Land disposal of sewage is preferred, e.g., pit privy, chemical/incinerator toilets, holding tanks (48-hour retention time) or septic tank and tile field located well away from the foreshore.

6.6 Management of Log-Bundle Strand

Almost 50 million feet of log-bundle strand is used annually to keep log bundles together during transport in water. Its use greatly reduces the amount of wood debris and number of sunken logs. Historically, strand was disposed of in the water after log bundles were opened, resulting in large accumulations on the bottom of lakes, rivers and marine waters, along with sunken logs and other wood debris. The strand is a hazard to boats and recreational users. The galvanized zinc coating used on most log-bundle strand does not dissolve in the marine environment and forms a poor substrate for animals and plants.

When waterways are dredged to maintain navigation, large amounts of log-bundle strand may be present and interfere with disposal of dredge spoils, typically disposed of at sea. Bundle strand is not approved for ocean disposal, given that it degrades habitat and displaces organisms. The economic and environmental costs of dealing with these massive "hair-balls" of strand and debris are great. Costs become unsustainable when the potential for delay in obtaining approval for dredging, damage to booming boats, refusal of an ocean disposal application and subsequent and costly upland disposal are considered. Recycling and recovery options become more attractive and cost effective in the long term.

Recovering Log-Bundle Strand

O83. Log-bundle wire should be recovered.

Recycling Log-Bundle Strand

O84. The recovered log-bundle strand should be stored for pickup by the recycling contractor or other acceptable, environmentally sound practices followed.

Reusing Log-Bundle Strand

O85. Recycled log-bundle strand should be used wherever possible.

Photo 31. Log bundle strand on a log boom

Photo 32. Recycled log bundle strand

7.0 Site Deactivation & Remediation

Site deactivation requirements are set by DFO, EC, MWLAP and other agencies associated with the referral process, and are outlined in LWBC lease agreements. Deactivation and decommissioning procedures are site-specific and usually have the goal of returning an area to a pre-existing state or to conditions closely resembling those of adjacent natural areas. Sources of BMPs listed in this section include Hutton and Samis (2000), Warrington (2000) and Environment Canada (undated).

Numbered statements refer to specific BMPs, with the "D" code referring to site deactivation and remediation.

7.1 Decommissioning Facilities

If and when an operator desires to close, abandon or decommission an authorized facility (unless transferring interests to a third party), the Navigable Waters Protection Division of CCG must be advised and the area restored to a satisfactory condition, as defined in the lease. All works, including anchors and piles, must be removed from the water. The proponent is liable for any damage or injuries caused by remaining works. A separate review is required if the proponent desires to leave works in the water. Use of logs to mark anchors is not acceptable. A removal order will be issued for any works remaining in the water and the Crown will recover from the owner all costs associated with removal.

	Decommissioning Facilities
D1.	All woody debris and demolition materials must be disposed of or reused in an appropriate manner and in accordance with applicable provincial and municipal laws and policies.
D2.	When removing a whole pile, a slow, steady pull should be used to minimize substrate disturbance and avoid bringing contaminated sediments to the surface. If the pile breaks off below the biologically active sediment zone, no attempt should be made to extract the buried portion, as impacts from dredging may outweigh any benefit from removing a minor source of polycyclic aromatic hydrocarbons (PAH).
D3.	When cutting off a pile, it should be cut off at or near the substrate level with an underwater saw. This prevents release of contaminated sediments, eliminates the hazard associated with broken off piles and retains existing substrate features (e.g., gravel bars in channels).
D4.	Proper silt control measures must be applied when deactivating roads in the upland area of the operation.
D5.	When decommissioning log dumps, the skidway must be removed from the site.
D6.	When deactivating log booming and storage operations, all boomsticks used to contain logs stored in the water must be removed.
D7.	Logs lining the drop pocket at helicopter drop zones must be removed.
D8.	All anchors, cables, buoys and dolphins must be removed.

7.2 Site Rehabilitation

Upon deactivation, the site should be rehabilitated to approximately its original condition. DFO should be consulted prior to removal of submerged wood debris.

	Site Rehabilitation
D9.	When decommissioning log dumps, woody debris that has accumulated immediately below the slide should be removed.
D10.	Fill material should be removed only where required as part of a rehabilitation plan.
D11.	Foreshore riprap and other fill should not be removed if it is shown to provide productive habitat; for example, rockweed (*Fucus* sp.) can colonize clean, angular fill and provide important habitat for other organisms (e.g., herring).
D12.	Floating woody debris should be removed, to the extent possible.
D13.	Deadheads and sunken woody debris deemed unfavourable should be removed, to the extent possible.
D14.	Exposed upland areas subject to erosion by runoff or wind should be seeded with an appropriate grass mixture.
D15.	Landfills must be closed according to the *Waste Management Act*.
D16.	Decommissioning fueling equipment or fuel storage areas may require that specific conditions of the Contaminated Site Regulations of the *Waste Management Act* (MWLAP) be met.

Photo 33. The colonized riprap fill along the shore should not be disturbed when the site is decommissioned

8.0 Monitoring & Reporting

Facility operators are to monitor conditions and report to regulatory agencies, given that many aspects of log handling operations have the potential to impact the environment. Environmental monitoring provides a direct link between policies and objectives for protecting the environment and their implementation, and should be considered at the planning stage rather than as an afterthought. Regulatory agencies require auditing of compensatory habitat constructed as part of a HADD Authorization.

This section describes requirements for monitoring and reporting and provides resources for preparing environmental assessments. Facility operators will be able to prepare some types of reports (e.g., oil sheen reporting, bark monitoring), whereas a qualified professional biologist or technologist with adequate training and knowledge of fish habitat typically prepares habitat and environmental assessments.

8.1 Environmental Monitoring & Reporting Requirements

Proponents of log handling facilities are responsible for developing and submitting to LWBC a *Proponent Application* (Section 1) that contains a Debris Management Plan describing relevant environmental protection measures to be followed. The complexity of the Debris Management Plan and other requirements will depend on the complexity and location of the proposed operation. Debris management reports, sheen and spill reporting procedures, a Pollution Prevention Plan for use of compounds listed in CEPA's *List of Toxic Substances* or details of compliance with *Waste Management Act* permits (e.g. for settling ponds associated with dryland sort and storage yards) may be required.

Debris Management Plan

Habitat and Enhancement Branch (HEB) and Canadian Coast Guard (CCG) of DFO, under the *Fisheries Act*, require preparation of site-specific Debris Management Plans. These plans describe environmental management objectives, operation-specific BMPs to be followed (e.g., woody debris accumulation, oil sheens, surface runoff) and methods to be used in monitoring BMPs. After approval by DFO, the plan is posted at the site and staff advised of the procedures. Examples of Debris Management Plans are provided in Appendix 3.

As part of the Debris Management Plan, monitoring of intertidal and subtidal areas for accumulated bark and other wood waste may be required. Monitoring requirements will vary, depending on the operation and its location. Monitoring should be conducted prior to the operating season and at defined intervals during the operating season. Monitoring should assess the effectiveness of debris control measures. Methods should be modified, as needed (e.g., repair of containment structures) and accumulated debris removed and disposed of in upland areas. At intermittently used facilities, monitoring should occur during the operational period. At long-term facilities, underwater surveys (dive or remotely operated vehicle) of subtidal areas may be required annually or every few years.

Monitoring may involve walks of the intertidal area and collection of accumulated wood waste. More comprehensive surveys may be required in some cases. Underwater surveys (dive or remotely operated vehicle) of intertidal and subtidal areas, including permanent transects and measurements of area covered, thickness and percent coverage of bark debris may be required.

Monitoring reports submitted to DFO (CCG and HEB) as part of the Debris Management Plan are intended to inform CCG of occurrence of large woody debris (e.g., logs, deadheads) that can pose navigation hazards and HEB of occurrence of woody debris accumulation that can negatively impact habitat. Reports should be complete, accurate and timely, and describe the following:

- operational details (site location, operations, permit holder and/or operator, starting and ending dates of the operating season, number of operating days per season, volume of wood handled in cubic metres or number of bundles;
- written documentation of periodic monitoring (with monitoring data) and corrective and preventative measures taken (e.g., periods of non-compliance, operational changes); and,
- results of any required monitoring (e.g., underwater surveys).

Oil Sheen & Spill Monitoring & Reporting

The *Canada Shipping Act* requires that all spills into the marine environment, no matter what size, be reported. A specific program to monitor presence of oil sheens on the water surface, originating from equipment and vessels used at the facility, is required. Requirements include daily visual monitoring for oil sheens during operational periods, procedures to trace and clean up sources and reporting of spills to CCG (marine and other navigable waters) or the Provincial Emergency Program Spill Response Line (freshwater) within 24 hours. Appendix 3 contains a sample Spill Report Form. Necessary details include the date, location, name of observer, type of product, cause or source and corrective measures taken.

Use of Compounds on the CEPA List of Toxic Substances

Under Part 4 of the *Canadian Environmental Protection Act*, 1999, the Minister of the Environment has the authority to require preparation and implementation of pollution prevention plans related to those substances on the *List of Toxic Substances* (Schedule 1 of *CEPA*). The process is initiated by the publication of a notice outlining details of the requirements, including substance(s), industry sector(s), threshold use(s) or release(s), etc. In general, the facility declares that a plan has been prepared and is being implemented, rather than submitting an actual plan. Types of compounds likely to be used at log handling facilities include those found in fuels, lubricants and wood preservatives.

Compensatory Habitat Monitoring

DFO requires that habitat compensation works undertaken for a HADD authorization be assessed to determine whether works were correctly implemented and function as intended. Ultimately, the goal of the compensatory habitat is to achieve No Net Loss. This is interpreted as the functionality and productivity of the habitat as well as dimensional characteristics. Monitoring programs must be able to assess whether this goal has been achieved by the compensatory habitat. Assessment results for compensatory habitat should be compared to those from the HADD site and from reference sites unaffected by compensation or HADD. Assessment methods should also address temporal and spatial variability.

Photo 34. Evaluating compensatory habitat. Creation of marsh habitat was successful relative to the unvegetated areas; however, woody debris accumulation has reduced effectiveness of the compensation.

8.2 Environmental Monitoring & Assessment Methods

The use of standard procedures and best available science to assess and describe aquatic habitats potentially affected by log handling operations is important in producing the quality data required for sound environmental and management decisions by regulatory agencies such as DFO. Environmental monitoring and assessment may be required for the *Proponent Application*, Debris Monitoring Plans or to evaluate the effectiveness of compensatory habitat in achieving No Net Loss. Such habitat studies are typically conducted by a qualified biologist or technician with adequate training and knowledge of fish habitat and access to required resources. Required assessments will vary with project type, location, development, length of proposed tenure and other operational and environmental factors.

Several publications describe monitoring and assessment methods. Given the variety of aquatic habitats in which log handling occurs, no standardized approach has been developed to guide all habitat assessment, monitoring and reporting requirements. BC's Resource Information Standards Committee (RISC; formerly RIC) provides methodology for freshwater assessments, including biological sampling, lake and stream sediment sampling and fish collection (RIC, 1997, 1997a, 1997b). Although methods for coastal shore zone mapping (RIC, 1995) and large-scale ecological unit classification (RIC, 2002) are available, provincial (RISC) standards for marine foreshore and subtidal habitat assessment at the field level have not yet been developed.

Marine Habitat Assessment

Resources for assessing intertidal and subtidal marine environments are provided by Williams and Associates (1993), Cowardin *et al.* (1979) and NOAA (2001). Some subtidal survey methods require underwater (SCUBA) techniques. Guidelines and procedures for field surveys of marine foreshore habitat have been prepared by DFO (Appendix 4). It is recommended that regional DFO staff be consulted before conducting a survey to ensure that regional objectives and applicable standards are met.

Photo 35. Assessment of intertidal habitat

Photo 36. Assessment of intertidal and subtidal habitat

Lake Habitat Assessment

Assessment methods and requirements specific to log handling facilities in lakes have not been developed; however RISC (RIC, 1997, 1997a, 1997b) and modified DFO marine assessment methods (Appendix 4) may be followed and provide sufficient information. Prior consultation with regional DFO and MWLAP personnel, where appropriate, is recommended.

Stream Habitat Assessment

Standardized stream assessment methodology is available. Fish stream classification is required where a proposed project includes stream crossings or development adjacent to a stream. If fish stream classification information is not available for the stream, RISC or Forest Practices Code methods described in RIC (2001) and MELP and MOF (1998) should be followed. Riparian classification and assessment is required where a project may impact riparian habitat, using methods described in MELP and MOF (1995). Stream crossings should be installed in accordance to standards described in MOF (2002).

Additional Regulatory Requirements

Consultation with regional DFO personnel is recommended to ensure compliance with regional DFO habitat assessment and other regulatory requirements. Appropriate permits for fish collection must be obtained from DFO and MWLAP prior to any required fish collection. For SCUBA surveys, Workers Compensation Board (WCB) of BC requires that divers conducting occupational diving in BC, including habitat assessments, meet WCB Occupational SCUBA Diving standards (WCB, 1998). Part 24 of the Occupational Health and Safety Regulation (WCB, 1998) is particularly relevant. Works completed in and about a stream often require approval from MWLAP pursuant to Section 9 of the *British Columbia Water Act*. It is recommended the proponent contact regional MWLAP personnel to determine requirements for in-stream activities.

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Glossary

Algae A group of simple chlorophyll-containing plants, mostly aquatic; range in size from microscopic to several metres.

Anadromous Fish species that incubate and rear in freshwater, migrate to the ocean for additional rearing, then return to freshwater for spawning.

Anoxic Lacking oxygen.

Armouring Application of materials, e.g., riprap, to protect stream banks or shorelines from erosion.

Benthic Living on or near the bottom.

Benthic Fauna Vertebrate and invertebrate animals associated with a lake, river or ocean bottom.

Best Management Practices (BMPs) A standard set of measures taken by industry to prevent damage to habitat and water quality and to mitigate negative impacts.

Biodiversity or Biological Diversity The relative variety of living organisms; includes the diversity of genes, species and ecosystems and the evolutionary and functional processes that link them.

Biota Living organisms.

Cover Objects providing protection from predators or high stream flow; may be for the purpose of escape, feeding, hiding or resting.

Crustaceans Members of the class Crustacea; includes crabs, shrimps, crayfish, copepods and water fleas.

Debris Organic material deposited in the floodplain or within the channel.

Dolphin A mooring post in relatively shallow water to which log booms can be attached.

Dolphin Line A series of dolphins positioned in a line (e.g., along the shore) to protect sensitive onshore habitat (e.g., embayment, intertidal area, river shoreline).

Ecosystem The total vegetation, animals and physical environment in a segment of the world chosen for study.

Endangered Species facing imminent extirpation (extinction in a defined region) or extinction.

Enhancement In this report, the outcome of any method or process by which the quality or carrying capacity of a habitat unit is improved beyond natural levels.

Environment In this report, the total organic and inorganic context within which an ecosystem component (such as an animal or plant) being studied functions.

Estuary, Estuarine A semi-enclosed body of water (e.g., river mouth) where salinity is intermediate between the ocean and freshwater and influenced by tidal action.

Fauna Assemblage of animals inhabiting a region.

Fish Habitat Spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes.

Floodplain A flat or nearly flat lowland bordering a stream and covered by water during floods.

Foreshore A strip of land along a waterbody, exposed between high and low water periods.

Habitat The place where a population lives and its surroundings, both living and non-living; includes provision of life requirements such as food and shelter.

HADD Harmful alteration, disruption, or destruction of fish habitat, as defined under the federal *Fisheries Act*.

Heavy Metals Metallic elements of high atomic weight (e.g., copper, lead).

Impact A discernible change directly or indirectly brought about by a human-produced activity; positive or negative impact should be specified; negative impact is often implied.

Infauna Benthic animals living in the substrate, especially in a soft sea bottom.

Invertebrates Animals without backbones; includes insects, crustaceans, shellfish and worms.

Large Mammal Mammals with an adult weight typically over 5 kg (e.g., wolves, cougars, bears).

Large Woody Debris (LWD) Fallen tree trunks and large limbs in watercourses and riparian areas, important to stream morphology and fish habitat and as nutrient sources.

Marsh A type of wetland that does not accumulate appreciable peat deposits and is dominated by herbaceous vegetation; may be fresh or salt water, tidal or non-tidal.

Mitigation Environmental management techniques used in response to a predicted or actual negative impact on a valued part of the ecosystem, with the aim of controlling extent, magnitude or duration of impact to levels tolerated by applicable regulatory bodies.

Nutrient A substance necessary for growth and development of organisms.

Organic Referring to or derived from living organisms.

pH An expression of acidity and alkalinity on a scale of 0-14; pH 7 represents neutrality, pH values below 7 represent acid conditions and values above 7 are alkaline; pH of water can have an important influence on toxicity of many compounds.

Plankton Small, usually microscopic, fauna and flora that inhabit open water habitats.

Prescription In this report, a restorative or rehabilitative recommendation at the specific task level, based on higher level watershed objectives.

Productive Capacity The maximum natural capability of habitats to produce healthy fish, safe for human consumption, or to support or produce aquatic organisms upon which fish feed.

Rehabilitation Environmental design measures that stabilize and improve the condition of disturbed sites.

Resident (fish) Non-anadromous fish, spending entire life history in fresh water.

Restoration Environmental design measures aimed at rehabilitating disturbed sites to the point at which they resemble the pre-disturbance condition to the extent practicable.

Riparian Synonymous with streamside; riparian zones may be defined functionally as zones of direct interaction between terrestrial and aquatic environments.

Salmonid Fish species belonging to the family Salmonidae, including Pacific salmon, trout, chars, whitefishes and graylings.

Sediment Fragmental material resulting from weathering of rocks and organic materials, transported, suspended and deposited by water (or air).

Shear Sticks Containment boomsticks fixed to the side of dolphins; comprise a "line of defense" against loss of the log bundle.

Silt Inorganic bed material between 0.004 mm and 0.062 mm diameter.

Small Mammal Mammal species with an adult weight typically under 5 kg (e.g., rodents, mustelids).

Spawning Reproduction in fish.

Species The smallest discrete unit of biological classification; organisms are said to belong to the same species if they are members of a population that breeds under natural conditions and produces viable (i.e., fertile) offspring.

Stream A natural watercourse with an alluvial channel formed when water flows between continuous, definable banks.

Turbidity The optical property of water, measured in turbidity units, reflecting the amount of material suspended in the water.

Wetlands Lands that are wet enough or inundated frequently enough to develop and support a distinctive natural vegetation cover compared to adjacent better drained lands.

Wildlife Tree A standing live or dead tree with special characteristics that provide valuable habitat for conservation or enhancement of wildlife.

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Appendix 1

Notes on Applicable Legislation

APPENDIX 1: Notes on Applicable Legislation

The Fisheries Act

The *Fisheries Act*, one of Canada's strongest pieces of environmental legislation, provides legislative authority for management and regulation of fisheries (salt and fresh waters) and is responsible for protection of fish habitat. DFO is responsible for fisheries protection and enforcement. EC administers pollution control regulations, provides technical expertise on effluent treatment technology and oversees environmental effects monitoring for permitted discharges. The *Act* is applied to thousands of development proposals across BC each year and forms the basis of DFO involvement in the inter-agency referral system.

The *Act* broadly defines fish as "all fish, shellfish, crustaceans and marine animals and the eggs, spawn, spat and juveniles of fish, shellfish, crustaceans and marine animals" (Section 2). Fish habitat is defined as "the spawning grounds, nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes" (Section 34). Section 35 refers to protection of fish habitat and Section 36 prohibits deposition of a deleterious substance in water frequented by fish or in any place where it may enter such water.

Under Section 35, if proposed projects are likely to damage fish habitat, a proponent must seek authorization from DFO prior to construction. Section 35(1) states that no person shall carry on any work that results in harmful alteration, disruption or destruction of fish habitat (HADD). It is designed to prevent physical damage of fish habitat, including spawning, rearing, food supply and migration areas and riparian vegetation. Section 35(2) states that no person contravenes Section 35(1) by causing a HADD of fish habitat under any conditions authorized by the Minister or by regulation. This section triggers the *Canadian Environmental Assessment Act* (*CEAA*), as DFO must carry out an environmental assessment before granting approval for a HADD.

DFO adopted the policy objective of Net Gain of habitat for Canada's fisheries resources as part of the *Policy of the Management of Fish Habitat* (DFO 1986). The policy seeks to "increase the natural productive capacity of habitats for the nation's fisheries resources, to benefit present and future generations of Canadians" through conservation, restoration and development. The principle of No Net Loss guides conservation of fish habitat. It is to be achieved through such measures as relocating proposed developments to sites of lower habitat value, reducing impacts of proposed developments by applying mitigation measures and building compensatory habitat where impacts would be unavoidable and the project is in the public interest.

DFO has a procedure for ensuring proponents of log handling facilities fulfill No Net Loss policy. If habitat impacts cannot be fully mitigated, DFO requires that proponents compensate by constructing compensatory habitat. DFO sets conditions relating to the location and size of compensatory habitat and to development schedule and may also stipulate annual monitoring for a number of years by a recognized professional acceptable to DFO.

The Navigable Waters Protection Act

The *Navigable Waters Protection Act* (*NWPA*) regulates activity in, around, under and over navigable waters. The Act is administered by Navigable Waters Protection Division within the Canadian Coast Guard (CCG), part of DFO. Navigable waters are defined as any waters capable of being used for commerce, transportation or recreation.

Any project requiring works below the high water mark, such as dredging, placement of riprap or replacement of a bridge or major culvert, requires referral to CCG. Sections 5(1), 5(2), 6(4) and 10(1) describe the types of approval that may be granted. Section 10(2) allows for repairs and modifications. An approval under Section 5(1) requires a set of plans be deposited, advertising in two local newspapers and the *Canada Gazette* and a *CEAA* review. The approval will include conditions that must be followed to mitigate navigational impacts. Under Section 5(2), various works such as small docks, small booming grounds, skidways and float camps can be exempted if they have little or no impact on navigation. Plans are required for such an exemption. All changes to mitigate adverse impacts on navigation and on the environment must be agreed upon before an exemption is issued. Under Section 6(4), a work on which construction has already commenced or is completed may be approved after the fact. All requirements for approval under Section 5(1) must be met. Under Sections 10(1) and 10(2), any lawful work can be rebuilt, repaired or altered if such action does not, in the opinion of the Minister (or representative), create further interference with navigation.

The Canadian Environmental Assessment Act

The *Canadian Environmental Assessment Act* (*CEAA*) establishes a process for conducting environmental assessments (EA) of projects for which the federal government holds decision-making authority as regulator, proponent, land administrator or source of funds. It requires a determination as to whether or not a proposed project will result in significant adverse environmental effects. DFO must complete an EA before issuing an approval under the *Fisheries Act* Sections 22, 32, 35(2) and 37(2). Most DFO EAs are conducted as a result of Section 35(2) authorizations and NWPA Section 5(1) permits. DFO often utilizes assessment work undertaken by proponents.

The Canadian Environmental Protection Act, 1999

The *Canadian Environment Protection Act*, *1999* (*CEPA*), administered by EC, focuses on pollution prevention and protection of the environment and human health, regulating production and control of toxic substances. A company may be required to develop a Pollution Prevention Plan to deal with a substance defined as toxic under the *Act*. Although these plans are not normally submitted to EC, facilities must file written declaration that a plan has been prepared and implemented. *CEPA* also addresses Disposal-at-Sea, which requires a permit for disposal (and incineration) of wastes in oceans within Canadian jurisdiction and by Canadian ships in international waters. Log handling operations occasionally request permits to dispose of dredged materials.

Species At Risk Act

The *Species at Risk Act* was proclaimed, with Part 1 coming into effect in 2003 and Part 2 to be in effect in 2004. The *Act* was designed to protect wildlife, including aquatic species, from being extirpated or extinct, and protects their habitat. Part 1 provides a protocol for evaluating and listing species at risk and requires mandated recovery planning (Recovery Strategies, Action Plans) for such species. Part 2 will provide prohibitions and enforcement provisions. Three competent ministers have been identified:

the Ministry of Environment (overall coordination, migratory birds, all other non-aquatic species), the Minister of Fisheries and Oceans (for aquatic species) and the Minister for Canadian Heritage (for species in national parks or historic sites).

Canada Shipping Act

The *Canada Shipping Act*, administered by Transport Canada, regulates activities of vessels operating in waters under Canadian control and of Canadian-registered vessels operating outside of waters under Canadian jurisdiction. The Oil Pollution Prevention Regulations are relevant to log handling operations involving use of oils as fuel for vessels. The regulations prohibit discharge of oil and oily mixtures from a ship.

The Migratory Birds Convention Act

Most migrating birds found in Canada are protected under the *Migratory Birds Convention Act* (*MBCA*). The Wildlife Enforcement Division of EC administers the *Act* in co-operation with provincial and territorial governments. Section 35 states: "no person shall deposit or permit to be deposited oil, oil wastes or any other substance harmful to migratory birds in any waters or any area frequented by migratory birds."

Provincial Laws

The Land Act

The *Land Act* regulates use and sale of Crown land within BC and is administered by LWBC. Applications for log handling operations are submitted to LWBC, given that most applications require a lease of Provincial foreshore land. LWBC then refers the application to relevant federal and provincial agencies for comment.

The Water Act

The Water Protection Branch of MSRM licenses and regulates water under the *Water Act*. Section 9 approvals are required for any work in and about a stream to ensure that changes meet standards for protecting water quality, aquatic habitat and private property. It addresses preventing sedimentation and deposition of deleterious substances into streams, timing to avoid fish-sensitive periods, maintaining minimum flows, fish salvage and protection of private property from erosion and sedimentation. While *Section 9* defers to the Forest Practices Code, proponents are responsible for ensuring that works in and about a stream are undertaken in accordance with the *Water Act*.

The Waste Management Act

The *Waste Management Act* is the main anti-pollution law in BC and is administered by MWLAP. The *Act* requires a permit to be issued before any waste is discharged, unless it complies with a waste management plan or the *Act's* regulations, enters an approved public waste disposal system or has special approval under the *Act*. The *Act* applies to the forestry industry mainly for items like fuel leaks and landfills. A permit may require monitoring, reporting, spill contingency plans, construction of spill containment works or recycle of certain wastes and recovering of reusable resources.

The BC Environmental Assessment Act

The BC *Environmental Assessment Act* (*BCEAA*) established a single, comprehensive environmental assessment process for major development projects in BC (similar to *CEAA*) and is administered by the Environmental Assessment Office of MSRM. The *Act* is aimed at ensuring that major projects are constructed and operated in a manner that avoids or reduces environmental impacts and provides economic and social benefits over the long term. Although the forest industry is exempt from *BCEAA*, coastal log handling facilities may be subject to *BCEAA*, depending on the size and nature of the operations.

The Forest Act & Forest Practices Code

The *Forest Act*, administered by MOF, establishes management structure and regulations that govern the forestry industry. The *Forest Practices Code of BC Act* (*FPC*), the main law regulating forest practices, consists of the *Act*, province-wide regulations and guidebooks describing recommended procedures and practices. The *FPC* applies to approximately 85 percent of the land base in the province (mostly Crown land in provincial forest or wilderness areas). It does not apply to private land unless that land is within a tree farm or woodlot license issued under the *Forest Act*.

The *FPC* contains provisions that protect habitat of threatened, endangered and regionally important species and habitat of fish supporting a fishery on public forest lands. This includes fish stream identification, riparian zone preservation, watershed assessment and control of logging practices adjacent to streams. The *FPC* protects coastal areas through, e.g., regulations for riparian areas that protect streams and estuaries; "marine sensitive zones" that include herring spawning beds, marsh areas, aquaculture sites, juvenile salmonid rearing sites, shellfish beds and adult holding areas.

Appendix 2

Requirements for Using Treated Wood

APPENDIX 2: Requirements for Using Treated Wood

Treated wood has long been used for constructing shoreline facilities in order to render wood toxic to organisms that would otherwise consume it. Creosote, pentachlorophenol (PCP), copper naphthenate, ammoniacal copper arsenate (ACA), ammoniacal copper zinc arsenate (ACZA), and chromated copper arsenate (CCA) have been registered under the *Pest Control Products Act* of Canada (administered by Pest Management Regulatory Agency, Health Canada). Ammoniacal copper quat (ACQ), is not registered for use in Canada, although wood products preserved with ACQ can be imported. Guidelines for use of these compounds are described in the following table. Specific BMPs follow. Refer to Hutton and Samis (2000) for more information.

Summary of Preferred Use of Wood Preservatives

Preservative	Environment			Concerns
	Freshwater	Brackish Water	Marine Water	
creosote	No	Yes	Yes	high leaching rates
PCP	not if immersed	not if immersed	not if immersed	CCA preferred over PCP
ACA	Yes	Yes	Yes	Do not use metal-salt preservatives in water of low hardness, low pH, elevated background metals or metals-sensitive biota
ACZA	Yes	Yes	treat Douglas-fir	
CCA	Yes	Yes	treat only western hemlock or ponderosa pine	
ACQ	Yes	not if immersed	not if immersed	

Use & handling of treated wood products

1. All treated wood must be visually inspected and any wood that has obvious surface residues or bleeding of preservatives must be rejected.
2. All wood treated with ACA or ACZA must be rejected if, when inspected, it has an obvious ammonia odour (indicating the chemical is not properly fixed in the wood).
3. All CCA-treated wood must pass a chromotropic acid test before it is used.
4. If possible, on-site treatment of wood timbers used for docks and float camps should be avoided by ordering pre-treated timbers that have been cut to size.

5. All construction timbers should be prefabricated, treated and dried in a contained upland area prior to use, not in place and over the water; where this is not possible, drapery should be used to prevent preservatives entering the water. A minimum of 45 days should be allowed for drying.
6. Creosote-treated wood should be aged at least 45 days before use to enable volatile constituents to evaporate.
7. Treated wood debris should be disposed of on land in accordance with provincial and municipal laws and policies.

Preferred wood preservatives for various uses

8. Creosote-treated wood should not be used in locations with sediment of little or no oxygen, low total organic carbon or elevated levels of polycyclic aromatic hydrocarbons (PAH).
9. Wood treated with PCP should only be used where it will not be immersed in water (e.g., overhead construction). CCA is preferred over PCP.
10. ACZA is the preferred metal-oxide pesticide for treating marine pilings of Douglas fir.
11. CCA is the preferred metal-oxide pesticide for treating marine pilings of western hemlock or ponderosa pine, but should not be used to treat Douglas fir.
12. In most instances, use of CCA-treated piles and timbers should be restricted to brackish and freshwater environments, as copper and chromium leach from CCA-treated wood up to twenty times more in saltwater than in freshwater.
13. Wood treated with ACQ is not appropriate for marine use, except when limited to above-water applications, such as decking.
14. Metal-salt treated wood should not be used in conditions of low water hardness (15 mg/L to 25 mg/L $CaCO_3$), low pH (5.5 or lower), elevated levels of background metals or where metals-sensitive biota (e.g., shellfish) are prevalent.
15. Where ambient levels of heavy metals are already high and use of wood treated with CCA, ACAZ or ACZ is proposed, consideration should be given to having the wood pre-washed at the manufacturing site.

Appendix 3

Examples of Debris Management Plans & Spill Reporting Forms

DEBRIS MANAGEMENT PLAN FOR _____ LOG STORAGE AND BARGE LOADING FACILITY

This plan was adapted from a specific log storage and barging operation and is provided as an example. Such plans are developed in consultation with DFO for specific operations and locations.

These debris management procedures apply to the log storage and barge loading facility at _____. The objective of the plan is to minimize the deposition of debris such as bark, log chunks and slabs, or any other debris generated from the log storage and barge loading operations. These activities are intended to manage for the No Net Loss of Fish Habitat Policy of DFO.

General Conditions

- Only bundle booms will be stored at the site.
- All bundle booms will be secured at all times to ensure that bundles are kept at water depths greater than the "0 Chart Datum" line.
- Log bundles will be approximately 30 m^3 to 50 m^3 per bundle. The licensee will attempt to maximize the bundle sizes where operationally feasible in order to minimize exposed individual log surfaces and minimize loss of wood debris and bark from bundles.
- No loose logs will be stored at this site.
- All logs will be limbed prior to watering at the Log Dump.
- Log bundles will not be allowed to touch the ocean bottom or de-water.
- Logging-related boats (i.e. boom boats, crew boats) will not drive in and around the intertidal flats
- No fuel will be stored on-site.
- Log bundles will be removed from the storage area as soon as practically possible for towing or barge loading (typically within two months).
- All bundle booms will be towed to deep water areas in the bay for ship or barge loading to ensure that bundles do not contact the ground during loading.
- Bundle booms will not be stored within 30 m of the mouth of the creek on the eastern shore of the tenure area between mid-May and the end of June unless there is stream inventory/classification data that confirms that the stream is non-fish bearing.

Regular Assessment

- Visual assessment by boat of bark and wood debris accumulations in the intertidal zone will be completed at low tide periodically during each operating season. Visual inspections by boat will be completed after every significant storm event to monitor for potential debris accumulations in the intertidal zone.
- At least two inspections of the intertidal zone will be completed during the operating season by walking the beach area.

- Inspection photographs and a brief report will be sent to the regional DFO Habitat and Enhancement Branch for DFO files.
- If any bark or wood debris is identified during the inspections, it will be hand cleaned from the intertidal zone at low tide and collected for upland disposal by burning at ___.
- Annual inspection reports and photographs will be kept in a binder at the Licensee office in ___.
- The Licensee will complete a dive or underwater camera survey as soon as possible within the first two years of the tenure term. If there is no significant bark or wood debris deposition identified by the survey during the first two years of operation, an additional dive or underwater camera survey will be conducted prior to the end of the fifth year of the tenure. If there is no significant bark or wood debris deposition identified by the survey at the end of year five, a final survey will be conducted prior to the end of term of the tenure.
- If bark or wood debris is identified during the dive or underwater camera surveys, the Licensee will reassess the containment protocols and increase the survey frequency to an annual basis until the debris management plan is found to be effective at controlling debris and Department of Fisheries and Oceans approves a new assessment protocol.

_____ LOG DUMP BEST MANAGEMENT PRACTICES

This plan was adapted from a management plan developed by D. Gordon for the Ochwe Bay Log Dump, operated by Triumph Timber Ltd. It is provided as an example. Such plans are developed in consultation with DFO for specific operations and locations.

The following BMPs will be followed during operations of the log slide in ___ Bay:

1. Woody debris will not be allowed to accumulate in the intertidal zone under and adjacent to the log slide. Debris will be hand cleaned daily, or as required.
2. Woody debris will not be allowed to accumulate on the intertidal flats of the ___ River to the east of the site. Double boom sticks will be anchored immediately east of the slide to prevent any debris from floating toward these flats. The flats will be periodically inspected by Licensee personnel walking the flats at low tide to identify if any logging-related woody debris is accumulating in this area. These inspections will be daily during the first week of the project, and will be reduced in intensity if no woody debris is found in the area. If woody debris is found, it will be removed by hand and/or skiff. As well, its mechanism for escaping the immediate log dump area will be investigated and rectified.
3. Log bundles will be approximately 50 m^3. No loose logs will be dumped at this site.
4. All logs will be limbed prior to watering in ___ Bay.
5. Log bundles will not be allowed to touch the ocean bottom or de-water.
6. The log storage area will be offset from the shoreline to prevent log bundles from grounding on the shore. The log storage area will be in water greater than 20 m deep.
7. Log bundles will be removed from the storage area as soon as practically possible (typically less than 1 month).
8. Logging-related boats (i.e., boom boats, crew boats) will not drive in and around the intertidal flats of the ___ River. All booming activity will be confined to within the boomed area in front of, and the west of the log slide.
9. The road adjacent to the dump site will be capped with non-erodible materials such that sediment laden water does not enter the ___ River estuary area.
10. Brow logs will line the edge of the roadway in the vicinity of the log dump area to prevent woody debris from entering the intertidal zone.
11. A suitable spill response kit will be kept at the log dump site and will be readily accessible in the event of a hydrocarbon spill.
12. Any oily sheen on the water surface will be investigated as to its source and cleaned up. All hydrocarbon spills will be immediately cleaned up. Spills over 1000 litres will be immediately reported to the Provincial Emergency Program Spill Response Line.
13. Solid waste generated on site (i.e., cables, etc.) will not be disposed of in the marine environment.

Spill Report Form

Page 1 of 2

Spill Location: Geographical Name _____

Latitude: _____ Longitude:_____

Person Reporting Spill: _____

Date And Time Of Spill: _____

Product Type:_____

Quantity Of Spill:_____

Source Of Spill:_____

Name Of OHF: _____
(Oil Handling Facility, where designated)

Owner/Operator: _____

Personnel Safety: _____

Fire/Explosions Hazard:_____

Cause Of Spill: _____

Weather: Wind Direction _____ Speed_____

Precipitation_____ Visibility_____

Sea Conditions: Direction of Current Flow_____ Speed _____

Flood _____ Ebb _____ Trend _____

Spill Report Form

Page 2 of 2

Response Actions: _____
_____
_____
_____
_____

Persons On Scene Or Advised: _____
_____
_____
_____
_____
_____
_____

Is Assistance Required? _____
Type? _____
_____
_____
_____
_____
_____

Date/Time Of Next Report: _____

Signature: _____

Appendix 4

Marine Foreshore Environmental Assessment Procedures

APPENDIX 4: MARINE FORESHORE

ENVIRONMENTAL ASSESSMENT PROCEDURES

Source: Scott Northrup and Allan Cowan, Fisheries and Oceans Canada (Revised March 2002)

Marine development projects have the potential to affect fish[1] and fish habitat[2]. Fisheries and Oceans Canada (DFO) is responsible for the protection and management of fish habitats under the authority of the *Fisheries Act* and may request plans, specifications and environmental assessments specific to marine projects where more detailed information is required. Assessments may be necessary for all types of projects, including, but not limited to aquaculture, log handling, industrial port development, marinas, private moorage facilities, marine repair facilities, pipeline or outfall installations, vessel launches or barge ramps, dredging projects and shoreline protection projects (breakwaters and seawalls). Presented below are standardized, transect-based assessment procedures intended to provide DFO with the basic information required to determine the potential effects of a development project on fish habitat.

Assessment Area

For comparative purposes, the assessment area should include both the foreshore site proposed for development as well as the adjacent foreshore. This will provide a context for the project and may provide data about cumulative effects if similar developments already occur on-site. A large scale site plan, preferably an enlargement of the hydrographic chart, with a small scale insert of the general geographic location will serve as a base map of the study area.

Tidal Height and Water Depth Measurements

The lowest normal tide (0.0 m), or chart datum, will be used as the reference point for the measurement of tidal height and water depth. Tidal height is recorded as positive relative to chart datum, while water depth below chart datum will be recorded as a negative value. For example, if the assessment is made when the tide is at 2 m, and observations are taken at a water depth of 6 m, then the depth will be recorded as -4 m. Tidal height will be corrected using the closest secondary port to the reference port found in the Canadian Tide and Current Tables, with further correction made for daylight savings time as required.

Transect Layout

Transects should be established perpendicular to the shoreline at regular intervals both within and adjacent to the proposed or active development area so as to sample representative fish habitat conditions. A preliminary low water reconnaissance or dive survey may be advisable to establish appropriate boundaries for the assessment. Transects should begin at the highest high water mark (HHWM: distance

1. shellfish, crustaceans, marine animals and any parts of shellfish, crustaceans or marine animals, and the eggs, sperm, spawn, larvae, spat and juvenile stages of fish, shellfish, crustaceans and marine animals;

2. spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes.

referenced as Station 0.0 m) and, at a minimum, extend to a depth of -20 m (–30 m if the development has the potential to effect deeper benthic habitats). Though small-scale intertidal projects may only require intertidal transects, care must be taken to ensure that a representative sample is collected across the proposed development area. Procedural manuals are available from DFO if sampling of intertidal clam or benthic invertebrates is required. To ensure complete assessment of marine plants and animals in the photic zone, deeper transects may be necessary, especially to determine the effects of sunken debris or woodwaste accumulations resulting from existing developments. Transects should be spaced approximately 25 m apart, although this interval may vary depending on the width of the site. The number of transects required will depend on the nature of the foreshore development proposed, anticipated effects of the development, and local site conditions (tides and currents, geography, fetch, geology, etc.). Transects should be individually numbered and indicated on the site plan, and their commencement point referenced to benchmarks, where possible.

Recording Observations

Habitat inventories should be conducted during the more productive spring and summer months. At that time, algae and saltmarsh species are more readily identifiable, enabling a better assessment of the productive capacity of the site.

Observations should be recorded every 5 m along the transect or at significant changes in habitat type. Observations should include substrate type and composition, presence and relative abundance of marine animals and plants, and any other notable features (e.g., debris accumulations) using the format described below for individual parameters.

Observations should be correlated to the transect distance from the HHWM and (corrected) tidal height or water depth (e.g., Sta 0+80 m / +4.5 m), with information compiled in tabular form, by transect. Common names of observed animals and plants are acceptable for the data table; a species list with scientific names should, however, be appended to the report.

General marine plant categories (e.g., rockweed, eelgrass, bull kelp, saltmarsh, etc.) and any other notable features should be sketched to scale directly on a copy of the site plan, drawings or photographs of the site. A site profile should be prepared for each transect showing the slope of the foreshore and the location of indicator marine plants or invertebrates. A sketch of the proposed marine development should be superimposed over the site plan so that any potential effect of the project on fish habitat is clear. Compensatory habitat proposed for offsetting altered habitat should also be sketched on site maps and profiles to enable review of the positioning of replacement habitat relative to the project.

Substrate

Substrate types are to be subdivided into the following size class categories and recorded cumulatively as percentage out of a total of 100% (e.g., Boulder 5%; Cobble 15%; Gravel 60%, Sand 20%):

	Boulder	Cobble	Gravel	Sand.	Silt/mud/clay
Bedrock	**>256 mm dia.**	**64-256 mm dia.**	**2-64 mm dia.**	**0.062-2 mm dia**	**<0.062 mm dia.**

Marine Plants

Marine plants include rooted vascular vegetation (e.g., eelgrass, saltmarsh vegetation, etc.) and marine algae (e.g., rockweed, kelp, etc.). Marine plant observations are recorded as percent areal coverage estimated per 5 m by 1 m transect segment. Observations can be recorded as percentages (5%, 10%, 15%, etc.) or by utilizing the following areal coverage classes:

+	1	2	3	4
<5%	5-25%	25-50%	50-75%	75-100%

Sessile Animals

Many marine animals permanently attached to substrates function as important fish habitat (e.g., barnacles, bay mussels, etc.). Sessile animals are recorded as percent areal coverage along the transect line using either estimated percentages or by areal coverage classes, as presented above.

Motile Animals

Motile animals include fish and marine invertebrates such as crabs and snails. These can be individually counted along the transect or, where too numerous, their estimated numbers can be recorded. Population estimates will most likely be applied to species such as herring or mysid shrimp that naturally occur in large numbers.

Other Features

Accumulations of wood bark and debris, sunken logs or other waste materials arising from on-site or nearby development activities should also be recorded. For wood bark and related small size debris, observations are recorded as percent areal coverage estimates per 5 m by 1 m transect segment and estimated deposition depth (e.g., 15% / 10 cm). For larger materials (sunken logs, wood chunks, etc.), observations can be recorded by individual piece count or by estimate of percent areal coverage.

Photographic Documentation

It is essential to produce a photographic record along the intertidal and subtidal transects. A videographic record of subtidal transects is also recommended. Photos and videos provide a real-time record of characteristic fish habitat at the proposed site and can be invaluable to future post-development site monitoring. Photographic records also facilitate comparison of the productivity of natural habitats with any compensatory habitat constructed to offset habitat losses. As visibility may be a problem, careful attention should be given to appropriate tidal levels, and midday lighting conditions are recommended. Aerial photos, taken at low tide, are often useful to put the site into context with the surrounding area and to verify information provided from other sources.

Assessment reports should include photographs of representative fish habitat types. Depending upon the scope of the proposed foreshore development, an unedited, labeled copy of the assessment video may also be required for the report submission. The video footage should be referenced with pertinent information (e.g., time, date, depth, heading, etc.), and a written or recorded interpretation should accompany the video.

Summary of information to be submitted

1. Base map showing tenure area boundaries, surrounding area, transect locations and sampling stations

2. Shoreline video/photographs of intertidal zone

3. Underwater video/photographs of transects

4. Tabular data for each transect describing substrate type and composition, marine plants, sessile and motile marine animals, and other notable features

5. Habitat map showing location of different substrate types, plants, animals and operational infrastructure

6. Profile diagrams of each transect showing slope, sediment types and the major marine plants or animals observed

7. Photographs of site and aerial photographs if available.