Associated Environmental

FINAL REPORT

Regional District of North Okanagan

Water Shortage Management Review
For Greater Vernon Water

September 2017

ISO 9001 and 14001 Certified | An Associated Engineering Company

CANADA'S BEST MANAGED COMPANIES Platinum member

Associated Environmental

Associated Environmental Consultants Inc.
Suite 200, 2800 29 Street
Vernon, B.C., Canada V1T 9P9

TEL: 250.545.3672
FAX: 250.545.3654
www.ae.ca | ISO 9001 & 14001 Certified

September 27, 2017
File: 2016-2159.000.005

Jennifer Miles
Water Sustainabiliity Coordinator - Greater Vernon Water
Regional District of North Okanagan
9848 Aberdeen Road
Coldstream, BC V1B 2K9

Re: WATER SHORTAGE MANAGEMENT REVIEW FOR GREATER VERNON WATER - FINAL REPORT

Dear Ms. Miles:

Associated Environmental Consultants Inc. is pleased to provide this final report that provides a review of water shortage management by the Regional District of North Okanagan – Greater Vernon Water (GVW). This document is provided to support the development of a water shortage management plan.

Our Project Team members and Advisors contributed to the development of this report. All comments and opinions received from GVW on the draft report were reviewed and are considered within this final report.

If you have any questions about this report, please contact me at 250-545-3672.

Yours truly,
Associated Environmental Consultants Inc.

Drew Lejbak, M.Sc., GIT
Senior Hydrologist

dl

Acknowledgements

This document was developed by Drew Lejbak, M.Sc., GIT, and Rod MacLean, P. Eng., of Associated Environmental Consultants Inc. (Associated) and Phil Epp, P.Ag. Reviews were completed by Brian Guy, Ph.D., P.Geo. (Associated), Brian Symonds, P.Eng., and Clay Allison, MA, M.Sc. (SR Management Services Ltd.).

Material included within this document was based on a technical assessment (Associated 2016a) that was completed as part of the water shortage management plan update process.

Table of Contents

List of Tables

List of Figures

Glossary

DCWTP	Duteau Creek Water Treatment Plant
DFO	Fisheries and Oceans Canada
DMP	Drought Management Plan
DSWG	Drought Stakeholder Working Group
EFN	Environmental Flow Needs
ERP	Emergency Response Plan
ET	Evapotranspiration
FLNRO	BC Ministry of Forest, Lands, and Natural Resource Operations
GSC	Geodetic Survey of Canada
GVW	Greater Vernon Water
ICI	Industrial, Commercial, Institutional
LTmad	Long term mean annual discharge
masl	meters above sea level
mbgs	meters below ground surface
MHWTP	Mission Hill Water Treatment Plant
MSC	Meteorological Service of Canada
PTDWG	Provincial Technical Drought Working Group
RDNO	Regional District of North Okanagan
SCADA	Supervisory Control and Data Acquisition
SWE	Snow Water Equivalent
TODRIP	Thompson Okanagan Drought Response Implementation Plan
TODRT	Thompson Okanagan Drought Response Team
WSC	Water Survey of Canada
WSMT	Water Supply Management Team
WSMP	Water Shortage Management Plan
WSRP	Water Shortage Response Plan

1 Introduction

1.1 OVERVIEW

This document was prepared at the request of the Regional District of North Okanagan – Greater Vernon Water (hereafter referred to as GVW) and represents a review of GVW's water management during times of water shortages (i.e., drought and/or loss of supply). This document is in support of an update to the 2011 Drought Management Plan (DMP) produced by Clarke Geoscience Ltd. (2011) for GVW; the 2011 DMP update is being completed by GVW. The update is a result of GVW's commitment to review and update the DMP every five years (or when concerns are raised by the community) for the plan to be responsive to changes within the utility (e.g., infrastructure modifications), as well as to consider external factors such as climate change. The 2011 DMP update will build upon previous DMP's (i.e., 2007, 2011) by including new information and planning and monitoring approaches reported herein. This document includes information that was contained within a technical assessment (Associated 2016a) completed to provide recommended revisions and/or inclusions for GVW to consider for the update to the 2011 DMP.

The goal of GVW's DMP is to ensure that adequate water supplies are available under drought conditions in the near term, as well as in the future considering population growth, changes in agricultural practices and crop types, and climate change. GVW identified that as part of the update, the DMP will consider all times/situations of water supply shortages (including water distribution system limitations) not only times of hydrological and/or meteorological droughts. Accordingly, the focus of the DMP will change to a GVW Water Shortage Management Plan (WSMP).

As this document was developed to support an update to the 2011 DMP, portions of the document have been extracted from Clarke Geoscience Ltd. (2011) and 2012 GVW Master Water Plan technical memorandums.

1.2 COMPONENTS TO SUPPORT THE WATER SHORTAGE MANAGEMENT PLAN

The objective of the WSMP is to provide GVW with a decision-making framework to prepare, plan, communicate, and respond to situations of water supply shortage within their service area. To meet this objective, the water shortage management review provided herein is structured to be consistent with components of the template provided by the BC Ministry of Environment (2016a) in *Dealing with Drought – A Handbook for Water Suppliers in BC*. These specific components are as follows:

- Water Supply Management Team and Drought Stakeholder Working Group (Section 2);
- Water System Profile (Section 3);
- Water Shortage Stages and Communication Plan (Section 4);
- Water Shortage Decision Process (Section 5);
- Water Shortage Forecast Parameters (Section 6); and
- Water Shortage and Emergency Response Plans (Section 7).

2 Water Supply Management Team and Drought Stakeholder Working Group

The following section summarizes the water supply management team structure of GVW, as well as the Drought Stakeholder Working Group that GVW has implemented to advise on water conservation strategies from a stakeholder and community perspective.

2.1 GVW WATER SUPPLY MANAGEMENT TEAM

As outlined within Regional District of North Okanagan (RDNO) Bylaw No. 1764, GVW serves as the primary water purveyor for the following jurisdictions:

- City of Vernon;
- District of Coldstream; and
- Portions of Spallumcheen as well as Electoral Areas “B”, “C”, and “D”, as outlined within Schedule A of Bylaw No. 1764 and Bylaw No. 2545.

The scope of services that GVW provides is outlined within Bylaw No. 1764. These services are summarized as follows:

- Constructing, operating, maintaining, repairing, and replacing water supply and distribution facilities and property;
- Acquiring and holding water licences and planning for water supply and distribution needs within the service area; and
- Providing bulk water to other local authorities.

To meet these servicing needs, the management of the GVW system is provided by the RDNO. Operations and maintenance of the GVW water supply and treatment system is completed by RDNO operators and the operation, maintenance and repair of the distribution system is contracted to the City of Vernon and District of Coldstream (RDNO 2016).

During times of water shortages, the RDNO General Manager responsible for the Greater Vernon Water function, or any other person that the RDNO Board of Directors delegates, is responsible for implementing all stages of the WSMP. This individual will coordinate with administrative and operations staff from both the RDNO and the partner jurisdictions to comprise the GVW Water Supply Management Team.

2.2 DROUGHT STAKEHOLDER WORKING GROUP

To help GVW consider impacts to the local economy and community livelihoods during periods of water supply shortages, a Drought Stakeholder Working Group (DSWG) was initiated. The DSWG is supported by GVW staff and the scheduling of meetings depends on the severity of the actual or impending water supply shortage. The specific roles of the DSWG are to assist in the development of efficient water use strategies, inform the community on water supply levels, and provide feedback on the effect of water use restrictions on the community. The DSWG includes representation from institutions, local businesses, range users, agricultural producers, provincial government staff, as well as other local large water users (e.g., parks and recreation) and community members. The terms of reference for the DSWG is provided in Appendix A.

3 Water System Profile

GVW relies on surface water and groundwater for raw water supply. GVW's two major surface water sources are Duteau Creek and Kalamalka Lake; both of which are subject to water licensing, runoff, and storage limitations. Water supplies from Duteau Creek are managed by GVW, while the BC Ministry of Forests, Lands, and Natural Resource Operations (FLNRO) manages Kalamalka Lake water levels to optimize water use and environmental needs. GVW also holds water licences for Deer Creek, which is used as an irrigation supply for agricultural customers in the Coldstream Ranch area, as well as licences on B.X. and Coldstream Creeks. Groundwater licences are also being sought under the recently enacted *Water Sustainability Act* to continue to use wells at Antwerp Springs and Coldstream Ranch. A breakdown of GVW's water use by source (for 2015) is shown in Figure 3-1 and is generally considered representative of the total distribution of annual water use in the GVW area.

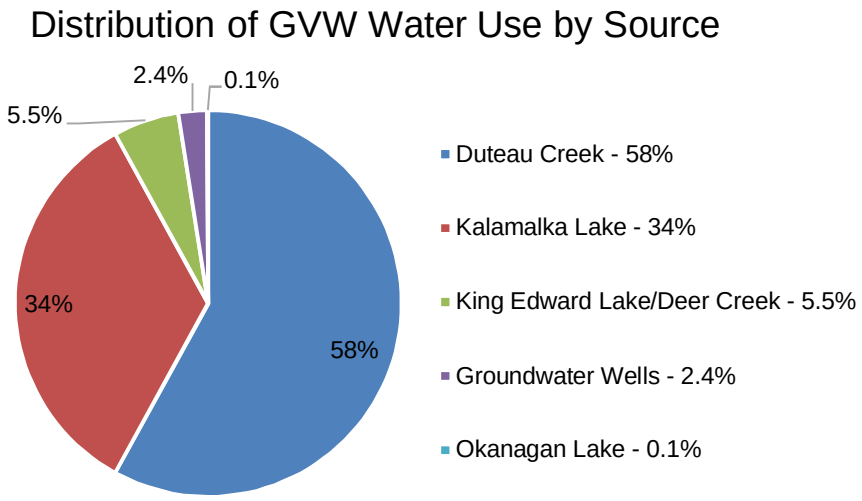

Figure 3-1 Summary of GVW's water use by water supply source (for 2015) (Miles, pers. comm., 2016)

The following sections provide an overview of GVW water sources, demand, capital components, and system interconnection options. The information presented here is as reported within the 2011 DMP, the 2012 GVW Master Water Plan (AECOM et al. 2013a-d), and the Duteau Creek Watershed Assessment (Kerr Wood Leidal Associates Ltd. and Dobson Engineering Ltd. 2008; RDNO 2014).

3.1 DUTEAU CREEK WATER SUPPLY SYSTEM

3.1.1 System Overview

Duteau Creek is a tributary of Bessette Creek, which is a tributary of the Shuswap River. The watershed is located approximately 20 km southeast of the City of Vernon within the Thompson Plateau of the Interior

Plateau Physiographic Region (Figure 3-2). The Duteau Creek watershed includes Interior Douglas Fir and Interior Cedar Hemlock bio-geoclimatic zones at the lower elevations and Montane Spruce and Englemann Spruce Sub-Alpine Fir bio-geoclimatic zones at the mid to upper elevations.

The total drainage area of Duteau Creek watershed is 216 km^2. The GVW Headgates dam water intake defines the most downstream extent of the water supply source area for GVW's Duteau Creek water supply (Figure 3-2). The contributing area to the Headgates dam water intake is 182 km^2 and it is designated as a community watershed under the *Forest and Range Protection Act*. The Headgates dam water intake is located at an elevation of the 660 meters above sea level (masl) and the headwater areas (i.e., Grizzly Hills) lie at approximately 1,800 masl.

GVW's Duteau Creek water source is drawn from a group of upland reservoirs, diversions, and control structures. As described within the 2012 GVW Master Water Plan (AECOM et al. 2013a), the contributing area to the Headgates dam water intake consists of five sub-watersheds summarized as follows (Figure 3-2):

- Aberdeen Reservoir – largest reservoir with a sub-watershed area of 45.6 km^2. Heart Creek drains into the reservoir, which is supplemented by streamflows from the Gold-Paradise Diversion. Water can also be transferred into Aberdeen Reservoir from the Grizzly Reservoir sub-watershed through a constructed diversion. The total live storage for Aberdeen Reservoir is 10,330 ML.
- Grizzly Reservoir – sub-watershed area of 51 km^2 that collects water from the Grizzly Hills. The total live storage for Grizzly Reservoir is 5,280 ML and the reservoir is approximately 10 m higher than Aberdeen Reservoir at full pool.
- Haddo Reservoir – small sub-watershed that is supplied by both the Aberdeen and Grizzly Reservoirs. The outlet of Haddo Reservoir supplies the controlled releases to Lower Duteau Creek and the Headgates dam raw water intake. The total live storage for Haddo Reservoir is 2,730 ML.
- Gold-Paradise Diversion – a 3 km interceptor channel intercepts water from Paradise and McAuley (Gold) Creeks within the Harris Creek watershed (i.e., adjacent watershed to Duteau Creek) and diverts water into Heart Creek within the Aberdeen Reservoir sub-watershed.
- Lower Duteau Creek – the sub-watershed between the outlet of Haddo Reservoir and the Headgates dam raw water intake. There are several unregulated lakes within this sub-watershed; therefore, runoff from this watershed is considered uncontrolled.

GVW's total annual licensed volume for Duteau Creek at the Headgates dam water intake is 34,582 ML (including 9,868 ML for the Gold-Paradise Diversion) for domestic and irrigation water use purposes (AECOM et al. 2013a). The total licensed storage capacity for GVW's Aberdeen-Grizzly-Haddo Reservoir system is 28,369 ML and the current (live) storage capacity for the three reservoirs is 18,340 ML (AECOM et al. 2013b). Under the 'first-in-time, first-in-right' licensing system under the *Water Sustainability Act*, GVW holds senior level water licences on Duteau Creek.

VERNON NORTH
VERNON SILVER STAR LODGE
(2F19)
MHWTP
08NM143
North Kal
VERNON AUTO
Coldstream Ranch 1
Coldstream Ranch 2
Antwerp 1 & 2
DCWTP
Headgates Dam
Deer Creek
Delcliffe
Outback Resort
OYAMA LAKE (2F19)
POSTILL LAKE (2F07)
Aberdeen Lake (1F01A/MW1103)
Forested (2702/MW1102)
Clearcut (2701/MW1101)
Goose Lake
Swan Lake
Wood Lake
Oyama Lake
Kalamalka Lake
MacKay Reservoir
King Edward Lake
Swalwell Lake
Okanagan Lake
Aberdeen Reservoir
Haddo Reservoir
Grizzly Reservoir
Heart Creek
Duteau Creek
Vernon
Lumby
Okanagan Landing
Okanagan Centre
Winfield
Woodsdale
Coldstream Creek
Bessette Creek
Deafies Creek
Vance Creek
Blue Springs Creek
Shuswap River
Bigg Creek
Woodward Creek
Creighton Creek
Beetle Creek
Nicklen Creek
McAuley Creek
Paradise Creek
West Harris Creek
Harris Creek
Fish Creek
Home Creek
Brewer Creek
Craster Creek
Vernon Creek
Mill Creek
Morrison Creek
Clark Creek
Deer Creek
B.X. Creek
Irish Creek
Deep Creek
Newport Creek
Musgrave Creek
McGregor Creek
Equesis Creek
Bradley Creek
Naswhito Creek
Bouleau Creek
Browns Creek
Whiteman Creek
South Whiteman Creek
Attenborough Creek
Morden Creek
Shorts Creek
Stuart Creek
Bald Range Creek
North Oyama Creek
Kalamalka Lake Provincial Park
Ellison Provincial Park
Predator Ridge Golf Course
Fintry Provincial Park
Silver Star Provincial Park
Winfield Provincial Park
Mabel Lake
Shuswap Falls
Lumby
Duteau Creek
Nicklen Creek
Aberdeen Reservoir
Haddo Reservoir
Grizzly Reservoir
Heart Creek
Duteau Creek
Kalamalka Lake Watershed
Aberdeen
Gold-Paradise Diversion
Grizzly
Haddo Lake
Lower Duteau Creek
WSC Hydrometric Station
BC River Forecast Centre Snow Pillow
BC River Forecast Centre Snow Course
MSC Climate Station
GVW Climate Station
GVW Snow Course and Soil Moisture Monitoring Site
GVW Intake
Kalamalka Lake Outlet Weir
Duteau Creek WTP
Mission Hill WTP
Groundwater Well
GVW Small Water System
GVW Dam
MOE Mapped Aquifer (#352)
Waterworks Catchments
N
S
E
W
0 1 2 3 4 5
Kilometers
Figure 3-2.mxd / 9/22/2017 / 9:45:04 AM
Associated Environmental
PROJECT NO.: 2016-8159.000.000
DATE: September 2017
DRAWN BY: DA
FIGURE 3-2 GVW WATER SOURCES AND WATER SHORTAGE FORECAST PARAMETER MONITORING SITES
Greater Vernon Water
GVW Water Shortage Management Plan

Note that a portion of water from the Headgates dam water intake is diverted to fill Goose Lake (Figure 3-2). Goose Lake (live storage = 2,360 ML) only supplies non-potable water to agricultural customers in the separated areas of Bella Vista and West Swan Lake (Section 3.6). The maximum agricultural water demand on Goose Lake is approximately 617 ML (based on 2015 GVW water use records) and the lake can store at least two years of water for the separated areas if the reservoir is filled in the first year.

The original operating intent of Goose Lake (when constructed) was to divert water from Lower Duteau Creek watershed during freshet periods to capture this uncontrolled water source and to store it in Goose Lake. However, based on recent negotiations with Fisheries and Oceans Canada (DFO), and with the construction of the Duteau Creek Water Treatment Plant (DCWTP) (Figure 3-2), GVW's operating philosophy has changed to divert water all winter at a consistent rate. This change supports a more naturalized fisheries flow release for Rainbow Trout spawning in the spring, provides an increased water flow through the DCWTP during low winter streamflows, and reduces chemical use as freshet water higher in turbidity requires increased chemicals for treatment purposes. Though, if the Aberdeen-Grizzly-Haddo Reservoir system was in a drought situation one year, GVW has the ability to change operations so that water is conserved during the winter and diverted during the Lower Duteau Creek watershed snowmelt period. In a worst-case scenario, GVW may not divert any water into Goose Lake for up to one year if there was insufficient water available during freshet.

3.1.2 Hydrologic Regime

The Duteau Creek watershed lies in the Okanagan Highlands Hydrologic Zone #23; subzone "c" (Obedkoff 1998). Streams within this hydrologic zone are generally characterized by a snowmelt dominated peak rising in April or May and peaking sometime in May or June. Rain-on-snow events occasionally occur in this region enhancing winter streamflow and spring peaks. In addition, late fall rainstorms are common, recharging soil moisture heading into the winter and producing short duration peak streamflows. Low streamflows occur generally from the end of November to March, and in the hot summer months, with the lowest streamflows commonly occurring in January or February.

Epp (2015a) identified that the quantity of spring runoff from the headwaters of the Duteau Creek watershed is directly related to:

- snowpack levels;
- weather (i.e., high runoff is a result of early spring hot dry periods or rain-on-snow events); and
- volume of spring precipitation (i.e., April, May, and June).

The above parameters influence the volume of water demand, as well as when upland storage is used. Specifically, when the three (upland) Duteau reservoirs stop spilling, the use of storage starts and the earlier the spillway stops flowing, the earlier the storage starts to be used. Also, based on GVW's experience, precipitation and weather in June is often the driver of whether drought conditions are experienced in Duteau Creek watershed. If the reservoir spill ends in early June (or before) and/or June has low precipitation and the weather is hot and dry, above normal water demands may occur during spring and early summer, which can contribute to reduced Aberdeen-Grizzly-Haddo Reservoir system storage volumes and can increase the risk for drought conditions.

3.1.3 Upland Reservoir Management and Storage Trends

Reservoir storage is managed within the Duteau Creek watershed to ensure adequate water supplies are available to downstream users and aquatic resources. During times of drought or water shortages, the water shortage stage storage levels (outlined within Section 6.1.1) are used to support water conservation efforts (i.e., water demand reductions) and supply needs when reservoir storage levels are outside of normal operating conditions. However, even with water shortage stages in place, GVW has faced challenges with the refilling of reservoirs due to low snowpacks and/or low spring precipitation, as well as meeting water demands downstream. Specifically, Epp (2015a) concluded that the Aberdeen-Grizzly-Haddo Reservoir system has a 15-20% probability of not reaching full storage capacity in any year (based in part on the reservoirs not having refilled completely in 4 of 20 years from 1997 to 2016).

The total reservoir storage volume for the Aberdeen-Grizzly-Haddo Reservoir system is monitored by GVW. The annual pattern of reservoir inflows and releases from 1997-2015 is illustrated in Figure 3-3, and includes the range of maximum and minimum storage volumes recorded over the monitoring period, as well as the normal storage operational stage (from Section 6.1.1).

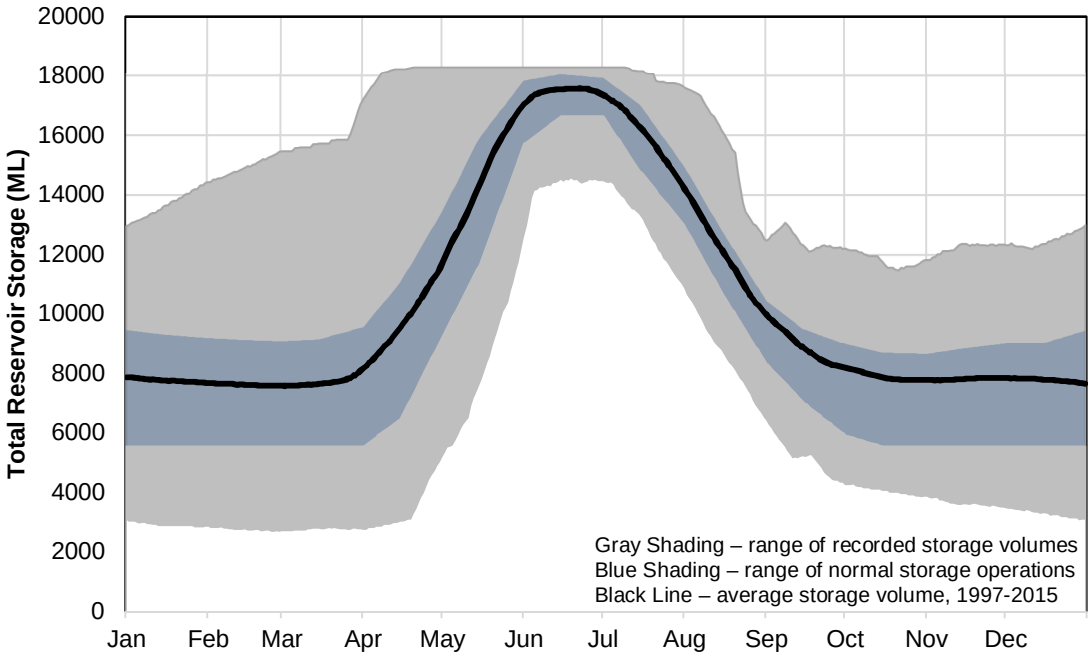

Figure 3-3 Summary of total reservoir storage volume for the Aberdeen-Grizzly-Haddo Reservoir system from 1997-2015

Referring to Figure 3-3, the general storage trends for the Aberdeen-Grizzly-Haddo Reservoir system are as follows:

- Inflows into the reservoirs generally begin between late March and early April, but can occur in early March, or be delayed until late April or early May. Inflows are largely related to the melting of the upland watershed snowpack.

- Reservoirs reach full storage capacity generally between mid-May and early July (however reached full capacity in April in 2015 and 2016). Seasonal snowpack within the upper portion of the Duteau Creek watershed have generally melted by mid-May; therefore, rainfall supplements inflows to the reservoirs within late spring periods.
- During July, August, and September, water is released from the reservoirs to meet consumption requirements. Maximum consumption occurs from mid-July to mid-August and is related to the peak irrigation demands.
- In late fall and winter, the reservoirs are managed to meet domestic demands and fisheries flow release requirements, which are generally consistent for that period.

3.1.4 Fishery Flow Targets

Monthly fishery flow release for Duteau Creek below the Headgates dam were first negotiated in 1978 by DFO and GVW (then Vernon Irrigation District) in conjunction with the issuance of a conservation storage licence for 1,233 ML for Grizzly Reservoir at that time. The monthly fishery flow releases (plus releases for downstream water licences) at the Headgates dam were as follows:

- January 1st to March 31st = 0.057 m^3/s;
- April 1st to August 31st = 0.170 m^3/s;
- September 1st to September 30th = 0.227 m^3/s; and
- October 1st to December 31st = 0.142 m^3/s.

There targets were implemented by GVW until 2015, after which, the targets were replaced by the fishery flow targets developed by Epp (2015b). The fishery flow targets allow for the varying of fishery flow releases based on available water supplies and by the specific Aberdeen-Grizzly-Haddo Reservoir system water shortage stage (Section 6.1.1). Epp (2015b) notes that the fishery flow targets are an improvement over the DFO fishery flow releases, since the DFO releases are only suitable for very low streamflow years, but do not provide proper aquatic resource considerations during average and/or wet streamflow years.

GVW operations staff have been attempting to implement the fishery flow staged targets since 2015. Although there have been some successes, there have also been challenges due to the limitations of the infrastructure at the Headgates dam. GVW staff are continuing to work with FLNRO and are making changes to improve fisheries flows within Duteau Creek. Hence, the fishery flow targets are currently considered to be open to review and revision if warranted.

The fishery flow targets (and specific target values) are provided in Section 6.1.1.1.

3.1.5 Water Demand

Duteau Creek supplies domestic and agriculture water to GVW's water users in the Stepping Stones/Spallumcheen, east and west Swan Lake, North and South B.X., Foothills, Coldstream Estates, Middleton east and south, central Coldstream, and Lavington areas (Figure 3-4).

From the outlet of the Aberdeen-Grizzly-Haddo Reservoir system, water travels within Lower Duteau Creek approximately 13 km before entering Harvey Lake (a small retention reservoir) and into the Headgates dam water intake, which diverts raw water to the DCWTP through a 1.2 m diameter transmission line (Figure 3-2) (RDNO 2016). The design capacity of the DCWTP of 160 ML/day is based on the demand forecasts made to the year 2052 in the 2012 GVW Master Water Plan (AECOM et al. 2013c).

The Headgates dam water intake is currently licensed to withdraw 34,582 ML annually from Duteau Creek (AECOM et al. 2013a). Based on GVW diversion records, the total annual diversions from 1997-2013 have ranged between approximately 11,700 ML (1997) and 19,750 ML (2002), with an average of approximately 15,600 ML. Figure 3-5 presents a summary of the total Headgates dam water intake monthly diversion volumes. Water diversions vary throughout the year largely due to agriculture water requirements, with approximately 85% of the diverted water used between April and September. During the summer months (July and August), average daily water use is 119 ML/day, while during the winter (November – February), average daily water use is 5 ML/day.

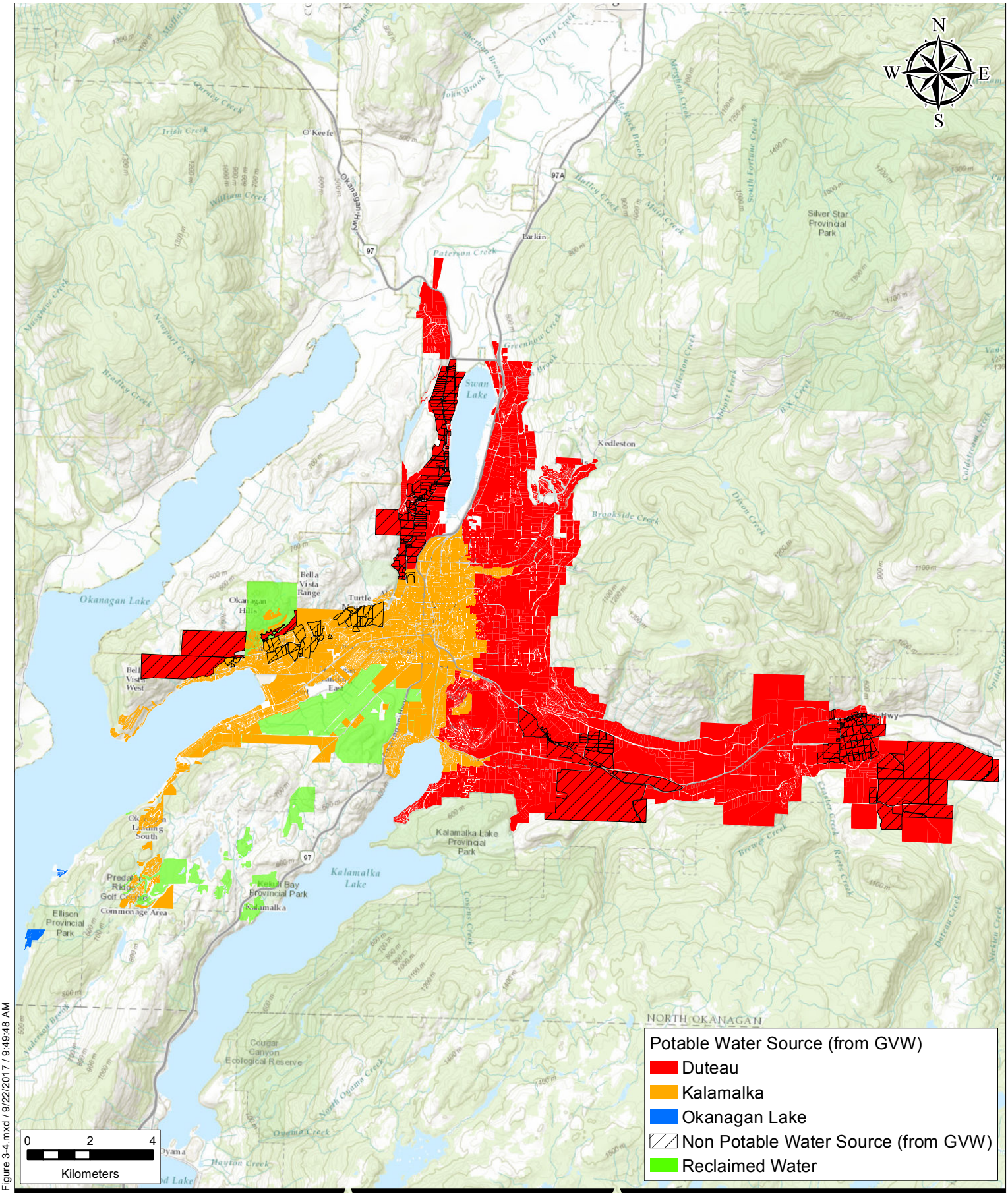

Figure 3-4.mxd / 9/22/2017 / 9:49:48 AM

Associated Environmental

PROJECT NO.: 2016-8159.000.000
DATE: September 2017
DRAWN BY: DA

FIGURE 3-4: GVW'S WATER DISTRIBUTION AREAS BY WATER SOURCE

Greater Vernon Water

GVW Water Shortage Management Plan

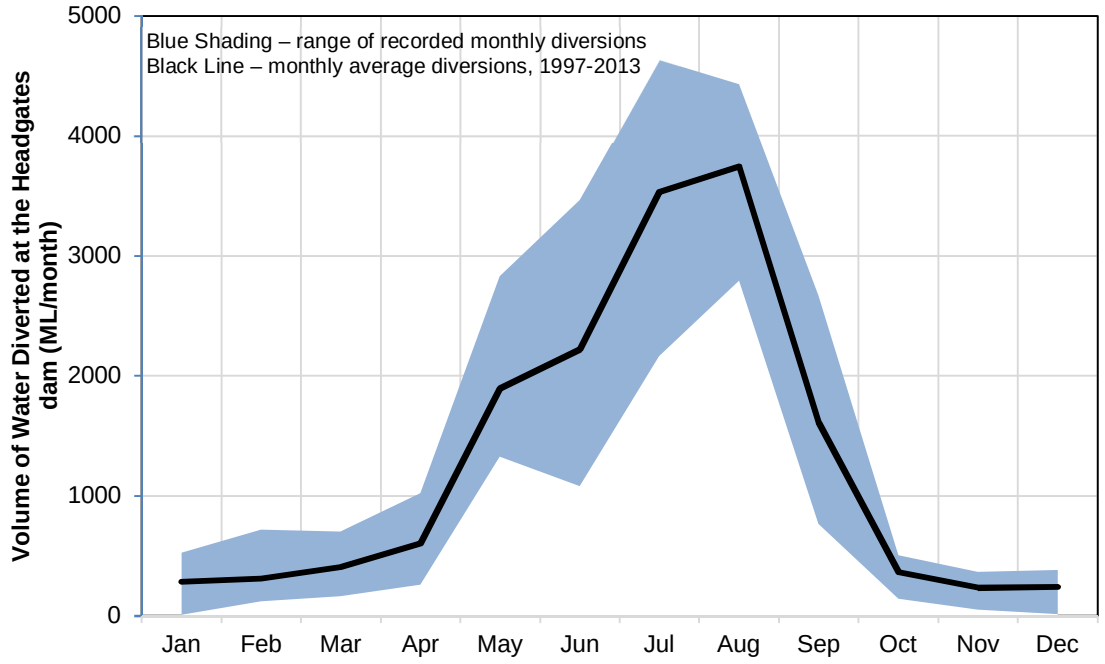

Figure 3-5 Monthly volume of water diverted from Duteau Creek at the Headgates dam water intake, 1997-2013

3.2 KALAMALKA LAKE WATER SUPPLY SYSTEM

3.2.1 System Overview

Kalamalka Lake is a large valley bottom lake that is located within the Vernon Creek watershed (Figure 3-2). Kalamalka Lake is connected to Wood Lake via a narrow channel and water level elevations within both lakes are considered the same. For management purposes, FLNRO considers these two lakes a single waterbody (OBWB 2016). As such, the two lakes are referred to hereafter as Kalamalka-Wood Lake, but Kalamalka Lake is used if specifically referring to the individual lake itself.

The total upstream drainage area for Kalmalka-Wood Lake is 572 km^2, which includes inflows from Middle Vernon, Oyama, and Coldstream Creeks, as well as a number of groundwater springs (Larratt Aquatic 2011). The headwaters of Kalamalka-Wood Lake are within the Thompson Plateau of the Interior Plateau Physiographic Region. The Kalamalka-Wood Lake watershed includes Interior Douglas Fir and Interior Cedar Hemlock bio-geoclimatic zones at the lower elevations and Montane Spruce and Englemann Spruce Sub-Alpine Fir bio-geoclimatic zones at the mid to upper elevations.

The surface area of Kalamalka Lake is 35 km^2 and the lake has a maximum depth of 142 m. The residence time of the lake is 55-65 years (Larratt Aquatic 2011). GVW operates a single water intake on Kalamalka Lake (i.e., the North Kal intake) that is used to supply potable water (Figure 3-2). The intake was extended in 2016 and is now located 323 m offshore and approximately 20 m below the water surface. The invert of the top of intake screen is at an elevation of 373 masl referenced to the Geodetic Survey of Canada (GSC)

datum (the old intake length was 252 m and the top of intake screen elevation was 370 masl). All water pumped from Kalamalka Lake is treated by the Mission Hill Water Treatment Plant (MHWTP) (Figure 3-2). Larratt Aquatics (2011) completed a source assessment and identified that the largest impact to water quality within Kalamalka-Wood Lake is the size of the spring freshet, which can cause variable concentrations of nitrogen, phosphorus, pH, calcium, sulphate, and organic/inorganic particles within the lake.

GVW's total annual licensed volume for Kalamalka Lake is 8,842 ML for domestic and waterworks use purposes (AECOM et al. 2013a). Kalamalka Lake has also been declared as fully allocated by FLNRO (AECOM et al. 2013a), so limited opportunities exist for GVW to obtain additional water supplies from the lake. Under the provincial 'first-in-time, first-in-right' licensing system, GVW holds intermediate and senior level water licences on Kalamalka Lake.

3.2.2 Hydrologic Regime

The contributing watershed to Kalamalka-Wood Lake is in the Fraser Plateau Hydrologic Zone #15; subzone "e" (Obedkoff 1998). Like the Duteau Creek watershed, streams within this hydrologic zone are generally characterized by a snowmelt dominated peak rising in April or May and peaking sometime in May or June. Low flows occur generally from the end of November to March, and in the hot summer months, with the lowest flows commonly occurring in January or February.

The general water level trend for Kalamalka-Wood Lake is summarized within the next section.

3.2.3 Reservoir Management and Storage Trends

Kalamalka-Wood Lake is maintained by FLNRO to manage water levels, as well as streamflow releases into Lower Vernon Creek (and eventually Okanagan Lake) (Figure 3-2). Water levels within Kalamalka-Wood Lake are managed following water level and downstream streamflow release targets outlined by the Okanagan Basin Implementation Board (MOE 1982). The operating targets (i.e., month end water levels) are maintained by FLNRO at the Kalamalka Lake outflow weir (Figure 3-2).

The operating targets were developed to balance economic development (e.g., flood control, water supply, lakeshore development, tourism), environmental quality (e.g., environmental flows for fish), and social betterment (OBWB 2016). Kalamalka-Wood Lake is regulated to capture and store as much freshet volume as possible for use later in the year and under drought years FLNRO closely monitors levels and streamflow releases to balance environmental and human needs (OBWB 2016). There is no formal drought operations procedure currently for Kalamalka-Wood Lake; however, the Okanagan Basin Water Board (OBWB) is currently leading an initiative for the development of recommended drought triggers for Okanagan and Kalamalka-Wood Lakes.

To support the management of Kalamalka-Wood Lake, FLNRO uses inflow and lake level forecasts provided by the BC River Forecast Centre, as well as considers the distribution and timing of the freshet in comparison to a normal period.

Water levels within Kalamalka Lake (and Wood Lake) are monitored by the Water Survey of Canada (Station No. 08NM143) and the annual pattern of lake inflows and releases from 1972-2013 is illustrated in Figure 3-6. Figure 3-6 also includes the month end water level operating targets used by FLNRO to manage Kalamalka-Wood Lake.

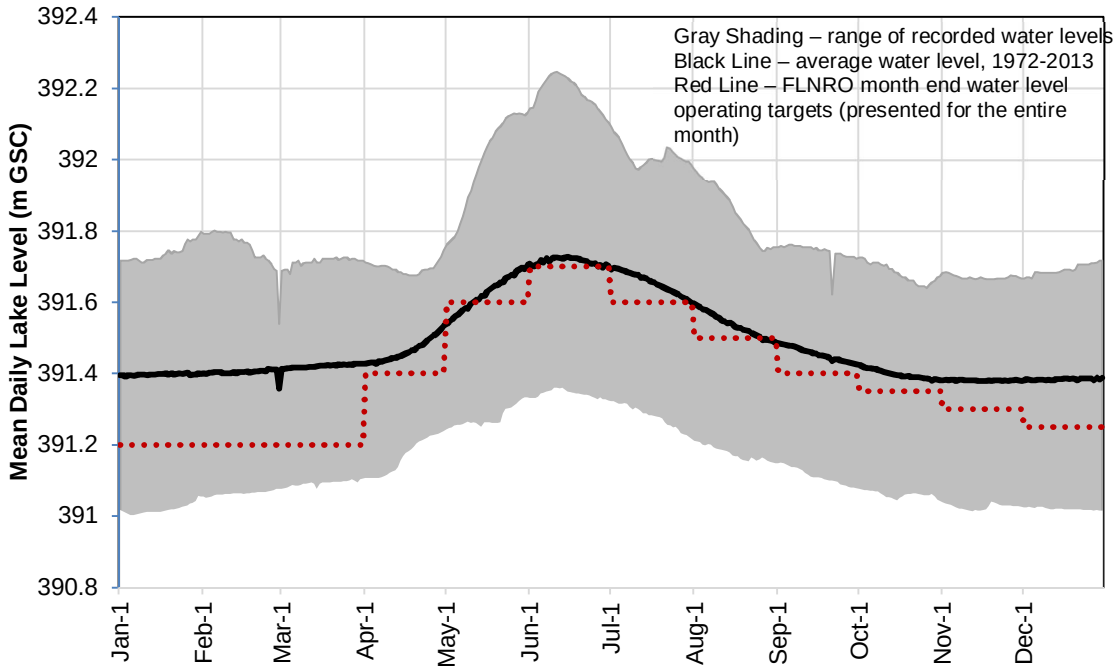

Figure 3-6 Summary of Kalamalka Lake water levels (WSC Station No. 08NM143), 1972-2013

Following Figure 3-6, the general pattern of inflows and releases from Kalamalka-Wood Lake are as follows:

- Inflows into the lake generally begin around mid-April, but can occur in March, or be delayed until early May. Inflows are largely related to the melting of the upland watershed snowpack.
- The lake reaches its highest water levels generally between mid-May to early July. Seasonal snowpacks within the headwaters have generally melted by mid-May; therefore, rainfall supplements inflows into the lake within late spring periods.
- During July, August, and September, water is released from the lake to meet downstream consumption and fisheries flow requirements.

3.2.4 Fishery Flow Release

The minimum fishery flow releases from Kalamalka Lake are 0.085 m^3/s and the normal range of releases range between 0.085 m^3/s and 5.70 m^3/s. The flow releases are managed by FLNRO based on forecasted inflows into Kalamalka-Wood Lake provided by the BC River Forecast Centre, as well as setting the release rates to the necessary levels to maintain or achieve the operating targets.

In addition to the above, the OBWB, in conjunction with the Okanagan Nation Alliance (ONA) and FLNRO, are leading an initiative for the establishment of environmental flow needs (EFN) for tributaries within the Okanagan Basin. As defined by the *Water Sustainability Act*, an EFN is the volume and timing of water flow required for the proper functioning of the aquatic ecosystem of a stream that decision-makers must consider when making watershed management decisions that could influence fish and aquatic habitat (Associated 2016b). As such, EFNs are particularly important to know and consider for drought planning.

As part of the Okanagan EFN-setting project, Lower Vernon Creek (i.e., outlet of Kalmalka Lake to Okanagan Lake) is included and fish and streamflows are currently being monitored by the ONA. The results of the project are to be completed in 2017 and could result in different fishery flow releases from Kalamalka Lake that should be considered as part of the next update to the WSMP.

3.2.5 Water Demand

Kalamalka Lake supplies domestic water to GVW's water users in the Predator Ridge, Central Vernon, southwest Vernon, Bella Vista, east and west Kal, and selected central Coldstream areas (Figure 3-4).

The North Kal water intake diverts raw water to the MHWTP through a 900 mm diameter transmission line (Figure 3-2) (RDNO 2016). The design capacity of the MHWTP is 60 ML/day, although operationally the maximum is 50 ML/day, and water is pumped from the intake to the MHWTP and distribution area via two 200 HP (138 L/s) and two 400 HP (235 L/s) vertical turbine pumps (RDNO 2016).

The North Kal intake is currently licensed to withdraw 8,842 ML annually from Kalamalka Lake. Based on GVW diversion records, the total annual diversions from 2011-2013 and 2015 have ranged between approximately 5,100 ML (2013) and 7,415 ML (2012), with an average of approximately 6,650 ML. Figure 3-7 presents a summary of the North Kal water intake total monthly diversion volumes for the available period of record. The water diversion is consistent throughout the winter and increases between May and September related to lawn and garden watering requirements (since no or very limited agricultural water use due to water license and system limitations). During the summer months (July and August), average daily water use is approximately 30 ML/day, while during the winter (November – February), average daily water use is 16 ML/day.

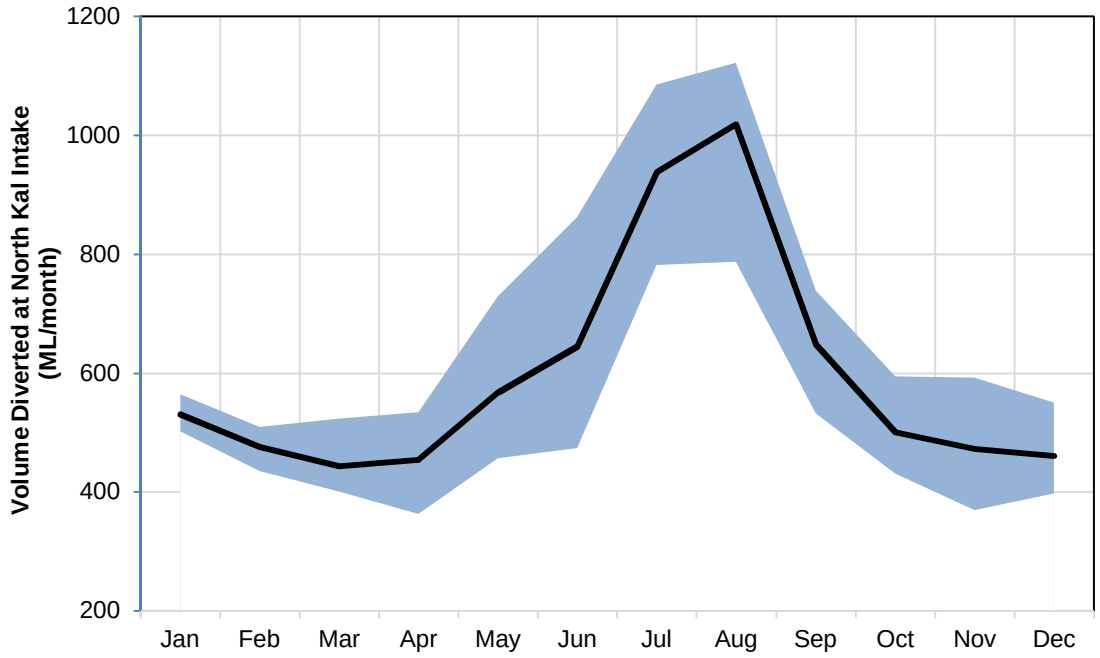

Figure 3-7 Monthly volume of water diverted from Kalamalka Lake at the North Kal water intake, 2011-2013 and 2015

3.3 OTHER SURFACE WATER SUPPLY SOURCES

3.3.1 Systems Overview

GVW holds water licences for Coldstream Creek (415 ML for waterworks purposes) and B.X. Creek (8,153 ML for waterworks and irrigation purposes and 1,912 ML for storage [that includes Goose Lake storage]) (Figure 3-2); however, the water intakes for each source have been abandoned by GVW. As described in the 2011 DMP, Coldstream Creek was used for domestic water supplies for the community of Lavington until the water intake was abandoned in 1998 due to slope stability issues upstream in the watershed, while B.X. Creek was removed as a water supply for the City of Vernon in 2000 due to water quality issues and centralized water treatment. Both sources are still considered by GVW as potential future agricultural water supplies.

GVW also uses Deer Creek (a tributary to Coldstream Creek) to supply non-potable water for irrigation to the Coldstream Ranch area (Figure 3-2). Water within Deer Creek is regulated by King Edward Lake (live storage = 1,357 ML) and GVW is licensed to divert 3,700 ML from the creek for irrigation purposes and a much smaller volume (332 ML) for waterworks. This water source allows GVW to relieve some water demand from the DCWTP during the peak summer irrigation season.

Lastly, GVW holds water licences on Okanagan Lake (1,355 ML for irrigation and waterworks purposes) to supply water to the Outback and Delcliffe residential developments through two small water systems

(Figure 3-2), as well as an additional 1,820 ML for irrigation and waterworks purposes and 148 ML for storage for water supply for other areas.

3.3.2 Water Demand

Based on GVW diversion records, the total annual diversions from Deer Creek from 2012-2015 have ranged between approximately 500 ML (2012) and 1,060 ML (2015), with an average of approximately 785 ML. Figure 3-8 presents a summary of the Deer Creek water intake total monthly diversion volumes. Since Deer Creek provides irrigation water to the Coldstream Ranch area, the diversion generally occurs in the late spring and summer, with no diversions occurring within the winter periods (Figure 3-8).

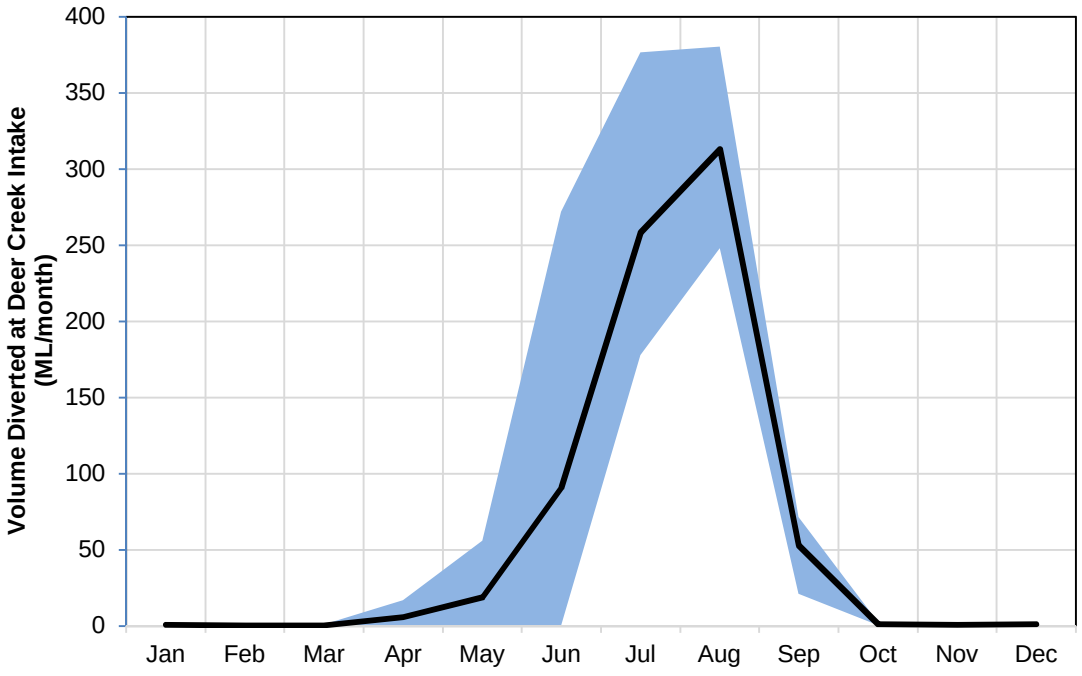

Figure 3-8 Monthly volume of water diverted by the Deer Creek water intake, 2012-2015

The Outback residential development has reported total annual water uses of 25-40 ML. No information is available for the Delcliffe area, as GVW took over the management of the system from a private operator in 2016 and have just initiated monitoring water use.

3.4 GROUNDWATER SUPPLY SYSTEM

3.4.1 System Overview

Groundwater is not a primary source of water for GVW; however, it does supplement agricultural water demands and remains a viable emergency source. GVW currently maintains four groundwater wells: Coldstream Ranch Well 1 and 2, and Antwerp Shallow Well and Antwerp Deep Well (Figure 3-2). The two

deeper wells (Coldstream Ranch Well 1 and Antwerp Deep Well) are likely located within the Coldstream Valley Aquifer (#352), while the shallow wells are screened in localized aquifers (Figure 3-2). Aquifer #352 is 15 km^2 and comprised of a mixture of unconfined, semi-confined, and confined units of sands, gravels, silts, and clays (Golder 2006). The aquifer characteristics for each well were summarized by Golder (2006) as follows:

- Coldstream Ranch Well 1 – located at a depth of 50 meters below ground surface (mbgs) within a confined aquifer (likely Aquifer #352) comprised of sands and gravels;
- Coldstream Ranch Well 2 – located at a depth of 24 mbgs within two aquifers, an unconfined sands and gravel unit and a semi-confined sands and gravel unit with a confining clay layer;
- Antwerp Shallow Well – located at a depth of 13 mbgs within a shallow semi-confined to confined sands and gravel unit; and
- Antwerp Deep Well – located at a depth of 62 mbgs within a deep confined aquifer (likely Aquifer #352) comprised of a sands and gravel unit.

Antwerp Shallow Well was compromised by contamination in January 2010 and has not been used since that date. In the future, GVW plans to have the Antwerp Shallow Well brought on as an irrigation supply, once agricultural water separation has reached that area.

Water supply from groundwater wells is regulated by the *Water Sustainability Act* which, as of 2016, requires water licences for groundwater use. GVW has applied for water licences for the wells to ensure ongoing availability.

3.4.2 Water Demand

Currently, Coldstream Ranch Wells 1 and 2 are used to supply non-potable water for irrigation for the Coldstream Ranch and area. The Antwerp Wells remain idle until separated water distribution lines are connected; however, the pump house and infrastructure is kept operational. Coldstream Ranch Well 1 and Antwerp Deep Well have been approved by Interior Health as emergency backup wells and can supply domestic water to GVW's water users in emergency situations.

The pumping capacity for GVW's groundwater wells is as follows:

- Coldstream Ranch Well 1 – 8.7 ML/day;
- Coldstream Ranch Well 2 – 5.5 ML/day;
- Antwerp Shallow Well – 3.5 ML/day; and
- Antwerp Deep Well – 4.9 ML/day.

The reported well yields by GVW (for 2004) for each well were 240 ML (Antwerp Shallow Well), 200 ML (Antwerp Deep Well), 660 ML (Coldstream Ranch Well 1), and 110 ML (Coldstream Ranch Well 2) (Golder 2006). For 2015, the total well yields for the Coldstream Ranch wells were 347 ML (Well 1) and 125 ML (Well 2).

In addition to the Coldstream Valley Aquifer (#352), AECOM et al. (2013a) identified four other aquifers within the Vernon area and provides estimates of total annual sustainable aquifer discharge. These

additional aquifers and their sustainable aquifer discharge estimates include Vernon Centre (14,700 ML), B.X. Valley (12,800 ML), Swan Lake (152 ML), and Okanagan Landing (13,800 ML). GVW currently does not have the infrastructure to obtain water from these aquifer sources; however, drilling of additional wells could be an option to explore in a time of extended drought or loss of supply.

3.5 RECLAIMED WATER SYSTEM

As outlined within the 2011 DMP, the City of Vernon supplies reclaimed water for irrigation in the Commonage Road and Bella Vista areas, totalling 970 hectares of land (Figure 3-4). The reclaimed water is used to irrigate agricultural lands, three golf courses (Predator Ridge, The Rise, and the Vernon Golf and Country Club), Vernon Seed Orchard, Kalamalka Forestry Centre, and Pacific Regeneration's Vernon Nursery. The supply and use of reclaimed water by the City of Vernon is referred to as the spray irrigation program.

The reclaimed water system includes the pumping of tertiary treated water from the Vernon Water Reclamation Centre to MacKay Reservoir (Figure 3-2). Water is drawn from the reservoir (and chlorinated) for irrigation from late April to early October. The total available supply of reclaimed water for irrigation purposes is approximately 9,400 ML and the City of Vernon currently provides approximately 4,500 ML to 5,200 ML annually. AECOM et al. (2013c) reports that the peak daily capacity for the spray irrigation program is 65 ML/day (with an average daily value of 13 ML/day).

There is no interconnection between the GVW distribution system and the reclaimed water system and the system is managed by the City of Vernon. In addition, this source can currently only be used for agricultural uses that are indirect to human consumption (i.e. growing crops for livestock or watering livestock, but not for crops that humans consume directly), hence the availability for use by GVW is limited.

3.6 SYSTEM SEPARATION AND INTERCONNECTIONS

3.6.1 System Separation

As summarized in Sections 3.1 and 3.2, GVW supplies domestic and agriculture users with treated water from DCWTP and MHWTP. However, for most agricultural practices, treated water is not required. Thus, GVW has implemented a series of separation projects with the goal of reducing water demand on the DCWTP, and thereby reducing capital, operations and maintenance costs for that facility (AECOM et al., 2013d). As outlined by AECOM et al. (2013d) and RDNO (2016), the following system separation projects have been completed:

- Bella Vista and West Swan Lake – the dependence on Goose Lake to provide domestic and agricultural water was removed by separating the system so domestic water is provided by Kalamalka Lake (BV) and Duteau (WSL) and agricultural water is provided by Goose Lake.
- King Edward – the domestic component of the Deer Creek supply system was removed and a separate agricultural supply system was completed. This also includes the expansion to the Binns / Highway 6 area.

- Von Keyserlingk (and Springfield) – construction of separate domestic and agricultural water systems were completed for the area directly downstream of the DCWTP that receives raw water from Duteau Creek.

AECOM et al. (2013d) also provides additional options for the complete or partial separation of agricultural water that are currently being considered by GVW.

3.6.2 System Interconnections

System interconnections provide GVW with the flexibility of meeting water demands by individual or through a combination of water supply sources. Interconnection opportunities are particularly important for periods of drought or water supply shortages, as this builds redundancy and a more resilient system. Interconnections are also considered part of GVW's emergency response plan during situations of loss of surface source (Section 6.2). However, as described within the 2011 DMP, GVW's ability to combine water supply sources is largely limited by water pressure differentials within their distribution systems.

A summary of GVW's current system interconnection options are as follows:

- A pumping system via the PRV1 pump house is available to provide approximately 11 ML/day of water from Kalamalka Lake into the Duteau Creek water supply system.
- A gravity interconnect at McMechan reservoir is available to provide approximately 27 ML/day of water from Duteau Creek into the Kalamalka Lake water supply system.
- Coldstream Ranch Well 1 and Antwerp Deep Well have been declared as emergency backup wells (or available during very dry periods) for GVW's domestic water supply.
- Various interconnections throughout the system can switch certain neighbourhoods from one source to another, for instance Middleton Mountain and Foothills.

Lastly, AECOM et al. (2013d) identified the option for an interconnection of the City of Vernon's reclaimed water system to Goose Lake to support agricultural water demands within the Bella Vista area. However, due to the abundance of orchards and other food crop production supplied by Goose Lake there is a potential legislative restructure and limited interest to pursue a change.

3.7 TOTAL EXISTING AND FUTURE WATER DEMANDS

As reported by RDNO (2016), GVW has approximately 22,000 active service connections, including 700 farm or agriculture status connections, 1,300 industrial, commercial, and institutional (ICI) connections, and 20,000 residential connections. All service connections are metered.

Sections 3.1 to 3.4 provide a summary of water demand by water supply source, while the total annual water demand within the GVW distribution area was reported by AECOM et al. (2013c) to range between 22,000 ML to 27,000 ML. AECOM et al. (2013c) also reports that approximately 40% of the total water used is for domestic (residential and ICI purposes), while approximately 40% is used by agriculture and 20% is lost to unaccounted for water losses.

The total area available for agricultural purposes within the GVW distribution area is 3,452 ha, but as of 2011 only 2,564 ha was being supplied with water (AECOM et al. 2013c). Allocation is based on a maximum 5.5 ML/ha/year (or 550 mm/year/ha) with properties that exceed their allocation being charged a punitive Overconsumption Fee. Hence, the total water volume of allocation is 18,986 ML for the entire available area, while currently only 12,600 ML is being used (based on 2011 data) (AECOM et al. 2013c).

A summary of the peak daily demand values for GVW's various water uses is provided in Table 3-1 and the distribution of total water use by month is provided in Table 3-2.

Table 3-1 GVW peak daily demand summary (from AECOM et al. 2013c)

Water Use	Flow Rate[1,2] (ML/d)			
	Average	Base	Seasonal	Maximum
Total (All Uses)	62	21	171	192
Domestic (Residential and ICI)	26.5	19.7	39.7	59.4
Agricultural	35.5	1.3	131.3	132.6

Notes:
1. Values based on 2011 GVW diversion records.
2. Average = average day demand (ADD); Base = base (winter) demand (BD); Maximum = maximum day demand (MDD); Seasonal = Difference between MDD and BD (SD).

Table 3-2 Average monthly water demand from all sources

Month	Percent of Annual Demand[1] (%)	Month	Percent of Annual Demand[1] (%)
January	3.3	July	21.1
February	3.0	August	21.7
March	3.5	September	10.7
April	4.2	October	4.1
May	10.2	November	3.3
June	11.7	December	3.2

Notes:
1. Values represent the average of 2011-2015 GVW diversion records.

3.7.1 Future Water Demands

AECOM et al. (2013c) provides a summary of projected water demands to 2052 and the values are summarized in Table 3-3. Note that a maximum agricultural design allocation (17,400 ML) was included to account for future watering requirements.

Table 3-3 Projected future water demands for GVW (from AECOM et al. 2013c)

Year	Annual Demand (ML)				Max. Day Demand (ML/d)		
	Domestic	Agricultural (actual)	Agricultural (allotment)	Total	Domestic	Agricultural	Total
2011	9,670	12,600	17,400	27,100	59.4	213	272
2016	9,880		17,400	27,300	60.1	213	273
2021	10,470		17,400	27,900	63.1	213	276
2026	11,060		17,400	28,500	66.0	213	279
2031	11,550		17,400	29,000	68.1	213	281
2041	12,450		17,400	29,900	73.4	213	286
2052	13,360		17,400	30,800	78.5	213	292

4 Water Shortage Stages and Communication Plan

The following section provides a description of the water shortage stages implemented by GVW and the BC provincial drought levels.

4.1 GVW WATER SHORTAGE STAGES

GVW established descriptions for water shortage stages (or drought stages) in the 2011 DMP. Each stage was initially developed in reference to the volume of water available within the Aberdeen-Grizzly-Haddo Reservoir system (Section 3.1). Through the preparation of the 2011 DMP, additional water shortage forecast parameters were established (Sections 5.1 and 6). The stages form the basis for the WSMP and the associated responses implemented (i.e., watering restrictions) through RDNO's Bylaw No. 2545 or as amended (Appendix B). GVW's communication plan for each stage is as outlined in Section 4.3.

The stages outlined herein are consistent with the 2011 DMP and are being updated for the WSMP. However, because of GVW's shift from a solely drought-focused plan, the stages listed below also apply to a water shortage situation resulting in similar reductions in supply availability due to limitations from infrastructure or an emergency incident. It should be noted that GVW may implement restrictions on a sub-area within its service area in the event of a water shortage that affects an isolated portion of the system, such as the Outback or Delcliffe neighbourhoods or the agricultural customers serviced from King Edward Lake. A summary of each water shortage stage is provided below.

Normal Condition
Normal Conditions are defined by the average Aberdeen-Grizzly-Haddo Reservoir system storage condition, where storage volumes are sufficient to meet water supply needs at current and near-future levels of demand. Storage volumes that are within the 95% confidence limit (established using 1997 to 2010 data in the 2011 DMP) are considered within normal operational ranges. The water conservation goals of this stage are to encourage water use efficiencies and promote water supply shortage awareness and preparedness. A maximum 3-day a week sprinkler irrigation schedule for outdoor water use (i.e., a best practice for efficient sprinkler irrigation to encourage healthy plant growth) is established year-round during normal conditions (Appendix B).

Stage 1 – Dry Condition
Stage 1 – Dry Conditions represent an early (or mild) drought condition and elevates the community awareness level for a first indication of a potential water supply shortage. Public communication informs on-going status, potential future shortages, and further water restrictions. This stage represents a condition where Aberdeen-Grizzly-Haddo Reservoir system storage volumes are 30 to 90% of the total available live storage (based on time of year). Operations may be adjusted to reduce water loss downstream. Communications strategies will focus on encouraging stewardship and voluntary conservations measures by the community. An increased level of enforcement and monitoring, particularly of large water users, occurs during this stage and warnings may be issued if misuse is deemed to be occurring.

Water conservation goals during this stage are to reduce total water use by 10% to reduce the potential to move to Stage 2. Water use restrictions implemented during this stage are primarily focused on the reduction of domestic and ICI outdoor water use as per the recommendations of the DSWG (Section 2.2) to prioritize agricultural water needs at this stage (Appendix B).

Stage 2 – Very Dry Conditions

Stage 2 – Very Dry Conditions represent conditions of prolonged periods of no rain and hot, dry weather, combined with below normal snowpack conditions. This stage is considered a time of moderate drought or when water supplies are becoming stressed. Aberdeen-Grizzly-Haddo Reservoir system storage volumes are 20 to 82% of the total available live storage (based on time of year). An increased level of communication, education, monitoring, and enforcement occurs at this stage with moderate fines issued and lower tolerance for water waste. Water conservation goals during this stage are to reduce total water use by 20% to reduce the potential to move to Stage 3. Water use restrictions implemented during this stage are focused on the reduction of domestic and ICI outdoor and agricultural water use (Appendix B).

Specifically, this stage implements a maximum of 2-day a week sprinkler irrigation schedule in addition to other limitations on domestic and ICI outdoor water use. A 20% reduction in the total agricultural water allocation is also implemented and a late turn on[1] or early turn off for agricultural water may also occur to help achieve this reduction in consumption (Appendix B). During this stage, GVW would likely review the total volume of agricultural water used at a critical decision point, as well as the forecasted water demand values for the rest of the irrigation season, and would restrict the remaining water availability by 20%. However, this approach would be re-assessed depending on the ability to work with individual customers on achieving overall demand reductions following the installation of the Automated Meter Reading system to improve GVW's understanding of customer demand patterns.

Stage 3 – Extremely Dry Conditions

Stage 3 – Extreme Conditions represent extremely dry conditions. This stage is considered a time of extreme drought, when water supplies are at a critical shortage level. Supply limitations of this magnitude may also be caused by wildfire in Duteau Creek watershed or failure of key infrastructure. This stage represents the condition where Aberdeen-Grizzly-Haddo Reservoir system storage volumes are 10 to 43% of the total available live storage (based on time of year). A high level of communication, education, monitoring, and enforcement occurs at this stage with fines issued and zero tolerance for misuse permitted. GVW staff resourcing may need to increase during this stage to ensure community compliance and/or to support emergency management and communication. GVW would seek the support of its municipal partners for resources such as restrictions enforcement via bylaw officers or public communications.

Water conservation goals during this stage are to reduce total water use by 50% to reduce the potential to move to Stage 4. Critical services for fire protection, household consumption, and sanitation are maintained at this stage; however, domestic and ICI outdoor water use is severely restricted to a 1-day a week irrigation schedule (Appendix B).

[1] Late agricultural water turn on may include a change from April 15th to April 30th for example. Early turn-off may have the date shift from September 15th to September 1st.

A 50% reduction in the total agricultural water allocation is implemented and a late turn on or early turn off for agricultural water services may also occur (Appendix B). Like Stage 2, GVW may restrict remaining water availability by 50% at the time of the stage declaration. If forecasts indicate drought early enough in the year, GVW may choose to inform agricultural customers well in advance of planting to give them the option not to plant certain crops and/or keep fields in fallow. Plans can then also be put into place by agricultural producers to irrigate minimum amounts on orchards, vineyards, and other high value perennial crops to mitigate economic impacts. However, this would likely only be done in a multi-year drought with a high probability of low water supplies.

Stage 4 – Emergency Conditions

Stage 4 – Emergency Conditions are characterized by a loss of supply as a result of drought, contamination, or a loss of critical infrastructure. This stage represents the condition where Aberdeen-Grizzly-Haddo Reservoir system storage volumes are at 5% of the total available live storage. During this stage, water supplies are limited to domestic (indoor) use only; at the base (winter) demand rate (i.e., 30 ML/day).

Water conservation goals during this stage are to reduce total water use by 90% through the elimination of domestic and ICI outdoor water use, as well as an 80% reduction in the total agricultural water allocation (Appendix B). Like Stages 2 and 3, GVW may restrict remaining water availability by 80% at the time of the stage declaration, with the remaining water to be used to maintain minimum water supplies for perennial operations, such as orchards and vineyards, as well as livestock to mitigate economic impacts.

At this stage, fire protection services could be compromised. In addition, the GVW Emergency Response Plan (Section 7.2) and Provincial Emergency Program would be invoked. GVW staff resourcing would increase during this stage, as per the appropriate Emergency Response Plan (ERP-05 Loss of Water) (Section 7.2), to ensure community compliance and to support emergency management and communication.

4.2 PROVINCIAL DROUGHT LEVELS

4.2.1 Provincial Drought Levels

As part of striving for consistent drought response strategies across the BC, four provincial drought levels each with specific objectives and suggested water use targets have been established (MOE 2016b). The four drought levels are summarized in Table 4-1 and are declared by the Provincial Technical Drought Working Group (PTDWG) based on streamflows and snowpack conditions at selected monitoring locations.

Table 4-1 Summary of provincial drought levels (MOE 2016b)

Level	Conditions	Significance	Objective	Target
1	Normal	There is sufficient water to meet human and ecosystem needs	Preparedness	Ongoing reductions in community water use
2	Dry	First indications of a potential water supply problem	Voluntary conservation	Minimum 10% reduction
3	Very Dry	Potentially serious ecosystem or socio-economic impacts are possible	Voluntary conservation and restrictions	Minimum additional 20% reduction to a minimum total of 30%
4	Extremely Dry	Water supply insufficient to meet socio-economic and ecosystem needs	Voluntary conservation, restrictions, and regulatory action as necessary	Maximum reduction
Loss of Supply		Potential loss of a community's potable or fire fighting supply	Emergency response	Ensure health and safety

For the RDNO region, the Thompson Okanagan Drought Response Team (TODRT) works with the PTDWG to declare drought levels for the Okanagan and Shuswap River watersheds, as well as conducts follow-up communications and recommends responses (as required) to local governments as outlined through the Thompson Okanagan Drought Response Implementation Plan (TODRIP) (i.e., FLNRO [2016]). The TODRIP is a guide for FLNRO staff and the TODRT to assess and respond to worsening drought conditions to help minimize the effects on both aquatic ecosystems and water users (FLNRO 2016). The TODRIP also identifies the specific streams that are monitored within the Okanagan and Shuswap region to assess the provincial drought levels, as well as indicates that snow survey and water supply bulletins for the region (published by the BC River Forecast Centre) are also used to support the drought declarations.

The **provincial drought levels are independent of the water shortage stages used by GVW**. As demonstrated in 2015, it was not necessary for GVW (or many of the Okanagan water utilities supported by storage) to increase water restrictions beyond Stage 1 despite a Provincial Drought Level 4 declaration. GVW has advocated for the Province to declare drought warnings on a watershed scale to highlight those areas of actual concern. This would make the provincial drought levels more relatable to the communities they will impact, as was demonstrated by FLNRO's 2015 drought response to the Coldwater River, rather than the large regional zones currently reported. Therefore, at this time, the **provincial drought levels provide guidance to GVW on the general water supply conditions within the region, but do not directly correlate to system operations, water restrictions, or reservoir management responses**.

4.3 GVW COMMUNICATION PLAN

The BC Drought Response Plan (MOE 2016b) highlights the importance of a well-structured and clearly defined communication strategy between key parties for effective drought preparation and response. To date, communication of drought or water shortages by GVW is through the public notification procedures outlined by RDNO (2012), as well as direct communication with the DSWG (Section 2.2). Once a change to water shortage stage has been triggered, specific public communication strategies and appropriate responses are as outlined in the water supply shortage communication plan included in Appendix C.

GVW also communicates with the public on the differences between GVW water shortage stages and provincial drought levels to ensure that the public is aware of the current difference between the two different types of declarations.

5 Water Shortage Stage Decision Process and Triggers

The following sections outline GVW's process for reviewing water shortage status, critical dates, decision process used to predict potential water shortages and to trigger stage declarations. A trigger is defined as the final decision by the GVW to change a water shortage stage. An overview of GVW's water shortage decision process and parameters used is illustrated in Figure 5-1. The water shortage forecast parameters used to assess water shortage status and to support the triggering of a stage declaration are summarized in Section 6.

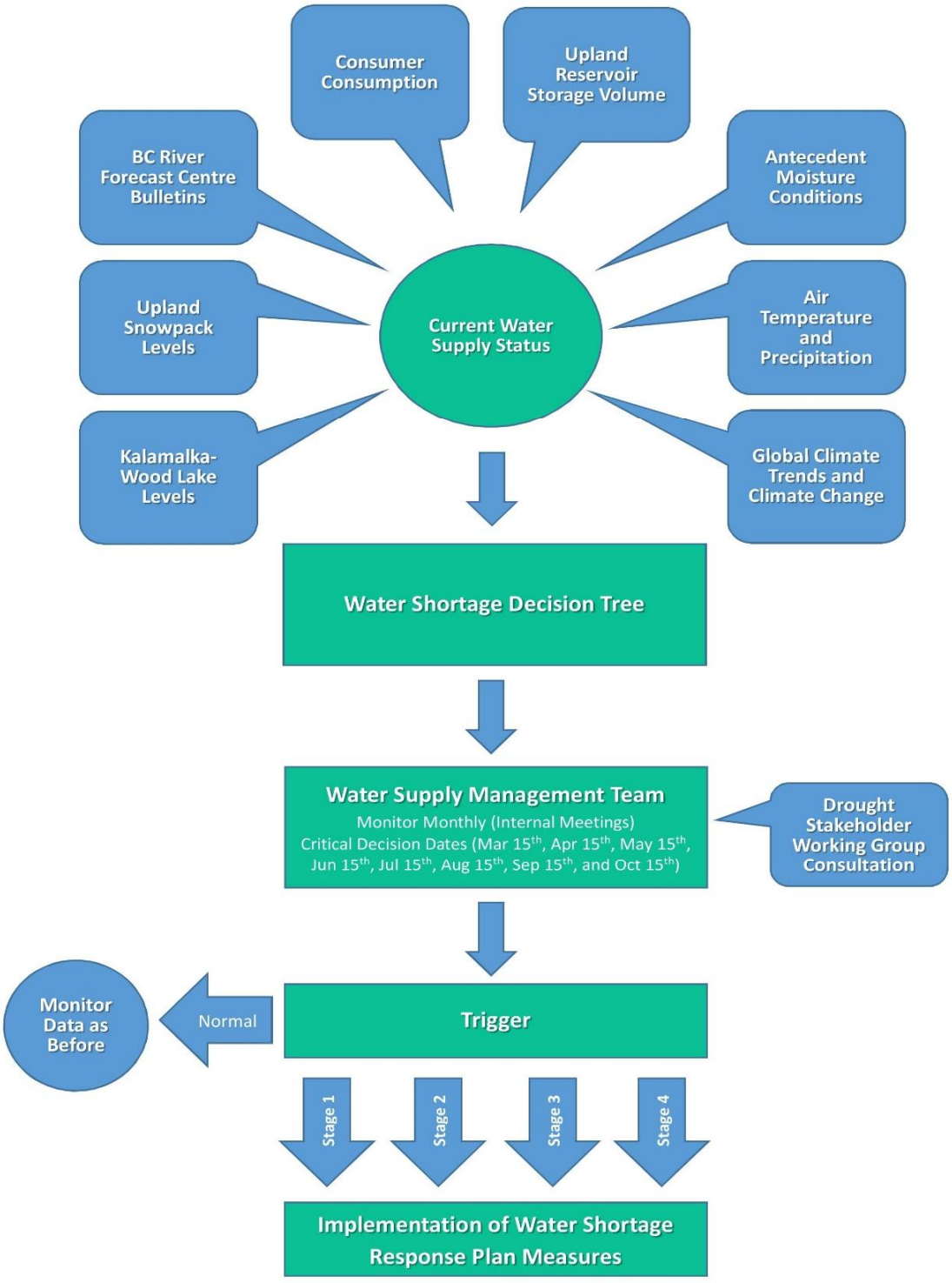

Figure 5-1 GVW water shortage decision process

5.1 MEETINGS AND CRITICAL DATES

To determine the status of water supplies, the GVW Water Supply Management Team (WSMT) (Section 2.1) meets monthly (formally and informally) to review the current water supply status (see Figure 5-1). The purpose of these meetings is to discuss the current state of water supplies and forecasted trends to develop an understanding of the potential for future shortages and to what level of severity (i.e., stage). These meetings also provide the opportunity to implement operational measures (e.g., regulating spill from the Aberdeen-Grizzly-Haddo Reservoir system to increase storage volumes, move water demand from one source to another source) prior to the triggering (and declaration) of water shortage stages and associated responses.

The triggering (and declaration) of a water shortage stage involves complex considerations, as personal hardship, economic losses to the agricultural and ICI communities, damage to infrastructure such as parks, and lost revenue to GVW may result because of the declaration. As such, the WSMT will recommend the implementation of a stage in an informed manner with the understanding of the consequences. This includes the consequences of having to rescind a declaration within a short timeframe (particularly in the early spring when planting may be occurring).

While water shortage forecast parameters (Section 6) are monitored weekly to monthly (as supply status may shift at end time as a result of infrastructure or contamination emergencies), monthly critical decision dates are also used by the WSMT to assess the year's expected water supply status as follows:

- March 15th (or as close to as possible) – decisions on this date consider the current state of storage volumes, previous fall antecedent conditions, BC River Forecast Centre water supply bulletins, weather forecasts, and snowpack bulletins, GVW water demands to-date, as well as the current state of the snowpack within the headwaters and lower areas of Duteau Creek watershed and regionally.
- April 15th and May 15th – decisions on this date consider the current state of storage volumes, freshet predictions, BC River Forecast Centre water supply bulletins, weather forecast, and snowpack bulletins, GVW water demands to-date, as well as the current state of the snowpack within the headwaters and lower areas of Duteau Creek watershed and regionally.
- June 15th (or as close to as possible) – decisions on this date consider the current state of storage volumes, the volume of precipitation (in the form of rain) received specifically within the month of June (to-date) in the headwaters area of Duteau Creek watershed, BC River Forecast Centre water supply and snowpack bulletins, weather forecasts, as well as current and forecasted GVW water demands.
- July 15th and August 15th (or as close as possible) – decisions on this date consider the current state of storage volumes, the volume of precipitation (in the form of rain) received in the region, as well as summer air temperatures, and GVW water demands to-date to assess the need for an early irrigation turn off.
- September 15th and October 15th (or as close as possible) – decisions on this date consider current state of storage volumes, the volume of precipitation (in the form of rain) received in the region, as well as summer and fall air temperatures, in addition to soil moisture conditions to assist in managing fall reservoir levels and developing the winter streamflow strategy for water releases (i.e.,

low water levels – minimize water releases and spill from the Headgates dam; or very high water levels – increase streamflow releases to Duteau Creek).

Once a water shortage stage has been triggered, the WSMT continues to review storage volumes and other water shortage forecast parameters on a weekly basis and recommend a change (or rescinding) of stage following the water shortage stage decision tree (Section 5.2). When a water shortage stage change is triggered, the Water Shortage Response Plan (Section 7.1) is enacted by the WSMT for the respective stage. The WSMT also engages with the DSWG (Section 2.2) once a trigger (or impending declaration) has occurred to effectively communicate the water shortage status and potential future supply challenges.

5.2 DECISION TREE AND STAGE TRIGGERING

To support the triggering of a water shortage stage, a decision tree is used by GVW. The decision tree is a guide for decision-makers in weighing information and understanding the potential outcomes when deciding what water shortage action(s) to undertake. The decision tree is provided in Figure 5-2 and represents an update to the decision tree included within the 2011 DMP. The decision tree is used by the WSMT to determine the status of water supplies at any point throughout the year, on a critical decision date, or forecasted for the near future.

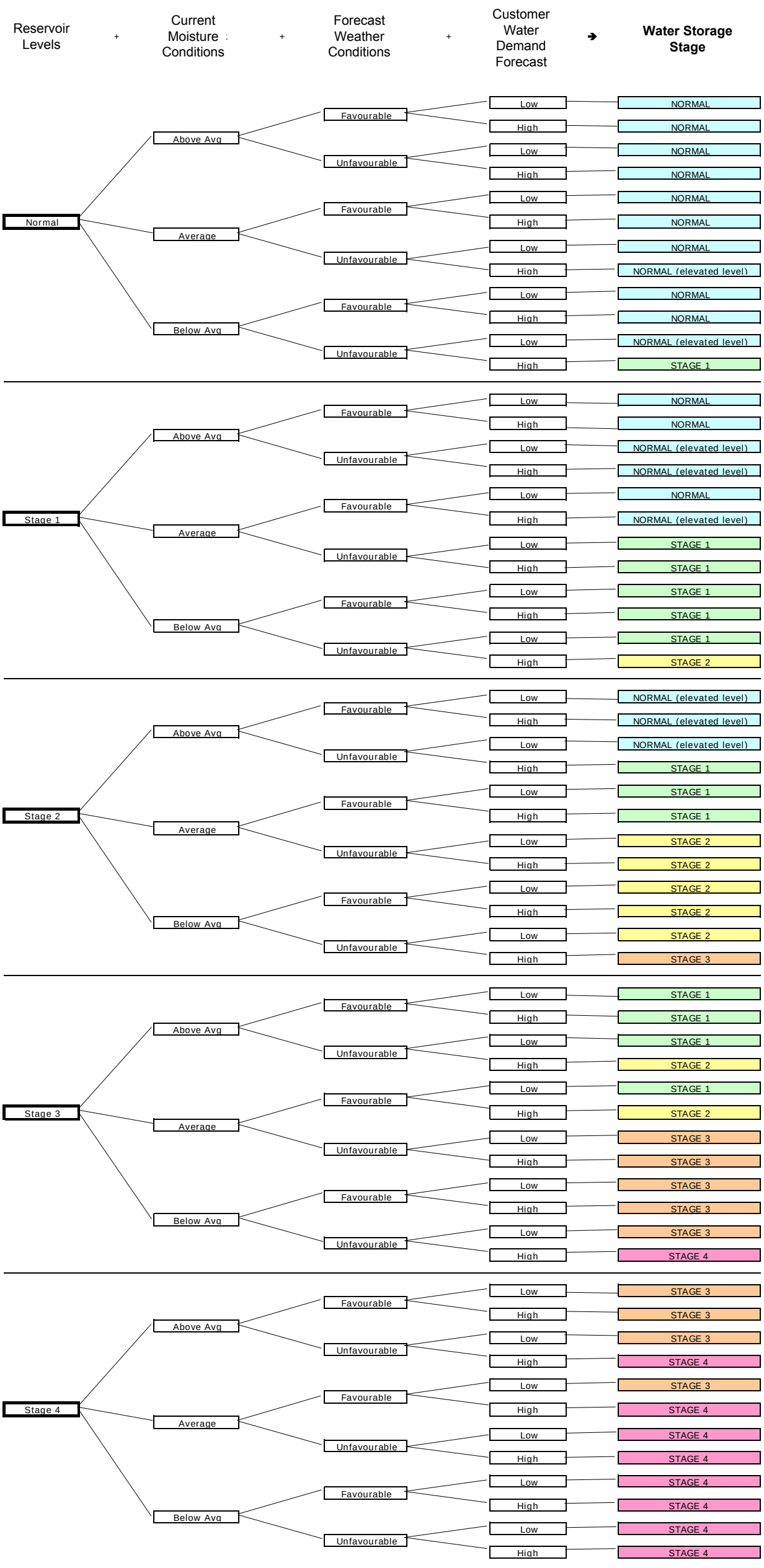

Figure 5-2 Water shortage stage decision tree

The sequence of actions used by the WSMT to determine water supply status (using the decision tree) is as follows:

1. Determine reservoir storage volumes (and associated stage and staged fishery flow target) for the Aberdeen-Grizzly-Haddo Reservoir system with respect to the water shortage stage storage diagram (Figure 6-1). Also, assess King Edward Lake storage volumes in comparison to live storage, as well as Kalamalka-Wood Lake level elevation in reference to respective FLNRO month end target.
2. Assess upland moisture conditions for respective month/period of interest. When snowpacks are present, determine whether upland snowpack storage is above average, average, or below average, using GVW upland snow course information and regional BC River Forecast Centre snowpillow and snow course bulletins. When snowpacks are absent (or at minimal levels), determine whether total precipitation (in the form of rain to-date) is above normal, normal, or below normal, using available real-time Meteorological Service of Canada climate station records. Total precipitation received in June is of particular importance to review. Also, supplement snowpack and/or precipitation status by considering antecedent moisture conditions measured by GVW's groundwater and soil moisture and temperature monitoring program.
3. Assess forecasted weather conditions for respective month/period of interest. Review (or consult) the BC River Forecast Centre bulletins to determine whether the water supply outlooks for the Vernon area (e.g., Kalamalka Lake inflows) are considered favourable or unfavourable. Also, review Environment Canada short-term forecasts to determine forecasted air temperatures and precipitation. Finally, consider the current phase (i.e., El Nino or La Nina) of the El Nino/Southern Oscillation cycle to assess general weather trends at the global scale.
4. Assess total water demand. For critical decision dates, determine whether total water consumption is above or below normal values and consider forecasted evapotranspiration and calculated soil moisture deficit values.

Following Figure 5-2, the triggering of a water shortage stage is based on water shortage forecast parameter values outlined in Section 6. A trigger is considered the point at which a water shortage stage change is identified (i.e., change from Normal to Stage 1) following the decision tree process. A trigger is the resultant action (i.e., declaration and response measures) that is required based on the combination of all water shortage forecast parameters; a trigger is not specific to one forecast parameter alone (i.e., storage level). Note that a trigger can also lead to the rescinding (i.e., moving from Stage 1 to Normal) of a stage declaration as well.

Note that confidence in the water shortage forecast parameters involved in the decision-making process continues to improve with every GVW plan update. It is understood that some of the information sources identified herein (i.e., Section 6) require more scrutiny and development to obtain this confidence. Confidence is required particularly for trigger decisions between Stages 2 through 4. Trigger decisions between Normal and Stage 1 rely heavily on data and models that forecast future conditions, while Stages 2, 3 and 4 represent more the reality of the present situation. During the latter triggering decision processes, there is likely to be less reliance on predictive modelling results and more of an emphasis on actual data and interpretation, as well as provincial communications and daily/weekly feedback from GVW operations.

6 Water Shortage Forecast Parameters

The following section provides a summary of the forecast parameters used by GVW to assess water supply status, as well as to support the use of the decision tree (Figure 5-2). The structure of this section is consistent with the headings included within the decision tree (Figure 5-2). Note that some of the parameters are new and/or updated from the 2011 DMP.

6.1 RESERVOIR LEVELS

6.1.1 Aberdeen-Grizzly-Haddo Reservoir system

The storage volume within the Aberdeen-Grizzly-Haddo Reservoir system is considered the primary water shortage forecast parameter for the GVW distribution area. The total storage volume is monitored by GVW in real-time through a supervisory control and data acquisition (SCADA) system. The respective water shortage stage is then identified using the water shortage stage storage diagram (i.e., Figure 6-1).

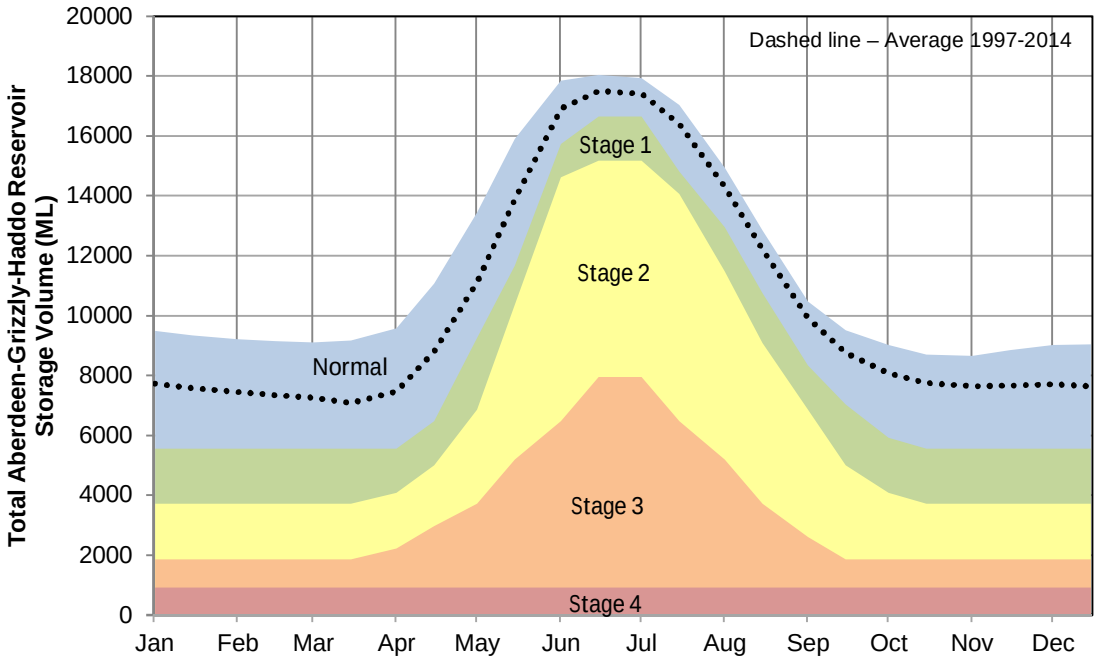

Figure 6-1 GVW water shortage stage storage ranges defined for the Aberdeen-Haddo-Grizzly Reservoir system

The Aberdeen-Grizzly-Haddo Reservoir water shortage stage storage ranges were defined within the 2011 DMP and are in reference to the total volume of water available. The stage storage ranges represent a percentage of the total live storage available at a specific point in the year (Figure 6-1). The stage storage ranges were derived in the 2011 DMP using data from 1997-2010 and storage levels encountered during

previous drought years (e.g., 2003) and are generally still considered effective for current operations and water demands. The stage ranges are provided in tabular format in Appendix D.

However, even with water shortage stage storage ranges in place, in some years GVW has faced challenges with the refilling of the Aberdeen-Grizzly-Haddo Reservoir system due to low snowpacks and/or low spring precipitation, as well as meeting water demands downstream (Section 3.1). Accordingly, Epp (2015a) concluded that due to the annual reservoir refill variability that GVW has experienced, the upper level of the Stage 1 storage range could be increased to help reduce reservoir refill variability. Specifically, Epp (2015a; pers. comm., 2017) recommended that the Stage 1 (upper) storage range be updated to be consistent with the Low Normal fishery flow storage target [Section 6.1.1.1]. This Stage 1 storage range modification is considered a tool for establishing minimum reservoir operations in the fall periods to support water supply management.

6.1.1.1 Fishery Flow Targets

As outlined in Section 3.1.4, GVW currently implements a water shortage stage-based method (Epp 2015b) for varying the fishery flow targets for releases into Duteau Creek downstream of the Headgates dam based on the respective water shortage stage. The fishery flow targets allow for the varying of fishery flow releases based on available storage volumes within the Aberdeen-Grizzly-Haddo Reservoir system.

The fishery flow targets were developed as a function of monthly EFN values developed for the Bessette Creek watershed by Epp (2014). The EFN values were defined as percent of long term mean annual discharge (LT mad) and were based on an LT mad value of 1.15 m^3/s for Duteau Creek below the Headgates dam.

Five fishery flow targets have been defined in reference to the EFN values developed by Epp (2014). The five targets are as follows:

- Normal Flow – set at 100% of the EFN values;
- Low Normal – set at an average of 58% of the EFN values (and to be used when storage volumes indicate good water availability);
- Level 1 Flow – set at an average of 40% of the EFN values (and reflects low water availability);
- Level 2 Flow – set at an average of 24% of the EFN values (and corresponds approximately to the DFO monthly fishery flow releases [Section 3.1.4]);
- Level 3 Flow – set at an average of 10% of the EFN values (and corresponds to emergency level water availability).
- Level 4 Flow – same as Level 3 Flow values.

For Duteau Creek, Normal corresponds to median and wetter natural flows, Low Normal corresponds to between the 25th percentile and median natural streamflows, Level 1 Flow corresponds to between the 10th percentile and the 25th percentile natural streamflows, Level 2 Flow corresponds to <10th percentile natural streamflows, and Levels 3 and 4 Flow correspond to unforeseen extreme low streamflows. The weekly fishery flow targets are illustrated in Figure 6-2 and provided in tabular format in Appendix D. The

respective weekly fishery flow storage targets are also provided in Appendix D – these values are slight modifications of the reservoir shortage stage ranges (Section 6.1.1) to support operational use.

A Microsoft Excel based stage/flow calculator is used to automate the fisheries flow calculations. The calculator requires storage volumes from the Aberdeen-Grizzly-Haddo Reservoir system and the releases through the Headgates dam scour pipe. The calculator determines the water shortage stage, the corresponding fishery flow storage target (Appendix D), and the required Headgates dam spill required to meet the fishery flow target downstream.

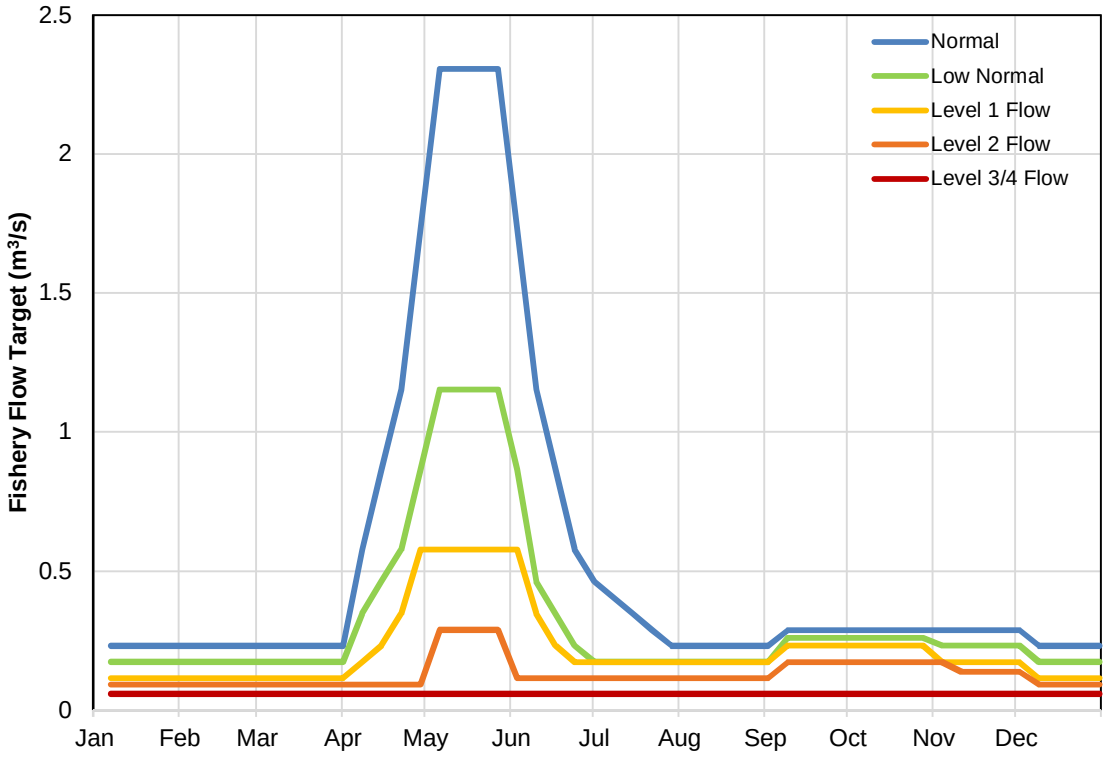

Figure 6-2 Fishery flow targets for Duteau Creek below Headgates dam

Testing of the fishery flow targets and GVW's operating experiences in 2015 and 2016 indicated that the recommended targets are suitable for ongoing implementation. Nevertheless, ongoing records of reservoir levels/volumes, Headgates dam diversions, bypass, and spill will still be maintained and reviewed annually. This will serve to demonstrate compliance with the fishery flow targets, and to provide a basis for reviewing and revising the targets if the results demonstrate undue reservoir system drawdown due to the streamflow releases.

6.1.2 King Edward Lake

Water shortage stage ranges have not been defined for King Edward Lake; however, storage volumes (compared to 1,357 ML live storage) are often used as an indicator of water shortage to the Coldstream Ranch area. The storage volume of the lake is monitored by GVW in real-time using a SCADA system.

During normal operations, the Coldstream Ranch Wells are used continually and water from King Edward Lake is only used during freshet, as well as peak water demand times in July and August. If a water shortage is expected, GVW implements weekly meetings with Coldstream Ranch to closely manage the water supply and to ensure that water released from the lake is not wasted. GVW can also supplement water demands with the Duteau Creek water supply; however, if this Duteau Creek water supply is considered to be in drought, then use by the Coldstream Ranch area would likely exacerbate drought conditions.

6.1.3 Kalamalka-Wood Lake

FLNRO manages Kalamalka-Wood Lake to reduce the risk of flooding and to optimize use of the water available to meet off stream demands, environmental flows, and recreational and tourism interests. Water shortage or drought lake levels have not been defined for Kalamalka-Wood Lake; however, Kalamalka Lake level elevations are monitored in real-time by the WSC at the hydrometric station *Kalamalka Lake at Vernon Pumphouse* (Station No. 08NM143) (Figure 3-2). Therefore, for water shortage planning purposes, lake level elevations compared to the FLNRO month end operational targets (Figure 3-6) can be used a preliminary indicator of a possible water supply shortage or restrictions to water supplies from Kalamalka Lake. Thus, during times of water shortage, either locally or regionally, GVW staff will remain in frequent communication with FLNRO to get updated status checks on lake levels and possible provincially imposed water restrictions.

Although water shortage lake levels have not been defined for Kalamalka-Wood Lake, following the severe drought within the southern interior of BC in the summer of 2015, the OBWB commissioned a study to develop guidelines for drought triggers to be considered as part of the Okanagan Lake Regulation System (OBWB 2016). The drought triggers are currently in draft form and use end of month lake level elevations for Okanagan and Kalamalka-Wood Lakes, since actual and forecasted lake level elevations are used to determine water availability. The draft drought triggers have been defined for five drought stages (i.e., non-drought, stage 1, stage 2, stage 3, stage 4) (OBWB 2016). The drought triggers are intended to help Okanagan water suppliers in the development of DMPs, to help ensure consistent and coordinated responses during drought, as well as to provide an understanding of a water supplier's risk to water availability (from a mainstem lake) during times of drought.

The drought triggers are considered draft at this time and have not been officially adopted by FLNRO. Accordingly, future revisions of the WSMP will consider Okanagan Lake and Kalamalka-Wood Lake drought triggers if/when they are established.

6.2 MOISTURE CONDITIONS

6.2.1 Snowpack Conditions

The annual winter snowpack drives the hydrologic regime of the Duteau Creek watershed, so variability in snowpack accumulation and melt can be dominant factors (see Section 3.1.2). Snow accumulation, expressed as snow water equivalent (SWE), represents stored water that is later released into the upland reservoirs. SWE is measured by GVW within the Duteau Creek watershed and reported to the BC River Forecast Centre who compiles snow course information within nearby watersheds to provide a regional snow course update. This information is considered a primary water shortage forecast parameter for the GVW distribution area in the early spring months.

The following sections summarize the snowpillows and snow courses used by GVW to forecast water shortages (in support of the March 15th meeting and anytime there is snow in the watershed after March 15th).

6.2.1.1 GVW snow courses

Snowpack conditions within Duteau Creek watershed are monitored by GVW at three snow course locations (Figure 3-2):

- Aberdeen Lake [1F01A];
- Clearcut [2701]; and
- Forested [2702]).

Snow course surveys are completed at each site on (or close to) the 1st of the month in January, February, March, April, and May by GVW[2]. Surveys have been conducted at Aberdeen Lake site (1F01A) from 1970-present and at the Clearcut (2701) and Forested (2702) sites from 2008-present (Figure 6-3). For the March 15th critical decision date, snow course survey results from March 1st are compared to the long-term average (1970-2016) SWE for March 1st of 140 cm for Aberdeen Lake (1F01A) and average (2008-2016) SWE values of 150 cm and 110 cm at the Clearcut (2701) and Forested (2702) sites, respectively. The March 1st (and other dates) survey results are identified as above average, average, or below average and used to support the use of the decision tree (Figure 5-2). For decision tree and forecasting purposes, “above average” is when GVW snow course survey results indicate SWE > 85% of average, “average” occurs when SWE is between 70% to 85% of average, and “below average” occurs when SWE < 70% of average.

The SWE percentage division (above) is generally consistent with the core drought indicators (for basin snow measurements) used by FLNRO (2016) for declaring provincial drought levels (Section 4.2).

[2] To obtain better precision, it may be necessary that an April 15th survey is added in some years to better understand snowpack variability across the upland watershed area(s) if water shortage decisions are needed to be made between March 1st and June 15th.

However, the SWE percentage divisions have been slightly modified[3] to account for annual reservoir refill variability experienced in the Duteau Creek watershed. The 2011 DMP identified that the ability of the Aberdeen-Grizzly-Haddo Reservoir system to fill is compromised when SWE < 100 mm (i.e., approximately 70% of average) on March 1st at Aberdeen Lake (1F01A). Thus, due to the annual reservoir refill variability that GVW has experienced (Epp 2015a), careful planning occurs and reservoir storage volumes and operations are closely monitored when SWE < 100 mm (Figure 6-3).

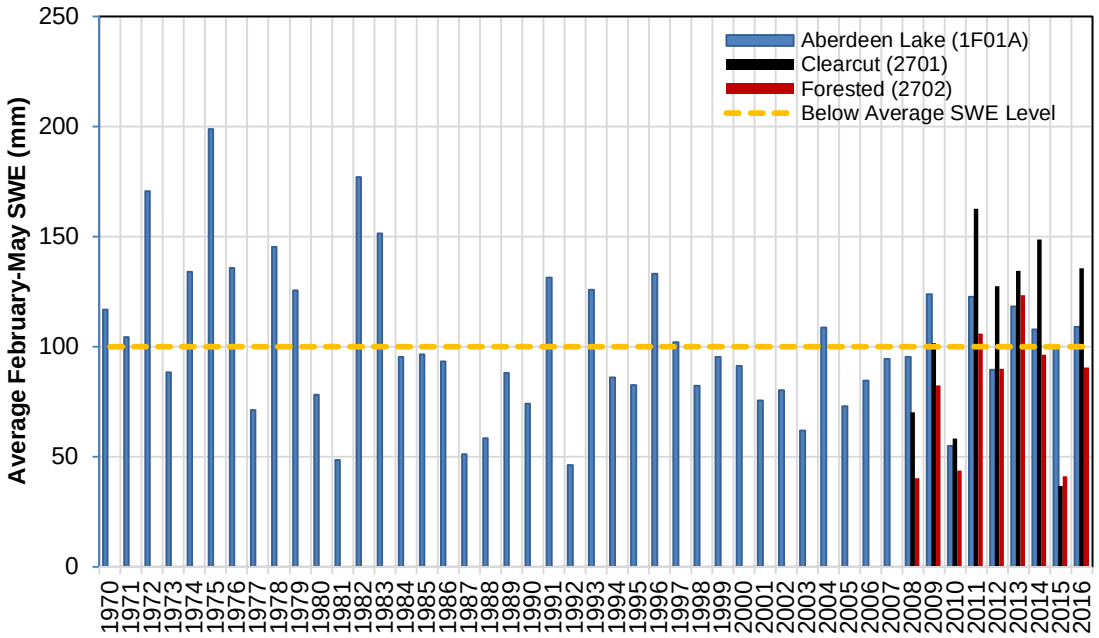

Figure 6-3 Snow water equivalent (SWE) monitoring at GVW's three snow courses: Aberdeen Lake (1F01A), Clearcut (2701), and Forested (2702)

Similarly, as noted within the 2011 DMP, a decreasing SWE trend in the long-term records at Aberdeen Lake (1F01A) has been observed. As such, GVW also reviews more recent period SWE averages (e.g., 10-year) in comparison to March 1st (and other dates) survey results to ensure that current climate variabilities are considered in the water shortage decision process. As noted in Section 3.1.3, Epp (2015a) identified a 15-20% probability of the Aberdeen-Grizzly-Haddo Reservoir system not reaching full storage capacity in any year (based in part on the reservoirs not having refilled completely in 2003, 2007, 2009, and 2010 between 1997 to 2016).

[3] FLNRO (2016) uses a value of SWE < 65% of normal (i.e., average from 1981-2010) as the point at which Provincial Drought Level 3 snowpack conditions are declared, while SWE > 80% of normal is considered to be Provincial Drought Level 1. To account for GVW's noted reservoir refill variability during periods when the snowpack at Aberdeen Lake (1F01A) when SWE < 70% of average (i.e., SWE = 100 mm), the FLNRO (2016) values were updated to consider this site-specific experience.

6.2.1.2 BC River Forecast Centre – Snow Survey Bulletins

Another forecast parameter used by GVW to support water shortage decisions making are the snow courses managed by the BC River Forecast Centre at Oyama Lake (2F19) and Postill Lake (2F07) (Figure 3-2). These sites are located to the south of the Duteau Creek watershed and are within the same upper plateau physiographic region and at representative elevations. These snow course sites have long term records and usually have snow still present by May 1st. The BC River Forecast Centre releases snow course survey information as bulletins in January (1st), February (1st), March (1st), April (1st), May (1st and 15th), and June (1st and 15th). These snow courses are used to support water shortage forecasting by providing additional insights into snowpack variability within the general upper plateau area of Duteau Creek watershed. For the March 15th critical decision date, the average (1981-2010) SWE for Oyama Lake (2F19) is 157 cm and for Postill Lake (2F07) is 186 cm, and above average (SWE > 80% normal), average (SWE = 65% - 80% normal), and below average (SWE < 65% normal) conditions at these sites are as outlined by FLNRO (2016).

The BC River Forecast Center added a new snowpillow in 2015 to their Okanagan monitoring network at Silver Star Mountain (2F10P) (Figure 3-2). Although this snowpillow is located at a higher elevation than the general upland watershed area of Duteau Creek, the real-time information can be used to support the identification of the times of peak snowpack development and early stages of snowmelt within the North Okanagan region. This snowpillow will be a valuable source of information in the future.

Lastly, the BC River Forecast Centre also provides Basin Snow Water Index values for larger regional areas within their bulletins, in reference to normal (average) climate conditions. The information published for the Okanagan and South Thompson Basins is relevant to the GVW and is used as supplemental information to the BC River Forecast Centre's site-specific values and GVW's snow course measurements.

6.2.2 Precipitation Conditions

The 2011 DMP identifies that spring and summer precipitation at the Meteorological Service of Canada's Vernon CS climate station (Station No. 1128581) was used by GVW to provide a rough indication of precipitation inputs to the upland reservoirs. However, this climate station was discontinued in 2008. Thus, the following Meteorological Service of Canada climate stations are available (in real-time) to support the determination of total precipitation status (as well as to be used for forecasting [Section 6.3]) in a particular year (Figure 3-2):

- Vernon North (Station 1128583; Period of Record = 1990-present; Elevation = 538 m GSC);
- Vernon Silver Star Lodge (Station No. 1128584; Period of Record = 1970-present; Elevation = 1,586 m GSC); and
- Vernon Auto (Station No. 1128582; Periods of Record = 2005-present; Elevation = 482 m GSC).

The climate station on Silver Star Mountain is more representative of the uplands of the Duteau Creek and used to assess reservoir inflow status, while the lower elevation stations represent the lowlands and are used to generally assess water demand status. A summary of monthly total precipitation (in the form of rain) for each of the climate stations is provided Table 6-1. The total precipitation (in the form of rain) for the

spring and summer in comparison to normal (average) conditions is used to inform the decision tree (Figure 5-2) when snowpacks are no longer present. Specifically, for the June 15th critical decision date, total precipitation for the month of June up to June 15th (Table 6-1) is used to support the water shortage decision process. Based on available information, the total precipitation by June 15th, represents approximately 50% of the total monthly volume.

For decision tree and forecasting purposes, “above average” is defined when monthly or seasonal precipitation (in the form of rain) results indicate total precipitation is >80% of average, “average” occurs when total precipitation is between 51% to 80% of average, and “below average” occurs when total precipitation is <50% of average. The percentage division (above) is consistent with the divisions used by FLNRO (2016) to support provincial drought level monitoring.

In addition to the information included within Table 6-1, GVW also reviews more recent period precipitation averages (e.g., 10-year) in comparison to the June 15th (and other months) results to ensure that current climate variabilities are considered in the water shortage decision process.

Table 6-1 Summary of total rainfall volumes for climate stations within and near Vernon

Climate Station	Total Rainfall (mm)												
	Jan	Feb	Mar	Apr	May	Jun		Jul	Aug	Sep	Oct	Nov	Dec
						15th	Month						
Vernon North[1]	11.6	11.7	17.0	27.2	46.3	26.8	49.6	35.4	31.9	32.7	40.7	31.1	9.7
Vernon Silver Star Lodge[2]	0.0	0.0	0.6	2.9	17.0	38.4	81.0	61.3	46.4	49.4	33.0	1.1	0.0
Vernon Auto[3]	-	-	-	-	-	33.2	62.5	-	-	-	-	-	-

Note:
1. Based on climate normal data (1981-2010) published by the Meteorological Service of Canada.
2. Based on calculated climate normal data (1981-2010), using available monthly records.
3. Based on available period of record (2005-2015). Total precipitation data (rain and snow) only available, so June records assumed to be rainfall only and no other records are reported.

Lastly, GVW installed a climate station at Aberdeen dam in 2015 (Figure 3-2). The climate station records air temperature, relative humidity, and rainfall precipitation, and is connected directly to GVW’s SCADA system. At this time, the Aberdeen dam climate station provides a valuable measure of rainfall volumes in the uplands of Duteau Creek watershed and can be used along with the Silver Star Mountain climate station to assess upland reservoir inflow status. GVW plans to use this climate station to help guide their reservoir operations. In the future, data can be compared to Meteorological Service of Canada climate stations for further analysis.

6.2.3 Antecedent Moisture Conditions

Previous fall (i.e., September to November) soil moisture and groundwater conditions can impact runoff from year to year. To this end, GVW includes a qualitative understanding of antecedent conditions within the headwaters of Duteau Creek watershed in their early season critical decision date meetings (i.e., March 15th, April 15th, and May 15th) and for normal reservoir operations.

GVW has been operating a groundwater and soil moisture and temperature monitoring program since 2012. The monitoring program includes a piezometer (i.e., MW11-01, MW11-02, and MW11-03) at each GVW snow course location, as well as soil moisture and temperature probes at three depths (shallow, middle, and deep) (Figure 3-2). Groundwater levels and soil moisture and temperature readings are generally taken monthly by GVW staff. GVW has not completed a specific review of the data collected at each monitoring site, but a preliminary review of the data (completed as part of the development of this document) did not identify any specific or notable trends over the available period of record (i.e., 2012-2015).

To support further use of the antecedent moisture information within GVW's water shortage decision process, GVW is considering the following for the future to support planning purposes:

- Installation of continuous dataloggers within the piezometers at the three snow course monitoring locations to determine general aquifer recharge patterns. Current monthly readings have some ability to provide an understanding of antecedent moisture conditions, but more frequent monitoring would be an improvement. By determining recharge patterns and establishing normal monthly groundwater elevations, periods of lower than normal elevations could be identified (e.g., lower than normal elevations within the fall period). The identification of these periods could then be used to help prepare or plan for lower runoff within the spring.
- Continuation of the monitoring of soil moisture at each of the snow course locations to assess soil moisture status throughout the year. Since soil moisture is monitored manually, a monitoring focus within the fall, winter, and early spring periods will provide a qualitative understanding of soil moisture status. Low soil moisture could suggest that a portion of snowmelt and precipitation could be used to recharge soil moisture conditions to field capacity or above and result in reduced runoff volumes to the upland reservoirs.
- Continuation of monitoring soil temperature as an indicator to support runoff production. The presence of frozen ground can influence the timing and volume of runoff (e.g., frozen ground can lead to overland flow and as a result, the faster routing of runoff/inflow to reservoirs). Since soil temperature is monitored manually once a month, monitoring within the fall, winter, and early spring periods will provide a qualitative understanding of the status of frozen ground.

6.3 FORECASTED WEATHER CONDITIONS

6.3.1 BC River Forecast Centre – Water Supply Bulletins

In addition to the Basin Snow Water Index values (Section 6.2.1.2), Okanagan and Kalamalka-Wood Lake runoff volume and in-season inflow forecasts are included within BC River Forecast Centre bulletins. The forecasts are provided for respective months, generally March, April, and/or May to June, July, and September. The forecasts are in reference to normal (average) climate conditions.

The Kalamalka-Wood Lake forecast is a critical water shortage indicator for GVW. The Kalamalka-Wood Lake runoff volume forecast is dual-purpose, in that it is directly applicable to water availability for GVW's Kalamalka-Wood Lake source, as well as the forecasted inflows reflect upland plateau water supply generation (i.e., Duteau Creek upland watershed runoff). The Kalamalka-Wood Lake forecast is used by GVW as a tool to support water shortage planning; however, understanding that there is uncertainty associated with forecasting, GVW also considers the Okanagan Lake forecasted values.

The runoff volume and in-season inflow forecasts are used to support mainly the March 15th to June 15th critical decision dates. A decision is made by GVW at each critical decision date (or anytime when using the decision tree) as to whether the forecasted values are considered "favourable" or "unfavorable" (Figures 5-2). Favourable conditions are considered when the forecasted values are >80% of normal (average), while unfavourable conditions are considered when forecasted values are <80% of normal (average). The division between favourable and unfavourable conditions still needs to be confirmed operationally by GVW, possibly through hindcasting of previous year forecasts and reservoir levels. However, GVW is implementing this approach as a preliminary decision support option.

Lastly, volume runoff forecasts are typically published during the second week of the month based on conditions on the first of the month in the winter and early spring periods. GVW could ask for a specific Kalamalka-Wood Lake forecast from the BC River Forecast Centre for April 15th and May 15th to support planning purposes.

6.3.2 Air Temperature and Precipitation Forecasts

As noted in Section 3.1.2, low and high runoff from the headwaters of the Duteau Creek watershed are related to snowpack levels, weather, and the volume of spring precipitation (i.e., April, May, and June). Accordingly, forecasted and air temperatures (in the uplands and valley bottom) and precipitation (in the form of rain) are also considered to support water shortage management decisions.

Forecasted air temperatures and precipitation (by Environment Canada) are used to support reservoir management and operational forecasting. Air temperatures and precipitation are also monitored by the three Meteorological Service of Canada real-time climate stations within the Vernon area, as well as by the climate station at Aberdeen dam noted in Section 6.2.2.

The real-time air temperature information, as well as forecasted weather (and air temperatures) are also used to support water demand management and decisions (Section 6.4). Average mean daily air temperature and total precipitation forecasts are used to assess evapotranspiration potential and soil moisture deficits (Section 6.4.2), which dictate plant water demands and thereby customer demands for irrigation water. Air temperature records, on the other hand, are used to assess how much evaporation was experienced in the previous weeks/months, which may increase water demands.

Air temperature and precipitation forecasts are used qualitatively within the decision tree by considering the current status of water supplies, reviewing the air temperature and precipitation forecasts, and then identifying whether the weather conditions look favourable or unfavourable.

6.3.3 Global Climate Trends and Climate Change

Based on the available climate change information by the Pacific Climate Impacts Consortium (PCIC) and the Okanagan Water Supply and Demand Project (Summit 2010), the following is the current understanding of the general climate and hydrologic trends predicted for the North Okanagan area:

- The climate in the North Okanagan is predicted to warm, with air temperatures increasing in both the summer and winter periods.
- Annual precipitation is predicted to increase. Summer precipitation is likely to decrease and winter precipitation is likely to increase.
- Snowpacks are projected to increase at higher elevations, but reduce at lower elevations.
- Snowmelt is projected to occur earlier with meltwater runoff expected to decrease due to more rain generated runoff throughout the winter.
- Late fall, winter and early spring streamflows are projected to be greater; while late spring, summer, and early fall streamflows are projected to decrease.
- The magnitude of extreme peak flows is projected to increase.

The 2011 DMP provides a summary of climate change at an overview level and detailed summaries of the El Nino/Southern Oscillation (ENSO), Pacific Decadal Oscillation (PDO), and the Arctic Oscillation (AO). For the WSMP, the U.S. NOAA National Weather Service, Climate Prediction Centre provides a commentary on the potential global influence to water supplies[4]. The commentary is particularly useful for an understanding of the ENSO interaction and phase (i.e., El Nino or La Nina) and its affect on other global climate patterns (i.e., PDO, AO).

Understanding that climate change is not a specific (known) variable or value that can be specifically accounted for within immediate term monthly water supply forecasting, GVW uses projected changes to streamflow timing, reservoir refilling, and water demand as guidelines to confirm that current reservoir operation practices and the water shortage forecast parameters (and threshold values) continue to be accurate for the present and into the future. GVW currently receives information on the current influence of ENSO, PDO, and the AO on annual weather patterns through weather updates provided by DFO (Edwards, pers. comm., 2017). This information is used by GVW within the decision tree as supporting information.

[4] http://www.cpc.ncep.noaa.gov/products/precip/CWlink/MJO/enso.shtml

In addition to supporting weather forecast decisions, the following are (or are being) implemented by GVW for the consideration of climate change within upland reservoir operations:

- Climate variability is being considered in current upland reservoir levels by comparing long-term reservoir levels (i.e., 1997-2015) to a 10-year moving average. The comparison helps to identify if the trend of inflows (and therefore reservoir levels) is changing within the immediate period and whether the water supply shortage triggers are adequately considering changes in climate since they are based on historic drought levels experienced by GVW.
- Understanding that future population growth and land use changes will likely change the volumes of water required for domestic and agricultural needs, the cumulative annual/monthly water demand pattern (i.e., Figure 6-4) is being considered as a tool to help identify timing changes or distribution system challenges in the face of changes to the climate (i.e., warmer, drier, and longer summers and lower streamflows may suggest increased water use requirements outside of current use patterns). Of particular concern is the potential extension of the growing season, as agricultural water demand will increase if irrigation is needed earlier/later in the year.
- Understanding that shifts in precipitation patterns during the winter to more precipitation in the form of rainfall are projected, monitoring and assessment of reservoir refill in more abnormal years (i.e., low snowpack, large or small volumes of early season rainfall, large or small volumes of previous fall precipitation) is being considered to fully appreciate future challenges that GVW may face because of shifting climate patterns.
- Understanding that the Duteau Creek watershed is an operational watershed for forest harvesting, a study is being completed by FLNRO on the assessment of impacts of climate change on future water yield from the watershed. Climate change projections indicate a shift in streamflow patterns to more runoff earlier in the year and lower runoff in summers, so an assessment of the influence of harvesting and its cumulative impact on water supply availability is necessary for future planning.
- GVW is also exploring how to increase the capture of precipitation under a more rainfall dominated climate regime. Raising the height of the Aberdeen dam, thereby increasing the reservoir size, has been determined the most cost effective option to do so. As this is an expensive undertaking, GVW is exploring grants and other financing options to support this project and examining operational procedures to use water more efficiently.

6.4 CUSTOMER WATER DEMAND FORECAST

6.4.1 Customer Consumption (Demand)

Total water consumption (demand) and diversion for each water source are recorded by GVW's SCADA system and are useful forecast parameters in the decision tree process. This information supports the use of the decision tree by determining if the total water consumed to-date is considered "high" or "low" (Figure 5-2).

To support a water shortage decision, GVW reviews the cumulative water demand (to-date) in comparison to normal (average) information, as well as specific past periods of dry conditions and corresponding high water demand values. Using this, as well as forecasted water demand trends (based on forecasted weather and timing and status of the agricultural growing season [Sections 6.3.2 and 6.4.2]), water consumed is identified as “high” or “low”. The total cumulative water demand for the period 2011-2015 is illustrated in Figure 6-4 and is used to support the use of the decision tree.

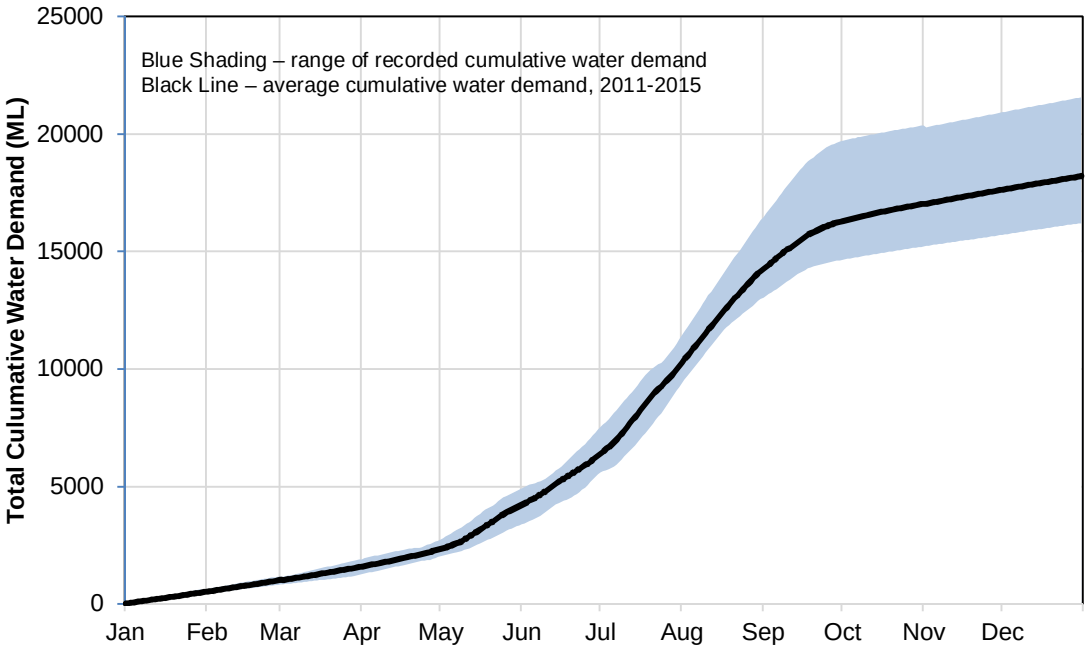

Figure 6-4 GVW annual cumulative water demands, 2011-2015

6.4.2 Evapotranspiration Forecasts and Soil Moisture Deficit

Farmwest[5] provides climate information to farmers and irrigators in BC and includes climate stations that report evapotranspiration (ET) for irrigation scheduling, growing degree days, air temperature, precipitation, soil moisture deficit, as well as five-day weather forecasts. The Farmwest climate station network is updated daily to provide the most current information possible and includes the following climate stations in the GVW distribution area:

- Vernon;
- Vernon North (B.X.);
- Okanagan Landing (Bella Vista); and
- Kalamalka Lookout.

[5] http://www.farmwest.com/

Theses climate stations include those operated by the Meteorological Service of Canada, BC Ministry of Transportation and Infrastructure, and Growers Supply Company Ltd.

GVW uses the forecasted ET values, as well as calculated soil moisture deficits[6] (since the date of irrigation water start up) to support water management decisions to estimate the required irrigation demand (i.e., high or low) in the near-term period.

[6] Soil moisture deficit is the difference between measured ET and effective precipitation. It represents the amount of water removed (or added) to the soil since a reference date (i.e., start of irrigation when soils are at field capacity).

7 Water Shortage and Emergency Response Plans

7.1 WATER SHORTAGE RESPONSE PLAN

The overall components of GVW's water shortage stages (Section 4.1) and triggers (Section 5.2) are summarized within the water shortage matrix (Table 7-1). The matrix is an update to the version included within the 2011 DMP and represents a simplified version of the response component (also referred to as the Water Shortage Response Plan [WSRP]) for the WSMP. The WSRP is the staged approach to water management during periods of water shortage through the identification and evaluation of factors that trigger a response.

As noted in Section 2.1, the RDNO General Manager responsible for the Greater Vernon Water function, or any other person that the RDNO Board of Directors delegates, is responsible for implementing all stages of the WSMP, and therefore determining whether a response action is warranted. Response actions are those included within RDNO's Bylaw No. 2545 or as amended that are focused on the reduction (and/or conservation) of water use during periods of water supply shortages (Appendix B), or by invoking GVW's Emergency Response Plan during periods of loss of supply or other emergency that causes a water supply shortage (Section 7.2), in addition to any applicable operational changes staff can implement.

The triggering (and declaration) of a water shortage stage is determined using a decision tree (Figure 5-2) and based on current and forecasted water supply conditions. GVW's decision process and associated communication plan (by stage) supporting the WSRP are as described in Sections 5 and 4.3, respectively.

7.2 EMERGENCY RESPONSE PLAN

GVW has developed an emergency response plan (ERP) that includes procedures to respond to a loss of water source. The ERP considers a loss of the Duteau Creek, Kalamalka Lake, groundwater wells, and Goose Lake water sources. Following a loss of supply, the ERP outlines the procedures for the emergency supply of water, as well as the notification process to all system water users. All other water management strategies during times of water shortages are included as part of the WSRP (Section 7.1). The GVW's ERP is provided in Appendix E.

As the stand alone small water systems servicing the Outback Resort and Delcliffe residential developments are managed and operated by GVW, emergency response for these systems is also included within the GVW ERP.

Figure 7-1 GVW water shortage response plan overview

Water Shortage Stage	Normal	Stage 1 - Dry	Stage 2 – Very Dry	Stage 3 – Extremely Dry	Stage 4 - Emergency
Definition of Water Shortage Stage	Normal or above average conditions	Mild	Moderate	Severe	Loss of Supply
Explanation of Water Shortage Stage	Defined by the ability to meet or exceed average supply conditions, based on several forecast parameters, including storage volumes that are within the 95% confidence limit.	Stage 1 is the first indication of potential water shortage as determined using the water shortage state decision tree. Reservoir storage volumes are 30 to 90% of the total available live storage (based on time of year).	Stage 2 can occur during prolonged periods of no rain and hot, dry weather and/or below-average snowpack conditions. Reservoir storage volumes are 20 to 82% of the total available live storage (based on time of year). This stage is considered a time of moderate drought or when water supplies are becoming stressed.	Stage 3 represent extremely dry conditions. This stage is considered a time of extreme drought, when water supplies are at a critical shortage level (as per decision tree parameters), or upland fire, or failure of key infrastructure. Storage volumes are likely at 10 to 43% of the total available live storage (based on time of year).	Stage 4 is characterized by a loss of supply via loss of upland storage supply through drought (storage at less than 5% of total available live storage), or due to contamination, or loss of critical infrastructure. Water supplies are limited to domestic (indoor) use only; at the base (winter) demand rate (i.e., 30 ML/day).
Fishery Flow Target	Normal or Low Normal	Level 1 Flow	Level 2 Flow	Level 3/4 FLOW	Level 3/4 FLOW
Goals	Encouragement of water use efficiencies and promotion of water supply shortage awareness and preparedness.	Reduce total water use by 10%.	Reduce total water use by 20%.	Reduce total water use by 50%.	Maintain minimum water supply to maintain basic community health and basic needs (90% reduction).
Regulations and Response	3-day a week watering schedule for outdoor water use to promote/ensure water conservation.	Voluntary reduction of domestic and ICI outdoor water use. GVW Operations modified to minimize water loss.	Mandatory reduction of domestic and ICI outdoor water use. Implementation of a 20% reduction in agricultural water allocation.	Severe reduction of domestic and ICI outdoor water use. Implementation of a 50% reduction in agricultural water allocation.	Elimination of domestic and ICI outdoor water use and implementation of an 80% reduction in agricultural water allocation.
Communication and Enforcement	Normal levels of communication and education. Roll out best management and conservation practices.	Water stewardship and voluntary conservation measures promoted. Increased level of enforcement and monitoring with warnings issued if misuse is deemed to be occurring.	Increased level of communication, education, monitoring, and enforcement, with moderate fines issued and lower tolerance for misuse permitted.	High level of communication, education, monitoring, and enforcement, with moderate fines issued and zero tolerance for misuse permitted.	High level of communication, education, monitoring, and enforcement, with stiff fines issued and zero tolerance for misuse permitted. GVW Emergency Response Plan invoked.

References

AECOM, Associated Engineering B.C. Ltd., and Kerr Wood Leidal Associates Ltd. 2013a. Technical Memorandum No. 2 – Evaluation of Water Supply Sources. Prepared for Greater Vernon Water, February 2013.

AECOM, Associated Engineering B.C. Ltd., and Kerr Wood Leidal Associates Ltd. 2013b. Technical Memorandum No. 3 – Source Storage and Supply. Prepared for Greater Vernon Water, February 2013.

AECOM, Associated Engineering B.C. Ltd., and Kerr Wood Leidal Associates Ltd. 2013c. Technical Memorandum No. 1 – Domestic and Agricultural Water Demand Forecast. Prepared for Greater Vernon Water, February 2013.

AECOM, Associated Engineering B.C. Ltd., and Kerr Wood Leidal Associates Ltd. 2013d. Technical Memorandum No. 9 – System Separation Option Analysis. Prepared for Greater Vernon Water, February 2013.

AECOM, Associated Engineering B.C. Ltd., and Kerr Wood Leidal Associates Ltd. 2013e. Technical Memorandum No. 6 – Water Conservation Strategies. Prepared for Greater Vernon Water, February 2013.

Associated Environmental Consultants Inc. (Associated). 2016a. Drought Management Plan Update: Summary of Technical Assessments. Prepared for Greater Vernon Water, December 2016.

Associated Environmental Consultants Inc. (Associated). 2016b. Collaborative Development of Methods to Set Environmental Flow Needs in Okanagan Streams. Working Document Version 1. Prepared for the Okanagan Basin Water Board, Okanagan Nation Alliance, and the BC Ministry of Forests, Lands, and Natural Resource Operations, July 2016.

BC Ministry of Environment (MOE). 2016a. Dealing with Drought – A Handbook for Water Suppliers in BC. Prepared for the Deputy Minister's Committee on Drought, updated July 2016.

BC Ministry of Environment (MOE). 2016b. BC Drought Response Plan. Prepared for the Inter-Agency Drought Working Group, updated July 2016.

BC Ministry of Environment (MOE). 1982. Okanagan Basin Implementation Board - Summary Report on the Okanagan Basin Implementation Agreement, September 1982.

BC Ministry of Forests, Lands, and Natural Resource Operations (FLNRO). 2016. Thompson Okanagan Region – Drought Response Implementation Plan. Prepared by the Thompson Okanagan Drought Response Team, July 2016.

BC Ministry of Health (MOH). 2016. Emergency Response and Contingency Planning for Small Water Systems. Prepared by the Health Protection Branch, June 2016.

Clarke Geoscience Ltd. 2011. Greater Vernon Water Utility – Drought Management Plan (update revised October 2016). Prepared for Regional District of North Okanagan, October 2016.

Edwards, D. Fisheries and Oceans Canada. 2017. Personal communication with Jennifer Miles of GVW regarding- Monthly Climate Conditions, River Flows, and Forecasts Compilation Bulletins, August 2017.

Epp, P. 2017. Hydrology Consultant. Personal communication with Drew Lejbak of Associated, January 2017.

Epp, P. 2015a. Duteau Creek – Snow Course Data, April to June Runoff, Reservoir Refill Risk and Drought Management Plan Trigger Levels. Prepared for Greater Vernon Water, April 2015.

Epp, P. 2015b. Duteau Creek Variable Instream Flow Targets and Operational Guidelines for Achieving Target Flows with Varying Water Availability, November 2015.

Epp, P. 2014. Environmental Flows and Hydrologic Assessment for the Bessette Creek Watershed, 2011 - 2013. Prepared for BC Ministry of Forests, Lands, and Natural Resource Operations, Kamloops, BC.

Golder Associated Ltd. (Golder). 2006. Preliminary Steps in the Development of a Groundwater Protection Plan – Antwerp and Coldstream Ranch Wells. Prepared for Regional District of North Okanagan, March 2006

Kerr Wood Leidal Associated Ltd. and Dobson Engineering Ltd. 2008. Duteau Creek Watershed Assessment and Recommendations for Source Protection. Prepared for Regional District of North Okanagan, December 2008.

Larratt Aquatic Consulting Ltd. (Larratt Aquatic). 2011. Source Assessment of the Regional District of North Okanagan – Greater Vernon Water Utility North Kalamalka Lake Intake. Prepared for Regional District of North Okanagan, September 2011.

Miles, Jennifer. 2016. Water Sustainability Coordinator, Greater Vernon Water. Personal communication with Drew Lejbak of Associated and Microsoft Excel files, September 2016.

Obedkoff, W. 1998. Streamflow in the Southern Interior Region. BC Ministry of Environment, Lands, and Parks, Water Inventory Section. December 1998.

Okanagan Basin Water Board (OBWB). 2016. Drought Trigger Guidelines for Okanagan Mainstem Lakes and River. Draft 1.0. Prepared by Brian Symonds, October 2016.

Regional District of North Okanagan (RDNO). 2016. 2016 Greater Vernon Water Annual Report. Prepared for Interior Health and RDNO, June 2016.

Regional District of North Okanagan (RDNO). 2014. Duteau Creek Watershed Assessment Response Plan. May 2014.

Regional District of North Okanagan (RDNO). 2012. Regional Communication Strategy. December 2012.

Summit Environmental Consultants Inc. (Summit). 2010. Okanagan Water Supply and Demand Project Summary Report. Prepared for the Okanagan Basin Water Board. Kelowna.

Appendix A – Drought Stakeholder Working Group Terms of Reference

REGIONAL DISTRICT OF NORTH OKANAGAN

TERMS OF REFERENCE – Drought Stakeholder Working Group	
ENDORSED BY THE BOARD OF DIRECTORS ON:	May 18, 2016
PURPOSE	The role of the *Drought Stakeholder Working Group* (DSWG) is to assist Regional District of North Okanagan (RDNO) staff in the development of efficient water use strategies, informing the community on water supply levels, and providing feedback on the effect of water use restrictions. • Promoting water sustainability goals and accomplishments in the community. • Recruiting participants to ensure a wide coverage of information. • Provide knowledge and expertise (networking, connections, research information etc.) to assist in promoting demand management technologies and water efficiency initiatives.
SCOPE:	The scope of the DSWG is to: • Review and understand the background information provided by staff, as directed by the Greater Vernon Water (GVW) Drought Management Plan, which includes current Provincial and local water supply/drought levels and associated triggering factors used to determine each level. • Provide input into communications strategies (i.e. bulletins, posters, signage, website links and presentations) appropriate for the stakeholder group they represent on the DSWG. • Act as a communications liaison to the group they represent and identify opportunities to learn from others in their sector outside the local area. • Identify opportunities to improve water use efficiency with respect to the group they represent as well as challenges that may delay or impair the implementation of drought response and water efficiency (conservation) strategies.
DEFINED RESPONSIBILITIES AND CONDUCT:	Overall, the DSWG shall work together to satisfy the following roles and responsibilities: • Commit to regular attendance at meetings and ensure the appointed staff member has current contact information and is informed of any change in the member's ability to participate in the DSWG. • Be informed on the Drought Management Plan and associated Drought Response Actions (e.g. bylaws, conservation programs, communications strategy).

	• Assist in communicating with various stakeholders and agencies on drought response efforts where applicable. • The DSWG will follow a collaborative format amongst its membership, recognizing that respectful dialogue will help to better understand the impacts of drought on the community.
PROTOCOL:	The DSWG will encourage collaboration with the intent of working towards a common goal, committing to the process and building public awareness and support for drought response strategies. • Participants are encouraged to express their personal views in a respectful manner. Participants are present to give a voice to the community; however, participants are equally responsible to listen and understand the views of others. • DSWG participants will have equal opportunity to contribute at meetings, as well as responsibility to respect the opinions of others. Group members are encouraged to actively participate in the discussions and use their experience, education, and insight to speak about any issues or opportunities to be considered. • Participants are encouraged to speak about the process to others outside the DSWG but may not speak on behalf of or in any way create the impression that they are speaking for the Regional District of North Okanagan or the DSWG as a whole. In order to ensure open and honest dialogue, participants should not discuss comments or opinions expressed by other DSWG participants without their knowledge and consent. In the spirit of respectful dialogue, participants are asked to present any information they are planning to publish in the media to the DSWG so that the group is aware of the forthcoming publication.
COMPOSITION:	DSWG Representative areas of expertise should include: • Institutional water uses dependent on a safe and reliable water supply for their sensitive population (Hospital, School District, and Health Care Facilities). • High water need business activities: Landscaping, Irrigation, Greenhouses, Food and Beverage Production, Agriculture, Manufacturing, Recreational Product Sector (pools/spas). • Management of infrastructure including parks, water features/amenities/pools, and school grounds. • Economic development impacts from drought and business adaptation strategies. • Local environmental/sustainability issues such as the impact of drought on wildlife and fisheries. • Provincial drought response actions via representation from the Ministry of Forest Lands Natural Resource Operations (Water Stewardship; Wildfire Management).

	The Composition of the DSWG will include a representative from but not limited to: • One (1) Vernon Jubilee Hospital • One (1) School District #22 • Two (2) Municipality Operations – COV and DoC • Two (2) Parks and Recreation – CoV / DoC / RDNO • One (1) Fruit Growers Association • One (1) Landscaping Representative • One (1) Irrigation Association • One (1) Hotel Association • One (1) Tourism Representative • One (1) Field Crop / Livestock Representative • One (1) Brewery Representative / Food and Beverage Production • One (1) Pools and Spas Representative • One (1) Turf supplier Representative • One (1) Nursery or Garden Center Representative • One (1) Car Wash Representative • One (1) Water Stewardship – Provincial Representative • Two (2) Community members at-large • Chairperson The DSWG will be chaired by a staff member appointed by the RDNO General Manager of Engineering. The Chairperson will facilitate the meetings. • Staff Support The RDNO will provide staff support to the DSWG with regard to the coordination of meetings and agendas in accordance with the goals of the Drought Management Plan and Work Plan approved by the Board of Directors. Staff will follow the Communication Plan for Drought Response and communicate with the Board of Directors, GVAC, DSWG and the public. • RDNO will advertise the opportunity to participate in the DSWG annually.
TERM:	Participants are asked to serve a two year term and may continue to serve on the group until an alternate representative is found. • During normal water supply conditions (non-drought years), the RDNO will provide updates on water supply levels in a timely manner and water conservation programs to participants through email or mail in addition to regular updates posted on the RDNO website. • If staff forecast a supply shortage that may require the initiation of a higher restriction stage the DSWG will be informed and may be asked to meet. • During a drought, the DSWG would meet as required. • During a severe drought, the DSWG would meet no more than once per month.

REPORTING:	Staff will record minutes and forward to GVAC for information. The DSWG minutes will be utilized by staff for reports.
REMUNERATION:	There shall be no remuneration for these voluntary positions.
OTHER:	For clarity, these Terms of Reference do not delegate any authority or corporate powers to the DSWG.

Appendix B – RDNO Bylaw No. 2545 or as Amended – Stage Based Water Restrictions (from AECOM et al. 2013e)

	Residential Water Use Restrictions	NORMAL	STAGE 1	STAGE 2	STAGE 3	STAGE 4
		DESCRIPTION: Represents normal (i.e. average) conditions for local area. Water use restrictions focus on water use efficiencies and drought awareness.	DESCRIPTION: Represents below normal conditions for local area. Water use restrictions focus on water use efficiencies intended to reduce water use by roughly 10%. If triggered by drought, represents early drought (drier than average) conditions for local area.	DESCRIPTION: Represents low water supply conditions for local area. Water use restrictions are necessary to sufficiently reduce water demand. Intended to reduce water use by roughly 20%. If triggered by drought, represents moderate drought conditions.	DESCRIPTION: Represents very low water supply conditions. Water use restrictions are necessary to maintain supplies during a period of critical water shortage. Intended to reduce water use by roughly 50%. If triggered by drought, represents severe drought conditions for local area.	DESCRIPTION:Strict water use restrictions are necessary to maintain critical supply. Intended to reduce water use by 90%. Represents an emergency loss of supply during which water is spared for consumptive and sanitary purposes only.
	ACTIVITY	RESTRICTION DETAILS*	RESTRICTION DETAILS*	RESTRICTION DETAILS*	RESTRICTION DETAILS*	RESTRICTION DETAILS*
A	**Lawn and Aesthetic Garden Watering - Manual Sprinklers**	Watering allowed between 6am-10am and 7pm-12am up to 3 days per week.	Watering allowed between 6am-10am and 7pm-12am up to 3 days per week.	Watering allowed between 6am-10am and 7pm-12am, up to 2 days per week.	Watering allowed between 6am-10am and 7pm-12am, 1 day per week.	Use of GVW supplied water for all forms of aesthetic lawn and garden watering is prohibited.
	Odd Address Schedule	Tuesday, Thursday, Saturday	Tuesday, Thursday, Saturday	Tuesday & Saturday	Saturday	
	Even Address Schedule	Wednesday, Friday, Sunday	Wednesday, Friday, Sunday	Wednesday & Sunday	Sunday	
B	**Lawn and Aesthetic Garden Watering - Automatic Timer Sprinkler Systems**	Watering allowed between 12am-6am up to 3 days per week.	Watering allowed between 12am -6am up to 3 days per week.	Watering allowed between 12am -6am, up to 2 days per week.	Watering allowed between 12am -6am, 1 day per week.	
	Odd Address Schedule	Tuesday, Thursday, Saturday	Tuesday, Thursday, Saturday	Tuesday & Saturday	Saturday	
	Even Address Schedule	Wednesday, Friday, Sunday	Wednesday, Friday, Sunday	Wednesday & Sunday	Sunday	
C	**Lawn and Aesthetic Garden Watering - Micro Jet or Drip Irrigation**	Anytime	Watering allowed any day between 7pm-10am .	Watering allowed up to 3 days a week as per Stage 1 odd/even Lawn Sprinkling restriction days (Line A) between 7pm-10am.	Watering allowed Tuesdays & Fridays between 7pm-10am.	
D	**Lawn and Aesthetic Garden Watering - Handheld Sprinkling (spring-loaded nozzle on hose or watering can)**	Anytime	Anytime	Watering allowed up to 3 days a week as per Stage 1 odd/even Manual Sprinkler restrictions (Line A) between 6am-10am & 5pm-12am.	Watering allowed Wednesdays & Sundays between 6am-10am & 7pm-12am.	
E	**New (non-established) Lawns and Landscaping Sprinkling**	Follow supplier recommended watering schedule. After installation (2 weeks for Sod or 6 weeks for Seeded Lawns) resume watering as per Lawn & Aesthetic Garden Watering restrictions for your irrigation system (Lines A-D).	Follow supplier recommended watering schedule. Recommended that seeding start no later than May 31 or after Sept. 1. After installation (2 weeks for Sod or 6 weeks for Seeded Lawns) resume watering as per Stage 1 Lawn & Aesthetic Garden Watering restrictions for your irrigation system (Lines A-D).	RDNO sprinkling permit required. Sod requires 2 week permit to be displayed on lawn. Seeding must start before April 30 or after Sept. 1 and requires a 6 week permit to be displayed on lawn. After permit period, resume watering as per Stage 2 Lawn & Aesthetic Garden Sprinkling restrictions for your irrigation system (Lines A-D).	No new permits issued for seeded lawns. Placement of sod may take place with sprinkling permit not to exceed 2 week period. After permit period, resume watering as per Stage 3 Lawn & Aesthetic Garden Sprinkling restrictions for your irrigation system (Lines A-D).	No new permits issued or renewed. Use of water supplied by GVW prohibited.
F	**Food Gardens and Fruit Trees/Shrubs**	Follow Lawn and Aesthetic Garden Watering restrictions, as noted above (Lines A-D), for the irrigation system in use.	Follow Stage 1Lawn and Aesthetic Garden Watering restrictions (Lines A-D above) for the irrigation system in use.	Follow Stage 1Lawn and Aesthetic Garden Watering restrictions (Lines A-D above) for the irrigation system in use.	Watering allowed Tuesdays & Fridays between 6am – 10am and 7pm to 12am, as required to maintain plant health.	Use of water supplied by GVW prohibited.
G	**Garden Ponds, Aesthetic Fountains, and Water Features**	Filling and refilling is permitted on days and times specified for Lawn & Aesthetic Garden Watering-Manual Sprinkling (Line A).	Filling and refilling is permitted on days and times specified for Stage 1 Lawn & Aesthetic Garden Watering-Manual Sprinkling (Line A).	Filling and refilling is permitted on days and times specified for Stage 2 Lawn & Aesthetic Garden Watering-Manual Sprinkling (Line A).	Filling and refilling with water supplied by GVW is prohibited.	Filling and refilling with water supplied by GVW is prohibited.
H	**Pools**	Filling and refilling is permitted on days and times specified for Lawn & Aesthetic Garden Watering-Manual Sprinkling (Line A).	Filling and refilling is permitted on days and times specified for Stage 1 Lawn & Aesthetic Garden Watering-Manual Sprinkling (Line A).	Filling and refilling is permitted on days specified for Stage 2 Lawn & Aesthetic Garden Watering-Manual Sprinkling (Line A). Topping up only from June 15-Aug. 31 unless pool has cartridge filter.	Topping up allowed once per week on Wednesday. Filling and refilling are prohibited unless pool has cartridge filter - then filling/re-filling allowed on Wednesdays.	Filling, topping up, and refilling with water supplied by GVW is prohibited.
I	**Cleaning Outdoor Surfaces (driveways, sidewalks, decks, artificial turf, patios)**	Use a broom, device or hose with a spring-loaded nozzle, or mop and bucket.	Use a broom, device or hose with a spring-loaded nozzle, or mop and bucket.	Washing with spring-loaded nozzel for health and safety purposes or to prepare a surface for painting or similar treatment. Washing for aesthetic purposes is prohibited.	Washing with spring-loaded nozzel for health and safety reasons only. Washing for aesthetic purposes is prohibited.	All forms of cleaning of outdoor surfaces with GVW water are prohibited unless ordered by a regulatory authority (i.e. WCB, public health inspector, etc.).
J	**Vehicle (boat/ automobile/ATV/ etc.) Washing**	Use a bucket with cloth or sponge, or visit a water wise commercial car wash.	Use a bucket with cloth or sponge, or visit a water wise commercial car wash.	Use a bucket with cloth or sponge, or visit a water wise commercial car wash.	No washing or rinsing except for safety purposes (windows, lights, licenses).	No washing or rinsing with GVW water except for safety purposes (windows, lights, licenses).

*** These restrictions are for water supplied by GVWU only. They do not apply to the use of reclaimed or recycled water, greywater, rainwater harvested by the customer, or any other sources of water not supplied by GVWU. Customers are encouraged to utilize rainwater for appropriate uses such as garden irrigation.**

	Commercial Water Use Restrictions	NORMAL	STAGE 1	STAGE 2	STAGE 3	STAGE 4
		DESCRIPTION: Represents normal (i.e. average) conditions for local area. Water use restrictions focus on water use efficiencies and drought awareness.	DESCRIPTION: Represents below normal conditions for local area. Water use restrictions focus on water use efficiencies intended to reduce water use by roughly 10%. If triggered by drought, represents early drought (drier than average) conditions for local area.	DESCRIPTION: Represents low water supply conditions for local area. Water use restrictions are necessary to sufficiently reduce water demand. Intended to reduce water use by roughly 20%. If triggered by drought, represents moderate drought conditions.	DESCRIPTION: Represents very low water supply conditions. Water use restrictions are necessary to maintain supplies during a period of critical water shortage. Intended to reduce water use by roughly 50%. If triggered by drought, represents severe drought conditions for local area.	DESCRIPTION:Strict water use restrictions are necessary to maintain critical supply. Intended to reduce water use by 90%. Represents an emergency loss of supply during which water is spared for consumptive and sanitary purposes only.
	ACTIVITY	RESTRICTION DETAILS*	RESTRICTION DETAILS*	RESTRICTION DETAILS*	RESTRICTION DETAILS*	RESTRICTION DETAILS*
A	**Lawn, Aesthetic Garden, and Plants for Sale - Manual Sprinkling**	Watering allowed between 6am-10am and 7pm-12am up to 3 days per week.	Watering allowed between 6am-10am and 7pm-12am up to 3 days per week.	Watering allowed between 6am-10am and 7pm-12am, up to 2 days per week.	Watering allowed between 6am-10am and 7pm-12am, 1 day per week.	Use of GVW supplied water for all forms of aesthetic lawn and garden watering is prohibited.
	Odd Address Schedule	Tuesday, Thursday, Saturday	Tuesday, Thursday, Saturday	Tuesday & Saturday	Saturday	
	Even Address Schedule	Wednesday, Friday, Sunday	Wednesday, Friday, Sunday	Wednesday & Sunday	Sunday	
B	**Lawn, Aesthetic Garden, and Plants for Sale -Automatic Timer Sprinkler Systems**	Watering allowed between 12am-6am up to 3 days per week.	Watering allowed between 12am -6am up to 3 days per week.	Watering allowed between 12am -6am, up to 2 days per week.	Watering allowed between 12am -6am, 1 day per week.	
	Odd Address Schedule	Tuesday, Thursday, Saturday	Tuesday, Thursday, Saturday	Tuesday & Saturday	Saturday	
	Even Address Schedule	Wednesday, Friday, Sunday	Wednesday, Friday, Sunday	Wednesday & Sunday	Sunday	
C	**Lawn, Aesthetic Garden, and Plants for Sale - Micro Jet or Drip Irrigation**	Anytime	Watering allowed any day between 7pm-10am .	Watering allowed up to 3 days a week as per Stage 1 odd/even Lawn Sprinkling restriction days between 7pm-10am (Line A).	Watering allowed Wednesday & Friday between 7pm-10am.	
D	**Lawn, Aesthetic Garden, and Plants for Sale - Handheld Sprinkling (spring-loaded nozzle on hose or watering can)**	Anytime	Anytime	Hand watering of potted plants can be done any day between 6am-10am & 5pm-12am. In-gound plant watering is allowed up to 3 days per week as per Stage 1 Manual Sprinkling restrictions (Line A).	Hand watering of potted plants is allowed on Tuesday, Thursday, & Sunday between 6am-10am & 7pm-12am. In-ground plant watering is allowed up to 2 days per week as per Stage 2 Manual Sprinkling restrictions (Line A).	
E	**New (non-established) Lawns and Landscaping Sprinkling**	Follow supplier recommended watering schedule. After installation (2 weeks for Sod or 6 weeks for Seeded Lawns) resume watering as per Lawn & Aesthetic Garden Watering restrictions for your irrigation system (Lines A-D).	Follow supplier recommended watering schedule. Recommended that seeding start no later than May 31 or after Sept. 1. After installation (2 weeks for Sod or 6 weeks for Seeded Lawns) resume watering as per Stage 1 Lawn & Aesthetic Garden Watering restrictions for your irrigation system (Lines A-D).	RDNO sprinkling permit required. Sod requires 2 week permit to be displayed on lawn. Seeding must start before April 30 or after Sept. 1 and requires a 6 week permit to be displayed on lawn. After permit period, resume watering as per Stage 2 Lawn & Aesthetic Garden Sprinkling restrictions for your irrigation system (Lines A-D).	No new permits issued for seeded lawns. Placement of sod may take place with sprinkling permit not to exceed 2 week period. After permit period, resume watering as per Stage 3 Lawn & Aesthetic Garden Sprinkling restrictions for your irrigation system (Lines A-D).	No new permits issued or renewed. Use of water supplied by GVW prohibited.
F	**Garden Ponds, Aesthetic Fountains, and Water Features**	Filling and refilling is permitted on days and times specified for Lawn & Aesthetic Garden Watering-Manual Sprinkling (Line A).	Filling and refilling is permitted on days and times specified for Stage 1 Lawn & Aesthetic Garden Watering-Manual Sprinkling (Line A).	Filling and refilling is permitted on days and times specified for Stage 2 Lawn & Aesthetic Garden Watering-Manual Sprinkling (Line A).	Filling and refilling with water supplied by GVW is prohibited.	Filling and refilling with water supplied by GVW is prohibited.
G	**Pools**	Filling and refilling is permitted on days and times specified for Lawn & Aesthetic Garden Watering-Manual Sprinkling (Line A).	Filling and refilling is permitted on days and times specified for Stage 1 Lawn & Aesthetic Garden Watering-Manual Sprinkling (Line A).	Filling and refilling is permitted on days specified for Stage 2 Lawn & Aesthetic Garden Watering-Manual Sprinkling (Line A). Topping up only from June 15-Aug. 31 unless pool has cartridge filter.	Topping up allowed once per week on Wednesday. Filling and refilling are prohibited unless pool has cartridge filter - then filling/re-filling allowed on Wednesdays.	Filling, topping up, and refilling with water supplied by GVW is prohibited.
H	**Cleaning Outdoor Surfaces (driveways, sidewalks, decks, artificial turf, patios)**	Use a broom, device or hose with a spring-loaded nozzle, or mop and bucket.	Use a broom, device or hose with a spring-loaded nozzle, or mop and bucket.	Hosing with spring-loaded nozzel for health and safety purposes or to prepare a surface for painting or similar treatment. Washing for aesthetic purposes is prohibited.	Hosing with spring-loaded nozzel for health and safety reasons only. Washing for aesthetic purposes is prohibited.	All forms of hosing of outdoor surfaces with GVW water are prohibited unless ordered by a regulatory authority (i.e. WCB, public health inspector, etc.).
I	**Vehicle Washing - including commercial operations, dealerships, fleets**	Use a commercial car wash or hose equipped with spring-loaded nozzle.	Use a commercial car wash or hose equipped with spring-loaded nozzle. Conveyorized/automatic car wash facilities should strive to be water wise as per industry standards.	Car washes using recycled water systems may continue to operate with no restrictions. Conveyorized/automatic car wash facilities should strive to be water wise as per industry standards- shorten wash times. Wand wash or washing with spring-loaded nozzle is permitted.	Spring-loaded nozzle or wand wash permitted for health and safety purposes only. Car washes using recycled water systems may continue to operate if wash times are shortened.	No washing or rinsing of vehicles and pleasure crafts, except spot cleaning with sponge and bucket for health and safety reasons (windows, lights, license plates).
J	**Golf courses**	Irrigation should only occur between 7pm-6am.	Reduce watering of fairways to three days per week as per Line B restriction times.	Reduce watering of greens and tees. Fairway watering limited to two days per week as per Line B restriction times.	No watering permitted for fairways. Minimal watering only for tees and greens.	All forms of watering are prohibited.
K	**Artificial turf and outdoor tracks (i.e. Bicycle, motorcycle, and running tracks)**	Cleaning, with a hose or sprinkler, permitted for health and safety only. Use spring-loaded nozzle.	Cleaning, with a hose or sprinkler, permitted for health and safety only. Use spring-loaded nozzle.	Cleaning, with a hose or sprinkler, permitted for health and safety only. Use spring-loaded nozzle.	Cleaning, with a hose or sprinkler, permitted for health and safety only. Use spring-loaded nozzle.	All forms of cleaning of outdoor surfaces with GVW water are prohibited unless ordered by a regulatory authority (i.e. WCB, public health inspector, etc.).

*** These restrictions are for water supplied by GVWU only. They do not apply to the use of reclaimed or recycled water, greywater, rainwater harvested by the customer, or any other sources of water not supplied by GVWU. Customers are encouraged to utilize rainwater for appropriate uses such as garden irrigation.**

**** These restrictions apply to all businesses supplied by the RDNO-GVW. Any activity relating to irrigation, including the watering of plants for sale (nursery stock) or cemetaries, is required to adhere to the restrictions as they apply to the type of irrigation used by the business.**

	Public Institutional Water Use Restrictions	NORMAL	STAGE 1	STAGE 2	STAGE 3	STAGE 4
		DESCRIPTION: Represents normal (i.e. average) conditions for local area. Water use restrictions focus on water use efficiencies and drought awareness.	DESCRIPTION: Represents below normal conditions for local area. Water use restrictions focus on water use efficiencies intended to reduce water use by roughly 10%. If triggered by drought, represents early drought (drier than average) conditions for local area.	DESCRIPTION: Represents low water supply conditions for local area. Water use restrictions are necessary to sufficiently reduce water demand. Intended to reduce water use by roughly 20%. If triggered by drought, represents moderate drought conditions.	DESCRIPTION: Represents very low water supply conditions. Water use restrictions are necessary to maintain supplies during a period of critical water shortage. Intended to reduce water use by roughly 50%. If triggered by drought, represents severe drought conditions for local area.	DESCRIPTION:Strict water use restrictions are necessary to maintain critical supply. Intended to reduce water use by 90%. Represents an emergency loss of supply during which water is spared for consumptive and sanitary purposes only.
	ACTIVITY	RESTRICTION DETAILS*	RESTRICTION DETAILS*	RESTRICTION DETAILS*	RESTRICTION DETAILS*	RESTRICTION DETAILS*
A	**School Yards, Sports Fields, and Sand-based Playing Fields**	Avoid irrigation between 10am-7pm.	Limit irrigation to 3 times per week (Tuesday, Thursday, Saturday) and avoid irrigation between 10am-7pm.	Limit irrigation to 2 times per week (Tuesday & Saturday) and avoid irrigation between 10am-7pm.	Irrigate 1 day/week at minimum levels permitted to maintain areas in useable condition.	All forms of irrigation are prohibited.
B	**Water Spray Parks and Indoor/Outdoor Pools**		Recirculating pool water only.	No restrictions on spray parks with user-activated switches. Other spray parks must be turned off from 8pm-9am. Filling, refilling and topping is permitted two days per week (Tuesday & Thursday) between 6am-10am & 7pm-12am.	No restrictions on spray parks with user-activated switches. Other spray parks must be turned off from 8pm-9am. Filling and refilling is not permitted. Topping is permitted one day per week between 6am-10am & 7pm-12am.	Water parks shut down. Municipal outdoor pools closed.
C	**Aesthetic Fountains and Water Features**	Recirculating water only.	Recirculating water only.	No filling or refilling permitted unless using recycled/reclaimed water or rainwater. To avoid health and safety problems drain and use water to irrigate landscaping.	Filling and refilling are prohibited. To avoid health and safety problems drain and use water to irrigate landscaping.	Filling and refilling are prohibited. To avoid health and safety problems drain and use water to irrigate landscaping.
D	**Municipal Parks and Cemetaries**	Avoid irrigation between 10am-7pm.	Limit irrigation to 3 times per week and avoid irrigation between 10am-7pm.	Irrigation allowed 2 days per week, (Tuesday & Thursday) between 7pm-6am.	Irrigate 1 day/week - minimum levels permitted to maintain areas in useable condition.	All forms of irrigation are prohibited.
E	**Municipal Ornamental Lawns and Grassed Boulevards**	Avoid irrigation between 10am-7pm.	Limit irrigation to 3 times per week (Tuesday, Thursday, Saturday), between 7pm-6am, except where Parks Department is authorized for safety and security reasons.	Two days per week, (Tuesday & Thursday) between 7 pm and 6 am.	Irrigate 1 day/week - minimum levels permitted to maintain areas in useable condition.	All forms of irrigation are prohibited.
F	**Municipal Water Main Flushing and Hydrant Maintenance**	No restrictions.	No restrictions.	Only for unscheduled safety or public health reasons. No routine flushing.	Only for unscheduled safety or public health reasons. No routine flushing.	Only for unscheduled safety or public health reason. No routine flushing.
G	**Artificial Turf and Outdoor Tracks (i.e. bicycle, motorcycle and running tracks)**	Cleaning, with a hose or sprinkler, permitted for health and safety only. Use spring-loaded nozzle.	Cleaning, with a hose or sprinkler, permitted for health and safety only. Use spring-loaded nozzle.	Cleaning, with a hose or sprinkler, permitted for health and safety only. Use spring-loaded nozzle.	Cleaning, with a hose or sprinkler, permitted for health and safety only. Use spring-loaded nozzle.	All forms of cleaning of outdoor surfaces with GVW water are prohibited unless ordered by a regulatory authority (i.e. WCB, public health inspector, etc.).

*** These restrictions are for water supplied by GVWU only. They do not apply to the use of reclaimed or recycled water, greywater, rainwater harvested by the customer, or any other sources of water not supplied by GVWU. Customers are encouraged to utilize rainwater for appropriate uses such as garden irrigation.**

	NORMAL	STAGE 1	STAGE 2	STAGE 3	STAGE 4
Agricultural Water Use Restrictions	DESCRIPTION: Represents normal (i.e. average) conditions for local area. Water use restrictions focus on water use efficiencies and drought awareness.	DESCRIPTION: Represents below normal conditions for local area. Water use restrictions focus on water use efficiencies intended to reduce water use by roughly 10%. If triggered by drought, represents early drought (drier than average) conditions for local area.	DESCRIPTION: Represents low water supply conditions for local area. Water use restrictions are necessary to sufficiently reduce water demand. Intended to reduce water use by roughly 20%. If triggered by drought, represents moderate drought conditions.	DESCRIPTION: Represents very low water supply conditions. Water use restrictions are necessary to maintain supplies during a period of critical water shortage. Intended to reduce water use by roughly 50%. If triggered by drought, represents severe drought conditions for local area.	DESCRIPTION:Strict water use restrictions are necessary to maintain critical supply. Intended to reduce water use by 90%. Represents an emergency loss of supply during which water is spared for consumptive and sanitary purposes only.
ACTIVITY	RESTRICTION DETAILS*	RESTRICTION DETAILS*	RESTRICTION DETAILS*	RESTRICTION DETAILS*	RESTRICTION DETAILS*
Crop Irrigation**	Maximum water use permitted: 5500 m^3/ha for season	Maximum water use permitted: 5500 m^3/ha for season Increased surveillance of allocation compliance and communication to encourage users to take voluntary conservation measures.	Mandatory reduction of maximum water use by 20%: 4400 m^3/ha for season GVW may decide to implement late turn on or early turn off of agricultural water.	Mandatory reduction of maximum water use by 50%: 2750 m^3/ha for season GVW may decide to implement late turn on or early turn off of agricultural water.	Mandatory water restrictions. Outdoor water use prohibited except water for livestock and minimal maintenance of perennial fruit trees. (80% reduction of allowable water use) GVW may decide to implement late turn on or early turn off of agricultural water.

*** These restrictions are for water supplied by GVWU only. They do not apply to the use of reclaimed or recycled water, greywater, rainwater harvested by the customer, or any other sources of water not supplied by GVWU.**

**** Typical irrigation season is April 15 - September 15. The GVWU reserves the right to change turn on and turn off dates, thereby affecting irrigation season duration, based on current water supply availability and drought forecasts. If the restriction stage is reduced during the growing season, customer allocation would be prorated based on the number of days the higher restriction level was instituted.**

Appendix C – Water Shortage Communication Plan

Drought Management Communications Plan (2011)	NORMAL	STAGE 1	STAGE 2	STAGE 3	STAGE 4
Explanation of Supply Status:	Average Water Storage Available. On going water conservation education and practising efficient water use. Strive to maintain , not exceed , average summer usage.	Drought in early stage where there is heightened awarness by the community. Potential increased drought conditions may mean earlier information to public. Reduce Impact to customers with early warning.	Represents low water supply conditions for local area. Water use restrictions are necessary to sufficiently reduce water demand. Intended to reduce water use by roughly 20%. If triggered by drought, represents moderate drought conditions.	Represents very low water supply conditions. Water use restrictions are necessary to maintain supplies during a period of critical water shortage. Intended to reduce water use by roughly 50%. If triggered by drought, represents severe drought conditions for local area.	Strict water use restrictions are necessary to maintain critical supply. Intended to reduce water use by 90%. Represents an emergency loss of supply during which water is spared for consumptive and sanitary purposes only.
Goal:	Promote demand management initiatives to support long term water efficiency.	10% reduction in total and peak flow. Implement short and long term strategies to ensure existing supplies last and do not further decrease to a unsustainable level.	20% reduction in total and peak flow. Implement short term strategies to ensure existing supplies last and do not further decrease to a unsustainable level.	50% reduction in total and peak flows to maintain critical supply levels. Implement short term strategies to ensure existing supplies last and do not further decrease to a unsustainable level.	90% reduction in total and peak flows to maintain critical supply levels. Maintain minimum water supplies needed to support basic community health and sanitation.
Public messaging and Communication: What is our Message?	Customers should strive to be efficent water users.	Avoid worse restrictions by taking steps now to be more efficient water users.	Communicate likelihood/risk of needing to increase to a higher stage. Avoid worse restrictions by taking steps now to be more efficient water users. Set goals such as: "Reduce consumption by 20%" or "Today's Water Use Goal: 95 ML / Yesterday's Water Use: 104 ML"	Communicate likelihood/risk of needing to increase to a higher stage. Avoid worse restrictions by taking steps now to be more efficient water users. Set goals such as: "Reduce consumption by 50%" or "Today's Water Use Goal: 80 ML / Yesterday's Water Use: 84 ML"	Community Emergency - work with PEP (if deemed appropriate) to coordinate and ensure customers are aware of emergency supply options to ensure basic/hygeine needs met.
	Make Water Work - OBWB Campaign. E.G. lawns usually only need an inch per week of water.	Ensure strategies do not create undue economic hardship. Efforts made now to change behaviour may even save money in long term.	Short term hardship now will help us get through in the long term.	Recognition that restrictions may cause some hardship and that certain water uses have to be prioritized for the good of the community. Efforts made now will save water in long term.	GVW recognizes hardship and appreciates the community's efforts.
		Increase awareness of what is causing supply situation - drought, infrastructure issues, etc.	Increase awareness of what is causing supply situation - drought, infrastructure issues, etc.	Increase awareness of what is causing supply shortage situation - drought, infrastructure issues, etc.	
		Communicate likelihood/risk of needing to increase to a higher stage.	GVW recognizes hardship and appreciates the community's efforts.	GVW recognizes hardship and appreciates the community's efforts.	
Water Utility Actions:	Communicate Normal year-round restrictions online and at public events, but focus message on how people should use water, not why they can't use water.	Implement Stage 1 Water Use Restrictions and communicate change in stages in local media & online, as well as jurisdictional partners.	Implement Stage 2 Water Use Restrictions and communicate change in stages in local media & online, as well as jurisdictional partners, major water users, and sensitive customers (i.e. Hospital).	Implement Stage 3 Water Use Restrictions and communicate change in stages in local media & online, as well as jurisdictional partners, major water users, and sensitive customers (i.e. Hospital).	Implement Stage 4 Water Use Restrictions and communicate change in stages in local media & online, as well as jurisdictional partners, major water users, and sensitive customers (i.e. Hospital).
	Publish educational materials targeted to high water use activities via media, public events, online.	Analyze water use (meter data) to determine possible high water users. Publish educational materials targeted to high water use activities via media, public events, online.	Increase frequency of media Public Serve Announcements (PSAs). Directly contact high water use customers and ask for support in curbing consumption.	Increase frequency of media Public Serve Announcements (PSAs). Directly contact high water use customers and ask for support in curbing consumption.	Increase frequency of media Public Serve Announcements (PSAs). Directly contact high water use customers and ask for support in curbing consumption.
	Research Best Management Practices (BMP) for water efficiency as per DMP recommendations.	Meet with municipal partners to ensure municipal staff are implementing restrictions in public facilities and investigate concerns.	Target efforts at high (inefficient) water users within major water use sectors, based on metered use data analysis.	Target efforts at major water users (use largest % of supply) and communicate priorities for supply use.	Advertise to public options for short-term supplemental supply sources to meet basic needs.
	Seek out opportunities to promote water efficiency through public events, speaking engagements, children's activities.	Seek out opportunities to promote water efficiency through public events, speaking engagements, children's activities.	Contact high water users via letter and inform them of current restriction status, required actions under bylaw.	Investigate alternative water sources for short-term supply supplementation.	Meet with Sensitive customers with critical water needs (e.g. hospital) and assess supply options.

Drought Management Communications Plan (2011)	NORMAL	STAGE 1	STAGE 2	STAGE 3	STAGE 4
Water Utility Actions:	If available, summer student will aid in restriction complaint response, otherwise will be part of regular staff duties.	Increase enforcement activities - increase time alloted to summer student monitoring and complaint response.	Increase enforcement effort - hire second student	Meet with municipal partners to ensure municipal staff are implementing restrictions in public facilities and investigate concerns. Do so with other public institutions - School District, Interior Health, etc. Encourage those agencies to put out media releases/communications materials to note their actions.	Meet with municipal partners to ensure municipal staff are implementing restrictions in public facilities and investigate concerns. Do so with other public institutions - School District, Interior Health, etc. Encourage those agencies to put out media releases/communications materials to note their actions.
		Focus residential/commercial education efforts on minimizing outdoor water use so to avoid higher stages.	Meet with municipal partners to ensure municipal staff are implementing restrictions in public facilities and investigate concerns. Do so with other public institutions - School District, Interior Health, etc. Encourage those agencies to put out media releases and/or signs to note their actions (e.g. Metro Van water wise park/pool/splash pad signs informing customers as to why water turned off).	Increase enforcement effort - seek assistance from municipal bylaw staff.	Increase enforcement effort - seek assistance from municipal bylaw staff.
		Monitor supply status and demand levels, as per Section 5.3.1 of DMP, to determine if necessary to move to Stage 2	Monitor supply status and demand levels, as per Section 5.3.1 of DMP, to determine if necessary to move to Stage 3	Monitor supply status and demand levels, as per Section 5.3.1 of DMP, to determine if necessary to move to Stage 4	
			Investigate posting "Water Supply Shortage Graphic" (rainbow reservoir) in public locations. This may include, but not be limited to, billboard signs, sandwich board/A-Frame signs (utilizing frames held by municipalities for this purpose), digital information signs at arenas or on highways.	Implement signage as listed under Stage 2 with updated Stage information	Implement signage as listed under Stage 2 with updated Stage information

Appendix D – Aberdeen-Grizzly-Haddo Reservoir Water Shortage Stages and Fishery Flow Targets

Table D-1 GVW water shortage stage storage levels

Week Ending	Stage 1		Stage 2		Stage 3		Stage 4	
	Stage Storage Level[1] (ML)	% of total reservoir storage	Stage Storage Level (ML)	% of total reservoir storage	Stage Storage Level (ML)	% of total reservoir storage	Stage Storage Level (ML)	% of total reservoir storage
1-Jan	5550	30	3700	20	1850	10	925	5
15-Jan	5550	30	3700	20	1850	10	925	5
1-Feb	5550	30	3700	20	1850	10	925	5
15-Feb	5550	30	3700	20	1850	10	925	5
1-Mar	5550	30	3700	20	1850	10	925	5
15-Mar	5550	30	3700	20	1850	10	925	5
1-Apr	5550	30	4070	22	2220	12	925	5
15-Apr	6475	35	4995	27	2960	16	925	5
1-May	9250	50	6845	37	3700	20	925	5
15-May	11655	63	10360	56	5180	28	925	5
1-Jun	15725	85	14615	79	6475	35	925	5
15-Jun	16650	90	15170	82	7955	43	925	5
1-Jul	16650	90	15170	82	7955	43	925	5
15-Jul	14800	80	14060	76	6475	35	925	5
1-Aug	12950	70	11470	62	5180	28	925	5
15-Aug	10730	58	9065	49	3700	20	925	5
1-Sep	8325	45	6845	37	2590	14	925	5
15-Sep	7030	38	4995	27	1850	10	925	5
1-Oct	5920	32	4070	22	1850	10	925	5
15-Oct	5550	30	3700	20	1850	10	925	5
1-Nov	5550	30	3700	20	1850	10	925	5
15-Nov	5550	30	3700	20	1850	10	925	5
1-Dec	5550	30	3700	20	1850	10	925	5
15-Dec	5550	30	3700	20	1850	10	925	5

Note:

1. Stage storage level values represent the total storage volume of the Aberdeen-Grizzly-Haddo Reservoir system.

Table D-2 Fishery flow storage level targets

Week Ending	Low Normal		Level 1 Flow		Level 2 Flow		Level 3 Flow		Level 4 Flow	
	Storage Level Target[1] (ML)	% of total reservoir storage	Storage Level Target[1] (ML)	% of total reservoir storage	Storage Level Target[1] (ML)	% of total reservoir storage	Storage Level Target[1] (ML)	% of total reservoir storage	Storage Level Target[1] (ML)	% of total reservoir storage
7-Jan	7,050	38	5,550	30	3,700	20	1,850	10	925	5
14-Jan	7,050	38	5,550	30	3,700	20	1,850	10	925	5
21-Jan	7,050	38	5,550	30	3,700	20	1,850	10	925	5
28-Jan	7,050	38	5,550	30	3,700	20	1,850	10	925	5
4-Feb	7,050	38	5,550	30	3,700	20	1,850	10	925	5
11-Feb	7,050	38	5,550	30	3,700	20	1,850	10	925	5
18-Feb	7,050	38	5,550	30	3,700	20	1,850	10	925	5
25-Feb	7,050	38	5,550	30	3,700	20	1,850	10	925	5
4-Mar	7,050	38	5,550	30	3,700	20	1,850	10	925	5
11-Mar	7,050	38	5,550	30	3,765	20	1,915	10	925	5
18-Mar	7,050	38	5,550	30	3,918	21	2,068	11	925	5
25-Mar	7,050	38	5,550	30	4,070	22	2,220	12	925	5
1-Apr	7,513	41	6,013	33	4,533	25	2,590	14	925	5
8-Apr	7,975	43	6,475	35	4,995	27	2,960	16	925	5
15-Apr	9,189	50	7,689	42	5,458	30	3,363	18	925	5
22-Apr	10,403	56	8,903	48	5,920	32	3,765	20	925	5
29-Apr	11,609	63	10,109	55	8,100	44	4,229	23	925	5
6-May	12,811	69	11,311	61	9,858	53	4,969	27	925	5
13-May	14,352	78	12,852	69	11,611	63	5,561	30	925	5
20-May	16,028	87	14,528	79	13,364	72	6,094	33	925	5
27-May	17,357	94	15,857	86	14,694	79	6,686	36	925	5
3-Jun	17,820	96	16,320	88	14,972	81	7,426	40	925	5
10-Jun	18,150	98	16,650	90	15,170	82	7,955	43	925	5
17-Jun	18,150	98	16,650	90	15,170	82	7,955	43	925	5
24-Jun	18,150	98	16,650	90	15,170	82	7,955	43	925	5
1-Jul	17,225	93	15,725	85	14,615	79	7,215	39	925	5
8-Jul	16,300	88	14,800	80	14,060	76	6,475	35	925	5
15-Jul	15,538	84	14,038	76	12,994	70	5,942	32	925	5
22-Jul	14,776	80	13,276	72	11,927	64	5,409	29	925	5
29-Jul	13,816	75	12,316	67	10,783	58	4,757	26	925	5
5-Aug	12,706	69	11,206	61	9,580	52	4,017	22	925	5
12-Aug	11,664	63	10,164	55	8,543	46	3,439	19	925	5
19-Aug	10,674	58	9,174	50	7,629	41	2,982	16	925	5
26-Aug	9,733	53	8,233	45	6,713	36	2,537	14	925	5
2-Sep	9,085	49	7,585	41	5,788	31	2,167	12	925	5
9-Sep	8,461	46	6,961	38	4,937	27	1,850	10	925	5
16-Sep	7,975	43	6,475	35	4,533	25	1,850	10	925	5
23-Sep	7,489	40	5,989	32	4,128	22	1,850	10	925	5
30-Sep	7,261	39	5,761	31	3,911	21	1,850	10	925	5
7-Oct	7,076	38	5,576	30	3,726	20	1,850	10	925	5
14-Oct	7,050	38	5,550	30	3,700	20	1,850	10	925	5
21-Oct	7,050	38	5,550	30	3,700	20	1,850	10	925	5
28-Oct	7,050	38	5,550	30	3,700	20	1,850	10	925	5

Week Ending	Low Normal		Level 1 Flow		Level 2 Flow		Level 3 Flow		Level 4 Flow	
	Storage Level Target[1] (ML)	% of total reservoir storage	Storage Level Target[1] (ML)	% of total reservoir storage	Storage Level Target[1] (ML)	% of total reservoir storage	Storage Level Target[1] (ML)	% of total reservoir storage	Storage Level Target[1] (ML)	% of total reservoir storage
4-Nov	7,050	38	5,550	30	3,700	20	1,850	10	925	5
11-Nov	7,050	38	5,550	30	3,700	20	1,850	10	925	5
18-Nov	7,050	38	5,550	30	3,700	20	1,850	10	925	5
25-Nov	7,050	38	5,550	30	3,700	20	1,850	10	925	5
2-Dec	7,050	38	5,550	30	3,700	20	1,850	10	925	5
9-Dec	7,050	38	5,550	30	3,700	20	1,850	10	925	5
16-Dec	7,050	38	5,550	30	3,700	20	1,850	10	925	5
23-Dec	7,050	38	5,550	30	3,700	20	1,850	10	925	5
31-Dec	7,050	38	5,550	30	3,700	20	1,850	10	925	5

Note:

1. Storage level target values represent the total storage volume of the Aberdeen-Grizzly-Haddo Reservoir system.

Table D-3 Fishery flow targets for Duteau Creek below Headgates dam

Week Ending	Fishery Flow Targets (m^3/s)					DFO Releases (m^3/s)
	Normal	Low Normal	Level 1 Flow	Level 2 Flow	Level 3/4 Flow	
7-Jan	0.231	0.173	0.115	0.092	0.058	0.057
14-Jan	0.231	0.173	0.115	0.092	0.058	0.057
21-Jan	0.231	0.173	0.115	0.092	0.058	0.057
28-Jan	0.231	0.173	0.115	0.092	0.058	0.057
4-Feb	0.231	0.173	0.115	0.092	0.058	0.057
11-Feb	0.231	0.173	0.115	0.092	0.058	0.057
18-Feb	0.231	0.173	0.115	0.092	0.058	0.057
25-Feb	0.231	0.173	0.115	0.092	0.058	0.057
4-Mar	0.231	0.173	0.115	0.092	0.058	0.057
11-Mar	0.231	0.173	0.115	0.092	0.058	0.057
18-Mar	0.231	0.173	0.115	0.092	0.058	0.057
25-Mar	0.231	0.173	0.115	0.092	0.058	0.057
1-Apr	0.231	0.173	0.115	0.092	0.058	0.057
8-Apr	0.577	0.346	0.173	0.092	0.058	0.170
15-Apr	0.865	0.461	0.231	0.092	0.058	0.170
22-Apr	1.153	0.577	0.346	0.092	0.058	0.170
29-Apr	1.730	0.865	0.577	0.092	0.058	0.170
6-May	2.306	1.153	0.577	0.288	0.058	0.170
13-May	2.306	1.153	0.577	0.288	0.058	0.170
20-May	2.306	1.153	0.577	0.288	0.058	0.170
27-May	2.306	1.153	0.577	0.288	0.058	0.170
3-Jun	1.730	0.865	0.577	0.115	0.058	0.170
10-Jun	1.153	0.461	0.346	0.115	0.058	0.170
17-Jun	0.865	0.346	0.231	0.115	0.058	0.170
24-Jun	0.577	0.231	0.173	0.115	0.058	0.170
1-Jul	0.461	0.173	0.173	0.115	0.058	0.170
8-Jul	0.404	0.173	0.173	0.115	0.058	0.170
15-Jul	0.346	0.173	0.173	0.115	0.058	0.170
22-Jul	0.288	0.173	0.173	0.115	0.058	0.170
29-Jul	0.231	0.173	0.173	0.115	0.058	0.170
5-Aug	0.231	0.173	0.173	0.115	0.058	0.170
12-Aug	0.231	0.173	0.173	0.115	0.058	0.170
19-Aug	0.231	0.173	0.173	0.115	0.058	0.170
26-Aug	0.231	0.173	0.173	0.115	0.058	0.170
2-Sep	0.231	0.173	0.173	0.115	0.058	0.170
9-Sep	0.288	0.259	0.231	0.173	0.058	0.198
16-Sep	0.288	0.259	0.231	0.173	0.058	0.198
23-Sep	0.288	0.259	0.231	0.173	0.058	0.198
30-Sep	0.288	0.259	0.231	0.173	0.058	0.198
7-Oct	0.288	0.259	0.231	0.173	0.058	0.142
14-Oct	0.288	0.259	0.231	0.173	0.058	0.142
21-Oct	0.288	0.259	0.231	0.173	0.058	0.142
28-Oct	0.288	0.259	0.231	0.173	0.058	0.142
4-Nov	0.288	0.231	0.173	0.173	0.058	0.142
11-Nov	0.288	0.231	0.173	0.138	0.058	0.142

Week Ending	Fishery Flow Targets (m^3/s)					DFO Releases (m^3/s)
	Normal	Low Normal	Level 1 Flow	Level 2 Flow	Level 3/4 Flow	
18-Nov	0.288	0.231	0.173	0.138	0.058	0.142
25-Nov	0.288	0.231	0.173	0.138	0.058	0.142
2-Dec	0.288	0.231	0.173	0.138	0.058	0.142
9-Dec	0.231	0.173	0.115	0.092	0.058	0.142
16-Dec	0.231	0.173	0.115	0.092	0.058	0.142
23-Dec	0.231	0.173	0.115	0.092	0.058	0.142
31-Dec	0.231	0.173	0.115	0.092	0.058	0.142

Appendix E – Emergency Response Plan

EMERGENCY RESPONSE PLANS

ERP #1	FOREST FIRE
ERP #2	LANDSLIDE
ERP #3	WATERBORNE DISEASE
ERP #4	SOURCE CONTAMINATION
ERP #5	LOSS OF NON-GUDI WELL-SOURCE
ERP #6	LOSS OF GOOSE LAKE-SOURCE
ERP #7	LOSS OF SURFACE SOURCE
ERP #8	LOSS OF SURFACE SOURCE - OPEN RESERVOIR
ERP #9	HIGH WINDS
ERP #10	LIGHTNING
ERP #11	BROKEN WATER MAIN DISRUPTS SERVICE
ERP #12	RESERVOIR CONTAMINATION
ERP #13	BACKFLOW INCIDENTS
ERP #14	SABOTAGE / VANDALISM
ERP #15	POWER FAILURE
ERP #16	STRUCTURAL FIRE AT WATER FACILITY
ERP #17	CHLORINE SPILLS INTO FRESH WATER

ERP #01: FOREST FIRE

CONDITION	**FOREST FIRE IN THE AREA THREATENS GVW FACILITY**
OBJECTIVE	**To ensure operator safety and take all measures reasonable to prevent forest fire from impacting facility operations**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Immediately notify Manager, Utility Operations and immediate supervisor/facility manager	Operator
2	Contact Wildfire management authorities at 1-800-663-5555 or *5555 on cellular to assess situation	Operator
3	Evacuate facility if imminent health/safety concern and notify supervisor	Operators
4	Notify the GM of Engineering	Manager, Utility Operations
5	If necessary contact the Community/Protective Services Manager	GM Engineering
6	If evacuation required continue to monitor/operate facility remotely	Manager, Utility Operations and Operators
7	If facility is equipped with backup power ensure fuel level and operation	Operators
8	If the water supply is impacted and cannot meet demand implement the following as required: - Initiate water conservation measures - Appropriately adjust water system to increase supply from other sources - Discuss source use options and public communication with IH	Manager, Utility Operations / RDNO Engineering and Operations Staff
9	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	Manager, Utility Operations and Operators

Version Number	Date of Issue	Author	Brief Description of Change
1	May 21/14	Sandy Edwards	Consolidated ERP's – Duteau, Mission Hill, Delcliffe and Outback.
2	Jan. 21/15	Renee Clark	Order 5 – Deleted Ron Bakers name.
3	June 20/16	Donna Douglas	Updated Manager – Greater Vernon Water title to Manager, Utility Operations

ERP #02: LANDSLIDE

CONDITION	**LANDSLIDE HAS AFFECTED WATER SOURCE AND INTAKE**
OBJECTIVE	**To ensure personal/ infrastructure safety and take all measures reasonable to prevent impact to Headgates, King Edward Intake and Kalamalka Lake**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Immediately notify WQ Manager or Manager, Utility Operations	Operator, Forestry Road Licensee or MFLNRO
2	Immediately notify the Chief Water Supply & Treatment Operator to assist in assessment if a treatment plant will be impacted, if a source needs to be turned off, or if charges need to be made to increase water production from a treatment plant closure.	Manager, Utility Operations and Operator
3	Assess Dam Safety and report to Dam Safety if necessary	RDNO Dam Safety Reps
4	If not initially contacted by Road Licensee - See Contact List for Tolko Industries Ltd. or Ministry of Forests (MFLNRO)	WQ Manager
5	Notify the GM of Engineering	Manager, Utility Operations
6	If necessary contact Community/Protective Services Manager	GM Engineering
7	If the water supply is impacted and cannot meet demand, implement the following as required: - Initiate water conservation measures - Appropriately adjust water system to increase supply from other sources	RDNO Engineering staff responsible
8	Discuss source use options and possible public notification with IH	WQ Manager
9	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	WQ Manager and Operator

Version Number	Date of Issue	Author	Brief Description of Change
1	Nov.8/13	Renee Clark	Dam Safety and inspection added
2	Mar.26/14	Renee Clark	Change at MFLNRO – Engineering Dept
3	Jan. 21/15	Renee Clark	Order 6 – Deleted Ron Baker's name
4	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water title to Manager, Utility Operations and Water Treatment Manager to Chief Water Supply & Treatment Operator

ERP #03: WATERBORNE DISEASE

CONDITION	**WATERBORNE DISEASE HAS BEEN DETECTED IN WATER SOURCE**
OBJECTIVE	**Minimize the impact to customers by removing source from entering distribution if existing treatment is not successful in removal or inactivation. Use Water Quality Deviation Response Plan for Guidance.**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Upon discovery notify the WQ Manager	WQ Staff/Operator
2	Isolate or remove source from entering the affected source and determine if water treatment will reduce impact to water quality	Operations and Chief Water Supply & Treatment Operator
3	Determine other water supply to provide for customers if needed	Operations and Chief Water Supply & Treatment Operator
4	WQ Manager to develop sampling plan and sample source for suspected contaminant	WQ Manager
5	Notify IH. Prepare and deliver notification to customers if affected. Type of notification will depend on the contaminant and the size of the potentially affected area i.e.: Media, signs or door to door	WQ Manager
6	Notify the GM of Engineering	WQ Manager
7	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	WQ Manager

* Ensure that all contacts, notifications and advisories correspond with existing ERPs and/or the Water Quality Deviation Response Plan in Appendix G.*

Version Number	Date of Issue	Author	Brief Description of Change
1.0	Feb. 24, 2016	Dave Klassen	Included note to reference WQ Deviation Response Plan
2	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water title to Manager, Utility Operations and Water Treatment Manager to Chief Water Supply & Treatment Operator

APPENDIX E

ERP #04: SOURCE CONTAMINATION

CONDITION	**SPILLS, VEHICLE ACCIDENT, ACT OF SABOTAGE OR VANDALISM RESULTS IN CONTAMINATION OF WATER SOURCE**
OBJECTIVE	**Minimize the impact and attempt to prevent any contaminants reaching Customers Use Water Quality Deviation Response Plan for Guidance.**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Immediately remove source from water system if it is believed that the contamination has potential to also contaminate the distribution system.	Operator
2	Immediately notify the Chief Water Supply & Treatment Operator and WQ Manager	Operator or first on scene
3	Determine if water treatment will reduce impact to water quality	Operations and Chief Water Supply & Treatment Operator
4	Determine other water supply to provide for customers if needed	Operations and Chief Water Supply & Treatment Operator
5	Assess the contamination and complete water quality analysis near intake	WQ Manager
6	Notify IH. Prepare and deliver notification to customers if affected. Type of notification will depend on the contaminant and the size of the potentially affected area i.e.: Media, signs or door to door. Notify RAPP (1-877-952-7277) if a spill; or PEPP (1-800-663-3456) if provincial assistance is required.	WQ Manager
7	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	WQ Manager and Operator

* Ensure that all contacts, notifications and advisories correspond with existing ERPs and/or the Water Quality Deviation Response Plan in Appendix G.*

Version Number	Date of Issue	Author	Brief Description of Change
1	July 11, 2014	Zee Marcolin	Added RAPP and PEPP to #6
1.1	Feb. 24, 2016	Dave Klassen	Included note to reference WQ Deviation Response Plan
2	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water title to Manager, Utility Operations and Water Treatment Manager to Chief Water Supply & Treatment Operator

APPENDIX E

ERP #05: LOSS OF NON-GUDI WELL-SOURCE

CONDITION	**LOSS OF NON-GUDI WELL DUE TO CONTAMINATION OR SUPPLY**
OBJECTIVE	**Minimize the impact to customers by providing an alternate supply**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Immediately remove source from water system if it is believed that there is potential contamination. During critical times of high water demand an alternate source may be limited	Operator
2	Immediately notify Manager, Utility Operations and WQ Manager	Operator
3	Assess the contamination or other issue that has caused a loss of source	Manager, Utility Operations / WQ Manager
4	Contact IH and determine Public Notification if needed	WQ Manager
5	Complete water quality analysis near wellhead and distribution if potential contamination	WQ Manager
6	Notify the Chief Water Supply & Treatment Operator and the GM of Engineering	Manager, Utility Operations
7	If necessary contact Manager, Information Technology & Emergency Services	GM Engineering
8	If the water supply is impacted and cannot meet demand implement the following as required: - Initiate water conservation measures - Appropriately adjust water system to increase supply from other sources	Manager, Utility Operations, Chief Water Supply & Treatment Operator
9	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	WQ Manager and Operator

* Ensure that all contacts, notifications and advisories correspond with existing ERPs and/or the Water Quality Deviation Response Plan in Appendix G.*

Version Number	Date of Issue	Author	Brief Description of Change
1	Jan. 21/15	Renee Clark	Order 7 – deleted Ron Baker's name
1.1	Feb. 24/16	Dave Klassen	Included note to reference WQ Deviation Response Plan
2	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water title to Manager, Utility Operations, Water Treatment Manager to Chief Water Supply & Treatment Operator and Community/Protective Services Manager to Manager, Information Technology & Emergency Services

ERP #06: LOSS OF GOOSE LAKE-SOURCE

CONDITION	**LOSS OF GOOSE LAKE RESERVOIR**
OBJECTIVE	**Minimize the impact to customers by providing an alternate supply**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Immediately remove source from water system if it is believed that there is potential contamination. During critical times of high water demand an alternate source may be limited	Operator
2	Immediately notify Manager, Utility Operations and WQ Manager	Operator
3	Assess the contamination or other issue that has caused a loss of source	Manager, Utility Operations / WQ Manager
4	Determine if public notification is needed	WQ Manager
5	Complete water quality analysis near intake and distribution if potential contamination.	WQ Manager
6	Contact Chief Water Supply & Treatment Operator if water supply can not meet demand	Manager, Utility Operations
7	If the water supply is impacted and cannot meet demand, implement the following as required: - Initiate water conservation measures - Appropriately adjust water system to increase supply from other sources	Manager, Utility Operations, Chief Water Supply & Treatment Operator
8	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	WQ Manager and Operator

NOTE: All land around Goose Lake is private property. Landowners should be made aware of any safety issues that may affect their activities.

Version Number	Date of Issue	Author	Brief Description of Change
1	Jan. 23, 2015	Renee	Order 4 – deleted reference to reporting to IH.
1.1	Feb. 24, 2016	Dave Klassen	Order 4
2	May 12, 2016	Donna Douglas	Updated Manager – Greater Vernon Water title to Manager, Utility Operations and Water Treatment Manager to Chief Water Supply & Treatment Operator

ERP #07: LOSS OF SURFACE SOURCE

CONDITION	**LOSS OF SURFACE SOURCE - DUTEAU CREEK OR KALAMALKA LAKE DUE TO CONTAMINATION OR SUPPLY**
OBJECTIVE	**Minimize the impact to customers by providing an alternate supply**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Immediately remove source from water system if it is believed that there is potential contamination. During critical times of high water demand an alternate source may be limited	Operator
2	Immediately notify Manager, Utility Operations and WQ Manager	Operator
3	Notify the Chief Water Supply & Treatment Operator and GM of Engineering	Manager, Utility Operations
4	Assess the contamination or other issue that has caused a loss of source	Manager, Utility Operations / WQ Manager
5	If the water supply is impacted and cannot meet demand implement the following as required: - Initiate water conservation measures - Appropriately adjust water system to increase supply from other sources	Manager, Utility Operations, Chief Water Supply & Treatment Operator
6	Contact IH and determine Public Notification if needed	WQ Manager
7	Complete water quality analysis near wellhead and distribution if potential contamination	WQ Manager
8	If necessary contact Emergency Operations Manager 250- 550-3775 or cell 250 306 1572	GM Engineering
9	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	WQ Manager and Operator

* Ensure that all contacts, notifications and advisories correspond with existing ERPs and/or the Water Quality Deviation Response Plan in Appendix G.*

Version Number	Date of Issue	Author	Brief Description of Change
1	Jan. 21/15	Renee Clark	Order 8 – deleted Ron Baker's name
1.1	Feb. 24/16	Dave Klassen	Included note to reference WQ Deviation Response Plan. Updated Order 8 to new title "Emergency Operations Manager" and updated contact information.
2	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water title to Manager, Utility Operations and Water Treatment Manager to Chief Water Supply & Treatment Operator

ERP #8 LOSS OF SURFACE SOURCE – OPEN RESERVOIR

CONDITION	**EMPTYING AN OPEN RESERVOIR LAKE**
OBJECTIVE	**Minimize the impact to customers by providing an alternate supply**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Notify Manager, Utility Operations, WQ Manager and Chief Water Supply & Treatment Operator	Operator
2	Notify GM of Engineering	Manager, Utility Operations or Alternate
3	Contact Ecosystem Biologist – Possible fish salvage Grant Furness Ecosystems Section Head Ministry of Forests, Lands and Natural Resource Operations Penticton 250.490.8277	Manager, Utility Operations or Alternate
4	Decide on a reasonable drawdown rate as to minimize turbidity release and impact on fish but also accommodates emergency situation	Manager, Utility Operations or Alternate
5	If the water supply is impacted and cannot meet demand implement the following as required: - Initiate water conservation measures - Appropriately adjust water system to increase supply from other sources	Manager, Utility Operations, WQ Manger, Chief Water Supply & Treatment Operator
6	Contact Ministry of Forests, Lands & Natural Resources, DFO, IH and public depending on the emergency situation	Manager, Utility Operations, WQ Manger
7	Take samples downstream, test for turbidity, solids, etc	WQ Manager
8	Monitor water quality when filling of the reservoir and returning to normal operation	WQ Manger, Chief Water Supply & Treatment Operator
9	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	Chief Water Supply & Treatment Operator and Operations

Version Number	Date of Issue	Author	Brief Description of Change
0	May 21, 2014	Sandy Edwards	New ERP
1	Feb. 13, 2015	Zee Marcolin	Removed “draft” stamp
2	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water title to Manager, Utility Operations and Water Treatment Manager to Chief Water Supply & Treatment Operator

APPENDIX E

ERP #09: HIGH WINDS

CONDITION	**HIGH WINDS CAUSES LOSS OF POWER – LONG DURATION**
OBJECTIVE	**Minimize the impact to users by returning water system to normal**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Immediately assess back up power possibilities and gravity supply (reservoirs) levels are at critical points.	Operator
2	Immediately notify Manager, Utility Operations and immediate supervisor/facility manager	Operator
3	If the water supply is impacted and cannot meet demand implement the following as required: - Initiate water conservation measures - Appropriately adjust water system to increase supply from other sources Discuss source use options and public communication with IH	Manager, Utility Operations / RDNO Engineering and Operations Staff
4	Notify GM of Engineering if demand is cannot being met	Manager, Utility Operations
5	Arrange for alternatives – bottled water, bulk haulers, etc	RDNO Engineering Staff and PEP
6	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	Manager, Utility Operations and Operators

Version Number	Date of Issue	Author	Brief Description of Change
1	May 21, 2014	Sandy Edwards	Consolidated ERP's – Duteau, Mission Hill, Delcliffe and Outback
2	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water title to Manager, Utility Operations and Water Treatment Manager to Chief Water Supply & Treatment Operator

ERP #10: LIGHTNING

CONDITION	**LIGHTNING CAUSES LOSS OF POWER – LONG DURATION**
OBJECTIVE	**Minimize the impact to users by returning water system to normal**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Immediately assess back up power possibilities and gravity supply (reservoirs) levels are at critical points	Operator
2	Immediately notify Manager, Utility Operations and immediate supervisor/facility manager	Operator
3	If the water supply is impacted and cannot meet demand implement the following as required: - Initiate water conservation measures - Appropriately adjust water system to increase supply from other sources Discuss source use options and public communication with IH	Manager, Utility Operations / RDNO Engineering and Operations Staff
4	Notify the GM of Engineering if demand is cannot being met	Manager, Utility Operations
5	Arrange for alternatives – bottled water, bulk haulers, etc	RDNO Engineering Staff and PEP
6	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	Manager, Utility Operations and Operators

Version Number	Date of Issue	Author	Brief Description of Change
1	May 21, 2014	Sandy Edwards	Consolidated ERP's – Duteau, Mission Hill, Delcliffe and Outback
2	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water to Manager, Utility Operations

ERP #11: BROKEN WATER MAIN DISRUPTS SERVICE

CONDITION	**NOTIFICATION OF A BROKEN WATER MAIN**
OBJECTIVE	**Minimize the effects of a broken water main and return service to normal**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Notify Manager, Utility Operations	Operator
2	Isolate broken water main by shutting down the nearest valves on both sides of the main break. (Shut down nearest valves to break to avoid shutting down additional water users)	Operations
3	Notify Manager, Utility Operations which areas are affected	Operator
4	Repair broken mainline as quickly and efficiently as possible	Operations
5	Notify GM of Engineering and WQ Manager	Manager, Utility Operations
6	Notify IH (if necessary)	WQ Manager
7	Initiate increased water quality monitoring if necessary	WQ Manager
8	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	Manager, Utility Operations and Operations

Version Number	Date of Issue	Author	Brief Description of Change
1	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water to Manager, Utility Operations

APPENDIX E

ERP #12: RESERVOIR CONTAMINATION

CONDITION	**ACT OF SABOTAGE VANDALISM, INTRUSSION OF HUMAN OR RODENT, BIRD ETC THAT HAS RESULTED IN CONTAMINATION OF WATER RESERVOIR**
OBJECTIVE	**Minimize the impact to customers by removing reservoir from entering distribution. Use Water Quality Deviation Response Plan for Guidance.**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Immediately remove reservoir from water system if it is believed that the contamination has potential to also contaminate the distribution system	Operator
2	Upon discovery notify WQ Manager and Manager, Utility Operations	Operations
3	Assess the contamination. WQ Manager develop sampling plan and sample reservoir for suspected contaminant	Operations, WQ Manager and Staff
4	Determine if water distribution has been affected	Operations and Manager, Utility Operations
5	Notify IH. Prepare and deliver notification to customers if affected. Type of notification will depend on the contaminant and the size of the potentially affected area i.e.: Media, signs or door to door	WQ Manager
6	Sample in distribution as needed	WQ Staff
7	Notify GM of Engineering	Manager, Utility Operations
8	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	Manager, Utility Operations

* Ensure that all contacts, notifications and advisories correspond with existing ERPs and/or the Water Quality Deviation Response Plan in Appendix G.*

Version Number	Date of Issue	Author	Brief Description of Change
1	Feb. 24, 2016	Dave Klassen	Included note to reference WQ Deviation Response Plan
2	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water to Manager, Utility Operations

ERP #13: BACKFLOW INCIDENTS

CONDITION	**A BACKFLOW INCIDENT HAS BEEN IDENTIFIED**
OBJECTIVE	**To provide instructions to isolate and rectify backflow contamination incidents.**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Contact the Manager, Utility Operations and/or the WQ Manager	Operators
2	Isolate the area by shutting off valves surrounding the contaminated area. Start where the contamination was first reported and work outward until the contamination boundary is found.	Operators
3	Identify the source and/or possible contaminant and determine Hazard Rating of incident: - High Hazard: If the contaminant could present an immediate health hazard. - Low hazard: the contaminant is not an immediate health risk. Unknown contaminants should be considered a High Hazard until the source/contaminant is identified or after flushing and sufficient sampling indicates the risk has been removed.	WQ Manager and CCC Officer
4	Identify what samples should be taken. Take appropriate samples using the WQ Field Sampling Kit based on the type of contamination. Ensure accurate field notes are taken with all observations recorded and all samples taken recorded on a laboratory chain of record or RDNO sampling form. - The technician should wear eye protection and rubber gloves. - A respirator fitted with a HEPA filter should be worn when working with asbestos wrapped pipe, asbestos concrete pipe, mold, legionella and high concentrations of contaminated aerosol (fine solid particles or liquid droplets). - Samples should be taken **before** any flushing takes place. - Collect samples from a variety of locations.	WQ Manager (WQ Tech)
5	Notify all customers that could be directly affected by the contamination. - Ensure that all contacts, notifications and advisories correspond with existing ERPs and/or the Water Quality Deviation Response Plan in Appendix G. - The type of notification will depend on the Hazard Rating, contaminant and the size of the potentially affected area. - High Hazard: notification should be issued as soon as possible through the local media and “DO NOT USE” signs should be placed liberally in the impacted area. Door to door	WQ Manager

	notices may also be required as determined by Management (ERP contact list Appendix 2) - Low Hazard: customers may be notified by local newspapers (ERP contact list Appendix 2) or by other means as determined by Management	
6	If the source is unknown - perform a field investigation to identify the source of contamination. Inform the Cross Connection Control Officer such that the officer can perform further investigation. Possible indicators include: - Drops in operating pressure - Drops in disinfectant residual - Water meters running in reverse - Water Quality parameters (i.e. increasing turbidity or change in pH from source or other distribution areas)	Operators / CCC Officer
7	Once the contaminant has been effectively isolated from the system, flush the system to remove the contaminant. Take continued water quality samples to verify the efficacy of the flushing.	Operators / WQ Tech
8	If flushing does not remove contaminant(s) sufficiently such that the water is not considered safe to drink, the pipes should be physically cleaned. - Acceptable methods are sandblasting, jetting, pigging, and rodding, etc. - Disinfect and flush the pipes after a physical cleaning by the above methods. - Verify the efficacy of the cleaning by taking water quality samples.	Manager, Utility Operations / Operators
9	If physical cleaning does not remove enough contaminants such that the water is still not safe to drink, affected pipelines and fixtures connected to the system should be replaced. Some examples of contaminants that would require pipeline replacement are: - Highly corrosive or explosive materials - Pesticides such as chlordane, heptachlor, etc. which absorb into the pipe material and are slowly rereleased into the system over time - Radioactive materials that can permanently irradiate pipe materials. Where it is determined that the pipes need to be replaced, an interim plan to service the effect customers must be developed.	Manager, Utility Operations / Operators
10	Rescind the notification to impacted customers when the health risk has been removed and the water has been determined to be safe to drink based on sampling results.	WQ Manager

* Ensure that all contacts, notifications and advisories correspond with existing ERPs and/or the Water Quality Deviation Response Plan in Appendix G.*

APPENDIX E

Version Number	Date of Issue	Author	Brief Description of Change
1	May 21, 2014		Format update.
2	May 11, 2016	Dave Klassen	Changed ERP#17 to ERP #13
3	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water to Manager, Utility Operations

ERP #14: SABOTAGE/VANDALISM

CONDITION	**SABOTAGE / VANDALISM THREATENS WATER SECURITY AND WATER QUALITY**
OBJECTIVE	**Minimize the impact to users by returning water system to normal**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Immediately assess site to determine cause of alarm (Note: if needed call 911 - RCMP)	Operator
2	Immediately notify Manager, Utility Operations and immediate supervisor	Operator
3	If distribution is not affected go to step 6 and 8. If assessment suggests - isolate the affected portion of the distribution system by shutting off nearest valves surrounding the contaminated area. Start where contamination was first reported and works outwards until boundary is determined	Manager, Utility Operations / WQ Manager
4	WQ Manager develop sampling plan and sample suspected area for water quality impacts	WQ Manager
5	Notify IH. Prepare and deliver notification for affected area. Type of notification will depend on the contaminant and the size of the potentially affected area i.e.: Media, signs or door to door	WQ Manager
6	Notify GM of Engineering	Manager, Utility Operations
7	Flushing and cleaning the system once source of contaminant is identified and isolated	Manager, Utility Operations and Operations
8	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	Manager, Utility Operations and Operator

Version Number	Date of Issue	Author	Brief Description of Change
1	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water to Manager, Utility Operations

ERP #15: POWER FAILURE

CONDITION	**POWER FAILURE – LONG DURATION**
OBJECTIVE	**To minimize impact of extended power interruption**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Determine the duration of the power failure if possible	Operator
2	Immediately notify Manager, Utility Operations and immediate supervisor/facility manager	Operator
3	If the water supply is impacted and cannot meet demand implement the following as required: - Initiate water conservation measures - Appropriately adjust water system to increase supply from other sources Discuss source use options and public communication with IH	Manager, Utility Operations / RDNO Engineering and Operations Staff
4	Notify GM of Engineering that demand is not being met	Manager, Utility Operations
5	Arrange for alternatives – bottled water, bulk haulers, etc	RDNO Engineering Staff and PEP
6	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	Manager, Utility Operations and Operators

Version Number	Date of Issue	Author	Brief Description of Change
1	May 21, 2014	Sandy Edwards	Consolidated ERP's – Duteau, Mission Hill, Delcliffe and Outback
2	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water to Manager, Utility Operations

ERP #16: STRUCTURAL FIRE AT WATER FACILITY

CONDITION	**A STRUCTURAL FIRE THREATENS THE OPERATIONS OF A WATER FACILITY**
OBJECTIVE	**To provide instruction to minimize the effects of a structural fire and aid in resuming normal operations**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Pull the fire alarm and evacuate the facility or area if required	Operators
2	Call 911 to notify the fire department	Operators
3	Immediately notify Manager, Utility Operations and immediate supervisor/facility manager	Operator
4	If the water supply is impacted and cannot meet demand implement the following as required: - Initiate water conservation measures - Appropriately adjust water system to increase supply from other sources Discuss source use options and public communication with IH	Manager, Utility Operations / RDNO Engineering and Operations Staff
5	Notify GM of Engineering that demand is not being met	Manager, Utility Operations
6	Ensure emergencies are documented along with action taken and kept on file and review ERP for improvements	Manager, Utility Operations and Operators

Version Number	Date of Issue	Author	Brief Description of Change
1	May 21, 2014	Sandy Edwards	Consolidation of ERP's – Duteau, Mission Hill, Delcliffe and Outback
1.1	Feb. 26, 2016	Dave Klassen	Removed Order 4
2	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water to Manager, Utility Operations

ERP #17: CHLORINE SPILLS INTO FRESHWATER

CONDITION	**A POTENTIAL CHLORINE SPILL IN A FRESHWATER WATERWAY OR INUNDATION AREA HAS BEEN REPORTED**
OBJECTIVE	**To provide instructions for investigation, reporting and remediation of chlorinated water spills into freshwater**
NOTE	1. Vary the sequence of actions as appropriate for the specific situation 2. Document all activities in detail throughout the emergency event 3. Ensure each action is checked off once complete

Order	Action	Responsibilities
1	Immediately contact the Manager, Utility Operations and/or the WQ Manager and Operator on Call (if first responder is not an operator)	First Responder
2	Stop or isolate the source of chlorinated water or chlorine that is getting into the water source.	Operations
3	Contact the local Hazmat Team. (Note: the Hazmat Team is run by the City of Vernon Fire Department). The Hazmat Team would be arranged by dialing 911. It is at the discretion of the Manager to contact one or more of the following government agencies depending on the severity of the incident. The manager should base their decision on the estimated volume, risk assessment, residual chlorine levels and requirements of the *BC Spill Reporting Regulation*. - Provincial Emergency Program (1-800-663-3456) - Ministry of Forests, Lands and Natural Resource Operations - Department of Fisheries and Oceans (604-663-3500) To assist in decision making before contacting a government agency, the managers should consider Province of BCs ambient water quality criteria levels for chlorine: - <25 minutes @ 0.1 mg/L - 30 minutes @ 0.087 mg/L - 90 minutes @ 0.038 mg/L - >120 minutes (continuous exposure) @ 0.002 mg/L To assistant in decision making before contacting a government agency, the managers should perform a risk assessment based on: - The volume of water or chlorine released - Concentration of chlorine in the receiving water body - Available dilution capacity of receiving water body - Nature of aquatic life in the waterbody. A consulting biologist may need to retain to assist in the assessment.	Manager, Utility Operations or WQ Manager
4	If the source cannot be stopped or isolated, dechlorinate with sodium thio sulphate to neutralize the chlorine.	Operators

5	Use the field chlorine testing kit to confirm concentrations of chlorine. Ensure accurate field notes of all observations are recorded and all samples taken are recorded on a laboratory Chain of Record or RDNO sampling form. To test for continuous chlorine levels a minimum of 5 samples should be taken over set time intervals. To test for current chlorine concentrations a minimum of 3 samples shall be taken within close time proximity to the spill but at different locations.	WQ Technician
6	If the source cannot be stopped or isolated, management should re-evaluate Order 3 periodically.	Manager, Utility Operations or WQ Manager
7	If the cause of the spill or source of the chlorine is unknown a field investigation shall be conducted to ensure the issue causing the spill is not repeated.	Operators and GVW Management

* Ensure that all contacts, notifications and advisories correspond with existing ERPs and/or the Water Quality Deviation Response Plan in Appendix G.*

Version Number	Date of Issue	Author	Brief Description of Change
0	May 11, 2014	Dave Klassen	Changed ERP 18 to 17.
1	June 20, 2016	Donna Douglas	Updated Manager – Greater Vernon Water to Manager, Utility Operations