British Columbia Wetland Identification and Delineation Manual

Draft Standard for Field Testing

Prepared by
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for the
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For more information about the Resources Information Standards Committee, please access the RISC website at https://www2.gov.bc.ca/gov/content?id=EF4CF4C85E9047DC92156C40E393447E or email RISCWeb@gov.bc.ca.

For more information about wetlands please access the Wetlands in B.C. website at: https://www2.gov.bc.ca/gov/content?id=A1E008AAC4FD4BD4A482608735F5F563

For more information or questions about this protocol please email wetlands@gov.bc.ca.

Preface

This draft manual has been developed to support wetland identification and delineation assessments for regulatory applications in British Columbia (B.C.). It is intended for use by Qualified Professionals and others with relevant expertise.

As this document is in draft form, it remains subject to change. Revisions may be made based on expert feedback and practical experience gained during the trial period, which is expected to last a minimum of one year from the initial posting date. Use of this manual is voluntary during the trial period and can be recommended at the discretion of a statutory decision maker.

To provide feedback on the B.C. Wetland Identification and Delineation Manual, please fill out the form available here: https://forms.office.com/r/aW9xkFKKTv. If you would like to provide detailed review and feedback of the manual, please contact wetlands@gov.bc.ca and we will send you the relevant documents.

The Government of B.C. is seeking photos to help supplement the B.C. Wetland Identification and Delineation Manual, specifically looking for examples of wetland indicators (hydrophytic vegetation, hydric soils, wetland hydrology) and of difficult wetland situations. Photos must be in accordance with government's copyright process. B.C.'s copyright guidelines and form can be accessed at through B.C.'s Copyright and model consent webpage[1]. Photos to be submitted should be high-quality JPEG, not include any person, be compressed (e.g. zip file), include a description of the photo in the title, and include photo credit information. Photos should be submitted to wetlands@gov.bc.ca.

This manual has been adapted from the Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Western Mountains, Valleys, and Coast Region (USACE 2010a; hereafter WMVC Regional Supplement), Alaska Regional Supplement (USACE 2007) and Arid West Regional Supplement (USACE 2008) collectively referred to the USACE Regional Supplements. The Regional Supplements were designed to complement that of the original Corps of Engineers Wetland Delineation Manual (USACE 1987; hereafter USACE Manual), which outlines foundational technical procedures for identifying and delineating wetlands. Information has been revised to align with ecosystems in British Columbia and terminology used in Canadian classification systems where possible.

[1] https://www2.gov.bc.ca/gov/content?id=604D64FC9D6C477C82A118391C3D5E31

Effort has been made within this manual to include all pertinent information; however, the reader is directed at times to the appropriate USACE Manual or regional supplement for further explanation or photographic reference. Future edits of this manual are intended to provide additional visual aids.

A glossary of important terminology is included in Appendix A: Glossary. Terms defined in the glossary are highlighted in **<u>bold and underlined</u>** the first time they appear in the manual.

Disclaimer

This draft manual is provided for informational purposes only and is intended to support field assessments by practitioners involved in wetland identification and delineation for regulatory applications in British Columbia. The content of this document is not intended to constitute legal advice or direction.

While references to legislation and regulatory frameworks are included, users are responsible for consulting official versions of applicable laws and regulations. For case-specific interpretations or legal guidance, users should seek advice from qualified legal professionals.

The Government of British Columbia makes no warranties or representations regarding the completeness, accuracy, or applicability of the information contained in this draft manual. Use of this document during the trial period is voluntary and at the discretion of the user.

Version Table

Version #	Date	Description
1.0	Sep 22, 2025	Draft released for field testing

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The Government of British Columbia provides funding of the Resources Information Standards Committee (RISC) work, including the preparation of this document. The Resources Information Standards Committee supports the effective, timely and integrated use of land and resource information for planning and decision making by developing and delivering focused, cost-effective, common provincial standards and procedures for information collection, management and analysis. Representatives to the Committee and its Task Forces are drawn from the ministries and agencies of the Canadian and the British Columbia governments, academia, industry and First Nations.

The Resources Information Standards Committee evolved from the Resources Inventory Committee (RIC), which received funding from the Canada-British Columbia Partnership Agreement of Forest Resource Development (FRDA II), the Corporate Resource Inventory Initiative (CRII), Forest Renewal BC (FRBC) and addressed concerns of the 1991 Forest Resources Commission.

An initial version of this manual was developed by EcoFish Research Ltd., led by Nicole Wright, Professional Wetland Scientist (PWS). Subsequent revisions and technical refinement were conducted by Kristen Andersen, an experienced wetland delineator and PWS with Sweetflag Environmental. Oversight of the development of this manual was provided by Karen Stefanyk of the B.C. Ministry of Water, Land and Resource Stewardship (WLRS). The following individuals and their organizations are acknowledged for their review, comments and contributions: Deepa Filatow (WLRS), Sacha O’Regan (WLRS), Ian Wright (WLRS), Robin Pike (WLRS), Dan Ciobotaru (WLRS), Klaus Rathfelder (WLRS), and Christine Bieber (WLRS), Jacqueline Howard (BC Energy Regulator), Barbara Sutherland (WLRS), and Malissa Smith (WLRS), Amanda J. Miller (WLRS), Jackie Churchill (WLRS), Gillian Munroe (WLRS), Martyna Tomczynski (WLRS) and Cory McGregor (WLRS).

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Table of contents

List of Tables

List of Figures

List of Abbreviations

Ah	topsoil enriched with organic material
Ahe	topsoil enriched with organics and eluviated
B.C.	British Columbia
BCSEE	BC Species and Ecosystem Explorer
BEC	Biogeoclimatic Ecosystem Classification
Bfh	subsoil enriched with organics and iron oxides
CDED	Canadian Digital Elevation Data
cm	centimetre
DEM	Digital Elevation Model
DUC	Ducks Unlimited Canada
FAC	facultative
FACU	facultative-upland
FACW	facultative-wetland
FWA	Freshwater Atlas
GIS	geographic information system
GPS	global positioning system
LiDAR	Light Detection and Ranging
LMH	Land Management Handbook
m	metre
OBL	obligate
Of	organic-fibric
Oh	organic-humic
Ohi	organic-humic with minor inclusions of mineral
Om	organic-mesic
PEM	Predictive Ecosystem Mapping
QP	qualified professional
ROW	right of way
SEI	Sensitive Ecosystem Inventory
SHIM	Sensitive Habitat Inventory and Mapping
SIFT	Soil Information Finder Tool
TEM	Terrestrial Ecosystem Mapping
TRIM	Terrain Resource Information Management
UPL	upland
US	United States of America
USACE	United States Army Corporation of Engineers
VRI	Vegetation Resource Inventory
WMVC	Western Mountains, Valleys and Coast
Δh	change in hue

Part I: Overview

1 Introduction

This manual is organized into five main parts:

- **Part I – Overview** - describes the organization, purpose, scope and regulatory application of the document, provides a discussion of wetland types and distribution in B.C., and discusses the concept between wetland and non-wetland areas.
- **Part II – Pre-field methods** – describes principles of desktop review for potential wetlands and field planning with specific sections on the following:
    - Preliminary data review – which discusses the review of existing data sources to identify potential wetland areas for a particular site;
    - Approaches – discusses application to both simple (routine) and complex (comprehensive) approaches to identification and delineation of wetlands; and
    - On-site evaluation planning – discusses both required sampling intensity and timing of work.
- **Part III – Hydrophytic vegetation, hydric soils and wetland hydrology indicators** – provides details on the three main indicators for wetland identification and delineation including specifics of each.
- **Part IV – Field methods** – provides several sections on specific methods and procedures and includes the following:
    - Field procedures – provides procedures for both wetland identification and delineation; and
    - Difficult wetland situations – provides the user with a series of methods and procedures to work through when wetland indicators are obscured or missing due to normal variations in environmental conditions (problem areas) or due to human activities or natural events (atypical situations).
- **Part V – Documentation** – provides a summary of information required when submitting a wetland identification and delineation report for regulatory purposes.

Appendix A: Glossary includes the glossary of terms; Appendix B: Wetland determination data form includes the datasheet to be used in the field and submitted with regulatory applications and Appendix C: Wetland delineation report checklist provides a checklist for documentation requirements. Appendix D: Spatial data submission standards provides data submissions standards for delineation activities. Appendix E: Determination of normal circumstances provides a key to determining normal circumstances.

1.1 Purpose

This manual addresses a critical gap in existing resources by providing clear, step-by-step guidance for practitioners involved in the identification and delineation of wetlands. Developed for use in regulatory contexts, it serves as a comprehensive tool to support consistent and accurate delineation practices.

It outlines the decision-making framework, technical guidelines, methodologies, and supporting resources used to determine whether a wetland is present within a designated study area (**identification**) and to define the boundaries separating wetlands from adjacent non-wetlands (**delineation**) in accordance with regulatory requirements in British Columbia (B.C.).

Accurate identification and delineation of wetland boundaries are essential components of wetland management, as they provide critical information about the location, extent, and characteristics of wetlands on a given site. This informs land-use planning and decision-making processes.

The manual offers a standardized approach to data collection and documentation, with the objective of enhancing accuracy, consistency, and transparency in wetland delineation practices.

1.2 Scope

The methods presented in this manual apply identification and delineation of tidal and non-tidal wetlands within B.C. In Canada, **wetlands** are scientifically defined as "land that is saturated with water long enough to promote wetland or aquatic processes as indicated by [generally] poorly drained soils, hydrophytic vegetation and various kinds of biological activity that are adapted to a wet environment" (National Wetlands Working Group 1997).

The wetland indicators and delineation methods described in this manual emphasize vegetation, soil, and hydrology—key **indicators**. These methods incorporate criteria and thresholds that are particularly relevant for **wetland identification** in areas with broad transition zones or where environmental disturbances are present.

This manual provides detailed guidance to support wetland identification and delineation. For expanded methodologies or additional context, refer to Wetland Indicators: A Guide to

Wetland Delineation, Classification, and Mapping (Tiner 2017), as well as the foundational documents from which this manual was adapted (USACE 1987, 2007, 2008, and 2010).

Some wetlands will be more difficult to identify and delineate at certain times of the year. Collecting and documenting data is one of the most important aspects of completing wetland delineation.

Where delineation aims to find the precise wetland boundary it does not subdivide wetlands into classification or assessment units even though these activities are critical to wetland management. **Wetland classification**, **wetland function assessment** and **wetland impact assessment** methodologies are outside the scope of this manual. However, a brief overview of wetland classification is provided in Section 1.4 Wetland types and distribution.

This manual is intended for use by **Qualified Professionals** (QPs), responsible for identifying and delineating wetland boundaries in the field or verifying the accuracy of wetland jurisdictional determinations under applicable legislation, including the Water Sustainability Act, Riparian Areas Protection Act, Forest and Range Practices Act, and others.

For the purposes of this manual, a QP is defined as an individual with the requisite training and expertise to identify and delineate wetlands or to assume professional responsibility for a wetland delineation conducted by a team of qualified practitioners.

The necessary competency and skills required to apply the procedures in this manual include at a minimum the following:

- Combination of training (relevant courses in wetland delineation) and experience (across different seasons, types of wetlands and wetland situations for the area in which work is being performed) in wetland delineation methods involving the identification of hydrophytic vegetation, hydric soils, and wetland hydrology, including the
    - ability to identify all trees, shrubs and at least 80% of the common forbs in vegetative and reproductive states;
    - ability to identify all common graminoids in a reproductive state;
    - ability to apply regionally appropriate wetland plant indicator status;
    - ability to describe soil profiles, including texturing, and description of colours with the use of a Munsell Soil Color Chart, for the purposes of identifying hydric soil indicators; and
    - ability to recognize wetland hydrology indicators and the use of groundwater monitoring tools, if needed.
- Use of GPS and mapping tools for accurate boundary delineation.

1.3 Regulatory application

Section 1.2 Scope references the scientific definition of a wetland, which forms the basis for wetland identification and delineation. However, legal and administrative definitions may vary across different statutes and municipal bylaws. Where applicable, regulatory definitions—such as those outlined in the Water Sustainability Act—should be applied to determine whether a wetland is subject to specific regulatory requirements.

1.4 Wetland types and distribution

Three main factors characterize a wetland: hydrology (water), substrate (physiochemical environment, soil) and biota (vegetation, animals, microbes) (Figure 1). These factors are also influenced by regional differences in geomorphology and climate which leads to considerable diversity in wetland types across B.C.

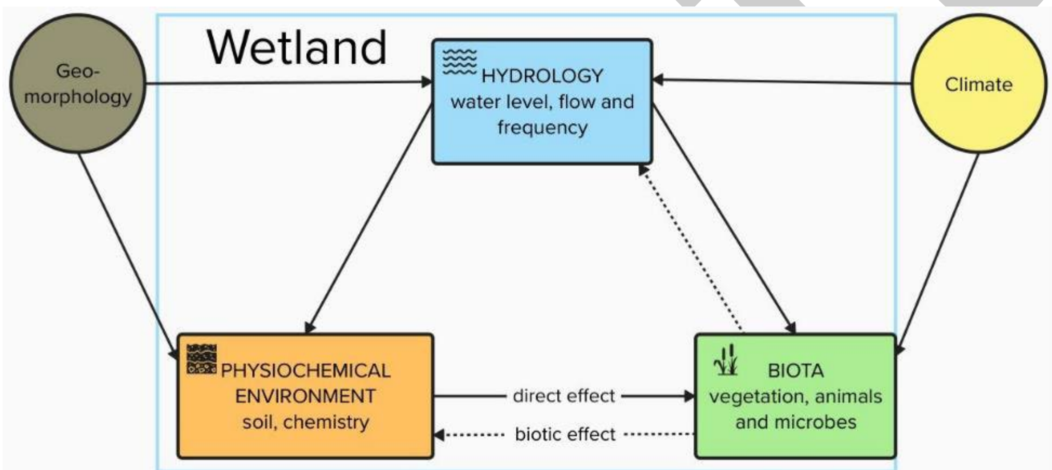

Figure 1 Conceptual diagram showing the different interconnected components involved in wetland formation. For interpreting these factors in the field, a three-factor approach is used where indicators of hydrophytic vegetation (plants adapted to wet environments), hydric soils (soils formed under wet conditions) and wetland hydrology (water presence) are used in most cases. Adapted from Mitsch et al. (2023).

Wetlands range from tidal to freshwater environments and include estuaries, tidal salt marshes, tidal freshwater wetlands, interdunal wetlands, wet meadows, open and forested wetlands, riparian wetlands and peatlands (e.g., fens and bogs).

Wetlands may be underlain by organic or mineral soils and can contain static or flowing water. Water conditions may be fresh, brackish or saline. Some wetlands are permanently inundated, while others undergo periodic drying. For example, certain wetlands may dry during the summer months, whereas tidal wetlands experience daily drying between high and low tides (Cox and Cullington 2009). Wetlands may occur in isolation or exist as part of broader hydrologic networks, forming complexes with other wetland types, aquatic ecosystems and upland terrestrial environments.

In addition to naturally occurring wetlands, **anthropogenic wetlands** may also be present. These include **human-modified wetlands**, natural wetlands that have been altered through activities affecting vegetation, soils and/or hydrology (e.g., partial drainage for agriculture or vegetation removal), and **human-created wetlands**, which are purposefully constructed in areas without prior wetland conditions. The latter may be established for purposes such as wastewater treatment, stormwater management or regulatory compensation.

A Note on Wetland Classification:

Although not the focus of this manual, wetland classification is a valuable next step after identifying and delineating wetlands. However, it serves a different purpose.

Delineation identifies where a wetland begins and ends—often for regulatory use. In contrast, **classification** groups wetlands into types based on shared features like vegetation, water source or landform. Classification doesn't define boundaries; it describes what kind of wetland it is.

In B.C., various classification systems are used, each suited to different applications:

- **Hydrogeomorphic (HGM) systems** help assess wetland functions (e.g., flood storage or nutrient cycling).
- **Wetland plant associations** are useful for planning projects involving impact, restoration or habitat offsetting.
- **Wetland class and form** are useful for mapping and inventory, in both local efforts and national databases.

The Canadian Wetland Classification System[a] (Wetland Research Centre 1997) identifies five main types of wetlands: **bogs, fens, swamps, marshes** and **shallow open water**. The BC Supplement to the Canadian National Wetland Inventory: BC Supplement[b] (ECCC 2024) expands these categories with more detail relevant to B.C.'s diverse landscapes.

The Land Management Handbook *52* (LMH 52) (Mackenzie and Moran 2004) offers another classification approach using B.C.'s Biogeoclimatic Ecosystem Classification (BEC). Regional LMH guides[c] such as LMH 78 build on this by focusing on specific site-level plant associations found within that region.

Different classification systems use different methods. For instance, vegetation-based classification typically requires sampling in the center of a vegetation community, while delineation focuses on the edges. That's because classification tries to match a wetland to a central concept or type, while edges are often transitional and don't fit cleanly into any one category.

It's also worth noting that classification systems aren't always directly comparable. For example, LMH 52 may place both poor fens and poor swamps under the bog class based on vegetation similarity, even though they represent different wetland classes in other systems.

[a] https://publications.gc.ca/site/eng/9.867506/publication.html
[b] https://catalogue.data.gov.bc.ca/dataset/c8d6abae-a650-4682-b57d-5c74be0b7166/resource/37e21584-0e17-4508-b142-30631d70d9ce/download/cnwibcsupplement_executivesummary.pdf
[c] https://www.for.gov.bc.ca/hre/becweb/

1.5 Wetland vs. non-wetland

Wetland identification is based on three-factors: hydrology, substrate and biota. The states of the three factors that characterize wetlands are the criteria for identification of wetlands: recurrent, sustained saturation (the hydrologic criterion), physical and chemical conditions in the substrate that reflect recurrent, sustained saturation (the substrate criterion) and the presence of organisms that are specifically adapted to recurrent and sustained saturation of the substrate (the biological criterion) (NRC 1995).

Although hydrologic conditions are paramount to the maintenance of a wetland, it is often more difficult to evaluate hydrology than it is to assess substrate or biota. Therefore, even though water is in a sense more important than any other factor, substrate and biota will typically provide the most easily obtained and reliable evidence for the presence of wetlands, except where hydrology has been altered (NRC 1995).

Wetlands are associated with specific conditions of water, substrate and biota. These specific conditions correspond to thresholds or criteria that are used to judge whether a particular ecosystem is a wetland. Each of the three are interpreted in terms of indicators that can be documented under field conditions (NRC 1995) and generally include hydrophytic vegetation, hydric soils and wetland hydrology, as described in Part III.

Some indicators are general; others are more specific and can be used only as secondary evidence or to support a more general indicator. A wetland boundary is delineated by determining the extent of the area where all three indicators are positively identified.

Although vegetation is often the most visible and accessible indicator, relying solely on vegetation—or on a single indicator—can yield inaccurate results. Many plant species occur in both wetland and non-wetland settings, and hydrophytic vegetation or hydric soils may persist long after hydrologic conditions have been altered. Therefore, incorporating indicators of hydric soil and wetland hydrology alongside vegetation provides a more robust, defensible basis for delineating wetlands (USACE 1987).

Areas that do not show positive indicators for one or more of the three wetland indicators are typically classified as non-wetlands. However, exceptions can occur under certain conditions. Some wetlands do develop where hydric soils are absent or where vascular plants cannot grow, and the wetland supports instead other kinds of organisms that are reflective of recurrent, sustained saturation (NRC 1995). In these cases, wetlands may still be identified even without all three indicators—provided there is sufficient supporting rationale. For guidance on how to evaluate such situations, refer to Section 9 Difficult wetland situations.

Part II: Pre-field methods

Effective wetland identification and delineation begins with pre-field preparation. This phase establishes the foundation for efficient and accurate fieldwork by integrating existing information and formulating a site-specific approach. Pre-field methods help identify potential wetlands, inform field strategies and ensure compliance with applicable regulatory frameworks.

This section outlines key preparatory steps including the review of available data sources, a description of wetland determination approaches and the development of an on-site evaluation plan. These methods support systematic decision-making and enhance the reliability of field evaluations.

> Wetland identification and delineation should be conducted as early in the project planning stage as possible. Early identification and delineation of wetlands can also support development planning and engineering designs to inform appropriate mitigation strategies in accordance with the mitigation hierarchy (avoid, minimize, restore on-site or offset).
>
> Aerial imagery and Light Detection and Ranging data (LiDAR) (if available) should always be reviewed prior to the field evaluation.

2 Preliminary data review

This section outlines key considerations and information sources relevant to the preliminary data review process. Preliminary data review is conducted prior to field evaluation to develop an understanding of the landscape context, identify areas requiring on-site assessment, support the interpretation of field observations and guide the intensity of data collection.

The methods and results of the preliminary data review should be documented in the wetland delineation report, as described in Section 10 Wetland delineation report. Upon completion of this review, the delineator should be able to determine the appropriate level of evaluation—whether routine or comprehensive determination approach should be conducted or cases where on-site evaluation may be unnecessary.

2.1 Aerial photographs

Review of aerial photographs and satellite imagery will help to identify potential wetland areas for detailed delineation. This review can also help inform the desktop stratification of plant communities that may represent wetlands, which guides field sampling locations to confirm their presence or absence.

While mapping approximate wetland boundaries before fieldwork is recommended, it is not necessary. Desktop mapping should be replaced with more accurate field-delineated boundaries.

When field delineation is delayed and desktop mapping is used for initial planning, the best practice is to use at least five years of recent aerial imagery including one image representing wet conditions. If this is not feasible, use a minimum of three images: one representing normal precipitation, one wet and one dry. Refer to Section 2.5 Climate data for guidance on selecting images that represent wet, normal and dry conditions.

The ability to identify peatland wetlands and those in forested environments is diminished from aerial interpretation.

Aerial photos/satellite imagery are recommended to have a minimum resolution of 1 m, or a scale between 1:10,000 and 1:20,000. The most detailed mapping is possible with high resolution photos (0.25 to 0.5 m), ideally using colour infrared photos, which are used in conjunction with LiDAR. However, all other imagery (i.e., true colour, black and white and low-resolution photos) may be useful in understanding site characteristics. In potentially disturbed sites, review available historic imagery to identify factors that may have altered wetlands such as drainage ditches, irrigation, impoundments, dredging, filling, tilling, vegetation removal or planting and natural disturbances. Drainage features are often most visible using black-and-white photos captured in spring.

Resources for acquiring, selecting and interpreting aerial imagery for wetlands include digital aerial photos in B.C.[d], Guidance for Mapping Wetlands from Imagery in B.C. for the Canadian National Wetland Inventory[e] (Blackwell and Associates 2024) and Wetland Indicators (Tiner 2017).

[d] https://www2.gov.bc.ca/gov/content?id=6EE271173B014AC293F6872139A1A8AE
[e] https://catalogue.data.gov.bc.ca/dataset/canadian-national-wetland-inventory-cnwi-bc-supplement

2.2 Elevation data

Elevation data provides information on surface shape typically presented as digital elevation models (DEM), contour lines and hillshade. These provide key information about topographic features, like depressions, and can be found on the B.C. Website for Topographic Data[2] including freely available 25 m resolution Canadian Digital Elevation Data (CDED).

High-resolution LiDAR data is available for purchase from private companies and is available from the provincial government through LiDAR BC[3]. Point cloud, hillshade, and contours derived from high resolution LiDAR should be used for delineation if available. This information can also be used to identify disturbances such as ditches, berms, infilling and other features that divert flows.

2.3 Wetland mapping

Available wetland-related map products provide valuable background information. They show approximate locations of mapped wetlands using remote sensing techniques with varying degrees of field verification. These maps help identify potential wetland locations but are not necessarily exhaustive or spatially accurate. Several wetland types are difficult to detect, such as wetlands with heavy tree canopy, ephemeral and seasonal wetlands, slope wetlands, disturbed vegetation or sites with manipulated hydrology.

Sources of wetland inventory data include federal (Canadian National Wetlands Inventory[4]), provincial and local government inventories, land conservancies or non-government environmental organizations (British Columbia Wetlands Atlas[5], Canadian Wetland Inventory[6]).

The B.C. Freshwater Atlas[7] (FWA) is an important dataset with coverage of the entire province including watershed boundaries, wetlands, streams, lakes and other waterbodies.

Predictive wetland mapping has been completed by the Government of B.C., and other organizations, for some areas including the Lower Fraser, Williston[8], Northern Boreal

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[2] https://www2.gov.bc.ca/gov/content?id=2317BC6BB66448218779A89DC3E4914B

[3] https://lidar.gov.bc.ca/

[4] https://www.canada.ca/en/environment-climate-change/services/wildlife-habitat/canadian-national-wetland-inventory.html

[5] https://cmnmaps.ca/WETLANDS/

[6] https://www.ducks.ca/initiatives/canadian-wetland-inventory/

[7] https://www2.gov.bc.ca/gov/content?id=2317BC6BB66448218779A89DC3E4914B

[8] https://arcg.is/0OzL9X

Mountains Ecoprovince, Thompson-Nicola, Okanagan and the Canadian Western Boreal (Ducks Unlimited Canada). The Government of B.C. is working on capturing footprints of these projects to improve access for wetland delineators. Users are advised to review the methodologies and limitations associated with these predictive maps to ensure appropriate application in wetland delineation efforts.

Vegetation inventory maps such as Vegetation Resource Inventory (VRI), Predictive Ecosystem Mapping (PEM), Biogeoclimatic Ecosystem Classification (BEC), Terrestrial Ecosystem Mapping (TEM) and Sensitive Ecosystem Inventory (SEI) are useful for identifying plant communities that are highly associated with wetlands and are available through the BC Data Catalogue[9].

Additionally, the BC Species and Ecosystem Explorer[10] (BCSEE) can be used to identify locations where wetlands have previously been identified by searching site associations [i.e., a search for cattail marsh (*Typha latifolia*) will return locations where Wm05 site association has been identified]. Use of the BCSEE can also help determine the existence of previously documented red- or blue- listed ecological communities (i.e., those that are assessed as being Extirpated, Endangered or Threatened; or of Special Concern, respectively).

Local and regional mapping, which includes wetlands, may exist for the study area, including Terrestrial Ecosystem Mapping (TEM), Sensitive Ecosystem Mapping (SEI) and Sensitive Habitat Inventory and Mapping (SHIM). Other provincial wetland-related mapping studies may be available on EcoCat[11].

[9] https://catalogue.data.gov.bc.ca/

[10] https://www2.gov.bc.ca/gov/content?id=DB888ABF936D478295BC87C99B5CA4DC

[11] https://www2.gov.bc.ca/gov/content?id=9B421133D7E9407587F26CB5B21E37B3

Caution! Wetlands in the Freshwater Atlas (FWA) in B.C. are derived from a 1:20,000 Terrain Resource Information Management (TRIM) topographic base map. In this dataset, wetlands are part of a connected network with streams and lakes. Limitations when using the FWA include, but are not limited to the following: small, ephemeral and forested wetlands are poorly represented; spatial accuracy of the wetlands varies so that field verification is almost always required; the wetlands appear to be classified or designated a wetland type (swamp, marsh), but those designations are based on feature code symbols designated only for cartographic purposes.

The example in Figure 2 shows the discrepancy in the FWA polygon overlain with imagery.

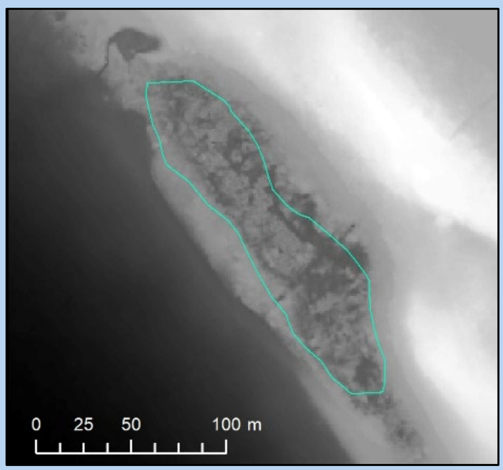

Figure 2 Example of FWA polygon on LiDAR DEM at 1 m resolution.

2.4 Soil data

Soil survey information can be valuable for planning purposes and landscape context. Mapped soil polygons can be used to identify broad areas where wetlands and hydric soil conditions might be encountered. Soil orders such as Gleysols and Organic are common in wetlands. It is important to note that soil classification criteria/thresholds differ from delineation hydric soil indicators by design. Soil surveys may also be older and not representative of current conditions. Information regarding soil classification and related properties such as drainage classes are highly associated with wetlands (i.e., poorly drained and very poorly drained). Available information from soil surveys can be found using the Soil Information Finder Tool[12] (SIFT) (Provincial Soils Working Group 2018) which provides access to soil survey data, reports and maps.

2.5 Climate data

Climate data may be used to evaluate **antecedent precipitation** conditions associated with site observations and aerial photographs. Historical data and climate normals for precipitation and temperature are available from the Government of Canada's Historical Climate Data[13]. British Columbia meteorological data have been compiled in other resources including ClimateBC[14] and Pacific Climate Impacts Consortium[15]. The BC Drought Portal[16] outlines current and historic drought levels for geographic regions in B.C.

2.6 Hydrology data

Stream or tidal gauge data may exist for some locations, and these may provide records of flow events that inform anticipated water levels. Data sources include Real-time Water Data Tool[17] and River Forecast Centre[18], which are maintained by the Government of B.C. Environment Canda provides monitoring data[19] for tidal stations and hydrometric data for rivers. This information is typically utilized as required when wetland hydrology decisions are problematic.

2.7 Other sources

Environmental impact assessments or similar reports may exist from previous studies completed at a site. Information on wetland locations may be included, or vegetation, soil and hydrology data may be documented in reports that provide detailed accounts of current or historic features.

Landowners and local individuals from municipal or provincial government and stewardship groups may be available for interviews and can often provide essential information related to historical human activities that may have affected the location of wetlands on the site.

[12] https://governmentofbc.maps.arcgis.com/apps/MapSeries/index.html?appid=cc25e43525c5471ca7b13d639bbcd7aa

[13] https://climate.weather.gc.ca/index_e.html

[14] https://climatebc.ca/

[15] https://www.pacificclimate.org/data/bc-station-data-disclaimer

[16] https://droughtportal.gov.bc.ca/

[17] https://www2.gov.bc.ca/gov/content?id=9B421133D7E9407587F26CB5B21E37B3

[18] https://www2.gov.bc.ca/gov/content?id=0ED72C0820814B96B4B346374D05056C

[19] https://wateroffice.ec.gc.ca/

Many wetlands in B.C. are the subject of research studies that can be found through literature searches on gazette wetland names (e.g., Burns Bog).

Information for past or future engineering designs should be reviewed prior to conducting a site visit. The location of existing and future culverts, earthworks and drainage infrastructure provides information about modification to site hydrology and will be essential to future assessment of potential wetland impacts, including direct, indirect or secondary impacts.

3 Wetland determination approaches

There are two general approaches to wetland determination: **routine** and **comprehensive**.

- **Routine determinations** (Section 3.1) use straightforward, rapid methods to collect sufficient **qualitative** data for identifying wetlands. This approach is typically appropriate for **simple wetlands**, those that are relatively homogeneous in terms of vegetation, soils and hydrology, and where wetland indicators are clearly present or absent.
- **Comprehensive determinations** (Section 3.2) involve more detailed and time-intensive methods to gather **quantitative** data. This approach is reserved for **complex wetlands**, which may exhibit significant heterogeneity, ambiguous or borderline indicators, or other complicating factors that require a more rigorous assessment.

In general, most delineations can be completed using the routine approach.

3.1 Routine determinations

Three options, or levels of evaluation, are summarized below for routine situations.

- Level 1 – Desktop evaluation
- Level 2 – On-site evaluation
- Level 3 – Combination of levels 1 and 2

If it is more expedient to conduct an on-site evaluation rather than search for available information in a Level 1 evaluation, then it is recommended to continue to Level 2 or Level 3. More accurate results are possible with on-site data.

3.1.1 Level 1: Desktop evaluation

Level 1 delineation **may** be appropriate **if there is sufficient off-site information** to make a wetland determination for the project area. Level 1 is typically used when the exact boundary of a wetland is not critical. There may be cases where desktop assessment results provide unequivocal evidence that there is/are no wetland(s); however, this is rare, and clear justification for lack of field verification is required.

Resources described in Section 2 Preliminary data review may be used to determine the potential presence and estimate the approximate boundaries.

Desktop evaluations may be sufficient when:

- Wetland presence is clearly identifiable from imagery and GIS data.
- No development or alteration is proposed, or the project is in early-planning stages.
- Field access is restricted, and desktop review is used for screening or prioritization.

3.1.2 Level 2: On-site evaluation necessary

Level 2 delineation requires on-site collection of field data and physical marking of the wetland boundaries. It is always used when permanent wetland impacts are proposed or have the potential to occur and compensatory mitigation may be required. In some cases, Level 2 may be warranted if a landowner wants to know the exact boundaries for planning purposes. **This is the most common method used.** More information on sampling intensity requirements is provided in Section 4.1 Sampling intensity.

On-site evaluation is typically required when:

- Wetland boundaries are unclear or disputed;
- Desktop data is outdated or low-resolution;
- Project involves potential impacts to wetlands (e.g., development, drainage); and/or
- Sensitive or wetland types with the potential for listed species and/or ecological communities are present.

3.1.3 Level 3: Combination of levels 1 and 2

Level 3 delineation combines Level 1 and Level 2 when a portion of the study area requires detailed delineation, and a portion can be assessed using off-site resources. This may be used where exact boundaries are necessary for a portion of the study area (such as cases where access is only granted for a portion of an area where a wetland may exist).

3.2 Comprehensive determinations

Comprehensive determinations for wetland identification and delineation should only be used for very complex sites or when the determination requires rigorous documentation. It is intended to provide the strongest possible evidence through intense data collection.

Cases that warrant comprehensive determination inlcude but are not limited to the following:

- The applicant and regulator disagree on a routine delineation and cannot resolve the dispute, such as when the selection of sampling locations has a significant influence on the result and the comprehensive method provides a systematic approach to sampling that reduces bias; or

- The decision or project is likely to be challenged in court, and the situation could require more data collection to support boundary locations.

There may be instances in which only one indicator is disputed (vegetation, soil or hydrology). In these cases, the procedures in this manual may be completed for the disputed indicator only.

4 On-site evaluation planning

In most cases, wetland identification and delineation will require an on-site field evaluation. Prior to on-site evaluation, results of the preliminary data review will inform the available environmental attributes and landscape details of the site including topographic position of the site (i.e., is it located on elevated ground surface, in a depression, or toe of a slope) as well as the condition of the surrounding area that may influence hydrology. Evidence of human disturbance may call for more rigorous sampling. Numerous factors influence the wetness of a site, and the preliminary data review will support the development of a field sampling plan.

The field sampling plan should include details on the potential number and location of plots that may be needed to confirm identification of wetlands and delineate their boundaries. This pre-field plot selection is based on the size and shape of the wetland and the diversity (heterogeneity) of vegetation communities expected to be present based on desktop analysis. It is often beneficial to do a preliminary site visit before detailed field data collection to better understand site conditions and the complexity of vegetation communities and to support sampling plan development.

4.1 Sampling intensity

4.1.1 Routine determinations

Establish at least one transect per wetland, oriented perpendicular to the wetland boundary and along the wetness gradient. Each transect should include a minimum of two wetland determination plots: one within the wetland plant community and one in the adjacent non-wetland area. This is referred to as a **paired plot**.

Increase the number of plots based on site complexity, especially in disturbed or heterogeneous areas. Larger wetlands with uniform conditions may not require more samples, but diverse plant communities or unclear boundaries may. Add representative points as needed to support a reliable wetland determination.

4.1.2 Comprehensive determinations

The comprehensive method is used for highly complex sites or where determinations require rigorous documentation. Sampling intensity for the comprehensive determination method includes the following considerations:

- Establish a baseline by selecting an appropriate study area boundary that is reflective of the complexity of the site. The baseline should be parallel to any major watercourse and/or perpendicular to a topographic gradient (i.e., wetness gradient).
- Once a baseline is established, transects should be established perpendicular to the wetness gradient or parallel to major watercourses, depending on site conditions.
- Each plant community type must be included in at least one transect.
- Multiple wetland determination plots are then placed along each transect to assess each of the three indicators.

The number of wetland determination plots is determined by:

- **Site Size:** Larger sites require more transects.
- **Site Complexity:** Heterogeneous or disturbed areas need more intensive sampling.

The number of wetland determination plots should aim to provide representation of site conditions and contribute to thorough documentation.

Additional guidance on comprehensive determinations is provided within the USACE Manual (USACE 1987). It is recommended that when the comprehensive method is used, the applicant discusses the plan with the regulator on the exact methods prior to beginning the field work and that methods are thoroughly documented.

4.1.3 Large and linear projects

The following protocol is recommended for large or linear project wetland delineations (i.e., roads, highways, pipelines, transmission lines, etc.).

A **project footprint** is considered to be the study area for large projects or for linear projects, it is the linear ROW plus: permanent or temporary access roads; any associated disturbed areas including, but not limited to, temporary work areas, lay-down areas, storage areas, temporary and permanent infrastructure (sedimentation basins, pump stations, transformer sub-stations, sewage treatment facilities, etc.). The Potential ROW Area of Influence for a project is the linear ROW plus 100 metres on either side of the ROW corridor.

The following approach is recommended to be considered:

Comprehensive desktop delineation

When determining the placement of infrastructure or “Right of Way” (ROW) locations, complete an initial comprehensive desktop review to identify the presence, location and ecological extent of all potential wetlands in the study area to generate a constraint mapping. This wetland constraint map is to be based on a review of the best available aerial imagery or other remotely sensed images (i.e., LiDAR, etc.) topographic maps as well as other available pertinent data layers (i.e., available mapping, depth-to-water table mapping, etc.). The wetland interpreter should have a strong background in photo interpretation, vegetation identification, wetland delineation and GIS skills for digitizing wetland boundaries.

Field delineation

Once the project footprint has been finalized, the following approach is recommended:

- All wetlands in or within a minimum of 30 m of the project footprint are to be identified, delineated on the ground and mapped.
- Wetlands of the same type may be grouped in the report provided that soil conditions do not change. Completing two data forms per wetland may provide diminishing returns where plant community and soil conditions are the same across several wetlands. All wetlands should be delineated on the ground, but the number of wetland determination forms to document all three indicators may be reduced.
- For each class/type of wetland or wetland complex, only one data form is required to be submitted. This wetland is considered the **control wetland**. The remaining wetlands that are considered the same type as the control wetland can be delineated using only two indicators at the discretion of the wetland professional.
- Data forms should be paired to include one wetland and one non-wetland sampling point and should be submitted with the wetland delineation report. If soil conditions change within the study area, then additional datasheets for each wetland class/type should be completed.

4.2 Timing of work

The ideal time to conduct a field visit to assess the three indicators is when conditions are representative of typical growing-season conditions which are discussed in Section 7.2 Growing season.

Other considerations when scheduling a site visit include:

- Vegetation indicators are easiest to detect during peak plant biomass; however, ideally try to time field visits with the flowering period of cryptic species such as sedges (*Carex* spp.).
- Hydrologic indicators may be more visible, especially for wetlands which are precipitation-driven, during the normal wet period.

When sampling must occur during years with abnormal climatic conditions or at different stages of the season, professional judgement and other sources of information (e.g., species inventories and soil surveys) may be required to support wetland identification, but an additional follow-up field visit will likely be required.

To support permitting decisions, a rationale must be provided by the qualified professional if professional judgement is used to work outside of the ideal timing window.

Part III: Hydrophytic vegetation, hydric soils, and wetland hydrology indicators

5 Hydrophytic vegetation

5.1 Introduction

Hydrophytic vegetation grows in water or on a substrate that is saturated at a frequency and duration during the growing period sufficient to affect plant occurrence (Tiner 2012). The presence of hydrophytic vegetation is one of the three indicators for identifying and delineating wetlands. In this manual, the decision as to whether hydrophytic vegetation is present at a site is based on the plant community rather than on the presence or absence of any one indicator species.

Resources for field plant identification include the Wetland Plants of British Columbia: Field Guide to Common Species [f] (BCWF 2025), E-Flora BC[g] (Klinkenberg 2023), the Illustrated Flora of British Columbia[h] (2002), Field Guide to the Sedges of the Pacific Northwest (Wilson et al. 2014) and various regional guides in the Lone Pine series, such as Plants of the Pacific Northwest Coast (Pojar and Mackinnon 2016); Plants of Northern British Columbia (MacKinnon et al. 1992); Plants of the Western Boreal Forest and Aspen Parkland (Johnson et al. 1995); and Wetland Plants of Oregon and Washington (Guard 1995).

[f] https://bcwfwatershedteam.ca/wetland_plants_of_bc/
[g] https://linnet.geog.ubc.ca/DB_Query/QueryForm.aspx
[h] https://ibis.geog.ubc.ca/biodiversity/eflora/IllustratedFloraofBritishColumbia.html

5.2 Vegetation sampling

When assessing an area for the presence of wetlands, it is important to first identify and map the major landscape units or vegetation units. A wetland determination plot should be established in each major vegetation type.

In general, determining whether hydrophytic vegetation indicators are present is based on visual estimates of percent cover of plant species within the plant community unit or within one or more wetland determination plots in representative locations within each unit. Each wetland determination plot is typically broken down into strata.

A stratum for sampling purposes is defined as having 5% or more total plant cover. If a stratum has less than 5% cover during the peak of the growing season, then those species and their cover values can be combined into another stratum.

Vegetation stratum types, descriptions and recommended sample plots are provided in Table 1.

Table 1 Strata type, description, and recommended sample plot size for vegetation sampling.

Strata	Strata Definition	Sample Plot Size and Type
Tree	Consists of woody plants 8 cm or more in diameter at breast height (DBH), regardless of height.	10 m radius
Sapling/Shrub	Consists of woody plants less than 8 cm DBH, regardless of height.	5 m radius
Herb	Consists of all herbaceous (non-woody) plants, including herbaceous vines, regardless of size.	1 m quadrat
Woody vine	Consists of all woody vines, regardless of height.	5 m radius

Plot sizes and shapes may be adjusted based on professional judgement with supporting rationale to suit site conditions and must be recorded on the data form (Appendix B) to support field verification. When sampling near plant community or wetland boundaries, plots should be shaped and positioned to avoid extending into areas with different vegetation, hydrology or soil characteristics.

Figure 3 provides an example of vegetation plot layout. However, adjustments may be necessary to ensure sampling remains within the target plant community. Extending beyond these boundaries can result in inaccurate assessments of wetland indicators.

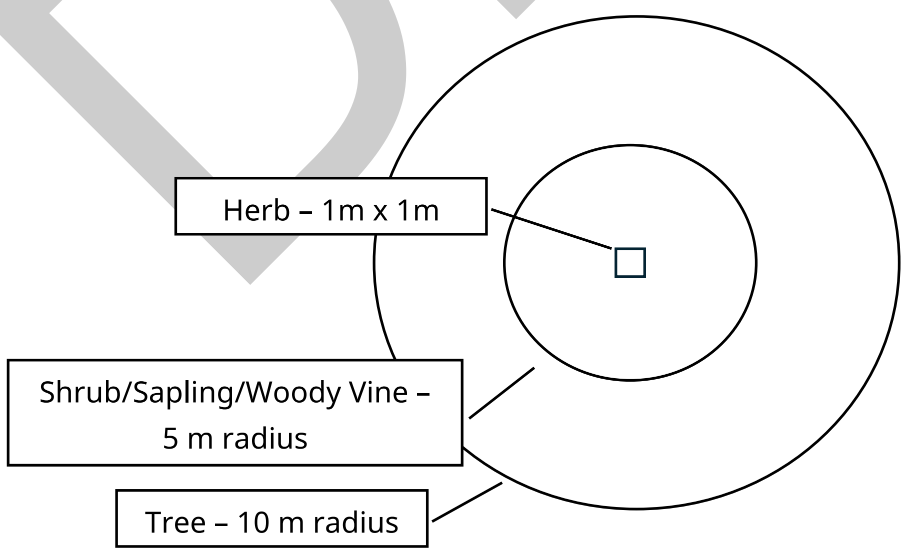

Figure 3 Example of stratum plot arrangements for vegetation sampling - single plots in graduated, nested sizes. Adapted from USACE 2010b.

In each stratum, the delineator identifies species present within the plot and then estimates the **absolute cover** of each species. The minimum proportion of identified species within a plot depends on which hydrophytic vegetation indicator is being used and is further discussed in Section 5.3.

Absolute cover is the percent of the ground surface that is covered by the areal portion (leaves and stems) of a plant species when viewed from above. Due to overlapping plant canopies, the sum of absolute cover values for all species in a plot may exceed 100%.

For percent cover estimates, it is acceptable to include plants that overhang the plot and are not rooted in the plot if they are growing under the same soil and hydrological conditions. Absolute cover can be used for both the dominance test and prevalence index, which are further described in Section 5.3.1. Absolute cover is the preferred abundance measure for all species.

Due to variations in vegetation structure, diversity and spatial arrangement, more complex sampling situations may be warranted at the wetland delineator's discretion and with rationale and methods documented in the delineation report.

Typical abundance measures include basal area (for trees), percent areal cover, stem density, or frequency based on point-intercept sampling.

If alternative measures are used, this should be documented in data forms or within the report. The data must include abundance values for each species present and must be in a format that can be used in the dominance test or prevalence index for hydrophytic vegetation (Section 5.3 Hydrophytic vegetation indicators).

5.3 Determination of plant indicator status

After identifying species in each stratum, the delineator must record their wetland indicator status (Table 2).

Hydrophytic vegetation is considered present when the plant community is dominated by species adapted to prolonged soil saturation or flooding during the growing season, not just by the presence of a single indicator species. Hydrophytic vegetation decisions are based on the wetland indicator status of the species that make up the plant community.

Table 2 Hydrophytic plant indicator status and descriptions.

Category	Abbreviation	Description
Obligate	OBL	Almost always occurs in wetlands, rarely in non-wetlands
Facultative Wetland	FACW	Usually occurs in wetlands, but occasionally occurs in non-wetlands
Facultative	FAC	Equally likely to occur in wetlands and non-wetlands
Facultative Upland	FACU	Sometimes occurs in wetlands, but usually occurs in non-wetlands
Upland	UPL	Rarely occurs in wetlands, but occurs almost always in non-wetlands

Adapted from: Luchvar et al. 2012.Facultative species (FACW, FAC, FACU) occur in both wetlands and non-wetlands to varying degrees. While most wetlands are dominated by OBL, FACW and FAC species, some, like western hemlock (*Tsuga heterophylla)*-dominated communities, may be primarily FACU.

In these cases, dominant species alone may not confirm hydrophytic vegetation. Instead, consider other species and indicators of wetland conditions, especially when hydric soils and wetland hydrology are present. This does not mean indicator ratings are wrong. Some species simply tolerate a wide range of moisture conditions, making classification challenging.

A wetland indicator status list has been created for B.C. based on the indicator status ratings from Western Mountains, Valleys and Coast Region (USACE 2023), which is applicable to the majority of the province. Where some areas of the B.C. have similar climate and biophysical characteristics to Alaska, in this guide they are referred to as the Northwest, in which case the indicator status for the Alaska region (USACE 2023) is appropriate. The most recent version of appropriate wetland plant indicator status is available on the Wetlands in B.C.[i] webpage.

Wetland determination forms (Appendix B) should document the source of the hydrophytic vegetation indicator status list that was used.

[i] https://www2.gov.bc.ca/gov/content?id=A1E008AAC4FD4BD4A482608735F5F563

The hydrophytic vegetation indicators and procedures described in this section are used to identify most wetland plant communities in B.C. However, some wetland communities may lack any of these indicators. Procedures to guide wetland determinations in these instances are described in Section 9 Difficult wetland situations.

5.4 Hydrophytic vegetation indicators

There are four main indicators used to determine if a plant community meets the criteria to be a positive indicator of hydrophytic vegetation and they are applicable to all areas of B.C. for purposes of wetland determination. The indicators and listed below:

- Indicator V1 – Rapid Test;
- Indicator V2 – Dominance Test;
- Indicator V3 – Prevalence Index; and
- Indicator V4 – Morphological adaptations.

The indicators in this section are to be applied in a stepwise fashion as described in Section 5.3.1, below and the sequence in application is summarized in Figure 4.

5.4.1 Procedure

The procedure to evaluate hydrophytic vegetation indicators begins with a Rapid Test (Indicator V1), which is met if all dominant species across all strata are OBL, FACW or a combination of the two. If this is not the case, the delineator must continue to the Dominance Test (Indicator V2). **Either the Rapid Test (Indicator V1) or Dominance Test (Indicator V2) should be applied in every wetland determination.**

In rare instances, a plant community will fail a test based only on dominant species even though hydric soil and wetland hydrology are present. If this occurs, the vegetation should be re-evaluated with the Prevalence Index (Indicator V3) which considers all plant species in the community as opposed to only dominant plants.

Morphological adaptations (Indicator V4) can be used to distinguish certain wetland plant communities. Disturbed or problematic wetland situations may lack hydrophytic vegetation indicators, and in these situations the reader is directed to Section 9 - Difficult wetland situations.

STEP 1. Apply Rapid Test for Hydrophytic Vegetation (Indicator V1)

a. If all dominant plant species in all strata are FACW or OBL based on a visual assessment, the plant community passes the rapid test for hydrophytic vegetation and no further vegetation analysis is needed.
b. If the site is not solely dominated by OBL and FACW species, then the rapid test for hydrophytic vegetation is not met. Continue to STEP 2.

STEP 2. Apply Dominance Test (50/20 Rule) (Indicator V2)

a. The plant community passes the dominance test if more than 50% of the dominant plant species in all strata are OBL, FACW or FAC. The vegetation is hydrophytic and no further analysis is required. The dominance test requires application of the 50/20 rule to identify dominant species as described under V2 – Dominance Test (50/20 Rule).

b. If the plant community fails the dominance test and indicators of hydric soil and wetland hydrology are absent, then hydrophytic vegetation is absent unless the site meets requirements for a problematic wetland situation (see Section 9.1 Problem situations).

c. If the plant community fails the dominance test but indicators of hydric soil and wetland hydrology are both present, then continue to STEP 3.

STEP 3. Apply Prevalence Index (Indicator V3)

a. If the plant community satisfies the prevalence index described below, then the vegetation is hydrophytic and no further analysis is required.

b. If the plant community fails the prevalence index, continue to STEP 4.

STEP 4. Apply Morphological Adaptations (Indicator V4).

a. If the plant community is mostly comprised of FACU plants that have signs of physical (morphological) adaptation to wet conditions.

b. If none of the indicators are satisfied, then hydrophytic vegetation is absent unless indicators of hydric soil and wetland hydrology are present, and the site meets the requirements described in Section 9.1 Problem situations.

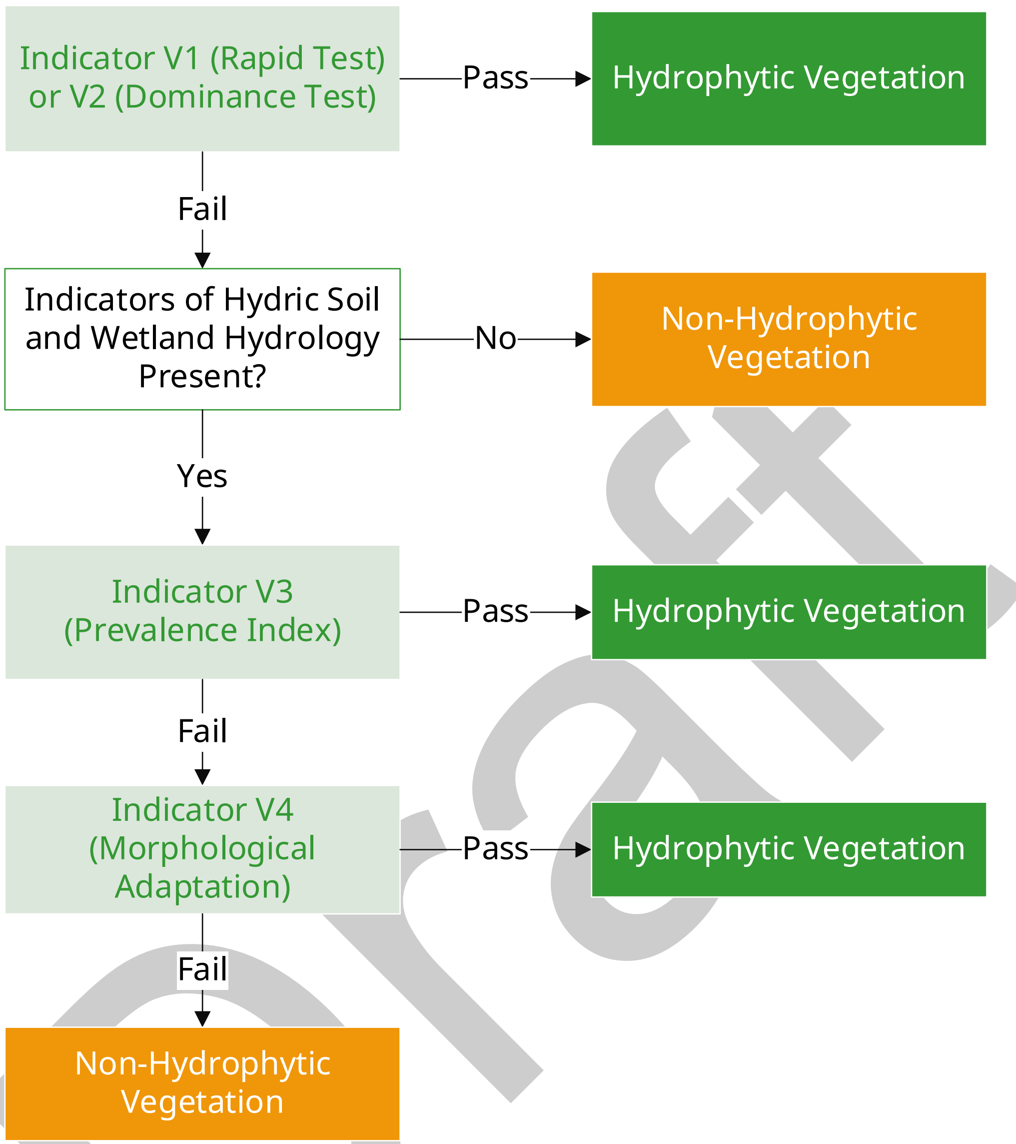

Figure 4 Flow chart of the stepwise procedure for using the hydrophytic vegetation indicators.

Indicator V1 - Rapid Test for Hydrophytic Vegetation

Description: All dominant species across all strata are rated OBL, FACW or a combination of these two categories. Dominant plant species are the most abundant species in the community; they contribute more to the character of the community than do the other non-dominant species present.

In obvious cases, this test allows for quick confirmation that a site has hydrophytic vegetation, without the need to collect more quantitative data. Dominant species are identified visually from each stratum of the plant community using the 50/20 Rule (as defined under Indicator V2), and only the dominant species in each stratum must be recorded on the datasheet.

If Indicator V1 fails and wetland hydrology and hydric soils are present, proceed to the other vegetation indicators. If V1 fails and wetland hydrology and hydric soils are not present, the area is a non-wetland.

Indicator V2 - Dominance Test (50/20 Rule)

Description: The dominance test is met when more than 50% of the dominant plant species across all strata are rated OBL, FACW or FAC.

Procedure for selecting dominant species by the 50/20 rule:

The 50/20 rule is a repeatable procedure for selecting dominant plant species and is recommended when data are available for all species in the community.

Dominant species are chosen independently from each stratum of the community. In general, dominants are the most abundant species that individually or collectively account for more than 50% of the total coverage of vegetation in the stratum, plus any other species that, by itself, accounts for at least 20% of the total. Absolute cover is the recommended abundance measure for plants in all vegetation strata.

Steps in selecting dominant species by the 50/20 rule are as follows:

STEP 1. **Estimate the absolute cover of each species in the first stratum**. Since the same data may be used later to calculate the prevalence index, the data should be recorded as **absolute cover** and not converted to relative cover.

STEP 2. **List all species in the stratum from most to least abundant**. Organize the list of plants so that the most abundant species are followed by the less abundant species. It is easier to find the most abundant species when adding cover values as described in STEP 4.

STEP 3. **Calculate the total coverage of all species in the stratum** (i.e., sum their individual percent cover values).

STEP 4. **Select plant species from the ranked list, in decreasing order of coverage, until the cumulative coverage of selected species exceeds 50% of the total coverage for the stratum**. If two or more species are equal in coverage (i.e., they are tied in rank), they should all be selected. The selected plant species are all considered to be dominant.

STEP 5. **Select any other species that, by itself, is at least 20% of the total percent cover in the stratum.** These must also be identified to the species level and if they are at least 20% would also be considered dominant.

STEP 6. **Repeat steps 1-5 for any other stratum present.**

STEP 7. Combine the lists of dominant species across all strata. Note that a species may be dominant in more than one stratum (e.g., a woody species may be dominant in both the tree and sapling/shrub strata).

To determine if hydrophytic vegetation is present based on the 50/20 rule, most dominant species would have to be categorized as either OBL, FACW or FAC. An example of how to apply the 50/20 rule is provided in Table 3.

In the example provided in Table 3, below, the number of dominant species across all strata is six. In this case, more than 50% of the species are either FAC, FACW or OBL, which meets the criteria of hydrophytic vegetation for this indicator. If the plant community failed the test based on one dominant species and hydric soil and wetland hydrology indicators are present, the vegetation should be re-evaluated using Indicator V3 – Prevalence Index.

Table 3 Example of selecting dominant species using the 50/20 rule and determining hydrophytic vegetation using the Western Mountains, Valleys and Coast regional list with the dominant test.

Stratum	Species Name	Indicator Status	Absolute Cover	Dominant?
Herb	*Deschampsia caespitosa*	FACW	30	Yes
	Carex crawfordii	FACW	15*	Yes
	Urtica dioica	FAC	15*	Yes
	Trifoliium pratense	FACU	10	No
	Poa trivialis	FACW	10	No
	Agrostis capillaris	FAC	5	No
	Juncus tenuis	FACW	1	No
		Total cover	**86**	
		50/20 Thresholds: 50% of total cover (86 x 50%) = 43% 20% of total cover (86 x 20%) = 17.2%		
Shrub	*Holodiscus discolor*	FACU	25	Yes
	Crataegus douglasii	FAC	15	Yes
	Alnus rubra	FAC	5	No
		Total cover	**45**	
		50/20 Thresholds: 50% of total cover (45 x 50%) = 22.5% 20% of total cover (45 x 20%) = 9.0%		
Tree	*Alnus rubra*	FAC	25	Yes
		Total cover	**25**	
		50/20 Thresholds: 50% of total cover (25/50%) = 12.5% 20% of total cover (25/20%) = 5.0%		
Hydrophytic Vegetation Determination	Total number of dominant species across all strata = 6. Percent of dominant species that are OBL, FACW, or FAC = 83%. Therefore, **this community is hydrophytic** by Indicator V2 (Dominance Test).			

* When two or more absolute covers are equal, both are selected.

Indicator V3 - Prevalence Index

Description: The Prevalence Index (PI) is a weighted-average wetland indicator status of all plant species in the sampling plot. All plants are given a numeric value based on indicator status (OBL = 1, FACW = 2, FAC = 3, FACU = 4 and UPL = 5) and their abundance (absolute cover) is used to calculate the PI.

$$PI = \frac{\sum C_{OBL} + 2\sum C_{FACW} + 3\sum C_{FAC} + 4\sum C_{FACU} + 5\sum C_{UPL}}{\sum C_{OBL} + \sum C_{FACW} + \sum C_{FAC} + \sum C_{FACU} + \sum C_{UPL}}$$

where

PI is the prevalence index

$\sum C_x$ is the summed percent cover values for each indicator status

The PI is a more comprehensive analysis of the hydrophytic status of the community than one based on just a few dominant species. It is particularly useful (1) in communities with only one or two dominants; (2) in highly diverse communities where many species may be present at roughly equal coverage; and (3) when strata differ greatly in total plant cover (e.g., total herb cover is 80%, but sapling/shrub cover is only 10%). The prevalence index is used in this supplement to determine whether hydrophytic vegetation is present on sites where indicators of hydric soil and wetland hydrology are present, but the vegetation initially fails the dominance test.

Procedure for calculating a plot-based prevalence index:

The method was described by Wentworth *et al.* (1988) and modified by Wakeley and Lichvar (1997). It uses the same field data (i.e., percent cover estimates for each plant species) that were used to select dominant species by the 50/20 rule, with the added constraint that at least 80% of the total vegetation cover on the plot must be of species that have been correctly identified and have an assigned indicator status (including UPL). For any species that occurs in more than one stratum, cover estimates are summed across strata. Steps for determining the prevalence index are as follows:

STEP 1. **Identify and estimate the absolute cover of each species in each stratum of the community.** Sum the cover estimates for any species that is present in more than one stratum.

STEP 2. **Organize all species (across all strata) into groups according to their wetland indicator status (i.e., OBL, FACW, FAC, FACU, or UPL) and sum their cover values within groups**. Do not include species that have not been identified to the species level.

STEP 3. **Calculate the prevalence index using the following worksheet** (included on the data form in Appendix B)**:**

Summed Absolute Cover of:		Multiply by:	Product:
OBL species	__________	x1	__________
FACW species	__________	x2	__________
FAC species	__________	x3	__________
FACU species	__________	x4	__________
UPL species	__________	x5	__________
Column totals:	__________ (A)		__________ (B)

Prevalence Index = B/A ______________

STEP 4. **Determine if the prevalence index (B/A) is 3.0 or less.** If yes, the plant community passes the test and hydrophytic vegetation is present.

Table 4 provides an example calculation of the prevalence index using the same data set as in Table 3, above.

Table 4 Example of the prevalence index.

Indicator Status Group	Species Name	Absolute %cover by Species	Total % cover by group	Multiply by*	Product
OBL species	None	0	0	1	0
FACW species	*Deschampsia caespitosa* *Carex crawfordii* *Poa trivialis* *Juncus tenuis* *Alnus rubra***	30 15 10 1 30	- - - - 86	- - - - 2	- - - - 172
FAC species	*Crataegus douglasii* *Agrostis capillaris* *Urtica dioeca*	15 5 15	- - 35	- - 3	- - 105
FACU species	*Holodiscus discolor* *Trifoliium pratense*	10 25	- 35	- 4	- 140
UPL species	None	0	0	5	0
		Sum	156 (A)	NA	417 (B)
Hydrophytic Vegetation Determination	Prevalence Index = B/A = 417/156 = 2.67 Therefore, the prevalence index is less than 3.0 and **this community is hydrophytic** by Indicator V3 (Prevalence Index).				

* Where OBL = 1, FACW = 2, FAC = 3, FACU = 4, and UPL = 5.
** *Alnus rubra* was recorded in two strata (i.e., tree and sapling/shrub) (see Table 3), so the cover estimates for this species were summed across strata.

A prevalence index of 3.0 or less indicates that hydrophytic vegetation is present. The prevalence index ranges from 1 to 5. To calculate the prevalence index, at least 80% of the total vegetation cover in the plot (summed across all strata) must be of species that have been correctly identified and have assigned wetland indicator statuses that are OBL, FACW, FAC or are upland (UPL and FACU) species.

Indicator V4 - Morphological Adaptations

Description: This indicator is used when the plant community has failed the dominant test (Indicator V2) and prevalence index (Indicator V3) but has hydric soil and wetland hydrology indicators.

Some plants develop easily recognized physical characteristics, or morphological adaptations, when they occur in wetlands. Some of these adaptations may help them to survive prolonged inundation or saturation in the root zone; others may simply be a consequence of living under such wet conditions. Common morphological adaptations in an area include, but are not limited to, adventitious roots, multi-stemmed trunks, tussocks and buttressing in tree species. These adaptations on FAC, FACW or OBL species are additional evidence for the presence of a hydrophytic plant community. These adaptations may occur on FACU species, indicating those individuals are functioning as hydrophytes in that setting.

Procedure for the application of morphological adaptation indicator:

To apply this indicator, these morphological features must be observed on more than 50% of the individuals of a FACU species living in an area where indicators of hydric soil and wetland hydrology are present. Use caution in areas where buttressed tree bases and multiple stems may be due to shallow bedrock, browsing by herbivores, timber harvest or other factors not related to wetness. Follow this procedure:

STEP 1. Confirm that the morphological feature is present mainly in the potential wetland area and is not common on the same species in the surrounding non-wetlands.

STEP 2. For each FACU species that exhibits morphological adaptations, estimate the percentage of individuals that have the features. Record this percentage on the data form.

STEP 3. If more than 50% of the individuals of a FACU species have morphological adaptations for life in wetlands, that species is a hydrophyte, and its indicator status on that plot should be reassigned as FAC. All other species retain their published indicator statuses. Record any supporting information on the data form, including a description of the morphological adaptation(s) present and any other observations of the growth habit of the species in adjacent wetland and non-wetland locations (photo documentation is recommended).

STEP 4. Recalculate the Dominance Test (Indicator V2) and/or the Prevalence Index (Indicator V3) using a FAC indicator status for this species. The vegetation is hydrophytic if either test is passed.

Note: Sites which are positive for Indicator V4 - Morphological Adaptations and those that meet the criteria for problematic hydrophytic vegetation (Section 9.1.1) must also have indicators of hydric soil and wetland hydrology to be confirmed as wetlands.

Which hydrophytic vegetation indicator to use depends on the situation and is summarized in Table 5, below.

Table 5 Summary of hydrophytic vegetation indicators, their uses and the criteria to be met as a positive indicator for hydrophytic vegetation.

Indicator	Description	Use case	Criteria for positive indicator of hydrophytic vegetation
V1 - Rapid Test	A quick visual assessment is used when all dominant species across all vegetation strata are clearly wetland species. Dominants are selected using the 50/20 rule; no plot necessary.	• when dominant species are all OBL and/or FACW • ideal for obvious wetlands dominated by species like cattails and/or sedges	All dominant species (across strata) must be rated OBL or FACW.
V2 - Dominance Test	Plot-based assessment where dominant species are identified in each stratum and assessed according to their wetland indicator status. Dominants for each stratum are defined using the 50/20 rule.	• when conditions for the rapid test are not met • most used	More than 50% of the dominant species across all strata are rated as OBL, FACW and/or FAC.
V3 - Prevalence Index	Plot-based assessment where a weighted average of indicator statuses is based on species cover.	• when dominance test (V2) fails but hydric soils and wetland hydrology are present • the site has a mix of wetland and upland species • at least 80% of the total vegetation cover on the plot must be of species that have been correctly identified and have an assigned indicator status (including UPL)	Prevalence Index ≤ 3.0
V4 - Morphological Adaptations	Used when species lack indicator status or in disturbed areas. Assesses the physical traits of plants that suggest adaptation to saturated conditions. Requires botanical experience and documentation of adaptation.	• when hydric soils and wetland hydrology indicators are present • typically used in problematic or disturbed sites where vegetation does not follow typical patterns • hydrophytic species are present but not dominant • plants show morphological adaptations • when V1 and V2 have not been met	Passes if more than 50% of individuals of a FACU species exhibit one or more adaptation(s), the species is reclassified as FAC and the dominance test and/or the prevalence index criteria is met using the adjusted indicator status.

6 Hydric soil

6.1 Introduction

A **hydric soil** is defined as soil that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic (low-oxygen) conditions in the upper part of the soil profile (USDA Soil Conservation Service 1994).

Saturation or inundation, when combined with microbial activity in the soil, depletes oxygen. The resulting anaerobiosis promotes certain biogeochemical processes that result in distinctive soil characteristics useful for identifying hydric soils. Examples of these biogeochemical processes include the accumulation of organic matter and the reduction or movement of iron and other elements.

This section presents indicators that are designed to help identify hydric soils. The indicators listed here are a subset of the National Technical Committee for Hydric Soils Field indicators of Hydric Soils in the United States [US Department of Agriculture-Natural Resource Conservation Service (USDA-NRCS), 2024] and have been adapted for B.C. Changes to the list may be made in the future with new soils research and field testing.

For ease of cross-referencing, soil indicator numbers follow the same system used by the USDA-NRCS. However, the names and terms have been adjusted to match the Canadian System of Soil Classification (CSSC) (Soil Classification Working Group 1998) where possible. Canadian terms are listed first, with the US terms in brackets where appropriate.

6.2 Concepts

Hydric soil indicators are based on observable and measurable soil characteristics that result from prolonged saturation. These processes result in differences in colour, smell and texture that can be observed, recorded, and measured. Important characteristics for determining hydric soil indicators include:

- Colour;
- Soil composition (percent of mineral particles vs. organic matter);
- Mineral soil particle texture;
- Organic material texture and degree of decomposition; and
- Soil layer thickness and depth.

The following sections describe the main processes that may lead to the formation of hydric soils.

> All colours in this guide refer to moist Munsell colours (X-Rite 2009). Prior to documenting the soil colours, dry soils should be moistened just enough until the colour no longer changes, and wet soils should dry out until they no longer glisten. The Munsell soil colour will be recorded for the horizon and feature described (e.g., 10YR 1/3). Several indicators require a chroma of 2 or less. If a colour is between two Munsell chips, it should not be rounded. For example, record 2.5 if the colour is between a chroma of 2 and 3.

6.2.1 Organic matter accumulation

Soil microbes are less efficient in an anaerobic environment and organic matter decomposition is slow. This may result in the accumulation of soil organic matter, rich in organic carbon, at or near the soil surface. Identifying, estimating, and describing organic matter in the soil is critical to many of the hydric soil indicators.

Poorly decomposed organic matter forms thick surface horizons in many permanently saturated wetlands. It is fibrous and typically black, brown or beige.

Organic matter accumulation can also occur simultaneously with mineral deposition such as where flooding, stream flow and/or wave action bring periodic or continual mineral inputs. The size and number of mineral particles vary with energy of the water and sediment source. Sedimentation events can also bury diagnostic organic horizons.

> **Tips for recognizing mineral and organic mixing:**
>
> - Shiny sand and silt particles can be seen with the naked eye and with a hand lens.
> - Silt particles feel gritty when felt between the thumb nails.
> - Organic material will stain the fingers black or dark brown.

Determining the texture of soil materials high in organic carbon

Soil material high in organic carbon can fall into three categories: organic, humus-rich mineral or mineral (Table 6). These categories are based on laboratory analyses of organic carbon content by weight, which are provided in Table 6.

Table 6 Organic carbon content by horizon type.

Soil Type	Organic Carbon by Weight	Typical CSSC Horizons	Analogous US Soil Type Terms
Organic	>17%	Oh, Om, Of, Ohi	Muck or Peat
Humus-rich mineral	>5% and <17%	Ah, Ahe, Ohi	Mucky Mineral
Mineral	Typically 0.5% and <5%	Ah, Ahe, Bfh	Mineral

CSSC = Canadian System of Soil Classification; US= United States; Oh = Organic-humic; Om = Organic-mesic; Of = Organic-fibric; Ohi=Oh with minor inclusions of mineral; Ah=Topsoil-enriched with organic material; Ahe = Topsoil-enriched with organics and eluviated; Bfh = Subsoil-enriched with organics and iron oxides (common in coastal podzols).

Lab tests to confirm the organic content can be useful for calibrating field test consistency and for supporting high consequence or difficult determinations. However, field estimates of organic content in conjunction with evidence of soil physical indicators, landscape and vegetation indicators are often sufficient to confirm or reject the presence of a wetland.

In lieu of laboratory data, practitioners can apply the following Rub Test method to determine soil material category for the purpose of supporting evaluations of hydric soil indicators.

The **Rub Test** can be used in most cases to determine if a soil is organic, humus-rich mineral (mucky) or mineral. Gently rub the wet soil material between the forefinger and thumb. If, upon the first or second rub, the material feels gritty (i.e., you feel sand particles), it is mineral soil material. If, after the second rub, the material feels greasy, it is either humus-rich (mucky) mineral or organic soil material. To decipher between the two, gently rub the material two or three more times. If, after these additional rubs, it feels gritty or plastic (i.e., you feel silt and clay resistance), it is humus-rich (mucky) mineral soil material; if it still feels greasy, it is organic soil material.

Determining degree of decomposition in organic soil material

Organic soil material is classified by degree of decomposition as **fibric** (peat), **mesic** (mucky peat), or **humic** (muck) (Figure 5) as described in the Canadian System of Soil Classification (Soil Classification Working Group 1998).

Figure 5 Organic Soil Horizon Degree of Decomposition Descriptors (Source: BCWF and FLNRORD 2024).

Two field methods are used to determine the degree of decomposition: 1) the use of the Von Post scale, which rates the degree of decomposition (humification) on a scale of 1 to 10 (Table 7); and 2) by assessing the rubbed fibre content, which requires evaluating the percentage of visible fibres observable with a hand lens in an undisturbed state and after rubbing between thumb and fingers 10 times (Table 8).

Table 7 Degree of decomposition - Von Post.

Von Post Scale	Description	Canadian Horizon Descriptor [(a)]	US Horizon Descriptor (Texture)[(b)]
1	Undecomposed; plant structure unaltered; yields only clear water coloured light yellow brown.	Fibric	Fibric (peat)
2	Almost undecomposed; plant structure distinct; yields only clear water coloured light yellow brown.		
3	Very weakly decomposed; plant structure distinct; yields distinctly turbid brown water, no peat substance passes between the fingers, residue not mushy.		
4	Weakly decomposed; plant structure distinct; yields strongly turbid water, no peat substance escapes between the fingers, residue mushy.		Hemic (mucky peat)
5	Moderately decomposed; plant structure evident, but becoming indistinct; yields much turbid brown water, some peat escapes between the fingers, residue very mushy.	Mesic	
6	Strongly decomposed; plant structure somewhat indistinct but more evident in the squeezed residue than in the undisturbed peat; about one-third of the peat escapes between the fingers, residue strongly mushy.		
7	Strongly decomposed; plant structure indistinct, but recognizable; about half of the peat escapes between the fingers.	Humic	Sapric (muck)
8	Very strongly decomposed; plant structure very indistinct; about two-thirds of the peat escapes between the fingers, residue almost entirely resistant remnants such as root fibres and wood.		
9	Almost completely decomposed; plant structure almost unrecognizable; nearly all the peat escapes between the fingers.		
10	Completely decomposed; plant structure unrecognizable; all the peat escapes between the fingers.		

Adapted from LMH25 (B.C. Ministry of Forests and Range and B.C. Ministry of Environment, 2010); Table 2.23.

Table 8 Degree of decomposition – rubbed fibre test.

Canadian		United States	
Horizon Descriptor	**Rubbed Fibre Content**	**Horizon Descriptor (Texture)**	**Rubbed Fibre Content**
Fibric (Of)	>40%	Fibric (peat)	>40%
Mesic (Om)	10-40%	Hemic (mucky peat)	17-40%
Humic (Oh)	<10%	Sapric (muck)	<17%

6.2.2 Iron and manganese reduction, translocation and accumulation

When soils lack oxygen, soil microbes reduce iron from the ferric (Fe^{3+}) to the ferrous (Fe^{2+}) form and manganese from the manganic (Mn^{4+}) to the manganous (Mn^{2+}) form. Iron reduction is more commonly observed than manganese reduction because iron is a primary colouring agent in soils. Observable, measurable colour changes in the soil are key to many of the hydric soil indicators.

Areas in the soil where iron is reduced develop blueish-grey or greenish-grey colours known as **gley** (Figure 6A). Ferrous iron is soluble and easily moves with soil water and may be translocated to other areas of the soil. Soil areas that have lost iron typically develop grey colours and are called **redox depletions** (Figure 6 B, C). When oxygen is reintroduced as soil dries out, the reduced iron that is in the soil solution becomes oxidized and concentrates in patches and along root channels. These areas of oxidized iron are called **redox concentrations** (Figure 6 B, C). These redox features are also known as **mottles** (Figure 6C). Saturated soil may contain ferrous iron and change colour when exposed to air, as ferrous iron is rapidly converted to ferric iron in the presence of oxygen. Such soils are said to have a **reduced matrix** (Vepraskas 1992).

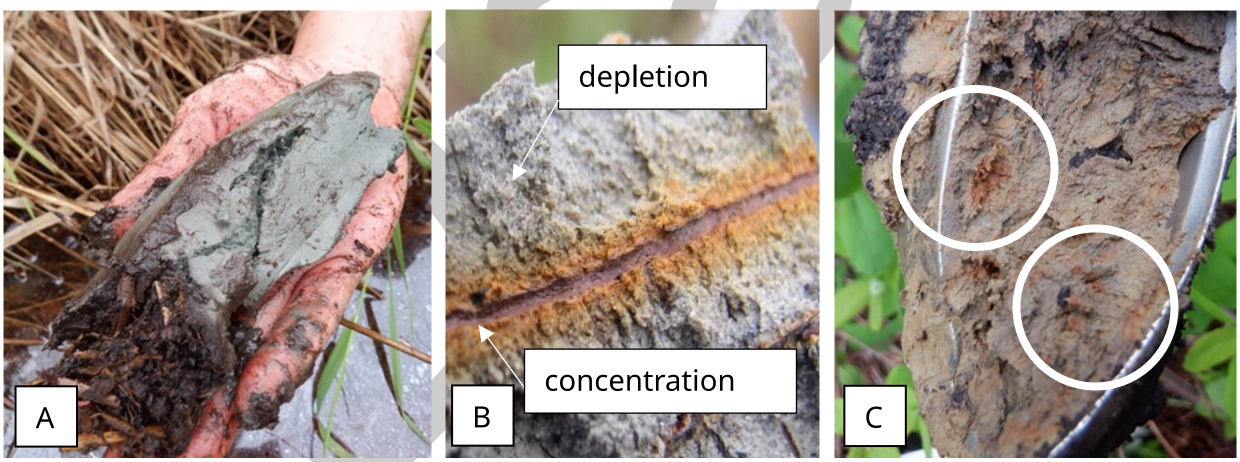

Figure 6 Example of gleyed matrix (A), redox depletions and concentrations where blueish-grey colours are redox depletions and rusty redox concentrations showing an oxidized rhizosphere (B); and prominent mottles shown in the white circles (C) (Photo Credits from left to right A and B: EcoFish Research and C: BC Wildlife Federation).

6.2.3 Texture

Redox depletions and concentrations (redox features) in mineral soil layers vary in colour and intensity in relationship to soil texture. Soil texture classes are defined by particle size distribution and are estimated in the field using hand texturing procedures. Coarser textured soils have different chemistry and permeability than finer textured soils resulting in different concentrations and movement of visible oxidized and reduced minerals. Texture is, therefore, a key factor in determining hydric soil indicators, and colour and thickness criteria differ between indicators. Hydric soil indicators are divided into sandy soils (S indicators) and finer (F indicators) textured soils (loamy and clayey soils). It is thus important for wetland delineators to be able to evaluate the texture of mineral soils and differentiate between sandy soils [Loamy Sand (LS)/Sand (S)] and the remaining textures that are not considered sandy for delineation purposes (Figure 7). Section 6.5 Hydric soil indicators describes these concepts further.

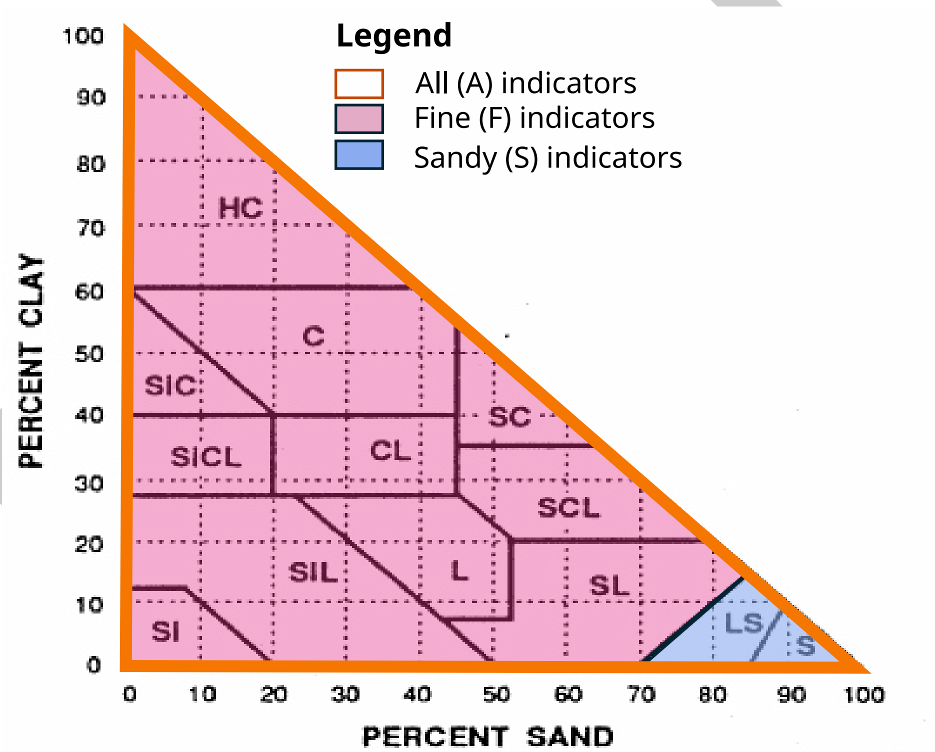

Figure 7 Soil Indicators as they relate to the Soil Texture Triangle. All (A) Indicators apply to the entire triangle, whereas Sandy (S) Indicators apply to soil textures inclusive of Loamy Sand (LS) and Sand (S), and Fine (F) Indicators would apply to the remaining soil textures (silt, clay, and loam).

In addition, texture differences in the soil profile are also a clue to flooding, sedimentation and hydrodynamics of a wetland. Coarser textured soils and high coarse fragment content often indicate periods of higher energy deposition and erosion, while finer textures indicate slow moving or stagnant water deposition. The thickness and textural differences, and the number of layers can indicate flood frequency. Proficiency in hand texturing in the field is an important skill for a wetland delineator.

6.2.4 Sulfate reduction

Sulfur is one of the last elements to be reduced by soil microbes in an anaerobic environment. In soils that are inundated or saturated for long periods of time, microbes convert SO_4^{2-} to H_2S, or hydrogen sulfide gas. Hydrogen sulfide gas smells strongly like rotten eggs. The presence of a rotten egg smell is a strong indicator of hydric soil, and this indicator is only in the wettest sites in soils that contain sulfur-bearing compounds.

A note on soil classification for users coming from a soil taxonomy background:

As stated in Section 1.2 Scope, this document is not intended for classification. Soil classification is based on the same soil concepts and observable traits of saturated conditions used for delineation, such as colour and texture. However, criteria differ because delineation is used to find the edges of wetlands, and classification assigns soils into taxonomic groups that describe centralized concepts of soil development. Taxonomy and hydric soil criteria for delineation are not perfectly aligned.

Several soil types under the Canadian System of Soil Classification (CSSC) are common to wetlands. Many of these will satisfy criteria specified in the hydric soil indicator list but not in a 1:1 match. It is not necessary to classify a soil to be able to delineate a wetland. If one of the following soil types is present, it is likely one or more hydric soil indicators will be met.

Orders: Organic, Glysolic
Great Groups: Organic Cryosol, Humic Podzol, Gleyed Humic Regosol
Subgroups: Gleysolic subgroups of Vertisols and Regosols
Phases: Peaty phases of Regosols and Brunisols

6.3 Cautions

A soil that is artificially drained or isolated from its natural hydrology source (e.g., by dikes, levees, roads) is still hydric if the soil in its undisturbed state would meet the definition of a hydric soil. To be identified as hydric, these soils should generally have one or more of the indicators. However, not all areas that have hydric soils will qualify as wetlands if they no longer have wetland hydrology or support hydrophytic vegetation.

Hydric soil features that represent a former **hydrologic regime** and do not reflect **contemporary features** or recent conditions are called **relict features** and provide useful information to inform where hydrology has been modified. Contemporary and relict hydric soil features can be difficult to confirm, especially without hydrologic data, but guidelines exist. Actively forming iron (Fe) concentrations often have gradual or diffuse boundaries, whereas relict or degrading features have sharp boundaries (Vepraskas 1992). Common problem hydric soils are described in Section 9 Difficult wetland situations. When soil observations seem inconsistent with the landscape, vegetation or hydrology, it may be necessary to obtain assistance from an experienced soil or wetland scientist with expertise in soils to determine if the soil is hydric.

6.4 Procedures for sampling soils

STEP 1. **Observe the site and how the landscape interacts with water and soil before making any decision about whether hydric soils are present.** Understanding how water moves across the site provides clues as to the possible presence of hydric soils.

STEP 2. **Remove any loose leaves, needles, or bark from the soil surface without removing any organic layers**.

STEP 3. **Dig a hole to the depth needed—typically, 50 cm—to document the presence or absence of indicator**. A shallower excavation is possible for some indicators, but excavating to a greater depth (1 m) may be required for soils with a thick dark surface (indicator A12; Section 6.5) and in cummulic soils, where organic horizons may be buried (A1; Section 6.5). Identify layers present that may restrict soil drainage. Photograph the soil pit or core(s) use a measuring tape for scale.

STEP 4. **Observe and document the soil profile** as outlined on the Wetland determination data form (Appendix B) including depth and texture of each layer; a description of matrix colour and percentage; and description of redox feature (where present) colours, percentage, type (concentration, depletion, reduced matrix, or masked sand grains), and location (pore lining or matrix).

STEP 5. **Determine whether hydric soil is present.** Use the information collected in STEP 4 and apply the soil indicators listed in Section 6.5 Hydric soil indicators.

Depths used in the hydric soil indicators are measured from the mineral soil surface for mineral soils or from the top of well humified surface organic horizon (Oh or muck) if one is present.

For organic soil indicators (A1, A2, and A3; Section 6.5), depths are measured from the top of the organic material. If organic soils are buried below mineral soil material, then depths are measured from the top of the mineral material.

Hydric Soil Indicators

Hydric soil indicators were developed for use in wetland delineation. Soils are investigated near the wetland edge to help identify the wetland boundary. Therefore, soils found in the wettest central portions of wetlands were not always examined in developing these indicators. If soils are hydric near the wetland edge, it is assumed that soil in the wetter more central portion of the wetland are also hydric.

Hydric soil indicators are presented in three groups.

- **A** indicators may be used for All Soils regardless of texture.
- **S** indicators may be used for Sandy Soils with soil texture of loamy fine sand or coarser.
- **F** indicators may be used for Fine Soils which include soil layers with textures of sandy loam and finer and are inclusive of silt, clay and loam.[20]

Both sandy and fine layers (see Figure 7) may be present in the same soil profile. Therefore, a soil that contains a loamy surface layer over sand is hydric if it meets all the requirements of matrix colour, amount and **contrast** of redox concentrations, depth and thickness for a specific A (All Soils), S (Sandy Soils) or F (Fine Soils) indicator. It is acceptable to combine indicators where appropriate, as described in the WMVC Regional Supplement (USACE 2010a).

The hydric soil indicators listed below include indicators used in the Western Mountain Valleys and Coast Region, which are acceptable for use throughout B.C. Areas of B.C. resembling Alaska's climate, physical and biological characteristics may use indicators in Section 6.5.2 Hydric soil indicators for the Northwest Region, which were developed for the Alaska Regional Supplement (USACE 2007). For purposes of this manual, this area is being referred to as the Northwest Region, shown previously in Figure 8.

[20] The USACE Manual refers to "F" Indicators as having loamy and clayey texture.

It is recommended to refer to the photographs provided for each indicator in the original source document, Field Indicators of Hydric Soils of the United States (USDA-NRCS 2024, or as updated). A summary of hydric soil indicators and a description of each indicator is provided below in Table 9.

Table 9 Summary of hydric soil indicators.

Indicator	All Regions	Northwest
All soils (A)		
A1 – Organic soil	X	X
A2 – Organic surface (aquic conditions)	X	X
A3 – Black organic	X	X
A4 – Hydrogen Sulfide	X	X
A11 – Depleted below dark surface	X	-
A12 – Thick dark surface	X	X
A13 – Alaska gleyed	-	X
A14 – Alaska redox	-	X
A15 – Alaska gleyed pores	-	X
A18 – Iron monosulfides	X	-
Sandy soils (S)		
S1 – Sandy mucky mineral	X	-
S4 – Sandy gleyed matrix	X	-
S5 – Sandy redox	X	-
S6 – Stripped matrix	X	-
Fine soils (F)		
F1 – Loamy mucky mineral	X	-
F2 – Loamy gleyed matrix	X	-
F3 – Depleted matrix	X	-
F6 – Redox dark surface	X	-
F7 – Depleted dark surface	X	-
F8 – Redox depressions	X	-
Problem soils – for testing		
A10 – 2 cm muck	X	X
F18 – Reduced vertic	X	X
F21 – Red parent material	X	X
F22 – Very shallow dark surface	X	X

It may seem challenging and time consuming to compare a soil profile to the entire list of hydric soil indicators to confirm the presence or absence of an indicator. The following recommendations may assist new wetland delineators:

1. Only one indicator must be found. Soils may meet the criteria of more than one indicator. It is not required to identify all indicators that are met to determine the presence of hydric soil.
2. The most common indicator near wetland boundaries is F3 where loamy or clayey soils are predominant, and the most common indicator is S5 in sandy soil layers. These may be checked before reviewing other indicators on the list.
3. Soils with high-chroma matrix colours [greater than 2] immediately underlying the topsoil horizon are generally non-hydric.

6.4.1 Hydric soil indicators for British Columbia

All soils (A)

All Soils (A) refers to soil layers with any soil texture. These indicators apply to all soils regardless of soil texture.

All mineral layers above any of the layers meeting the requirements of any A indicator (except indicator A18) have a dominant chroma of 2 or less, or the mineral layer(s) with a dominant chroma of more than 2 is/are less than 15 cm thick to meet any hydric soil indicator. In addition, nodules and concretions are not considered to be redox concentrations for the application of the indicators.

Indicator A1 – Organic soil (Histosol)

Soils that contain an Organic soil layer (O horizons) with a thickness of 40 cm or more in the upper 80 cm.

User Notes - For use in all regions.

Organic soil materials that have organic carbon content (by weight) of 17% or more. These materials include humic, mesic and fibric organic material (Of, Om, Oh horizons). This does not pertain to folic materials found in upland humus forms (LFH horizons).

Indicator A2 - Organic surface (Histic Epipedon)

An organic surface horizon (O horizons) 20-40 cm thick, underlain by mineral soil material with chroma equal or less than 2.

User Notes - For use in all regions.

Aquic conditions (i.e., a state of saturation and reduction sufficient to produce redoximorphic features) or artificial drainage are required to produce this indicator. Aquic conditions can be assumed if indicators of hydrophytic vegetation and wetland hydrology are present.

Indicator A3 - Black organic (Black Histic)

Organic soil layers (O horizons) with a thickness of 20 cm or more, starting at a depth of 15 cm or less from the soil surface with a hue of 10YR or yellower, value of 3 or less, and chroma of 1 or less and underlain by mineral soil material with chroma equal or less than 2.

User Notes - For use in all regions.

Unlike indicator A2, this indicator does not require proof of aquic conditions and/or artificial drainage.

Indicator A4 - Hydrogen sulfide

A hydrogen sulfide odor starting at a depth of 30 cm or less from the soil surface.

User Notes - For use in all regions.

This rotten egg smell indicates that sulfate-sulfur has been chemically reduced to hydrogen sulfide gas, which indicates the soil is anaerobic. Indicator A4 is most likely to occur in salt marshes and other permanently saturated or inundated wetlands. It can sometimes be found in fringe wetlands adjacent to lakes.

Indicator A11 - Depleted below dark surface

A layer with a depleted or **gleyed matrix** that has 60% or more chroma of 2 or less, starting at a depth of 30 cm or less from the soil surface and having a minimum thickness of either:

a) 15 cm, or
b) 5 cm if it consists of fragmental soil material.

Organic, loamy or clayey layer(s) above the depleted or gleyed matrix must have value of 3 or less and chroma of 2 or less starting at a depth of 15 cm or less from the soil surface and extending to the depleted or gleyed matrix.

Sandy layers (loamy fine sand and coarser material) above the **depleted matrix** must have value of 3 or less and chroma of 1 or less starting at a depth of 15 cm or less from the soil surface and extending to the depleted or gleyed matrix. When viewed through a 10x or 15x hand lens, at least 70% of the visible sand particles must be darkened with organic material. Observed without a hand lens, the sand particles appear to be close to 100% masked (WTI 2022).

User Notes - For use in all regions excluding NW. One of the most common indicators.

The depleted matrix can occur in either sandy soil layers or fine soil layers. For soils with dark surface horizons—greater than 30 cm thick—use indicator A12. A depleted matrix requires value of 4 or more and chroma of 2 or less. Redox concentrations, including soft iron-manganese masses and/or pore linings, are required in soils with matrix colours of 4/1, 4/2, or 5/2. A, Ae and calcic horizons may have low chromas and high values and may, therefore, be mistaken for a depleted matrix. However, they are excluded from the concept of depleted matrix unless the soil layer has 2% or more **distinct** or **prominent** redox concentrations occurring as soft masses or pore linings. In sandy textures observed without a hand lens, the masked sand particles appear to be closer to 100% masked with organic material when moist. Masked sand grains can disappear quickly if a soil has been drained or disturbed.

Many soils that meet indicator A11 also meet indicator F3. Indicator A11 allows a deeper depleted matrix than indicator F3.

Indicator A12 - Thick dark surface

A layer 15 cm or more thick with a depleted or gleyed matrix that has 60% or more chroma of 2 or less, starting at a depth below 30 cm from the soil surface. The layer(s) above the depleted or gleyed matrix and starting at a depth of less than 15 cm from the soil surface must have value of 2.5 or less and chroma of 1 or less to a depth of 30 cm or more and a value of 3 or less and chroma of 1 or less in any remaining layers above the depleted or gleyed matrix. In any loamy fine sand and coarser material above the depleted or gleyed matrix, at least 70% of the particles must be masked with organic material when viewed through a 10x or 15x hand lens.

User Notes - For use in all regions.

The depleted matrix can occur in either sandy soil layers or fine soil layers. This indicator applies to soils that have a very dark layer of 30 cm or more thick and then can get a little less dark in any remaining layers directly above a depleted or gleyed matrix. This indicator is most often associated with overthickened soils in concave landscape positions. A depleted matrix requires a value of 4 or more and chroma of 2 or less. Redox concentrations, including soft iron-manganese masses and/or pore linings, are required in soils with matrix colours of 4/1, 4/2, or 5/2. A, Ae and calcic horizons may be mistaken for a depleted matrix because they may have low chromas and high values. These horizons are excluded from the concept of a depleted matrix unless they have at least 2% distinct or prominent concentrations occurring as soft masses or pore linings. In sandy textures observed without a hand lens, the masked sand particles appear to be closer to 100% masked with organic material when moist. Masked sand grains can disappear quickly if a soil has been drained or disturbed.

Observations deeper in the profile are needed to determine whether a soil meets the requirements of this indicator. The depth to the depleted matrix could be greater than 50 cm.

Indicator A18 - Iron monosulfides

Positive identification of dark-grey or black **iron monosulfide** concentrations with value of 4 or less and chroma of 2 or less, starting at a depth of 25 cm or less from the soil surface.

User Notes - For use in all regions.

Positive identification of this indicator requires a minimum of two separate observations of iron monosulfide (FeS) concentrations in the soil occurring as stains, coatings, soft masses, or pore linings. Care should be taken to observe the occurrence of FeS immediately following excavation as these compounds can oxidize rapidly with exposure to the atmosphere. The presence of FeS concentrations is confirmed by documenting dark-grey or black coloured areas within the soil matrix and its subsequent degradation using either: (A) oxidation following exposure to the atmosphere or with application of an oxidizing agent such as dilute hydrogen peroxide, both of which result in an increase in Munsell value of 1 or more; or (B), the evolution of hydrogen sulfide gas following application of dilute hydrochloric acid. See Appendix A - Iron monosulfide for a description of methods to identify FeS.

Sandy Soils (S)

Sandy Soils (S) have layers that have a texture of loamy fine sand and coarser. All mineral layers above any of the layers meeting the requirements of any S indicator, except for indicator S6, have a dominant chroma of 2 or less, or the thickness of the layer(s) with a dominant chroma of more than 2 is less than 15 cm. In addition, nodules and concretions are not considered to be redox concentrations. Use the following S indicators for soils with mineral layers that are sandy.

Indicator S1 - Sandy mucky mineral

A layer of humic organic matter rich (mucky modified) sandy soil (Ohi or Ah) material 5 cm or more thick starting at a depth of 15 cm or less from the soil surface.

User Notes - For use in all regions except NW.

Indicator S4 - Sandy gleyed matrix

A gleyed matrix that occupies 60% or more of a layer starting at a depth of 15 cm or less from the soil surface.

User Notes - For use in all regions except NW.

Gley colours (see Glossary for gleyed matrix) are not synonymous with grey colours as described in Munsell. They are the colours on the gley colour pages in the Munsell Soil Color Book (X-Rite, 2009) that have hue of N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B or 5PB and value of greater than or equal to 4. For this indicator, the gleyed matrix only has to be present at a depth of 15 cm or less from the surface; there is no thickness requirement for the layer.

Indicator S5 - Sandy redox

A layer starting at a depth of 15 cm or less from the soil surface that is 10 cm or more thick and has a matrix with 60% or more chroma of 2 or less and 2 or more percent distinct or prominent redox concentrations occurring as soft masses and/or pore linings.

User Notes - For use in all regions except NW.

Redox concentrations include iron and manganese masses (reddish mottles) and pore linings (Vepraskas 1992). Included within the concept of redox concentrations are iron-manganese bodies occurring as soft masses with diffuse boundaries. Common (2 to less than 20%) or many (20% or more) redox concentrations are required. If the soil is saturated at the time of sampling, it may be necessary to let it dry to a moist condition for redox features to become visible. This is a common indicator of hydric soils and is often used to identify the hydric and non-hydric soil boundary in sandy soil layers.

Indicator S6 - Stripped matrix

A layer starting at a depth of 15 cm or less from the soil surface in which iron-manganese oxides and/or organic matter have been stripped from the matrix and the primary base colour of the soil material has been exposed. The stripped areas and translocated oxides and/or organic matter form a faintly contrasting pattern of two or more colours with diffuse boundaries. The stripped zones are 10% or more of the volume and are rounded.

User Notes - For use in all regions except NW.

This indicator was previously referred to as organic streaking. Common or many areas of stripped (unmasked) soil materials are required. The stripped areas are typically 1 to 3 cm in size but may be larger or smaller. Commonly, the stripped areas have a value of 5 or more and chroma of 2 or less, and the unstripped areas have chroma of 3 and/or 4. The matrix may not have the material with chroma of 3 and/or 4. The mobilization and translocation of oxides and organic matter is the important process and should result in a splotchy pattern of masked and unmasked soil areas. This may be a difficult pattern to recognize and is more evident when a horizontal slice is observed. Assistance from an experienced soil or wetland scientist can aid in identifying this indicator.

Fine Soils (F)

Fine soils (F) have layers with textures of loamy very fine sand and finer. All mineral layers above any of the layers meeting the requirements of any F-indicator(s) except for indicator F8 have a dominant chroma of 2 or less, or the thickness of the layer(s) with a dominant chroma of more than 2 is less than 15 cm. Nodules and concretions are not considered to be redox concentrations. Use the following F indicators for mineral layers that are fine.

Indicator F1 - Loamy mucky minerals

A layer of humic organic matter rich (mucky modified) loamy or clayey soil material 10 cm or more thick starting at a depth of 15 cm or less from the soil surface.

User Notes - For use in all regions except NW.

Indicator F2 - Loamy gleyed matrix

A gleyed matrix that occupies 60% or more of a layer starting at a depth of 30 cm or less from the soil surface.

User Notes - For use in all regions except NW.

Gley colours are not synonymous with grey colours. They are the colours on the gley colour pages of the Munsell Soil Color Book (X-Rite, 2009) that have hue of N, 10Y, 5GY, 10GY, 5G, 10G, 5BG, 10BG, 5B, 10B or 5PB and value of 4 or more. The gleyed matrix only has to be present at a depth of 30 cm or less from the soil surface, and there is no thickness requirement for the layer.

Indicator F3 - Depleted matrix

A layer that has a depleted matrix with 60% or more chroma of 2 or less and that has a minimum thickness of either:

a) 5 cm, starting at a depth of 10 cm or less from the soil surface, or
b) 15 cm, starting at a depth of 25 cm or less from the soil surface.

User Notes - For use in all regions except NW.

This is a common indicator used to delineate wetland soils in many regions and landscape positions. A depleted matrix requires a value of 4 or more and chroma of 2 or less. Redox concentrations, including soft iron-manganese masses and/or pore linings, are required in soils with matrix colours of 4/1, 4/2, or 5/2. A, Ae and calcic horizons may have low chromas and high values and may, therefore, be mistaken for a depleted matrix. However, they are excluded from the concept of depleted matrix unless the layer has 2% or more distinct or prominent redox concentrations occurring as soft masses or pore linings. The low-chroma matrix must be the result of wetness and not a weathering or parent material feature.

Indicator F6 - Redox dark surface

A layer that is 10 cm or more thick, starting at a depth of 20 cm or less from the mineral soil surface, and has:

a) A matrix value of 3 or less and chroma of 1 or less and 2% or more distinct or prominent redox concentrations occurring as soft masses or pore linings, or
b) A matrix value of 3 or less and chroma of 2 or less and 5% or more distinct or prominent redox concentrations occurring as soft masses or pore linings.

User Notes - For use in all regions except NW.

This is a common indicator used to delineate wetland soils that have a dark surface layer. Redox concentrations in mineral soils with a high content of organic matter and a dark surface layer are commonly small and difficult to see. The organic matter masks some or all the concentrations that may be present. Careful examination is required to see what commonly brownish redox concentrations in the darkened materials are. If the soil is saturated at the time of sampling, it may be necessary to let it dry at least to a moist condition for redox features to become visible.

Typically, unless the soil is ponded with saturation only occurring near the surface, the material below the indicator will have a depleted or gleyed matrix. Soils that are subject to ponding or have a shallow, perched layer of saturation may have any colour below the dark surface. It is recommended that delineators evaluate the hydrologic source and examine and describe the layer below the dark-coloured surface layer when applying this indicator. This indicator is easily human-induced if a **plow pan** or other human-made confining layer is present. In these cases, the human-induced feature may have caused the development of a hydric soil. Removal of the feature that is causing the perching of water can eliminate the source of water causing anaerobic conditions to occur; therefore, the soil is no longer actively forming as a hydric soil.

A soil that meets the requirements of indicator F6 must have a dark surface layer with value of 3 or less and chroma of 2 or less and redox concentrations in the dark layer.

Indicator F7 - Depleted dark surface

Redox depletions with value of 5 or more and chroma of 2 or less in a layer that is 10 cm or more thick, starting at a depth of 20 cm or less from the mineral soil surface, and has:

a) a matrix value of 3 or less and chroma of 1 or less and 10% or more redox depletions, or
b) a matrix value of 3 or less and chroma of 2 or less and 20% or more redox depletions.

User Notes - For use in all regions except NW.

Care should be taken not to mistake mixing of an Ae or calcic horizon into the surface layer for depletions. The pieces of Ae and calcic horizons are not redox depletions. Knowledge of local conditions is helpful in areas where Ae and/or calcic horizons may be present. In soils that are wet because of subsurface saturation, the layer directly below the dark surface layer will typically have a depleted or gleyed matrix. Redox depletions should have associated redox concentrations that occur as Fe pore linings or masses within the depletion(s) or surrounding the depletion(s). A soil that meets the requirements of indicator F7 commonly also meets the requirements of indicator F6. If the dark surface layer has depletions, it most likely also has concentrations.

Indicator F8 - Redox depressions

In closed depressions subject to ponding, 5% or more distinct or prominent redox concentrations occurring as soft masses or pore linings in a layer that is 5 cm or more thick and starts at 10 cm or less from the soil surface.

User Notes - For use in all regions except NW.

This indicator occurs on depressional landforms, such as **vernal pools** and potholes. This indicator is also common in backwater depressions of flood plains such as swamps or sloughs. It does not occur in solitary micro-depressions (approximately 1 m scale) or on convex or planar slope shape positions.

6.4.2 Hydric soil indicators for the Northwest Region

As described in Section 6.5, above, it may be appropriate to use other indicators in the Northwest Region of B.C., which share climate, physical and biological characteristics like

Alaska. For the purposes of this manual, the Northwest includes the Northern Boreal Mountains and Southern Alaska Mountains ecoprovinces, plus the northern most **ecosections** of the Coast and Mountains ecoprovince that borders the Alaksa panhandle (Figure 8). In this region, the following three soil indicators should be used in addition to the above-listed indicators as applicable and summarized in Table 9, above.

Practitioners must use professional discretion in determining if the three additional indicators are appropriate, or not, based on climatic and landscape characteristics. A practitioner may also determine that these three indicators are appropriate in areas outside the Northwest Region boundaries shown in Figure 8 and must provide sufficient rationale for their use in these cases.

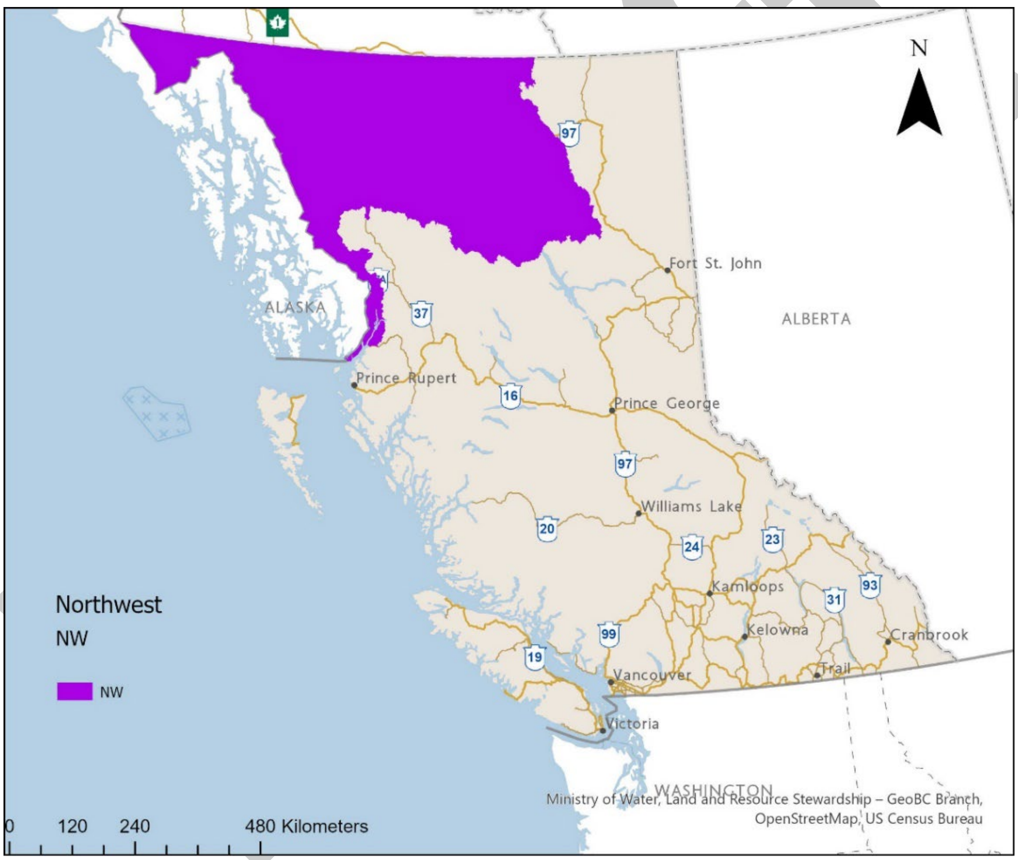

Figure 8 Area referred to as the Northwest for purposes of applying hydric soil indicators for the Northwest Region which includes indicators A13, A14 and A15.

Indicator A13 - Alaska gleyed

A mineral layer with more than 50% gleyed matrix. The layer starts at a depth of 30 cm or less from the mineral surface and is underlain at a depth 1.5 m or less from the soil surface by soil material with hue of 5Y or redder in the same type of parent material.

User Notes - For use in NW.

The indicator has two requirements. First, one or more of the specified gley colours occurs at 30 cm or less from the soil surface. These must be the colours on the pages of the Munsell Soil Color Book (X-Rite, 2009) that show gley colours, not simply grey colours. Second, below these gley colours, the colour of similar soil material is 5Y or redder (2.5Y, 10YR, 7.5YR, etc.). The presence of truly gley colours indicates that the soil has undergone reduction.

The requirement for 5Y or redder colours lower in the profile ensures that the gley colours are not simply the basic colour of the parent material. Some tidal sediments, lacustrine sediments, loess and glacial tills have base colours that appear as gley. This indicator proves that the near-surface gley colours are the result of anaerobic conditions. When comparing the near-surface and underlying colours, make sure that both are the same type of soil material. Many soils in Alaska consist of two or more types of material (e.g., silty loess overlying gravelly glacial till or sand and gravel river deposits).

Indicator A14 - Alaska redox

A mineral layer that has dominant hue of 5Y with chroma of 3 or less or a gleyed matrix of 10% or more distinct or prominent redox concentrations occurring as pore linings with value and chroma of 4 or more. The layer occurs at a depth of 30 cm or less from the soil surface.

User Notes - For use in NW.

In a soil layer that has been reduced, one of the first areas where oxygen will be reintroduced is along pores and the channels of live roots. As oxidation occurs in these areas, characteristic reddish orange redox concentrations (with value and chroma of 4 or more) will be apparent along the pores and linings. These will stand out in contrast to the matrix colour of the overall soil layer. First, determine if the dominant colour(s) of the soil layer match the chroma 3 or less or gley colours indicated. Then, break open pieces of the soil and look for reddish orange redox concentrations along pores and root linings. The occurrence of these concentrations indicates that the soil has been reduced during periods of saturation and is now oxidizing in a drier state.

Indicator A15 - Alaska gleyed pores

A mineral layer of 10% or more gleyed matrix colours along root channels or other pores and that starts at a depth of 30 cm or less from the soil surface. The matrix has a dominant hue of 5Y or redder.

User Notes - For use in NW.

In a soil layer that is becoming anaerobic, reduced conditions will first occur where the soil microbes have an ample supply of organic carbon. Colder soils normally have a low content of organic carbon, so the microbes will congregate along the channels containing dead roots. Gley colours will first appear along these channels. In a soil layer that is not already dominated by gley colours, break open pieces of the soil and look closely at the root channels. Many of these will be very thin or fine. Look for thin coatings along the channels that match the gley colours listed in the indicator. If they occur, they indicate that the soil experiences anaerobic conditions.

6.4.3 Hydric soil indicators for problem soils

The indicators below may be used in problem wetland situations where there is wetland hydrology and hydrophytic vegetation and the soil is believed to meet the definition of a hydric soil despite the lack of other hydric soil indicators. To use these indicators, follow procedures described in Section 9.1.2 Problematic hydric soils. These indicators are for use in testing throughout B.C.

Indicator A10 - 2 cm muck

A layer of humic organic matter (muck) 2 cm or more thick with a value of 3 or less and chroma of 1 or less, starting at a depth of 15 cm or less from the soil surface.

User Notes - This indicator requires a minimum muck thickness of 2 cm. Normally, this expression of anaerobiosis is at the soil surface; however, it may occur at any depth of 15 cm or less. Organic soil material is called muck if the material has undergone sufficient decomposition to limit the recognition of plant parts. Mesic (mucky peat) and/or fibric (peat) material do not qualify. Typical horizons include Oh, Ohi and Ah.

Indicator F18 - Reduced vertic

In Vertisols and Vertic intergrades, a positive reaction to alpha, alpha-dipyridyl that:

a) Is the dominant (60% or more) condition of a layer 10 cm or more thick, starting at a depth of 30 cm or less, or 5 cm or more thick starting at a depth of 15 cm or less from the mineral or muck soil surface;
b) Occurs for at least seven continuous days and 28 cumulative days, and
c) Occurs during a normal or drier season and month.

User Notes - These soils have thick dark surface horizons but indicators A11, A12, and F6 are often lacking, possibly due to masking of redoximorphic features by organic carbon.

Indicator F21 - Red parent material

A layer derived from red parent materials that is 10 cm or more thick, starting at a depth of 25 cm or less from the soil surface with a hue of 7.5YR or redder. The matrix has a value and chroma of greater than 2 and less than or equal to 4. The layer must contain 10% or more depletions and/or distinct or prominent concentrations occurring as soft masses or pore linings. Redox depletions should differ in colour by having:

a) a minimum difference of one value higher and one chroma lower than the matrix, or
b) a value of 4 or more and chroma of 2 or less than the matrix.

User Notes - This indicator was developed for use in areas of red parent material. It is recommended to involve a soil scientist or geomorphologist familiar with soil landscape relationships if this indicator is suspected. In glaciated areas, the indicator may form in glacial till, outwash, deltaic sediments, or glaciolacustrine sediments derived from similar parent materials in the area. Soils potentially derived from red parent materials should be evaluated to determine the Color Change Propensity Index (CPPI) and be shown to have CCPI values less than 30 (Rabenhorst and Parikh 2000). In landscapes where mixing or stratification of parent materials occurs, it cannot be assumed that sediment overlying red parent material is derived solely from that parent material. The total percentage of all redox concentrations and redox depletions must add up to 10 % or more to meet the threshold for this indicator. This indicator is typically found at the boundary between hydric and non-hydric soils. Other, more common indicators may be found on the interior.

Indicator F22 - Very shallow dark surface

In depressions and flood plains subject to frequent ponding and/or flooding, one of the following must be observed:

a) If bedrock occurs between 15 cm and 25 cm of the soil surface, a layer of 15 cm or more thick starting at a depth 10 cm or less from the soil surface with value of 2.5 or less and chroma 1 or less, and the remaining soil to bedrock must have the same colours as above or any other colour that has chroma of 2 or less, or

b) If bedrock occurs at a depth of 15 cm or less from the soil surface, more than half of the soil thickness must have value of 2.5 or less and chroma 1 or less, and the remaining soil to bedrock must have the same colour as above or any other colour that has a chroma of 2 or less.

In simple terms — you typically have a hydric soil when there is:

1. Accumulation of Organic Matter
    - A soil with 40 cm or more of organic soil (fibric, mesic, humic) at the surface is always considered hydric (A1).
    - A soil with 20 cm or more of organic soil underlain by a mineral horizon (A2, A3).
2. Mineral soil with a low chroma (2 or less) matrix and mottles (distinct or prominent) within the upper 25 cm (F3), with several variations especially related to depth (A11, A12, S5 and F6).
3. A gleyed matrix (i.e., colour on gley pages of Munsell) starting 30 cm or less from the surface for loamy and clayey soils (F2) or starting 15 cm or less for sandy soil (S4).
4. Smell of hydrogen sulfide (rotten eggs) in the upper 30 cm (rare at wetland boundary but common in wetland center) (A4).

7 Wetland hydrology

7.1 Introduction

Wetland hydrology refers to the sum of wetness characteristics in areas that are inundated or have saturated soils at some time during the **growing season** (discussed further in Section 7.2). Areas with evident wetland hydrology are those in which the presence of water exerts a dominant influence on vegetation and soil characteristics through anaerobic and reducing conditions.

Among the three factors of wetlands, hydrology is often the most variable and difficult to observe directly in the field. Nonetheless, it is critical to establish that an area is subject to periodic inundation or soil saturation during the growing season.

Indicators of wetland hydrology are evaluated in conjunction with indicators of hydrophytic vegetation and hydric soils to confirm wetland presence. While vegetation and soil indicators reflect medium- to long-term hydrologic conditions, hydrology indicators demonstrate that the current hydrologic regime is sufficient to support ongoing wetland processes rather than representing a legacy condition from a past wet period.

Hydrology indicators are the most transient. Those involving direct observations—such as direct observation of surface water or saturated soils—are typically present only during the wet portion of the growing season and may be absent during dry periods or years with below-average precipitation. Land that appears dry may in fact be wetland that simply does not have obvious indicators at the time of the visit. For example, temporary or seasonal wetlands may visually resemble upland forest during dry periods but exhibit hydric soils and plants morphologically adapted to a wet environment. Conversely, areas that appear wet during a flood event may be ephemeral and may not meet wetland criteria.

Wetland hydrology is inherently dynamic and can vary on daily, seasonal and annual timescales as well as between wetland types and across regions (Tiner 2017).

The absence of observable indicators does not constitute evidence for the absence of wetland hydrology. Section 9 Difficult wetland situations describes scenarios in which wetlands may lack hydrology indicators.

Areas exhibiting both hydrophytic vegetation and hydric soils are expected to possess wetland hydrology unless the site's hydrologic regime has been altered by natural processes or human activities (National Research Council 1995). When hydrology indicators are missing in such areas, additional information may be necessary to evaluate whether wetland hydrology is currently present.

To improve reliability, site visits should, when feasible, be scheduled during the normal wet portion of the growing season. This timing increases the likelihood of detecting hydrologic conditions representative of the site's true wetland or non-wetland status. Conversely, indicators of wetland hydrology may appear in non-wetland areas following periods of heavy rainfall or during abnormally wet conditions, which can lead to false-positive assessments. In such cases, site visits may need to be postponed.

7.2 Growing season

The start and end date of the growing season is important to evaluate some indicators, including observations of flooding, ponding, or shallow water tables. It is also required to analyze recorded data to determine if wetland hydrology is present on highly disturbed or problematic sites.

Oxygen depletion and chemical reduction of iron and other elements in soil results from biological activity associated with plant roots and soil microbial populations (National Research Council 1995). Growing season indicators include growth of vascular plants, and soil temperature. If growing season information is needed to evaluate specific wetland hydrology indicators, the following two approaches may be used:

1. The growing season has begun on a site when two or more non-evergreen vascular plant species growing in the wetland or surrounding areas exhibit one or more of the following indicators:
    a. Emergence of herbaceous plants from the ground;
    b. Appearance of new growth from vegetative crowns (e.g., in graminoids, bulbs and corms);
    c. Coleoptile/cotyledon emergence from seed;
    d. Bud burst on woody plants (i.e., some green foliage is visible between spreading bud scales);
    e. Emergence or elongation of leaves of woody plants; and/or
    f. Emergence or opening of flowers.

The end of the growing season is when woody deciduous species lose their leaves and/or the last herbaceous plants cease flowering, and their leaves become dry or brown due to cold temperatures or reduced moisture. If early senescence occurs from excessively dry conditions, then soil temperature should be used to determine the end of the growing season. Evergreen species and non-vascular plants are not included in this method.

2. The growing season has begun and is still in progress when soil temperature measured 30 cm below the soil surface is 5^0C or higher. Temperature measurements are not necessary if growing season information is not needed to evaluate specific wetland hydrology indicators or if the determination can be made using vegetation. Using this approach, the end of the growing season would also include when the soil temperature measured 30 cm below the surface is 5^0C or lower.

7.3 Wetland hydrology indicators

Indicators of wetland hydrology may include, but are not limited to: drainage patterns, drift lines, sediment deposition, watermarks, stream gauge data, visual observation of saturated soils and visual observation of inundation. Any of these indicators may be evidence of wetland hydrologic characteristics.

Methods for determining hydrologic indicators can be categorized according to the type of indicator. Recorded data include stream gage data, lake gage data and tidal gage data, but the use of these data is commonly limited to areas next to streams or other similar areas. Recorded data usually provide both short- and long-term information about frequency and duration of inundation, but they contain little or no information about soil saturation. The remaining indicators require field observations. Field indicators are evidence of present or past hydrologic events (e.g., location and height of flooding)

Wetland hydrology indicators are presented in four groups. Indicators in Group A (Section 7.3.1) are based on the direct observation of surface water or groundwater during a site visit. Group B (Section 7.3.2) consists of evidence that the site is subject to flooding or ponding, although currently, it may not be inundated. Group C (Section 7.3.3) consists of other evidence that the soil is currently saturated or was recently saturated. Group D (Section 7.3.4) consists of landscape characteristics, vegetation and soil features that indicate contemporary rather than historical wet conditions.

Within each group, indicators are divided into two categories, primary and secondary, based on their estimated reliability. One primary indicator (P) from any group is sufficient to conclude that wetland hydrology is present. The area is a wetland if indicators of hydric soil and hydrophytic vegetation are also present. In the absence of a primary indicator, two or more secondary indicators (S) from any group are necessary to conclude that wetland hydrology is present. Each indicator described below is based on the Corps. Manual (USACE 2010a; USACE 1987) and numbering conventions have been kept for cross-referencing purposes. Indicators of wetland hydrology include, but are not necessarily limited to, those listed in Table 10, below.

Table 10 Summary of wetland hydrology indicators

Indicator	Primary	Secondary
Group A – Observation of surface water or saturated soils		
A1 – Surface water	X	-
A2 – High-water table	X	-
A3 - Saturation	X	-
Group B – Evidence of recent inundation		
B1 – Water marks	X	-
B2 – Sediment deposits	X	-
B3 – Drift deposits	X	-
B4 – Algal mat or crust	X	-
B5 – Iron deposits	X	-
B6 – Surface soil cracks	X	-
B7 – Inundation visible on aerial imagery	X	-
B8 – Sparsely vegetated concave surface	X	-
B9 – Water-stained leaves	-	X
B10 – Drainage patterns	-	X
B11 – Salt crust	X	-
B13 – Aquatic invertebrates	X	-
Group C – Evidence of current or recent soil saturation		
C1 - Hydrogen sulfide odour	X	-
C2 – Dry-season water table	-	X
C3 – Oxidized rhizospheres along living roots	X	-
C4 - Presence of reduced iron	X	-
C6 – Recent iron reduction in tilled soils	X	-
C9 – Saturation visible on aerial imagery	-	X
Group D – Evidence from other site conditions or data		
D1 – Stunted or stressed plants	-	X
D2 – Geomorphic position	-	X
D3 – Shallow aquitard	-	X
D5 – FAC-neutral test	-	X
D6 – Raised ant mounds	-	X
D7 – Frost-heave hummocks	-	X

Below is a description of each indicator and information on if it is primary or secondary. Photographs for each of these indicators can be found in the WMVC Regional Supplement (USACE 2010a).

7.3.1 Group A: Direct observation

These indicators are based on direct observation of water and/or reduced soil conditions during a site visit (in the growing season), including:

Indicator A1 - Surface water (primary)

Direct visual observation of surface water during a site visit. When applying this indicator, care must be taken because surface water may be present in non-wetland areas for brief periods and following unusually high precipitation, runoff, tides, or river stages.

Indicator A2 – High-water table (primary)

Direct visual observation of the water table within 30 cm of the soil surface in a soil pit, auger hole or shallow monitoring well. This indicator includes water tables derived from **perched water table**, **throughflow** and discharging groundwater (e.g., seeps) that may be moving laterally near the soil surface. Sufficient time must be allowed for water to infiltrate into a newly dug hole and stabilize at the water-table level. Time needed will vary based on soil texture. In some cases, water table can be determined by observing the wall of soil pit to identify the upper level of water seeping into the pit. For an accurate measurement of water table, the shovel or auger should avoid penetrating any restrictive soil layer capable of perching water near the surface.

Indicator A3 - Saturation (primary)

Visual observation of saturated soils within 30 cm of the soil surface as indicated by water glistening (Figure 9) on the soil surfaces. This indicator must be associated with a water table located immediately below the saturated zone, but this requirement is waived if there is a perched water table associated with a restrictive soil layer or bedrock within 30 cm of the surface.

Figure 9 Example of saturated soil that is glistening.

Glistening indicates that soil saturation is present because the soil is below the water table or within the saturated capillary fringe just above the water table. Surface wetness from recent rainfall does not qualify. Water in soil cracks or on the faces of aggregates (peds) is not sufficient unless the interiors are also saturated. Samples should not be squeezed to force water from soil pores.

7.3.2 Group B: Evidence of recent inundation

These indicators are based on indirect evidence of recent inundation (ponding or flooding), including:

Indicator B1 - Water marks (primary)

Discolorations or stains on the bark of woody vegetation, rocks, fences, bridge supports or other fixed objects because of inundation. When several water marks are present, it is the maximum extent of inundation. Water marks indicate a water-level elevation and can be extrapolated from nearby objects across lower elevation areas.

Indicator B2 - Sediment deposits (primary)

Thin layers or coatings of fine-grained mineral material (e.g., silt or clay) or organic matter (e.g., pollen) staying on tree bark, plant stems or leaves, rocks and other objects after surface water recedes. Sediment deposits most often occur in riverine backwater and ponded situations where standing water was present for sufficient time for suspended sediment to settle. Sediment deposits indicate the minimum inundation level and may be extrapolated across lower elevation areas.

Indicator B3 - Drift deposits (primary)

Debris (e.g., branches, stems and leaves) that has been deposited by flowing water on the ground surface or entangled in vegetation or other fixed objects after water has receded. Drift deposits are most likely to be found adjacent to streams. Drift material may be deposited at the high-water line in a ponded or flooded area, piled against the upstream side of trees or other fixed objects, or distributed throughout the dewatered area. Use caution with drift lines caused by extreme, infrequent or brief flooding events.

Caution! Water marks (B1), sediment deposits (B2) and drift deposits (B3) may have been caused by extreme, infrequent or very brief flooding events. Additionally, surface water may be present on a non-wetland site immediately after a heavy rain or during periods of unusually high precipitation, runoff, tides or river stages. Checking weather conditions prior to a field visit can avoid misidentifying these indicators as evidence of wetland hydrology.

Indicator B4 - Algal mat or crust (primary)

This indicator consists of a mat or dried crust of algae often on or near the soil surface after dewatering. Algal deposits include green algae (Chlorophyta) and blue-green algae (cyanobacteria), which may be attached to low vegetation and other objects, or may cover the soil surface. Dried threads of filamentous algae may also be seen. Algal deposits are most often observed in seasonally ponded depressions, tidal areas, lake fringes and low-gradient stream margins with prolonged wet conditions sufficient for algal growth.

Indicator B5 - Iron deposits (primary)

Thin orange or yellow crust or gel of oxidized iron on the soil surface or objects near the surface. Iron deposits form where reduced iron discharges with groundwater and oxidizes when exposed to air. The oxidized iron forms a film or sheen on standing water and an orange or yellow deposit on the ground surface after dewatering. Iron sheen on water can be distinguished from an oily film by touching it with a stick or finger; iron films are crystalline and will crack into angular pieces.

Indicator B6 - Surface soil cracks (primary)

Shallow cracks that form when fine-grained mineral or organic sediments dry and shrink, often creating a network of cracks or small polygons. Surface cracks are most often seen in concave landscape positions where water ponded long enough to impact surface soil structure. Use caution where surface cracks may form in non-wetlands with temporary ponds and puddles. These are easily distinguished by the absence of hydrophytic vegetation and/or hydric soils.

Indicator B7 - Inundation visible on aerial imagery (primary)

One or more recent aerial photographs or satellite images show the site to be inundated. Care must be taken when surface water may be present on a non-wetland site following heavy rain or high flow event. As required, utilize procedures to evaluate normality of precipitation prior to the photo date. Use multiple years of imagery and multi-season imagery when possible.

Indicator B8 - Sparsely vegetated concave surface (primary)

On concave land surfaces (e.g., depressions and swales) where the ground surface is either unvegetated or sparsely vegetated (less than 5% ground cover) due to long-duration ponding during the growing season. Ponding during the growing season can limit the establishment of vegetation. Compare the area with vegetated slopes and convex surfaces in the same area.

Indicator B9 - Water-stained leaves (secondary)

Fallen or recumbent dead leaves that have turned greyish or blackish in colour due to inundation for prolonged periods. Usually found in depressional wetlands and along streams in shrub-dominated or forested habitats but may also occur in herbaceous communities. Water-stained leaves keep their blackish or greyish colours when dry and will contrast strongly with the fallen leaves in nearby non-wetland areas.

Indicator B10 - Drainage patterns (secondary)

Flow patterns visible on the soil surface or eroded into the soil, low vegetation bent over in the direction of flow, absence of leaf litter or small woody debris due to flowing water, and similar evidence that water flowed across the ground surface. Usually seen in areas where water flows broadly over the surface and is not confined to a channel such as in areas next to streams, in seeps, vegetated swales and tidal flats. Note that similar patterns may be caused by snowmelt on non-wetland mountain slopes.

Indicator B11 - Salt crust (primary)

Hard or brittle deposits of salts formed on the ground surface due to the evaporation of saline surface water, often formed in ponded depressions, seeps and at the fringes of lakes. The salt crust may appear as a white ring at the high-water line after water recedes. This indicator is not intended to include fluffy or powdery salt deposits resulting from capillary rise and evaporation of saline groundwater that may be derived from a deep-water table.

Indicator B13 - Aquatic invertebrates (primary)

Presence of numerous live individuals, diapausing insect eggs or crustacean cysts, or dead remains of aquatic invertebrates such as clam shells, aquatic snail shells, aquatic insects, ostracods, shrimp and other crustaceans, either on the soil surface or clinging to plants or other emergent objects. Invertebrates or their remains should be reasonably abundant and more than one or two individuals. Use caution where remains may have been transported into non-wetland areas by unusually high-water or other animals.

7.3.3 Group C: Evidence of soil saturation

These indicators are based on indirect evidence of recent soil saturation, including:

Indicator C1 - Hydrogen sulfide odor (primary)

Rotten-egg odour within 30 cm of the soil surface produced by soil microbes in response to prolonged saturation in soils where oxygen, nitrogen, manganese and iron have been largely reduced and there is a source of sulfur. To be detectable, soils must be saturated at the time of sampling and have been saturated long enough to become highly reduced. This is an indicator of both hydric soil and wetland hydrology. To apply this indicator, dig the soil pit to a depth of 30 cm or less to avoid release of hydrogen sulfide from deeper in the profile.

Indicator C2 – Dry-season water table (secondary)

Visual observation of the water table between 30 cm and 60 cm below the surface during the normal dry season or during a drier than normal year. Due to seasonal fluctuations, water tables in wetlands often drop below 30 cm during the dry summer months. A water table between 0 and 60 cm during the dry season or an unusually dry year indicates a normal wet-season water table within 30 cm of the surface. Sufficient time must be allowed for water to infiltrate into a newly dug soil pit or auger hole and to stabilize at the water table level. The required time will vary depending upon soil texture. Water tables in wetlands often drop well below 60 cm during dry periods. Therefore, a dry-season water table below 60 cm does not indicate a lack of wetland hydrology.

Indicator C3 - Oxidized rhizospheres along living roots (primary)

Presence of a layer that has 2% or more iron oxide coatings on the surfaces of living roots and/or iron-oxide coatings on soil pores immediately surrounding living roots within 30 cm of the soil surface. These are caused by leakage of oxygen out of plant roots into anoxic soil, resulting in oxidation of iron compounds in the soil around the root. Note the location and abundance of oxidized rhizospheres in the soil profile description or remarks section of the Wetland determination data form (Appendix B). Oxidized rhizospheres must occupy at least 2% of the volume of the layer.

Indicator C4 - Presence of reduced iron (primary)

A layer having reduced (ferrous) iron in the upper 30 cm of the soil profile, as indicated by a ferrous iron test or by the presence of a soil that changes colour upon exposure to the air. The reduction of iron occurs in soils that have been saturated long enough to become anaerobic and chemically reduced. Ferrous iron is converted to oxidized forms when saturation ends, and the soil reverts to an aerobic state. The presence of ferrous iron indicates that the soil is saturated and anaerobic at the time of sampling and has been so for an extended period. The presence of ferrous iron can be verified with alpha, alpha-dipyridyl reagent or by observing a soil that changes colour upon exposure to air. Soils should be tested or examined at once after digging a soil pit because ferrous iron may oxidize and colours change soon after the sample is exposed to air.

Dry-season water table

A water table below 60 cm during the dry season does not preclude the site from having wetland hydrology.

Indicator C6 - Recent iron reduction in tilled soils (primary)

Presence of a layer that has 2% or more redox concentrations as pore linings or soft masses in the tilled surface layer. The layer that has redox concentrations must be within the tilled zone or within 30 cm of the soils surface, whichever is shallower. Cultivation breaks up or destroys redox features in the plow zone. Redox features that are continuous and unbroken indicate that the soil was saturated and reduced since it was last cultivated. Use caution with older features that may be broken up but not destroyed.

Indicator C9 - Saturation visible on aerial imagery (secondary)

One or more recent aerial photographs or satellite images indicate soil saturation that correspond to field-verified hydric soils, depressions or drainage patterns, differential crop management or other evidence of a seasonal high-water table. This indicator is useful when plant cover is sparse or absent and the ground surface is visible from above. Saturated areas generally appear as darker patches within the field. Care must be taken when surface water may be present on a non-wetland site following a heavy rain or high flow event. Use caution, as similar signatures may be caused by factors other than saturation. Use multiple years of imagery and multi-season imagery when possible. Saturation observed during the non-growing season may be an acceptable indicator if experience and professional judgement suggest that wet conditions normally extend into the growing season for sufficient duration in most years. Saturation may be absent from a wetland during the normal dry season or during extended periods of drought.

7.3.4 Group D: Landscape conditions or other features

These indicators are based on inferences from other site conditions or data, including:

Indicator D1 - Stunted or stressed plants (secondary)

In agricultural or planted vegetation found in a topographically low area, this indicator is present if individuals of the same species and growing in the potential wetland are clearly of smaller stature, are less vigorous or are stressed compared with individuals growing in nearby drier landscape situations. Most individuals in the potential wetland must be stunted or stressed.

Indicator D2 - Geomorphic position (secondary)

This indicator is present if the area is in a localized depression, swale or drainageway, concave position within a floodplain, at the toe of a slope, on an extensive flat, on the low-elevation fringe of a pond or other water body, or in an area where groundwater discharges. This indicator does not include concave positions on rapidly permeable soils (e.g., floodplains with sand and gravel substrates) that do not have wetland hydrology unless the water table is near the surface.

Indicator D3 - Shallow aquitard (secondary)

Prescence of an **<u>aquitard</u>** within 60 cm of the soil surface that is potentially capable of perching water within 30 cm of the surface. An aquitard is a relatively impermeable soil layer or bedrock. In some cases, the aquitard may be at the surface and may cause water to pond on the surface. Potential aquitards include fragipans, cemented layers, dense glacial till, lacustrine deposits and clay layers. An aquitard can often be identified by limited root penetration through the layer and/or presence of redoximorphic features in the layer(s) above.

Indicator D5 - FAC-neutral test (secondary)

The plant community passes the FAC-neutral test. The FAC-neutral test is performed by compiling a list of dominant plant species across all strata in the community and dropping from the list any species with a facultative (FAC) indicator status. The FAC-neutral test is met if more than 50% of the remaining dominant species are rated FACW and/or OBL. This indicator may be used in communities that have no FAC dominants. If there is an equal number of dominants that are OBL and FACW versus FACU and UPL, non-dominant species should be considered. This indicator is only applicable to wetland hydrology determinations.

STEP 1. Use the 50/20 rule (described in Section 5.3.1) to select dominant species from each stratum of the community.

STEP 2. Combine dominant species from all strata into a single list. Determine the wetland indicator status for each dominant species.

Example using the species list from Section 5.3 Hydrophytic vegetation indicators in Table 3 and Table 4, above.

Dominant Species	Stratum	Indicator Status
Deschampsia caespitosa	Herb	FACW
Carex crawfordii	Herb	FACW
Urtica dioica	Herb	FAC
Holodiscus discolor	Shrub	FACU
Crataegus douglasii	Shrub	FAC
Alnus rubra	Tree	FAC

STEP 3. Drop the FAC species from consideration

Dominant Species	Stratum	Indicator Status
Deschampsia caespitosa	Herb	FACW
Carex crawfordii	Herb	FACW

~~*Urtica dioica*~~	~~Herb~~	~~FAC~~
Holodiscus discolor	Shrub	FACU
~~*Crataegus douglasii*~~	~~Shrub~~	~~FAC~~
~~*Alnus rubra*~~	~~Tree~~	~~FAC~~

STEP 4. Sort the remaining species into two groups: FACW and OBL species.

Example from the species list above:

FACW and OBL Species	FACU and UPL Species
Deschampsia caespitosa	*Holodiscus discolor*
Carex crawfordii	-

STEP 5. Count the number of species in each group. If the number of dominant species that are FACW and OBL is greater than the number of dominant species that are FACU and UPL, the site passes the FAC-neutral test.

In the example, two species are FACW and/or OBL, and one species is FACU or UPL. Therefore, the site passes the FAC-neutral test.

Indicator D6 - Raised ant mounds (secondary)

Presence of elevated ant mounds 15 cm or more in height built in response to seasonal flooding, ponding or high-water tables. Nests often have grasses and other plants growing on their tops and sides and may be very numerous, giving the wet area a hummocky appearance. In well-drained soil, ground-nesting ants build mounds that are typically less than 10 to 12 cm in height.

Indicator D7 - Frost-heave hummocks (secondary)

Presence of hummocky microtopography produced by frost action in saturated wetland soils. This indicator is most often seen in northern B.C., where freeze/thaw action occurs in cold winters and high elevations.

Part IV: Field methods

8 Field procedures for wetland identification and delineation

The delineator should begin by walking the site and paying attention to the following features:

- **Hydrology –** Is there standing water on the site? What is the depth of the water table in the area? Is there indirect evidence of flooding or ponding?
- **Slope** – Is the site level or nearly level where the water does not run off easily, or is it sloped where water would run off the soil?
- **Slope shape** – Is the surface concave where water would tend to collect and possibly pond? Are there convergent slopes where water may be directed toward a central stream or swale?
- **Landform** – Is the soil on a low terrace or floodplain that may be subject to seasonal high-water tables or flooding? Is the site located in a depression? Does groundwater emerge at or near the surface? Has the microtopography been altered by cultivation?
- **Soil materials –** Is there a restrictive layer in the soil that could slow or prevent the infiltration of water, leading to a perched water table or hillslope seep?
- **Vegetation** – Does the vegetation at the site indicate wetter conditions than at other nearby sites, or is it like what is found at nearby non-wetland sites?

8.1 Wetland identification

In practice, wetlands typically must have (1) a plant community where greater than 50% of the dominant species have a wetland indicators status of facultative (FAC) or wetter; (2) soils with hydric soil properties; and (3) sufficient signs of wetland hydrology.

Verification of wetland presence is completed by examining each of the three factors (hydrology, substrate and biota) at individual wetland determination plot locations placed in each vegetation community present to determine if each location meets the criteria of a wetland. Positive indicators of wetlands include the presence of hydrophytic vegetation, hydric soils and wetland hydrology. It is important to note that some wetlands develop where hydric soils are absent or where vascular plants cannot grow, and the wetland supports instead other kinds of organisms that are reflective of recurrent, sustained saturation. Most wetlands can be identified using the approach below, however, in circumstances where certain indicators may be lacking, refer to Section 9.

The steps below walk a practitioner through the process to be completed at each wetland determination plot location to identify if a wetland is present:

STEP 1. **Locate the project area in the field and walk the site.** While walking the site, (a) determine the number and location of plant communities on the site; (b) determine if there is any evidence of natural or human alteration to vegetation, soil or hydrology that would make wetland identification difficult (for these areas refer to Section 9 – Difficult wetland situations); and (c) determine whether seasonal changes to hydrology or temperatures may cause a serious problem for identifying a wetland according to the three-factor method. Document any problem situations on the Wetland determination data form (Appendix B).

STEP 2. **Evaluate each plant community for positive indicators of hydrophytic vegetation, wetland hydrology and hydric soils, respectively**. Pick one community to begin with by selecting one or more wetland determination plots (as necessary) that typify the community and record the location on the Wetland determination data form (Appendix B) or in a field notebook.

STEP 3. **Characterize the plant community**. Using the Wetland determination data form (Appendix B), determine and document the dominant species in each stratum. Record the indicator status of each dominant species.

STEP 4. **Determine whether hydrophytic vegetation is present** using one of the four hydrophytic vegetation indicators (Section 5.3). If yes, then continue to STEP 5. If no, confirm that an atypical situation or problem area does not exist prior to determining the area is not a wetland.

STEP 5. If all dominants are OBL, or if all dominants are OBL and FACW and the wetland boundary is abrupt, soils do not need to be examined as hydric soils are assumed to be present (document this on the field form). If at this step you have positive indicators of hydrophytic vegetation, wetland hydrology and assumed hydric soils, then the area is a wetland. If not, continue to STEP 6.

STEP 6. **Determine if hydric soils are present.** Soils will need to be documented and inspected in any plant community which does not meet the plant community as described in STEP 4 and especially in cases where the community is dominated by one or more FAC species; the boundary between wetland and non-wetland is gradual or indistinct; or the area is known to have or is suspected of having significantly altered hydrology. Follow the procedures outlined in Section 6.4 – Procedures for sampling soils and examine for hydric soil indicators (Section 6.5). If soils are positive for hydric soil indicators, continue to STEP 7. If not, the area is not a wetland.

STEP 7. **Determine if wetland hydrology is present**. Evaluate the site's hydrology by looking for positive indicators of wetland hydrology. Any community having a positive indicator of wetland hydrology is potentially a wetland. If no indicators are present, the area is not a wetland. If yes, then continue to STEP 8.

STEP 8. Repeat STEPS 2-7 for each remaining plant community and determine whether the area(s) is a wetland or non-wetland. Use the Wetland determination data form (Appendix B) to fill out the field indicators for each wetland determination plot.

If, at any time during wetland identification and delineation, a wetland is suspected to be present but certain indicators are not apparent or are lacking, consider if you may have a difficult wetland situation, further described in Section 9.

The delineator should consider the following and adjust their field approach accordingly:

- Determine if normal environmental conditions are present (refers to climatic conditions of the current year and growing season);
- If normal environmental conditions are not present, determine if it is suspected that a potential wetland may be present but may be lacking indicators of one of the three indicators due to naturally occurring conditions such as seasonal or annual variations, or if there has been recent disturbance (either anthropogenic or natural event). In these cases, refer to Section 9 - Difficult Wetland Situations to consider whether an alternative approach is required and the area can be considered wetland despite the lack of one or more indicators. Then return to this section to characterize indicator that were not significantly altered.

A typical sampling layout, examining each plant community for wetland identification, is shown in Figure 10, below.

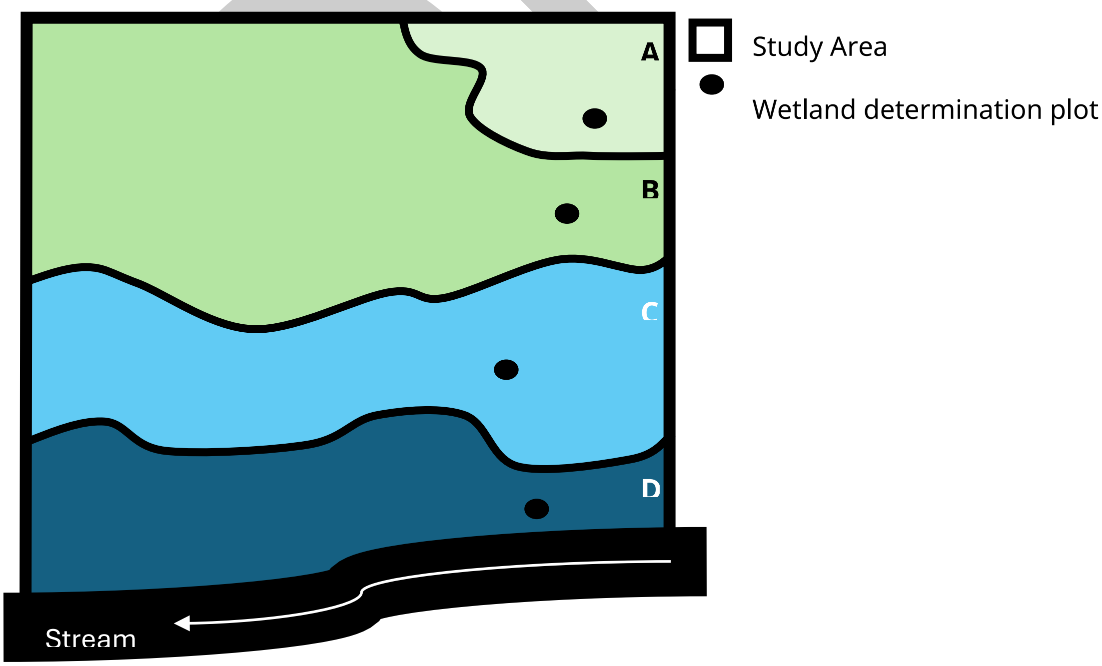

Figure 10 Example showing a wetland determination plot for each unique plant community (A, B, C, D) where the three-factor approach will determine whether an area is a wetland or non-wetland.

Note that in natural, undisturbed situations, all three indicators will be present; however, in difficult situations not all indicators will be present. In this case, the missing indicator(s) can be reassessed using other information. Guidance on how to continue under these circumstances is provided in Section 9 Difficult wetland situations.

8.2 Wetland delineation

Wetland delineation builds on the process of identifying whether wetland conditions exist at a specific plot location and applies it at multiple locations to adequately characterize and delineate the wetland boundary. In most cases, as described in Section 3, on-site field evaluation is a mandatory component of wetland delineation.

The wetland boundary may be established by any of the three following approaches:

1. Making an interpretation of significant vegetation changes between the wetland and non-wetland communities.
2. Locating the point at which there is an absence of one of the three indicators.
3. Examining the soil for direct and indirect signs of seasonal high-water tables that would indicate prolonged saturation within 30 cm of the surface.

Approach 1 works in situations where there is an abrupt change in the topography and a distinct change in vegetation. Approach 2 works well in situations where surface wetland hydrology indicators may be lacking, especially near the upper edge of seasonally saturated wetlands despite the presence of hydrophytic vegetation and hydric soil indicators. Approach 3 is best applied in areas of low topographic relief where it is common for hydrophytic vegetation to be present in the wetland and adjacent non-wetland, but the soils should be significantly distinct and demarcate the limits of the seasonal high-water tables.

Regardless of the approach applied, the following provides the step-by-step guide to determining the wetland boundary:

STEP 1. **Walk the wetness gradient that is parallel to the direction of slope**. This establishes a sampling transect that is perpendicular to the wetland boundary.

STEP 2. **Identify the plant community that is estimated to adjoin the wetland boundary**. The wetland boundary often corresponds to the location that is near the edge of a plant community and/or break in topography. However, sites with little slope may not have an obvious shift in topography or plant community.

STEP 3. **Establish a data plot and complete steps 1-8** in Section 8.1 Wetland identification on either side of the wetland boundary, referred to as a paired plot (Figure 11). Determine the <u>wetland/non-wetland</u> boundary. Establish additional paired data plots as required.

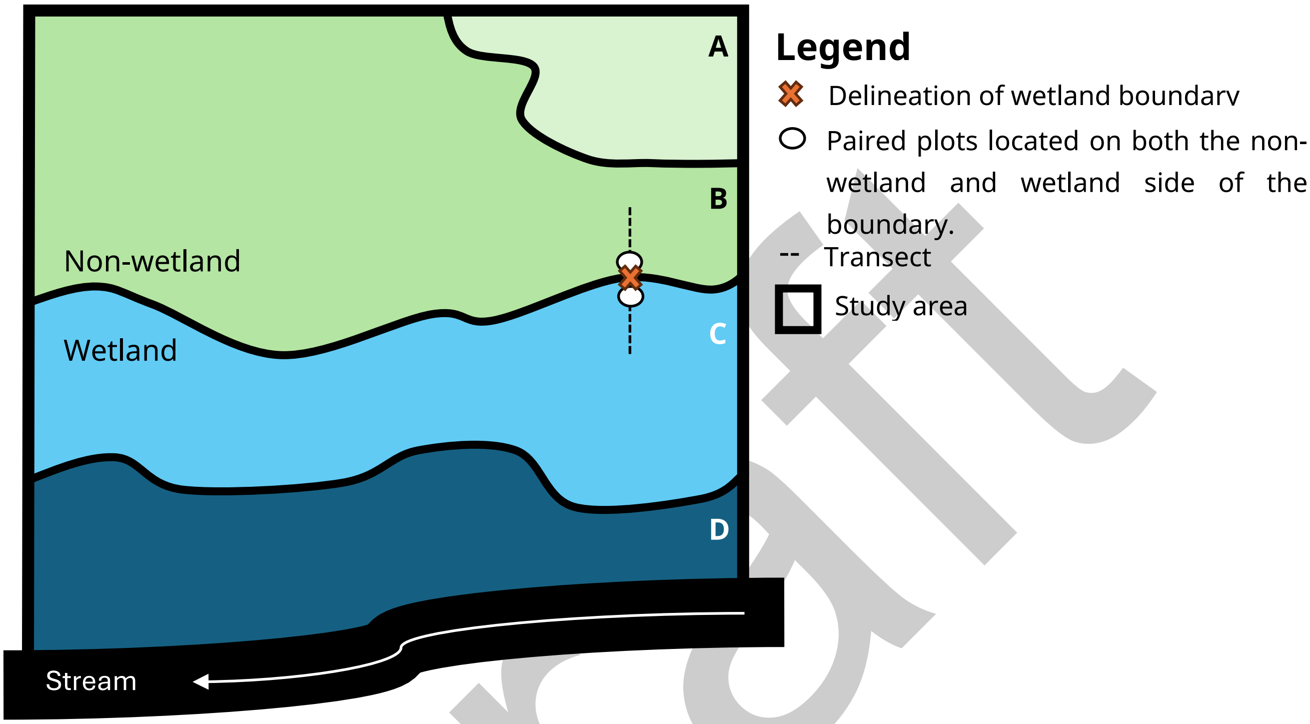

Figure 11 Example transect for delineating the wetland boundary where one wetland determination plot is established in the non-wetland vegetation community where indicators are not present for all three-factors and the other in the wetland vegetation community where this is positive indicators for all three-factors. Together they are referred to as a paired plot.

STEP 4. Complete the wetland boundary survey for the entire perimeter of the wetland. Details are further described in Section 8.2.1, below.

STEP 5. (If necessary or applicable). Mark the boundary of the wetland with prominent flagging tape at regular intervals when planning avoidance or minimization of impacts to the wetland. Obvious markers of the wetland area will help developers and construction crews circumvent impacts to wetland area while reducing their own risk and liability.

STEP 6. Upload the GPS data and overlay it on the base reference image using mapping software. Using the point data, draw a polygon to represent wetland boundaries.

Important! For some projects, it may be necessary to delineate wetland boundaries beyond property lines or in cases for when a rapid function assessment will also be conducted. If a wetland extends into adjacent landowner's property, contact the landowner and ask for permission to conduct the survey. If access is denied, conduct wetland determination plot as close to where the edge meets the property line as possible. The remainder of the wetland will then have to be delineated using image interpretation, which should be documented in the delineation report. Wetlands typically do not stop at property boundary lines. If a subsequent function assessment is warranted, the entire wetland boundary will need to be delineated.

8.2.1 Wetland boundary survey methods

Wetland boundaries may be mapped by a wetland specialist or a professional land surveyor using a GPS. Boundaries mapped with GPS equipment must use equipment, methods, and settings capable of achieving a minimum of 5 m accuracy, with a preference for high accuracy (submeter) when possible.

High accuracy mapping is highly recommended when proposed project activities have potential to occur within 30 m of a wetland. Point data collected along wetland boundaries must be at a frequency capable of accurately depicting the shape and size of each wetland.

Collecting GPS data and installing visible markers along wetland boundaries can help construction crews and land users recognize and avoid wetland areas, thereby reducing the likelihood of unintended impacts.

GPS Unit Standards should be set-up as outlined below:

- **Projection:** Geographic Coordinate System (GCS)
- **Datum:** NAD83 (GRS80) - North American Datum 1983, with earth-centered ellipsoid derived from Geodetic Reference System 1980
- **Units:** Metre [stored without offsets (e.g., in direct Albers projection coordinates)]

Physically marking the wetland boundary in the field is important for projects where wetland avoidance or minimization is planned. It is recommended to physically demarcate wetland boundaries in the field, such as by using flagging tape or survey stakes.

8.2.2 Validity of Wetland Delineations

Wetland delineations generally considered valid for five years. This timeline may be reduced if natural or artificial changes to hydrology, vegetation or soils occurred that may alter the wetland boundary.

9 Difficult wetland situations

Wetland indicators may be missing due to natural processes or recent disturbances. This section includes procedures for these circumstances, which are described as either problem situations (Section 9.1) or atypical situations (Section 9.2).

More than one wetland indicator may be problematic or atypical on a given site. In general, wetland determinations in difficult wetland sites must be based on the best information available to the delineator, interpreted considering their professional experience and knowledge of the ecology of wetlands in the region.

Problem situations refer to areas where wetlands may exist but lack indicators of hydrophytic vegetation, hydric soil or wetland hydrology periodically due to seasonal or annual variability, or permanently due to the nature of the soils or plant species on the site.

Atypical situations refer to circumstances where wetlands may exist, but vegetation, soil or hydrology indicators are absent due to recent human activities or natural events. Procedures for quantifying the extent of wetlands in locations where wetland and non-wetland areas are highly interspersed in a mosaic pattern are also described in Section 9.2.4.

> **Tip!** When providing in-the-field guidance for wetland boundaries — for example, for survey crews and visits from regulators — use labeled field markers that match points on a georeferenced map (Section 10). Markers can include plot numbers or GPS waypoints to help others, such as surveyors or regulators, find exact locations. This is especially useful in forested areas where GPS signals may be weak.

9.1 Problem situations

Where wetlands lack indicators due to seasonal or annual variability, or permanently due to the nature of the soils or plant species on the site, methods in this section should be used. Examples are included below for instances where a particular indicator may be lacking.

9.1.1 Problematic hydrophytic vegetation

Description of the problem

Some wetlands may exhibit indicators of hydric soil and wetland hydrology but lack clear hydrophytic vegetation indicators. This can be attributed to climatic variability, regional variation in moisture availability, salinity, natural events and land-use practices, which can affect plant communities.

In these cases, examples of specific vegetation situations, along with recommended approaches on how to aid in determining if the area in question is or is not a wetland include the following:

Evergreen forested wetlands. Wetlands dominated by evergreen trees occur in many parts of the country. In some cases, the trees are OBL, FACW and FAC species. In other cases, however, the dominant evergreen trees are FACU species such as Western Hemlock (*Tsuga heterophylla*). In dense stands, these trees may preclude the establishment of understory vegetation or in some cases, understory vegetation may be FACU species. Since plant communities of these types are usually found in non-wetlands, the ones established in wetland areas may be difficult to recognize at first glance. The landscape position of evergreen forested areas such as depressions, drainage ways, bottomlands, flats in sloping terrain and seepage slopes should be considered because it often gives clues to the likelihood of a wetland. If the site is a wetland, there should be clear indications of both hydric soils and wetland hydrology.

Highly variable seasonal wetlands. In many regions (especially in arid and semi-arid regions) depressional areas occur that may have indicators of all three wetland criteria during the wetter portions of the growing season (e.g., early spring) but may lack indicators of wetland hydrology (e.g., all of the ponded surface water has evaporated) and/or hydrophytic vegetation (e.g., the short-lived wetland annuals have completed their life cycle and died) during the drier portion of the growing season. In addition, soil profiles in some of these areas do not have classic wetness characteristics as observed in most other wetlands. In these systems, OBL and FACW species are generally dominant during the wetter portion of the growing season while FACU and UPL species (also usually annuals) may be dominant during the drier portion of the growing season and during droughts. Wetland hydrology indicators that are helpful during the dry season of these wetlands include the presence of oxidized rhizospheres, the FAC-neutral test and geomorphic position.

Temporal shifts in vegetation. Plant composition may change in response to seasonal weather patterns and long-term climate fluctuations, seasonal shifts in plant communities and extended drought conditions lasting more than two growing seasons. If possible, visit the site during the typical wet portion of the growing season to re-evaluate vegetation; examine the site for plant remains that indicate hydrophytic vegetation was present during the wet portion of the growing season; use off-site data sources such as air photos, interviews or previous reports about the site, or investigate climate records. This situation includes seasonal wetlands.

Sparse and patchy vegetation. Some wetlands may lack vegetation such as tidal marshes and alkaline flats. Patchy vegetation can occur when there are residual patches of wetland vegetation such as bog species on a raised islet in a pond or in a depression along a field perimeter. For wetland delineation purposes, an area should be considered vegetated (and a potential wetland) if there is 5% or more areal cover of plants at the peak of the growing season.

Riparian areas. Hydrology can vary from perennial to intermittent, and water tables can drop quickly after flooding events. Some woody species may have germinated during wet conditions. These may have deep root systems that can access groundwater too deep to support wetlands so that there is a hydrophytic overstory and a non-hydrophytic understory. Soils can be problematic in riparian areas due to recent deposits from flood events. When soils and hydrology are problematic, then the understory species are more indicative of current wetland conditions.

Areas affected by grazing. Grazing may cause a shift in the dominant plant species through selective grazing of certain species, soil compaction or altered soil permeability. Approaches to evaluating vegetation may include investigating a nearby ungrazed reference site with similar soil and hydrologic condition; removing livestock and allowing the vegetation to recover prior to evaluation; or using aerial photos or other off-site resources such as landowner interviews. If required, delineate the wetland based on indicators of hydric soil and wetland hydrology.

Managed plant communities. Sites subject to vegetation management such as tree clearing, cultivation, planting of crops, irrigation, wildfire suppression and use of herbicides may exhibit changes in the presence or abundance of certain plants. Approaches to evaluating vegetation may include investigating a nearby unmanaged reference site with similar soil and hydrologic conditions; leaving cleared or tilled areas unmanaged for at least one growing season with normal rainfall; and using off-site data sources such as aerial photography or interviews.

Aggressive invasive plants. Aggressive FACU or UPL plants may dominate wetland areas and prevent other species from establishing. Examples include blackberry (*Rubus armeniacus* and R. *lacinatiatus*), English ivy (*Hedera helix*), and pasture grasses such as sweet vernalgrass (*Anthoxanthum odoratum).* If aggressive plants are suspected, first confirm if there is evidence of the invasive nature of the species present such as literature or inclusion on a provincial or local list of invasive plants, then continue with the following: (1) examine a nearby reference site; (2) if feasible, remove the invasive species and re-evaluate the vegetation during the next growing season; (3) if 1 and 2 are not feasible, make the wetland determination based on indicators of hydric soil and wetland hydrology.

Areas affected by fire, floods and other natural disturbances. These natural disturbances can cause vegetation to be removed or become unidentifiable. Approaches to evaluating vegetation may include investigating an undisturbed reference site with similar soil and hydrologic conditions, using off-site information such as aerial photography or interviews, or delineating the wetland based on hydric soil and wetland hydrology.

Vigor and stress responses to wetland conditions. In agricultural fields, crop stress may be evident in wet locations. In frost-free areas, early-season germination of FACU and UPL species prior to wet conditions may indicate signs of stress. Decreased vigor or signs of stress such as stunting or yellowing of vegetation may appear. Approaches to evaluating vegetation may include comparing the size, vigor or stress-related characteristics of the same species within the wetland to those immediately surrounding the wetland, observing trends in plant vigor or stress that may reflect the extent of hydric soils, wetland hydrology and topography, and using these spatial patterns to delineate the wetland boundary.

Vegetated flats. In both coastal and interior areas, vegetated flats are often dominated by annual species that are categorized as OBL. Application of the procedures outlined in Section 8 Field procedures for wetland identification and delineation during the growing season will clearly result in a positive wetland determination. However, these areas will appear to be unvegetated mudflats when examined during the non-growing season, and the area would not qualify at that time as a wetland due to an apparent lack of vegetation.

General procedure

Where indicators of hydric soil and wetland hydrology are present, but no indicators of hydrophytic vegetation are observed, the following general procedure is recommended:

STEP 1. Verify that at least one indicator of hydric soil and one primary or two secondary indicators of wetland hydrology are present. If indicators of either hydric soil or wetland hydrology are absent, the area is likely non-wetland unless soil and/or hydrology are also problematic. If indicators of hydric soil and wetland hydrology are present (or absent due to other problem situations), continue to STEP 2.

STEP 2. Verify that the area is in a landscape position that is likely to collect or concentrate water. Examples include concave surface; active floodplain or low terrace; toe of a slope or convergent slopes; fringe of another wetland or water body; area with a restrictive soil layer or aquitard within 60 cm of the surface; area where groundwater discharges; or other. If the landscape setting is appropriate document findings and continue to STEP 3. If the landscape setting is not appropriate (i.e., not in a depression or unlikely where water would accumulate), then the area is likely non-wetland.

STEP 3. Use one or more of the approaches described in STEP 4 (Specific Problematic Vegetation Situations) **or STEP 5** (General Approach), below, to determine whether the vegetation is hydrophytic.

STEP 4. Determine if a Specific Problematic Vegetation Situation is present. Examples of specific problematic vegetation situations are described above in Section 9.1.1 Problematic hydrophytic vegetation. Follow the proposed approach specific to that situation.

STEP 5. If it has been determined that a Specific Problematic Vegetation Situation, as described above, is not present, apply the following to determine if problematic vegetation is present due to other circumstances. Problematic hydrophytic vegetation can occur in other circumstances such as wetlands dominated by FACU species or unlisted species that are functioning as hydrophytes. In these cases, a wetland may be delineated based on direct hydrologic observations to verify that the plant community occurs in an area subject to prolonged inundation or soil saturation during the growing season.

A recommended approach is to visit the site at two- or three-day intervals during the portion of the growing season when inundation or saturation is most likely to be present. Direct hydrologic observations include where surface water is present and/or the water table is 30 cm or less from the soil surface for at least 14 consecutive days during the growing season, when antecedent precipitation has been normal or drier than normal. If so, then a positive indicator of hydrophytic vegetation is inferred for a problematic situation.

STEP 6. Document rationale on the Wetland determination data form or delineation report to explain why it was determined that the plant community is hydrophytic even though indicators of hydrophytic vegetation described in Section 5.3 Hydrophytic vegetation indicators were not observed.

9.1.2 Problematic hydric soils

Description of the problem

Descriptions of situations with problematic hydric soils for soils with faint or no descriptors and soils with relict hydric soil indicators are provided below.

Soils with faint or no indicators

This section describes problematic hydric soils that meet the hydric soil definition without exhibiting any hydric soil indicators as presented in Section 6 Hydric soil.

Moderately to strongly alkaline soils occur in some regions and are associated with depressional wetlands at lower elevations. Redox concentrations and depletions form when iron, manganese and organic matter are present. These features do not form well in saturated soils with high pH. High pH (7.9 or higher) is typically caused by high salt content. Soils with high pH are also referred to as Moderately Alkaline or Strongly Alkaline (Expert Committee on Soil Survey 1982). The soil may be hydric if hydric soil indicators are absent when the pH is high, indicators of hydrophytic vegetation and wetland hydrology are present, and the landscape position is consistent with wetlands in the area. Document soil conditions and include pH and all rationale for identifying the soil as hydric.

Vegetated sand and gravel bars within floodplains include coarse-textured soils that may lack hydric soil indicators because of deposition of new soil during flood events, low iron or manganese content, and low organic matter content. Redox concentrations may be found on coarse fragments with close examination, but they may not be identifiable.

Dark parent materials may not have readily observed redoximorphic features. These soils are formed from parent materials such as dark shales and phyllites and are not dark due to high organic matter content. Rationale can be provided by documenting soil and landscape conditions of the wetland and surrounding non-wetland areas and other supporting evidence including landscape position, vegetation, and evidence of wetland hydrology.

Newly created wetlands include anthropogenic (created or constructed) wetlands, beaver-created wetlands and other natural wetlands. Such wetlands may be purposely or accidentally created by human activities (e.g., road impoundments, undersized culverts, irrigation and seepage from earth-dammed impoundments). Many of these will have indicators of wetland hydrology and hydrophytic vegetation, but the area may lack typical soil profile characteristics frequently associated with other hydric soils since the soils have only recently been exposed to inundation and/or saturation. Since all these types of wetlands are newly established, field indicators of one or more of the wetland identification criteria may not be present.

Seasonally ponded soils may exist in depressional wetlands that are ponded above a restrictive soil layer near the surface, which may lack hydric soil indicators due to limited saturation depth, high salinity or other factors. If these situations occur, hydric soil would be documented as problematic and explained on the Wetland determination data form (Appendix B).

Soils with relict hydric soil indicators

Soils may exhibit redoximorphic features that formed under historic conditions that do not reflect current hydrology. Relict features may exist on sites that no longer have wetland hydrology such as drained wetlands, wetlands near abandoned river channels or deeply incised stream channels. In addition, wetlands that have been drained for agricultural purposes may contain persistent hydric soil indicators. Relict redox concentrations are hard to identify but typically have abrupt boundaries. If indicators of hydrophytic vegetation and wetland hydrology are present, the hydric soil indicators should be assumed to be contemporary.

Procedure

Soils that are believed to meet the definition of a hydric soil but lack indicators described in Section 6 Hydric soil can be identified by following the procedure below. This procedure should be used only where indicators of hydrophytic vegetation and wetland hydrology are present, unless they are absent due to disturbance or other problem situations.

STEP 1. Verify that at least one indicator of hydrophytic vegetation and one primary or two secondary indicators of wetland hydrology are present. If indicators of either hydrophytic vegetation or wetland hydrology are absent, the area is likely non-wetland unless vegetation and/or hydrology are also disturbed or problematic. If indicators of hydrophytic vegetation and wetland hydrology are present (or absent due to disturbance or other problem situations), continue to STEP 2.

STEP 2. Document the soil profile and verify the area is in a landscape position that is likely to collect or concentrate water. Landscape positions which are likely to collect or concentrate water include: concave surfaces (e.g., depression or swale); active floodplain or low terrace; level or nearly level areas (0-3 precent slope); toe slopes or area of convergent slopes; fringe of another wetland or water body; area with restrictive soil layer or aquitard within 60 cm of the surface; area where groundwater discharges (seep); other (explain in field notes).

STEP 3. Determine if one of the problematic soil situations described in this section is present and consider the soil to be hydric if present.

Two other options exist for documenting hydric soil by documenting the presence of reduced iron as described below.

OPTION 1: Soils that have been saturated for extended periods and contain sufficient iron may change colour when exposed to air with rapid oxidation of ferrous iron (Fe^{2+} to Fe3+), also known as a reduced matrix. The soil is hydric if a mineral layer at least 10 cm thick starting within 30 cm of the soil surface that has a matrix value of 3 or more, and chroma of 2 or less and becomes redder in hue by one or more pages of the Munsell Soil Color Book (X-Rite 2009) and/or increases by one or more chroma value(s) when exposed to air within 30 minutes (Vepraskas 1992). This is also described in Section 7.3.3 Group C: Evidence of soil saturation.

OPTION 2: If the soil is saturated at the time of sampling, use alpha, alpha-dipyridyl reagent to determine if ferrous iron is present. This reagent reacts with reduced iron and can provide evidence that a soil is hydric if it lacks other hydric soil indicators. During the growing season, applying the alpha, alpha-dipyridyl reagent to mineral soil, covering at least 60% of a layer that is at least 1 cm thick and located within 30 cm of the soil surface, should produce a positive reaction within 30 seconds, indicated by a pink or red coloration.

Use a dropper to apply a small amount of reagent to a freshly broken ped face. Comparing this to a non-wetland soil will help to confirm observations. A positive reaction may not occur in soils with low iron or high pH. The lack of a positive reaction does not mean the soil is non-hydric.

9.1.3 Wetlands periodically lacking wetland hydrology

Description of the problem

During the dry season, some wetlands may dry out and, in some cases, multi-year droughts may occur causing wetlands not to become inundated or saturated for several consecutive years. Some wetlands may lack hydrology indicators during the dry season or in a dry year. The procedure below may be used to determine wetland hydrology is present if indicators of hydrophytic vegetation and hydric soils are present and the hydrology indicators are lacking due to normal variations in rainfall or runoff or human activities that destroyed wetland hydrology indicators.

Specific situations that periodically lack wetland hydrology include the following:

Site visits during the dry season. Determine if the site visit occurred during the dry season. The dry season is the period when soil moisture is normally depleted, and groundwater levels are falling to low levels because of decreased precipitation and/or increased evapotranspiration. If the site visit occurred during the dry season, hydric soils and hydrophytic vegetation are present and there is no significant hydrologic alteration (dams, levees, water diversions, drainage ditches or subsurface drains), then consider the site a wetland. If these factors are unclear, revisit the site during the normal wet season to confirm that hydrology indicators are present prior to making a wetland determination.

Periods with below-normal rainfall. Determine if the amount of rainfall in the preceding two to three months was normal, above normal or below normal. This may be calculated from long-term (30-year) weather records. Procedures that may be used were created by USDA-NRCS, including the 30-day Rolling Total Method and Combined Method for evaluating antecedent precipitation (Sprecher and Warne 2000).

Drought years. Determine if the area was subject to short- or long-term drought lasting a minimum of two consecutive years by comparing annual rainfall totals within the normal range of annual rainfall. This may be done by consulting resources such as the B.C. Drought Information Portal [21] which includes information on current and historical drought conditions across the province. The site may be identified as wetland if hydrology indicators appear to be absent on a site with hydrophytic vegetation and hydric soils, there is no significant hydrologic alteration (dams, levees, water diversions, drainage ditches or subsurface drains), and the region has been affected by drought.

Years with unusually low winter snowpack. Wetlands that depend on snow melt as an important source of hydrology may not exhibit wetland hydrology indicators if the site visit occurred following a winter with unusually low snowpack. Information relating to snow conditions in B.C. can be found through the River Forecast Centre[22] under Snow Conditions and Water Supply Bulletin[23]. If these conditions exist, hydrophytic vegetation indicators and hydric soil indicators are present and the site has no significant hydrologic alteration (dams, levees, water diversions, drainage ditches or subsurface drains), then the site should be considered wetland.

Wetlands on glacial till. Sloping wetlands can occur in glaciated areas where thin soils cover relatively impermeable glacial till or where layers of glacial till have different hydraulic conditions that permit groundwater seepage. Such areas are seldom if ever flooded, but downslope groundwater movement keeps the soil saturated for a sufficient portion of the growing season to produce anaerobic and reducing conditions in the soil. This promotes the development of hydric soils and hydrophytic vegetation. Since these are groundwater-dominated systems, indicators of wetland hydrology may be lacking during the drier

[21] https://droughtportal.gov.bc.ca/

[22] https://www2.gov.bc.ca/gov/content?id=0ED72C0820814B96B4B346374D05056C

[23] https://www2.gov.bc.ca/gov/content?id=75257196157C4376A2029FE5F933E315

portion of the growing season (e.g., summer or early fall in B.C.). Likewise, soil profiles may be difficult to examine in particularly stony tills.

Hydrology tools

Hydrology Tools for Wetland Identification and Analysis (USDA-NRCS 2021) is a collection of methods that can be used to evaluate the presence of wetland hydrology. This approach is only recommended if the indicator-based approach is not possible or would yield misleading results. A hydrologist may be required to select and carry out the analysis.

- **Evaluate multiple years of aerial photography**. In agricultural lands where human activities altered other wetland indicators or in sites lacking a dense tree canopy, hydrology may be visible on aerial photography. The methods are detailed within the Hydrology Tools for Wetland Identification and Analysis (USDA-NRCS 2021), which describes three key messages: (a) multiple imagery sources from many years should be assessed with at least five years used for the determination; (b) imagery should be evaluated for antecedent moisture conditions; and (c) a procedure for field verification should be incorporated.
- **Long-term hydrologic monitoring.** Where hydrology has been altered by human activity or natural events modified a site to the extent that hydrology indicators may be missing, then direct monitoring of surface and groundwater can verify the presence or absence of wetland hydrology. The USACE (2025) created a technical standard to design, build and install shallow groundwater monitoring wells to determine wetland presence on highly disturbed sites. The technical standard requires at least 14 consecutive days of inundation or water table within 30 cm of the soil surface during the growing season most years (i.e., a minimum of 50% probability or at least five out of 10 years). Guidance on the installation of monitoring wells for purposes of wetland delineation is provided through various documents produced by the USACE (2000, 2005) and Sprecher 2008.

Note: The wetland hydrology technical standard is intended only for use in problematic sites and is not meant to overrule an indicator-based wetland determination. If hydrophytic vegetation and/or hydric soil criteria have not been met, this standard would not apply, and the area would be considered a non-wetland.

Procedure

STEP 1. **Verify that indicators of hydrophytic vegetation and hydric soil are present** (or absent due to problem or atypical situations). If so, continue to STEP 2; if not, record on the datasheet that wetland hydrology is absent.

STEP 2. **Verify that the area is in a landscape position that is likely to collect or concentrate water.** If the landscape setting is appropriate, continue to STEP 3. If the landscape position is not appropriate, then the area is likely a non-wetland.

STEP 3. **Use one or more of the following approaches outlined in this section to document whether wetland hydrology** is present and provide rationale on the Wetland determination data form (Appendix B) or wetland delineation report.

9.2 Atypical situations

Atypical situations occur when temporary or unusual conditions may affect wetland indicators, or when wetland indicators—vegetation, soil or hydrology—are missing due to recent human disturbance or natural events. Examples of these situations include drought years, recent flood, recent fire, areas managed for agricultural activities or areas disturbed by draining, filling and clearing. In these cases, standard methods may not apply. This section provides alternative procedures for identifying and delineating wetlands when it is determined that indicators are absent specifically because of such disturbances. If sufficient rationale exists, these methods should be used rather than concluding that the area is non-wetland.

Some cases require evaluating whether normal circumstances exist.

Normal circumstances can be described as:

- The long-term or stable condition of a site including any authorized or other legal alterations such as highways, dams, weirs and other relatively permanent infrastructure and development;
- The conditions indicated by the soils and hydrology normally present on a site in cases where the vegetation has been altered or removed; and
- The conditions that would exist on a site in the absence of any hydrologic manipulation.

Normal circumstances are present on sites that are undisturbed, including those with naturally problematic wetlands (i.e., one or more wetland indicators are missing due to environmental conditions or natural variability). It is necessary to evaluate normal circumstances when conditions have been physically altered (i.e., atypical situation: hydrophytic vegetation, hydric soil or wetland hydrology were removed or obscured due to human activity or a natural event). Wetland delineations on sites that represent normal circumstances are based on current conditions. Appendix E provides a key to help determine normal circumstances.

Examples of atypical situations include the following:

Unauthorized activities such as alteration or removal of vegetation; dredging; placement of fill material over hydric soils; and hydrological alteration such as construction of drainage systems, berms, levees, pipes or dams. This section is not for use if alterations were authorized or exempted under the regulation.

> Document and report any suspected unauthorized wetland alterations to the Natural Resource Violation Reporting System[k] or by calling 1-877-952-7277, Option 2.
>
> A useful resource for signs of altered wetlands includes the Signs of Drained Wetlands[l] info sheet by Thomas Biebighauser (2023).
>
> [k] https://forms.gov.bc.ca/industry/report-a-natural-resource-violation/
>
> [l] https://wetlandrestorationandtraining.com/wp-content/uploads/Signs-of-Drained-Wetlands-Tom-Biebighauser.pdf

Natural events that may create or alter existing wetlands. A natural event would include recent beaver dams that impounded water, establishing wetland hydrology and hydrophytic vegetation, but where hydric soils indicators have not had sufficient time to develop. Fires, avalanches, volcanic activity and changing river courses are other examples. Relative permanence of the changes is necessary. If the site is expected to persist as a functioning wetland, then they are considered normal circumstances, and the area is considered wetland.

Anthropogenic wetlands (previously described in Section 1.4 Wetland types and distribution) that have been purposefully or unintentionally created are also considered under atypical situations as they may be missing indicators of one or more indicators. Examples include impoundments, irrigation projects and stream channel realignments (Tiner 2017).

For example, if road construction resulted in an impoundment of water creating wetland hydrology and hydrophytic vegetation, but hydric soil indicators are lacking, this is an atypical situation. A wetland determination can be made if the new condition represents normal circumstances. Normal conditions require that the condition is expected to persist.

When an atypical situation is present, application of the general methods requiring positive indicators of hydrophytic vegetation, hydric soils, and wetland hydrology will lead to the determination that the area is not a wetland because one of the three indicators will be missing.

When atypical situations are present, follow the steps outlined below based on the appropriate descriptor of what indicator may be lacking [vegetation (Section 9.2.1), soils (Section 9.2.2) or hydrology (Section 9.2.3)] or anthropogenic wetlands (Section 9.2.4).

9.2.1 Lack of vegetation indicators

Determine whether hydrophytic vegetation previously occurred by employing the following steps:

STEP 1: **Describe the type of alteration** (e.g., has all or part of the wetland been altered/ disturbed and how?) Look for evidence of tree removal, agricultural activities (land conversion, ditching, etc.), land clearing or other activities (e.g., burning, presence roads, buildings, dams, levees, parking lots, etc.). Preliminary data review (Section 2) will support this assessment. Estimate and document the time since disturbance or when the disturbance occurred[24].

STEP 2: **Document the effects of the alteration on the vegetation.** Consider the following: (a) Has all or a portion of the area been cleared of vegetation? (b) Has only one stratum been removed (e.g., trees)? (c) Has the vegetation been covered by fill, dredged material or structures? (d) Have increased water levels resulted in the death of some individuals?

STEP 3: **Characterize the previous vegetation.** Obtain all necessary supporting evidence of the type of plant communities that occurred in the area prior to alteration. Some potential sources include: aerial photography; on-site evaluation of remaining vegetation; previous site surveys or available inventories; vegetation in adjacent areas (or comparable reference area); existing records or reports; landowner observations; and information from the public or local knowledge.

[24] Time of alteration is important for the consideration of application for regulatory purposes.

STEP 4: Determine whether the previous plant community types constitute hydrophytic vegetation and record the results. Develop a list of species, based on information collected in preliminary data review and site observations, which provide evidence of vegetation that previously occurred occurred on-site. Then record and rank according to indicator status on the Wetland determination data form (Appendix B).

- If more than 50% of the dominant plant species were FAC, FACW and/or OBL, the previous vegetation was hydrophytic.
- If the condition above is not satisfied, the location is non-wetland.
- If the previous vegetation could not be characterized, base the decision on soil and hydrology (Sections 9.2.2 and 9.2.3, below).

STEP 5: Determine whether the soils or hydrology of the site have been altered.

- If soils and hydrology have not been altered, use the methods in Section 9.1 Problem situations, noting the vegetation determination from STEP 4.
- If either soils or hydrology have also been altered, continue to the steps outlined in Section 9.2.2 Lack of soils indicators, below.

9.2.2 Lack of soil indicators

Determine whether hydric soil previously occurred by following the steps below:

STEP 1: Describe the type of alteration. Look for evidence of deposition of dredged or fill materials such as the presence of non-woody debris at the surface (rocks, bricks, concrete), agricultural activities (plowing, land conversion, ditching, etc.), land clearing, removal of surface layers or presence of human-made structures. Estimate and document the time since disturbance or when the disturbance occurred[25]. Continue to STEP 2.

STEP 2: Document the effects of the alteration on the soil. Consider the following: (a) has the soil been buried? If so, record the depth of fill and determine whether original soil is intact; (b) has the soil been mixed at a depth below the A-horizon or within 30 cm? If so, examine the soil at a depth below the disturbance; (c) has the soil been sufficiently altered to change the soil phase? Document findings and continue to STEP 3.

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[25] Time of alteration is important for the consideration of application for regulatory purposes.

STEP 3: Characterize the soils that previously occurred. Obtain all necessary supporting evidence. Some potential sources include: soil surveys; characterization of buried profiles; examination of adjacent unaltered soil (or reference a site that must be of the same topographic position and nearby); and remnant profile where the soils have been removed. Document findings and continue to STEP 4.

STEP 4: Determine whether the previous soil was hydric by applying the indicators as described in Section 6.5 Hydric soil indicators and record result:

- If a positive indicator is found, hydric soil was formerly present.
- If no positive indicator is found, the location is non-wetland.
- If previous soils could not be characterized, base decision on vegetation and hydrology.

STEP 5: Determine whether the hydrology of the site has been altered.

- If hydrology has not been altered, then continue to the methods described in Section 9 Difficult wetland situations, noting the soils determination from STEP 4.
- If hydrology has been altered, continue to the steps outlined in Section 9.2.3 Lack of hydrological indicators, below.

9.2.3 Lack of hydrology indicators

Determine whether wetland hydrology previously occurred by following the steps below:

STEP 1: Describe the type of alteration. Look for evidence of deposition of dams, levees, dikes and similar structures; ditching; filling of channels and depressions (land-leveling); diversion of water; ground-water extraction and channelization. Estimate and document the time since disturbance or when the disturbance occurred[26]. Continue to STEP 2.

STEP 2: Document the effects of the alteration on hydrology. Consider the following: (a) Is the area more or less frequently inundated than prior to alteration? To what degree and why?; (b) Is the duration of inundation and soil saturation different than prior to alteration? How much and why? Continue to STEP 3.

STEP 3: Characterize the previous hydrology that existed in the area. Obtain all necessary supporting evidence. Some potential sources include: stream, lake or

[26] Time of alteration is important for the consideration of application for regulatory purposes.

tidal gage data; remaining field indicators; aerial photography; historical records; floodplain management maps; and knowledge from public officials or local observers. Continue to STEP 4.

STEP 4: Determine whether wetland hydrology previously occurred by applying the wetland hydrology indicators in Section 7.3 and record the results.

- If a positive indicator is found, wetland hydrology formerly was present. Continue to STEP 5.
- If no indicator is found, the location is non-wetland.
- If previous hydrology could not be characterized, base decision on vegetation and soil and continue to STEP 5.

STEP 5: Go to the methods in Section 9 Difficult wetland situations and continue the procedure from that point, inserting the conclusion regarding hydrology made in STEP 5.

9.2.4 Anthropogenic wetlands

In virtually all cases, anthropogenic wetlands involve a significant change to the hydrologic regime, which may either increase or decrease the wetness of the area. Positive indicators of hydrophytic vegetation, hydric soils and wetland hydrology are often found in human-induced wetlands, but hydric soils may be absent if there has not been sufficient time for hydric soil characteristics to develop [some take a few years (mottles), while others may take several decades or hundreds of years]. Wetland determinations in anthropogenic wetlands must be based on the presence of hydrophytic vegetation and wetland hydrology, along with documented evidence that the wetland resulted from human activities. The following steps outline the approach for anthropogenic wetlands.

STEP 1: Consider if the area has been influenced by anthropogenic activities such as:

- Has a recent human-caused activity resulted in changes in hydrology such as making the site wetter to drier?
- Has human-induced stream channel realignment significantly altered the areas of hydrology?
- Has the area been subject to long-term irrigation practices?

If the answer is yes to any of these questions, document the approximate time the change in hydrology occurred and continue to STEP 2.

STEP 2: Determine whether a permit will be needed if the area is determined to be a wetland. If no, document findings, and no further action is needed. If yes, continue to STEP 3.

STEP 3: Characterize the vegetation, soils and hydrology of the area and continue to STEP 4.

STEP 4: Wetland determination. Based on the information from STEP 3, determine whether the area is a wetland. When wetland indicators of all three indicators are found, the area is a wetland. When indicators of hydrophytic vegetation and wetland hydrology are found and there is documented evidence that the change in hydrology occurred so recently that soils could not have developed hydric characteristics, hydric soils are documented as problematic on the datasheet along with comments as to what circumstance makes the soils problematic, and the area is determined to be a wetland. If evidence of hydric soil indicators is lacking and indicators of hydrophytic vegetation and/or wetland hydrology are also absent, the area is not a wetland.

Caution! If hydrophytic vegetation is being maintained only because of anthropogenic wetland hydrology that would no longer exist if the activity (e.g., irrigation) were to be terminated, the area should not be considered a wetland.

The exception to this is where wetland hydrology is being maintained by anthropogenic activities (e.g., weirs, ditch blocks) that are licensed, relatively permanent, or for the purposes of a wetland compensation project. These cases are expected to persist and are considered normal circumstances.

9.3 Wetland /non-wetland mosaics

9.3.1 Description of the problem

In this manual, a wetland mosaic refers to a landscape where wetland and non-wetland areas are closely associated to be easily delineated or mapped separately, such as in coastal swamps in B.C. These sites have topographic high and low areas that change over short distances, with high areas lacking indicators and low areas that contain hydrophytic vegetation, hydric soils, and wetland hydrology. The distance between the trough (depression) and the ridge (or top of hummock) may be as little as 30 cm or less and up to 3 m or more in broadly hummocky areas.

Care must be taken to differentiate wetland/non-wetland mosaics from natural wetland types that at first may appear to be a mosaic. For example, coastal Sitka spruce wetlands often support a significant component of non-hydrophytic vegetation that is rooted on top of large tree roots or downed logs rather than in the soil substrate. Plants not rooted in the soil should not be considered in hydrophytic vegetation decisions. Also, anthropogenic factors such as grazing may create small ridges that support non-hydrophytic vegetation.

Wetland components of a mosaic are often not difficult to identify. The problem for the wetland delineator is that microtopographic features are too small and intermingled, and there are too many such features per hectare, to delineate and map them accurately. Instead, the following sampling approach is designed to estimate the percentage of wetland in the mosaic. From this, the number of hectares of wetland on the site can be calculated if needed.

9.3.2 Procedure

This section identifies two recommended procedures. Other appropriate sampling methods may also be used. Make sure to document the method and the rationale for selecting it in the delineation report.

After areas of wetland that are large enough to be delineated and mapped separately have been completed, the remaining area may be delineated as a wetland/non-wetland mosaic and denoted on associated maps. The approximate percentage of wetland within that area may be documented using one of the two procedures below:

Option 1: Establish transects across the mosaic area.

- Measure the length of each transect by stretching a tape measure across the site and leave it in place during sampling.
- Use separate data forms for the swales or troughs and for the ridges or hummocks.
- Sampling of vegetation, soil and hydrology will follow the procedures described in this manual.
- Plot sizes and shapes for vegetation must be adjusted to represent the microtopographic feature being sampled to avoid overlapping adjacent low or high spots. Use only one or two data forms for each microtopographic feature, and do not repeat for similar features with the same plant community if it was represented by one or more data plots.
- Identify every wetland boundary in every trough or swale encountered on each transect by recording the distance along the stretched measuring tape.

- Determine the total distance along each transect occupied by wetland and non-wetland.
- Sum the distances across transects and calculate the percentage of wetland using:

$$\text{Wetland \%} = \frac{\text{Total Wetland Distance}}{\text{Total Transect Distance}} \text{x}100$$

Option 2: Alternatively, use the point-intercept sampling method at fixed intervals along transects across the mosaic. This eliminates the need to identify wetland boundaries at the edge of each hummock or swale and can be completed by pacing instead of stretching a measuring tape across the site.

- Use a compass, GPS, or other method to transverse a straight line.
- At a fixed distance (e.g., every 5 m), observe for indicators of hydrophytic vegetation, hydric soil and wetland hydrology and make a determination if the location is wetland or non-wetland. Data forms are not required for every point but at least one representative swale and hummock should be documented.
- After all the transects have been sampled, the percent of wetland can be calculated based on the number of wetland and non-wetland determination plots.

$$\text{Wetland \%} = \frac{\text{Number of Wetland Points}}{\text{Total Points Sampled}} \text{ x } 100$$

Part V: Documentation

10 Wetland delineation report and submission

A summary report detailing the methodology (including rationale for method selection and associated level of effort) for data collection, analysis and the uncertainties associated with the conclusion must be completed by a QP with experience and expertise in wetland identification and delineation. A checklist is provided in Appendix C to help applicants and reviewers of delineation reports on the expected elements of a wetland delineation report. Appendix D provides guidance on data submission standards.

Completed wetland delineations and associated spatial data should be submitted as per the applicable regulatory requirements. All other delineations and data can be submitted to wetlands@gov.bc.ca.

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Appendix A: Glossary

This glossary is a supplement to other available sources. See the following publications for additional terms that are not provided here:

- USACE Wetland Delineation Manual[27] (USACE 1987) and WMVC Regional Supplement[28] (USACE 2010a)
- Field Indicators of Hydric Soils of the United States[29] (USDA-NRCS 2024).
- The Canada Soil Information System (CanSIS) Manual for describing soils in the field[30] (Expert Committee on Soil Survey 1982).
- The Canadian System of Soil Classification (CSSC)[31] (Soil Classification Working Group 1998)

Absolute cover. In vegetation sampling, the percentage of the ground surface that is covered by the aerial portions (leaves and stems) of a plant species when viewed from above. Due to overlapping plant canopies, the sum of absolute cover values for all species in a community or stratum may exceed 100%. In contrast, relative cover is the absolute cover of a species divided by the total coverage of all species in that stratum, expressed as a percent. Relative cover cannot be used to calculate the prevalence index. (USACE 2010a).

Antecedent precipitation. In the context of wetland delineation, refers to the amount of rainfall that has occurred in the area prior to a specific observation date or field visit. It is a crucial factor in determining if a site is considered a wetland, as it helps assess whether the soil is saturated or inundated for long enough to support wetland vegetation.

Anthropogenic wetland. An area that developed wetland characteristics through being created or modified by human activity rather than forming through entirely natural processes. These wetlands can form intentionally (e.g., created for compensation) or unintentionally (e.g., road impoundment, irrigation).

Aquic conditions. Refers to a soil moisture regime characterized by saturation and resulting in anaerobic (oxygen-depleted) environments that support the reduction of iron, manganese and other elements. These conditions typically lead to the development of redoximorphic features such as gleying and mottling. Aquic conditions are indicative of

[27] https://usace.contentdm.oclc.org/digital/collection/p266001coll1/id/4530

[28] https://usace.contentdm.oclc.org/utils/getfile/collection/p266001coll1/id/7646

[29] https://www.nrcs.usda.gov/resources/guides-and-instructions/field-indicators-of-hydric-soils

[30] https://sis.agr.gc.ca/cansis/publications/manuals/1982-forms/index.html

[31] https://sis.agr.gc.ca/cansis/publications/manuals/1998-cssc-ed3/index.html

prolonged or periodic saturation and are a key diagnostic criterion in identifying hydric soils, which are essential in wetland delineation and classification.

Aquitard. A layer of soil or rock that restricts downward flow of water and may perch water above it (U.S. Army Corps of Engineers. 2010).

Areal cover. A measure of dominance that defines the degree to which above-ground portions of plants cover the ground surface.

Atypical. Refers situations to areas in which one or more indicators have been sufficiently altered by recent human activities or natural events to preclude the presence of wetland indicators of the factor.

Biogeoclimatic Ecosystem Classification (BEC) system delineates ecological zones (biogeoclimatic units) by vegetation, soils, and climate. It is more commonly used in forestry and conservation. It also classifies ecosystems within the ecological zones based on the potential of the site at climax or mature successional stages (B.C. Ministry of Forests, Research Branch).

Contemporary features. Soil morphological features which reflect current hydric soil condition and include signs of prolonged saturation, such as gleying and redox concentrations with diffuse boundaries and are associated with ped faces or root channels.

Contrast. The colour difference between a redox concentration and dominant matrix colour. Differences are classified as faint, distinct or prominent. Different tabular systems have been developed to assess mottle contrast. Table A 1 below is adapted from USACE 2010a.

Table A-1 Tabular key for contrast determinations using Munsell notation

Hues are the same (Δ h=0)			Hues differ by 2 pages (Δ h=2)		
Δ Value	Δ Chroma	Contrast	Δ Value	Δ Chroma	Contrast
0	≤1	Faint	0	0	Faint
0	2	Distinct	0	1	District
0	3	Distinct	0	>2	Prominent
0	≥4	Prominent	1	<1	Distinct
1	≤1	Faint	1	>2	Prominent
1	2	Distinct	>2	-	Prominent
1	3	Distinct			
1	≥4	Prominent			
≤2	≤1	Faint			
≤2	2	Distinct			
≤2	3	Distinct			
≤2	≥4	Prominent			
3	≤1	Distinct			
3	2	Distinct			
3	3	Distinct			
3	≥4	Prominent			
≥4	-	Prominent			
Hues differ by 1 page (Δ h=1)			**Hues differ by 3 or more pages (Δ h≥3)**		
Δ Value	Δ Chroma	Contrast	Δ Value	Δ Chroma	Contrast
0	<1	Faint	Colour contrast is prominent, except for chroma and value		Prominent
0	2	Distinct			
0	>3	Prominent			
1	≤1	Faint			
1	2	Distinct			
1	≥3	Prominent			
2	≤1	Distinct			
2	2	Distinct			
2	≥3	Prominent			
≥3	-	Prominent			

Note: if both colours have values of ≤3 and chromas of ≤2, the colour contrast is faint (regardless of the difference in hue).
Δ = change in; h = hue
Adapted from USDA Natural Resources Conservation Service (2002)

Control wetland. A single, representative wetland of a certain class/type within a study area that has been delineated using the paired plot method and the three wetland indicators of hydrophytic vegetation, hydric soils and wetland hydrology have been thoroughly documented. Other wetlands of the same type/class can be delineated based on the control wetland using two of the three indicators.

Delineate. The process of carrying out on-site field evaluations to determine the precise boundaries of a wetland.

Delineation. See Delineate.

Depleted matrix. The volume of a soil horizon or sub-horizon from which iron has been removed or transformed by processes of reduction and translocation to create colours of low chroma and high value. A, Ae and calcic horizons may have low chromas and high values and may, therefore, be mistaken for a depleted matrix. However, they are excluded from the concept of depleted matrix unless common or many, distinct or prominent redox concentrations as soft masses or pore linings are present. In some places the depleted matrix may change colour upon exposure to air (reduced matrix); this phenomenon is included in the concept of depleted matrix. The following combinations of value and chroma identify a depleted matrix:

- Matrix value of 5 or more and chroma of 1, with or without redox concentrations occurring as soft masses and/or pore linings, or
- Matrix value of 6 or more and chroma of 2 or 1, with or without redox concentrations occurring as soft masses and/or pore linings, or
- Matrix value of 4 or 5 and chroma of 2, with 2% or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings, or
- Matrix value of 4 and chroma of 1, with 2% or more distinct or prominent redox concentrations occurring as soft masses and/or pore linings (USDA-NRCS 2024).

The description above outlines that common (2 to less than 20%) to many (20% or more) redox concentrations (USDA-NRCS 2024) are required in soils with matrix colours of 4/1, 4/2, and 5/2. Redox concentrations include iron and manganese masses and pore linings (Vepraskas 1992). See contrast in this glossary for the definitions of distinct and prominent. (USACE 2008).

Distinct. In relation to redox concentrations, see Contrast.

Dominant species. Dominant species are the most abundant plant species that individually or together account for more than 50% of the total coverage of vegetation in the stratum, plus any additional species that, by itself, comprises at least 20% of the total determined by the 50/20 rule.

Ecoprovince. An area with consistent climatic processes, oceanography, relief and regional landforms. There are one oceanic, three marine/ terrestrial and seven terrestrial ecoprovinces occurring within British Columbia. Ecoprovinces are meant to be mapped at a general scale of 1:2,000,000 for use in provincial state-of-the-environment reporting (Demarchi 2011).

Ecosection. Areas with minor physiographic and macroclimatic or oceanographic variations. There are 139 ecosections in British Columbia, varying from pure marine units to pure terrestrial units. Ecosections are meant to be mapped at small scales (1:250,000) for resource emphasis and area planning, but the boundaries have been drawn at a large scale 1:20,000.

Factor. see wetland factor.

Fibric. Organic materials that are readily identifiable as to botanical origin. A fibric horizon has 40% or more of rubbed fibre by volume. Fibric material usually is classified on the von Post scale of decomposition as class 1 to class 4. This term is used in both the US and Canadian Soil Classification systems.

Fine. Used to describe all soil textures that are not sandy, including silt, loamy and clayey textures as defined in Figure 6. This definition is specific to the context of soil texture for hydric soil indicators.

Gley. A soil condition resulting from prolonged soil saturation, which is manifested by the presence of bluish or greenish colours throughout the soil mass or in mottles (usually orange spots or streaks).

Gleyed matrix. A gleyed matrix has one of the following combinations of hue, value and chroma and the soil is not glauconitic (Figure A 1):

- 10Y, 5GY, 10GY, 10G, 5BG, 10BG, 5B, 10B, or 5PB with value of 4 or more and chroma of 1; or
- 5G with value of 4 or more and chroma of 1 or 2; or
- N with value of 4.

Figure A-1 For hydric determinations, a gleyed matrix has the hues and chromas in this illustration with a value of 4 or more.

Due to inaccurate colour representation.DO NOT use this page to determine soil colours in the field. Background image from the Munsell Soil Color Charts (X-Rite 2009)

Growing Season. Growing season dates are determined through on-site observations of the following indicators of biological activity in a given year: (1) above-ground growth and development of vascular plants, and/or (2) soil temperature (see Section 7.2 for details).

Hemic. One of three US classes of organic soil material (others being fibric and sapric). Hemic soil material is intermediate in its degree of decomposition. It is used as a diagnostic characteristic in organic soils. For soil classification purposes, hemic soil material generally has between one-sixth and three-fourths fibres remaining after rubbing. Hemic soil materials commonly have intermediate bulk density and water content on a dry-weight basis compared to other kinds of organic soil materials. It is most closely related to Mesic soils in the Canadian System of Soil Classification.

High pH. pH of 7.9 or higher. Includes Moderately Alkaline, Strongly Alkaline, and Very Strongly Alkaline (USDA-NRCS 2024).

Humic. Canadian soil term for highly decomposed organic material. Small amounts of fibre are present that can be identified as to their botanical origin. Fibres can be easily destroyed by rubbing (<10% remaining). Humic material is usually classified on the von Post scale of decomposition as class 7 or higher and rarely as class 6. Roughly equivalent to sapric in the US soil classification system.

Human-created wetland. A wetland that is purposefully constructed in an area without prior wetland conditions.

Human-modified wetland. Natural wetlands that have been altered or impacted by human activities, which may affect the vegetation, soils and/or hydrology of a wetland. Examples include those that have been partially drained for agriculture or vegetation removal. Human-constructed wetland.

Hydrologic regime. Refers to the pattern of water presence, movement, and fluctuation within a wetland over time, including the timing, frequency, duration, and depth of inundation or soil saturation. This regime governs the anaerobic conditions necessary for wetland soil processes. It influences the composition of hydrophytic vegetation and the delivery of ecosystem services.

Hydric soil. A soil that is saturated, flooded or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation (Soil Conservation Service 1985). Hydric soils that occur in areas having positive indicators of hydrophytic vegetation and wetland hydrology are wetland soils (USACE 1997).

Hydrophytic vegetation. Plant life that is adapted to growing in low-oxygen (anaerobic) conditions associated with prolonged saturation or flooding.

Identification. See wetland identification.

Indicator. Specific tests and criteria that support a positive finding that a **wetland factor** is present. Examples: F3 is a soil indicator that hydric soil is present, and a positive finding in the 50:20 test is an indicator that hydric vegetation is present.

Iron monosulfide. Dark-gray or black precipitates with matrix of 4 or less and chroma of 2 or less occurring in the soil as stains, coatings, soft masses, or pore linings (Duball *et al.* 2020). These compounds rapidly oxidize when exposed to the atmosphere, resulting in a one or more unit increase in Munsell value. Proper identification of FeS is critical to differentiate it from other dark soil materials such as organic matter and manganese oxides.

The flowchart below and the Iron monosulfide definition were included in the latest revision of Hydric Soil Indicators (USDA-NRCS 2024) and should be employed to identify FeS features (Figure A2).

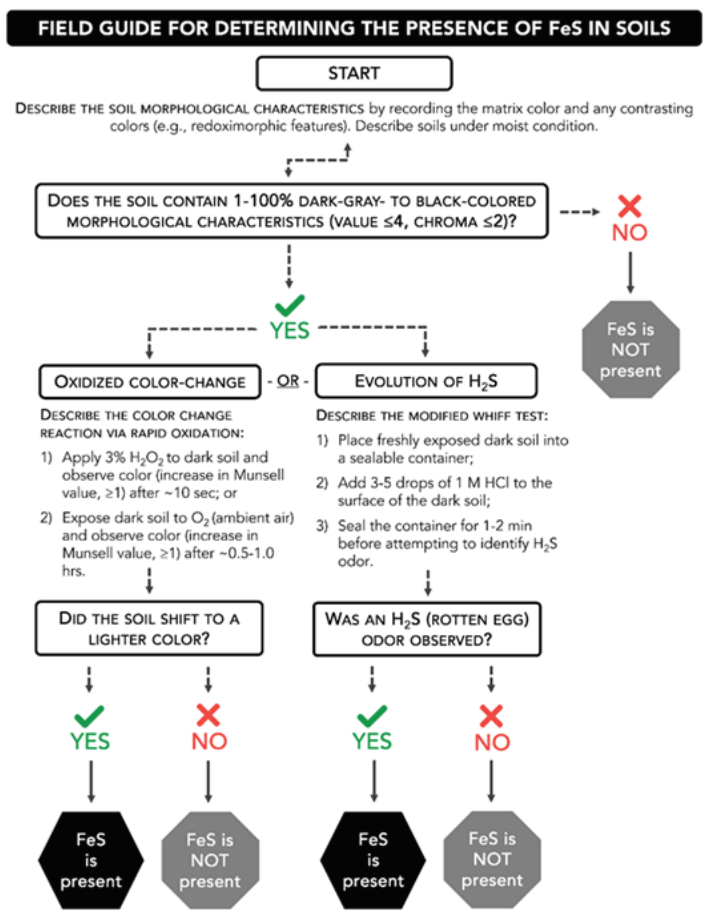

Figure A-2 Field Guide for determining the presence of Iron Monosulfide (FeS) in soils. Duball et al. 2020.

Mesic. Canadian soil term for organic material in an intermediate stage of decomposition. Intermediate amounts of fibre are present that can be identified as to their botanical origin.

Mesic material has >10% and <40% rubbed fibres and is usually classified in the von Post scale of decomposition as class 5 or 6. Roughly equivalent to Hemic in the US soil classification system.

Mineral soil. Mineral horizons contain 17% or less organic carbon (about 30% organic matter) by weight (Soil Classification Working Group. 1998).

Mottles. Spots or blotches of color that are interspersed with the dominant soil color (the matrix). They are used as a diagnostic property to identify poorly drained or gleyed soil conditions. Mottles are characterized by their abundance, size, and contrast with the matrix color, and their presence indicates fluctuating water tables or periods of soil saturation

Muck. Humic (sapric) organic soil material in which virtually all the organic material is so decomposed that identification of plant forms is not possible. Use only with organic horizons (of any thickness) of mineral and organic soils that are saturated for 30 or more cumulative days in normal years or are artificially drained (USDA-NRCS 2024). These correspond to Oh horizons in the CSSC.

Mucky mineral. A USDA soil texture modifier (e.g. mucky sand). Mucky modified material has between 5 and 12% organic carbon. Where the organic component is fibric (peat) material or mesic (mucky peat) material, mucky mineral soil material does not occur (USDA-NRCS 2024). These are humic organic matter rich mineral horizons in the CSSC.

Mucky peat. Mesic (hemic) organic material, which is characterized by decomposition that is intermediate between that of fibric (peat) material and that of humic (muck). Use only with organic horizons (of any thickness) of mineral and organic soils that are saturated for 30 or more cumulative days in normal years or are artificially drained (USDA-NRCS, 2024). These correspond to Om horizons in the CSSC.

Naturally occurring wetland are areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Naturally occurring wetlands differ from anthropogenic wetlands because their presence is independent of human activities.

Nodules and concretions. Irregularly shaped, firm to extremely firm accumulations of iron and manganese oxides. When broken open, nodules have uniform internal structure whereas concretions have concentric layers (Vepraskas 1992).

Normal circumstances. The soil and hydrologic conditions that are normally present, without regard to whether the vegetation has been removed.

Organic soil. Organic soils contain more than 17% organic carbon (30% or more organic matter) by weight; organic materials are commonly saturated with water and consist mainly of mosses, sedges or other hydrophytic vegetation (Soil Classification Working Group 1998).

Oxidized rhizosphere. A type of redoximorphic features (e.g., iron concentrations) occurring as pore linings. They are the result of oxygen leakage from living roots into the surrounding anoxic soil, causing oxidation of ferrous iron present in the soil solution. They provide evidence of saturated and reduced soil conditions during the plant's lifetime.

Paired plot. Refers to a set of two sampling points which are uniquely identified and georeferenced and used to compare and contrast wetland and adjacent non-wetland conditions. This method is essential for accurately identifying the boundary between wetland and non-wetland areas.

Peat. For purposes of wetland delineation and reference to terms used in this manual, peat refers to the U.S soil term for fibric organic soil material. The plant forms can be identified in virtually all the organic material. Use only with organic horizons (of any thickness) of mineral and organic soils that are saturated for 30 or more cumulative days in normal years or are artificially drained. Peat has three-fourths or more fibres after rubbing. This corresponds to Of horizons in the CSSC.

Plow pan. A compacted layer of soil that develops below the topsoil due to repeated plowing or other tillage operations.

Perched water table. Refers to a localized zone of saturation above the regional water table, often created by an impermeable layer like dense silts, clay, or rock that prevents water from draining down.

Problem situations. Where wetlands lack indicators due to seasonal or annual variability, or permanently due to the nature of the soils or plant species on the site.

Project footprint. The physical or environmental area impacted by a project's activities or the scope of the work involved in completing a project. It can refer to the ground area occupied by a building, the area disturbed by construction, or the total resources and waste associated with a project's lifecycle, often used in contexts like environmental impact assessments or project management to define boundaries and track impacts.

Prominent. In relation to redox concentrations, see contrast.

Qualified Professional. An individual with the requisite training and expertise to identify and delineate wetlands or to assume professional responsibility for a wetland delineation conducted by a team of qualified practitioners.

Redox concentration. Bodies of apparent accumulation of Fe-Mn oxides. Redox concentrations include soft masses, pore linings, nodules and concretions. For the purposes of the indicators, nodules and concretions are excluded from the concept of redox concentrations unless otherwise specified by specific indicators. See Vepraskas (1992) for a complete discussion (USDA-NRCS 2024).

Redox depletion. Bodies of low chroma (2 or less) having value 4 or more where Fe-Mn oxides have been stripped or where both Fe-Mn oxides and clay have been stripped. See Vepraskas (1992) for a complete discussion (USDA-NRCS 2024).

Reduced matrix. Soil matrix that has a low chroma in situ due to presence of reduced iron but whose colour changes in hue or chroma when exposed to air as Fe2+ is oxidized to Fe3+ (Vepraskas 1992).

Relict features. Soil morphological features that reflect past hydrologic conditions of saturation and low-oxygen (anaerobic). See Vepraskas (1992) for a complete discussion.

Sandy. Used to describe coarse soil textures including loamy sand and sand, as defined in Figure 5. This definition is specific to the context of soil texture for hydric soil indicators.

Sapric. Term used in the US System of soil classification for the most decomposed of three classes of organic soil material (others being fibric and hemic); used as a diagnostic characteristic in organic soils. For soil classification purposes, sapric soil material generally has one-sixth or less fibres remaining after rubbing. Due to their advanced decomposition, these materials are fairly resistant to further decomposition compared to other organic soil materials. Referred to as humic in the CSSC.

Saturation. For wetland delineation purposes, a soil layer is saturated if almost all pores between soil particles are filled with water (National Research Council 1995; Vepraskas and Sprecher 1997). This definition includes part of the capillary fringe above the water table (i.e., the tension saturated zone) in which soil water content is approximately equal to that below the water table (Freeze and Cherry 1979).

Throughflow. Lateral movement of groundwater in saturated substrates, such as on sloping terrain.

Typically adapted. Refers to a species being normally or commonly suited to a given set of environmental conditions, due to some morphological, physiological or reproductive adaptation.

Vernal pool. Vernal pools are seasonal wetlands that form in depressions over impermeable layers like hardpan, claypan or bedrock. In British Columbia, they are mainly found in southeastern Vancouver Island, the adjacent Gulf Islands, and the dry southern interior. These pools are unique because they are temporary, filling with rainwater in the fall and winter and drying out by summer. Their wet phase supports different species than the surrounding uplands, while their dry phase prevents the establishment of species typical of permanent wetlands. Vernal pools on Vancouver Island go through four phases: 1) Wetting phase: Soils become saturated; 2) Aquatic phase: Pools contain water or alternate between being inundated and saturated; 3) Water-logged drying phase: Pools lose water through evaporation and absorption, but soil moisture remains high. 4) Dry phase: Pools and soils are completely dry. (Holland and Jain 1977, Keeley and Zedler 1998; Zedler 1987). Most pools fill directly from rain, though some receive additional water from small watersheds.

Wetland. Land that is saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation and various kinds of biological activity which are adapted to a wet environment.

Wetland soils. See hydric soils.

Wetland assessment. The evaluation of functions and values for a specific wetland or group of wetlands.

Wetland classification. The process of defining wetlands into groups based on characteristics, including vegetation, soil and hydrology.

Wetland delineation. See delineate.

Wetland determination. Refers to a technical decision about whether a specific area qualifies as a wetland based on the presence of hydrophytic vegetation, hydric soils, and wetland hydrology.

Wetland factor. Refers to the three-factors which define a wetland and inlcude the causal relationship between water, substrate and biota. Each of the three factors need to be examined in terms of indicators that can be documented in the field. The three main indicators for positive identification and delineation of wetlands include hydrophytic vegetation, hydric soils and wetland hydrology.

Wetland function assessment. The evaluation of the ecological roles that wetlands play within a landscape.

Wetland hydrology. Refers to the presence of water within 30 centimetres of the soil surface for at least 14 consecutive days during the growing season in most years to develop soil characteristics and plant associations that are indicative of wetlands (i.e., the site also has positive indicators of vegetation and soil except in atypical wetlands or atypical conditions).

Wetland identification. The process of determining the presence of a wetland within a specific area.

Wetland indicator. See Indicator.

Wetland impact assessment. A formal evaluation used to determine how a proposed project or activity may affect wetlands.

Appendix B: Wetland determination data form

WETLAND DETERMINATION DATA FORM – British Columbia

Project/Site: ____________ City/District: ____________ Date YYMMDD: ____________

Applicant/Owner: ____________ Province ________ Plot Number: ________

Delineator(s): ____________ Parcel Identifier (PID): ____________

Mesoslope Position* ____________ Surface Shape* (CC, CV, ST): ____________ Slope (%): ______

Ecoprovince: ____________ Lat: ____________ Long: ____________ Datum: ________

*denotes fields consistent with LMH25 (more info Pg. 3)

CWCS/HGM[#] Class: ____________

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ______ No______ (If no, explain in Remarks.)

Are Vegetation ______, Soil ______, or Hydrology ______ significantly disturbed? Are "Normal Circumstances" present? Yes No

Are Vegetation ______, Soil ______, or Hydrology ______ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present?	Yes ______ No	**Is the Sampled Area within a Wetland?** **Yes ______ No ______**
Hydric Soil Present?	Yes ______ No	
Wetland Hydrology Present?	Yes ______ No	
Remarks:		

VEGETATION – Use scientific names of plants.

[#]CWCS = Canadian Wetland Classification System/ HGM = Hydrogeomorphic System

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: ________)			
1.			
2.			
3.			
4.			
	______ = Total Cover		
Sapling/Shrub Stratum (Plot size: ________)			
1.			
2.			
3.			
4.			
5.			
	______ = Total Cover		
Herb Stratum (Plot size: ________)			
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
	______ = Total Cover		
Woody Vine Stratum (Plot size: ________)			
1.			
2.			
	______ = Total Cover		
% Bare Ground in Herb Stratum ________			

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC: ________ (A)

Total Number of Dominant Species Across All Strata: ________ (B)

Percent of Dominant Species That are OBL, FACW, or FAC: ________ (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:
OBL species	________	x 1 = ________
FACW species	________	x 2 = ________
FAC species	________	x 3 = ________
FACU species	________	x 4 = ________
UPL species	________	x 5 = ________
Column Totals:	________ (A)	________ (B)

Prevalence Index = B/A = ________

Hydrophytic Vegetation Indicators:

___ 1 - Rapid Test for Hydrophytic Vegetation
___ 2 - Dominance Test is >50%
___ 3 - Prevalence Index is ≤3.0[a]
___ 4 - Morphological Adaptations[a] (provide supporting data in Remarks or on a separate sheet)
___ Problematic Hydrophytic Vegetation[a] (Explain)

[a] Indicators of hydric soil and wetland hydrology must be present, unless problematic or disturbed.

Hydrophytic Vegetation Present? **Yes ______ No ______**

Remarks:

SOIL

Plot Number: ___________

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (cm)	Matrix Color (moist)	Matrix %	Redox Features Color (moist)	Redox Features %	Type[a]	Loc[b]	Texture	Remarks

[a]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [b]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators:

- ___ Organic Soil (A1)
- ___ Organic Surface (A2)
- ___ Black Organic (A3)
- ___ Hydrogen Sulfide (A4)
- ___ Depleted Below Dark Surface (A11)
- ___ Thick Dark Surface (A12)
- ___ Alaska Gleyed (A13)[d]
- ___ Alaska Redox (A14)[d]
- ___ Alaska Gleyed Pores (A15)[d]
- ___ Iron Monosulfides (A18)
- ___ Sandy Mucky Mineral (S1)
- ___ Sandy Gleyed Matrix (S4)
- ___ Sandy Redox (S5)
- ___ Stripped Matrix (S6)
- ___ Loamy Mucky Mineral (F1)
- ___ Loamy Gleyed Matrix (F2)
- ___ Depleted Matrix (F3)
- ___ Redox Dark Surface (F6)
- ___ Depleted Dark Surface (F7)
- ___ Redox Depressions (F8)

For Problematic Hydric Soils[c]

- ___ 2 cm Muck (A10)
- ___ Reduced Vertic (F18)
- ___ Red Parent Material (F21)
- ___ Very Shallow Dark Surface (F22)
- ___ Other (Explain in Remarks)

[c] Indicators of hydophytic vegetation and wetland hydrology must be present, unless problematic or disturbed.

[d] Indicators are only applicable for use in northwest British Columbia

Restrictive Layer (if present):

Type: ______________________________

Depth (cm): ______________________________

Hydric Soil Present? Yes ______ No ______

Remarks:

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

- ___ Surface Water (A1)
- ___ High Water Table (A2)
- ___ Saturation (A3)
- ___ Water Marks (B1)
- ___ Sediment Deposits (B2)
- ___ Drift Deposits (B3)
- ___ Algal Mat or Crust (B4)
- ___ Iron Deposits (B5)
- ___ Surface Soil Cracks (B6)
- ___ Inundation Visible on Aerial Imagery (B7)
- ___ Sparsely Vegetated Concave Surface (B8)
- ___ Salt Crust (B11)
- ___ Aquatic Invertebrates (B13)
- ___ Hydrogen Sulfide Odor (C1)
- ___ Oxidized Rhizospheres along Living Roots (C3)
- ___ Presence of Reduced Iron (C4)
- ___ Recent Iron Reduction in Tilled Soils (C6)
- ___ Other (Explain in Remarks)

Secondary Indicators (2 or more required)

- ___ Water-Stained Leaves (B9)
- ___ Drainage Patterns (B10)
- ___ Dry-Season Water Table (C2)
- ___ Saturation Visible on Aerial Imagery (C9)
- ___ Stunted or Stressed Plants (D1)
- ___ Geomorphic Position (D2)
- ___ Shallow Aquitard (D3)
- ___ FAC-Neutral Test (D5)
- ___ Raised Ant Mounds (D6)
- ___ Frost Heave Hummocks (D7)

Field Observations:

Surface Water Present? Yes ______ No ______ Depth (cm):

Water Table Present? Yes ______ No ______ Depth (cm):

Saturation Present? (includes capillary fringe) Yes ______ No ______ Depth (cm):

Wetland Hydrology Present? Yes ______ No ______

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Remarks:

VEGETATION Continued – Use scientific names of plants.

Plot Number: ________

Tree Stratum	Absolute % Cover	Dominant Species?	Indicator Status
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
	=Total Cover		

Sapling/Shrub Stratum	Absolute % Cover	Dominant Species?	Indicator Status
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
	=Total Cover		

Herb Stratum	Absolute % Cover	Dominant Species?	Indicator Status
12.			
13.			
14.			
15.			
16.			
17.			
18.			
19.			
20.			
21.			
22.			
23.			
	=Total Cover		

Woody Vine Stratum	Absolute % Cover	Dominant Species?	Indicator Status
3.			
4.			
5.			
6.			
7.			
	=Total Cover		

***Fields consistent with LMH25:**

Latitude/Longitude: degrees, minutes, decimal seconds (Section 10).

Mesoslope Position. Indicate the position of the plot relative to the localized catchment area. CR (crest); UP (upper Slope), MD (Middle slope), LW (Lower slope), TO (Toe), DP (Depression), LV (Level), GU (Gully) (Section 31).

Surface Shape. Notes the general surface shape as CC (Concave), CV (Convex) or ST (Straight) (Section 32) modifiers can be applied as appropriate according (Section 33).

Definitions of Vegetation Strata:

Tree – Woody plants 8 cm or more in diameter at breast height (DBH), regardless of height.

Sapling/Shrub – Woody plants less than 8 cm or more in DBH, regardless of height.

Herb – All herbaceous (non-woody) plants, including herbaceous vines, regardless of size.

Woody Vine – All woody vines, regardless of height.

Recommended Plot Size (Record on Page 1)

Tree – 10 m radius

Sapling/Shrub – 5 m radius

Herb – 1 m x 1 m quadrat

Woody Vine – 5 m radius

Remarks:

Appendix C: Wetland delineation report checklist

This document is intended to provide a checklist of basic components that should be considered when reviewing wetland delineations, and to serve as a useful guide for those conducting delineations and preparing reports. This checklist is for most routine wetland delineations in B.C. Other report components and review considerations may be applicable depending on the characteristics of the site being evaluated.

A completed wetland delineation report should include the following:

General

- ☐ **Site Identification:** A description of the site, including physical address, geographic position (e.g., latitude and longitude, and Parcel Identifier number (PID).
- ☐ **Ownership:** description of property ownership
- ☐ **Qualified Professional (QP):** name and description of the QP who conducted the delineation along with a brief statement of relevant training and experience in wetland identification and delineation (can be included in an appendix).
- ☐ **Site Context**: Description of current and historical land use; applicable watershed(s); other aquatic features such as streams, ditches, lakes, etc. with relevant flow direction, description of wetland features in the study area including wetland size, plant communities, and landscape position in the context of adjacent non-wetland areas.
- ☐ **Purpose of Delineation:** Explanation of the reason for delineation and for whom the delineation is being conducted.
- ☐ **Regulatory Context:** Explanation of regulatory context and what permits may be required to undertake the proposed work.
- ☐ **Field Visit Details:** Dates of site visits, activities conducted, and weather conditions during delineation.

Mapping and Spatial Documentation

- ☐ **Site Location Map**: includes watershed context, relevant aquatic features, property boundary with identifying labels (e.g., street labels, PID, etc.)
- ☐ **Supporting Maps:** Map(s) showing representative information including watershed, soil surveys, inventory information, location of species and ecosystems at-risk, etc.
- ☐ **Wetland Boundary Map:** includes study area, clearly delineated wetland boundaries, data collection points consistent with associated datasheets and labels used in the wetland delineation report overlain on an aerial image.
- ☐ **Cartographic Standards:** All maps follow cartographic best practices and include a title, legend, scale, and North arrow. Labels must be legible and not obscure map content.

Methodology and Data

- ☐ **Approach:** An explanation of the methodology used (routine or comprehensive), including use of Difficult Wetland Situations procedures and rationale if used. Include rational for any deviations from the methodology.
- ☐ **Site Photos:** Georeferenced full resolution, representative photos with captions showing site conditions and wetland features.
- ☐ **Preliminary Data Review:** summary of the available information used in making the wetland determination as described in Section 2 Preliminary data review. Information sources consulted should be listed in a References Cited section of the report and appendices should include historical aerial images or LiDAR derivatives (i.e., themed contours, hillshade) with overlain wetland boundary delineations.
- ☐ **Wetland Features:** detailed description of each wetland feature including a summary of vegetation, soils, hydrology. The following summary table may be used:

Wetland Feature	**Description**
Identifier	Same as on associated map, spatial data, and in report and datasheets; Example: Wetland 1
Location	Lat/long
Landform	Hillslope, terrace, etc.
Local Relief	concave, convex, none
Wetland Classification	
CWCS Class	bog, fen, swamp. marsh, shallow-open water
BEC Site Association	Example: Wf01]
Hydrogeomorphic Class	Estuarine, Fluvial, Lacustrine, Palustrine
Summary of Findings	
Conditions typical for time of year?	Yes / No (explain)
Are normal circumstances present?	Yes / No (explain)
Are any of the three indicators significantly disturbed?	Yes (explain) / No
Are any of the indicators natural problematic?	Yes (explain) / No
Hydrophytic Vegetation Present?	describe indicator(s) met and summarize dominant species)
Hydric Soil Present?	describe indicator(s) met and summarize soil profile including depths, colours and textures
Wetland Hydrology Present?	describe indicator(s) met, and field observations of the presence and associated depths of surface water, water table and saturation.
Total area of wetland feature	Squared metres or hectares

- ☐ **Scientific nomenclature:** Use of scientific plant names throughout the report and data forms.

- ☐ **Wetland Determination Data Forms:** The most recent wetland determination data forms corresponding to indicated sampling point locations denoted on figures within the report and included in an appendix.
- ☐ **Digital Deliverables:** List of all submitted digital files included in an appendix (e.g., geodatabase, photos) (Table C-1).

Table C-1: Example table summarizing deliverables and digital files.

Date Submitted	**File Name**	**Description**
1-JUN-2025	Report_1234.pdf	Wetland delineation report for Wetland application #1234
1-JUN-2025	Delineation_1234.gdb	Spatial data including Delineation_Boundary (1 polygon), Determination_Points (4 points), LidarHillshade (raster), data dictionary
1-JUN-2025	FieldForms.pdf	4 Scanned field forms to support delineation determination
1-JUN-2025	Photo.zip	Zip file of 25 georeferenced field photos in .tif format. Naming convention matches plot numbers.

Checklist for Reviewers on Report Contents (review report and data forms for these elements)

General Review

- ☐ Methodology for identifying potential wetland areas described (include spatial accuracy of field data collection).
- ☐ All potential wetlands from hydric soil, inventories and other mapping sources adequately investigated as appropriate and described in the report.
- ☐ Wetland-non-wetland transitions described for each wetland in terms of vegetation, soils, and hydrology (inclusion of paired-datasets in report appendix).
- ☐ Vegetation and landscape position of all adjacent non-wetland areas identified and described.
- ☐ Wetlands, wetland types and plant community types identified for each wetland.

Wetland Determination Data Form(s)

- ☐ Normal, atypical, and problematic conditions correctly identified.
- ☐ Vegetation stratified into layers (tree, shrub, herb, vine). Scientific names and indicator statuses provided. Appropriate hydrophytic vegetation indicators tests applied and where used, the 50/20 dominance test applied properly for each vegetation strata.
- ☐ Soil pits deep enough to document presence/absence of hydric soil indicators.
- ☐ Soil textures and Munsell colours described for each layer.

Field Review (conduct a field review and verify the following elements):

- ☐ Adequate number of sampling transects at major transition zones (see notes)

- ☐ Sample points are representative of the plant community and landscape position being sampled (see notes)
- ☐ Appropriate vegetation sample plot sizes used (see notes)
- ☐ Vegetation accurately identified and quantified.
- ☐ Soil layers accurately described with texture, color, and redox features.
- ☐ Hydric soil indicators correctly applied.
- ☐ Hydrology indicators documented and interpreted appropriately. (see notes)
- ☐ Delineation flag spacing appropriate to site visibility and complexity (see notes)

Notes for review

Sampling Transects – Typically, sampling transects should be located at each major wetland/non-wetland transition area on the site. This may result in several transects on a single wetland or a single transect for two similar wetlands depending on the characteristics of the site. Delineators should carefully choose transect locations that are representative of the major wetland/non-wetland transitions. More standardized approaches for establishing sampling transects are detailed in the USACE Manual (USACE 1987).

Vegetation Sample Plot Sizes – Recommended sample plot sizes for vegetation are stated in Section 5.2 . In general, sizes are as follows: for trees, 10 m radius; shrub/sapling and woody vines, 5 m radius; and herb, 1x1 m quadrant.

Soil Sample Point Locations – Soil sample points should be indicative of the landscape position of the non-wetland, wetland or transition area being sample. For example, soil sample pits located in a micro- depression or on a small hill in an otherwise uniform topographic area should not be considered representative.

Hydrology Indicators – Hydrology indicators can often be seasonal or ephemeral. For example, observation of surface water may only be present during the wet portion of the growing season in normal precipitation years for some wetlands. Once a wetland hydrology indicator is observed, it is an indicator and should be noted on the data form and in the wetland delineation report.

Delineation Flag Spacing – Where flagged boundaries are required, the spacing of flags to delineate a wetland should correspond with how easy it is to see previous and subsequent flags. The more meandering the edge of the wetland boundary or the thicker the vegetation, the greater the number of flags needed.

Appendix D: Spatial data submission standards

Submitted spatial data should include delineated wetland boundary (polygon) and associated wetland determination plots. Other supporting information should also be submitted in the recommended digital formats outlined in Table D-1 and may include: wetland transect(s), assessment area polygon(s), project footprint, georeferenced field photos, scanned field forms (if hard copy forms used) etc. The report must contain a listing of the digital files and feature classes submitted as specified in Appendix C. A data dictionary should be included with the data to describe non-standard fields and feature classes.

Templates for wetland delineation spatial data are available on the Wetlands in B.C. website. Use of the geodatabase template Wetland_Delineation.gdb ensures the correct data specifications (datum, projection, domains, mandatory fields etc.) are met. If additional fields or feature classes are added to the geodatabase, corresponding entries are to be made in the Data_Dictionary table to be included with the deliverables. If geopackage, shape, keyhole markup language (kml) or other format are used, it is the user's responsibility to ensure all the specifications are met (i.e., field names, types, domains etc.).

Map projection and datum

Spatial data submitted to the Government of B.C. must be in the BC Environment Albers projection. This projection is already assigned to the feature class templates included in the Wetland_Delineation.gdb template. In the BC Environment Albers projection, locations are specified in terms of rectangular (projection) coordinates that specify northing, easting, and elevation. Northing and easting are stored in metres. The parameters of the BC Environment Albers projection are as follows:

- **Projection:** Albers
- **Units**: Metre [stored without offsets (e.g., in direct Albers projection coordinates)]
- **Datum**: NAD83 (GRS80) - North American Datum 1983, with earth-centred ellipsoid derived from Geodetic Reference System 1980
- **Central Meridian**: 126° 00' 00" West Longitude (-126.0)
- **First Standard Parallel**: 50° 00' 00" North Latitude (50.0)
- **Second Standard Parallel**: 58° 30' 00" North Latitude (58.5)
- **Latitude of Projection Origin**: 45° 00' 00" North Latitude (45.0)
- **False northing:** 0.0m

- **False easting**: 1000000.0m

Refer to the Terrestrial Ecosystem Information Digital Data Submission Standard: Database and GIS Data Standards* (WLRS 2023) for further information.

*https://www2.gov.bc.ca/assets/gov/environment/natural-resource-stewardship/nr-laws-policy/risc/tei_digital_submission_standards_v3.pdf

Wetland ecological communities

Field detection of wetland ecological communities (EC) or any ecosystem tracked by the B.C. Conservation Data Centre[32] (BC CDC) should be submitted to the Government of B.C. to update ecological community element occurrences and inform conservation status assessments.

Information on how to submit data to the BC CDC is available on the Submit Data to the Conservation Data Centre website.[33]

[32] https://www2.gov.bc.ca/gov/content?id=018D1F92D3904A67890CDADC8E0E6019

[33] https://www2.gov.bc.ca/gov/content?id=9071F32DC29A4403A17842C158EA9910

Appendix E: Key to determination of normal circumstances

1. Soils, vegetation, and hydrology are undisturbed……………………… **normal circumstances**

1. Physical alteration(s) to soils, vegetation and/or hydrology has occurred………………………**2**

2. Physical alteration(s) to soils, vegetation and/or hydrology is minor, i.e., insufficient to remove or obscure field indicators………………………………………….**normal circumstances**

2. Physical alteration(s) to soils, vegetation and/or hydrology is more than minor (e.g., significantly disturbed is checked on the data form) ……………………………………………. **3**

3. Physical alteration(s) is/are legally established, maintained and represents the long-term conditions of the site; OR is a newly-authorized physical alteration (e.g., permitted fill, new concrete dam)………………………………………….**normal circumstances**

3. Physical alteration(s) is/are due to:

- an unauthorized or illegal activity;
- activities done with the intent of evading wetland regulations;
- total or partial clearing of vegetation, or selective removal of plant species;
- the presence of a crop, tree farm, improved pasture, other planted vegetation, or cultivars;
- destruction of hydric soil field indicators by cultivation or mixing of soil layers;
- irrigation;
- active and discretionary manipulation of water tables, such as subirrigation and other active water management for crop production (e.g., cranberry beds);
- discretionary pumping of surface or groundwater, such as pumping for agricultural purposes; and/or
- a major natural event (e.g., a river changes course, fire, beaver, avalanche)

……………**not normal circumstances**

Notes

- The full range of pristine conditions to highly disturbed conditions may constitute the normal circumstances.
- The extent, duration, and relative permanence of the physical alteration(s) to the soils, vegetation and/or hydrology are key.
- Maintenance is a factor – if a physical alteration (e.g., ditch system) is abandoned and wetlands re-establish, the normal circumstance is wetland.
- Ongoing hydrologic manipulation that is permanent and non-discretionary, such as pumping for a municipal water supply, is considered the normal circumstance.
- Ditches and subsurface tile lines that were installed legally and are maintained constitute normal circumstances.
- A planted crop is not the normal circumstance; rather, the normal circumstance is a plant community adapted to the site's normal soils and hydrology.

Adapted from: USACE 2015; Appendix C.