

Dam Removal Option– Middle and Lower Dams

Chris Gräpel, M.Eng., P.Eng.

May 2013



MIDDLE CHASE RESERVOIR NOW



MIDDLE CHASE RESERVOIR AFTER DEWATERING



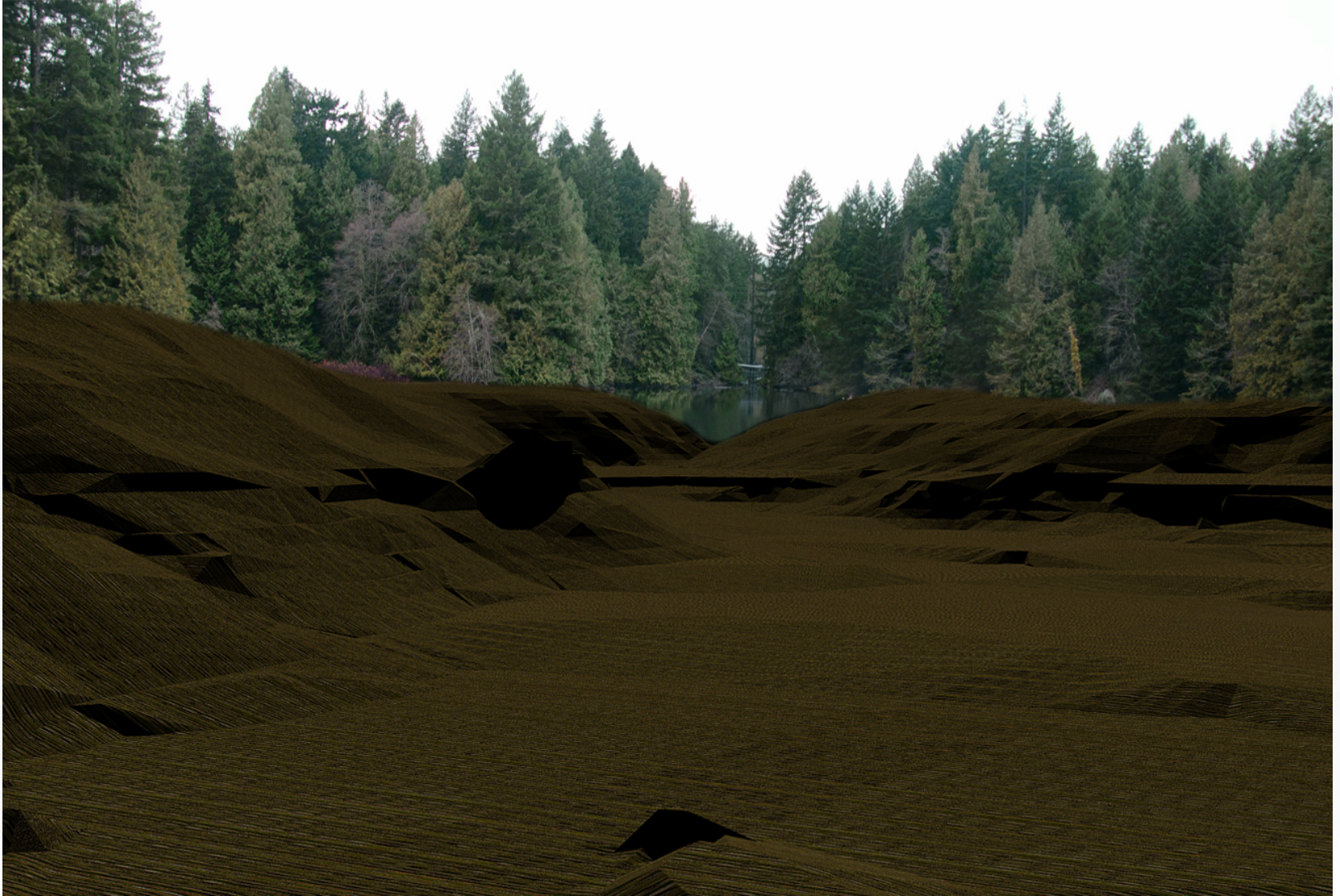
RESERVOIR BOTTOM AFTER RENATURALIZATION



LOWER CHASE RESERVOIR NOW



LOWER CHASE RESERVOIR AFTER DEWATERING



RESERVOIR BOTTOM AFTER RENATURALIZATION



KCB SCOPE OF WORK

- Technical Support to City
- Biophysical Assessments
- Archaeological Assessment
 - Madrone Environmental of Duncan
- Public Consultation
- Engagement of Snuneymuxw First Nation
- Regulatory and Permitting
- Engineering Design of Removal
 - Field Services for geo/materials by Lewkowich Engineering Associates
- Renaturalization Design
 - In co-operation with Gemella Design Inc. of Nanimo

SUMMARY OF BIOPHYSICAL WORK

- Stage 1 – Biophysical Overview (completed)
- Stage 2 – Terrestrial Assessment (everything but fish, started)
- Stage 3 – Fisheries Assessment (started)
- Brief summary of findings so far:
 - Vegetation species (flora) identified in different areas of park
 - Conducted overview of terrestrial and aquatic species (fauna) present
 - Many invasive species (terrestrial and aquatic) – a regional issue
 - Natural upstream and downstream environment very productive
 - Recreational fishery (humans) and fish eating species (eagles/otters) supported by frequent stocking
 - Low biodiversity relative to Upper Chase

SUMMARY OF ARCHAEOLOGICAL WORK

- Archaeological Overview Assessment (AOA) completed
- Findings:
 - Archives appear to indicate there were no deaths at the Pest House quarantine facility near Lower Chase Dam
 - There is long standing First Nation presence in the vicinity of Colliery Dam Park
- An in-depth Archaeological Impact Assessment will likely be required upon reservoir drawdown

SUMMARY OF ENGINEERING WORK

- 90% Complete Dam Removal drawings
- Contamination testing conducted on various materials
 - Concrete from Lower Wall (no asbestos)
 - Cinders, Ash from Lower Chase Dam (classified as “clean”)
 - Lakebed sediments (has minor chloride content, from highway de-icing chemicals)
 - Encountered steel reinforcing in Lower Dam wall with coring and deep GPR
 - Rebar located near centre of wall
- Hydrologic/Hydraulic calculations of flood flows for before and after removal
 - Dams have little impact on mitigating floods, reservoirs too small

SUMMARY OF RENATURALIZATION WORK

- Renaturalization design based on:
 - Results of biophysical studies and use of a reference segment of the Chase River (upstream of Upper Chase reservoir)
 - Previous KCB experience with restoration and dam removal
 - Input from City Parks and Engineering
 - Findings of engineering studies, including review of reservoir bottom bathymetry (i.e. "shape")
- Renaturalization design will be finalized when reservoirs are dewatered and sediment removal is conducted to re-establish the original riverbed
- Chloride content of sediments not an issue for renaturalization
- Requires management, monitoring and maintenance

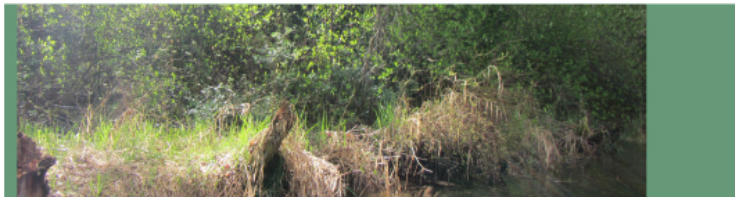
RENATURALIZATION SPECIES

RE-NATURALIZATION: RIPARIAN RESTORATION



STREAM, STREAM EDGES AND POOLS: EMERGENTS AND WILLOWS

<i>Salix lucida</i> ssp. <i>Lasiandra</i>	Pacific willow
<i>Salix scouleriana</i>	Scouler's willow
<i>Salix sitchensis</i>	Sitka willow



LOWER RIPARIAN - WET TO MOIST AREAS: NATIVE GRASSES, DOGWOOD, SALMONBERRY AND ALDER

<i>Alnus rubra</i>	alder
<i>Prunus emarginata</i>	bitter cherry
<i>Cornus stolonifera</i>	red-osier dogwood
<i>Oemleria cerasiformis</i>	Indian plum
<i>Rubus spectabilis</i>	salmonberry
<i>Spirea douglasii</i>	hardhack



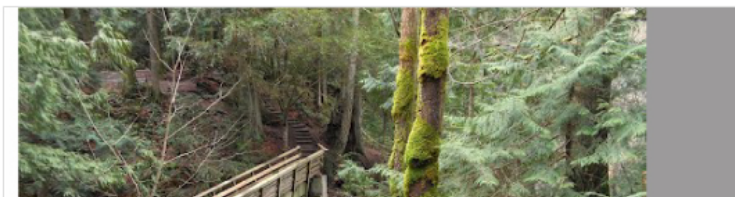
MID ELEVATION RIPARIAN - MOIST FOREST: SWORD FERN, MAPLES, AND CEDAR

<i>Acer macrophyllum</i>	big leaf maple
<i>Lonicera involucrata</i>	black twinberry
<i>Symphoricarpos albus</i>	common snowberry
<i>Sambucus racemosa</i>	red elderberry
<i>Thuja plicata</i>	western red cedar
<i>Rubus parviflorus</i>	thimbleberry
<i>Polystichum munitum</i>	sword fern



HIGHER RIPARIAN - DRIER UPPER LEDGES: FIR, MAPLE, AND HEMLOCK

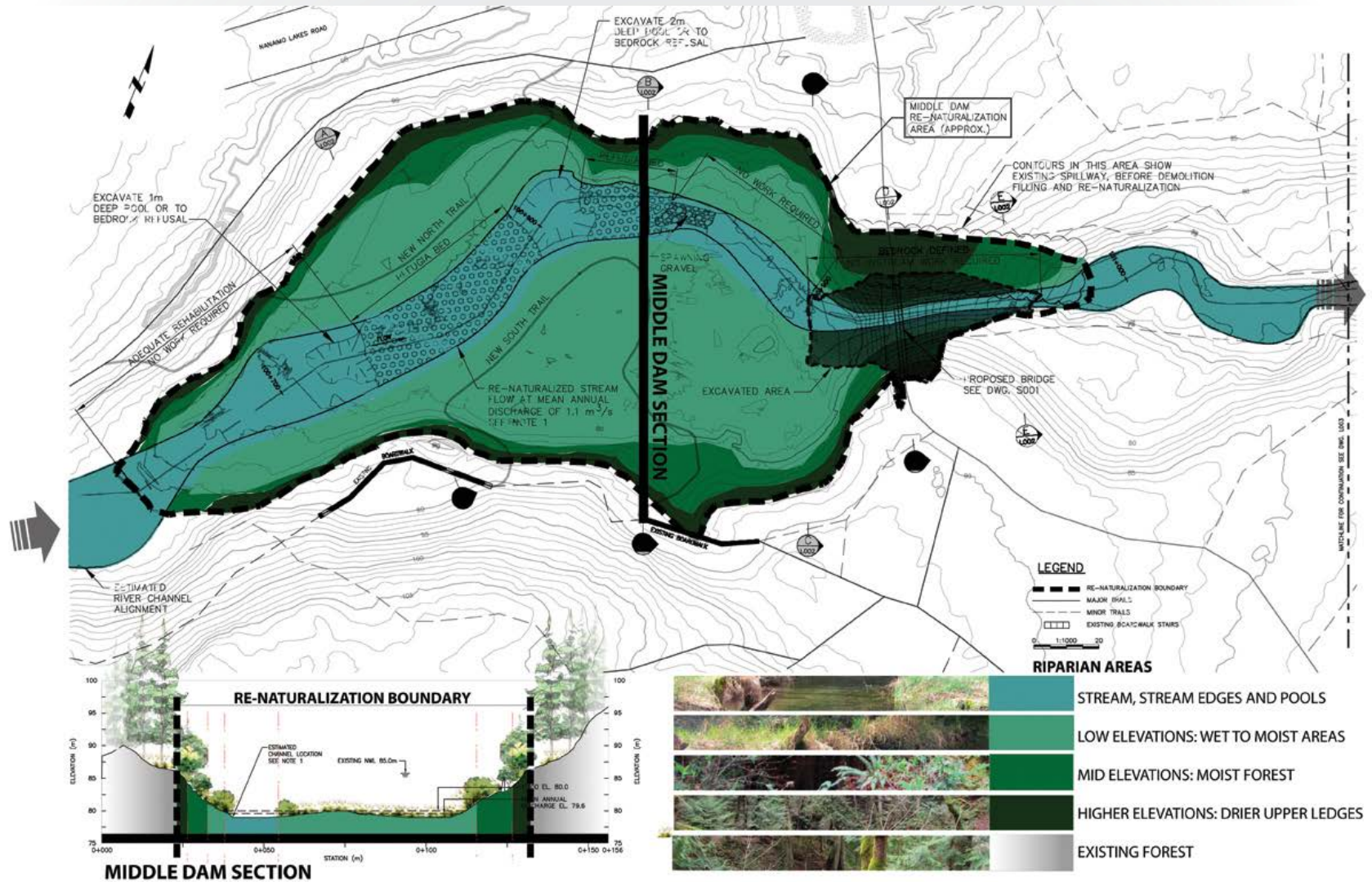
<i>Acer circinatum</i>	vine maple
<i>Acer glabrum</i>	Douglas maple
<i>Mahonia nervosa</i>	oregon grape
<i>Pseudotsuga menziesii</i>	Douglas fir
<i>Sorbus aucuparia</i>	mountain ash
<i>Tsuga heterophylla</i>	hemlock



EXISTING FOREST: COASTAL HEMLOCK FOREST & COASTAL DOUGLAS FIR

<i>Tsuga heterophylla</i>	hemlock
<i>Pseudotsuga menziesii</i>	Douglas fir
<i>Thuja plicata</i>	western red cedar
<i>Polystichum munitum</i>	sword fern

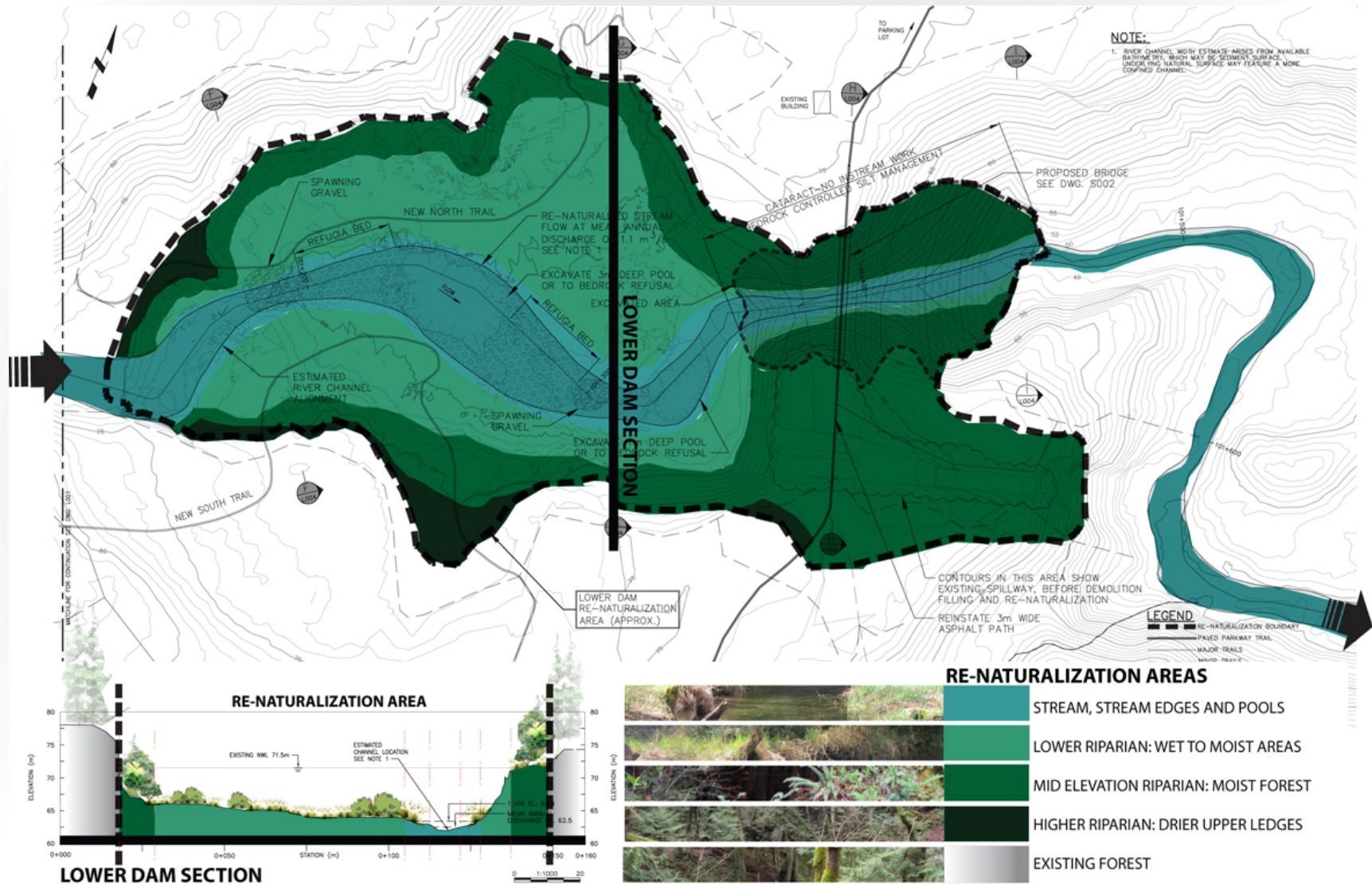
MIDDLE RESERVOIR RENATURALIZATION



RESERVOIR BOTTOM AFTER RENATURALIZATION

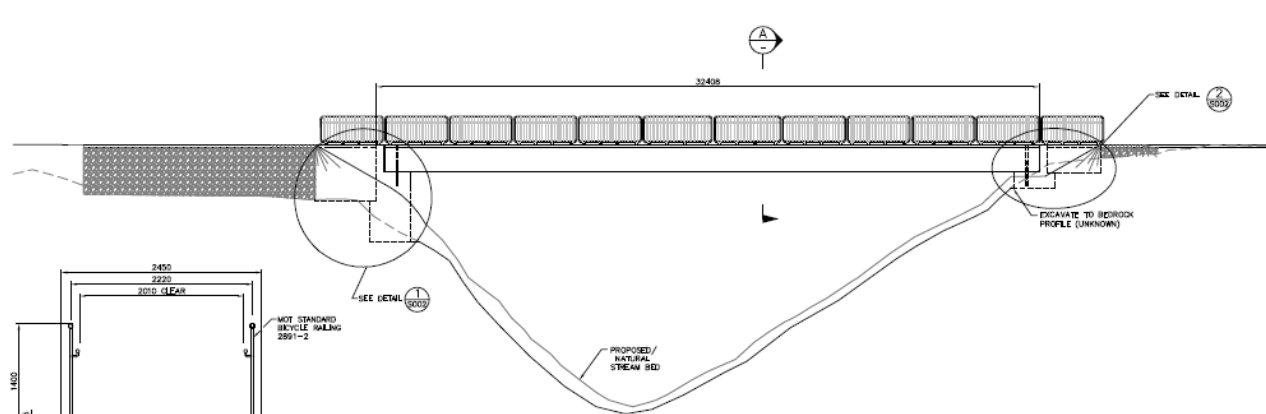
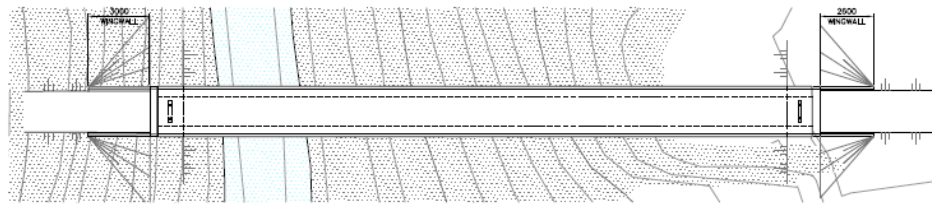


LOWER RESERVOIR RENATURALIZATION



RESERVOIR BOTTOM AFTER RENATURALIZATION





SECTION (A)
SCALE 1:50

1. BRIDGE DIMENSIONS AND ABUTMENT LAYOUT WILL BE FIELD
CONFIRMED WHEN BEDROCK IS EXPOSED DURING DAM
REMOVAL.

DRAFT

DRAWING REVISIONS										ORIGINAL TITLE		CLIENT  CITY OF NANAIMO PARKS, RECREATION AND SPACES	PROJECT					
										DRAWN: _____	DESIGNED: JP		CHECKED: _____	APPROVED: _____	IS A MATERIAL PROPERTY OF THE CITY OF NANAIMO AND IS NOT TO BE REPRODUCED OR TRANSMITTED IN ANY FORM OR BY ANY MEANS, ELECTRONIC OR MECHANICAL, INCLUDING PHOTOCOPYING, RECORDING, OR BY ANY INFORMATION STORAGE AND RETRIEVAL SYSTEM, WITHOUT PERMISSION IN WRITING FROM THE CITY OF NANAIMO	CHASE RIVER DAM REMOVAL AND RE-NATURALIZATION		
											TITLE							
											MIDDLE DAM BRIDGE PLAN & ELEVATION							
A		SUBMITTED FOR REVIEW		2015-04		MB	JP				SCALE							
revision		DESCRIPTION OF REVISION		(DATE)		BY	REASON	APPROVED			AS NOTED	PROJECT NO. AGS1330A01	DWG. NO. 5001	REV. A				

DAM REMOVAL COST ESTIMATE

- Dam removal cost estimate conducted in tandem with rehabilitation/replacement
 - Rebuild option involved dam removal
 - Some rehab/rebuild options included renaturalization
 - The unit costs used in this cost estimate were peer reviewed as part of Hatch 3rd party review
- Based on KCB, Gemella and City experience with costs for the various tasks and “pay items”

COST ESTIMATE SUMMARY

- Total cost of \$5.5M, excluding contingency,
 - \$6.3M including engineering and City costs and taxes and contingency
 - Detailed breakdown of costs (45 cost items)