



September 15, 2015

Project No: 15-1448

Attn: Patti Meger and Mike Mitchell  
District of Lake Country  
10150 Bottom Wood Lake Road  
Lake Country, BC V4V 2M1

**Subject: Source Water Assessment Implementation and Response Plans**

In 2010, the District of Lake Country (DLC) finalized a Source Water Assessment (SWA) of the Vernon and Oyama Creek watersheds<sup>1</sup>. The SWA identified current and/or future drinking water health hazard(s) and vulnerabilities, characterized the risk posed by each identified hazard, and provided recommendations to reduce the overall impacts on the drinking water source.

As a condition of the DLC's permit to operate, the Interior Health Authority (IHA) requires that all recommendations made in the SWA be officially addressed. To evaluate the status of each recommendation for both watersheds, watershed stakeholders were invited to participate in a planning meeting held on April 16<sup>th</sup>, 2015. Approximately 39 stakeholders from 25 different organizations were invited to participate. The meeting was facilitated by Jason Schleppe and Mary Ann Olson-Russello of Ecoscape Environmental Consultants Ltd., who were also the primary authors of the 2010 SWA. The meeting format encouraged open discussion amongst the stakeholders to identify progress made in addressing source protection, barriers or challenges to achieve recommendations, and general status updates or current concerns. Each SWA recommendation was reviewed and then responsible stakeholder parties were asked to provide an update as to what has been accomplished to date. If stakeholders were unable to attend the meeting, individuals were asked to provide a written update for pertinent recommendations. A list of stakeholders who participated in the April 16th, 2015 meeting is provided in Table 1.

Using the information collected during the stakeholder meeting, as well as follow-up discussion with stakeholders who could not participate, a summary table for each watershed was generated. Tables 2 and 3 include SWA recommendations, action items that have been undertaken or have yet to be completed, the responsible parties for

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<sup>1</sup> Olson-Russello, M.A. and Schleppe, J. 2010. Oyama and Vernon Creek Source Water Assessment. Prepared for: District of Lake Country. Prepared by: Ecoscape Environmental Consultants Ltd. File: 09-367 / 09-415.



each recommendation and a suggested timeframe for completing outstanding actions for both the Vernon and Oyama Creek watersheds, respectively.

**Table 1. Stakeholder Representatives Who Participated in the April 16<sup>th</sup> Meeting**

<b>Name</b>	<b>Organization</b>
Gordon Moseley	Interior Health Authority
Paul Dupuis	District of Lake Country
Blake Dixon	Ministry of Transportation and Infrastructure
Bruce Williams	Dee Lake Resort
Margaret Bakelaar	Regional District of Central Okanagan
Brad McKim	Coldstream Ranch
Renee Clark	Regional District of North Okanagan
Rob Dinwoodie	Forests, Lands and Natural Resource Operations
Kevin Bennett	Eldorado Ranch
Eddy Davis	Okanagan Indian Band
Keith Louis	Okanagan Indian Band
Mike Kamann	Okanagan Fish and Game Club
Mike Mitchell	District of Lake Country
Patti Meger	District of Lake Country
Nelson Jatel	Okanagan Basin Water Board
Harold Waters (provided comments prior to the meeting)	Tolko

\*Participants are listed in order of sign-in

In addition to the specific action items that were identified to address the SWA recommendations, other ideas/topics for general improvement to source water were discussed and included:

- **Governance Concerns** – Source water protection is the responsibility of individual stakeholders, yet many of the watershed activities are outside of stakeholder jurisdictional control, or it is unclear who has ultimate jurisdiction. There is a need for enhanced support from higher levels of government to ensure watershed activities do not impact source water. A letter from the various stakeholder groups (including regional districts and First Nations) to the Province that outlines the top watershed priorities may be a critical step forward to implementing provincial standards and change.
- **Stakeholder Planning Meetings** – The importance of bringing the various stakeholders together to discuss watershed issues should not be understated. Working collaboratively is much more efficient, both in terms of time and cost, than working as individual organizations or entities. Biannual meetings were discussed, with one of those consisting of an on the ground field tour.
- **Stakeholder Fatigue and Cost Sharing** – Joint watershed meetings were proposed to reduce costs and stakeholder fatigue, as many of the issues identified in the DLC community watersheds are similar to those occurring in local irrigations districts of other municipalities. This is especially important for watersheds that have large stakeholder overlap.



- Forest Fire Emergency Response – A list of watershed stakeholders and partner agencies with contact information and alternative contacts should be updated on an annual basis to ensure there is a mechanism in place to rapidly notify stakeholders of emergency planning.
- Forest Fire Response Plans - Firefighting measures typically include the use of fire retardants and water extraction from area reservoirs. Both of these activities have the potential to affect source water over the short and long-term. There is a need for active and immediate communication between firefighting personnel and the water purveyor.

Individual watershed stakeholders were asked to review Tables 2 and 3 for accuracy and completeness, as well as to identify additional action items to lessen the impact on source water. Stakeholder comments were collected over a 3-week period and were incorporated into the summary tables. These summary tables are to be revisited on an annual basis and stakeholders will be asked to report on works that have been undertaken since the previous year.

Most of the Action Items that are identified in Tables 2 and 3 are derived from best management practices (BMPs) or from provincial and municipal regulations. Links to guidance documents are provided for reference.

**Range BMPs:**

<https://www.for.gov.bc.ca/hra/Publications/practices/RangelandWaterBMP.pdf>

**Provincial Regulations:**

<https://www.for.gov.bc.ca/hra/practices/index.htm>

[http://www.env.gov.bc.ca/okanagan/documents/BMPBoat\\_LaunchDraft.pdf](http://www.env.gov.bc.ca/okanagan/documents/BMPBoat_LaunchDraft.pdf)

<http://www.env.gov.bc.ca/wld/instreamworks/generalBMPs.htm>

**Forest Stewardship Plans:**

Tolko: <http://tolko.com/responsibility/certification-stewardship/okanagan-woodlands>

BC Timber Sales: [https://www.for.gov.bc.ca/bcts/areas/toc/toc\\_FSP.htm](https://www.for.gov.bc.ca/bcts/areas/toc/toc_FSP.htm)

<https://www.for.gov.bc.ca/ftp/TOC/external/!publish/Forest%20Stewardship%20Plan/BCTS-FSP/FSP-Consolodated-Text.pdf>

**Forest and Range Practices Act:**

<https://www.for.gov.bc.ca/tasb/legsregs/frpa/frparegs/>

**Bill 18: Water Sustainability Act of BC:**

<http://engage.gov.bc.ca/watersustainabilityact/the-proposal/>

**Drinking Water Protection Act of BC:**

[http://www.bclaws.ca/civix/document/id/complete/statreg/200\\_2003](http://www.bclaws.ca/civix/document/id/complete/statreg/200_2003)



**Guidelines for Canadian Drinking Water Quality:**

<http://www.hc-sc.gc.ca/ewh-semt/water-eau/drink-potab/guide/index-eng.php>

**District of Lake Country Guidance Documents:**

Potable Water Supply Emergency Response Plan: A Guideline for Response. Prepared by District of Lake Country. Last Revised 9/10/2015.

Water Quality Sampling Plan. 2015. Protocol for Water Quality Monitoring and Reporting. Prepared by District of Lake Country. Last Revised 6/16/2015.

Oyama and Vernon Creek Source Water Assessment including vulnerability Zones:

<https://lakecountry.civicweb.net/Documents/DocumentList.aspx?ID=5868>

Protection of source water is the responsibility all watershed stakeholders. This work brings the Oyama and Vernon Creek watersheds one step closer to ensuring source water quality.

Respectfully Submitted,  
ECOSCAPE Environmental Consultants Ltd.

Mary Ann Olson-Russello, M.Sc., R.P.Bio.  
Natural Resource Biologist  
Direct Line: (250) 491-7337 ext.205

Jason Schleppe, M.Sc., R.P.Bio.  
Natural Resource Biologist  
Direct Line: (250) 491-7337 ext.202



**Table 2 - Summary of Source Water Assessment (SWA) Recommendations and Stakeholder Action Items Undertaken in the VERNON CREEK Watershed (as of September 2015).**

Contaminant Source Type, Description and Risk Level (as defined by SWA)	SWA Recommendation	Action Items	Responsible Parties	Suggested Timeframe
Range Tenures - Cattle presence at the Vernon Creek intake (Very High)	Fencing should be used to entirely eliminate cattle from the Vernon Creek intake.	Completed in 2010, District of Lake Country (DLC), in collaboration with Eldorado Ranch and Coldstream Ranch contributed to fencing costs to eliminate cattle access from the immediate proximity of the Vernon Creek intake. Coldstream Ranch maintains the fencing and there is a dedicated full-time cowboy that oversees the area. The total cost of the fencing (\$36,000) was split three ways by the responsible parties. A good working relationship was highlighted between the responsible party stakeholders.	DLC, Eldorado Ranch & Coldstream Ranch	Complete
Range Tenures - There were a number of highlighted cattle issues within the SWA including: 1. High cattle densities were observed below the Swalwell Reservoir in the low lying treed area adjacent to a large floodplain (Very High) 2. Cattle utilizing non-status roads and trails to access Vernon Creek (Very High) 3. Cattle accessing Vernon Creek from Beaver Lake Main via ephemeral creeks and drainage channels (High)	A fence should be constructed along the top of bank from the intake all the way to Swalwell Reservoir in order to exclude cattle from the Vernon Creek canyon.	Constructing a fence along the entire canyon from Swalwell Reservoir to the Vernon Creek intake was not considered a practical solution due to the financial resources required to undertake such a project. Alternatively, the following action items were undertaken, with the assumption that the highest risk sites occur between Swalwell Reservoir and the intake, and that cattle access to the reservoir is less of a concern due to the residence time and likelihood that the reservoir acts as a buffer: 1. Best Management Practices (BMPs) for range operations on Crown land within community watersheds was developed in 2011 and was immediately applied to the Vernon Creek watershed. On-going monitoring is necessary to document BMPs and how well they are working within the watershed. 2. In 2010, a range pasture boundary fence was constructed between Swalwell Reservoir and Kelowna Creek. It separates Vernon Creek watershed from the Postill watershed and ensures that livestock are contained within their respective watershed. The contiguous fence extends from Vernon Creek to Kelowna Creek in a north/south direction. This fence should be monitored on an annual basis to ensure functionality. 3. Cattle stocking rates were reduced so that the number of cattle at each pasture was cut in half (reduced from 600 to 300 cow/calf pairs). 4. A silvopasture pilot project began in 2011 and is in its fourth year with the goal of drawing cattle away from sensitive riparian areas and improving water quality. It is an integrated management of forestry and livestock with conservation practices to protect drinking water while also promoting industry. 5. A research project headed by the UBCO Engineering Department, is sampling <i>Escherichia coli</i> and <i>Cryptosporidium</i> within the Vernon Creek watershed to test livestock best management practices and virulence of the organisms.	Ministry of Forests & Range, UBCO Engineering Department, Silvopasture Pilot Partners include Ministry of Agriculture, FLNRO, Agriculture and Agri-Food Canada, RDCO, Coldstream Ranch, Tolko Industries Ltd., OBWB, Legerwood Natural Resources Inc., BC Cattlemen's Association, Farmland Riparian Interface Stewardship Program, AgForInsight.com	1. Ongoing 2. Ongoing 3. Complete 4. Ongoing 5. Ongoing
Slope failure/debris flows - Evidence of seven landslides upstream of the Vernon Creek intake	A detailed assessment and mapping of terrain features should be undertaken between Swalwell Reservoir and the intake. Macintosh Properties should be notified of the landslides within their property and permission should be granted to inspect them.	This recommendation was completed in 2012 with the Vernon Creek Landslide Mapping, Risk Assessment and Restoration Planning study that was completed by the DLC with funding from the Okanagan Basin Water Board (OBWB \$10,300/DLC \$3,000). Recommended restoration sites included landslide 17 (highest priority), 2 & 8. Subsequent mitigation was completed in November 2012 on site 17 (debris Jam). Mitigation works for sites 2 & 8 were completed in September 2013. Participating partners: DLC ~\$2,900, Ecoscape and Clarke Geoscience \$2,500 in-kind contributions, Interior Land Reclamation (ILR) provided in-kind support planning, on-site monitoring, volunteer planting time (through the Oceola Fish and Game Club) and native planting materials at cost. Landslides and log jams within the Vernon Creek canyon should be regularly monitored to identify the presence of newly developed issues.	DLC	Assessment and landslide rehabilitation complete, but monitoring is ongoing

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Slope failure/debris flows - location, integrity and vulnerability of Vernon Creek Intake (Very High)	An assessment of possible intake locations should be undertaken to determine if there are other more favorable sites.	This recommendation was completed in the spring of 2012 via a visual inspection of the Vernon Creek canyon from Swalwell Reservoir to the intake from a helicopter. Based on this assessment, the DLC does not believe there is a more favorable intake location. During this flight, it was also determined that road drainage needs to be prevented from arriving at the intake location.	DLC	Complete
Forestry -Harvesting within sensitive Lakeshore Management Zones (LMZs) (Very High)	Forest harvesting should only occur within LMZs of reservoirs (Swalwell and Crooked) when the risk of wildfire and forest health factors out weigh the potential access issues and water quality impacts.	The Ministry of Forests is in the process of reviewing harvesting within Lakeshore Management Zones (LMZs). No applications will be approved within LMZs, until the review is complete. Small scale salvage operators have a licence to remove timber on a salvage basis and in the past have been allowed within LMZs. Site visits will be conducted prior to future approvals. DLC requests site visits within all LMZs and within all very high and high vulnerability zone areas. In addition, it was noted that Ministry staff will be arranging a field trip with DLC and RDNO to initiate further discussions surrounding forest harvesting in LMZs. Finally, it was noted that the lack of forest management within LMZs can also be an issue due to forest health issues (e.g. fir bark beetle can result in blow down and erosions issues).	Ministry of Forests, Small Scale Salvage Program, DLC, RDNO	Ongoing
Forestry - proposed harvest (High) and Natural characteristics of raw water - enhanced turbidity which results from the scouring of available source material as the channels fill during spring freshet and the level of snow pack influences freshet (High)	There should be no further salvage above the snowline until the ECA returns to a low range. Exceptions may include the need to manage for wildfire or forest health factors.	Proposed harvesting in 2015 is either below the snow sensitive zone or is for forest health salvage (pers. comm., Harold Waters, Tolko). The current ECA within the snow sensitive zone is approximately 45%. Action Items include: 1. DLC to send the watershed vulnerability shapefile to Tolko, as it will help with their future harvest planning.	Tolko and Small Scale Salvage Program	Immediately
Access and Recreation - Abandoned vehicle and hazardous material dumping at extensive landslide on Vernon Creek canyon (High)	The high risk non-status road that extends across the plateau and parallels the extensive landslide should be deactivated to prevent a variety of unsanctioned activities.	In August 2011 garbage and vehicles were extracted from the Vernon Creek canyon. A road inspection was conducted and the nonstatus road was deactivated. FLNRO authorized DLC to install barriers and provided signage advising of new regulations with \$100,000 fines, etc. The barriers and nonstatus road condition should be regularly monitored to ensure that the deactivation continues to be effective.	DLC, FLNRO	The nonstatus road has been deactivated, but monitoring is ongoing

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Contaminant Source Type, Description and Risk Level (as defined by SWA)	SWA Recommendation	Action Items	Responsible Parties	Suggested Timeframe
Stream Crossings and Roads - Stream crossings and roads within the watershed were identified as either Very High, High, Moderate or Low risk.	Very High and High risk roads should be addressed through a combination of improvements or deactivation on FSR's and other permitted roads, and preferably permanent deactivation in the case of non-status roads. Prescriptions prepared by qualified professionals should be required in all cases. Moderate and Low risk roads should continued to be monitored to ensure crossing functionality.	In September 2014, the DLC had a Road Drainage Assessment of the Vernon Creek Watershed commissioned with funding from OBWB. The report highlighted problems with blocked culverts and the need for ongoing maintenance. The report was provide to the following stakeholders: Director of Infrastructure Services and Roads and Utility Superintendents to review and develop action points, build strategy and develop a work plan . Action Items include annual follow-up on road conditions during June (wettest month) and on-going road maintenance as needed.	DLC, Tolko, Ministry of Transportation, Forest Investment Account (for non-status roads)	Initial road assessment complete, but ongoing road maintenance and follow-up on an annual basis is necessary
Access and Recreation - Unsanctioned campsite at Crooked Lake Dam (High)	The access to unsanctioned camping around the Crooked Lake Dam should either be decommissioned, or DLC should work with FLNRO (Recreation Sites and Trails BC) to re-establish a sanctioned recreational site.	The DLC and logging activities require driving access to the Crooked Lake Dam, therefore alternative solutions, other than road decommissioning, have been and continue to be sought. Ideally, unsanctioned camping should be prevented from occurring at the Crooked Lake Dam, as it has the potential to pose a threat to drinking water quality. Since the SWA, signage was installed, but it has since been vandalized. Ian McLellan (FLNRO, Recreation Sites and Trails, BC) has been notified that camping at Crooked Lake Dam is a concern, however resources are currently being applied to the expansion of the rec site at Island Lake. The following action items were brainstormed at the stakeholder meeting: 1. Informational signage that describes the importance of the source water, rather than regulatory signage, 2. FLNRO Recreation Sites and Trails BC should implement an access management plan to help ensure limited future recreational access in undesirable areas. 3. Given the importance of the dam's infrastructure, DLC will determine if fencing and signage can be used to block access, as there is legislation that supports access prevention when there is infrastructure that needs protected.	DLC, FLNRO Recreation Sites and Trails BC	Within 1 year
Human Access - integrity and vulnerability of Vernon Creek Intake (High)	Thought should be given to fortification, fencing, observation (e.g. closed circuit TV) and a shut down mechanism in the event of vandalism or intentional disruption of service.	Water from the Vernon Creek intake flows down to the Eldorado Reservoir where real-time turbidity monitoring data is collected. This allows the DLC to make immediate changes to the water distribution if there is elevated turbidity. Existing fortification includes a locked gate off of Beaver Lake Road and the intake building is also locked. Closed circuit television is not an option at the intake as solar is only available. Outstanding action items include: 1. signage off of Beaver Lake Road, stating, "Private Property, Do Not Enter", 2. Consider the possibility of installing an additional locked gate at the top of the hill above the intake.	DLC	Within 1 year

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Contaminant Source Type, Description and Risk Level (as defined by SWA)	SWA Recommendation	Action Items	Responsible Parties	Suggested Timeframe
Access and Recreation - Illegal Activities (High)	There should be additional resources put forth to deal with illegal activities, and watershed users should consistently report them.	<p>Illegal activities within the watershed are the responsibility of the RCMP, however it is noted that recreational pressures within the watershed are vastly growing. Currently there are not enough campsites to keep up with the recreational demand and as a result, users are camping in unsanctioned locations typically in close proximity to water (pers. comm., Ian McLellan). Action items include: 1. FLNRO (Recreation Sites and Trails BC) to develop a comprehensive recreational management plan for the Vernon Creek watershed, that considers the numerous sensitivities of the watershed including water quality concerns. 2. An increased level of compliance and enforcement action is also badly needed. 3. An increased level of public education is necessary to inform users of the importance of the watershed for drinking water.</p> <p>It is acknowledged that funding is limited, but opportunities do exist. For example, Vernon Creek watershed may be a good location for a pilot study, there may also be opportunities for local government/first nation controlled campsites.</p>	FLNRO (Recreation Sites and Trails BC), RDCO, DLC	<ol style="list-style-type: none"> <li>1. Within 1 year</li> <li>2. Immediately</li> <li>3. Immediately</li> </ol>
Access and Recreation - the presence of wildlife (including birds, mammals and fish) has resulted in excellent sport fishing and hunting opportunities (High)	Additional education (watershed signage, pamphlets, and stakeholder word of mouth) that informs watershed users of source waters and appropriate behaviors.	The education of Crown users is vitally important. Work by NORD and FLNRO (Recreation Sites and Trails, BC) is underway to develop a new educational pamphlet. Action items include: 1. RDCO and DLC to jointly development a regionally consistent education program, 2. Other opportunities include bumper stickers and pamphlets available through the off road vehicle licencing. 3. There would also be great value in an OBWB funded project to develop educational tools that could be distributed throughout the Okanagan Valley.	FLNRO, NORD, RDCO, DLC, OBWB	<ol style="list-style-type: none"> <li>1. Within 1 year</li> <li>2. Complete</li> <li>3. Within 1-3 yrs</li> </ol>
Mountain Pine Beetle - Vernon Creek watershed has extensive stands of lodgepole pine, which are highly susceptible to MPB (Moderate)	Major and minor licensees should critically evaluate the stands proposed for salvage and only log those stands which make the most sense from a MPB perspective.	Tolko and Small Scale Salvage operations currently follow this recommendation through field reconnaissance site visits to identify stand damage from insects and disease to aid in harvest planning decisions. Typically hydrological studies are undertaken approximately every 5 years and take into account planned harvesting.	Tolko & Small Scale Salvage Program	Ongoing
Access and Recreation - FLNRO regulated recreation camp sites (at Swalwell, Island & Lost Lakes) (Moderate)	Sediment point sources originating from access roads and boat launches were identified and should be addressed to reduce the potential affects on source water quality. The sites at Lost, Island and Swalwell all had minor erosion.	Point sediment sources from regulated recreation camp sites has yet to be addressed. Recreation Sites and Trails BC have contractors that deal with ongoing trail and maintenance issues. These sites will be added to their work list. As there is a need for additional recreational sites within the Vernon Creek watershed and future development should consider erosion potential of roads and cleared areas.	FLNRO (Recreation Sites and Trails BC),	Within 1 year

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Contaminant Source Type, Description and Risk Level (as defined by SWA)	SWA Recommendation	Action Items	Responsible Parties	Suggested Timeframe
Land Ownership - commercial lease lot (Beaver Lake Mountain Resort) (Moderate)	The sedimentation associated with the boat launch should be controlled with the use of standard erosion control techniques such as water bars, sumps, ditch/swale, etc.	Sedimentation due to the boat launch has yet to be addressed. A guideline for building and maintaining boat launches is available at: <a href="http://www.env.gov.bc.ca/okanagan/documents/BMPBoat_LaunchDraft.pdf">http://www.env.gov.bc.ca/okanagan/documents/BMPBoat_LaunchDraft.pdf</a>	Beaver Lake Mountain Resort	Within 1 year
Land Ownership - commercial lease lot (Dee Lake Wilderness Resort) (Moderate)	Minor erosion was documented at this site and should be controlled with the use of standard erosion control techniques such as water bars, sumps, ditch/swale, etc.	Erosion at Dee Lake Wilderness Resort has yet to be addressed. General Best Management Practices are available here: <a href="http://www.env.gov.bc.ca/wld/instreamworks/generalBMPs.htm">http://www.env.gov.bc.ca/wld/instreamworks/generalBMPs.htm</a>	Dee Lake Wilderness Resort	Within 1 year
Land Ownership - There are lake front lease lots within the Vernon Creek watershed including: fifteen residential lease lots on Crooked Lake and twenty-seven residential lease lots on Swalwell Reservoir (Moderate)	An education program should be developed to provide resort and lease lot owners with specific strategies to lessen their impact on source waters.	An educational program has yet to be developed. Ideally the province would provide lease lot owners watershed protection information at the time of lease renewal. Key information should include the importance of retaining native vegetation between developed areas and adjacent waterbodies, erosion and sediment control, and best management practices for boat launches and moorages. Another action item is obtain the names of individual lease lot owners so that they can be included in all stakeholder correspondence.	FLNRO - Front Counter, Individual Lease Lot Owners	Within 1 year
Land Ownership - privately held parcels near the Vernon Creek intake (Moderate)	Cooperation and integration of source protection concerns into local government planning policies, Official Community Plans, Zoning, and bylaws is critical to the source water protection.	This recommendation has yet to be undertaken, but bylaw amendments will take place when the Official Community Plan is amended (likely in the next couple of years).	DLC	Within 1-3 years
Slope failure/debris flows -a steep, coupled slope with soft material immediately adjacent to the screening shack and head pond (Moderate)	A professional assessment should be undertaken to prescribe mitigative measures to prevent sedimentation at this site.	Native plant live staking at this location may be one option to prevent slope failure in areas close to the intake. Helpful suggestions for live staking can be found here: <a href="http://soundnativeplants.com/nursery/live-stakes-and-cuttings/">http://soundnativeplants.com/nursery/live-stakes-and-cuttings/</a>	DLC	Within 1 year

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Contaminant Source Type, Description and Risk Level (as defined by SWA)	SWA Recommendation	Action Items	Responsible Parties	Suggested Timeframe
Natural characteristics of raw water -wildlife (including birds and mammals) are capable of carrying and disseminating fecal coliforms and <i>E. coli</i> (Moderate)	Comprehensive water quality testing should continue at numerous locations in the watershed to pinpoint any changes to background levels.	Nutrient sampling is undertaken annually to bi-annually as funds allow or in response to elevated NTU, bacteriological and/or other events that trigger further investigation.	DLC	Ongoing
Access and Recreation - Motorized recreation (4x4/ATV/motorbikes) below the high water level of important creeks and/or reservoirs (Moderate)	Efforts should be made to prevent additional access points to reservoirs and source water streams.	Within the last five years recreational activity on the Aberdeen Plateau has increased significantly. Although there are more regulated recreation camp sites than any other location in the Okanagan, the province struggles to keep up with demand (pers. comm. Ian McLellan, District Recreation Officer). Discussed action items include: 1. Development of a pilot study to address recreational concerns on water quality. Rob Dinwoodie volunteered to take the lead on a field tour to look at the feasibility of a pilot study (tentatively scheduled for October 2015) 2. There is a need to develop a comprehensive recreation plan for the Aberdeen Plateau 3. Additional resources are needed to ensure compliance and enforcement action is undertaken. 4. Public education is needed to inform motorized recreational users of the importance of the watershed for drinking water (Provincial wide program). 5. Off road vehicle licencing is to be implemented in November 2015 will allow motorized recreationalists to do the bulk of policing. 6. Natural Resource Offenses should be reported here: <a href="https://www.for.gov.bc.ca/hen/nrv/report.htm">https://www.for.gov.bc.ca/hen/nrv/report.htm</a>	FLNRO, motorized recreational users	1. Within 1-3 yrs 2. Within 1-3 yrs 3. Within 1-3 yrs 4. Within 1 year 5. Within 1 year 6. Complete
Wind Generation - One Investigative tower within the Vernon Creek watershed (Low)	Wind generation should follow the same standards as forestry; namely that their activities do not impact water quality, water quantity or timing of flows.	Wind generation within the Vernon Creek watershed is not proceeding at this time, as it was determined to not be viable. DLC will be contacted as part of a referral process if future wind generation is to be considered.	Integrated Land Management Bureau and private wind generation and mining licensees	Complete
Mining and Quarries - Three mineral and placer claims (Low)	Mining should follow the same standards as forestry; namely that their activities do not impact water quality, water quantity or timing of flows.	There are no active mining or quarry sites at this time. DLC staff should identify the local representative from Energy and Mines, to ensure that DLC will be informed of any future mining proposals within the Vernon Creek watershed.	DLC	Immediately

**Table 3 - Summary of Source Water Assessment (SWA) Recommendations and Stakeholder Action Items Undertaken in the OYAMA CREEK Watershed (as of September 2015).**

Contaminant Source Type, Description & Risk Level (as Defined by SWA)	Recommendation	Action Items	Responsible Parties	Suggested Timeframe
<p>Range Tenures - There were a number of highlighted cattle issues within the SWA including:</p> <p>1. High cattle density and source contaminants observed in two locations on the main channel of Oyama Creek (Very High)</p> <p>2. High cattle densities on the north fork of Oyama Creek, around Chatterton Lake and directly below Damer Reservoir (Very High)</p> <p>3. Range Tenures - Cattle congregating in a moist pocket with ground water seepage along a fence that is approximately 5 m from the Oyama Creek (High)</p>	<p>1. and 2. Fencing should be constructed to prevent access at these locations. If it cannot be completed prior to spring turnout (2010), then these sites should be closely monitored.</p> <p>3. The fence should be moved away from the creek to the top of ridge. Moving the fence back would substantially reduce fecal inputs and will likely require less maintenance as blow down would be reduced near the top of the ridge.</p>	<p>1. High risk sites have been excluded using fencing. Fencing needs to be monitored on an annual basis to ensure functionality 2. Best Management Practices (BMPs) for range operations on Crown land within community watersheds was developed in 2011 and was immediately applied to the Oyama Creek watershed. Example activities include off stream watering, monitoring of grazing adjacent to source water streams to evaluate health of function and seeding of cutblocks to increase forage. Ongoing monitoring will be undertaken to ensure the effectiveness of the applied BMPs. 3. Cattle stocking rates were reduced to 80 cow/calf pairs, but not specifically due to water quality 4. A research project headed by the UBCO Engineering Department, is sampling <i>Escherichia coli</i> and <i>Cryptosporidium</i> within the Oyama Creek watershed to test livestock best management practices and virulence of the organisms.</p>	<p>Ministry of Forests and Range, UBCO Engineering Department</p>	<p>1. Ongoing 2. Ongoing 3. Complete 4. Ongoing</p>
<p>Forestry -Harvesting within sensitive Lakeshore Management Zones (LMZs) (Very High)</p>	<p>Forest harvesting should only occur within LMZs of reservoirs (Oyama &amp; Damer) when the risk of wildfire and forest health factors outweigh the potential access issues and water quality impacts.</p>	<p>The Ministry of Forests is in the process of reviewing harvesting within Lakeshore Management Zones (LMZs). No applications will be approved within LMZs, until the review is complete. Small scale salvage operators have a licence to remove timber on a salvage basis and in the past have been allowed within LMZs. Site visits will be conducted prior to future approvals. DLC requests site visits within all LMZs and within all very high and high vulnerability zone areas. In addition, it was noted that Ministry staff will be arranging a field trip with DLC and RDNO to initiate further discussions surrounding forest harvesting in LMZs. Finally, it was noted that the lack of forest management within LMZs can also be an issue due to forest health issues (e.g. fir bark beetle can result in blow down and erosions issues).</p>	<p>Ministry of Forests, Small Scale Salvage Program, DLC, RDNO</p>	<p>Ongoing</p>

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Natural characteristics of raw water peak coliform values were considerably higher along the north fork of Oyama Creek (below the lakes) than compared to the mainstem of Oyama Creek downstream of Oyama Lake (Phippen, 2008) (High)	Cattle is one source of coliforms that can be controlled. Therefore cattle presence along the north fork of Oyama Creek should be eliminated as much as possible. Ecoscape understands that DLC currently dilutes water from the north arm of Oyama Creek with water originating from Oyama Lake. This practice should continue as one means of improving water quality.	In 2011, the DLC changed the way they manage water to ensure there are continuous flows to the north fork of Oyama Creek. Dilution practices continue and cattle presence within this area has been limited with fencing. Regular monitoring of cattle and the conditions along the north fork of Oyama Creek is important to ensure that works undertaken continue to be successful.	Ministry of Forests and Range, DLC	Ongoing
Natural characteristics of raw water north arm of Oyama creek dries up annually, providing access for wildlife, cattle and recreation (High)	Fencing should be used to prevent access of cattle to the dry creek bed.	The north fork of Oyama Creek has been fenced but cattle still manage to get some access to the area. Because of this, there are annual inspections to ensure the health and function of the area.	Ministry of Forests and Range	Ongoing
Forestry - Proposed harvest (High) and Natural characteristics of raw water - enhanced turbidity which results from the scouring of available source material as the channels fill during spring freshet (High)	There should be no further salvage above the snowline in the Oyama Creek watershed until the ECA returns to a low range (likely about 20 – 25 years from now). Exceptions may include the need to manage for wildfire or forest health factors.	The current ECA above the snowline is approximately 51%. Tolko has no plans for logging above the snowline, however there is 37 ha of planned harvesting below the snowline in the Oyama Creek watershed. BC Timber sales has no logging planned over the next few years. Typically, hydrological assessments are completed approximately every 5 years and take into account proposed logging.	Tolko, BC Timber Sales and Small Scale Salvage Program	Complete as of 2015, but evaluations in future years will be necessary
Stream Crossings and Roads - Stream crossings and roads within the watershed were identified as either Very High, High, Moderate or Low risk.	Very High and High risk roads should be addressed through a combination of improvements or deactivation on FSR's and other permitted roads, and preferably permanent deactivation in the case of non-status roads. Prescriptions prepared by qualified professionals should be required in all cases. Lower risk road should continued to be monitored to ensure functionality.	Tolko and BC Timber Sales monitor and maintain all permitted roads and FSR's where they are the primary user. Action items include: 1. DLC to send the spatial road file (shapefile) to Tolko and BC Timber Sales, so that they may consider road improvements on the Very High and High risk roads. 2. Roads that are not under a particular licensee should be prioritized by risk and improvements should be made one by one as resources allow.	Permitted road users (Tolko, BC Timber Sales) Forest Investment Account (for non-status roads)	1. Immediately 2. Within 1-3 yrs

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Human Access - integrity and vulnerability of Oyama Creek Intake (High)	Thought should be given to fortification, fencing, observation (e.g. closed circuit TV) and a shut down mechanism in the event of vandalism or intentional disruption of service.	The Oyama water intake building is locked and is only accessible to authorized personnel. A locked gate and the Pier Mac gravel pit also prevent public access. Real time monitoring data (SCADA) for turbidity is also undertaken at this site. The conditions at the intake are regularly monitored. Through SCADA, if an alarm is triggered due to intrusion, mechanical failure or water quality concerns, the Potable Water Deviation Response Plan is immediately implemented.	DLC	Ongoing
Algae - Documented algae near the outflow of Damer Lake (High)	Damer Reservoir should be either kept at a higher water level or the high point near the outflow should be dredged to prevent an isolated shallow area where algae growth is enhanced.	In 2011, the DLC changed the way they manage water in Damer Lake. The water is now kept close to full until the late fall.	DLC	Complete
Natural characteristics of raw water north fork of Oyama Creek has high colour (High)	Current practices of diluting water from the north arm of Oyama Creek with water that originates from Oyama Lake should continue.	In general, water from the north arm of Oyama Creek is diluted with water from Oyama Lake. Although, at select times during the season, dilution may not be possible due to dam maintenance and/or water quantity concerns. Kalamalka Lake interconnect has also helps with discoloration by providing water during the freshet period.	DLC	Complete
Access and Recreation - the presence of wildlife (including birds, mammals and fish) has resulted in excellent sport fishing and hunting opportunities (High)	Additional education (watershed signage, pamphlets, and stakeholder word of mouth) that informs watershed users of source waters and appropriate behaviors.	The education of Crown users is vitally important. Work by NORD and FLNRO (Recreation Sites and Trails, BC) is underway to develop a new educational pamphlet. Action items include: 1. RDCO and DLC to jointly development a regionally consistent education program, 2. Other opportunities include bumper stickers and pamphlets available through the off road vehicle licencing. 3. There would also be great value in an OBWB funded project to develop educational tools that could be distributed throughout the Okanagan Valley.	RDCO, DLC, OBWB	1. Within 1 year 2. Complete 3. Within 1-3 yrs
Access and Recreation - Illegal Activities (High)	There should be additional resources put forth to deal with illegal activities, and watershed users should consistently report them.	Illegal activities within the watershed are the responsibility of the RCMP, however it is noted that recreational pressures within the watershed are vastly growing. Currently there are not enough campsites to keep up with the recreational demand, and as a result, users are camping in unsanctioned locations typically in close proximity to water. Action items include: 1. FLNRO (Recreation Sites and Trails BC) to develop a comprehensive recreational management plan for the Oyama Creek watershed, that considers the numerous sensitivities of the watershed including water quality concerns. 2. An increased level of compliance and enforcement action is also badly needed. 3. An increased level of public education is necessary to inform users of the importance of the watershed for drinking water.  It is acknowledged that funding is limited, but opportunities do exist. For example, Oyama Creek watershed may be a good location for a pilot study, there may also be opportunities for local government/first nation controlled campsites.	FLNRO (Recreation Sites and Trails BC), RDCO, DLC	1. Within 1 year 2. Immediately 3. Immediately

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Slope failure/debris flows - location, integrity and vulnerability of Oyama Creek Intake (High)	An assessment of possible intake locations should be undertaken to determine if there are other more favorable sites.	There are no other possible locations for the Oyama Creek intake, therefore regular stream channel assessments are undertaken upstream of the intake, as well as monitoring of the outflow and intake structure. Action items include addressing operational practices when sediment is removed from the head pond, and improved communication by keeping a list of completed maintenance actions.	DLC	Complete, but ongoing maintenance is required
Mountain Pine Beetle - Oyama Creek watershed has extensive stands of lodgepole pine, which are highly susceptible to MPB (Moderate)	Major and minor licensees should critically evaluate the stands proposed for salvage and only log those stands which make the most sense from a MPB perspective.	Tolko, BC Timber Sales and Small Scale Salvage operations currently follow this recommendation through field reconnaissance site visits to identify stand damage from insects and disease to aid in harvest planning decisions. Typically hydrological studies are undertaken approximately every 5 years and take into account planned harvesting.	Tolko, BC Timber Sales & Small Scale Salvage Program	Complete
Slope failure/debris flows - Evidence of three previous landslides upstream of intake (Moderate)	Ecoscope understands that these landslides are no longer a significant threat. Alternatively, efforts should be directed at deactivating the non-status road (OR2 lower) that parallels Oyama Creek canyon to ensure that flows originating from this road do not contribute to future landslides.	Timber licensees do not have FIA funds for nonstatus roads. It is recommended that the province include nonstatus roads within future regulations associated with the Natural Resource Road Act. The crown then takes on the liability if improvements are not made.	FLNRO	Within 1-3 yrs
Access and Recreation - Regulated recreation camp sites (at Oyama, Streak, High and Damer Lakes) (Moderate)	Sediment point sources originating from access roads and boat launches were identified and should be addressed to reduce the potential affects on source water quality. The Damer Lake site had moderate levels of erosion, while the Oyama Lake site has minor erosion.	FLNRO (Recreation Sites and Trails BC) have contractors that deal with ongoing trail and maintenance issues. The identified rec sites that are acting as a sediment point source should be added to the contractors work list.	FLNRO (Recreation Sites and Trails BC)	Immediately
Land Ownership - There is a commercial lease lot (Oyama Lake Wilderness Fishing Resort) and thirteen residential lease lots on Oyama Reservoir (Moderate)	An education program should be developed to provide resort and lease lot owners with specific strategies to lessen their impact on source waters.	An educational program has yet to be developed. Ideally the province would provide lease lot owners watershed protection information at the time of lease renewal. Key information should include the importance of retaining native vegetation between developed areas and adjacent waterbodies, erosion and sediment control, and best management practices for boat launches and moorages. An additional action item is for the DLC to obtain the names of individual lease lot owners so that they can be included in all stakeholder correspondence.	FLNRO - Front Counter, Oyama Lake Wilderness Fishing Resort, Individual Lease Lot Owners, DLC	Within 1 year

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Natural characteristics of raw water wildlife (including birds and mammals) are capable of carrying and disseminating fecal coliforms and <i>E. coli</i> (Moderate)	Comprehensive water quality testing should continue at numerous locations in the watershed to pinpoint any changes to background levels.	Nutrient sampling is undertaken annually to bi-annually as funds allow or in response to elevated NTU, bacteriological and/or other events that trigger further investigation.	DLC	Ongoing
Access and Recreation - Motorized recreation (4x4/ATV/motorbikes) below the high water level of important creeks and/or reservoirs (Moderate) and Access and Recreation - "The Lookout" (Low)	Efforts should be made to prevent additional access points to reservoirs and source water streams.	Within the last five years recreational activity on the Aberdeen Plateau has increased significantly. Although there are more regulated recreation camp sites than any other location in the Okanagan, the province struggles to keep up with demand (pers. comm. Ian McLellan, District Recreation Officer). Discussed action items include: 1. Development of a pilot study to address recreational concerns on water quality. Rob Dinwoodie volunteered to take the lead on a field tour to look at the feasibility of a pilot study (tentatively scheduled for October 2015) 2. There is a need to develop a comprehensive recreation plan for the Aberdeen Plateau 3. Additional resources are needed to ensure compliance and enforcement action is undertaken. 4. Public education is needed to inform motorized recreational users of the importance of the watershed for drinking water (Provincial wide program). 5. Off road vehicle licencing is to be implemented in November 2015 will allow motorized recreationalists to do the bulk of policing. 6. Natural Resource Offenses should be reported here: <a href="https://www.for.gov.bc.ca/hen/nrv/report.htm">https://www.for.gov.bc.ca/hen/nrv/report.htm</a>	FLNRO (Recreation Sites and Trails BC), motorized recreational users	1. Within 1-3 yrs 2. Within 1-3 yrs 3. Within 1-3 yrs 4. Within 1 year 5. Within 1 year 6. Ongoing
Land Ownership - Three privately held parcels near the Oyama Creek intake (Low)	Cooperation and integration of source protection concerns into local government planning policies, Official Community Plans, Zoning, and bylaws is critical to the source water protection.	This recommendation has yet to be undertaken, but bylaw amendments will take place when the Official Community Plan is amended (likely in the next couple of years).	DLC	Within 1-3 yrs
Wind Generation - Four Investigative towers within the Oyama Creek watershed (Low)	Wind generation should follow the same standards as forestry; namely that their activities do not impact water quality, water quantity or timing of flows.	Wind generation within the Oyama Creek watershed is not proceeding at this time, as it was determined to not be viable. DLC will be contacted as part of a referral process if future wind generation is to be considered.	Integrated Land Management Bureau and private wind generation and mining licencees	Complete

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Wildfire Potential - 2 km wildfire occurred within 50 m of the Oyama Reservoir on June 11th, 2009 (Low)	The road which was built to fight the 2 km fire in the Oyama Creek watershed should be deactivated to entirely prevent vehicle access to the lease lots on Oyama Lake. Ecoscape understands that this road was rehabilitated and inspected in November of 2009, but we do not know if the possibility for vehicle access remains.	The road that was built to fight the fire now provides more direct access for cabin owners. Action Items include talking with the fire service to determine the status and standard of this road and if additional deactivation is needed.	DLC	Within 1 year