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TOWN OF COMOX
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STRATEGIC PLANNING COMMITTEE MEETING

AGENDA FOR WEDNESDAY JANUARY 20, 2021

We respectfully acknowledge that we live, work and play on the traditional lands of the K'ómoks First Nation ... Gila'kasla ... Hay ch q'a'

NOTICE is hereby given that, pursuant to Ministerial Order, this meeting will be conducted by electronic means with some or all members of Council participating electronically. Further, in accordance with Ministerial Order, the public will not be permitted to be in attendance. The meeting will also be live-streamed on the Town's YouTube pages.

Public Question Period takes place at the end of each Meeting. Questions concerning agenda items can be emailed to agenda@comox.ca during each meeting. Questions will be read out at the meeting and responses provided. Please include both your name and address for identification purposes.

Meeting Location: Council Chambers, 1801B Beaufort Avenue, Comox

Call to Order: 5:00 p.m.

Adoption of the Agenda

NOTICE IS HEREBY GIVEN THAT A VIRTUAL PUBLIC HEARING HAS BEEN SCHEDULED FOR 06:00 PM, IN ORDER TO CONSIDER THE FOLLOWING: REZONING APPLICATION RZ 19-4 (1564 BIRCH AVENUE)

1. DEPARTMENTAL UPDATES:

2. STRATEGIC PRIORITIES REPORT:

(5) a. Strategic Priorities Report

That the Strategic Priorities Report for January 20, 2021 be received and filed for information.

3. DISCUSSION ITEMS: NIL

4. STAFF REPORTS:

(25) a. Grant Application – FCM Municipal Asset Management Program (MAMP)

That Council direct staff to apply for a grant opportunity from the Federation of Canadian Municipalities' Municipal Asset Management Program for Sanitary Sewer Condition Assessment Program for additional Sanitary Sewer Condition Assessment;

That Council commit to undertaking Sanitary Sewer Condition Assessments as proposed in the application to FCM, should the application be approved;

And further that Council commit towards $10,000 of the Sanitary Inflow and Infiltration (I&I) operating budget toward the costs of this initiative.

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(27) b. Grant Application – Investing in Canada Infrastructure Program, COVID 19 Resilience Infrastructure Stream

THAT Council formally authorizes Staff to proceed with an application for the Investing in Canada Infrastructure Program, COVID 19 Resilience Infrastructure Stream for Comox Avenue Sidewalk Extension (south side) between Rodello Street and Ellis Street;

And further, that the Town of Comox will fund from its general reserves any costs for the project which are ineligible for reimbursement.

(29) c. NE Comox SWMP Implementation - Post Public Consultation

THAT the Town prepare NE Comox SWMP implementation bylaws for Council consideration based on Option 3 as outlined in the staff report PR 21-1 dated January 20, 2021 and;

THAT Administration consider technical submissions which may alter the requirements such as slope that may be suited considering the needs contained within option 3.

5. CORRESPONDENCE:

(245) a. Dogs Off-Leash in Town Parks

ADJOURNMENT

CORPORATE OFFICER

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TOWN OF COMOX – STRATEGIC PRIORITIES REPORT - CAO January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
1.	Build on K'omoks First Nation Relationship	Create increased communication between both Administrative and Council levels to ensure a strong and harmonious relationship.	Meeting between CAO's took place on June 23rd 2020 Council to Council meeting agreed upon but not date determined as of yet. Last follow up: August 2020
2.	Mack Laing Trust	Modification of the Mack Laing Trust in order to reach a resolution of on the Shakesides building future.	Court hearing to be scheduled to determine terms of trust. Awaiting direction from the Solicitor General.
3.	Garbage Collection and Organics Program	Provide weekly organic and bi-weekly garbage and recycling pick up to residents with curbside service.	The construction of an organics facility by the CVRD has been delayed due to lack of interest in the RFP. The town will remain with current service levels until surety is reached on organics processing capabilities.
4.	Review of Council Remuneration	A Council Remuneration Advisory Group be established in order to determine fair and reasonable compensation levels for the Town of Comox Mayor and Councillors.	A new report seeking clarification on next steps expected in December
5.	Asset Management Funding Linkage	To develop an understanding of the replacement cost of all Town assets and develop a funding strategy.	Finance presentation on budgeting on November 18th
6.	Marina Park Vendor Policy and Program	A policy to regulate in a fair and consistent manner access for street vendors at Marina Park as well as address ongoing garbage issues.	
7.	Marina Park Enhancement and Parking Improvements	Development of a plan to increase youth enjoyment at the park, alleviate parking issues, and expand Marina boat rentals.	
8.	Shovel Ready Grant Project Strategy	Development of shovel ready projects for grant opportunities.	A grant writer has been hired with grants totaling over $4,000,000 applied for. Announcements expected in the new year.
9.	Town Website Rebuild	Overall development of new Town website and a rebranding process.	Project targeted for start in late 2020/early 2021.
10.	RCMP Cost Review	Examine and provide rationale for increased RCMP costs.	Waiting on information from Courtenay

TOWN OF COMOX – STRATEGIC PRIORITIES REPORT - CAO January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
11.	DL 194 Parks Property Transfer	Agreement with Province and KFN to lease the park property for 99 from KFN.	Agreement and Parks Management framework have been sent to KFN. Awaiting response and meeting.
POLICIES			
12.	Council Conference Attendance Policy	A staff report to be provided on the effectiveness of providing individual annual spending limits for Council members' conference attendances.	
13.	CAO Performance Review Policy	Develop an annual review process for the CAO.	Complete.
14.	Senior Staff Performance Review Policy	Develop an annual review process for all senior and exempt staff.	***Complete.***
15.	Exempt Staff Benefits Policy	Develop a salary and benefits policy for all exempt staff.	***Complete.***

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TOWN OF COMOX - STRATEGIC PRIORITIES REPORT - PLANNING SERVICES January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
1.	Subdivision Bylaw: Update	Rewrite of current bylaw. Includes clarification of what Town infrastructure works are required at time of building permit differentiated by land use, new infrastructure construction inspection and verification requirements, revised subdivision application processing procedures, and introduction of driveway access permitting procedures.	Rough draft of new specifications, permits and application processing requirements completed. Next step is creation of final draft documents and completion of legal review. Given the procedural and technical complexity of this document, creation of final draft document needs be undertaken by Director of Works and Director of Development Services.
2.	Open House - Climate Crisis Climate Change Adaptation Strategy	That an open house be held on the topic of Current Town of Comox Strategic Priorities and Climate Crisis and Adaptation at a future date to be determined by staff.	Council has placed this as a low priority to be started once other projects have been completed.
3.	Decrease Processing Times	Overall effort to decrease the amount of time it takes to receive and respond to applications.	Additional planner hired and backlog of applications likely to decrease end of year 2020.
4.	Draft Anderton Corridor Land Use Plan	To provide a land use plan for modeling of infrastructure servicing for future public consultation.	Project on hold until Northeast Comox issues resolved.
5.	Report for Affordable Housing and Short Term Rentals	That staff be instructed to prepare a report on: a. Options for local government provision of affordable housing; b. Options for the use of rental zoning; and c. Impact of short term rentals on the supply of affordable housing, including an allowance for rental of primary units. That the Town request that the Comox Valley Regional District amend its Development Cost Charge Bylaws (DCCs) to exempt from required DCCs payments the construction or alteration of self-contained dwelling units in buildings in which each unit is not larger than 45 m2.	Complex issues that will require considerable staff time to complete. Current priority is working with developer at 695 Aspen to achieve some affordable housing in this project. Letter sent May 24, 2019 from Mayor to CVRD chair. No update received to date.

TOWN OF COMOX - STRATEGIC PRIORITIES REPORT - PLANNING SERVICES January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
6.	Urban Food Production	That Council support urban agricultural opportunities and increase food security by directing staff to receive and consider feed back from the Planning department, the Comox Valley Food Policy Council, community associations, and residents, and develop options in a report to Council to allow small-scale commercial urban food production, including but not limited to chickens (not roosters), bees and urban farmstands on all residential property within the town of Comox.	Town and Courtenay staff coordinating research and policy development. Project is in its initial stage, no timeline for completion as of yet.
6.	Downtown Vitalization Zone Expansion	Amendment of Downtown Vitalization Program with includes Revitalization Tax Exemption, Priority Planning and Building Permit application processing and reduced application processing fees to include multi-family and commercial development along Comox Ave to Town's west boundary including closed Comox Elementary Site on Rodello.	
8.	Heritage Registry Report	That a staff report be provided on whether a Heritage Registry be created within the Town of Comox.	Direction required from Council as previously noted in the Management Report as "not a strategic priority of Council".
9.	Town Website Rebuild: Planning and Building Permitting	The website will highlight all development procedures for simple and complex buildings, zoning application, zoning rules, building permit applications, and other items pertaining to development and zoning.	
10.	Participation in CVRD Regional Poverty Reduction Strategy	Joint project of CVRD, Cumberland, Comox, Courtenay, and K'omoks First Nation. Lead by the CVRD to undertake a regional poverty assessment and reduction strategy to promote awareness of local poverty, identify systemic barriers that facilitate the cycle of poverty, and provide an action plan to reduce Comox Valley poverty by at least 25% by 2024 (over 2016 baseline levels).	Consultant hired and currently preparing engagement plan and community profile.

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TOWN OF COMOX - STRATEGIC PRIORITIES REPORT - PLANNING SERVICES January 20, 2021			
MAJOR DEVELOPMENT APPLICATIONS			
11.	2310 Guthrie	42 townhouse units and approx. 530 sq. m of commercial space.	Nov. 25 2020 RCM – Bylaws Adopted.
12.	2309 McDonald	22 Townhouses, 8 duplex units, approx. 50 single family lots of varying lots sizes.	Bylaws given 3rd Reading Nov 25, 2020. Next step is applicant resolution of outstanding issues.
13.	468/490 Anderton	15 duplex / townhouse units.	Next step: Issuance of preliminary subdivision approval by Approving Officer and Planning Report on 1st and 2nd reading of Rezoning Application.
14.	1582 Balmoral	52 apartment units (BC Housing Subsidized for 55+).	DVP and DP issued September 2, 2020.
15.	695 Aspen-Affordable Housing Contract	6 apartment units purchased by Town using Affordable Housing reserve funds with BC Housing Mortgage, operated as affordable housing by Makola Housing.	Next step: Public Notification of Council intent to lease 6 housing units and commercial space at below market rates to non-profits for affordable housing and daycare purposes
16.	North East Comox Storm Water Management Plan	Implementation of North East Comox Storm Water Management Plan.	Open House held on Nov 20. Comment sheets being received. Next step - staff report on results on open house.
MINOR DEVELOPMENT APPLICATIONS			
17.	Parklet Adaptation and Winterization applications	Expansion of Temporary Patio & Parklet Program created 20-May-2020 and permanent parklet program to allow for additional facilities necessary to support winter operation.	BIA has provided information on what winterization facilities are being considered. Staff are working with interested businesses as to their specific plans.
18.	7-10 Minor RZ/DP/DVP Applications	Includes: • provincial referral of recreational cannabis store application • rezoning, DVP applications for infill single family • hazardous area and environmental DP applications for single family • industrial and residential rezoning applications as a result of bylaw enforcement	Cannabis Licence Review Application – 278 Anderton Road (Prime Cannabis) – Letter sent to provincial Liquor and Cannabis Regulation Branch advising of Dec 16 2020 RCM resolution of support of provincial license issuance.

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TOWN OF COMOX – STRATEGIC PRIORITIES REPORT – CORPORATE January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
1.	Policy Manual Creation	Creation of a policy manual that will include all Town policies organized by department.	Current focus on Council policies (55 policies to be reviewed). Policies added in 2020: CAO Performance Review, Fire Deployment to Outside Areas, Criminal Record Check, Bylaw Notice Screening Officer, Council Meeting Video Recording, ***Proclamations,*** ***Flag Raising,*** ***Exempt Staff Performance Review Policy,*** ***Exempt Staff Benefits Policy,*** ***Exempt Staff Salary Policy,*** ***Personal Use of Town Assets and*** ***GPS Fleet Management*** .
2.	Council Procedure Bylaw Update	Update of Council Procedure bylaw.	Complete.
3.	Records Management System - Administration	Review/synchronize existing physical system with electronic system. Retention and destruction of physical records.	Review initiated. May require hiring of casual staff. May require Records Management Policy and IT support.
4.	Boundary Extension Request – Torrence Road	Boundary extension proposal in the Noel, Torrence and Lazo Roads area.	Discussions held with Ministry staff regarding condition of Lazo Road and Town desire for grant funding or improvements to be made prior to bringing it into Town boundary. Ministry staff advised that it is not a priority for them for the next few years. Property owner of Northern three parcels asked to be removed from application**.** Property owner initially requesting boundary extension has confirmed interest in proceeding, which will be considered in 2021.

TOWN OF COMOX – STRATEGIC PRIORITIES REPORT – CORPORATE January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
5.	Town Website Rebuild and Town Rebranding	Development of overall look for website plus Corporate Administration Departmental Section – Council information, meeting schedules, bylaw enforcement, elections, reports and publications, news, etc. Project to consider Town of Comox rebranding process to coincide with new website.	***Work on Request For Proposal has been initiated.***
6.	Council Delegation Bylaw	Bylaw outlining and authorizing the powers, duties and functions that Council wishes to delegate.	Draft bylaw for Council consideration in early 2021.
7.	Review of Corporate/Legal Agreements	Establish a system to better manage the requirements (payments, insurance renewals, agreement renewals, etc.) of various corporate and legal agreements.	Database management system established. Review of over 700 legal agreements initiated.
8.	Solid Waste Collection Changes	Review of solid waste collection program – bi-weekly garbage collection, collections of organics from strata properties, collection on Statutory holidays. Development of communication and implementation plan.	Council resolution July 15 to move towards bi-weekly garbage collection. ***Implementation to coincide with opening of new organics processing facility.***
9.	Bylaw Notice Adjudication System	Development and implementation of a Bylaw Notice Adjudication System as an alternative to the provincial court for resolving minor local government bylaw contraventions.	Bylaw adopted Nov 4 RCM. Awaiting adjudicator appointment by Province.
10.	Marina Lease Renewal	Renewal of lease with Provincial government for Comox Municipal Marina.	Notice of Final Review received from Province. ***Agreement signed and forwarded to Province. Complete.***
11.	K'omoks First Nation Fire Protection Agreement	Renewal of agreement with K'omoks First Nation for the provision of fire protection services on KFN land.	Report to Council to be provided on Nov 25 RCM agenda. Awaiting Council approval of K'omoks First Nation.
12.	SPCA Agreement	Renewal of agreement with the SPCA for the provision of dog kennel / animal control services.	Exploring options for the provision of dog kennel / animal control services.
13.	Solid Waste Collection – Statutory Holidays	Prepare for closure of the landfill on Stat holidays beginning January 1. May require Add-a-Day schedule and communications strategy for residents.	Town 2021 collections calendar and notification letter to residents and commercial businesses delivered week of Dec 14. Website updates and social media posts beginning week of Dec 7, complemented by print advertising and a press release. ***The adjusted schedule started Jan 5, and***

TOWN OF COMOX – STRATEGIC PRIORITIES REPORT – CORPORATE January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
			generated a number of questions from residents. Staff/Emterra addressed all and missed collections were picked up. Individual collection maps being prepared and will be posted to website to provide clarity on routes.
14.	Hire Communications Specialist	Staff included in the 2019 budget, the provision of salary to hire a communications specialist.	Complete.
15.	COVID Safety Plan	Develop COVID-19 Safety Plan for Town Hall/Finance, d'Esterre House.	Complete.
16.	Economic Recovery in Comox	Communication strategy (report) highlighting the work Council and the Town have undertaken to promote economic recovery in Comox	Initiatives and measures that have been undertaken by the Town and Council have been shared via social media channels, and will continue to be shared as appropriate. ***Complete***.
17.	Increased Affordable Childcare Spaces	Communications plan highlighting the need for increased affordable day care spaces	
18.	Flag and Proclamation Policy Development	Prepare two draft policies for Council review and consideration to help guide requests for Town support of proclamations and flag raisings.	***Complete.***

TOWN OF COMOX - STRATEGIC PRIORITIES REPORT – FINANCE January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
1.	Asset Management Replacement Funding Strategy	The Town of Comox has built its asset management road map, which has provided the path for the Town to most strategically improve their asset management capacity. The staff & Council are funding their road map & are continuing to improve their capacity. The Town has also completed an asset management plan & is currently identifying the annual revenue requirements to meet their risk & level of service performance targets. The challenge the Town now faces relates to determining how to increase current funding levels to meet the identified revenue requirements while taking into consideration affordability, impact on reserves, debt levels etc.	The Town of Comox is proposing to build a Long-Term Financial Plan for their General, Water & Sewer Funds to ensure they have the financial means to replace their assets when needed. This will ensure the Town can bridge its funding gap in a sustainable manner. Below are the proposed activities for this project: 1. Compile existing financial data & information required to build the long-term financial plan (for November 2020). 2. Build Long-Term Financial Model & Plan (for January 2021). 3. Develop Long-Term Financial Plan Report (for February 2021).
2.	Payroll Software adoption	Payroll is running through the new Ceridian Dayforce web application.	1. Training for managers is being scheduled to be completed in September 2020. 2. Major user features: a) "banked balances" to be delivered to end-users November 2020. 3. Other adaptions identified will be scheduled for the new year.
3.	Conversion of municipal accounting codes and work orders	Updating the Town's chart of accounts improves department budgeting/reporting and streamlines the work for the year-end financial statements. Redesign of the Account framework started in 2018 and is ready to be finalized and converted.	Chart of accounts final review – September 2020. Work Order final setup and review – October 2020. Conversion completes – November 2020.
4.	Fiber Optics (network backbone)	Fiber optics installed connecting all municipal office buildings to create a single domain for the organization. Benefits include improved reliability, flexibility for the future, and lower total cost of ownership.	90% completed. The last-mile connection needed from Telus and final connections from Teraspan is anticipated by November 2020.
5.	Phone System Replacement	The current phone system is outdated, and replacement phones are no longer built.	***Launch expected February 2021. Training and porting of lines January 2021.***

TOWN OF COMOX - STRATEGIC PRIORITIES REPORT – FINANCE January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
6.	Online account balances and payment option	To provide online access to Town billing balances, including property taxes, utility billings, marina moorage, business licenses, and other Town receivables. Payment may be made online with a credit card, where the card merchant fee is charged to the payor.	Commence in fall 2020. Once the configuration completes, a link will be placed on the Town's website in December 2020.
7.	Accounting Software: Accounts Payable, Purchase Orders, and Inventory to move to a cloud-based software solution.	The Town's paper intensive accounts payable software, lack of a working purchase order solution, and outdated inventory software is time-intensive and lacks the internal controls needed both now and in the future. The new work orders are required for providing sub asset categories to the new asset management system.	This project has not started. To be brought to capital budget deliberations for 2021.
8.	Town Website Rebuild	A new website allows clear paths to yearly financial documents and pages to answers questions on property taxes, Utility billing options, and other financial services.	This project has not started. To be brought to capital budget deliberations for 2021.

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TOWN OF COMOX - STRATEGIC PRIORITIES REPORT - PARKS/BUILDING AND MAINTENANCE January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
1.	Wayfinding Project	Identification of key areas within the Town.	Complete. 30+ signs have been installed.
2.	Lazo Greenway Development: Detailed Design	Multi use pedestrian path from Forester to Guthrie along Lazo	Deferred 2021 design construct 2022. Applied for grant. Investing in Canada Infrastructure Program – Community, Culture, and Recreation Program October 1, 2020.
3.	Off-Leash Dog Park Creation	That a public consultation process regarding the feasibility of a dog park be undertaken, for an amount up to $20,000.	Looking at two leash optional areas – fenced in area plus larger trailed area. Meeting with KFN requested in order to discuss use of a portion of Northeast Woods. Project deferred to 2021. Letter sent out to SD 71 for use of portion of Comox Elementary School November 5, 2020 for interim off leash dog park.
4.	695 Aspen Daycare Construction Management and Affordable Housing Units	12 infant spaces and 16 preschool spaces for a total of 28 for childcare. Affordable housing quality control and assurance.	
5.	Marina Condition Assessment	The physical structure of some aspects of the Marina have started to degrade. Repair and replacement will be guided by this assessment.	Boat launch float replacement deferred to 2021.
6.	New Garbage Truck & Tractor	New mechanized 3-tonne garbage compactor truck to modernize and improve the garbage collection program for the Town's public parks, gathering spaces, and pedestrian hubs. Tractor to replace existing 26 year old tractor that is past its life cycle.	Complete.

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TOWN OF COMOX - STRATEGIC PRIORITIES REPORT - PARKS/BUILDING AND MAINTENANCE January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
7.	Town Website Rebuild	Parks maps/locations/ park use permits/tree permits etc./ wayfinding/trails/water park/projects/community stewardship partners projects.	
8.	COVID Adaption for Parks and Public Restrooms	Review improvements to ensure public health and safety.	
9.	Service Contract for Building Maintenance Tender	Current contract ends September 2020	
10.	Parks Job-Description Review	Redefine parks Job Descriptions to include specialized positions (arborist/irrigation technician/etc.)	
11.	Garbage Collection Efficiency Review	Redesign of public refuse collection program - adapting to new refuse collection vehicle	2021 - new refuse vehicle to arrive early 2021.
12.	***Roof Between Sail Buildings***	***Construction of a roof between the two sail buildings***	
13.	***Waterfront Walkway***	***Exploration of options for completion of the walkway from the Marina west to Ellis Street***	

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TOWN OF COMOX - STRATEGIC PRIORITIES REPORT - PUBLIC WORKS AND ENGINEERING January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
1.	Anderton Servicing Plan [water/sanitary and storm]	To provide an overall conceptual plan for the provision of water, sanitary and storm services to the lands that were annexed to the Town in 2016 (2309 McDonald Road, 941 Aspen Road and 2077 Hector Road) as well as the entire catchment boundary so that plans can be implement as development takes place. Same principles of that of NE Comox applied to the servicing plan.	75% complete. On hold until NE Comox issues resolved.
2.	Subdivision Bylaw Update	Rewrite of current bylaw. Includes clarification of what Town infrastructure works are required at time of building permit differentiated by land use, new infrastructure construction inspection and verification requirements, revised subdivision application processing procedures, and introduction of driveway access permitting procedures.	Rough draft of new specifications, permits and application processing requirements completed. Next step is creation of final draft documents and completion of legal review. Given the procedural and technical complexity of this document, creation of final draft document needs be undertaken by Director of Works and Director of Development Services.
3.	Foreshore Sanitary Replacement	Upgrade section of sanitary that was identified in the 2013 Town of Comox Sanitary Model Update study in anticipation of the re-purposing of the St. Joseph's facility or eventual reconstruction within the site. Also in response to continued operational issues and age of main.	Delay is getting DFO approval will work with KFN and project watershed to discuss projects that could potentially assist with the restoration requirements.
4.	Transportation Plan: Update	Minor update to the 2011 Comox Transportation Study to confirm capital projects and needs are still current.	75% completed.
5.	North East Comox Stormwater Management Plan	Stormwater system and associated bylaws required to allow development in the Northeast Comox area	North East Comox Stormwater Management Plan in-person Open House cancelled due to COVID, replaced with virtual meetings, as well as encouraging virtual engagement via online review of information boards and the submission of Comment Forms between November 20-30.

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TOWN OF COMOX - STRATEGIC PRIORITIES REPORT - PUBLIC WORKS AND ENGINEERING January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
6.	Anderton and Robb Intersection Improvements	Draft transportation study recommended installation of rectangular rapid flashing beacons (RRFP) to further improve pedestrian safety due Anderton being arterial road and high traffic volumes as well as a high pedestrian use due to its connectivity to Robb Road School and Comox Community Centre.	Installed November 9, 2020. Completed
7.	Dryden Watermain and Multi Use Path	To loop watermain to improve water quality identified in Water Study as well to construct a multiuse trail to provide regional linkage to NE Comox from Courtenay.	Design complete need to secure statutory right of way.
8.	Noel Avenue Upgrade (Pritchard to Torrence)	Works include road resurfacing, sidewalks, curb and gutter and bike lanes. Also replacement of the existing 900 mm diameter CMP and 1500 mm x 900 mm arch CMP crossing Noel Ave which conveys flows for Brooklyn Creek.	Completed.
9.	Sidewalks South side of Comox Avenue (Rodello to Ellis)	Design exercise to review the costs implications of the project.	Design 95% complete. Will be shovel ready and will keep eye on grant opportunities. Need to coordinate with LWMP conveyance timeline.
10.	Port Augusta/ Comox Avenue turning radius	To improve turning radius for buses per the new transit exchange location.	Design complete.
11.	Torrence and Balmoral Road upgrade	Works include road reconstruction (of 478 linear meters), concrete curb and sidewalk, storm and sanitary sewer installation, and line painting on Balmoral Avenue and Torrence Road from Donovan Drive to Albatross Avenue.	Design Complete. Applied for grant September 2020. Investing in Canada Infrastructure Program – Rural and Northern Communities Program deadline October 22, 2020. Total project $1,156,660 - Eligible $1,040,994
12.	Manor Outfall Improvements	Design and construction of outfall to mitigate ongoing erosion over bank at 141 Manor Place.	Design complete, DFO approved. Working with property owners on construction impact and need to perform test holes to confirm soil conditions.
13.	Sidewalk Bolt and Aspen	To improve pedestrian connectivity and safety which serves Aspen School, high residential area as well as high commercial site.	Design complete. Shovel ready and will keep eye on grant opportunities.

TOWN OF COMOX - STRATEGIC PRIORITIES REPORT - PUBLIC WORKS AND ENGINEERING January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
14.	Town Website Rebuild	Permits/studies/maps/projects/sectors transportation, water, storm, sewer, / reports.	
15.	Downtown Parking Strategy	Overall review of parking in the downtown to consider more temporary parking spots and diagonal parking along Church Street.	Work with BIA fall 2020.
16.	Traffic Calming Measures and Speed Limits	Review of current traffic calming measures and speed limits within Comox.	

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TOWN OF COMOX - STRATEGIC PRIORITIES REPORT - FIRE January 20, 2021			
ITEM	SUBJECT	PROJECT DESCRIPTION	STATUS
1.	Volunteer Retention/ Recruitment Updated Nov.2020	Retention and recruitment of volunteer firefighters has been a significant issue in North America for at least the past twenty years. Our department has experienced about a twenty percent turnover every year for the past decade. While this would cripple most organization we have been able to managed our way through it.	So far in 2020 seventeen members have left the department and they have been replaced by seventeen more. We have been very successful in recruiting and training new members however retention is difficult. This is largely because of the lack of good paying jobs and affordable housing in our area. Because of our capable staff and training centre we believe we are well positioned to continue to manage this turnover effectively for several more years, while providing above average services. A new recruitment class (9) was start in September 2020.
2.	Wildfire Deployment Policy	For many years our fire department has provided assistance to the province (when requested) during wildfire season by deploying some of our resources outside of our typical jurisdictional areas. In the past the CAO and Fire Chief would authorize these deployments and advise Council afterwards.	Council approved a new policy in August of 2020. We did not received any provincial requests for assistance in 2020.
3.	Sound of Life-Smoke Alarm Program Updated Nov.2020	For almost thirty years now our fire department has been providing and installing free smoke alarms to citizens in single family homes in our community. We strongly believe that by doing so we can reduce injuries/deaths and damage caused by fires. To date we have given away over 2000 smoke alarms. Most of this program is funded by donations from our firefighters and other groups. This model is difficult to sustain.	Our smoke alarm program continues to be very successful. Late last year we had applied, through the Fire Chief Association of BC, for some free smoke alarms through a promotion from First Alert. I am very excited and pleased to report that in September we received 2000 FREE smoke carbon monoxide alarms (approx. $50K+ value) from First Alert. This should provide us with inventory to keep this program going for the next two years. To date (Nov 2020) we have delivered free alarms to all our mobile home parks, provide KFN with over 100 alarms and given away dozens to other residents.

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TOWN OF COMOX - STRATEGIC PRIORITIES REPORT - RECREATION January 20, 2021			
ITEM	SUBJECT	COUNCIL DIRECTION	STATUS
1.	Site Master Plan	Urban Systems contracted to provide a Community Centre site master plan composed of three parts: determine future building footprint; maximize customer access to and through site; develop Village Park for broad community use.	First draft plan complete. Next steps are: determine and incorporate ground capacity of geo-thermal field into plan; review plans with staff; community engagement; review and release final report.
2.	Fitness Studio: Capital Equipment	Replacement of aging fitness equipment and adding new equipment at fitness trends and customer demands change	Recommend cancelling 2020 capital purchases for additional budget savings ($20,000); resume 2021.
3.	Low Income Regional Recreation All Access Pass Program	That staff participate with the Regional District and other local municipalities to investigate options for a regional, low-income, all access pass and report to Council with the operational and policy implications.	COVID-19 delayed the regional committee's progress on this project. Once regional recreation departments complete their work staff will submit a report to Council.
4.	Town Website Rebuild	The new site will provide: • Dependable, predicable and engaging platform through which customers access recreation guides, program information and online recreation registrations • Event and calendar information • Documents and forms (program waivers, summer camp information, facility booking information, etc.) • Town and Recreation branding Reliable and consumable communication with the public and customer.	
5.	COVID Recreation Delivery Adaptation	Adapting Recreation Department services to BC Recreation and Parks, WorkSafeBC, ViaSport, provincial health authorities and other organizations' COVID-19 operating guidelines. It also involves planning responses to various COVID second wave scenarios.	The Recreation Department planned its restart in three phases. We are now in phase 3 (open Monday to Friday at 6am, open to 9pm Monday to Thursday and open weekends 8am-1:45pm) with additional programs and Fitness Studio timeslots modified for COVID-19.
6.	Hands on Farm Re-Start	Hands on Farm re-start with COVID-19 protocols for June 2021.	Not started. Restart will depend on Covid-19 conditions, current guidelines and restrictions imposed by the Hands on Farm site.

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TOWN OF COMOX - STRATEGIC PRIORITIES REPORT - RECREATION January 20, 2021			
ITEM	SUBJECT	COUNCIL DIRECTION	STATUS
7.	Active-Net Implementation	Implementation of ActiveNet recreation software, training staff, converting customer accounts and reviewing business systems	***Software went live for winter registration November 16, 2020. Project complete.***
8.	Children Summer Camp	Summer camps moved outside where possible for 2020, camp maximums reduced and other changes to ensure safety of participants.	Summer camps 2020 end September 4. Staff will review summer programming and make recommendations for 2021.
9.	Recreation Guide	Quarterly project to program, design, edit and manage Comox section of publication.	Ongoing.
10.	Programmer Weekly Hour Increase	Increase weekly programmer budgeted hours from 30/week to 35/week.	Planned for 2021 budget – special projects.
11.	Volunteer Promotion Campaign		

A1 A2

2020 STRATEGIC PRIORITIES CHART
January 20, 2021

Strategic Statement

OPERATIONAL STRATEGIES (CAO/Staff)

CHIEF ADMINISTRATIVE OFFICER

1. Build on K'omoks First Nation Relationship
2. Mack Laing Trust
3. Garbage Collection and Organics Program
4. Review of Council Remuneration
5. Asset Management Funding Linkage
6. Marina Park Vendor Policy and Program
7. Marina Park Enhancement and Parking Improvements
8. Shovel Ready Grant Project Strategy
9. Town Website Rebuild
10. RCMP Cost Review
11. DL 194 Parks Property Transfer

Policies

12. Council Conference Attendance Policy
14. Senior Staff Performance Review Policy
15. Exempt Staff Benefits Policy

Complete

13. CAO Performance Review Policy
16. Criminal Record Check Policy

PLANNING SERVICES

1. Subdivision Bylaw: Update
2. Open House - Climate Crisis Climate Change Adaptation Strategy
3. Decrease Processing Times
4. Draft Anderton Corridor Land Use Plan
5. Report for Affordable Housing and Short Term Rentals
6. Urban Food Production
7. Downtown Vitalization Zone Expansion
8. Heritage Registry Report
9. Town Website Rebuild: Planning and Building Permitting
10. Participation in CVRD Regional Poverty Reduction Strategy

Major Development Applications

11. 2310 Guthrie
12. 2309 McDonald
13. 468/490 Anderton
14. 1582 Balmoral
15. 695 Aspen- Affordable Housing Contract
16. North East Comox Stormwater Management Plan

Minor Development Applications

17. Parklet Adaptation and Winterization applications
18. 7-10 Minor RZ/DP/DVP Applications

Complete

19. Step Code 2/3 Implementation
20. Childcare Space Creation Funding Applications

FINANCE

1. Asset Management Replacement Funding Strategy
2. Payroll Software adoption
3. Conversion of municipal accounting codes and work orders
4. Fiber Optics
5. Phone System Replacement
6. Online account balances and payment options
7. Accounting Software
8. Town Website Rebuild

CORPORATE

1. Policy Manual Creation
3. Records Management System- Administration
4. Boundary Extension Request- Torrence Road
5. Town Website Rebuild and Rebranding
6. Council Delegation Bylaw
7. Review of Corporate/Legal Agreements
8. Solid Waste Collection Changes
9. Bylaw Adjudication System
11. KFN Fire Protection Agreement
12. SPCA Agreement
13. Solid Waste Collection- Statutory Holidays
17. Increased Affordable Childcare Spaces

2020 STRATEGIC PRIORITIES CHART January 20, 2021	A1 A2
Strategic Statement	
OPERATIONAL STRATEGIES (CAO/Staff)	
FINANCE <u>Complete</u> 9. Production of Audited Financial Statements 10. Production of Municipal Budget documents	**CORPORATE** <u>Complete</u> 2. Council Procedure Bylaw Update 10. Marina Lease Renewal 14. Hire Communications Specialist 15. COVID Safety Plan 16. Economic Recovery in Comox 18. Flag and Proclamation Policy Development
PARKS/BUILDING MAINTENANCE 1. Wayfinding Project 2. Lazo Greenway Development 3. Off-Leash Dog Park Creation 4. 695 Aspen Daycare Construction Management and Affordable Housing Units 5. Marina Condition Assessment 6. New Garbage Truck & Tractor 7. Town Website Rebuild 8. COVID Adaption for Parks and Public Restrooms 9. Service Contract for Building Maintenance Tender 10. Parks Job-Description Review 11. Garbage Collection Efficiency Review 12. ***Roof Between Sail Buildings*** 13. ***Completion of Waterfront Walkway – Marina West to Ellis Street***	**PUBLIC WORKS & ENGINEERING** 1. Anderton Servicing Plan 2. Subdivision Bylaw Update 3. Foreshore Sanitary Replacement 4. Transportation Plan: Update 5. North East Comox Stormwater Management Plan 6. Anderton and Robb Road Intersection Improvements 7. Dryden Watermain and Multi Use Path 8. Noel Avenue Upgrade 9. Sidewalks South Side of Comox Avenue 10. Port Augusta / Comox Avenue Turning Radius 11. Torrence and Balmoral Road Upgrade 12. Manor Outfall Improvements 13. Sidewalk Bolt and Aspen 14. Town Website Rebuild 15. Downtown Parking Strategy <u>Complete</u> 16. Guthrie/Brooklyn Cross Walk Upgrade
FIRE 1. Volunteer Retention/Recruitment 2. Wildfire Deployment Policy 3. Sound of Life-Smoke Alarm Program	**RECREATION** 1. Site Master Plan 2. Fitness Studio: Capital Equipment 3. Low Income Regional Recreation All Access Pass Program 4. Town Website Rebuild 5. COVID Recreation Delivery Adaptation 6. Hands on Farm Re-Start 7. Active-Net Implementation 8. Children Summer Camp 9. Recreation Guide 10. Programmer Weekly Hour Increase

TO:	Strategic Planning Committee	**FILE:**	1855-04 / 2021
FROM:	Shelley Ashfield, Director of Operations	**DATE:**	January 15, 2021
SUBJECT:	Grant Application – FCM Municipal Asset Management Program (MAMP)		

Prepared by:	Supervisor:	Financial Approved:	Report Approved:
Shelley Ashfield		*Clive Freundlich, Fin. Director*	*Jordan Wall, CAO*

RECOMMENDATION(S) FROM THE CHIEF ADMINISTRATIVE OFFICER:

That Council direct staff to apply for a grant opportunity from the Federation of Canadian Municipalities' Municipal Asset Management Program for Sanitary Sewer Condition Assessment Program for additional Sanitary Sewer Condition Assessment;

And further that Council commit to undertaking Sanitary Sewer Condition Assessments as proposed in the application to FCM, should the application be approved;

And further that Council commit towards $10,000 of the Sanitary Inflow and Infiltration (I&I) operating budget toward the costs of this initiative.

PURPOSE

To obtain authority from Council to apply for a grant opportunity from the Federation of Canadian Municipalities' Municipal Asset Management Program for Sanitary Sewer Condition Assessment Program for additional Sanitary Sewer Condition Assessment.

BACKGROUND

FCM's Municipal Asset Management Program (MAMP) opened in May 2020 and have seen an exceptional number of applications for its Asset management grants for municipalities. This program has been ongoing since opening in 2020 to assist Canadian municipalities in improving asset management practices with the support of MAMP funding and resources.

A second application period will begin on January 19, 2021 and must be completed within 12 months of receiving funding approval notice.

EXECUTIVE SUMMARY

Inflow and infiltration (I&I) is an ongoing concern with municipal infrastructure and as such the Town continues to deal with I&I on an ongoing basis.

I&I is when water from the environment enters the Town sanitary system and gets treated when it doesn't need to, increasing sanitary sewer costs to the Town. Infiltration refers to groundwater entering the system and inflow refers to rainwater entering the system.

The Town currently has an I&I program in place where we do an annual sanitary manhole inspections and repairs as needed. The Town's current financial plan has an annual budget amount of $20,000 for this service. Additional sanitary sewer condition assessment would provide information to support sound rehabilitation and/or replacement decisions on the sanitary sewer system. The objectives of the assessment is to evaluate sewer assets without expending unnecessary time and resources.

The funding under this grant program is 80% of total eligible costs to a maximum of $50,000.

TO:	Strategic Planning Committee	**FILE:**	1855-04 / 2021
FROM:	Shelley Ashfield, Director of Operations	**DATE:**	January 15, 2021
SUBJECT:	Grant Application – Investing in Canada Infrastructure Program, COVID 19 Resilience Infrastructure Stream		

Prepared by:	Supervisor:	Financial Approved:	Report Approved:
Shelley Ashfield		*Clive Freundlich, Fin. Director*	*Jordan Wall, CAO*

RECOMMENDATION(S) FROM THE CHIEF ADMINISTRATIVE OFFICER:

THAT Council formally authorizes Staff to proceed with an application for the Investing in Canada Infrastructure Program, COVID 19 Resilience Infrastructure Stream for Comox Avenue Sidewalk Extension (south side) between Rodello Street and Ellis Street;

And further, that the Town of Comox will fund from its general reserves any costs for the project which are ineligible for reimbursement.

PURPOSE

To obtain authority from Council to submit a grant application for the retrofit construction of approximately 720 m of sidewalk extension on Comox Avenue south side from Rodello Street to Ellis Street, this will include the installation of dedicated bike lanes.

BACKGROUND

Investing in Canada Infrastructure Program (ICIP) - British Columbia – COVID-19 Resilience Infrastructure Stream (CVRIS) goal is to create long-term economic growth, build inclusive, sustainable communities and support a low carbon, green economy. Under ICIP, the CVRIS funding is focused on building infrastructure that will help British Columbian's with the significant health and socio-economic challenges brought on by the COVID-19 pandemic by responding to specific needs of the communities. Investments in British Columbia's infrastructure will help build stronger, more inclusive communities, help safeguard the environment and the health of residents, and help support local, low-carbon green economies, as well as work towards reconciliation with Indigenous communities, both on and off-reserves.

The governments of Canada and British Columbia are investing in CVRIS to support infrastructure projects in communities across the province. Funding represents a commitment of up to $80.29 million by the Canadian and BC governments, for this stream, and must not exceed $10M of total costs per project.

The CVRIS is focused on infrastructure that will: upgrade local government and indigenous buildings, improve health and educational facilities; increase access to active transportation; and increase resilience/adaptation to natural disaster events.

Once approved, construction of projects must be able to start before September 30, 2021 and be completed by Dec. 31, 2021.

The deadline for the intake is January 27, 2021

EXECUTIVE SUMMARY

This project is shelf ready and is at 100% tender ready. The Town's current draft financial plan has the project scheduled for year 2021 with a proposed budget of $930,000, subject to grant approval.

The funding under this grant program is 100% funded of eligible costs, up to 80% Government of Canada Contribution and up to 20% Provincial Contribution.

TO:	Strategic Planning Committee	**FILE:**	PR 21-1
FROM:	Jordan Wall, CAO; Shelley Ashfield Dir. of Operations; Clive Freundlich, Dir. Of Finance; Marvin Kamenz; Dir. of Development Services	**DATE:**	Jan 20 2021
SUBJECT:	NE Comox SWMP Implementation - Post Public Consultation		

Prepared by:	Supervisor:	Financial Approved:	Report Approved:
Jordan Wall *Shelley Ashfield* *Clive Freundlich* *Marvin Kamenz*		*Clive Freundlich, Fin. Director*	*Jordan Wall, CAO*

RECOMMENDATION(S) FROM THE CHIEF ADMINISTRATIVE OFFICER:

THAT the Town prepare NE Comox SWMP implementation bylaws for Council consideration based on Option 3 as outlined in the staff report PR 21-1 dated January 20, 2021 and;

THAT Administration consider technical submissions which may alter the requirements such as slope that may be suited considering the needs contained within option 3.

PURPOSE

To inform Council of the public consultation results on options for implementation of the NE Comox SWMP and recommend Council proceed with implementation based on Option 3.

STRATEGIC PLAN LINKAGE

This Report addresses the following task identified in the 2020 Strategic Priorities Chart for Planning Services: North East Comox Stormwater Management Plan.

BACKGROUND

At the April 1, 2020 RCM, Council arose and reported that the following resolutions where passed at its March 18, 2020 In-Camera meeting:

1. That Council endorse Scenario 3 [where property owners, either individually or jointly, are granted the right to design and build detention ponds and infiltration galleries for their own properties] as the preferred solution for North East Comox storm drainage, subject to receiving comments from the area residents, property owners and the public.
2. That the Town hold an open house with residents, property owners, and the public in order to receive feedback on the preferred storm drainage plan for North East Comox.
3. That the Town provide information to property owners on the March 18, 2020 In-Camera resolutions of Council, and on the upcoming open house.

The open house was scheduled for November 20, 2020 at the Comox Community Centre.

Due to changing COVID restrictions, the open house format was modified from preregistration for in-person small groups to virtual meetings with staff. Ten parties returned comment forms and/or letters, copies of which are contained in **Attachment 1**. (Town communications undertaken to advertised the open house/virtual meetings and encourage attendance/participation, including the open house information boards, are detailed in **Attachment 2**.)

NOTE FROM CHIEF ADMINISTRATIVE OFFICER

Lands within North East Comox have been unable to develop due to downstream flooding liabilities the Town would incur. The area which lays downstream from North East Comox has been a historical flood plain and regularly floods with current storm water conditions and mitigations. The downstream area has already been the subject of a lawsuit in the past and land owners have informed the Town and its representatives that they are prepared to undertake court action against the Town should development in North East Comox increase flooding or related damage. Storm water nuisance has resulted recently in a number of court cases across BC with municipalities being found at fault or having contributory negligence. As such a cautious approach for storm water management infrastructure development is recommended.

The solution identified by engineering firms hired by land owners within North East Comox and acceptable to the Town is to construct dry detention ponds which will monitor flow and produce trackable data on flow rates. Through this system the Town will take ownership of ponds at the time of subdivision and pay for maintenance costs through the establishment of a Local Area Service (LAS). It will also provide the Town with a data cache which will show that, if working properly, post development storm flows will not exceed pre-development storm flows for events up to a 1 in 100 year nature.

Development in this area can be broken into two areas: west North East Comox and east North East Comox the latter comprise of lands unable to drain by gravity into the Knight Road Ditch. The current North East Comox Storm Water Management Plan (NE Comox SWMP) will provide servicing to the western section due to the ability of water in this area to flow into the Town's portion of the Knight Road Ditch, then into the Queen's Ditch and then into the ocean. Land below the 20m contour, due to elevation, is unable to reach the Queen's Ditch and will need to flow through the Comox Valley Regional District (CVRD) and private land. The overall engineering approach for the western section will likely apply to the eastern section as well. However, Statutory Right of Ways and agreements with the CVRD and private land owners will need to be sought. This was explored by the Comox Valley Regional District in the past with no initial success and will need to be started again. There may also exist other engineered solutions for this land not considered with the current NE Comox SWMP. It is staff's intention to restart conversations with the Comox Valley Regional District to examine viability of storm water management in the area and remain open to alternative engineered solutions for storm water in the area.

Overall Comments on Current Plan

The recommendation for the Town to move to option 3 below and allow individual ponds is based on the Town not being willing to take on the upfront risk of the infrastructure development and no single land owner being large enough to provide the 1 or 2 larger sized ponds. With the Town signaling preference for this option, land acquisition within the area has started to take place in anticipation of pond locations and to allow larger sized ponds to be constructed. Fewer larger ponds will result in lower upfront and long term costs which has provided incentive for land owners and developers to work together.

Concerns from Developers

Concerns from developers can be broken into three main areas, speed and surety, unnecessary costs, and lack of development potential.

Speed and surety: these developers would like to see the Town move as quickly as possible with a highly prescriptive plan. The feedback from these developers is generally similar to, 'tell us what needs to be done and allow us to do it as soon as possible.'

Unnecessary costs: These developers are concerned that the Town is prescribing requirements which are not needed and provide too high of a cost. These concerns center around the Town requiring ponds to be constructed to a 1 in 100 rain fall event, not allowing alternative measures of storm water abatement and the side slope requirements taking up too much land.

- 1 in 100 year storm event: current Town bylaws require construction of storm water systems to withstand this size of event. Although some developers feel this to be unnecessary, a 1 in 100 year event standard is quickly becoming, if it is not already, common place and best practice across BC. In some instances, 1 in 200 year event standards are being adopted. New MOTI standards reference the 1:100 year event and therefore it is unclear if the Town would be granted approval for a lower storm event.
- Alternative Measures for abatement: alternative measures such as cisterns, paving stones, roof gardens, and others can all provide a level of storm water mitigation. However, for such a large undertaking and the complexity of calculating these measures across large developments it is common place for municipalities to allow these mitigation measures but not permit them to decrease the size of required ponds.
- Side slope requirements: the initial side slope requirements were set at a 5:1 ratio to help ensure safety and that during dry times ponds would be accessible to the community as a type of recreational space. In moving to smaller area servicing ponds, this may be able to be changed. As an example the Town varied the requirement for the Silversmith pond to a 3.5:1 slope with fencing required. This will be examined during drafting of the implementation bylaws and the Town has requested a table of acceptable slope from McElhanney Engineering

Lack of development potential: The lands on the eastern portion of North East Comox, cannot drain by gravity into the Town's portion of the Knight Road ditch. This will mean they are not serviceable under this plan. The Town will need to work with other landowners and the CVRD to advocate for infrastructures services that will allow the development of this area.

Conclusion

There remains other options for the Town to consider in moving forward and options that were unsuccessful in the past may be viable today due to changing attitudes, increased land value, and different owners in the area. However, to consider the viability and preference for these options will require the Town to pause our current efforts and delay implementation. It is Administration's opinion that this would not be welcomed by a number of developers and landowners who wish to and can move forward under the current plan. Council has at its discretion the ability to lower the pond size requirement by decreasing the required size from a 1 in 100 year event. This action should be carefully considered as any decrease in this requirement will decrease costs for development while at the same time increasing liability risk for the Town. Option 3 provides flexibility for developers to work together to decrease costs and develop on their own timelines. While adopting a new and innovative standard such as being proposed will have a number of bumps, mistakes, and setbacks in the process, it will also provide staff and the developers a set of technical specifications to be met that will increase surety and speed in the process for all involved.

ANALYSIS/ISSUES/IMPLICATIONS

Three implementation options where presented for public comment:

Option 1 – Town construction of 1 to 2 ponds for the **service area (80 ha) as defined in the NE Comox SWMP**[1] - see Figure 1

- estimated cost of land acquisition and construction – $12.0 million to be paid by property owners within service area
    - up front payment option - approx. $200,000 per ha
    - annual payment option – approx. $12,350 per ha for 25 years

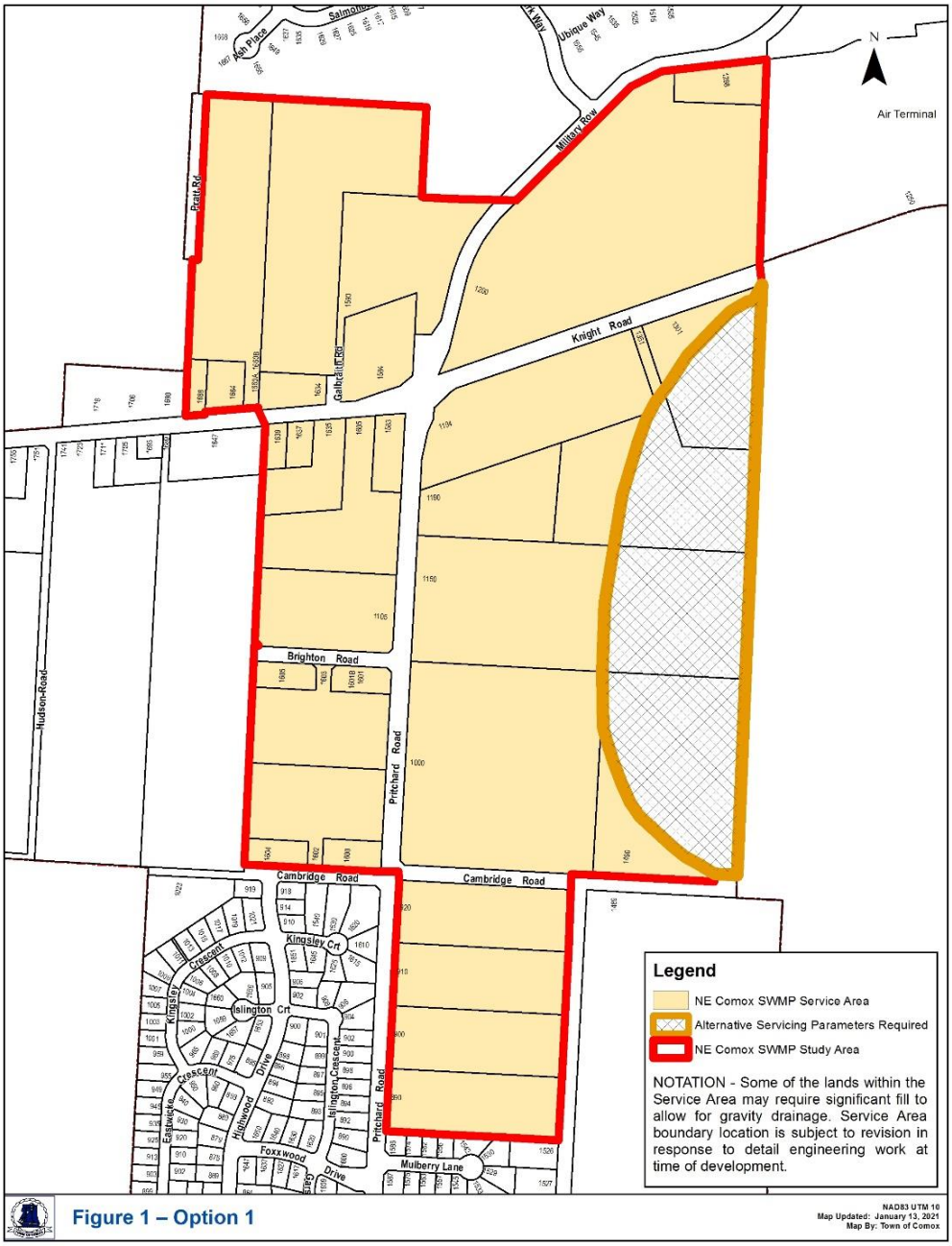

Figure 1 – Option 1

[1] While the study area for the SWMP was NE Comox only a portion (the service area) can be developed under Phase 3 Report stormwater servicing specifications.

Option 2 – Town construction of 1 to 2 ponds for approx. 31 ha sub- area – see Figure 2

- estimated cost of land acquisition and construction – $8.0 million to be paid by property owners within 31 ha sub-area
    - up front payment option - approx. $170,000 per ha
    - annual payment option – approx. $10,375 per ha for 25 years

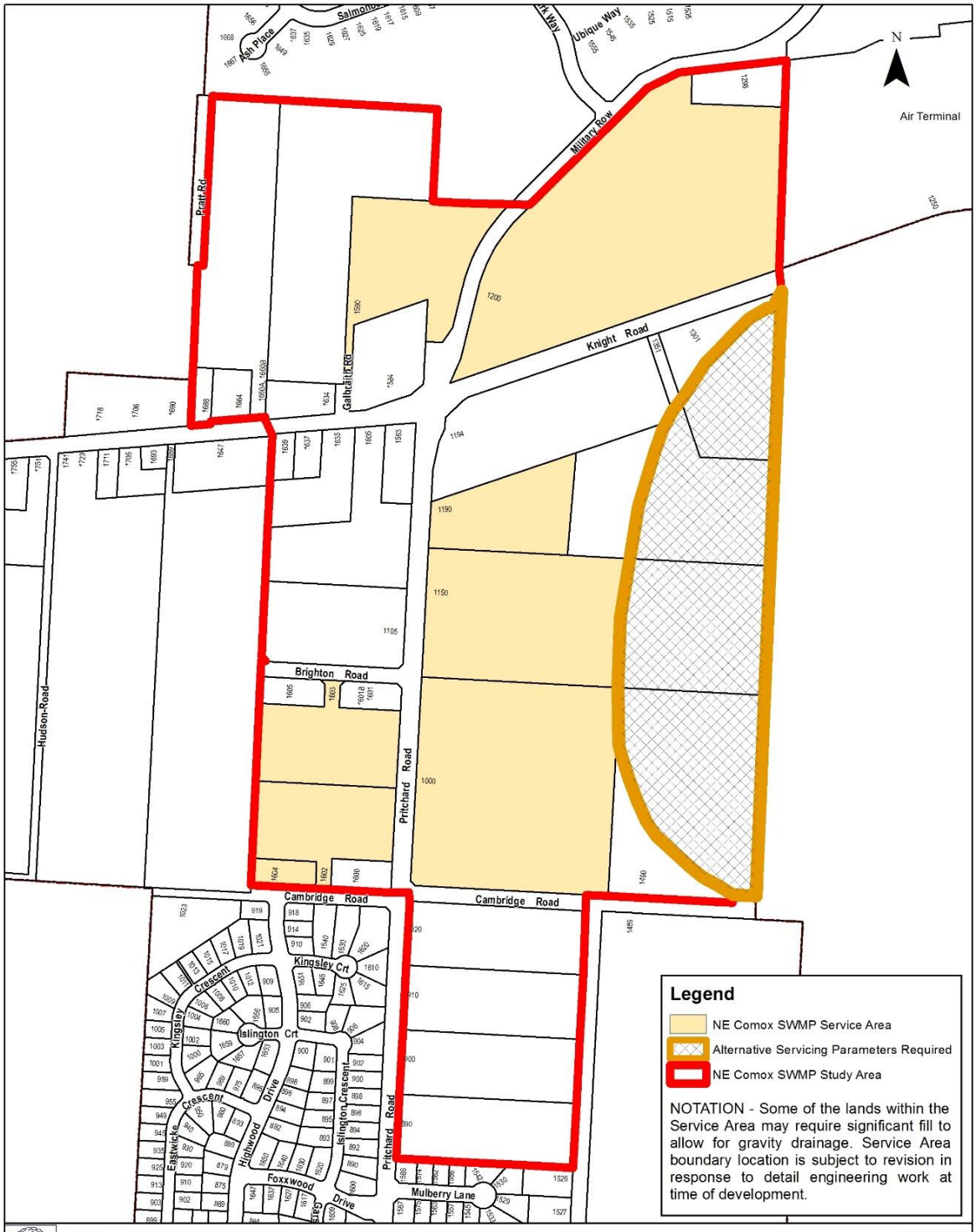

Figure 2 – Option 2

Option 3 – developer construction of detention ponds necessary to service development for **service area (80 ha) as defined in the NE Comox SWMP** - see Figure 1

- developer construction of pond to service subject property/surrounding properties (determined at time of development in relation to development interest in area of subject property)
- pond land acquisition and construction funded by developer(s), which will then be owned and maintained by the Town
- latecomer agreement option available for developer

In the public submissions (**Attachment 1**), Option 3 has the highest support.

The following is a high level overview of concerns expressed in the public submissions and corresponding staff comments. The latter shown in in italics. (A detailed overview of these concerns and staff comments are contained in **Attachment 3**.)

1. Need for pre-development professional site assessments to avoid negative environmental and ecological impacts

   No pre-development professional site assessments are proposed in the NE Comox SWMP as
   - *Existing Federal/provincial "Sensitive Ecosystems Inventory Mapping" does not identify any Sensitive Ecosystems within the boundaries of North East Comox.*
   - *The Town has a Development Permit Area in place for protection of Riparian Areas in accordance with provincial regulations **(Attachment 4)**.*
   - *Appendix G to the report "North East Comox Neighbourhood Storm Water Management Plan – Phase 3 of 3" by McElhanney Consulting Services Ltd. (dated March 1, 2018) includes certification by Cindy Lipp, Registered Professional Biologist that the SWMP will not adversely impact the existing downstream fish habitat or the environmental integrity of Lazo Marsh, and by Bob Hudson, Professional Engineer as to the ability of the SWMP to maintain surface and groundwater flows including groundwater flows and quality to Hilton Springs and Lazo Marsh (**Attachment 5**).*

2. Past deforestation within NE Comox has resulted in a major increase in water runoff to downslope NE Comox Lands. Developers should pay for necessary drainage improvements to ensure downslope properties are not negatively impacted by increased water runoff.

3. Flooding in the Lazo watershed occurs because Queen's Ditch does not have the capacity to handle existing flows. "As the Town of Comox is responsible for any downstream flooding it causes, make certain that any changes are not making the problem worse."

   *A history of flooding and limitation of Queen's Ditch capacity including restriction of discharge into the Strait by high tides and storm surges has been noted by a Professional Engineer in the report "North East Comox Neighbourhood Stormwater Management Plan – Phase 1 of 3" (**Attachment 6**).*

4. NE Comox SWMP requirement that detention ponds capacity be sufficient to address the 1:100 storm event is excessive; a 1:10 year event is sufficient and the industry standard.

   Provision of a storm drainage system designed to handle the 1:100 year storm event is an existing Town bylaw requirement. Typically, roads are used to provide an overland flood route for the major storms greater than the 1:10 year event. In

this case the downslope road and drainage system is insufficient to handle these larger events thereby requiring detention of the 1:100 event within NE Comox to align discharge with Queen's Ditch capacity limitations so as not to increase flooding.

5. Why does the Town not work with the CVRD to obtain an statutory right of way to connect to Queen's Ditch?

   In response to residents' concerns of flooding in the lowland areas, the CVRD engaged a Professional Engineer to investigate the viability of a local service area to manage drainage in the Lower Lazo Creek Watershed which includes Queen's Ditch. Five options were evaluated for improving Queen's Ditch Drainage including deepening of the ditch, diking and pumping, and managed retreat/wetland restoration ***(Attachment 7)****. Additional modeling of the managed retreat/wetland restoration option was then undertaken which showed flooding, while reduced, would continue* ***(Attachment 8)****. In addition, a separate report on the liability considerations of establishing a regional district service to control drainage was also prepared. Subsequently at its May 28, 2019 meeting, the CVRD Board resolved "not [to] proceed with further study work to investigate options for the creation of a local service area to upgrade and maintain the Queen's Ditch drainage system."*

6. "Please rename the Lands currently mislabelled "non-developable area" to "Land below 22 meter contour". This land is developable with different parameters…"

   Future reports and implementing bylaws would not label this area as non-developable but rather note that alternative servicing parameters required.

7. Need an accurate cost breakdown for maintenance costs as opposed to the preliminary estimate provided to date of 20% of the construction cost of the retention pond to determine the feasibility of any development.

   The proposed LAS is to fund the operation, repairs, maintenance, amortization and capital replacement of the required Best Management Practices (BMP's).

   Standard engineering practice is to allow for annual maintenance of 20% of construction costs until actual costs are known.

   As actual costs are unknown at this time. The preliminary budget is weighted towards over rather than underestimation to take into account the limited ability of post development property owners to finance unexpected significant cost increases especially where high ratio mortgages are involved.

a. Applicable Policies and Legislation

Comox Official Community Plan Bylaw 1685:

- Section 2.4.2.1 Utilities and Services Objectives:
  "3. To reduce post-development stormwater flows to predevelopment levels."
  "4. To require new developments or redevelopment of existing sites to be responsible for required services without subsidy from the Town."
- Section 2.4.2.6 Storm Drainage System:
  "Development of North Comox along Prichard Road, north of Highridge Drive and lands along Knight Road will require careful planning and design to protect the Lazo Conservation and Lazo Wildlife Management Areas. Additional drainage works will

be required to ensure post development flows do not exceed pre-development levels. Water quality impacts on these environmentally sensitive areas will need to be minimized and historical issues relating to the Queen's Ditch, Hilton Springs at the east end of Cambridge Road, and farming of the low lying lands addressed."

- Section 2.4.2.7 Storm Water Collection Supporting Policies:
  "a. New developments are required to provide storm water collection to protect land and buildings from flooding; generally, storm water must connect to the Town's storm water collection systems."
  "b. Stormwater management practises, which reduce the burden on infrastructure and enhance ecological and amenity values, including reducing impermeable areas, will be encouraged."
  "f New developments will be required to provide facilities to limit negative impacts to fish and other aquatic habitat."

NE Comox SWMP implementation bylaws based on Option 3 would included the following:

- Erosion and Sediment Control Bylaw – New
- Runoff Control Bylaw – New
- Highway Use Bylaw – New
- Subdivision and Development Services Bylaw – Amend
- Storm Drainage Connection Bylaw – Amend
- Building Bylaw – Amend
- Planning Application Procedures Bylaw – Amend
- Official Community Plan Bylaw – Amend
- Local Area Service (LAS) Bylaw – New
- Zoning Bylaw - Amend
  (Provision of ALR screening regulations by a Professional Agrologist are an outstanding item under the NE Comox SWMP Terms of Reference. McElhanney advises that the intent is to undertake this work upon Town decision to proceed with implementation of NE Comox SWMP.)

b. Legal

Local Government Act, Section 478:

"(1) An official community plan does not commit or authorize a municipality … to proceed with any project that is specified in the plan."

"(2)(a) All bylaws enacted or works undertaken by a council . . . after adoption of an official community plan must be consistent with the relevant plan."

c. Financial

The financial advancement of the project is two parts.

1. Developer builds the detention pond and turns ownership over to the Town.
2. The Town recovers an annual maintenance fee of 20% of the pond's construction through annual parcel taxes established in a Local Area Service.

Maintenance costs include operation, repairs, maintenance, amortization and capital replacement.

The mechanism for maintenance cost recovery is by way of an annual parcel tax in a local area service (LAS). The LAS are services for a specific area within the Town that is paid by local property owners in that area through local service taxes and/or any other means with respect to debt.

The *Community Charter* (CC) first requires a Petition and approval of 50% of owners representing 50% of the property area address in the local area service petition.

CC S.212 Petition for local area service

1. The persons who may petition for a local area service are the owners of parcels that would be subject to the local service tax for the service.
2. Each page of a petition for a local area service must do the following:
3. describe the service in general terms;
4. define the boundaries of the local service area;
5. provide an estimate of the costs of the service;
6. indicate the proposed methods of cost recovery for the service, including the form of local service tax and the portion of the costs of the service that are to be recovered by the local service tax.

After a successful petition to create a local area service to collect maintenance fees from the area properties, a bylaw for the service is created.

The Town may alter parcel tax rates up to the estimate in the petition. To alter parcel tax rates to above the estimate a new petition is required and therefore it is important to ensure costs are not underestimated

GOVERNANCE CONSIDERATIONS

Work was initiated on a number of the implementing bylaws, but not the amendment to the Subdivision and Development Services Bylaw or creation of a template Local Area Service Bylaw for pond maintenance. Should the Town decide to proceed with preparation of implementing bylaws based on Option 3, it is anticipated that adoption of the bylaws and processing of applications would allow for subdivision/development to commence in 2022.

Attachments

1	Public Submissions
2A	Town Communications Undertaken to Advertised the Open House/Virtual Meetings and Encourage Attendance/Participation, including the Open House Information Boards
2B	Letter from Mayor to NE Comox Property Owners
2C	Open House Invitation Letters to NE Comox Property Owners & Tenants
2D	Open House Newspaper Ad
2E	Open House Information Boards
3	Detailed Overview of Concerns Raised in Public Submissions
4	Development Permit Area #7 Riparian Areas
5	Appendix G to the Report “North East Comox Neighbourhood Storm Water Management Plan – Phase 3 of 3”
6	Section B to the Report “North East Comox Neighbourhood Storm Water Management Plan – Phase 1 of 3”
7	Nov 16, 2017 CVRD Staff Report to Electoral Areas Services Committee
8	May 8, 2019 CVRD Staff Report to Electoral Areas Services Committee

ATTACHMENT 1

PUBLIC SUBMISSIONS

WE WANT TO HEAR FROM YOU

1809 Beaufort Avenue
Comox, BC V9M 1R9

e-mail
town@comox.ca

fax
250-339-7110

North East Comox Stormwater Management Plan
Comments Form

The Town of Comox is providing information to the community about Council's preferred solution for North East Comox storm drainage to receive comments from the community on how this would impact community members.

Feedback:

Do you have particular comments or concerns about the preferred solution (Option III) for storm drainage in North East Comox?

It seems most appropriate that costs for storm drainage solutions be incurred by property owners / developers for their land at time of development. Costs for needed improved drainage have previously been solely paid for by the property owners for 1605 Brighton (my parents land). We need not incur further costs so others can develop their land.

Do you have any additional comments you wish to provide?

Deforestation of the parcels of land between Brighton and Cambridge resulted in a major increase of water runoff into and through the property at 1605 Brighton. This resulted in the need to install drainage pipes to divert water from the developed portion of the property to the undeveloped portion, which acts as a natural pond / flora sponge.

Submitting Your Comments

Please return your completed form via email to town@comox.ca or mail to Town Hall, 1809 Beaufort Avenue, V9M 1R9 by 4:00 PM on November 30, 2020.

We are listening.
Thank you for your comments.

For more information, see the North East Comox Stormwater Management Plan reports available at:
https://comox.ca/modx/planning-and-building.

WE WANT TO HEAR FROM YOU

1809 Beaufort Avenue
Comox, BC V9M 1R9

e-mail
town@comox.ca

fax
250-339-7110

North East Comox Stormwater Management Plan
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The Town of Comox is providing information to the community about Council's preferred solution for North East Comox storm drainage to receive comments from the community on how this would impact community members.

Feedback:

Do you have particular comments or concerns about the preferred solution (Option III) for storm drainage in North East Comox?

Has the Town finished creating bylaws relating to the SWMP? If not, what is the time line?

Has the Town considered how to reimburse property owners who have paid for the SWMP?

Has the Town costed land acquisition for ponds in Option #1 and #2?
Option #1 and #2 - the market conditions are good and the cost of borrowing is cheap.
Has these options been reconsidered?

Maintenance cost recovery seems excessive. Property owners should pay for monitoring costs to an independent party.

Do you have any additional comments you wish to provide?

There has been no communication between the Town and the affected property owners, and for that, I am very disappointed.

Respectfully submitted,
Chris Gage, 434438 BC Ltd.

We are listening.
Thank you for your comments.

Submitting Your Comments

Please return your completed form via email to town@comox.ca or mail to Town Hall, 1809 Beaufort Avenue, V9M 1R9 by 4:00 PM on November 30, 2020.

For more information, see the North East Comox Stormwater Management Plan reports available at:
https://comox.ca/modx/planning-and-building.

WE WANT TO HEAR FROM YOU

1809 Beaufort Avenue
Comox, BC V9M 1R9

e-mail
town@comox.ca

fax
250-339-7110

North East Comox Stormwater Management Plan

Comments Form

The Town of Comox is providing information to the community about Council's preferred solution for North East Comox storm drainage to receive comments from the community on how this would impact property and its members.

Comments By: Adam Ho

RECEIVED
Nov. 28, 2020
TOWN OF COMOX

Feedback:

Do you have particular comments or concerns about the preferred solution (Option III) for storm drainage in North East Comox?

Of the options presented, #3 seems to make the most sense.

Do you have any additional comments you wish to provide?

The Town of Comox is, or should be aware of the flooding problems caused in the Lazo watershed given that the Queen's Ditch does not posses the capacity to handle current water flows.

This problem is made worse by the lack of effective Queen's Ditch maintenance.

Flooding is not just in the areas downstream of the NE Comox area, but in other areas which flood because water does not flow through the Ditch at a sufficient rate.

As the Town of Comox is responsible for any downstream flooding it causes, make certain that any changes are not making the problem worse.

For greater certainty, my, and many other properties, flood not because of water falling on or flowing from applicable groundwater, but because of water flowing from other areas.

As a residential property owner, all I ask for is basic respect for my private property rights

We are listening.
Thank you for your comments.

Submitting Your Comments

Please return your completed form via email to town@comox.ca or mail to Town Hall, 1809 Beaufort Avenue, V9M 1R9 by 4:00 PM on November 30, 2020.

For more information, see the North East Comox Stormwater Management Plan reports available at:
https://comox.ca/modx/planning-and-building.

From: Rob Leighton <estimating@leightoncontracting.net>
Sent: November 24, 2020 10:16 AM
To: Town of Comox – Administration <town@comox.ca>
Subject: NE Comox Stormwater Comments

To whom it may concern,
I am the owner of Leighton Contracting, a local civil excavating company that specializes in land development. I have no interest in any of the lands in question, nor do I intend on purchasing any of them. I feel there are some fundamental flaws with the basics of the NE Comox Stormwater Management Plan that are being ignored by the Town of Comox staff. I hope this letter can be circulated to the Mayor and Council for their review and information.
I would think that Option III is the preferred option by some of the parties involved, but the dynamics of the already in place NE Comox Stormwater Management Plan is a nearly impossible document to implement. The 1:100 year flood retention onsite is an enormous volume of water for each property to retain onsite. The 1:10 year retention is a more realistic specification that is the industry standard and would certainly retain enough water to match the historical flows to the Queens Ditch from forested land. I understand this document is already approved and would be difficult to over ride at this point but each development should be given an opportunity for reduced onsite retention.
I look at this proposed developable area map and wonder why making the land below the 20m contour undevelopable is a favoured approach? The water from that entire ridge currently flows to an existing wetland with numerous aquatic species, then flows to an existing ditch on the north side of the Richards property, located in the CVRD and the ALR. If this approach is constructed it will cut off the historical flow of water to the wetland. What biologist has signed off on this plan? Shouldn't historical flows be maintained via a pond and orifice structure to keep the wetland "wet" and the ditch outlet controlled at a stabilized flow rate as per industry standard stormwater management specifications? Why wouldn't the historical flow be maintained and make everything outside the 30m setback from this wetland developable on the Semechuk, Hegg and Toews properties? I fully understand all of the history with the Queens Ditch, the perceived Town risk with the historical court case and all of the DND history, but what is being proposed is not the right solution. Why is the Town planning staff not just negotiating an SRW across the Richards property to the Queens Ditch? I'm sure with the historical flow data the Town could sit down with the CVRD and negotiate a simple solution.
The Town expects the development community to be environmentally responsible and construct the highest quality developments yet the Town is proposing exactly the opposite. I feel in this instance the Town of Comox is ignoring the basics of stormwater management and are blatantly ignoring the impact this will have on the wetland and neighbouring farmland.
It may be easier for planning staff to avoid the CVRD and ALR but it certainly isn't the right solution.
Thanks,
Rob Leighton
Leighton Contracting (2009) Ltd.
(250) 338-6460

WE WANT TO HEAR FROM YOU

1809 Beaufort Avenue
Comox, BC V9M 1R9

e-mail
town@comox.ca

fax
250-339-7110

North East Comox Stormwater Management Plan
Comments Form

The Town of Comox is providing information to the community about Council's preferred solution for North East Comox storm drainage to receive comments from the community on how this would affect [illegible] members.

RECEIVED
Dec. 2, 2020
TOWN OF COMOX

Feedback: Comments By: Julie Micksch

Do you have particular comments or concerns about the preferred solution (Option A) for storm drainage in North East Comox?

Has there been any assessments to identify if there are any existing wetlands that could be potentially impacted during the development process. Natural wetlands in themselves manage storm water until they are impacted or filled in. Treed swamps are frequently overlooked as they are less obvious than open water or marshy wetlands (i.e. Lazo Marsh) and yet they can absorb and contain storm water quite effectively. Treed swamps are frequently destroyed and replaced by engineered open water wetlands which is concerning as engineered open water wetlands often become source for invasive plants and species such as yellow flag iris, purple loosestrife and bullfrogs. If wetlands are to be constructed, they should be ephemeral to avoid the introduction of invasive species. Bullfrog tadpoles require more than one year to metamorphose and thus spread rapidly in areas with permanent waterbodies such as constructed ponds.

Do you have any additional comments you wish to provide?

- Please avoid damaging all natural wetlands by hiring a QEP to survey proposed development areas.
- All well, preliminary ecological assessments will also determine whether there are any species at risk that you need to be concerned about in the area.
- Clearing of any vegetated properties, whether previously impacted or not, should not occur during the song bird breeding season to avoid impacting ground and shrub nesting birds. Destroying any nest of any species while it is active is a violation of the wildlife act.

We are listening.
Thank you for your comments.

Submitting Your Comments

Please return your completed form via email to town@comox.ca or mail to Town Hall, 1809 Beaufort Avenue, V9M 1R9 by 4:00 PM on November 30, 2020.

For more information, see the North East Comox Stormwater Management Plan reports available at:
https://comox.ca/modx/planning-and-building.

AURORA

AURORAMJ.COM

510 Seymour St., 9th Floor
Vancouver, British Columbia, Canada
V6B 3J5

O - Cfile: 6520-20/01 (submissions)
Copies - Council
- JW/MK/SA/CF/LG/LP

LOG: 20-455	REFER:	AGENDA: --
FILE: 6520-20/0	ACTION: MR	

December 7, 2020

Mayor and Council
Town of Comox
1809 Beaufort Avenue
Comox, BC
V9M 1R9

RECEIVED
Dec. 7, 2020
TOWN OF COMOX

Re: Comments on Stormwater Management in North East Comox

Dear Mayor and Council,

The purpose of this letter is to provide comments on the proposed revisions to the North East Comox Stormwater Management Plan (NECSMP), as well as summarize the challenges Aurora Cannabis has experienced working with the Town of Comox on stormwater management during development of our research facility at 1590 Galbraith Road. I have been involved with this issue since Anandia started the project (Anandia was acquired by Aurora in 2018 and the site was transferred to them). I appeared before Council in January 2018 to discuss our development variance permit application for this site. I consulted the local Aurora team on the recent delays in completing the pond on Military Row so as to include their input in this letter.

Aurora (initially as Anandia) has worked with the Town since October 2017 on the design and implementation of a stormwater management system for our research facility (Aurora Coast). It has been a complex project that has required navigating not only the Town's requirements, but also Health Canada licensing and the rapidly changing landscape of the cannabis industry in Canada. While Aurora is both patient and experienced with stringent regulations, we have found the Town's approach to managing stormwater to be exceptionally challenging. We are over three years into the project and, through no lack of effort, have yet to meet the Town's requirements for a permanent stormwater system.

We consider stormwater management to be a key part of our commitment to sustainability at Aurora Coast. We use LED lighting to reduce our energy use, compost 100% of our cannabis and organic waste, planted our landscape with meadows, native trees and shrubs to support biodiversity, and built our main research building out of mass timber to reduce its environmental footprint. We have recruited leading scientists to staff the facility, many of whom now make their home in Comox after relocating from Vancouver and Ontario. It is disappointing to me that our commitment to build a sustainable, world-class research facility is over-shadowed by the ongoing challenges around stormwater management and the resulting strained relationship with the Town.

AURORA

AURORAMJ.COM

510 Seymour St., 9th Floor
Vancouver, British Columbia, Canada
V6B 3J5

The comments below have been divided into two sections: 1) general comments on the Northeast Comox Stormwater Management Plan, and 2) specific comments on the implementation of stormwater management on our site.

General Comments

1. **New municipal policies require a balance between regulation and incentives to support their adoption.** The Town's approach to stormwater management in North East Comox has been to overwhelm landowners with regulation and technical requirements, require them to gift high value land to the municipality, as well as pay for the design, implementation, testing, monitoring, and maintenance of the stormwater system. We consider this to be an unsustainable model even for landowners like Aurora who have stronger financial resources than many landowners in North East Comox.

2. **The burden of stormwater management in North East Comox unfairly targets a small number of landowners.** The NECSMP is directed at properties totaling about 82 ha or less than 6% of the total 1410 ha in the Lazo / North Comox catchment. This approach to managing runoff from only a small portion of the catchment is contrary the established principles of urban watershed management, avoids working with the City of Courtenay, regional district, and DND who control land use in portions of the catchment, and ignores the cumulative impacts of development throughout the catchment. We believe stormwater management requirements and their associated costs should be borne by all landowners and municipal governments in the catchment.

3. **The Town has not implemented bylaws to manage stormwater.** The ability of municipal governments to manage runoff under the Local Government Act must be exercised by bylaw. The Town has ignored this requirement and instead regulates stormwater using a vague Development Permit system and antiquated Subdivision and Development Services bylaw, neither of which specifically addresses stormwater management. The only Development Permit Area encompassing the Aurora site is "#16: Energy and Water Conservation and Reduction of Greenhouse Gas Emissions" yet the DP process was used to regulate stormwater. We consider stormwater management and erosion and sediment control without a bylaw or other Council-approved regulation to be an example of municipal over-reach. The absence of bylaws or formal regulation has in turn led to Town staff having a significant level of ad hoc control over the process to implement stormwater infrastructure.

4. **The Town's focus on detention ponds and infiltration galleries has increased costs and neglected alternative solutions for managing runoff.** Ponds and infiltration galleries are only one approach to managing stormwater runoff. Indeed, most urban municipalities in BC have broadened the number of tools for stormwater management to include green infrastructure and distributed infiltration techniques because of the cost and poor performance of detention

AURORA

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510 Seymour St., 9th Floor
Vancouver, British Columbia, Canada
V6B 3J5

ponds. Green infrastructure techniques, such as infiltration swales, rainwater cisterns, rain gardens, and permeable paving are particularly relevant to North East Comox because the area's topography and surface geology supports high rates of infiltration. We recommend the Town modernize the NECSWP and reconsider options for performance-based regulations that support a broader range of techniques and approaches for managing runoff.

5. **The Town has not adequately consulted with landowners or the public around stormwater management approaches in North East Comox.** The Town's infrequent open houses and informal communication with landowners does not replace the need to provide a forum for meaningful public consultation. We have found Town staff to be secretive about the development of the amended NECSWP. Aurora now has over three years of experience with the implementation of stormwater management in North East Comox yet Town staff have never sought our opinions or advice during the development of the proposed revision to the NECSWP.

Specific Comments

6. **The Town's engineering and planning staff are inexperienced at implementing stormwater policies and projects.** Stormwater management is a complex task and it is not unexpected that Town staff have been challenged to respond to the technical issues involved in completing Aurora's stormwater project. However, instead of addressing these challenges, the Town's has adopted an inflexible and bureaucratic approach has substantially increased costs and time requirements without any functional benefit to stormwater management. The Town will need to strengthen its staff resources to manage the implementation of the NECSWP.

7. **Town staff have frequently ignored the technical direction from professional engineers.** Aurora has worked with McElhanney throughout the Aurora Coast project and they were also the primary consultant on all three phases of the NECSMP for the Town of Comox. Yet their professional opinion on technical issues has frequently been ignored by Town staff on the Aurora Coast project. More recently we have sought professional assistance to help us navigate the Town's bureaucracy, however, it is difficult to find anyone willing to work on stormwater management in the Town of Comox because of the long history of difficulties.

8. **The high financial costs of stormwater management will limit development of North East Comox.** The financial costs of stormwater management include land, design, permitting, construction, landscaping, inspection, testing, surveying, maintenance, and monitoring. The sum of these costs is much higher than Town of Comox estimates in the NECSWP and will limit investment in North East Comox. Even for companies like Aurora with stronger financial resources, stormwater management has been a blackhole for incremental costs and staff time. While tasks like adaptive management plans, additional surveys, and infiltration gallery tests are relatively minor costs, they add to the already substantial costs of stormwater management

AURORA

AURORAMJ.COM

510 Seymour St., 9th Floor
Vancouver, British Columbia, Canada
V6B 3J5

system construction. The NECSWP will need to respond to the financial challenges Aurora has experienced if it is to successfully implemented by other landowners.

Thank you for this opportunity to comment on the NECSWP and discuss our experience working on stormwater management.

Sincerely,

Jonathan Page

Jonathan Page, PhD
Chief Science Officer

Cc: Charles Pick, VP Plant Science, Aurora
Nick Page, General Manager, Aurora Coast
Jordan Wall, CAO, Town of Comox

COMOX VALLEY AIRPORT YQQ *Where journeys begin.*

His Worship Mayor Russ Arnott and Council
Town of Comox
1809 Beaufort Avenue
Comox, BC V9M 1R9

30 November 2020

Dear Mayor Arnott and Council,

I would like to thank you for your support of the Comox Valley Airport while I have been in the Acting CEO role. The support from the Mayor, the Comox Town Council, and the staff has indeed been greatly appreciated by the entire Comox Valley Airport team, and I am certain that this close relationship will continue with the arrival of the new CEO, Mike Atkins.

Much of the assistance provided has been with regard to the subdivision process, and I am optimistic that its completion will allow us to commence development next year. This project is fundamental to our airport's growth; however, it also supports the Town of Comox's long-awaited plan to improve stormwater management in north east Comox. In addition, it establishes a baseline for further growth in the surrounding area which will no doubt spur on additional development, thus adding to the overall economic prosperity of our community.

We have carefully examined the details of the expansion project to determine an effective timeline. In order to meet several important milestones, further support from the Town of Comox is critical, especially in terms of the timely completion of stormwater management bylaws. These bylaws are required to be in place by 15 February 2021 in order to ensure that we have time to make the necessary preparations (engineering, environmental, and tendering) in advance of the optimum construction period. The Northeast Comox Storm Water Management Program (SWMP) implementation bylaws identified as critical include the following:

a. Erosion and Sediment Control Bylaw;
b. Runoff Control Bylaw;
c. Highway Use Bylaw;
d. Subdivision and Development Services Bylaw;
e. Storm Drainage Connection Bylaw;
f. Building Bylaw; and
g. Planning Application Procedures Bylaw.

Comox Valley Airport Commission | 118-1250 Knight Road | Comox, British Columbia | Canada, V9M-4H2 | 250-890-0829

Your assistance in completing the stormwater bylaw process is invaluable to the successful completion of our first expansion phase, therefore, I thank you very much for your attention to this time-sensitive matter.

Sincerely,

A. Robertson

Alex Robertson
Acting CEO, Comox Valley Airport Commission

Comox Valley Airport Commission | 118-1250 Knight Road | Comox, British Columbia | Canada, V9M-4H2 | 250-890-0829

North East Comox Stormwater Management Plan

Feedback from Comox Valley Airport

26 November 2020

1. The local Area Service (LAS) charges are our biggest concern with option 3. The Town's open house presentation featured a slide stating that the LAS was an estimate based on 20% of the construction cost of the retention pond; however, it is important to note that this is an annual expense that never ends. The construction cost of a retention pond for the property we are trying to purchase is estimated to be between $500,000 and $750,000; therefore, under the Town of Comox's model, the LAS would be $100,000 per year—an unmanageable expense even under the best of conditions. We were told that this was only a preliminary estimate, but we require an accurate figure (with the cost breakdowns) to determine the feasibility of any development. Logically, an accurate estimate for the cost of our retention pond should be available by looking at the LAS that is paid by Aurora Cannabis to maintain their pond. When queried about this precedent, we were told by Town of Comox staff that Aurora Cannabis is not paying an LAS at the present time.
2. The CVAC property at 1301 Knight Road is very difficult to develop because most of the lot lies below the elevation of the required exit point for the stormwater run-off. An extensive amount of engineered fill would be required the meet the Town of Comox requirements for development of any nature. We were happy that the Town would be open to the possibility of dividing the lot, thereby allowing the airport to recover some of its investment. We recognize that this would require maintaining the current run-off by not pursuing any development at this time, as well as concurrence from neighbouring landowners.
3. We would be interested in any follow-up regarding the town's process in having DFO relax easement restrictions for other properties in Comox, and would greatly appreciate support if we require similar assistance.

Additional Comments:

The stormwater management plan for North East Comox is clearly very challenging from a development perspective. We appreciate the support provided by the CAO, Jordan Wall, and his

staff, in assisting the Comox Valley Airport in solving property issues in a timely manner that benefits all stakeholders.

From: Richard Stephens <rkstephens@highland-eng.ca>
Sent: Monday, November 23, 2020 5:41 PM
To: Shelley Ashfield <ashfield@comox.ca>
Cc: Anne Erickson <anne@highland-eng.ca>
Subject: North East Comox Neighbourhood Stormwater Management Plan

Ms. Ashfield

My primary interest in the Town of Comox North East Neighbourhood SWMP was to see how it unfolded over the years as we have faced similar issues with the management of stormwater within our areas of practice and I was looking forward to viewing the public presentation.

I am not sure what the reference to the term LT in my phone conversation with your staff is either, but I was surprised by the Town was willing to take over the operations and maintenance of all the facilities. (Option 3)

The MMCD 2014 Design Guidelines recommends that multi-family, commercial and industrial properties are required to clean and detain their stormwater on site prior to discharge to a City managed conveyance system.

The responsibility and costs to maintain the discharge remains with the generator of that discharge and are not passed on to the City.

Thank you

R.K. Stephens, P. Eng., Principal
Highland Engineering Services Ltd.
104-950 Alder Street
Campbell River BC V9W 2P8
T:250.287.2825
C:250.830.7068
website *www.highland-eng.ca*

O-CFile: 6520-20/01
Copies: Council
-JW/MK/LG/LP

LOG: 20444	REFER:	AGENDA:
FILE: 6520-20/01	ACTION: MR	

Bill Toews
#110 - 1807 Beaufort Ave.
Comox, BC V9M 1R9

RECEIVED
NOV 30 2020
TOWN OF COMOX

November 30, 2020

Mayor Arnott and Councillors – Town of Comox

Re: North East Comox Stormwater Management Plan

Thank you for inviting comment on the latest proposal to manage development of N.E. Comox.

I feel that the past Administration did not welcome comments or ideas that were different than theirs. There was an atmosphere of intimidation and reprisals. Speaking out was a way to have your project put on hold and delayed, or to have your contracts to work with the Town on projects, not reviewed.

I now believe this has changed.

Solution III has too much inertia to stop. Any previous alternative proposals have been sidelined. Many landowners are either dead, weary or afraid to speak.

The current "preferred solution option III" is flawed, as the first two solutions also were. I wonder if the "preferred solution" is now needed to justify the fast tracking that the Aurora Project received, to appease the airport authority and Mr Gage's group and possibly to help process the Vincent/Peterson group more quickly.

Solution III demands that historical water flows (ie down hill) be ignored and all water flows are to be moved sideways across the slope - a very expensive and wasteful decision. This demand is resulting in 40% of the land east of Pritchard Road to be limited in use or deemed not useable at the present time.

We must recognize Option III's shortcomings and act to help the other properties remain an area that will be a useful and valuable contribution to our Community's future.

1. Please rename the Lands currently mis-labelled "non-developable area" to "land below 22 meter contour". This land is developable with different parameters (ie zoning, future engineering, cooperating with CVRD, drainage/ponding partnerships with downslope farmers, septic fields, other solutions not previously allowed to be presented).

2. I have been told that current Option III requirements will have ¼ to 1/3 of properties east of Pritchard Road be retention ponds. The Engineers I have asked have said there are better ways.

3. I am also told, R1 zoning is a very wasteful use of Town infrastructure and services. If we want a sustainable, green, environmentally friendly community; we must increase density in N.E. Comox. This should be addressed now.

4. In November 2010, a group of property owners in NE Comox presented a plan developed from 2007 to 2010 by McElhanney Engineering that met the then current Town requirements, for zoning, sewer, storm water management, etc. That plan was delayed over and over again, as

new requirements were requested. In 2012, Mr Marvin Kamenz, Town Planner, stated that engineering and associated studies would be paid back using "late comer fees" in some fashion or another.

5. Our Kelada/Toews group presented to Comox Town Council in 2014, the most environmentally progressive subdivision plan in BC history, to that time. This was further delayed until 2017 when town planning decided that the "new solution" would be Option I. Having spent 9 years working towards our subdivision and in excess of $300,000.00 in studies, engineering, etc., to satisfy the Town's whims, we gave up.

   We are asking for the re-imbursement of costs for engineering, etc. that have and will be used to move the storm water plan forward. I am quite sure others will be asking as well.

6. This "Option III" must have within it a mechanism to adjust or alter requirements to allow future development of other properties.

I thank Mayor Arnott and Town Council for their time and efforts to further educate themselves on the N.E Woods. I am available to answer questions and/or share more history. I sincerely hope that other affected property owners, consulting engineers and contractors, involved in the N.E. Woods project this past 13 years, have also risked speaking out at this time.

Respectfully,

Bill Toews

DocuSign Envelope ID: 37D20DF5-EE21-474B-94FA-CF6E7455D497

O - Cfile: 6520-20/01
Copies - Council
- JW/MK/LG/LP

SIMBA INVESTMENTS

LOG: 20-443	REFER:	AGENDA: --
FILE: 6520-20/0	ACTION: MR	

His Worship Mayor Russ Arnott and Council
Town of Comox
1809 Beaufort Avenue
Comox, BC V9M 1R9

RECEIVED
Nov. 30, 2020
TOWN OF COMOX

November 25, 2020

Dear Mayor Arnott and Council,

We would like to take this opportunity to thank Mayor and Council for the opportunity to develop properties in the Town of Comox. We are excited new owners of 1000 and 1194 Pritchard Rd in Comox. We have exciting development plans that we've been working on for several months including the development and design of retention ponds located at the bottom of 1194 Pritchard Rd that are currently designed to retain the excess runoff water from all the properties located on the East side of Pritchard Rd up to but not including Mulberry Lane.

We have had our engineers design this pond in an effort to be collaborative and thoughtful to the surrounding properties so that everyone has the opportunity for potential land development in the future. We would also request a clear and concise budgetary amount provided from the Town of Comox on the monitoring and maintenance requirement costs for the retention pond so that we can budget accordingly.

We bought these properties in large part based on the April 7, 2020 letter that was distributed to the previous landowners and our research with the Town of Comox and our consultants. We would respectfully request that Option 3, your preferred option, for the stormwater management bylaws that have been in the works for some time, be adopted by the end of February 2021 so that we may review and submit our development design for approval. We have no interest in being in the same situation as the previous landowners.

Should you have any questions about our exciting new projects, please feel free to contact Shawn Vincent at 250 792-3700 or shawn@simbainvestments.ca.

Again, thank you for your consideration in receiving this letter.

Sincerely,

DocuSigned by:
B466511D6E79461...

Shawn Vincent
Owner/Agent

3455 Cumberland Road
Courtenay, BC V9N 9N6
Telephone: (250) 898-8824
Facsimile: (250) 898-8854

Town of Comox – Administration

From: Emily Ferguson <E.ferguson@simbainvestments.ca>
Sent: November 26, 2020 10:26 AM
To: Town of Comox – Administration
Subject: RE: Open House: North East Comox Stormwater Management Plan

Hello,

I realized that I never defined which option we were supporting. The response was in favour of Option 3.

Thank you.

SIMBA DEVELOPMENTS

REGARDS,
EMILY FERGUSON
PROJECT MANAGEMENT
PROFESSIONAL ASSISTANT

Email:
e.ferguson@simbainvestments.ca
Phone: 250.898.8824
Fax: 250.898.8854
3455 Cumberland Rd.

We respectfully acknowledge that we live and operate within the unceded traditional territory of the K'omoks First Nation.

From: Emily Ferguson
Sent: November 20, 2020 4:00 PM
To: town@comox.ca
Subject: RE: Open House: North East Comox Stormwater Management Plan

Hello,

Please see attached the comment form from Shawn Vincent.

Thank you.

SIMBA DEVELOPMENTS

REGARDS,
EMILY FERGUSON
PROJECT MANAGEMENT
PROFESSIONAL ASSISTANT

Email:
e.ferguson@simbainvestments.ca
Phone: 250.898.8824
Fax: 250.898.8854
3455 Cumberland Rd.

We respectfully acknowledge that we live and operate within the unceded traditional territory of the K'omoks First Nation.

WE WANT TO HEAR FROM YOU

1809 Beaufort Avenue
Comox, BC V9M 1R9

e-mail
town@comox.ca

fax
250-339-7110

North East Comox Stormwater Management Plan
Comments Form

The Town of Comox is providing information to the community about Council's preferred solution for North East Comox storm drainage to receive comments from the community on how this would impact community members.

Feedback:

Do you have particular comments or concerns about the preferred solution (Option III) for storm drainage in North East Comox?

We support this option and look forward to moving ahead ASAP. We are now in control of two properties 1000 Pritchard Rd. and 1194 Pritchard Rd. and have the ability to service the properties on the East side of Pritchard Rd from Mulberry Lane North in one pond.

Do you have any additional comments you wish to provide?

We have two exciting residential projects planned for Pritchard Rd and would like to get going n them in 2021. Let's work together to make this happen.

Submitting Your Comments

Please return your completed form via email to town@comox.ca or mail to Town Hall, 1809 Beaufort Avenue, V9M 1R9 by 4:00 PM on November 30, 2020.

We are listening.
Thank you for your comments.

For more information, see the North East Comox Stormwater Management Plan reports available at:
https://comox.ca/moodx/planning-and-building.

ATTACHMENT 2A

TOWN COMMUNICATIONS UNDERTAKEN TO ADVERTISED THE OPEN HOUSE/VIRTUAL MEETINGS AND ENCOURAGE ATTENDANCE/PARTICIPATION, INCLUDING THE OPEN HOUSE INFORMATION BOARDS

Attachment 2B contains a copy of the April 7, 2020 letter from the Mayor to property owners of lands within North East Comox noting that an open house would be scheduled once the Covid-19 virus is under control and group gatherings are permissible.

The open house was scheduled for November 20, 2020 at the Comox Community Centre.

The following communications occurred to support awareness and attendance/participation:

- invitation letters mailed to all NE Comox property owners (24) and tenants (21), plus businesses in the area received hand-delivered invitations (**Attachment 2C**);
- open house ad placed in the November 4, 2020 Comox Valley Record (**Attachment 2D**);
- open house details and information loaded on comox.ca including links to previous NE Comox SWMP Reports, the open house comments form, and the open house information boards (**Attachment 2E** - open house information boards); and
- ongoing social media postings via Facebook and Twitter.

Due to changing COVID-19 restrictions, the open house format was changed from preregistration for in-person small groups to virtual meetings with staff. All those that had preregistered to attend the open house (nine parties) were contacted via email and by follow-up phone calls to invite them to patriciate in a virtual meeting with staff, to ensure they had the opportunity to ask any questions. Further, the website and social media postings announcing the cancelation of the in-person open house, also indicated the opportunity to schedule a virtual meeting with staff was available to anyone interested, and continued to encourage the submission of comment forms. Four parties participated in virtual meetings with staff from Planning, Public Works and Finance. Ten parties returned comment forms and/or letters, copies of which are contained in **Attachment 1**.

ATTACHMENT 2B

LETTER FROM THE MAYOR TO NE COMOX PROPERTY OWNERS

TOWN OF COMOX

OFFICE OF THE MAYOR

April 7, 2020

[redacted]

Re: North East Comox Storm Drainage

I am writing to you because you are a property owner in the area of North East Comox where development opportunities are presently restricted pending a solution to the challenge of disposing of additional storm water run-off resulting from development. A map showing the affected area is attached.

It is recognized that as an owner in the area you may or may not have any interest in redevelopment opportunities at this time.

The Town of Comox has been considering this development challenge for quite some time, and has been working with certain property owners in the area with development intentions to learn about various options to address the matter and consider alternatives. All solutions involve the use of the detention ponds to capture excess storm water run-off, but variations exist in the size and locations of the ponds. After looking at various options, the Town has selected a preferred option, pending discussion and input from the property owners.

Under this preferred option each property owner wishing to develop would be required to build a detention pond and disposal system solution for their development. This solution could be in conjunction with one or more neighbouring properties or solely for their own development.

The Town of Comox will be scheduling an open house once the Covid-19 virus is under control and it is once again permissible to hold group gatherings. The intention of the open house is to provide information to the community about Council's preferred solutions, and to receive comments from our community on how this would impact community members. You will be notified of this at the appropriate time.

In the meantime, please feel free to call or email staff at Town Hall to obtain further information. The appropriate contact information is provided below.

Please see the attached staff report provided for additional information.

Yours truly,

Russ Arnott
Mayor

File No: 6520-20/01
Copy: A. Kenning, CAO
M. Kamenz, Director of Development Services
S. Ashfield, Director of Operations

Contact information:

Town of Comox Planning Department
Phone: 250-339-1118
Email: planning@comox.ca

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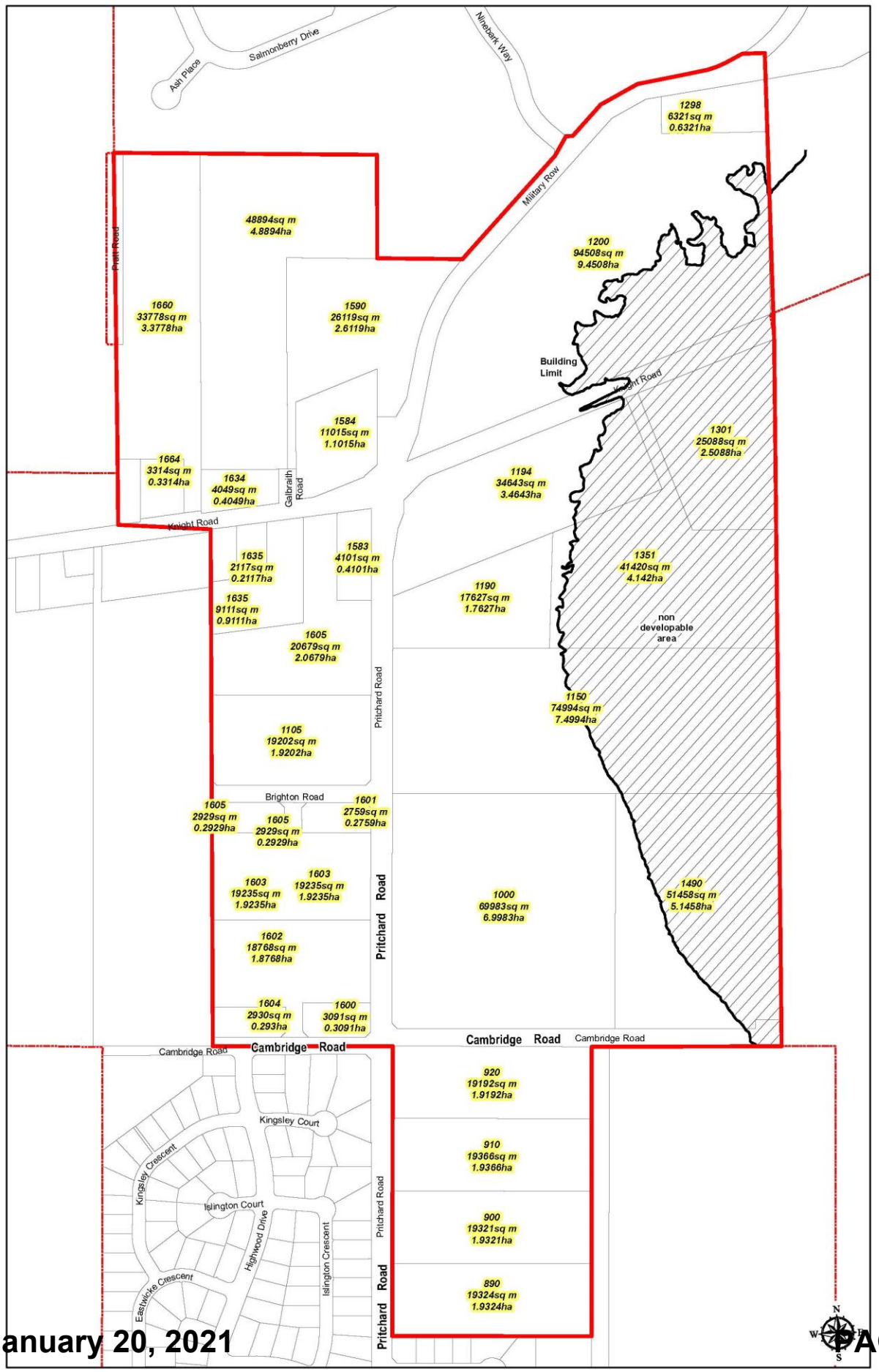
Ash Place
Salmonberry Drive
Ninebark Way
Military Row
Pratt Road
48894sq m
4.8894ha
1298
6321sq m
0.6321ha
1200
94508sq m
9.4508ha
1660
33778sq m
3.3778ha
1590
26119sq m
2.6119ha
Building
Limit
Knight Road
1584
11015sq m
1.1015ha
1301
25088sq m
2.5088ha
1664
3314sq m
0.3314ha
1634
4049sq m
0.4049ha
Galbraith
Road
1194
34643sq m
3.4643ha
Knight Road
1635
2117sq m
0.2117ha
1583
4101sq m
0.4101ha
1351
41420sq m
4.142ha
1635
9111sq m
0.9111ha
1190
17627sq m
1.7627ha
non
developable
area
1605
20679sq m
2.0679ha
Pritchard Road
1150
74994sq m
7.4994ha
1105
19202sq m
1.9202ha
Brighton Road
1605
2929sq m
0.2929ha
1601
2759sq m
0.2759ha
1605
2929sq m
0.2929ha
1603
19235sq m
1.9235ha
1603
19235sq m
1.9235ha
Pritchard Road
1000
69983sq m
6.9983ha
1490
51458sq m
5.1458ha
1602
18768sq m
1.8768ha
1604
2930sq m
0.293ha
1600
3091sq m
0.3091ha
Cambridge Road
Cambridge Road
Cambridge Road
Cambridge Road
920
19192sq m
1.9192ha
Kingsley Court
Kingsley Crescent
910
19366sq m
1.9366ha
Islington Court
Highwood Drive
Islington Crescent
Pritchard Road
900
19321sq m
1.9321ha
Eastwicke Crescent
Pritchard Road
890
19324sq m
1.9324ha
N
W
E
S

ATTACHMENT 2C

OPEN HOUSE INVITATION LETTERS TO NE COMOX PROPERTY OWNERS & TENANTS

TOWN OF COMOX

File No. 65220-20/01

November 2, 2020

NAME
ADDRESS
ADDRESS

Dear NAME,

Re: Notice of North East Comox Stormwater Management Plan Open House, November 20, 2020

I am writing to follow-up on my correspondence regarding North East Comox Storm Drainage (April 7, 2020).

As was noted in that letter, the Town of Comox would schedule an open house to provide information to the community about Council's preferred solution for stormwater management, and receive comments from the community on how this would impact community members. Within this option, in the event that property owners wish to develop, they will be able to present a storm drainage solution for their own property, including pond and infiltration galleries on their own land. This solution could be in conjunction with one or more neighboring properties, or solely for their own development.

The open house has been scheduled as follows:

North East Comox Stormwater Management Plan Open House
Friday, November 20, 2020
3:00 pm – 6:00 pm
Comox Community Centre, 1855 Noel Avenue, Comox, Multi-Purpose Room

With physical distancing and other COVID-19 protocols in place, we will be limiting the number of people in the room at one time. Attendees are encouraged to pre-book a 15 minute time slot to progress through the board stations. To book a time slot, please email your request to attend: town@comox.ca.

Attendees will be required to wear a mask, stay in their small groups, and transition through the open house stations in a staggered way, to review information and speak with staff. There will be an opportunity to complete and submit a comments form at the open house, and/or after the open house until November 30, 2020, 4:00 pm.

Following this open house, Council will consider all comments and feedback, and confirm a final solution, which will support the update and/or creation of applicable bylaws to enable property owners to proceed with development applications.

We recognize the Town has been considering this development challenge for some time and are optimistic that the open house will provide a safe, yet informative way for the public to engage in the Town's decision making processes. For those not able to attend the open house in person, the same information will be available on the website, comox.ca, prior to the open house for review.

Thank you for your interest,

Russ Arnott
Mayor

We respectfully acknowledge that we live, work and play on the traditional lands of the K'ómoks First Nation ... Gila'kasla ... Hay ch q' a'

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TOWN OF COMOX

File No. 65220-20/01

November 5, 2020

NAME
ADDRESS
ADDRESS

Dear NAME,

Re: Notice of North East Comox Stormwater Management Plan Open House, November 20, 2020

The Town of Comox has scheduled an open house to provide information to the community about Council's preferred solution for stormwater management in North East Comox, and receive comments from the community on how this would impact community members. Within this option, in the event that property owners wish to develop, they will be able to present a storm drainage solution for their own property, including pond and infiltration galleries on their own land. This solution could be in conjunction with one or more neighboring properties, or solely for their own development.

The open house has been scheduled as follows:

North East Comox Stormwater Management Plan Open House
Friday, November 20, 2020
3:00 pm – 6:00 pm
Comox Community Centre, 1855 Noel Avenue, Comox, Multi-Purpose Room

With physical distancing and other COVID-19 protocols in place, we will be limiting the number of people in the room at one time. Attendees are encouraged to pre-book a 15 minute time slot to progress through the board stations. To book a time slot, please email your request to attend: town@comox.ca.

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Following this open house, Council will consider all comments and feedback, and confirm a final solution, which will support the update and/or creation of applicable bylaws to enable property owners to proceed with development applications.

We recognize the Town has been considering this development challenge for some time and are optimistic that the open house will provide a safe, yet informative way for the public to engage in the Town's decision making processes. For those not able to attend the open house in person, the same information will be available on the website, comox.ca, prior to the open house for review.

Thank you for your interest,

Russ Arnott
Mayor

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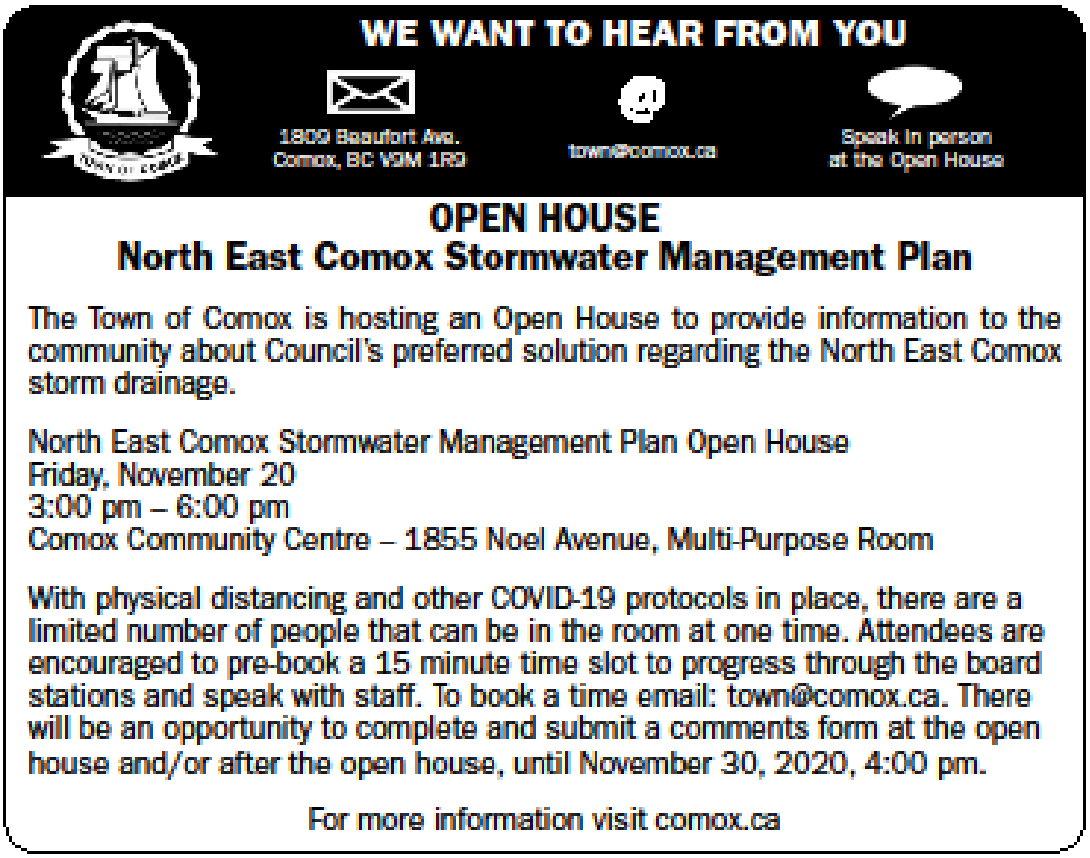
ATTACHMENT 2D

OPEN HOUSE NEWSPAPER AD



WE WANT TO HEAR FROM YOU

1809 Beaufort Ave.
Comox, BC V9M 1R9

town@comox.ca

Speak in person
at the Open House

OPEN HOUSE
North East Comox Stormwater Management Plan

The Town of Comox is hosting an Open House to provide information to the community about Council's preferred solution regarding the North East Comox storm drainage.

North East Comox Stormwater Management Plan Open House
Friday, November 20
3:00 pm – 6:00 pm
Comox Community Centre – 1855 Noel Avenue, Multi-Purpose Room

With physical distancing and other COVID-19 protocols in place, there are a limited number of people that can be in the room at one time. Attendees are encouraged to pre-book a 15 minute time slot to progress through the board stations and speak with staff. To book a time email: town@comox.ca. There will be an opportunity to complete and submit a comments form at the open house and/or after the open house, until November 30, 2020, 4:00 pm.

For more information visit comox.ca

ATTACHMENT 2E

OPEN HOUSE INFORMATION BOARDS

What is the North East Comox Stormwater Management Plan?

North East Comox drains eastward into the Queens Ditch, discharging into the Strait of Georgia;

The Queens Ditch provides drainage for surrounding agricultural lands, fish habitat and has a history of winter flooding;

The North East Comox Stormwater Management Plan (NECSMP) provides a stormwater servicing plan for the development area.

NECSMP Area Zoning

Three Phases of NECSMP

Phase I:
How much rain is falling in NE Comox and where does this surface run off and ground water flow?

Phase II:
What would be the impact of land development?

Phase III:
Engineering specifications for infiltration galleries and detention ponds to mitigate the impacts of development.

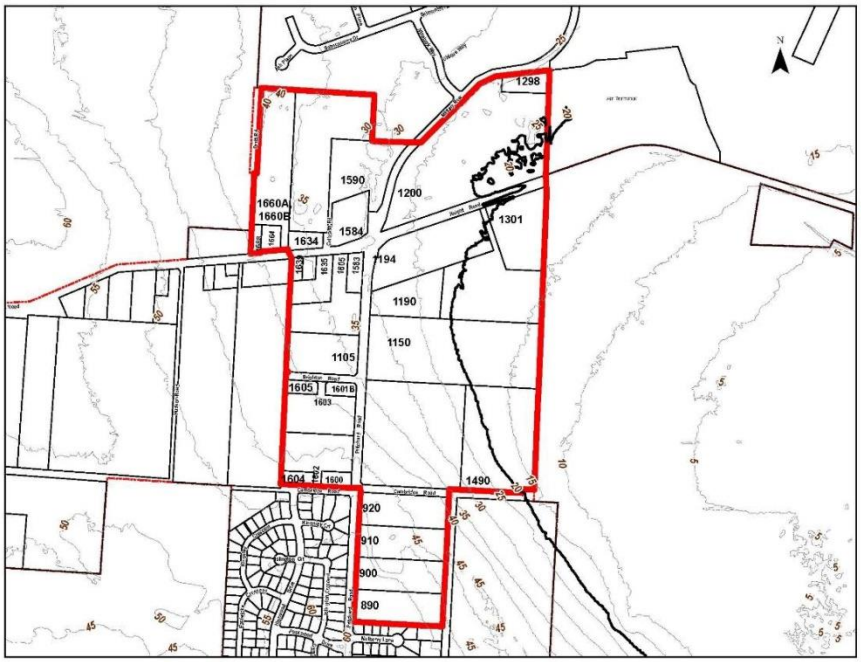
Key Objectives of the Plan

No increase in downstream flood damage;

No significant change to downslope ground water;

No negative impact on downslope:

- Existing agricultural potential;
- Fish habitat; or
- Lazo Marsh.



Where Are We in the Process?

The Town has developed three options implementation of the NE Comox stormwater management and completed financial implications for Options I and II;

Option I and II is based on the Town taking responsibility for design, build, ownership, ongoing monitoring and maintenance of stormwater management ponds;

Option III envisions property owners will design and build the ponds at their cost, and the Town will own and maintain the ponds;

Council has identified Option III as the preferred option.

www.comox.ca

Next Steps

Public feedback & comments will be received from Nov. 20 – 30, 2020;

All feedback is anticipated to be provided to Council for consideration in December 2020, relative to implementation of the NECSMP;

Should Council decide to proceed with implementation, the implementing bylaws are then drafted for Council consideration;

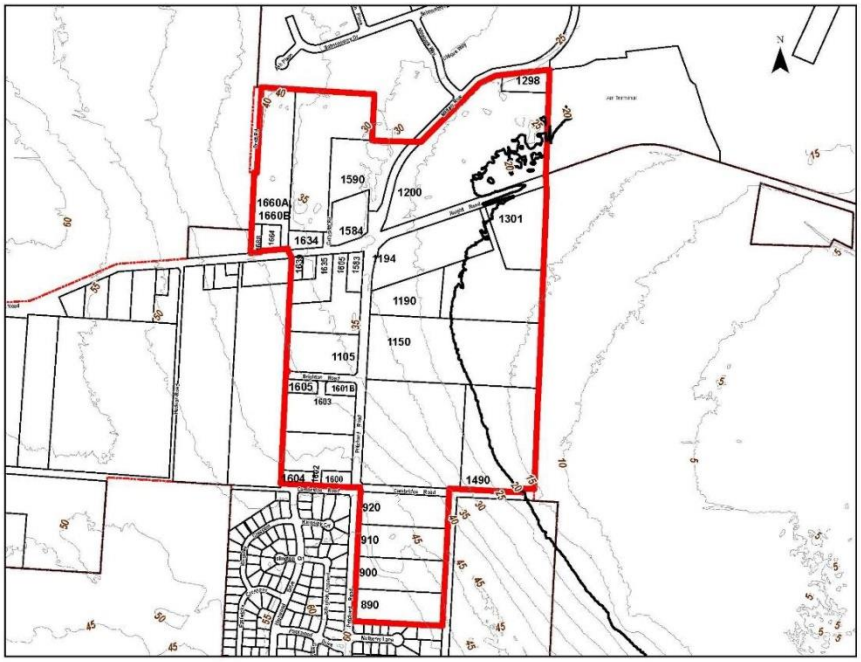
Once implementing bylaws are adopted, property owners can submit development applications.

Option I: Total Area Coverage

Covers 80 ha of land, 35,360 cubic metres of total runoff volume and includes 28 properties;

The Town would build 2 ponds of approx. 3.5 ha with full build out costs estimated at $12 million (not including ongoing maintenance costs);

Property owners could pay upfront approximately $80,000 per acre or $200,000 per ha, or annual payment of $5,000 per acre or $12,350 per ha over 25 years (assuming no upfront payments).



Option I: Pros and Cons

Pros:

- All necessary stormwater ponds are constructed in advance of development;
- Minimizes construction, land & maintenance costs;
- Minimizes processing times for development permitting.

Cons:

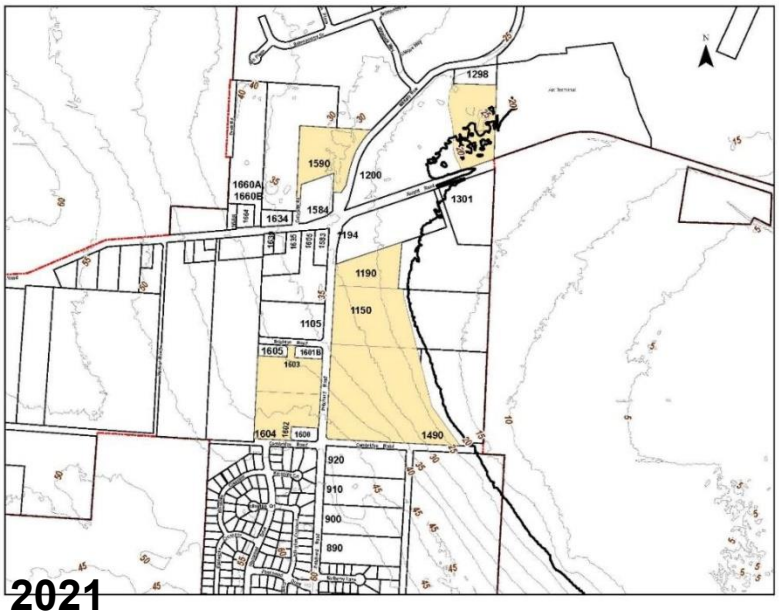
- Some property owners may choose to not develop now or ever, but will have to incur these new cost burdens regardless;
- All the land/construction costs are upfront, but the timing of the expenditures don't align to developer timelines which flow with market demand cycles and property owner determined timelines.

Option II: Partial Area Coverage

Covers 30.7 ha of land, 13,815 cubic metres of total runoff volume, and includes 16 properties;

The Town would build 1-2 ponds of approx. 2 ha with full build out costs estimated at $8 million (not including ongoing maintenance costs);

Serviced property owners could pay upfront approximately $70,000 per acre or $170,000 per ha, or annual payment of $4,200 per acre or $10,375 per ha over 25 years (assuming no upfront payments).



Option II: Pros and Cons

Pros:

- Reduces the service area to attempt to focus the costs to properties that are anticipated to develop in the near future.

Cons:

- Some property owners may choose to not develop now or ever, but will have to incur these new cost burdens regardless;

- All the land/construction costs are upfront, but the timing of the expenditures don't align to developer timelines, which flow with market demand cycles and property owner determined timelines.

Option III: Preferred

Property owners can present a storm drainage solution for development, and incur the construction costs at time of development;

Includes developer construction of detention pond and infiltration galleries in accordance with NECSMP standards, which will then be owned and maintained by the Town. This solution could be in conjunction with one or more neighbouring properties;

Instead of having one or two large ponds designed and built by the Town, multiple smaller ponds, suitable to specific property needs, are envisioned.

Option III: Pros and Cons

Pros:

- No costs incurred until the time of development, which is at the discretion of the property owner, while maintaining their development potential.

Cons:

- More land is taken up with ponds and increases construction costs, and ongoing maintenance costs.

Maintenance Cost Recovery: Applies to All Options

Local Area Service (LAS)

A LAS is a mechanism for the Town to recover maintenance costs (i.e. operations, repairs, amortization expenses) for a particular service, such as the new ponds;

The cost for a LAS is recovered by an annual parcel tax paid in perpetuity by the benefiting parcels in the area;

***For example:**

7 ha property with 140 single family homes
Estimated construction cost of $500,000
= annual LAS maintenance cost of ~$715 per lot, per year

Note: Additional lots would increase the benefiting parcel area, which would decrease the maintenance cost per lot.

* Estimate is based on 20% of the total construction costs of the Town being recovered annually.

We Want to Hear from You

Complete a Comments Form between November 20 - 30, 2020, 4:00 pm and submit as follows:

- Email the form to: town@comox.ca
- Drop or mail the form to Town Hall, 1809 Beaufort Avenue, V9M 1R9
- Visit comox.ca for additional information

www.comox.ca

ATTACHMENT 3

DETAILED OVERVIEW OF CONCERNS RAISED IN PUBLIC SUBMISSIONS

STAFF COMMENTS ARE SHOWN IN ITALICS

1. Has there been any assessments to identify any existing wetlands that may be impacted during development? Existing treed swamps as opposed to engineered open water wetlands should be used. Any constructed wetlands should be ephemeral to avoid invasive plants and species. Request that QEP be hired to survey proposed development areas to avoid damaging natural wetlands and preliminary ecological assessments undertaken to determine if any species at risk may be affected.

   "Sensitive Ecosystems Inventory Mapping" of Environment Canada / BC Ministry of Sustainable Resources (2014), does not identify any Sensitive Ecosystem within the boundaries of North East Comox.

   Areas within NE Comox that require provincial receipt of a QEP report in accordance with Development Permit Area #7 Riparian Areas guidelines are shown in ***Attachment 4****.*

   Appendix G to the report "North East Comox Neighbourhood Storm Water Management Plan – Phase 3 of 3" by McElhanney Consulting Services Ltd. (dated March 1, 2018) includes certification by Cindy Lipp, Registered Professional Biologist that the SWMP will not adversely impact the existing downstream fish habitat or the environmental integrity of Lazo Marsh, and by Bob Hudson, Professional Engineer as to the ability of the SWMP to maintain surface and groundwater flows including groundwater flows and quality to Hilton Springs and Lazo Marsh (see ***Attachment 5****)*

   Engineered ponds will be dry ponds based on requirement from aviation Canada.

2. Deforestation within NE Comox has resulted in a major increase of water runoff to down slope NE Comox lands. Support that costs for storm drainage solutions be incurred by property owners / developers for their land at time of development as opposed to downslope property owners having to improve drainage due to upslope land clearing / development.

3. "flooding problems caused in the Lazo watershed given that the Queen's Ditch does not posses[s] the capacity to handle current flows."

   "As the Town of Comox is responsible for any downstream flooding it causes, make certain that any changes are not making the problem worse."

   The report "North East Comox Neighbourhood Stormwater Management Plan – Phase 1 of 3" by McElhanney Consulting Services (dated January 14, 2013) addresses the history of flooding within the Queen's Ditch catchment area (sec 4.1) and related existing characteristics of Queen's Ditch (section 5.2).

   "Lowland areas adjacent to the Queen's Ditch have a long history of flooding"

   "Visual inspection of lands adjacent to the Queen's Ditch during extended periods of precipitation, indicates surficial flooding remains a frequent occurrence."

   "Past studies of the Queen's Ditch suggest channel capacity is insufficient to meet the demands of existing land uses. The Queen's Ditch capacity is also influenced by tidal action and storm surges. It is not uncommon for the ditch to experience backwater effects nearly all the way to Knight Road during extended periods of rainfall concurrent with high tides/storm surges."

*(Section B of the Phase 1 Report which includes the above referenced sections is contained in **Attachment 6**.)*

4. " . . . NE Comox Stormwater Management Plan is nearly impossible document to implement. The 1:100 year flood retention onsite is an enormous volume of water for each property to retain onsite. The 1:10 year retention is a more realistic specification that is the industry standard and would certainly retain enough water to match the historical flows to Queens Ditch from forested land."

Town of Comox Subdivision and Development Servicing Bylaw, 1261, requires that a storm drainage system be comprised of minor and major components:

- *minor underground system- capable of conveying runoff from the ten year return storm*
- *major – capable of conveying runoff from the 100 year return storm event*

Typically, the major component consists of roadways and open channels which drain downslope to a receiving water body such a Comox Harbour. In this instance the downslope system is comprised of open channels which drain into the Queen's Ditch, which has a history of flooding, before discharging into the Strait.

Town of Comox Subdivision and Development Servicing Bylaw 1261 also states "The presence of an existing Town drainage facility or natural channel does not imply that such is a suitable or adequate point of discharge. Where existing downstream facilities are inadequate to handle the increase flow from the proposed subdivision, a special design is required." (Schedule C.1, Appendix E, section 1.2) In this case this includes the minor and major storm events to ensure the peak run off rates are attenuated to pre development peaks to align with Queen's Ditch capacity limitations so as not to increase flooding.

5. ". . . why making the land below the 20m contour undevelopable is a favoured approach? The water from the entire ridge currently flows to an existing wetland with numerous aquatic species, then flows to an existing ditch . . . located in the CVRD and the ALR. If this approach is constructed it will cut off the historical flow of water to the wetland."

Why does the Town not work with the CVRD to obtain an statutory right of way to connect to Queen's Ditch instead of ignoring the impact on the wetland and farmland?

The Town drainage system in NE Comox has one downslope discharge: the Knight Road ditch at the east Town boundary which discharges into the Ministry of Transportation portion of the Knight Road ditch which in turn connects to Queen's Ditch. There is an area of land along the east boundary of NE Comox which is currently too low in elevation to drain by gravity to the Town portion of the Knight Road ditch (i.e. the portion for the NE Comox study area not contained in the service area as shown in Figure 1 above).

The CVRD recently completed a two phase study to evaluate the viability of a local service area to manage drainage in the Lower Lazo Creek Watershed which includes Queen's Ditch. A separate report on liability considerations of a regional district service to control drainage was also considered.

"In response to residents' concerns of flooding in the lowland areas, the CVRD committed to undertake a feasibility study to evaluate the viability of a local service area (LSA) to manage drainage in the lower Lazo Creek Watershed. . . .

As part of this work, McElhanney Consulting Services Ltd. (MCSL) was retained to evaluate options for improving the Queen's Ditch drainage system. Hydraulic modeling was undertaken to analyze system response to five drainage improvement options":
Option 1 – Cleaning and Deepening of the Queen's Ditch
Option 2 – Overflow Channeling/Redirection of Flows (DND/Lazo Bypass)
Option 3 – Diking and Pumping
Option 4 – Managed Retreat/Wetland Restoration
Option 5 – Stormwater Detention/Off-Channel Storage
(Nov 16, 2017 CVRD Staff Report to the Electoral Areas Services Committee. A copy of this staff report which includes the McElhanney report "Comox Valley Regional District – Queen's Ditch Lowland Area Drainage Improvements Option Analysis", (September 14, 2017) certified by Bob Hudson, Professional Engineer, is contained in ***Attachment 7****)*

"Of the five options included in the first phase of analysis, the CVRD Board approved the managed retreat/wetland option for further study. Additional modeling of managed retreat/wetland restoration options shows only moderate improvement to flood extents in the short term, with minimal improvement in the medium to long term once sea level rise and climate change are factored in. . . . There are liability considerations to contemplate prior to establishing a regional district service to control drainage, which will be discussed in a separate report to the EASC."
(May 8, 2019 CVRD Staff Report to the Electoral Areas Services Committee. A copy of this staff report which includes the McElhanney Technical Memo "Queen's Ditch Drainage Improvements Options Analysis – Phase 2A – Modeling Results – Rev. 2" (May 7, 2019) certified by Bob Hudson, Professional Engineer, is contained in ***Attachment 8****.)*

At the CVRD Electoral Areas Services Committee meeting on May 13, 2019, the May 8, 2019 CVRD staff report was received and it was resolved that the Comox Valley Regional District not proceed with further study work to investigate options for the creation of a local service area to upgrade and maintain the Queen's Ditch drainage system. This resolution was subsequently ratified at the May 28, 2019 CVRD Board Meeting.

In addition to the Registered Professional Biologist and Professional Engineer certifications noted above, Appendix G to the report "North East Comox Neighbourhood Storm Water Management Plan – Phase 3 of 3", includes the certifications of Jim Richard, Professional Agrologist and Gilles Wendling a Professional Engineer and Professional Hydrogeologist that the SWMP will not adversely impact the existing agricultural potential of down-slope lands within the Agricultural Land Reserve. (see ***Attachment 5****)*

6. "Please rename the Lands currently mislabelled "non-developable area" to "Land below 22 meter contour". This land is developable with different parameters (i.e. zoning, future engineering, cooperation with CVRD, drainage/ponding partnerships with downslope farmers, septic fields, other solutions not previously allowed to be presented)."

While the study area for the SWMP was NE Comox only a portion (the service area in Figure 1) can be developed under Phase 3 Report stormwater servicing specifications. Therefore, any implementing bylaws would only apply to the service area: North East Comox land not within the service area would remain

subject to existing stormwater servicing requirements which allow for a special design where existing downstream facilities are inadequate to handle the increase flow from a proposed subdivision.

7. "The local Area Service (LAS) charges are our biggest concern with option 3. The Town's open house presentation featured a slide stating that the LAS was an estimate based on 20% of the construction cost of the retention pond . . . were told that this was only a preliminary estimate, but we require an accurate figure (with cost breakdowns) to determine the feasibility of any development."

The proposed LAS is to fund the operation, repairs, maintenance, amortization and capital replacement of the required Best Management Practices (BMP's). Standard engineering practice is to allow for annual maintenance of 20% of construction costs until actual costs are known. The breakdown for the 20% allowance in the open house example of a $500,000 pond is as follows:

Data Collection Modelling and Reporting	*est. $25,000 per pond regardless of size*
Annual Maintenance Costs	*4% (2 days a month)*
Annual Inspection Costs	*1% (2 days per year)*
5 year Inspection and Maintenance Costs	*1%*
10 year Inspection and Maintenance Costs	*1%*
Life Cycle Pond 50 years	*2%*
Regulations and Reporting	*0.5%*
Life Cycle Monitoring Equipment	*0.5%*
Contingency including additional BMPs if required	*5%*

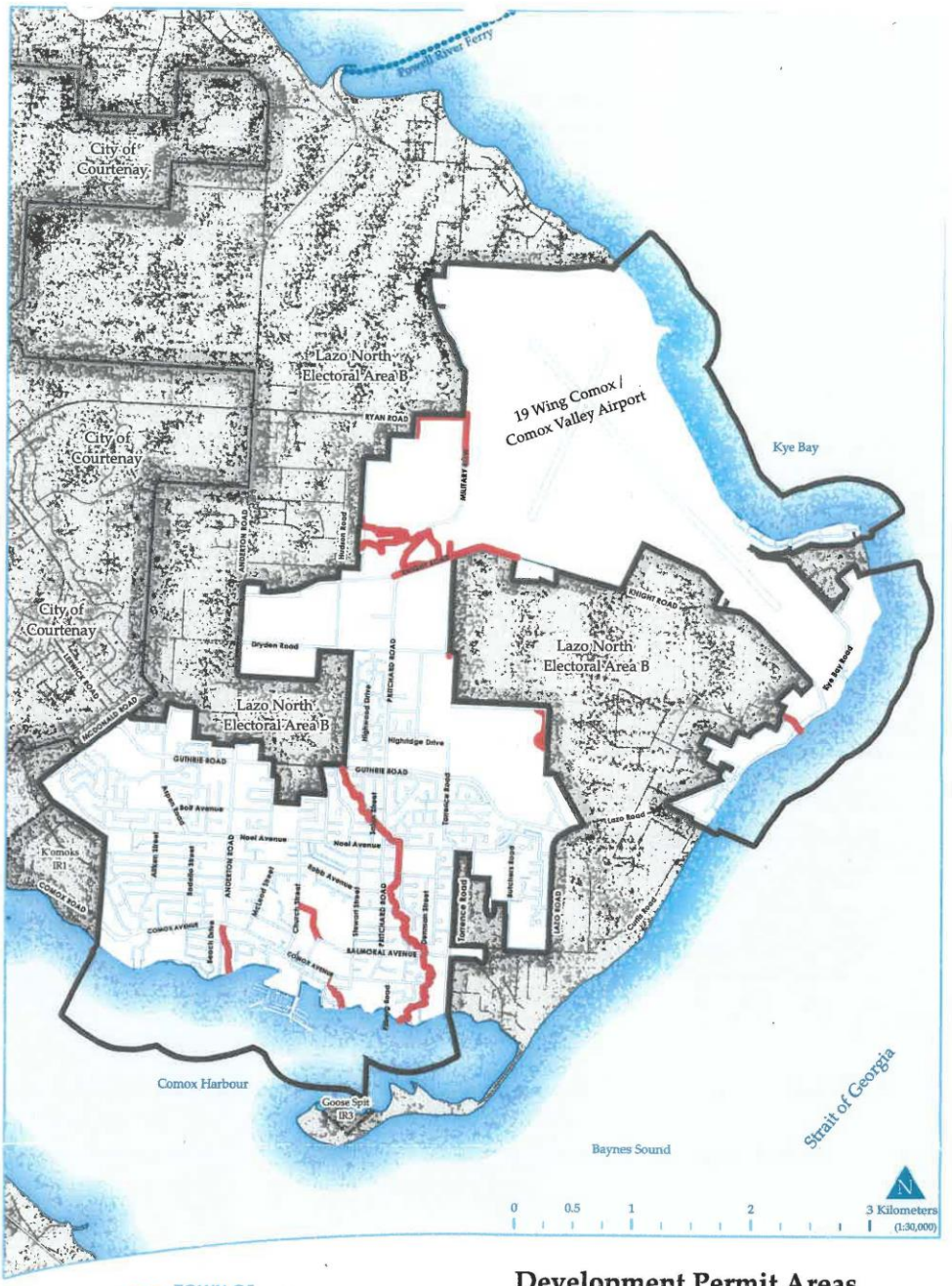
As actual costs are unknown at this time, this preliminary budget is weighted towards over rather than underestimation to take into account the limited ability of post development property owners to finance unexpected significant cost increases especially where high ratio mortgages are involved.

8. "Green infrastructure techniques, such as infiltration swales, rainwater cisterns, rain gardens, and permeable paving are particularly relevant to North East Comox . . . recommend the Town modernize the NECSWP and reconsider options for performance-based regulations that support a broader range of techniques and approaches for managing runoff."

The green infrastructure techniques mentioned above (cisterns, rain gardens and permeable paving) are lot level controls that have been reviewed as part of the implementation of the SWMP in section 3.3 of the report "North East Comox Neighbourhood Storm Water Management Plan – Phase 2 of 3". In summary, the techniques listed above all play a role in stormwater management but at a limited capacity. Considering a performance based regulation for private owners that implement these type of stormwater techniques may be something that the Town could consider in the future. The implementation of such a performance based regulation would have a major impact on staff resources to manage and enforce.

ATTACHMENT 4

DEVELOPMENT PERMIT AREA #7 RIPARIAN AREAS



TOWN OF Comox Official Community Plan UPDATE

Development Permit Areas

#7: Riparian Areas

April 2011

map created by the Arlington Group for the Town of Comox

data provided by:
Town of Comox, Comox Valley Regional District,
Province of British Columbia,
Department of Natural Resources Canada © All rights reserved

DEVELOPMENT PERMIT AREAS

3.7 Development Permit Area (DPA) #7 Riparian Areas

The following definitions apply to DPA #7 only:

Assessment methods: means the methods set out in the Schedule to the *Riparian Areas Regulation* approved under the *Fish Protection Act.*

Assessment report: means a report prepared in accordance with assessment methods to assess the potential impact of a proposed development in a riparian assessment area and which is certified for the purposes of the Riparian Areas Regulation by a qualified environmental professional.

Qualified environmental professional: means a qualified environmental professional as defined in and contemplated by the Fish Protection Act Riparian Areas Regulation BC Reg 376/2004, as amended from time to time.

Riparian area high water mark: means, as determined by a qualified environmental professional, the visible high water mark of a stream where the presence and action of the water are so common and usual, and so long continued in all ordinary years, as to mark on the soil of the bed of the stream a character distinct from that of its banks, in vegetation, as well as in the nature of the soil itself, and includes the active floodplain.

Riparian assessment area means:

a) for a stream, the 30 meter strip on both sides of the stream, measured from the riparian area high water mark,
b) for a ravine less than 60 meters wide, a strip on both sides of the stream measured from the riparian area high water mark to a point that is 30 meters beyond the top of the ravine bank, and
c) for a ravine 60 meters wide or greater, a strip on both sides of the stream measured from the riparian area high water mark to a point that is 10 meters beyond the top of the ravine bank.

Ravine: means a narrow, steep-sided valley that is commonly eroded by running water and has a slope grade greater than 3:1.

Stream: includes any of the following that provides fish habitat:

a) a watercourse, whether it contains water or not;
b) a pond, lake, river, creek or brook; or
c) a ditch, spring or wetland that is connected by surface flow to something referred to in paragraph a) or b).

Top of the ravine bank: means the first significant break in a ravine slope where the break occurs such that the grade beyond the break is flatter than 3:1 for a minimum distance of 15 metres measured perpendicularly from the break, and the break does not include a bench within the ravine which could be developed.

3.7.1 Area Affected

DPA #7 – Riparian Areas applies to all areas within the Town that are within the riparian assessment area of:

- Brooklyn Creek;
- those portions of Golf Creek south of Comox Ave and north of Balmoral Ave;
- that portion of Carthew Creek south of Comox Avenue;
- the headwaters of Hilton Springs, southeast of Cambridge Road;
- Lazo Marsh;
- Queen's Ditch drainage channel on the north side of Southwind Drive;
- the ditches along and north of Knight Road and south of Salmonberry Drive that discharge into the Queen's Ditch
- the ditches located within and west of the road dedication of Military Row and south of Oceanspray Drive that discharge into Little River; and
- the ditch that travels along Ryan Road and Military Row north of Ocean Spray Drive that discharges into Little River.

Unless all development, including the alteration of vegetation, will be clearly outside DPA #7, the proposed location of development relative to the DPA #7 boundary as determined by a BC Land Surveyor (BCLS), and incorporated into a BCLS certified site plan, may be required in accordance with Comox Development Approval Information Bylaw No. 1530, 2007.

3.7.2 Purpose

In accordance with sections 488, 489, 490 and 491 of the *Local Government Act*, the purpose of DPA #7 is to protect the natural environment, its ecosystems and biological diversity in relation to freshwater streams as they pertain to fish and fish habitat. It is not the intent of this Development Permit Area to vary a regulation of any other bylaw.

3.7.3 Justification

The *Riparian Areas Regulation*, an Order in Council approved under the *Fish Protection Act*, directs local governments to protect riparian areas from development so they can provide natural features and conditions that support fish life processes. The streams identified in this DPA #7 are fish-bearing, or connected to fish-bearing streams through surface flow.

3.7.4 Exemptions

A development permit is not required for the following actions. Written confirmation of exemption from the Town is available prior to the commencement of such actions:

A. Reconstruction or repair of a permanent structure described in section 532 of the *Local Government Act* if the structure remains on its existing foundation;
B. The repair, renovation, maintenance or reconstruction of an existing permanent structure on its existing foundation, including roads;
C. Farm operations as defined under the *Farm Practices Protection Act*;
D. Hydroelectric facilities and forestry activities;
E. Developments that are not associated with or resulting from residential, commercial or industrial activities, or ancillary activities thereto; or
F. Developments authorized by the Minister of Fisheries and Oceans or a regulation under the *Fisheries Act (Canada)*.

3.7.5 Guidelines

Unless exempted under Section 3.7.4 no subdivision, alteration of land, including vegetation, or construction of, addition to, or alteration of a building or structure is to occur unless the applicant first obtains a development permit.

Use of the word "should" in a guideline does not indicate that compliance is at the option of the applicant. Rather compliance to the guideline will be required as a condition of issuance of a development permit unless there are exceptional reasons why the guideline should not be applied to its fullest extent.

Use of the term "encourage" indicates that compliance with the guideline may at the discretion of the Council be required as a condition of issuance of a development permit.

1) A development permit should not be issued unless the Town has received notification from the Ministry of Environment that Fisheries and Oceans Canada and the Ministry of Environment have been:
    a) notified of the development proposal, and

b) provided with a copy of an assessment report prepared by a qualified environmental professional that
   i. certifies that he or she is qualified to carry out the assessment,
   ii. certifies that the assessment methods have been followed, and
   iii. provides their professional opinion that:
      a. if the development proposal is implemented as proposed there will be no harmful alteration, disruption or destruction of natural features, functions and conditions that support fish life processes in the riparian area, or
      b. if the streamside protection and enhancement areas identified in the report are protected from the development and the measures identified in the report as necessary to protect the integrity of those areas from the effects of the development are implemented by the developer, there will be no harmful alteration, disruption or destruction of natural features, functions and conditions that support fish life processes in the riparian area.

ATTACHMENT 5

APPENDIX G TO THE REPORT
"NORTH EAST COMOX NEIGHBOURHOOD STORM WATER MANAGEMENT PLAN – PHASE 3 OF 3"

I, Jim Richard, Professional Agrologist, have reviewed the North East Comox Neighbourhood Stormwater Management Plan as prepared by Bob Hudson, P.Eng. and dated March 2018, hereafter referred to as the SWMP. The SWMP will not adversely impact the existing agricultural potential of down-slope lands within the Agricultural Land Reserve.

Submitted by,

Soil Matters Consulting Ltd.

I certify this to be report prepared by

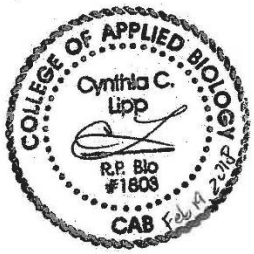
Jim Richard, P.Ag., Professional Agrologist

I, Cindy Lipp, Registered Professional Biologist have reviewed the North East Comox Neighbourhood Stormwater Management Plan as prepared by Bob Hudson, P.Eng and dated March 2018, hereafter referred to as the SWMP. The SWMP will not adversely impact the existing downstream fish habitat or the environmental integrity of Lazo Marsh.

Submitted by,

McElhanney Consulting Services Limited

I certify this to be report prepared by



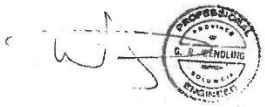
Cindy Lipp, RPBio, Registered Professional Biologist

I, Gilles Wendling, P.Eng. Ph.D, Professional Hydrogeologist have reviewed the North East Comox Neighbourhood Stormwater Management Plan as prepared by Bob Hudson, P.Eng. and dated March 2018, hereafter referred to as the SWMP. The SWMP will not adversely impact the existing agricultural potential of down-slope lands within the Agricultural Land Reserve.

Submitted by,

GW Solutions

I certify this to be report prepared by



Gilles Wendling, P.Eng. Ph.D, Professional Hydrogeologist

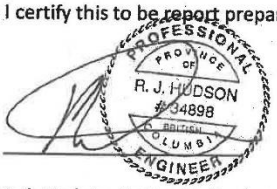
The purpose of this Storm Water Management Plan (the "SWMP") is to ensure that when and if all those lands within the Town of Comox identified in the SWMP (the "Water Management Area") are ultimately improved and developed as contemplated by the SWMP and either current zoning or the current Official Community Plan, the impact of surface and ground water flows originating from the Water Management Area on downstream and down-slope flood frequency and flood duration for up to and including the 100 year runoff event will be the same or less as of the date of this SWMP and ground water flows and quality originating from the Water Management Area will be substantially the same as of the date of this SWMP including ground water flows and quality to Hilton Springs, Lazo Marsh and down-slope lands. This statement is made on the basis that historic rainfall patterns remain consistent into the future with an allowance for climate change adaptation limited to using the climate change projections from the Pacific Institute for Climate Solutions, the lands in the Water Management Area are developed in accordance with either the current zoning or the current Official Community Plan of the Town of Comox; that the Town adopts as recommended in this SWMP such drainage regulations and requirements as are recommended in the SWMP; and that the SWMP is fully implemented by the Town of Comox in respect of the future development of the lands in the Water Management Area.

Notwithstanding any other statement in this SWMP, this SWMP may be relied upon by the Town of Comox in establishing storm water management requirements for the Water Management Area.

Submitted by,

McElhanney Consulting Services Ltd.

I certify this to be report prepared by



Bob Hudson, P.Eng, Professional Engineer

ATTACHMENT 6

SECTION B TO THE REPORT
"NORTH EAST COMOX NEIGHBOURHOOD STORM WATER MANAGEMENT PLAN – PHASE 1 OF 3"

SECTION B EXISTING PHYSICAL CONDITIONS

4.0 QUEEN'S DITCH CATCHMENT OVERVIEW

The Queen's Ditch/Lazo Marsh Watershed encompasses approximately 1000 hectares of land, most of which drains to the Queen's Ditch. Topography within the catchment varies from flat to gently rolling, with elevations ranging from sea level to approximately 55m. Present day land use within the catchment consists of a mixture of urban residential, rural residential, light industrial, institutional, agricultural, and airfield (CFB Comox). Existing vegetation within the 80 hectare study area is predominantly second growth forest, with some grass lands and gravel extraction operations.

Present day drainage infrastructure within public roadways consists mainly of roadside ditching along Pritchard and Knight Roads with some underground piping along Brighton Road and the south west end of Pritchard. Underground piping has also been constructed to drain the intersection roundabout at Knight and Pritchard Roads. This hard pipe system discharges into the roadside ditching on the south side of Knight Road.

Lands upstream of the study area are generally comprised of large lot, semi-forested rural residential properties, although a number of agricultural operations also exist. Constructed storm drainage systems up-gradient of the study area are predominantly roadside ditches and culverts. A stormwater detention pond exists in the Forest Grove subdivision on Hudson Road. Run-off from this area passes through the study area, unmitigated, discharging into the Queen's Ditch.

4.1 HISTORY OF FLOODING IN THE AREA

Lowland areas adjacent to the Queen's Ditch have a long history of flooding, this having been the subject of ongoing dialogue between land owners, the Ministry of Transportation and Infrastructure, the Department of National Defence, Town of Comox, and Comox Valley Regional District.

The Queen's Ditch was initially constructed in 1946 as a sewage outfall, disposing of wastewater from CFB Comox. The ditch has, over time, transitioned from a sewage outfall to a storm drainage conduit for the airbase. As development of upland areas proceeded, a formalized drainage network was gradually constructed. Nearly all of these (primarily) open ditches led directly to the Queen's Ditch. Over time, agricultural operations were established on lands adjacent to the ditch, as these lands were drained and converted to arable fields. By approximately 1960, most of the low lying marsh area adjacent to the ditch had been dewatered and converted to agricultural use.

Figure 4 Headquarters of the Queen's Ditch

Discussions with Chris Williams, land owner and

farmer of lands which lie at the headwaters of the Queens Ditch, suggest flooding has occurred regularly from the 1970s to the present. Mr. Williams was not aware of any flooding prior to his occupation of 1271 Knight Road.

In 1997, flooding of "Woodrow Farms" led to a suit being filed against the Crown, alleging that land development within upland areas of the catchment had caused flooding which, in turn, led to the loss of crops. Fault was eventually attributed equally to the plaintiff and defendant, based on the lack of maintenance of the ditch, and alteration of natural drainage on private lands.

Visual inspection of lands adjacent to the Queen's Ditch during extended periods of precipitation, indicates surficial flooding remains a frequent occurrence.

Lands down gradient of the study area are largely low lying agricultural properties. Storm drainage and groundwater table management within the farm lands is manipulated by an extensive series of excavated ditches, culverts, and a number of privately operated flow-regulating structures. The Queen's Ditch travels through these agricultural lands, within a statutory right of way in favour of the Department of National Defence.

Figure 5 Seasonal flooding of agricultural lands adjacent to the Queen's Ditch

5.0 FIELD RECONNAISSANCE AND PHOTO LOG

MCSL has undertaken a series of site investigations allowing verification of existing drainage patterns, ground cover, land usage, etc., as required to establish Queen's Ditch catchment baseline conditions. These inspections, carried out on May 7th, May 10th and June 6th of 2012, have been documented in the photo log attached as Appendix B. Drawing A-2, overleaf, indicates the location and direction of each photo.

5.1 GENERAL FINDINGS OF SURFICIAL INVESTIGATION – DRAINAGE MAPPING

Major constructed drainage features within the study area include:

- Roadside ditching along Knight Road (photo #39), along the northern portion of Pritchard Road from Foxxwood Drive to Knight Road, and at several locations along Military Row.
- Open ditching extends across multiple properties lying north of Knight Road, conveying run-off from further upcatchment to the Queen's Ditch.
- A piped drainage system is utilized at the roundabout at Knight and Pritchard Roads.
- A piped drainage system was installed along Brighton Road, discharging to the drainage ditch on the west side of Prichard Road.
- Constructed ditching/fisheries enhancement works completed on Lot 1, Plan 15375 (the "Gage" property).

Drawing A-3, overleaf, indicates all inventoried drainage features within, and adjacent to, the study area.

Artesian groundwater conditions were observed at Hilton Springs (photo #3) and at the western terminus of Brighton Road (photo #1). Flow emanating from Hilton Springs is sufficient to create a defined drainage path (photo #5). This open channel flows east from the Springs to a series of formalized farm ditches near the CFB Comox fuel pipeline right-of-way (photo #8). The farm ditching downstream of Hilton Springs is also directly connected to Lazo Marsh, as well as a number of smaller lateral drainage ditches. A number of these lateral ditches appear to be capable of reversing flow direction, depending on the amount of run-off and the configuration of downstream outlet controls. The presence of natural springs and the use of outlet controls allow for year round flow in the agricultural ditching network.

Drainage ditches located within the agricultural land area (adjacent to the Queen's Ditch) have been excavated to a grade sufficient to force the dewatering of arable lands. Detrimental effects of intentional dewatering are documented in the 2002 Marsh Study[2]. An extensive series of informal outlet control structures are utilized by farmers to manipulate ground and surface water conditions throughout the year. The outlet control in photo #37 is located near the mouth of the Queen's Ditch, and affects a large portion of the catchment area upstream. This control is used by the farmers to flood fields during winter months, and provide water for irrigation during the dry months.

5.2 QUEEN'S DITCH

The Queen's Ditch was constructed initially as an outfall for sanitary sewerage generated within CFB Comox. It is believed this watercourse was a formalization of Lazo Creek, modified over time to accommodate the bulk of the stormwater drainage originating from the air base. The Queen's Ditch begins at a point approximately 100m east of the CVAC terminal, on the south side of Knight Road. The ditch drains to the south east, eventually discharging to the Strait of Georgia, at Point Holmes.

Channel geometry is relatively consistent, both in terms of cross section and gradient. The capacity of the ditch continues to decrease over time, as accumulated sediment and vegetation reduce channel cross section and conveyance efficiency. We understand from a past 19 Wing maintenance contractor that essentially no maintenance of this ditch has occurred over the past (approximately) 10 years. Photo #32 was taken at the headwaters of the Queen's Ditch, and clearly indicates the excessive vegetation within the ditch. Note the (approximately) 20cm diameter tree growing in the middle of the ditch, indicative of the infrequent maintenance the ditch receives.

Past studies of the Queen's Ditch suggest channel capacity is insufficient to meet the demands of existing land uses. The Queen's Ditch capacity is also influenced by tidal action and storm surges. It is not uncommon for the ditch to experience backwater effects nearly all the way to Knight Road during extended periods of rainfall concurrent with high tides/storm surges.

5.3 GENERAL CONDITION OF DRAINAGE INFRASTRUCTURE

Existing culverts within and downstream of the study area range in size from 450mm to several meters in diameter, at the outlet of the Queen's Ditch (photo #34). A number of existing culverts

[2] "Toward a Management Plan for the Lazo Watershed & Queen's Ditch", 2002, William Marsh

were observed to be undersized (photo #28), and/or at the end of their service life (photo #30). Overall, it would appear that most culverts are functional, although a large number are nearing, or have reached the end of their effective service lives.

Ditching within the study area, with the exception of the Queen's Ditch, appears to be adequately maintained.

The limited pipe network, having been installed relatively recently within the study area, appears to be in excellent condition.

6.0 SUBSURFACE INVESTIGATIONS

A number of geological/hydrogeological studies have been undertaken within the NE Comox area in the past. This information has been supplemented with a series of studies completed as part of the current SWMP process. Key studies referred to in this SWMP include:

- *Toward a Management Plan for the Lazo Watershed and Queen's Ditch*, 2002, William Marsh
  - *Documented land use changes within the catchment over time, assessed hydraulic constraints within the watershed, and began to develop a management framework for the watershed.*
- *Environmentally Sensitive Areas Study – N.E. Sector Development Plan*, 1993, Chislett, Lattey Manson.
  - *Develops recommendations for development within North East Comox, based on environmental constraints within the catchment.*
- *Hydrogeological Assessment for Storm Water Infiltration, Knight Road*, 2007, Koers and Associates Engineering.
  - *Assessed the geology/hydrogeology within the catchment, makes recommendations for future stormwater management.*
- 2010 Simpson Geotechnical Stormwater Detention Pond Feasibility Assessment, Lot 1, VIP 15375, Comox District (attached as Appendix C).
  - *Assessed the feasibility of constructing storm water management features on the above noted property.*
- 2010 Simpson/GW Preliminary Hydrogeological Assessment Report (attached as Appendix C).
  - *Preliminary assessment of the hydrogeological regime within select areas of the catchment.*
- 2010 GW Solutions Pritchard Road Detailed Hydrogeological Assessment Report (attached as Appendix C).
  - *Final assessment of hydrogeological regime within select areas of the catchment, makes recommendations for maintaining the existing groundwater regime.*
- 2012 MCSL Infiltration Potential Analysis (ongoing).

- *Determination of infiltration potential within specific portions of the study area, for fine calibration of hydraulic models.*

The complex nature of the hydrogeology within NE Comox is well documented. GW Solutions has described the geomorphology of the area as "a series of nearly flat benches, trending north west to south east, with intervening gentle slopes", with surficial lithology alternating between "loose, dry, silty sand, dense, damp, gravely silt, and firm, wet, silt and clay".

Based on available provincial aquifer mapping, the study area is underlain by aquifer No. 408. This confined aquifer covers approximately 148 km^2, reaching from the Comox Harbour to within 10km of Merville. The confined nature of the aquifer has led to a "low vulnerability" rating from the province.

Analysis undertaken by GW Solutions has determined that artesian flow conditions exist within portions of the study area. Generally, these conditions exist below a geodetic elevation of 25m, although seasonal variations in piezometric head of up to 2m were noted during the course of study.

A series of shallower aquifers and aquatards also exists in the Knight and Pritchard Roads area. This complex, irregular system of permeable sand and gravel lenses, separated by dense glacial morain caps, extends throughout the study area. A number of permeable strata discharge to the ground surface. The Hilton Springs is one such example.

Based on the geological and hydrogeological conditions encountered, a number of fundamental design parameters are indicated:

- Avoid penetration of artesian strata during servicing/grading of the site.
- Avoid modification of the surface of the land, or subsurface, that would result in lowering the various water tables within the site.
- Introduce groundwater into areas of shallow recharge, in order to effectively mimic pre-development conditions.
- Monitor groundwater conditions for a period of time, to ensure that ongoing hydrogeological processes are consistent with the findings of past reports, etc.

In order to assess the recharge capacity of shallow aquifers within the study area, a series of infiltration tests are being performed during winter 2013. Test locations have been selected based on the relative location of detailed soils information already in hand, and recommendations made by the project's geotechnical team. The results of this analysis will be used to inform the design of mitigating features, detailed in Phases 2 and 3 of this report.

7.0 STUDY SUBCATCHMENTS

For the purpose of developing a detailed and differentiated hydraulic model, the study area has been segmented into four distinct subcatchment areas. These areas were selected based on a number of criteria, including:

- Existing property boundaries.
- Existing drainage patterns; points of concentration.
- Ground cover.

- Soils conditions expected.
- Present day land use.

The study area consists of approximately 80 hectares, in varying states of improvement. The relative locations of each subcatchment are identified on Drawing A-4, overleaf.

- **Subcatchment 1** is approximately 8 hectares and lies east of Pritchard Road and south of Cambridge. This area represents the highest point of land within the study area, with elevations ranging from 35 to 55m. The land is largely forested at present, with the exception of the gravel pits located on Lots 1-3, Block A, D.L. 194, Comox District, Plan 442. Additionally:
    - Lands within Subcatchment 1 generally slope to the north east, at an average gradient of approximately 5%.
    - There are no known man-made drainage systems within the subcatchment.
    - In general, the groundwater table ranged from 0.5 to 2.4m in depth where test holes detected measurable groundwater. In some cases boreholes were not extended past 2.4m depth or met with refusal conditions, with no groundwater noted or detected. Refer to the 2010 GW Solutions hydrogeological report attached as Appendix C for further details.
    - The Town of Comox Official Community Plan (OCP) has designated this area as Residential: Low Rise Apartments, Townhouses & Ground Oriented Infill, and Residential: Ground Oriented Infill.
    - A catchment discharge point was selected in the lower north east corner of the catchment (Hilton Springs).
- **Subcatchment 2** lies west of Pritchard Road, and south of Knight Road. Present day ground cover consists of grasslands, second growth forest, and cleared light industrial land. A large portion of the catchment is currently vacant, though residential, institutional and light industrial uses also exist.
    - The 12 hectare parcel ranges in elevation from 25 to 45m and gently slopes north east with an average grade of 3.5%.
    - Shallow groundwater tables range from 1.5m below existing grade along the south subcatchment border, to artesian conditions along the western edge of the boundary.
    - A spring was observed at the west end of Brighton Road. This run-off follows the roadside gutter and is collected by a catchbasin.
    - Existing drainage is limited to a small amount of hard piping along Brighton Road, which discharges into the drainage ditching on the west side of Pritchard Road, thence along Pritchard Road and into the Knight Road open ditch system. An urban style (catchbasin/hard pipe) drainage system was installed at the Knight Road roundabout.

- A catchment discharge point was selected at the lower (north eastern) corner of the subcatchment (corner of Knight and Pritchard Roads).

- **Subcatchment 3** is bounded to the south by Knight Road, and to the north, east and west by the study area boundary. The catchment is 28 hectares in size and is at present utilized primarily as commercial/light industrial.
  - Shallow groundwater tables range from 0.5 to 2.0m deep while ground elevations range from 20 to 35m.
  - The area gently slopes south east at approximately 2.5%.
  - An open channel meanders across the subcatchment and connects to the roadside ditching at the east end of Knight Road as shown in Drawing A-2. The open channel conveys run-off from lands upstream of the study area. Roadside ditching along Military Row and Knight Road drain directly to the Queen's Ditch.
  - A subcatchment discharge point run-off from the subcatchment discharges at the east study area boundary in the roadside ditching along Knight Road.

- **Subcatchment 4** covers 34 hectares, and is bound by Pritchard Road to the west, Knight Road to the north, Cambridge Road to the south and the study boundary to the east.
  - The area is largely covered in second growth tree cover, with the exception of modest openings around existing residences and a small cleared area along the south side of Knight Road.
  - Current zoning within the subcatchment is residential and light industrial. The area is largely undeveloped, save for four existing houses.
  - Elevations in the subcatchment range from 15 to 40m, and the area generally slopes north east with an average grade of 3.5%.
  - Shallow groundwater tables range from 0.5 to 2.0m in depth. Areas showing potentiometric surfaces above ground elevations were observed just south of the subcatchment.
  - Constructed drainage within the subcatchment is minimal, consisting of roadside ditching along the south side of Knight Road.

The study area subcatchments presented above are defined for the purposes of the post-development case, each parcel being developed separately and with varying land use. For the pre-development scenario, the study area is viewed as homogenous, and therefore the baseline condition is formulated based on the whole rather than the individual parts.

ATTACHMENT 7

NOVEMBER 16, 2017 CVRD STAFF REPORT TO
ELECTORAL AREAS SEVICES COMMITTEE

Comox Valley REGIONAL DISTRICT

Staff report

DATE: November 16, 2017

FILE: 5330-20

TO: Chair and Directors
Electoral Areas Services Committee

FROM: Russell Dyson
Chief Administrative Officer

Supported by Russell Dyson,
Chief Administrative Officer

R. DYSON

RE: **Lazo Creek Watershed - Drainage Improvements Options Analysis**

Purpose
To update the Electoral Areas Services Committee (EASC) on the results of the Queen's Ditch options analysis and recommend a path forward.

Recommendation from the Chief Administrative Officer
THAT further study work be completed to assess the effectiveness and viability of managed retreat/wetland restoration in improving drainage in the lower Lazo Creek Watershed;

AND FURTHER THAT $27,000 from Service 152, Electoral Area B Feasibility Studies, be allocated to a flow monitoring program for the Lazo Creek Watershed;

AND FINALLY THAT the McElhanney report titled "Comox Valley Regional District Queen's Ditch Lowland Area Drainage Improvements Options Analysis" and dated September 14, 2017 be referred to the Committee of the Whole for information.

Executive Summary

- Queen's Ditch flood mitigation is a corporate strategic priority of the Comox Valley Regional District (CVRD) Board.
- The lowland areas of the Lazo Creek Watershed lie just above sea level with a drainage gradient of about 0.05 per cent, or nearly flat, and have longstanding issues with flooding that have and continue to affect local residents.
- Prior to the construction of the Queen's Ditch, much of the lower Lazo Creek Watershed was marshland.
- These lowland areas provide drainage for upland areas within the watershed, including lands within Lazo North (Area B), the Town of Comox (Comox), and Canadian Forces Base (CFB) Comox.
- In response to residents' concerns of flooding in the lowland areas, the CVRD committed to undertake a feasibility study to evaluate the viability of a local service area (LSA) to manage drainage in the lower Lazo Creek Watershed.
- A Lazo Creek Watershed Technical Advisory Committee (TAC) and Public Advisory Committee (PAC) were established to inform development of this work. Membership includes select stakeholder agencies and organizations with an interest or jurisdictions in the watershed area along with local area residents and affected community stakeholders.
- As part this work, McElhanney Consulting Service Ltd. (MCSL) was retained to evaluate options for improving the Queen's Ditch drainage system. Hydraulic modeling was undertaken to analyze system response to five drainage improvement options.

- Of these five options, managed retreat or wetland restoration, appears to offer reductions in flooding with modest ongoing maintenance requirements. Additional benefits include the restoration of lost wetland habitat and the potential for partnership opportunities with select stewardship organizations.
- Staff are seeking approval from the EASC to undertake further study work to better understand the effectiveness and viability of managed retreat/wetland restoration in reducing flooding frequency and duration within the lowland areas of the Lazo Creek Watershed.
- Staff are also seeking approval to implement a flow monitoring program to assist in verifying surface water flows at key locations within the Lazo Creek Watershed.
- The situation is complex with multiple competing interests and values. Continued consultation with all stakeholders will be key to identifying and implementing a sustainable solution.

Prepared by:	Concurrence:
	M. RUTTEN
Darry Monteith Engineering Analyst	Marc Rutten, P.Eng General Manager of Engineering Services

Stakeholder Distribution (Upon Agenda Publication)

Lazo Creek Watershed PAC	✔
Lazo Creek Watershed TAC	✔

Background/Current Situation

The Queen's Ditch is a constructed drainage channel, partially built within Lazo Creek. The Queen's Ditch catchment area, known as the Lazo Creek Watershed, is approximately 1300 hectares in size.

The lowland areas of the Lazo Creek Watershed lie just above sea level with a drainage gradient of about 0.05 per cent, or nearly flat, and have longstanding issues with flooding that have and continue to affect local residents. These lowland areas provide drainage for upland areas within the watershed, including lands within Area B, Comox, and CFB Comox.

Historic Land-Use Changes

Prior to the construction of the Queen's Ditch, much of the lower Lazo Creek Watershed was marshland. Outflows from the area were slow, with few open channels and very low gradients.

In 1946 the Department of National Defence (DND) constructed the Queen's Ditch to carry sewage and stormwater from CFB Comox to the Strait of Georgia. While this enhanced outflow from the area, the ditch's hydraulic gradient limited its ability to carry large flows efficiently.

Beginning around the 1950's, wetland areas started to be converted to agricultural lands through construction of drainage ditches along roads and farm fields, increasing the volume of surface and subsurface flows into the Queen's Ditch. This was coupled with residential development in the upper watershed and continued development of CFB Comox lands, adding large areas of impervious land cover and further increasing flows into the ditch.

Over time, expansion and intensification of the drainage network, along with further land clearing, wetland conversion, and development of impervious surfaces have continued to increase stormwater

loading and delivery rates into the Queen's Ditch. Added to this, sea level and gravity continue to be significant constraints to the hydraulic efficiency of the system.

Historic land-use changes within the Lazo Creek Watershed are documented in the 2002 report *"Toward a Management Plan for the Lazo Watershed and Queen's Ditch"* by William M. Marsh. Illustrative mapping developed as part of this work can be found in Appendix B.

Project History

In 1997, a large portion of the agricultural land adjacent to the Queen's Ditch was flooded for an extended period of time, resulting in the loss of an entire potato crop. The farmer subsequently filed a lawsuit naming the Attorney General of Canada, Province of BC, and the Comox-Strathcona Regional District (CSRD) as defendants. In 1999, the farmer discontinued the lawsuit against the CSRD in exchange for a waiver of legal costs, and a commitment by the CSRD to undertake a management plan for the Lazo Creek Watershed.

The William M. Marsh report was completed in 2002, with funding contributed by the CSRD, the provincial government, DND, and Comox. The report was well regarded and contained numerous recommendations for better rainwater management in the upper and lower reaches of the Lazo Creek Watershed.

Flooding has continued to affect many local residents in the lower Lazo Creek Watershed. Affected property owners feel there has been an increase in the frequency and severity of flooding over the past number of years. Property owners report that flood waters are entering basements and damaging structures, crops and equipment and they are worried about the effect that such regular flooding is having on their property values, and upset at the reduced access to their lands.

Consultation for the north-east Comox stormwater management plan in 2014, with the spectre of additional development in the upper reaches of the watershed, was the catalyst for formation of the Lazo Watershed Property Owner's Committee (LWPOC) in December 2014.

In 2015, the LWPOC presented their concerns to both the EASC and the Committee of the Whole (COW). During subsequent meetings with the Area B Director, senior CVRD staff, and DND representatives, the LWPOC communicated support for a feasibility study to explore the viability of a LSA to manage drainage in the lower Lazo Creek Watershed. In August 2015, in response to a letter from Area B Director Rod Nichol, the COW passed a motion to proceed with the feasibility study. A following staff report presented to the EASC in November 2015, provided further recommendations for completing this work.

In early 2016, the CVRD established two committees to advise on matters relating to improved drainage in the area including the possible creation of a LSA.

- A PAC was created to provide guidance and support on matters of public interest. Members include: LWPOC, Little River Enhancement Society and Nature Trust BC.
- A TAC was created to provide guidance and support on technical and jurisdictional matters. Members include: Comox, DND, Ministry of Transportation and Infrastructure (MoTI), Ministry of Agriculture and Fisheries and Oceans Canada.

In 2017 staff retained two consultant to evaluate the feasibility of establishing a LSA to manage drainage in the Lazo Creek Watershed. From this work the following two report were received:

1. *"Queen's Ditch Lowland Area Drainage Improvements Options Analysis"* completed by MCSL and dated September 14, 2017 (Appendix A).
2. *"Queen's Ditch Drainage Service Governance Study"* completed by Stewart McDannold Stuart (SMS) and dated July 14, 2017.

Both reports were presented and discussed with both the TAC and the PAC in fall 2017. The SMS report will be presented to the EASC in a separate staff report.

MCSL Options Analysis

MCSL was retained to investigate options for improving the Queen's Ditch drainage system with the intent of providing a level of service consistent with the following parameters:

- Residential properties should ideally not flood during a rainfall equivalent to a 1:10 year return, 24-hour rainfall event. This level of service is typical of many municipally operated storm drainage functions.
- Agricultural lands should be subject to the provincial Agricultural and Rural Development Subsidiary Agreement (ARDSA) requirements for drainage.

Hydraulic modeling was undertaken using PCSWMM software to analyze system response to five drainage improvement options.

1. Cleaning and deepening of the Queen's Ditch, including both a lined channel and unlined channel option.
2. The addition of overflow channeling, including both a Lazo Marsh bypass option and a DND bypass option.
3. Diking and pumping of the low areas.
4. Managed retreat/wetland restoration, modeled as a +/- 40m wide water surface along the Queen's Ditch and the abandoning of several low areas within adjacent agricultural lands that cannot be consistently drained.
5. Construction of detention ponds, or off-channel storage.

The PCSWMM software used for modeling only identified nodal flooding, or a loss of water at defined nodes within the system. Flood extents were not modeled.

To inform the hydraulic modeling, MCSL first completed a topographic survey and mapping of the drainage system to assist in determining major flow pathways. This mapping was not exhaustive but worked to identify those network components with the greatest degree of influence on flooding.

In the absence of flow monitoring data to accurately predict runoff at various point within the catchment, a land-use assessment of the entire Queen's Ditch catchment area was completed utilizing percent impervious as a proxy for surface water runoff. This methodology did not account for flow attenuation work completed as part of the land development process. Long term Official Community Plan build out conditions were used for modeling future scenarios.

Two modeled scenarios were completed for each of the five options, one under current conditions and a second under future sea level rise and climatic conditions. Sea level rise conditions were modeled as a rise of 1.0m above present day maximums by the year 2100, or 3.34m geodetic. Rainfall data was adjusted to anticipated climatic conditions as a result of climate change.

In 2017 DND completed construction of three large stormwater detention ponds intended to help mitigate peak flows from a portion of CFB Comox lands. Based on hydraulic modeling completed by DND, these ponds provide for a slight reduction in flooding of the lowland areas. The modeling undertaken as part of the MCSL study assumes the DND ponds are constructed and functioning as intended.

While the MCSL report does not offer specific recommendations on a preferred option, the following observations can be made:

- Diking and pumping provides the best opportunity to lower water table levels and decrease flooding and has the flexibility to adapt to changing hydrologic conditions. This option however, requires large infrastructure investments with high long-term operations and maintenance costs.
- Managed retreat provides the second greatest improvement in overall drainage however, flooding is still observed at points of lateral connection under sea level rise conditions.
- Operations and maintenance costs are lowest with the DND bypass option, followed by managed retreat. However, based on hydraulic modeling, managed retreat provides far greater flood mitigation with similar costs.
- All improvement options will require new statutory rights of way or the purchase of land.
- Improvement options that require works to existing channels, particularly the Queen's Ditch, will require extensive environmental approvals. Those options with less impact on existing channels are expected to have significantly less onerous permitting requirements.

Managed Retreat/Wetland Restoration
Managed retreat, or wetland restoration, offers added benefit over some of the other options analysed in the MCSL report.

Managed retreat benefits:

- Reductions in flooding
- Restores lost wetland habitat, increases biodiversity, and provides opportunities for enhanced salmonid returns
- Properly designed and constructed, will function naturally and require modest ongoing maintenance
- Provides for partnership opportunities with select stewardship organizations

Some challenges do exist with this option and more work will need to be completed to better understand its implications.

Detractors of managed retreat:

- Requires a significant amount of land to construct and will need approvals from numerous land owners. This process may be simplified given that a number of properties along the Queen's Ditch are held by the same owner. In total there are 14 distinct property ID's within the regional district fronting the Queen's Ditch, with a total of 11 individual property owners. The map in Appendix C shows those parcels fronting the Queen's Ditch.
- Improvements will result in a net loss of agricultural lands which will need to be addressed with the Agricultural Land Commission. This loss of land base may be partially offset by improvements to the surrounding agricultural lands due to decreased flooding and control of groundwater elevations.
- Requires significant environmental approvals. Further discussion with federal and provincial agency staff is required to better understand environmental requirements.
- Capital construction costs are high, however partnership opportunities may exist not only with DND through the Vote 10 funding program, but also with stewardship organizations interested in habitat and wetland restoration.

Next Steps
Staff are recommending that further work be completed to better understand the effectiveness and viability of the managed retreat option.

Next steps:

- Undertake a flow monitoring program to allow further calibration of hydraulic models, assist in conveyance system sizing and estimate relative runoff rates from each jurisdiction.
- Undertake more detailed hydraulic modeling work to understand flood water extents and confirm effectiveness in achieving the desired level of service.
- Undertake preliminary conceptual design work, confirm required environmental/regulatory approvals, costs, timing, and other considerations.
- Engage with interested stewardship organization to explore potential partnership opportunities.
- Continued engagement with the PAC and the TAC.

A flow monitoring program will be implemented as soon as possible so that 2017/2018 winter flows can be measured. A detailed budget and work plan for the proposed modeling and conceptual design work will be included for approval in the 2018-2022 financial plan for Service 152, Electoral Area B Feasibility Studies. It is expected that this study work will take place in 2018.

During consultation with both the PAC and the TAC it was noted that the MCSL study focused on improving the hydraulic efficiency of the lower drainage network and did not address strategies aimed at reducing the volume and rate of runoff from development within the watershed. It is understood that improved rainwater management within the Lazo Creek Watershed continues to be an important part of any solution. CVRD staff will work together with MoTI and Comox staff towards improved development standards for rainwater management within the watershed.

Policy Analysis
Queen's Ditch flood mitigation is a corporate strategic priority of the CVRD Board.

At their August 11, 2015 meeting the COW passed the following motion:

THAT a feasibility study be conducted to develop a rainwater drainage service that addresses capital upgrades and ongoing maintenance in and around the Queen's Ditch area of the Lazo Marsh.

At their November 9, 2015 meeting the EASC passed the following motions:

THAT a feasibility study be conducted in two-phases to assess the viability of establishing a local service area to rehabilitate and manage the lower Lazo watershed drainage system;

AND FURTHER THAT the Electoral Area 'B' feasibility studies service 152 2016 - 2020 financial plan include $5,000 for possible service establishment costs, and that the 2016 - 2020 financial plan also commit $30,000 of community works funds for capacity building and supporting planning work;

AND FURTHER THAT a staff report on findings of the first phase of a feasibility study be presented to the electoral area services committee by July 2016;

AND FINALLY THAT the Comox Valley Regional District provide a letter of interest to the Department of National Defence expressing interest to enter into negotiations for a contribution agreement with the Department of National Defence for the design and installation of infrastructure supporting the management of the lower Lazo watershed drainage system.

Options

1. EASC members direct staff to undertake further work to evaluate the effectiveness and viability of managed retreat/wetland restoration in improving drainage in the lower Lazo Creek Watershed.
2. EASC members direct staff to undertake further work to evaluate the effectiveness and viability of an alternative option(s).

Staff recommend option one as it offers reductions in flooding with additional opportunities for habitat restoration and strategic partnerships.

It is recommended that any option for further analysis also include a flow monitoring program to verify rainwater runoff at various points within the catchment. Approving this work now will ensure 2017/2018 winter flows are captured in this program.

Financial Factors
The potential exists for the CVRD to assume responsibility of the Queen's Ditch in return for a capital investment through the DND Vote 10 funding program. This process was initiated in March 2016 through a letter of interest sent to DND Vote 10 program staff. More recent discussions with Vote 10 program staff indicate there may also be a possibility of sharing in the cost of future project development work. CVRD staff will continue to work with Vote 10 program staff on cost sharing opportunities for the project.

Flow monitoring data is required to accurately predict rainwater runoff at various points within the catchment. In order ensure 2017/2018 winter flows are captured, it is recommended that $27,000 in unallocated funds for Service 152, Electoral Area B Feasibility Studies, be allocated to a flow monitoring program for the Lazo Creek Watershed.

If further project development work is supported, a detailed budget and work plan will be included in the 2018-2022 financial plan for Service 152, Electoral Area B Feasibility Studies.

Legal Factors
Governance options for the creation of a LSA along with an overview of the legal regulatory regime and common law legal liability risks associated with the provision of a drainage service are considered in a separate report to be presented to the EASC.

Regional Growth Strategy Implications
Project work will be developed to align with the goals and objectives of the Comox Valley Regional Growth Strategy to "provide affordable, effective and efficient services and infrastructure that conserves land, water and energy resources."

Intergovernmental Factors
Approximately 45 per cent of the Lazo Creek Watershed falls within CVRD Area B, 28 per cent within Comox, and 27 per cent within CFB Comox. Any viable solution to flooding in the lower Lazo Creek Watershed will require the collaboration of all jurisdictions within the watershed.

DND has indicated a desire to hand over responsibility for the Queen's Ditch to the CVRD and has also expressed willingness to participate in a possible future LSA set up to manage the Queen's Ditch and associated drainage network.

The Comox boundary wraps almost entirely around the Lazo Creek Watershed, with the last several hundred meters of the Queen's Ditch and outfall falling within town boundaries. PAC members feel strongly that Comox should be part of any drainage solution for the area and continue to voice concerns about development in the upper watershed.

The situation is complex with multiple competing interests and values. The CVRD will continue to work with DND, Comox and other members of the TAC and PAC towards identifying and implementing a sustainable solution.

Interdepartmental Involvement
The Engineering Services Branch has taken the lead in preparing this report.

Citizen/Public Relations
Staff will continue to work closely with the PAC through the next phase of this work. Consultation with all stakeholders will be key to identifying and implementing a sustainable solution.

Attachments: Appendix A – "McElhanney Consulting Serviced Ltd., *Queen's Ditch Lowland Area Drainage Improvements Options Analysis,* September 14, 2017"
Appendix B – "Map of Historic Land-Use Changes"
Appendix C – "Map of Property Boundaries along Queen's Ditch"

September 14, 2017

Appendix A

Comox Valley
REGIONAL DISTRICT

Comox Valley Regional District – Queen's Ditch Lowland Area Drainage Improvements

Options Analysis

McElhanney

McElhanney Consulting Services Ltd.
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Email: b.hudson@mcelhanney.com

MCSL File: 2211-47468-00

OQM | Organizational Quality Management Program

ISO 9001:2008

Executive Summary

Flooding of the Queen's Ditch and adjacent agricultural lands has occurred for many years. It is believed that this flooding has increased in duration and extents over time, likely corresponding to the infilling of the historic Lazo wetland that occupied the (present day) Queen's Ditch lowland areas, and the development of lands within the Queen's Ditch/Lazo catchment. This hypothesis appears to be corroborated by first hand accounts from land owners within the area.

In an effort to provide some relief, the Comox Valley Regional District (CVRD) has agreed to investigate the feasibility of creating a Local Service Area (LSA), to finance the initial construction of drainage network improvements, and to fund the ongoing operation and maintenance of this service.

McElhanney Consulting Services Ltd. (MCSL), has investigated the feasibility of implementing several different drainage system improvements, with the intent of providing a level of service for residential properties that is consistent with that provided by neighboring jurisdictions. It was also agreed that drainage improvements should ensure that arable lands meet Agricultural and Rural Development Subsidiary Agreement (ARDSA) requirements.

Five drainage improvement options were considered, each evaluating a based degree of effectiveness in reducing flooding, technical feasibility (including anticipated higher-level government approvals), estimated capital construction cost, and relative operation and maintenance costs.

1. **Diking and pumping of lowland areas** appears likely to provide the best opportunity to lower water table levels, and decrease flooding under current, and long term (climate change and sea level rise) conditions.
2. **Managed Retreat/Wetland Reinstatement**, is modeled as a +/- 40m wide (water surface) along the Queen's Ditch, and the abandoning of several low areas that cannot be consistently drained within the agricultural lands adjacent to the Queen's Ditch, provides significant improvement in overall drainage, under current sea level and climatic conditions. Longer term projected sea level rise will decrease the effectiveness of this option.
3. **Cleaning and deepening of the Queen's Ditch**, as described in Option 1-2, provides the next greatest reduction in hydraulic grade within the Queen's Ditch, provided that a lined channel section is constructed. Modest flooding of lateral connections persists, even with improvements. Significant flooding is modeled without lining the improved ditch section. Under climate change conditions, Significant flooding is modeled, regardless of lining
4. **The Lazo and DND Bypass** options provide varying levels of flood reduction. Under present-day conditions, the Lazo Bypass is modeled as being minimally effective in reducing the hydraulic grade within the Queen's Ditch. Performance of the DND bypass is approximately equivalent to cleaning and deepening the Queen's Ditch without channel lining improvements. When consideration is given to the impacts of climate change (sea level rise), neither bypass option is effective at reducing flooding under design rainfall conditions.

5. **Off-Channel Storage** is not considered practical, given the flat gradient of the lowland areas, and volume of storage that must be provided to mitigate flooding.

Contents

Figures

Tables

1. Introduction

The Comox Valley Regional District (CVRD) has retained McElhanney Consulting Services Ltd. (MCSL), to provide assistance and technical support, for the evaluation of options to improve drainage within portions of the Queen's Ditch drainage catchment.

This assignment includes the following components, and has been prioritized, as follows:

Phase 1 - Drainage Catchment Mapping - including assembly of existing mapping, survey data and information, survey of existing drainage features and topography to augment information already in hand, preparation of drainage mapping, and ground truthing of same.

Phase 2 – Land Use Assessment – preparation of mapping and tabulated land uses within the various jurisdictions that drain to the Queen's Ditch and Lazo Marsh. Land use is mapped by subcatchment, and point of connection to the Queen's Ditch System, and includes information on current land use/percent impervious, and longer term Official Community Plan land uses.

Phase 3 – Verification of Surface Water Flows in Select Lowland Waterways/Ditches – flow monitoring in select, representative locations to allow for the calibration of hydraulic models, conveyance system (infrastructure) sizing, and estimating of relative runoff rates from each contributing jurisdiction. Note Phase 3 has not proceeded at this time, due to budget constraints.

Phase 4 – Lowland Area Conveyance Improvements Options Analysis – evaluation of five specific options to decrease the extents, depth, and frequency of flooding. Options to be considered include:

- Cleaning and deepening of existing ditching, upsizing culverts as required.
- The addition of "overflow channeling" to redirect runoff around the Queen's Ditch, directly to the ocean.
- Diking and pumping of low areas.
- Managed retreat, or wetland restoration.
- Construction of detention ponds or off-channel storage (within the lowland areas).

Phase 5 – Implementation of Preferred Option and Development of a Management Plan – not completed at this time. (TBD).

2. Background Information

2.1. Site Description

The Queen's Ditch/Lazo Marsh Watershed consists of approximately 1000 hectares of land within the jurisdiction of the Comox Valley Regional District (Electoral Area B) and the Town of Comox. Topography within the Queen's Ditch watershed ranges from sea level, to approximately 55m, geodetic. The area of interest in this study is limited to the defined "lowland areas", surrounding

the Queen's Ditch. Land use within the "lowland areas" is generally agricultural, but the study area does interface with rural, residential properties as well.

MCSL drawing SK-1, overleaf, indicates the extents of the watershed, as well as jurisdictional boundaries.

Lands upstream of the study area are generally comprised of large lot, semi-forested rural residential and agricultural properties within the CVRD. Within those portions of the Town of Comox that drain to the Queen's Ditch and Lazo Marsh, land use ranges from commercial, to varying densities of residential development, to undeveloped, forested land. Additional detailing of existing land use/development can be found in later sections.

2.2. History of Flooding in the Area

The following excerpt is provided from the 2013 North East Comox Neighborhood Stormwater Management Plan, prepared by MCSL:

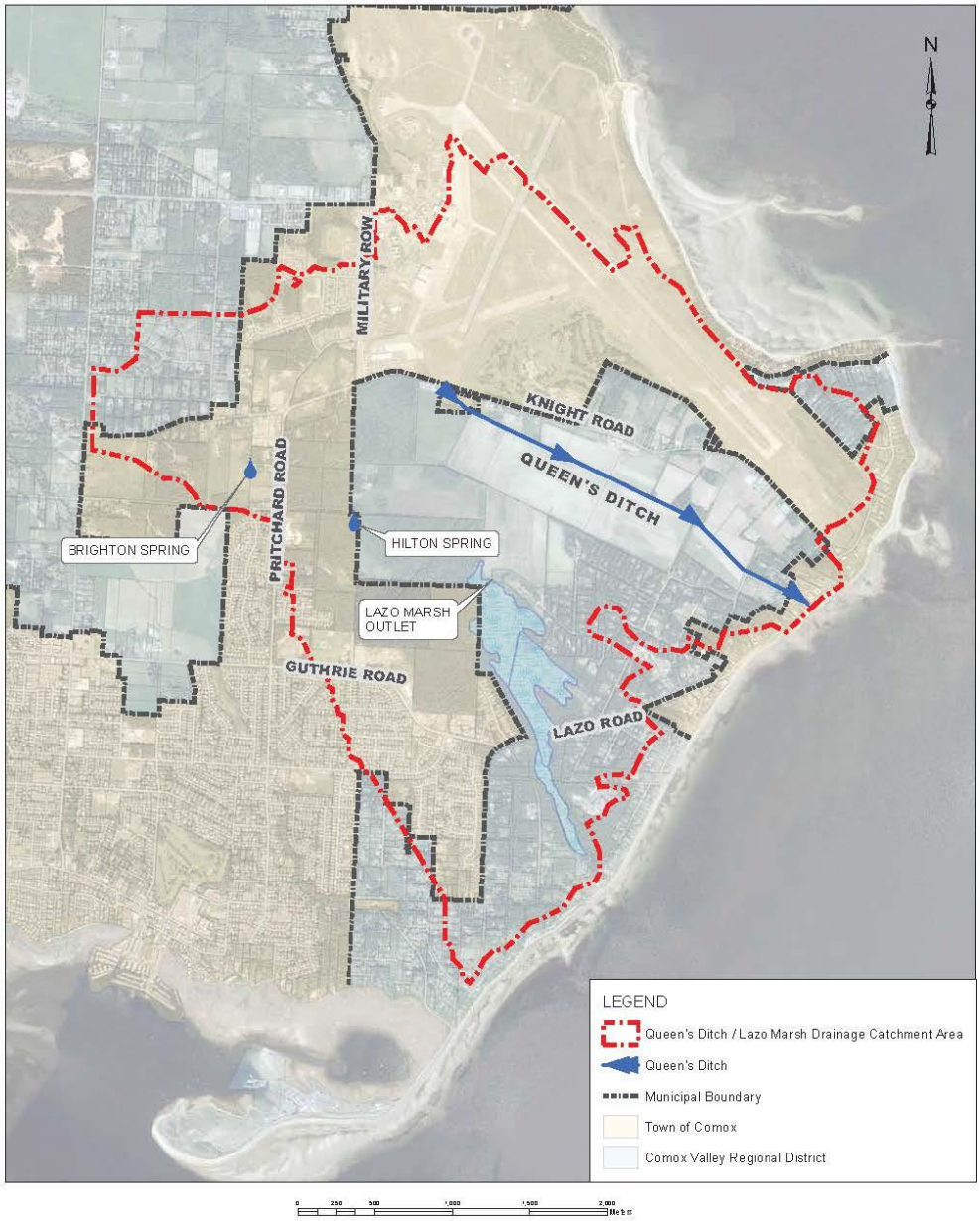
Lowland areas adjacent to the Queen's Ditch have a long history of flooding, this having been the subject of ongoing dialogue between land owners, the Ministry of Transportation and Infrastructure, the Department of National Defence, Town of Comox, and Comox Valley Regional District.

The Queen's Ditch was initially constructed in 1946 as a sewage outfall, disposing of wastewater from CFB Comox. The ditch has, over time, transitioned from a sewage outfall to a storm drainage conduit for the airbase. As development of upland areas proceeded, a formalized drainage network was gradually constructed. Nearly all of these (primarily) open ditches led directly to the Queen's Ditch. Over time, agricultural operations were established on lands adjacent to the ditch, as these lands were drained and converted to arable fields. By approximately 1960, most of the low-lying marsh area adjacent to the ditch had been dewatered and converted to agricultural use.

Discussions with Chris Williams, land owner and farmer of lands which lie at the headwaters of the Queen's Ditch, suggest flooding has occurred regularly from the 1970s to the present. Mr. Williams was not aware of any flooding prior to his occupation of 1271 Knight Road.

Figure 1 Headwaters of the Queen's Ditch

In 1997, flooding of "Woodrow Farms" led to a suit being filed against the Crown, alleging that land development within upland areas of the catchment had caused flooding which, in turn, led to the loss of crops. Fault was eventually attributed equally to the plaintiff and defendant, based on the lack of maintenance of the Ditch, and alteration of natural drainage on private lands.



Queen's Ditch / Lazo Marsh Drainage Improvements
Study Area

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Visual inspection of lands adjacent to the Queen's Ditch during extended periods of precipitation, indicates surficial flooding remains a frequent occurrence.

Lands down gradient of the study area are largely low-lying agricultural properties. Storm drainage and groundwater table management within the farm lands is manipulated by an extensive series of excavated ditches, culverts, and a number of privately operated flow-regulating structures. The Queen's Ditch travels through these agricultural lands, within an easement in favour of the Department of National Defence.

Figure 2 Seasonal flooding of agricultural lands adjacent to the Queen's Ditch

2.3. Ongoing Stormwater Management Improvement by the Department of National Defence

In 2015 the Department of National Defence (DND) commissioned a study to provide options to mitigate stormwater runoff from southern portions of CFB Comox, that directly or indirectly discharge into the Queen's Ditch. This study included the preparation of on-base drainage system mapping, and hydraulic models of the DND stormwater collection system, and the Queen's Ditch. This information was used to assess the feasibility, and efficacy, of a number of mitigating "tools" that could be utilized by DND. Three general types of improvements were considered, including:

- The construction of new stormwater detention ponds, and/or the expansion of existing ponds. This option was, through consultation with DND, determined to provide the greatest cost/benefit of the options analyzed, when consideration was given to maintaining ongoing base operations with minimal disruption, physical (site) constraints, and operation and maintenance requirements.
- Re-direction of outfalls away from the Queen's Ditch. Prior to development of the CFB Comox site, some of the lands that now drain to the Queen's Ditch were believed to have drained north to the Little River catchment, or directly over the Kye Bay Bluffs. This redirection of runoff has increased the land area tributary to the Queen's Ditch, to a degree, and exacerbates the high (peak) runoff rates that enter the Queen's Ditch.

  Although technically feasible to redirect several of the larger outlets from the base to the north, senior DND staff were not in favour of disrupting the airfields to construct the very large, and very deep storm drains required under this option.

- Conveyance Management. Options including constructing a parallel piped drainage, intercepting flows up to a 1:100 year return rainfall event, and conveying directly to the ocean, upgrading (widening and deepening) the existing Queen's Ditch, and managed retreat were investigated. It was ultimately decided that any off-base improvements would be deferred, as presently available funding was mandated to be spent on Federal lands.

DND has undertaken hydraulic modeling to determine peak runoff rates and flood water extents around the Queen's Ditch, with its preferred mitigating measures implemented (construction of three new detention ponds and the expansion of a fourth pond). The following observations of system performance have been made:

- Outflows from those portions of the CFB Comox site that were redirected to detention ponds were mitigated to 1:10 year, predevelopment levels. Although actual attenuated runoff rates are less than the 1:100 predevelopment levels initially targeted, significant reductions in peak runoff were achieved within those subcatchments that could be directed to new detention ponds.
- A slight reduction in flooding of the lowland areas was achieved by constructing the proposed detention ponds. This modest reduction in flood extents was only noted during rainfall events less intense than the Mean Annual Rainfall (MAR) (approximately 2mm/hr, for 24 hours).

Construction of three of the four proposed DND detention ponds will be complete in 2017. The fourth proposed pond is expected to be constructed in the near future, pending budget and regulatory approvals.

Modeling undertaken as part of this study assumes that DND's proposed detention ponds have been constructed, and are functioning as intended.

3. Drainage System and Catchment Mapping

MCSL has prepared overall drainage system mapping of the lowland study area utilizing data acquired via several sources, including:

- Data provided by the Department of National Defence.
- Topographic survey completed by MCSL in 2017.
- Visual inspections, and site reconnaissance.
- Input from CVRD Parks Staff.
- Input from existing land owners within, or adjacent to, the study area.
- Topographic survey and Lidar data, already in hand.

The mapping produced herein is intended to assist in the determination of major flow pathways/conduits within the drainage system, to allow for system modeling and evaluation of drainage improvement options. The drainage system mapping is not intended to be exhaustive, but rather to identify those network components having the greatest degree of impact/influence on flooding within the lowland areas.

In order to determine the hydraulic capacity of major drainage system components, culverts, pipes, ditches and other features were physically measured by field personnel at representative points within the system.

MCSL drawing SK-2, overleaf, contains an overview of drainage system routing within the study area.

4. Land Use Assessment

It was agreed amongst the project team that, in the absence of flow monitoring data of sufficient quality and duration to accurately predict rainwater runoff at various points within the catchment, percent impervious would be a reasonable proxy for surface runoff. This method of runoff estimation is not as accurate as flow monitoring utilizing continuous data logging, collected at multiple points within the drainage area. However, it does provide a reasonable starting point for analysis.

4.1. Land Use Mapping and Percent Impervious Calculation

Orthophoto imagery was utilized to create overall land use mapping throughout developed portions of the Queen's Ditch/Lazo Marsh drainage. Based on existing Official Community Plan (OCP), zoning designations, and observations of current development conditions, this mapping was delineated into drainage subcatchments, and further segregated into similar usage (and therefore percent impervious).

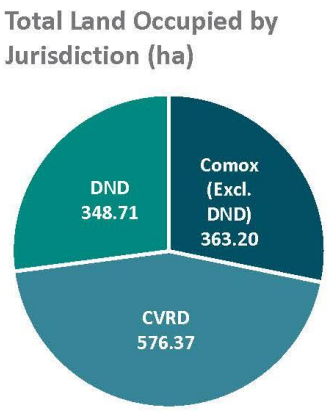


Figure 3

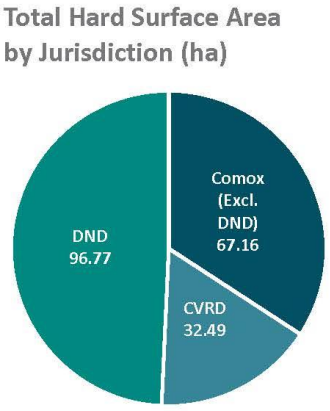
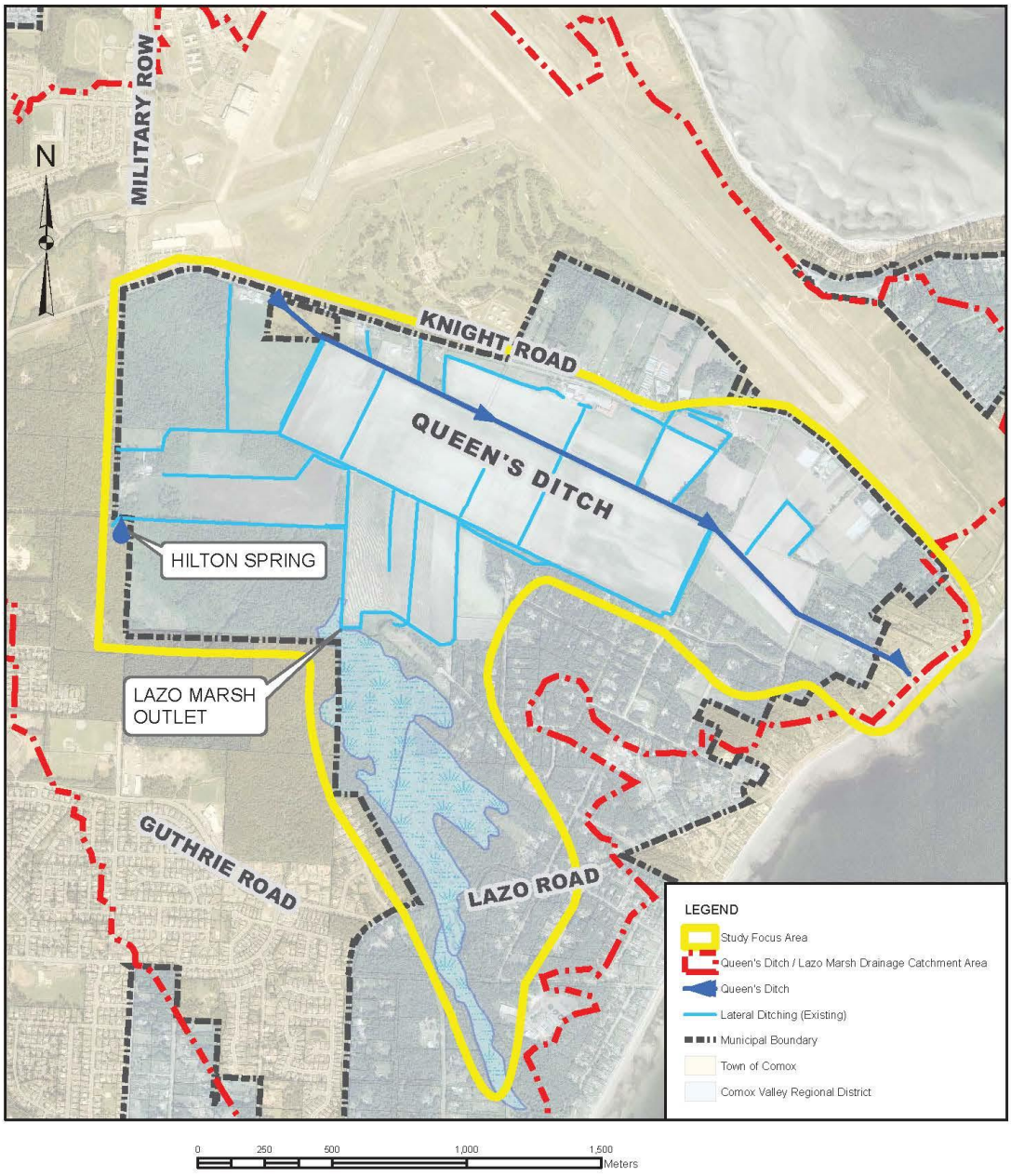


Figure 4

Representative land uses/neighbourhoods were sampled to determined their respective percent impervious. The process utilized in this exercise was similar to that used in the NE Comox Neighborhood Stormwater Management Plan.

Appendix A contains a number of figures that were used throughout the catchment to manually measure hard surfaced areas, i.e., rooftop, asphalt, concrete and other improvements, in order to



Queen's Ditch / Lazo Marsh Drainage Improvements
Study Focus Area and Drainage Network Overview

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provide a representative numeric value for each specific land use observed. This information will, in addition to providing an initial basis for flow apportionment between jurisdictions, inform the hydraulic model developed to evaluate drainage system improvement options. More specifically, land use data (hard surfaced areas) has been used to determine initial abstractions (the volume of rainwater that is lost to depression storage and evapotranspiration), CN numbers, drying time, zero impervious routing, catchment width (overland flow length and specific pathways within subcatchments), Manning's "n" value for overland conveyance, etc.

Drawing SK-3, overleaf, contains subcatchment boundary mapping, present-day land use, and points of connection to the Queen's Ditch System.

4.2. Percent Impervious Calculation

Present-Day, and longer term (Official Community Plan) land use/development conditions within the Queen's Ditch catchment, have been reviewed, and summarized in the following **Figures 5 to 10**:

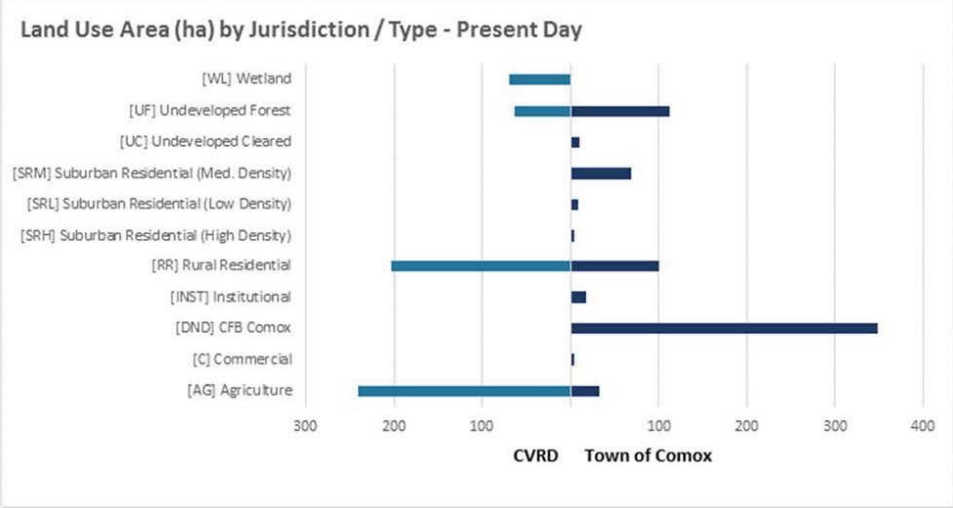
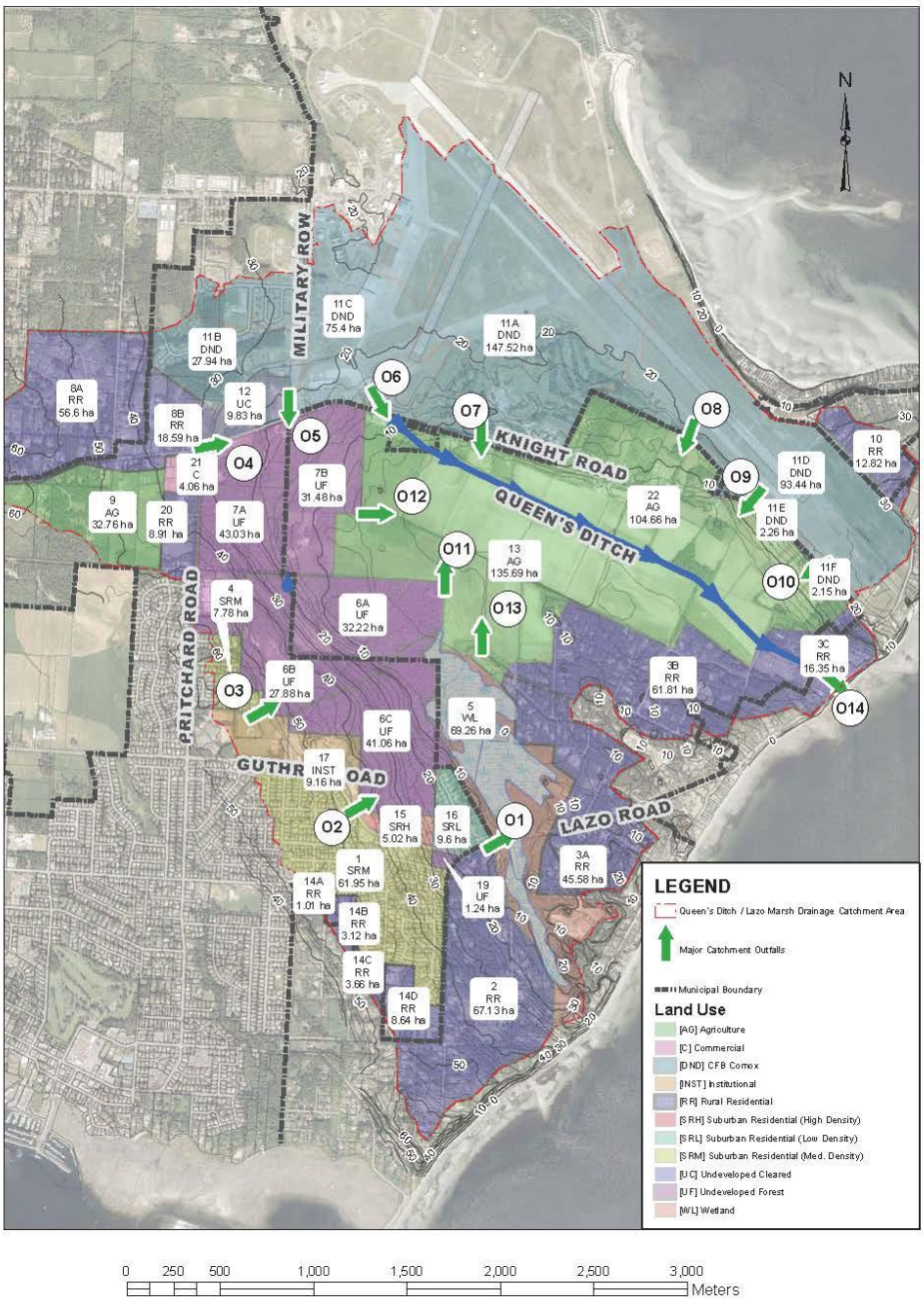


Figure 5



Queen's Ditch / Lazo Marsh Drainage Improvements
Land Use & Subcatchments
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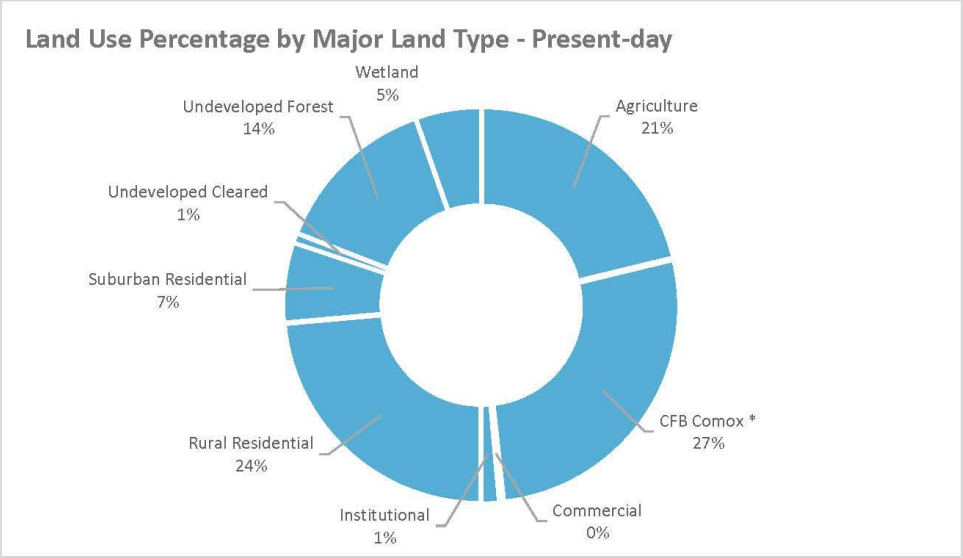
Land Use Percentage by Major Land Type - Present-day
Wetland
5%
Undeveloped Forest
14%
Agriculture
21%
Undeveloped Cleared
1%
Suburban Residential
7%
CFB Comox *
27%
Rural Residential
24%
Institutional
1%
Commercial
0%

Figure 6

Subcatchment Hard Surface / Impervious Values - Present-day

Subcatchment ID	Jurisdiction	Land Use Type	Subcatchment Area [ha]	Hard Surface Area [ha]	Hard Surface [%]
1	Comox	Suburban Residential (Med. Density)	61.95	33.45	54
2	CVRD	Rural Residential	67.13	10.74	16
3A	Comox	Rural Residential	45.58	7.29	16
3B	CVRD	Rural Residential	61.81	9.89	16
3C	Comox	Rural Residential	16.35	2.62	16
4	Comox	Suburban Residential (Med. Density)	7.78	4.20	54
5	CVRD	Wetland	69.26	0.00	0
6A	CVRD	Undeveloped Forest	32.22	0.00	0
6B	Comox	Undeveloped Forest	27.88	0.00	0
6C	Comox	Undeveloped Forest	41.06	0.00	0
7A	Comox	Undeveloped Forest	43.03	0.00	0
7B	CVRD	Undeveloped Forest	31.48	0.00	0
8A	CVRD	Rural Residential	56.60	9.06	16
8B	Comox	Rural Residential	18.59	2.97	16
9	Comox	Agriculture	32.76	0.00	0
10	CVRD	Rural Residential	12.82	2.05	16
11A	Comox	CFB Comox *	147.52	39.68	27
11B	Comox	CFB Comox *	27.94	7.33	26
11C	Comox	CFB Comox *	75.40	34.83	46
11D	Comox	CFB Comox *	93.44	14.93	16
11E	Comox	CFB Comox *	2.26	0.00	0
11F	Comox	CFB Comox *	2.15	0.00	0
12	Comox	Undeveloped Cleared	9.83	0.00	0
13	CVRD	Agriculture	135.69	0.00	0
14A	CVRD	Rural Residential	1.01	0.16	16
14B	Comox	Rural Residential	3.12	0.50	16
14C	CVRD	Rural Residential	3.66	0.59	16
14D	Comox	Rural Residential	8.64	1.38	16
15	Comox	Suburban Residential (High Density)	5.02	3.06	61
16	Comox	Suburban Residential (Low Density)	9.60	2.69	28
17	Comox	Institutional	9.16	2.93	32
18	Comox	Institutional	8.66	2.77	32
19	Comox	Undeveloped Forest	1.24	0.00	0
20	Comox	Rural Residential	8.91	1.43	16
21	Comox	Commercial	4.06	1.87	46
22	CVRD	Agriculture	104.66	0.00	0
			1288.27	196.42	

** DND supplied data*

Hard surface defined as asphalt, concrete, and packed gravel surfaces

Figure 7

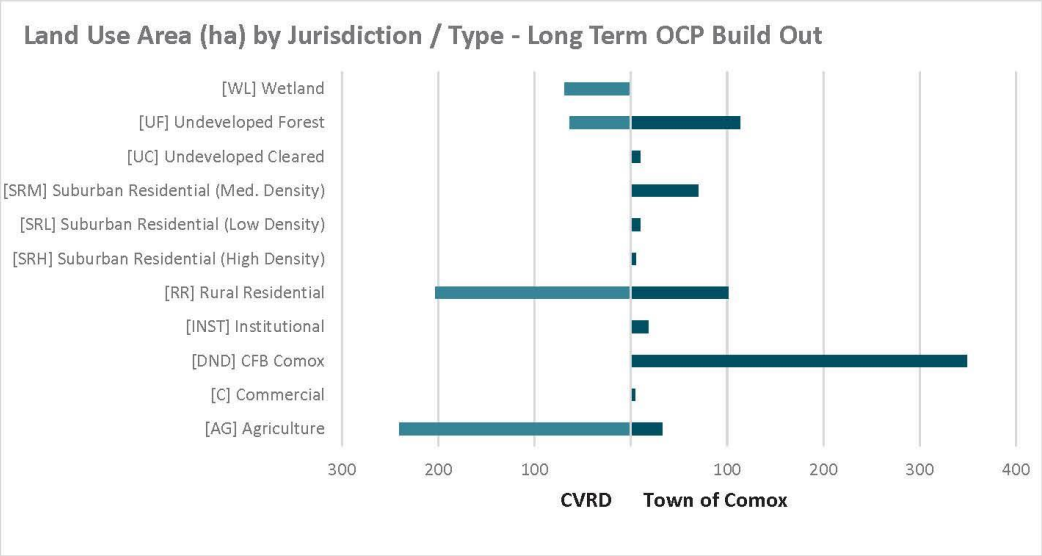

Figure 8

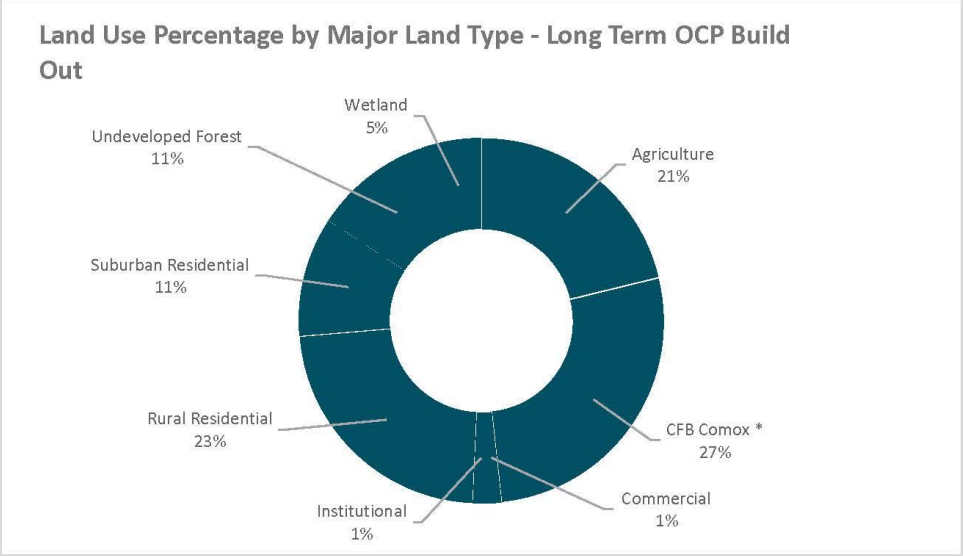

Figure 9

Subcatchment Hard Surface / Impervious Values - Long Term OCP Build Out (Assumed 20 Year Horizon)

Subcatchment ID	Jurisdiction	Land Use Type	Subcatchment Area [ha]	Hard Surface Area [ha]	Hard Surface [%]
1	Comox	Suburban Residential (Med. Density)	61.95	33.45	54
2	CVRD	Rural Residential	67.13	10.74	16
3A	Comox	Rural Residential	45.58	7.29	16
3B	CVRD	Rural Residential	61.81	9.89	16
3C	Comox	Rural Residential	16.35	2.62	16
4	Comox	Suburban Residential (Med. Density)	7.78	4.20	54
5	CVRD	Wetland	69.26	0.00	0
6A	CVRD	Undeveloped Forest	32.22	0.00	0
6B	Comox	Undeveloped Forest	27.88	0.00	0
6C	Comox	Undeveloped Forest	41.06	0.00	0
7A	Comox	Suburban Residential (High Density)	43.03	23.24	54
7B	CVRD	Undeveloped Forest	31.48	0.00	0
8A	CVRD	Rural Residential	56.60	9.06	16
8B	Comox	Rural Residential	18.59	2.97	16
9	Comox	Agriculture	32.76	0.00	0
10	CVRD	Rural Residential	12.82	2.05	16
11A	DND	CFB Comox *	147.52	39.68	27
11B	DND	CFB Comox *	27.94	7.33	26
11C	DND	CFB Comox *	75.40	34.83	46
11D	DND	CFB Comox *	93.44	14.93	16
11E	DND	CFB Comox *	2.26	0.00	0
11F	DND	CFB Comox *	2.15	0.00	0
12	Comox	Commercial	9.83	4.52	46
13	CVRD	Agriculture	135.69	0.00	0
14A	CVRD	Rural Residential	1.01	0.16	16
14B	Comox	Rural Residential	3.12	0.50	16
14C	CVRD	Rural Residential	3.66	0.59	16
14D	Comox	Rural Residential	8.64	1.38	16
15	Comox	Suburban Residential (High Density)	5.02	3.06	61
16	Comox	Suburban Residential (Low Density)	9.60	2.69	28
17	Comox	Institutional	9.16	2.93	32
18	Comox	Institutional	8.66	2.77	32
19	Comox	Undeveloped Forest	1.24	0.00	0
20	Comox	Suburban Residential (Med. Density)	8.91	1.43	16
21	Comox	Commercial	4.06	1.87	46
22	CVRD	Agriculture	104.66	0.00	0
			1288.27	224.18	

** DND supplied data*
Hard surface defined as asphalt, concrete, and packed gravel surfaces

- Area Changed based on OCP Land Use

Figure 10

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5. Desired Level of Service to be Achieved

Through discussions with the Comox Valley Regional District and the Public Advisory Committee (PAC), expectations for the desired level of service provided by the Queen's Ditch and lowland area drainage system were established. It was agreed that initial modeling and analysis would be carried out based on the following parameters:

- Residential properties should ideally not flood during rainfall equivalent to a 1:10 year return, 24-hour rainfall event. Nuisance flooding, or ponding may be acceptable within landscaped areas, yards, etc., but residences should not be inundated with flood waters during rainfall events with a recurrence interval of less than 1:10 years. This level of service is typical of that provided by many modern, municipally operated storm drainage functions. This implies that all conveyance system components, including piping, ditching, culverts and bridges, should be capable of conveying runoff from a 1:10 year design rainfall event.
- Agricultural lands, including fields, and improvements necessary to carry out agricultural activities (barns, sheds, outbuildings, etc.) should be subject to the Agricultural and Rural Development Subsidiary Agreement (ARDSA) requirements, also known as the "Agricultural Drainage Criteria". Briefly, these requirements note that agricultural drainage systems should:
    i. Be capable of removing runoff from the 10-year, 5-day storm, within 5 days during the dormant period (November 1 to February 28).
    ii. Be capable of removing runoff from the 10-year, 2-day storm, within 2 days during the March 1 to October 31 growing period.
    iii. Be capable, between storm events, and in periods where drainage is required, of maintaining base flows in channels at a minimum of 1.2m below field elevation.
    iv. Be sized to convey both base flows, and design storm events.

6. Hydraulic Model Development and System Response Modeling

Hydraulic Modeling Software and Approach

A rainfall runoff and conveyance system model was developed utilizing PCSWMM software. PCSWMM, developed by Computational Hydraulics International (CHI), uses the computational engine from the US Environmental Protection Agency's Stormwater Management Model, widely held as an industry standard hydrologic and hydraulic simulation platform. PCSWMM enhances the base software with additional features and flexibility for a more efficient user interface. The software's primary purpose is simulating stormwater runoff and conveyance, but also allows the user to calculate backwater effect, and flooding via a "2-Dimensional" software add-in module.

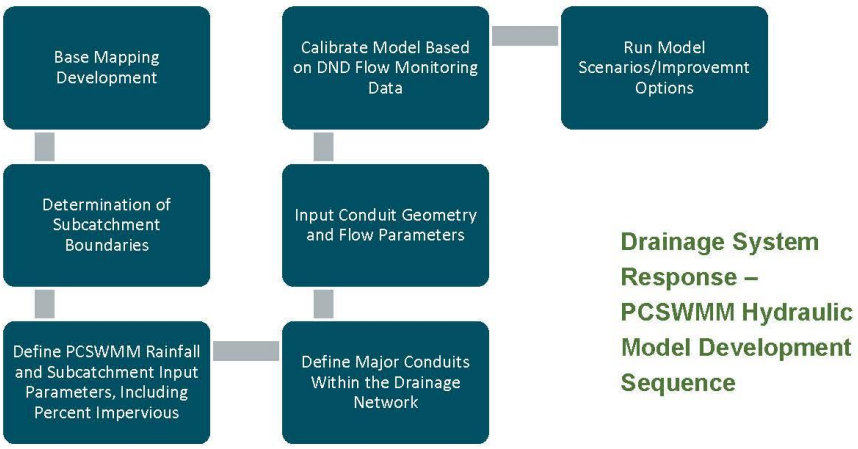


Figure 11

In order to estimate the existing performance of the Queen's Ditch drainage network, it is necessary to understand with some degree of certainty the peak surface and groundwater flows that are intercepted and conveyed by the Queen's Ditch System. To this end, data from a number of sources was compiled and reviewed, including:

- Flow monitoring data in hand from the Department of National Defence, including data recorded at major DND outfalls/points of connection to the Queen's Ditch System, and at the Queen's Ditch outlet at Point Holmes.
- Visual observations of typical wet weather flow conditions at key points within the system.
- Flow data collected by MCSL during past drainage studies in the catchment.
- Assessment of hydraulic constraints within conduits discharging into the system. I.e., a pipe of given diameter and slope has a maximum capacity that can be used as an upper bound flow "check".
- Measured percent impervious of the various subcatchments within the Queen's Ditch Catchment, as discussed in Section 4.

Sea Level, Storm Surge, Rainfall and Climate Change Modeling Parameters

Tera Tech, in its June 2014 report entitled "Functional Plan for Queen's Ditch", prepared on behalf of the Department of National Defence, has determined that the 200-year astronomical high tide at the Queen's Ditch outfall should be set at 2.34m geodetic, inclusive of allowance for storm surge. Past studies and modeling of the Queen's Ditch have utilized this value. For consistency, MCSL recommends that this value be held for modeling of present-day conditions in the current study.

The 2014 Tetra Tech report has also recommended that further analysis within the Queen's Ditch area account for anticipated rise in sea level, predicted at this time to reach 1.0m above present-day

maximums by year 2100. Although similar modeling recently undertaken by the Department of National Defence has excluded sea level rise, the CVRD has requested that sea level rise be considered in hydraulic modeling utilized to test drainage network improvement options. Present-day plus sea level rise model scenarios have therefore utilized a 200-year astronomical high tide plus storm surge elevation of 3.34m geodetic.

The design (modeled) rainfall event utilized in this analysis is a 10-year return, SCS Type 1A rainfall distribution, with Climatic data obtained from CFB Comox. The SCS Type 1A design storm is a synthetic design rainfall event commonly utilized in Pacific Coastal regions for the design of new stormwater infrastructure. The rainfall used in the modeling exercise was derived from the latest intensity duration frequency (IDF) curve for the Comox airport weather station. The 1:10 year SCS Type 1A storm is characterized by a daily rainfall of approximately 80mm and a peak intensity of 12.8mm/hr. The US Soil Conservation Service SCS Type 1A design storm is based on historic rainfall data recorded on the west coast of Washington and Oregon States. As a result, the SCS Type 1A is a good approximation of coastal British Columbia rainfall.

In order to more accurately model system response to a discrete rainfall event, the model was "primed" by running a 24-hour rainfall event, followed by 9 hours of "drying time", before the onset of the design rainfall event. This process allows modeled soil to become saturated, and more realistically simulate real world initial abstractions (depression storage and evapotranspiration), and infiltration.

Table 1 indicates modeled (Q_{10}) peak flow rates at the outfall locations identified on **Sketch SK-3** (noted as 01 through 014).

Q10 Modeled Peak Runoff Rates	
Outlet Number	Peak Runoff Rates (L/s)
O1	412
O2	1391
O3	288
O4	801
O5	409
O6	2114
O7	1570
O8	1700
O9	61
O10	67
O11*	614
O12*	200
O13*	866
O14*	5580

*Peak flow rates are governed by flooding in QD

Options Analysis – Model Results

Five specific drainage network improvement options have been considered to decrease flooding frequency and duration within the lowland areas. These options were selected as they provide a broad

cross section of the potential options available to the CVRD. Capital construction costs for each option, as well as the anticipated performance and relative benefits and detractors of each option, have been discussed. Provided below is a summary of modeled scenarios:

Model Scenario 1-1, Present-day/Existing Conditions– System Performance

Present-day drainage system function has been modeled to determine existing system performance, and to set a base line to allow for evaluation of improvement option efficacy. **Drawing Plan 1-1**, located in **Appendix B**, contains a PCSWMM generated (plan view) representation of conduit (ditch or channel) capacity. PCSWMM identifies "flooding", that is loss of rainwater from the defined conduit system, as a blue coloured node. Those conduits not experiencing flooding, i.e., operating within their modeled capacity, are shown in green.

The Queen's Ditch and many of its lateral connections are shown to flood under present-day conditions. These model results corroborate first hand accounts provided by land owners in the area.

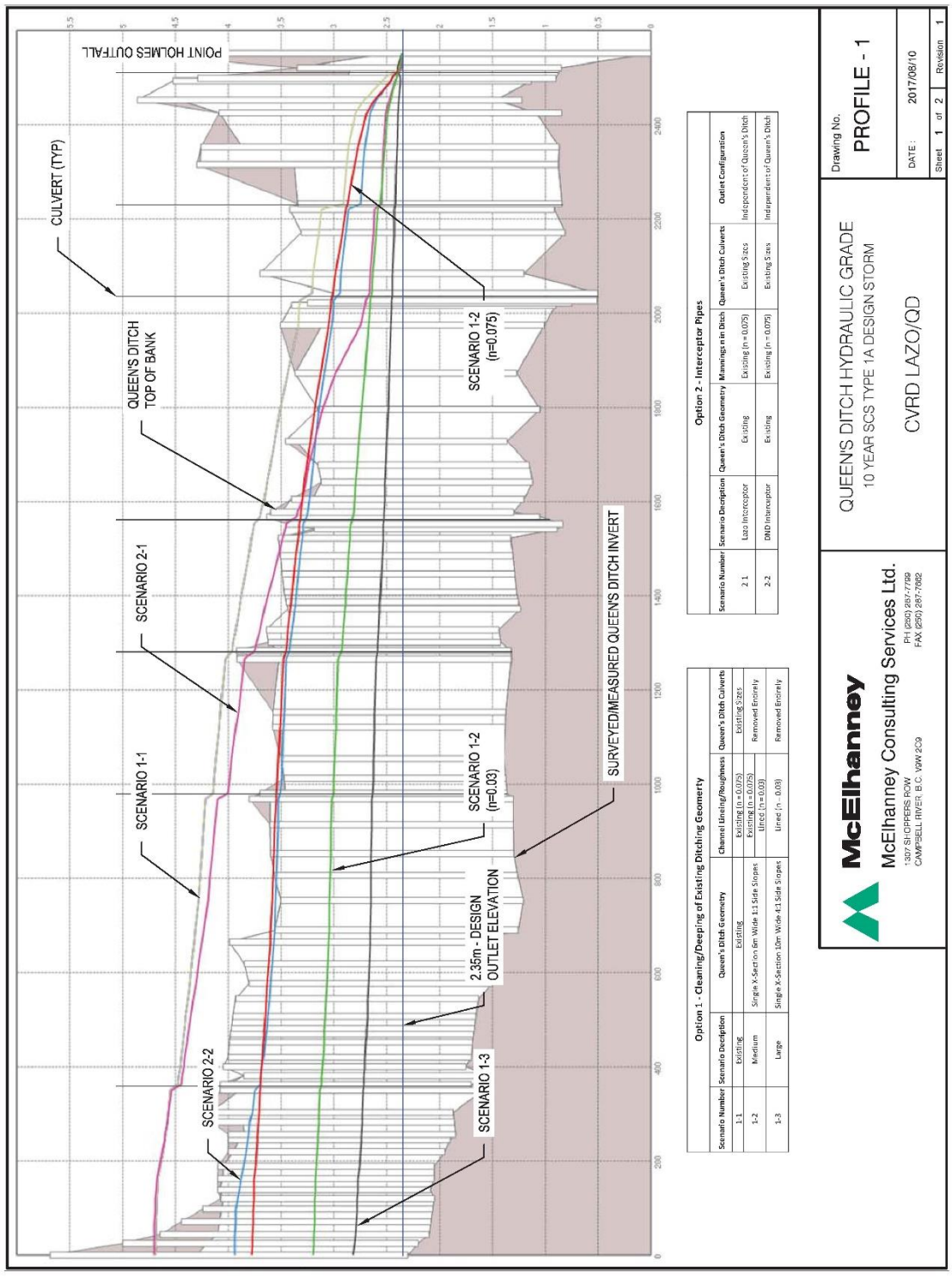
Drawing Profile-1 and Profile -2, overleaf, are PCSWMM generated hydraulic profiles of the Queen's Ditch. These profiles include a number of model scenarios, including present-day (Scenario 1.1). Key observations of present-day model results include:

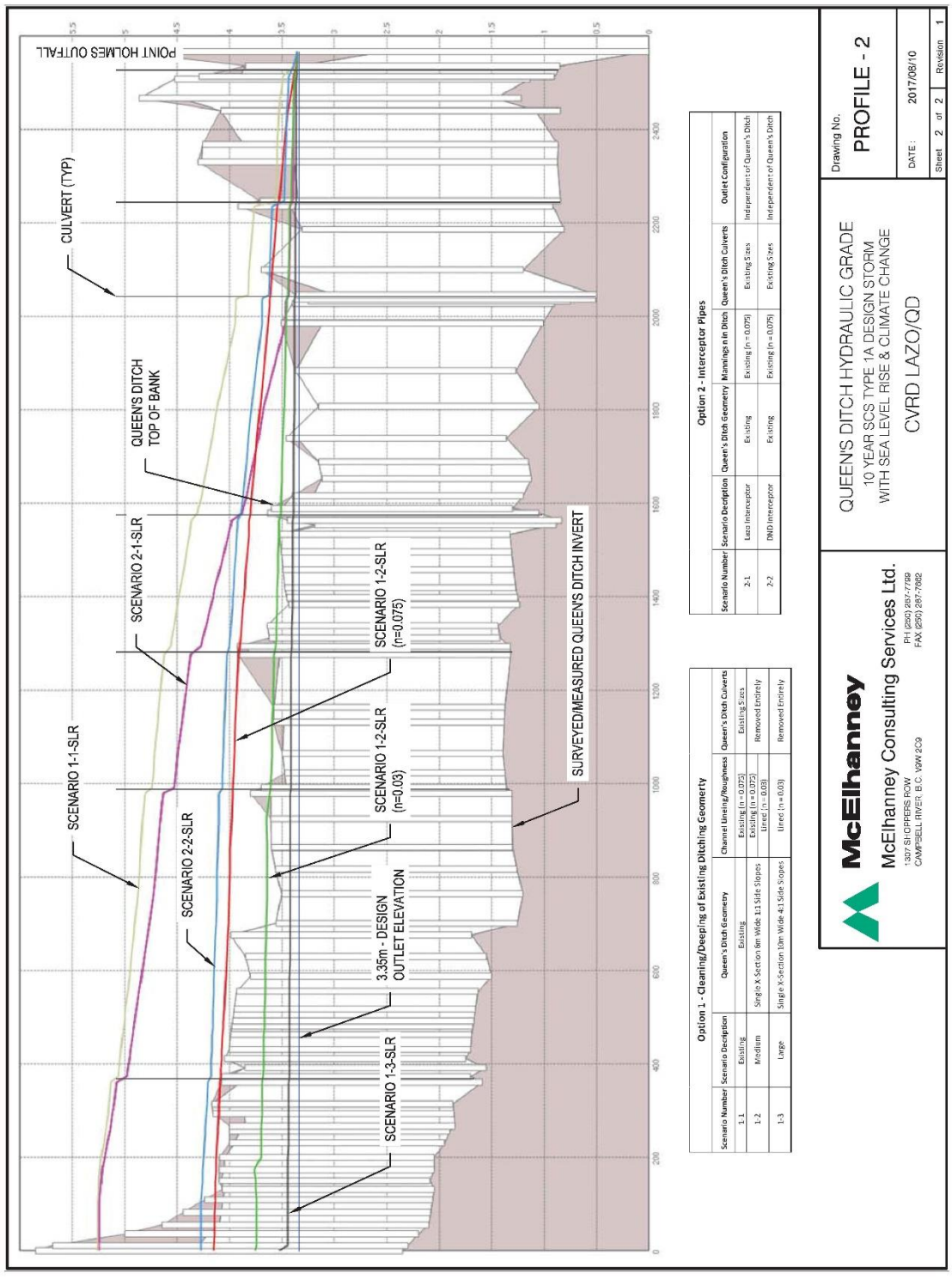
- The hydraulic grade of the Queen's Ditch as modeled exceeds the top-of-bank over most of the alignment, during a 1:10 year return rainfall event.
- Flooding begins at a point approximately 550m upstream of the Pt. Holmes outfall.
- A number of flow restrictions exist within the Queen's Ditch; these generally correspond to undersized culverts.
- The modeled top-of-bank was based on survey data collected in early 2017. It was determined during the collection of this data that much of the land surrounding the Queen's Ditch was lower in elevation than the ditch, i.e., the Queen's Ditch is diked.

Improvement Option 1 - Cleaning and Deepening of the Queen's Ditch (Model Scenario 1-2) – System Performance

Model Scenario 1-2 assumed that the Queen's Ditch alignment would be maintained horizontally, but a number of physical improvements would be made to improve hydraulic capacity. Specifically, it was assumed that:

- The base of the Queen's Ditch would be widened to 6m. **Drawing SK-4**, overleaf, indicates the assumed limits of cleaning and deepening.
- Side slopes of the Ditch would be graded at 1 horizontal to 1 vertical.
- All culverts would be removed (it was assumed that existing culverts would be replaced with new culverts of sufficient capacity to ensure no hydraulic restriction occurred).
- Two different channel roughness conditions were modeled; one assumed similar conditions to present-day (no channel lining), the other assumed that a lined section would be utilized (carefully placed and appropriately graded rock or synthetic liner).


POINT HOLMES OUTFALL
CULVERT (TYP)
QUEEN'S DITCH TOP OF BANK
SCENARIO 2-1
SCENARIO 1-1
SCENARIO 2-2
SCENARIO 1-3
SCENARIO 1-2 (n=0.075)
SCENARIO 1-2 (n=0.03)
2.35m - DESIGN OUTLET ELEVATION
SURVEYED/MEASURED QUEEN'S DITCH INVERT
Option 1 - Cleaning/Deeping of Existing Ditching Geometry
Scenario Number | Scenario Decription | Queen's Ditch Geometry | Channel Lining/Roughness | Queen's Ditch Culverts
1-1 | Existing | Existing | Existing (n = 0.075) | Existing Sizes
1-2 | Medium | Single X-Section 6m Wide 1:1 Side Slopes | Existing (n = 0.075) | Removed Entirely
1-3 | Large | Single X-Section 10m Wide 4:1 Side Slopes | Lined (n = 0.03) | Removed Entirely
Option 2 - Interceptor Pipes
Scenario Number | Scenario Decription | Queen's Ditch Geometry | Mannings n in Ditch | Queen's Ditch Culverts | Outlet Configuration
2-1 | Lazo Interceptor | Existing | Existing (n = 0.075) | Existing Sizes | Independent of Queen's Ditch
2-2 | DND Interceptor | Existing | Existing (n = 0.075) | Existing Sizes | Independent of Queen's Ditch
McElhanney
McElhanney Consulting Services Ltd.
1307 SHOPPERS ROW
CAMPBELL RIVER, B.C. V9W 2C9
PH (250) 287-7799
FAX (250) 287-7082
QUEEN'S DITCH HYDRAULIC GRADE
10 YEAR SCS TYPE 1A DESIGN STORM
CVRD LAZO/QD
Drawing No.
PROFILE - 1
DATE : 2017/08/10
Sheet 1 of 2 Revision 1


POINT HOLMES OUTFALL
CULVERT (TYP)
QUEEN'S DITCH TOP OF BANK
SCENARIO 2-1-SLR
SCENARIO 1-1-SLR
SCENARIO 2-2-SLR
SCENARIO 1-2-SLR (n=0.075)
SCENARIO 1-2-SLR (n=0.03)
3.35m - DESIGN OUTLET ELEVATION
SCENARIO 1-3-SLR
SURVEYED/MEASURED QUEEN'S DITCH INVERT
Option 1 - Cleaning/Deepring of Existing Ditching Geometry
Option 2 - Interceptor Pipes
McElhanney
McElhanney Consulting Services Ltd.
1307 SHOPPERS ROW
CAMPBELL RIVER, B.C. V9W 2C9
PH (250) 287-7799
FAX (250) 287-7082
QUEEN'S DITCH HYDRAULIC GRADE
10 YEAR SCS TYPE 1A DESIGN STORM
WITH SEA LEVEL RISE & CLIMATE CHANGE
CVRD LAZO/QD
Drawing No.
PROFILE - 2
DATE : 2017/08/10
Sheet 2 of 2
Revision 1

- Model scenarios were run to replicate (a) present-day high tide plus storm surge, and (b) present-day high tide, plus storm surge, plus sea level rise.
- **Drawing Plan 1-2 (Appendix B**), indicates present-day nodal flooding under scenario 1-2. **Drawing Plan 1-2 SLR** shows modeled nodal flooding under sea level rise conditions.

System Performance Under Improvement Option 1

- Present-day sea level - flooding was observed at several points along the Queen's Ditch with no channel lining. Improvement of the channel by lining resulted in no modeled flooding of the Queen's Ditch.
- Flooding was observed under both channel options (lining or no lining) in the lateral connections to the Queen's Ditch. Many of these lateral connections are believed to have lower top-of-bank elevation than that of the Queen's Ditch. Field elevations adjacent to both the Queen's Ditch and lateral ditching is, in many places, lower than the Queen's Ditch top-of-bank.
- Maintaining groundwater elevations a minimum of 1.2m below surface grade is problematic. With high tide elevations of 2.35m, a minimum ground elevation of 3.55, plus allowance for hydraulic grade would be required throughout agricultural lands. This implies raising of large tracts of farmland would be required.
- The time required to drain agricultural areas of flood waters has not been modeled at this time.
- Sea level rise – extreme flooding was observed under both channel lining options.

Benefits of Improvement Option 1

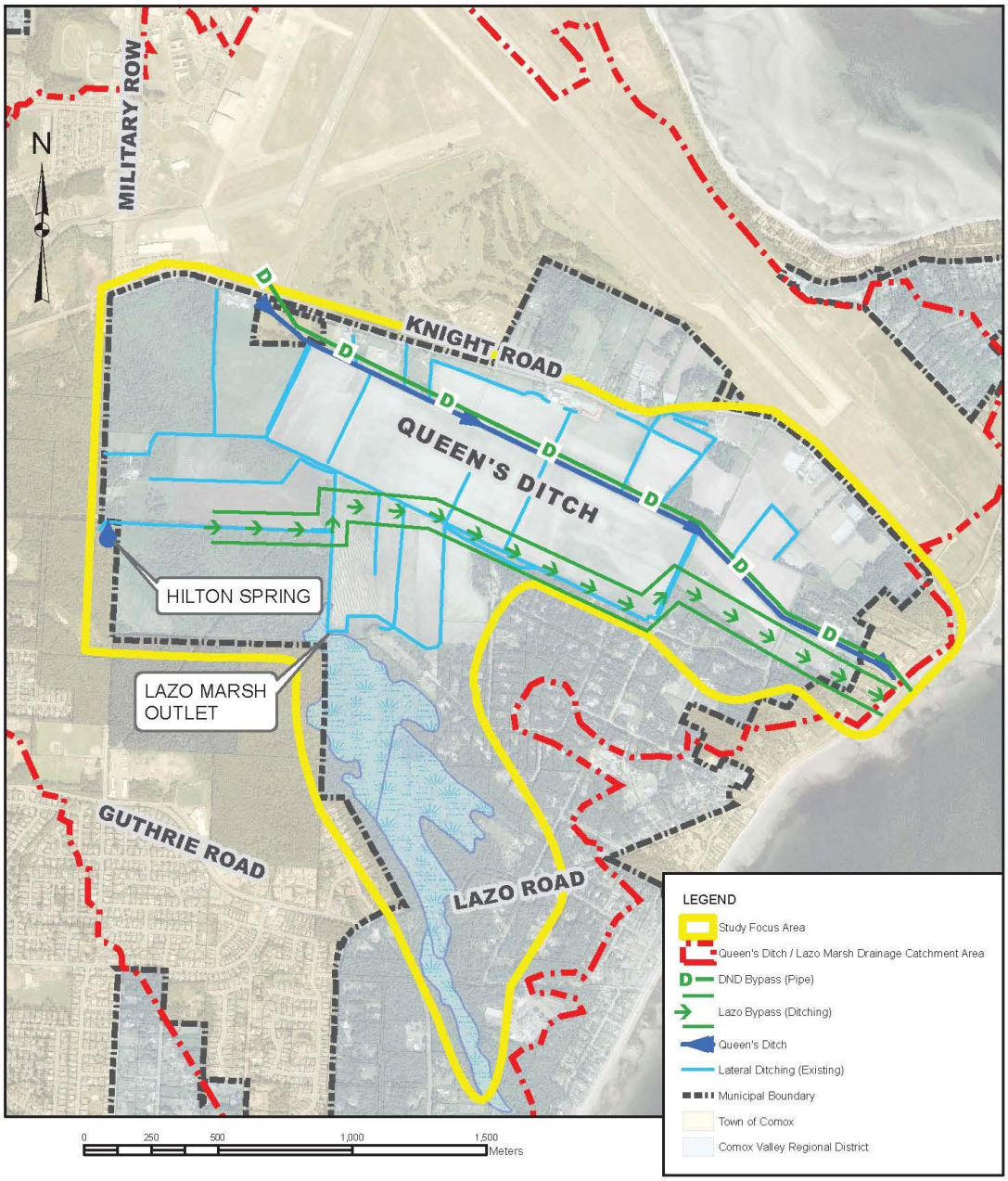
- Simplicity of construction, when channel lining is not required. However, constructing a lined channel section will be moderately difficult, and costly.
- This scenario would not require acquisition of additional lands, easements, or Rights-of-Way.

Detractors of Improvement Option 1

- Environmental approvals (Ministry of Environment, Fisheries and Oceans Canada) could be difficult to obtain. Restoration of habitat will likely be required.
- Regular maintenance of the new channel section will be required to ensure that performance is maintained.
- Does not resolve flooding issues under present-day conditions, without channel lining improvements.
- Neither channel lining option prevents flooding under sea level rise conditions.

Improvement Option 2 - Overflow Channeling/Redirection of Flows (Model Scenario 2-1 & 2-2) – System Performance

Two scenarios were considered that would redirect runoff that would otherwise be tributary to the Queen's Ditch away from the system. These options have been referred to as the "Lazo Marsh bypass" (Model Scenario 2-1), and the "DND bypass" (Model Scenario 2-2). **Drawing SK-5**, overleaf, indicates the general arrangement at the two bypasses.



Queen's Ditch / Lazo Marsh Drainage Improvements
"DND" & "Lazo" Bypass Options

SK-5
Rev 0

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The Lazo Marsh bypass was modeled as an overflow that would not allow the marsh's water level to exceed 4.3m geodetic. A number of routing options exist for the bypass, including:

- Through the lowland agricultural areas, across numerous private properties, to Point Holmes.
- Along Lazo Road, outletting near Point Holmes.
- Directly to the south of the marsh, crossing Curtis Road.

Each of the above route options has specific benefits and challenges. At this stage of investigation, routing feasibility has not been fully confirmed. Should the CVRD wish to pursue redirection of Lazo flows, further analysis will be required.

The "DND bypass" assumes that all flow tributary to the Queen's Ditch originating on CFB Comox would be intercepted and conveyed to Point Holmes, prior to entering the Queen's Ditch. Given the topography, and constraints with land tenure, if this option were to be pursued, it would likely require that a pipe interceptor be constructed. Preliminary modeling indicates that sufficient elevation head exists to convey stormwater from DND under modeled climate change, and present-day tidal/sea level rise conditions.

Drawing Plan 2-1 and **Plan 2-2 (Appendix B)** indicate flooding extents under present-day sea level conditions; **Drawings Plan 2-1 SLR** and **Plan 2-2 SLR** show flooding under sea level rise conditions.

System Performance Under Improvement Option 2 – Lazo Bypass

- Model results indicate that the Lazo Marsh bypass option moderately decreases the hydraulic grade of the Queen's Ditch, but does not alleviate flooding, under present-day conditions.
- Flooding resulting from sea level rise is significantly more extensive than present-day sea levels. **Drawings Plan 2-1**, and **Plan 2-1 SLR** indicate modeled (conveyance system) flooding extents under present-day and long-term sea level conditions.

System Performance Under Improvement Option 2 – DND Bypass

- Model results indicate a significant reduction in hydraulic grade within the Queen's Ditch resulting from the construction of the DND bypass. Flooding is still present, although it is generally limited to lateral connections to the Queen's Ditch.
- Construction of the DND bypass does not alleviate flooding when sea level rise is accounted for. Refer to **Drawings Plan 2-2** and Plan **2-2 SLR**.

Benefits of Improvement Option 2

- The DND bypass could provide a significant reduction in flooding of the lowland areas adjacent to the Queen's Ditch.
- It may be possible to utilize the existing Queen's Ditch easement, for DND bypass construction. Long-term upgrade requirements for the Queen's Ditch should be confirmed, to ensure that ample easement width exists for open channel improvements.
- Initial modeling indicates that conveyance within the DND bypass would not be adversely affected by sea level rise (assuming a pressure pipe conduit is utilized).
- Simplistic infrastructure, operation and maintenance requirements are not onerous.

- It may be possible to leverage funding from the Federal Government for design and construction of the DND Bypass.

Detractors of Improvement Option 2

- Some ROW or land acquisition would likely be required for either bypass option.
- The Lazo bypass is minimally effective in reducing flooding.
- Each Lazo bypass routing option has challenges to be resolved:
    - Across the lowland farm lands – the alignment would need to cross many properties with no existing ROW; the drainage would need to avoid existing open channels/ditching, minimal grade is available, etc.
    - Along Lazo Road – this 1.9 km alignment has minimal grade, and would require very large conduit; to reduce energy loss in the pipe, inlet structures would need to be large, to allow for escape of water from the marsh, without increasing the standing water level.
    - South under Curtis Road – this alignment is relatively short, but would need to cross a height of land that is approximately 20m higher than the marsh.
- The costs of constructing the DND bypass are high, and would require coordination with the federal government.
- Both bypass options would require significant environmental consideration and approvals.

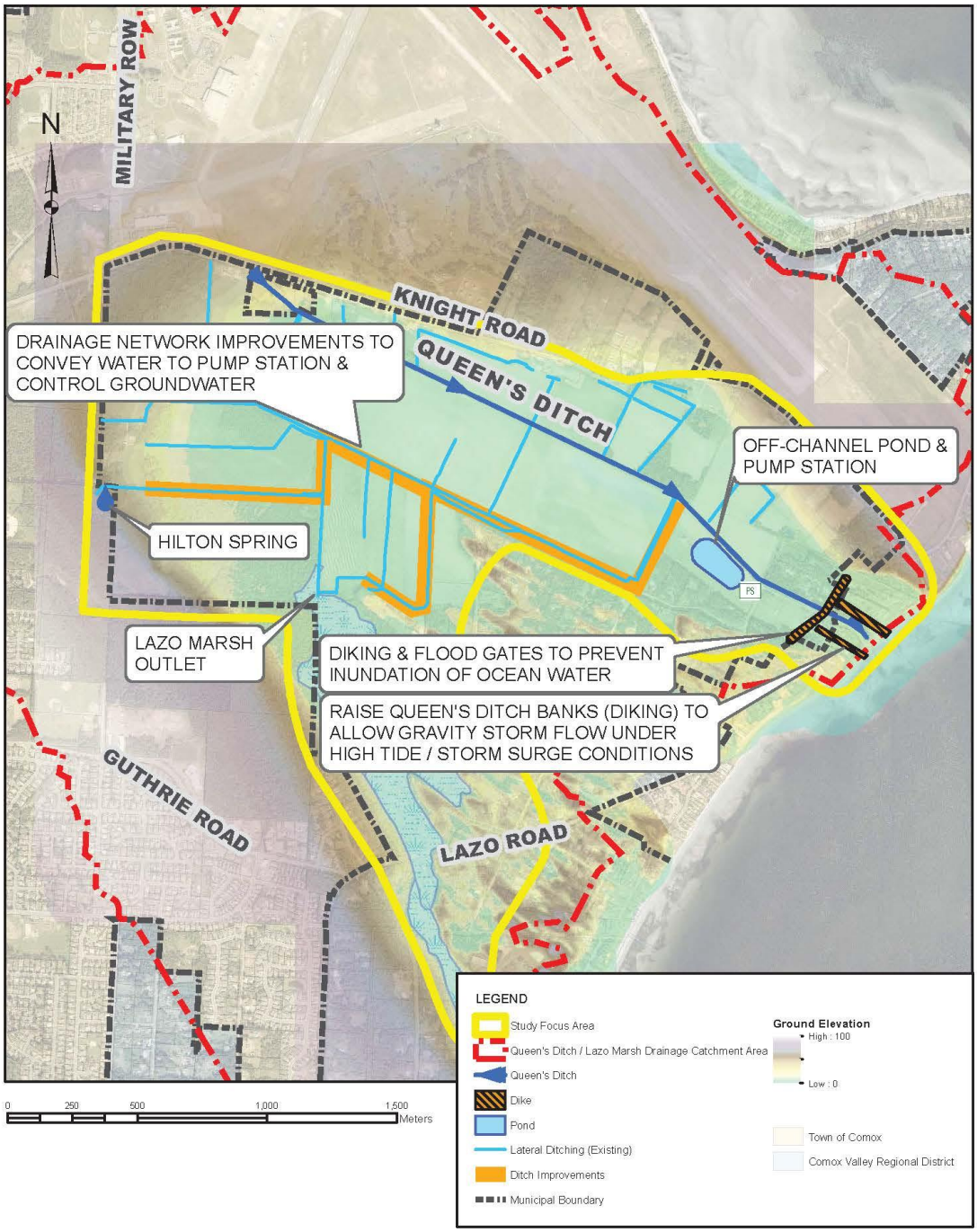
Improvement Option 3 - Diking and Pumping of Lowland Areas – System Performance

Consideration has also been given to the installation of flood protection diking and mechanical pump systems to alleviate flooding in lowland areas surrounding the Queen's Ditch. It would be desirable to utilize gravity drainage within the catchment to the extent possible, only calling upon mechanical pumps when tidal conditions and/or rainfall intensity overwhelm the drainage system. **Drawing SK-6,** overleaf, schematically indicates the potential arrangement of this improvement option. Conceptually, a dike and pump drainage system to service the Queen's Ditch area would require the following:

- Diking of any points of intrusion of seawater (likely limited to the discharge at Point Holmes, but to be confirmed).
- Installation of flood gates at the Point Holmes outfall.
- Construction of an "off-channel" storage facility that could be utilized to lower groundwater, and provide a reservoir from which to pump.
- Construction of a stormwater pump station sized appropriately to lift a (present-day modeled) 10-year/ 24-hour flow of approximately 6m^3/s.
- Drainage network improvements upstream of the proposed pumpstation, to ensure that runoff is allowed to drain freely to the storage facility/ pumpstation.

System Performance

Model scenarios were not run specifically to analyze the effectiveness of dike and pump improvements, at this time. The current PCSWMM model is not capable of modeling flood extents,



Queen's Ditch / Lazo Marsh Drainage Improvements
Dike & Pump Schematic Overview

SK-6
Rev 0

McElhanney

and would provide minimal information beyond what could reasonably be inferred based on information already in hand. More specifically, the existing model, if used to estimate dike and pump performance, would essentially remove any backwater effect from the model. This would simulate the removal of any effect that the ocean, including sea level rise and storm surge, would have on system conveyance capacity, upstream of the pump location.

A more sophisticated model, which simulates the time dependent relationship between flooding of the lowland areas and tidal levels, would assist in the optimization of pump system requirements, including pump sizing, estimated (annual) pump hours/runtime, and specific drainage network improvements required to ensure that runoff is conveyed within the existing drainage network, to the pump location. Notwithstanding model status, the following observations can be made.

- Given appropriate design, including provision for restriction of upward groundwater intrusion into the pump "well", and adequate depth and storage volume within the well to allow for drainage network ditching to flow freely, i.e., without flooding, or backwatering, groundwater depths could conceivably be lowered to meet Ministry of Agriculture guidelines.
- Gravity flow under typical operating (tidal, storm surge and rainfall) conditions is possible, assuming appropriate upstream drainage improvements are undertaken, and regular maintenance completed.

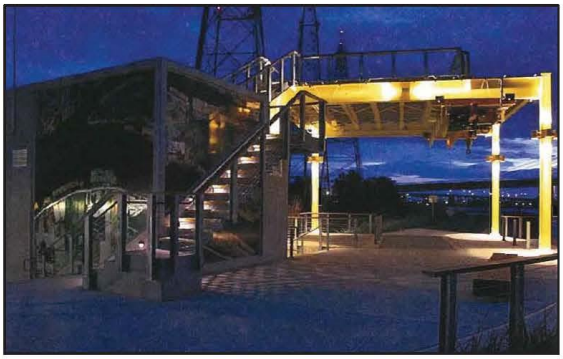
Benefits of Diking and Pumping

- Level of service can be controlled and modified over time. That is to say, the rate, duration, and frequency of pumping, and therefore flood control, can be manipulated based on sump design, pump logic, etc.
- Properly designed, a pump system could be utilized relatively infrequently, becoming activated only when tidal, storm surge, and rainfall conditions necessitate.
- A dike and pump arrangement could be established that allows for, and accommodates sea level rise and climate change. For example, the pumpstation could be designed with provision for additional pumps, or replacement with larger pumps to accommodate increasing flows, or increased pump head requirements.

Detractors of Diking and Pumping

- Stormwater pumps of this size are not uncommon in low-lying foreshore areas, but may be considered too large and costly for this application. As a point of reference, the City of Richmond's No. 4 Road Pumpstation is similarly sized (peak discharge of 6.0 m3/s), contains 4 -127 hp pumps, and was constructed in 2012 at a cost of $4.6 million, inclusive of adjacent diking improvements. In order for a pump system to alleviate flooding within the lowland areas, significant upgrades will also be required to collection and conveyance ditching, at additional cost.

- The Queen's Ditch is known to contain several fish species. The use of "fish friendly" pumps will likely be a requirement of Ministry of Environment and/or Fisheries and Oceans Canada permitting for works within fish habitat. This requirement will limit the types of pumps used to Archimedean screw pumps, or an axial flow pump.



City of Richmond - No. 4 Road Pumpstation

- Significant upgrades will likely be required in sections of the Queen's Ditch downstream of the pumpstation. The channel section along Southwind Road will need to be enlarged, and possibly diked, and the existing Lazo Road culvert replaced with a much larger pipe, or bridge to make full use of the utility provided by a pumpstation.

Improvement Option 4 - Managed Retreat, or Wetland Restoration – System Performance

The Queen's Ditch lowland area, historically, consisted of large extents of wetland habitat, spanning from Point Holmes to the Lazo Marsh. This wetland area was, over time, filled in and/or drained to allow for agricultural use. These modifications to the Queen's Ditch lowlands were documented in the 2002 document "Towards a Management Plan for the Lazo Watershed and Queen's Ditch", prepared by William Marsh, on behalf of the (then) Comox-Strathcona Regional District. To illustrate the significant loss of wetland in the area, Mr. Marsh compared available aerial photography from 1931 to 1996. The figures below, (from the 2002 Marsh report), illustrate the change in wetland area.

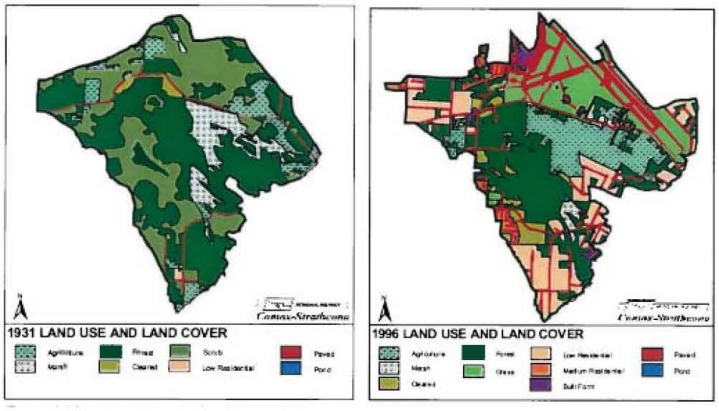


Figure 12

The vast capacity of the (historic) wetland to attenuate runoff has greatly diminished, while stormwater runoff from within the catchment has increased as a result of hard surfacing/development.

Managed Retreat is the term used to reference removal of flood protection works, to allow for controlled flooding of low-lying areas, particularly in coastal regions. Given the anticipated rise in sea level over the next 100 years, and the very high cost of protecting coastlines and low-lying (often agricultural) lands immediately inland, many jurisdictions are considering Managed Retreat as not only viable, but preferable to extensive flood protection works.

Flood protection works in the Queen's Ditch catchment are, presently, limited to drainage improvements (ditching, culverting, etc.), to convey upland runoff and lower groundwater. Removal of these improvements, given the adjacent residential development and ongoing agricultural land uses is not considered feasible. However, it may be possible to "reinstate" some, or all, of the wetland that historically occupied the QD lowland areas. We would envision this "reinstatement" to generally consist of extensive widening, dredging, and revegetation of the existing Queen's Ditch Channel, and potentially some of the lateral connections, in areas with the lowest average ground elevations.

To simulate the creation of a wetland area, Queen's Ditch model Scenario 1-3 was developed with the following cross-sectional elements, as illustrated on **Drawing SK-7**, overleaf.

- A base ditch width of 10m.
- 4H:1V side slopes, which will create a surface water area approximately 40m wide.
- Channel lining to increase hydraulic efficiency (additional depth/width of wetland could be used as an alternate to lining).
- All culverts and crossings removed entirely.

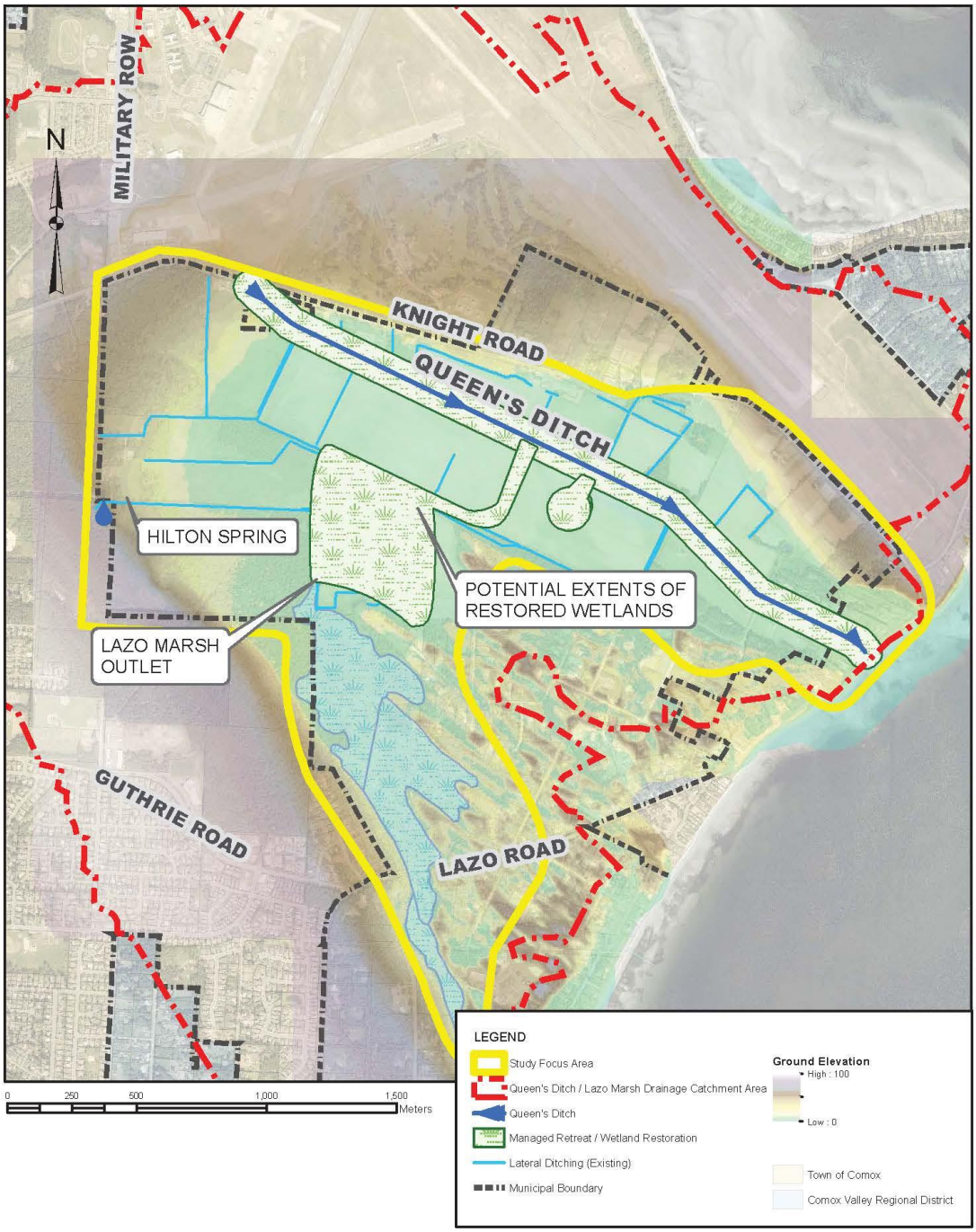
Refer to **Drawings Plan 1-3** and **Plan 1-3 SLR** for flooding extents.

System Performance

- Hydraulic grade in the Queen's Ditch is modeled below existing ground elevations, based on the design rainfall event and current sea levels.
- Minor flooding of lateral ditching was observed under present-day sea level conditions. Additional modeling would verify if this flooding could be alleviated by lateral ditch maintenance or enhancements.
- Flooding presents during sea level model scenarios. The Queen's Ditch (top-of-bank) elevation is lower in several locations than the expected maximum sea level. Raising the top-of-bank, or diking of channel, will not allow for drainage of field areas or existing lateral drainage connections.

Benefits of Managed Retreat/Wetland Restoration

- Restores lost wetland habitat, increases biodiversity in the region, and provides opportunities to enhance salmonid returns.
- Properly designed and constructed, the system will function naturally, and require modest ongoing maintenance.
- Excavated material from the wetland can potentially be used to regrade/raise lower areas adjacent to the existing Queen's Ditch.
- Opportunities to partner with organizations like Ducks Unlimited can be explored. Ducks Unlimited has completed many similar projects, are familiar with provincial and federal



Queen's Ditch / Lazo Marsh Drainage Improvements
Managed Retreat / Wetland Restoration

SK-7
Rev 0

McElhanney

approval requirements, and has experience in accommodating ongoing, adjacent, agricultural uses. Ducks Unlimited is often able to contribute financially to wetland restorations projects.

Detractors of Managed Retreat/Wetland Restoration

- Requires substantial amounts of land to construct. In the case of the Queen's Ditch, there are numerous land parcels (and therefore land owners), that will need to consent to the improvements.
- Improvements will result in a net loss of agricultural land. This issue will need to be addressed at the time of Agricultural Land Commission (ALC) approvals. It is important that, in making a case for ALC approvals, it be demonstrated that loss of land base would be potentially offset, to a degree, by increased productivity within agricultural lands surrounding the Queen's Ditch, due to decreased flooding and control of groundwater elevations. Longer term, sea level rise will lead to much greater loss of agricultural land.
- Will not control flooding, longer term, if sea level rise as modeled is realized. However, this option could potentially be augmented with diking and pumping.
- Capital construction costs are high.

Improvement Option 5 - Stormwater Detention / Off-Channel Storage

Consideration was given to the potential benefits of constructing stormwater detention ponds, or providing "off-channel storage", for high flows within the Queen's Ditch. This option was not modeled, explicitly. In order to simulate controlled flooding, or off-channel storage, a more complex 2D hydraulic model would be required. However, based on present-day condition model results, the following observations have been made:

- The total volume of rainfall to be conveyed by the Queen's Ditch during a 10-year return, 24-hour rainfall event, is approximately 600,000,000 litres, or 600,000 cubic metres. This volume is exclusive of groundwater inflow, and any residual ponded/flood waters from preceding rainfall events that are able to re-enter the drainage system.
- Given the very low (existing) ground elevations of the "lowland" areas, and present-day flooding (as modeled in scenario 1-1), it would be difficult to create sufficient "live" storage within the lowland areas to mitigate flooding. For example, if we were to assume that one quarter of the total runoff was to be "stored" for a period of 6 hours (between low tides), at a depth of 0.4m, an area of 50 hectares would be required (exclusive of any allowance for freeboard, etc.).
- Significant improvements would be required to the conveyance system downstream of the detention facility, to ensure that it could fully drain between tide cycles.
- Stormwater detention, as a best management practice for mitigating peak runoff rates into the Queen's Ditch, would be far more effective if located (hydraulically) above the lowland areas. By mitigating runoff at, or near the source, peak runoff entering the Queen's Ditch system would be significantly decreased.
- The efficacy of detention storage adjacent to the Queen's Ditch is questionable under current sea level land climatic conditions. Further, more sophisticated modeling is required to

determine feasibility. Longer term, under sea level rise conditions, off-channel storage will not function.

Comparison of Improvement Options – Hydraulic Performance

Provided below is a relative ranking of the hydraulic performance of the five conveyance system improvement options analyzed. Consideration has been given only to the selected improvement options' ability to reduce hydraulic grade within the Queen's Ditch, and modeled nodal flooding under the specific rainfall and tidal scenarios considered in this study.

1. Diking and pumping of lowland areas appears likely to provide the best opportunity to consistently lower water table levels, and decrease flooding. This option could continue to function under changing/increasing rainfall volumes and intensities, as is likely to occur due to climate change, sea level rise, and storm surge conditions. Flexibility to adapt to changing hydrologic conditions can be achieved with the diking and pumping option through the addition of more, or larger, pumps.
2. Managed Retreat, modeled as a +/- 40m wide (water surface) along the Queen's Ditch, and the abandoning of several low areas that cannot be consistently drained within the agricultural lands adjacent to the Queen's Ditch, provides significant improvement in overall drainage. Under present-day sea level and storm surge conditions, Managed Retreat is modeled without flooding of the Queen's Ditch. When sea level rise and storm surge are added, modest flooding is observed, primarily at points of lateral connection to the Queen's Ditch.
3. Cleaning and deepening of the Queen's Ditch, as described in Option 1-2, provides the next greatest reduction in hydraulic grade within the Queen's Ditch, provided that a lined channel section is constructed. Modest flooding of lateral connections persists, even with improvements. Significant flooding is modeled without lining the improved ditch section.

   Under climate change conditions, Significant flooding is modeled, regardless of lining. However, some of the flooding of the Queen's Ditch appears to be caused by localized depressions in the top-of-bank.
4. The Lazo and DND Bypass options provide varying levels of flood reduction. Under present-day conditions, the Lazo Bypass is modeled as being minimally effective in reducing HGL within the Queen's Ditch. Performance of the DND bypass is approximately equivalent to cleaning and deepening the Queen's Ditch without channel lining improvements.

   When consideration is given to the impacts of climate change (sea level rise), neither bypass option is effective at reducing flooding under design rainfall conditions.
5. Off-Channel Storage is not considered practical, given the flat gradient of the lowland areas, and volume of storage that must be provided to mitigate flooding.

7. Estimates of Cost

7.1. Capital Construction Costs of Improvement Options Considered

"Class D" capital construction cost estimates have been prepared for four of the five improvement options considered. Costing is not included at this time for the provision of off-channel storage/detention, as additional modeling is required to fully determine the extents of the improvements required. Detailed estimates can be found in **Appendix C**. Note that the costs of local improvement area wide ditch, culvert and pipe improvements that are common to all improvement options, are not included in the estimates below. It is important to note that Class D cost estimates are prepared in the absence of detailed engineering design, and contain large contingencies. These Class D estimates are intended to provide order of magnitude costing, and a relative cost ranking for those options considered.

Option 1 – Cleaning and Deepening of the Queen's Ditch (includes channel lining)

Estimated Construction Cost = $5.1 million

Engineering (10% of Estimated Cost) = $0.5 million

Contingency (30% of Estimated Cost) = $1.5 million

Total Estimated Cost = $7.1 million

Option 2 – DND/Lazo Bypass

Estimated Construction Cost = $6.4 million / $4.7 million

Engineering (10% of Estimated Cost) = $0.6 million / $0.4 million

Contingency (30% of Estimated Cost) = $1.9 million / $1.2 million

Total Estimated Cost = $9 million / $5.7 million

Option 3 – Diking and Pumping

Estimated Construction Cost = $6.3 million

Engineering (10% of Estimated Cost) = $0.6 million

Contingency (30% of Estimated Cost) = $1.9 million

Total Estimated Cost = $8.8 million

Option 4 – Managed Retreat/Wetland Restoration

Estimated Construction Cost = $11.1 million

Engineering (10% of Estimated Cost) = $1.1 million

Contingency (30% of Estimated Cost) = $3.3 million

Total Estimated Cost = $15.6 million

Option 5 – Off-Channel Storage/Detention

Not provided at this time.

7.2. Estimated Operation and Maintenance Costs of Improvement Options Considered

Given the very conceptual nature of this study, the determination of ongoing operation and maintenance costs for infrastructure improvements is challenging. Until such time as more detailed investigations (engineering design development, environmental approvals requirements, etc.) are undertaken, operation and maintenance budgets have been estimated utilizing data provided from a number of sources, including CVRD operations staff. Operation and maintenance costing noted herein should, at this preliminary stage, be used for comparative purposes only. Annual operation and Maintenance cost estimates can be found in **Appendix D**, and are summarized below.

Option 1 – Cleaning and Deepening of Existing Queen's Ditch	$202,000
Option 2 – DND Bypass	$27,000
Option 2 – Lazo Bypass	$184,000
Option 3 – Diking and Pumping	$136,000
Option 4 – Managed Retreat/Wetland Restoration	$80,000
Option 5 – Off-channel Storage/Detention	Not costed

8. Comparison of Improvement Options Considered

A brief comparison of improvement options was undertaken based on a number of broadly ranging criteria. The relative ranking of each option, is, admittedly, somewhat subjective. Notwithstanding, a number of relative observations can be made.

- Diking and pumping is likely to be the most impactful option, in terms of flood control and groundwater management. This option provides the additional benefit of flexibility to adapt to changing sea level and climatic conditions, the impacts and timing of which are difficult to estimate.
- All improvement options, with the exception of cleaning and deepening the Queen's Ditch, require acquisition of ROW or purchase of land.
- Improvement options that require works to existing channels (particularly the Queen's Ditch) will require extensive environmental approvals (Ministry of Environment, Fisheries and Oceans Canada). Those options with less impact on existing channels are expected to have significantly less onerous permitting requirements.

- Operation and maintenance costs are lowest with the DND Bypass Option, followed by Managed Retreat/Wetland Restoration. However, based on hydraulic modeling, the latter option provides far greater levels of flood mitigation than the DND Bypass, with similar construction costs.

Table 2

Evaluation Criteria, or Consideration	Cleaning and Deepening (with channel lining)	DND/Lazo Bypass	Diking and Pumping	Managed Retreat/ Wetland Restoration	Off-Channel Storage
Effectiveness in reducing flooding within the lowland areas under current sea level and climatic conditions.	4	2/2	5	5	1
Effectiveness in reducing flooding within the lowland areas under sea level rise and climatic change conditions.	1	2/2	5	3	1
Effectiveness in reducing depth to groundwater, per Agricultural Standards.	2	1/1	5	4	1
Makes use of existing Rights of Ways of Easements.	5	1/1	1	1	1
Minimizes land dedication required to construct (loss of agricultural land).	5	3/3	3	1	1
Limits environmental impacts, including potential loss or disruption of aquatic habitat.	1	4/2	2	3	4
Difficulty anticipated in obtaining environmental approvals.	2	4/2	1	4	3
Expected capital construction costs.	3	3/2	2	1	3
Anticipated ongoing operation and maintenance costs, including electricity. (not costed at this time)	3	5/3	4	5	3
Potential funding partnerships (DND, Ducks Unlimited, etc.)	1	3/1	1	3	1

*Numeric rating represents increasing relative benefit, from 1 to 5

9. Next Steps

A number of additional tasks related to the work carried out herein should be undertaken, prior to marking the final determination of local service area feasibility, including:

- Engage neighboring jurisdictions and stakeholders (Town of Comox, DND), to establish a preliminary commitment to a Local Service Area. The ability to finance works that benefit multiple jurisdictions may not exist, without the participation of said jurisdictions.
- Undertake conceptual designs of the preferred option, and potentially an alternate, to confirm feasibility, (constructability, required higher level government approvals, costing, etc.). This

information will likely be required prior to seeking final stakeholder approval for the creation of a Local Service Area.

- Seek feedback from the PAC regarding desire to explore development of a Local Service Area, based on the expected magnitude of construction and operation and maintenance costs.
- Undertake a flow monitoring programme to allow for further calibration of hydraulic models, assist in conveyance system sizing, and to estimate the relative runoff rates from each jurisdiction. Consideration should be given to involving representatives from the Town of Comox, CVRD, and DND, to ensure that all jurisdictions are in agreement as to monitoring locations, and methodology.
- Apportion capital construction and operation and maintenance costs for the preferred option, based on the expected local service area boundaries, to allow stakeholders to evaluate the efficacy infrastructure being considered, versus relative cost for service.

10. Closure

We trust the information provided herein is sufficient to allow the Comox Valley Regional District to proceed with approval of the Options Analysis. Please do not hesitate to contact the undersigned at your convenience, if you have any questions or wish to discuss further.

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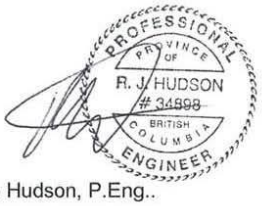


Bob Hudson, P.Eng..
Branch Manager

Reviewed by:

Randy Watson, P.Eng.

BH/njg

REVISION HISTORY

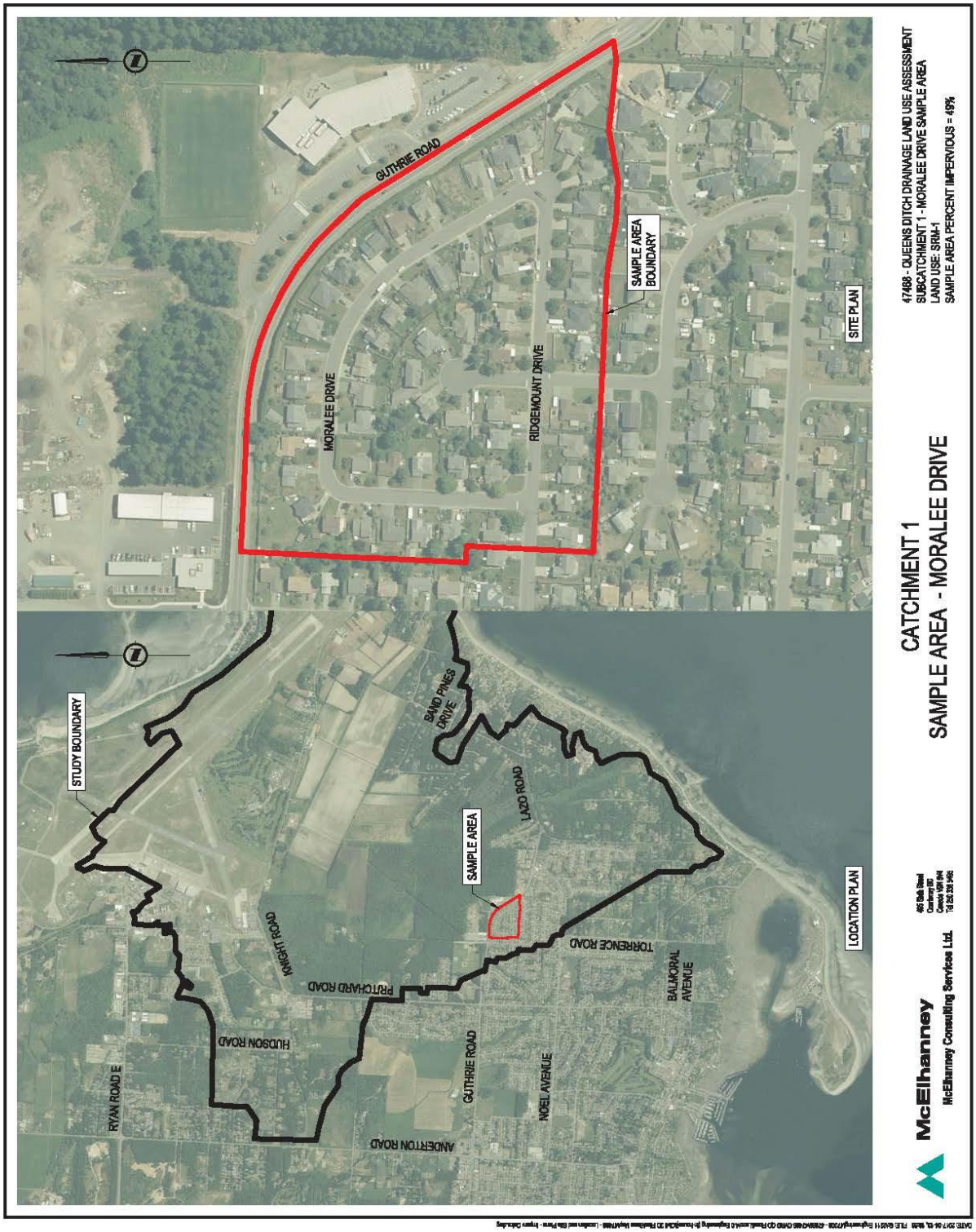
Date	Status	Revision	Author
September 14, 2017	Final	Rev.0	BH
August 14, 2017	Draft2	Rev. 2	BH
July 14, 2017	Draft1	Rev. 1	BH
July 7, 2017	Draft0	Rev. 0	BH

LIMITATION

This report has been prepared for the exclusive use of the Comox Valley Regional District. The material in it reflects the best judgement of the Consultant in light of the information available to the Consultant at the time of preparation. As such, McElhanney, it employees, sub-consultants and agents will not be liable for any losses or other consequences resulting from the use or reliance on the report by any third party.

Appendix A

FIGURES MEASURING PERCENT IMPERVIOUS THROUGHOUT CATCHMENT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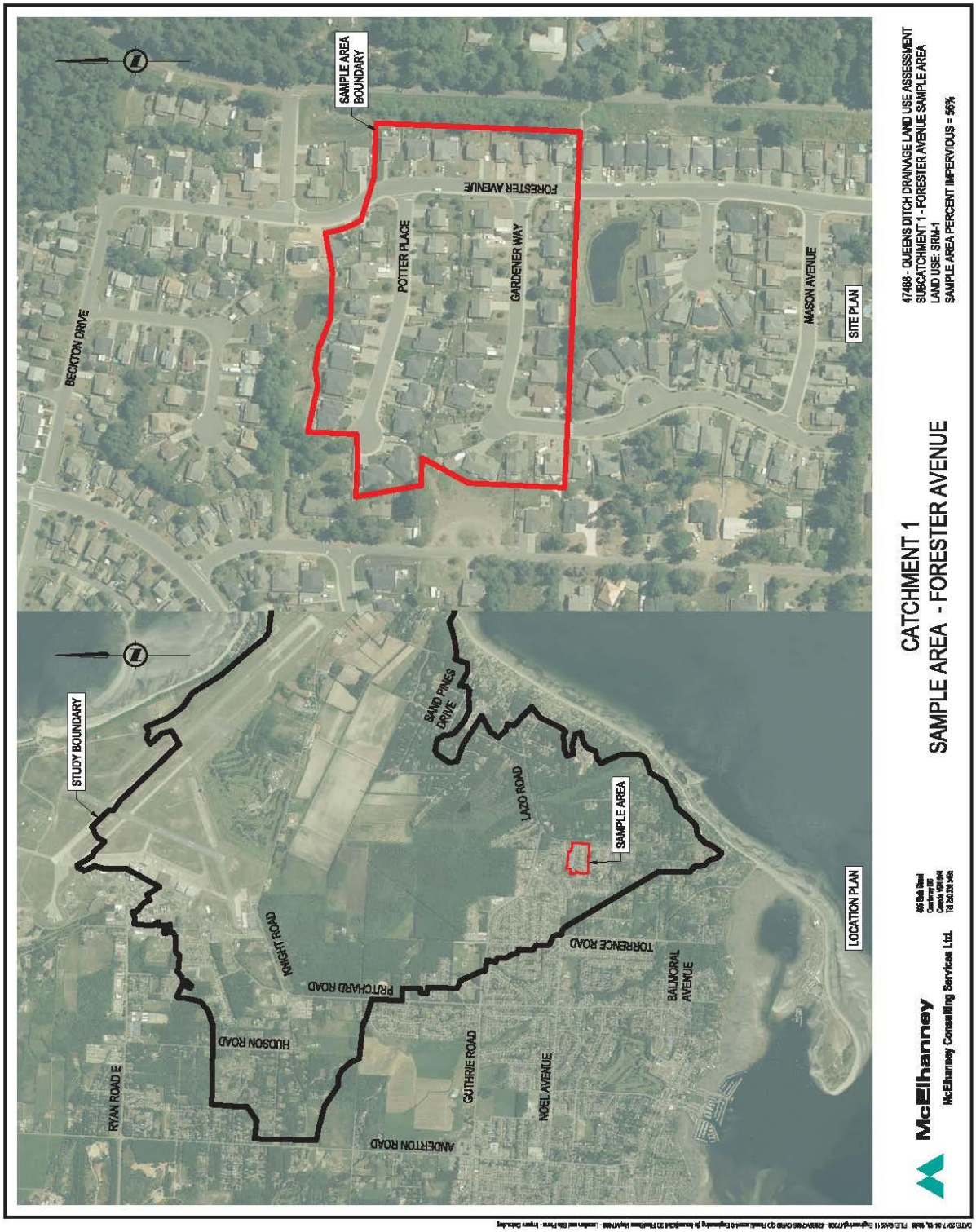
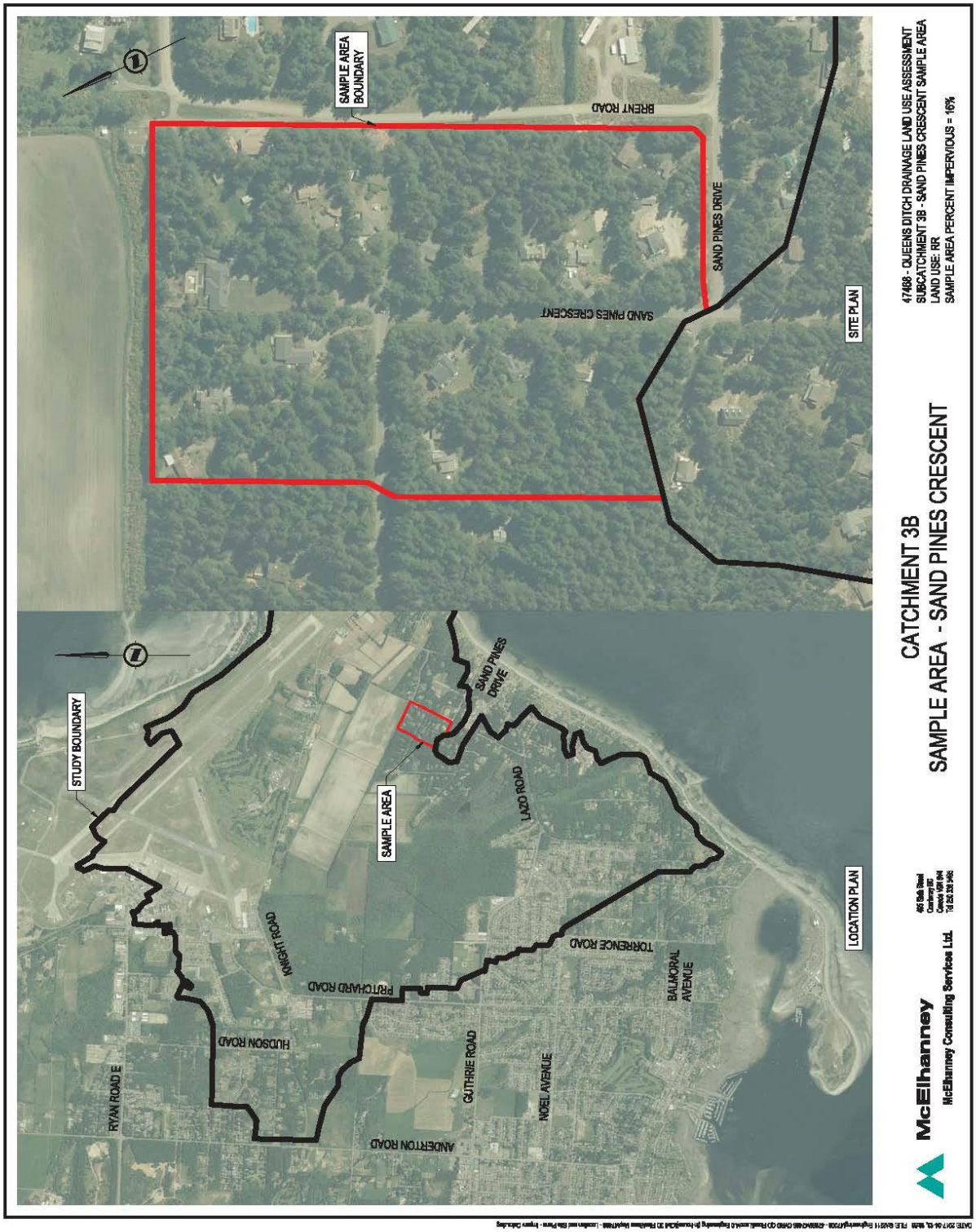
SAMPLE AREA - MORALEE DRIVE
47468 - QUEENS DITCH DRAINAGE LAND USE ASSESSMENT
SUBCATCHMENT 1 - MORALEE DRIVE SAMPLE AREA
LAND USE: SRM-1
SAMPLE AREA PERCENT IMPERVIOUS = 49%
McElhanney
McElhanney Consulting Services Ltd.
SITE PLAN
SAMPLE AREA BOUNDARY
GUTHRIE ROAD
MORALEE DRIVE
RIDGEMOUNT DRIVE
LOCATION PLAN
STUDY BOUNDARY
SAMPLE AREA
SAND PINES DRIVE
LAZO ROAD
KNIGHT ROAD
PRITCHARD ROAD
TORRENCE ROAD
BALMORAL AVENUE
HUDSON ROAD
RYAN ROAD E
GUTHRIE ROAD
NOEL AVENUE
ANDERTON ROAD


CATCHMENT 1
SAMPLE AREA - FORESTER AVENUE
47468 - QUEENS DITCH DRAINAGE LAND USE ASSESSMENT
SUBCATCHMENT 1 - FORESTER AVENUE SAMPLE AREA
LAND USE: SRM-1
SAMPLE AREA PERCENT IMPERVIOUS = 56%
McElhanney
McElhanney Consulting Services Ltd.
SITE PLAN
LOCATION PLAN
SAMPLE AREA BOUNDARY
FORESTER AVENUE
POTTER PLACE
GARDENER WAY
MASON AVENUE
BECKTON DRIVE
STUDY BOUNDARY
SAND PINES DRIVE
LAZO ROAD
SAMPLE AREA
TORRENCE ROAD
BALMORAL AVENUE
PRITCHARD ROAD
KNIGHT ROAD
HUDSON ROAD
RYAN ROAD E
GUTHRIE ROAD
NOEL AVENUE
ANDERTON ROAD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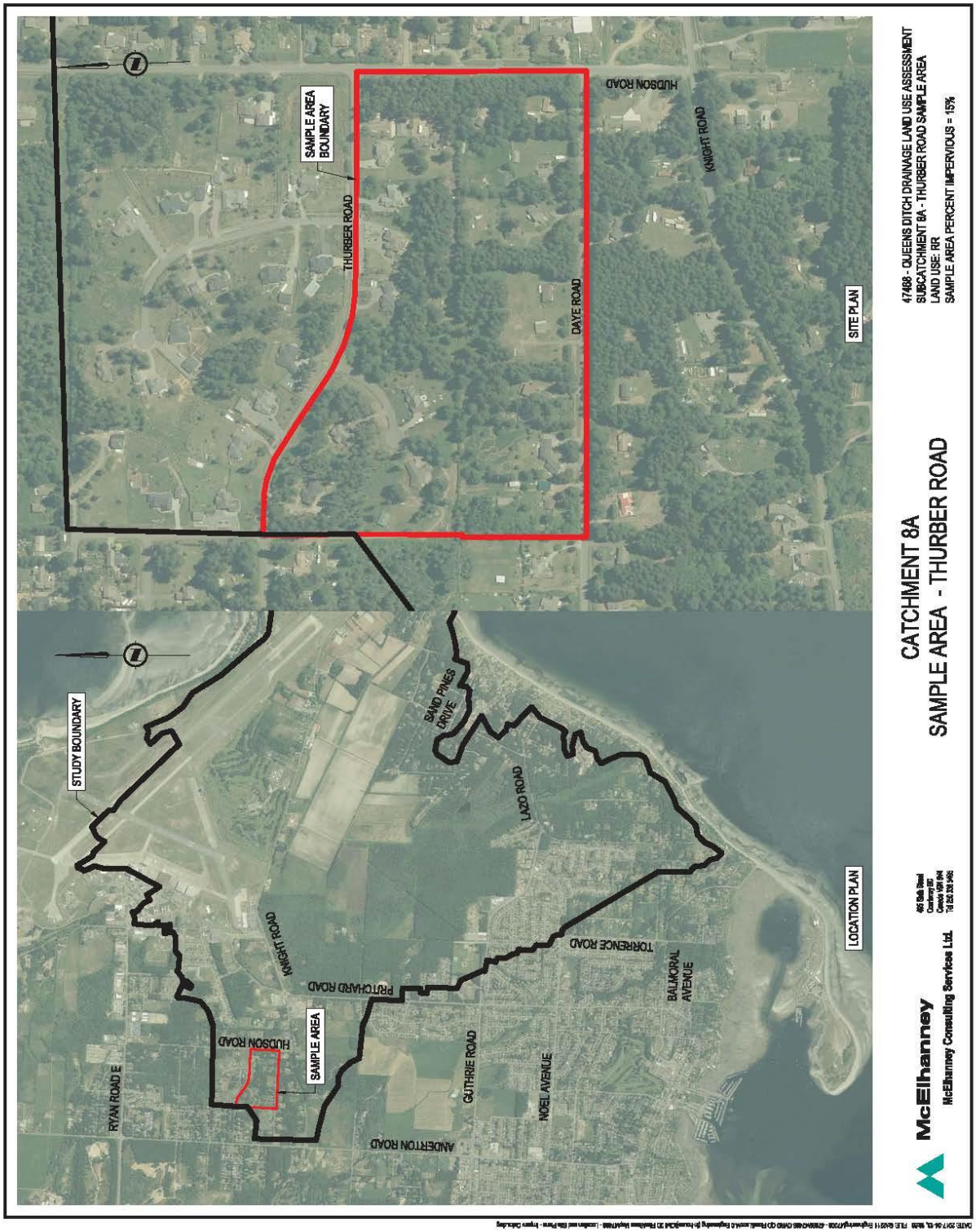
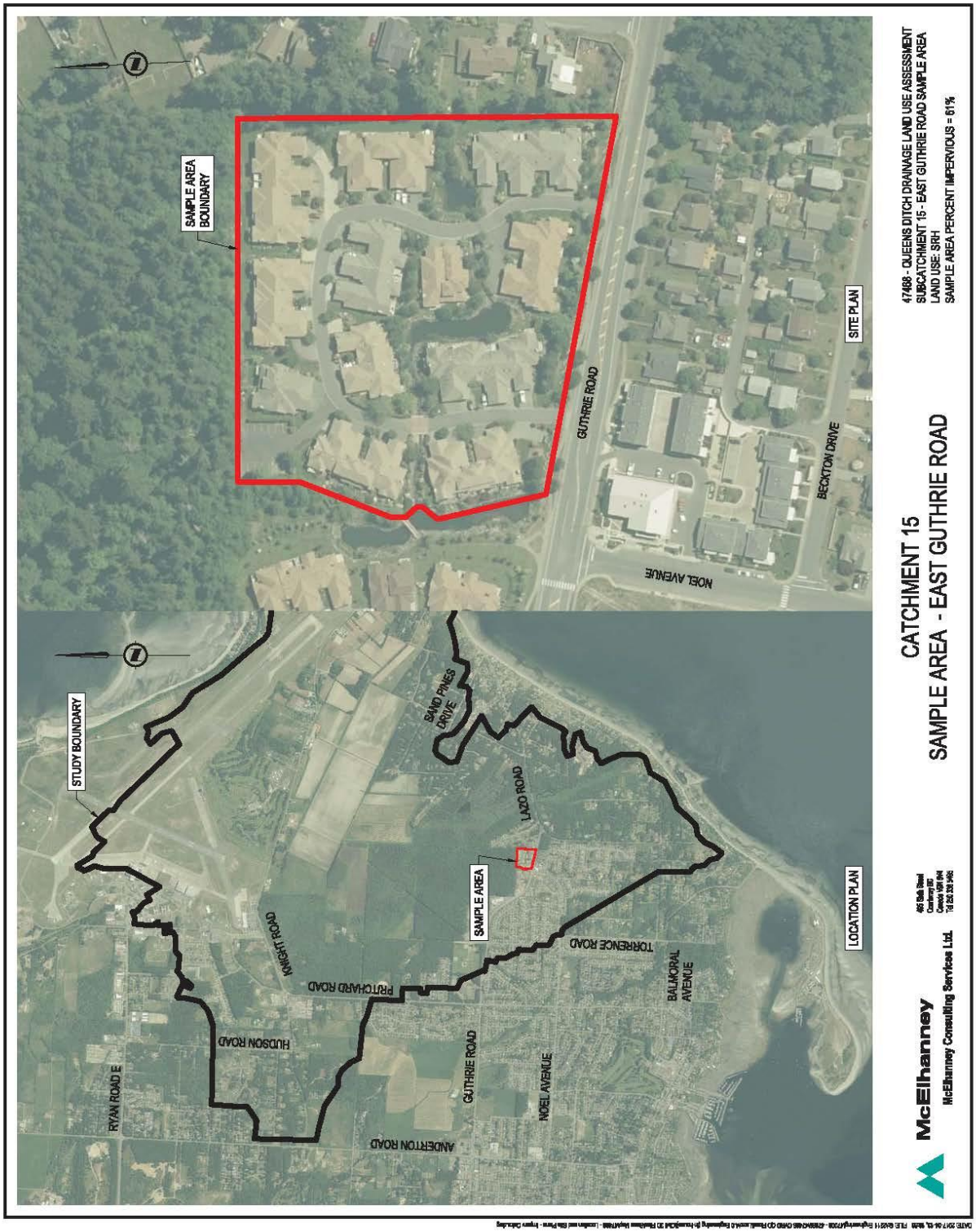
BRENT ROAD
SAND PINES DRIVE
SAND PINES CRESCENT
SITE PLAN
STUDY BOUNDARY
SAMPLE AREA
SAND PINES DRIVE
LAZO ROAD
KNIGHT ROAD
PRITCHARD ROAD
TORRENCE ROAD
BALMORAL AVENUE
HUDSON ROAD
RYAN ROAD E
GUTHRIE ROAD
NOEL AVENUE
ANDERTON ROAD
LOCATION PLAN
CATCHMENT 3B
SAMPLE AREA - SAND PINES CRESCENT
47468 - QUEENS DITCH DRAINAGE LAND USE ASSESSMENT
SUBCATCHMENT 3B - SAND PINES CRESCENT SAMPLE AREA
LAND USE: RR
SAMPLE AREA PERCENT IMPERVIOUS = 16%
McElhanney
McElhanney Consulting Services Ltd.


CATCHMENT 8A
SAMPLE AREA - THURBER ROAD
47468 - QUEENS DITCH DRAINAGE LAND USE ASSESSMENT
SUBCATCHMENT 8A - THURBER ROAD SAMPLE AREA
LAND USE: RR
SAMPLE AREA PERCENT IMPERVIOUS = 15%
SITE PLAN
LOCATION PLAN
SAMPLE AREA BOUNDARY
THURBER ROAD
DAYE ROAD
HUDSON ROAD
KNIGHT ROAD
STUDY BOUNDARY
SAND PINES DRIVE
LAZO ROAD
TORRENCE ROAD
BALMORAL AVENUE
PRITCHARD ROAD
SAMPLE AREA
GUTHRIE ROAD
NOEL AVENUE
ANDERTON ROAD
RYAN ROAD E
McElhanney
McElhanney Consulting Services Ltd.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NOEL AVENUE
BECKTON DRIVE
SITE PLAN
STUDY BOUNDARY
SAND PINES DRIVE
LAZO ROAD
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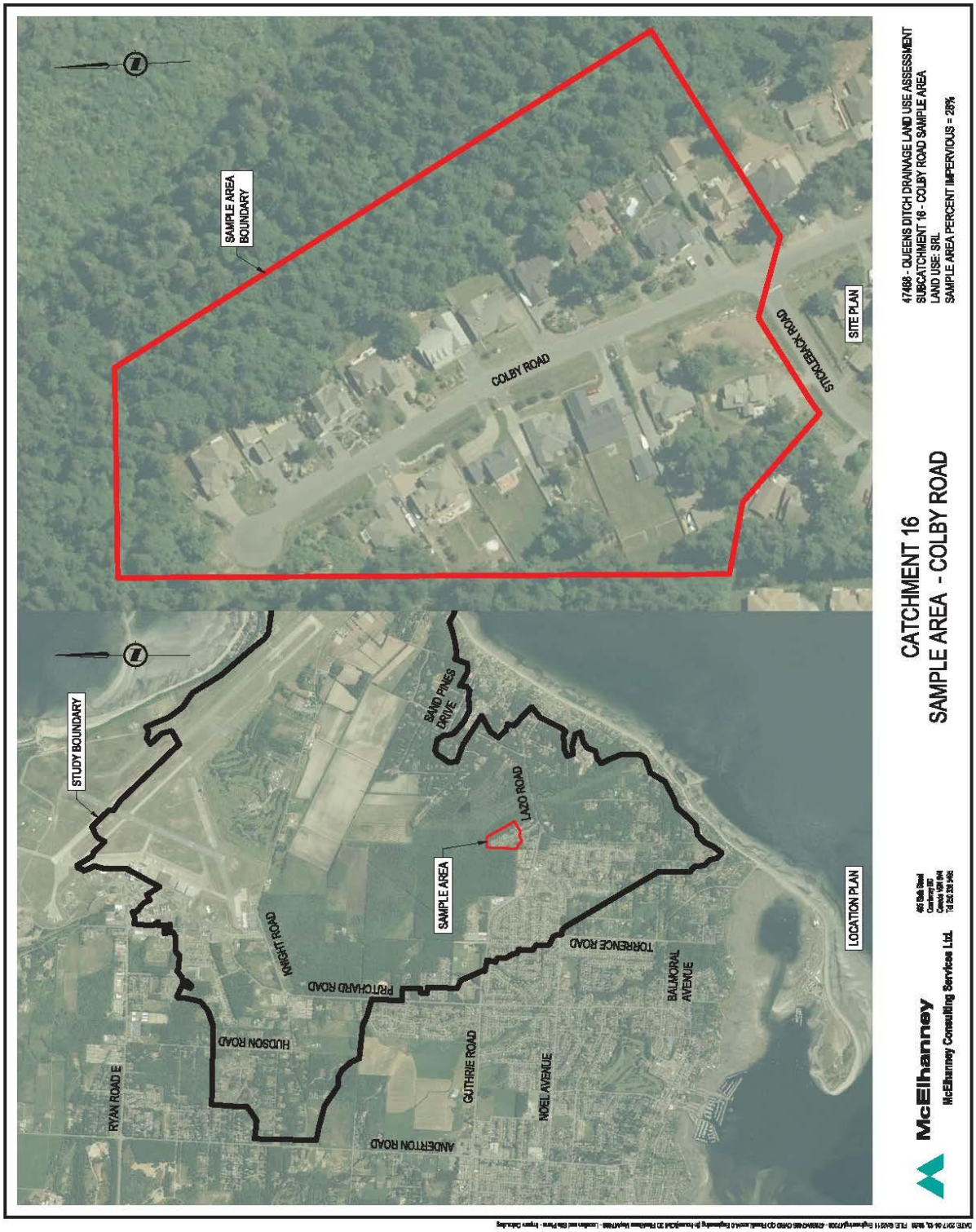
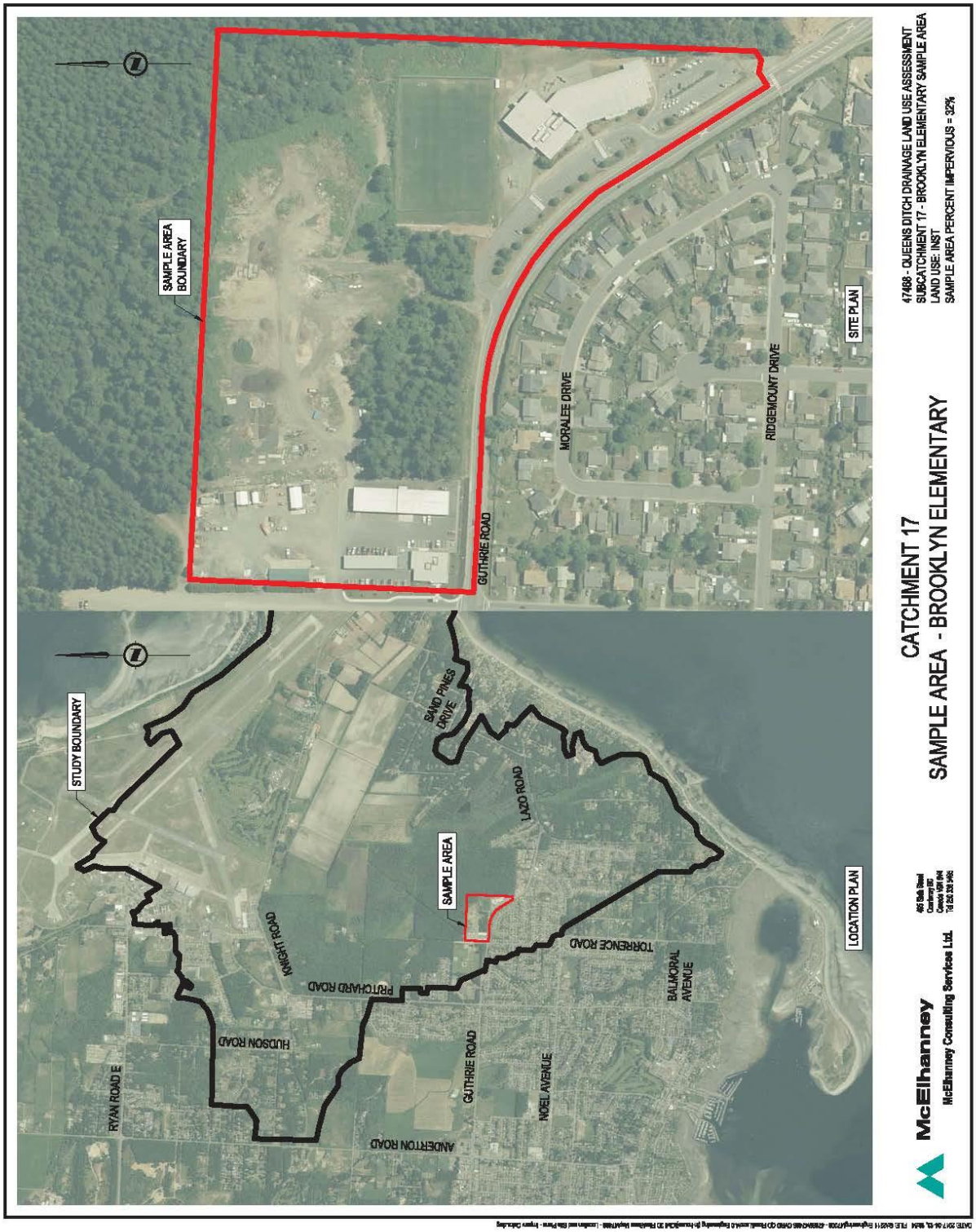
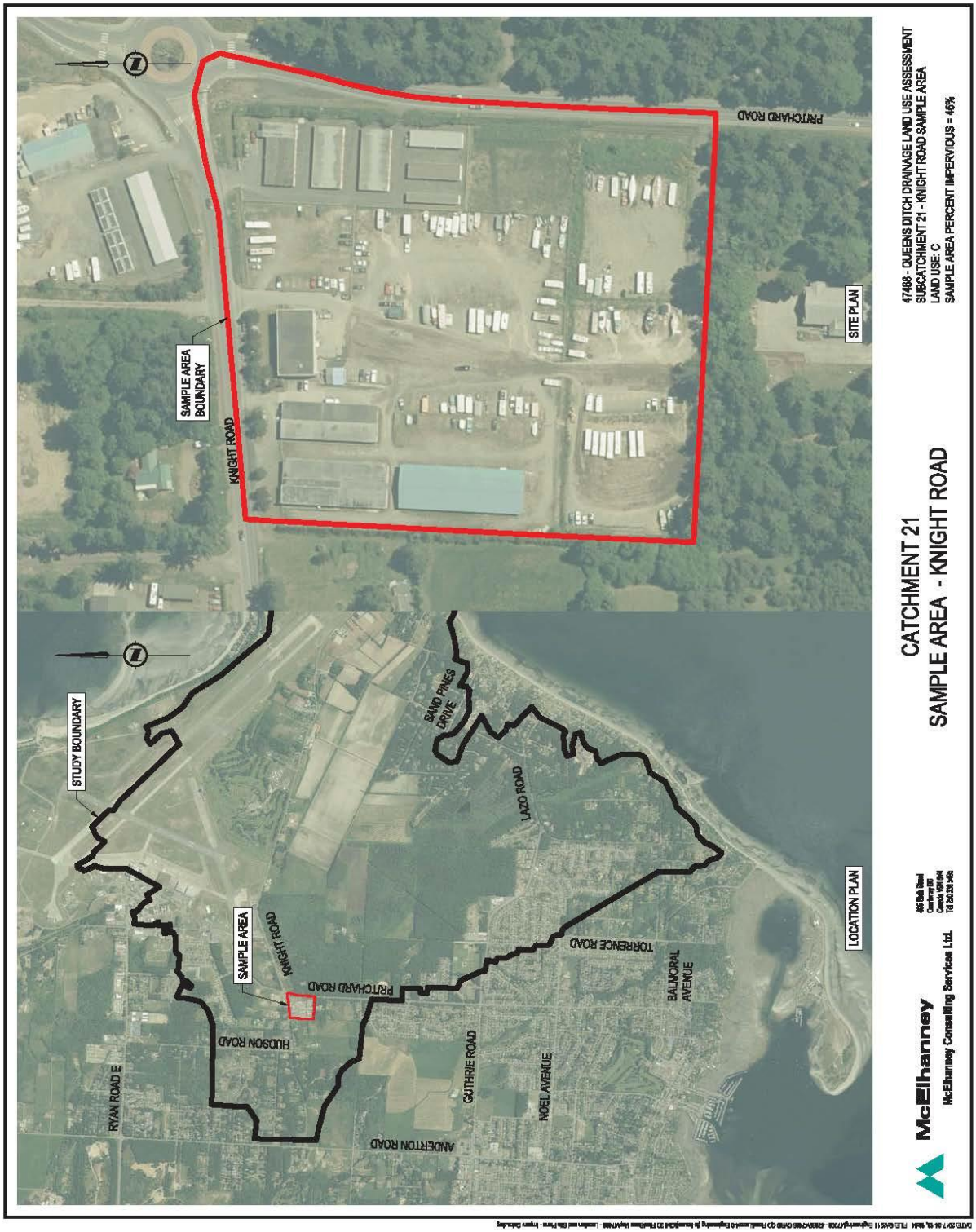
KNIGHT ROAD
PRITCHARD ROAD
TORRENCE ROAD
BALMORAL AVENUE
HUDSON ROAD
RYAN ROAD E
GUTHRIE ROAD
NOEL AVENUE
ANDERTON ROAD
LOCATION PLAN
47468 - QUEENS DITCH DRAINAGE LAND USE ASSESSMENT
SUBCATCHMENT 15 - EAST GUTHRIE ROAD SAMPLE AREA
LAND USE: SRH
SAMPLE AREA PERCENT IMPERVIOUS = 61%
CATCHMENT 15
SAMPLE AREA - EAST GUTHRIE ROAD
McElhanney
McElhanney Consulting Services Ltd.

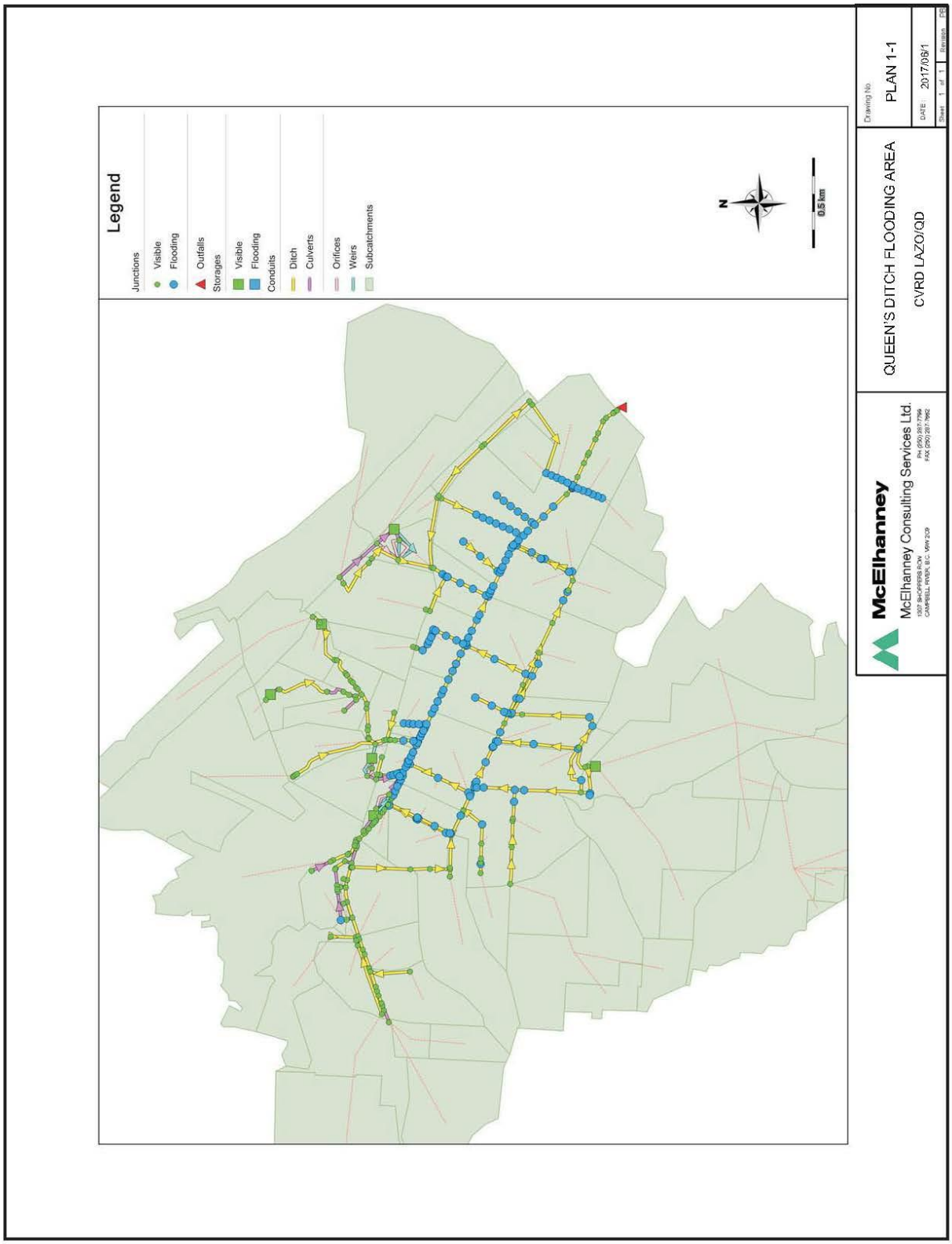

SAMPLE AREA BOUNDARY
COLBY ROAD
STOCKLEBACK ROAD
SITE PLAN
47468 - QUEENS DITCH DRAINAGE LAND USE ASSESSMENT
SUBCATCHMENT 16 - COLBY ROAD SAMPLE AREA
LAND USE: SRL
SAMPLE AREA PERCENT IMPERVIOUS = 28%
CATCHMENT 16
SAMPLE AREA - COLBY ROAD
STUDY BOUNDARY
SAND PINES DRIVE
LAZO ROAD
SAMPLE AREA
KNIGHT ROAD
PRITCHARD ROAD
TORRENCE ROAD
BALMORAL AVENUE
HUDSON ROAD
RYAN ROAD E
GUTHRIE ROAD
NOEL AVENUE
ANDERTON ROAD
LOCATION PLAN
McElhanney
McElhanney Consulting Services Ltd.


SAMPLE AREA BOUNDARY
GUTHRIE ROAD
MORALEE DRIVE
RIDGEMOUNT DRIVE
SITE PLAN
STUDY BOUNDARY
SAND PINES DRIVE
LAZO ROAD
SAMPLE AREA
KNIGHT ROAD
PRITCHARD ROAD
TORRENCE ROAD
BALMORAL AVENUE
HUDSON ROAD
RYAN ROAD E
GUTHRIE ROAD
NOEL AVENUE
ANDERTON ROAD
LOCATION PLAN
CATCHMENT 17
SAMPLE AREA - BROOKLYN ELEMENTARY
47468 - QUEENS DITCH DRAINAGE LAND USE ASSESSMENT
SUBCATCHMENT 17 - BROOKLYN ELEMENTARY SAMPLE AREA
LAND USE: INST
SAMPLE AREA PERCENT IMPERVIOUS = 32%
McElhanney
McElhanney Consulting Services Ltd.


CATCHMENT 21
SAMPLE AREA - KNIGHT ROAD
47468 - QUEENS DITCH DRAINAGE LAND USE ASSESSMENT
SUBCATCHMENT 21 - KNIGHT ROAD SAMPLE AREA
LAND USE: C
SAMPLE AREA PERCENT IMPERVIOUS = 46%
SITE PLAN
LOCATION PLAN
McElhanney
McElhanney Consulting Services Ltd.
SAMPLE AREA BOUNDARY
KNIGHT ROAD
PRITCHARD ROAD
STUDY BOUNDARY
SAMPLE AREA
SAND PINES DRIVE
LAZO ROAD
TORRENCE ROAD
BALMORAL AVENUE
HUDSON ROAD
RYAN ROAD E
GUTHRIE ROAD
NOEL AVENUE
ANDERTON ROAD

Appendix B

DRAWING PLAN FIGURES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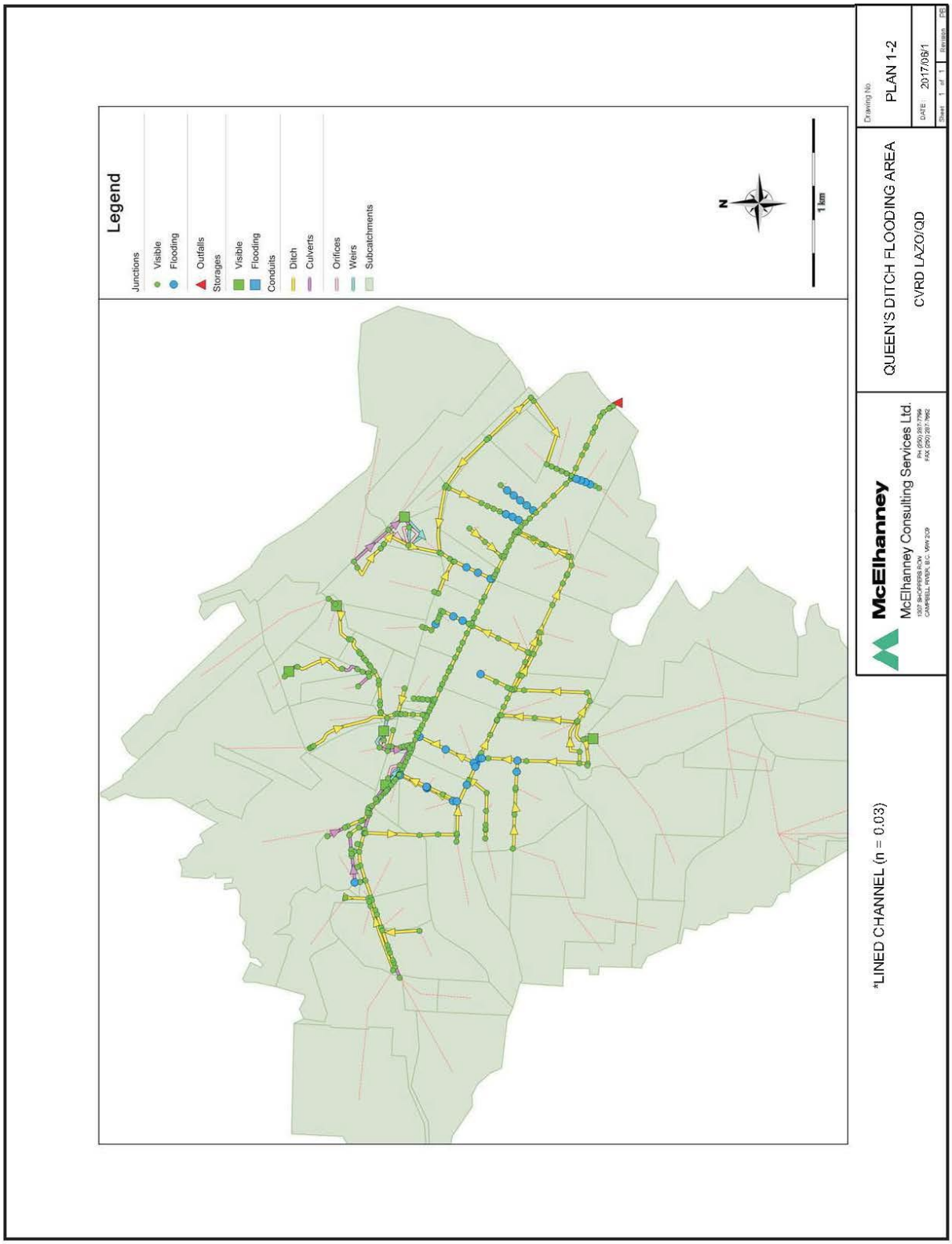
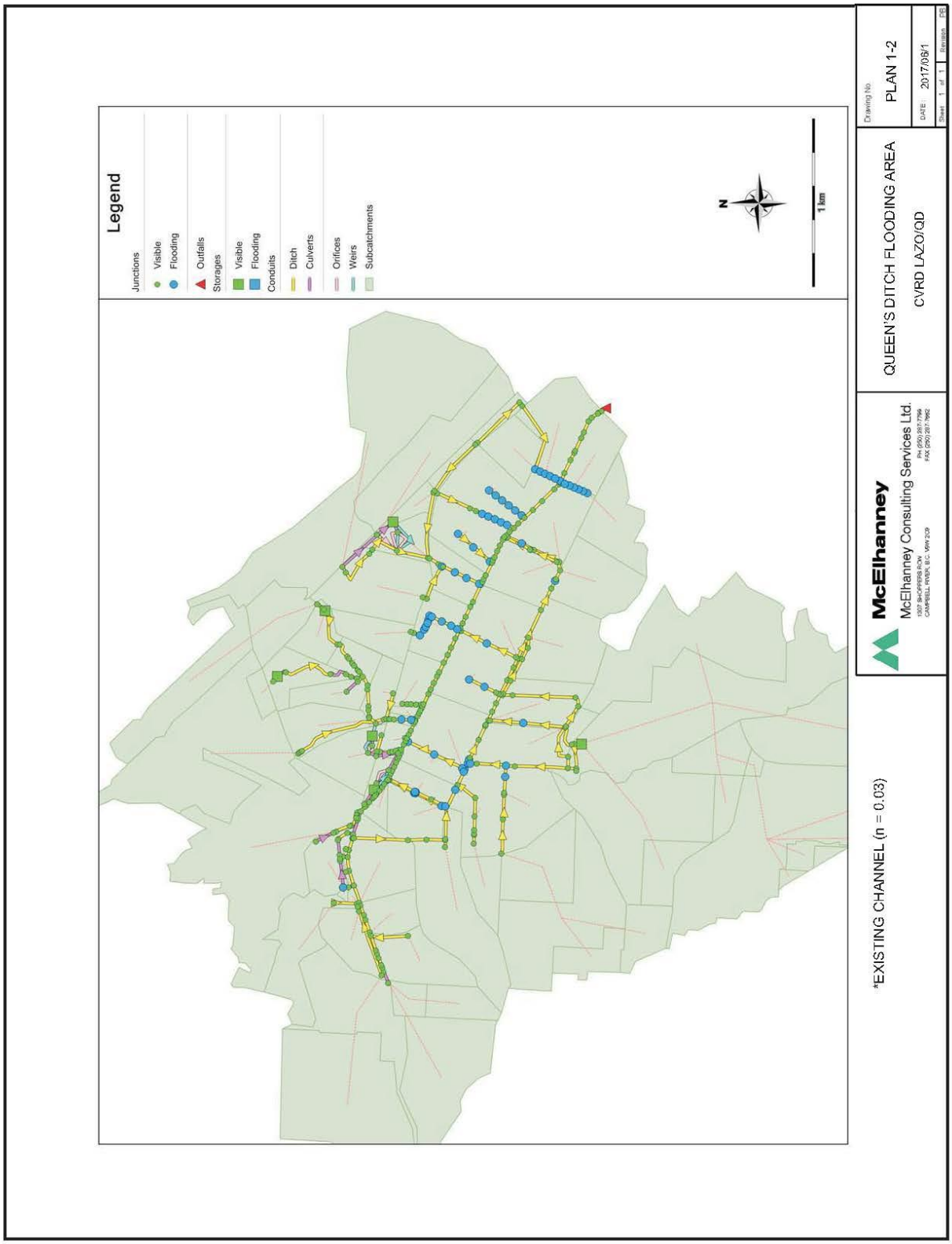
Junctions
Visible
Flooding
Outfalls
Storages
Visible
Flooding
Conduits
Ditch
Culverts
Orifices
Weirs
Subcatchments
N
0.5 km
Drawing No.
PLAN 1-1
DATE:
2017/09/1
QUEEN'S DITCH FLOODING AREA
CVRD LAZO/QD
McElhanney
McElhanney Consulting Services Ltd.


Legend
Junctions
Visible
Flooding
Outfalls
Storages
Visible
Flooding
Conduits
Ditch
Culverts
Orifices
Weirs
Subcatchments
N
1 km
*LINED CHANNEL (n = 0.03)
McElhanney
McElhanney Consulting Services Ltd.
QUEEN'S DITCH FLOODING AREA
CVRD LAZO/QD
Drawing No.
PLAN 1-2
DATE: 2017/09/1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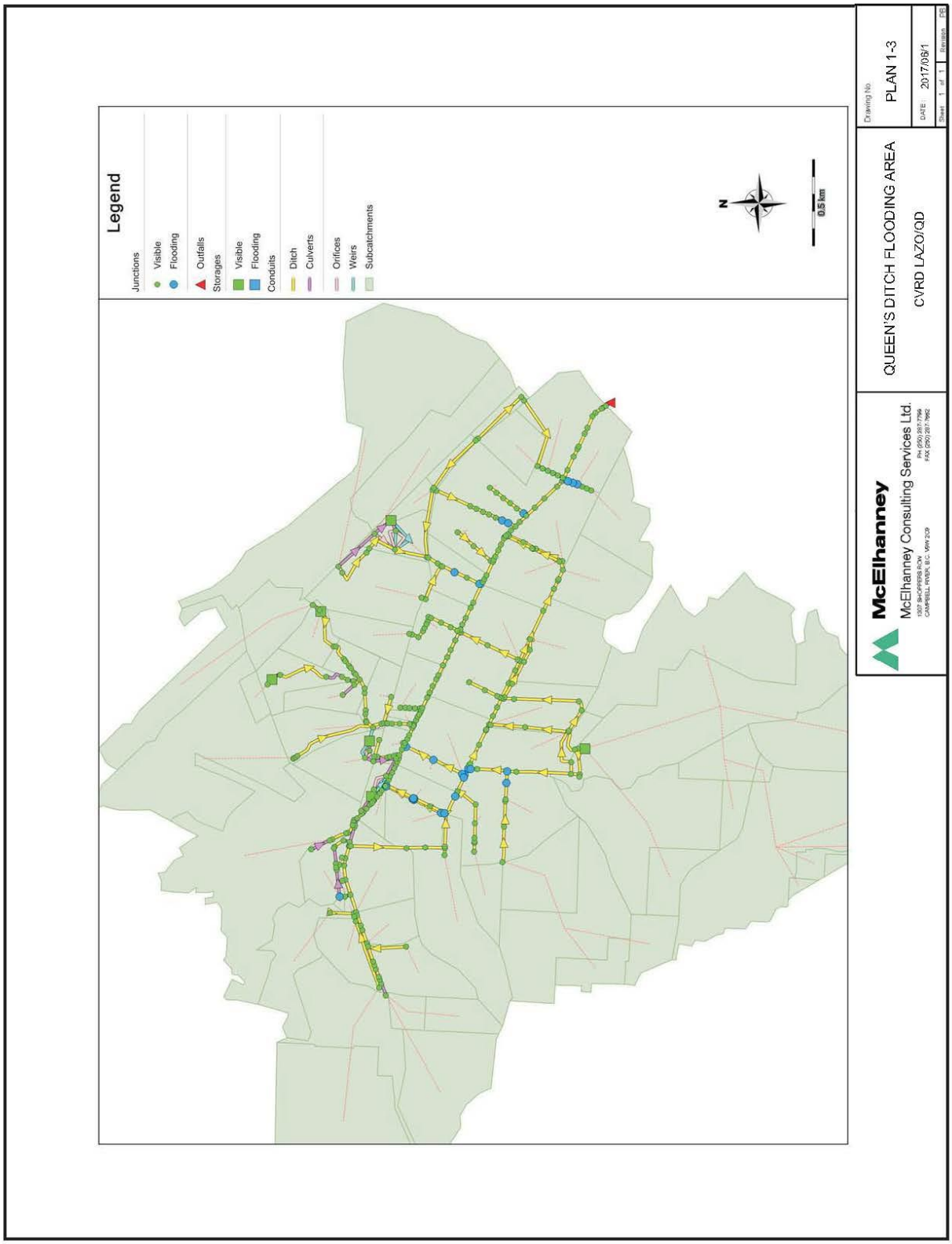
McElhanney Consulting Services Ltd.
QUEEN'S DITCH FLOODING AREA
CVRD LAZO/QD
Drawing No.
PLAN 1-2
DATE: 2017/09/1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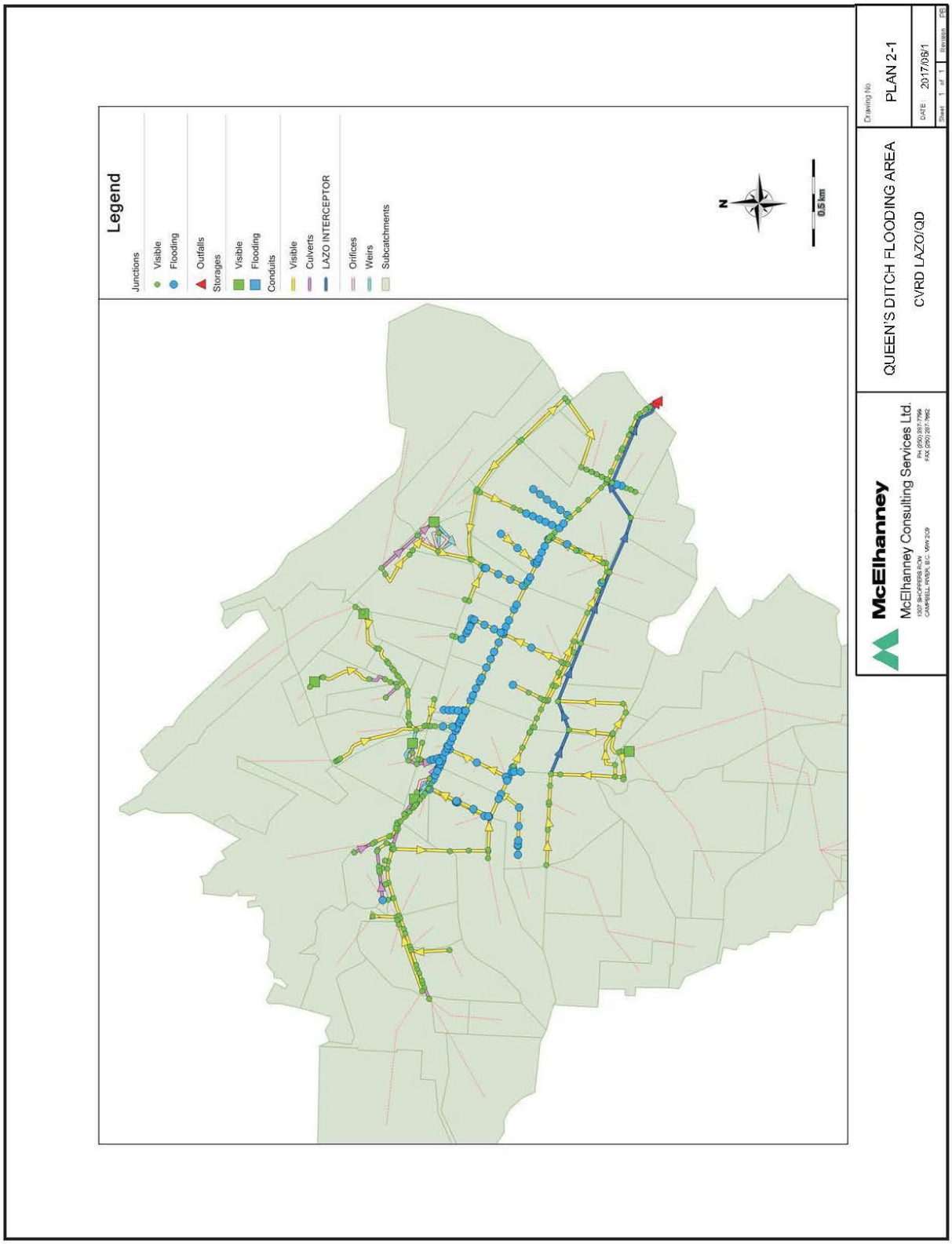
QUEEN'S DITCH FLOODING AREA
CVRD LAZO/QD
Drawing No.
PLAN 1-3
DATE: 2017/09/1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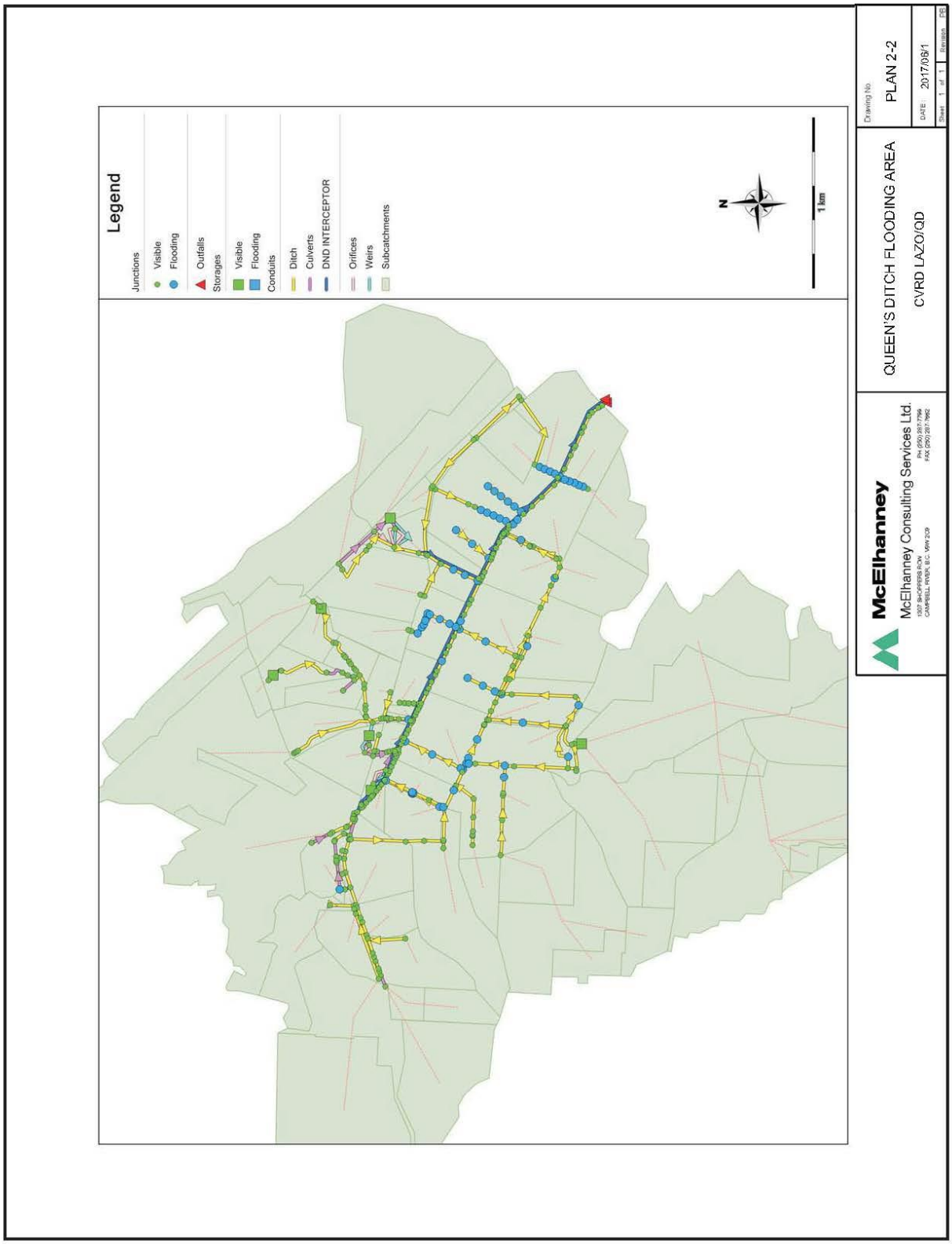
Drawing No.
PLAN 2-1
DATE:
2017/09/1
QUEEN'S DITCH FLOODING AREA
CVRD LAZO/QD
McElhanney
McElhanney Consulting Services Ltd.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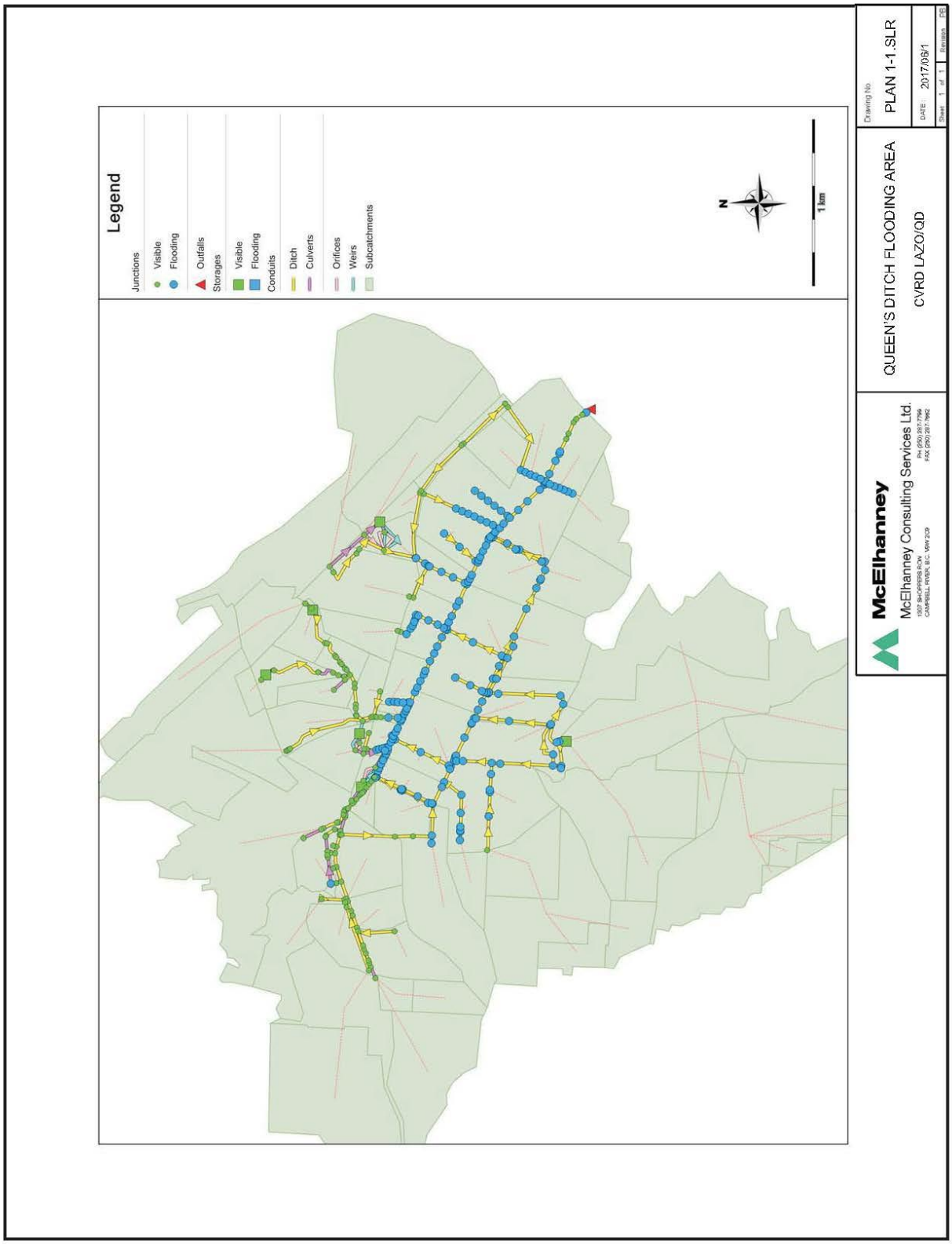
Drawing No.
PLAN 2-2
DATE: 2017/09/1
QUEEN'S DITCH FLOODING AREA
CVRD LAZO/QD
McElhanney
McElhanney Consulting Services Ltd.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QUEEN'S DITCH FLOODING AREA
CVRD LAZO/QD
Drawing No.
PLAN 1-1.SLR
DATE: 2017/09/1
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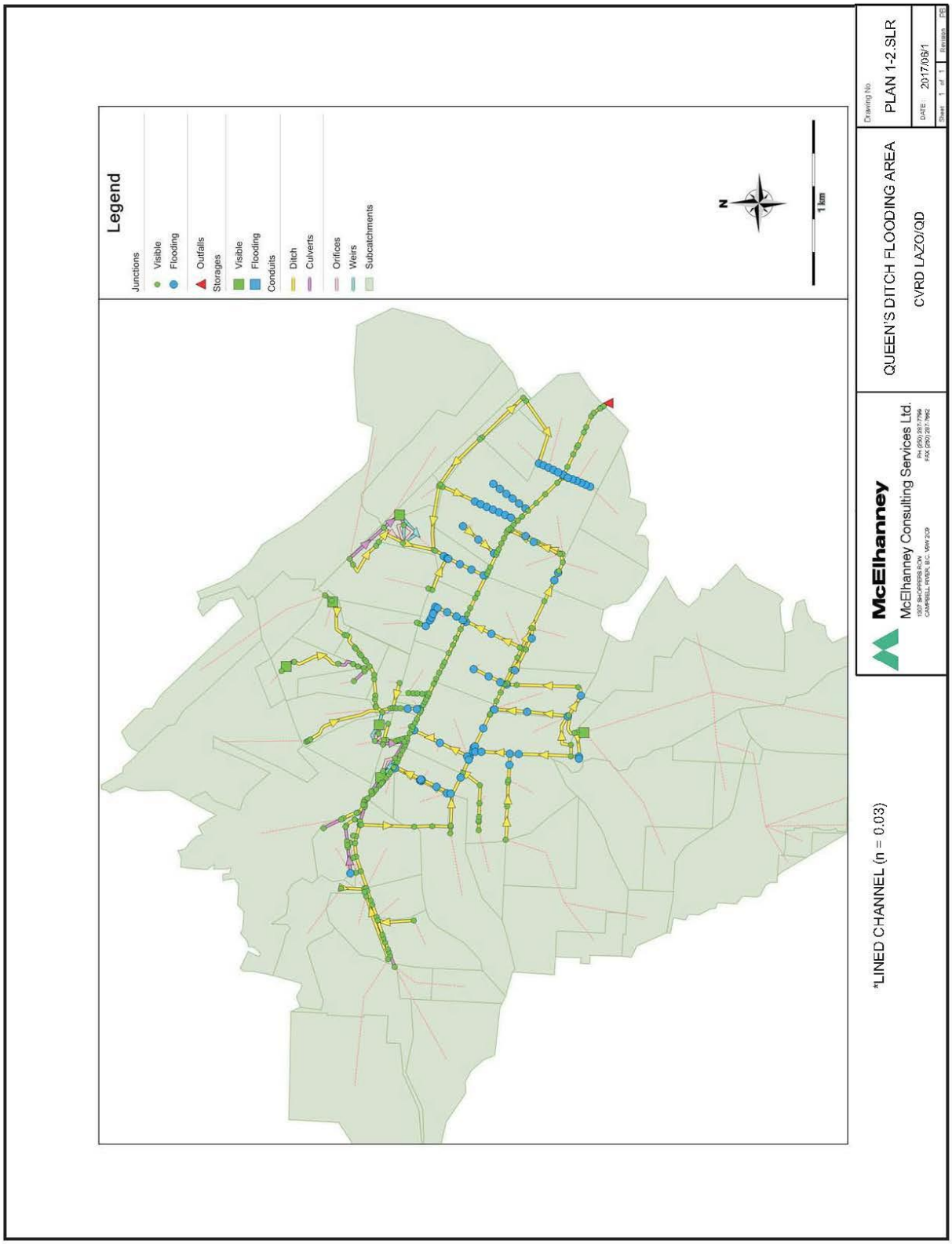
McElhanney Consulting Services Ltd.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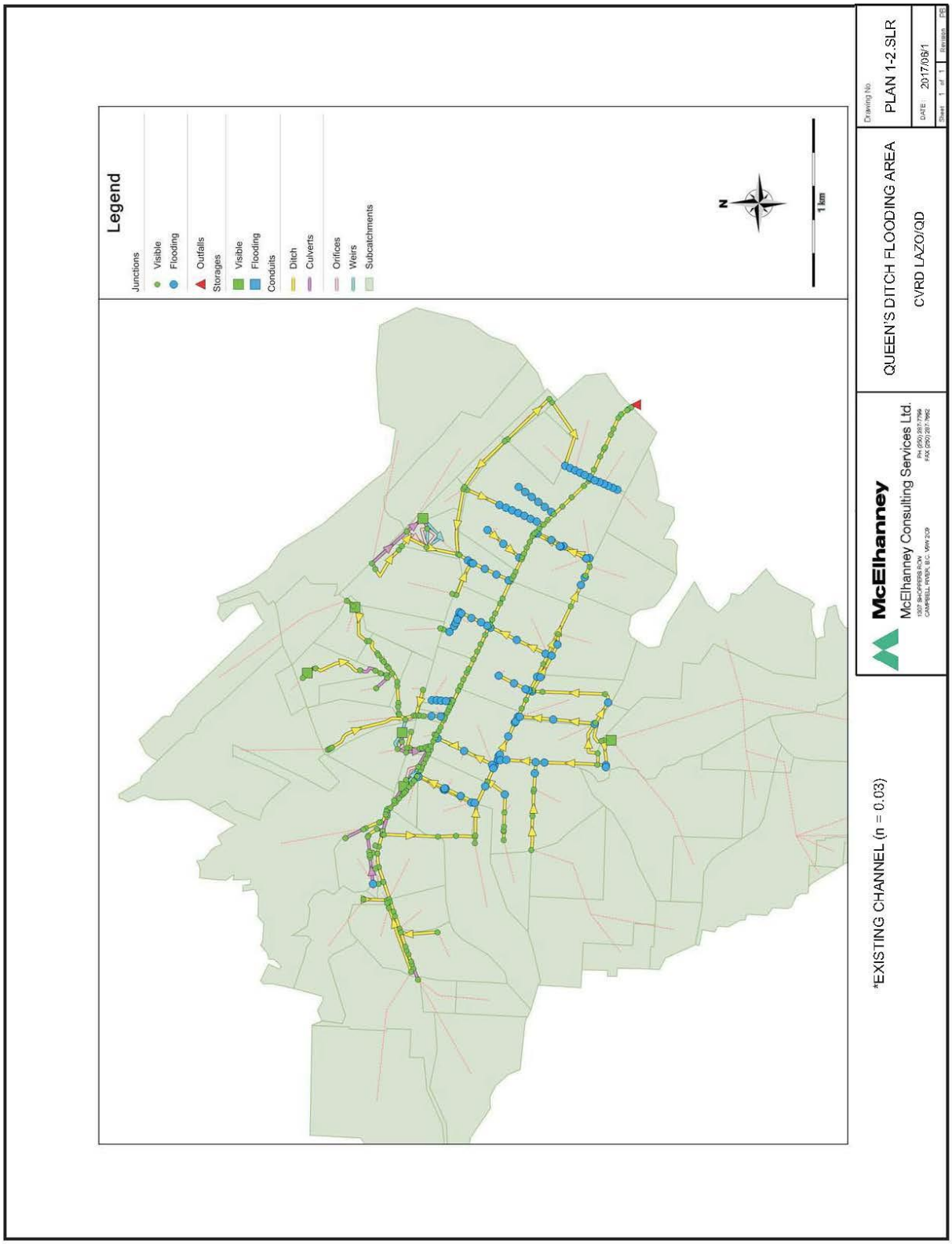
McElhanney Consulting Services Ltd.
QUEEN'S DITCH FLOODING AREA
CVRD LAZO/QD
Drawing No.
PLAN 1-2.SLR
DATE: 2017/09/1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McElhanney Consulting Services Ltd.
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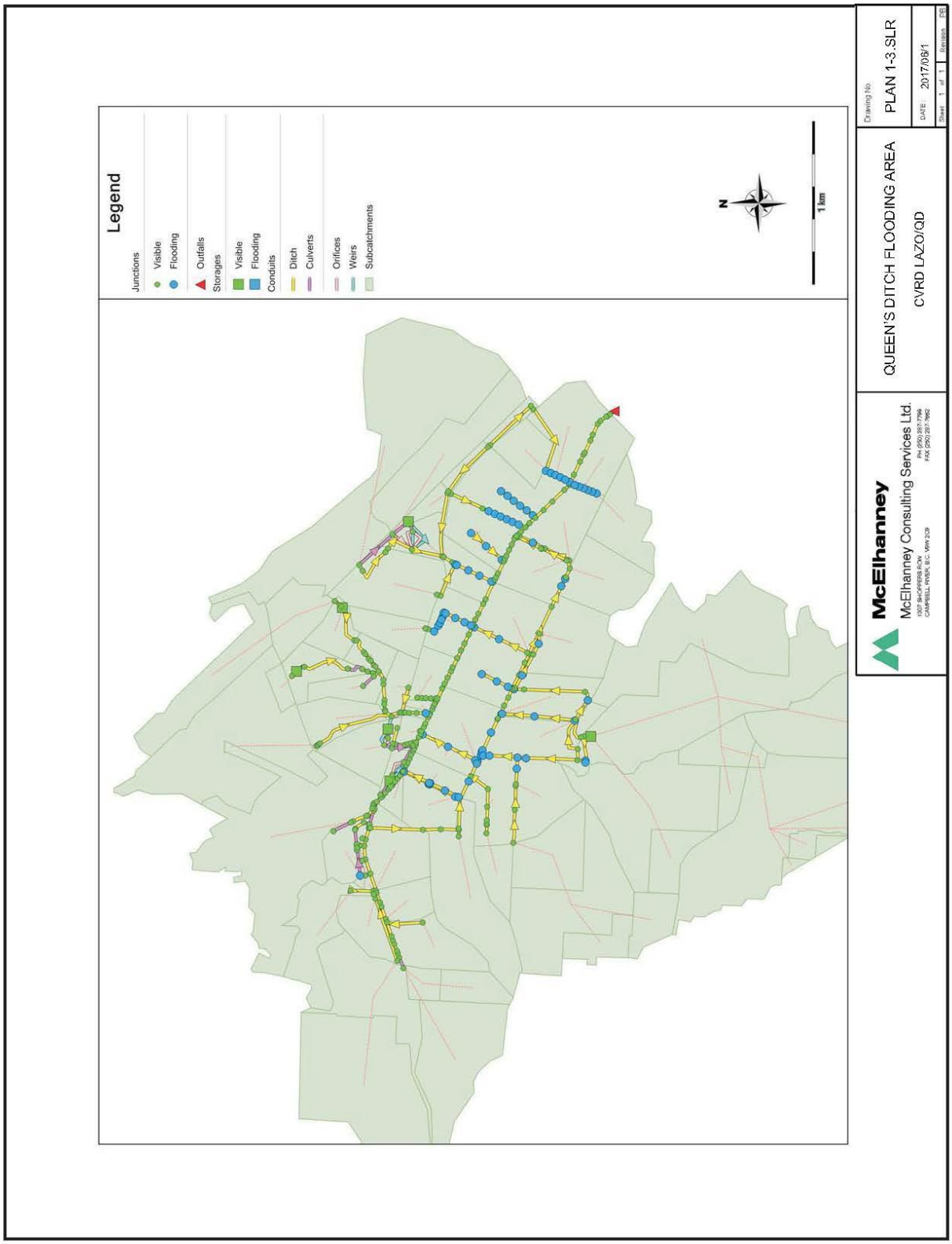
CVRD LAZO/QD
Drawing No.
PLAN 1-2.SLR
DATE: 2017/09/1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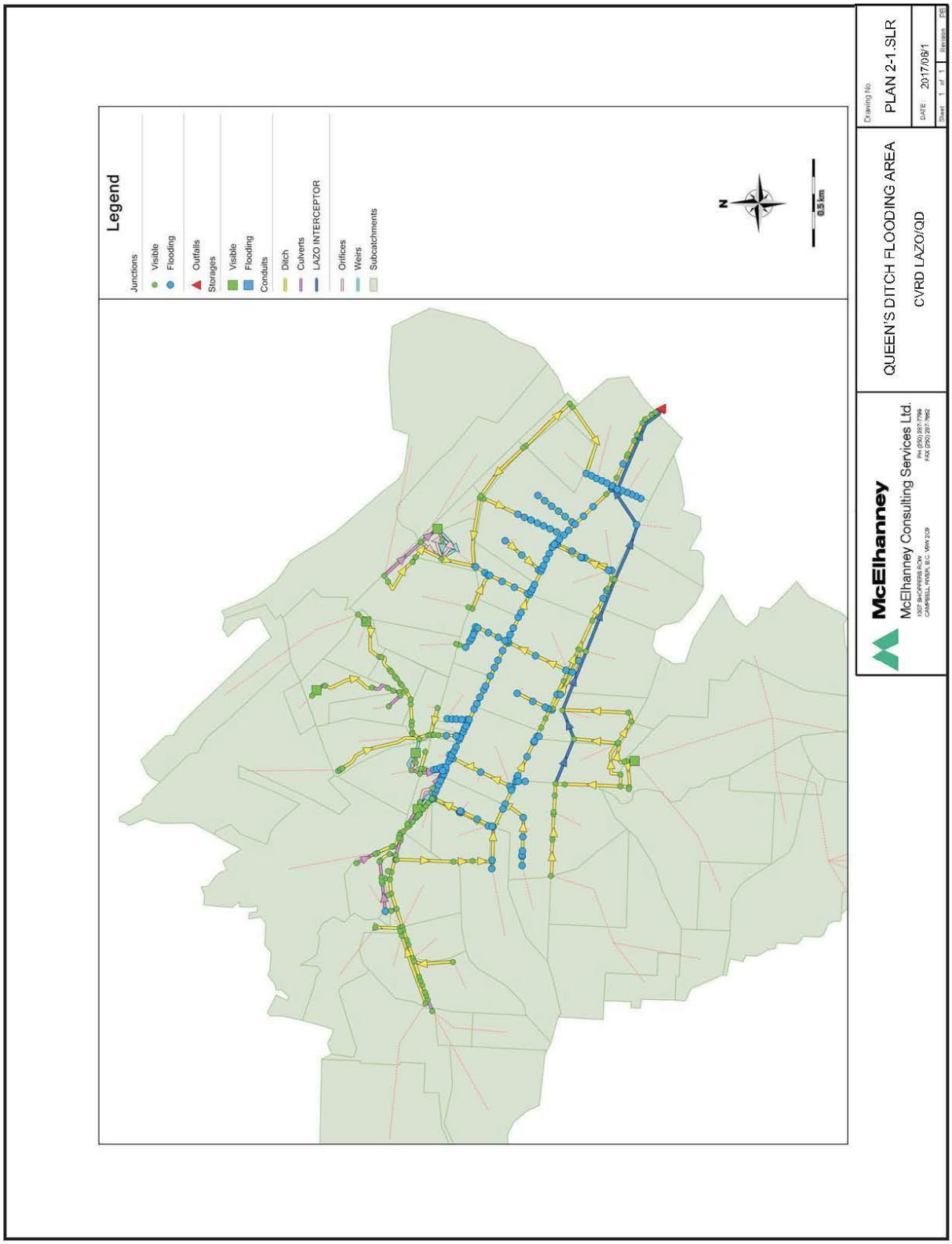
McElhanney Consulting Services Ltd.
QUEEN'S DITCH FLOODING AREA
CVRD LAZO/QD
Drawing No.
PLAN 1-3.SLR
DATE: 2017/09/1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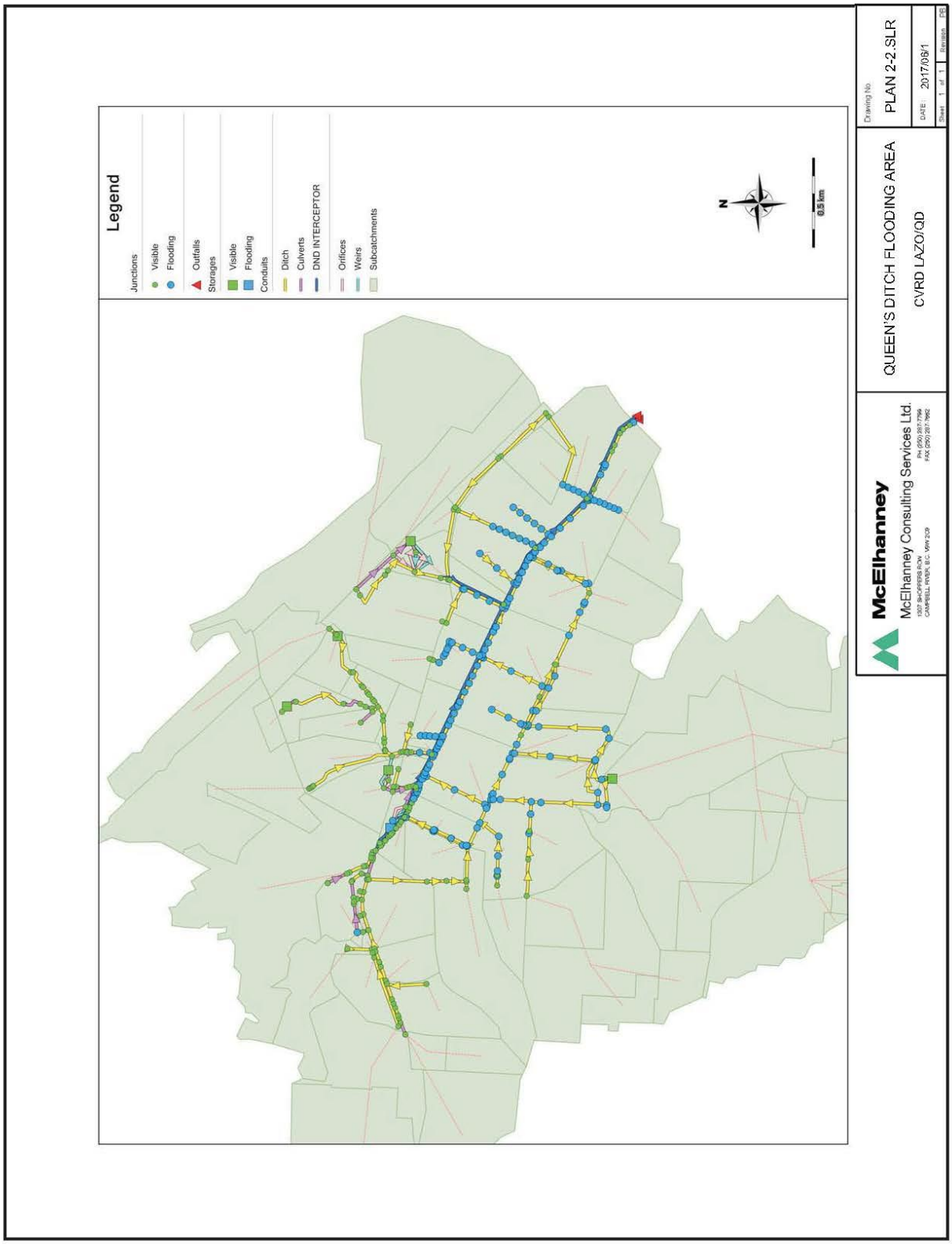
McElhanney
McElhanney Consulting Services Ltd.
QUEEN'S DITCH FLOODING AREA
CVRD LAZO/QD
Drawing No.
PLAN 2-1.SLR
DATE: 2017/09/1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McElhanney
McElhanney Consulting Services Ltd.
QUEEN'S DITCH FLOODING AREA
CVRD LAZO/QD
Drawing No.
PLAN 2-2.SLR
DATE: 2017/09/1

Appendix C

"CLASS D" CAPITAL CONSTRUCTION COST ESTIMATES

COMOX VALLEY REGIONAL DISTRICT July 5, 2017
MCSL 2211-47468-00 - Queens Ditch Drainage System Upgrade Options Analysis Rev 0
Construction Cost Estimate By: CDE
Chk: BH

Class D - Issued for Options Analysis Reporting

Item	Description	Unit	Quantity	Unit Price	Sub total	Total
	Option #1 - Cleaning and Deepening of Existing Chann					
	Earthworks					
1.1	Soil Stripping, stockpiling and reuse	m^2	12,750	$ 7	$ 89,250	
1.2	Channel excavation	m^3	70,750	$ 17	$ 1,202,750	
1.3	Class 25 riprap channel liner supply and placement c/w geotextile underlay	lm	2,550	$ 1,420	$ 3,621,000	
					Subtotal	$ 4,913,000
	STORMWORKS					
2.1	Existing culvert removal and offsite disposal	ea.	15	$ 1,250	$ 18,750	
					Subtotal	$ 18,750
	MISCELLANEOUS					
3.1	Fish salvage	ls	1	33,000	$ 33,000	
3.2	Environmental monitoring	ls	1	50,000	$ 50,000	
3.3	Bypass pumping (100m-150m sections)	ls	1	40,000	$ 40,000	
3.4	Native species replanting & hydroseeding	ls	1	65,000	$ 65,000	
3.5	Land Acquisition (SRW)	ha	-	20,000	$ -	
					Subtotal	$ 188,000
					Construction Total (Rounded)	$ 5,120,000
				Engineering and Construction Services (10%)	$512,000	
				Contingency (30%)	$1,536,000	
					Total (Rounded)	***$7,168,000.00***

COMOX VALLEY REGIONAL DISTRICT July 5, 2017
MCSL 2211-47468-00 - Queens Ditch Drainage System Upgrade Options Analysi Rev 0
Construction Cost Estimate By: CDE
Chk: BH

Class D - Issued for Options Analysis Reporting

Item	Description	Unit	Quantity	Unit Price	Sub total	Total
	Option #2 - Overflow Channeling and/or Piping					
	LAZO BYPASS					
1.1	Soil Stripping, stockpiling and reuse	m^2	35,250	$ 7	$ 246,750	
1.2	Channel excavation	m^3	49,680	$ 17	$ 844,560	
1.3	Class 25 riprap channel liner supply and placement c/w geotextile underlay	lm	2,760	$ 1,000	$ 2,760,000	
					Subtotal	$ 3,851,310
	LAZO BYPASS MISCELLANEOUS					
2.1	Fish salvage	ls	1	11,500	$ 11,500	
2.2	Environmental monitoring	ls	1	40,000	$ 40,000	
2.3	Bypass pumping (100m-150m sections)	ls	1	25,000	$ 25,000	
2.4	Native species replanting & hydroseeding	ls	1	35,000	$ 35,000	
2.5	Land Acquisition	ha	6	20,000	$ 110,400	
					Subtotal	$ 221,900
					Part A Construction Total (Rounded)	$ 4,073,000
					Engineering and Construction Services (10%)	$407,300
					Contingency (30%)	$1,221,900
					Part A Total (Rounded)	**$5,702,000.00**
	DND BYPASS					
3.1	Existing culvert removal and offsite disposa	ea.	6	$ 1,250	$ 7,500	
3.2	Twin 1.375m HDPE storm pipe	lm	2,550	$ 1,700	$ 4,335,000	
3.3	Pipe berm	m^3	48,500	$ 30	$ 1,455,000	
3.4	Box culvert manhole	ea.	8	$ 22,000	$ 176,000	
3.5	Storm system inlets / overflow structures	ea.	7	$ 35,000	$ 245,000	
3.6	Lazo Road crossings	ea.	2	$ 25,000	$ 50,000	
3.7	Outlet structures	ea.	2	$ 40,000	$ 80,000	
					Subtotal	$ 6,348,500
	DND BYPASS MISCELLANEOUS					
4.1	Environmental monitoring	ls	1	10,000	$ 10,000	
4.2	Bypass pumping (minor	ls	1	5,000	$ 5,000	
4.3	Native species replanting & hydroseeding	ls	1	5,000	$ 5,000	
4.4	Land Acquisition (SRW)	ha	5.10	20,000	$ 102,000	
					Subtotal	$ 122,000
					Part B Construction Total (Rounded)	$ 6,471,000
					Engineering and Construction Services (10%)	$647,100
					Contingency (30%)	$1,941,300
					Part B Total (Rounded)	**$9,059,000.00**

COMOX VALLEY REGIONAL DISTRICT July 5, 2017
MCSL 2211-47468-00 - Queens Ditch Drainage System Upgrade Options Analysi Rev 0
Construction Cost Estimate By: CDE
Chk: BH

Class D - Issued for Options Analysis Reporting

Item	Description	Unit	Quantity	Unit Price	Sub total	Total
	Option #3 - DIKING AND PUMPING					
	Earthworks					
1.1	Clearing and grubbing	m^2	4,000	$ 5	$ 20,000	
1.2	Soil Stripping, stockpiling and reuse	m^2	11,900	$ 7	$ 83,300	
1.3	Pond excavation	m^3	6,150	$ 17	$ 104,550	
1.4	Berm construction	m^3	9,000	$ 30	$ 270,000	
1.5	Pump flume constructior	m^3	8,000	$ 30	$ 240,000	
1.6	Class 25 riprap channel liner supply and placement c/v geotextile underlay	lm	500	$ 1,420	$ 710,000	
1.7	Ditch cleaning / widening	lm	5,000	$ 12	$ 60,000	
					Subtotal	$ 1,487,850
	STORMWORKS					
2.1	Diversion structure (to pond)	ls	1	$ 50,000	$ 50,000	
2.2	Flood gates, piping and structure at dik	ls	1	$ 80,000	$ 80,000	
2.3	Pumphouse (at pond)	ls	1	$ 4,500,000	$ 4,500,000	
2.4	Lazo Road crossings	ea.	1	$ 25,000	$ 25,000	
2.5	Outlet structures	ea.	1	$ 40,000	$ 40,000	
					Subtotal	$ 4,695,000
	MISCELLANEOUS					
3.1	Fish salvage	ls	1	9,500	$ 9,500	
3.2	Environmental monitoring	ls	1	50,000	$ 50,000	
3.3	Bypass pumping (100m-150m sections)	ls	1	25,000	$ 25,000	
3.4	Native species replanting & hydroseeding	ls	1	50,000	$ 50,000	
3.5	Land Acquisition (SRW)	ha	3	20,000	$ 60,000	
					Subtotal	$ 134,500
					Construction Total (Rounded)	$ 6,317,000
				Engineering and Construction Services (10%	$631,700	
				Contingency (30%)	$1,895,100	
					Total (Rounded)	**$8,844,000.00**

COMOX VALLEY REGIONAL DISTRICT July 5, 2017
MCSL 2211-47468-00 - Queens Ditch Drainage System Upgrade Options Analysi Rev 0
Construction Cost Estimate By: CDE
Chk: BH

Class D - Issued for Options Analysis Reporting

Item	Description	Unit	Quantity	Unit Price	Sub total	Total
	Option #4 - MANAGED RETREAT					
	Earthworks					
1.1	Clearing and grubbing	m^2	15,000	$ 5	$ 75,000	
1.2	Soil Stripping, stockpiling and reuse	m^2	25,500	$ 7	$ 178,500	
1.3	Channel excavation and local placement of surplu	m^3	255,000	$ 15	$ 3,825,000	
1.4	Class 25 riprap channel liner supply and placement c/\ geotextile underlay	lm	2,550	$ 2,600	$ 6,630,000	
					Subtotal	$ 10,708,500
	MISCELLANEOUS					
2.1	Fish salvage	ls	1	66,000	$ 66,000	
2.2	Environmental monitorin	ls	1	100,000	$ 100,000	
2.3	Bypass pumping (100m-150m sections)	ls	1	60,000	$ 60,000	
2.4	Native species replanting & hydroseedin	ls	1	175,000	$ 175,000	
2.5	Land Acquisition (SRW)	ha	30	20,000	$ 590,000	
					Subtotal	$ 401,000
					Construction Total (Rounded)	$ 11,110,000
					Engineering and Construction Services (10%	$1,111,000
					Contingency (30%)	$3,333,000
					Total (Rounded)	**$15,554,000.00**

Appendix D

ANNUAL OPERATION AND MAINTENANCE COST ESTIMATES

COMOX VALLEY REGIONAL DISTRICT *August 11, 2017*
MCSL 2211-47468-00 - Queens Ditch Drainage System Upgrade Options Analysis *Rev 0*
Estimate Operation and Maintenance Costing *By: BH*
Chk: BH

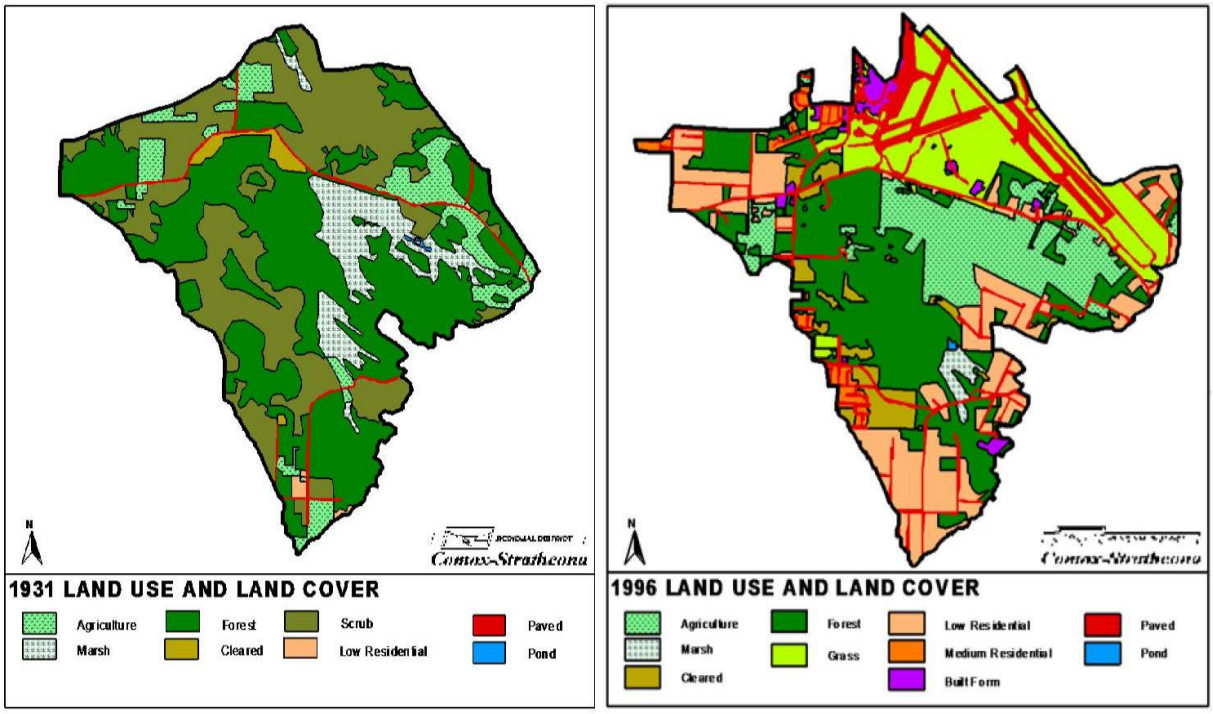
Class D - Issued for Options Analysis Reporting

Item	Description	Hours	Hourly Rate	Lump Sum	Sub Total	Total
	Option 1 - Cleaning and Deepening					
1.1	Weekly "drive by" inspection by CVRD Staff	78	$ 48		$ 3,752	
1.2	Budget for minor repairs by CVRD Staff (back sloughing, removing large woody debris, etc.)			$ 10,000	$ 10,000	
1.3	Ditch cleaning by subcontract (assumed required every 5 years, budget 20% of total per year)	510	$ 336		$ 171,360	
1.4	Annual culvert inspections by CVRD Staff	24	$ 48		$ 1,154	
1.5	Access road maintenance by subcontractor	2550	$ 2		$ 5,738	
1.6	Misc Expenses budget (insurance, administration, etc.)			$ 10,000	$ 10,000	
						$ 202,000
	Option 2 - DND Bypass					
2.1.1	Weekly "drive by" inspections	91	$ 48		$ 4,377	
2.1.2	Annual flushing of pipes (no allowance for video inspection, mobilization charges included)	2550	$ 3		$ 7,013	
2.1.3	Annual access road maintenance	2550	$ 2		$ 5,738	
2.1.4	Misc Expenses budget (insurance, administration, etc.)			$ 10,000	$ 10,000	
						$ 27,000
	Option 2 - Lazo Bypass					
2.2.1	Weekly "drive by" inspection by CVRD Staff	91	$ 48		$ 4,377	
2.2.2	Budget for minor repairs by CVRD Staff (back sloughing, removing large woody debris, etc.)			$ 10,000	$ 10,000	
2.2.3	Ditch cleaning by subcontract (assumed required every 5 years, budget 20% of total per year)	552	$ 275		$ 151,800	
2.2.4	Annual culvert inspections by CVRD Staff	24	$ 48		$ 1,154	
2.2.5	Access road maintenance by subcontractor	2760	$ 2		$ 6,210	
2.2.6	Misc Expenses budget (insurance, administration, etc.)			$ 10,000	$ 10,000	
						$ 184,000
	Option 3 - Diking and Pumping					
3.1	Daily inspection (1.5 man hours)	78	$ 48		$ 3,744	
3.2	Weekly maintenance of station internals (3 man hours per week, plus annual disposables budget of $5000)	156	$ 48	$ 5,000	$ 12,488	
3.3	Annual minor component replacement (budget allowance, does not include major component replacement)			$ 15,000	$ 15,000	
3.4	Annual major component replacement fund (highly dependent on system design)			$ 60,000	$ 60,000	
3.5	Dike Maintenance Act Inspection and reporting			$ 5,000	$ 5,000	
3.6	Dike Maintenance			$ 10,000	$ 10,000	
3.7	Estimate electrical consumption (highly variable)			$ 20,000	$ 20,000	
3.8	Misc Expenses budget (insurance, administration, etc.)			$ 10,000	$ 10,000	
						$ 136,000
	Option 4 - Managed Retreat					
4.1	Weekly "drive by" inspections	91	$ 48		$ 4,377	
4.2	Access road maintenance by subcontractor	3500	$ 2		$ 7,875	
4.3	Annual culvert inspections	24	$ 48		$ 1,154	
4.4	Vegetation/organics removals (assumed required every 10 years, 10% of cost carried per year)	13000	$ 5		$ 65,000	
4.5	Misc Expenses budget (insurance, administration, etc.)			$ 10,000	$ 10,000	
						$ 80,000
					Total Estimated Operations & Maintenance (Rounded)	***$ 629,000***

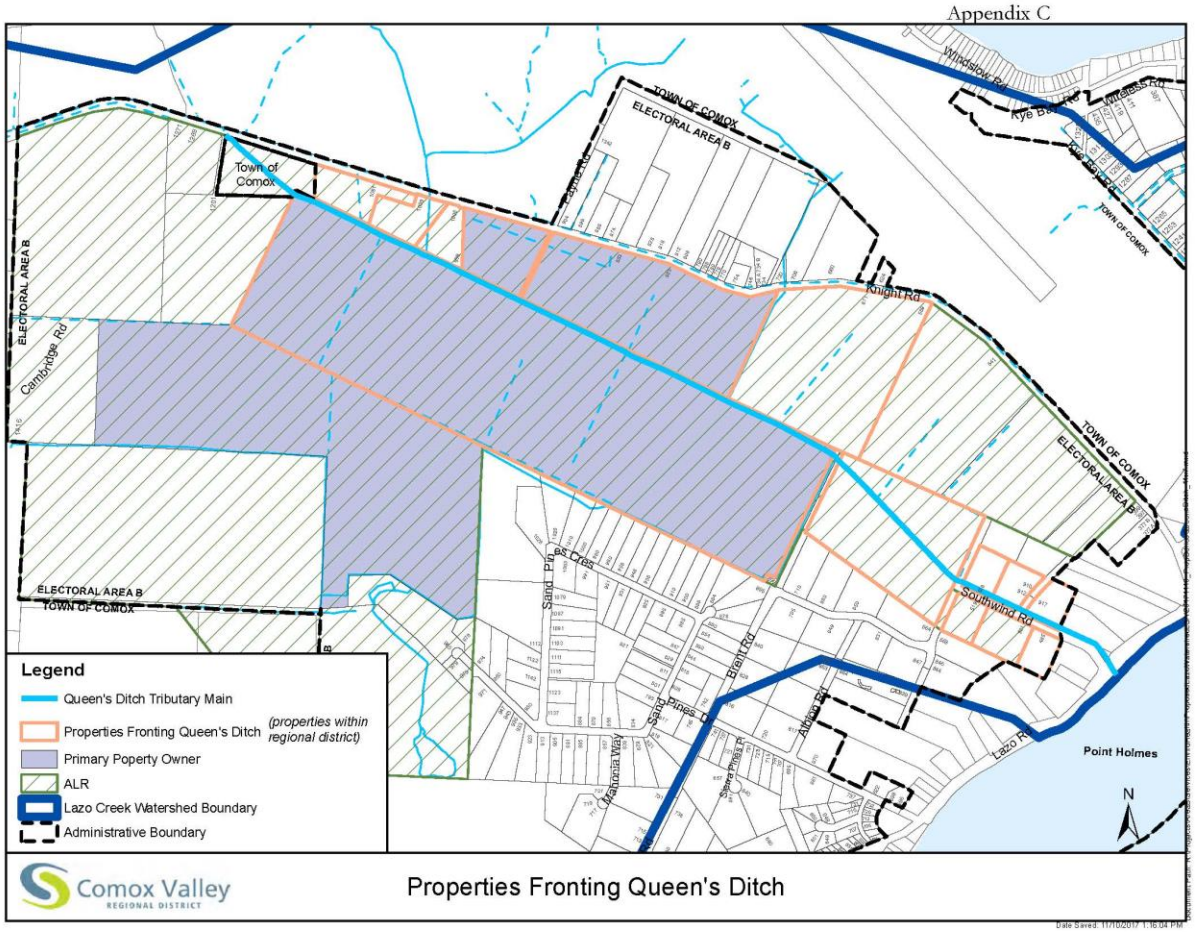
Appendix B

Land Use 1931 vs 1996

'Towards a Management Plan for the Lazo Watershed & Queen's Ditch', prepared by William Marsh



Appendix C


Town of Comox
ELECTORAL AREA B
TOWN OF COMOX
Cambridge Rd
Knight Rd
Southwind Rd
Sand Pines Dr
Sand Pines Cres
Brent Rd
Aitken Rd
Lazo Rd
Point Holmes
Windsor Rd
Kye Bay Rd
Whittaker Rd
Legend
Queen's Ditch Tributary Main
Properties Fronting Queen's Ditch
(properties within regional district)
Primary Poperty Owner
ALR
Lazo Creek Watershed Boundary
Administrative Boundary
N
Comox Valley
REGIONAL DISTRICT
Properties Fronting Queen's Ditch

ATTACHMENT 8

MAY 8, 2019 CVRD STAFF REPORT TO
ELECTORAL AREAS SEVICES COMMITTEE

Comox Valley REGIONAL DISTRICT

Staff Report

DATE: May 8, 2019

FILE: 5330-20/LAZO

TO: Chair and Directors
Electoral Areas Services Committee

FROM: Russell Dyson
Chief Administrative Officer

Supported by Russell Dyson
Chief Administrative Officer

R. Dyson

RE: **Lazo Creek Watershed Drainage Improvements – Phase 2a Results**

Purpose

The purpose of this report is to present to the Electoral Areas Services Committee (EASC) members results of the drainage improvement study work in the Lazo Creek Watershed.

Recommendations from the Chief Administrative Officer:

1. THAT the Comox Valley Regional District not proceed with further study work to investigate options for the creation of a local service area to upgrade and maintain the Queen's Ditch drainage system;

   AND FURTHER THAT correspondence be sent to the Department of National Defence indicating that the Comox Valley Regional District is no longer interested in pursuing federal Vote 10 funding to assume responsibility for the Queen's Ditch.

2. THAT correspondence be sent to current Lazo Creek Watershed Public Advisory Committee and Technical Advisory Committee members seeking their continued participation in a Lazo Creek Watershed working group.

Executive Summary

- Investigation of Lazo Creek Watershed drainage improvement options has been an ongoing corporate strategic priority of the Comox Valley Regional District (CVRD) Board.
- The lowland areas of the Lazo Creek Watershed lie just above sea level with a drainage gradient of about 0.05 per cent, or nearly flat, and have longstanding issues with flooding that continue to affect local residents.
- The Lazo Creek watershed contains multiple jurisdictions—Lazo North (Electoral Area B), Town of Comox, Department of National Defense (DND)—with various competing interests and values. Managing drainage in the lower Lazo Creek Watershed will require the collaboration of all jurisdictions within the watershed.
- In response to residents' concerns of flooding in the lowland areas, the CVRD committed to undertake a feasibility study to evaluate the viability of a local service area (LSA) to rehabilitate and manage the lower Lazo Creek Watershed drainage system.
- Of the five options included in the first phase of analysis, the CVRD Board approved the managed retreat/wetland restoration option for further study.
- Additional modeling of managed retreat/wetland restoration options shows only moderate improvement to flood extents in the short term, with minimal improvement in the medium to long term once sea level rise and climate change are factored in.
- Sea level and gravity continue to be significant constraints to the hydraulic efficiency of the system, reflective of the lower watershed's historical status as a wetland.

- Estimated costs of the managed retreat/wetland restoration options range between $12.3 – 16.9 million, not including land acquisition. Recovery of costs in an equitable manner would be a challenge to implementation.
- Recent efforts to improve drainage include work by Forest Lakewood LLC on the drainage ditches on their lands, design for Queen's Ditch remediation and construction of three stormwater detention ponds by DND and implementation of the North East Comox Stormwater Management Plan (SWMP) in the Town of Comox.
- Collaboration between watershed stakeholders will continue to be important to address drainage challenges in this area.
- There are liability considerations to contemplate prior to establishing a regional district service to control drainage, which will be discussed in a separate report to the EASC.

Prepared by:	Concurrence:	Concurrence:
V. Van Tongeren	***D. Monteith***	***M. Rutten***
Vince Van Tongeren, B.Sc. Environmental Analyst	Darry Monteith Manager of Liquid Waste Planning	Marc Rutten P.Eng. General Manager of Engineering Services

Stakeholder Distribution (Upon Agenda Publication)

Lazo Creek Watershed PAC	✔
Lazo Creek Watershed TAC	✔

Background/Current Situation

The Queen's Ditch is a constructed drainage channel, partially built within the historic Lazo Creek. The Queen's Ditch catchment area, known as the Lazo Creek Watershed, is approximately 1300 hectares in size. Lowland areas of the watershed lie just above sea level with a drainage gradient of about 0.05 per cent, or nearly flat.

Prior to the construction of the Queen's Ditch by the DND in 1946 much of the lower Lazo Creek watershed was marshland. While construction of the Queen's Ditch enhanced outflows from the area, the ditch's hydraulic gradient limited its ability to carry large flows efficiently. Over time, expansion and intensification of the drainage network, along with further land clearing, wetland conversion and development of impervious surfaces have continued to increase stormwater loading and delivery rates into the Queen's Ditch. Added to this, sea level and gravity continue to be significant constraints to the hydraulic efficiency of the system.

The lowland areas of the Lazo Creek Watershed have longstanding issues with flooding that affect local residents. In response to residents' concerns of flooding, the CVRD committed to undertake a feasibility study to evaluate the viability of a local service area to manage drainage in the lower Lazo Creek Watershed.

The CVRD hired McElhanney Consulting Services Ltd. (MCSL) to complete an options analysis for potential drainage improvements to the lowland areas of the watershed. This analysis is attached as Appendix A to the November 2017 staff report titled "Lazo Creek Watershed – Drainage Improvements Options Analysis"; the staff report also includes a summary of prior flooding issues and past study work.

Managed Retreat/Wetland Restoration Analysis

Phase 2a scope of work

Of the five options included in the first phase of analysis, the CVRD Board approved the managed retreat/wetland restoration option for further study. The wetland restoration options analysis was to be completed in two phases: Phase 2a to confirm viability and Phase 2b to complete a more detailed assessment of a preferred option. The initial phase (Phase 2a) of this study is now complete. A summary of the Phase 2a work is provided below:

- Hydraulic modelling using recent LiDAR data provided by DND to evaluate the effectiveness of different wetland reconstruction and channel improvement options considering current and long term climatic and tidal conditions. Options modeled include:
    - Current drainage system configuration and conditions.
    - Option 1 – reinstatement of historic wetland extents, modeled as channel improvements to the Queen's Ditch and existing Lazo Marsh outlet and lateral connection assuming future abandonment of land surrounding the improvements.
    - Option 2 – Reinstatement of wetlands in existing low-lying areas, modeled as channel improvements to the Queen's Ditch with excavation of specified low-lying areas to try to force flooding into those areas surrounding the main stem of the Queen's Ditch that have the lowest ground elevations.
    - Option 3 – Reinstatement of wetlands within one low-lying property, modeled as channel improvements to the Queens Ditch and existing Lazo Marsh outlet, with channel widening/wetland reconstruction inside a single property near the centre of the historic wetland area.

  Modeling parameters include:
    - Level of service – residences should not flood during a 1:10 year, 24 hour rainfall event, and agricultural lands would meet the Agricultural and Rural Subsidiary Agreement (ARDSA) drainage criteria.
    - Current climatic/tide conditions – 10 year design storm based on Comox Airport IDF curve, 2.34m high tide.
    - Long term (2100) climatic/tide conditions – 10 per cent added to 10 year design storm, 3.34m high tide.
    - All options (aside from current system) assume Queen's Ditch channel with 10m bottom width, 4:1 side slopes and no restrictions due to crossings.
- Class D construction cost estimates for the three options.
- A preliminary screening of options by an agrologist and biologist and review of modelling results with the Agricultural Land Commission.
- An assessment of the current condition of the Queen's Ditch outfall under Lazo Road.
- Presentation of modelling results and outfall condition assessment at Technical Advisory Committee (TAC) and Public Advisory Committee (PAC) meetings in early March.

Summary of results

For the three options modelled, flood extents and flood duration were moderately reduced under current climate and tide conditions.

- Option 1 provided improvements in the areas closest to Lazo Marsh, and to the fields in the upstream reaches of the Queen's Ditch.
- Option 2 provided improvements in the fields at the upstream end of the Queen's Ditch, but little change near Lazo Marsh as conveyance capacity from the marsh was unchanged.
- Option 3 provides improvements similar to those in Option 1, with the added benefit of better drainage of fields south of the Queen's Ditch.

Figures 6, 9, 11 & 13 of Appendix A illustrate the modelling results under current climatic/tide conditions.

Once future climatic conditions and sea level rise are incorporated into the modelling, the effectiveness of the three options is significantly diminished. While they do provide benefits when compared to the predicted response of the current drainage system to future rainfall and sea level rise conditions, the modeling shows significant inundation of low lying lands. Figures 8, 10, 12 & 14 of Appendix A illustrate the modelling results under future climatic/tide conditions.

Cost estimates for the three options range from $12.3 - $16.9 million. These estimates do not include land acquisition costs or construction of crossings over the Queen's Ditch.

Queen's Ditch outfall assessment
The outfall assessment found that, while still functioning, the outfall is in poor condition, and plans for repair or replacement are necessary. Interim recommendations are to remove vegetation, install rip rap at the inlet and outlet, monitor the road surface above the culvert for signs of settlement and to complete regular inspections. At the March 4, 2019 TAC meeting, DND and the Town of Comox agreed to discuss remediation of the culvert, in advance of the Town's plans to resurface Lazo Road in the near to mid-term.

Planned and completed drainage improvements
Since the most recent flooding concerns arose in 2015, there has been significant work to address drainage by many of the parties in the area.

- Forest Lakewood BC LLC, a major landowner in the area, has completed many drainage improvement projects on their lands, including culvert upgrades and lateral ditch improvements, and have reported substantial reductions in flooding on their lands and neighboring properties as a result of these works. Additional improvements are planned for Forest Lakewood lands to the north of the Queen's Ditch.
- In 2017, DND completed the construction of three stormwater ponds, intended to mitigate peak stormwater flows from a portion of DND property. DND is also near completion of a remediation design for the Queen's Ditch, which could include dredging of the ditch and replacement of multiple culverts, and is considering implementing these improvements during a future fisheries window.
- The Town of Comox is working to implement the North East Comox SWMP this year, including completion of a design for the first stormwater pond in that area and drafting of erosion and sediment control and runoff control bylaws.

While none of these changes can completely mitigate flooding in the lower watershed, they do represent noteworthy efforts to improve upon past practices.

Property interests, cost recovery and other considerations

- Management of the Queen's Ditch drainage network – All improvement options will require new statutory rights of way or the purchase of land including rights of way over the lateral connections that form part of the larger drainage network to ensure CVRD control over system function. Land owners within the lowland areas have a long history of modifying the ditch network on their lands for farming purposes and some have indicated they would not support a management system which would limit their control over these ditches for farming activities.
- Agriculture – Producers in the area have indicated the loss of farmland to implement drainage improvements is not favourable. Initial consultation with the Agricultural Land Commission indicated loss of arable land, the ability of farm equipment to access fields,

detention pond locations on agricultural lands and the effectiveness of flood mitigation in shoulder seasons would all be important factors in their review of any option brought forward for further consideration.

- Cost recovery considerations – Some land owners adjacent to the Queen's Ditch have indicated they are opposed to a future service that would see Electoral Area B residents taxed for the management of the Queen's Ditch, and feel that costs should be recovered from upstream stakeholders. Further to this, there exist challenges with service cost benefit differential and service cost burden differential due to the nature of the service. This suggests low support for recovery of costs that would be necessary to support a local service area, which is a significant factor in considering the viability of the service.
- There are liability considerations to contemplate prior to establishing a regional district service to control drainage. These considerations will be discussed in further detail in a separate report to be presented to the EASC.

Next steps

Technical analysis completed to date has been unable to identify a viable option for improvement of the Queen's Ditch drainage system that can achieve the identified level of service to support the establishment of a local service area. As such, there is limited benefit to continuing with Phase 2b of the managed retreat/wetland restoration analysis at this time.

The following activities could instead be undertaken in a continued effort towards improved rainwater management in the Lazo Creek Watershed:

- Continued work with watershed stakeholders to ensure open communication and collaboration towards improved rainwater management practices within the watershed.
- Continue to support collaboration in the implementation of drainage improvements including rehabilitation of the Queen's Ditch and the Point Holmes outfall.
- Continued development of regulatory tools for enhanced on-lot rainwater management within the electoral areas supported by a public education program. Implementation of the electoral areas rainwater management strategy is a key initiative of the 2019 work plan for the Liquid Waste Planning Service, function 340.
- Utilize completed technical analysis to inform future updates to Bylaw No. 2782 being the "Floodplain Management Bylaw, 2005".

In early 2018, a flow monitoring program was initiated with the installation of data loggers at four locations in the lower watershed. This monitoring program will continue through 2019, and will assist in verifying surface water flows and their response to rainfall events. Continuation of this program will be evaluated during the 2020-2024 budgeting process.

Looking ahead, this clause from the 2002 William Marsh report "Towards a Management Plan for the Lazo Watershed and Queen's Ditch" is suggestive of the challenges drainage presents in the watershed:

> We conclude that flooding of the lower Lazo Basin was frequent and extensive long before humans introduced it to roads, farms, houses, drains and other facilities. Indeed, it can fairly be argued that in most winters the entire basin floor (save for the sand dune area) was covered with standing water for two to three months, and for most remaining months of the year, the soil was saturated.

Climate change impacts such as increased winter rain and sea level rise suggest drainage challenges in this watershed will persist in years to come. In the absence of CVRD movement towards a local service area, continued collaboration with watershed stakeholders remains important.

Correspondence will be sent to current TAC and PAC members, seeking their continued collaboration on a Lazo Creek Watershed working group.

Policy Analysis
At their August 25, 2015 meeting the CVRD Board, the following motion was carried:

> *THAT a feasibility study be conducted to develop a rainwater drainage service that addresses capital upgrades and ongoing maintenance in and around the Queen's Ditch area of the Lazo Marsh.*

At the November 24, 2015 meeting of the CVRD Board, the following motion was carried:

> *THAT a feasibility study be conducted in two-phases to assess the viability of establishing a local service area to rehabilitate and manage the lower Lazo Watershed drainage system;*
>
> *AND FURTHER THAT the Electoral Area 'B' feasibility studies service 152 2016-2020 financial plan include $5,000 for possible service establishment costs, and that the 2016-2020 financial plan also commit $30,000 of community works funds for capacity building and supporting planning work.*
>
> *AND FURTHER THAT a staff report on findings of the first phase of a feasibility study be presented to the electoral area services committee by July 2016.*
>
> *AND FINALLY THAT the Comox Valley Regional District provide a letter of interest to the Department of National Defence expressing interest to enter into negotiations for a contribution agreement with the Department of National Defence for the design and installation of infrastructure supporting the management of the lower Lazo Watershed drainage system.*

At the November 28, 2017 meeting of the CVRD Board, the following motion was carried:

> *THAT further study work be completed to assess the effectiveness and viability of managed retreat/wetland restoration in improving drainage in the lower Lazo Creek Watershed;*
>
> *AND FURTHER THAT $27,000 from Service 152, Electoral Area B Feasibility Studies, be allocated to a flow monitoring program for the Lazo Creek Watershed;*
>
> *AND FINALLY THAT the McElhanney report titled "Comox Valley Regional District Queen's Ditch Lowland Area Drainage Improvements Options Analysis" and dated September 14, 2017 be referred to the Committee of the Whole for information.*

Options
In regards to continuing with further study work to investigate options for the creation of a local service area to rehabilitate and manage the lower Lazo Creek Watershed drainage system, the following options are available:

1. Not proceed with further work to establish of a local service area to manage drainage in the lower Lazo Creek Watershed, and communicate to the Department of National Defence that the CVRD does not wish to proceed with taking on responsibility for the Queen's Ditch.
2. Investigate alternative options for flood mitigation and an associated local service area.

For multiple reasons as discussed in this report, a local service area to manage drainage in the lower Lazo Creek Watershed would be minimally effective in reducing flood extents in the medium to

long-term. Without a local service area, there would be no funding mechanism for the CVRD to take on responsibility for the Queen's Ditch. For these reasons, Option 1 is recommended.

In regards to continued collaboration with the TAC and PAC towards planning and implementation of drainage improvements in the Lazo Creek Watershed, the following options are available:

1. Correspond with existing TAC and PAC members to seek their continued collaboration in a Lazo Creek Watershed working group.
2. Leave the existing TAC and PAC Terms of Reference unchanged to support the investigation of alternative options for flood mitigation and an associated local service area.

As continued investigation into the establishment of a local service area is not being recommended at this time, Option 1 is recommended.

Financial Factors

High level (Class D) cost estimates were provided for each option, for the purposes of establishing the relative ranking of costs between options. Cost estimates to implement the options range from $12.3 - $16.9 million, not including costs for land acquisition or enhanced crossings of the main Queen's Ditch. Without significant external funding, these costs would be a substantial burden on the relatively small number of land owners if a local service area were created.

The potential exists for the CVRD to assume responsibility of the Queen's Ditch in return for a capital investment through the DND Vote 10 funding program. This process was initiated in March 2016 through a letter of interest sent to DND Vote 10 program staff. A formal commitment was pending completion of the feasibility study work and identification of a preferred option.

In 2018, the CVRD Board allocated $80,000 in Electoral Area B Community Works Funds towards assessing managed retreat in the Lazo Creek Watershed. Following completion of the Phase 2A work, approximately $47,500 in Community Works Funding will remain for further study work or allocation to other projects.

Legal Factors

The Woodrow case of the late 1990s demonstrated that there is some potential for government liability in the multi-jurisdictional Lazo Creek Watershed. In their discussions with staff, members of the Lazo Watershed Property Owners Committee have made it clear that legal recourse could be considered if action is not taken by government to mitigate the risk of future flooding through adequate maintenance of the Queen's Ditch.

Governance options for the creation of a local service area along with an overview of the legal regulatory regime and common law legal liability risks associated with the provision of a drainage service are considered in a separate report to be presented to the EASC.

Regional Growth Strategy Implications

Project work aligns with the goals and objectives of the Comox Valley Regional Growth Strategy (RGS) to "provide affordable, effective and efficient services and infrastructure that conserves land, water and energy resources." In particular, stormwater management initiatives within the Lazo Creek watershed support the following objectives of the RGS:

- Objective 2-B: Frame environmental protection and policies around the principles of precaution, connectivity and restoration.
- Objective 2-C: Promote environmental best practices in Agricultural and Resource Areas.
- Objective 5-C: Stormwater is managed to preserve ecosystem and watershed health.
- Objective 8-F: Plan for climate change adaptation.

Intergovernmental Factors
Approximately 45 per cent of the Lazo Creek Watershed falls within Electoral Area B, 28 per cent within Comox, and 27 per cent within CFB Comox. Work to mitigate flooding in the lower Lazo Creek Watershed requires the collaboration of all jurisdictions within the watershed.

DND has indicated a desire to hand over responsibility for the Queen's Ditch to the CVRD in return for a capital investment through the DND Vote 10 funding program.

The Town of Comox boundary wraps almost entirely around the Lazo Creek Watershed, with the last several hundred meters of the Queen's Ditch and outfall falling within its boundaries. Comox has been working over the past several year to develop improved standards for rainwater management within the Lazo Creek Watershed through development of the North East Comox Stormwater Management Plan.

The situation is complex with multiple competing interests and values. The CVRD will continue to work with DND, Comox and other members of the TAC and PAC towards improved rainwater management within the Lazo Creek Watershed.

Interdepartmental Involvement
The Engineering Services Branch has taken the lead in preparing this report with input from the Planning and Development Services and Corporate Services branches.

Citizen/Public Relations
Staff will continue to work closely with PAC members as further work is planned and implemented. Continued consultation with all stakeholders will be key to improved rainwater management in the Lazo Creek Watershed.

The modelling results, when future climatic conditions and sea level rise are accounted for, have implications beyond the geographic reach of the lower Lazo Creek Watershed. Other low-lying areas within the CVRD could also be at risk due to the anticipated impacts of climate change. The CVRD currently has a pending funding application to complete coastal floodplain mapping for the entire coastal portion of the CVRD, and is anticipating a decision on this funding this spring. This project will be designed in two phases, with phase one to include data collection and mapping and phase two to include a consultation strategy for implementation. A comprehensive communications plan will be developed as part of this project.

Attachments: Appendix A – "Queen's Ditch Drainage Improvements Options Analysis – Technical Memo #1", McElhanney Consulting Services Ltd.

TECHNICAL MEMO

McElhanney | CANADA'S BEST MANAGED COMPANIES

To Darry Monteith, Manager of Liquid Waste Planning Vince Van Tongeren, Environmental Analyst	**From** Bob Hudson, P. Eng.
Company Comox Valley Regional District	**McElhanney Branch** 2211- Courtenay
Re Queen's Ditch Drainage Improvements Options Analysis Phase 2A – Modelling Results – Rev. 2	**Date** May 7, 2019 **File Number** 2211-47546-00

1. BACKGROUND

The Comox Valley Regional District (CVRD) has elected to proceed with further evaluation of the feasibility of undertaking drainage improvements within the Queen's Ditch/Lazo Creek area, in Lazo, British Columbia. This document builds upon past modelling, analysis and recommendations made in the CVRD's Queen's Ditch Lowland Area Drainage Improvements Options Analysis (the Phase 1 Study). This Memorandum assumes that the reader is familiar with this document.

The information presented herein is intended to facilitate discussion amongst stakeholders and CVRD staff, and to provide context and information for the CVRD to decide if advancing a drainage function within the Queen's Ditch lowland areas is feasible or, in fact, needed.

Figure 1, overleaf, shows the limits of the Queen's Ditch Catchment, and the current study area.

2. PAST MODELLING RECOMMENDATIONS

The Phase 1 study evaluated the performance of five differing drainage system improvement options for the lowland areas. These options were modelled using 2D PCSWMM. Initial modelling carried out in the Phase 1 study used hydraulic capacity of the Queen's Ditch (i.e., "spilling" of the ditch) as a tool to evaluate the potential reduction in flooding expected in the various improvement options considered. Scenarios modelled included:

- **Diking and pumping of lowland areas** - a hydraulic model was not created specifically for this option. Evaluation was based on comparison to similar pumped systems, and modelled inflow in the Queen's Ditch catchment. Diking and pumping of lowland areas appears likely to provide the best opportunity to consistently lower water table levels, and decrease flooding. This option could continue to function under changing/increasing rainfall volumes and intensities, as is likely to occur due to climate change, sea level rise, and storm surge conditions. Flexibility to adapt to changing hydrologic conditions can be achieved with the diking and pumping option through the addition of more, or larger pumps.
- **Managed Retreat/Wetland Reinstatement** was modelled as a +/- 10m wide channel bottom with 4:1 side slopes (total water surface 30-40m wide) along the Queen's Ditch, and the abandonment of several

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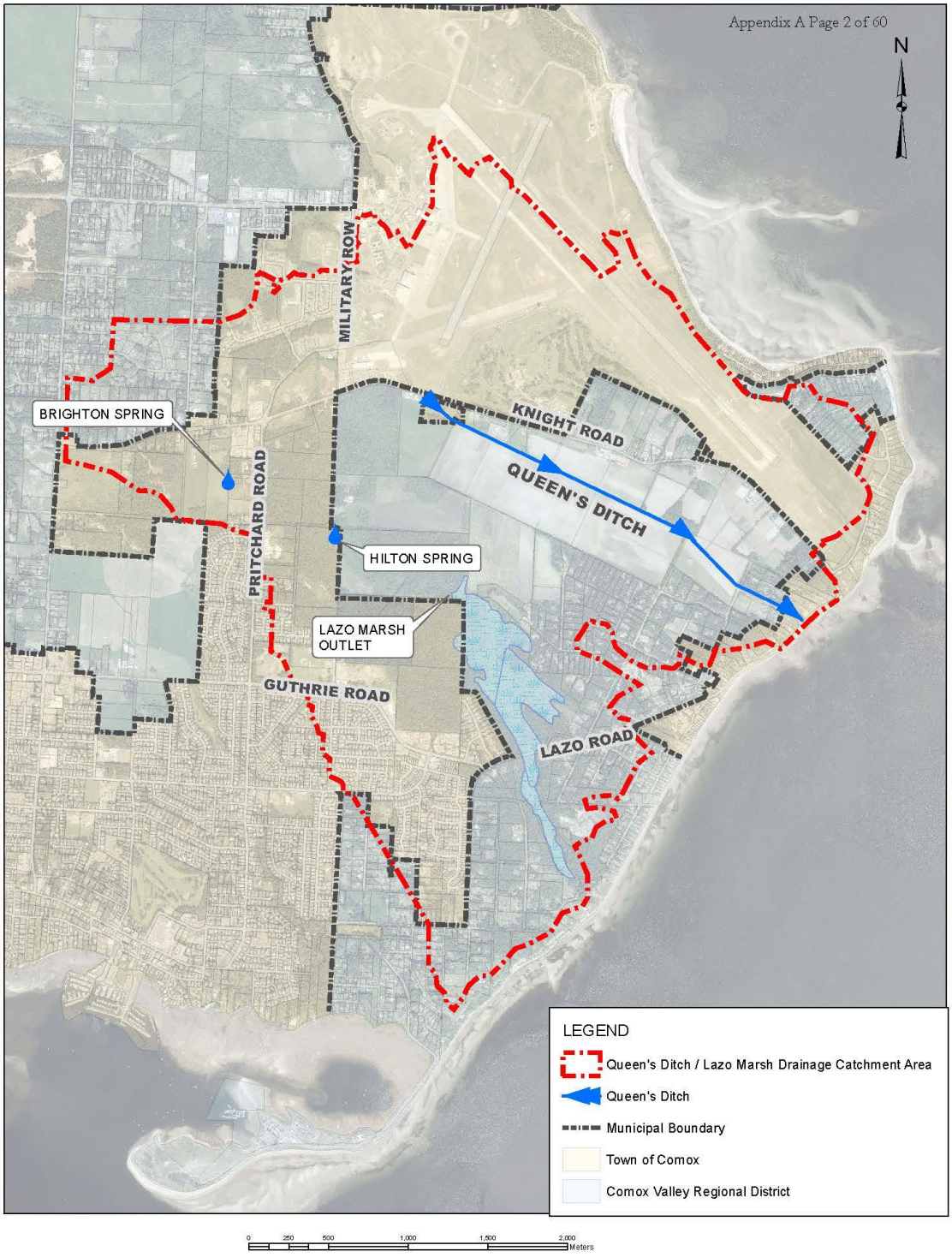


Queens's Ditch Drainage Improvements Options Analysis
Study Area

Figure 1
Rev 0

low areas that cannot be consistently drained within the agricultural lands adjacent to the Queen's Ditch. Managed Retreat/Wetland Reconstruction can provide significant improvement in overall drainage of the lowland areas. Under modelled present-day sea level and storm surge conditions, this option is modelled without exceeding the capacity of the Queen's Ditch. When sea level rise and storm surge are added, modest flooding is observed, primarily at points of lateral connection to the Queen's Ditch.

- **Cleaning and deepening of the Queen's Ditch** was modelled as a drainage course with a +/- 6m wide base. Cleaning and deepening of the Queen's Ditch was able to reduce the hydraulic grade in the Queen's Ditch, particularly if a lined channel section is constructed. Modest flooding of lateral connections persists, even with improvements. Significant flooding is modelled without lining the improved ditch section.
    - Under climate change conditions, significant flooding is modelled, regardless of lining. However, some of the flooding of the Queen's Ditch appears to be caused by localized depressions in the top-of-bank.
- **The Lazo and Department of National Defence (DND) Bypass** was modelled as two separate diversions of runoff from the Lazo wetland and the DND airfields. This option removed significant flow from the Queen's Ditch, conveying the water in separate, dedicated conduits. The Lazo and DND bypass options provide varying levels of flood reduction. Under present-day conditions, the Lazo bypass is modelled as being minimally effective in reducing Hydraulic Grade Line within the Queen's Ditch. Performance of the DND bypass is approximately equivalent to cleaning and deepening the Queen's Ditch without channel lining improvements.
    - When consideration is given to the impacts of climate change (sea level rise), neither bypass option is effective at reducing flooding under design rainfall conditions.
- **Off-Channel Storage** is not considered practical, given the flat gradient of the lowland areas, and volume of storage that must be provided to mitigate flooding.

A number of additional subjective criteria were used to round out the evaluation process, including effectiveness in reducing elevated ground water conditions, use of existing easements and rights-of-way, land required, anticipated higher level government approvals, and potential for funding partnerships. With consideration given to the data presented, the managed retreat/wetland reinstatement option was determined to be the preferred option to advance to feasibility analysis.

3. DATA ACQUISITION AND TERRAIN MODEL DEVELOPMENT

The CVRD acquired updated LiDAR data for the lowland areas surrounding the Queen's Ditch from DND. The site was flown in the summer of 2018, at a resolution of 30 points per square metre. This density is considered adequate for developing bare earth models of sufficient accuracy for use in 2D flood modelling. McElhanney confirmed key elevations, including culvert and ditch inverts at several points within the modelled area, to ensure hydraulic models are reflective of actual ground conditions at the time of study.

Land owners within the lowland areas and adjacent residents have a long history of modifying the ditch network within the study area. If the implementation of a coordinated, improved drainage system is to be successful and enduring, it will be imperative that the system not be manipulated in any way. The modelling and analysis in this study are based on conditions as encountered during the acquisition of survey data and LiDAR in the summer 2018.

4. HYDRAULIC MODELLING OF WETLAND REINSTATEMENT OPTIONS

4.1. Description of options considered

Four drainage system scenarios have been developed for evaluation and refinement. The intent of this process is to inform a comparative analysis of sub-options, based on hydraulic function, cost, impact to private property, impact/benefit to agriculture and the environment, and higher level government permitting requirements.

In order to evaluate the hydraulic performance and potential impacts on flood extents and duration, several assumptions have been made. These include:

- To simplify ground surface models, the geometry of each option considered has been idealized. That is to say, consistent channel cross sections have been modelled, without the hydraulic restrictions of culverts imposed.
- The channel widths modelled provide a starting point for analysis and comparison. It may be decided that constructed channel sections should be larger than those noted herein, to allow for sediment deposition, scour, growth of vegetation, etc.

Each option is described below.

Option 1 – Reinstatement of historic wetland extents, as determined by photographs and other available data.

The historic extents of the Lazo Marsh covered much of the present day lowland agricultural areas. The practicality of acquiring such a large land base is questionable at this time. Under present day climatic conditions, this land is reasonably productive. It is conceivable, however, that as climate change and sea level rise begin to increase the frequency and severity of flooding, properties within the lowlands will become unsuitable for farming, and could be abandoned or sold.

Option 1 is modelled as channel improvements along the flatly graded section of the Queen's Ditch (approximately the lowest 2,500m of ditch, from the Lazo outfall, to a point roughly adjacent to Knight Road), and along the existing Lazo Marsh outlet, and "highways" ditch, to the point of connection to the Queen's Ditch. The intent of this option is model channel improvements to manage drainage in the short to medium term, with the understanding that at some point in the future, climate change and sea level rise will cause flooding and lack of production on lands around the improvements. Option 1 is the simplest improvement option, relying on the abandonment of land in the future, in place of more extensive physical improvements today.

Figure 2 indicates the historic extents of the Lazo wetland (circa 1931) based on information obtained in "Towards a Watershed Management Plan" by Will Marsh.

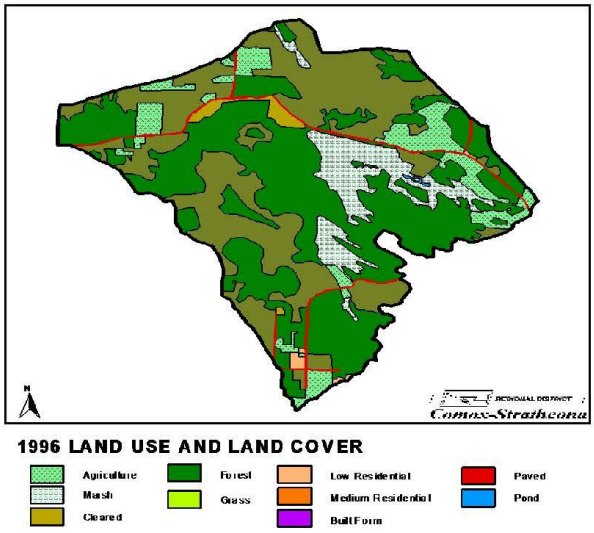


Figure 2 – History of Lazo Wetland Extents

Option 2 – Reinstatement of wetlands in areas that are currently noticeably lower in elevation than surrounding areas

Option 2 attempts to force flooding into those areas surrounding the main stem of the Queen's Ditch that have the lowest ground elevations. There are significant additional areas that are of similarly low elevation within the subject area; however, given the practicalities and cost of acquiring this much land, a smaller area was selected for analysis. Modelling of this configuration will determine if floodwaters can be evacuated more quickly in those areas with constructed improvements.

Of the four options considered, Option 2 requires the greatest area of land to be acquired and/or removed from the arable land base, initially. The practicality of this is not yet fully understood, as discussions with the Ministry of Agriculture, the Agricultural Land Commission and land owners are ongoing.

Option 3 – Reinstatement of wetlands corresponding with existing legal property lines

Option 3 is similar to Options 1 & 2, in that additional channel capacity is provided and a section of the Lazo Marsh discharge/"highways ditch" is established as point of controlled flooding. This option limits channel widening to a single property near the centre of the historic wetland area. This option will test the ability of improvements (channel widening and regrading of areas around the "highways" ditch) to reduce flooding in the fields adjacent to the densely developed Sand Pines Crescent area.

Option 4 – Reinstatement of wetlands corresponding to areas of lowest agricultural value

The fourth option considered is the reinstatement of wetland in areas identified as having the lowest agricultural value. The rational to reviewing this option is that there are likely low-lying areas, that due to frequent flooding, have a low production yield. Formalizing these areas would have a low impact on loss of agricultural land and could provide an overall improvement to the surrounding agricultural lands. Feedback from the Agricultural Land

Commission (ALC) was requested for input. The ALC indicated that the formalization of loss of any agricultural land would not be favourable, though additional feedback could be provided if a formal request was made. After reviewing this option in more detail, the team felt that the option would closely resemble option 2, and therefore was not modelled in this phase.

Figures 3a, 3b and 4 (overleaf) indicate the general arrangement of drainage improvement **Options 1, 2 and 3.**

4.2. Model Input Parameters

The above options have been modelled using the U.S. Army Corps of Engineers Hydraulic Engineering Centre's River Analysis System (HEC-RAS) software.

The following summarizes HEC-RAS model input parameters:

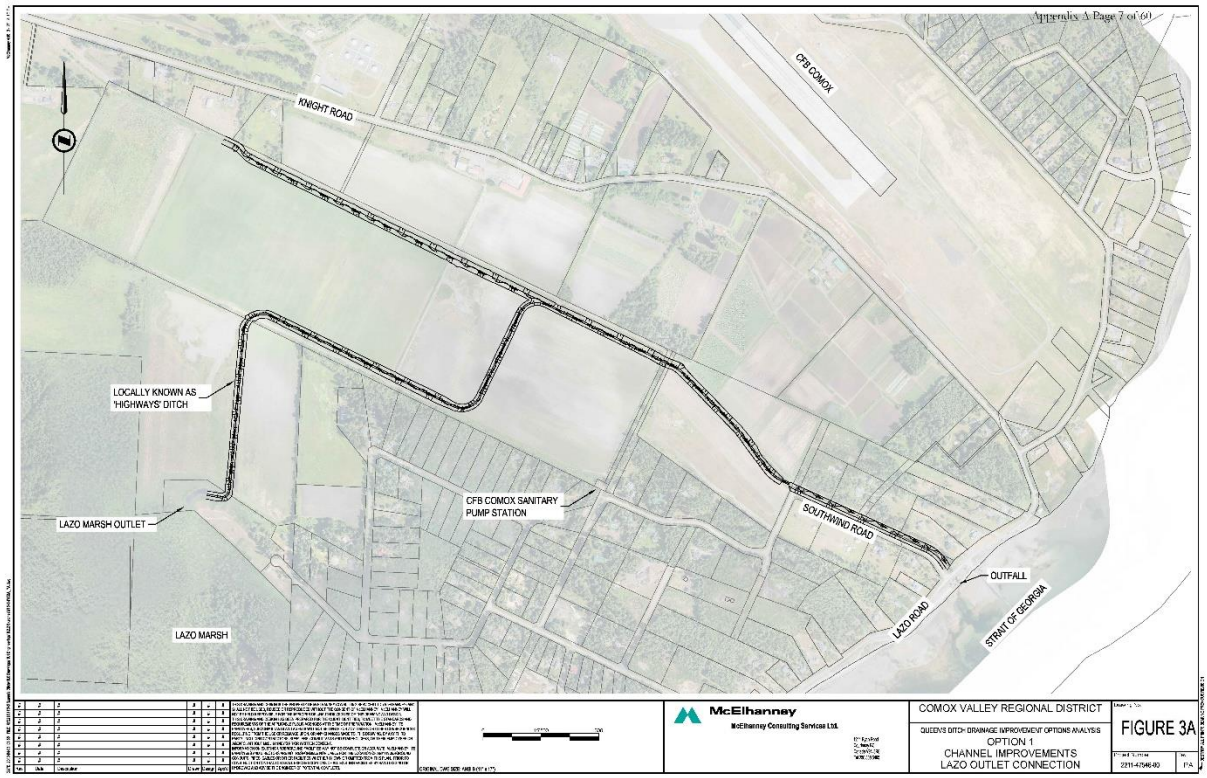
- **Tides** – Based on Tetra Tech's Functional Plan for the Queen's Ditch (dated June 2014), prepared for the DND. This data has been used in subsequent modelling carried out by DND, as well as the CVRD in Phase 1 of this study.
    - Present day peak high tide = 2.34m
    - Present day low tide = -1.56m
    - Year 2100 peak high tide = 3.34m
    - Year 2100 low tide = -0.56m
- Peak tide set to 09:00 hours.
- Peak high tide and peak flow in the Queen's Ditch were aligned to be approximately coincident (within ~1 hour).
- Inflows to the system were modelled at 11 unique locations within the HEC-RAS Model. Peak inflows under 10 year rainfall events were as follows:
    - 10 year peak inflow into catchment area under present day climatic conditions = 12.5m³/s.
    - 10 year peak inflow into catchment area under climate change conditions = 14.8m³/s.

PCSWMM Model Parameters to Provide Inflows

- Rainfall – 10-year design storm based on the Comox Airport Intensity Duration Frequency (IDF) curve. 1:10-year plus climate change adjusted approximately +10% (~2080). This is consistent with the Climate Change Factoring for the DND QD modelling program, which was based on the Pacific Climate Impacts Consortium (PCIC) data.
- Hotstart (preloading of the PCSWMM) model included 2mm/hr for the first two thirds of the previous day (which is consisted with the previous PCSWMM modelling for the QD for DND).
- Present Day 1:10 year rainfall peak intensity = 12.8mm/hr, total rainfall depth in 24 hrs = 81.9mm.
- 1:10 year rainfall inclusive of climate change, peak intensity = 14.1mm/hr, total rainfall depth in 24 hours = 90.1mm.

HEC-RAS Model Parameters:

- 2D Mesh with 10,000 cells, covering 3.6 square kilometers.


Appendix A Page 7 of 60
KNIGHT ROAD
CFB COMOX
LOCALLY KNOWN AS 'HIGHWAYS' DITCH
LAZO MARSH OUTLET
CFB COMOX SANITARY PUMP STATION
SOUTHWIND ROAD
OUTFALL
LAZO ROAD
STRAIT OF GEORGIA
LAZO MARSH
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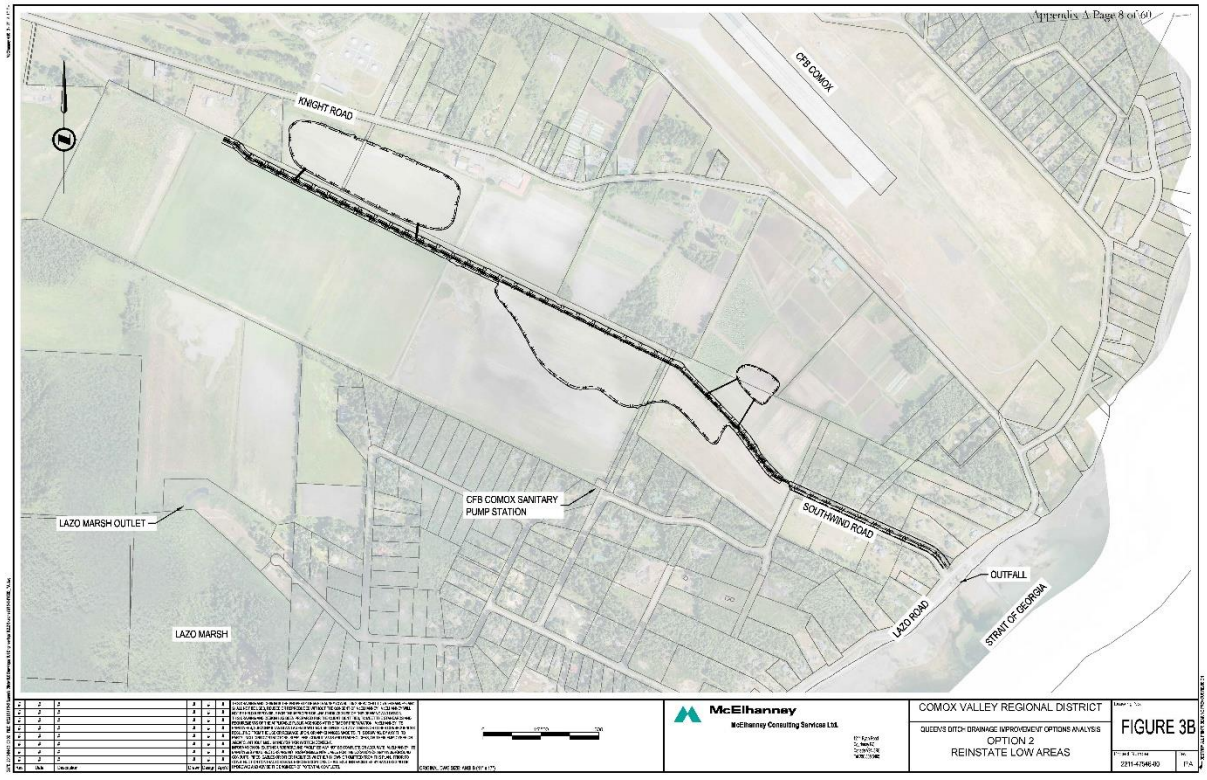
COMOX VALLEY REGIONAL DISTRICT
QUEEN'S DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
OPTION 1
CHANNEL IMPROVEMENTS
LAZO OUTLET CONNECTION
FIGURE 3A


Appendix A Page 8 of 60
KNIGHT ROAD
CFB COMOX
LAZO MARSH OUTLET
CFB COMOX SANITARY PUMP STATION
SOUTHWIND ROAD
OUTFALL
LAZO ROAD
STRAIT OF GEORGIA
LAZO MARSH
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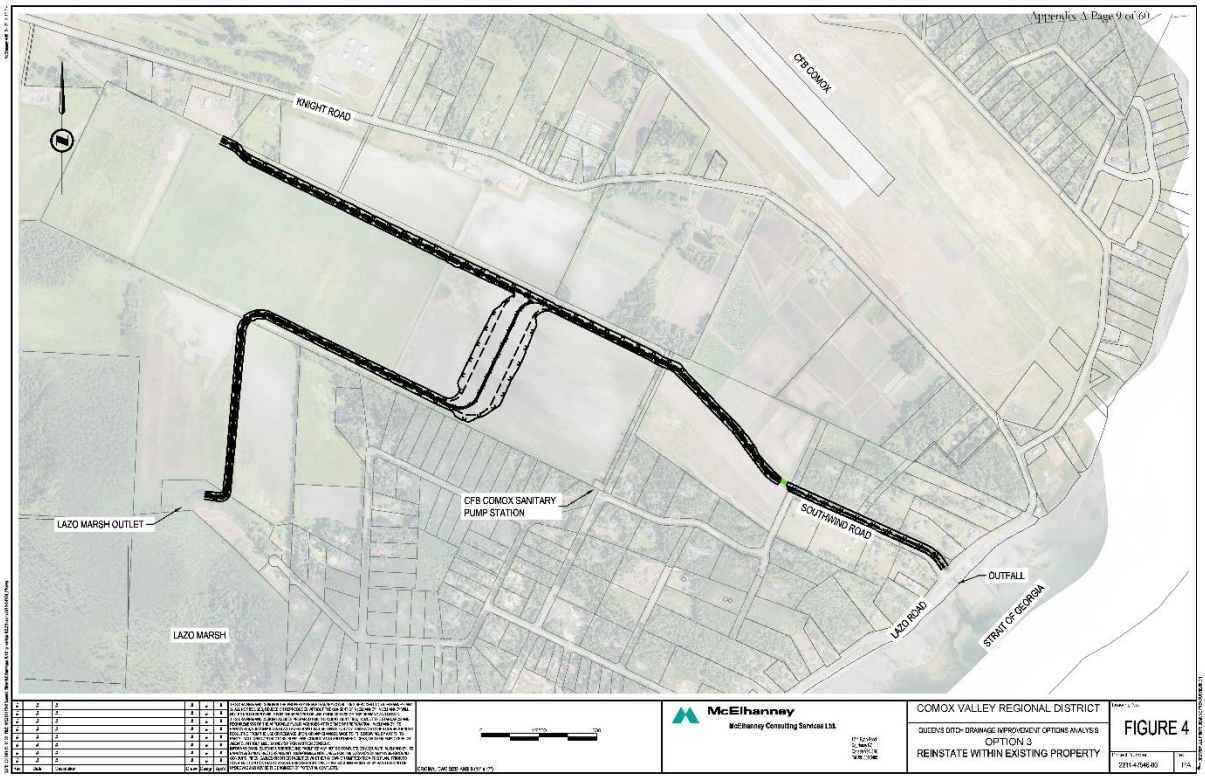
COMOX VALLEY REGIONAL DISTRICT
QUEEN'S DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
OPTION 2
REINSTATE LOW AREAS
FIGURE 3B


Appendix A Page 9 of 60
KNIGHT ROAD
CFB COMOX
CFB COMOX SANITARY PUMP STATION
LAZO MARSH OUTLET
LAZO MARSH
SOUTHWIND ROAD
OUTFALL
LAZO ROAD
STRAIT OF GEORGIA
McElhanney
McElhanney Consulting Services Ltd.
COMOX VALLEY REGIONAL DISTRICT
QUEENS DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
OPTION 3
REINSTATE WITHIN EXISTING PROPERTY
FIGURE 4

- Cell size = 20m x 20m ("overbank" floodplain areas), 8m x 8m (flow channels).
- Terrain Data = 0.3m DEM derived from LiDAR data provided by the Department of National Defence.
- No infiltration within the study area, i.e., saturated winter conditions assumed.
- Manning's n = 0.035 in improved channel sections. This would correlate to a grassed, maintained channel (not wooded, no accumulated debris, etc.).

4.3. Model Results – Present Day Drainage System Conditions

Model scenarios of existing drainage system conditions have been run under both present-day climate and tidal conditions, as well as year 2100 climate change and sea level rise conditions, to provide a basis for comparison of improvements to flood frequency and duration expected under the four improvement options considered.

Model scenarios have also been run for each improvement option considered, with both present-day rainfall/sea level paraments, as well as year 2100 rainfall and sea level. Provided below are graphics indicating the extents of flooding under each scenario considered, and a brief description of each. General comments and discussion follow. **Appendix A** contains larger versions of the graphics.

Figure 5 Present Day Drainage System Conditions with High Tide models the impact of present-day high tide on the Queen's Ditch and its major tributaries, without the influence of any rainfall. This scenario shows the Ditch in its current state. Ocean water can be seen as far up stream as 1081 Knight Road.

Figure 6 Present Day Drainage System Conditions with Present Day 1:10 Year Rainfall and High Tide models the impacts of present day drainage system geometry, and high tide, with the addition of a 1:10 year SCS type 1A rainfall. Significant flooding is observed. Past modelling (Phase 1) has shown that the extents of flooding modelled under 2, 5 and 10 year rainfall events is similar. Modest increases in flood extents with increasing rainfall volume would confirm that the primary challenge in managing rainfall in the lowland areas is the very small differential in grade from the easternmost extents of the lowland areas, to the Strait of Georgia

Figure 7 Present Day Drainage System Geometry with Sea Level Rise and No Rainfall models the impact of high tide plus sea level rise, with no rainfall input into the model. Significant inundation of the subject area will result from sea level rise alone. In the absence of any change in grade of those lands flooded and/or drainage system improvements, this area should be considered the minimum extents of retreat.

Figure 8 Present Day Drainage System Geometry with Sea Level Rise and Climate Change Adjusted 1:10 Year Rainfall models the impact of high tide plus sea level rise, with the introduction of a 1:10 year SCS type 1A rainfall event on the current drainage system. Nearly all of the study area is flooded for a period of time, following a design rainfall event.

Figure 9 Flood Extents Option 1, Present-Day shows a comparison of flood extents under present-day climatic and sea level conditions with the existing drainage system (red coloured areas) vs. flood extents with the same rainfall and sea level conditions, and the constriction of Option 1 (blue areas). Option 1 does provide a significant improvement in terms of reduction of flood extents, though most properties that were subjected to flooding prior to construction remain flooded to some degree. It is reasonable to expect that further refinement of the drainage system, particularly the lateral connections to the Queen's Ditch that drain many of the fields, could further reduce flooding. This is expected to be the case with all improvement options.

Figure 10 Flood Extents Option 1, Long Term shows a comparison of flood extents under long term climatic and sea level (rise) conditions with the existing drainage system (red coloured areas) vs. flood extents with the same

rainfall and sea level conditions, and the construction of Option 1 (blue areas). No relief is expected for those properties subject to tidal inundation. Areas west and south of the tidal inundation zone experience flooding similar to that modelled under present day sea level and climate conditions.

Figure 11 Flood Extents Option 2, Present Day shows a comparison of flood extents under present-day climatic and sea level conditions with the existing drainage system (red coloured areas) vs. flood extents with the same rainfall and sea level conditions, and the construction of Option 2 (blue areas). Option 2 does not appear to provide any additional benefit over Option 1, other than formalizing some of the deepest flooded areas. Lands closest to the Lazo Marsh outlet receive no benefit from improvements.

Figure 12 Flood Extents Option 2, Long Term shows a comparison of flood extents under long term climatic and sea level (rise) conditions with the existing drainage system (red coloured areas) vs. flood extents with the same rainfall and sea level conditions, and the construction of Option 2 (light blue areas). As with Option 1, no relief is expected for those properties subject to tidal inundation, nor is there any modelled reduction in flooding of lands near the Lazo Marsh outlet.

Figure 13 Flood Extents Option 3, Present Day shows a comparison of flood extents under present day climatic and sea level conditions with the existing drainage system (red coloured areas) vs. flood extents with the same rainfall and sea level conditions, and the construction of Option 3 (blue areas). Option 3 provides a greater reduction in flooding than Option 1, and requires significantly less land than Option 2. Further analysis is required to determine if the increased cost of land acquisition justifies the modest decrease in short term flooding.

Figure 14 Flood Extents Option 3, Long Term shows a comparison of flood extents under long term climatic and sea level (rise) conditions with the existing drainage system (red coloured areas) vs. flood extents with the same rainfall and sea level conditions, and the construction of Option 3 (light blue areas). Option 3 does provide a very modest reduction in flood extents under long term future conditions. This reduction in flood extents was not observed in Options 1 and 2, but is not significant enough on its own to justify construction of Option 3.

Figure 15 Percent Time Inundated, Existing Drainage Conditions, Present Day Climate and Sea Level indicates, using colour gradient, the percentage of total modelled time that an area is inundated with flood or ocean water. This graphic is based on a total elapsed time of 72 hours, a 24 hour design rainfall event, an additional (approximately) 48 hours of runoff entering the system, and an overlapping drawdown period where fields are modelled as draining. During the model simulation, the peak high tide is timed with the peak in runoff entering the Queen's Ditch to simulate a "worst case" backwater effect. Throughout the balance of the simulation, tides function with typical variation.

The red colouring on this graphic indicates that many areas within the study boundary are not able to dry within two days of rainfall ending.

Figure 16 Percent Time Inundated, Option 1, Present Day Climate and Sea Level indicates that a significant reduction in the amount of time that inundated areas take to drain can be achieved with Option 1. However, many areas and properties are still unable to fully drain.

Figure 17 Percent Time Inundated, Option 2, Present Day Climate and Sea Level shows that Option 1 provides similar or better performance, without increased loss of agricultural lands.

Figure 18 Percent Time Inundated, Option 3, Present Day Climate and Sea Level shows that the Option 3 performs similarly to Option 2, with a lower inferred construction cost, less land lost for construction of enlarged channels, and some benefit to those lands closest to the Lazo Marsh outlet.

Figure 19 Percent Time Inundated, Existing Drainage Conditions, with Sea Level Rise and No Precipitation shows that large portions of the study area will be permanently inundated. Any rainfall would cause water levels to rise, beyond what is shown.

Figure 20 Percent Time Inundated, Existing Drainage Conditions, with Sea Level Rise and a 1:10 Year Rainfall Event shows that roughly three times the area inundated by sea level can be expected, with no improvements to the drainage system.

Figure 21 Percent Time Inundated, Option 1, with Sea Level Rise and a 1:10 Year Rainfall Event shows that significant areas cannot be drained, particularly those lands north of the Queen's Ditch. Tidally inundated areas described in **Figure 7** only drain between tide cycles.

Figure 22 Percent Time Inundated, Option 2, with Sea Level Rise and a 1:10 Year Rainfall Event shows that Option 2 performs less effectively than Option 1.

Figure 23 Percent Time Inundated, Option 3, with Sea Level Rise and a 1:10 Year Rainfall Event shows that Option 3 performs similarly to Option 1.

Figure 5 - Present Day Drainage System Conditions with High Tide

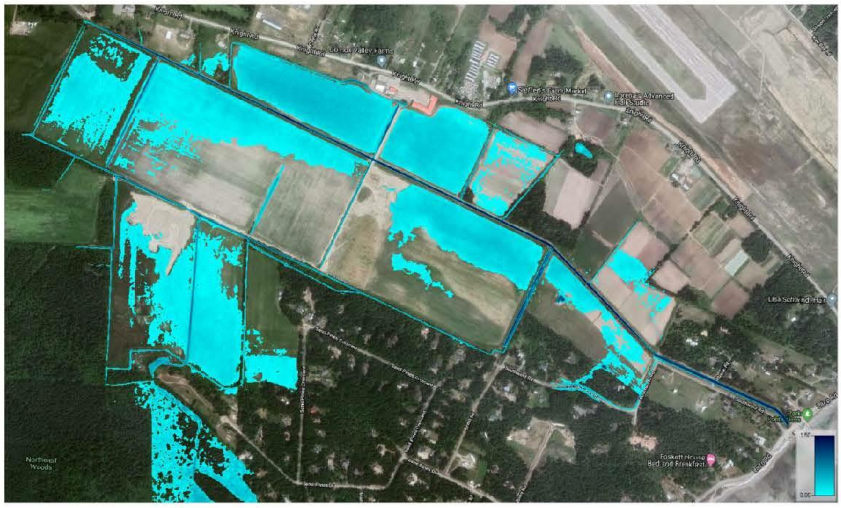


Figure 6 - Present Day Drainage System Conditions with Present Day 1:10 Year Rainfall and High Tide

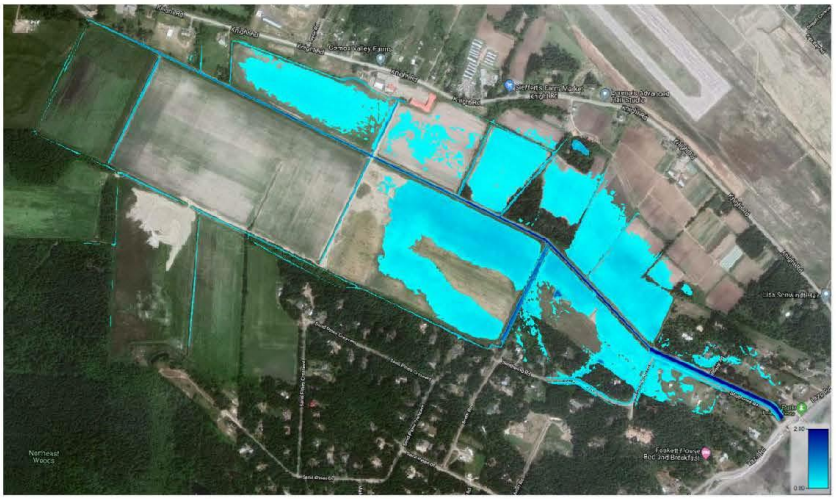


Figure 7 - Present Day Drainage System Geometry with Sea Level Rise and No Rainfall

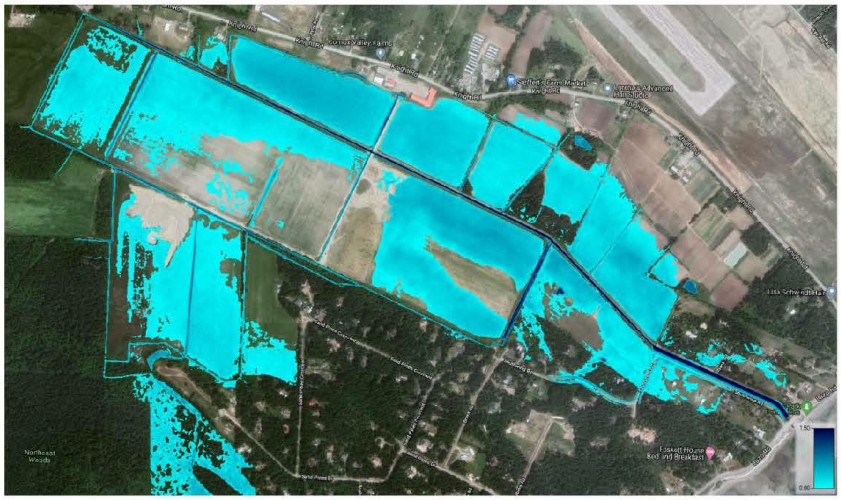


Figure 8 - Present Day Drainage System Geometry with Sea Level Rise and Climate Change Adjusted 1:10 Year Rainfall

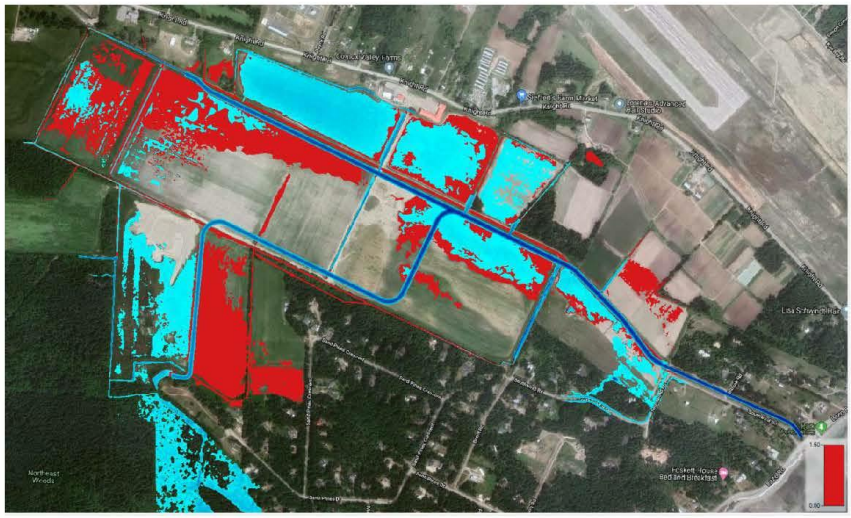


Figure 9 - Flood Extents Option 1, Present-Day

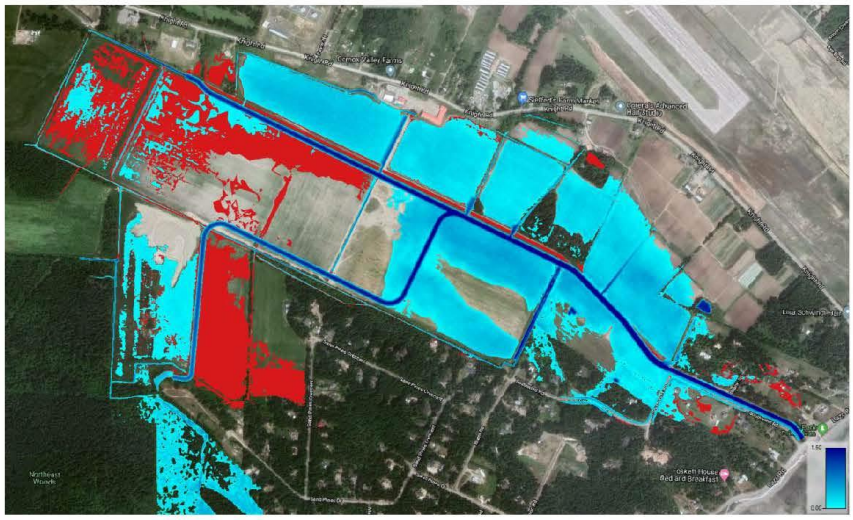


Figure 10 - Flood Extents Option 1, Long Term

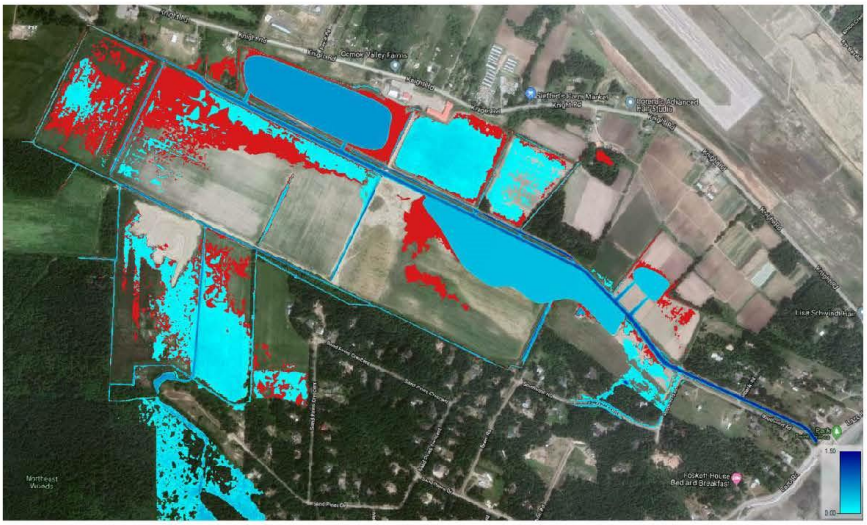


Figure 11 - Flood Extents Option 2, Present Day

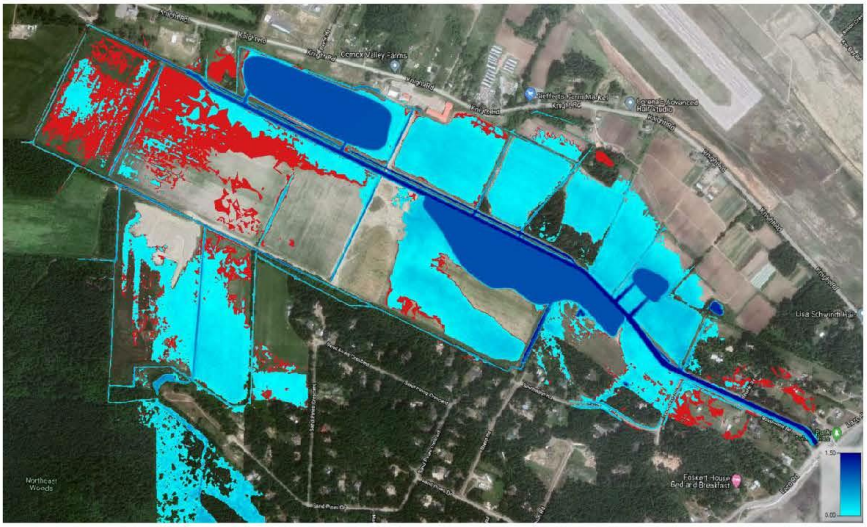


Figure 12 - Flood Extents Option 2, Long Term

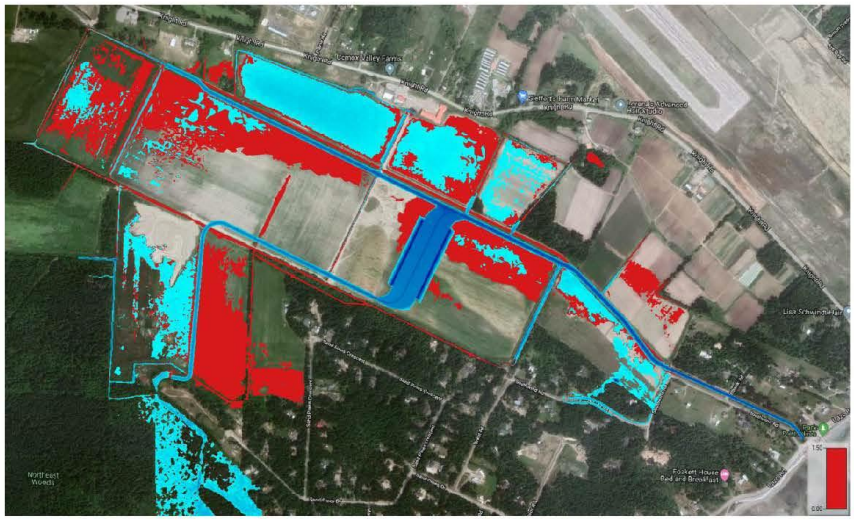


Figure 13 - Flood Extents Option 3, Present Day

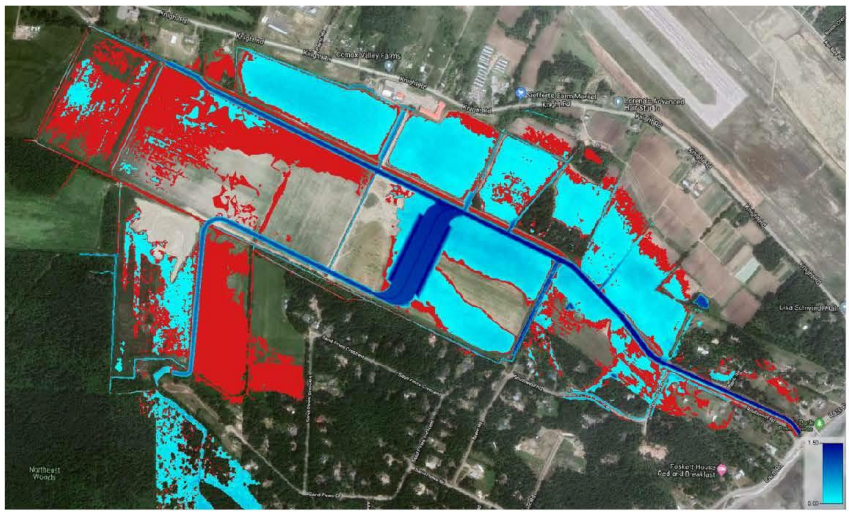


Figure 14 - Flood Extents Option 3, Long Term

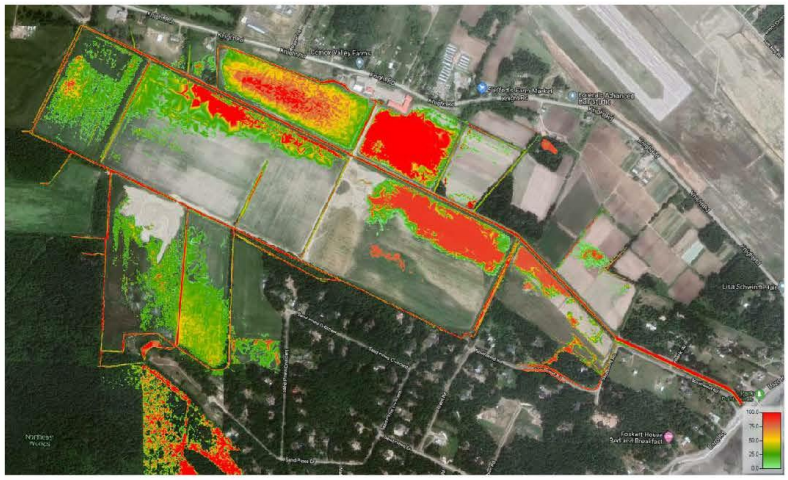


Figure 15 - Percent Time Inundated, Existing Drainage Conditions, Present Day Climate and Sea Level

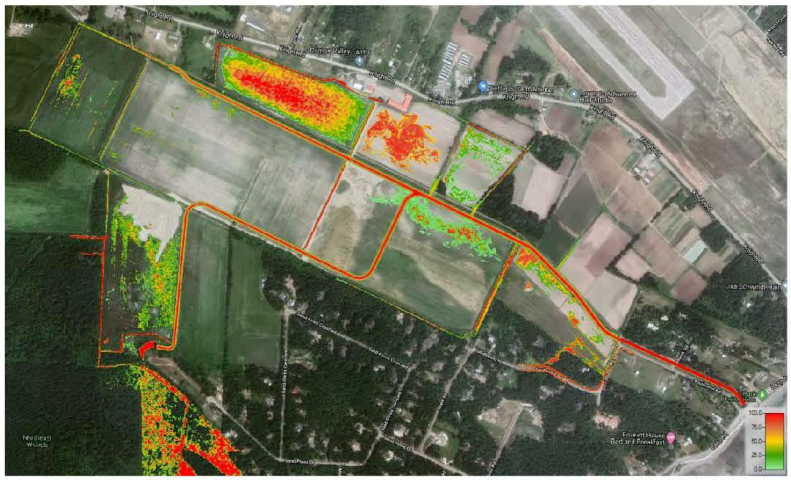


Figure 16 - Percent Time Inundated, Option 1, Present Day Climate and Sea Level

Figure 17 - Percent Time Inundated, Option 2, Present Day Climate and Sea Level

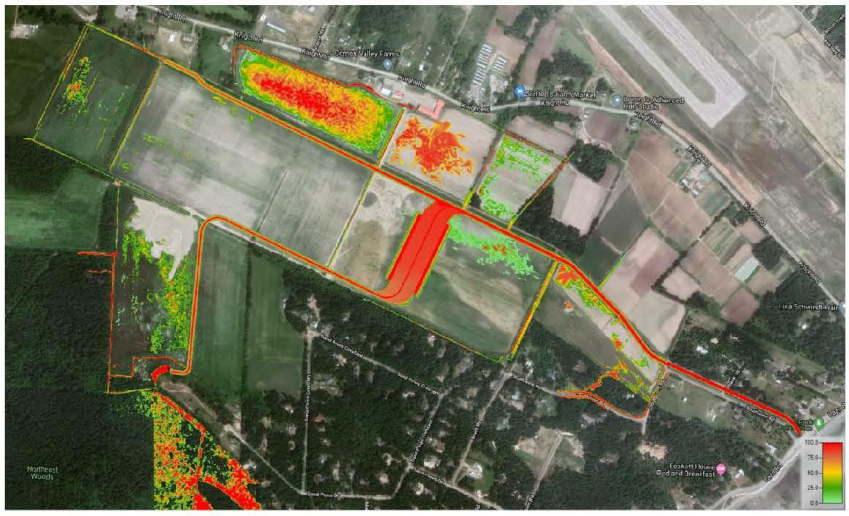


Figure 18 - Percent Time Inundated, Option 3, Present Day Climate and Sea Level

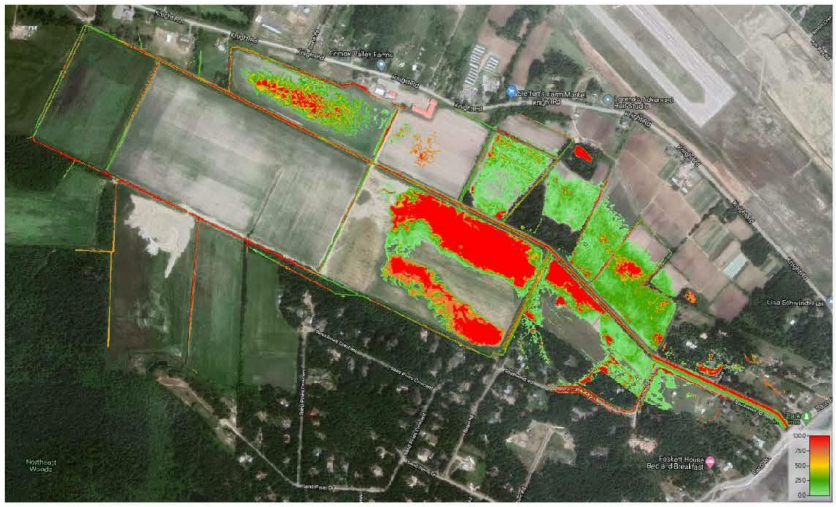


Figure 19 - Percent Time Inundated, Existing Drainage Conditions, with Sea Level Rise and No Precipitation

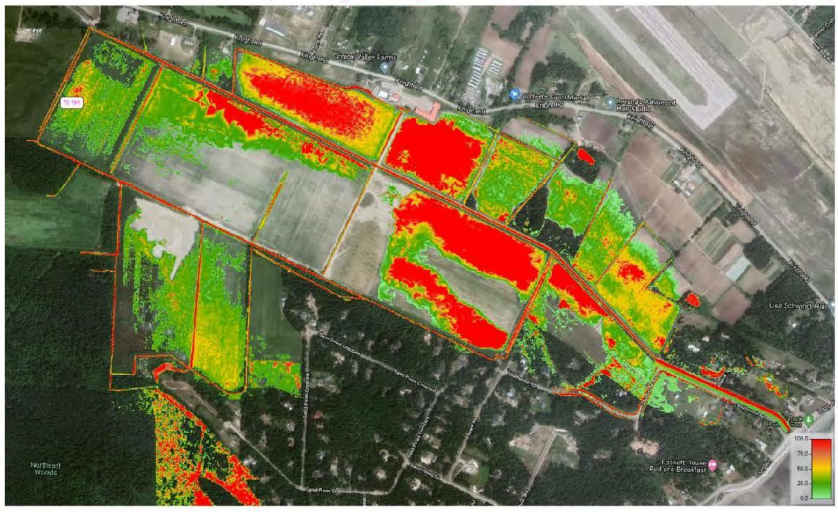


Figure 20 - Percent Time Inundated, Existing Drainage Conditions, with Sea Level Rise and a 1:10 Year Rainfall Event

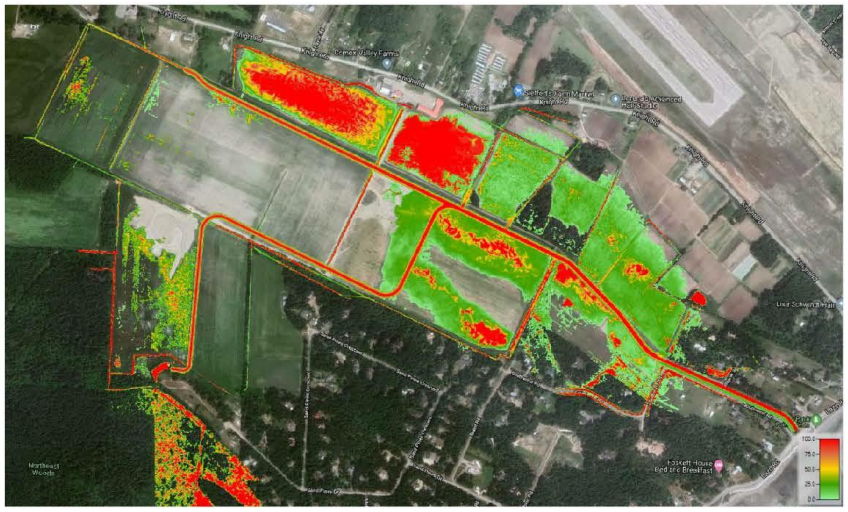


Figure 21 - Percent Time Inundated, Option 1, with Sea Level Rise and a 1:10 Year Rainfall Event

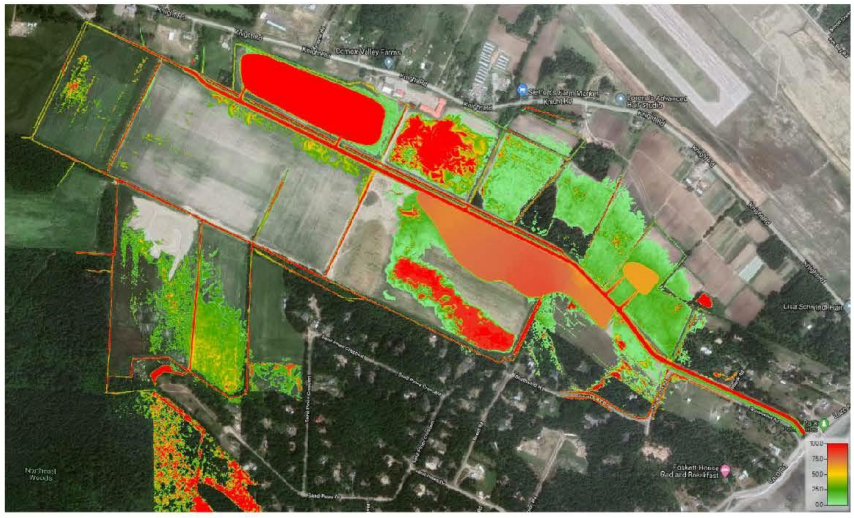


Figure 22 - Percent Time Inundated, Option 2, with Sea Level Rise and a 1:10 Year Rainfall Event

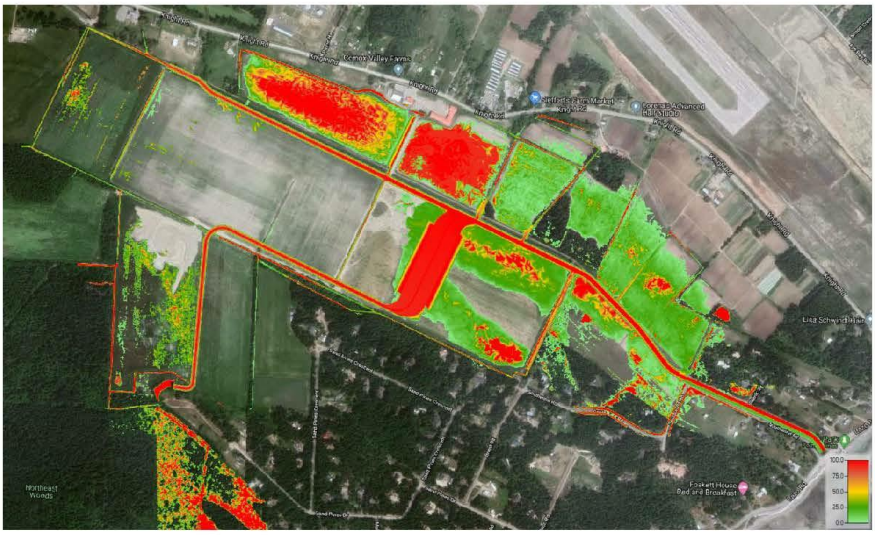


Figure 23 - Percent Time Inundated, Option 3, with Sea Level Rise and a 1:10 Year Rainfall Event

For comparison purposes, the % reduction of flooded area for each option during the peak of the flood event was calculated. The maximum flooded area is only one measure of the effectiveness of a design option. Other metrics such as depth & duration of flooding should be considered before choosing the preferred design option. This information was not available at the time of writing.

Table 1

Terrain	Time Period	Max. Area Flooded (hectares)	% of Area Covered (Existing is 100)
Existing	Present	64	*100%*
Option 1	Present	34	53%
Option 2	Present	50	78%
Option 3	Present	41	65%
		0	
Existing	2100	96	*100%*
Option 1	2100	77	80%
Option 2	2100	79	82%
Option 3	2100	75	78%

4.4. Discussion of Model Results

- During the peak of the modelled 1:10 year rainfall event, the high-tide and peak rainfall are such that the water level in the fields and the Ditch is essentially the same for 8 to 12 hours. However, once the rainfall ceases, the Ditch quickly drains within a matter of a few hours and has capacity to drain water from the field, if grade allows. After the peak of the rainfall, it appears the geometry of the fields does not allow water to drain as quickly as the Queen's Ditch could convey it. Removing obstacles to surface drainage (such as berms alongside ditches) and maintaining ditches (re-grading if necessary, cleaning/grubbing out) will help drain the fields faster after the rainfall passes. Having a clear, continuous surface flow path to the Queen's Ditch will allow fields to dry more quickly after a rainfall.
- Long term future tide level (including sea level rise) inundates a significant amount of land, regardless of rainfall. Preventing this inundation is not possible, unless the entire lowland area is raised or very significant infrastructure is constructed (berms, tide gates & pump stations).
- Under the current-day, large-tide condition, the high-tide level itself does not inundate the fields, but it does significantly reduce the capacity of the Queen's Ditch due to backwater effects. Therefore, a relatively small rainfall event combined with a large-tide event can cause considerable inundation of fields.
- For both the above tidal cases, preventing inundation is very difficult and expensive. It is most beneficial to ensure that all field areas can drain to the ditches as freely as possible once the water level in the Ditch is lower. Partial blockages to flow off the fields (such as berms with "gaps" in them) are counter-productive. The backwater or high water levels in the Ditch will enter through the gaps and inundate similar areas regardless of the existence of a berm, but that same berm will slow or constrain the ability of the water to drain back off the field.
- The Hydraulic Grade Line in the Queen's Ditch during a high-tide event, even with significant rainfall/inflows, is very close to flat. This means that widening the Queen's Ditch beyond the modelled (improved) section will have negligible benefit in reducing the inundation areas during a high-tide. However, after the peak of the rainfall event, the Hydraulic Grade Line is steeper as the tide recedes and the fields drain. Therefore, there is some benefit to widening the Queen's Ditch to help the area drain faster during the lower tides. This is especially true for the furthest downstream portion of the Queen's Ditch (approximately 600m to 1,000m extending up from Lazo Road). Additionally:
    - Option 1 – provides significant improvements for the fields located closest to Lazo Marsh (West of Sand Pines Crescent), as well as significant improvements to the fields near the furthest upstream end of the Queen's Ditch.
    - Option 2 – Conveyance capacity towards Lazo Marsh was not improved as it was under Option 1, so there is minimal change to flood extents in that direction. Similar benefit to the fields at the upstream end of the Queen's Ditch as Option 1. Only minor benefits to the rest of the areas.
    - Option 3 – As in Option 1, the increased conveyance capacity from Lazo Marsh benefits the fields located closest to Lazo Marsh (West of Sand Pines Crescent). As in all options, there are significant improvements to the fields near the furthest upstream end of the Queen's Ditch. Option 3 provides the greatest benefit to the section of farmland located South of the Queen's Ditch, at the end of Brent Road.

- For the maximum extents of inundated areas during the Year 2100 scenario, the options compare to the existing scenario as follows:
    - Options 1 & 2 – provide the same benefits noted above under the Present Day scenario;
    - Option 3 – In addition to the options noted above for the Present Day scenario, Option 3 provides a moderate benefit to most areas along the Queen's Ditch. For essentially all areas that experience inundation for the Year 2100 scenario under the Existing, Option 1 & Option 2 configurations, Option 3 reduces the extents of total inundated area.
- The Percent Time Inundated Maps indicate how long a specific location was inundated for. In general, the benefits from each option are the same as noted above. However, for the Year 2100 scenario the inundation extents for the various options are similar to those for the existing condition, and the percent time inundated is somewhat improved. Generally, this applies to areas that are inundated due to the extremely large tide event (including sea level rise). This would indicate that the proposed improvement options would not prevent these areas from being inundated, but would help them drain faster after the peak of a large tidal event.

4.5. Preliminary Screening of Options by Agrologist and Biologist

The following comments have been provided by Thomas R Elliot, PhD, PGeo, of Madrone Environmental Services. These comments are based on a brief review of Options 1 through 3, as noted herein, and are provided without the benefit of a site investigation, or discussions with land owners, the Agricultural Land Commission, or the Ministry of Agriculture.

General Procedure for Approval of Non Farm Use

- *ALC non-farm use applications is required for each parcel.*
    - *Data needs: Soil test pits to ALC Policy P-10 to inform the application; modelling data for groundwater and 5 & 25 year flood levels (if applicable).*
- *Procedure:*
    - *Field work for affected parcels.*
    - *Land Capability Report (includes statement on improvement to drainage conditions for remainder of lands based on McElhanney modelling and local context).*
    - *Potential application to Municipality for zoning change (depending on bylaw land-use requirements surrounding agricultural zoned land and regional storm water management facilities).*
    - *Application for 'non-farm use' of ALR land, unless there is sufficient evidence from the initial report to demonstrate a local net-benefit to agriculture – in which case, the installation can be framed as 'agricultural improvement' – although ALC approval would be needed for this.*
    - *If it is not deemed a 'farm use', then Section 11 is required, otherwise the Farm Practices Protection Act is in effect. That said, even when FPPA is in effect, the ideal is to have FLNRORD support.*
    - *Planning surrounding prevention of waste discharge (nutrients, sediment, etc.) from Ag lands to the Fish stream.*

Option 1

- *10 affected parcels.*
- *Bisecting organization (unfavourable to agriculture).*
- *'sharp' interface between ag lands and drainage feature clearly delineates and makes awareness easier for Ag operators.*

Option 2

- *11 affected parcels.*
- *More amoebic in shape, creating the easiest fields for agricultural operators to work.*
- *'Soft' interface in the form of floodplain/seasonal water volume storage area (if I am interpreting the drawings correctly) may provide opportunity to put forage or hay-crops on the floodplain during growing-season, resulting in lowest 'loss' of agricultural lands.*

Option 3

- *10 affected parcels.*
- *Bisecting Organization (unfavourable to agriculture).*
- *'Soft' interface in the form of floodplain area may provide opportunity to put forage or hay-crops on the land during mid-season, resulting in lower 'loss' of agricultural lands.*

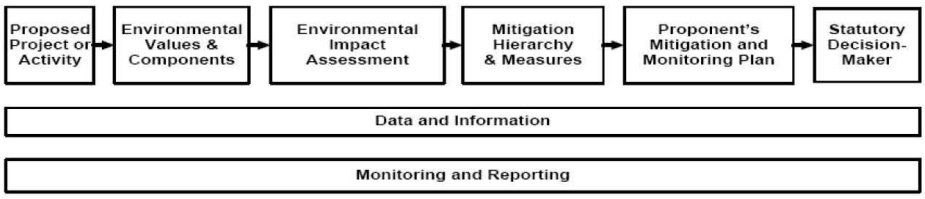
The following comments have been provided by Rupert Wong, B.Sc., R.P. Bio, of Current Environmental. These comments are based on a brief review of Options 1 through 3, as noted herein.

Back when the agricultural area was owned by a potato farmer the drainages would be seasonally blocked and fields flooded as part of the operation. DFO had issues with this practice and posed restrictions to avoid field flooding during fry emergence in Apr/May, smolt outmigration between Apr - Jun and adult migration in Oct/Nov.

Having reviewed your prelim options it appears that the majority of the proposed channelizing and widening would occur in the migratory reach of Queen's Ditch and potential impacts to rearing and spawning habitat could be avoided with mitigation measures in place. Known coho and cutthroat spawning occurs in Sieffert's trib, Golf Course trib and 2 locations in the mainstem. The upper limits of proposed widening and channelization may encroach into 1 or more of the known spawning habitats. Any encroachment can be offset with installation of a suitable volume of Coho spawning substrate in the same location and possibly some kind of control weir to maintain the gravel depth. Juvenile Coho rear in the system for 1 year. During the summer the lower mainstem where most of the work is proposed tends to become inhospitable for salmonids with stagnant hydrology, elevated water temperatures and low dissolved oxygen. Juveniles will spend the summer near Knight Rd, in Hilton Springs, Golf Course Trib and Sieffert's trib. Any disturbance to mainstem channel banks will require reinstating with a suitable assemblage of riparian plants to provide shade, litter drop and bank stability. This is especially critical on the south bank. DND has been directed by DFO at least once to restore riparian habitat along Queen's Ditch.

We anticipate the permitting will be a Water Sustainability Act Section 11 Approval that can take about 3-4 months as well as a DFO Request for Review (1+ month). As per the flow chart below the permit applications will need to be furnished with a deliverable such as an Environmental Impact Assessment that describes how the

mitigation hierarchy (i.e. avoid, minimize, restore on-site, offset). Regulators may require post construction monitoring for 1 - 3 years to ensure the offsets and mitigation measures are performing as planned.



4.6. Relative Costing of Options

Provided below are Class D cost estimates for Options 1, 2 and 3. The costs provided are conceptual, and suitable only for establishing the relative ranking of costs between options. Costs include estimated common excavation required, and do not include crossings, upgraded culverts or other work that may be required as part of the upgrades. Further refinement of costs for the preferred option could be provided in the next phase of this Study.

Option 1

Estimated Cost =	$12.1m
Contingency (30%) =	$3.6m
Engineering (10%) =	$1.2m
Total =	**$16.9m**

Option 2

Estimated Cost =	$8.8m
Contingency (30%) =	$2.6m
Engineering (10%) =	$0.9m
Total =	**$12.3m**

Option 3

Estimated Cost =	$11.8m
Contingency (30%) =	$3.6mm
Engineering (10%) =	$1.2m
Total =	**$16.6m**

5. CLOSURE

We trust the information provided herein is sufficient to allow the Comox Valley Regional District to proceed with approval of the Options Analysis. Please do not hesitate to contact the undersigned at your convenience, if you have any questions or wish to discuss further.

MCELHANNEY LTD.

PROFESSIONAL ENGINEER R. J. HUDSON # 34898 BRITISH COLUMBIA

Bob Hudson, P.Eng.
Branch Manager

Reviewed by:

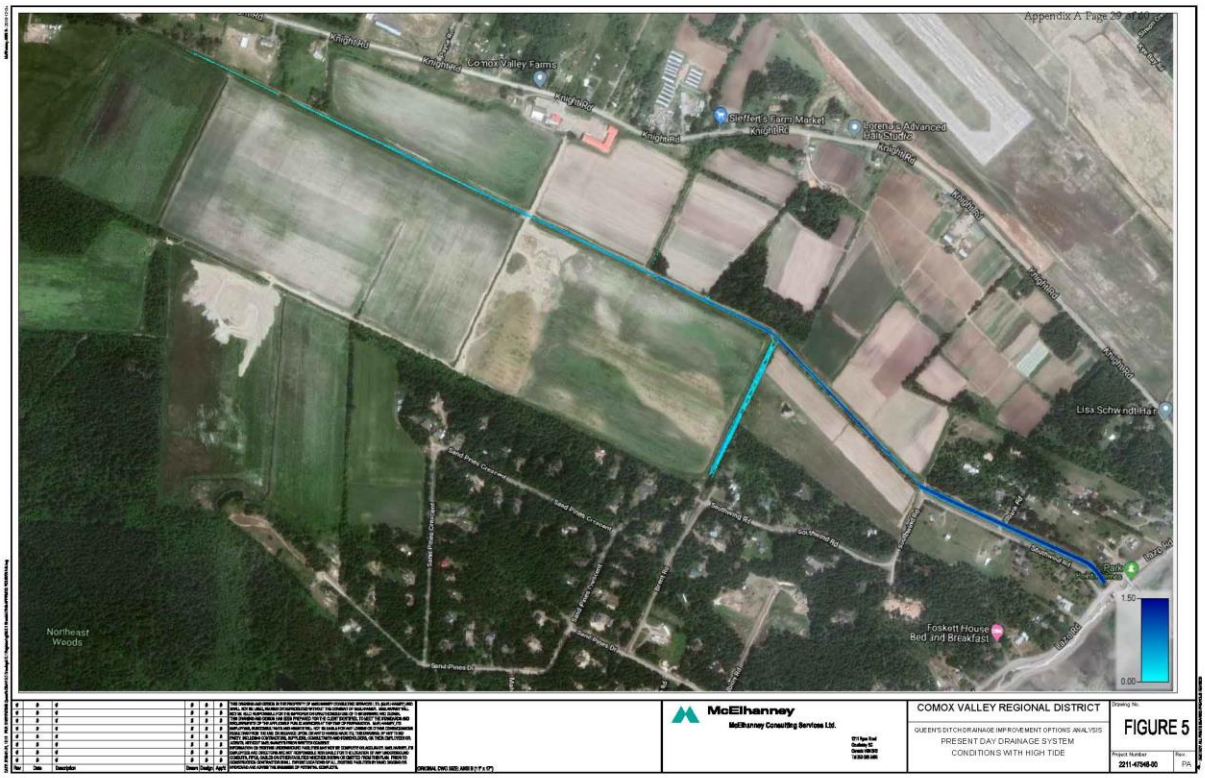
Eric Heel, P.Eng.

BH/njg

REVISION HISTORY

Date	Status	Revision	Author
February 2, 2019	Draft	Rev.0	BH
April 5, 2019	Draft	Rev. 1	BH
May 7, 2019	Final	Rev. 2	BH

APPENDIX A
GRAPHICS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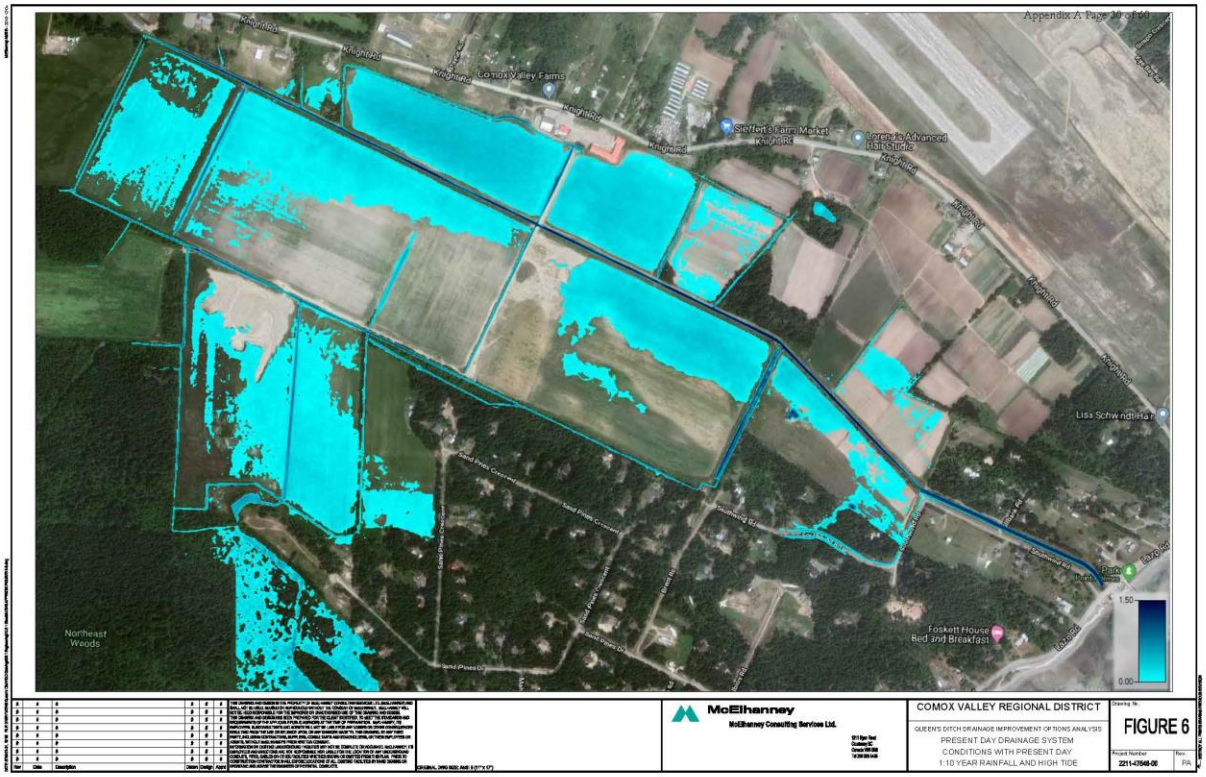
Knight Rd
Comox Valley Farms
Steffert's Farm Market
Lorena's Advanced Hair Studio
Lisa Schwindt Hair
Northeast Woods
Foskett House Bed and Breakfast
McElhanney
McElhanney Consulting Services Ltd.
COMOX VALLEY REGIONAL DISTRICT
QUEEN'S DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
PRESENT DAY DRAINAGE SYSTEM
CONDITIONS WITH HIGH TIDE
FIGURE 5
2211-47548-00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Knight Rd
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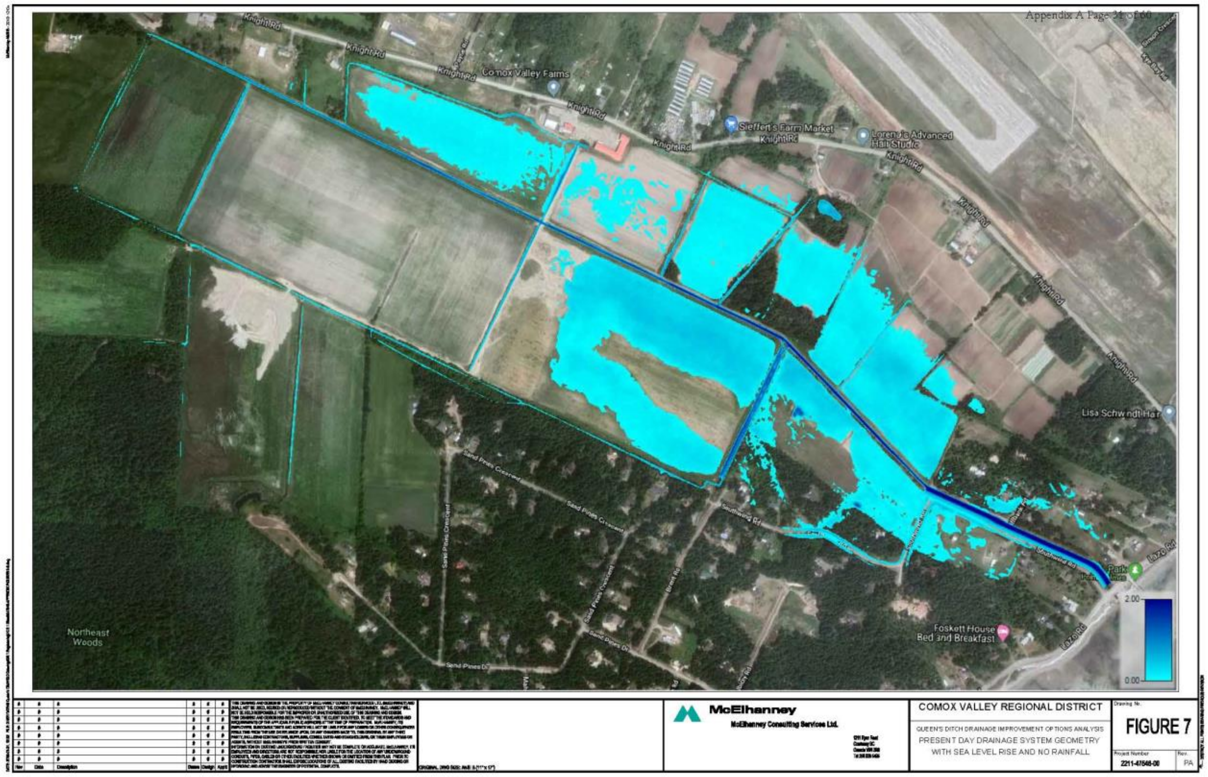
COMOX VALLEY REGIONAL DISTRICT
QUEEN'S DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
PRESENT DAY DRAINAGE SYSTEM
CONDITIONS WITH PRESENT DAY
1:10 YEAR RAINFALL AND HIGH TIDE
FIGURE 6
2211-47548-00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Knight Rd
Comox Valley Farms
Sieffert's Farm Market
Lorenz's Advanced Hair Studio
Lisa Schwindt Hair
Northeast Woods
Foskett House Bed and Breakfast
Lazo Rd
2.00
0.00
McElhanney
McElhanney Consulting Services Ltd.
COMOX VALLEY REGIONAL DISTRICT
QUEEN'S DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
PRESENT DAY DRAINAGE SYSTEM GEOMETRY
WITH SEA LEVEL RISE AND NO RAINFALL
Drawing No.
FIGURE 7
Project Number
2211-47546-00
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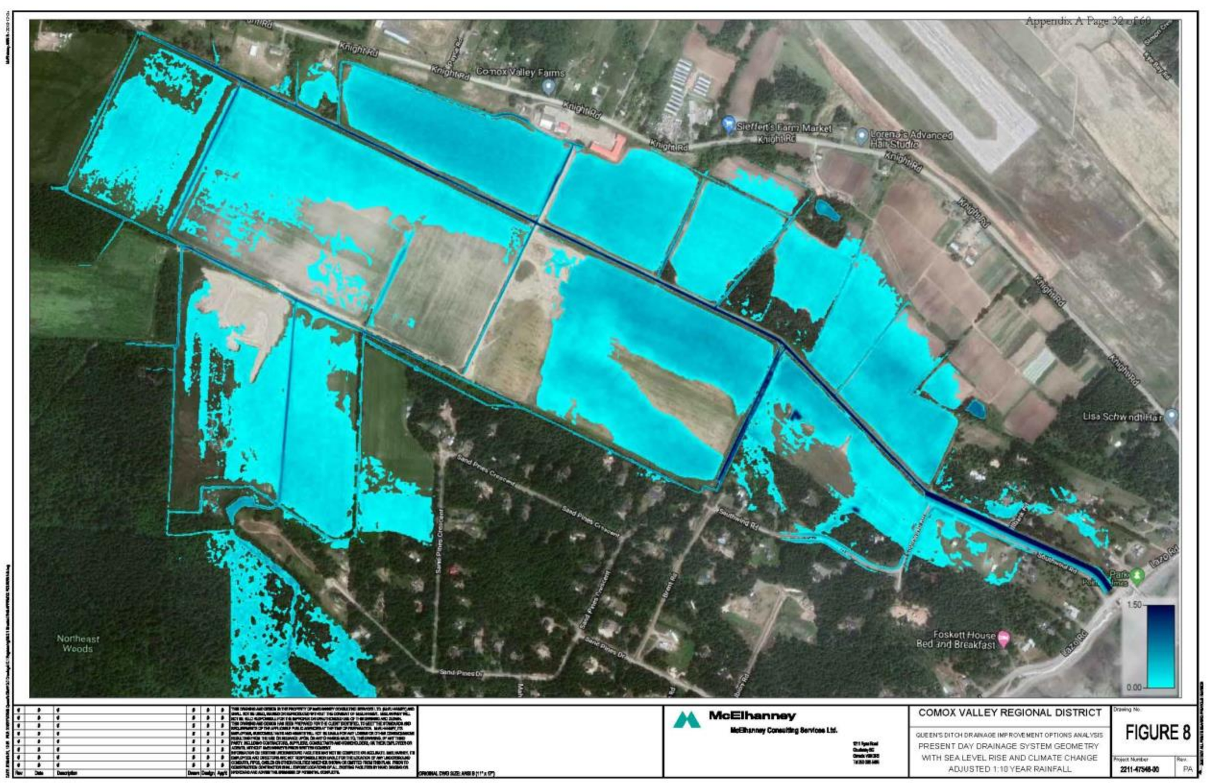
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Knight Rd
Comox Valley Farms
Sieffert's Farm Market
Lorenz's Advanced Hair Studio
Lisa Schwindt Hair
Northeast Woods
Foskett House Bed and Breakfast
Lazo Rd
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McElhanney
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COMOX VALLEY REGIONAL DISTRICT
QUEEN'S DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
PRESENT DAY DRAINAGE SYSTEM GEOMETRY
WITH SEA LEVEL RISE AND CLIMATE CHANGE
ADJUSTED 1:10 YEAR RAINFALL
Drawing No.
FIGURE 8
Project Number
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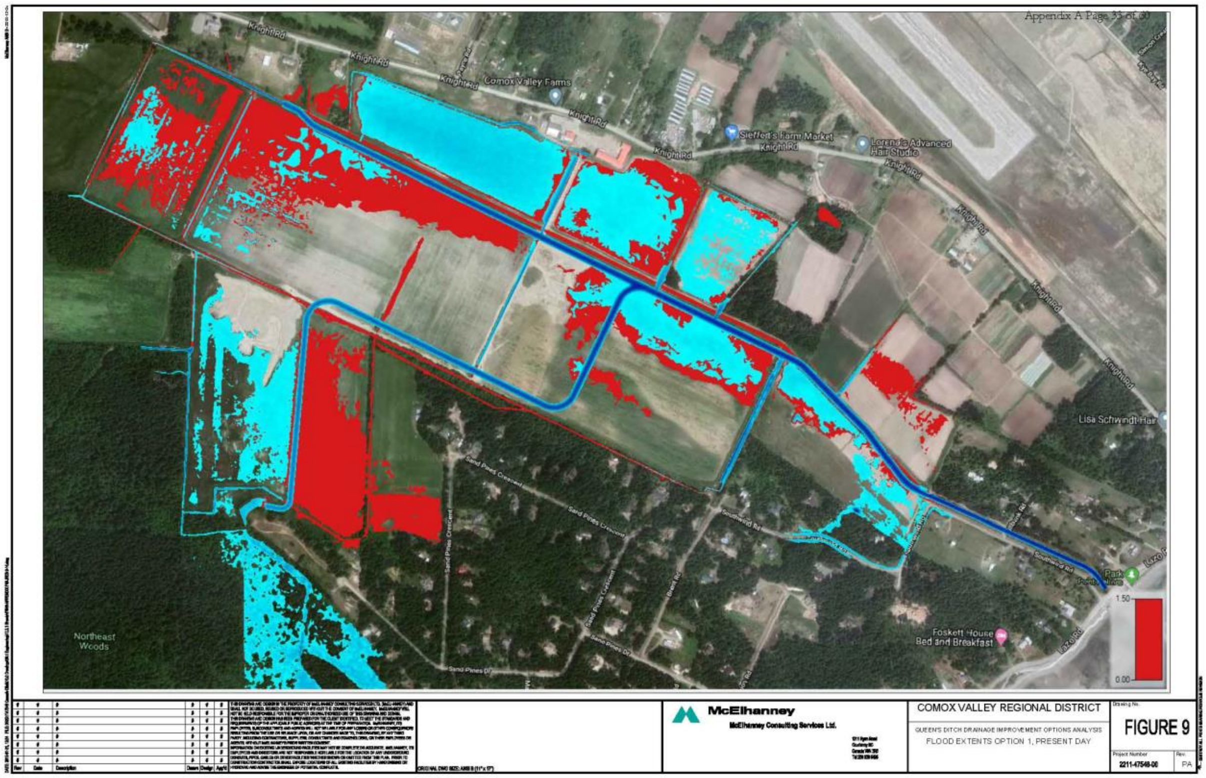
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Comox Valley Farms
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Lisa Schwindt Hair
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COMOX VALLEY REGIONAL DISTRICT
QUEEN'S DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
FLOOD EXTENTS OPTION 1, PRESENT DAY
FIGURE 9
2211-47546-00
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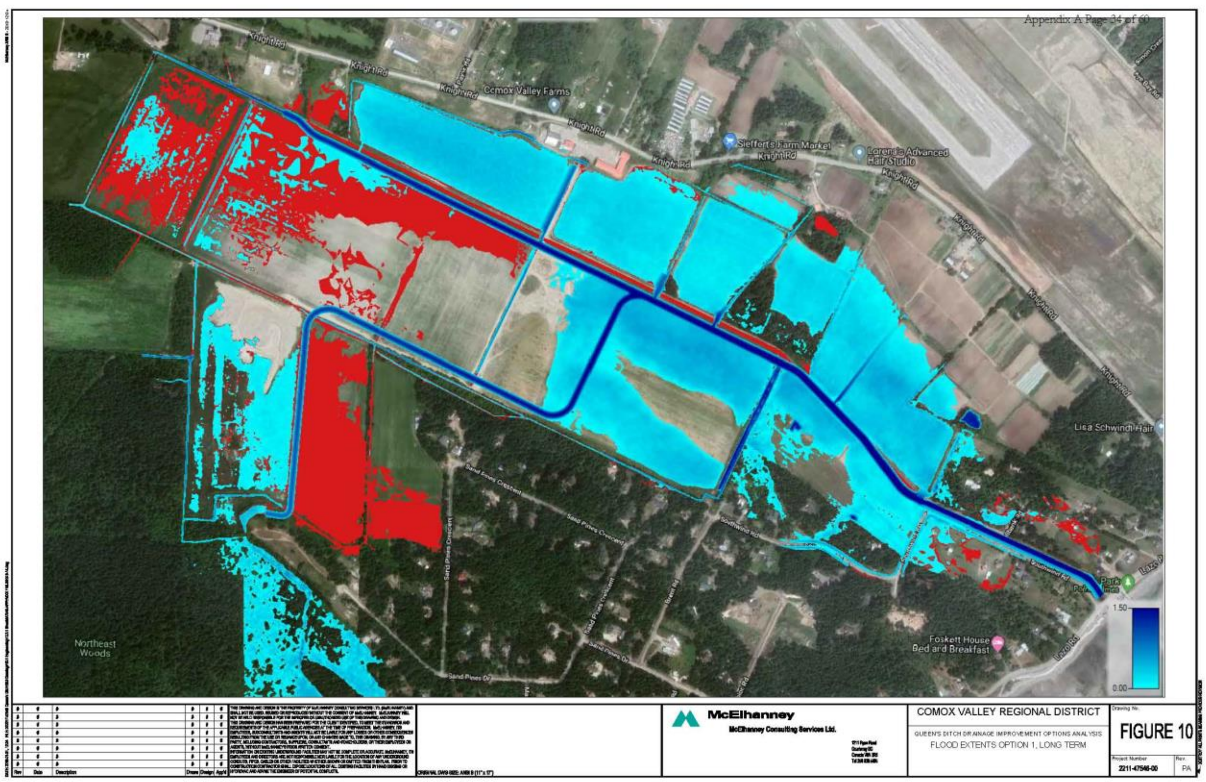
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QUEEN'S DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
FLOOD EXTENTS OPTION 1, LONG TERM
FIGURE 10
2211-47546-00
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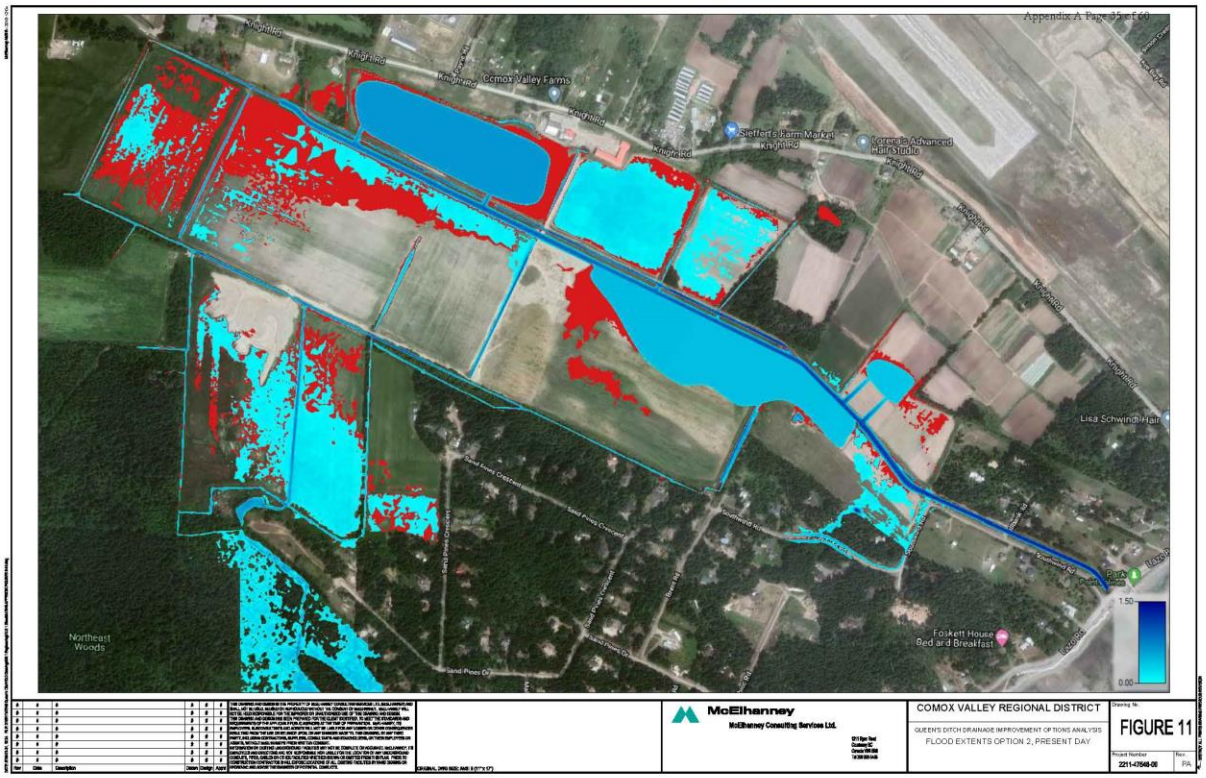
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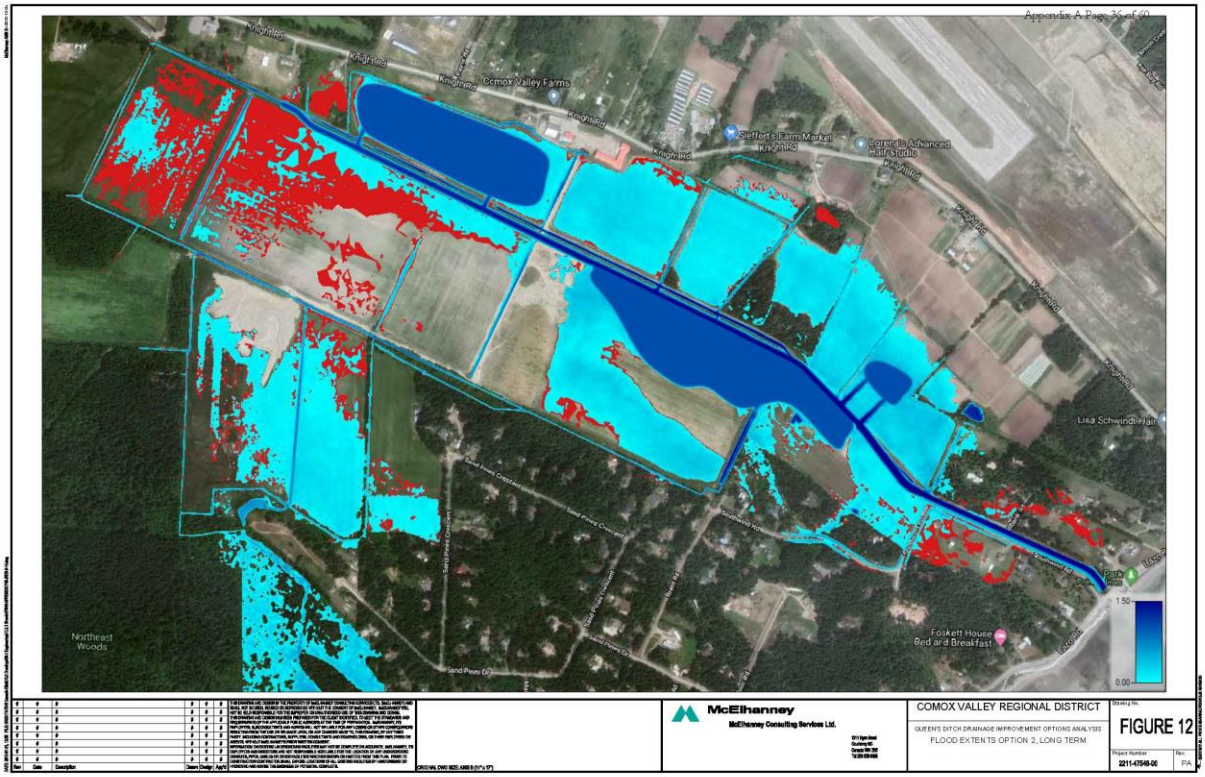
COMOX VALLEY REGIONAL DISTRICT
QUEENS DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
FLOOD EXTENTS OPTION 2, PRESENT DAY
FIGURE 11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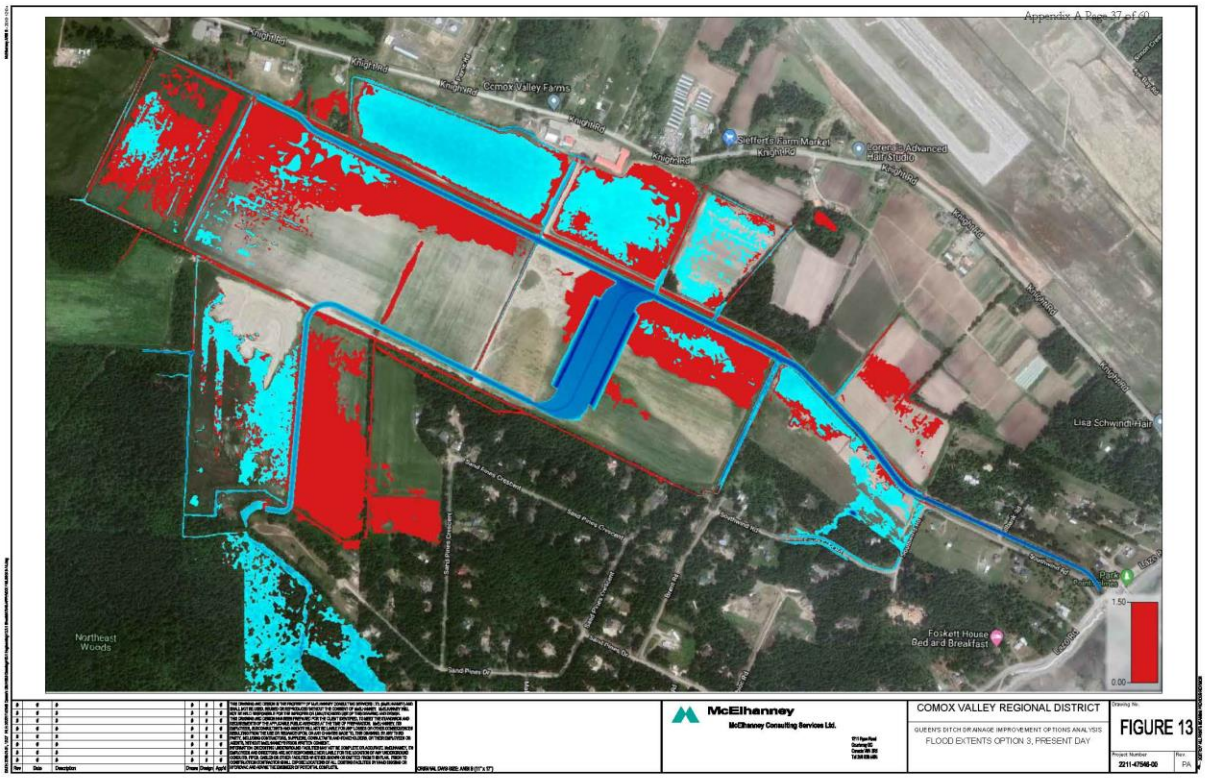
COMOX VALLEY REGIONAL DISTRICT
QUEENS DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
FLOOD EXTENTS OPTION 2, LONG TERM
FIGURE 12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Foxkett House Bed and Breakfast
Northeast Woods
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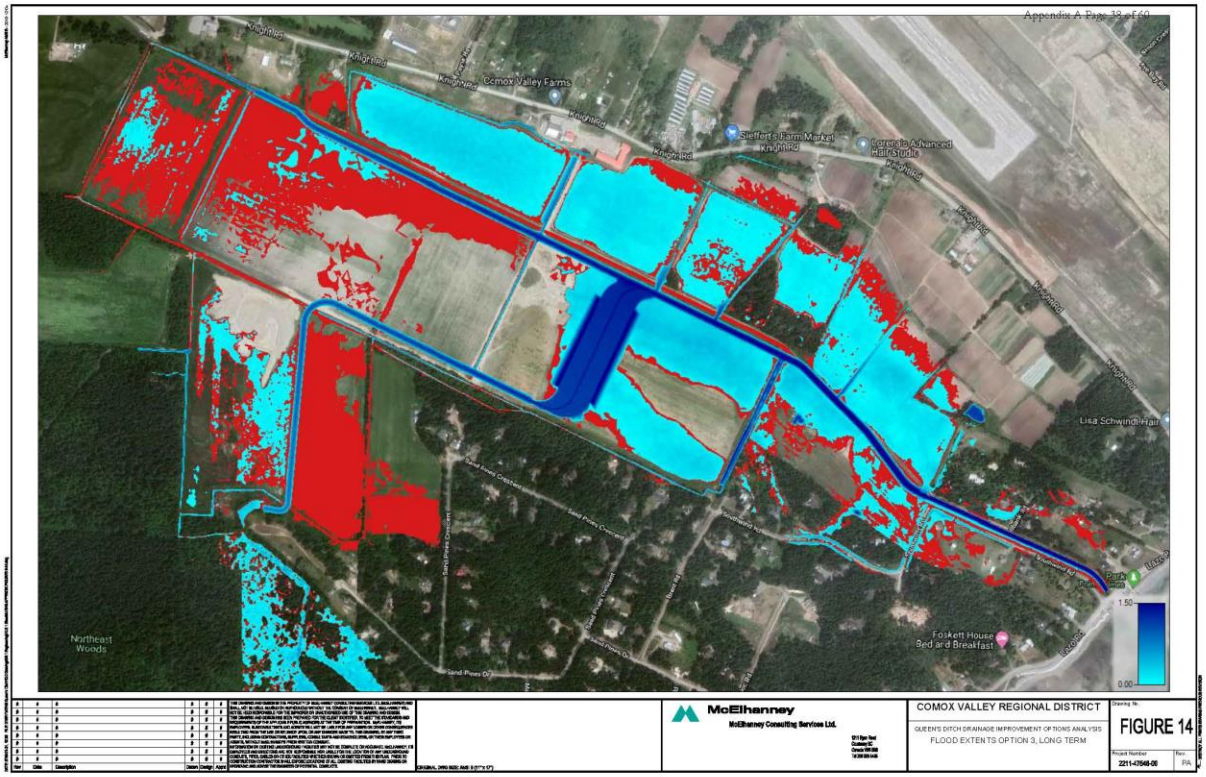
COMOX VALLEY REGIONAL DISTRICT
QUEEN'S DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
FLOOD EXTENTS OPTION 3, PRESENT DAY
FIGURE 13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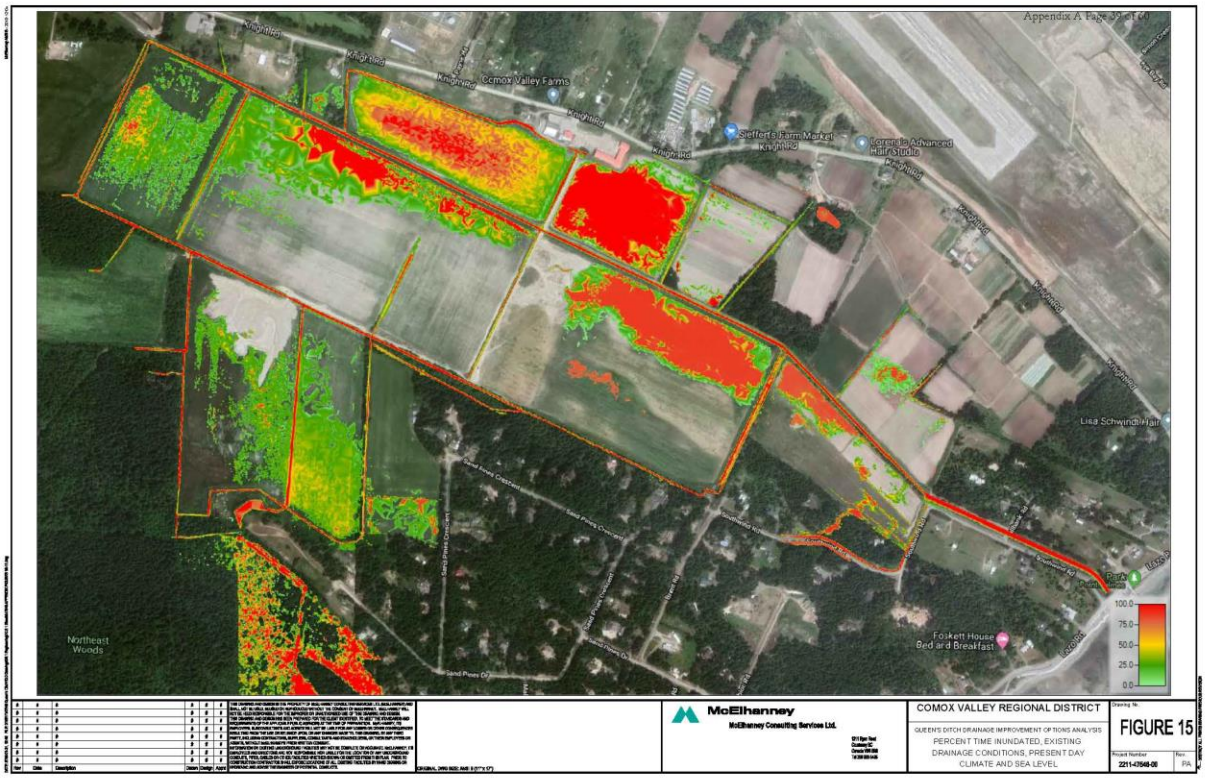
QUEEN'S DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
FLOOD EXTENTS OPTION 3, LONG TERM
FIGURE 14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Lorenzo's Advanced Hair Studio
Lisa Schwindt-Hair
Foskett House Bed and Breakfast
Northeast Woods
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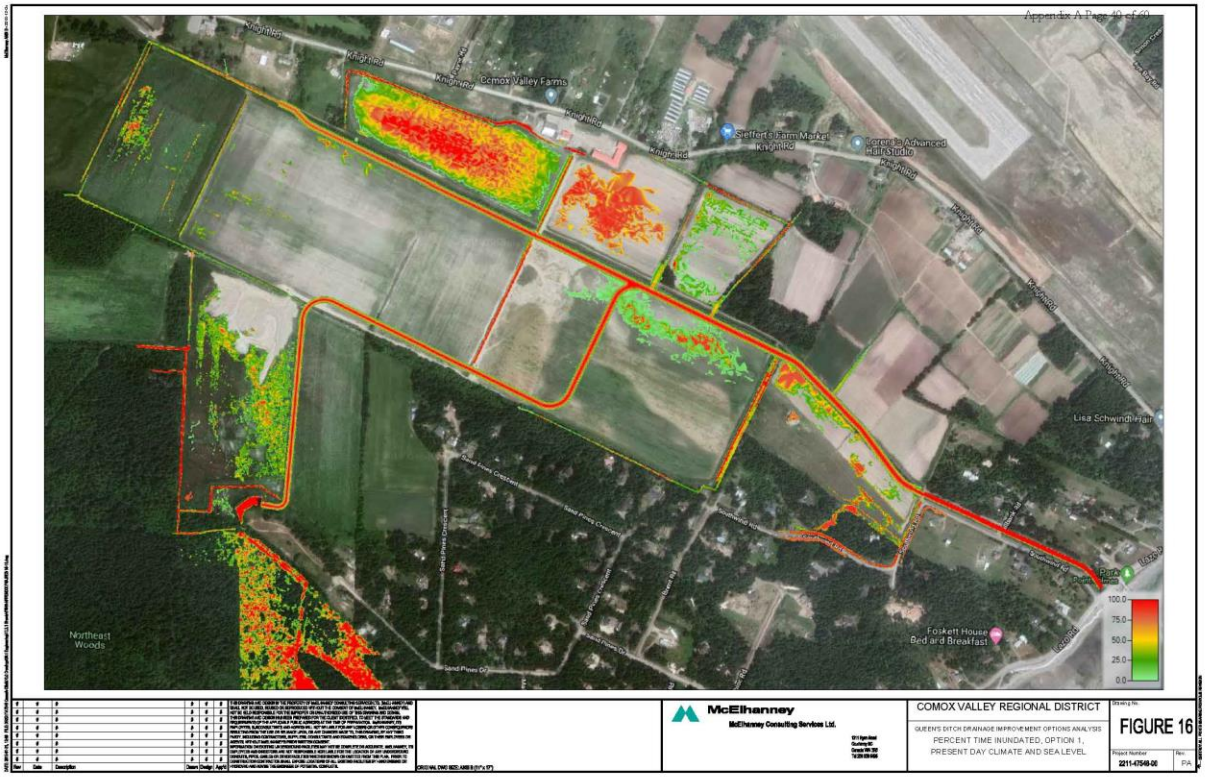
COMOX VALLEY REGIONAL DISTRICT
QUEENS DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
PERCENT TIME INUNDATED, EXISTING DRAINAGE CONDITIONS, PRESENT DAY CLIMATE AND SEA LEVEL
FIGURE 15
2211-47548-00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Lisa Schwindt-Hair
Foskett House Bed and Breakfast
Northeast Woods
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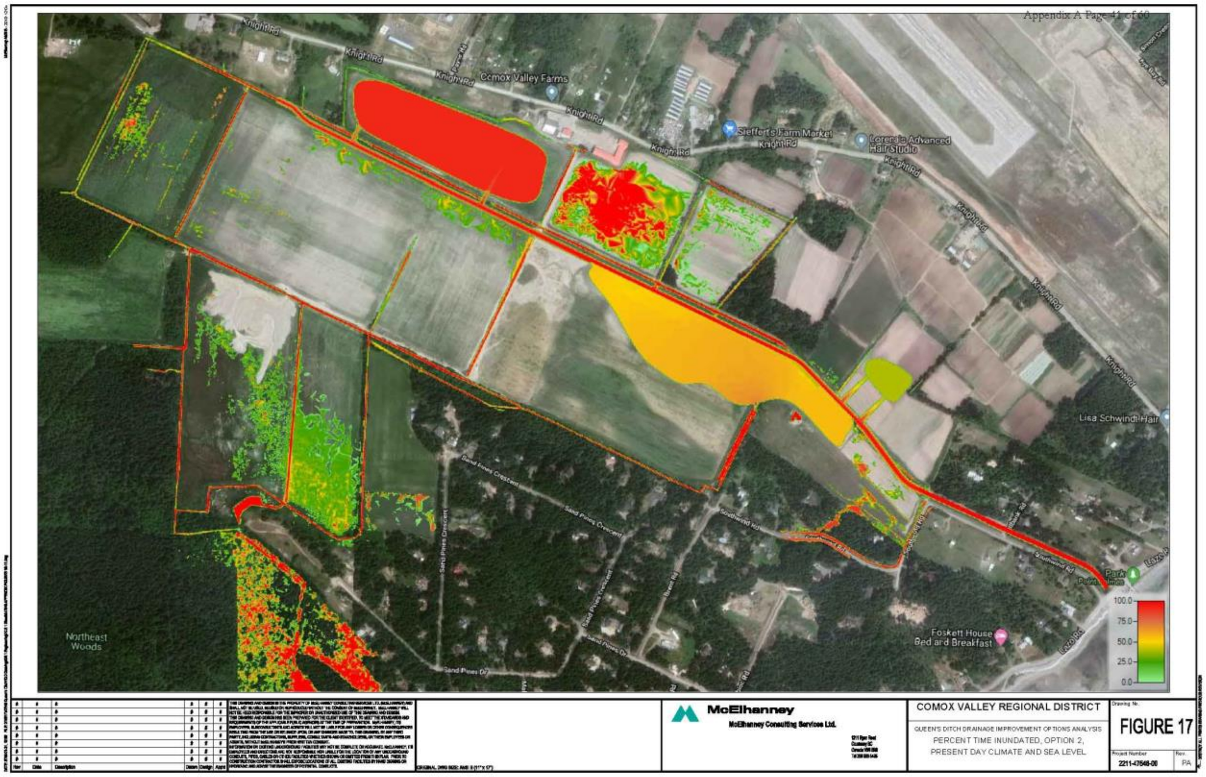
COMOX VALLEY REGIONAL DISTRICT
QUEENS DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
PERCENT TIME INUNDATED, OPTION 1, PRESENT DAY CLIMATE AND SEA LEVEL
FIGURE 16
2211-47548-00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Comox Valley Farms
Sieffert's Farm Market
Lorenzo Advanced Hair Studio
Lisa Schwindt Hair
Northeast Woods
Sand Pines Crescent
Sand Pines Dr
Foskett House Bed and Breakfast
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QUEEN'S DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
PERCENT TIME INUNDATED, OPTION 2,
PRESENT DAY CLIMATE AND SEA LEVEL
Drawing No.
FIGURE 17
Project Number
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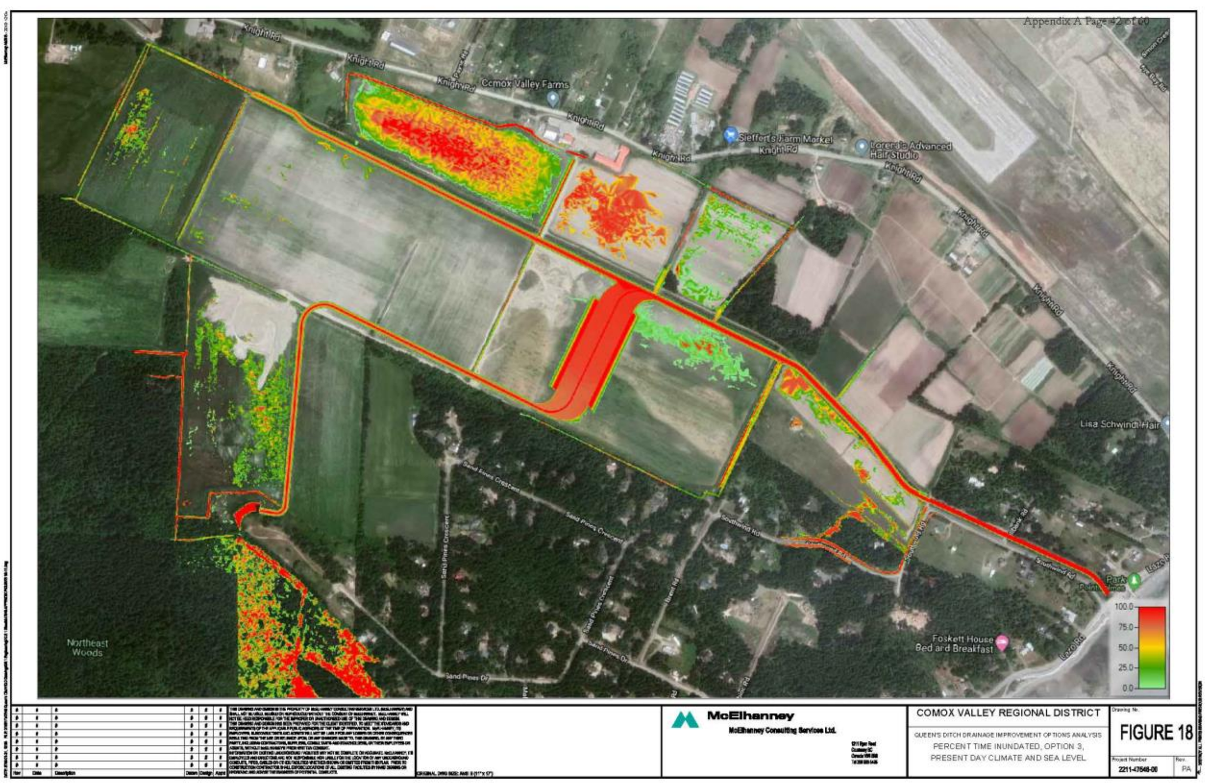
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Comox Valley Farms
Sieffert's Farm Market
Lorenzo Advanced Hair Studio
Lisa Schwindt Hair
Northeast Woods
Sand Pines Crescent
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Foskett House Bed and Breakfast
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QUEEN'S DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
PERCENT TIME INUNDATED, OPTION 3,
PRESENT DAY CLIMATE AND SEA LEVEL
Drawing No.
FIGURE 18
Project Number
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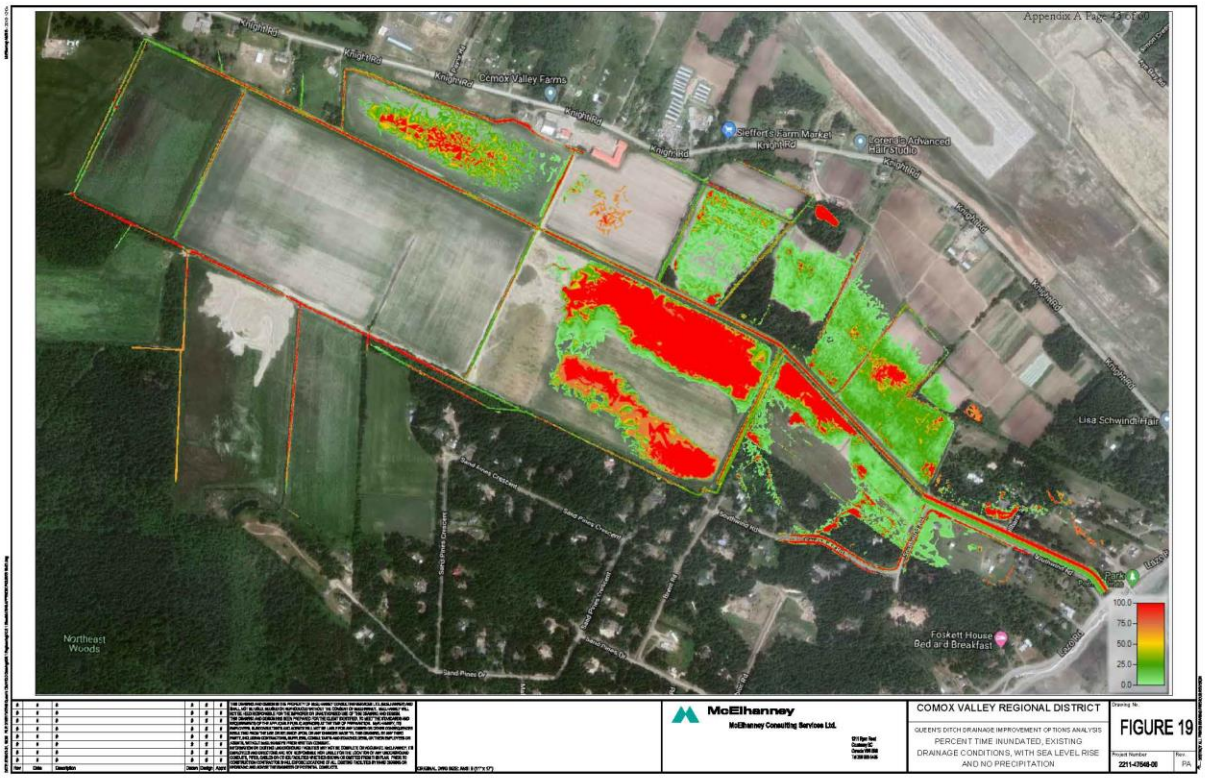
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Knighthill
Knight Rd
Comox Valley Farms
Sieffert's Farm Market
Knighthill
Sisters in Advanced Hair Studio
Lisa Schwindt Hair
Foskett House Bed and Breakfast
Northeast Woods
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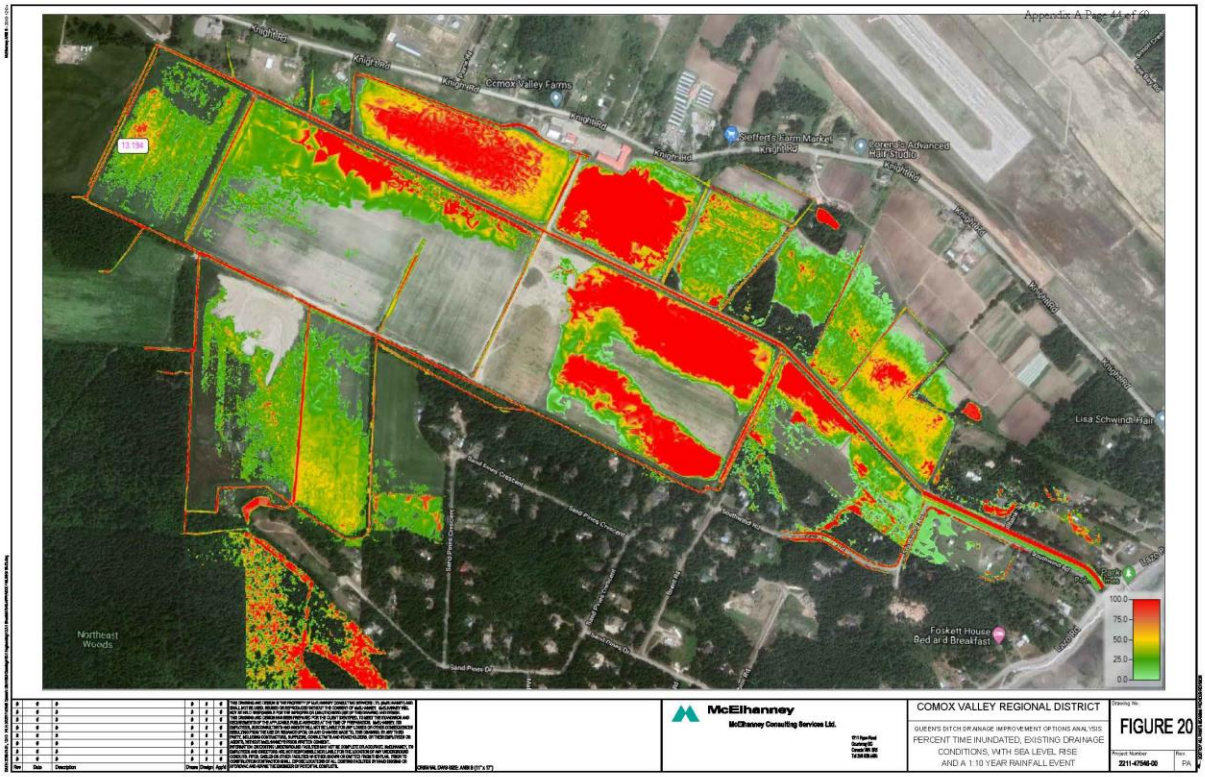
COMOX VALLEY REGIONAL DISTRICT
QUEENS DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
PERCENT TIME INUNDATED, EXISTING DRAINAGE CONDITIONS, WITH SEA LEVEL RISE AND NO PRECIPITATION
FIGURE 19
2211-47648-00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Knight Rd
Comox Valley Farms
Sieffert's Farm Market
Knighthill
Sisters in Advanced Hair Studio
Lisa Schwindt Hair
Foskett House Bed and Breakfast
Northeast Woods
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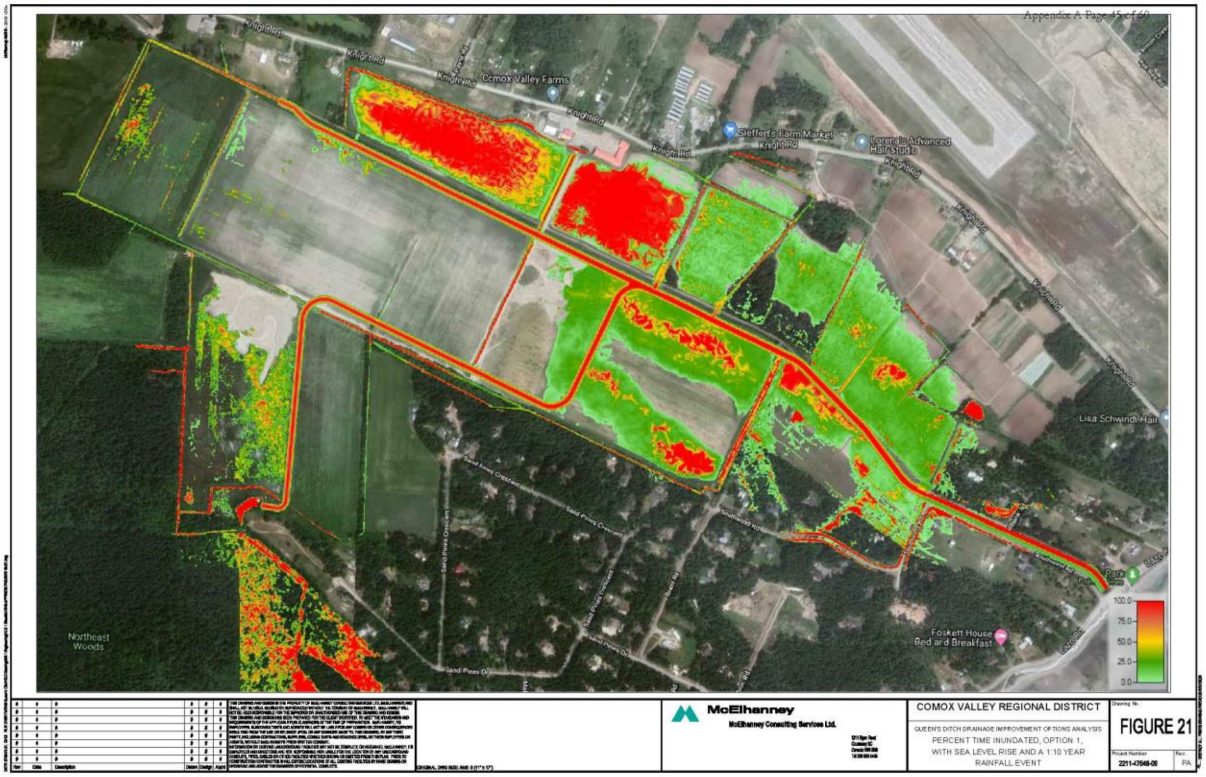
QUEENS DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
PERCENT TIME INUNDATED, EXISTING DRAINAGE CONDITIONS, WITH SEA LEVEL RISE AND A 1:10 YEAR RAINFALL EVENT
FIGURE 20
2211-47648-00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Knight Rd
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Sieffert's Farm Market
Lorena's Advanced Hair Studio
Lisa Schwindt Hair
Northeast Woods
Foskett House Bed and Breakfast
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QUEEN'S DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
PERCENT TIME INUNDATED, OPTION 1, WITH SEA LEVEL RISE AND A 1:10 YEAR RAINFALL EVENT
Drawing No.
FIGURE 21
Project Number
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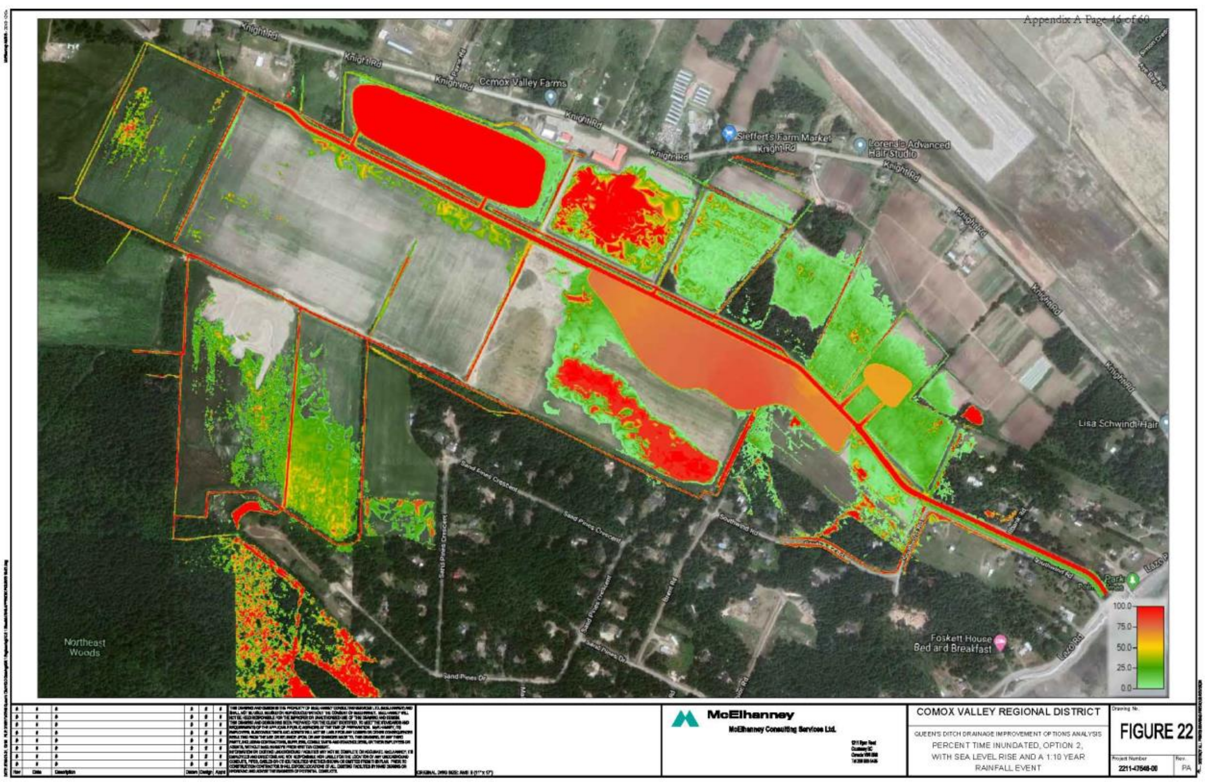
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Comox Valley Farms
Sieffert's Farm Market
Lorena's Advanced Hair Studio
Lisa Schwindt Hair
Northeast Woods
Foskett House Bed and Breakfast
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QUEEN'S DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
PERCENT TIME INUNDATED, OPTION 2, WITH SEA LEVEL RISE AND A 1:10 YEAR RAINFALL EVENT
Drawing No.
FIGURE 22
Project Number
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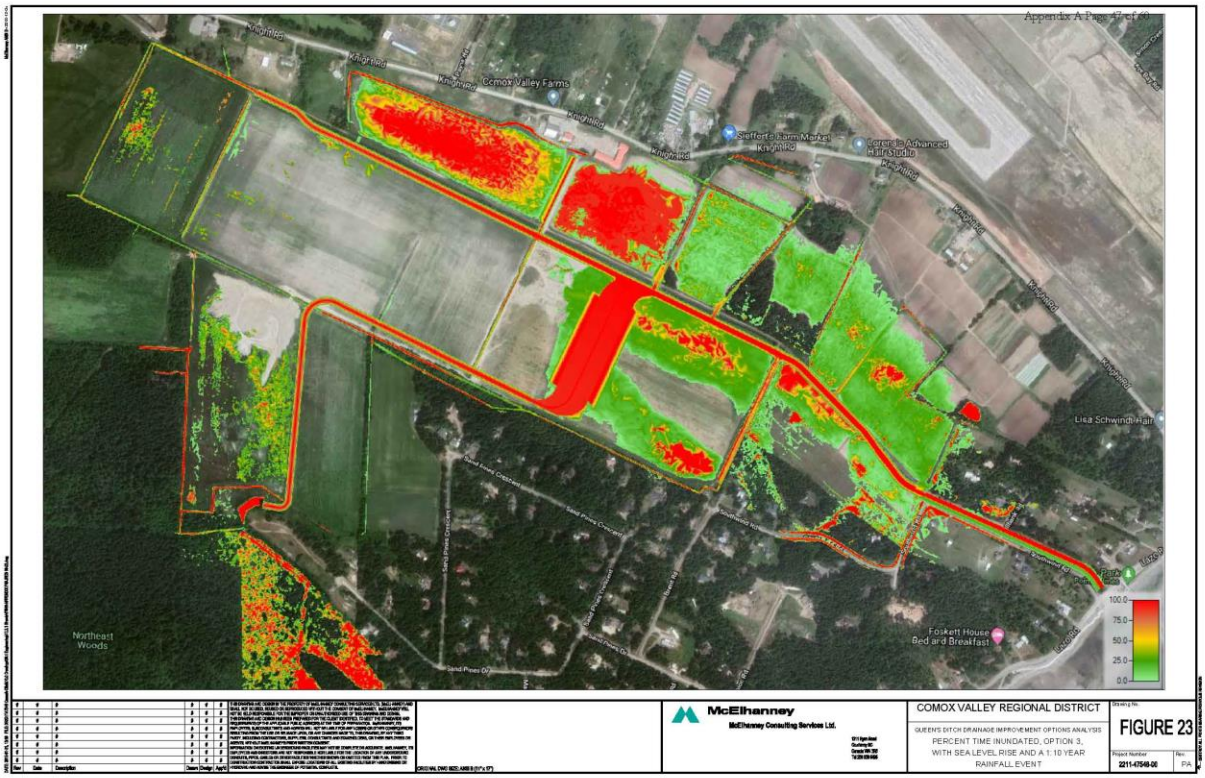
PA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Knightlee
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Lisa Schwindt Hair
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QUEENS DITCH DRAINAGE IMPROVEMENT OPTIONS ANALYSIS
PERCENT TIME INUNDATED, OPTION 3,
WITH SEA LEVEL RISE AND A 1:10 YEAR
RAINFALL EVENT
FIGURE 23
2211-47548-00

APPENDIX B
CONDITION ASSESSMENT OF THE EXISTING QUEEN'S DITCH OUTFALL

Structure Data

Structure Name: *Queen's Ditch Outfall Culvert and Retaining Wall*

Location: *Lazo Road, Point Holmes, approx. 53m southwest of Point Holmes boat launch, Comox BC*

Geographic Coords: *49°41' N, 125°52'W*

Structure Details:

25m long 3100mm x 1980mm Multi-Plate Steel Pipe Arch Culvert [date unknown]

Lock-Block Retaining Wall (Outfall to foreshore) [1998]

Field Inspection Information

Date of Inspection: *2018 Nov 09* Inspected by: *M. Sanderson, MCSL*

Weather: *Partly Cloudy, 7° C, Calm*

Additional Investigations Required (Summary)

Element	Priority
Culvert Barrel Structural Integrity / Road Load Limit	Urgent
Retaining Wall Integrity	Urgent
Culvert Inlet	Normal

Element Data (Details)

Element Group	*Culvert*	**Element Name**	*Inlet*

Condition Data	Excellent	Good	Fair	Poor
Cusping / crimping		*None observed*		
Global deformation			*<5% of dia*	
Corrosion (pitting)		*Above water*		*No pipe below water*
Corrosion (scale)		*Above water*		*No pipe below water*
Bolt tilting		*None observed*		
Cracks	*n/a*			

Comments
Heavy vegetation at inlet, observation of steel / earth interface difficult (photo 1 & photo 2)
First ±2m of culvert missing below waterline due to corrosion. (photo 3)
Above water, light surface corrosion at bolts (photo 3)
Culvert supported ±0.5 above inlet sump, bare earth channel, no rip rap present

Suspected Performance Deficiencies
Potential for piping, continued erosion, reduced bank stability

Recommended Work
Remove / trim inlet vegetation to allow for inspection
Inspect steel / earth interface for signs of piping after vegetation removed
Add rip rap to inlet along channel invert and armor road embankment per BC MoTI standards

Element Group	*Culvert*	**Element Name**	*Barrel*

Condition Data	Excellent	Good	Fair	Poor
Cusping / crimping		*None observed*		
Global deformation			*<5% of dia*	
Corrosion (pitting)		*Above water*		*Below water*
Corrosion (scale)		*Above water*		*Below water*
Bolt tilting		*None observed*		
Cracks		*None observed*		

Comments
Deformation along pipe crown (<5% diameter), location and length varied along barrel length.
Moderate to very severe corrosion at and below waterline along floor of culvert. Corrosion appears to be active and estimated to be greater than 50% cross-sectional loss (CSL) based on visual observation. (photo 4)
Above water, light surface corrosion and pitting observed at inlet end (photo 4) gradually increasing to moderate at outlet end (photo 5, photo 6).
No deformation or cracks observed on roadway asphalt above culvert. (photo 7, photo 8)

Recommended Work
Monitoring of road surface for potential settlement (sink holes, asphalt cracks)
Monitoring of culvert interior for sudden changes / indications of reduced or compromised structural integrity.
Recommended inspection intervals: maintenance contractor every 2 weeks, MCSL every 2 months

Element Group	*Culvert*	**Element Name**	*Outlet*
Condition Data	Excellent	Good	Fair	Poor
Cusping / crimping		*None observed*		
Global deformation			*<5% of dia*	
Corrosion (pitting)			*Above water*	*No pipe below water*
Corrosion (scale)			*Above water*	*No pipe below water*
Bolt tilting		*None observed*		
Cracks	*n/a*			

Comments
Outlet pipe deformed (end area reduced <10%) and severely corroded (multiple perforations and estimated CSL >50%) (photo 9)
Culvert supported ±1.0 above outlet sump (too deep to enter), gravel channel
No visible rip rap within outlet sump, sand & gravel <100mm diameter
Outlet channel obstructed by gravel / debris (photo 11)

Suspected Performance Deficiencies
Outlet channel susceptible to erosion and particle migration during high flows
Blocked channel forcing water to undermine retaining wall

Recommended Work
Remove deformed section of pipe
Add rip rap to inlet along channel invert and buttress retaining wall per BC MoTI standards
Restore channel centreline

Element Group	*Retaining Wall*	**Element Name**	*n/a*
Condition Data	Excellent	Good	Fair	Poor
Horizontal Alignment			*<5% deflection*	
Vertical Alignment			*<5% deflection*	

Comments
SE corner (River Right) shows signs of differential settlement. Several blocks out of alignment with normal course of wall. (photo 11, photo 12)
Observed majority of low flow water passing under SE corner of wall due to debris and highly mobile channel deflecting water. (photo 12)
No surface indications of sinkholes observed.

Suspected Performance Deficiencies
Blocked channel forcing water to undermine retaining wall, leading to further settlement / failure.

Recommended Work
Restore channel centreline
Add rip rap to inlet along channel invert and buttress retaining wall per BC MoTI standards

Photos

Photo 1 Inlet Overview

Photo 2 Inlet Closeup

Photo 3 Missing Pipe Floor [Inlet, Looking Downstream]

Photo 4 Varied Corrosion, Light to Very Severe at Water Line [Inlet, Looking Upstream, River Left]

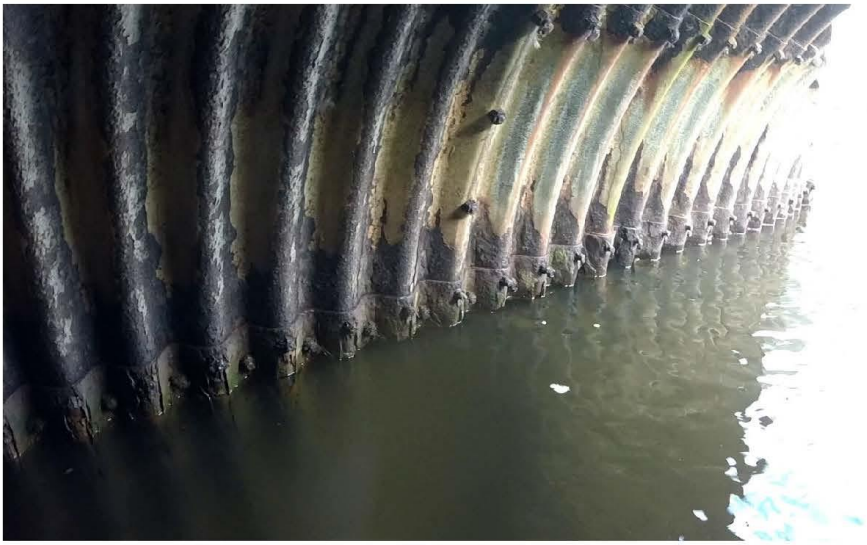

Photo 5 Moderate to Very Severe Corrosion [Outlet, Looking Downstream, River Left]

Photo 6 Moderate to Very Severe Corrosion [Outlet, Looking Upstream, River Right]

Photo 7 Road Surface [Looking NW]

Photo 8 Road Surface [Looking SE]

Photo 9 Outlet Overview [Looking Upstream]

Photo 10 Outlet Overview [Looking Downstream]

Photo 11 Outlet Channel & Debris Blocking Flow Path [Looking Upstream]

Photo 12 Outlet Retaining Wall [Looking NW]

Photo 13 Undermining Retaining Wall [River Right, Looking SE]

TECHNICAL MEMO

McElhanney | CANADA'S BEST MANAGED COMPANIES

To	From
Darry Monteith, Manager of Liquid Waste Planning Vince Van Tongeren, Policy and Sustainability Analyst	Matt Sanderson, AScT.
Company	**Company**
Comox Valley Regional District	2211- Courtenay
Re	**Date**
Queen's Ditch Drainage Improvements Options Analysis Phase 2A – Modelling Results – **Appendix B**	April 5, 2019
	File Number
	2211-47546-00

This technical memo supplements the Queen's Ditch Outfall Culvert and Retaining Wall Assessment of November 2018 and is in response to questions submitted February 2019.

1. REMAINING SERVICE LIFE

The estimated remaining service life of the existing culvert and retaining walls are difficult to quantify with any degree of certainty. This is primarily due to the lack of inspection history of which to draw trends, compounded with the structure's location in a dynamic foreshore environment. Based on the visual evidence in the November 2018 inspection, it can be said the culvert is closer to the end of its useful service life on the basis of the various forms and extents of corrosion. The retaining walls, with corrective maintenance, have a serviceable life for many years to come.

2. COSTS OF IDENTIFIED MAINTENANCE & IMPROVEMENTS

Class D cost estimates for maintenance and improvements at the Queen's Ditch Outfall Culvert are in Table 1, below. These costs account for known items such as site preparation, spoil removal and rock placement. Costs to secure environmental permits and compensation as a result of working instream are not included.

Table 1

Item	Estimated cost
Vegetation removal	$1,000 - $2,500/year
Armor inlet	$40,000 - $70,000
Culvert / road monitoring – Owner	$3,500 / year
Culvert inspection – McElhanney	$3,000 / year
Armor outlet / buttress retaining wall	$60,000 - $80,000
Seasonal foreshore drainage maintenance	$5,000 / year

1211 Ryan Road
Courtenay, BC
V9N 3R6
Tel 250 338 5495
www.McElhanney.com

3. REPLACEMENT OPTIONS

The Queen's Ditch Outfall Culvert will require replacement; however, the ideal option may be dependent on the selected upstream catchment rework option. Therefore, we recommend deferring until the upstream options are advanced further.

From: Town of Comox – Administration
Sent: Monday, January 4, 2021 4:10 PM
To: Shelly Russwurm: Town of Comox
Subject: FW: Dogs off leash

SUZANNE CASANOVA
Clerk II Administration Department, Town of Comox

A 1809 Beaufort Avenue Comox, BC V9M 1R9
T 250 339-2202 **E** town@comox.ca
W www.comox.ca

From: bill morrison [redacted]
Sent: January 4, 2021 4:03 PM
To: Town of Comox – Administration <town@comox.ca>
Subject: Dogs off leash

I frequently walk along Brooklyn Creek and Mac Laing park and see a lot of dogs running off leash contrary to the bylaws of the town. Sunday was a busy day in the park and I encountered a group with 2 large dogs off leash which repeatedly ran into me. I have an injured knee so am very leery of uncontrolled dogs.
Later in the afternoon we were returning from the beach and were almost overrun by a deer followed closely by an Alsatian dog that was chasing it. We soon heard some screaming and within minutes that unleashed Alsatian returned from the Park, sweating, very agitated, and covered in blood. At this time it jumped through the window of my cousin's car and would not leave. A lady came up from the Park and said they deer had been killed and then finally the owner arrived and removed the dog from the car.
My point in this story is that it seems to be a secret that dogs must be under leash in all Comox parks. They're are no signs to this effect and their need is long overdue. This park has a pre school group that use it daily and it would be unfortunate if an unleashed dog attacked one of these children, let alone another deer.
It has been my experience that without adaquate signage bylaws are useless. When speaking to an off leash dog owner you need some signage to refer them to.
Off leash dogs are also often running amok thru the Creek and disrupting spawning beds and salmon fry.
Let's get the signs up before someone gets severely injured!

Sincerely
Bill Morrison

130 Donovan Drive
Comox
[redacted]

From: Dianne Hentschel [redacted]
Sent: Sunday, January 10, 2021 2:12 PM
To: Andrew Burger
Cc: Russ Arnott
Subject: Dog control in Mack Laing and Baybrook Parks

Attention: Andrew Burger,

Dear Andrew

Lately, we have noticed a big increase in the number of dogs, mostly off-leash, throughout Mack Laing and Baybrook parks at all times of day. Many are large dogs enjoying playing on the trails and beach and in and out of Brooklyn Creek. While we have been enthusiastic dog owners ourselves, we find the numbers and lack of control hazardous for walkers. Last Sunday morning at high tide there were 12 dogs, about 45 pounds each, running for sticks around the paved area where the house used to be in Baybrook park. Some were running through the trees and into the creek. Setting out on the trail we found no place to walk safely in the park.

On your website it says
"Please note: there are no off leash parks, greenways or fields in the town of Comox".

There is a sign asking people to keep dogs on leash at the Comox Avenue entrance to Mack Laing Park. If we are to preserve the creek for salmon, and the park for ALL walkers, it would be great to have more signs as soon as possible. The longer you wait the more entitled people become. The longer there is no enforcement, the more entitled and "libertarian" people become.

Jim and Dianne Hentschel