

District of Highlands Groundwater Protection
Work Plan and Implementation Report

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Acronyms and Abbreviations

BC	British Columbia
BCCF	BC Conservation Foundation
CRD	Capital Regional District
DAIA	Development Approval Information Area
DPA	Development Permit Area
DFO	Department of Fisheries and Oceans
DoH	District of Highlands
DVP	Development Variance Permit
EHO	Environmental Health Officer
ELC	Environmental Law Clinic
EMS	Environmental Monitoring System
GW	Groundwater
HVA	Highly Vulnerable Area (of aquifer)
IC	Industrial-Commercial
MDA	Master Development Agreement
MOE	Ministry of Environment
MFLNRORD	Ministry of Forests, Lands and Natural Resource Operations and Rural Development
OCP	Official Community Plan
RDN	Regional District of Nanaimo
SGRA	Significant Groundwater Recharge Area (of aquifer)
SLUSC	Sustainable Land Use Select Committee
SW	Surface Water
WHPA	Wellhead Protection Area

District of Highlands Groundwater Protection Work Plan and Implementation Report

Introduction

This document presents a groundwater protection work plan to support the District of Highlands (District) in the long-term maintenance of a sustainable groundwater resource. This plan builds on three phases of Golder and Associates studies, as well as recommendations from the Highlands Sustainable Land Use Select Committee (SLUSC) and the University of Victoria Environmental Law Clinic (ELC) gap analysis.

This work plan was developed based on recommendations from prior work, research into current best practices, and an assessment of the current status of groundwater in the District. The plan provides a 'road map' to the sustainable management of the Highland's groundwater resources, identifying recommended actions, associated sequencing, potential partnerships, and resource implications. The plan was developed with a recognition of the limited resources available to the District and wherever possible, proposes the most low-cost and effective approach to the long-term protection of the community water supply source.

Background

The District of Highlands is a small, primarily rural residential community that is blessed with an exceptional abundance of natural beauty. The majority of residents in the District obtain their drinking water from private wells that tap into the local bedrock aquifer (BC Aquifer #680). The community has a strong interest in maintaining the health of the aquifer and has invested heavily in groundwater protection initiatives over the past 20 years. The work to-date, as outlined in Figure 1, has been well-timed, well-executed, and provides a solid foundation for future groundwater protection efforts.

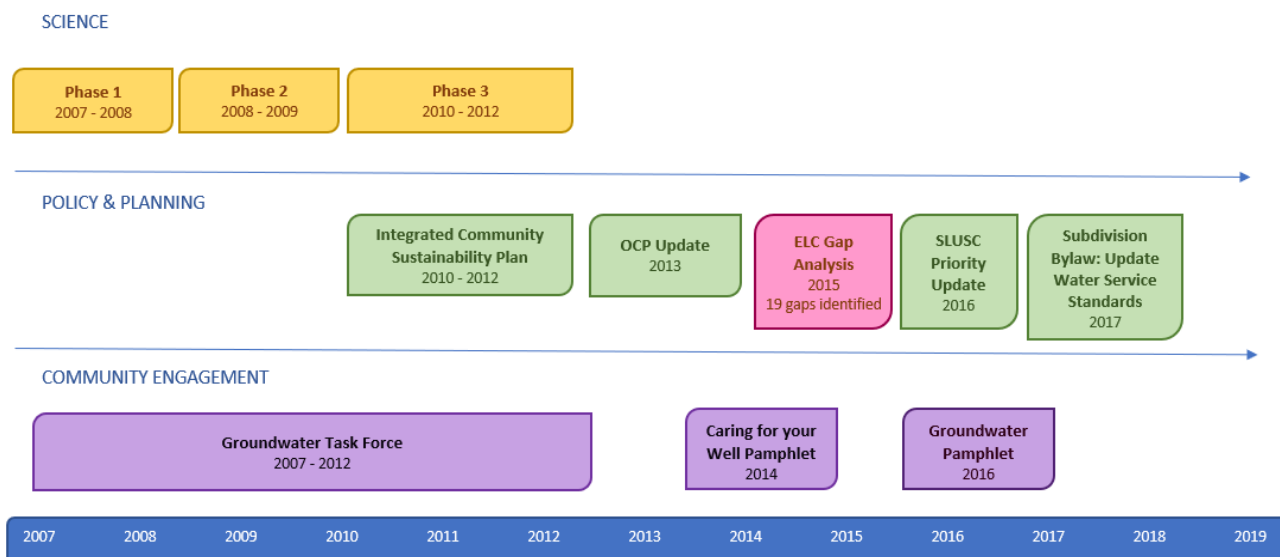


Figure 1: Groundwater Protection in the Highlands - What's Been Done?

Develop groundwater protection work plan

Previous studies have provided a good understanding of the aquifer, identified risks to water quality, and provided high-level recommendations for action. With this firm foundation, the District of Highlands is seeking to understand the next steps to move forward and support the long-term sustainable management of the Highland's water resource.

Rationale

The District of Highlands is in a unique position as the primary level of government responsible for land use planning over the community aquifer. Although the provincial government is responsible for water allocation, through land use planning, the District plays a large role in managing how much water enters the aquifer (through recharge), how much water is extracted from the aquifer (through land development), and how much contamination may impact the aquifer (as a result of land use activities).

The District is in a unique position as the level of government that is best able to communicate community interests with other levels of government. The District is also in a unique position as the level of government able to work most closely with the community in support of groundwater protection actions.

However, at this point, the District does not have a well-developed understanding of the groundwater entry points (significant recharge areas) or which areas are most sensitive (areas that are highly vulnerable to groundwater contamination or areas with limited water supplies). The information that is available is not at a scale that can be used with policy and regulatory tools such as zoning and official community plans (OCP). There are also currently limited opportunities for collaboration with other levels of government that are involved in managing the aquifer.

In 2019 the District developed an Asset Management Plan, to support the long-term sustainable management of services in the District and protect future generations of Highlands's residents. In this plan, the local aquifer was identified as a critical piece of infrastructure for the community, with a replacement cost of approximately \$47 million. Given the value of the aquifer to the community, it will be important to take steps to maintain this resource and ensure its long-term sustainability.

Linked Projects

The District of Highlands is already taking several actions to protect groundwater for the community. These include:

- Ongoing planning and management of development (with a focus on groundwater protection)
- South Highlands Local Area Plan
- Monitoring of the Bear Mountain Master Development Agreement (MDA)
- Ongoing groundwater monitoring (thanks to volunteer private well owners)
- Community outreach regarding water levels and groundwater stewardship (inserts in tax bills)
- Emergency response planning

This work plan proposes several new actions to enhance the understanding of the resource and to address gaps in aquifer protection. Where possible, it integrates recommendations for future work with existing activities to increase efficiency and effectiveness.

Work Plan Development

To develop the plan, the following steps were taken. Full details are provided in Appendix B.



Review background materials and identify implementation options

Reviewed the Golder Groundwater Study: Phase 1, 2, 3, the University of Victoria ELC Gap Analysis, and SLUSC Recommendations. Identified 50+ recommendations in these reports.

Reviewed other relevant materials including the Highlands Strategic Plan, Official Community Plan (OCP), and the Integrated Community Sustainability Plan.



Develop a 'prioritization framework'

A "prioritization framework" was developed, to guide the research and support the use of a consistent approach when assessing options. It considered the effectiveness of actions, the resources required, as well as the ease of implementation.



Research implementation options and other best practices

Implementation options were researched and ranked according to the prioritization framework. Research was also conducted to identify new best practices and implementation options, considering new legislation. These options were also ranked.



Groundwater status update

Groundwater and surface water quality and quantity data and information was reviewed to assess the current status of groundwater in the District and to identify any red flags or trends requiring attention.



Draft and then finalize groundwater protection work plan

Recognizing the following priorities:

- Least costly and most effective approach
- Recognize associated District goals and initiatives (e.g. next OCP update)
- Provide full flexibility with respect to timing and implementation
- Identify critical sequencing of items and situations where there are efficiencies in delivering tasks concurrently
- Utilize opportunities for cost-savings and partnerships.

Work Plan Goals

This work plan was developed to support the Highlands community in maintaining a sufficient **quantity** and **quality** of groundwater now and in the future, considering the uncertainty created by climate change and potential increases in population.

Objectives

The plan was developed to support the following objectives:

- 1) Maintain or improve groundwater levels
- 2) Maintain or improve groundwater quality
- 3) Maintain groundwater storage
- 4) Maintain groundwater extraction within sustainable levels
- 5) Protect ecological health by protecting interconnected surface water flows

Strategy

The following work plan provides an achievable set of steps that the District can take to support long-term groundwater sustainability. The plan recognizes associated District goals such as the next OCP update and identifies opportunities for cost-savings and partnerships. The work plan is developed to provide full flexibility to the District with respect to timing and implementation. It identifies critical sequencing of items and any situations where there are efficiencies in delivering tasks concurrently.

The work plan begins by proposing several low-cost and effective steps to support groundwater sustainability. They include increasing collaboration with other levels of government that play a role in aquifer management, updating existing land use planning policies, and supporting the sharing of currently collected groundwater data to enhance decision-making at provincial and regional levels.

Once these initial steps have been taken, the District can begin identifying key parts of the aquifer that require special considerations in land use planning and then use tools such as Development Permits Areas (DPAs) to protect these areas.

The plan recommends ongoing engagement with the community and a Highlands Groundwater Stewardship Program to support residents in caring for the aquifer.

Throughout, it will be important to continue monitoring groundwater levels and quality so that any changes to aquifer health can be addressed as soon as possible.

Actions

Proposed actions in this work plan can be grouped into the three main categories as shown in Figure 2.

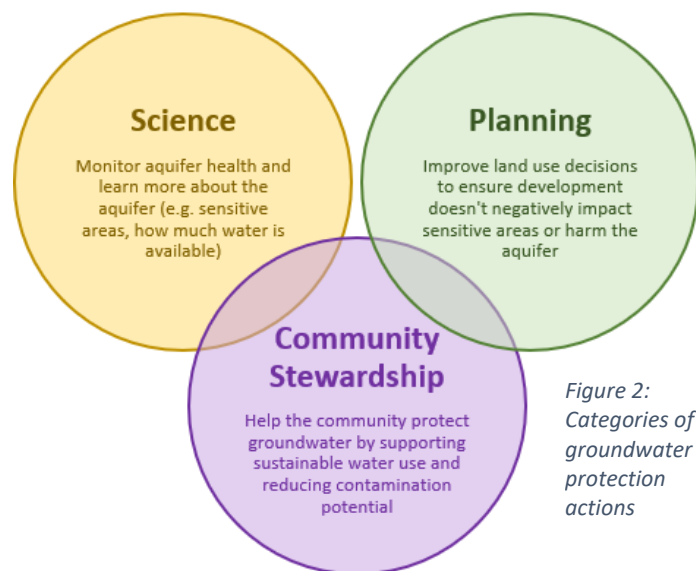


Figure 2: Categories of groundwater protection actions

Table 1, below, provides an overview of the recommended short, medium, and long-term priorities. Details on the recommended actions are provided in the ‘Work Plan’ section.

Table 1: District of Highlands groundwater protection work plan - short, medium, and long-term priorities

Planning Horizon	Science	Planning	Community Stewardship
Pre-Implementation	<ul style="list-style-type: none"> Continue groundwater level monitoring 	<ul style="list-style-type: none"> Incorporate groundwater protection actions in strategic planning; determine level of investment in groundwater protection Support greater collaboration with the emergency response program Ensure implementation of Bear Mountain Master Development Agreement (MDA) Update the requirements for hydrogeological assessments in the Development Approval Information Area (DAIA) 	<ul style="list-style-type: none"> Continue to provide information on groundwater levels to the community in yearly tax inserts
Short Term	<ul style="list-style-type: none"> Identify sensitive areas that require special management such as significant recharge and highly vulnerable areas Continue monitoring groundwater levels, add new wells to fill monitoring gap, compile third party groundwater level and quality data Implement “easy to access” data management system Delineate ‘community aquifers’, collect hydrometric data for water budget 	<ul style="list-style-type: none"> Take early protective actions District-wide to support land use decision-making Develop a Technical Advisory Committee to increase coordination across multiple levels of government and the community Provide feedback where appropriate on referrals for groundwater license applications Continued collaboration with emergency planning efforts 	<ul style="list-style-type: none"> Install signage Update website Deliver workshops Stewardship program (e.g. rebates for private well testing, wellhead protection, septic maintenance, low flow plumbing upgrades, rainwater harvesting, etc.)
Medium Term	<ul style="list-style-type: none"> Continue monitoring groundwater quality and quantity Develop monthly water budgets on community aquifers to identify areas with seasonal water stresses (at a resolution that can be used in land use planning) 	<ul style="list-style-type: none"> In OCP update, consider DPAs for sensitive aquifer areas (significant groundwater recharge areas, highly vulnerable aquifer areas, and community aquifers with water quantity concerns) Consider net zero/water offsets bylaw 	<ul style="list-style-type: none"> Continue communications and stewardship support Share information about the aquifer
Long Term	<ul style="list-style-type: none"> Continued monitoring Additional science as needed (refine water budgets, recharge mapping)* 	<ul style="list-style-type: none"> Continue improved assessment of development applications and input on groundwater license referrals 	<ul style="list-style-type: none"> Continued communications New incentives and education programs as needed
Ongoing	Continue groundwater protection efforts		

*With climate change uncertainty, it is wise to have funds available for additional monitoring and analysis as needed

Work Plan Overview

A work plan overview is provided in Figure 3 on the following page. The pages following this provide a detailed description of each work item. A summary table of all the actions/tasks is also provided as an appendix to this report.

District of Highlands Groundwater Protection Work Plan Overview

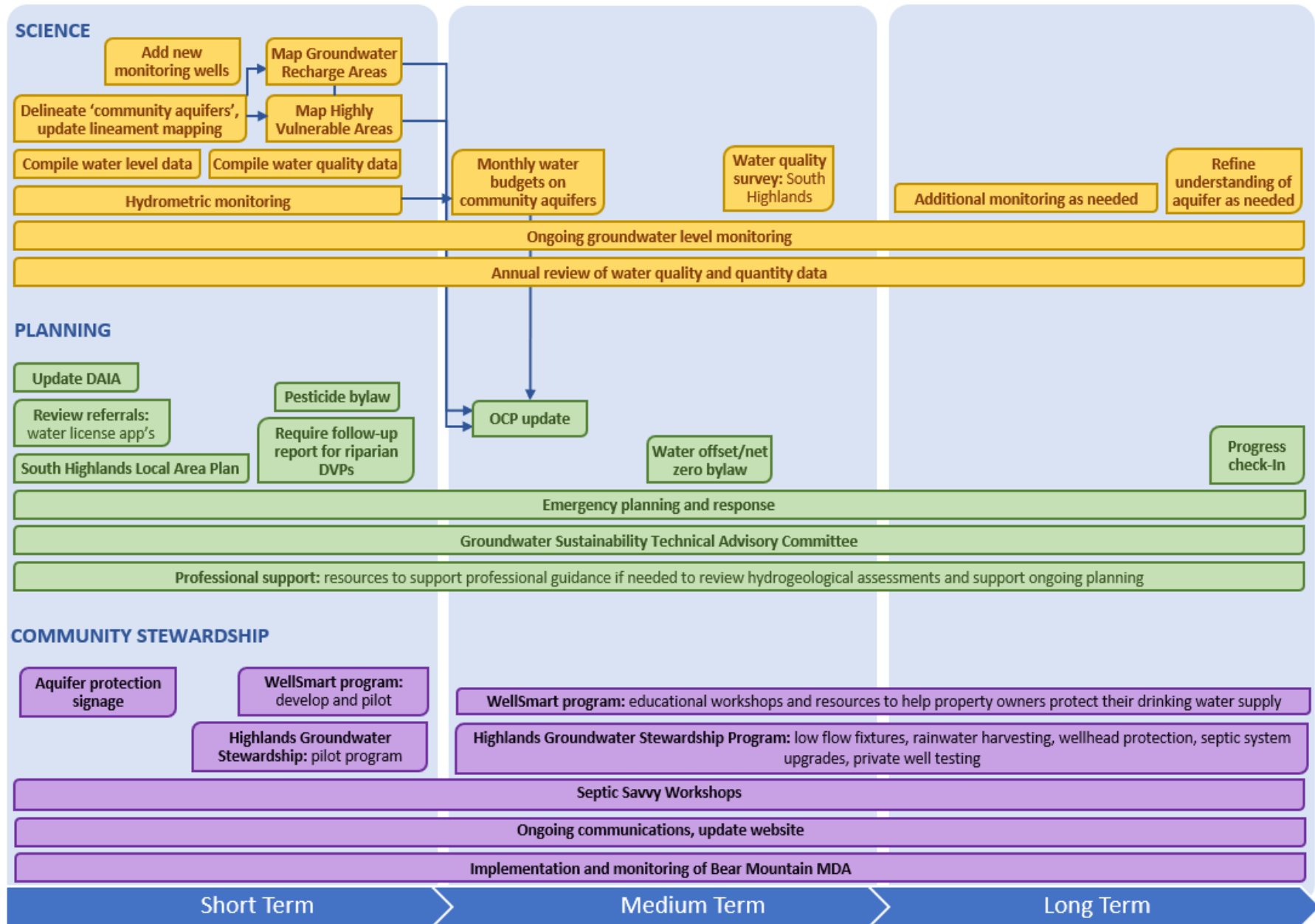


Figure 3: District of Highlands Groundwater Protection Work Plan Overview

Work Plan ‘Legend’

The following provides further details on the activities proposed above. Each item below summarizes the recommended action, and provides relevant background, details on the approach, and estimated cost/resources necessary to carry out the work. The estimated cost/resource level is based on the project team’s collective experience with this area of work. For the purposes of attributing cost, we have assumed the need to have auxiliary/contract staff carry out the work at a cost of \$40/hour. For any tasks where a consultant would be hired to do the work instead of a contract staff, it is reasonable to multiply the cost by a factor of 2.5.

SCIENCE

Short Term and Ongoing Timeframe

Add new monitoring wells

Summary: There is currently a lack of groundwater-level monitoring in the centre of the Highlands and it is recommended that monitoring equipment is added to two wells to fill this data gap. See Figure C-1 in Appendix C.

Background: A review of the Districts groundwater monitoring network identified gaps in the coverage of the water level monitoring in the centre of the Highlands (in the area of wells that were used in water quality monitoring, labelled DOH-05, DOH-06, DOH-08, and DOH-10). This is consistent with the findings of the Golder report that recommended monitoring in the area of DOH-05 and DOH-10.

While it would be slightly better to first determine if there are any unused wells in the area (because they are not influenced by pumping and there is a lower chance that the owner will ask for the equipment to be removed), searching for unused wells takes time (sending a letter to property owners or knocking on doors) and may be unsuccessful. Monitoring water levels in an existing in-use domestic well is still valuable, as the scientist reviewing the data would simply select water level data from 3am when it is unlikely that the well is in use. There is also value in using the four listed wells for water level monitoring, because water quality samples have been taken from these wells and it is helpful to be able to correlate water quality and level information.

Approach: If the funds became available to drill dedicated monitoring wells, it would be wise to add wells in this area. However, in the absence of that funding, it is suggested that the District contact the owners of wells and ask if they can install monitoring equipment in them. The top priority well would be a well in which the property owner was willing to enter into a long-term agreement for monitoring. If all well owners are willing to agree to long-term monitoring, then it is recommended that the District request wells in the following order of priority: DOH-05, DOH-10, DOH-06, DOH-08.

Good communication with well owner is advised so that he/she is fully aware of importance of the information gained.

Timing: Suggest in 2020 or 2021.

Cost: Depends on approach. Estimated \$3,000, for adding equipment to two of the four existing wells.

Further details on cost:

If drilling new wells, approx. \$5,000-\$8,000/well to drill and \$1,200/well to add monitoring equipment.

If adding monitoring equipment to existing wells then \$1,000-\$1,200/well for the equipment and installation. Staff (or contractor time) would be needed to either search for unused wells (estimated \$1600) or communicate and coordinate with the owners of wells DOH-05 and DOH-10 (estimated \$800).

Delineate ‘Community Aquifers’

Summary: Create aquifer management units (e.g. sub-aquifers) so that development can be better managed in areas where there are more concerns about the sustainability of groundwater use.

Background: A similar approach is being used on the Southern Gulf Islands. The intent would be to calculate monthly water budgets for each of the community aquifer units.

Approach: The units would need to be mapped at a resolution that could be used for planning purposes (e.g. at a relatively high resolution e.g., 10m grid cell resolution – or at the resolution used on the Gulf Islands). This action should include detailed lineament mapping. This lineament mapping is important because groundwater movement is controlled by flow through fractures/lineaments. It is critical to identify the fracture network in order to understand the geometry of the main groundwater pathways.

Cost: \$12,600.

Map significant groundwater recharge areas

Summary: Map areas of significant groundwater recharge at a resolution useful for planning so that development can be more carefully managed in these areas.

Background: To manage risk, it is important to identify the spatial variability of risk to water. Significant groundwater recharge areas and highly vulnerable areas are areas where there is a greater risk to water quality (and potentially quantity).

Many of the recommended actions include suggestions to protect recharge areas but the current recharge mapping is overly simplistic (only based on topography) and is not at a scale suitable for planning. Although topography is a key dataset used in estimating length of lineaments prone to recharge and steep slopes should be considered when estimating recharge to fractured zones/lineaments, it would be helpful to consider other factors and improve the resolution of the mapping. Islands Trust is developing recharge mapping at a suitable scale for planning so that it can be used with planning tools (e.g. DPAs). As recharge areas are the "real" water sources, protecting them should definitively be a priority and mapping them at a scale that can be used for planners is important.

Approach: Complete before next OCP update (estimated, 2023) so that information can be used to support OCP updates (e.g. through establishment of DPAs). Once these areas have been mapped at a scale that can be applied on a parcel basis, this information can be used in land use planning. For example, the community may decide to prohibit potentially polluting uses in critical aquifer recharge areas and highly vulnerable areas. The community may also want to modify land use zoning to prohibit or limit development in groundwater recharge areas.

Cost: \$5,000 initially. An additional \$5,000 to refine in year 10 based on additional data gathered through hydrogeological assessments and monitoring.

Map highly vulnerable areas

Summary: Map groundwater vulnerability to identify areas at a higher risk of contamination. This work should be done at a resolution that is useful for planning (e.g. 10m x 10m grid cells).

Background: There has been some vulnerability mapping done in the area, but the approach that was used is not very applicable to bedrock aquifers and has not been done at a scale that is useable for planning.

Approach: Complete before next OCP update (estimated, 2023) so that information can be used to support improved planning (e.g. establishment of DPAs). There may also be an interest in modifying land use zoning in these areas to prohibit potentially polluting uses in these areas.

Cost: \$3,000 initially. An additional \$3,000 to refine in year 10 based on additional data gathered through DAIA and monitoring.

Compile groundwater level data

Summary: Engage with groups that are currently collecting groundwater level data and request that they share it through provincial databases.

Background: The provincial Aquarius database has been designed to host third party hydrometric data. This data is shared publicly and used to enhance decision-making at the provincial and regional level.

Approach: Year 1: Reach out to third party data collectors and request that they share data online in the provincial Aquarius database. Then, work with the third-party data collectors and provincial staff who manage the Aquarius database to input available groundwater level data and establish automatic uploads for real-time continuous data. Request that third party data gatherers continue to upload data on an ongoing basis.

Potential third-party data sources include the District's monitoring wells (currently managed by Golder), as well as data from the Bear Mountain monitoring wells, any water suppliers that monitor water levels (potentially River Road, Hannington Creek), and the Capital Regional District (CRD) (they may monitor water levels as part of the Millstream Meadows remediation project).

In year two, ensure that data continues to be uploaded to Aquarius.

Cost: Most cost-effective if done by contract staff. \$1,600 (year one), \$800 (year two).

Compile groundwater quality data

Summary: Gather and upload existing water quality data into provincial databases.

Background: The provincial Environmental Monitoring System (EMS) database is designed to host third party water quality data. It makes data publicly available to enhance decision-making at the provincial and regional level. Many water suppliers already collect water quality data and are required to share it publicly through Island Health. However, this data is not stored or shared in a format that is easily accessible and it would be ideal to upload this data to the EMS. Many water quality testing labs can automatically upload data to the EMS (if requested). In recent years, the Ministry of Environment (MOE) Environmental Monitoring Reporting Program has been working with water suppliers in some areas to upload test results to the EMS. Labs will often upload to one database for free.

However, if a water supplier has already asked the lab to upload to their own database, it may cost more to upload to the EMS, too. (It is recommended that the District contact the MOE Environmental Monitoring Reporting staff and determine if its possible to obtain financial assistance with additional upload costs.)

Water quality data is generally viewed as more sensitive information than water level data, so there may be some third-party collectors that do not want to share. Because of this, it is proposed that this work happens after the collection of water level data, once relationships have been established, and water level data is already being shared.

Approach:

1. Connect with Regional Hydrogeologist, MOE Water Reporting team, Island Health to determine if there are opportunities to share costs of automatic uploads from lab to EMS. Connect with local lab to determine automatic upload options for water suppliers and options for private well owners.

2. Connect with third party data collectors to request participation. For those who do not want to share publicly, obtain data under confidentiality agreement for future studies.

2. Support third party data collectors in uploading to EMS.

4. In year two of this work, check that participants continue to upload data.

Cost: \$2,400 (year one), \$800 (year two).

Hydrometric monitoring

Summary: Monitor streamflow at the outlets of the Craigflower and Millstream for three years to support water budgeting (locations shown in Figure C-2 in Appendix C).

Background: There is limited hydrometric data for the area. To develop water budgets, at least three years of good quality hydrometric data is required. Both the MFLNRORD and the British Columbia Conservation Foundation (BCCF) could potentially support the District in obtaining high quality hydrometric data. The Department of Fisheries and Oceans (DFO) could also play a supporting role. The MFLNRORD Regional Hydrologist is experienced and interested in working with local governments and stewardship groups to establish hydrometric monitoring programs across the Island. MFLNRORD staff can install monitoring equipment, train volunteers, support equipment calibration, conduct data review and analysis, and develop rating curves. They ask that local governments provide funding for a level logger at each monitoring point (\$700), if possible. BCCF is also experienced in working with volunteer groups to gather high quality hydrometric data and may be considering installing a monitoring station on the Millstream in partnership with the Goldstream Volunteer Association. The DFO Community Advisor has less technical equipment available and is available as a potential resource and support for volunteers. The Peninsula Streams Society and the Goldstream Volunteer Association (related to the Goldstream Hatchery) groups are active in the area and may be interested in collaboration. Several local governments, including the Regional District of Nanaimo (RDN) have developed partnerships for stream monitoring and can be contacted for guidance, if needed.

Approach: Partner with MFLNRORD Regional Hydrologist, BCCF, DFO and stewardship groups. When this project is initiated, all potential organizations should be contacted as soon as possible to identify interest, availability, and resource needs. Stewardship groups should be consulted with a formal letter that can be taken to the organization's decision-makers. It makes sense to work with volunteers for this data collection because groups such as BCCF,

DFO, and MFLNRORD have well-developed programs to support volunteers through training, supervision, and support. Hydrometric monitoring is also aligned with the objectives of several volunteer groups.

Cost: Equipment cost (\$1,400). Equipment may be provided MFLNRORD, but \$1,400 should be budgeted to purchase two \$700 level loggers, if needed. Contract staff/volunteer time (\$4,800/year) for data collection. \$2,000 first year for contract staff time setting up the program. The contract staff/volunteer time estimate for data collection is conservative as it assumes limited volunteer support and it is likely that volunteers will be able to assist with this task.

Ongoing groundwater level monitoring data collection

Summary: Continue to monitor water levels in existing wells and begin monitoring water levels in newly added wells (see: Add new Monitoring Wells) in year two. Upload data to Aquarius.

Approach: It would be most cost-effective to have the groundwater level data collection done by District contract staff. Contract staff could easily be trained to collect and upload to Aquarius and a hydrogeologist be paid to review and report out annually. It would be important for staff to be trained in how to calibrate and use the equipment properly. This training could be done by MFLNRORD for free or a consulting hydrogeologist for \$1,000. It would be valuable to have a dedicated District staff person doing this work to ensure integration with other projects and effective coordination of work with MFLNRORD staff, consultants, and the private well owners.

The data obtained from the volunteer private wells is very valuable for the long-term management of the aquifer. If possible, set up long-term agreements with the existing monitoring well owners to ensure long-term access to the data. Alternately, pursue grant funding to drill new observation wells that are owned by the District.

Cost: Data collection cost: \$2,200 year one (including training). \$1,200/year in following years. Cost for review and analysis of all data (see: Review and Interpret Surface Water and Groundwater Data, below: \$5,000).

Annual review of water quality and quantity data

Summary: Review monitoring data and share information on the status of the aquifer with the community.

Timing: Once per year, on an ongoing basis.

This review should consider groundwater and surface water monitoring data from the provincial Environmental Management System (EMS), Aquarius, and other sources. It should be done by a professional and a summary provided to Highlands contract staff to be used in public communications. Staff should communicate the results to the public as part of the communications plan.

Cost: \$5,000 yearly.

Medium Term Timeframe

Monthly water budgets on 'community aquifers'

Summary: Conduct monthly water budgets to understand which areas of the Highlands are more water scarce and which areas are more abundant. It is important that this is done with a level of certainty and at a high enough resolution that it can be used for planning purposes. This would help planners identify which areas could support additional development (e.g. secondary suites) and which areas may not be able to support additional development.

Cost: \$15,000 for a high-level monthly water budget on all community aquifers in the District. \$20,000 for a more detailed water budget on areas of concern.

Background data required: Three years of hydrometric monitoring on the Millstream and Craigflower watersheds and community aquifer mapping. Information on water use by large extractors such as Bear Mountain. (Note: if Bear Mountain has not fixed the leaks in the storage pond, the budget should consider the volumes of pumped water discharging from pond to the creek).

Cost: \$3,000 initially. An additional \$3,000 to refine in year 10 based on additional data gathered through DAIA and monitoring.

Water quality survey: South Highlands

Summary: Check water quality in residential wells around Industrial Commercial (IC) properties to ensure that there has been no migration of contaminants.

Approach: Do one sampling event at a time where there is a high-water table and identify any red flags. Sample wells within 500 m of contaminant sources.

Timing: In 5 years. There is currently significant monitoring as part of the Millstream Meadows remediation project.

Cost: Approximately \$6,000. Estimate local groundwater regime and potential locations of concerns/wells (\$1,500); review of land activities and selections of potential contaminants of concern: \$500: 5 wells @ \$300 (lab) + sampling & data review (approximately \$2,500, based on water quality test requirements).

Long Term Timeframe

Refine understanding of aquifer as needed; Additional monitoring as needed

Summary: Over time, as new information becomes available on the aquifer (from hydrogeological assessments) and conditions change (potentially as a result of climate change and/or population growth) it is wise to have funds available for additional monitoring and analysis as needed.

Cost: Variable. Estimated \$5,000-\$20,000 based on task.

PLANNING

Short Term and Ongoing Timeframe

Update development approval information area requirements

Summary: Provide clarity on the requirements for hydrogeological assessments. This would help Council uphold the policies and objectives in the OCP and minimize potential impacts of development on existing groundwater or surface water users and sensitive ecosystems. This would also help provide consistency in the review of development applications and provide clarity for applicants. One of the proposed examples (the RDN Board Policy) was developed in consultation with the Province and may save costs for applicants, by reducing duplication between assessments required by the Province and those for local government.

Background: The entire District is covered by a Development Approval Information Area (DAIA). This allows Council to require a development applicant to provide information on the impacts of the development they are proposing and how those impacts will be mitigated. This information can help Council to assess the suitability

of the development and develop the terms and conditions of the development permit.

The DAIA should be updated to provide guidance on the information required to understand impacts on groundwater quality and quantity.

Approach: It is recommended that the DAIA be updated to require a hydrogeological assessment and mitigation plan for uses that might impact:

- 1) Water quality, and
- 2) Water quantity

Simple draft guidance can be found in the Groundwater Bylaws Toolkit¹. For more detailed example, the following references are available:

Water quality impact assessment

The RDN Aquifers Development Permit Area provides details on the information that should be provided in an assessment of the impacts to water quality from select land uses (See RDN Zoning Bylaw: Part 5 - 5.1.4 (4) Aquifer Development Permit Area²).

Water availability and impact assessment

To assess water availability, the RDN Board Policy B1.21 Groundwater Assessment Requirements for Rezoning Un-serviced Lands and for Development Permits³ (April 2019) and the Highlands Subdivision Bylaw: Water Service Standards should be used. In places where the Highlands requirements are higher, those should be used as they are more specific to the Highlands area.

To assess impact on surrounding users, or require the installation of a monitoring well, the RDN Yellow Point Aquifer DPA² has sample language that can be used.

It would be appropriate to require an assessment of water availability and impact in cases of subdivision, rezoning, or where a significant increase in water demand is expected.

Cost: Estimated \$1,600.

Request referrals when groundwater license applications go to adjudication

Summary: Through the Water Sustainability Act, the Province has stated that it will provide local governments with an opportunity to provide input on water license applications. However, the Province has not yet formalized a process for this. The Water Authorizations Section Head at MFLNRORD has stated that the District will be notified when groundwater license applications go to adjudication, but it is not yet 100% clear if the referral system 'works'.

Approach: As the Highlands has a strong interest in ensuring that groundwater is used sustainably in the region, the District should ensure it will be notified when groundwater license applications in the District are going to adjudication, by checking with the

1

https://www.obwb.ca/fileadmin/docs/groundwater_bylaws_toolkit.pdf

² https://www.rdn.bc.ca/dms/documents/rdn-bylaws/land-use-and-subdivision---bylaw-no.-500,-1987/part_5_development_permit_areas.pdf

³ https://www.rdn.bc.ca/sites/default/files/2019-07/policy_b1-21_groundwater_assessment_requirements_for_rezoning_un-serviced_lands_and_for_development_permits.pdf

MFLNRORD Water Allocations Section Head in 2020 to ensure that the District is receiving referrals.

When the District does receive a referral, if there is a concern regarding the impact on the community or the sustainability of the extraction, staff and Council can provide feedback to the Province.

If the District is particularly concerned about an application, it would be wise to obtain the support a hydrogeologist in reviewing the referral and providing feedback. This would cost a minimum of \$1,500 and may cost more in more complex situations. If professional support is required, this could be taken from the 'Professional Support' budget.

Although it does not make sense for the District to respond to all referrals, it would be helpful to be aware of major proposed changes to groundwater use in the area. As science evolves (e.g. as a result of monitoring and the water budget), the District may play a greater role in the referral process.

Cost: \$840/year ongoing (assuming 21 hours/year of staff-time).

South Highlands Local Area Plan

Summary: The District of Highlands should ensure that the South Highlands Local Area Plan includes groundwater protection and water conservation considerations.

Approach: There are examples of groundwater protection language in a local area plan in the RDN Bowser Village Plan.

Cost: It is unclear how much of the cost is part of existing plan development and how much would need to be identified separately. Estimated: \$0.

Pesticide bylaw

Summary: Finish the draft pesticide bylaw.

Background: District staff have had a draft bylaw in development for several years.

Timing: To be discussed. Sooner is better but flexible.

Cost: Variable. Estimated \$2,000.

Emergency planning and response

Summary: Provide greater connections between the emergency planning and response program and the groundwater protection initiative.

Approach: To start, provide the contractor responsible for the Highlands emergency response plan implementation/update with the sections of the Phase 3 report related to Emergency Management. Also, include an emergency response representative on the Technical Advisory Committee.

The following suggestions are based on the timing and tasks identified in the 2018-2023 Strategic Plan for the Emergency Response Program.

Assess Risks: In 2020, when a contractor is engaged to assess vulnerabilities in the community, this should include a map of water supply wells and (if complete) the mapping of highly vulnerable areas and groundwater recharge areas. These should be considered in the assessment of high-risk areas.

Update Emergency Response Plan: In 2021, when the Highlands Emergency Response Plan is updated, it is suggested that the following updates are added to specifically address events that could

potentially result in a loss of water supply or contamination of groundwater resources:

- The existing Hazard-Specific Plans for Dangerous Goods Release, Flood, and Transportation Accident – Road should be revised to reflect the first response measures that are outlined in the Golder Phase Three report, Section 13.0.
- The District should prepare a Hazard-Specific Plan for groundwater contamination to outline the first response and follow-up activities that are required to prevent groundwater contamination.

Plan for Disaster Recovery: This should recognize the value of rainwater harvesting infrastructure as a backup water supply and form of water storage (if bulk water deliveries are required).

It is also recommended that when the Strategic Plan for the Highlands Emergency Response Program is updated in 2023, that consideration be given to addressing ways to prevent and respond to events that results in the loss or contamination of the groundwater supply.

Cost: \$400 for staff time in year one. Other work included in the Emergency Response program.

Groundwater Sustainability Technical Advisory Committee (TAC)

Summary: Develop a Groundwater Sustainability Technical Advisory Committee to increase coordination among different community groups, staff, and levels of government.

Background: Other local governments have found that a Technical Advisory Committee can support knowledge-sharing, collaboration, and coordinated management of water resources. A TAC also demonstrates a level of organization and commitment that attracts funding and partnerships. A TAC requires minimal staff and financial resources (about 1.5 contract staff days/meeting and \$200 to cover lunch). Although members may not attend every meeting, the TAC allows other levels of government and community stakeholders to stay engaged via meeting minutes.

Approach: Suggest inviting First Nations to participate in a format that works for them. Invite representatives from the MFLNRORD (Regional Hydrogeologist), BC Ministry of Environment (Aquatic Ecosystems or Water Allocations staff), Island Health (EHO), DFO, District of Highlands planning, Highlands District Community Association, Industrial/Commercial businesses, Bear Mountain, Environmental Stewardship Community (e.g. Peninsula Streams, Goldstream Volunteer Association), Capital Regional District (Onsite System Coordinator), the general public, academic community, and emergency response program. Suggest meeting two times/year.

Cost: \$2,200 (year one), \$1,200 (years 2-10).

Professional support

Summary: Consider having a small amount of funding available yearly to hire professional expertise who can support the District planner and contract staff in reviewing development applications and referrals from the Province.

Approach: For large development applications or water license applications, it would be helpful for the District to retain professional support to review the impacts on the aquifer. Although,

through the DAIA, the District can require applicants to provide information on the impacts of development, there is value in the District obtaining professional support that will work on behalf of the community to review the potential impacts of larger developments/extractions. A basic review would cost \$1,500. A more complex review could cost more (an estimate can be obtained from a hydrogeologist). If the District foresees land development pressure (e.g., new subdivisions), then it would be wise to budget funds accordingly in advance.

Cost: Average of \$2,000/year. Likely not used every year.

Medium Term Timeframe

Incorporate groundwater protection tools into OCP update

Background: Source water protection efforts are most successful when they are focused on areas where the greatest amount of harm reduction can occur. If the recommended mapping projects have been completed (significant groundwater recharge areas and highly vulnerable areas), then the next OCP update would be a good time for the community to decide how this information should be considered with future development. The community may decide to prohibit potentially polluting uses in critical aquifer recharge areas and highly vulnerable areas. They may also want to prohibit or limit development in groundwater recharge areas.

Suggested Approach: Propose Development Permit Areas (DPAs) over Significant Groundwater Recharge Areas (for Environmental Protection and Water Conservation), Highly Vulnerable Areas (for Environmental Protection), and Community Aquifers that have water supply limitations (Water Conservation).

Timing: Next OCP update (estimated, 2023)

Cost: This would be incorporated into the overall terms of reference for the OCP review so would not require additional funds.

Require follow up report for riparian development variance permits

Approach: Require a follow up report for riparian development variance permits to ensure riparian areas are protected.

Background: The Riparian Areas Regulation (RAR), calls on local governments, to protect Riparian Areas during residential, commercial, and industrial development by ensuring that proposed activities are subject to a science-based assessment conducted by a Qualified Environmental Professional (QEP). Currently, the Highlands OCP and Zoning bylaw contain requirements to protect riparian areas. A resident can apply for a Development Variance Permit (DVP) and request that Council allow them to develop in the riparian area. Council generally requires that a QEP assess the riparian area and provide recommendations regarding development in the area. However, there is no enforcement of this and the DVP applicant may or may not follow the QEP's requirements. Riparian areas play an important role in maintaining stream health and the hydrologic regime and requiring a final inspection of the development by a QEP would help the District ensure compliance with legislative requirements under RAR and maintain the hydrologic regime.

Approach: There are several ways in which a follow-up report could be required. This could be done by requiring the applicant to submit

a security deposit (Section 925, LGA) which would be repaid once the QEP confirmed that the work had been done correctly, or as part of the DVP conditions (the District may require that the applicant's biologist or QEP provide confirmation that the property has been developed in accordance with the QEPs recommendations).

Cost: Staff-time to identify preferred option and develop. Estimated two days (\$560).

Water offsets/net-zero bylaw

Summary: Develop a bylaw requiring proof that any additional water demand resulting from secondary suites, accessory dwelling units, or major renovations is offset by increased water efficiency to meet BC Building Code standards in existing homes (or businesses).

Background: As many households in the District do not irrigate and were built prior to the BC Building Code water efficiency updates, it is estimated that the greatest residential water use is related to older plumbing fixtures. It is possible to require water offsets, or upgrades as part of major renovations under the Community Charter 53 (2) (b) & 8 (3) (1). In addition, the Sustainable Highlands document states that by 2030 in the Highlands "Net-zero" energy, water and zero-waste will be the standard for all developments.

Approach: Timing is flexible, but sooner is better. Implementation would need to be simplified, as it is not advisable to request before/after water audits. One way that implementation could be simplified would be for the District to require before and after photos showing old fixtures removed and new water efficient fixtures installed (as is done in the RDN toilet rebate program).

Cost: Estimated \$4,000.

Long-Term Timeframe

Progress check-in

Summary: In year 10 conduct an assessment of the status of groundwater to identify any red flags or trends requiring attention. In yearly check-ins, consultants will report out on groundwater levels. In this step, a consultant will take a more thorough look at the data and consider additional measures of aquifer health (e.g. how the aquifer is recharging to identify potential impacts of changes in storage). There should also be a review of program activities that considers feedback from staff and the community. This feedback, combined with the groundwater status update, will be used to assess program effectiveness, identify any new priorities or concerns that need to be addressed, and guide the next steps in groundwater protection.

Cost: \$20,000 (\$10,000: science/technical, \$10,000: planning)

COMMUNITY STEWARDSHIP

Short Term and Ongoing Timeframe

Aquifer protection signage

Summary: Install aquifer protection signage at every entrance to the District. This action is relatively low cost and would help keep aquifer protection 'top of mind' for residents and visitors. See examples in Appendix C Figure C-3 to Figure C-8.

Costs: It costs approx. \$350-\$400 per sign to buy (base, sign, pole) and install. Plus \$400-\$500 for graphic design and layout first time. Add 10 hours of contract staff time for coordination (\$400).

Highlands Groundwater Stewardship Program

Summary: It is recommended that the Highlands develop the Highlands Groundwater Stewardship Program to support community members in sustainable groundwater management. This incentive program would encourage landowners to use water more sustainability, store rainwater, improve contaminant management, test their wells (and share the data, as desired), and maintain their septic systems. A two-phased approach is recommended, with an initial pilot in the short-term and then expanded implementation to follow, based on information learned in the pilot.

Background: Many local governments deliver incentive programs to support residents in reducing water use, harvesting rainwater, and protecting water quality. For example, the RDN has an incentive program and offers rebates for improvements that support rural water quality (e.g. wellhead protection, septic system maintenance and upgrades, private water well testing) and sustainable water use (low flow fixtures and rainwater harvesting). The Sunshine Coast Regional District (SCRD) has also developed a rainwater harvesting incentive program. With the RDN private well testing incentive, a private well owner can volunteer (by 'checking a box') to share water quality test results with the RDN or the province on the EMS. This supports the property owner in identifying any concerns with their water supply and helps increase the level of knowledge about groundwater quality in the District. Both the RDN and SCRCD can be used as models and staff at both organizations expressed an interest in sharing resources.

Approach: It is suggested that a phased approach is taken. In the first year, the Highlands could deliver a pilot version of the program, offering rebates for homeowners who upgrade to low flow toilets (the highest discretionary water use in the home). There are many examples of toilet rebate program available and this is a relatively low-cost incentive program. This pilot would allow staff to establish an administrative process and assess community interest.

Based on staff and community feedback from the pilot, the initiative could be expanded to include a wider range of best practices. In year two, it is recommended that rainwater harvesting incentive is added (as budget permits). Incentivizing rainwater harvesting in the Highlands would be effective at addressing many water concerns, as it would provide additional water storage in the event of an emergency, help modulate flows from marginal wells, assist with slowing down rainwater to increase infiltration and reduce erosion, provide an alternative supply for outdoor watering, and provide additional supply for fire fighting. As rainwater harvesting is a higher-cost upgrade, and there are fewer examples available in other jurisdictions, it is suggested that this incentive is delivered after the pilot.

In later years, as funding is available, the District could add incentives for other best practices to support groundwater protection, including septic system maintenance and upgrades, wellhead protection, and private well testing. The District can look to the RDN for guidance in program planning and delivery.

Timing: Establish as soon as possible.

Cost: \$7,000 (Pilot: \$5,000 incentives and staff time to develop program), \$13,000 (years 2-10).

Ensure Implementation of Bear Mountain MDA

Summary: Monitor and ensure the implementation of the Bear Mountain MDA, including appropriate timing of irrigation and use of storage, as well as water quality and level monitoring.

Background: Bear Mountain is a significant groundwater user and manages several potential contaminants on site (e.g. landscaping chemicals, equipment maintenance supplies, etc.). Ongoing monitoring of the impact of activities and MDA implementation is required for the long-term sustainability of the aquifer. The District is currently investigating the impact of the irrigation wells on the aquifer and this should continue. The MDA may be updated in the near future. If the MDA is to be revised, it is suggested that the DoH retains a hydrogeologist to provide clarity in the MDA on how aquifer impacts should be assessed.

Cost: To be discussed. Estimate \$1,000 (year one) and \$600/year after, plus some funds from the Professional Support budget.

Workshops and events

Summary: Support continued delivery of Septic Savvy Workshops, develop and pilot WellSmart Workshops.

Approach: Work with the CRD to deliver the Septic Savvy workshops in the Region for the first year. This program is already paid for by District residents. Approximately 10 hours of time would be needed to coordinate. In the following year, develop a WellSmart program to support communities in managing their private wells. This program would share information on wellhead protection, well maintenance, water quality testing, contaminant management, and water conservation practices. The WellSmart workshops could be customized to the District of Highlands context (with support from the MFLNRORD, Island Health, the BC Groundwater Association, local well drillers, and water quality labs, as available). The RDN can share resources. It is recommended that outreach programs are delivered for five years. After that, assess to determine if there are new messaging needs (e.g. how to use rainwater for potable use, as new guidelines are released).

Cost: Variable by year. Year 1 (Septic Savvy only): \$400, Year 2 (Septic Savvy, develop WellSmart Program): \$3,400, Ongoing: \$2,800/year.

Communications

Summary: Ongoing communications and outreach can provide residents and business with up-to-date information on the aquifer, the groundwater sustainability program, and guidance on groundwater stewardship. Communications can also provide relevant, seasonal information on how residents and business can take care of the aquifer and share details of the Highlands Groundwater Stewardship Program.

Background: Communications alone are not necessarily effective at supporting improved water stewardship, so this program should be paired with incentives to support residents in protecting groundwater quality and quantity through the Highlands Groundwater Stewardship Program.

Approach: If possible, a contract staff person who is responsible for the other groundwater protection initiatives would be the person developing and delivering communications initiatives. That staff person would be able to identify suitable opportunities to pair communication with other groundwater protection activities (e.g. WellSmart program, monitoring, groundwater recharge mapping, etc.).

In the absence of a dedicated staff-person, it is recommended that the following communications actions are taken, as resources become available:

- 1) Update website: include information on the groundwater protection initiative, aquifer, and provide links to available resources, including any Highlands groundwater brochures and links to pertinent resources such as rainwater harvesting information (e.g. RDN brochure, list of nearby retailers), well stewardship (e.g. the RDN WellSmart program), and septic case (e.g. the CRD Septic Savvy program)
- 2) Emergency preparedness and prevention: identify ways in which residents can reduce the likelihood of emergencies and reduce the impacts of spills or reduced water supplies through appropriate handling and storage of hazardous materials, wellhead protection, and building water storage on their properties. It will be important to coordinate this with work done through the WellSmart program, as there is overlapping content.
- 3) Share information on the aquifer, such as the results of the aquifer recharge and highly vulnerable areas mapping and water budget projects.
- 4) Business stewardship: provide information on how businesses can protect groundwater resources through improved handling of hazardous materials, water conservation, and spill response. This may take the form of a poster that can be displayed in workspaces with a 'we protect our groundwater' message.

Any communications materials should include a brief overview of the work that the Highlands is doing to protect groundwater and what residents can do.

Cost: \$2,000-\$6,000/year ongoing (contract staff time and limited graphic design support).

Funding Mechanisms

The need for a Local Government to fund the work necessary to develop, implement and maintain an effective groundwater protection program is likely the most important and limiting issue as part of this consideration. The ideal is to have some form of stable annual funding for a program however this is not always possible. There are several possible funding mechanisms that can be considered for groundwater protection measures. These include:

- Special Projects Funds
- Grant Funding (e.g. Gas Tax Community Works Fund, Infrastructure Planning Grants)
- A Groundwater Protection Service

Special Projects Funds

The District's budget includes provisions for Special Projects under the General Government Services budget (for Council Special Projects) and the Planning Services budget (for Planning Special Projects).

Grant Funding

The District can apply for grants through several funding programs. Examples include the Gas Tax Community Works Fund, administered by the Union of BC Municipalities (UBCM) and the Infrastructure Planning Grants administered by the Ministry of Municipal Affairs and Housing.

Gas Tax Community Works Fund

The Gas Tax funding program is provided through an agreement between the Federal Government, Province of BC, and the UBCM. It provides local governments with predictable, long-term and stable funding (from gas taxes) to support investment in infrastructure and capacity building projects. The Community Works Fund is based on a per capita formula with a funding floor and delivered twice annually. The District can make choices about which projects to fund.

Infrastructure Planning Grants

The infrastructure planning grant program offers grants of up to \$10,000 to support local government in projects related to the development of sustainable community infrastructure. The grants are intended to help develop or improve long-term comprehensive plans and can be used for a range of activities related to assessing the technical, environmental and/or economic feasibility of municipal infrastructure project. The program is open for applications year-round and has regular processing deadlines.

Groundwater Protection Service

Under the Local Government Act, municipalities have broad authority to provide any services that Council considers necessary or desirable. Examples of services that local governments provide include traditional services such as sewer, water and roads and newer services such as drinking water protection and public Wi-Fi.

Some local governments have established watershed protection service areas (e.g. Regional District of Nanaimo and Cowichan Valley Regional District Drinking Water and Watershed Protection Programs). These programs are intended to increase collaboration between stakeholders and local and provincial governments, support community stewardship, and inform land use planning.

Appendix D includes a sample budget, showing how much a 10-year groundwater protection program would cost.

Conclusion

This draft groundwater protection work plan has been provided to the District of Highlands and the community for feedback and comment. The work plan has been developed to support the long-term protection of the groundwater resource and aid the District in meeting its responsibilities related to land use planning and emergency preparedness. Implementation of the recommended actions will help support the community in managing its most valuable asset – its drinking water source.

Appendix A: District of Highlands Groundwater Protection Work Plan Summary

Table A-2: Recommended Actions - Science and Monitoring

Task #	Action	Goal	Key Steps	Collaboration Needs/ Partners	Linked Projects	Method of Delivery	Resource Needs	Information/ Data Needs	Timing	Expected Outcome	Priority	Estimated Cost	Term
S1	Groundwater Monitoring	Understand the health of the aquifer and identify any changes requiring attention	<ol style="list-style-type: none"> Continue monitoring existing wells Begin monitoring water levels in wells DoH05, DoH08 in year two (see S9: Add New Monitoring Wells) 	Owners of private wells	Current groundwater monitoring Add new monitoring wells (S9)	Contract staff	Yearly: 30 hrs (4 days) Year 2: see S9	Contact information of private well owners	Continue	District and provincial staff will have information to understand the health of the aquifer, identify trends, and respond, as needed	High	\$1,200/year	Ongoing
S2	Annual review of water quality and quantity data	Understand health of aquifer	Hire consultant to review groundwater and surface water quality and quantity data from monitoring programs		Current groundwater monitoring (S1) Bear Mountain MDA (C4) Hydrometric monitoring (if applicable) (S4) Add new monitoring wells (S9)	Consultant	Yearly: \$5,000 + 5 hrs contract administration	Data from EMS, Aquarius, other DoH monitoring (e.g. hydrometric data), IC property owners, CRD, any volunteer private water quality test results)	Yearly	Understanding of status of aquifer health	High	\$5,200 yearly	Ongoing

Appendix A: Work Plan Summary

Task #	Action	Goal	Key Steps	Collaboration Needs/ Partners	Linked Projects	Method of Delivery	Resource Needs	Information/ Data Needs	Timing	Expected Outcome	Priority	Estimated Cost	Term
S3	Compile Groundwater Level Data	Increase understanding of groundwater levels, to support improved groundwater management, by supporting the sharing of data that is already being collected	<ol style="list-style-type: none"> Engage with third-party data collectors Work with Aquarius team to support users in uploading Ensure work continues (Year 2) 	Bear Mountain River Road Hannington Creek Estates Golder Associates	Current groundwater monitoring (S1) Bear Mountain MDA (C4) Ongoing planning and information from DAIA (P8)	Contract staff	Year 1: 40 hrs Year 2: 20 hrs	Contact information of third-party data gatherers	ASAP	Groundwater level data stored in provincial database (Aquarius) and accessible by provincial and regional government, academia, and the public	High	Year 1: \$1,600 Year 2: \$800	Short
S4	Surface Water / Hydrometric Monitoring	Understand the amount of water leaving the District via streams, in order to conduct a monthly water budget	<ol style="list-style-type: none"> Develop partnerships/ approach Install gauges on the Craigflower and Millstream Volunteer training Data collection, calibration, reporting Share data on Aquarius 	MFLNRORD BCCF Peninsula Streams Goldstream Volunteer Salmonid Enhancement Society DFO	Internal: Water budget (S11) External: Millstream Fishway Project (Peninsula Streams Society)	Partnership with MFLNRORD, BCCF, DFO, stewardship groups	Depends on approach: If District of Highlands (DoH) purchases equipment: \$1,400 (2 x \$700) If DoH does all data collection (no volunteer support): 120 hrs/year Coordination: Year 1: 50 hrs Ongoing: 20 hrs MFLNRORD can provide equipment installation, training, data analysis	Map showing preferred location of monitoring sites	Three years prior to Water Budget (S11)	Three years worth of hydrometric data from the Craigflower and Millstream watersheds, rating curve	Medium-High	Year 1: up to \$8,200 Year 2 & 3: up to \$6,800	Short

Appendix A: Work Plan Summary

Task #	Action	Goal	Key Steps	Collaboration Needs/ Partners	Linked Projects	Method of Delivery	Resource Needs	Information/ Data Needs	Timing	Expected Outcome	Priority	Estimated Cost	Term
S5	Delineate Community Aquifers	Create aquifer management units (e.g. sub-aquifers) so that groundwater can be managed at a more local level	<ol style="list-style-type: none"> Hire consultant to develop model Refine geological knowledge - map lineaments 	Refer to Southern Gulf Islands: Groundwater Sustainability Project	<p>OCP update (P12)</p> <p>Water budget (S11)</p> <p>Significant groundwater recharge area (S7)</p> <p>Groundwater vulnerability mapping (S8)</p>	Consultant	\$12,000 + 15 hrs contract administration	<p>Data from Golder Phase 1, 2, 3 studies</p> <p>Existing lineament mapping (Murray Journey, Natural Resources, 2004)</p> <p>Lidar data for the Highlands (if available)</p>	Once. At least a year before OCP update	<p>Mapping of aquifer management units, at a 10m grid resolution.</p> <p>Detailed lineament mapping.</p>	Medium-High	\$12,600	Short
S6	Compile Groundwater Quality Data	Collect existing water quality data and upload to provincial database (EMS) to enhance decision-making at the provincial and regional level	<ol style="list-style-type: none"> Develop partnerships/ approach Connect with third party data collectors Support participants in uploading to EMS Ensure work continues (Year 2) 	<p>Third party data collectors: Bear Mountain, Hannington Creek, CRD, River Road, IC property owners, Golder, private well owners</p> <p>Potential partners: MFLNRORD, MOE Environmental Monitoring and Reporting, water quality testing lab(s), Island Health</p>	<p>Bear Mountain MDA (C4)</p> <p>Highlands Groundwater Stewardship Program (private well testing rebate) (C3)</p>	Contract staff	Year 1: 60 hrs Year 2: 20 hrs	Contact information of water suppliers	Year 3, Year 4	Publicly available water quality data that is already being collected in the Highlands is now shared publicly in an easy to use format on the provincial EMS	Medium-High	Year 1: \$2,400 Year 2: \$800	Short

Appendix A: Work Plan Summary

Task #	Action	Goal	Key Steps	Collaboration Needs/ Partners	Linked Projects	Method of Delivery	Resource Needs	Information/ Data Needs	Timing	Expected Outcome	Priority	Estimated Cost	Term
S7	Map Significant Groundwater Recharge Areas	Identify areas that act as significant 'entry points' for water into the aquifer at a resolution that can be used by planners	<ol style="list-style-type: none"> 1. Map recharge areas. Combine with work on S8 2. In 10 years, update recharge area mapping based on groundwater monitoring and hydrogeological assessments from DAIA 		<p>Delineate community aquifers (S5)</p> <p>Monthly water budgets on community aquifers (S11)</p>	Consultant	\$5,000 + 15 hrs contract administration (per mapping)	<p>Based on task S5</p> <p>Combined with S8</p> <p>More efficient if S5, S7, S8, S11 done by same consultant</p>	<p>Twice</p> <p>Suggest before OCP update, then in 10 years</p>	Mapping of significant groundwater recharge areas at a resolution that can be used for planning (e.g. 10m grid cells)	Medium-High	\$5,600	Short & Long
S8	Map Highly Vulnerable Areas	Identify areas more vulnerable to contamination at a resolution that is useable for planning	Combine work with Task S8		<p>Delineate community aquifers (S5)</p> <p>Mapping of significant groundwater recharge areas (S7)</p>	Consultant	\$3,000	<p>Based on task S5</p> <p>Combined with S7</p> <p>More efficient if S5, S7, S8, S11 done by same consultant</p>		Mapping of highly vulnerable areas at a resolution that can be used for planning (e.g. 10m x 10m grid cells) and included in the next OCP update	Medium-High	\$3,000	Short

Appendix A: Work Plan Summary

Task #	Action	Goal	Key Steps	Collaboration Needs/ Partners	Linked Projects	Method of Delivery	Resource Needs	Information/ Data Needs	Timing	Expected Outcome	Priority	Estimated Cost	Term
S9	Add new monitoring wells	Address gap in water level monitoring in the central Highlands	<ol style="list-style-type: none"> (If time) Send letter to properties to determine if there are any unused wells. (If no unused wells and/or no time to search for wells) Contact property owners to inquire about participation in monitoring program. Hire consultant to install monitoring equipment in wells. 	Private well owners	Groundwater monitoring (S1) Review and interpret surface water and groundwater data (S2)	<p>Contract staff (to coordinate with well owners)</p> <p>Consultant (to purchase and install equipment)</p>	<p>Year 1: 20 hours to coordinate with owners of wells DOH-05, -06, -08, 10.</p> <p>Add an additional (optional) 20 hours to search for unused wells.</p> <p>Estimated \$3,000 for adding equipment to two of the four mentioned wells.</p>	Contact information for well owners	Year two or three	New information gathered on water levels in the central Highlands	Medium-High	\$3,000	Short
S10	Water Quality Survey: South Highlands	Test water quality in volunteer private wells around contaminated sites and Industrial Commercial (IC) properties to ensure that there has been no migration of contaminants	<ol style="list-style-type: none"> Obtain any available data on water quality from IC property owners to provide to the consultant Hire consultant, provide them with water quality results, request that they identify sampling locations and analytical program, conduct sampling, and interpret results 	MFLNRORD CRD (Millstream Meadows) Private well owners	CRD Millstream Meadows remediation	Consultant, contract staff	<p>\$6,000: consultant</p> <p>+ 20-50 hrs contract staff time (depending on approach)</p>	<p>Water quality results from IC property owners, CRD Millstream Meadows remediation project</p> <p>Phase 2 Golder Report</p>	Once In year five or later	Report on water quality, protecting anonymity of private well owners to the greatest degree possible	Medium	\$6,800-\$8,000	Medium

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Task #	Action	Goal	Key Steps	Collaboration Needs/ Partners	Linked Projects	Method of Delivery	Resource Needs	Information/ Data Needs	Timing	Expected Outcome	Priority	Estimated Cost	Term
S11	Monthly Water Budgets on Community Aquifers	Identify which areas of the Highlands are more water scarce and which areas are more abundant (and associated water use) at a resolution that can be used for planning	<ol style="list-style-type: none"> 1. Conduct a high-level monthly water budget on all community aquifers in the District 2. Conduct a more detailed water budget on areas of concern 		<p>Delineate community aquifers (S5)</p> <p>Hydrometric monitoring (S4)</p> <p>OCP update (P12)</p>	Consultant	<p>High-level monthly water budget: \$15,000</p> <p>Detailed monthly water budget: \$20,000</p> <p>+ 25 hrs contract administration</p>	<p>Three years of hydrometric data on the Millstream and Craigflower</p> <p>Water consumption data from large extractors (e.g. Bear Mountain)</p> <p>More efficient if S5, S7, S8, S11 done by same consultant</p>	<p>Once</p> <p>Suggest before OCP update</p>	Monthly water budgets for community aquifers	Medium-High	\$36,000	Medium

Appendix A: Work Plan Summary

Table A-3: Recommended Actions - Planning

Task #	Action	Goal	Key Steps	Collaboration Needs/ Partners	Linked Projects	Method of Delivery	Resource Needs	Information/ Data Needs	Timing	Expected Outcome	Priority	Estimated Cost	Term
P1	Professional Support as Needed	Provide technical support to DoH staff	Allocate funding to support District in assessing development and water license applications			Consultant	\$2,000/year (likely not used every year)		ASAP	Improved capacity to assess development and water license applications	Medium-High	\$2,000	Ongoing
P2	Groundwater Sustainability Technical Advisory Committee	Increase coordination among stakeholders, staff, and multiple levels of government	<ol style="list-style-type: none"> 1. Invite participants 2. Create Terms of Reference 3. Meet twice yearly 	Many		Contract staff	Year 1 (setup): 25 hrs Ongoing: 20 hrs + \$200/meeting for lunch	Recommended membership list	Ongoing	Improved coordination of groundwater protection efforts, increased opportunities for partnership, funding, and engagement	Very High	Year 1: \$2,200 Year 2+: \$1,200	Ongoing
P3	Review Referrals for Groundwater License Applications	Be aware of, and provide input on, proposed groundwater extractions in the District	<ol style="list-style-type: none"> 1. Ensure the Province notifies the DoH when water license applications in the Highlands go to adjudication 2. As provided, review applications, focusing on large withdrawals or areas of concern (particularly after water budgets complete) 	MFLNRORD MOE CRD	Groundwater Sustainability Technical Advisory Committee (P2)	Contract staff	Estimated: 21 hrs/year		ASAP, ongoing	More informed decisions about groundwater use within the District	High	\$840 yearly	Ongoing

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Task #	Action	Goal	Key Steps	Collaboration Needs/ Partners	Linked Projects	Method of Delivery	Resource Needs	Information/ Data Needs	Timing	Expected Outcome	Priority	Estimated Cost	Term
P4	South Highlands Local Area Plan	Protect groundwater quality and quantity in the South Highlands	Include groundwater protection and water conservation policies	DoH Planner	South Highlands Local Area Plan	DoH Planner, contract staff	Included in existing budget.	Example of groundwater protection and water conservation policies and net-zero groundwater policy (e.g. RDN Bowser Village Plan)	TBD	Increase protection of groundwater in the South Highlands and improve information sharing	High	\$0	Short
P5	Emergency Preparedness and Response	Integrate groundwater considerations into emergency preparedness and response efforts	<ol style="list-style-type: none"> 1. Provide the emergency response plan contractor with the emergency response planning materials from the Golder Phase 3 2. Include contractor on the Technical Advisory Committee 3. Coordinate communications 	Emergency Response Plan Contractor	<p>Highlands Emergency Program Strategic Plan</p> <p>Groundwater Sustainability Technical Advisory Committee (P2)</p>	Contract staff	Year 1: 10 hrs	<p>Highlands Emergency Program Strategic Plan implementation schedule</p> <p>Golder Phase 3 Report: Emergency Response Planning</p>	ASAP, ongoing	Increased coordination and improved messaging	Very High	\$400	Short
P6	Pesticide Bylaw	Protect groundwater quality by prohibiting pesticide use	Complete draft pesticide bylaw	DoH Planner		DoH Planner, contract staff	Up to 50 hrs		ASAP / Flexible	Pesticide bylaw	Medium-High	\$2,000	Short
P8	Update DAIA Requirements	Ensure that new development will not negatively impact aquifer, provide clarity regarding DAIA requirements, increase amount of groundwater data	Add clear requirements for information on groundwater quality and quantity impacts and suggested mitigation strategies	DoH Planner		DoH Planner, contract staff	Estimate 40 hrs		ASAP	Clear requirements regarding hydrogeological assessments for the DAIA, improved aquifer protection, more groundwater data	High	\$1,600	Short

Appendix A: Work Plan Summary

Task #	Action	Goal	Key Steps	Collaboration Needs/ Partners	Linked Projects	Method of Delivery	Resource Needs	Information/ Data Needs	Timing	Expected Outcome	Priority	Estimated Cost	Term
P9	Require Follow-up Report for Riparian DVPs	Maintain hydrologic regime and help District ensure compliance with legislative requirements	1. Determine approach (security or terms and conditions) 2. Implement	DoH Planner		DoH Planner, contract staff	Estimate 14 hrs		Near future	Applicant for a DVP follows the conditions required by a QEP	Medium-High	\$560	Short
P10	Water Offsets	Net-zero water development	Develop a bylaw that requires that any additional water demand from secondary suites, accessory dwelling units, or major renovations to be offset by increased water efficiency in the existing structure (up to BC Building Code standards)	DoH Planner	Secondary Suites and Accessory Dwelling Units Study	DoH Planner, contract staff	Up to 100 hrs		Flexible	Fixtures in existing homes are updated when a new dwelling unit is added to a property (or a major renovation is completed)	Medium	\$4,000	Medium
P11	Progress Check-in	Assess effectiveness of groundwater protection efforts and determine if there are any new priorities that need to be addressed	1. Assess aquifer health including potential changes in storage 2. Assess program effectiveness		All	Contract staff, consultant	\$20,00 + 30 hrs contract admin (\$1,200)		Year 10	Understanding of aquifer health, key priorities, program effectiveness	Medium-High	\$21,200	Long-term

Appendix A: Work Plan Summary

Task #	Action	Goal	Key Steps	Collaboration Needs/ Partners	Linked Projects	Method of Delivery	Resource Needs	Information/ Data Needs	Timing	Expected Outcome	Priority	Estimated Cost	Term
P12	OCP Update	Protect groundwater by incorporating groundwater protection tools in the OCP update	<ol style="list-style-type: none"> 1. Identify areas that are at greater risk for water quality or quantity issues, and/or areas that are experiencing water quality/quantity concerns 2. Present this information to the community. Identify options for protecting those areas in the OCP (e.g. DPAs). 3. Work with the community to determine the best tools and approach to protecting groundwater 	DoH Planner	<p>S2: Annual Review of water quality and quantity data</p> <p>S5: Delineate Community Aquifers</p> <p>S7: Map Significant Groundwater Recharge Areas</p> <p>S8: Map Highly Vulnerable Areas</p> <p>S11: Monthly Water Budgets on Community Aquifers</p>	DoH Planner, contract staff (if needed)	Included in OCP update budget	<p>Community aquifer mapping</p> <p>Water budgets on community aquifers</p> <p>Highly vulnerable areas mapping</p> <p>Significant groundwater recharge areas mapping</p> <p>Examples of groundwater protection tools in OCPs (e.g. RDN Aquifers DPA, Yellow Point Aquifer DPA, any new tools used on the Gulf Islands)</p>	Currently, estimated time for update is 2023 (may be postponed)	Greater aquifer protections District-wide and for more vulnerable portions of the aquifer	High	Included in budget for OCP update	Medium

Appendix A: Work Plan Summary

Table A-4: Recommended Actions - Community Stewardship

Task #	Action	Goal	Key Steps	Collaboration Needs/ Partners	Linked Projects	Method of Delivery	Resource Needs	Information/ Data Needs	Timing	Expected Outcome	Priority	Estimated Cost	Term
C1	Signage	Remind residents and inform visitors of the importance of groundwater protection	<ol style="list-style-type: none"> 1. Create sign (message and graphic design) 2. Install signs at entrances to District 	DoH Building Inspector		Contract staff	Staff time: 10 hrs + Sign installation: \$400/sign x 4 + Graphic design: \$500		ASAP	Groundwater protection signs at entrances to the District	Medium	\$2,500	Short
C2	Communica-tions	Provide residents and business with up-to-date information on the health of the aquifer, DoH groundwater protection initiatives, and guidance/tips on groundwater stewardship	<ol style="list-style-type: none"> 1. Update website 2. Maintain website 3. Develop communications materials (e.g. emergency preparedness and prevention, aquifer studies, business stewardship) 4. Communications (outgoing messaging) 			Contract staff	Update website: 50 hrs (year 1) + \$1,000 graphic design Maintain website: 10 hrs/year Develop materials: 50 hrs + \$2,000 graphic design (once approx. every 3 years) Outgoing communica-tions: 40 hrs/year		ASAP	Improved engagement with community and improved groundwater stewardship	Medium-High	\$2,000-\$6,000/year	Short-Ongoing

Appendix A: Work Plan Summary

Task #	Action	Goal	Key Steps	Collaboration Needs/ Partners	Linked Projects	Method of Delivery	Resource Needs	Information/ Data Needs	Timing	Expected Outcome	Priority	Estimated Cost	Term
C3	Highlands Groundwater Stewardship Program (Incentive Program)	Improved groundwater stewardship	<ol style="list-style-type: none"> 1. Develop Incentive program 2. Pilot program with simple rebates 2. Phase in more rebates in following years 		Communications (C2)	Contract staff	<p>Year 1 Pilot: program development and basic incentives: 50 hrs</p> <p>Program delivery (ongoing): 50 hrs</p> <p>Incentives: Variable. Suggest \$5,000 in pilot, and \$11,000/year in full program (years 2+)</p>		ASAP	Residents use water more sustainability, store rainwater, manage water quality risks, test their wells (and share data if desired), and maintain septic systems	Medium-High	Year 1: \$7,000 Year 2+: \$13,000/year	Short-Ongoing
C4	Ensure Implementation of Bear Mountain MDA	Ensure that Bear Mountain will not negatively impact the community water supply	<ol style="list-style-type: none"> 1. Ensure appropriate timing of irrigation (and water storage use) and continued monitoring and assessment of water quality and quantity 2. If the MDA is updated, retain a hydrogeologist to provide clarity in the MDA on how aquifer impacts should be assessed 		P1: Professional Support as Needed		<p>Variable.</p> <p>Year 1: approx. 25 hrs Year 2: approx. 15 hrs</p>		ASAP	Bear Mountain provides water level and quality monitoring data and does not use irrigation wells in dry months.	Very High	\$600-\$1,000	Short-Ongoing

Appendix A: Work Plan Summary

Task #	Action	Goal	Key Steps	Collaboration Needs/ Partners	Linked Projects	Method of Delivery	Resource Needs	Information/ Data Needs	Timing	Expected Outcome	Priority	Estimated Cost	Term
C5	Events and Workshops	Support community groundwater stewardship and share information on the aquifer	<ol style="list-style-type: none"> 1. Work with CRD to deliver Septic Savvy Program in Highlands yearly 2. Partner to develop WellSmart program for the Highlands 3. Pilot WellSmart program 3. Deliver WellSmart program on an ongoing basis 	<p>Septic Savvy: CRD</p> <p>WellSmart: MFLNRORD, Island Health, BC Groundwater Association, local well drillers, water quality testing labs</p>	Communications (C2) Groundwater Stewardship Program (C3)	Contract staff, CRD partnership, consultants	<p>Septic Savvy: 10 hrs/year</p> <p>Year 2 (WellSmart program dev.): 50 hrs + \$1,000 graphic design</p> <p>Ongoing: 45 hrs/year + \$600 in expenses</p>		Soon	<p>Improved well and septic management and understanding of aquifer</p> <p>Brochures and resources available</p>	Medium-High	<p>Year 1 : \$400</p> <p>Year 2: \$3,400</p> <p>Ongoing: \$2,800/year</p>	Short-Ongoing

Appendix B: Work Plan Development

The following approach was taken to develop the District of Highlands Groundwater Protection work plan.

- 1) Review background materials and identify implementation options
- 2) Develop a 'prioritization framework'
- 3) Research implementation options and other best practices
- 4) Assess Implementation Options According to Prioritization Framework
- 5) Groundwater status update
- 6) Draft and then finalize groundwater protection work plan

This work was supported by two sub-contractors: Gilles Wendling of GW Solutions, who conducted the groundwater status update and provided technical guidance, and Mike Donnelly, retired Manager of Water Services at the Regional District of Nanaimo (one of the primary developers of the RDN Drinking Water and Watershed Protection Program), who provided guidance on program development and implementation.

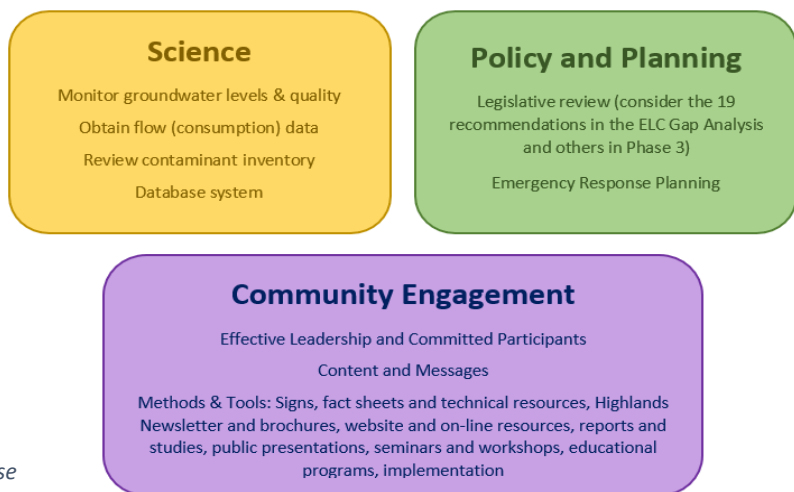
The above steps are described in further detail below.

1) Review background materials and identify implementation options

The following materials were reviewed:

- District of Highlands Groundwater Study: Phase 1, 2, 3 Reports
- University of Victoria Environmental Law Clinic Gap Analysis
- District of Highlands Strategic Plan (2019-2022)
- District of Highland OCP
- Subdivision or Development of Land Bylaw (154): focus on On-Site Sanitary and Water Wells (373), Stormwater Management, Water Wells Requirements (393)
- Sustainable Highlands 2012 Indicator Report
- Sustainable Highlands: District of Highlands Integrated Community Sustainability Plan (2011)
- Scan of Minutes of SLUSC, Council

- District of Highlands Emergency Response Plan (2018), District of Highlands Emergency Response Strategic Plan (2013)



In the Phase Three Report and ELC Gap Analysis, 50+ implementation options were identified. These could be divided into three categories, as shown in Figure B1.

Figure B-1: Recommendations from Phase Three and ELC Gap Analysis

2) Develop a Prioritization Framework

In order to develop a defensible implementation report and work plan, it was proposed that the team begin by developing a guiding strategy, or “prioritization framework”, for researching and assessing groundwater protection options. This helped guide the research and supported the use of a consistent approach when assessing options.

Figure B-2 provides an overview of the framework. The criteria are described in further detail below.

Effectiveness

Impact: refers to the speed and scale of impact in groundwater protection.

Comprehensiveness: refers to the ability of an option to meet a range of water management objectives (protects water quality, quantity, supports aquatic health, emergency response, climate change adaptation).

Independent Benefits: refers to the ability of an option to produce benefits independent of water protection (e.g. increased property values, reduced energy use, climate change mitigation, biodiversity).

Resources Required

Resources to Initiate: refers to the initial cost and staff resources of implementing an option. Considers resources required by District, residents, and partners.

Resources to Maintain: refers to the ongoing cost and staff resources to maintain an option. Considers resources required by District, residents, and partners.

Potential Partnerships and Support: degree of support provided by external organizations, volunteer groups, and other agencies.

Ease of Implementation

Adoptability: refers to the ease with which the District can implement an option (considers compatibility with existing resources, organizational structure, roles, and jurisdiction).

Community Interest: refers to the level of public interest in the option and compatibility with community culture and values. This could be assessed by through perceived public interest (based on prior research and documentation) and/or public feedback (at COW and/or in a survey or through feedback obtained through engaging via a newsletter, media release, etc.).

Flexibility: refers to the degree of commitment vs flexibility and the amount of that option can be adapted to meet future conditions.

Fairness and Equity: refers to the degree to which an option benefits a wide range of residents.

Table 1 on the following page shows how each option will be evaluated according to these criteria.

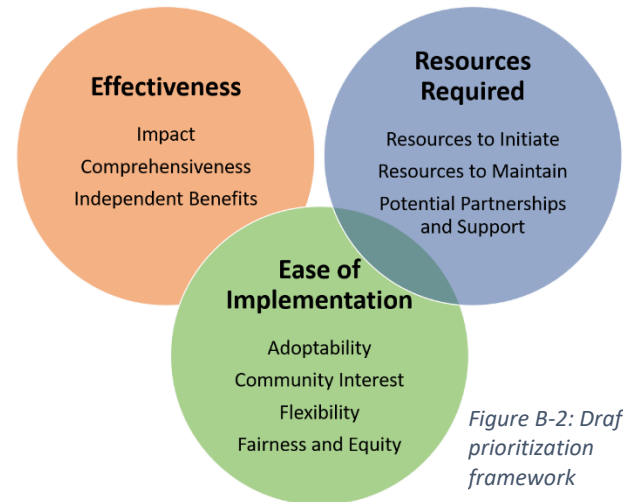


Figure B-2: Draft prioritization framework

Table B-5: Prioritization framework: approach to assessing options

Metric/Criteria	Scale	Evaluation Criteria
Impact	1	Very low impact
	2	Moderately low impact
	3	Neutral
	4	Moderately impactful
	5	Very impactful
Resources Required	1	High amount of increased resources required
	2	Moderate amount of increased resources required
	3	Low increased resources
	4	Uses existing resources
	5	Reduces current resource requirements
Independent Benefits	1	High trade-offs
	2	Moderate trade-offs
	3	Neutral
	4	Moderate independent benefits
	5	Significant independent benefits
Adoptability	1	Very low adoptability
	2	Moderately low adoptability
	3	Neutral
	4	Moderately adoptable
	5	Very adoptable
Comprehensiveness	1	Supports 1 water management goal
	2	Supports 2 water management goals
	3	Supports 3 water management goals
	4	Supports 4 water management goals
	5	Supports 5 water management goals
Community interest	1	Likely negative community reaction
	2	Potential negative community reaction
	3	Neutral (or equally positive and negative)
	4	Likely positive community reaction
	5	Positive community response
Flexibility	1	Highly committing and inflexible
	2	Moderately committing and inflexible
	3	Neutral
	4	Moderate flexibility
	5	Low commitment, high flexible
Potential Partnerships and Support	1	None
	2	Minor partnership & resource support
	3	Moderate partnership & resource support
	4	Likely partnership & resource support
	5	Committed partnership and resource support
Fairness and Equity	1	Benefits some stakeholders to the detriment of others
	2	Benefits 1 or 2 stakeholders
	3	Benefits several stakeholders
	4	Benefits most stakeholders
	5	Benefits all stakeholders

3) Research implementation options and other best practices

Research was conducted to better understand the implementation options provided in Phase 3 of the Golder reports. This research included a review of available documents as well as several targeted interviews. A brief summary of this research is provided below.

Materials Reviewed

Community Engagement

- Websites and communications materials from the following organizations: City of Kelowna, Township of Langley, Regional District of Nanaimo, Sunshine Coast Regional District, Alberni-Clayoquot Regional District, Capital Regional District, Okanagan Water Wise, Islands Trust, City of Surrey, Langley City, City of Armstrong, City of Burnaby, City of Abbotsford, Regional District of Okanagan Similkameen, Cowichan Valley Regional District, BC Automotive Recyclers Environmental Association, BC ArdCorp Environmental Farm Plan

Policy and Planning

- Gulf Islands Groundwater Protection: A Regulatory Toolkit (2014)
- Groundwater Sustainability Strategy Master Project Charter & Report to Council (June 4, 2019), Groundwater Sustainability Project: An Ecosystem Approach to Groundwater Management
- Galiano Island Development Permit Area 4 – Elevated Groundwater Catchments, Galiano Land Use Bylaw (Water Management Areas)
- Regional District of Nanaimo (RDN) ‘Aquifer DPAs’, Freshwater and Fish Habitat Development Permit Area DPAs, and ‘Yellow Point Aquifer DPA’
- Salt Spring Island – Community Well Capture Zones DPA
- Saturna Island Land Use Bylaw: East Point Water Management Area
- Salt Spring Island OCP Community Well Capture Zones DPA
- Community Charter and Local Government Act
- RDN Hydrogeological (groundwater) assessment requirements for rezoning unserviced lands and for development permits

Science

- Website and related materials: RDN Drinking Water and Watershed Protection monitoring programs, South Gulf Islands, phone interviews (see below)
- Regional District of Nanaimo Drinking Water & Watershed Protection Program: 10 Year Action Plan Implementation Review (2018)
- South Gulf Islands groundwater studies

Best Practices

- Green Bylaws Document (2007)
- Groundwater Protection Bylaws Toolkit (2009)
- A Handbook for Water Champions: Strengthening Decision-Making and Collaboration for Healthy Watersheds (2019)
- California Groundwater Sustainability Planning

Phone Interviews

Targeted phone interviews were also conducted to assess implementation options. Interviewees were asked to provide information on the following:

- Available programs
- Staff and financial resources required
- Implementation approach
- Partnerships
- Community response
- Effectiveness (including whether there had been any formal assessment of effectiveness)
- Lessons learned

These conversations are summarized below.

Table B-6: Summary of Phone Interviews

Jurisdiction	Reason for Inquiry	Results of Contact	Suggestions/Lessons Learned
City of Kelowna	WaterWise program, Irrigation audits, QWEL, Landscape Water Conservation Reports (mandatory), incentives	Interview: Ed Hoppe, Water Quality & Customer Care Supervisor	<ul style="list-style-type: none"> • It is difficult to change behaviours. Outreach for the sake of outreach can have limited effectiveness. More change expected with smart water meters, incentives. • Partnership with IIABC through QWEL is efficient for government (makes use of people already on the ground) and hopefully effective (TBD).
City of Surrey	Outreach program: door-to-door, community events, irrigation, incentives	Interview: Youngjin Kim, Engineering Assistant, Water Services	<ul style="list-style-type: none"> • Did an outreach program for 10 years that they assumed was effective. However, when they did an assessment at the end of 10 years, they could not ascertain whether it was effective. In addition, residents commented that they disliked some components of the program (e.g. the door-to-door irrigation outreach) and asked that City use social media and various existing communications avenues.
Sunshine Coast Regional District	Rainwater harvesting incentive program	Interview: Raphaël Shay, Water & Energy Project Coordinator	<ul style="list-style-type: none"> • Incentives very popular and support summer outdoor water use. • Cisterns support community resilience and behavioural change. They are going to be very important for the future. Rainwater cisterns are the only way many residents can have a garden. • People often assume they can collect more water than they really can with cisterns.

Jurisdiction	Reason for Inquiry	Results of Contact	Suggestions/Lessons Learned
Capital Regional District	Septic Savvy outreach program, Septic Maintenance Bylaw	Interview: Tara Stott, Onsite Wastewater Program Coordinator	<ul style="list-style-type: none"> Interested in partnering to provide septic education workshops and support septic outreach communications (e.g. provide content for septic communications in the Highlands Newsletter, social media, emails, etc.) If Highlands is interested in participating in bylaw, it is possible (suggest not, as the amount of the program \$25/parcel could help fund a groundwater protection program for the Highlands that included monitoring and reporting, stewardship incentives, and planning initiatives)
Cowichan Valley Regional District	Signage	Interview: Louise Knodel-Joy, Sr. Engineering Technologist, Water Management, Engineering Services	<ul style="list-style-type: none"> Signage is relatively easy to implement. Sign design can be shared if desired.
Regional District of Nanaimo	Effectiveness of Aquifer Protection DPAs and standards for hydrogeological assessments	Call: Stephen Boogaards, Planner	<ul style="list-style-type: none"> The Aquifers DPA seem to be very effective at addressing concerns about impacts to water quality and quantity on Industrial Commercial properties and larger residential developments. The Yellow Point Aquifer was strongly supported by the community when it was developed, but after it was adopted, the Area Director requested several exemptions that resulted in it being applicable to fewer properties (potentially less effective). Community has been very supportive of aquifer protection DPAs and they have now been used across the Regional District Updating the subdivision servicing bylaw is viewed as a major task and has been postponed for many years. In order to address groundwater protection in development applications, the RDN brought together a committee of planners, hydrogeologists, and other experts to establish standards for hydrogeological assessments in re-zoning and development permit applications. This is helpful because it clarifies requirements for developers.
Regional District of Nanaimo	Groundwater monitoring programs data management, lessons learned	Interview: Julie Pisani, Drinking Water and Watershed Protection Coordinator	<ul style="list-style-type: none"> Although there can be challenges in working with provincial databases (EMS, Aquarius, WURC), data needs to be stored somewhere and it makes sense to support provincial efforts to improve their databases and make data available to support improved decision-making at the provincial level. It's important to be strategic about data collection to save resources and make efforts more effective.

Jurisdiction	Reason for Inquiry	Results of Contact	Suggestions/Lessons Learned
Islands Trust	Planning tools (zoning bylaws, DPAs, etc.), information requirements, blasting, ecosystem connections	Interview: William Shulba, Freshwater Specialist (hydrogeologist)	<ul style="list-style-type: none"> • Studies and monitoring must be done strategically for water resource information to be effectively used with planning tools. • Property-level mapping of groundwater protection areas is needed (20 or 50m grids in mapping). DRASTIC FM and recent recharge mapping project is at a suitable scale. • It's important for local government to protect recharge areas, because local government is the main level of government responsible for protecting 'water-in' to aquifers. • The existing DPAs and zoning tools have limited effectiveness. • More cautious politicians are hesitant to support initiatives on a project-by-project basis because they're unsure how things fit into the bigger picture.
Ministry of Forests, Lands, Natural Resource Operations, and Rural Development	General comments on aquifer, Provincial partnerships for monitoring	Interview: Sylvia Barroso, Regional Hydrogeologist	<ul style="list-style-type: none"> • Province would like to see groundwater well monitoring data in Aquarius, EMS. There is a long-term plan to link the EMS, wells, and aquifer database. • There has been an effort to start adding water system testing data to EMS (supply well samples can be more useful than observation well samples because the water is not stagnant). There might be potential for funding/partnership through the MOE Environmental Monitoring and Reporting Program (otherwise, \$1-\$25/sample). • Suggested unused well at fire hall in an optimal location for observation well (unsure how connected it is to fracture network, might need to be rehabilitated) • Highlands aquifer very similar to Gulf Islands, very short flow patterns, keeping large lots sizes is important, density isn't sustainable. • The fractured rock aquifers have limited storage capacity and climate change impacts recharge patterns and use. For example, people are using more groundwater earlier, causing the dry season to elongate. In some areas, well users are seeing a late dry season decline in well water quantity and quality. An annual water budget would show no problem, so the water budget needs to be done monthly to show areas of concern.

Jurisdiction	Reason for Inquiry	Results of Contact	Suggestions/Lessons Learned
Ministry of Forests, Lands, Natural Resource Operations, and Rural Development	Recommendations on approach to groundwater protection	Interview: Pat Lapcevic, Water Protection Section Head (Hydrogeologist)	<ul style="list-style-type: none"> • Focus on water security. Data is necessary to understand the long-term impacts of climate change and development on the aquifer. Groundwater data is fairly easy to collect. Surface water data is harder to get but there may be opportunity for partnerships (connect with Regional Hydrologist). • It makes sense to update hydrogeological assessments for subdivision servicing and re-zoning applications because under the Water Sustainability Act, provincial requirements have changed. Want to make sure there is no duplication between the tests required at the local government and provincial levels (See RDN policy). • Modelling the RDN WellSmart Program and adding water storage and conservation information could be helpful. • Rainwater harvesting will be very helpful in the future. • If concerned about contaminated sites, suggest monitoring water quality near contaminated sites once every 5 years to see if contamination is travelling. If it is travelling into a drinking water supply, it is a high-risk site and more effort can be made (see interview with Lavinia). • If zoning is protective, it may make sense to focus on region/aquifer-wide protective measures rather than identifying recharge areas, highly vulnerable areas, etc. Particularly because bedrock aquifers are so difficult to understand. • The Provincial Observation Well in that area may not be representative of the whole aquifer. • Blasting/gravel extraction can have an impact if there is dewatering. No water license is required for dewatering and it often involves the extraction of large volumes of water.
Island Health	Private water well testing, private well education	Interview: Paul Cseke, Environmental Health Officer	<ul style="list-style-type: none"> • Interested in partnering with outreach activities regarding private well testing and maintenance (pending supervisor approval)
Island Health	Drinking water protection, rainwater use	Interview: Lynne Magee, Drinking Water Coordinator	<ul style="list-style-type: none"> • Once the upcoming standards for rainwater harvesting (the Rainwater Harvesting National Standard, May 2018, CSA/ICC B805-18 - Provincial draft guidelines are under public review) are adopted, with sufficient storage, rainwater may be an acceptable water source in source approvals.

Jurisdiction	Reason for Inquiry	Results of Contact	Suggestions/Lessons Learned
District of Highlands	Questions related to Report and applicability of tools	Email and phone call: Mike Dillistone	<ul style="list-style-type: none"> • Context: Uncertain how many properties use irrigation systems, high-flow fixtures (e.g. toilets). Good working relationship with Industrial Commercial property owners. Agreement with Bear Mountain for BMPs as part of Master Development Agreement. • Include residential properties when considering incentives. • Doesn't know number of home-based business (District doesn't license). • Private water use monitoring, water quality audits, tax rebate for BMPs unlikely/unpopular. • Current strategic priority is South Highlands Local Area Plan due to public concerns about gravel extraction and Industrial Commercial properties. No boundary defined at time of interview. • Use existing regulatory tools are much as possible. Consider recommendation for a comprehensive review and amendment of the Subdivision Bylaw with regard to groundwater resources. • Note in strategic plan about 'well water systems maintenance plan' relates to District wells.
District of Highlands	Understand the information needed by land use planners	Phone call: Laura Beckett, Highlands Planner	<ul style="list-style-type: none"> • It would be helpful to know which areas of the Highlands have sufficient water supply to support more development and which areas do not. This could be helpful, for example, in informing the secondary suites conversation. There may be places where this would be a good idea and places where it would not. Getting higher resolution information on water supply and demand would be helpful.
MFLNRORD, Peninsula Streams Society, Goldstream Volunteer Association, Goldstream Hatchery, Pacific Streamkeepers, DFO, BC Conservation Foundation	Hydrometric monitoring	MFLNRORD: Neil Goeller (Regional Hydrologist), DFO: Community Advisor, other groups: various contacts	<ul style="list-style-type: none"> • Investigated potential to partner in hydrometric monitoring.

Jurisdiction	Reason for Inquiry	Results of Contact	Suggestions/Lessons Learned
District of Highlands	Questions related to sign installation, prevalence of irrigation, and high flow-fixtures	Phone call: Chris Leek, Highlands Building Inspector	<ul style="list-style-type: none"> • Installing signs is easy and would be useful for keeping groundwater protection top of mind. Does not require permits from other levels of government. Signs cost approx. \$350-\$400 per sign to buy (base, sign, pole) and install. For the first sign, add \$400-\$500 for graphic design and layout to meet District standards. Four entrances to Highlands so one at each. • There is one groundwater protection sign as you enter the Highlands on Finlayson. It could use an upgrade. It may be helpful to add additional information about groundwater protection (e.g. tips on groundwater stewardship, dynamic information on post drought levels, etc.) • Re water use: most homes probably have older high flow fixtures inside. There are approx. 600 homes in the Highlands, and it is estimated that only about 70 (11.6%) built after 2006, so the most would have high flow fixtures. Very few have irrigation (only new subdivisions – max 100 homes have irrigation and those are not maintained by a strata). The major user is the golf course. • People are really concerned about groundwater and are quite aware of need for groundwater protection. Some new residents who have never been on a well may leave a tap running and then have their well run dry. But they have one bad experience and learn from that.
Ministry of Environment	Options for monitoring and remediating contaminated sites	Interview: Lavinia Zanini, Senior Contaminated Sites Officer	<ul style="list-style-type: none"> • There is very little that is done about contaminated sites unless a site becomes a high-risk site. A high-risk site is identified if someone complains and writes to the Director. If that occurs, the Director asks the source property owner to fill out a site risk classification form to determine the risks of the site. If it is found that contaminants are migrating from it into drinking water or the aquatic receiving environment at a certain concentration, then there is a procedure to address it as a high-risk site. First, the MOE would send a letter imposing requirements for remediation. If the property owner doesn't do anything, the MOE can order action. If they still don't anything, the property owner may declare bankruptcy and the site will become orphaned, which means the land is fenced off and the owner walks away. If a high-risk site is expected, there is a legal requirement to notify MOE.
Tried to contact but did not respond Ministry of Agriculture Regional Agrologist, BC Agriculture Council Environmental Farm Plan program coordinator), Alberni-Clayoquot Regional District, Township of Langley, Abbotsford-Mission Water and Sewer Commission			

4) Assess Implementation Options According to Prioritization Framework

Implementation options were researched and ranked according to the prioritization framework. Research was also conducted to identify new best practices and implementation options, considering new legislation. These options were also ranked, using the prioritization framework. Options received rankings from 19 to 38 out of 50. **Options that scored 25 or less were not included in the work plan.** The following table lists the implementation options, the source of the option (or reference), the ranking according to each of the prioritization framework parameters, and the final priority ranking.

Table B-7: Assessment and Ranking of Implementation Options

Implementation Option	Source of Recommendation/Reference	Impact	Resources Required	Independent Benefits	Adaptability	Comprehensiveness	Community interest	Flexibility	Potential Partnerships and Support	Fairness and Equity	Priority Ranking
Create and Coordinate Technical Advisory Committee	Phase Three Recommendation: 14.1.1: Effective Leadership and Committed Participants	5	3	3	4	5	5	4	5	4	38
Emergency Response Planning	Phase Three Recommendation: 6. Emergency Response Planning	4	4	3	5	3	4	5	4	5	37
Collect Groundwater Level Data from Other Data Collectors	Phase Three Recommendation: 14.2.1: Water-Level Monitoring, 14.4: Database System	4	3	3	5	4	4	5	4	4	36
Collect Pumping/ Consumption Data	Phase Three Recommendation: 14.2.3: Flow Monitoring, 14.4: Database System	4	3	4	5	3	4	5	4	4	36
Obtain Groundwater Quality Data from IC Properties and Bear Mountain	Phase Three Recommendation: 14.2.2: Groundwater Quality Monitoring, 14.4: Database System	4	3	3	5	3	5	5	4	4	36
Review Groundwater Data	Phase Three Recommendation: 14.2: Groundwater Monitoring	4	3	3	5	5	4	5	2	5	36
Collect Data from Highlands Monitoring Wells	Phase Three Recommendation: 14.2.1: Water-Level Monitoring	4	3	3	5	5	5	5	2	4	36
Review Referrals for Groundwater License Applications	NEW: MFLNRORD	4	4	3	5	5	5	4	2	4	36
Communications: Signage	Phase Three Recommendation: 14.1.3 Methods and Tools: Signs	4	3	4	5	5	5	4	2	4	36

Implementation Option	Source of Recommendation/Reference	Impact	Resources Required	Independent Benefits	Adoptability	Comprehensiveness	Community interest	Flexibility	Potential Partnerships and Support	Fairness and Equity	Priority Ranking
Map Highly Vulnerable Areas (HVAs) at a Scale Suitable for Planning Use	Phase Three Recommendation: 14.5: Legislative Review	4	2	3	5	4	5	5	3	4	35
Map Significant Groundwater Recharge Areas (SGRAs) at a Scale Suitable for Planning	Phase Three Recommendation: 14.5: Legislative Review	4	2	3	5	5	4	5	3	4	35
Council Policy: Hydrogeological Assessment Requirements for Rezoning Un-serviced Lands and for Development Permits	NEW: RDN, MFLNRORD	5	3	3	5	3	4	4	4	4	35
Communications: Outgoing Messaging	14.1.3 Methods and Tools: Fact Sheets and Technical Resources, Highlands Newsletter and Brochures	4	2	3	4	5	5	5	3	4	35
South Highlands Local Area Plan	NEW	4	4	3	5	5	5	3	1	4	34
Encourage Private Well Owners to Test Wells	Phase Three Recommendation: 14.2.2: Groundwater Quality Monitoring, Phase Three Recommendation: 14.4: Database System, Phase Three Recommendation: 14.1: Public Education and Communications	4	3	3	5	2	4	5	3	4	33
Incorporate Groundwater Protection Tools in OCP Update	Phase Three Recommendations: 14.5: Legislative Review, 10:1.1: Official Community Plan (OCP), 10.1.3: Development Permit Areas, 11.1.1: OCP, 11.1.3: Development Permit Areas	5	4	3	5	5	3	2	1	4	32
Communications: Online Resources	Phase Three Recommendation: 14.1.3 Methods and Tools: Website and On-line Resources, Reports and Studies	4	2	2	5	5	4	4	1	4	31
Water Stewardship Program (Incentive Program)	Phase Three Recommendation: 10.3: Market Approaches, 10.2.3 Rainwater Harvesting, 11.3: Market Approaches, 10.3: Market Approaches, 12.2.3 Preliminary Contingency Planning - Rainwater	5	2	5	2	5	5	2	1	4	31

Implementation Option	Source of Recommendation/Reference	Impact	Resources Required	Independent Benefits	Adoptability	Comprehensiveness	Community interest	Flexibility	Potential Partnerships and Support	Fairness and Equity	Priority Ranking
Monitor Water Quality Near Contaminated Sites	NEW: MFLNRORD	4	2	3	4	3	5	4	3	3	31
Update Subdivision Servicing Bylaw	Phase Three Recommendation: 10.1.4: Bylaws, ELC	5	1	3	5	5	4	2	1	4	30
Water Budgets	NEW: Islands Trust, GW	4	2	2	4	4	4	4	2	4	30
Collect Groundwater Level Data: detailed water-level monitoring in the areas of monitoring well DOH-05 and DOH-10	Phase Three Recommendation: 14.2.1: Water-Level Monitoring	4	2	2	4	4	4	3	4	3	30
Technical Assistance Programs: Bear Mountain Comprehensive Development	Phase Three Recommendation: 14.3: Contaminant Inventory Review, 11.2.2.2: Technical Assistance Programs: Bear Mountain Comprehensive Development	4	3	3	4	3	4	3	2	2	28
Collect Groundwater Level Data: investigate northwest-trending lineament in the area of the Bear Mountain Golf Course	Phase Three Recommendation: 14.2.1: Water-Level Monitoring	5	4	2	3	3	4	2	2	3	28
Require follow-up report with riparian DVPs	NEW: Councilor Baird	4	3	4	4	4	3	4	1	1	28
Work with Property Owners to Manage Contaminants	Phase Three Recommendation: 14.3: Contaminant Inventory Review, 11.2.2.1: Technical Assistance Programs: Commercial/Industrial Properties	5	2	4	2	3	3	4	2	2	27
Require follow up report for riparian development variance permits	NEW: Councilor Baird	4	3	3	4	4	3	4	1	1	27
Events, workshops, seminars education programs	Phase Three Recommendation: 14.1.3 Methods and Tools: Educational Programs, Public Presentations, Seminars, and Workshops	4	2	1	2	4	4	4	2	3	26
Pesticide Bylaw	ELC	4	3	3	4	2	3	2	1	4	26

Implementation Option	Source of Recommendation/Reference	Impact	Resources Required	Independent Benefits	Adoptability	Comprehensiveness	Community interest	Flexibility	Potential Partnerships and Support	Fairness and Equity	Priority Ranking
Household Hazardous Waste Collection	Phase Three Recommendation: 14.3: Contaminant Inventory Review, 11.2.3: Technical Assistance Programs - Household Hazardous Waste	4	1	4	2	2	4	2	2	4	25
Run-off Control & Impermeable Areas Regulations	ELC	4	3	3	4	3	2	2	1	3	25
Landscape and Irrigation Bylaw	Phase Three Recommendation: 10.1.4: Bylaws, ELC	4	3	3	4	2	2	3	1	3	25
Tax Rebates for Stewardship Actions	Phase Three Recommendations: Market Approaches	4	3	1	1	4	4	2	1	3	23
Pledge and Commitments	Phase Three Recommendation: 1.1 Effective Leadership and Committed Participants	1	3	3	4	1	4	2	2	3	23
Declare the natural watercourses within the District to be natural water infrastructure	NEW: Councilor McLean	4	2	2	2	4	3	1	1	4	23
Septic and Fuel Tank Bylaw	Phase Three Recommendation: 11.1.4: Bylaws, ELC	4	3	4	3	2	1	2	2	1	22
Bylaw Requiring Unused Wells or Closed or Upgraded	Phase Three Recommendation: 11.1.4: Bylaws, ELC	5	3	4	3	1	1	2	2	1	22
Watercourse Protection Bylaw	ELC	4	1	3	2	3	3	2	1	3	22
Contaminant Inventory: Bear Mountain, home-based businesses, hobby farms	Phase Three Recommendation: 14.3: Contaminant Inventory Review	4	2	3	2	3	1	2	2	3	22
Drill New Monitoring Wells to Replace Volunteer Wells	Phase Three Recommendation: 14.2.1: Water-Level Monitoring	4	1	1	4	3	3	1	1	4	22
Obtain Water Use Data: private wells/Audit of water use	Phase Three Recommendation: 2.3 Flow (Consumption) Data	4	1	3	2	2	1	2	2	3	20
Contaminant Inventory: residential	Phase Three Recommendation: 14.3: Contaminant Inventory Review	4	1	3	2	2	1	2	2	3	20
Develop and Maintain Database System	Phase Three Recommendation: 4. Database System	2	1	1	2	5	3	2	1	3	20

Implementation Option	Source of Recommendation/Reference	Impact	Resources Required	Independent Benefits	Adoptability	Comprehensive-ness	Community interest	Flexibility	Potential Partnerships and Support	Fairness and Equity	Priority Ranking
Riparian Areas Regulations	ELC	2	3	3	2	1	2	2	1	3	19
Re-zone Land in Wellhead Protection Areas (WHPA) and SGRAs	Phase Three Recommendations: 10.1.2: Zoning and Land Use Designations	5	1	1	2	3	1	1	1	4	19

5) Groundwater Status Update

Water quantity

- Based on the BC Provincial Well Database, within the District of Highland, there are approximately 837 wells from which 726 are drilled in bedrock, 58 in overburden, and 14 wells are unknown. The maximum depth of overburden wells is 150 ft. whereas the maximum depth of bedrock wells is over 350 ft.
- Within the District of Highland there are 14 groundwater monitoring stations at the 10 different locations plus one provincial observation well (ID: OW 372). The District of Highland has collected continuous water level data since 2011 in the 6 wells (DOH 01, DOH 02A, DOH 03, DOH 04B, DOH 07B, DOH 09A). The Provincial observation well (OW 372) has continuous data since 2007.
- The available water level data within the District of Highlands together with daily precipitation data from nearby stations (Victoria Intl A BC 51337 and Saanichton CDA BC 87) were studied.
- Static water-levels in the Highlands monitoring wells generally follows the seasonal precipitation patterns. Water-levels are generally high during the wet season between November and April, declining during relatively drier months from May to September and increasing between September and November in response to the onset of the wet season.
- The seasonal responses were relatively greater in monitoring wells located at higher elevations suggesting a stronger dependency to precipitation events. For instance, the difference in water-levels between the wet season and the dry season is approximately 17 m in DOH-02A, and 9 m in DOH-101, located at 220 m and 260 m elevation, respectively. However, lower amplitude seasonal water-level fluctuations were observed in wells located at lower elevations. For example, fluctuation of 2 m in DOH-03 (elevation: 79.4 m) and 5 m in DOH-09A (103.4 m) were observed. DOH-09A is located near Eagles Lake and DOH 03 close to Mill Stream.
- The cumulative precipitation departure (CPD) from average is a concept utilized to evaluate the temporal correlation of precipitation with surface water or groundwater levels. The CPD method was applied to the groundwater level information. A strong correlation with precipitation was observed in the all wells. Water levels for the headwater wells such as DOH-04B, DOH-07B and DOH-09A follows the exact pattern of precipitation. However, water level in observation wells located downgradient (DOH-03, DOH-02A and OW 372) shows a deviation of water level patterns from precipitation starting in 2017. This suggest that other factors such as water consumption and change in land use may have caused water levels to deviate from climatic factors.
- There is lack of groundwater level information at the center of District of Highland area (ex, location of DOH 05, DOH 06 and DOH 08). This should be further addressed by adding monitoring locations.

Water quality

- The District of Highlands provided water quality data (data from 2007) for 9 wells/piezometers (GW-DOH-01, GW-DOH-02A, GW-DOH-02B, GW-DOH-03, GW-DOH-04A, GW-DOH-05, GW-DOH-06, GW-DOH-07A, GW-DOH-08, GW-DOH-09B, and GW-DOH-10).
- The water quality results at the monitoring wells were cleaned, standardized, and integrated with EMS (BC Environmental Monitoring System) water quality data into GW Solutions water quality platform. EMS is the main source of information for surface water quality results.

- The groundwater quality results show the guideline exceedances (referring to the Canadian Drinking Water Quality Guideline - CDWQG) for Total Manganese, Total Iron, Total Dissolved Solids, pH, Coliforms (total, Fecal), Temperature and color. This is summarized below (table).
- The surface water quality results show the guideline exceedances (CDWQG) for Aluminum Total, Antimony Total, Arsenic Total, Cadmium Total, Iron Total, Lead Total, Manganese Total, Selenium Total, Color, pH, Coliforms – Fecal, total and Streptococcus. Most of the data corresponds to lake and ponds; therefore, more parameters exceeding the drinking water quality guideline were observed for this group.

Table B- 8: Wells exceeding the Canadian Drinking Water Quality Guideline


Parameters exceeding DW guideline	Monitoring station	Parameters exceeding DW guideline	Monitoring station	
Coliform - Total (MPN/100mL)	GW-DOH-01	pH (pH)	GW-DOH-02A	
	GW-DOH-02A		GW-DOH-02B	
	GW-DOH-02B		GW-DOH-03	
	GW-DOH-03		GW-DOH-04A	
	GW-DOH-04A		GW-DOH-05	
	GW-DOH-05		GW-DOH-06	
	GW-DOH-06		GW-DOH-07A	
	GW-DOH-07A		GW-DOH-08	
	GW-DOH-08		GW-DOH-09B	
	GW-DOH-09B		GW-DOH-10	
Coliform - Fecal (CFU/100mL)	E267282 (OW 372)	Iron Total (mg/L)	E267282 (OW 372)	
Coliform - Total (CFU/100mL)	E267282 (OW 372)		GW-DOH-01	
Manganese Total (mg/L)	E267282 (OW 372)		GW-DOH-02A	
	GW-DOH-01		GW-DOH-02B	
	GW-DOH-02A		GW-DOH-03	
	GW-DOH-02B		GW-DOH-04A	
	GW-DOH-03		GW-DOH-05	
	GW-DOH-04A		GW-DOH-09B	
	GW-DOH-05		Color True (Col.unit)	GW-DOH-02A
	GW-DOH-06		Temperature-Field (C)	GW-DOH-08
	GW-DOH-09B	Total Dissolved Solids (mg/L)	GW-DOH-03	
	GW-DOH-10			

Table 9: Number of surface water stations (lakes/ponds and river/creeks) exceeding the Canadian Drinking water quality guideline

Location Type / Exceedance Analysis GC-DW / Number of stations exceeding guideline				
Parameter Standard (Unit)	LAKE OR POND		RIVER,STREAM OR CREEK	
	Detection limit greater than guideline	It exceeds guideline	Detection limit greater than guideline	It exceeds guideline
Aluminum Total (mg/L)		10		
Antimony Total (mg/L)	31	2	1	
Arsenic Total (mg/L)	28	4	2	
Cadmium Total (mg/L)	23	12	2	
Iron Total (mg/L)		4		1
Lead Total (mg/L)	31	7	1	
Manganese Total (mg/L)		11		1
Selenium Total (mg/L)	29	9	1	
Color True (Col.unit)		17		1
pH (pH)		23		
Coliform - Fecal (CFU/100mL)	22	33		1
Coliform - Total (CFU/100mL)		6		
Streptococcus -Fecal (CFU/100mL)		2		

Groundwater Monitoring

A gap in groundwater monitoring has been noticed in the central part of the District of Highlands, as shown in Figure B-3.below. It is recommended to add the monitoring wells with yellow square symbols to the monitoring program.

 It is recommended to monitor water levels.

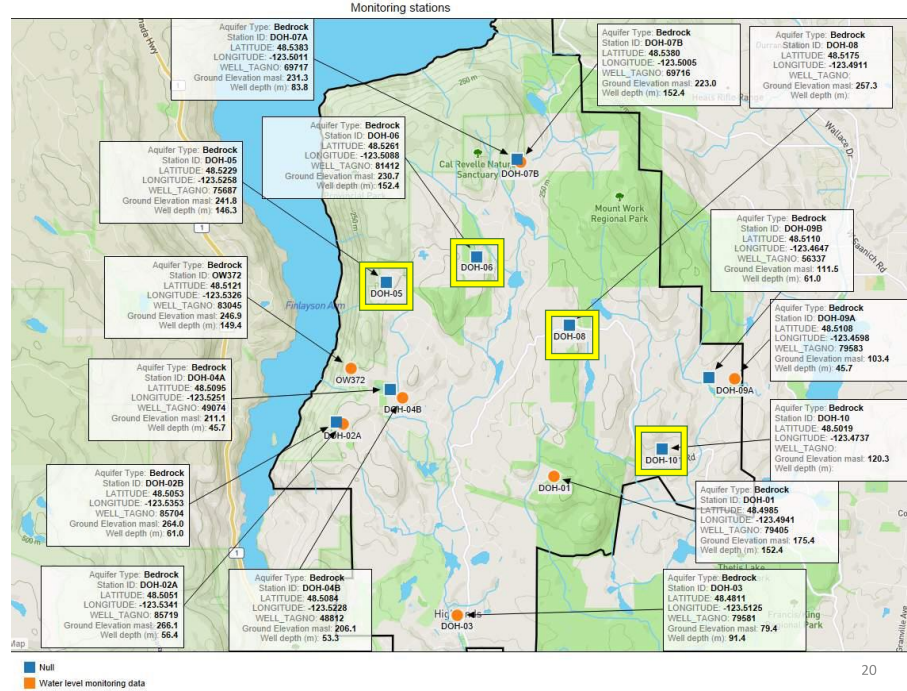


Figure B-3: Proposed Locations for New Groundwater Monitoring Wells

6) Draft and Finalize Groundwater Protection Work Plan

A draft work plan was developed and provided to staff for review and comment. This was then provided to the District of Highlands Council for review and comment.

At the District of Highlands Council’s Committee of the Whole meeting on September 9, 2019, the Elucidate Consulting team presented a draft Groundwater Protection Work Plan to Mayor and Council. In this presentation, the consulting team shared information on the development of the Work Plan and provided an overview of the recommended actions, sequencing, and resource needs.

Following the presentation, Mayor and Council posed questions on the plan and provided input on the draft Groundwater Protection Work Plan. Several community members also asked questions and provided feedback.

Following the meeting, community members were asked to review the draft plan (available on the District of Highlands website) and provide feedback by October 1, 2019.

Table B-6 provides a summary of all input received and the proposed approach to addressing feedback.

The consultant team took this input and developed a final Work Plan and Implementation Plan, to be presented to staff and Council by end of November 2019.

Appendix B: Work Plan Development

Table B-10: Feedback on Draft Work Plan and Recommended Approach to Addressing Feedback

Comment	Comment (Summary)	Recommended Approach to Address Feedback	Source/ Format	Comment (Full)
1	<p>The District and consultant should be aware that the Community Charter has provisions which allow a municipality to make a watercourse part of the municipal drainage system, whether the watercourse is on municipal land, private land or a highway.</p>	<p>This is an interesting option and there are aspects of this tool that could be useful (e.g. may support access to different funding sources, allow for the use of different regulatory tools such as source control bylaws). But it would likely take a fair amount of effort to initiate and implement (the District would need to develop a role in drainage and demonstrate that they are proposing works in the near future). Success of this approach would be reliant on District of Highlands resources, which are currently very limited. It is recommended that this approach is included in the list of implementation options and assessed according to the prioritization matrix. The implementation options that scored well in the prioritization matrix scheme tended to be fairly direct and easy to implement, so this may not rank as a priority tool. If it is identified as a lower priority option, it is recommended to include this (and the other options from Golder and the ELC that rated lower using the prioritization framework) in an appendix as a 'toolbox'. It is important to identify these options as available, so that they can be used in the future, as needed, if conditions change.</p>	<p>Email, Council meeting</p>	<p>A municipality has the ability to declare the natural watercourses etc. within their municipal jurisdiction of course as their natural water infrastructure ...All be it perhaps needing further investigating, it appears the opportunity might still be there under the Community Charter section 69 (a)-(d) in particular (d), and, 70. <i>Specific authority in relation to drainage, sewage and dikes</i> <i>69 A council may, by bylaw, do one or more of the following:</i> <i>(a)in relation to drainage and sewerage works provided by persons other than the municipality,</i> <i>(i)regulate their design and installation, and</i> <i>(ii)require property owners to connect their buildings and structures to the works in the manner specified in the bylaw;</i> <i>(b)impose requirements on persons undertaking the construction of works to</i> <i>(i)maintain the proper flow of water in a stream, ditch, drain or sewer in the municipality, or</i> <i>(ii)reclaim or protect part of the land mass of the municipality from erosion by any cause;</i> <i>(c)impose requirements on the owners of dikes or persons undertaking the construction of dikes;</i> <i>(d)make a watercourse part of the municipal drainage system, whether the watercourse is on municipal land, private land or a highway.</i> <i>Drainage control</i> <i>70 (1)This section applies if a council</i> <i>(a)considers that, in the public interest,</i> <i>(i)the drainage of surface water from outside the municipality into or through an area inside the municipality should be prevented, diverted or improved, or</i> <i>(ii)drainage of or from an area in the municipality should be prevented, continued beyond the municipality, diverted or improved, and</i> <i>(b)proposes to undertake works for these purposes.</i> <i>(2)Before undertaking the proposed works, the council must</i> <i>(a)serve notice of its intention on all owners of land that may be affected,</i> <i>(b)give notice of its intention to any other local government whose area may be affected, and</i> <i>(c)provide an opportunity for persons who consider they are affected by the works to make representations to council.</i> <i>(3)After complying with subsection (2), the municipality may enter on property, including property outside the municipality, for the purpose of undertaking the proposed works.</i> <i>Orders and awards respecting drainage or reclamation works</i></p>

Appendix B: Work Plan Development

Comment	Comment (Summary)	Recommended Approach to Address Feedback	Source/ Format	Comment (Full)
2	<p>Consider the invitation the District received from the Songhees Nation to participate in the Colquitz/Gorge Watershed Special Management Area (SMA) Project (Craigflower drains into the Gorge). Support opportunities to collaborate with Songhees in the protection of surface water/salmon/rivers.</p>	<p>In the initialization phase of the workplan, it is suggested that the Mayor reach out to the Chief of the Songhees Nation (and the other Nations with traditional territories in the Highlands) to express an interest in groundwater and surface water protection and see if there are any potential areas for collaboration. The Mayor should ask the First Nations if they would like to participate in the Advisory Committee or stay connected in another way. Currently, the Craigflower watershed is not included in the boundaries for the SMA, but that may change, as the Craigflower drains into the Gorge. If the SMA expands to include Craigflower then it will be valuable to collaborate and share information.</p>	Council meeting	Reference: see Colquitz/Gorge Watershed Special Management Area Concept Paper
3	<p>Focus more on action/policy to protect groundwater, than science. We have enough science to act, so we should prioritize action now (both policy and community stewardship work)</p>	<p>The intent of the work plan is to support action. It will be important to strike a balance between action and science because the information obtained from science gives us the power to act. Ongoing monitoring and mapping/study (as needed) can show changes and identify priority areas, then give us the tools to deal with them.</p> <p>To address this concern, move the net zero/water offset bylaw sooner in work plan. Create more clarity around the stewardship work so it is as easy as possible to implement. Also, dedicate some time to considering District-wide groundwater protection policies in the event that the scientific work/mapping is not done prior to the next OCP update. Also, determine if it is possible to do some of the proposed mapping with funding from this project.</p>	Email	<p>Hi Michael, I was chatting with Ingo Lambrecht on Sat while picking and pressing apples for the community and he wanted to make his comments from the CoW meeting clear. He said to me that he would like more focus on acting (creating policy to protect our water) than on more study. Sure, we need to keep up the whole monitoring program, but our focus now should be more on action and less on study. As you know, Ingo is one of the most experienced and qualified hydrogeologists in our region. We could always use more information, but we now have enough information (science) to act, meaning that the work plan should prioritize action (policy and community). Thanks for all your work on this, Ann</p>

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Comment	Comment (Summary)	Recommended Approach to Address Feedback	Source/ Format	Comment (Full)
4	Clarify requested actions under 'collaborate with emergency response planning'. Also, is this a suggestion to engage in a Risk and Vulnerability Assessment?	It is suggested that we provide more clarity in this section. We can provide an overview of the recommended emergency planning actions from the Phase 3 report and connect with Dean Ford (Fire Chief) to identify appropriate linkages to the Emergency Response Plan and the Emergency Program Strategic Plan. Although a risk and vulnerability assessment sounds like a valuable and informative exercise (which would likely highlight the value of groundwater protection), it was not proposed by Golder in their emergency response planning section.	Email	Could there be more clarification as to how the Emergency Response Planning is being or could be linked to groundwater protection? Example of what that scope would include would be useful. "Provide resources from Phase 3 report to Emergency Response Contractor"... - we have held off as a council from engaging in a Risk and Vulnerability assessment - are you (consultant) suggesting that the Emergency Response Contractor engage in a Risk and Vulnerability assessment as part of their workplan?
5	I have concerns about the will of council to enforce the Bear Mtn. MDA as it has been discussed many times over the 5 years. Will the report expand on the rationale as to the importance of such?	Keep the line about ensuring the implementation of the MDA in the work plan.	Email	I have concerns about the will of council to enforce the Bear Mtn. MDA as it has been discussed many times over the 5 years. Will the report expand on the rationale as to the importance of such?
6	Suggest requirement of follow up report on riparian DVPs to ensure compliance with limited enforcement resources.	Review riparian DVPs. If it seems that requiring a follow up report would help ensure compliance with legislative requirements and protect groundwater resources, then suggest this addition.	Email	Question to consultant - Enforcement and follow up of Riparian area development variances - just recently we discussed this (last week) and staff noted that the variances are never followed up on due to limited resources. Will options/recommendations be noted that can help address this - perhaps if there is a requirement on RAR DVPs that require a follow up report from the QP - thus placing cost upon the applicant to demonstrate that they followed the requirements of the DVP?

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Comment	Comment (Summary)	Recommended Approach to Address Feedback	Source/ Format	Comment (Full)
7	What is needed by staff to support the review of groundwater license application referrals?	Contact MFLNRORD to get clear information on any steps currently required to be sent referrals. Highlands staff have stated that the primary barrier is currently at the Provincial level and that additional resources are not required, beyond what is already identified in the workplan for 'Professional Expertise'. Consultant to check the resources identified in the 'Professional Expertise' section to ensure they are sufficient.	Email	Question to staff - Asking for referrals from the Province on Groundwater License had been a request in the past, last term. What would you need from the workplace to aid you in this process? Could having an engineering firm on retainer to review and comment on groundwater license applications be useful? We did speak to the Minister Responsible at a UBCM on this very topic and there was not pushback at that time... 4 years ago?
8	Should some DPAs be combined in the OCP update?	Staff have stated that there may be a need to combine DPAs in the next OCP update, but that a recommendation regarding <i>which</i> DPAs to combine is beyond the scope of this work. The ELC gap analysis has a recommendation regarding which DPAs should be combined. We will review the DPAs to see if this is applicable, and if so, add this recommendation as a note in the workplan.	Email	OCP - Will the work plan make recommendations as to rolling in some Development Permit Areas to simplify policy?
9	There are updated guidelines for use of rainwater inside homes that are currently under review. There were also updates to the SSR to include greywater and composting toilet guidelines.	The team is aware of this. We will contact Councillor Baird to ensure that we fully understand this comment and how he is suggesting these guidelines are considered in the work plan. There may be a linkage to the secondary suite conversation.	Email	Comment to consultant - With regard to stewardship, a reminder that there is the Rainwater Harvesting National Standard (May 2018) CSA/ICC B805-18, the Provincial draft guidelines are under public review, and there is the updated Sewerage System Regulations that includes the newest greywater and composting toilets guidelines (July 2016).

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Comment	Comment (Summary)	Recommended Approach to Address Feedback	Source/ Format	Comment (Full)
10	Suggest supporting private well owners in measuring their well, using District equipment	The District currently does not currently have equipment that could be made available. However, it would be helpful to obtain funding to buy equipment and have a 'tool library' that interested private well owners could use to measure water levels in their wells. If the District was able to purchase equipment under a 'community stewardship' program, there are several models available for equipment sharing (e.g. RDN). We will conduct research to identify tools and protocols which could be used to support private well owners in monitoring their water levels safely and with a reasonable degree of accuracy. If possible, this could be advantageous, as it supports community stewardship, raises awareness of groundwater, and provides additional (although lower quality) data.	Email	Comment to staff - I would add that the Districts well depth meter be offered to the community for use to measure well depth. Presently it is unused and policy, from my understanding, does not allow it to be signed out by the community.
11	STRENGTHS - Net Zero Bylaw, - Water Quality Data, - Pesticide Bylaw, - Aquarius wells - data, - Groundwater Sustainability TAC (I would add the HSF to the list)	Add HSF to the TAC list	Email	STRENGTHS - Net Zero Bylaw, - Water Quality Data, - Pesticide Bylaw, - Aquarius wells - data, - Groundwater Sustainability TAC (I would add the HSF to the list)

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Comment	Comment (Summary)	Recommended Approach to Address Feedback	Source/ Format	Comment (Full)
12	There is an interest in addressing Potential Contaminants of Concern (POCs), however, this has been requested before with little response. There are also concerns about current operations and their discharges.	Add a recommendation to update the Development Approval Information Area to recommend the identification of POCs in cases where commercial-industrial development is proposed. Conduct further research to identify approaches in other jurisdictions (e.g. the Cassidy Aquifer DPA) so that recommended actions can be as clear as possible. Where appropriate, provide further detail in the work plan and implementation report. For current operations, it may be most appropriate to contact the Conservation Officer Service. Source control bylaws would be appropriate if the Highlands played a role in stormwater management, but do not appear appropriate at this time.	Email	Comment to Staff - re: South Highlands Local Area Plan & contaminants Identification of Potential Contaminants of Concern. This was something I had asked for at a Variance request in some of the waterbodies as the housing would be having storm drains draining to water bodies, and the building materials have fire retardants, as well, staff has been requesting additional retardant sprays be applied thus enhancing retardant loading rates to water bodies. Also, we have at least one maintenance yard that does not have spill containment for their waste oils and antifreeze - of which we were toured through the yard 5 years ago.
13	Potential error in well numbers	Compare well numbers with Golder report and Ecoasis report and update as needed. Error not found in this report – may be in Golder or Ecoasis report.	Email	Error in Golder report Page 8, Paragraph 1 — says ‘pumping of wells 407,407 and 411’ I suspect it should be “ 405,407 and 411”.
14	In future water budget, ensure that water is not double counted. Of concern is the water that is shown as an extraction from the Bear Mountain irrigation wells and discharge to the creek. Given that their storage pond is leaking, some of the water is likely going back into the creek.	Add note in the water budget portion of the work plan	Council meeting	

Comment	Comment (Summary)	Recommended Approach to Address Feedback	Source/ Format	Comment (Full)
15	Bear Mountain irrigation wells are a large water use and their use should be noted.	Noted	Council meeting	
16	Suggest remove reference to enforcement of MDA as it is no longer relevant and there will be a replacement. Suggest Bear Mountain wells not having an impact.	Suggest 'ensure implementation of MDA' remains. If the MDA is to be revised, suggest that the DoH retains a hydrogeologist to provide clarity in MDA on how aquifer impacts should be assessed. Also, if the MDA is updated, ensure implementation of any updated MDA.	Email letter	<p>Re: Draft Groundwater Protection Implementation and Work Plan</p> <p>Dear Mr. Dillistone,</p> <p>Ecoasis Development LLP wishes to provide commentary on the above noted program, as offered by the District of Highlands.</p> <p>We note that enforcement of the Bear Mountain MDA is referenced in the work plan. It has been acknowledged by Ecoasis and the District that this MDA is no longer relevant to current conditions and requires an update. When the original document was drafted, the effects of the ground water use for golf course irrigation were not known. Since that time and in accordance with the Irrigation Plan submitted to the District in the spring of 2019, Ecoasis and its consulting team have implemented its own ground water monitoring program for the last 5 years (and have committed to do so on going) and have offered to share that information with District staff upon request.</p> <p>Ecoasis has committed to cease ground water use should deleterious aquifer draw down occur. To date no adverse effects of this practice has been identified.</p> <p>We also understand that the District has commissioned a third-party review of the reports submitted to the District by Ecoasis regarding the irrigation use. We trust that the District will provide us with an opportunity to review and comment on that analysis.</p> <p>To this end, Ecoasis requests that reference to the existing MDA be removed from the work plan until a new MDA has been drafted and adopted by Council. Otherwise, misinformation and inappropriate monitoring efforts may result.</p> <p>Best Regards,</p>  <p>Ryan Mogensen P.Eng. Land Development Manager Ecoasis Development LLP</p>

Appendix B: Work Plan Development

Comment	Comment (Summary)	Recommended Approach to Address Feedback	Source/ Format	Comment (Full)
17	Would like the District of Highlands to provide input on groundwater license application referrals	Provide enough detail in the work plan to support this action.	Council meeting	
18	Appreciate prioritization framework process	Include an overview of the approach in the report and details in an appendix	Council meeting	
19	The task 'Ensure implementation of Bear Mountain MDA' is important. Would like to see more information provided to the community on the impact of extraction from irrigation wells. Would like to see the results of the Golder review of the Ecoasis report.	This work is underway by Golder Associates and not yet complete.	Council meeting	
20	Suggestion that steep slopes have far more runoff and less recharge. Understanding recharge areas is useful.	This concept will be explored as part of recharge area mapping. Slopes and geology are key inputs in that work.	Council meeting	
21	See work by Diana Allen on upland surface water monitoring	Will investigate	Council meeting	

Appendix C: Figures



It is recommended to monitor water levels.

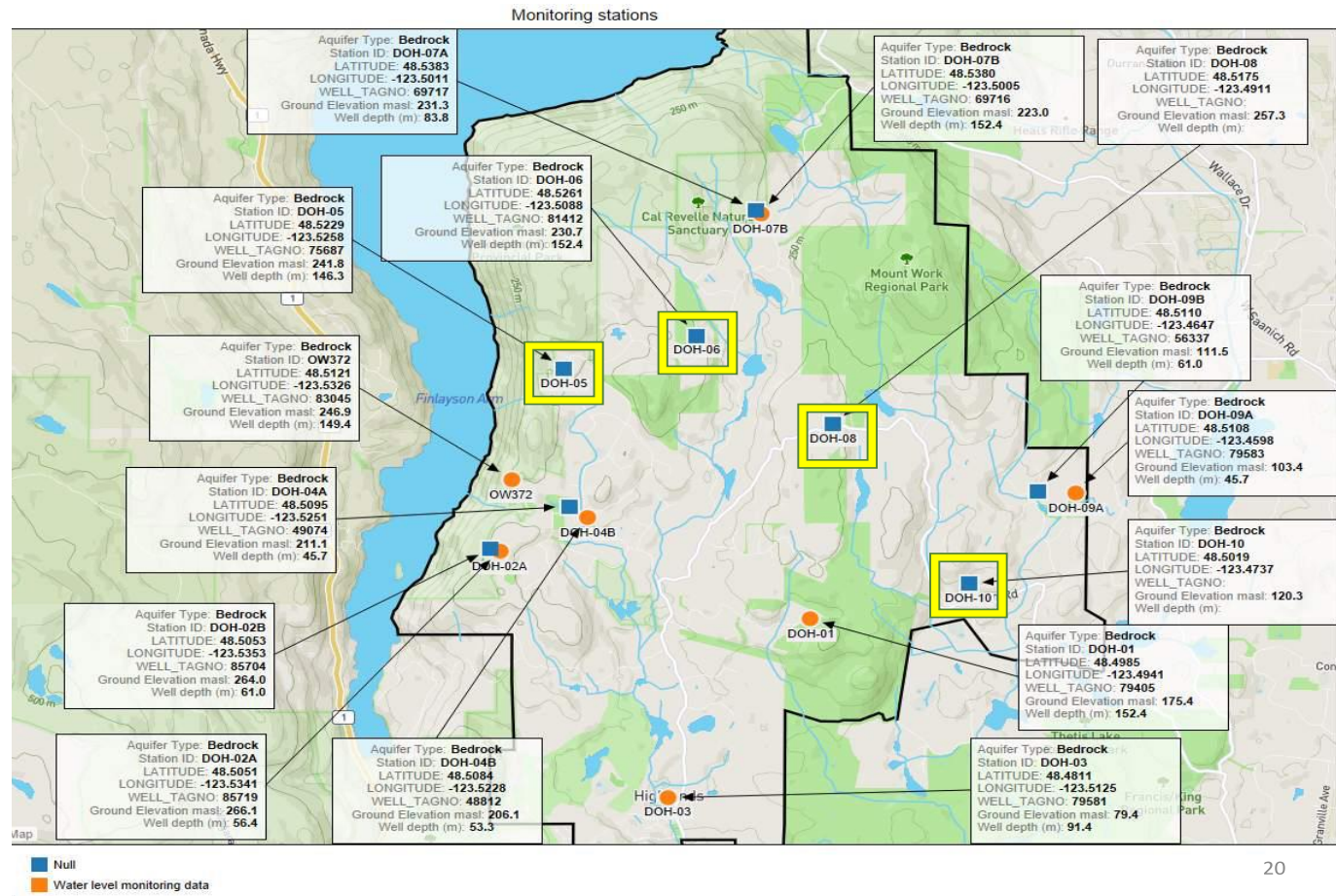


Figure C-2: Proposed Locations for New Groundwater Monitoring Wells

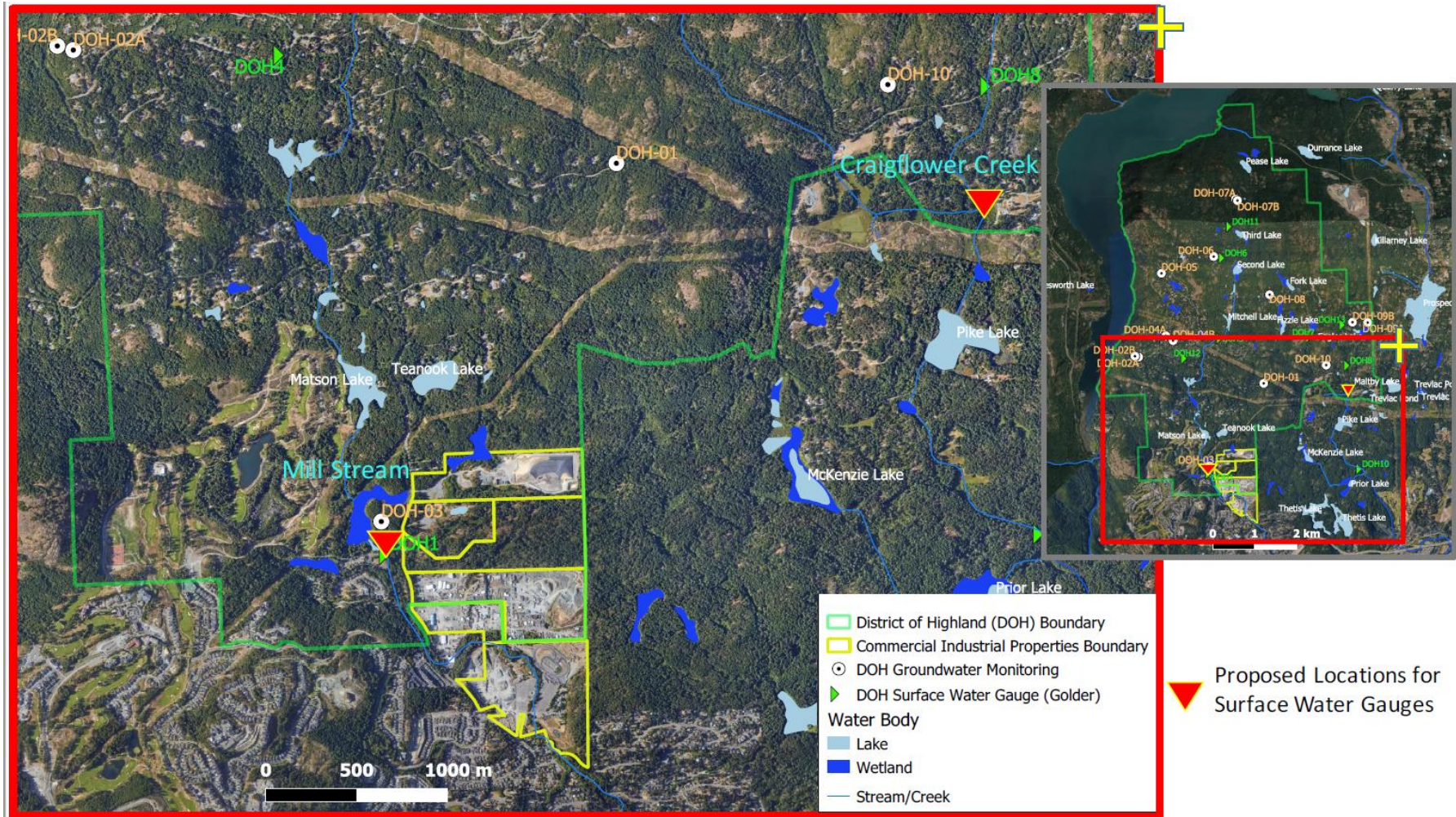


Figure C-3: Proposed Locations for Hydrometric Monitoring



Figure C-3: Example of Aquifer Protection Signage (Abbotsford/Mission Water and Sewer Commission (2012). Groundwater Management Strategy: Protection, Management and Governance (Report No. 10-1435-0013). Retrieved from <https://www.abbotsford.ca/Assets/201>



Figure C-4: Example of Aquifer Protection Signage (B.C. Ministry of Environment, Water and Sustainability Branch (2014). Underground Stormwater Infiltration: Best Practices for Protection of Groundwater in British Columbia. Retrieved from http://www.env.gov.bc.ca/wsd/plan_protect_sustain/groundwater/library/underground_stormwater_infiltration-2014.pdf



Figure C-6: Example of Aquifer Protection Signage (urbanworkbench. (2019). Groundwater Protection Zone. Retrieved from <https://www.flickr.com/photos/urbanworkbench/3623949644>)



Figure C-5: Example of Aquifer Protection Signage (Ohio Environmental Protection Agency. (2019). Retrieved from <https://epa.ohio.gov/ddagw/swap>)

Appendix D: Budget for a 10-Year Groundwater Protection Program

The following is a proposed budget for a sample 10-year groundwater protection program. This budget assumes the proposed work plan with the following time horizons:

- Short-Term Actions: Years 1-3
- Medium-Term Actions: Years 4-6
- Long-Term Actions: Years 7-10

The budget shows that the proposed work could be completed for an estimated average of \$45,000-\$50,000/year. This would require approximately \$50/year per property or a tax of approx. \$0.0444 per \$1,000 of net taxable value of land in the District.

Table D-1 provides a sample 10-year budget. Figure D-1 on the following page show the distribution by program area.

Table D-11: Sample 10-Year Budget

Total Costs	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	TOTAL	Average
Science	\$ 26,900	\$ 23,100	\$ 21,800	\$ 6,400	\$ 21,920	\$ 26,880	\$ 14,400	\$ 6,400	\$ 16,400	\$ 26,400	\$ 190,600	\$ 19,060
Planning	\$ 7,040	\$ 6,600	\$ 4,040	\$ 4,040	\$ 8,040	\$ 4,040	\$ 4,040	\$ 4,040	\$ 4,040	\$ 15,240	\$ 61,160	\$ 6,116
Community Stewardship	\$ 10,000	\$ 12,000	\$ 19,000	\$ 22,400	\$ 18,400	\$ 18,400	\$ 22,400	\$ 18,400	\$ 18,400	\$ 22,400	\$ 181,800	\$ 18,180
Total	\$ 43,940	\$ 41,700	\$ 44,840	\$ 32,840	\$ 48,360	\$ 49,320	\$ 40,840	\$ 28,840	\$ 38,840	\$ 64,040	\$ 433,560	\$ 43,356

**This budget assumes that non-technical work is done by contract staff, rather than consultants. If non-technical work was done by consultants, the program would cost an average of \$59,600/year.*

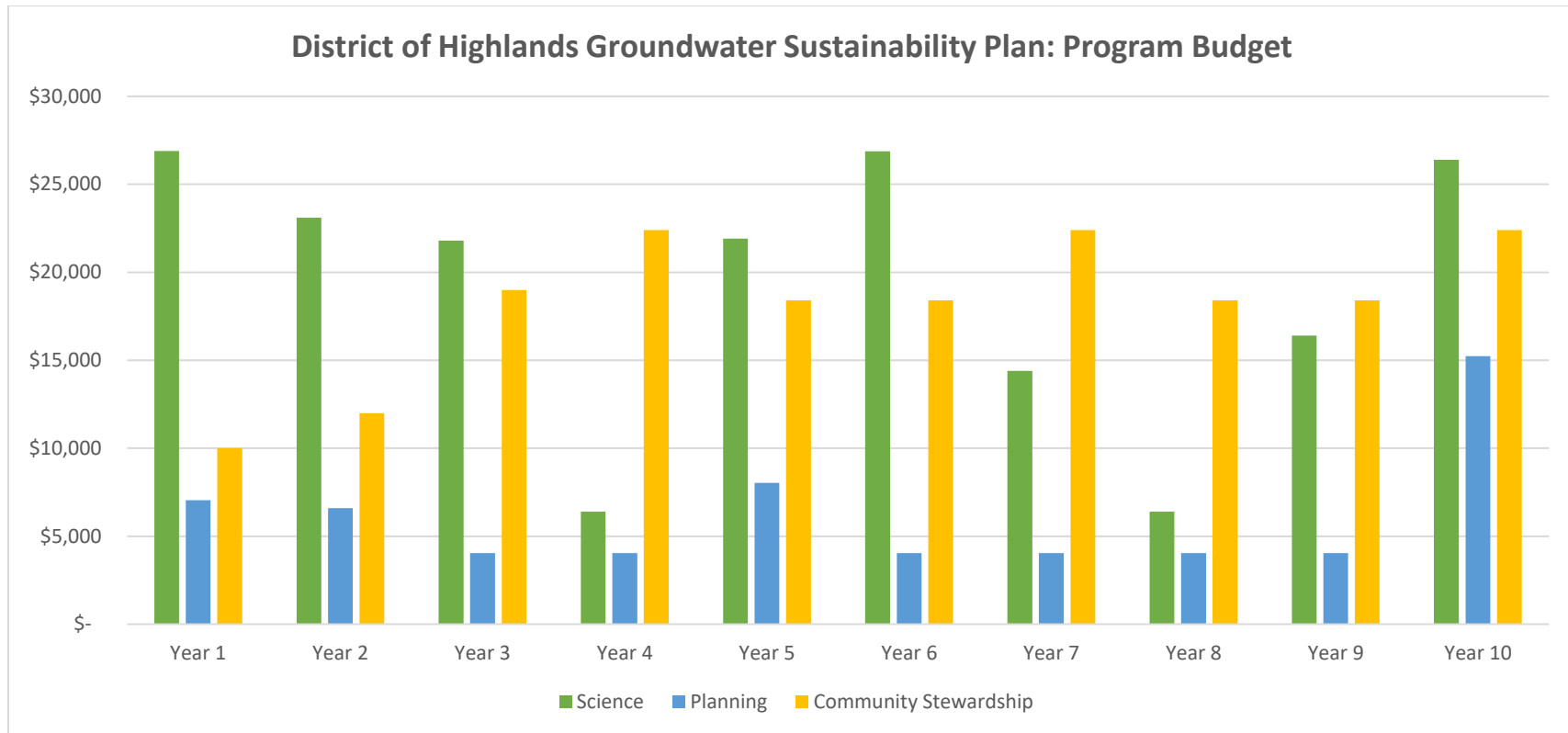


Figure D-7: Sample 10-Year Budget