Best Management Practices Guidelines

FOR PACIFIC WATER SHREW IN URBAN AND RURAL AREAS

Denis Knopp photos

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WORKING DRAFT

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Working Draft

Executive Summary

The Pacific Water Shrew is a semi-aquatic shrew that lives in aquatic and streamside (i.e., riparian) habitats in and around many types of watercourses and wetlands, preying mostly on invertebrates. The distribution of the species in Canada is limited to the Lower Mainland region of B.C. The Pacific Water Shrew has been designated as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and has been listed on Schedule 1 of the *Species at Risk Act* (SARA)

The Ministry of Environment, with the Pacific Water Shrew Recovery Team, has developed this document to provide planners, developers, and consultants with information about the Pacific Water Shrew, and guidelines on how to include Pacific Water Shrew in environmental assessments. This document suggests actions that municipalities, regional districts and developers can take to ensure the recovery of Pacific Water Shrew, and use of these guidelines demonstrates due diligence towards species protection and recovery.

All environmental assessments that occur within the range of the Pacific Water Shrew, and involve projects that will occur within, or result in habitat modification within 100 m of any waterbody (stream, creek, wetland, marsh, ocean, ephemeral or intermittent watercourse) should include Pacific Water Shrew. This document provides detailed guidelines for consultants to follow on when and how they should conduct an environmental assessment for Pacific Water Shrew.

Environmental assessments for Pacific Water Shrew should use a 2-prong approach that includes habitat sampling, followed by live-trapping for Pacific Water Shrew in select habitats. Where a Pacific Water Shrew is captured, or in areas of habitat rated as high or moderate capability for Pacific Water Shrew (based on ratings available from the Ministry of Environment), these guidelines recommend the implementation of a 100 m protective area around the habitat (*e.g.* a 100 m area on each side of a linear feature such as a stream, or a 100 m protective area around a more circular feature such as a wetland). Within the outer 40 m of the identified 100 m protective area, low-impact activities can occur, such as the construction of a small walking trail, which will increase the value of the area to the surrounding community.

In addition to guidelines for environmental assessments, this document also includes suggested actions for conservation organizations, and best management practices for habitat, including information on habitat protection, habitat rehabilitation, activities around crossings over watercourses or wetlands, recommendations for retention and addition of riparian vegetation or coarse woody debris, recommendations to help maintain habitat connectivity for Pacific Water Shrew, and information for municipalities on management options, such as the implementation of Development Permit Areas, Streamside Protection Zones, and Integrated Stormwater Management.

Preface

British Columbia is recognized globally for its exceptional wildlife, diversity of ecosystems and its rich natural resources. The Ministry of Environment (MOE) works to maintain these valuable natural assets, which are at the heart of many recreational end economic activities enjoyed by British Columbians in all regions of the province.

MOE has responsibility for the protection and stewardship of B.C.'s environment. To achieve this goal, the Ministry develops policy and legislation, regulations, codes of practice, environmental contracts and covenants (legal agreements). In addition, the Ministry sets science- and results-based objectives and standards for activities that affect biodiversity. It monitors and reports on selected species and habitats, and acquires information on habitat and species health.

Clear goals, objectives, meaningful performance measures and science-based tools guide Ministry actions in improving environmental management. Regulatory frameworks allow headquarters and regional staff to set and report on standards for environmental quality, and for discharges and emissions to air, land and water. Regulatory compliance is addressed through policy development, enforcement and publicly reporting the results of compliance monitoring.

An Increasing Role for Stewardship

While the Ministry takes a leading role in the protection of B.C.'s natural resources, species, and habitats, environmental protection and stewardship is the responsibility of all British Columbians. Stewardship of natural resources is key to maintaining and restoring the province's natural diversity, and achieving the Ministry's important environmental mandate. A stewardship approach involves all British Columbians taking responsibility for the well being of the environment by acting to restore or protect a healthy environment.

The Ministry is actively pursuing opportunities for sharing the responsibility of environmental protection. As a Ministry, MOE looks to establish vital partnerships and move forward together to protect the environment and the health of all British Columbians. MOE is listening to and developing partnerships with governments, First Nations, communities, academic institutions, industries, volunteer organizations, and citizens. The involvement of these partners in the shared environmental protection and stewardship of B.C.'s resources is essential because of their local knowledge, resources and expertise. The environment will benefit as a result of an increased level of responsible environmental stewardship ethics, immediate and long-term improvements to environmental health and an increased awareness of ecosystem needs among the partners.

A Changing Process

Over the next several years, the Ministry will be making strategic shifts (changes in business practices) towards:

- Shared stewardship between the Ministry and other stakeholders;
- Clear roles for gathering environmental information and achieving environmental objectives;
- Integrated MOE program delivery based on the best available science and an ecosystem-based approach; and
- Clear, reasonable environmental outcomes, with discretion as to how to achieve these outcomes.

This document is an interim document and will change in the future. Changes to the delivery model of this information are also expected, through the movement towards Internet-based access.

What will this document do for me?

This document exists to help you act as a steward of the environment. The information you will find in this document will help you to ensure that your proposed development activities are planned and carried out in compliance with the various legislation, regulations, and policies that apply to your activity and relate to the Pacific Water Shrew. By understanding the standards your activities must meet, you can choose an appropriate set of best practices to help you carry out your activities to achieve the required standards.

This document also provides information regarding Pacific Water Shrew biology, environmental assessment and habitat restoration methodologies, and links to stewardship organizations and relevant literature.

How does this version of the document differ from previous versions?

This version has updated requirements on:

1. conducting the habitat assessment (Section 2.3 and Figure 6), which includes the requirement that consultants make a reasonable effort to identify ALL potential Pacific water shrew habitat in the project area; and
2. conducting Pacific water shrew surveys (Section 2.5), which includes the requirement that consultants check traps more frequently.
3. consulting the Pacific Water Shrew Recovery Team.'s Preliminary partial critical habitat identification for Pacific Water Shrew (*Sorex bendirii*). document to ensure the avoidance of known occupied sites (Section 1.9).

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1 Introduction

1.1 Range of the Pacific Water Shrew

The Pacific Water Shrew (*Sorex bendirii*) is sometimes also referred to as the Marsh Shrew. This small mammal inhabits aquatic and streamside (i.e., riparian) habitats in and around many types of watercourses and wetlands, preying mostly on invertebrates. The distribution of the species in Canada is limited to the Lower Mainland region of B.C. It is also found along the coast of the United States in Washington, Oregon, and northern California (Figure 1).

Figure 1. The global distribution of the Pacific Water Shrew is limited to a central region of the Pacific coast.

The current known distribution of the species in B.C. (which may be an underestimate) ranges from Point Grey in the west, north to Squamish (perhaps as far North as Whistler), east to

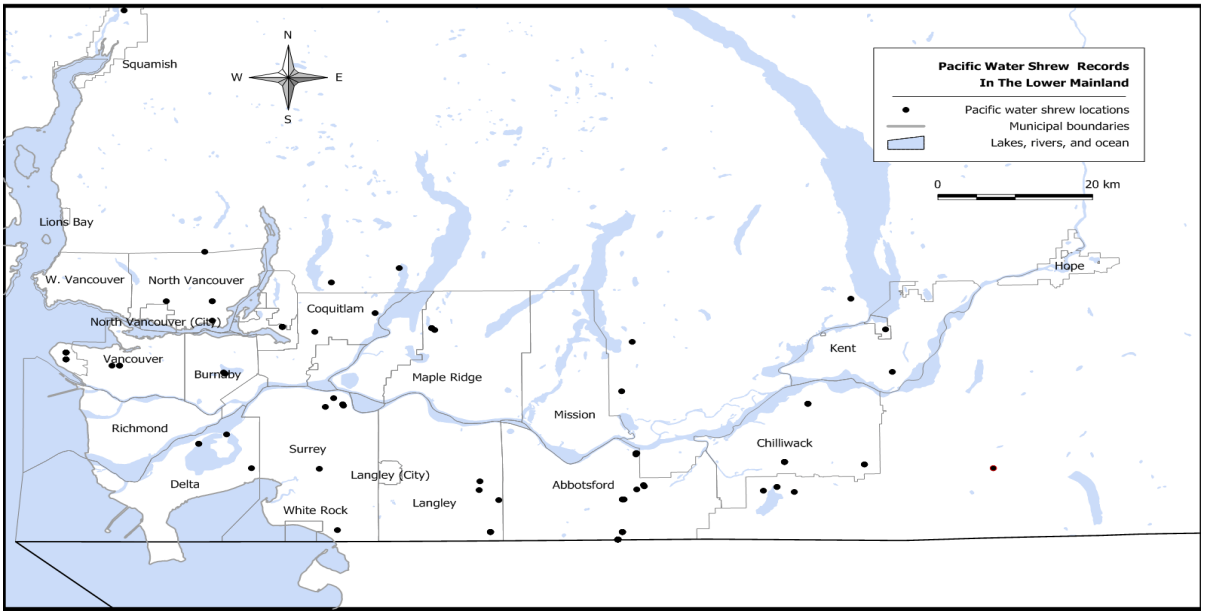

Figure 2. Location of Pacific Water Shrew captures in the Lower Mainland. Contact the B.C. Conservation Data Centre and the Recovery Team for up-to-date information about water shrew capture locations.

the Chilliwack Valley (sightings in the Skagit Valley suggest it the shrew may occur further east), and south to the U.S. border (Figure 2).

The current known distribution of the species likely reflects sampling effort and the difficulty of capturing these shrews more than their actual distribution. Sampling for the Pacific Water Shrew has been extremely limited. During the last survey for the species in the Lower Mainland in 1992, only 3 shrews were captured at the 55 sites surveyed.

1.2 Species description

The Pacific Water Shrew is not a rodent; it is a member of the order Insectivora, along with moles. It is the largest shrew in B.C. (Figure 3, Figure 4). The overall body length of the Pacific Water Shrew averages 15.4 cm, 7 cm of which is tail. The average weight is 13.2 g. The fur is dark brown to black dorsally and dark brown ventrally (Figure 3, Figure 4a). The hind feet of the shrew have a fringe of stiff hairs to assist with swimming (Figures 4b, 11). See *Section 2.6* for a detailed description of Pacific Water Shrew in relation to other local small mammals.

Figure 3. The Pacific Water Shrew (*Sorex bendirii*) is the largest shrew in British Columbia. Denis Knopp photo.

1.3 Habitat description

The Pacific Water Shrew is a riparian, or streamside, specialist and is usually captured within 60 m of watercourses or wetlands, but shrews have been captured in moist forest up to 1 km away from standing water (these may be dispersing juveniles). Home ranges of these shrews are likely long and linear and follow the water's edge. This shrew forages on land and in the water. Soft-bodied aquatic invertebrates comprise about 25% of its diet. The interlocking stiff hairs on the feet create a web-like effect for more powerful swimming. Foraging bouts in water last up to 3 ½ minutes during which these shrews pry under rocks and debris looking for food. All food captured is carried to the shore to be eaten. On land this shrew primarily forages in

leaf litter and in and under logs for prey such as earthworms, sowbugs, and centipedes.

Figure 4. Close up views of Pacific Water Shrew showing a) fur colour (left) and b) stiff hairs on rear foot (right). Chris Schmidt photos.

Pacific Water Shrews have been captured along a variety of watercourses and wetlands including channelised watercourses with dense surrounding vegetation, along the edges of lakes, ponds and beaches with dense vegetation, small ephemeral creeks, and at the edges of marshes and swamps.

Based on the data available, the ***best quality habitat*** *for the species is currently defined as:*

- *a riparian area around and including a permanent stream or creek (<10 m wide) or any size wetland (including swamps, marshes, lakes, ocean beaches, etc.) with a mature coniferous forest (structural stages 5-7) of western red-cedar and/or western hemlock or a mature deciduous or mixed forest (structural stages 4-7); these sites should be rated as high or moderate in habitat capability mapping;*
- *habitat surrounding the stream or wetland sufficient to protect the normal functioning of the riparian ecosystem (i.e., a protective area).*

Other suitable and/or important habitats include:

- sites similar to those described above, but at younger structural stages (although the site might not be currently the most suitable, it is still capable of becoming suitable with time);
- non-forested sites around streams/wetlands with heavy shrub cover;
- ephemeral or intermittent waterways;
- streams 10-20 m (bankfull width) with suitable surrounding habitat;
- corridors for connecting habitat patches (preferably riparian habitat but potentially moist mature coniferous or deciduous forest); these sites may be rated high, moderate, or low in habitat capability mapping.

Site indicators of rich moist habitat (*e.g.*, skunk cabbage, salmon berry, devil's club; see Craig 2009), indicate capable/suitable habitat. Dense riparian vegetation and downed wood are also valuable habitat components as they provide cover and travel corridors.

Two habitat models have been produced using the current definition of best quality habitat identified above: 1) habitat suitability/capability ratings have been assigned to habitat based on Biogeoclimatic zone site series (Terrestrial Ecosystem Mapping [TEM]; Craig 2009), and 2) habitat suitability ratings have been assigned to habitat based on characteristics of the stream and surrounding vegetation (Sensitive Habitat Inventory Mapping [SHIM]; Craig 2006). Please see these documents for a draft comprehensive review and rating system for Pacific Water Shrew habitat in the lower mainland.

These habitat definitions and models are subject to change based on continuing research – contact the Ministry of Environment for the latest information. Structural stages are used per *Field Manual for Describing Terrestrial Ecosystems* (see link in *Section 7.2*).

1.4 Threats to the species

The major threat to Pacific Water Shrew is the destruction or degradation of currently suitable or ultimately capable habitat. In addition, mortality from human sources, such as predation by domestic cats or mortality in fish traps, are potentially large threats to this species.

Because the Pacific Water Shrew is a riparian-dependent species that forages extensively in water, many of the guidelines for protecting fish habitat will also protect habitat for this shrew. Activities that result in the modification of stream channel structure or stability (*e.g.*, improperly funnelled stormwater run-off, road building, cattle access to streams) or water quality (*e.g.*, siltation, run-off from roads or agricultural areas, leaching from malfunctioning residential septic fields, removal or alteration of riparian vegetation) will affect this shrew's food sources.

The total channel length of natural rivers and streams in the Vancouver area has been reduced from > 120 km historically to < 20 km currently (Oke *et al.* 1992). Steyn *et al.* (1992) reported a 24% reduction in the area of natural riparian vegetation in the Greater Vancouver Regional District between 1986 and 1992. Approximately 15% of streams in the Lower Fraser Valley have been lost (culverted, paved over, or filled in; Fisheries and Oceans Canada 1999). An additional 23% of streams are threatened (have been affected by 1 out of 8 possible impacts that degrade riparian habitat and water quality), 48% are endangered (affected by > 1 impact criteria), and only 14% are classified as wild (not significantly impacted).

The three categories of habitat threats are:

- Habitat loss: including permanent loss of habitat, and the loss of useful habitat. Caused primarily by:
    - removal of riparian vegetation,
    - inadequate riparian buffers, and
    - loss of streams or wetlands that are not protected during development.
- Habitat degradation: including modification of the waterbody, water quality or the surrounding riparian vegetation. Caused primarily by:

- altering or removing riparian habitat,
- inadequate riparian buffers,
- edge effects,
- effects from run-off (including pesticides, heavy metals, salts, manure), siltation, and leaching among others, and
- encroachment (especially problematic in urban areas).

- Habitat fragmentation: including loss or degradation of habitat resulting in the inability of shrews to move among habitat fragments. The ability of the shrew to recolonize areas from which they have been extirpated and ensuring gene flow among populations is dependent on habitat connectivity. Habitat within the Lower Mainland is currently highly fragmented (Zuleta 1993).

Recovery of the Pacific Water Shrew in Canada is dependent on successfully addressing all of these threats. A brochure produced by the Ministry of Environment, Lands and Parks (currently MOE) provides an overview of the threats to the Pacific Water Shrew in B.C. (See link in *Section 6.2*).

1.5 Species status and recovery efforts

The Pacific Water Shrew has been designated as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), and has been listed on Schedule 1 of the *Species at Risk Act* (SARA). It is also 'Red-listed' in British Columbia, meaning that it is a candidate for legal protection under the B.C. *Wildlife Act*. The reasons cited by COSEWIC when designating the species include: the limited distribution of the species, a continued decline in the quantity and quality of habitat, and fragmentation of the remaining habitat (and populations).

In October 2002, a recovery team was formed to guide work to maintain and restore Pacific Water Shrew in Canada. The team is composed of representatives from municipal governments, conservation organizations, B.C. Government ministries, First Nations, the federal government, the forestry sector and several shrew experts. The recovery strategy has been posted and can be downloaded at http://www.env.gov.bc.ca/wld/documents/recovery/rcvrystrat/pacific_water_shrew_rcvry_strat040609.pdf

The recovery team will be working with municipalities and conservation and stewardship organizations towards protecting, purchasing, or restoring habitat, and applying for funding for these activities. If you are interested in coordinating with the recovery team to protect or rehabilitate habitat, or to request the latest information on this species and recovery efforts contact the Ministry of Environment in Surrey.

1.6 Results-based management

This document uses the best available science and existing legislated requirements to define environmental objectives and performance targets to facilitate protection and recovery of Pacific Water Shrew. Users of this guide

that meet these objectives and targets demonstrate due diligence in the protection and recovery of this species.

The intent of this document is to be 'results-based'. Local and regional governments and development proponents may choose approaches that suit their context as long as the overall goal of working towards species protection and recovery is achieved. The Best Management Practices are recommendations rather than requirements. They provide examples of how species protection and recovery might be met. Alternative methods should be vetted through the B.C. Ministry of Environment in Surrey.

Municipalities and Regional Districts are strongly encouraged to use the many tools within the B.C. *Local Government Act* and B.C. *Community Charter* that enable effective environmental protection. Most of the objectives and best management practices listed in this document could be integrated into official community plans, bylaws, development permit areas, density bonuses and other tools in the *Local Government Act* and *Community Charter*.

1.7 Current legislation

Pacific Water Shrews are protected year round and cannot be killed, collected, held in captivity or harassed without a permit under the B.C. *Wildlife Act*. The federal *Species at Risk Act* (SARA) also protects Pacific Water Shrews by mandating planning and implementation of recovery actions for this species, no matter where it occurs, and with specific prohibitions against harm to individuals, residences or identified critical habitat if terrestrial or aquatic areas under federal jurisdiction are included in the project area.

1.8 Implications of the *Species at Risk Act*

The federal *Species at Risk Act* (SARA) is designed to protect Canada's species at risk and their critical habitat. The *Act* came fully into force between June 2003 and June 2004. SARA directly protects listed individual organisms, their residences, and identified critical habitat on federally administered lands and for aquatic species and migratory birds wherever they occur. The B.C. Government agreed in 1996 to provide complementary protection to listed species under its jurisdiction through the national *Accord for the Protection of Species at Risk*, and plans to meet this objective primarily through the use of cooperative stewardship and existing legislation (e.g., as outlined above, the B.C. *Wildlife Act* already protects this species). SARA stresses that cooperative solutions with the involvement of all stakeholders should be attempted before the use of regulated solutions. Nevertheless, SARA can be applied directly to provincially and privately owned lands if it is demonstrated that the laws of the province are not effectively protecting the individuals, residences or critical habitat of a listed species.

The *Canadian Environmental Assessment Act* (as amended by SARA) requires that a formal environmental assessment be conducted for projects that may affect species at risk or their habitat where the federal government has

decision-making authority (as defined in the *Act* if the federal government is acting as a proponent, land manager, source of funding or regulator). Through the 1996 national *Accord for the Protection of Species at Risk*, the B.C. Government agreed to provide a similar process on lands under its jurisdiction. Guidelines to assist in deciding when an environmental assessment is necessary for Pacific Water Shrew are provided in *Section 2* of this document.

Success and failure in recovery is formally documented every five years when recovery strategies and action plans are updated and this information is made freely available to the general public through the SARA Public Registry.

The most up-to-date information on species at risk in Canada is available at Environment Canada's website: http://www.speciesatrisk.gc.ca/; or at the SARA Public Registry: http://www.sararegistry.gc.ca/. For information on species at risk in British Columbia, visit: http://www.env.gov.bc.ca/wld/serisk.htm.

1.9 Recovery goals and objectives

The overall **goal** of the Pacific Water Shrew Recovery Team, as outlined in the Pacific Water Shrew Recovery Strategy[1], is:

***Goal A**: ensure that the current B.C. population of Pacific Water Shrew is maintained with no further loss of local populations (achieve within 5 years).*
***Goal B**: restore Pacific Water Shrew back to its historical range, where suitable and/or connecting habitat still exists, or can be rehabilitated, so that patterns of natural population dynamics and dispersal can be maintained or restored (achieve within 10 years).*

Specific short-term recovery **objectives** relevant to the scope of these guidelines, as outlined in the draft Pacific Water Shrew Recovery Strategy (2009), are:

1. Protect all known extant sites (habitat protection and management - within 2 years).
2. Restore historical and important potential habitats (habitat restoration – within 10 years).
3. Prevent habitat fragmentation and ensure habitat connectivity (habitat connectivity, modeling, mapping and restoration–within 10 years).
4. Prevent the inadvertent loss of not yet discovered populations (surveys, modeling and mapping, information management and education/outreach–within 5 years).
5. Address immediate threats (mitigate direct mortality–within 5 years).
6. Evaluate the implemented protective measures/recovery activities (monitoring and evaluation–within 5 years).
7. Increase our understanding of the critical habitat needs, life history, population dynamics, and habitat use of the species, and clarify threats to the populations (research–within 10 years).

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1 http://www.env.gov.bc.ca/wld/documents/recovery/rcvrystrat/pacific_water_shrew_rcvry_strat040609.pdf

This document outlines the best actions that proponents can take to reduce negative effects on Pacific Water Shrew populations from habitat loss and degradation. Proponents should undertake any feasible actions possible that will help to address the short-term recovery objectives listed above.

The success of the recovery process and associated guidelines and regulations will be regularly monitored and reported on to help guide the level of effort required to achieve recovery. The first review of progress is scheduled for posting on the SARA public registry (http://www.sararegistry.gc.ca/) five years after the recovery strategy is posted.

In order to achieve goal A and objective 1, proponents and consultant should consult the most current version of the Preliminary Partial Critical Habitat Identification for Pacific Water Shrew (*Sorex bendirii*)[2]. This document can be obtained through the MOE regional office on a need to know basis. In addition to measures outlined in this BMP document, areas identified in the proposed critical habitat document should be avoided and impacts mitigated.

[2] Pacific Water Shrew Recovery Team. Working Draft. Preliminary Partial Critical Habitat Identification for Pacific Water Shrew (*Sorex bendirii*). Draft rep. prep. for B.C. Minist. Environ, Victoria BC. 26 pp.

2 Environmental Assessments

2.1 When to conduct an environmental assessment

The *Canadian Environmental Assessment Act* requires that a formal environmental assessment be conducted for projects that may affect species at risk or their habitat where the federal government has decision-making authority (as defined in the *Act* if the federal government is acting as a proponent, land manager, source of funding or regulator). Through the 1996 national *Accord for the Protection of Species at Risk*, the B.C. Government agreed to provide a similar process on lands under its jurisdiction. Given that the B.C. Government has responsibility for private, municipal and regional lands through the B.C. *Local Government Act* and B.C. *Community Charter*, municipalities and regional districts have considerable authority to ensure that species at risk are included in environmental assessments.

The response of the development proponent or regulator to the findings of the assessment (*i.e.,* whether to protect habitat or establish areas of protective habitat) is not directly mandated by legislation. The process instead emphasizes the importance of cooperative stewardship by government, industry, private landowners and non-governmental organizations to ensure that sufficient habitat is protected and /or rehabilitated for this species. This document suggests actions that municipalities, regional districts and developers can take to ensure the recovery of Pacific Water Shrew, and use of these guidelines demonstrates due diligence towards species protection and recovery.

A decision flowchart for identifying projects that should include an assessment is included in Figure 5. In general, an environmental assessment of potential effects on Pacific Water Shrew should be conducted if all of the following conditions apply:

- the proposed development occurs within the range of this water shrew, currently defined as the area within the following boundary: UTM Zone 10 West: 480000, East: 622000, South: 5426000, North: 5530000, and
- the site is ≤ 1000 m in elevation, and
- the project is to occur within 100 m of any waterbody (stream, creek, wetland, marsh, swamp, ocean or ephemeral or intermittent watercourse, whether or not the site is fish-bearing), and
- the project will modify the vegetation within 100 m of the waterbody or modify the in-stream or wetland environment.

It is important during this initial phase of planning that the development proponent contacts the B.C. Conservation Data Centre (see link in *Section 6.2*) to determine whether there are any records of Pacific Water Shrews in

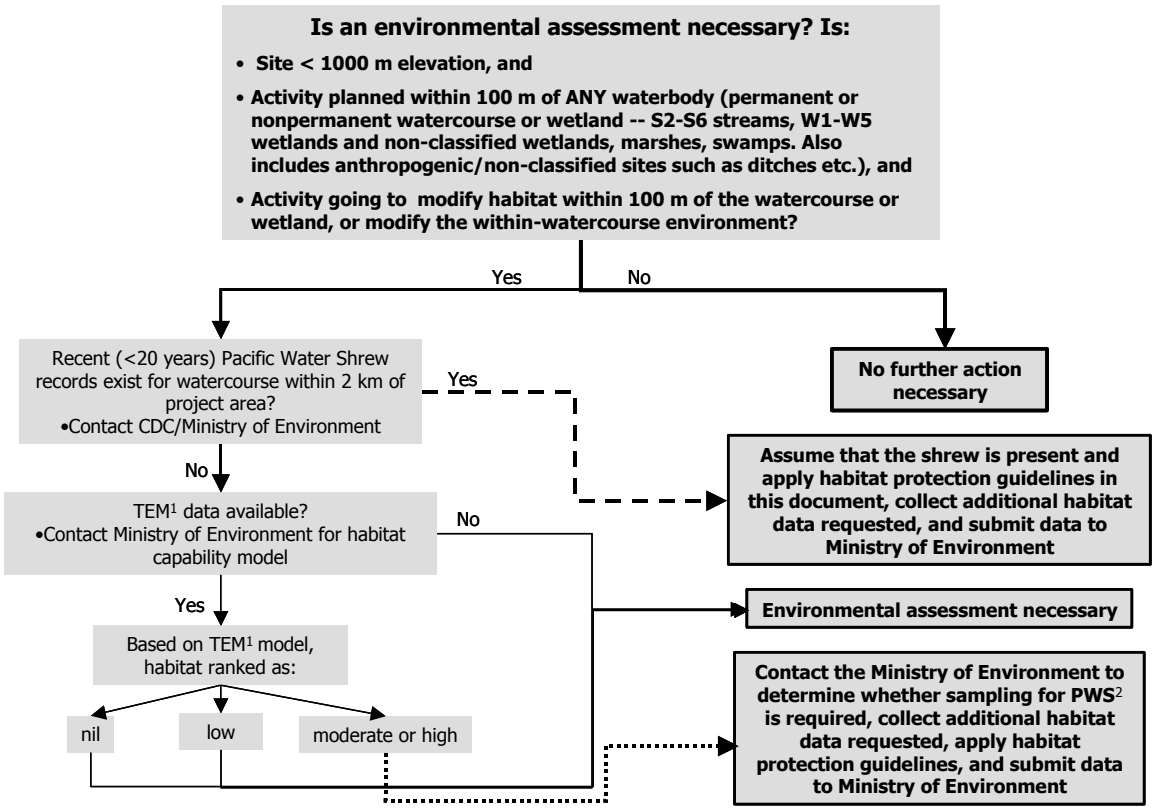

Figure 5. Decision flowchart to determine whether an environmental assessment is necessary. The results of any assessment should be submitted to the Ministry of Environment. [1] TEM = Terrestrial Ecosystem Mapping, [2] PWS = Pacific Water Shrew.

the area proposed for development. If there are, the habitat protection guidelines outlined in this document, including the establishment of a 100 m protective area around the record (see *Section 3* for more information) should be automatically implemented.

2.2 How to conduct the environmental assessment

Given the possibility that Pacific Water Shrews may be extirpated from areas with capable habitat, and the difficulty in capturing such a rare species, a simple presence/absence survey for the shrew is inadequate to assess the overall capability of the habitat. Instead, a two-prong approach to the assessment of habitat for the shrew should be implemented (Figure 6). In areas that qualify for an environmental assessment (no recent Pacific Water Shrew record for the area, and no TEM data available), a ground survey following the protocol outlined in *Field Manual for Describing Terrestrial Ecosystems* (see links in *Section 7.2*) should be performed first, to determine whether moderate or high capability habitat is present (contact Ministry of Environment for habitat rankings; included in Craig 2009). Please note that

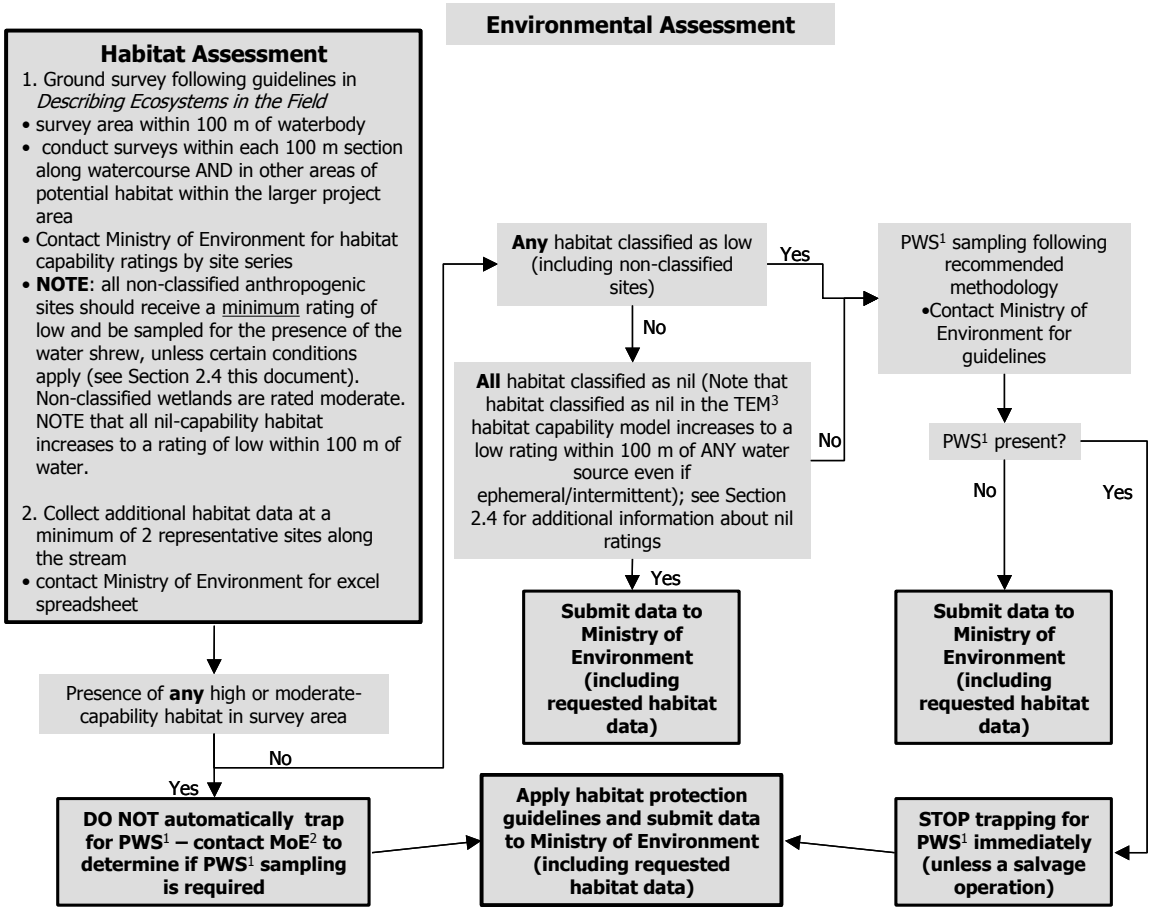

Figure 6. Recommended environmental assessment protocol for Pacific Water Shrew (PWS). [1] PWS = Pacific Water Shrew, [2] MOE = Ministry of Environment, [3] TEM = Terrestrial Ecosystem Mapping.

the emphasis is on habitat **capability** (the potential of the site), **not current suitability**. A site with a current suitability ranking of low may become a moderate or high suitability site in time, or with rehabilitation. If moderate or high capability habitat is not present, the site should be surveyed for the presence of the Pacific Water Shrew to provide some assurance that it is absent. The presence of either moderate or high capability habitat **or** an occurrence record of a Pacific Water Shrew should result in implementation of the habitat protection guidelines in this document, including defining a 100 m protective area around the habitat (*Section 3*). The Ministry of Environment (MOE) may require sampling for Pacific Water Shrew in some habitats ranked high or moderate capability; therefore, project proponents must consult with Ministry of Environment personnel prior to and after any habitat assessment to determine whether shrew sampling is required. All environmental assessments should be carried out by qualified consultants as required under the permitting conditions for such work by the Ministry of Environment. Additional standard habitat measurements should be taken at

2 locations in the area at all sites (contact Ministry of Environment, Surrey for an excel spreadsheet of variables). Careful photo documents and records of all captured shrews (all species) needs to be kept and submitted to ensure appropriate identification. **The results of all Pacific Water Shrew assessments should be submitted to the Pacific Water Shrew Recovery Team** (Chair: Kym Welstead, Ministry of Environment, Surrey) to facilitate monitoring of the recovery process. Occurence records of all red and blue listed species should be submitted to the Conservation Date Centre in a timely manner. **N.B. proponents and consultant should consult the most current version of the Preliminary Partial Critical Habitat Identification for Pacific Water Shrew (*Sorex bendirii*) see section 1.9.**

2.3 Habitat assessment

The goal of the assessment is to identify potential habitat for Pacific water shrew that will be affected by the project. The capability of the site to support Pacific Water Shrews is much more easily assessed through a ground survey than by sampling for water shrews. The habitat within 100 m of the waterbody should be surveyed along the entire project area. C**onsultants are responsible for making a reasonable effort to identify ALL potential Pacific water shrew habitat in the project area**. **At least one habitat plot should be placed within each 100 m linear section of habitat. Additional plots may be necessary if there are multiple areas of potential habitat within the larger project area (e.g. wetlands adjacent to watercourses, small islands of potentially useful habitat located away from watercourses).** If any of the site series ranked as high or moderate capability for Pacific Water Shrew (contact Ministry of Environment for habitat rankings; included in Craig 2009) are found in the area, the site is considered suitable for Pacific Water Shrew and the guidelines in this document should be implemented. Typically, live-trapping surveys for Pacific Water Shrew should **not** be conducted in habitat areas ranked as high or moderate capability to avoid potential shrew mortality and undue distress to shrews, and disruption to habitat. However, MOE may require sampling in these habitats under certain conditions. Details on the results of the habitat assessment should be discussed with MOE to determine whether sampling for PWS should occur in areas rated moderate or high capability. At all project sites additional standard habitat variables should be collected at 2 sites along the waterbody at least 200 m apart (contact Ministry of Environment for spreadsheet of variables).

Non-classified sites such as anthropogenic habitats (*e.g.*, constructed ditches) and wetlands frequently cannot be assigned a habitat ranking (contact Ministry of Environment for habitat rankings; included in Craig 2009). Non-classified wetlands default to a rating of moderate and all other potential habitat that cannot be rated will default to a low habitat suitability/capability. Habitat may be rated nil under certain conditions (see Section 2.4).

Results for **all** surveys (including TEM habitat surveys to determine habitat capability rating, additional habitat variables requested, and results of all

trapping projects for Pacific water shrew regardless of whether a shrew was captured) should be submitted to the Ministry of Environment.

2.4 Nil habitat ratings

Habitat may be rated as NIL if:

1) The habitat is greater than 100 m from any waterbody (including permanent, nonpermanent and intermittent streams, and wetlands);

or if:

2) Any **two** of the following situations apply (excluding A and B together), or

3) Any **three** of the following situations apply (including A and B together).

If 1), 2) or 3) apply, the habitat can be rated as NIL, and no further action is necessary.

A) The habitat is heavily managed for a majority (> 75%) of the watercourse or wetland **and** on both sides of the watercourse or wetland. Heavily managed is defined as mowing of the watercourse or wetland banks and removal of stream substrate (*e.g.*, digging, dredging) on at least an annual basis.

B) No riparian cover < 30 m from the top of watercourse or wetland bank for a majority (> 75%) of the watercourse or wetland. Cover can be from vegetation or other material that provides safety for shrews. Specifically, no cover is defined as 1) Structural Stage 1 - non-vegetated or sparse (defined as only non-vascular plants, < 10% cover of vascular plants, or < 5% total vegetation cover; Craig 2009), or 2) no non-vegetated cover material for shrews (cover examples here include coarse woody debris or other similar material). Cover material (vegetation or otherwise) must be > 1 m in width.

C) The banks of the watercourse or wetland are high (> 1 m) **and** steep (> 65 degrees) for a majority (> 75%) of the watercourse or wetland.

D) No connectivity to habitat rated as suitable (high, moderate or low suitability). Connectivity is defined as an available path for shrews under cover (vegetation, CWD, culvert, *etc.*) to suitable habitat within 100 m, or a path with no cover if suitable habitat is < 30 m distant. Culverts should be considered an available path for shrews only if < 30 m in length.

E) Linear length of watercourse is < 250 m. Culverts, or other similar barriers, should not be considered as breaks in the watercourse unless > 30 m in length. All wetlands that are not linear streams should be rated as moderate suitability. A meandering stream is considered linear – linear refers to a stream with an obvious channel.

If the project area does not contain moderate/high capability habitat but does contain low capability habitat, it should be surveyed for the presence of water shrews (Figure 6). The results of the assessment should be submitted to the Ministry of Environment to facilitate monitoring of the recovery process.

2.5 Survey for Pacific Water Shrew

The Pacific Water Shrew is an Endangered species; therefore, all sampling for its presence **must use live-trapping methodology and requires a permit from the Ministry of Environment**. Members of the recovery team will be conducting research on simpler less time-consuming methods to identify the presence of Pacific Water Shrews. For this reason, **prior to beginning a sampling program for Pacific Water Shrews, consultants should contact the Ministry of Environment to receive the latest sampling guidelines for this species**. It is the responsibility of the consultant to obtain the most current guidelines and trapping methods. General guidelines for sampling small mammals also exist (available from Resources Inventory Standards Committee, RISC – see *Section 6.7*). Sampling for Pacific Water Shrew should always occur in habitat rated low capability – no sampling should occur in habitat rated moderate or high capability, unless the Ministry of Environment notifies the consultant to do so. **For this reason it is the responsibility of the consultant to inform the Ministry of Environment of the habitat sampling results, and determine whether Pacific Water Shrew sampling in the moderate or high capability habitats is required.** If a Pacific Water Shrew is captured, all trapping should cease immediately, unless it's a salvage operation.

The following is the suggested protocol for sampling Pacific Water Shrews:

All consultants conducting environmental assessments must follow live-trapping guidelines for sampling Pacific Water Shrews. Contact the Ministry of Environment prior to beginning sampling to receive the most up-to-date sampling protocol, and to request a trapping permit for the species. If federally administered lands or waters are included in the assessment area, a federal permit will also be necessary for projects including species at risk (see http://www.sararegistry.gc.ca/default_e.cfm for details). The results of all assessments should be submitted to the Ministry of Environment to facilitate monitoring of the recovery process.

1) All consultants must report to the B.C. Conservation Data Centre (CDC), and the Ministry of Environment all sampling efforts (whether or not a water shrew was captured) including dates trapped, number of traps, UTMs of areas trapped, *etc.* This will help in compiling an up-to-date distribution map and monitoring the recovery process.

All shrews captured should be identified in the field, photographed, measured and released alive. **All reasonable efforts must be used to avoid accidental mortality.** Measurements of all captured shrews (whole body length, tail length, and length of hind foot) and weight if possible, should be recorded to assist in verifying the capture of a water shrew. Any capture suspected to be a PWS should be carefully photographed with particular attention to documenting length of body and tail, colour of belly and underside of tail, as well as the presence of hairs on the hind feet. Age and breeding condition should be recorded if known. Consultants should fill out

a Rare Vertebrate Animal Observation form (see link in *Section 6.3*) and submit it to the Conservation Data Centre and the Ministry of Environment. The local municipal government should also be informed of the occurrence. If dead, all specimens should be submitted to the Ministry of Environment.

2) At a minimum, sampling for the Pacific Water Shrew should follow these protocols:

- sampling for the shrew for **8 days** using pitfall traps with drift fences (Figures 7 & 8), with traps open 24 hours a day (minimum 192 total trap hours, including 8 over-night sessions). All 8 days need not be consecutive, but when trap days are broken up, trapping should be conducted in sessions that are at least 2 consecutive trap days. See further in this section for detailed direction on trap set up and design. Those conducting trapping are expected to use their best judgement to avoid trap flooding and desiccation or starvation of trapped animals.
- traps should be checked regularly to ensure that shrews are not killed. **Traps should be checked every 6 hours (minimum). If frost is expected or if heavy rainfall is expected, trapping should NOT occur. If temperatures are projected to drop to 3 ^{0}C or lower during the trapping period, trapping should NOT occur.** This requirement is subject to change based on research; check with Ministry of Environment.
- If possible, it would be beneficial to break the 8 trapping days into 2 sessions of 4 consecutive 24 hour periods 3-4 weeks apart. Alternatively, trapping could be conducted in 4, 2 consecutive 24 hour sessions spaced over 3-4 months, or 3 consecutive 24 hour sessions (4,2,2 or 3,3,2) spaced 3-4 weeks apart.
- it would be beneficial to have at least 1 trapping session during or immediately after a rain event, because shrews might be more active when the ground is moist.
- it would be beneficial if at least 1 trap session occurred in late summer/early fall (August/September), when the population of Pacific Water Shrew is likely at its largest.
- traps should be equipped with at least 10 g of food (raw meat, invertebrates such as meal worms, or moist cat food).
- fluffy and insulating bedding should be used for added warmth. Recommended material is a cellulose fibre. Cotton, or other material that absorbs water and does not insulate when wet, should not be used. Wood chips are also not recommended.
- pitfall traps with drift fences (Figures 7 & 8) should be placed every 15 m along a representative portion of the waterbody.
- trap lines should be a **minimum** of 500 m long, or long enough that a minimum of a third of the **entire** waterbody is covered, whichever is **greatest** (not limited to the section included in the proposed development). The results of the 500 m trapline may be extrapolated 500

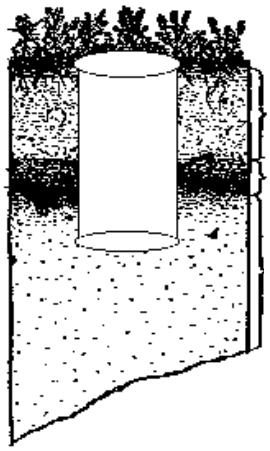

Figure 7. Pitfalls should be placed flush to the ground.

Figure 8. To funnel shrews into the pitfall, drift fences should be placed on both sides of the pitfall – running towards the water, and upland. EcoLogic Research photo.

m on either side of the line; therefore, areas >1.5 km long require >1 trapline.

- pitfalls should be buried flush with the surface (Figure 7). If sponges or other materials are added to the pitfall, the distance from the top of the added material to the top of the pitfall should be ≥20 cm. In areas with a high watertable, a few large stones placed on the edge of the can (placed to minimize the obstruction to shrew movement) will weigh the can down. Alternatively, traps can be moved up to 5 m away from the waterline.
- **traps should be placed within 5 m of water, taking advantage of naturally occurring features that are important to shrews, such as logs, that might funnel shrews into the trap (place pitfalls adjacent to logs on the side close to the water and drift fences perpendicular to the log to funnel shrews to the trap).** Where no logs are available, or where logs are parallel to the waterbody, drift fences should be placed on either side of the pitfall (towards water and upland) to funnel shrews into the trap (Figure 8).
- Use drift fences that are about 30 cm high and a minimum of 3 m long, and placed with the bottom against the ground (Figure 8). For ease of installation, drift fences can be made from any material sufficiently rigid to create a barrier. For example, use clear plastic sheeting stapled to wooden pegs or other support (Figure 8). In more visible locations, using dark material attached to thin wires will make the drift fences less visible.
- pitfalls should be ≥ 20 cm deep and ≥ 15.5 cm in diameter (Figure 7). The use of similar-sized traps will ensure consistent sampling effort across projects. The use of two #10 coffee cans duct-taped together provides a suitable pitfall (see *Section 6.8* for supplier information). Use of alternate pitfall trap types that meet the minimum size requirements mentioned above are acceptable.
- if any rain is expected, at least one of the following methods should also be employed:
    - the pitfall should be sheltered from rain by placing some type of cover over the trap that is high enough that it will not deter animals from entering the trap,
    - the pitfall should be equipped with a small sponge in the bottom of the trap to absorb extra water (make sure the trap is deep enough), or
    - Both of the above.
- consultants are expected to make every effort to ensure that no Pacific Water Shrews are killed during the survey. **All traps should be immediately closed and/or removed if a Pacific Water Shrew is captured**, unless the operation is a salvage operation.

Table 1. Small mammal species that occur in the Lower Mainland.

Common name	Scientific name
Pacific Water Shrew	*Sorex bendirii*
American Water Shrew	*Sorex palustris*
Wandering Shrew	*Sorex vagrans*
Dusky Shrew	*Sorex monticolus*
Common Shrew	*Sorex cinereus*
Trowbridge's Shrew	*Sorex trowbridgii*
Deer Mouse	*Peromyscus maniculatus*
Red-backed Vole	*Clethrionomys gapperi*
Townsend Vole	*Microtus townsendii*
Creeping Vole	*Microtus oregoni*
Long-tailed Vole	*Microtus longicaudus*
Heather Vole	*Phenacomys intermedius*
Townsend's Mole	*Scapanus townsendii*
Coast Mole	*Scapanus orarius*
Shrew-Mole	*Neurotrichus gibsii*

Figure 9. Voles (here a long-tailed vole) are heavier -bodied and have well-furred ears and medium-sized eyes. EcoLogic Research photo.

Figure 10. Deer mice have large ears and eyes. EcoLogic Research photo.

- the optional use of Longworth or Sherman livetraps (Longworth-type traps preferred) **in addition** to the use of pitfall traps is encouraged. These traps should be equipped with both food and bedding and checked on the same schedule as the pitfall traps.
- Minnow (gee) traps are efficient at capturing Pacific Water Shrews, and consultants are encouraged to consider using these traps (modified) in addition to pitfalls. The traps should be modified so that the top of the trap is out of the water, and a platform is provided for shrews to get out of the water. Food can be placed in a small plastic cup and tacked on to the platform. Contact MOE for instructions and illustrations on how to modify these traps. Shrews killed in minnow traps while sampling for fish should be recorded and reported to the B.C. Conservation Data Centre, and specimens submitted to MOE.
- **These guidelines represent the minimum effort that should be expended in a sampling survey for Pacific Water Shrew.**

2.6 Identification of Pacific Water Shrew

Consultants should access the small mammal ID guide (Nagorsen 2002), available from the Ministry of Environment (see link in *Section 6.7*)**.** This key is the most recent for identifying small mammals in B.C.

There are 5 shrew species that overlap the range of the Pacific Water Shrew (Table 1), but Pacific Water Shrews are unlikely to be confused with most other small mammal species that are found within the Lower Mainland.

Shrews have a long narrow snout, small non-distinguishable ears, small eyes, and have small claws and palms (not enlarged) on the front feet; features which distinguish them from most other small mammals (Figures 3, 4 & 11).

Voles are heavier-bodied with small (but larger than shrew), well-furred ears and medium-sized eyes (Figure 9), and mice have large, unfurred ears and large eyes (Figure 10).

The overall body length of the Pacific Water Shrew averages 15.4 cm, 7 cm of which is tail. The average weight is 13.2 g. The fur is dark brown to black dorsally and dark brown ventrally (the underside can be lighter in the winter).

Figure 11. Close-up photo of the hind foot of a Pacific Water Shrew. The fringe of stiff hairs is clearly visible. Leigh Evans photo.

The species is unlikely to be confused with most shrews that co-occur. *Sorex cinereus*, *S. monticolus*, *S. trowbridgii*, and *S. vagrans* (Table 1) are considerably smaller (average < 12 cm total length, and ≤ 7 g in weight), and lack the fringe of stiff hairs that are present on the feet of the Pacific Water Shrew (Figs. 4b, 11).

Pacific Water Shrews may be most easily confused with the American Water Shrew, *Sorex palustris*, which is also a large shrew that has a semi-aquatic lifestyle. The American Water Shrew (average 15.2 cm length, 10.6 g) tends to be slightly smaller than the Pacific Water Shrew, but the diagnostic difference between the species is the dark grey to black dorsal fur with a white belly and bi-coloured tail of the American Water Shrew (Figure 12).

Figure 12. *Sorex palustris* (top left – Richard Forbes photo) has a white belly and bicoloured tail while *Sorex bendirii* (below right – Denis Knopp photo) is a more uniform brown/grey with a unicoloured tail.

3 Best Management Practices for Habitat

The following are suggested guidelines for maintaining Pacific Water Shrew habitat in the Lower Mainland. These guidelines should be implemented in areas with moderate or high capability water shrew habitat, or areas where a Pacific Water Shrew has been captured or positively identified.

3.1 Habitat protection

Leave 100 m wide areas of protective habitat wherever possible on either side of currently suitable or ultimately capable Pacific Water Shrew habitat, or in areas where Pacific Water Shrew is known to occur. Habitat suitability and capability can be assessed using a habitat ranking system developed for the recovery team (Craig 2009), and known occupied locations can be requested from the B.C. Ministry of Environment and Conservation Data Centre.

Within the protective area (100 m on either side of a stream, 100 m on either side of an occurrence, or 100 m area around a wetland)), low-impact activities such as the construction of a small walking trail (following guidelines outlined in the stewardship document "Access Near Aquatic Areas") can occur in the outer 40 m, increasing the value of the area to the surrounding community, with minimal impacts on the protective area. However, no significant construction or habitat alteration should occur anywhere within the protective area.

If low or nil suitability habitat occurs within 100 m of moderate or high suitability habitat, the habitat ranked as low or nil should be included in the protective area and restored to a suitable condition (unless naturally unsuitable).

Implementation of a large protective area has many benefits:

- Protection of habitat important for the long-term survival of the Pacific Water Shrew.
- Increasing habitat connectivity for Pacific Water Shrew.
- Protection of habitat important for a wide variety of species of animals, plants, birds (many bird species require large areas of habitat for it to be suitable), and fish (depending on the habitat protected).
- The long-term effective protection of the stream or wetland and all of its ecological processes and biodiversity.

In addition, recent studies and guidelines have reported that **riparian greenways are highly valued by members of the community and property values in the proximity of greenways are higher than elsewhere (DFO/MELP 1994, Quayle and Hamilton 1999, Curran 2001). This benefit is then passed on to local governments through**

higher taxes. Quayle and Hamilton (1999) reported property value increases from 10% to 15% - funds that might provide for a significant amount of green space preservation by local governments.

3.2 Watercourse & wetland crossings

Placing roads across streams and through wetlands destroys and fragments habitat by creating barriers to the movement of small mammals and other wildlife species. In addition, roads affect wetlands up to 2 km away (*e.g.*, through loss of native plant and animal species, increases in invasive species, *etc.*), although it may take decades to show the effects (Findlay and Bourdages 2000). The following suggestions should be implemented wherever possible to minimize habitat loss and fragmentation due to stream and wetland crossings (listed here from least damaging to most damaging).

- Move the crossing and all associated roadways and structures away from known or potential Pacific Water Shrew habitat.
- Use bridges over streams and wetlands instead of culverts. This ensures greater continuity of habitat below the bridge and the retention of natural vegetation. Bridges should be long enough to have no impact on the stream or wetland (including pilings) within a 30–60 m area of the bridge structure (most Pacific Water Shrews are captured < 60 m from a wet area). This will also minimize requirements for riprap and other interventions that limit bank erosion. Natural plant stock should be planted to replace any vegetation removed during bridge building within 100 m of the stream or wetland. In areas where plants cannot be established (*e.g.*, under wide, low bridges), pools or coarse woody debris (*e.g.*, logs) can be placed to increase cover and foraging habitat for shrews. See *Section 5* for further detail on restoration.
- If culverts are used, they should be large-diameter (at least 2 m diameter) with open bottoms. Open-bottomed pipe arch culverts will increase the connectivity of habitat by maintaining a natural substrate. Closed bottom culverts should not be used. Natural plant stock should be planted to connect the remaining natural vegetation and create a pathway through the culvert. Debris pits should be avoided, because these discourage the use of culverts by small mammals. Culverts should not be longer than 30 m and should not have large drops that would impede water shrew (or fish) movement. On long culverts that are dark in the middle, consider the use of grates that will allow light and rain to enter.

Road Right-Of-Ways (ROWs) should be minimized around bridges to maximize the amount of natural riparian vegetation. Areas around the bridge that have been modified should be replanted with advanced native tree and shrub stock. Shrews and other animals avoid travelling in the open; the placement of vegetation or other cover structures (such as logs) along the ROW will increase the connectivity and suitability of habitat (see *Section 5* for further detail on restoration).

The use of armouring of stream crossing structures, especially culverts, should be avoided as these walls can limit escape options for shrews in the

current. If armouring must be used, providing a variable structure (*e.g.*, "biowalls", imbedded rocks, vegetation, *etc.*) can allow shrews to escape the current.

3.3 Riparian vegetation & Coarse Woody Debris (CWD)

Pacific Water Shrews, fish, and other species are dependent on the presence of riparian vegetation and Coarse Woody Debris (CWD) along streams and wetlands. Planting of native vegetation and retention or introduction of CWD can increase habitat connectivity, improve the condition of the aquatic environment, and minimize erosion and sedimentation problems. Plantings should include shrubs to provide low cover for shrews and large trees for high cover and to maintain a moist micro-climate. CWD should include all types of debris that would naturally occur at a site, especially larger items such as downed mature trees. See *Section 5* for further detail on habitat restoration.

- Maintain native trees and shrubs and CWD in the riparian zone and in the ROW adjacent to the waterbody to minimize erosion and sedimentation effects.
- Restore native riparian vegetation and CWD along degraded waterways to improve water quality and the suitability of the habitat for many species. See *Section 5* for a detailed description of habitat restoration for this species.
- Plant and maintain native riparian vegetation (shrubs and trees) and maintain or introduce CWD along open watercourses (*e.g.*, ditches) to create suitable habitat for many species, especially if the watercourse is connected to forested areas nearby. See *Section 5* for a detailed description of habitat restoration for this species.
- During municipal works, planting native riparian vegetation (shrubs and trees) and maintenance or introduction of CWD as soon as possible after the project is completed will provide important habitat for a variety of species, reduce the colonization of invasive and non-native vegetation, and help to control sedimentation. See *Section 5* for a detailed description of habitat restoration for this species.

3.4 Connectivity of habitat

Habitat fragmentation is a threat to the ability of Pacific Water Shrews and other species to move across the landscape and recolonize areas from which they have become extirpated. To minimize habitat fragmentation:

- Consider the landscape context of development. Protection of habitat that appears to have limited value (*e.g.*, non fish-bearing streams, small forest ponds, small areas of habitat, areas of low suitability) can maintain habitat connectivity between larger or more important habitat fragments (*i.e.*, serve as corridors).

- Expand protected areas. Increasing riparian protection around streams and wetlands adjacent to parks, riparian greenways, or other protected areas will increase the overall protective ability of the area, and increase its connectivity with the surrounding landscape.
- Minimize the effects of barriers to movement (such as roads) by creating crossing points (using either bridges or open bottomed culverts) for animals.

3.5 Management options

In areas where Pacific Water Shrew is known to occur, or in areas of potential Pacific Water Shrew habitat, the use of the 'habitat compensation' process by developers to gain approval for development should be avoided whenever possible.

In developments close to riparian areas, require the developer to include a fence and signage placed at the edge of the protective area. The fence will provide a clear limit of the development boundary and will limit encroachment. Fences also are useful to limit access by domestic dogs and cats into the riparian area.

Developments should use principles of Integrated Stormwater Management (ISM). In general, natural flow regimes and sensitive habitat should be maintained whenever possible. Further, stormwater should be cleaned and returned to ground at or near to the site of production and any detention facilities used should be minimized, be off line from the natural watercourses and not be placed near habitat for this species. Detailed information on ISM is available from the Ministry of Environment and Greater Vancouver Regional District, including Best Management Practices (see links in *Section 7.6*). ISM can be addressed within Official Community Plans (OCPs), Neighbourhood Concept Plans (NCPs) and/or Comprehensive Development Plans (CDPs). Planning in the early stages of development is important to avoid water quality and quantity issues associated with paved watersheds.

Consider pro-active protection of riparian habitat such as the establishment of Streamside Protection Zones or the use of Development Permit Areas (DPAs) around streams and wetlands. Development Permit Areas can ensure that work around riparian areas is guided by regulations set out in the DPA and the Official Community Plan (if one exists). The DPA could be used to establish a minimum buffer size (larger than the minimum required by Department of Fisheries and Oceans Canada) around all waterbodies. This will ensure that streams and wetlands that do not support fish or contribute to fish-bearing streams, but are important habitat features that support many wildlife and plant species, are maintained in the landscape.

The wording could be similar to:

- The Municipality/City of _____ considers the preservation of streams and wetlands to be important to the maintenance of local biodiversity and ecological processes. Therefore all areas within 100 m of

wetlands and watercourses have been designated as Development Permit Areas, known as Watercourse Development Permit Areas (WDPAs).

- All development applications for projects that will occur within a WDPA must comply with the requirements for an assessment of the effects of the project on the Pacific Water Shrew, as outlined by the Pacific Water Shrew Recovery Team.
- Prior to commencing an environmental assessment, the developer must contact the Ministry of Environment to obtain the most current Pacific Water Shrew BMP guidelines.
- The developer is fully responsible for the costs required to assess the potential effects of the project on the Pacific Water Shrew.
- If sampling for the Pacific Water Shrew is necessary [see decision flowcharts in *Section 2*] the developer must follow the sampling protocol included in this document.

Additional information on development permits, and examples of wording of development permits is provided in *Section 6.9*.

Conservation covenants or stewardship agreements are a useful way of ensuring the long-term protection of urban habitat. Landowner education, site visits, and co-managing conflict issues are important components of covenants. Consider working with conservation organizations to inform the public about land stewardship options. See *Section 5* and *Section 6.4* for further information.

The success of restrictive covenants can be improved by including a landowner education and site visit component. Land Trusts or other conservation organizations can be appointed to hold and oversee covenants.

Predation by domestic cats is a potential threat to Pacific Water Shrews. In urban areas, consider programs to increase the awareness of the potential impacts of domestic cats. Encourage pet owners living near riparian areas to equip cats with belled collars and fence off suitable habitat.

4 How These Guidelines Differ from Fisheries Regulations

The primary difference is that Pacific Water Shrew BMP guidelines emphasize the importance of the riparian zone and the inclusion of non-fish bearing and isolated waterbodies (not connected to or discharging to fish habitat), as well as non-classified bodies (such as ditches).

The focus of fisheries guidelines and regulations (e.g., federal *Fisheries Act* and provincial *Streamside Protection Act* with its Riparian Areas Regulation), are the fish bearing and fish-food producing (connected tributaries) aquatic environments. Guidelines and regulations for buffer size and activities conducted around streams (*e.g.*, road building) are designed to minimize impact on the in-stream habitat. Activities around waterbodies that are not connected to fish-bearing systems are not regulated. However, these types of habitat (*e.g.*, swamps or marshes in or adjacent to deciduous or coniferous forest) are suitable habitat types for shrews.

Pacific Water Shrews live primarily in the riparian zone adjacent to streams and wetlands. Most often, they are captured within 60 m of water bodies. This shrew is a semi-aquatic species that forages extensively on aquatic invertebrates, which in turn are dependent on the presence of good quality aquatic habitat. This species also is dependent on the conditions associated with the riparian environment. Fisheries guidelines protect only a small portion of the riparian zone. In contrast, these guidelines emphasize the protection of the entire riparian zone. The 100 m protective area will buffer the riparian habitat and its microclimate in the long-term against edge effects, such as changes in light, temperature, wind, species presence, and presence of invasive species associated with removal of the surrounding forest, as well as potentially increased run-off of oil, water, pesticides, fertilizers and road debris which are associated with urban or agricultural land development and use. See Chen *et al.* (1993), Chen *et al.* (1995), Kelsey and West (1998), Findlay and Bourdages (2000) for some discussion of changes to the riparian zone associated with edge effects.

Development guidelines from the Department of Fisheries and Oceans require buffers as small as 5 m under certain conditions. Millar et al. (1997), however, suggested that even buffers 15 m to 30 m wide may be insufficient to protect even the aquatic environment over the long term, and instead proposed fisheries management zones at least 30 m to 50 m wide. The current guidelines do not provide sufficient protection for Pacific Water Shrew habitat (Galindo-Leal and Runciman 1994, Pacific Water Shrew Recovery Team 2008).

5 Habitat Rehabilitation

Fisheries rehabilitation efforts normally include improvements to the stream channel or wetland and surrounding riparian zones that can also benefit Pacific Water Shrew. However, it must be stressed that fisheries rehabilitation efforts are designed to maximize benefit to in-stream organisms, not riparian organisms. Extra efforts are thus warranted to ensure that the streamside area is immediately and ultimately suitable for organisms such as small mammals.

Habitat restoration should not occur where habitat is rated high or moderate suitability. This assessment should be done prior to any habitat restoration work commencing. Minor restoration works such as the removal of garbage may be warranted but should also be done with caution. Where the presence of Pacific Water Shrew is documented, no habitat changes should occur within a minimum of 100 meters of the occurrence.

Placing significant amounts of Coarse Woody Debris (CWD; *e.g.*, logs or root balls) in the stream channel or wetland will create travelways for shrews and provide a substrate for aquatic macroinvertebrates to enhance foraging for shrews (Figures 12 & 13). Material can be placed to ensure it does not become a barrier to fish passage.

Figure 12. Creating habitat by placing logs to create pools and provide travel routes, and planting riparian vegetation to grow and shade the stream, will provide habitat for Pacific Water Shrews and fish. EcoLogic Research photo.

Placing CWD (*e.g.*, stems ≥ 6 cm diameter minimum, but preferably logs ≥ 12 cm diameter with bark still attached) adjacent to the stream channel or

wetland will provide important cover (Figure 13). A properly connected network of logs and brush piles along the banks will provide secure travel routes. Connectivity should be emphasized – contiguous cover is an important attribute. Riparian plantings can also be used to help network travel corridors.

Plant advanced native plant stock alongside streams and wetlands, concentrating on the riparian zone within 30 m of the stream or wetland. A properly connected network of vegetation (and/or CWD) along the stream or wetland bank will provide secure travel routes. Connectivity should be emphasized – contiguous cover is an important attribute. CWD can also be used to help network travel corridors.

Because suitable habitat can take a long period of time to develop, in areas where habitat has been rehabilitated it is crucially important to maximize retention and placement of CWD and riparian plantings to ensure adequate cover is available for small mammal travel. Lack of cover will result in higher rates of predation and will thus, at least partially, nullify restoration efforts.

Figure 13. This man-made fish spawning channel has lots of logs which are a benefit to shrews, but it was seeded with grass, and no riparian vegetation was planted, limiting its usefulness to water shrews. EcoLogic Research photo.

Creation of pools < 1 m deep (by placing CWD or rocks in the stream channel or wetland) will provide important foraging locations for water shrews (Figure 13).

Connecting adjacent marshes, swamps or streams by planting riparian vegetation, placing logs and other CWD, or by creating a water channel will increase the effective habitat area for water shrews.

Connect wet depressions alongside the stream channel or wetland by placing logs and other CWD and planting riparian vegetation to increase the amount of water flowing through.

If using grass seed mixture to stabilize slopes, make sure other species of plants are also planted to avoid ending up with a grassy slope with minimal native riparian vegetation (Figure 13). If retaining walls are necessary, consider the use of "bio-walls" (walls made of organic matter that plants can grow from).

Note barriers to water shrew movement such as roads and small culverts and determine whether it is possible to connect the habitat on either side of the barrier. Plant vegetation around culverts and road edges to provide cover for shrews and other animals.

Secondary dry culverts can be used in conjunction with wet culverts to increase travel corridor options for shrews. Such culverts should be a minimum of 500 mm diameter and have suitable substrate to mimic the natural environment. As above, grates can be used at intervals of < 30 m to allow light, rainfall and nutrients to enter the passageway.

Long culverts that already exist or must be installed for adequate technical reasons can be enhanced by the use of grates at intervals of < 30 m to allow light, rainfall and nutrients to enter the dark passageway.

With diversion, enhancement or compensation channels or wetlands (these must be authorized by an approving agency), biological recovery of new habitat can be enhanced if seeded with substrate containing benthic invertebrates and native vegetation (including large trees) salvaged from the channels or wet areas that are to be affected.

In areas where plants cannot be established (*e.g.*, under wide, low bridges), pools or coarse woody debris (*e.g.*, logs) can be placed to increase cover and foraging habitat options for shrews.

Some obstructions to fish passage are not barriers to water shrews (*e.g.*, log jams, beaver lodges) and may create water shrew habitat by partially flooding the surrounding area or by creating pools. If obstructions are removed to enable fish passage, consider ways of maintaining at least some of the previous habitat by leaving some logs or creating a side channel to maintain the flooded area.

In areas where domestic predators are present (e.g., cats and dogs), consider placing fencing around riparian areas (up to 60 m from the stream or wetland) to exclude these potentially damaging animals from habitat suitable for these small mammals.

6 Actions for Stewardship & Conservation Organizations

Conservation and stewardship organizations are already working to preserve and restore habitat in the Lower Mainland. There are many opportunities for Pacific Water Shrew to be included in new or ongoing projects.

The Pacific Water Shrew Recovery Team is interested in developing partnerships with environmental organizations to work towards protecting and restoring riparian habitat. Please contact the Ministry of Environment if you are interested in working with the recovery team to preserve or restore habitat for Pacific Water Shrew.

6.1 Education

- When preparing information pamphlets, contacting landowners, or giving presentations, include the Pacific Water Shrew in the discussion. Most people do not realize that there is an Endangered species of water shrew that in Canada is found only in the Lower Mainland.

- Distribute these guidelines and the B.C. Government brochure on the Pacific Water Shrew (see link in *Section 6.2*). Create a link to the brochure on your website.

- Write articles to newsletters or to local papers informing people about the Pacific Water Shrew.

- Ensure that if any members of your organization spot a water shrew, the sighting is reported to the B.C. Conservation Data Centre, preferably using a Rare Vertebrate Animal Observation form, available from http://www.env.gov.bc.ca/cdc/contribute.html. Also, report the sighting or capture to the environment department of the local municipality for inclusion in their records. A list of B.C. municipalities is available at http://www.civicnet.bc.ca/members/map.shtml.

6.2 Habitat protection

- Encourage landowners to create conservation covenants to protect riparian habitat on their property.

- Apply for funding to purchase or rehabilitate important habitats.

- Educate landowners about the sensitivity of riparian areas and encourage them to use management practices that limit erosion and run-off into the

aquatic environment. Inform landowners about the importance of properly maintaining septic fields.

7 Additional Information: Links, Downloads & Literature Cited

7.1 Contacts

For information on the Pacific Water Shrew or other species at risk in British Columbia contact:

Pacific Water Shrew Recovery Team

Chair: Kym Welstead
Ministry of Environment
10470 – 152nd St., Surrey, B.C. V3R 0Y3
Tel: (604) 582-5279
Kym.Welstead@gov.bc.ca

Wildlife Biologist

Ministry of Environment – Lower Mainland office
10470 - 152nd St.,
Surrey, B.C. V3R 0Y3
Tel: (604) 582-5200
Fax: (604) 930-7119

Small Mammal Specialist or Species at Risk Biologist

Ministry of Environment – Headquarters office
4th floor - 2975 Jutland Rd.
PO Box 9338 Stn Govt
Victoria, B.C. V8T 5J9
Tel: (250) 387-9500
Fax: (250) 356-9145

7.2 Background

Download an electronic copy of the B.C. Government brochure on Pacific Water Shrew, or one of the over 40 other brochures on wildlife at risk in B.C., at http://www.env.gov.bc.ca/wld/list.htm. View other biodiversity publications by the Ministry of Environment at http://www.env.gov.bc.ca/atrisk/reports.html.

For more information on species at risk and the *Species at Risk Act*, visit the Environment Canada/Canadian Wildlife Service species at risk website at http://www.speciesatrisk.gc.ca/, or the SARA Public Registry:

http://www.sararegistry.gc.ca/. At these sites you can also view approved species status reports, recovery strategies and recovery plans.

For more information on the Committee on the Status of Endangered Wildlife in Canada, visit the COSEWIC website at http://www.cosewic.gc.ca/index.htm. The national status report is available at this site.

The Ministry of Environment Biodiversity website has information about programs to conserve biodiversity in B.C., including information on recovery teams and recovery strategies/plans: http://www.env.gov.bc.ca/wld/bio.htm.

The Endangered Species in B.C. website provides links to information on species at risk in B.C. The site includes a link to the Species Explorer, which is a searchable database containing information about all documented species in B.C. Go to http://www.env.gov.bc.ca/atrisk/.

The B.C. Conservation Data Centre tracks occurrence data for species at risk in B.C. All sightings or captures of Pacific Water Shrews should be reported to the Conservation Data Centre on a standardized observation form (See link in *Section 6.3*). This information is important for monitoring of populations and the recovery process. Up-to-date data on local occurrences of the shrew can be obtained from http://www.env.gov.bc.ca/cdc/.

The *Field Manual for Describing Terrestrial Ecosystems* should be used for documenting habitat and is available here: http://www.for.gov.bc.ca/hfd/pubs/docs/mr/Mr074.htm. The standard instructions for a ground inspection of habitat are available at: http://ilmbwww.gov.bc.ca/risc/pubs/teecolo/fmdte/deif.htm.

7.3 Reporting of Pacific Water Shrew occurrences

All occurrences of Pacific Water Shrew should be reported to the Regional BC Ministry of Environment (MOE) immediately following the capture (see contact information) as well as the B.C. Conservation Data Centre on standard data sheets. The relevant data sheet is the Rare Vertebrate Animal Observation form, which can be downloaded from: http://www.env.gov.bc.ca/cdc/contribute.html. Any incidental mortalities – specimen should be frozen ASAP and arrangement should be made to have the specimen sent to the region MOE office. Careful documentation of location, UTMs, habitat and photos are specimen are also required.

The municipal government where the Pacific Water Shrew was observed should also be notified of the occurrence. A list of B.C. municipalities is available at http://www.civicnet.bc.ca/members/map.shtml.

7.4 Stewardship

The B.C. Stewardship Centre has many excellent guides on a variety of topics. All of the guides are available for download at: http://www.stewardshipcentre.bc.ca/stewardshipcanada/home/scnBCIndex.asp.

Specific documents of interest include:

- Access near aquatic areas
- Community greenways: linking communities to country, and people to nature
- Land development guidelines for the protection of aquatic habitat
- Stewardship bylaws: a guide for local government
- Stewardship options for private landowners in British Columbia
- The streamkeepers handbook: a practical guide to stream and wetland care
- Stream stewardship: a guide for planners and developers
- Landowner contact guide

Fisheries and Oceans Canada also has many useful reports available for download, including reports on the topics of legislation, policy, guidelines, educational resources, brochures, newsletters, scientific papers and reports. Now available at the B.C. Stewardship Centre website (link above).

The Land Trust Alliance of B.C. has information about conservation covenants, numerous stewardship documents, and links to local Land Trust and conservancy organizations that can help with conservation covenants and stewardship agreements. Go to: http://www.landtrustalliance.bc.ca/.

A Wetland Evaluation Guide aimed at planners and developers is available at: http://wlapwww.gov.bc.ca/wld/documents/WEG_Oct2002_s.pdf. The guide provides an overview of wetland functions, and includes a workbook that helps identify wetland functions and values that will be affected by development, and assists in assessing trade-offs.

Information on the B.C. *Fish Protection Act* and Riparian Areas Regulation, which emphasize the protection of fish habitat and the importance of local government in environmental planning, is available at: http://www.env.gov.bc.ca/habitat/fish_protection_act/.

7.5 Land value near to riparian corridors

Land values increase when in proximity to a riparian greenway (DFO/MELP 1994, Quayle and Hamilton 1999, Curran 2001). Read one study here:

http://www-heb.pac.dfo-mpo.gc.ca/publications/pdf/241452.pdf

Quayle, M., and S. Hamilton. 1999. Corridors of green and gold: impact of riparian suburban greenways on property values. Prepared for: Fraser River Action Plan, Dept. of Fisheries and Oceans, Vancouver, B.C.

7.6 Integrated Stormwater Management (ISM)

Information on ISM is available at the Ministry of Environment website:
http://www.env.gov.bc.ca/epd/epdpa/mpp/stormwater/stormwater.html

Information from the Greater Vancouver Regional District, including Best Management Practices, is available from:
http://www.gvrd.bc.ca/sewerage/stormwater_reports.htm

7.7 Small mammal identification and sampling

The latest small mammal identification manual is available for download at:
http://wlapwww.gov.bc.ca/wld/documents/techpub/id_keys_s.pdf

Nagorsen, D.W. 2002. An identification manual to the small mammals of British Columbia. Ministry of Sustainable Resource Management, Ministry of Water, Land and Air Protection, and the Royal British Columbia Museum. Province of British Columbia. 165 pp.

The Resources Inventory Standards Committee sampling methodology for small mammals is available here:
http://ilmbwww.gov.bc.ca/risc/pubs/tebiodiv/smallmammals/index.htm

7.8 Equipment suppliers

Coffee cans (#10 cans which are 6 3/16" in diameter and 7" deep - about 18 cm) can be purchased from Wells Cans in the Lower Mainland. Tel: 604-420-0959. They cost approximately $1.20 each (less if you order a large quantity). You need two cans per trap - remove the bottom out of one can with a can opener, and then duct tape the two cans together.

7.9 Development Permit Areas (DPAs)

Information about Development Permit Areas and development permits (including examples) are available at the links below.

- The Islands Trust
  http://www.islandstrust.bc.ca/ltc/np/pdf/npbroenvironmentaldpafactsheet.pdf
- Maple Ridge
  http://www.mapleridge.org/municipal/departments/environment/building_near_watercourse.html

- Sechelt http://www.district.sechelt.bc.ca/departments/landdp.php
- Parksville http://www.city.parksville.bc.ca/cms/wpattachments/wpID47atID62.pdf and http://www.rdn.bc.ca/cms/wpattachments/wpID408atID218.pdf

Many municipalities already have Official Community Plans (OCPs), Neighbourhood Concept Plans (NCPs), Comprehensive Development Plans (CDPs), or may use Development Permit Areas (DPAs), but the information may not be available on the web. Check with the local City Hall to access this information.

7.10 Additional reading and literature cited

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