



DATE: **October 24, 2017**

SUBJECT: **Chlorine Management Program Progress Report**

SUMMARY:

In 2016, Greater Vernon Water (GVW) initiated a Chlorine Management Program with the goal of reducing the formation of Disinfection By-products (DBP) within the distribution system. This program is predicted to be a multiyear program that brings together the GVW engineering and operations groups to review monitoring data, system configuration, water movement, water age and operational procedures in order to develop strategies to reduce chlorine input into the system and/or reduce water age.

Strategies developed for implementation in 2017 have included:

- improved monitoring
- equipment purchase to improve operations (i.e. reservoir mixers, chlorine boosting)
- improved operations (i.e. additional flushing in low water use areas, exercising reservoirs, compound loops for chlorine injection rate)
- capital work projects (i.e. installing water loops in problem areas).

BACKGROUND:

DBP occur when chlorine is combined with organic matter to form chlorinated compounds such as trihalomethanes (THM) and haloacetic acids (HAA). Long term exposure to DBP has been shown to have negative health outcomes and the Guidelines for Canadian Drinking Water Quality (GCDWQ) has set limits of 0.1 mg/L for THM and 0.08 mg/L for HAA.

Prior to the installation and commissioning of Diffused Air Floatation (DAF) at the Duteau Creek Water Treatment Plant (DCWTP), the DBP from the Duteau Creek source were two to three times the limits of the GCDWQ. DAF treatment has reduced DBP production significantly; however, there are times during the year where THM and HAA exceed the limits at the ends of the distribution system.

The creation of DBP is dependent on a number of factors:

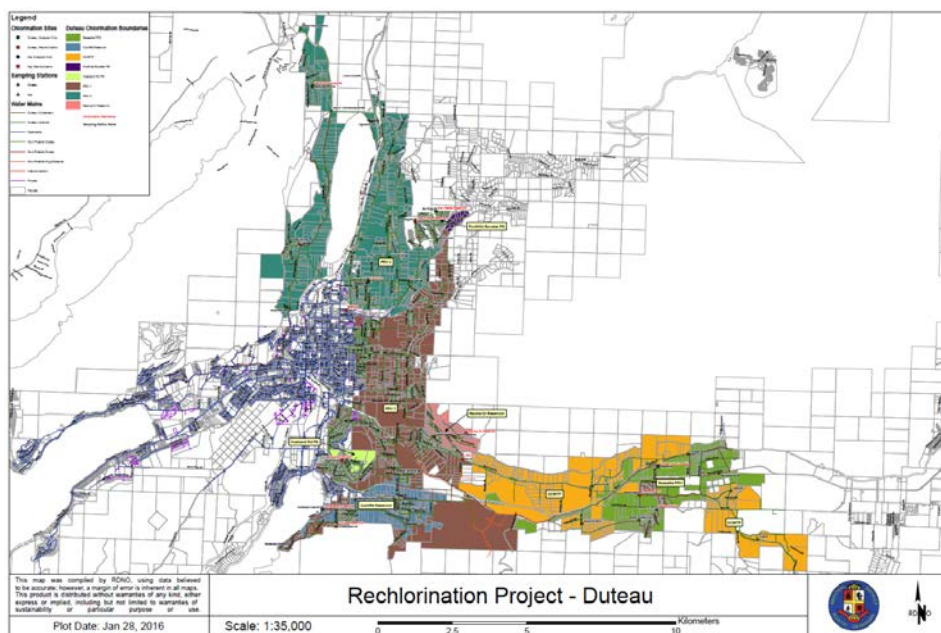
- Temperature
- pH
- Organic concentrations (Total Organic Carbon, Bromide ion)
- Chlorination Dose
- Water Age

Treating the cause of DBP would require further removal of organics from the source water that are still present after the DAF treatment; this would cost multiple millions of dollars.

As the DBP still exceed the GCDWQ in some areas of the distribution and due to the expense of additional treatment, GVW has been exploring other potential avenues for DBP reduction. In early 2017, Greater Vernon Water (GVW) initiated a Chlorine Management Program with the goal of reducing the formation of Disinfection By-products (DBP) within the distribution system. This program is predicted to be a multiyear program that brings together the GVW engineering and operations groups to review monitoring data, system configuration, water movement, water age and operational procedures in order to develop strategies to reduce chlorine input into the system and/or reduce water age.

PROGRAM METHODOLOGY:

The first step of the project was to map the chlorine dosing impact areas as polygons within a map of the GVW system. The map below shows the polygons for the Duteau source and a similar map was produced for the Kalamalka Lake source. Each polygon shown is influenced by a different (re)chlorination station.



The second step involved review sessions held with GVW staff and the City of Vernon and District of Coldstream operations crews. At these review sessions the following was reviewed:

- accuracy of the mapping and each polygon,
- chlorine dosing levels at each chlorine injection site (the inflow dose of each polygon) verses vulnerable areas. Vulnerable areas are described as the low chlorine concentration areas of the polygon and may include dead ends, large mains or reservoirs that supply few services (typically new neighbourhoods that are not fully built out), low flow areas or other issues. As a general rule, GVW attempts to keep chlorine between 2 ppm as the highest chlorine concentration and what customers can generally tolerate with the

lowest reading as 0.2 ppm to ensure adequate residual within the system. The lowest concentration is generally the “vulnerable” point(s) of each polygon,

- operations provided feedback on trouble areas, and
- developing strategies to reduce chlorine dosing, reduce water age, improve water movement and other strategies that would assist in reducing DBP production.

Throughout the GVW system there are a number of re-chlorination stations that allow GVW to re-dose the water as it gets further away from the water treatment plants. After the review sessions were completed, the records from the SCADA data for sample stations across the GVW system were reviewed and information cards produced for each polygon with the following information:

- Maximum recorded chlorine levels (multiple sample stations)
- Minimum recorded chlorine levels (multiple sample stations)
- Average chlorine levels (multiple sample stations)
- Number of data points taken per sample station
- Vulnerable sample stations
- Outflow polygons
- Inflow polygons
- Polygon equipment
- Action plan

RESULTS AND ACTIONS FOR 2016/2017:

In review of the polygons, it was noted that reducing chlorine dosing at the two main sources would likely provide the highest benefit to DBP reduction, however limitations at each site were determined and action plans to overcome were developed as follows:

- **DCWTP:** Chlorine dosing at the DCWTP is set to achieve sufficient Contact Time (CT) for 3-Log reduction of *Giardia* cysts. As *Giardia* is a public health risk on the Duteau source based on protozoa sampling completed by GVW, it was determined that chlorine dosing at the DCWTP could not be lowered until upgrades were made to address the risk to public health from viable *Giardia* cysts. In 2017, GVW received a grant to construct an Ultra Violet (UV) treatment facility at the DCWTP scheduled for commissioning in early 2018. As UV treatment will provide the 3-log reduction requirement for *Giardia*, GVW will be able to readjust the chlorine dosing to meet 4-log deactivation of viruses, which is significantly lower than required for *Giardia*. GVW will start to explore reducing the chlorine dosing at the DCWTP once UV treatment is fully operational.
- **MHWTP:** Water from Kalamalka Lake is treated at the Mission Hill Water Treatment Plant (MHWTP) using UV and chlorine disinfection. The MHWTP feeds into two pressure zones (PZ): the 550 pz and the 483 pz. The 550 pz is a small area of Vernon that services the DND lands and upper Mission Hill. The 483 pz represents a large portion of Vernon in the valley bottom and supplies a number of chlorine booster stations that feed into other pressure zones. It was determined during the analysis that chlorine dosing at the MHWTP was set to provide sufficient residual within the 550 pz limiting the ability to reduce chlorine dosing into the 483 pz. To remedy this, an action item for operations was to install a chlorine injection site within the MHWTP that boosts the chlorine to the 550 pz only. A

date goal of completion was set as early 2018 as there was a plant shut down requirement and the cost to purchase the required equipment. Once complete, GVW could continue examining reduction of the chlorine dosing to the rest of Vernon and Coldstream.

Other action items from the meeting for 2017 are as follows:

- **Data Review:** The data from water quality sampling and online monitoring sites for the last two years were downloaded and analyzed to determine where the locations of vulnerable areas were within polygons and assess if further sites were required. From this analysis, a number of new sampling and monitoring locations were identified.
- **Sampling Program:** based on the data review, a new sampling station was installed at 35th Street and the number of DBP sampling locations were increased to provide improved data moving forward as GVW starts to decrease chlorine.
- **Online Monitoring:** an online chlorine analyzer was installed at the Okanagan Pump Station 1 in 2017 on the outflow of the station (post-chlorination). This station was identified as a potential vulnerable location and the analyzer will assist in monitoring the impact from lowering chlorine input into the 483 pz in the future.
- **Operations of Reservoir:**
 - A reservoir mixer was installed in the Lavington (Antwerp) Reservoir as a trial. As this reservoir had low water usage, it required a high level of chlorine to ensure adequate residual. The installation of the mixer has resulted in a dosing rate of almost half of pre-mixing.
 - A reservoir mixer is included in the 2018 budget for the Foothills Reservoir as this is another reservoir with a high chlorine consumption. (Future planning also includes reservoir improvements with further development – installing a second cell, baffling, having a separate inflow and outflow to force water circulation to reduce water age).
 - Reservoir exercising was initiated a few years prior by operations, which has assisted in forcing out warm water and bringing in fresh cooler temperature water in the fall. This has been successful in dropping chlorine demand and will continue.
 - Analysis of operating levels of reservoirs, in order to determine if lower reservoir levels could be maintained during periods of lower water demand while still maintaining fire flow demands. This has resulted in running Duteau Reservoir at a lower level outside of the irrigation season.
- **SCADA improvements:** Were completed at DCWTP to provide continuous monitoring of *Giardia* CT values and to send an alarm to the on-call operator if the value drops to 3 log reduction. This live value has allowed operations to make a moderate reduction in chlorine dose while maintaining confidence that CT requirements are being met.
- **Rechlorination (“Booster”) Sites:** The current booster sites were evaluated and a number of new rechlorination sites were identified (Allenby, 435 pz Reservoir (new in-progress of building), MHWTP (in-progress), intersection of Tronson Road and Okanagan Avenue and Ricketts PRV (or Highway 97)). These would allow for a reduction of chlorine at the treatment plants with boosting chlorine within the distribution to maintain residual. With the exception of the booster stations at MHWTP, all new stations are on hold until the work at the treatment plants are completed and reduction in chlorine can be initiated.

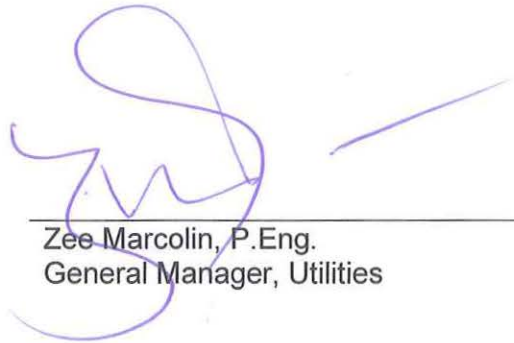
- **Capital works:** A number of capital projects were identified that would assist in reduction of chlorine in areas with low residual that have been included in the five year capital plan for GVW:
 - Water quality loops in the West Kalamalka area
 - Small diameter water line install to connect O'Keefe Ranch to main on Highway 97
 - Improvements to Foothills reservoir

Further planning meetings will be scheduled in 2018 once the work at the treatment plants are completed to identify future actions.

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