

Cowichan Estuary Restoration Project

Dinsdale Field Restoration Design Summary

Prepared by:

Northwest Hydraulic Consultants Ltd.
495 Dunsmuir Street, #405
Nanaimo, BC V9R 6B9
Tel: 250.754.6425
www.nhcwater.com

Prepared for:

The Nature Trust of British Columbia
2080 Labieux Road
Nanaimo, BC V9T 6J9

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Report prepared by:

Lucas Dunbar, EIT
Hydrotechnical Engineer
Hydrotechnical Design

Report reviewed by:

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA G. R. HILL # 28209

JUL 30, 2025

Graham Hill, PEng
Principal
Engineer of Record (Hydrotechnical)

PROFESSIONAL GEOSCIENTIST PROVINCE OF BRITISH COLUMBIA W. P. HILSEN # 34622

July 31, 2025

Wil Hilsen, PGeo
Principal
Senior Review (Geomorphology)

EGBC Permit to Practice Number: 1003221

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- Tom Reid West Coast Conservation Land Manager, NTBC
- Steve Henstra Restoration Biologist, NTBC

The following NHC personnel participated in the study:

- Wil Hilsen Project Manager, Geomorphology Lead
- Graham Hill Hydrotechnical Design, Engineer of Record
- Lucas Dunbar Hydrotechnical Design
- Zian Sally Hydrotechnical Design
- Vaughn Collins Tidal Marsh Specialist, Senior-level Input
- Vanessa McMaster Modelling Specialist, Senior-level Input
- Ryan Clark CAD Technologist
- Khal Hooper CAD Technologist

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1 INTRODUCTION

This report presents the detailed design for the proposed restoration features located on the Dinsdale Farm property (Block 2 [DD 4629], Plan 1725; Property Identification 002-032-783), herein referred to as Dinsdale Field (Figure 1.1). The restoration features include a network of marsh channels, raised habitat mounds, and an approximately 3.5 Ha area in the eastern extents of Dinsdale Field that is proposed to be filled in to varied elevations for habitat.

The proposed marsh restoration design is part of the Cowichan Estuary Restoration Project, a Nature Trust of British Columbia (NTBC) initiative to help restore the Cowichan-Koksilah River Estuary (Cowichan Estuary) by removing barriers to estuarine marsh development (NHC, 2022) and to support the revitalization of indigenous food systems (T. Reid, personal communication, March 27, 2025). Other project elements, which are not the subject of this report, include the decommissioning of Dinsdale Dike (Dike 49 as listed under the *Dike Maintenance Act*) to re-expose Dinsdale Field to natural estuarine processes, and construction of flood mitigation features related to the dike decommissioning (NHC, 2025a, 2025b).

Issued-for-Tender drawings are included in this report in Appendix A. The drawings depict project elements for a phased construction program beginning in summer 2025. The 2025 work includes restoration of Dinsdale Field and some mitigation elements; this report describes only the analysis and design of the restoration components. Future construction phases will be required to complete the mitigation features and decommission Dike 49.

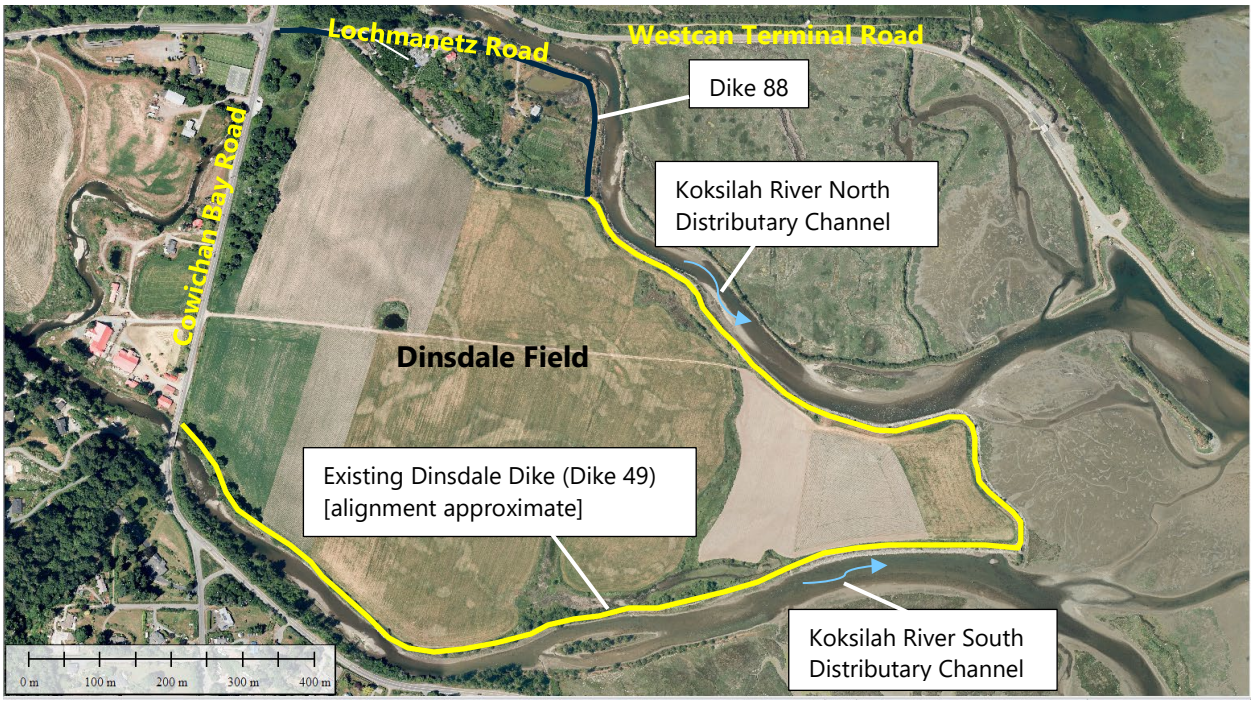


Figure 1.1 Cowichan Estuary Restoration Project site

1.1 Design Approach

The marsh and channel design process incorporates analytics, interpretive geomorphology, and numerical modelling (Figure 1.2). This design development approach acknowledges and mitigates the inherent limitations in any one approach to analyse the complex and dynamic physical processes in the estuary.

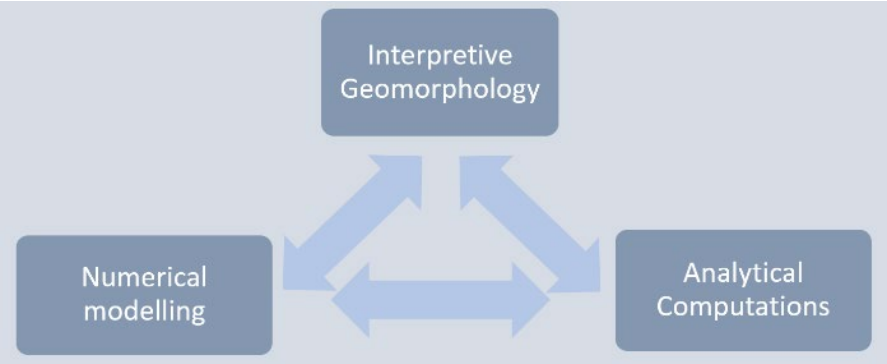


Figure 1.2 Three-pronged approach.

An iterative approach has been used to design the restoration features, incorporating the three prongs at each iteration. NHC engaged with the NTBC project biologist to receive feedback and input at each stage in the process.

Initially, NHC referenced the analogue marsh analysis undertaken in Phase 1 (NHC, 2022), then applied allometric relationships developed for the project site (discussed in Section 4), and incorporated design elements from a similar project in Washington State that NTBC identified as a restoration concept that they want to emulate (Steve Henstra, personal communication, May 9, 2024; referred to as the Zis-A-Ba Phase II Estuary Restoration Project).

NHC then undertook repeated hydraulic model simulations of the proposed restoration features, each time incorporating channel geometry and planform adjustments to iteratively assess the performance of the system and inform a series of design decisions, to optimize the hydraulic geometry of the proposed marsh channels and characteristics of the proposed raised habitat mounds and eastern infill area.

1.2 Background

The hydraulic model that was used in the flood risk analysis and mitigation feature design has been adapted for the restoration design presented herein. Details of the model development and adaption of the model to inform an assessment of flood risk transfer have been documented in previous NHC reports and only those modifications undertaken for the restoration analysis and design are discussed in Section 5 of this report.

1.3 Design References and Guidelines

The following sources have been referenced as part of the analysis and design process of the restoration features described in this report:

- Allometric predictions spreadsheet, based on South Fork reference marsh islands, provided by Greg Hood to NTBC via February 21, 2024 email, for the benefit of the Cowichan Estuary Restoration design.
- Journal articles: (W. Gregory Hood, 2007, 2020)
- Zis-A-Ba Phase II Estuary Restoration Project (Environmental Science Associates, 2024)
- Design Guidelines for Tidal Channels in Coastal Wetlands (Coats et al., 1995)
- Puget Sound Nearshore Ecosystem Restoration Project: Strategic Restoration Conceptual Engineering – Design Report Appendix C: Applied Geomorphology Guidelines and Hierarchy of Openings (Environmental Science Associates, 2011)

2 EXISTING CONDITIONS

This section summarizes aspects of the site's existing conditions that were assessed to support the restoration design; including geomorphic setting, coastal water levels, and river discharges.

A portion of Dinsdale Field is presently being used for an indigenous food systems nursery. The proposed restoration described in this report encompasses approximately 47 hectares of land on the project site.

From a geologic timescale, the Cowichan Estuary is classified as a *fluvial dominated* delta. Coastal water levels and waves are relatively more dominant in the southern portion of the estuary, south of the WestCan Terminal Causeway, which creates a barrier between the Cowichan River and Koksilah River mouths and Dinsdale Field.

Due to the relatively limited and intermittent discharge through the two Koksilah River distributary channels that drain into the southern part of the estuary, there is not expected to be large volumes of sediment inputs, unless a large event occurs farther upstream that alters discharge patterns. Under existing conditions sediment supply in the southern portion of the estuary is generally limited to scour and erosion events in the estuary that are capable of mobilizing, entraining, and redistributing sediment to other locations in the estuary.

After the dike is decommissioned Dinsdale Field will be exposed to waves and coastal water levels and altered discharge patterns within the estuary, which will alter sediment erosion and deposition patterns relative to the condition it has been in since Dinsdale Dike and WestCan Terminal were constructed.

3 GOALS AND OBJECTIVES

The intent of the Cowichan Estuary Restoration Project is to remove barriers to natural estuarine processes, promote marsh development within the project site, and to support the revitalization of indigenous food systems (T. Reid, personal communication, March 27, 2025). To support the project intent, the following goals and objectives have been identified for the design of the restoration features presented in this report:

- Reasonably mimic natural estuarine marsh channel planforms and channel geometries in comparable tidal marsh systems.
- Leverage and enhance historical channel locations and existing drainage patterns to kickstart tidal marsh development with an understanding and expectation that the site will change and adapt following exposure to ocean and riverine processes.
- Increase habitat complexity and functionality within the project site for plant life, and terrestrial and aquatic wildlife.
- Include habitat transition zones for sea level rise.
- Reuse material on site (i.e., balance project cut and fill) so that both material export and import is minimized.

4 ALLOMETRIC ANALYSIS

W. Gregory Hood (2020) describes marsh landscape allometry as "the proportional relative rates of change in a system between two entities of particular interest". Specifically for marsh restoration, it is the relationship between the area of marsh to be restored and a range of tidal-channel parameters (W. Gregory Hood, 2020). NHC has applied these marsh landscape allometry relationships in the proposed Cowichan Estuary restoration design.

The Zis-A-Ba Phase II Estuary Restoration Project is a recent project example that applies predictive allometric relationships developed by W. Gregory Hood. These predictions were developed based on the South Fork Skagit Delta marsh and the Stillaguamish Delta marsh. Similarly, Hood provided NTBC an allometric prediction spreadsheet based on the South Fork reference marsh for the benefit of the Cowichan Estuary Restoration Project. The sites both share a mixed, semi-diurnal tide. The tidal range between the higher high water mean tide and lower low water mean tide at Cowichan Bay is 2.4 m, which only differs from the South Fork marsh by approximately 6%. This provides a reasonable basis for developing an initial channel network for further refinement through iterative modelling and other analysis.

These predictive marsh allometry relationships developed by Hood have been utilized by NHC in the design process. Specifically, the initial channel layout for the site incorporated predictions for the following marsh attributes:

- Cumulative channel length, which is the sum of the lengths of all individual channels in the marsh system.
- Maximum channel length, which is the length along the longest channel in the marsh system.
- Number of marsh openings, which is the number of marsh channel entry/exit points to the marsh system
- Number of trunk branches, which is the number of tributaries draining to the mainstem of the largest channel.
- Total number of smallest order channels.

The Hood predictions and design values are presented in Section 6 along with the designed values for Dinsdale Field.

The initial planform developed using allometric relationships developed by Hood was subsequently optimized based on the iterative hydraulic modelling analysis (described in Section 5), input from the design team, and feedback from NTBC. The final proposed planform reasonably accommodates the predictions made for the site.

5 HYDRAULIC MODELLING

Hydraulic modelling has been completed using HEC-RAS software[1] version 6.6 to support the design of the Dinsdale Field restoration features. Localized terrain (i.e., the digital elevation model) and computational mesh updates have been undertaken to simulate the proposed marsh channels and habitat mounds. New upstream and downstream boundary conditions have been simulated as described in Section 5.2.

The hydraulic modelling undertaken to support this phase of the design process focusses on the hydraulic performance of the proposed restoration features. Model simulations to assess hydraulics during flood conditions and to assess for flood risk transfer have been undertaken previously, and are described in the *Dinsdale Field Mitigation Features Design Summary* (NHC, 2025a), and *Lot 2 Mitigation and Drainage Features Design Summary* (NHC, 2025b).

The following subsections discuss the terrain and computation mesh updates and model boundary conditions.

[1] HEC-RAS refers to the US Army Corps of Engineers Hydraulic Engineering Center River Analysis System

5.1 Terrain and Geometry Updates

The model terrain has been modified to incorporate the marsh channel and habitat mound features. It includes the proposed flood mitigation features (Figure 5.1) described in NHC, 2025a and 2025b. The iterative design process required the channel planform and model terrain to be updated to optimize the hydraulic performance of the marsh channels. NHC adapted the model's computational mesh with the model terrain using breaklines and computational cell edits to reasonably represent the channels.



Figure 5.1 HEC-RAS model terrain representing both proposed restoration and mitigation features.

5.2 Boundary Conditions

The marsh channel network allows inundation and drainage of the field surface during river flow and fluctuating coastal water conditions. For restoration simulations, the upstream boundary conditions applied a steady state mean annual discharge. This upstream boundary condition provides a relatively low water level, like a typical springtime discharge, such that the downstream boundary condition has a greater influence on the hydraulic conditions over the site. The downstream boundary condition driving coastal water levels were December 2023

astronomic tides[2] for Cowichan Bay. The tides were inputted on a 15-minute interval and design simulations ranged from a week of tidal cycles (14 cycles) to a month (62 cycles). The selected tides provide a downstream influence for coastal water levels in the model that are expected to typically occur during any given year.

To assess the performance of the marsh channels under river inflow condition that are expected occur periodically, model simulations were undertaken using the estimated 2-year instantaneous discharge (steady state) as the upstream boundary condition with the downstream boundary condition unchanged.

5.2.1 Tide Levels

Tides vary along the shoreline of the Strait of Georgia. The tide is caused by a long wave generated in the Pacific Ocean which propagates into the Strait of Georgia from Discovery Passage (in the North) and the Juan de Fuca Strait (in the south). As the wave travels into and out of the Strait of Georgia, factors such as geography and friction alter the wave parameters (height, wavelength, period) (Thomson, 1981). Therefore, there are differences in tide statistics along the coast.

The 2025 tide heights published by Canadian Hydrographic Services (CHS) for Cowichan Bay are provided in Table 5.1. The Higher High Water Large (HHWLT) Tide is the average of the higher high waters from each year over a rolling period of approximately 19 years. The HHWLT has been simulated using the hydraulic model to iteratively assess the performance of the marsh channel performance across an annually occurring large tidal range.

Table 5.1 Cowichan Bay Tide Heights (CHS, 2025).

Tide heights	Cowichan Bay	Cowichan Bay (MSL conversion)
	m, Chart Datum	**m, CGVD2013**
Higher High Water Large Tide (HHWTL)	3.83	1.62
Higher High Water Mean Tide (HHWMT)	3.38	1.17
Mean Water Level (MWL)	2.37	0.16
Lower Low Water Mean Tide (LLWMT)	0.98	-1.23
Lower Low Water Large Tide (LLWLT)	0.09	-2.12

[2] Astronomic tides refer to tides predicted by CHS, primarily influenced by gravitational forces. It does not include meteorological effects and other external forces.

Since CHS computes tidal statistics yearly based on a rolling past 19 years of data, small shifts may result to tidal parameters over time. Centimeter-level differences in tide heights between the 2022 NHC report and the present report can be attributed to this rolling calculation of tide heights. Currently, water levels at Cowichan Bay are converted to metres, relative to CGVD2013 and assuming MWL is equal to 0 m CGVD28. The 2025 tide heights have been applied to the analyses described in this report.

5.2.2 River Discharges

The project site is bounded on the north and south by distributary channels of the Koksilah River. Two steady-state river discharges have been considered for the restoration design: a mean annual discharge, and a 2-year peak instantaneous discharge. The Koksilah River main channel discharges are presented in Table 5.1, based on Water Survey of Canada records from 1991 to 2023.

Table 5.2 Koksilah River main channel discharges.

Return Period	Koksilah River main channel discharge
	m^3/s
Mean annual discharge	9.7
2-year instantaneous discharge	220

5.3 Iterative Approach

The preliminary layout of the proposed restoration features developed using analogue marsh analyses and applied allometry was simulated using HEC-RAS. The model outputs informed a series of iterative-design decisions to optimize the hydraulic geometry of the design. The following design decisions were made through the iterative process, based on model results:

- Assessed site drainage to ensure effective tidal flushing.
  - Channel locations were adjusted, or channels were added to drain closed depressions.
  - Additional marsh openings were added to improve system connectivity and provide opportunities for future marsh channel development.
- Used tidal-prism model-output data to validate channel cross-sectional geometry.
  - Tidal prism is the volume of water exchanged over a tidal cycle in a given area. Tidal prism was extracted using profile lines from locations within the marsh system, including at the downstream end of given channel orders and at marsh openings.
  - The tidal prism model outputs were plotted against tidal prism-channel geometry relationships (Coats et al., 1995) to validate design decisions against tidal channel design literature.

- Adjusted channel planform.
  - The channel planform is comprised of four channel orders, each with a typical cross-sectional geometry. The cross-sectional geometry of the channel orders was adjusted based on simulated velocities in combination with the tidal prism results.
- Evaluated shear stress to assess for potential of erosional or deposition within the network of marsh channels, or in adjacent channels (i.e., Koksilah River distributary channel).
- The simulations with the 2-year river discharge were used to assess hydraulic gradients across the marsh openings to help locate and size the channels.

5.4 Model Results

Figure 5.2 depicts simulated depths for a 1.6 m coastal water level (near-HHWLT) and river mean annual discharges. The figure demonstrates the hydraulic connectivity with the proposed restoration design. The figure also depicts post-project inundation extents on a near-HHWLT.

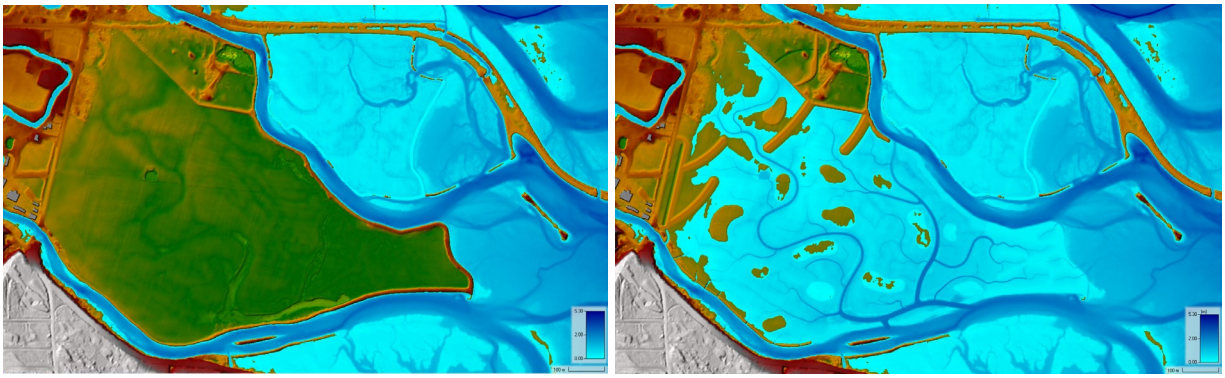


Figure 5.2 Model depths simulated for a near-higher high water large tide and mean annual discharge river flows for existing conditions (left) and with-project conditions (right).

6 DESIGN

This section presents the proposed Dinsdale Field restoration design. The design includes marsh channels (primary, secondary, tertiary, quaternary), habitat mounds, and an infilled eastern marsh area. The general layout is presented in Figure 6.1 and a description of the design features is presented below.

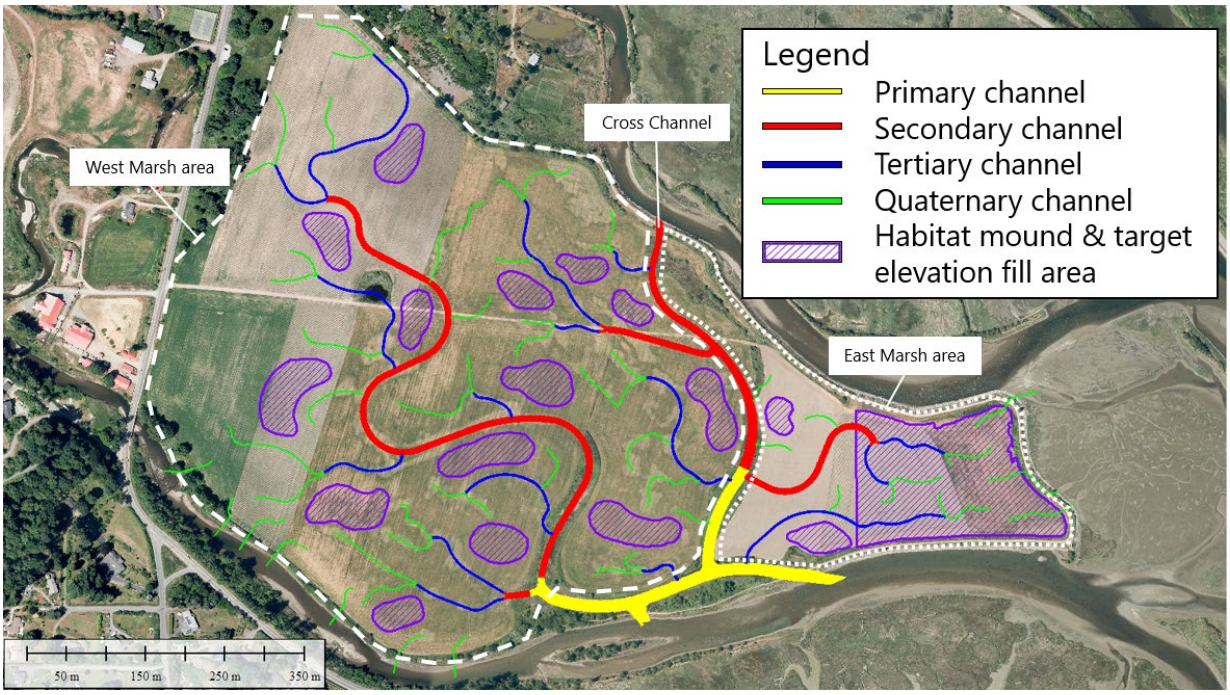


Figure 6.1 Restoration features layout depicting marsh channels, habitat mounds and the eastern fill area. The western marsh and eastern marsh areas are outlined.

6.1 Channel Layout

The marsh channel design includes approximately 80 tidal channels constructed across Dinsdale Field, and a cross channel that connects the two distributary channels that flow to the north and south of Dinsdale Field.

6.1.1 Marsh Channels

The marsh channel planform is a fourth-order system, meaning that there are four different channel sizes, each progressively smaller. The channels are designed to function as a unified system, though the design is described as the eastern marsh area and western marsh area. The eastern marsh area and western marsh area are connected hydraulically by a cross channel that connects to the North Distributary Channel and runs approximately south to connect to the South Distributary Channel. The eastern marsh area and western marsh area are approximately 37 hectares and 10 hectares, respectively.

The channels have been aligned to follow existing low-lying areas within the site, including historical channel pathways and natural drainage features. The benefits of this are to incorporate natural features within the restored channel system and to reduce the volume of soil excavation and handling.

The channels presented in the design drawings reasonably accommodate the allometric predictions based on Hood 2020, while optimizing the velocities and drainages simulated with the model. The Hood allometric predictions and final design values are presented in Table 6.1.

Table 6.1 Hood channel network allometry predictions and proposed design values.

Allometric Parameter	Prediction range for West Marsh (C.I.)	West Marsh Proposed Design	Predictions for East Marsh	East Marsh Proposed Design
Total channel length (m)	6,883 (95% C.I.: 27,713 – 1,709)	5,636	1,430 (95% C.I.: 363 – 5,635)	1,505
Max channel length (m)	2,655 (95% C.I.: 646 – 10,913)	1,456	682 (95% C.I.: 169 – 2,742)	389
Marsh outlets	18 (95% C.I.: 5 – 60)	12	8 (95% C.I.: 2 – 27)	7
Max trunk branches	14 (95% C.I.: 4 – 52)	11	6 (95% C.I.: 2 – 20)	3
Total number of quaternary channels	95 (80% C.I.[1]: 37 – 244)	44	26 (80% C.I.[1]: 10 – 66)	13

Notes:
1. The Hood spreadsheet only provided an 80% confidence interval (C.I.) for the total number of channel segments.

The channel planform is comprised of four orders of channels (Figure 6.2). Quaternary channels are the smallest drainage channels, which drain into tertiary channels, then secondary channels, then primary channels before draining out of the marsh.

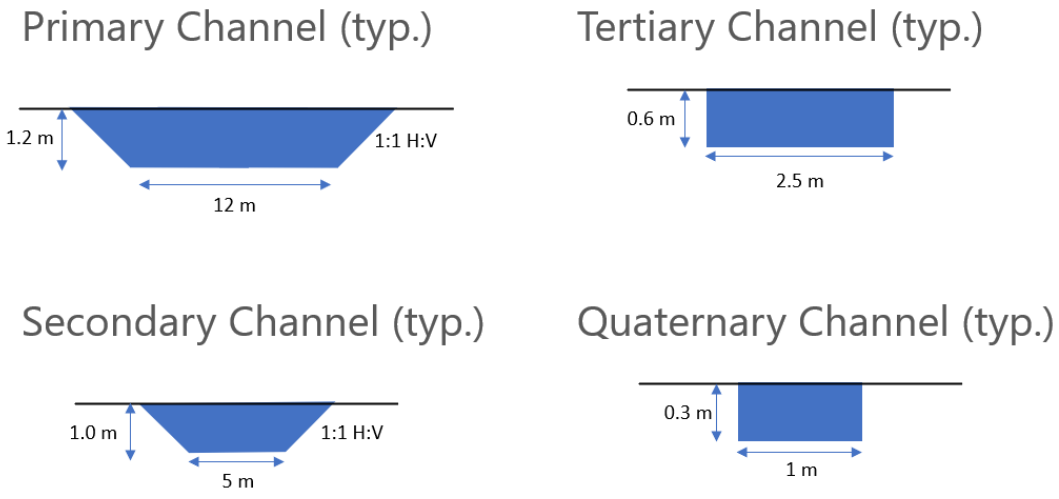


Figure 6.2 Typical cross-sectional geometries by channel order. Note that widths and depths are approximate and will vary with the channel slopes and variations in the existing ground surface.

6.1.2 Cross Channel

The cross channel extends from the North and South Distributary channels and hydraulically connects the eastern and western marsh areas. The proposed channel is predominantly located within a historical channel that is visible in aerial imagery. The northern approximately 200 m length of the historical alignment runs closely parallel to the North Distributary channel; this segment of the historical channel is susceptible to a channel avulsion because of its proximity to the North Distributary channel. The proposed cross-channel alignment is positioned further from the North Distributary channel in this area to reduce the likelihood of an avulsion occurring.

The cross channel has flow in both directions depending on a complex relationship between site grading, the river discharge, and coastal water levels. The cross channel is graded such that the north end is at a higher elevation than the connection with the primary marsh channel at the south end. On an incoming tide, flow is from the South Distributary channel up the cross channel. When water levels at the connection with the North Distributary Channel are at or above the inlet sill elevation of 0.4 m, flow in the connector channel is to the south. Also, on an outgoing tide, drainage from the eastern and western marsh channels flow in the connector channel to the south.

The proposed stepped inlet at the northern end of the cross channel will be stabilized with a layer of armour rock to increase its vertical and lateral stability. Channel stability at this location is important to NTBC and its project partners to reduce altering the existing supply of fresh water from the North Distributary channel to other parts of the estuary, particularly the constructed channel connections through the Westcan Terminal causeway. Model results indicate that on an ebb tide, the water surface elevation in the South Distributary Channel is higher than that of the North Distributary channel, which indicates the potential for headcutting to occur in the cross channel.

A six-meter bottom width opening was designed for the cross-channel connection at the North Distributary channel. The cross-channel width was designed to lower the likelihood of the channel inlet being plugged by debris or deposition. The width of the cross-channel inlet accounts for potential post-project morphological changes, including deposition of sediment and build up of wood debris. After Dike 49 is decommissioned, there will be a hydraulic expansion zone downstream of the confined reach of the North Distributary channel created by the confinement of the channel by Dike 88 and Westcan Terminal Road. There is potential for deposition to occur at the expansion zone.

6.2 Habitat Mounds and East Fill Area

Habitat mounds will be constructed throughout the project site and a larger fill area will be constructed on the eastern extent of the project site. Both the mounds and the fill area will provide additional elevation complexity for habitat and vegetation planting, sea level rise

adaption areas, and to balance project fill generation from channel excavation and dike decommissioning. The habitat mounds concept was incorporated by NTBC from a Washington State estuary restoration design (Environmental Science Associates, 2024).

The mounds vary in size and shape, but are approximately level across the top, with a height of 0.5 m relative to the existing ground adjacent to each mound. Side slopes will vary to create a varied appearance but generally are approximately 3H:1V. The mounds are offset from the marsh channels by 9 m, or greater, to allow the field to be inundated during high tides.

The East Fill Area is located outside of the Agricultural Land Reserve and the entire eastern area is proposed to be raised. The top surface of the eastern fill area is approximately 1.3 m CGVD2013, with minor surficial grading[3] to promote drainage into the marsh channels. This elevation was selected by NTBC to support native plant species and for sea level rise adaptation (S. Henstra, personal communication, March 6, 2025).

6.3 Dike Decommissioning

The decommissioning of Dike 49 is a proposed component of the restoration. Previous reports describe mitigation features that have been designed to satisfy DMA requirements associated with dike decommissioning. This section describes the dike decommissioning as it relates to the restoration features.

The dike will be decommissioned by grading the dike embankment down to the adjacent field elevation. Gentle grading from the inside of the dike footprint towards the river distributary channels will reduce ponding and encourage positive drainage into the channels. The material generated from removing the dike is planned for reuse with the proposed mitigation features.

Marsh channel openings through the dike will be graded below adjacent field elevations to hydraulically connect the channel network located within Dinsdale Field to the Koksilah River distributary channels and Cowichan Bay. Marsh channel openings have been planned throughout the dike removal extents, and seven openings have been planned through the remnant section of the dike that runs along the South Distributary channel. The geometries of the openings correspond to their respective channel order (Figure 6.2).

[3] Specific elevations will range with the positive drainage towards the marsh channels. Some allowance has been made for settlement in the drawings in Appendix A.

7 ASSUMPTIONS AND LIMITATIONS

The proposed design has been prepared using available data, design references, detailed analyses and assessments, and professional judgement. Assumptions and limitations for the analysis and design of the marsh channels are summarized below.

7.1 Analysis

- The HEC-RAS model is an update of the original version development for the Cowichan-Koksilah Floodplain Mapping project (NHC, 2021). Assumptions and limitations related to the previous model version may be found in the *Updated Cowichan-Koksilah Flood Mapping – Final Report* (NHC, 2021).
- Assumptions and limitations associated with HEC-RAS refinement in the project area associated with the mitigation features are described in the modelling appendix in *Dinsdale Field Flood Mitigation Features Design Summary* (NHC, 2025a). The same computation mesh used for the mitigation features' assessment was adapted for the restoration features' assessment.
- The model's computation mesh size and the digital elevation model's resolution limit the model's ability to resolve detailed in-channel hydraulics within the marsh channel network. The model still provides a reasonable basis for assessing the marsh's flooding and drainage during tidal cycles, determining tidal prism estimates, estimating typical velocities, and overall system functionality.
- NHC assumes that the tidal range for the project site is valid for the empirical relationships developed by Greg Hood based on South Fork reference marsh islands.

7.2 Design

- Balancing project material generation and use on site is a goal of the project set by NTBC. We have assumed that construction sequencing will be planned in a manner that material generated will either be used in the present construction phase or a future construction phase and will not be removed in bulk from the site.
- The topographic data is sourced from a combination of surveys, including remote sensing, topographic, and bathymetric. We have assumed that the surveys have reasonably captured the topography of the project site and nearby areas, and that the surveys form a reasonable basis for design.
- Assumptions of subsurface conditions are based on limited hand sampling previously completed by Thurber Engineering Ltd. and NHC. Different subsurface conditions may necessitate design adaptions during construction.

- The design is intended to provide opportunities for natural physical processes to take over tidal marsh development. NHC assumes that post construction channel changes will occur. Settlement and sediment movement (i.e., erosion and deposition) will occur.

8 CONCLUSIONS AND RECOMMEDATIONS

The restoration features design presented in this report are intended to remove barriers to tidal marsh development and to support the revitalization of indigenous food systems within the project site. The features will improve site connectivity with the Koksilah River distributary channels and with Cowichan Bay by restoring an integrated marsh system. The design reasonably mimics comparable natural tidal marsh systems and includes features to improve habitat complexity and sea level rise adaption.

Care was given during the design to balance project material generation and use on site. The design leverages and expands historic channels and existing low areas on the site to minimize excavation volumes while improving drainage. Habitat mounds and the East Fill Area allow productive reuse of channel excavation materials.

Other reports describe the design and supporting analyses for flood mitigation measures included in the overall project. The analysis completed for the restoration features was completed with river discharges and tide levels that are typical to any given year.

For construction, we understand NTBC will provide field instructions as it relates to the restoration features' ecologic function. We recommend that engineering field reviews be completed to assess design conformance as it relates to hydraulic performance. Specifically, spot checking channel order geometries, channel bottom elevations, and channel lengths.

Construction of the Lot 2 topographic and drainage features and the Dinsdale Field mitigation features must be completed in a sequence that minimizes flood risk to nearby properties for when Dike 49 is decommissioned.

We recommend an operations and maintenance program be implemented after construction of the project that describes an adaptive monitoring approach to both the restoration features and mitigation features.

9 REFERENCES

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NHC (2025b). *Cowichan Estuary Restoration Project - Lot 2 Mitigation and Drainage Features Design Summary Final Report Rev. 0*. The Nature Trust of British Columbia.

NHC (2025c). *Cowichan Estuary Restoration Project Dinsdale Mitigation Features Design Summary*. Draft, R2. Nanaimo BC. 56 pp.

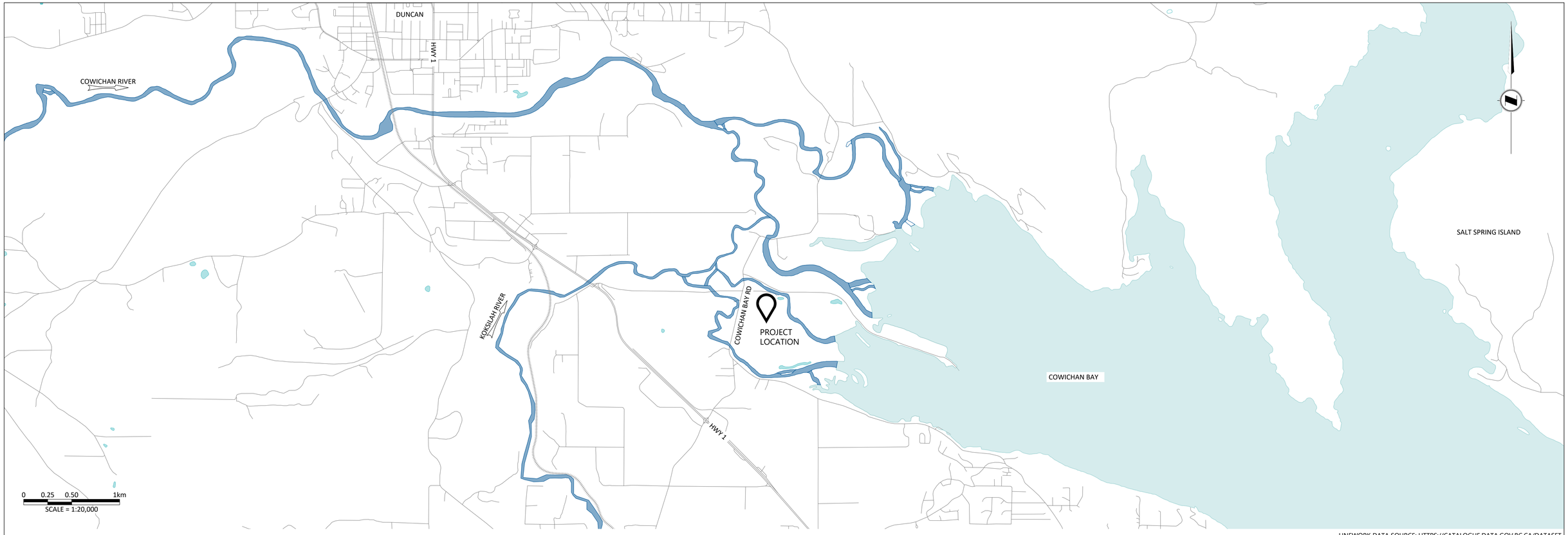
Thomson, R. E. (1981). Oceanography of the British Columbia Coast. *Canadian special publication of Fisheries and Aquatic Sciences*, 56, 25–41.

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W. Gregory Hood (2020). Applying tidal landform scaling to habitat restoration planning, design, and monitoring. *Estuarine, Coastal and Shelf Science*, 244.

APPENDIX A

ISSUED-FOR-TENDER DRAWINGS



LINEWORK DATA SOURCE: HTTPS://CATALOGUE.DATA.GOV.BC.CA/DATASET

COWICHAN ESTUARY RESTORATION PROJECT

2025 CONSTRUCTION PHASE PACKAGE

ISSUED FOR TENDER, JUNE 2025

NOT FOR CONSTRUCTION

DRAWING INDEX	
SHEET No.	SHEET DESCRIPTION
G-0-001	COVER SHEET
G-0-101	EXISTING SITE LAYOUT AND NOTES
C-1-101	OVERVIEW OF DESIGN ELEMENTS
C-2-101	ELEVATION TIE-IN FEATURE (ETIF) - PLAN VIEW &PROFILE
C-2-102	FLOODBOX CULVERT & OUTLET SWALE - PLAN VIEW & PROFILE
C-2-301	ELEVATION TIE-IN FEATURE (ETIF), FLOODBOX CULVERT & OUTLET SWALE - SECTIONS & DETAILS
C-3-101	KEY PLAN - PROPOSED CHANNELS & MOUNDS
C-3-102	PLAN VIEW - PROPOSED CHANNELS & MOUNDS
C-3-103	PLAN VIEW - PROPOSED CHANNELS & MOUNDS
C-3-104	PLAN VIEW - PROPOSED CHANNELS & MOUNDS
C-3-105	PLAN VIEW - PROPOSED CHANNELS & MOUNDS
C-3-106	PLAN VIEW - PROPOSED CHANNELS & MOUNDS
C-3-107	PLAN VIEW - PROPOSED EAST FILL AREA, CHANNEL AND MOUNDS
C-3-108	TYPICAL SECTIONS



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NHC PROJECT No. 3006733
REVISION 0
SHEET No.
G-0-001

FILENAME: \\nanfile-svn\Projects\Active\3006733 Cowichan Estuary Marsh Restoration\06 CAD\2_Production\0100_Drawings\3006733_DRAW_CONTEST_PTCONST_G-0-001_COVER.dwg, 26 Jun 2025, 10:59 AM, ----



THIS DRAWING MAY HAVE BEEN REDUCED AND IS HALF SCALE WHEN PRINTED TO 11" X 17".

1. GENERAL

1.1. THE DESIGN DRAWINGS REPRESENT THE NATURE AND GENERAL LAYOUT OF THE WORK UNDER CONTRACT AND NOT NECESSARILY THE WORKS AS THEY WILL BE CONSTRUCTED.
1.2. THESE DRAWINGS, INCLUDING DIMENSIONS, SHALL BE READ IN CONJUNCTION WITH ALL OTHER PROJECT DRAWINGS, REPORTS, AND SPECIFICATIONS.
1.3. THE CONTRACTOR SHALL INSTALL ALL PRODUCTS IN STRICT ACCORDANCE WITH THE MANUFACTURER'S RECOMMENDED PRACTICE.
1.4. COPIES OF ALL PERMITS AND APPROVALS ARE REQUIRED AT THE WORK SITE AT ALL TIMES.
1.5. THE CONTRACTOR IS RESPONSIBLE FOR ANTICIPATING AND LOCATING ALL EXISTING UTILITIES AND BURIED WORKS.

2. SURVEY AND DIMENSIONS

2.1. MCELHANNEY COMPLETED TOPOGRAPHIC AND LEGAL SURVEYS ALONG COWICHAN BAY ROAD. ALL OTHER PARCEL INFORMATION IS FROM THE CVRD'S ONLINE WEBMAP. OTHER TOPOGRAPHY IS BASED ON 2019 BC LIDAR.
2.2. MCELHANNEY COMPLETED TOPOGRAPHIC AND LEGAL SURVEYS FOR LOT 2, LOCHMANETZ ROAD. ALL OTHER PARCEL INFORMATION IS FROM THE CVRD'S ONLINE WEB MAP. OTHER TOPOGRAPHY IS BASED ON 2019 BC LIDAR.
2.3. ELEVATIONS AND HORIZONTAL LOCATIONS ARE EXPRESSED IN METERS AND ARE BASED ON GEODETIC DATA:
  2.3.1. HORIZONTAL DATUM: NAD83 (CSRS)
  2.3.2. VERTICAL DATUM: CGVD2013
  2.3.3. GEOID MODEL: CGG2013A
  2.3.4. PROJECTION: UTM 10 N
2.4. DIMENSION TOLERANCES FOR EARTHWORKS:
  2.4.1. 1.0 m LATERALLY FOR WAVE ATTENUATION FEATURES
  2.4.2. +/- 0.2 m LATERALLY FOR ELEVATION TIE-IN FEATURE
  2.4.3. 0 TO + 0.05 m VERTICALLY FOR FINAL GRADE OF ELEVATION TIE-IN FEATURE CREST
  2.4.4. 0 TO +0.05 m VERTICALLY FOR FINAL GRADE OF LOT 2 TOPOGRAPHIC FEATURE AND UNNAMED ROAD LIFT
  2.4.5. 0 TO + 0.15 m VERTICALLY FOR WAVE ATTENUATION FEATURES
  2.4.6. +/- 0.02 m VERTICALLY FOR FLOODBOX ASSEMBLY
2.5. SURVEY CONTROL POINTS WILL BE PROVIDED TO THE CONTRACTOR BY OTHERS PRIOR TO COMMENCEMENT OF CONSTRUCTION. THE CONTRACTOR SHALL ASSUME FULL RESPONSIBILITY FOR ESTABLISHING SURVEY CONTROL FROM PROVIDED POINTS AND OTHER PUBLICLY AVAILABLE CONTROL OR BENCHMARKS, STAKING AND LAYOUT, TO ENSURE PROPER ALIGNMENT, DIMENSIONS, AND ELEVATIONS FOR ALL ASPECTS OF THE WORK. ALL ELEVATIONS, DIMENSIONS, AND STATIONING SHALL BE VERIFIED BY THE CONTRACTOR BEFORE CONSTRUCTION COMMENCEMENT, WITH ANY DISCREPANCIES COMMUNICATED IMMEDIATELY TO THE ENGINEER.

3. DESIGN

3.1. GENERAL CIVIL AND HYDROTECHNICAL DESIGN COMPLETED BY NORTHWEST HYDRAULIC CONSULTANTS LTD. (NHC).
3.2. GEOTECHNICAL DESIGN COMPLETED BY THURBER ENGINEERING LTD.
3.3. MARSH CHANNEL DESIGN COMPLETED BY NORTHWEST HYDRAULIC CONSULTANTS LTD. WITH INPUT FROM THE NATURE TRUST OF BRITISH COLUMBIA
3.4. DESIGN STANDARDS AND CRITERIA ARE SUMMARIZED IN COWICHAN ESTUARY RESTORATION PROJECT DINSDALE FIELD MITIGATION DESIGN SUMMARY FINAL REPORT, REV. 1.
3.5. DESIGN STANDARDS AND CRITERIA ARE SUMMARISED IN COWICHAN ESTUARY RESTORATION PROJECT DINSDALE FIELD RESTORATION FEATURES DESIGN SUMMARY FINAL REPORT, REV. 0.

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0	ISSUED FOR TENDER	2025-06-26	LLD	KEH	GRH

CLIENT

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0 20 40 60 80 100m
SCALE = 1:2,000

SEAL

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
G. R. HILL
28209
2025-06-26

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COWICHAN ESTUARY RESTORATION PROJECT
2025 CONSTRUCTION PHASE PACKAGE

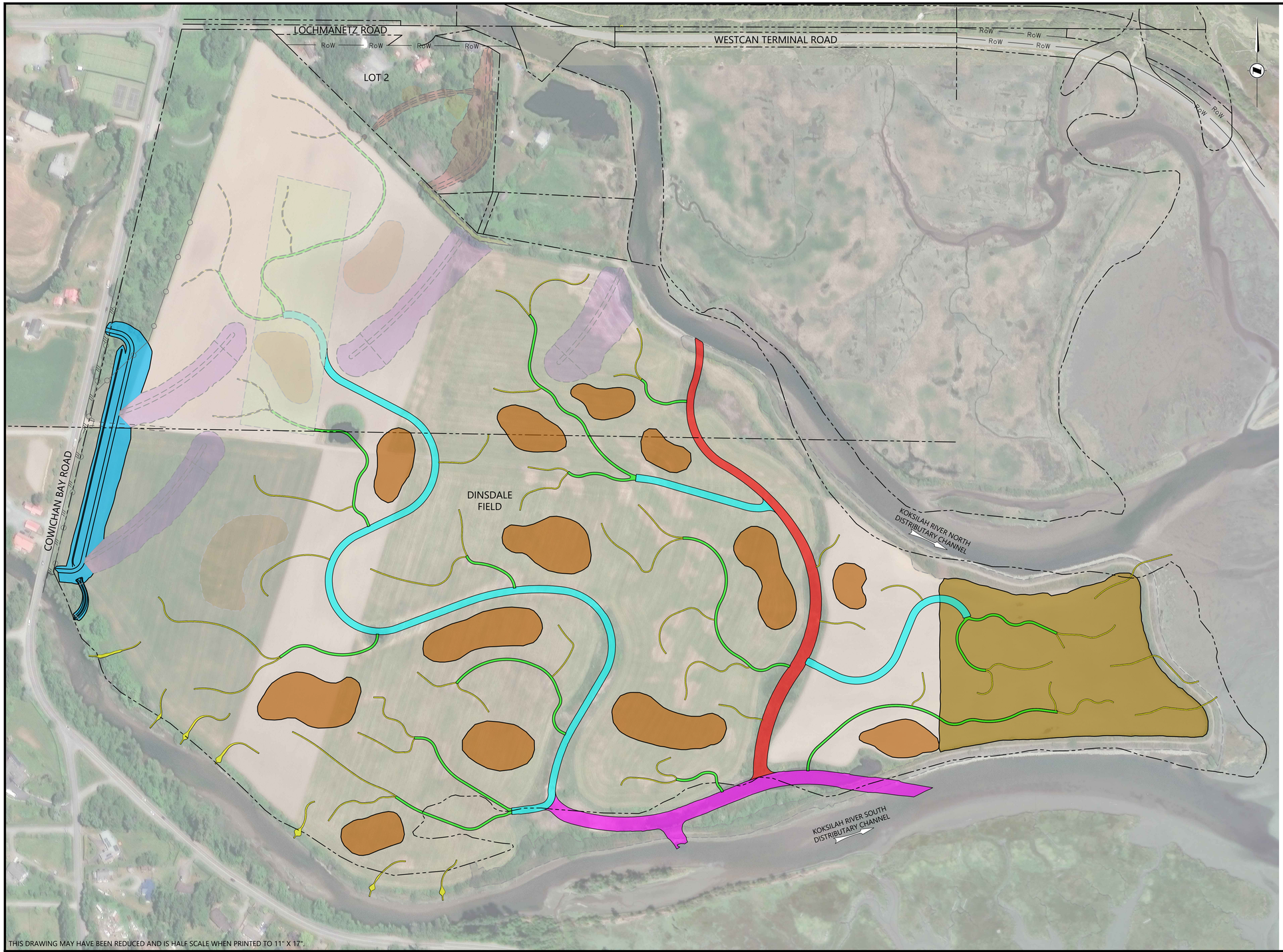
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NHC PROJECT No.
3006733

COORD SYS. AND DATUM
HORIZ: NAD83 UTM ZONE 10
VERT: CGG2013A

SHEET No.
G-0-101

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LEGEND:

- LOT 2 FEATURES DESIGN FOOTPRINT
  NOT IN CONTRACT (BY OTHERS IN FUTURE PHASE)
- WAVE ATTENUATION FEATURE (WAF) DESIGN FOOTPRINT
  NOT IN CONTRACT (BY OTHERS IN FUTURE PHASE)
- DIKE REMOVAL DESIGN FOOTPRINT
  NOT IN CONTRACT (BY OTHERS IN FUTURE PHASE)
- EXISTING NURSERY FOOTPRINT
  CHANNEL WORK NOT IN CONTRACT (BY OTHERS IN FUTURE PHASE)
- HABITAT MOUNDS DESIGN FOOTPRINT
  NOT IN CONTRACT (BY OTHERS IN FUTURE PHASE)
- 1ST, 2ND & 3RD ORDER CHANNEL DESIGN FOOTPRINT
  NOT IN CONTRACT (BY OTHERS IN FUTURE PHASE)
- UNNAMED ROAD RAISE DESIGN FOOTPRINT
- ELEVATION TIE-IN FEATURE (ETIF) DESIGN FOOTPRINT
- EAST FILL DESIGN FOOTPRINT
- HABITAT MOUNDS DESIGN FOOTPRINT
- QUATERNARY CHANNEL DESIGN FOOTPRINT
- TERTIARY CHANNEL DESIGN FOOTPRINT
- SECONDARY CHANNEL DESIGN FOOTPRINT
- PRIMARY CHANNEL DESIGN FOOTPRINT
- CROSS CHANNEL DESIGN FOOTPRINT

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V6C 3K4

0 20 40 60 80 100m
SCALE = 1:2,000

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G. R. HILL
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2025-06-26

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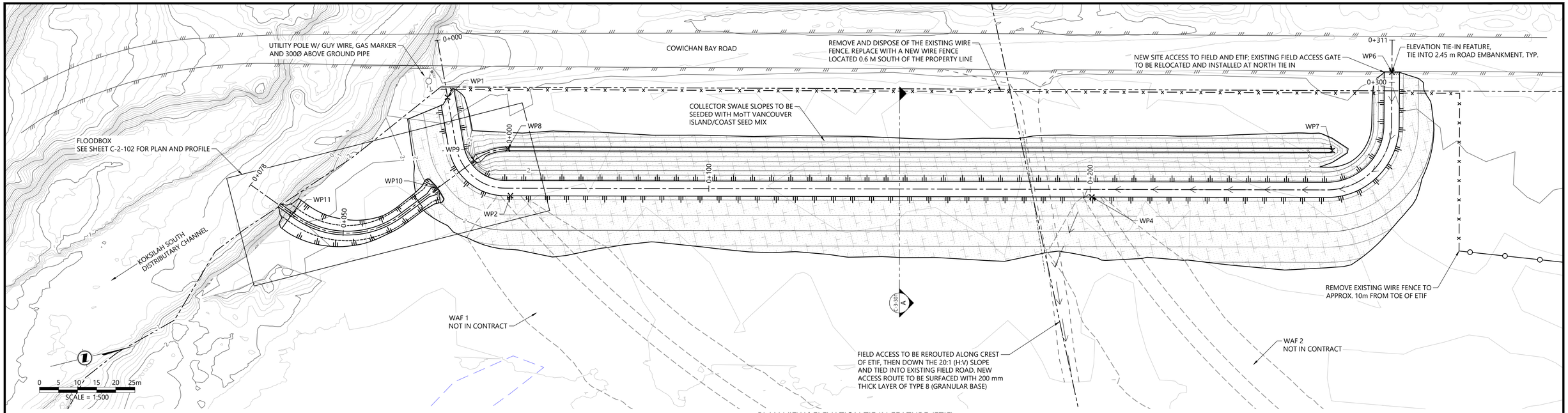
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NHC PROJECT No.
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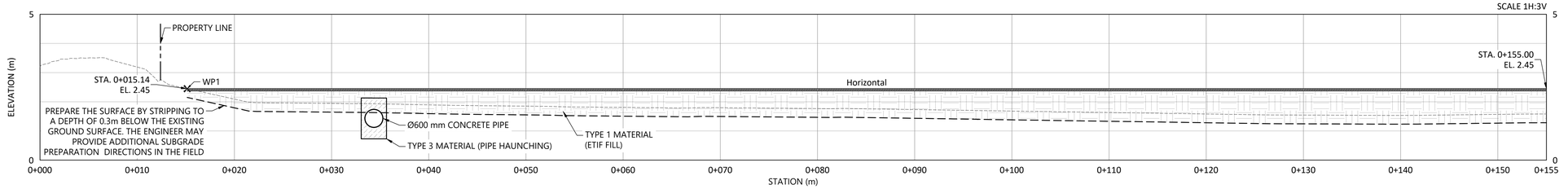
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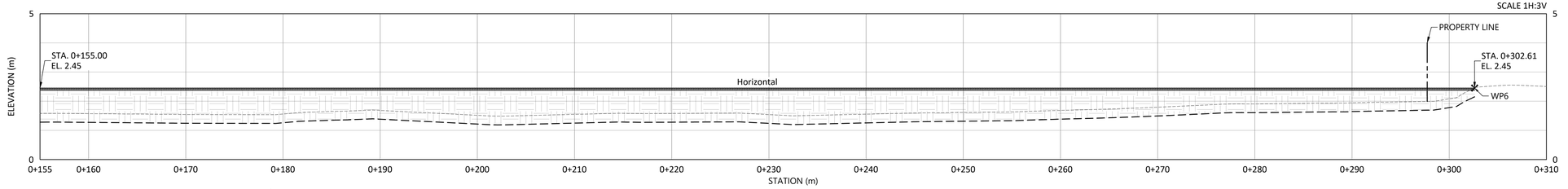
PLAN VIEW | ELEVATION TIE IN FEATURE (ETIF)

SCALE 1:500



ELEVATION TIE IN FEATURE (ETIF) PROFILE | STA 0+000 TO STA 0+155

SCALE 1:250 | 3x VERTICAL EXAGGERATION



ELEVATION TIE IN FEATURE (ETIF) PROFILE | STA 0+155 TO STA 0+310

SCALE 1:250 | 3x VERTICAL EXAGGERATION

LEGEND:

- PROPERTY BOUNDARY
- DESIGN LINEWORK
- APPROXIMATE EDGE OF ROAD SURFACE/SLOPE
- EXISTING FENCELINE
- PROPOSED FENCING
- TYPE 1 MATERIAL (ETIF FILL)
- TYPE 2 MATERIAL (GENERAL FILL)
- TYPE 3 MATERIAL (PIPE HAUNCHING)
- TYPE 8 MATERIAL (GRANULAR BASE)

NOT FOR CONSTRUCTION

POINT TABLE

POINT #	EASTING (m)	NORTHING (m)	ELEVATION (m)	DESCRIPTION
1	451765.80	5399924.15	2.45	CENTER OF ETIF CREST AT SOUTH TIE IN
2	451794.66	5399934.37	2.45	CENTER OF WAF 1 CREST WHERE IT MEETS ETIF CREST
4	451829.53	5400082.80	2.45	CENTER OF WAF 2 CREST WHERE IT MEETS ETIF CREST
6	451815.46	5400166.86	2.45	CENTER OF ETIF CREST AT NORTH TIE-IN
7	451831.92	5400146.94	1.15	CL OF NORTH END OF COLLECTOR SWALE INVERT
9	451783.57	5399927.35	1.15	CULVERT INLET INVERT WHERE HEADWALL APRON MEETS HEADWALL OPENING

THIS DRAWING MAY HAVE BEEN REDUCED AND IS HALF SCALE WHEN PRINTED TO 11" X 17".

DRAWING REVISION SCHEDULE

REV	DESCRIPTION	DATE	DESIGNER	DRAWN BY	APPROVED
0	ISSUED FOR TENDER	2025-06-26	LLD	KEH	GRH

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0 5 10 15 20 25m
SCALE = 1:500

0 5 10 15m
SCALE = 1:250

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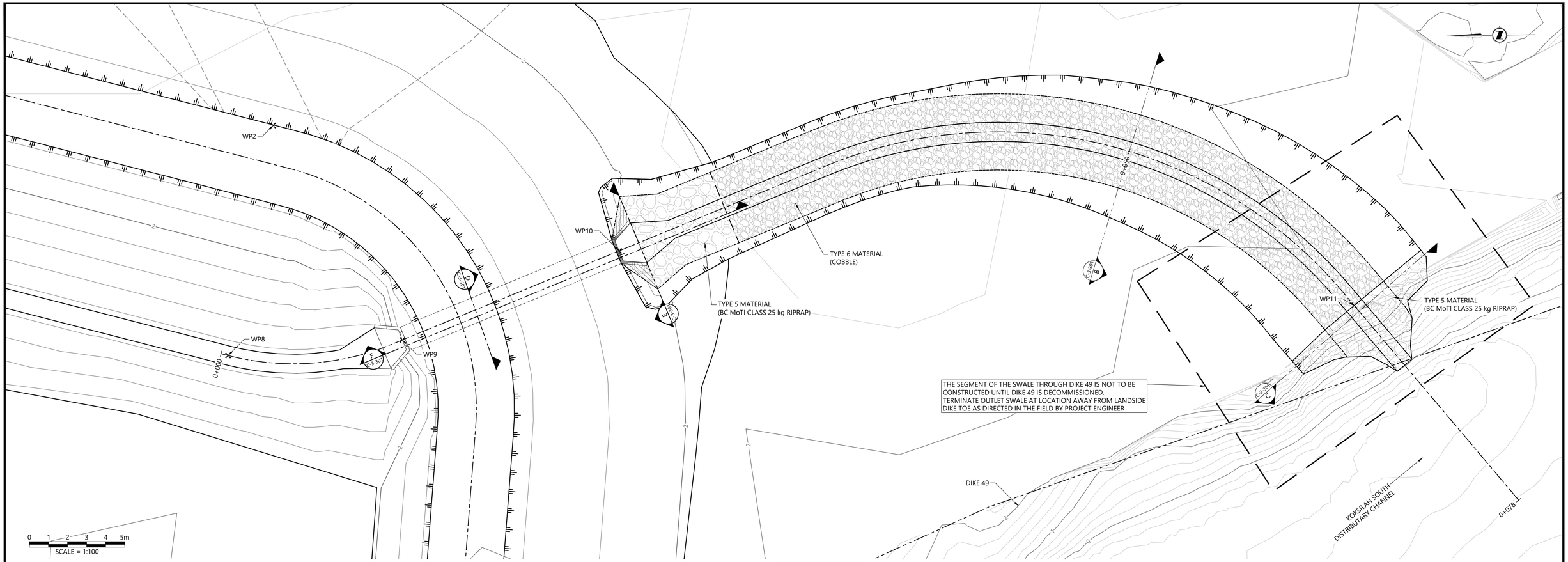
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3006733

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VERT: CGG2013A

ELEVATION TIE-IN FEATURE (ETIF)
PLAN VIEW AND PROFILE

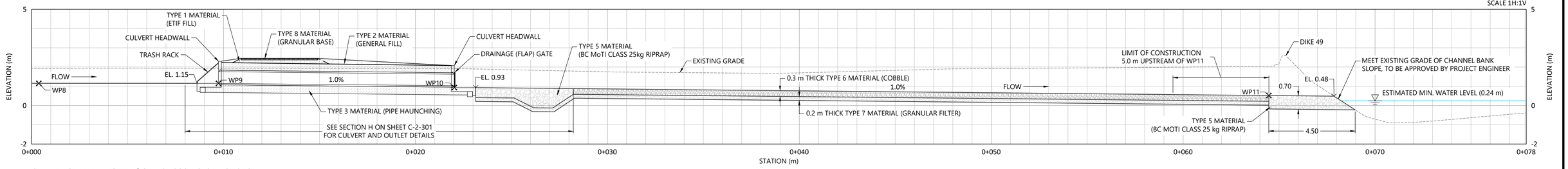
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OUTLET PLAN VIEW

SCALE 1:100



OUTLET SWALE PROFILE | STA 0+000 TO STA 0+070

SCALE 1:100 | NO VERTICAL EXAGGERATION

NOT FOR CONSTRUCTION

POINT TABLE

POINT #	EASTING (m)	NORTHING (m)	ELEVATION (m)	DESCRIPTION
8	451782.56	5399936.47	1.15	CL OF COLLECTOR SWALE INVERT BEFORE CURVE TO MEET HEADWALL
9	451783.57	5399927.35	1.15	CULVERT INLET INVERT WHERE HEADWALL APRON MEETS HEADWALL OPENING
10	451788.48	5399916.08	0.93	CULVERT OUTLET INVERT WHERE HEADWALL APRON MEETS HEADWALL OPENING
11	451786.44	5399877.48	0.52	CL OF OUTLET SWALE INVERT WHERE COBBLE MEETS RIPRAP

LEGEND:

- EXISTING GRADE
- DESIGN FINAL GRADE
- DESIGN GRADE BREAK
- LOW WATER LEVEL (EL. 0.24 m) OBSERVED BY NHC (2022-01-05 AT 00:00)
- TYPE 1 MATERIAL (ETIF FILL)
- TYPE 2 MATERIAL (GENERAL FILL)
- TYPE 3 MATERIAL (PIPE HAUNCHING)
- TYPE 5 MATERIAL (BC MoTI CLASS 25 kg RIPRAP)
- TYPE 6 MATERIAL (COBBLE)
- TYPE 7 MATERIAL (GRANULAR FILTER)
- TYPE 8 MATERIAL (GRANULAR BASE)

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DRAWING REVISION SCHEDULE

REV	DESCRIPTION	DATE	DESIGNER	DRAWN BY	APPROVED
0	ISSUED FOR TENDER	2025-06-26	LLD	KEH	GRH

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0 1 2 3 4 5m
SCALE = 1:100

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28209
2025-06-26

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COWICHAN ESTUARY RESTORATION PROJECT
2025 CONSTRUCTION PHASE PACKAGE

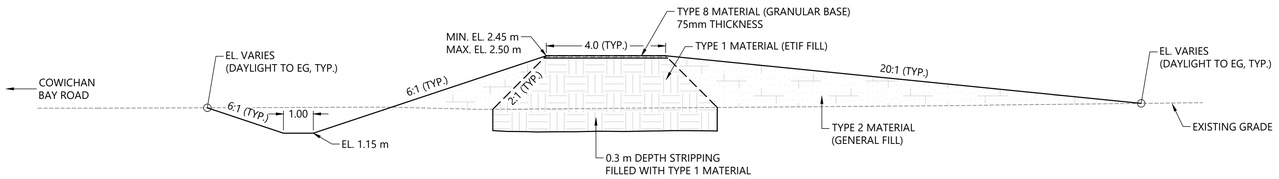
FLOODBOX CULVERT & OUTLET SWALE
PLAN VIEW & PROFILE

NHC PROJECT No.
3006733

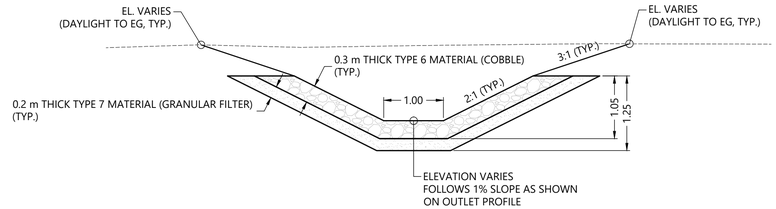
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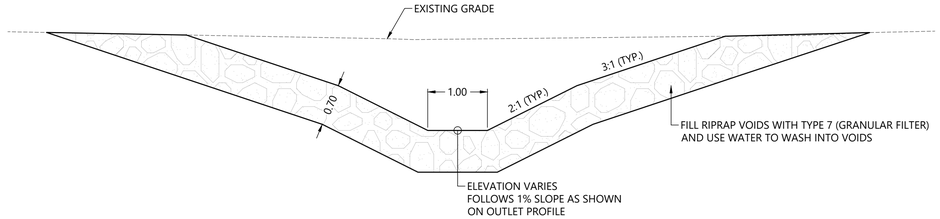
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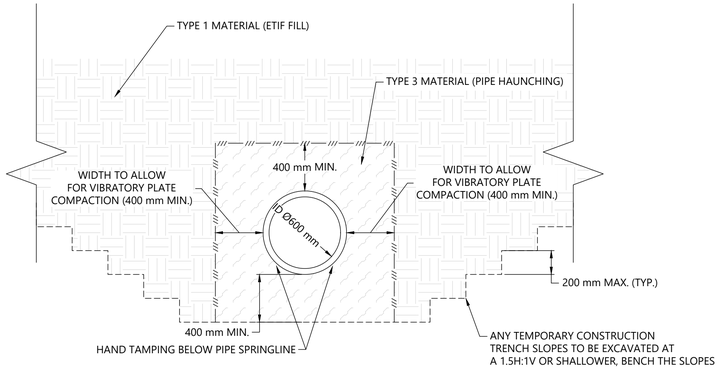
A C-3-101 ELEVATION TIE IN FEATURE |TYPICAL
SCALE 1:100 | 2x VERTICAL EXAGGERATION



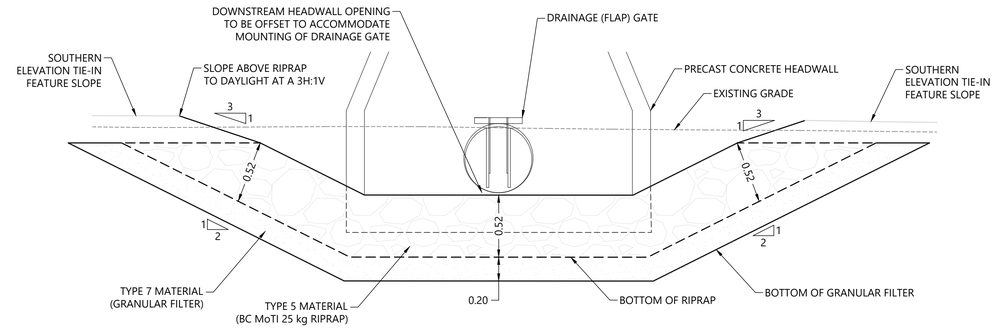
B C-3-102 OUTLET COBBLE SWALE | TYPICAL
SCALE 1:50 | NO VERTICAL EXAGGERATION



C C-3-302 OUTLET SWALE CHANNEL CONNECTION| TYPICAL
SCALE 1:50 | NO VERTICAL EXAGGERATION



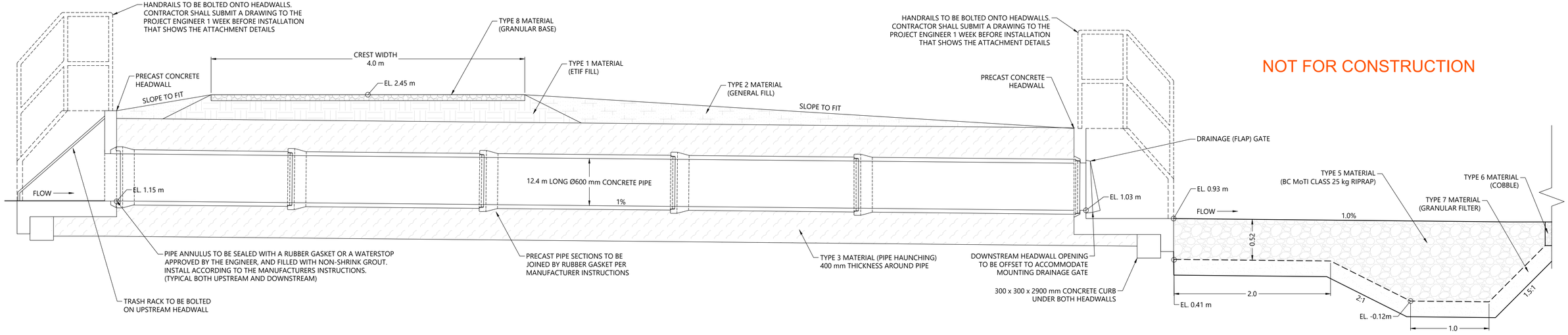
D C-3-102 TYPICAL SECTION
SCALE 1:25



E C-3-102 OUTLET DETAIL
SCALE 1:25

LEGEND:

- EXISTING GRADE
- DESIGN FINAL GRADE
- TYPE 1 MATERIAL (ETIF FILL)
- TYPE 2 MATERIAL (GENERAL FILL)
- TYPE 5 MATERIAL (BC MOTI CLASS 25 kg RIPRAP)
- TYPE 6 MATERIAL (COBBLE)
- TYPE 7 MATERIAL (GRANULAR FILTER)
- TYPE 8 MATERIAL (GRANULAR BASE)



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F C-3-102 CULVERT DETAIL
SCALE 1:25

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REV	DESCRIPTION	DATE	DESIGNER	DRAWN BY	APPROVED
0	ISSUED FOR TENDER	2025-06-26	LLD	KEH	GRH

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V6C 3K4

0 0.25 0.5 1m
SCALE = 1:25
0 1 2 3m
SCALE = 1:50
0 1 2 3 4 5m
SCALE = 1:100

SEAL

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
G. R. HILL
28209
2025-06-26

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COWICHAN ESTUARY RESTORATION PROJECT
2025 CONSTRUCTION PHASE PACKAGE

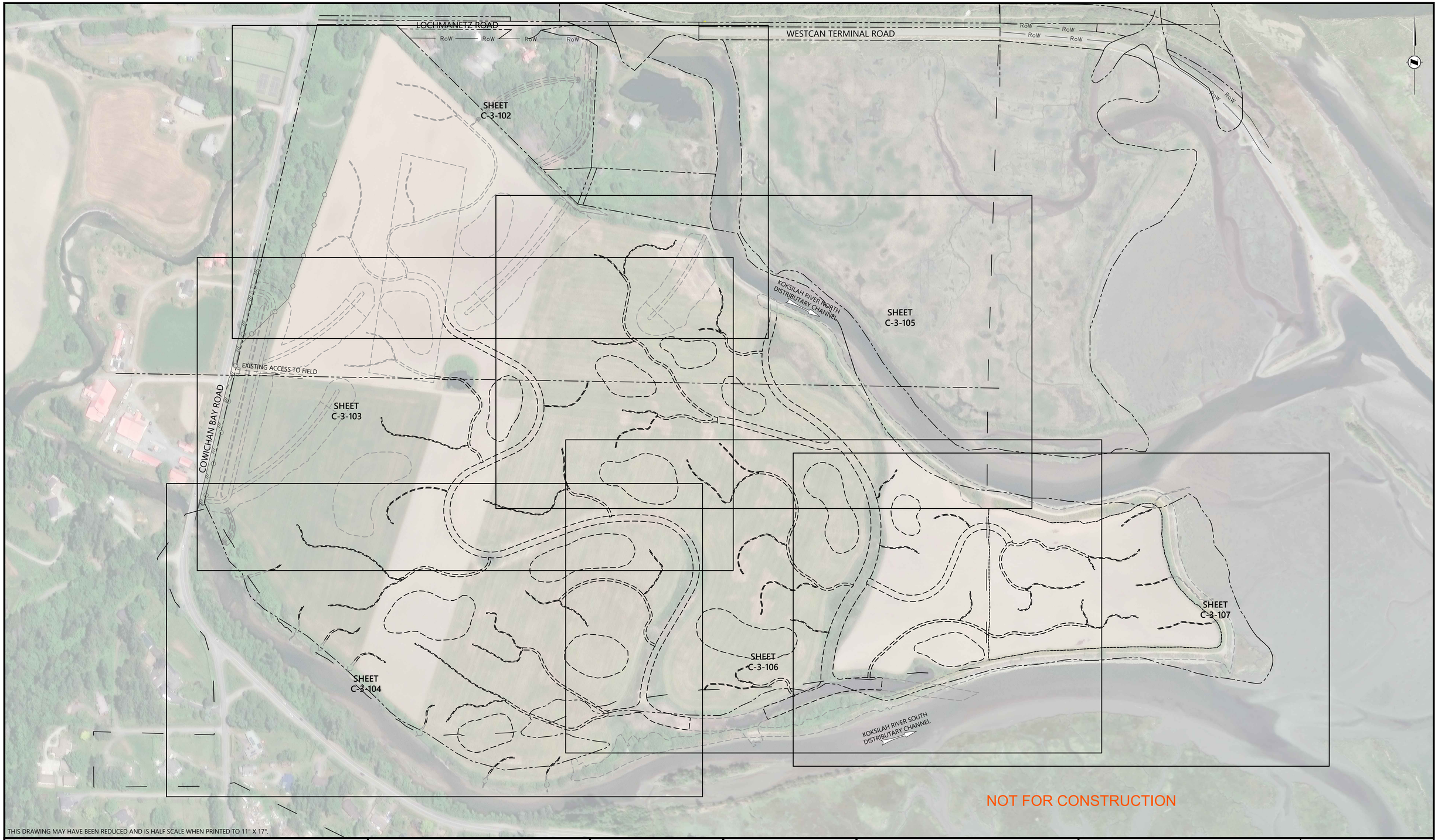
ELEVATION TIE-IN FEATURE (ETIF), FLOODBOX CULVERT & OUTLET SWALE SECTIONS AND DETAILS

NHC PROJECT No.
3006733

COORD SYS. AND DATUM
HORIZ: NAD83 UTM ZONE 10
VERT: CGG2013A

SHEET No.
C-2-301

FILE LOCATION: \\mainfile-van\Projects\Active\3006733 Cowichan Estuary Marsh Restoration\96 CADD_Production\0100_Drawings\3006733_DRAW_COWEST_PTCONST_C-2-101_ETIF.dwg PLOT DATE: 6/26/2025 11:03:26 AM PLOTTED BY: Khal Hooper



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0 20 40 60 80 100m
SCALE = 1:2,000

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G. R. HILL
26209
2025-06-26

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COWICHAN ESTUARY RESTORATION PROJECT
2025 CONSTRUCTION PHASE PACKAGE

KEY PLAN
PROPOSED CHANNELS AND MOUNDS

NHC PROJECT No. 3006733

COORD SYS. AND DATUM
HORIZ: NAD83 UTM ZONE 10
VERT: CGG2013A

SHEET No. C-3-101

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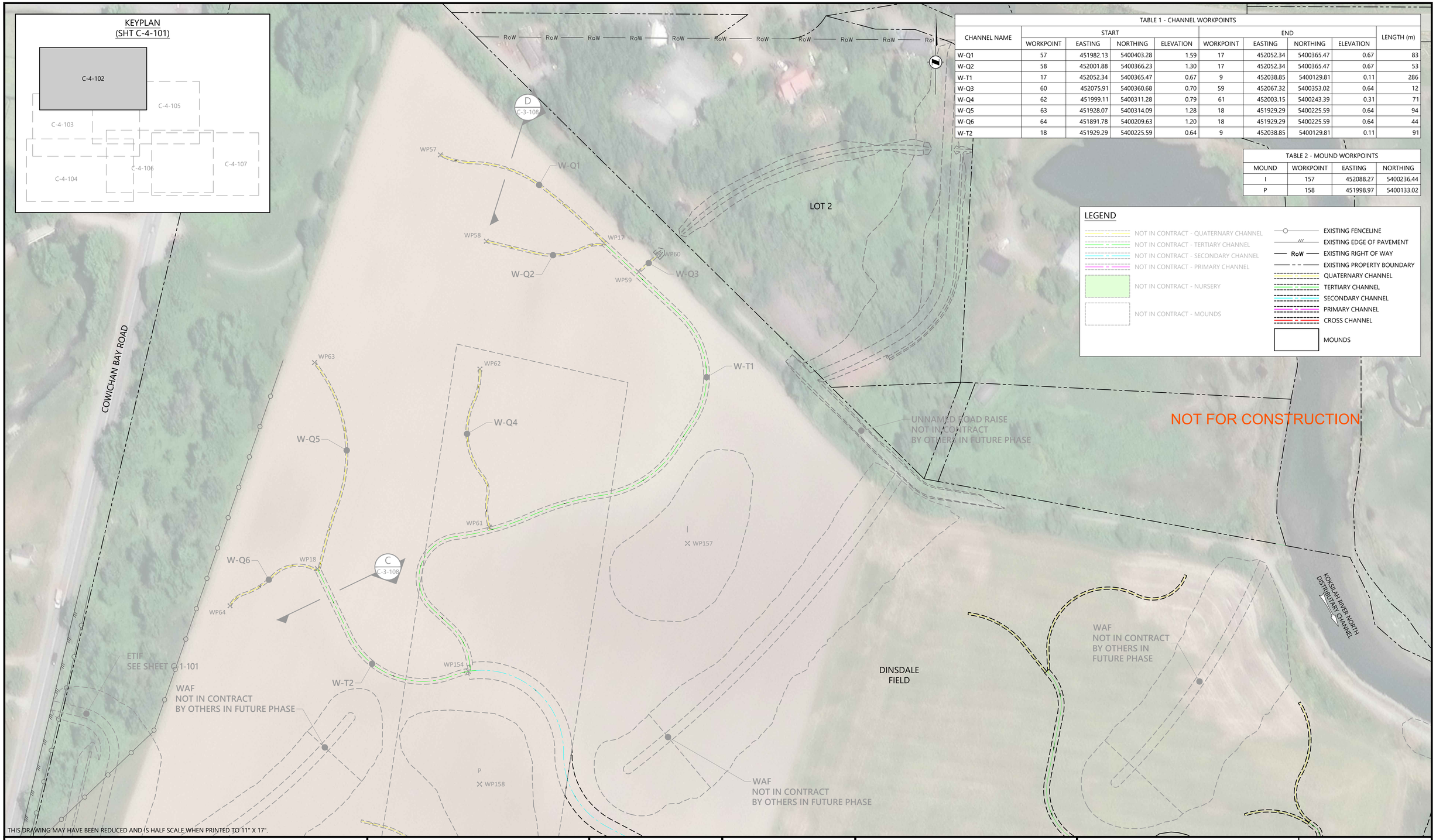


TABLE 1 - CHANNEL WORKPOINTS

CHANNEL NAME	START				END				LENGTH (m)
	WORKPOINT	EASTING	NORTHING	ELEVATION	WORKPOINT	EASTING	NORTHING	ELEVATION	
W-Q1	57	451982.13	5400403.28	1.59	17	452052.34	5400365.47	0.67	83
W-Q2	58	452001.88	5400366.23	1.30	17	452052.34	5400365.47	0.67	53
W-T1	17	452052.34	5400365.47	0.67	9	452038.85	5400129.81	0.11	286
W-Q3	60	452075.91	5400360.68	0.70	59	452067.32	5400353.02	0.64	12
W-Q4	62	451999.11	5400311.28	0.79	61	452003.15	5400243.39	0.31	71
W-Q5	63	451928.07	5400314.09	1.28	18	451929.29	5400225.59	0.64	94
W-Q6	64	451891.78	5400209.63	1.20	18	451929.29	5400225.59	0.64	44
W-T2	18	451929.29	5400225.59	0.64	9	452038.85	5400129.81	0.11	91

TABLE 2 - MOUND WORKPOINTS

MOUND	WORKPOINT	EASTING	NORTHING
I	157	452088.27	5400236.44
P	158	451998.97	5400133.02

LEGEND

- NOT IN CONTRACT - QUATERNARY CHANNEL
- NOT IN CONTRACT - TERTIARY CHANNEL
- NOT IN CONTRACT - SECONDARY CHANNEL
- NOT IN CONTRACT - PRIMARY CHANNEL
- NOT IN CONTRACT - NURSERY
- NOT IN CONTRACT - MOUNDS
- EXISTING FENCELINE
- EXISTING EDGE OF PAVEMENT
- RoW EXISTING RIGHT OF WAY
- EXISTING PROPERTY BOUNDARY
- QUATERNARY CHANNEL
- TERTIARY CHANNEL
- SECONDARY CHANNEL
- PRIMARY CHANNEL
- CROSS CHANNEL
- MOUNDS

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COWICHAN ESTUARY RESTORATION PROJECT
2025 CONSTRUCTION PHASE PACKAGE

PLAN VIEW
PROPOSED CHANNELS AND MOUNDS

NHC PROJECT No.
3006733

COORD SYS. AND DATUM
HORIZ: NAD83 UTM ZONE 10
VERT: CGG2013A

SHEET No.
C-3-102

FILE LOCATION: \\nanfile-van\Projects\Active\3006733 Cowichan Estuary Marsh Restoration\06 CAD\2_Production\0100_Drawings\3006733_DRAW_COWEST_PICONST_C-3-101_CHANS.dwg PLOT DATE: 6/26/2025 11:02:54 AM PLOTTED BY: Khal Hooper

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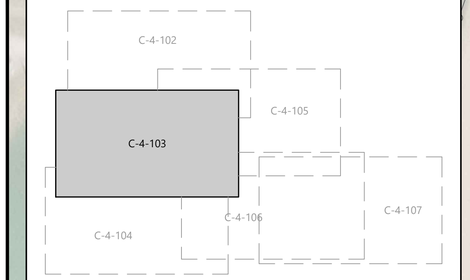


TABLE 3 - CHANNEL WORKPOINTS									
CHANNEL NAME	START				END				LENGTH (m)
	WORKPOINT	EASTING	NORTHING	ELEVATION	WORKPOINT	EASTING	NORTHING	ELEVATION	
W-S1	9	452038.85	5400129.81	0.11	3	452266.99	5399690.89	-0.49	851
W-Q7	66	452201.14	5400060.81	1.00	65	452151.00	5400033.10	0.77	66
W-Q8	67	451948.09	5400117.22	1.15	20	452026.14	5400065.96	0.53	52
W-Q9	68	451923.32	5400079.90	1.06	20	452026.14	5400065.96	0.53	61
W-T3	20	452026.14	5400065.96	0.53	19	452080.78	5399968.59	0.25	143
W-Q10	69	451965.51	5400019.90	1.05	70	452064.32	5399988.74	0.63	114
W-Q11	72	451979.04	5399898.56	0.84	71	452041.45	5399935.08	0.54	97
W-Q14	75	452171.41	5399985.55	0.97	24	452179.10	5399938.84	0.38	48
W-Q15	76	452082.35	5399925.73	0.91	24	452179.10	5399938.84	0.38	115
W-T5	24	452179.10	5399938.84	0.38	23	452227.53	5399906.36	-0.28	63

TABLE 4 - MOUND WORKPOINTS			
MOUND	WORKPOINT	EASTING	NORTHING
G	159	452088.27	5400236.44
J	160	451998.97	5400133.02
E	161	452243.92	5400065.60
O	162	452318.32	5400094.97
C	165	452264.89	5399950.52
F	164	452196.48	5399860.62

WAF
NOT IN CONTRACT
BY OTHERS IN
FUTURE PHASE

WP154

WP158

P

WP9

WP67

W-S1

B
C-3-108

W-Q8

W-Q9

WP68

WP155

C
C-3-108

EXISTING ACCESS TO FIELD

WP20

W-T3

WP66

JUNCTION INVERT
EL. 0.00

W-Q7

WP65

O
WP162

E
WP161

COWICHAN BAY ROAD

ETIF
SEE SHEET C-1-101

J
WP160

E
C-3-108

D
C-3-108

WP69

W-Q10

DINSDALE
FIELD

WAF
NOT IN CONTRACT
BY OTHERS IN FUTURE PHASE

WP70

JUNCTION INVERT
EL. 0.30

WP75

WP19

JUNCTION INVERT
EL. -0.07

W-Q14

C
WP165

W-Q11

G
WP159

WP71

JUNCTION INVERT
EL. -0.11

WP24

WP76

W-Q15

W-T5

JUNCTION INVERT
EL. -0.28

WP23

WP72

F
WP164

NOT FOR CONSTRUCTION

LEGEND

- NOT IN CONTRACT - QUATERNARY CHANNEL
- NOT IN CONTRACT - TERTIARY CHANNEL
- NOT IN CONTRACT - SECONDARY CHANNEL
- NOT IN CONTRACT - PRIMARY CHANNEL
- NOT IN CONTRACT - NURSERY
- NOT IN CONTRACT - MOUNDS
- EXISTING FENCELINE
- EXISTING EDGE OF PAVEMENT
- RoW EXISTING RIGHT OF WAY
- EXISTING PROPERTY BOUNDARY
- QUATERNARY CHANNEL
- TERTIARY CHANNEL
- SECONDARY CHANNEL
- PRIMARY CHANNEL
- CROSS CHANNEL
- MOUNDS

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26209

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COWICHAN ESTUARY RESTORATION PROJECT
2025 CONSTRUCTION PHASE PACKAGE

PLAN VIEW
PROPOSED CHANNELS AND MOUNDS

NHC PROJECT No.
3006733

COORD SYS. AND DATUM
HORIZ: NAD83 UTM ZONE 10
VERT: CGG2013A

SHEET No.
C-3-103

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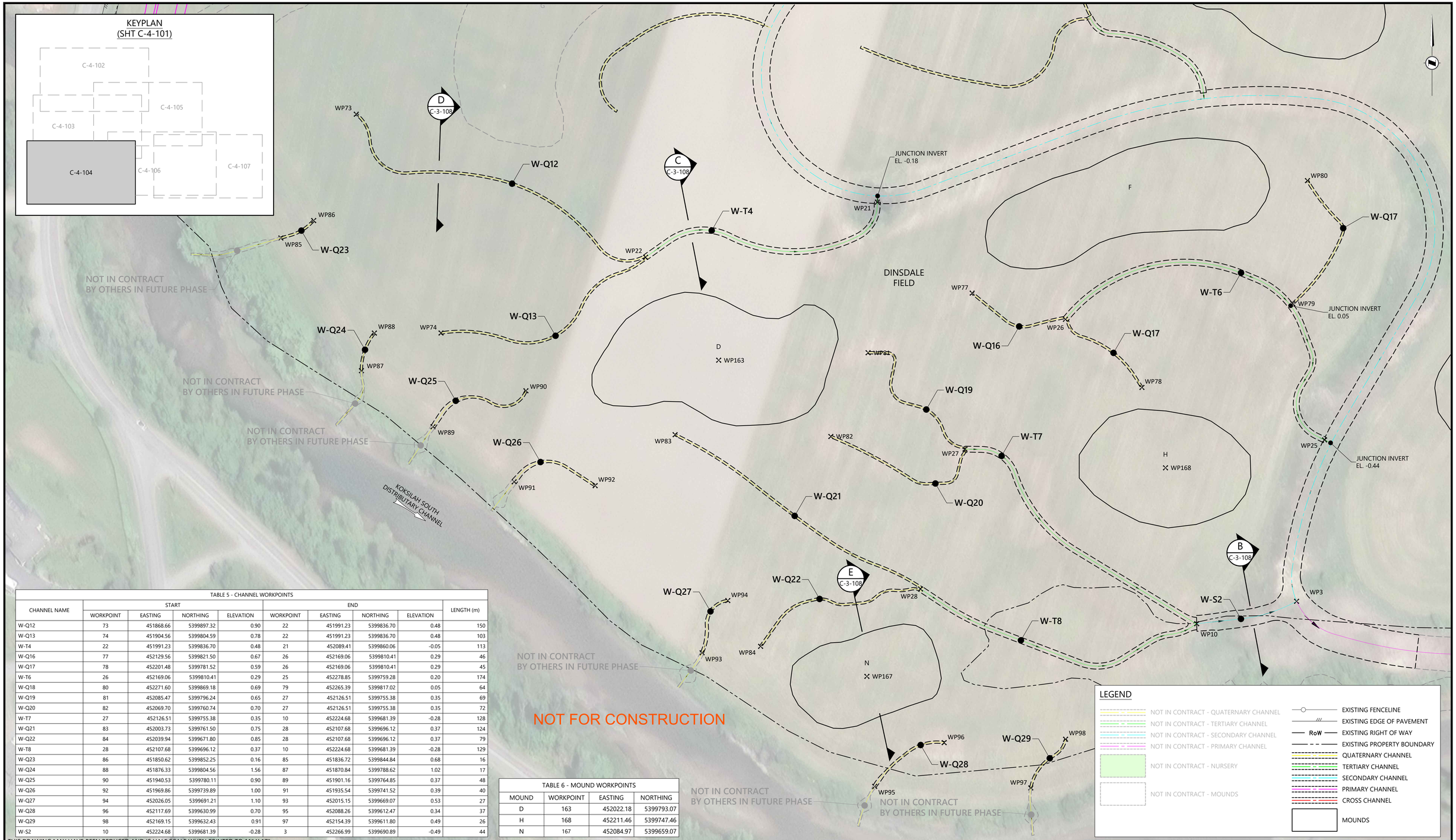


TABLE 5 - CHANNEL WORKPOINTS

CHANNEL NAME	START				END				LENGTH (m)
	WORKPOINT	EASTING	NORTHING	ELEVATION	WORKPOINT	EASTING	NORTHING	ELEVATION	
W-Q12	73	451868.66	5399897.32	0.90	22	451991.23	5399836.70	0.48	150
W-Q13	74	451904.56	5399804.59	0.78	22	451991.23	5399836.70	0.48	103
W-T4	22	451991.23	5399836.70	0.48	21	452089.41	5399860.06	-0.05	113
W-Q16	77	452129.56	5399821.50	0.67	26	452169.06	5399810.41	0.29	46
W-Q17	78	452201.48	5399781.52	0.59	26	452169.06	5399810.41	0.29	45
W-T6	26	452169.06	5399810.41	0.29	25	452278.85	5399759.28	0.20	174
W-Q18	80	452271.60	5399869.18	0.69	79	452265.39	5399817.02	0.05	64
W-Q19	81	452085.47	5399796.24	0.65	27	452126.51	5399755.38	0.35	69
W-Q20	82	452069.70	5399760.74	0.70	27	452126.51	5399755.38	0.35	72
W-T7	27	452126.51	5399755.38	0.35	10	452224.68	5399681.39	-0.28	128
W-Q21	83	452003.73	5399761.50	0.75	28	452107.68	5399696.12	0.37	124
W-Q22	84	452039.94	5399671.80	0.85	28	452107.68	5399696.12	0.37	79
W-T8	28	452107.68	5399696.12	0.37	10	452224.68	5399681.39	-0.28	129
W-Q23	86	451850.62	5399852.25	0.16	85	451836.72	5399844.84	0.68	16
W-Q24	88	451876.33	5399804.56	1.56	87	451870.84	5399788.62	1.02	17
W-Q25	90	451940.53	5399780.11	0.90	89	451901.16	5399764.85	0.37	48
W-Q26	92	451969.86	5399739.89	1.00	91	451935.54	5399741.52	0.39	40
W-Q27	94	452026.05	5399691.21	1.10	93	452015.15	5399669.07	0.53	27
W-Q28	96	452117.69	5399630.99	0.70	95	452088.26	5399612.47	0.34	37
W-Q29	98	452169.15	5399632.43	0.91	97	452154.39	5399611.80	0.49	26
W-S2	10	452224.68	5399681.39	-0.28	3	452266.99	5399690.89	-0.49	44

TABLE 6 - MOUND WORKPOINTS

MOUND	WORKPOINT	EASTING	NORTHING
D	163	452022.18	5399793.07
H	168	452211.46	5399747.46
N	167	452084.97	5399659.07

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26209
2025-06-26

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COWICHAN ESTUARY RESTORATION PROJECT
2025 CONSTRUCTION PHASE PACKAGE

NHC PROJECT No. 3006733

COORD SYS. AND DATUM
HORIZ: NAD83 UTM ZONE 10
VERT: CGG2013A

PLAN VIEW
PROPOSED CHANNELS AND MOUNDS

SHEET No. C-3-104

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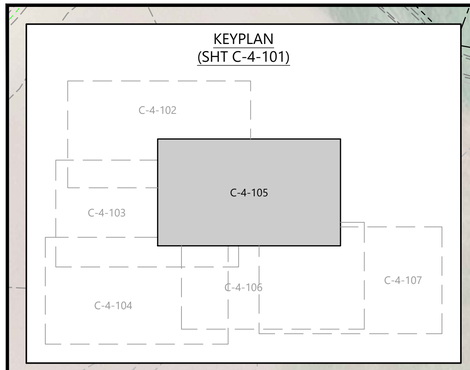


TABLE 7 - CHANNEL WORKPOINTS									
CHANNEL NAME	START				END				LENGTH (m)
	WORKPOINT	EASTING	NORTHING	ELEVATION	WORKPOINT	EASTING	NORTHING	ELEVATION	
W-Q30	99	452351.07	5400168.09	0.64	30	452355.17	5400116.58	0.38	56
W-Q31	100	452327.62	5400119.83	0.58	30	452355.17	5400116.58	0.38	29
W-T9	30	452355.17	5400116.58	0.38	29	452404.57	5400094.18	0.19	64
W-Q32	101	452302.23	5400222.80	0.56	31	452242.62	5400181.55	0.54	90
W-Q33	102	452208.83	5400206.27	0.91	31	452242.62	5400181.55	0.54	44
W-T10	31	452242.62	5400181.55	0.54	12	452349.77	5400017.47	-0.07	214
W-Q34	104	452206.41	5400107.63	1.06	103	452254.00	5400107.90	0.32	49
W-Q35	105	452240.96	5400028.36	0.69	32	452281.50	5400023.23	0.39	42
W-Q36	106	452233.05	5399984.78	0.97	32	452281.50	5400023.23	0.39	70
W-T11	32	452281.50	5400023.23	0.39	12	452349.77	5400017.47	-0.07	71
W-S3	12	452349.77	5400017.47	-0.07	11	452487.50	5399992.43	-0.26	143

TABLE 8 - CROSS-CHANNEL WORKPOINTS									
CHANNEL NAME	START				END				LENGTH (m)
	WORKPOINT	EASTING	NORTHING	ELEVATION	WORKPOINT	EASTING	NORTHING	ELEVATION	
XC	1	452413.63	5400134.79	0.33	2	452474.71	5399708.76	-0.73	512

TABLE 9 - MOUND WORKPOINTS			
MOUND	WORKPOINT	EASTING	NORTHING
K	166	452378.29	5400043.15

LEGEND

- NOT IN CONTRACT - QUATERNARY CHANNEL
- NOT IN CONTRACT - TERTIARY CHANNEL
- NOT IN CONTRACT - SECONDARY CHANNEL
- NOT IN CONTRACT - PRIMARY CHANNEL
- NOT IN CONTRACT - NURSERY
- NOT IN CONTRACT - MOUNDS
- EXISTING FENCELINE
- EXISTING EDGE OF PAVEMENT
- RoW EXISTING RIGHT OF WAY
- EXISTING PROPERTY BOUNDARY
- QUATERNARY CHANNEL
- TERTIARY CHANNEL
- SECONDARY CHANNEL
- PRIMARY CHANNEL
- CROSS CHANNEL
- MOUNDS

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2025-06-26

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COWICHAN ESTUARY RESTORATION PROJECT
2025 CONSTRUCTION PHASE PACKAGE

PLAN VIEW
PROPOSED CHANNELS AND MOUNDS

NHC PROJECT No. 3006733

COORD SYS. AND DATUM
HORIZ: NAD83 UTM ZONE 10
VERT: CGG2013A

SHEET No. C-3-105

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C-4-102
C-4-105
C-4-103
C-4-106
C-4-107
C-4-104

WP107
W-Q37
D
C-3-108
WP108
C
C-3-108
E
C-3-108
WP34
W-Q38
W-T12
B
WP170
M
WP171
DINSDALE
FIELD
W-Q39
JUNCTION INVERT
EL. 0.32
WP109
F
JUNCTION INVERT
EL. 0.24
JUNCTION INVERT
EL. -0.73
I
C-3-108
WP110
W-Q40
WP111
WP33
JUNCTION INVERT
EL. -0.73
MARSH
WP112
WP114
W-Q41
XC
A
WP169
WP113
JUNCTION INVERT
EL. -0.73
H
L
WP172
J
C-3-108
W-Q42
WP115
W-T13
WP6
WP36
WP116
W-Q43
WP2
WP35
W-P1 (B)
A
C-3-108
WP3
WP5
WP4
W-P1 (A)
NOT IN CONTRACT
BY OTHERS IN FUTURE PHASE
NOT IN CONTRACT
BY OTHERS IN FUTURE PHASE

NOT FOR CONSTRUCTION

TABLE 10 - CHANNEL WORKPOINTS

CHANNEL NAME	START				END				LENGTH (m)
	WORKPOINT	EASTING	NORTHING	ELEVATION	WORKPOINT	EASTING	NORTHING	ELEVATION	
W-Q37	107	452352.30	5399990.32	0.77	34	452397.07	5399956.75	0.47	59
W-Q38	108	452315.13	5399971.66	0.77	34	452397.07	5399956.75	0.47	123
W-T12	34	452397.07	5399956.75	0.47	33	452504.67	5399827.16	0.18	214
W-Q39	110	452380.12	5399840.41	0.50	109	452428.90	5399874.31	0.32	93
W-Q40	112	452399.09	5399793.70	0.58	111	452464.29	5399826.92	0.24	103
W-Q41	114	452433.30	5399788.95	0.50	113	452477.39	5399773.36	0.15	48
W-Q42	115	452384.83	5399735.59	0.54	36	452390.35	5399713.76	0.17	45
W-Q43	116	452334.85	5399707.72	0.56	36	452390.35	5399713.76	0.17	62
W-T13	36	452390.35	5399713.76	0.17	35	452437.03	5399701.01	-0.43	61
W-P1 (A)	3	452266.99	5399690.89	-0.49	4	452318.01	5399669.56	-0.56	58
W-P1 (B)	5	452404.66	5399681.17	-0.65	6	452537.70	5399715.14	-0.79	139

TABLE 11 - CROSS-CHANNEL WORKPOINTS

CHANNEL NAME	START				END				LENGTH (m)
	WORKPOINT	EASTING	NORTHING	ELEVATION	WORKPOINT	EASTING	NORTHING	ELEVATION	
XC	1	452413.63	5400134.79	0.33	2	452474.71	5399708.76	-0.73	512

TABLE 12 - MOUND WORKPOINTS

MOUND	WORKPOINT	EASTING	NORTHING
B	170	452482.65	5399918.41
M	171	452565.53	5399908.90
A	169	452379.32	5399769.24
L	172	452617.138	5399754.28

LEGEND

- NOT IN CONTRACT - QUATERNARY CHANNEL
- NOT IN CONTRACT - TERTIARY CHANNEL
- NOT IN CONTRACT - SECONDARY CHANNEL
- NOT IN CONTRACT - PRIMARY CHANNEL
- NOT IN CONTRACT - NURSERY
- NOT IN CONTRACT - MOUNDS
- EXISTING FENCELINE
- EXISTING EDGE OF PAVEMENT
- RoW EXISTING RIGHT OF WAY
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- QUATERNARY CHANNEL
- TERTIARY CHANNEL
- SECONDARY CHANNEL
- PRIMARY CHANNEL
- CROSS CHANNEL
- MOUNDS

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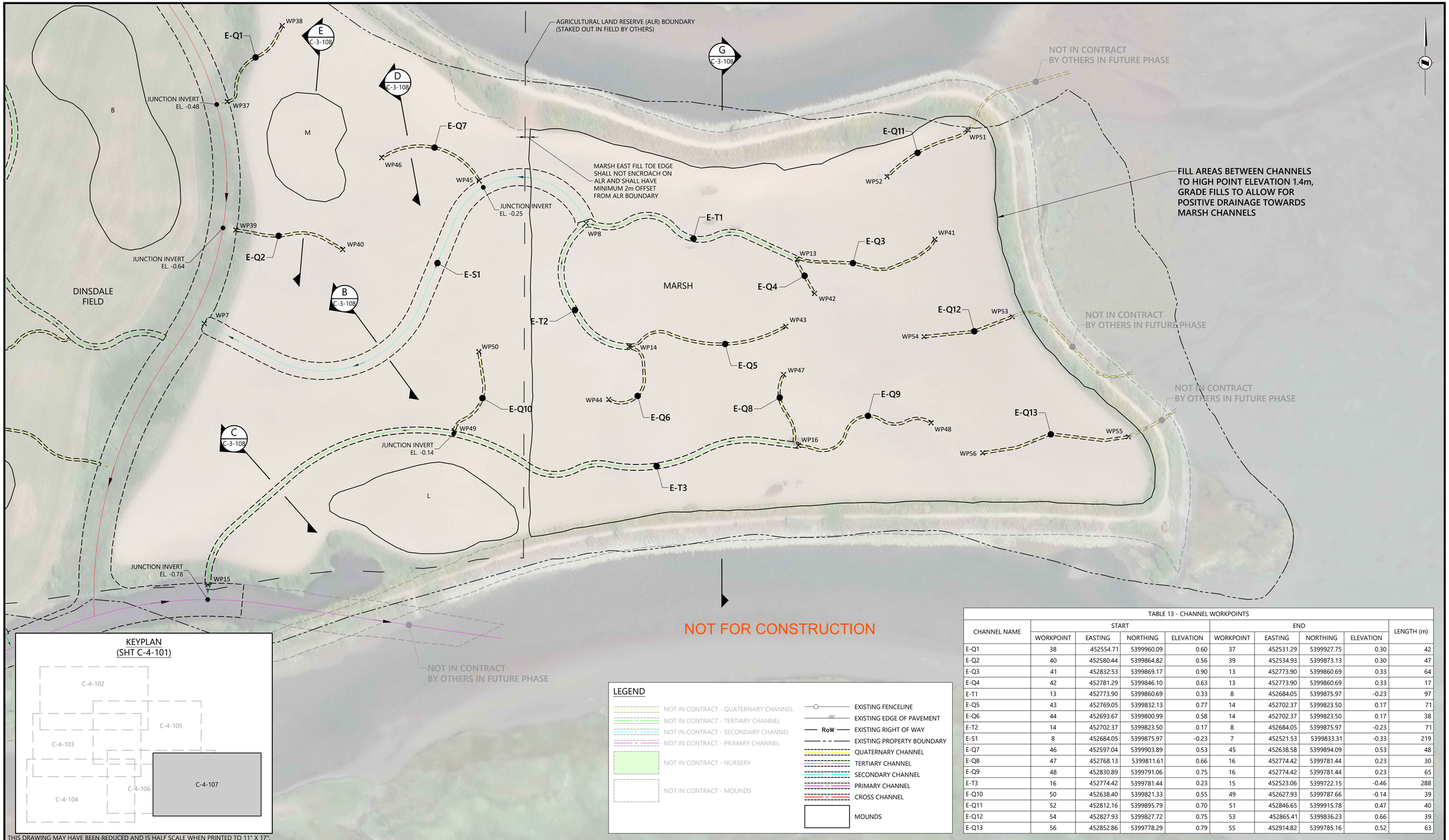
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COWICHAN ESTUARY RESTORATION PROJECT
2025 CONSTRUCTION PHASE PACKAGE

PLAN VIEW
PROPOSED CHANNELS AND MOUNDS

NHC PROJECT No. 3006733
COORD SYS. AND DATUM
HORIZ: NAD83 UTM ZONE 10
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SHEET No. C-3-106

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LEGEND

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- NOT IN CONTRACT - PRIMARY CHANNEL
- NOT IN CONTRACT - NURSERY
- NOT IN CONTRACT - MOUNDS
- EXISTING FENCELINE
- EXISTING EDGE OF PAVEMENT
- RoW — EXISTING RIGHT OF WAY
- EXISTING PROPERTY BOUNDARY
- QUATERNARY CHANNEL
- TERTIARY CHANNEL
- SECONDARY CHANNEL
- PRIMARY CHANNEL
- CROSS CHANNEL
- MOUNDS

TABLE 13 - CHANNEL WORKPOINTS

CHANNEL NAME	START				END				LENGTH (m)
	WORKPOINT	EASTING	NORTHING	ELEVATION	WORKPOINT	EASTING	NORTHING	ELEVATION	
E-Q1	38	452554.71	5399960.09	0.60	37	452531.29	5399927.75	0.30	42
E-Q2	40	452580.44	5399864.82	0.56	39	452534.93	5399873.13	0.30	47
E-Q3	41	452832.53	5399869.17	0.90	13	452773.90	5399860.69	0.33	64
E-Q4	42	452781.29	5399846.10	0.63	13	452773.90	5399860.69	0.33	17
E-T1	13	452773.90	5399860.69	0.33	8	452684.05	5399875.97	-0.23	97
E-Q5	43	452769.05	5399832.13	0.77	14	452702.37	5399823.50	0.17	71
E-Q6	44	452693.67	5399800.99	0.58	14	452702.37	5399823.50	0.17	38
E-T2	14	452702.37	5399823.50	0.17	8	452684.05	5399875.97	-0.23	71
E-S1	8	452684.05	5399875.97	-0.23	7	452521.53	5399833.31	-0.33	219
E-Q7	46	452597.04	5399903.89	0.53	45	452638.58	5399894.09	0.53	48
E-Q8	47	452768.13	5399811.61	0.66	16	452774.42	5399781.44	0.23	30
E-Q9	48	452830.89	5399781.44	0.75	16	452774.42	5399781.44	0.23	65
E-T3	16	452774.42	5399781.44	0.23	15	452523.06	5399722.15	-0.46	288
E-Q10	50	452638.40	5399821.33	0.55	49	452627.93	5399787.66	-0.14	39
E-Q11	52	452812.16	5399895.79	0.70	51	452846.65	5399915.78	0.47	40
E-Q12	54	452827.93	5399827.72	0.75	53	452865.41	5399836.23	0.66	39
E-Q13	56	452852.86	5399778.29	0.79	55	452914.82	5399785.16	0.52	63

NOT FOR CONSTRUCTION

DRAWING REVISION SCHEDULE

REV	DESCRIPTION	DATE	DESIGNER	DRAWN BY	APPROVED
0	ISSUED FOR TENDER	2025-06-26	LLD	KEH	GRH

CLIENT

NATURE TRUST BRITISH COLUMBIA

THE NATURE TRUST OF B.C.
500 - 888 DUNSMUIR STREET
VANCOUVER, B.C.
V6C 3K4

0 10 20 30 40 50m
SCALE = 1:750

SEAL

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
G. K. HILL
26209
2025-06-26

nhc

COWICHAN ESTUARY RESTORATION PROJECT
2025 CONSTRUCTION PHASE PACKAGE

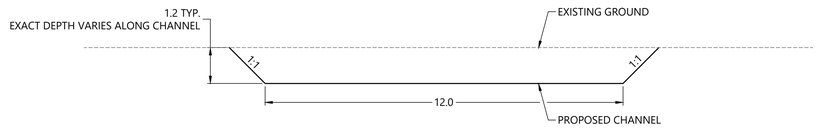
PLAN VIEW
PROPOSED EAST FILL AREA,
CHANNELS AND MOUNDS

NHC PROJECT No.
3006733

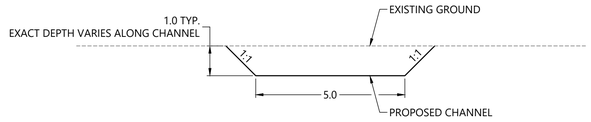
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HORIZ: NAD83 UTM ZONE 10
VERT: CGG2013A

SHEET No.
C-3-107

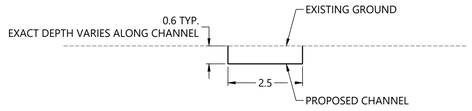
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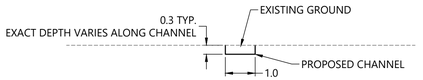
TYPICAL SECTION A - PRIMARY CHANNEL
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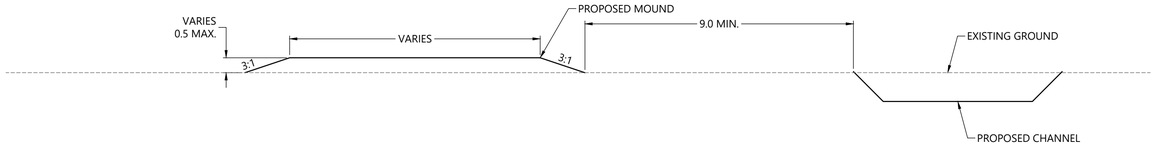
TYPICAL SECTION B - SECONDARY CHANNEL
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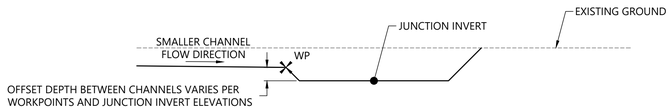
TYPICAL SECTION C - TERTIARY CHANNEL
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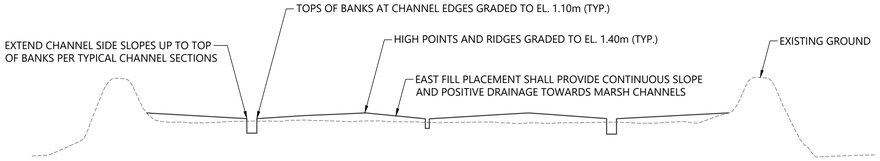
TYPICAL SECTION D - QUATERNARY CHANNEL
SCALE = 1:100



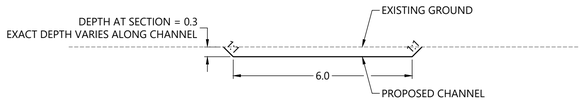
TYPICAL SECTION E - MOUND
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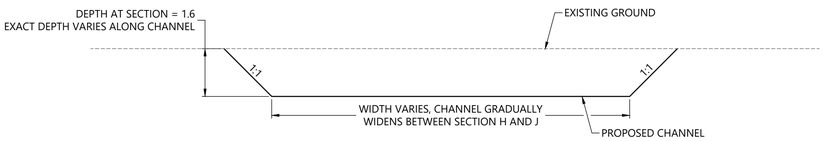
TYPICAL SECTION F - CHANNEL JUNCTION (LOOKING DOWNSTREAM ALONG THE LARGER CHANNEL)
SCALE = 1:100



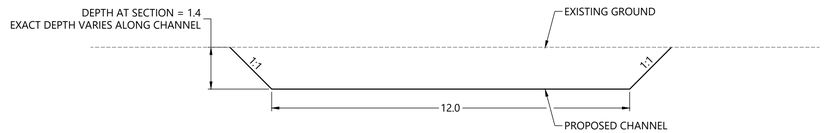
TYPICAL SECTION G - EAST FILL GRADING AREA
SCALE: H = 1:750 V = 1:150



SECTION H - CROSS CHANNEL UPSTREAM
SCALE = 1:100



SECTION I - CROSS CHANNEL UPSTREAM OF CHANNEL E-S1
SCALE = 1:100



SECTION J- CROSS CHANNEL DOWNSTREAM
SCALE = 1:100

NOT FOR CONSTRUCTION

THIS DRAWING MAY HAVE BEEN REDUCED AND IS HALF SCALE WHEN PRINTED TO 11" X 17".

DRAWING REVISION SCHEDULE

REV	DESCRIPTION	DATE	DESIGNER	DRAWN BY	APPROVED
0	ISSUED FOR TENDER	2025-06-26	LLD	KEH	GRH

CLIENT

NATURE TRUST BRITISH COLUMBIA

THE NATURE TRUST OF B.C.
500 - 888 DUNSMUIR STREET
VANCOUVER, B.C.
V6C 3K4

0 1 2 3 4 5m
SCALE = 1:100
0 2 4 6 8 10m
SCALE = 1:150
0 10 20 30 40 50m
SCALE = 1:750

SEAL

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
G. R. HILL
28209

2025-06-26

nhc

COWICHAN ESTUARY RESTORATION PROJECT
2025 CONSTRUCTION PHASE PACKAGE

TYPICAL SECTIONS

NHC PROJECT No.
3006733

COORD SYS. AND DATUM
HORIZ: NAD83 UTM ZONE 10
VERT: CGG2013A

SHEET No.
C-3-108

FILE LOCATION: \\mainfile-van\Projects\Active\3006733 Cowichan Estuary Marsh Restoration\96 CADD_Production\0100_Drawings\3006733_DRAW_COWEST_PTCONST_C-3-101_CHANS.dwg PLOT DATE: 6/26/2025 11:03:18 AM PLOTTED BY: Khal Hooper