Approved Work Practices
FOR SUBMARINE CABLE MAINTENANCE

A GUIDE TO APPROVED WORK PRACTICES FOR ROUTINE ELECTRICAL CABLE MAINTENANCE IN FRESHWATER AND MARINE COASTAL AREAS

Canada

BC Transmission Corporation

BC Hydro
Approved Work Practices for Routine Electrical Cable Maintenance in Freshwater and Marine Coastal Areas

A Guide to Best Management Practices to Facilitate Maintenance of BC Hydro Distribution’s and BC Transmission Corporation’s Submarine Cables While Protecting the Environment

Appendix C
of the Protocol Agreement for Maintenance Work In and Around Water Between BC Hydro and British Columbia Transmission Corporation, Fisheries and Oceans Canada, and the Ministry of Environment
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1. **FOREWORD**

BC Hydro (BCH) and BC Transmission Corporation (BCTC) recognize the vital physical and ecological roles fulfilled by aquatic, marine and riparian ecosystems and, concurrently, they recognize the importance of protecting these systems from adverse impacts and ensuring their long-term sustainability. To ensure the protection and sustainability of these systems while simultaneously streamlining regulatory agency activities, BCH-BCTC have developed the following document that also represents a component of the Protocol Agreement for Maintenance Work In and Around Water. Specifically, this document describes the work practices associated with maintaining BCH-BCTC submarine powerline cables and grounding grids. This document is herein referred to as the Approved Work Practices for Routine Electrical Cable Maintenance in Freshwater and Marine Coastal Areas (AWPCM).

**The main agreements of the AWPCM are that:**

- BCH-BCTC agree to apply the following work practices while maintaining and replacing their cable infrastructure in marine coastal, lacustrine environments; and
- Fisheries and Oceans Canada (DFO) and the Ministry of Environment (MOE) agree that work done according to the AWPCM constitutes an accepted practice not subject to formalized regulatory approval. Notifications for work compliant with the AWPCM will be made for information purposes and future monitoring only. Work proposed that is not fully consistent with the AWPCM is subject to review and may require approvals, acceptance of notification, letters of advice, or Authorization.

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2. STRATEGIC OBJECTIVE

2.1 Electrical System Needs

BCH-BCTC are responsible, through the BC Utilities Commission Act, for providing a reliable supply of electricity to customers throughout the province while ensuring public and worker safety. The authority of BCH-BCTC to conduct their business is derived from the Hydro and Power Authority Act and the Transmission Corporation Act. Submarine cables supply electricity to customers on islands and other isolated areas along the marine coastline and in remote interior areas where submarine lake crossings provide the most appropriate route of electricity delivery. Where ground conditions are not suitable for a land-based grounding grid, some facilities also require sea-grounding grids to be installed below high water.

To protect public safety, the cables and ground grids, BCH-BCTC must bury the infrastructure between their land termini (either a terminal pole or a station) and a suitable point at the low water line or below it. Burial depth generally ranges between 1 and 2 m. Concrete mattresses, piled rocks and/or concrete bags may be used to provide additional physical protection of the infrastructure where hard substrates prohibit burial. In the backshore, foreshore and sometimes, subtidal areas, the infrastructure must also be provided with additional physical protection either in the form of metallic or composite armoring and/or concrete bags.

BCH-BCTC maintain two types of submarine cables. They are:

2.1.1 Transmission Submarine Powerline Cables

Transmission submarine cables are managed by BCTC, although the transmission infrastructure and some properties are owned by BC Hydro, and BC Hydro staff or BCTC contractors generally conduct the maintenance work. These cables move high-voltage electricity (69kV to 550 kV) between stations either in the form of alternating current (AC) or direct current (DC). Transmission submarine cables provide most of the electrical supply to Vancouver Island.

2.1.2 Distribution Submarine Powerline Cables

Distribution submarine cables are generally the responsibility of BC Hydro Distribution. They provide relatively lower-voltage AC electricity (2.4 kV to 25 kV) to customers.

2.2 Regulatory Agency Needs

Both federal and provincial legislation affect work activities in and around water. The BC Water Act provides protection to water resources through restrictions and/or penalties. The federal Fisheries Act has the greatest impact on BCH-BCTC’s submarine cable maintenance in the marine environment, while this Act and the Water Act regulate maintenance activities in and around freshwater lakes and streams. 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.” (Fisheries Act, Section 34(1))

Marine coastal and lakeshore areas are often inhabited by fish and can provide critical spawning and rearing habitat. They are clearly fish habitat areas.

The Fisheries Act protects fish habitat through the following provision:

“It is an offence to harmfully alter, disrupt or destroy (HADD) fish habitat without authorization.” (Fisheries Act, Section 35 (1))
The *Fisheries Act* also prohibits the deposit of a deleterious substance (such as sediment) into water through the following provision:

“It is an offence to deposit a deleterious substance into waters frequented by fish.”

(*Fisheries Act*, Section 36 (3))

Therefore, all activities that involve harmful alterations of fish habitat require an Authorization from DFO. Deviations from the work plans submitted to obtain an Authorization may also result in a chargeable offence. Under Section 36 of the *Fisheries Act*, DFO may not authorize the deposition of a deleterious substance.

### 2.2.1 Fisheries and Oceans Review

DFO does not have a formal “permitting” process in which applications are received and a permit is issued. Section 35 of the *Fisheries Act* prohibits any work or activity that results in the harmful alteration, disruption or destruction (HADD) of fish habitat, unless authorized by the Minister or subject to Regulation. Therefore, DFO should be notified of any activities that may affect fish or fish habitat to ensure that a HADD does not occur. An assessment by a Qualified Environmental Professional (QEP) may be used by DFO to assist in their evaluation of whether a project will result in a HADD. Notification to DFO can be made either directly, indirectly through an alternate process such as a referral by other federal departments or provincial ministries, or per an alternate agreement such as a Protocol Agreement or Memorandum of Understanding.

Once notification is received, staff review the proposed activities in relation to Section 35 of the *Fisheries Act* and the accompanying *Policy for the Management of Fish Habitat*. The Habitat Policy along with current Standard Operating Policies establishes a process through which work is reviewed and a hierarchy of preferences is applied. This hierarchy is as follows: 1) avoidance of a HADD with possibly 2) the redesign of the proposal or relocation to a more suitable site; 3) mitigation to avoid the HADD; or 4) as a last resort, provide compensation for the HADD. Where there is the possibility to relocate or redesign the project or the HADD can be avoided through appropriate mitigative strategies, DFO may issue a Letter of Advice accepting the plan put forward by the proponent. Where it is not feasible to redesign or relocate a particular project, the Minister may provide an Authorization for the HADD, outlining mitigation or compensation requirements. Provided the proposed works meet the definition of a project under CEAA and are not on the exclusion list, an Environmental Assessment under CEAA must be completed, and environmental effects, with appropriate mitigation, found to be not significant, or if significant, are justifiable, before an authorization can be issued. This process involves reviews by various stakeholders and First Nations.

It is anticipated that BCH-BCTC’s routine submarine cable and grounding grid maintenance activities will not constitute a HADD if undertaken in accordance with this document. However, should routine maintenance activities not fall within the general provisions included here, advice will be given on how to avoid a HADD, or an Authorization will be considered. Submarine cables and grounding grid maintenance activities that are expected to cause a HADD, and are therefore not covered by this document, are defined in Section 5.1.
2.2.2 Ministry of Environment Review
Ownership of water and most lake and stream beds is vested in the Province of B.C. Changes in and about streams have been managed and regulated through legislation for many years to protect and maintain certain values, resources and legal rights associated with streams. Under the provincial *Water Act*, the *Water Regulation*, Part 7, Section 44 identifies specific activities that may be carried out under the notification process.

In general, maintenance of submarine cables and sea grounding grids can be undertaken in accordance with the *Water Regulation*. Where necessary, the designated Habitat Officer for MOE will, upon receiving a satisfactory review of the previous year’s work and/or planned work for the upcoming year, accept a Notification for Changes in and About a Stream (*Water Regulation* Section 44 (1)) excavation activity “below the top of bank” of a watercourse, and will provide details for the protection of habitat to BCH-BCTC prior to undertaking the work.

2.2.3 Other Government Agencies
This Approved Work Practice does not release BCH-BCTC from the responsibility of obtaining any other permits or approvals that may be required under applicable legislation that may apply to the work being carried out in relation to this Approved Work Practice.

Other government agencies such as Transport Canada, Environment Canada, Canadian Wildlife Service, and Port Authorities can sometimes have statutory requirements for notification and approval of work in marine coastal and lakeshore areas. For example, cable-laying vessels require approval from Port Authorities and notification of Transport Canada before starting cable-laying activities. Since the requirements of these agencies vary from job to job and none of these agencies are signatory to the Protocol Agreement, the AWPCM does not cover mandatory interaction between these agencies and BCH-BCTC.

2.3 Protocol Agreement and Approved Work Practices
As described above, maintenance of BCH-BCTC submarine cables and grounding grids is undertaken to ensure public safety and protect reliability of the system. Since these facilities may pass through sensitive marine and freshwater environments, this must be undertaken in full recognition of regulatory agency requirements. Mindful of these potentially conflicting factors, BCH-BCTC, DFO and MOE (i.e., the Partners) relate their strategic objectives as follows:

- **BCH-BCTC**
  To meet our electricity supply, line security and public safety obligations in a manner that preserves the functional integrity of aquatic, marine and riparian ecosystems over the long term.

- **DFO**
  To work toward safe, healthy, productive waters and aquatic ecosystems for the benefit of present and future generations by maintaining the highest possible standards of service to Canadians.

- **MOE**
  To develop, promote and measure achievement of provincial goals for the conservation of living resources (i.e., biodiversity and ecosystem protection); and, to manage protected areas and use of the province’s fish and wildlife populations to achieve those goals.
In recognition of these strategic objectives, and the need to ensure the protection and sustainability of aquatic, marine and riparian ecosystems while streamlining regulatory activities, the Partners have developed and ratified a Protocol Agreement for Maintenance Work In and Around Water (PA). The AWPCM serves as an Appendix to the PA.

**The main features of the PA are:**

- The Partners agree that the work practice documents appended to the PA (e.g., the AWPCM) represent acceptable activities associated with BCH-BCTC’s routine maintenance activities in and around water;
- BCH-BCTC will endeavor to undertake work according to these work practices; and,
- The regulatory Partners agree that work done according to these work practices constitutes accepted practice and does not require formal approvals. Work proposed that is not fully consistent with the appended practices is subject to further review and may require approvals, acceptance of notification, letters of advice or Authorization.

**The main features of the AWPCM are:**

- A definition of work practices that constitute accepted practices and require no permits or approvals;
- A requirement to notify appropriate staff from the respective regulatory Partners in advance of completing maintenance work as per the AWPCM;
- When maintenance activities deviate from the AWPCM, this document defines the processes for work requiring additional reviews;
- The commitment to schedule, at a minimum, annual meetings (to be coordinated by BCH-BCTC) of the regional or area staff to review:
  - results of monitoring reports of previous year’s work, and associated conditions (if any), conducted under the AWPCM;
  - proposed changes or modifications to the AWPCM based on results of annual monitoring and performance reviews;
  - plans for maintenance work in the upcoming year;
  - site-specific management plans for maintenance work that is not fully consistent with the AWPCM; and
  - the general efficacy of the working relationship at the local area level.

### 2.4 Submarine Cable Maintenance AWPCM Process

Submarine cable maintenance works under the AWPCM will normally adhere to the process described in Figure 1.
Figure 1 – Submarine Cable Maintenance AWPCM Process.
3. MAINTENANCE PRIORITIES

BCH-BCTC consider the complete or partial replacement of existing submarine cables to be a maintenance activity, providing that a HADD does not occur. Activities that may result in a HADD (as listed in Section 5.1) are excluded from this agreement. Cable replacement work involving an increase in voltage capacity (e.g., from 2.4 kV to 25 kV) is considered maintenance work, providing that the activities meet the criteria defined in this agreement.

The following describes how BCH-BCTC will apply this document to different types of maintenance priorities:

3.1 Emergencies

Submarine cables can suddenly fail for various reasons. To prevent circuit failure from affecting transmission of large amounts of electricity, transmission circuits often have two levels of redundancy. This, however, is not always the case for distribution circuits. If a submarine circuit fails and no backup cable allows the circuit to re-close, or an alternate radial loop feed does not exist, BCH-BCTC consider this an emergency as customers are without power. During an emergency cable failure, BCH-BCTC will take whatever measures are required to repair or replace the damaged circuit as soon as possible. Wherever possible, BCH-BCTC will incorporate into the repair work methodology the work practices outlined in the AWPCM. As per the MOE Standards and Best Practices for Emergency Works, BCH-BCTC must notify MOE, DFO and any other appropriate agencies within 72 hours. This notification should include the use of this AWP, the justification of the proposed emergency works and an assessment of the risk and impact potential as prepared by a QEP. Also included will be any special mitigating best practices used for completing the works outside this AWP if appropriate. BCH-BCTC will work with the Partners to identify and implement suitable site restoration and habitat impact mitigation measures given the scope of work completed during the emergency repair.

3.2 No Contingency Conditions

Where a submarine cable has failed but a backup cable can re-close the circuit or an alternate radial loop feed exists, BCH-BCTC consider the electricity grid to be operating at ‘no contingency condition’. This involves an electrical supply system with no backup where any additional damage will result in complete loss of electrical supply. BCH-BCTC are committed to provide a reliable supply of electricity to their customers, so repairs to ‘no contingency condition’ circuits must be undertaken as soon as possible. Work is to be planned so that time-sensitive processes such as ordering spare cable or scheduling work to coincide with favorable low tides are taken into consideration. Where this repair work can be undertaken in adherence to the work practices in this document, BCH-BCTC will proceed as outlined herein. Where the repair work cannot be completed according to the work practices outlined herein (e.g., the work will cause a HADD), the regulatory Partners and BCH-BCTC will agree upon a reasonable time frame to allow for project review and consultation while addressing system reliability needs.

3.3 Planned Maintenance

All submarine cables have a designed end-of-life. BCH-BCTC schedule replacement of these cables as they are approaching their end-of-life, but in the absence of confounding conditions, BCH-BCTC do not consider this work to be an emergency or no contingency condition. Where a cable has failed, but the circuit continues to have backup reliability, BCH-BCTC may plan to repair the circuit, but they do not consider this work to be an emergency or no contingency condition. Where planned maintenance work cannot be completed according to the work practices outlined herein, BCH-BCTC will adhere to normal regulatory Partner approval processes as required.
4. SITE ASSESSMENT AND PROJECT PLANNING

All projects will include a site assessment by both the Project Manager and a QEP to confirm whether work can be done in compliance with the AWPCM. A pre-tender environmental assessment will be completed. This will include an office-based review of regional mapping and habitat databases as well as a field assessment. The assessment will include the following:

- accessibility of the cables;
- condition, health and suitability of site for working as per AWP guidelines;
- location of riparian zones and other potentially sensitive areas;
- location and condition of land-based access to the work location, and amount of vegetation clearing and land disturbance required;
- site-specific work windows as per Appendix A;
- land tenure;
- a review of Conservation Data Centre (CDC) databases and maps for the presence of listed species; and
- presence of environmentally sensitive areas such as freshwater and brackish marshes, stream mouths, mudflats, salt marshes, eelgrass meadows, clam beds, sponge reefs or spawning habitat.

The criteria above will assist in determining the needs and methods for effectively managing the project.

Other considerations in determining how and when the work should be undertaken include:

- public and worker safety needs;
- site-specific environmental sensitivities—e.g., wildlife use and presence of species at risk, heritage, recreational, presence of a marine park or ecological reserve; and
- archaeology and First Nations concerns.

The site assessment will determine appropriate agreed work practices and mitigation as per the AWPCM.

5. AGREED WORK PRACTICES AND MITIGATION PROCEDURES

5.1 Excluded Activities

The following maintenance activities are NOT covered by the AWPCM and therefore require complete regulatory agency review and possibly approval or Authorization prior to undertaking the work:

- A major powerline project that undergoes a Canadian Environmental Assessment Act (CEAA) or BC Environmental Assessment Act (BCEAA) review, or that has undergone specific review by the BC Utilities Commission and been granted a Certificate of Public Convenience and Necessity (CPCN). Where CPCN and CEAA approvals and other government permits have been granted and result in conditions that apply to cable maintenance activities, those conditions will prevail over this AWPCM.
- Planned maintenance work (Section 3.3) outside the fisheries work window (Section 5.2) for the affected region.
- Clearing of a new access route greater than 5 m wide through a riparian area (Section 5.3).
- Use of heavy equipment (excavators and backhoes) in the intertidal portion of low compaction substrate beaches or any area containing eelgrass or other sensitive fish habitat that would be adversely impacted by the use of heavy equipment. These habitats will be identified in a site-specific EMP (Section 6.1).
• Manual excavation (i.e., using shovels) of a trench greater than 1 m wide in an intertidal area containing eelgrass or as dictated by a site-specific EMP (Section 5.6.2).
• Excavation of a trench wider than 4 m in medium or hard substrates.
• Water jetting or air lifting to excavate under water except as described in Section 5.6.3.
• Use of any explosives underwater or a distance from water less than distances outlined within the DFO Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters (http://www.dfo-mpo.gc.ca/oceans-habitat/habitat/water-eau/explosives-explosifs/page05_e.asp).
• Placement of concrete mattresses to protect submarine cables on the intertidal or subtidal portions of low compaction substrate areas.
• Placement of unprotected concrete bags or wet mixed concrete below the high water mark (Section 5.4).

5.2 Work Windows

Work windows apply to all planned maintenance work (Section 3.3) involving the use of heavy equipment below the high water mark of any water body. Manual excavation below a lake high water mark or in marine intertidal and subtidal areas that is compliant with the work practices outlined herein is not restricted by work windows. Emergency work or work under no contingency conditions would not be subject to work windows. All necessary environmental precautions, however, should be observed when working either inside or outside approved windows.

The appropriate window in which marine coastal and lakeshore work causes the least impact is determined by several factors, such as: season (i.e., summer low tides are the lowest of the year and summer is also the driest season in coastal British Columbia) and fish life cycles (primarily juvenile emergence and adult spawning and migration).

Fish use foreshore areas for spawning, feeding and rearing and these life cycles occur at different times of year throughout coastal BC. Planned work should not be scheduled during periods of high sensitivity such as herring spawning or shore spawning of salmonids in lacustrine environments.

It is important to note that work involving stream crossings is affected by work windows that vary across the province based on sub-region and the fish species present. “Reduced Risk Instream Work Windows” for both marine and freshwater environments are provided in Appendix A. Regional DFO Habitat staff should be consulted for area-specific work windows. The AWPCM does not cover instream work involving stream crossings. This work requires site-specific regulatory agency review and possibly approval.

5.3 Site Access

Marine coastal and lakeshore work sites are accessed by land, water, air or a combination thereof. Land access using an existing managed right of way (ROW) may require limited vegetation clearing. In other cases, an entirely new temporary access route requiring more intensive vegetation removals may be necessary. During access development, vegetation removals and ground disturbance (e.g., grubbing) will be kept to a minimum as dictated in a site-specific EMP. Riparian vegetation is protected because of its important role in preventing shoreline erosion as well as providing food and shelter to fish and wildlife. Therefore, all areas cleared for temporary access must be seeded with a suitable reclamation seed mix and, if required, planted with suitable vegetation following activity at the site to prevent short-term erosion and promote re-colonization of native plants. If planting occurs on an overhead line ROW, low-growing plants should be selected to prevent future vegetation management problems. Appendix B provides planting criteria for riparian and coastal areas. New temporary access routes through riparian areas can be cleared by up to 5 m in width, but they must be re-seeded and replanted, under the AWPCM. Grubbing and preparation of a new permanent access route is beyond the scope of the AWPCM.
If land disturbance occurs (e.g., trenching, heavy equipment operation, frequent foot traffic) on a sloped area with gradient exceeding 20%, all disturbed soils must be seeded with a suitable reclamation seed mix and covered with temporary erosion control blankets or other suitable erosion protection as defined in a site-specific EMP (Figure 2).

Tracked machinery is generally preferred over rubber-tired machinery because the former usually has lower ground pressure and therefore leaves less of an invasive footprint. This is particularly important if heavy machinery is required on the beach where micro and macro organisms inhabit the sand throughout the intertidal zone and may be harmed through compaction and other disturbances. The use of heavy machinery is to be limited to the corridor in which work is required to avoid off-site impacts. Moreover, solid substrate areas such as rock outcroppings should be used for heavy machinery access wherever possible to reduce compaction. Sections 5.6.2 and 5.6.3 describe settings where heavy machinery is prohibited.

Access over salt marshes should be avoided if possible. If access through salt marshes cannot be avoided, ‘swamp mats’, plywood sheets or logs are to be used to minimize disturbance.

Beach access often involves the movement of driftwood. Driftwood plays an important role in shoreline ecology and erosion protection, and therefore must be replaced in the location from which it was removed when construction activity has been completed.

If a barge is required for access, a landing location with minimal potential for habitat impacts will be chosen. Such a site would possess a solid substrate, preferably rock, cobble or sand. Mud areas, eelgrass beds and clam beds should be avoided. These areas provide important feeding and rearing areas for aquatic life and the underlying mud often contains micro and macro organisms with important roles in intertidal ecology.

Development of a permanent vessel-landing site or a boat launch would typically require regulatory agency approval and is outside the scope of the AWPCM.

Figure 2 – Erosion control blankets installed over a steep access route upon project completion.
5.4 **Concrete Bag Cable Protection**

BCH-BCTC historically used wet concrete bags to protect submarine cables and help secure them in place within the intertidal area. However, uncured concrete can be harmful to aquatic organisms, so this practice has been discontinued below the high water mark. All concrete bags used below the high water mark must be contained in a secondary bag consisting of three layers of kraft paper (Figure 3). Multiple-layered paper bags are preferred over plastic secondary containment because the latter creates non-biodegradable solid waste and makes the bags slippery and difficult to handle. In addition, *in situ* experiments to test the effects of unwrapped concrete bags have shown that multiple-layered paper bags are effective at keeping pH in the surrounding water within acceptable levels\(^1\).

Using unprotected concrete to protect cables is permissible above the high water mark provided that uncured concrete or concrete leachate does not reach water.

![Figure 3 – Example of special three-layer kraft paper bags for providing secondary containment of ready-mix concrete bags.](image)

5.5 **Cable Deactivation**

Submarine cables have finite design lives. As a result of wave action, mechanical damage from anchors or vandalism, some cables fail prematurely and must be replaced. To avoid confusion in the identification of new and old cables at multiple cable crossings, deactivated cables may need to be removed from the intertidal area and, in some cases, the entire length of the cable must be removed.

In some cases, it is preferable to leave old cables in place to avoid disturbance related to cable removal. If a deactivated cable must be removed, it will be coordinated with activities associated with installing the new cable, which falls under all environmental considerations mentioned in this document.

Some submarine cables are oil-filled or contain oil-saturated insulation. If this is the case, an evaluation of the environmental impacts associated with leaving the cable in place vs. removing it will be conducted by a QEP and Project Manager. If it is determined to leave a cable in place, it will be drained (if oil-filled), cut and capped and left in position as detailed in a site-specific EMP.

5.6  Site-Specific Work Practices

Cable maintenance activities occur in three distinct zones: above the high water mark (upland), between high and low water mark (intertidal) and below low water mark (subtidal). The intertidal zone may be further divided into salt marsh, soft, medium and hard substrate zones. Typical characteristics of these zones are presented in Figure 4.

5.6.1  Work Above the High Water Mark (upland)

All upland areas disturbed during submarine cable trenching must be restored to original gradient and, if necessary, protected with properly secured erosion control blankets or with hydroseed, or covered with straw as detailed in a site-specific EMP. Trench excavations and other disturbed soils will be seeded. In some cases (e.g., parks or private property), replanting may also be required. Requirements and specifications for seeding and replanting will be detailed in the EMP and follow specifications detailed in Appendix B.

5.6.2  Work Between High and Low Water Mark (intertidal)

Salt Marshes

Salt marshes are present in many coastal areas. Salt marshes are tracts of soft, wet land subject to overflow by salt water through tidal and spray action. They are characterized by plants such as sea asparagus, sedges and surf grasses and usually retain pools of water used by fish and birds. Due to their ecological importance, salt marshes are to be protected at all times.

Access routes are to be selected to avoid salt marsh habitat. Where excavation is required, salt marsh substrate is to be stockpiled, keeping it as intact as possible. Stockpiled salt marsh material must be kept wet through watering or allowed to be covered daily by tidal waters. To retain moisture, the removed marsh material can be covered in a polyethylene tarp if necessary. Salt marsh material can remain in this state for up to three days, but desiccation of the vegetation cannot be tolerated. Replace the marsh material in the same tidal elevation from where it was removed when work has finished. When working adjacent to salt marshes, plywood or protective matting can also be used to protect the substrates from disturbance. Any necessary salt marsh restoration will be completed under the direction of a QEP.
Figure 4 – Typical habitat in submarine cable work zones.
Low Compaction Substrates

Low compaction substrates consist of mud areas (not sand) common in low wave action bays and other protected areas. They often contain eelgrass meadows that provide critical habitat for many species of fish. Eelgrass is easily identified by its long (0.5–1.5 m), slender and soft blades (Figure 5). Figure 6 provides examples of typical low compaction substrate habitats.

Use of heavy machinery in low compaction substrate areas is prohibited under the AWPCM (Section 5.1). However, due to the low compaction of this substrate, hand digging of the trenches is generally efficient and effective. Use of heavy equipment in these areas requires site-specific regulatory agency review and approval.

Crews excavating in low compaction substrates must take care to minimize habitat impacts. If an area does not contain eelgrass and trenching must be done over a lineal distance greater than 5 m, crews must work from sheets of plywood or tarps to prevent foot traffic from causing excessive disturbance. If the area contains eelgrass, crews must work from sheets of plywood while excavating a trench of any length (Figure 7). Spoils must be placed on plywood to protect underlying habitat from unnecessary impacts. If present, eelgrass sod plugs should be salvaged and placed on plywood for transplanting over the trench excavation at the same tidal elevation following completion of cable burial. Extreme care must be used when salvaging eelgrass sod plugs as they do not hold together well when handled.

All trenches excavated through low compaction substrates containing eelgrass must be no more than 1 m wide at the surface. This is because eelgrass typically grows laterally in a vegetative fashion at about a rate of approximately 0.5 m per year. A maximum trench width of 1 m will theoretically allow for regeneration of a site within one year.

Figure 5 – View of typical eelgrass plants in a low compaction substrate area.
Figure 6 – View of typical habitats in low compaction substrate areas.

Figure 7 – Example of how crews can use sheets of plywood to protect eelgrass habitat during trench excavation and eelgrass sod plugs salvaged for transplanting back into work area. Eelgrass sods were covered with tarps and kept moist during the trench excavation.
Table 1: Do’s and don’ts for work in low compaction substrate areas:

<table>
<thead>
<tr>
<th>Do</th>
<th>Do Not</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Schedule work for suitable low tides and/or low water levels for lacustrine sites.</td>
<td>• Plan maintenance work outside the fisheries work window for the affected region.</td>
</tr>
<tr>
<td>• Use only manual tools for all excavation work.</td>
<td>• Clear an access route greater than 5 m wide through a riparian area.</td>
</tr>
<tr>
<td>• Check the substrate for the presence of sea life. Manually move sea life away from excavation area before and during excavation.</td>
<td>• Use heavy equipment anywhere in the intertidal portion of the beach.</td>
</tr>
<tr>
<td>• If area contains eelgrass, work in the dry only from sheets of plywood laid in the mid to low intertidal area to minimize disturbance (Figure 7). Also place excavated material on plywood to protect underlying areas from disturbance.</td>
<td>• Use any explosives underwater or a distance from water less than distances outlined within the DFO Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters.</td>
</tr>
<tr>
<td>• If area contains eelgrass, salvage the top sod layer of eelgrass and keep separate from other excavated spoils (on plywood) for transplanting back onto trench site when work is complete (Figure 7).</td>
<td>• Excavate any trench more than 1 m wide.</td>
</tr>
<tr>
<td>• Restrict trench excavation width to less than 1 m wide at surface.</td>
<td>• Damage sea life such as ghost shrimp while moving soft substrate.</td>
</tr>
<tr>
<td>• During the same tide cycle, reinstate disturbed areas using native material from trench excavation to avoid creation of dendritic channels.</td>
<td>• Use concrete mattresses for cable protection.</td>
</tr>
<tr>
<td>• Wrap all concrete bags in three-layer kraft paper bags or purchase bags pre-made with this feature.</td>
<td>• Use unprotected concrete bags for cable protection.</td>
</tr>
<tr>
<td>• Either re-bury any old, hard concrete bags in the trench or remove them from the site.</td>
<td>• Use water jetting or airlifting.</td>
</tr>
</tbody>
</table>

Medium Compaction Substrates

Medium compaction substrates consist of sand, gravel and cobble common in medium to high wave action sites (Figure 8). Although they can be productive, sand habitats do not generally require special environmental considerations for the burial of cables. Cobble and gravel beaches, however, provide excellent habitat for rock weed and other rock-bound seaweeds that provide habitat for aquatic organisms when submerged. Cobble and gravel substrates also provide habitat for intertidal organisms such as crabs and eels as well as burrowing organisms such as bivalves and seaworms. Therefore, they require protection and monitoring during trench excavation.

Prior to excavating a cobble or gravel beach, surface cobbles and gravels (typically to a depth of 0.3 m) will be separated from underlying material to be replaced on top after excavation is complete. The area where underlying spoil is to be stockpiled is also to be prepared to minimize impacts due to spoil placement. Efforts are to be made to minimize the footprint of excavated materials during trenching activities.
Table 2: Do’s and don’ts for work in medium compaction substrate areas:

<table>
<thead>
<tr>
<th>Do</th>
<th>Do Not</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Schedule work for suitable low tides and/or low water levels for lacustrine sites.</td>
<td>• Plan maintenance work outside the fisheries work window for the affected region.</td>
</tr>
<tr>
<td>• Check the substrate for the presence of sea life. Manually move surface rocks with attached sea life away from excavation area.</td>
<td>• Clear an access route greater than 5 m wide through a riparian area.</td>
</tr>
<tr>
<td>• Salvage sea life before and during excavation.</td>
<td>• Excavate a trench greater than 4 m wide.</td>
</tr>
<tr>
<td>• Separate excavated fines from surface substrate.</td>
<td>• Use any explosives underwater or a distance from water less than distances outlined within the DFO Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters.</td>
</tr>
<tr>
<td>• Replace surface substrate in same location once work is complete.</td>
<td>• Use unprotected concrete bags for cable protection.</td>
</tr>
<tr>
<td>• Wrap all concrete bags in three-layer kraft paper bags or purchase bags pre-made with this feature.</td>
<td>• Damage attached sea life such as barnacles, seastars or algae while moving cobble and boulders.</td>
</tr>
<tr>
<td>• Either re-bury any old, hard concrete bags in the trench or remove them from the site.</td>
<td></td>
</tr>
</tbody>
</table>

Figure 8 – View of typical habitats in medium compaction substrate areas.
**Hard Substrates**

Hard substrates include areas of rocky outcroppings where wave action can be intense (Figure 9). Protection of the cable in these areas is difficult and previous practices have involved routing the cable through crevices in the rock surface.

Fixing cables to hard surfaces can be difficult and the problem is compounded by the impracticality of burying cables in rock. Explosives are not permitted for use in rocky substrate areas unless setback distances can be observed (Section 5.1) or regulatory approval is granted. If concrete bags are used to anchor and protect the new cables, the bags must be wrapped in triple-layer kraft paper bags (Section 5.4) to prevent toxic concrete leachate from escaping into water. Manipulating existing large boulders to lay over the cables is another technique that is acceptable for hard substrate areas. Lastly, the use of concrete mattresses to protect cables in hard substrate areas is acceptable. Concrete mattresses consist of interlocking pre-cast mats that may be used for protection of underwater structures such as submarine cables.

![Figure 9 – View of typical habitats in hard substrate areas.](image)

<table>
<thead>
<tr>
<th><strong>Do</strong></th>
<th><strong>Do Not</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule work for suitable low tides and/or low water levels for lacustrine sites.</td>
<td>Plan maintenance work outside the fisheries work window for the affected region.</td>
</tr>
<tr>
<td>Check the substrate for the presence of sea life. Manually move surface rocks with attached sea life away from excavation area.</td>
<td>Clear an access route greater than 5 m wide through a riparian area.</td>
</tr>
<tr>
<td>Salvage sea life before and during excavation.</td>
<td>Use any explosives underwater or a distance from water less than distances outlined within the DFO Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters.</td>
</tr>
<tr>
<td>Separate excavated fines from surface substrate.</td>
<td>Excavate a trench greater than 4 m wide.</td>
</tr>
<tr>
<td>Separate excavated material from surface substrate.</td>
<td>Use unprotected concrete bags for cable protection.</td>
</tr>
<tr>
<td>Replace surface rocks in the same location from which they were moved.</td>
<td>Damage attached sea life such as barnacles, seastars or algae while moving cobble and boulders.</td>
</tr>
<tr>
<td>Wrap all concrete bags in three-layer kraft paper bags or purchase bags pre-made with this feature.</td>
<td>Either re-bury any old, hard concrete bags in the trench or remove them from the site.</td>
</tr>
</tbody>
</table>
5.6.3 Work Below Low Water (subtidal)

Distribution submarine cables (Section 2.1.2) are normally buried to lower low water in the marine environment. For lake crossings where ice can cause shoreline damage, high wave action sites or areas where boat traffic is frequent, distribution cables must be buried for a short distance below low water. All transmission submarine cables (Section 2.1.1) are buried below low water, normally to a depth of approximately 3 m, to protect against collisions from deep hull vessels or sailboat keels. In addition to burial of cables, rip rap and gravel may also be used to protect cables below lower low water. Placement of rip rap or gravel below the low water line would typically require agency review and approval.

Work Procedure for Cable Location of Existing Submarine Cables

When submarine cables need to be repaired or replaced, all cables in the crossing (most often four) may need to be located for safety and operational needs. Submarine cables are typically buried from the terminal pole, located above the high water mark, to the zero tide level. Below the zero tide, cables lay directly on the ocean bottom.

Where available, detailed GPS survey information will be used to locate covered cables, and under most circumstances, cables can be located by divers without disturbance to the ocean floor. However, below zero tide, the cables may become covered by a surficial layer of fine bottom materials, making it difficult for divers to locate the buried cable within the ROW.

To assist in the location of a buried de-energized cable, a locating signal tone will be applied and divers will locate the cable using a remote submersible signal receiver. In these cases, divers hand-dig to locate the buried de-energized cable. However, cable location signal tones cannot be applied to energized cables, and hand-digging is not permitted due to safety concerns. Once the general location of the faulted cable has been determined, and other options for cable location have been exhausted, water jetting over a faulted buried cable and laterally out to the other live cables will be required to facilitate location and placement of ropes and location buoys around the cables.

Water jetting for locating cables as described above will be kept to a minimum and will cease as soon as cables are located. Under no circumstances will water jetting be used in order to dig a trench to remove or install cables.

QEP involvement will be associated with all cable location activities involving water jetting. Timing and scope of involvement will be dictated by the type of work (replacement or repair) and urgency of the work (planned, no contingency or emergency) as described below:

Cable Replacement for Planned or No Contingency Works

If it is determined that cable replacement is required for either planned or no contingency works, cables will, under most circumstances, be located at the shore ends from the terminal poles without needing to water jet. In situations where cable investigations are required, there is enough lead time in the planning stages to conduct a habitat assessment if it is determined that water jetting is necessary to locate the cable. Under these circumstances, an assessment of the habitat that may be affected by water jetting will be made in advance by a QEP and submitted to the agencies for review as part of an overall EMP.

Emergency Works and Cable Repair Under No Contingency Conditions

Planning time is minimal under emergency conditions or no contingency conditions (Sections 3.1 and 3.2) where the decision has been made to repair rather than replace the cable. As cable repair includes locating cables off-shore below 0 tide, water jetting may be necessary. Under these circumstances, divers will minimize the amount of disturbance to the ocean bottom when locating the cable. After the cable has been located and work completed, a QEP will assess whether sensitive marine habitat was affected and if
necessary prepare a suitable restoration plan, subject to agency approval. Restoration will include effectiveness monitoring as described in an EMP.

**Table 4: Do’s and don’ts for work below low water (subtidal):**

<table>
<thead>
<tr>
<th>Do</th>
<th>Do Not</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule work for suitable low tides and/or low water levels for lacustrine sites.</td>
<td>Plan maintenance work outside the fisheries work window for the affected region.</td>
</tr>
<tr>
<td>Check the substrate for the presence of sea life. Manually move surface rocks with attached sea life away from excavation area.</td>
<td>Use heavy equipment in the subtidal zone.</td>
</tr>
<tr>
<td>Separate excavated fines from surface substrate.</td>
<td>Excavate under water using heavy machinery.</td>
</tr>
<tr>
<td>Manually excavate trenches under water using shovels to a maximum water depth of 0.5 m provided that requirements to protect low compaction substrates are followed and the area does not contain eelgrass.</td>
<td>Water jet or air lift in order to trench for cable removal or installation (water jet for cable location only as specified in Section 5.6.3).</td>
</tr>
<tr>
<td>Replace surface substrate in the same location from which it was moved.</td>
<td>Use any explosives underwater or a distance from water less than distances outlined within the DFO <em>Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters</em>.</td>
</tr>
<tr>
<td>Wrap all concrete bags in three-layer kraft paper bags or purchase bags pre-made with this feature.</td>
<td>Excavate trenches under water in areas containing eelgrass.</td>
</tr>
<tr>
<td>Either re-bury any old, hard concrete bags in the trench or remove them from the site.</td>
<td>Damage sea life while moving substrate.</td>
</tr>
<tr>
<td></td>
<td>Use rip rap or gravel to protect cables below low water. This has the potential to permanently bury large areas of fish habitat and is therefore prohibited under this agreement.</td>
</tr>
<tr>
<td></td>
<td>Use unprotected concrete bags for cable protection.</td>
</tr>
</tbody>
</table>

5.7 **Special Area Considerations**

Prior to construction activities, the work site location will be investigated for proximity to special areas such as marine protected areas (e.g., sponge reefs), marine parks, marine ecological reserves, archaeological sites and special management areas. The BCH-BCTC Environmental Representative will contact regional biologists from MOE or DFO to confirm the presence or absence of these special areas near the work site. Specific written approvals from park managers, local governments and/or Islands Trust may be required for work in these areas.

May 12, 2008
6. ENVIRONMENTAL MANAGEMENT PLAN AND REGULATORY NOTIFICATIONS

6.1 Environmental Management Plan

Based on the site assessment and project scoping, all submarine cable projects will have a site-specific Environmental Management Plan (EMP) prepared by a QEP. The EMP will be submitted with the notification to the agencies and included with the contract documents. The EMP will be reviewed with construction staff prior to initiation of work and be on site at all times for review and consultation. The EMP will include:

- justification for the work;
- location and timing of the work;
- site assessment as outlined in Section 4;
- project specifications and design drawings;
- Agreed Work Practices and Mitigation as outlined herein based on the site assessment;
- specific mitigation measures as recommended by the QEP (e.g., harvesting and installation of single strands of eelgrass in areas where sod replacement may be ineffective);
- mitigation strategies for use of machinery in medium to hard substrates;
- photographs of the site showing all work zones (upland, intertidal and subtidal);
- regulatory, emergency and project contacts;
- emergency response plans; and
- site restoration and monitoring requirements as per the AWPCM.

6.2 Regulatory Agency Notification Procedures

Agencies signatory to this document will be notified prior to any submarine cable works. For works completed according to work practices outlined herein, the notification will include:

- the maintenance priority;
- confirmation that the works will be conducted as per the AWPCM;
- location and timing of work; and
- site-specific Environmental Management Plan.

Notifications will be submitted to the appropriate DFO Area Office and the MOE Regional Office, where applicable.

Where maintenance work cannot be completed according to the work practices outlined herein, BCH-BCTC will adhere to normal regulatory approval processes.

If maintenance work can be completed in accordance with the work practices outlined herein, engineering designs and contract documentation will be finalized and tendered.
7. PROJECT IMPLEMENTATION

7.1 Pre-job and Tailboard Meetings
The pre-job meeting between the contractor and BCH-BCTC Project Manager must include the following items:

- a review of general and specific environmental specifications of the contract (EMP);
- the transfer of any further relevant environmental information or precautions that BCH-BCTC are aware of and that pertain to the job;
- the procedures for changing scope or specifications of work;
- roles and responsibilities;
- documentation needs; and
- reporting of environmental incidents.

In addition to the pre-job, a tailboard meeting with all field personnel will be held at the job site just prior to starting work. During the tailboard, the BCH-BCTC Environmental Representative will review and clarify all environmental procedures as described in the EMP, which will be documented in tailboard meeting minutes.

7.2 Inspections and Environmental Monitoring
The Project Manager or designate will inspect work while in progress. The purpose of this is to ensure that the contract is being implemented as per the specifications and to ensure that potential problems are identified and resolved prior to unwanted issues or incidents arising.

The BCH-BCTC Environmental Representative will monitor and record the construction methodologies, site activities and mitigation measures per the EMP. Full-time environmental monitoring by a QEP will be required below the high water mark (intertidal and subtidal work zones). Environmental monitoring reports, supported by photographs showing before, during and after images of the cable maintenance activities will be completed for each project and be available for review.

7.3 Changes in Project Scope
In some cases, the project scope may need to be altered during construction due to unforeseen circumstances or changes in field conditions. Any alterations to the project scope or contract specifications must be approved by the Project Manager, and if deemed necessary, referred to the BCH-BCTC Environmental Representative to confirm compliance with the AWPCM and EMP.

7.4 Non-Compliance
If the work deviates from the contract specifications, or work is undertaken that contravenes any section of this document, the Project Manager or the BCH-BCTC Environmental Representative will direct field personnel to immediately revise work practices to comply with the contract and this document. If compliance cannot be achieved, the Project Manager or the BCH-BCTC Environmental Representative will stop work activities until the issue can be resolved. In the event of a violation of federal and/or provincial law, appropriate regulatory agencies will be notified by the Project Manager or the BCH-BCTC Environmental Representative. Site-specific response plans for environmental incidents with appropriate regional contacts will be included with contract documentation. Actions to correct any contractual or regulatory non-compliances will be taken as necessary. In addition, appropriate restoration programs will be implemented in areas affected by adverse environmental impacts.
8. POST-CONSTRUCTION MONITORING AND ASSESSMENT

A crucial component of this integrated approach to coastal and lakeshore area work will be an evaluation to determine whether the project design, EMP and associated implementation have achieved the goals for the site. The BCH-BCTC Environmental Representative will complete a site assessment upon completion of all work and after a period of one year.

This assessment will involve assessment of the following as applicable:

- success of seeding and/or planting of upland areas;
- site stability and erosion of upland areas;
- formation of dendritic channels and cable exposure in intertidal;
- success of eelgrass or salt marsh vegetation transplants and recolonization in intertidal; and
- other residual impacts.

9. SUMMARY REPORTING TO REGULATORY AGENCIES

Under the Protocol Agreement (PA), an annual regulatory review is required. This review will help to ensure compliance with regulations and that the partnership concepts of the PA are being applied. In order for regulators to audit site activities, they must know what, when, where and why activities were conducted.

Based on this requirement, annual regional meetings will be conducted with the regulatory Partners to review past years’ work (review of post-construction reports and possible on-site reviews) as well as to discuss planned work. Based on outcomes from regional meetings, the Governance Committee will meet annually to review the PA and all associated appendices, including the AWPCM. Updates and amendments to the AWPCM will occur as specified in the PA.
APPENDIX A – REDUCED RISK INSTREAM WORK WINDOWS FOR BRITISH COLUMBIA†

Marine Environment – DFO

http://www-heb.pac.dfo-mpo.gc.ca/decisionsupport/os/timing_e.htm

Freshwater Environment – MOE

(see links below for detailed information)

Vancouver Island: http://wlapwww.gov.bc.ca/vir/wateract/terms_conditions_vir.pdf

Lower Mainland: http://wlapwww.gov.bc.ca/sry/wateract/work_windows_sry.pdf

Thomson-Nicola: http://wlapwww.gov.bc.ca/sir/wateract/terms_conditions_windows_thr.pdf

Okanagan: http://wlapwww.gov.bc.ca/okr/wateract/workwindows.html

Kootenays: http://wlapwww.gov.bc.ca/kor/wateract/least_risk_kor.pdf

Cariboo: http://wlapwww.gov.bc.ca/car/wateract/terms_conditions_car.pdf

Skeena: http://wlapwww.gov.bc.ca/ske/wateract/terms_conditions_skr.pdf


Peace: http://wlapwww.gov.bc.ca/nor/wateract_per/terms_conditions_per.pdf

† Reduced Risk Work Windows should be confirmed by regional agency representatives.
APPENDIX B – RIPARIAN PLANTING STANDARD

The following planting standard is to be used in conjunction with the AWPCM. The standard will be applied when the BCH-BCTC Environmental Representative determines that riparian ecosystem values will be compromised as a result of vegetation maintenance requirements.

The planting standard is designed to maintain riparian zone function. In cases where tree removal negatively impacts the site, replanting will occur in a well planned and efficient way. When planning total tree removal that may directly affect stream and coastline function, the goal of the planting will be to create stable, low-growing plant communities that still produce shading, bank stability and input of organic debris.

**Planting Design / Planting Criteria:**

- Planting over and immediately around underground cables will comply with BC Hydro Engineering Standard ES 42-C22 *Standard for Landscaping around Underground Transmission Lines*.
- Where possible, choose plant materials that are adapted to the site conditions. Local stands of willow or other suitable species are already well suited to the climate, soil conditions and available moisture and they make good candidates for survival. Cost efficiencies are possible using on-site native materials because plant costs are limited to labour for harvesting and handling. Extraction of donor materials from sensitive areas such as riparian zones and endangered plant communities is to be avoided.
- To produce on-site biodiversity, the mix of plantings should be planted in a random layout design leaving gaps so that natural biodiversity can be produced. Modify existing tall vegetation by crown reducing as this will produce shrub trees that in most cases grow more horizontal than vertical.
- Arrange planting programs in late fall (*September to November*) or early spring as (*March to April*) as planting is most effective when installed during the dormant season.
- When choosing live material, remember that young (less than one year old) wood or suckers will often sprout easier under optimum conditions, but healthy, older wood (one to four years old) has greater vegetative (energy) reserves necessary to consistently sprout, and the older wood is much stronger.
- All cuttings should be soaked for a minimum of 24 hours, whether they are stored or harvested and immediately installed.
- Tree stock should be a minimum of 0.5 m in height when purchased. The quantity of stock planted should ensure at least 80% take, or replanting will be required.
- Where planting is to be carried out, the BCH-BCTC Environmental Representative will advise on specific planting layout. The planting layout will depend on what is required to reestablish or enhance existing riparian zone, species selected, density of plants, mature plant heights and planting system: linear, random, grid, etc.

**LIVE STAKING**

**Definition:**

- Live stake planting involves the insertion and tamping of live, vegetative cuttings into the ground in a manner that allows the stake to take root and grow.

**Purpose:**

- Using a system of live stakes creates a root mat that stabilizes the soil by reinforcing and binding soil particles together and by extracting excess soil moisture.
Conditions Where Live Staking Applies:

- Live staking performs an important function of stabilizing and modifying the soil and stream banks, serving as a pioneer species until other plants become established.
- Live staking enhances conditions for natural invasion and the establishment of other plants from the surrounding plant community.
- Plant establishment can improve aesthetics and provide fish and wildlife habitat.

Planning Consideration:

- Live stake harvest and installation should be performed during its dormant season, late fall to early spring (November to April).
- Use site reconnaissance to identify species, growth form, soil and site conditions on adjacent sites and compare their conditions to the construction site. Planting will be more successful as soil, site and species selected match stable, vegetated nearby sites. If the native species that you want to plant are not found in the vicinity, live staking may not be a good option.
- Choose plant material adapted to the site conditions and confirm the availability of plant material that will be used on site before construction begins.

Harvesting:

- Stakes will be harvested and planted when the chosen species are dormant. When harvesting cuttings, select healthy, live wood that is reasonably straight. This period is generally from late fall to early spring (November to April), or before the buds start to break.
- Use live wood at least one year old or older. Avoid suckers of current year’s growth as they lack sufficient stored energy reserves to sprout consistently. The best wood is two to four years old with smooth bark that is not deeply furrowed.
- Make clean cuts with unsplit ends. Trim branches from cutting as close as possible. The butt end of the cutting will be pointed or angled and the top end will be cut square.
- Identification of the top and bottom of a cutting is accomplished by angle cutting the butt end. The top, square cut, can be painted by spraying the top 1–2 inches (2.5–5 cm) with a latex paint (navy blue). This procedure will assure that the stakes are planted with the top up, and makes the stakes more visible for subsequent planting evaluations.

Diameter:

- Cuttings should generally be ¾ inch (2 cm) or larger depending on the species. Highest survival rates are obtained from using cuttings up to 2 inches (5 cm) in diameter. Larger diameter cuttings (3 inch or 7.5 cm) are needed for planting in rocky conditions.

Length:

- Cuttings of small diameter (up to 1½ inches (4 cm)) will be 18 inches (0.5 m) long, minimum. Thicker cuttings should be longer (0.5 to 1 m).
- It is imperative that cuttings are long enough to reach into the mid-summer water table.
- No less than 80% total length must be into the ground.
- Stakes should be cut so that a terminal bud scar is within 1–4 inches (2.5–10 cm) of the top.
- At least 2 buds and/or bud scars will be above the ground after planting.

Installation:

- Stakes must be planted with butt ends into the ground. Leaf bud scars or emerging buds should always point up.
- Stakes must not be allowed to dry out. All cuttings should be soaked in water for a minimum of 24 hours. Soaking significantly increases the survival rate of the cuttings; however, they may be planted the same day they are harvested.
Approved Work Practices for Routine Electrical Cable Maintenance  
*in Freshwater and Marine Coastal Areas*

- Within the planting plan layout, plant stakes 0.5 to 1 m apart.
- Set the stake as deep as possible into the soil, preferably with **80% of its length into the soil** and in contact with mid-summer water table.
- It is essential to have good contact between the stake and soil for roots to sprout. Tamp the soil around the cutting.
- Use an iron stake or bar to make a pilot hole in firm soil.
- Do not damage the buds, strip the bark or split the stake during installation.
- Remove and replace split or damaged stakes.

**Inspection and Maintenance:**
- Periodic inspection, repair and maintenance will be required for one year. If 80% take is not achieved, supplementary planting and an additional year of monitoring will be required.

**Plant Species:**
The following species are recommended for riparian replacement planting. Not all species can be harvested locally or used in a live staking program.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Latin Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitka willow</td>
<td>Salix sitchensis</td>
</tr>
<tr>
<td>Indian plum</td>
<td>Oemleria cerasiformis*</td>
</tr>
<tr>
<td>Black twinberry</td>
<td>Lonicera involucrata*</td>
</tr>
<tr>
<td>Pacific ninebark</td>
<td>Physocarpus capitatus</td>
</tr>
<tr>
<td>salmonberry</td>
<td>Rubus spectabilis*</td>
</tr>
<tr>
<td>Nootka rose</td>
<td>Rosa nutkana*</td>
</tr>
<tr>
<td>red elderberry</td>
<td>Sambucus racemosa*</td>
</tr>
<tr>
<td>hardhack</td>
<td>Spiraea douglasii ssp. douglasii*</td>
</tr>
<tr>
<td>red osier dogwood</td>
<td>Cornus stolonifera*</td>
</tr>
<tr>
<td>oceanspray</td>
<td>Holodiscus discolor*</td>
</tr>
<tr>
<td>Sitka alder</td>
<td>Alnus crispa ssp. sinuata</td>
</tr>
<tr>
<td>black hawthorn</td>
<td>Crataegus douglasii*</td>
</tr>
<tr>
<td>Western red cedar</td>
<td>Thuja plicata</td>
</tr>
<tr>
<td>highbush cranberry</td>
<td>Viburnum edule*</td>
</tr>
<tr>
<td>red flowering currant</td>
<td>Ribes sanguineum*</td>
</tr>
<tr>
<td>Saskatoon</td>
<td>Amelanchier alnifolia/formosa</td>
</tr>
</tbody>
</table>

* denotes fruit-bearing species

**Ground Seeding:**
If ground seeding is required due to the disturbance of the area around where trees and/or vegetation have been removed, a regionally specific seed mix should be used to encourage a tight competitive grass sward to restrict the amount of unwanted tall-growing tree seedlings.

- Seeding reduces surface erosion, enhances the soil’s absorption and retention of water and promotes establishment of suitable soil conditions for larger plants. Generally, a combination of 2–5 species of sod-forming grasses, bunch grasses and nitrogen-fixing legumes are required, depending on soil type, climate, soil moisture and species compatibility.

**Seeding:**
- Seed area during early spring or after 15 August to within two weeks of freeze-up.
- Use a regionally specific seed mix.
• Sow half of the required amount of seed in one direction and the remainder at right angles. Incorporate seed into a minimum depth of 6 mm (1/4 inch) simultaneously or within one hour after seed operation.
• Mix carefully into the soil with a light chain harrow or wire rakes.
• If practical, water with a fine spray, avoiding washing out of the seed. Apply enough water to ensure penetration of a minimum 50 mm (2 inches).

Seeding Rate:
• Grass-legume ratio should be 70:30 in wet areas and 80:20 in dry areas.
• Dry seeding should be done at a minimum rate of 80 kg/ha.
• Fertilize with 19-20-12 or 18-18-18 at a minimum rate of 300 kg/ha. Fertilizers are to be applied by hand within 5 m from the high water mark of a water body. No fertilizers will be allowed to enter a water body.

Additionally:
• Legumes species should be inoculated when mixed.
• Seed immediately on disturbed area; do not allow the surface to become compacted.
1. INTRODUCTION

This Standard outlines the landscaping requirements for vegetation and landscaping placed above and around buried Transmission cables.

The ampacity of the buried cables is dependant on the thermal heat dissipation through the surrounding native soils and backfill materials. When trees are planted along the right of way the deep roots that develop can absorb all the moisture in the soil, altering the thermal properties of the surrounding soil and thereby negatively impact the cable’s ampacity rating. Also, root systems of large growth yield trees near the duct banks could structurally damage ductbanks and cable chases.

Each landscaping exercise must be reviewed on a case-by-case basis. Detailed landscaping drawings are to be submitted to BC Hydro Engineering Transmission Cables Design Department for approval, at least one month in advance of the work.

2. PURPOSE

The purpose of this landscaping standard is to provide requirements and guidelines for discussions with municipalities, developers, landowners or other interested parties, to try to plan and manage the vegetation and landscaping placed above and adjacent to Transmission cables and associated underground works in order to protect BC Hydro Underground assets from potential damage caused by landscaping. The standard covers both new installations as well as serves as a maintenance standard to ensure existing cable systems remain unaffected after they have been commissioned.

3. POLICY

Most herbaceous annuals, perennials, and ornamental grasses can safely be grown over the underground works.
Any woody shrubs or plants with a shallow root system will be allowed near the underground lines if they do not interfere with underground transmission installation. Normally, this will be about 3.0m from the trench duct bank/underground cable line. The stated distances shall be measured from the centre of the tree trunk or shrub mass to the centre line of the ductbank.

Many tall growing trees and some shrubs should not be planted near the duct banks. Normally this would be at least 5 m away. A useful rule of thumb is that a mature tree or shrub will have a root system that is twice as wide as the above ground canopy. Most trees and shrubs have the majority of their roots (>80%) in the top 0.5 m of soil. However, some trees are deeply taprooted. (see attached spreadsheet for details on commonly planted ornamentals).

For any potential encroachments of the ROW the Policies and Procedures stated in Engineering Standard ES42-A0001-R00 shall apply.

Refer to Installing Landscaping Around Electrical Facilities: Standard Procedure 10.20-01C-. Maintenance Standard, Substation Grounding. (BCTC and BCHydro)

http://w3.bchydro.bc.ca/sustainability/tools/bmp/veg_pest_wild/landscape/std.shtml
### TABLE 1: LIST OF VARIOUS BUSHES, PLANTS AND TREES AND NATURE OF THEIR ROOT SYSTEM

<table>
<thead>
<tr>
<th>Genus</th>
<th>Rooting System</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Shallow</td>
<td>Deep</td>
</tr>
<tr>
<td><strong>Conifers and Gymnosperms</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pine (<em>Pinus</em>) typical</td>
<td></td>
<td>moderately deep and wide spreading</td>
</tr>
<tr>
<td>western white pine (<em>P. monticola</em>)</td>
<td></td>
<td>deep</td>
</tr>
<tr>
<td>Ponderosa pine (<em>P. ponderosa</em>)</td>
<td>very wide spreading</td>
<td>may have deep massive tap root in good soils</td>
</tr>
<tr>
<td>larch (<em>Larix</em>)</td>
<td></td>
<td>wide spreading</td>
</tr>
<tr>
<td>spruce (<em>Picea</em>)</td>
<td></td>
<td>wide spreading, pliable laterals</td>
</tr>
<tr>
<td>hemlock (<em>Tsuga</em>)</td>
<td></td>
<td>wide spreading</td>
</tr>
<tr>
<td>Douglas-fir (<em>Pseudotsuga</em>)</td>
<td></td>
<td>strong, wide spreading</td>
</tr>
<tr>
<td>true firs (<em>Abies</em>)</td>
<td></td>
<td>wide spreading</td>
</tr>
<tr>
<td>amabilis fir (<em>A. amabilis</em>)</td>
<td></td>
<td>moderately deep and wide spreading</td>
</tr>
<tr>
<td>grand fir (<em>A. grandis</em>)</td>
<td></td>
<td>deep and windfirm</td>
</tr>
<tr>
<td>Arbor-vitae or cedar (<em>Thuja</em>)</td>
<td>wide spreading, strong</td>
<td></td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-----------------------</td>
<td>---</td>
</tr>
<tr>
<td>Yellow cedar (<em>Chamaecyparis</em>)</td>
<td>yes</td>
<td>yes</td>
</tr>
<tr>
<td>Junipers (<em>Juniperus</em>)</td>
<td>wide spreading</td>
<td>yes, where soils permit</td>
</tr>
<tr>
<td>Yew (<em>Taxus</em>)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>Other conifers:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sequoia (<em>Sequoiadendron</em>)</td>
<td></td>
<td>not well defined, but given their size should not be planted within 5 m of cable or duct banks</td>
</tr>
<tr>
<td>Japanese cedar (<em>Cryptomeria</em>),</td>
<td></td>
<td>ditto</td>
</tr>
<tr>
<td>Monkey puzzle tree (<em>Araucaria</em>)</td>
<td>ditto</td>
<td></td>
</tr>
<tr>
<td>Cedar of Lebanon (<em>Cedrus</em>)</td>
<td>ditto</td>
<td></td>
</tr>
<tr>
<td>Ginko (<em>Ginkgo</em>)</td>
<td>ditto</td>
<td></td>
</tr>
<tr>
<td>Deciduous or Broadleaf Trees and Shrubs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Willow (<em>Salix</em>)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Smaller ornamental shrub species</td>
<td>wide spreading</td>
<td>probably fine if planted 3 m from duct banks or cables</td>
</tr>
<tr>
<td>Weeping willow (<em>Salix alba ssp. vitelliana</em>)</td>
<td></td>
<td>seeks water, often damages sewer lines</td>
</tr>
<tr>
<td>Poplars (<em>Populus</em>)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trembling aspen (<em>P. tremuloides</em>)</td>
<td>very widepreading, suckers</td>
<td></td>
</tr>
<tr>
<td>Balsam/black cottonwood (<em>P. balsamifera ssp. balsamifera</em> and <em>P. balsamifera ssp. trichocarpa</em>)</td>
<td>wide spreading, like water</td>
<td></td>
</tr>
<tr>
<td>Tree Species</td>
<td>Root Characteristics</td>
<td>Recommendation</td>
</tr>
<tr>
<td>-------------------</td>
<td>----------------------------------</td>
<td>------------------------------</td>
</tr>
<tr>
<td>walnut (Juglans)</td>
<td>widespread, deep laterals and often tap rooted</td>
<td>not recommended within 5 m of underground installations</td>
</tr>
<tr>
<td>hickory (Carya)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>birch (Betula)</td>
<td>wide spreading</td>
<td>occasionally in some soils</td>
</tr>
<tr>
<td>alder (Alnus)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>beech (Fagus)</td>
<td>wide spreading</td>
<td>copper beech common ornamental</td>
</tr>
<tr>
<td>oak (Quercus)</td>
<td></td>
<td>often deep laterals and tap-rooted</td>
</tr>
<tr>
<td>Garry oak (Q. garryana)</td>
<td>widespread, little or no tap root</td>
<td></td>
</tr>
<tr>
<td>pin oak (Q. palustris)</td>
<td>shallow, not taprooted</td>
<td></td>
</tr>
<tr>
<td>elm (Ulmus)</td>
<td>wide spreading</td>
<td>occasionally</td>
</tr>
<tr>
<td>magnolia (Magnolia)</td>
<td>wide spreading on taller varieties</td>
<td>some small ornamentals o.k. (e.g. some M. stellata cultivars)</td>
</tr>
<tr>
<td>tulip-tree (Liriodendron)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>Tree Type</td>
<td>Spreading</td>
<td>Notes</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-------------</td>
<td>------------------------------------------------</td>
</tr>
<tr>
<td>horse-chestnut (<em>Aesculus</em>)</td>
<td></td>
<td>uncertain, do not plant near underground works</td>
</tr>
<tr>
<td>witch-hazel (<em>Hamamelis</em>)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>plane tree or sycamore (<em>Platanus</em>)</td>
<td>very shallow and wide spreading</td>
<td></td>
</tr>
<tr>
<td>mountain-ash (<em>Sorbus</em>)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>hawthorn (<em>Crataegus</em>)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>apples (<em>Malus</em>) and pears (<em>Pyrus</em>)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>Saskatoon or serviceberry (<em>Amelanchier</em>)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>cherry (<em>Prunus</em>)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>honey-locust (<em>Gleditsia</em>)</td>
<td>wide spreading</td>
<td>some cultivars are common ornamental shade trees</td>
</tr>
<tr>
<td>black locust (<em>Robinia</em>)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>sumac (<em>Rhus</em>)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>maples (<em>Acer</em>)</td>
<td>wide spreading, some very shallow</td>
<td></td>
</tr>
<tr>
<td>cascara (<em>Rhamnus</em>)</td>
<td></td>
<td>uncertain</td>
</tr>
<tr>
<td>basswood or linden (<em>Tilia</em>)</td>
<td></td>
<td>wide spreading</td>
</tr>
<tr>
<td>Tree Type</td>
<td>Characteristics</td>
<td>Notes</td>
</tr>
<tr>
<td>---------------------</td>
<td>--------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>dogwood (Cornus)</td>
<td>yes</td>
<td>Pacific dogwood (C. nutallii) often taprooted</td>
</tr>
<tr>
<td>arbutus (Arbutus)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>ash (Fraxinus)</td>
<td>wide spreading</td>
<td>yes in well-drained soils</td>
</tr>
<tr>
<td>viburnum (Viburnum)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>elderberry (Sambucus)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>lilac (Syringa)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>catalpa (Catalpa)</td>
<td>wide spreading, seeks moisture</td>
<td></td>
</tr>
<tr>
<td>euonymus (Euonymus)</td>
<td>wide spreading</td>
<td>many ornamental species</td>
</tr>
<tr>
<td>katsura tree (Cercidiphyllum)</td>
<td></td>
<td>uncertain</td>
</tr>
<tr>
<td>hazelnut (Corylus)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>rhododendrons and azalea (Rhododendron)</td>
<td>wide spreading</td>
<td></td>
</tr>
<tr>
<td>smoke tree (Cotinus)</td>
<td></td>
<td>uncertain, popular small tree in cultivation</td>
</tr>
</tbody>
</table>

**Subject:** Standard for Landscaping around Underground Transmission Lines

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<table>
<thead>
<tr>
<th>By:</th>
<th>Rev:</th>
<th>Acpt:</th>
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</tbody>
</table>

**Date:** 1 March 2006

**Rev:** G. A. MacPhail

**Acpt:** B. Anderson

**ES 42-C22**