City of Merritt – Water Supply

Committee of the Whole – December 1, 2020 – 6:00pm

FLOURISH UNDER THE SUN

Objects of the Presentation

1. Review Merritt's water usage statistics

2. Review the City's Water Utility Master Plan (2012)

3. Provide a high-level overview of the features of each aquifer in the Merritt area.

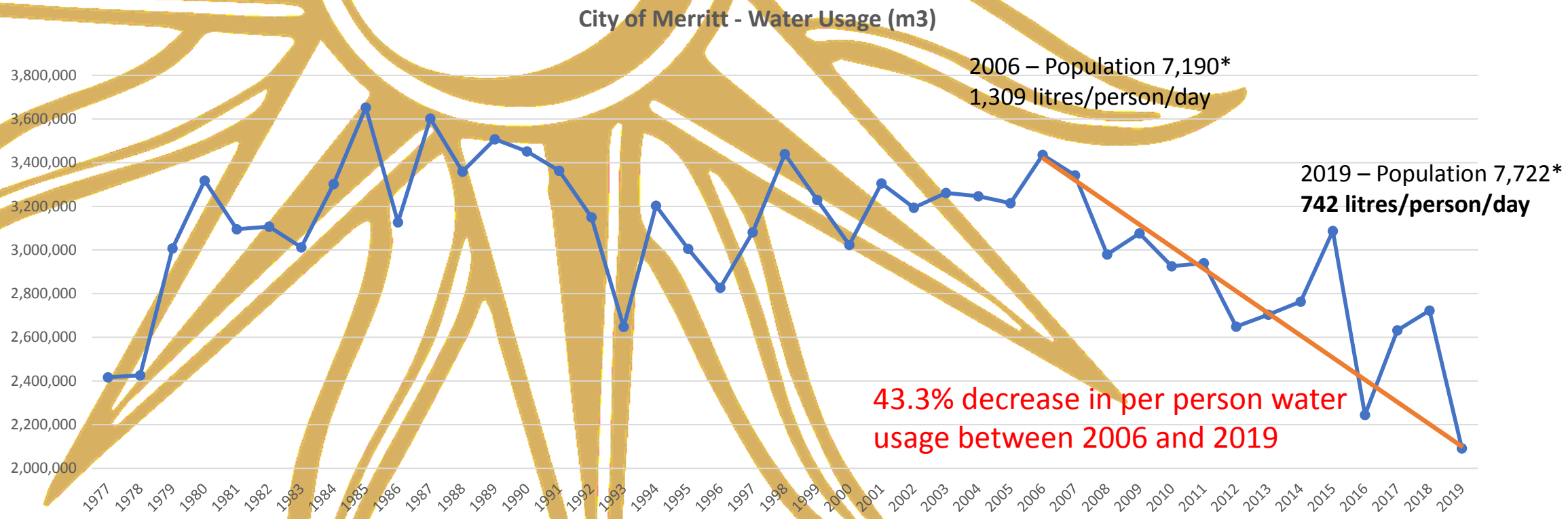
4. Explore what we know about the connection between the City's production wells and the Coldwater River.

Objects of the Presentation

5. Discuss potential methods that may support higher flows in the Coldwater River during drought conditions, namely:
    a. Draw from sources less hydrologically connected to the Coldwater River
        i. Kengard well (lower aquifer)
        ii. Upper or middle aquifer wells closer to the Nicola River
        iii. Nicola Lake
    b. Alternate water management techniques
        i. Pumping water directly from the upper aquifer to the Coldwater River
        ii. Aquifer storage and recovery (actively storing water in aquifer during wet periods, for recovery during dry periods)
        iii. Creation of reservoir
    c. Reduce Consumption
        i. Water meters

These options are not exhaustive and each would require further study and consultation with other levels of government, First Nations and water users in the Nicola Valley.

Part 1 - Water Usage – 1977 to 2019



2006 – Population 7,190*
1,309 litres/person/day

2019 – Population 7,722*
742 litres/person/day

43.3% decrease in per person water usage between 2006 and 2019

1985 – 43 Year High
@ 3,653,055 m3

2019 – 43 year low
@ 2,091,196 m3

*Source - BC Provincial Statistics – Population Estimates

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How does 742 litres/person/day stack up?

When including all residential, industrial and commercial uses:

- BC Average is 503 litres/person/day.
- Canada average is 427 litres/person/day

Source: StatsCan survey of Drinking Water Plants, 2017 (Released June 17, 2019)

The question remains, even with the significant reductions seen in Merritt over the last decade, why is Merritt significantly higher than the BC Average?

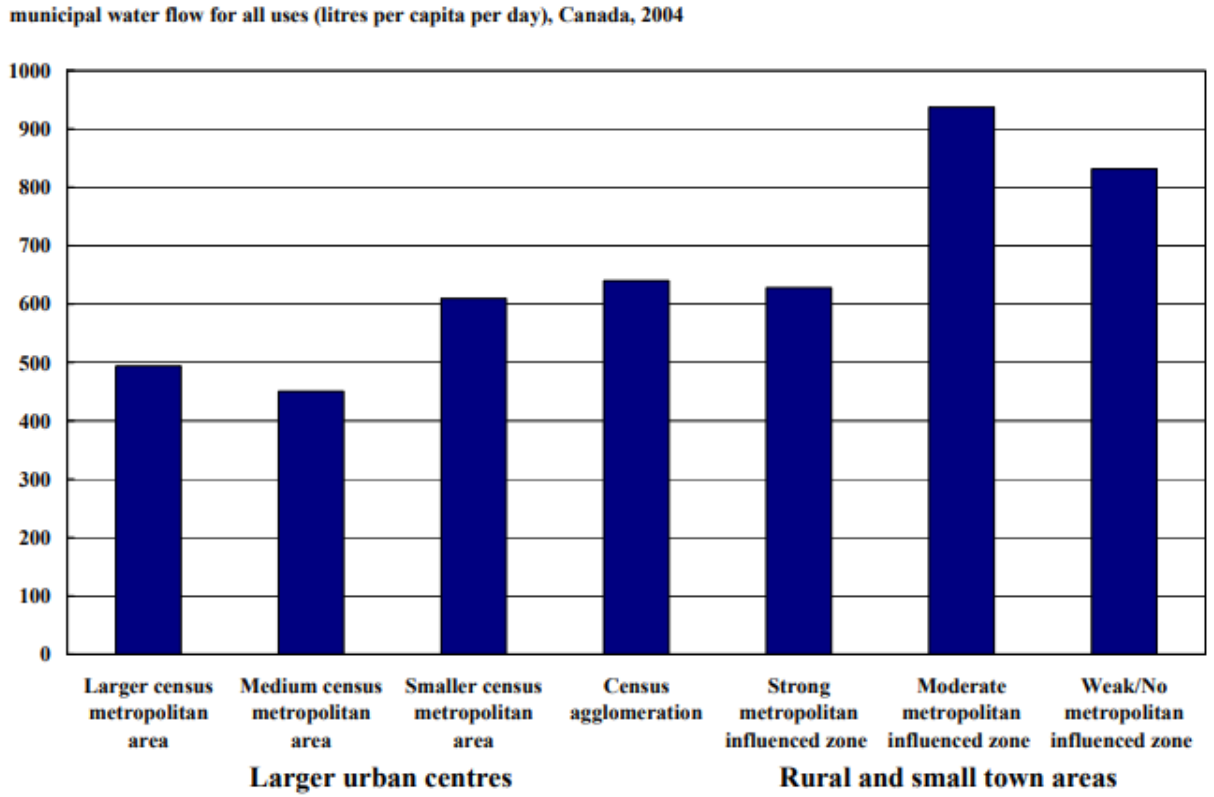
TABLE 4-5
WATER DEMAND IN SOUTHERN INTERIOR BC COMMUNITIES

Community	ADD (L/c/d)	MDD (L/c/d)
Vernon (Fully Metered)	550	1,280
Penticton (Fully Metered)	580	1,200
Kelowna (Fully Metered)	600	1,300
Salmon Arm	690	1,490
Kamloops	790	1,800
Merritt	1,100	2,537

Note: This data is from 2010 and is used for general comparison only

Rural vs. Urban Water Use

Figure 2 Municipal water use for all purposes, on a per capita basis, is highest in weak/no metropolitan influenced zone



Source: [Domestic Water Use: The Relevance of Rurality in Quantity Used and Perceived Water Quality](#) (2009 Paper, based on 2004 water statistics.)

Findings:

Water use per capita is higher in rural and small town areas.

Reasons:

1. Reduced density = more lawns and gardens = higher water use
2. Economic Incentives – Rural areas are less likely to be metered, which generally results in higher water use.

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Conclusions on Water Usage

- Merritt is a low-density community without a water metering program. Considering these factors, usage of 742 litres/person/day is at or near expectations.
- Given the water restrictions implemented in 2019, 742 litres/person/day is likely close to the minimum annual usage achievable at current density, unless water meters are implemented or there is a significant shift in water use habits.

Part 2 – Water Utility Master Plan Review

The following documents provide an overview of the City's water system:

1. Water Utility Master Plan (2012) – Provides details on all aspects of the City's wells, storage reservoirs, and distribution system. Considers impacts of various growth scenarios and recommends future infrastructure upgrades.
2. Source Water Assessment and Protection Plan (2017) – Identifies potential sources of groundwater contamination to the City's water system and recommends actions to reduce risk.
3. Community Water System Report (2019) – Current water statistics

Water Utility Master Plan (2012) – Overview

MERRITT
COUNTRY MUSIC CAPITAL OF CANADA

WATER UTILITY MASTER PLAN

1.1 Background

The Water Utility Master Plan for the City of Merritt is developed to provide the City a long term plan for decision making. The objective of the study is to assess the existing water system in terms of its capacity to meet current requirements and the City's OCP future development plans for the next 20 years. It also provides recommendations for necessary upgrades in order to meet those requirements based on the established level of service. The main system components that the study covers are source supply, source quality, storage, and fire protection. Furthermore, the study also includes a financial model to estimate the sustainable price for water, which would ensure the continuous and feasible operations of the water system for the 20-year horizon period and beyond.

South East Balancing Reservoir

Kengard Pump House

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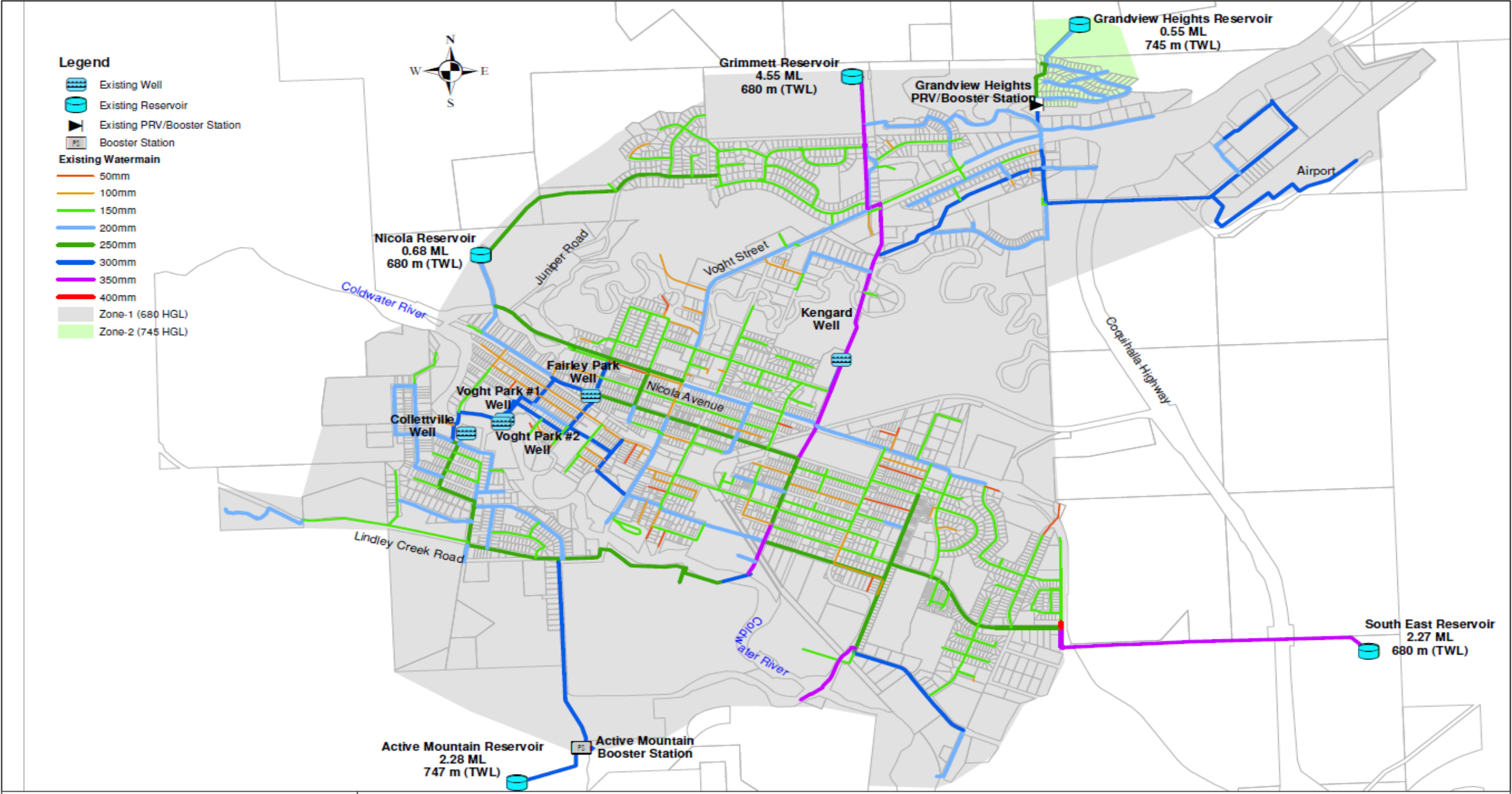
Legend
Existing Well
Existing Reservoir
Existing PRV/Booster Station
Booster Station
Existing Watermain
50mm
100mm
150mm
200mm
250mm
300mm
350mm
400mm
Zone-1 (680 HGL)
Zone-2 (745 HGL)
N
W
E
S
Grandview Heights Reservoir
0.55 ML
745 m (TWL)
Grimmett Reservoir
4.55 ML
680 m (TWL)
Grandview Heights
PRV/Booster Station
Airport
Nicola Reservoir
0.68 ML
680 m (TWL)
Juniper Road
Voght Street
Coldwater River
Kengard
Well
Coquihalla Highway
Fairley Park
Well
Voght Park #1
Well
Nicola Avenue
Collettville
Well
Voght Park #2
Well
Lindley Creek Road
Coldwater River
South East Reservoir
2.27 ML
680 m (TWL)
Active Mountain Reservoir
2.28 ML
747 m (TWL)
Active Mountain
Booster Station
OPUS DaytonKnight
PROJ NO: 364.05
DRAWN BY: ZA
DATE: JUN 2012
OPUS
0
187.5
375
750
1,125
1,500
Meters
SCALE 1:17,500
MERRITT
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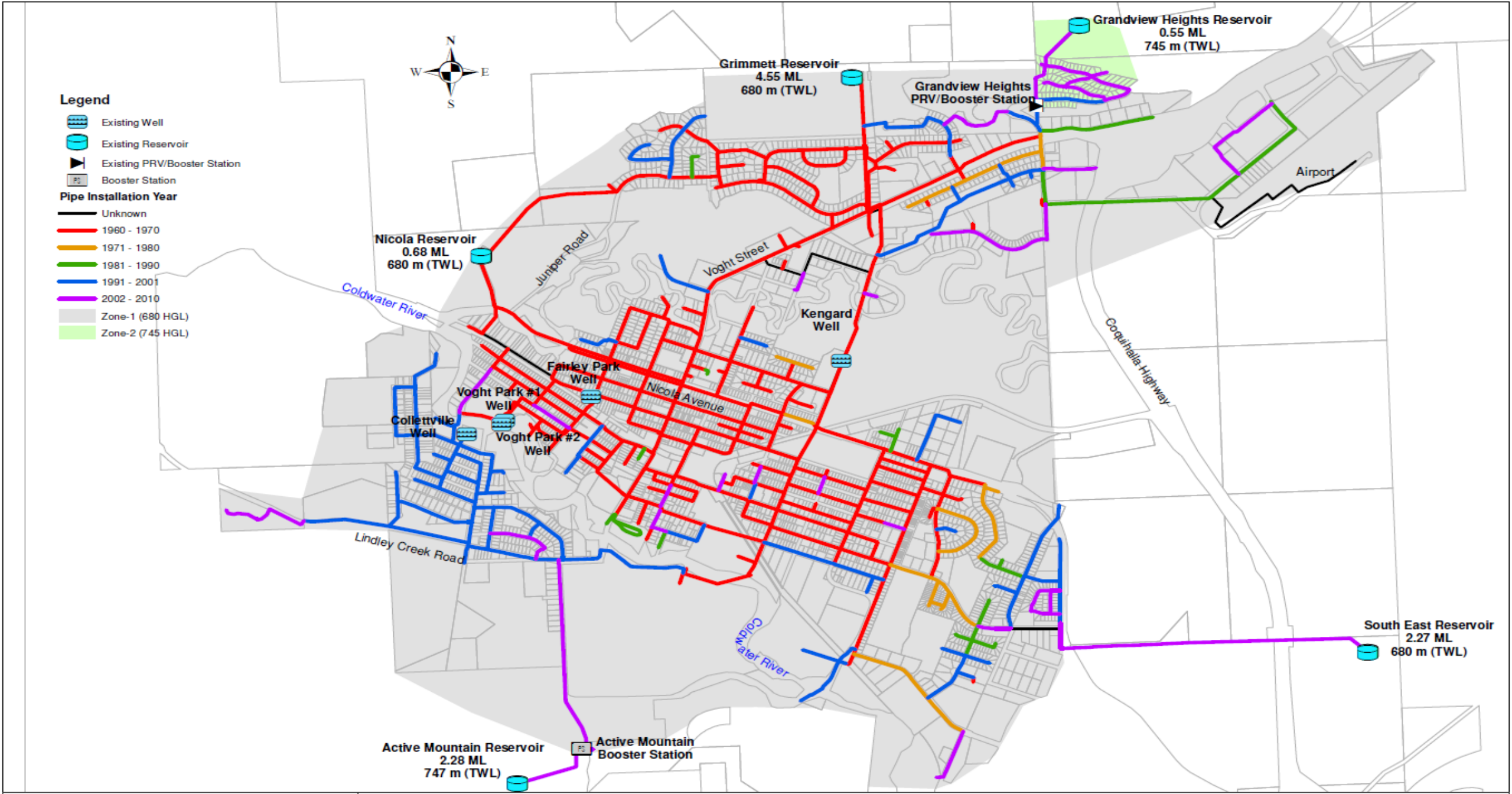
WATER UTILITY MASTER PLAN
EXISTING SYSTEM
FIGURE 3-1


Legend
Existing Well
Existing Reservoir
Existing PRV/Booster Station
Booster Station
Pipe Installation Year
Unknown
1960 - 1970
1971 - 1980
1981 - 1990
1991 - 2001
2002 - 2010
Zone-1 (680 HGL)
Zone-2 (745 HGL)
N
W
E
S
Grandview Heights Reservoir
0.55 ML
745 m (TWL)
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MERRITT
COUNTRY MUSIC CAPITAL OF CANADA
WATER UTILITY MASTER PLAN
EXISTING SYSTEM - INSTALLATION YEAR
FIGURE 3-1a

Water Utility Master Plan – Well Information

TABLE 3-2
PRODUCTION WELLS

Well Name	Pump Rate	Well Depth	Depth to Bottom of Suction
Voght Park #1	250 hp at 106 L/s	35 m	24 m
Voght Park #2 Gas/Electric	200 hp at 83 L/s (Electric pump) 200 hp at 59 L/s (Gas pump)	30 m	20 m
Fairley Park	100 hp at 76 L/s	30 m	17 m
Collettville	125 hp at 56 L/s (Submersible)	49 m	32 m
Kengard	100 hp at 50 L/s (Submersible)	135 m	113 m
Total Well Capacity	371 L/s		

- Considering pump upgrades and the reduction in ability to use Kengard well, the City's current functional well capacity is ~350L/s

- 2020 real-time measurements indicate that actual well capacity is 396L/sec

- Changes in health regulations relating to Manganese in drinking water have limited the City's ability to utilize the Kengard well.

Water Utility Master Plan – Water Quality

Section 6.2.3

Shallow Aquifer (Voght #1 and 2, Collettville, Fairley wells)

"The City's current water supply from the shallow aquifer is very high quality with low turbidity and moderate hardness (125 mg/L $CaCO_3$)"

Kengard Well

"The available data indicates that the well has a hardness of around 390 mg/L $CaCO_3$ and a manganese level of 0.076 mg/L. The hardness exceeds the recommended aesthetic level of 120 mg/L in the Drinking Water Quality Guidelines."

- Aesthetic Objective for manganese is 0.02mg/L.
- Maximum Acceptable Concentration for manganese is 0.12mg/L.

More recent testing at the Kengard well had hardness at 455 mg/L (very had) and manganese levels at 0.116 mg/L, though testing has varied between 0.10 mg/L (below MAC) and 0.14mg/L (above MAC).

Water Utility Master Plan – Storage

TABLE 3-5
STORAGE RESERVOIRS

Reservoir	Capacity (ML)	Top Water Elevation (m)
Grimmett	4.55	680
Nicola	0.67	680
Grandview Heights	0.55	745
South East	2.27	680
Active Mountain[7]	2.28	747
TOTAL	**10.32**	

- Grimmett reservoir is the main controlling reservoir for all the lead pumps connected to the City's water system.
- Through the City's SCADA system, pumps are set to start pumping into the system when Grimmett reservoir is at 80% capacity.
- Pumps stop when the Grimmett reservoir hits 96% capacity.

Water Utility Master Plan – Supply Analysis (Population 7,285 @ 1,100L/p/d)

TABLE 6-1
WATER SUPPLY ANALYSIS (EXISTING 2010-2011)

Item	Description	Capacity (L/s)
	Maximum Supply Capacity (L/s)	
A	Voght Park#1 VFD	106.4
B	Voght Park#2 G/E	83.3
C	Fairley Park	75.8
D	Collettville	56.4
E	Kengard	50.0
F	Total Production, = A+B+C+D+E	371.9
G	Total Production (with largest well out of service), = F-A	265.5
	Existing Demand (L/s)	
H	ADD	92.8
I	MDD	213.9
	Maximum Supply – Existing Demand (L/s)	
J	Total Production – ADD, = F-H	279.1
K	Total Production (with largest well out of service) – ADD, = G-H	172.7
L	Total Production – MDD, = F-I	158
M	Total Production (with largest well out of service) – MDD, = G-I	51.6

Water Utility Master Plan – Supply Analysis (Population 9,067 @ 1,100L/p/d)

TABLE 7-1
WATER SUPPLY ANALYSIS (FUTURE 2030 AT 1.1% GROWTH)

Item	Description	Capacity (L/s)
	Maximum Supply Capacity (L/s)	
A	Voght Park#1 VFD	106.4
B	Voght Park#2 G/E	83.3
C	Fairley Park	75.8
D	Collettville	56.4
E	Kengard	50.0
F	Total Production, = A+B+C+D+E	371.9
G	Total Production (with largest well out of service), = F-A	265.5
	Future Demand at 1.1% Growth (L/s)	
H	ADD	111.8
I	MDD	260.6
	Maximum Supply – Future Demand at 1.1% Growth (L/s)	
J	Total Production – ADD, = F-H	260.1
K	Total Production (with largest well out of service) – ADD, = G-H	153.7
L	Total Production – MDD, = F-I	111.3
M	Total Production (with largest well out of service) – MDD, = G-I	4.9

Water Utility Master Plan – Supply Analysis (Population 14,496 @ 880L/p/d)

TABLE 7-2
WATER SUPPLY ANALYSIS (FUTURE 2030 AT 3.5% GROWTH)

Item	Description	Capacity (L/s)
	Maximum Supply Capacity (L/s)	
A	Voght Park#1 VFD	106.4
B	Voght Park#2 G/E	83.3
C	Fairley Park	75.8
D	Collettville	56.4
E	Kengard	50.0
F	Total Production, = A+B+C+D+E	371.9
G	Total Production (with largest well out of service), = F-A	265.5
	Future Demand at 3.5% Growth (L/s)	
H	ADD	134.7
I	MDD	321.1
	Maximum Supply – Future Demand at 3.5% Growth (L/s)	
J	Total Production – ADD, = F-H	237.2
K	Total Production (with largest well out of service) – ADD, = G-H	130.8
L	Total Production – MDD, = F-I	50.8
M	Total Production (with largest well out of service) – MDD, = G-I	-55.6

Water Utility Master Plan – Conclusions

Supply

At a population of 14,496, and assuming usage of 880L/c/d, the plan indicates City would not need additional supply capacity to meet maximum daily demand. The plan discusses the potential of increasing capacity at the Kengard well to potentially increase redundancy (largest well out of service or well contamination). An additional well could also accomplish this, though there is no imminent need.

Storage

The City has sufficient storage to support a population of 14,496. The caveat is that depending on location of development (Exit 286, North Bench), higher elevation reservoirs or other alternatives will likely be required to be able to ensure sufficient water pressure.

Key Project Recommended – UV Disinfection Facilities

- The City's main 4 wells are classified as "Groundwater Under the Direct Influence of Surface Water (GUDI)" wells.
- GUDI wells have additional health requirements, so dual barrier treatment through UV disinfection was recommended.
- This project is complete and all City wells are now connected to UV disinfection systems.

Water Utility Master Plan – Deficiencies

- This plan is serviceable in analyzing the City's existing and future water supply, storage and distribution needs. However, it is deficient in the following areas:
  - It fails to consider drought effects and potential impacts on the Coldwater River, which impacts the City's future needs.
  - Overstated maximum well supply capacity.
  - Unless alternatives for increasing flows to the Coldwater river are possible, the two above factors likely create a need for the City to consider future water sources, where it wasn't previously seen as being needed to facilitate future growth.
- During the budget amendment process, staff will be bringing forward a request to update this Master Plan.

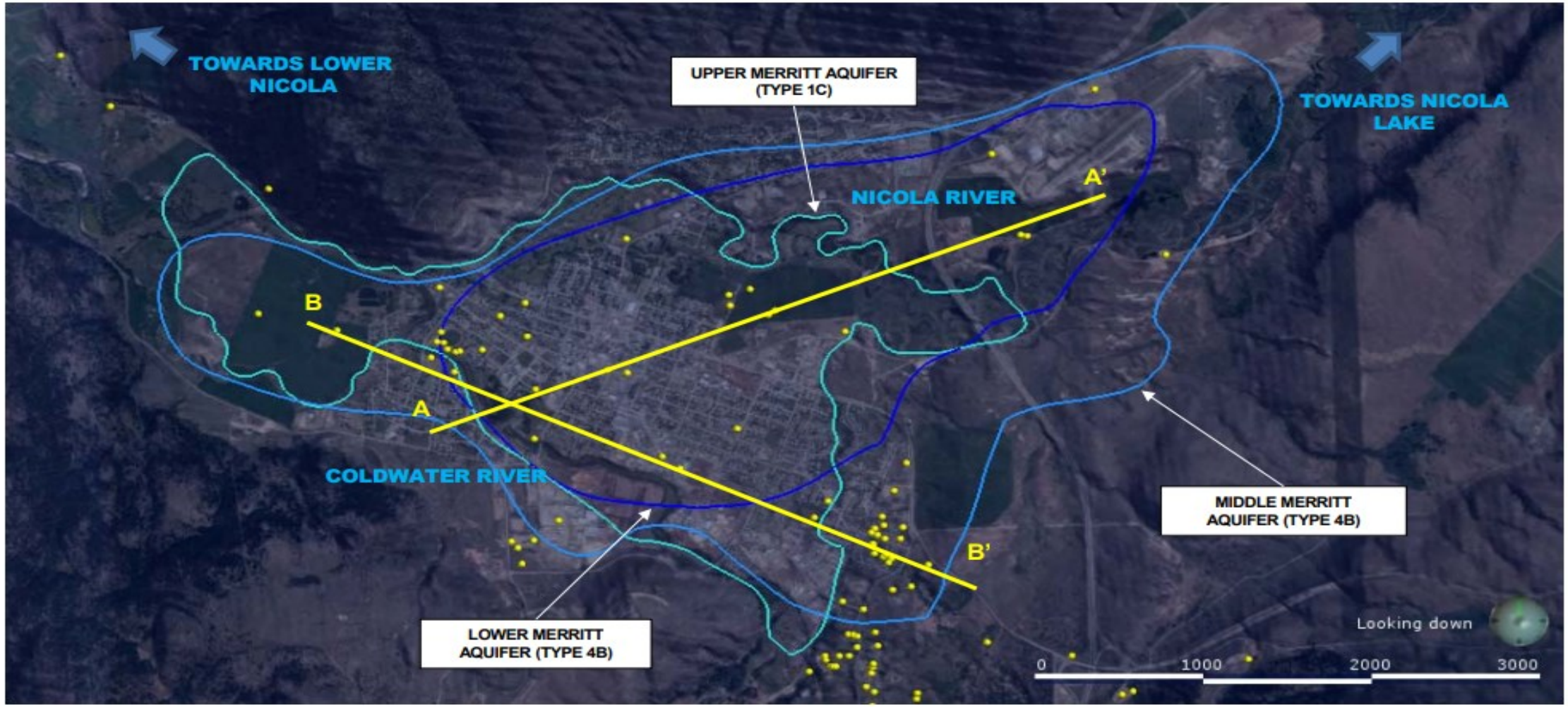
Part 3 – Aquifers in the City of Merritt

Nicola Watershed Aquifer Classification and Mapping Report (2018)

Nicola Valley Project Phase 3 (Part 2) – Hydrogeological modelling (2020)

3 Aquifers have been mapped under the Merritt Area:

1. Upper Merritt Aquifer (sometimes called the Shallow Aquifer)
2. Middle Merritt Aquifer
3. Lower Merritt Aquifer (sometimes called the Deep Aquifer)



FRASER BASIN COUNCIL AND MINISTRY OF FOREST LAND AND NATURAL RESOURCE OPERATIONS AND RURAL DEVELOPMENT

BRITISH COLUMBIA Ministry of Environment

GOLDER

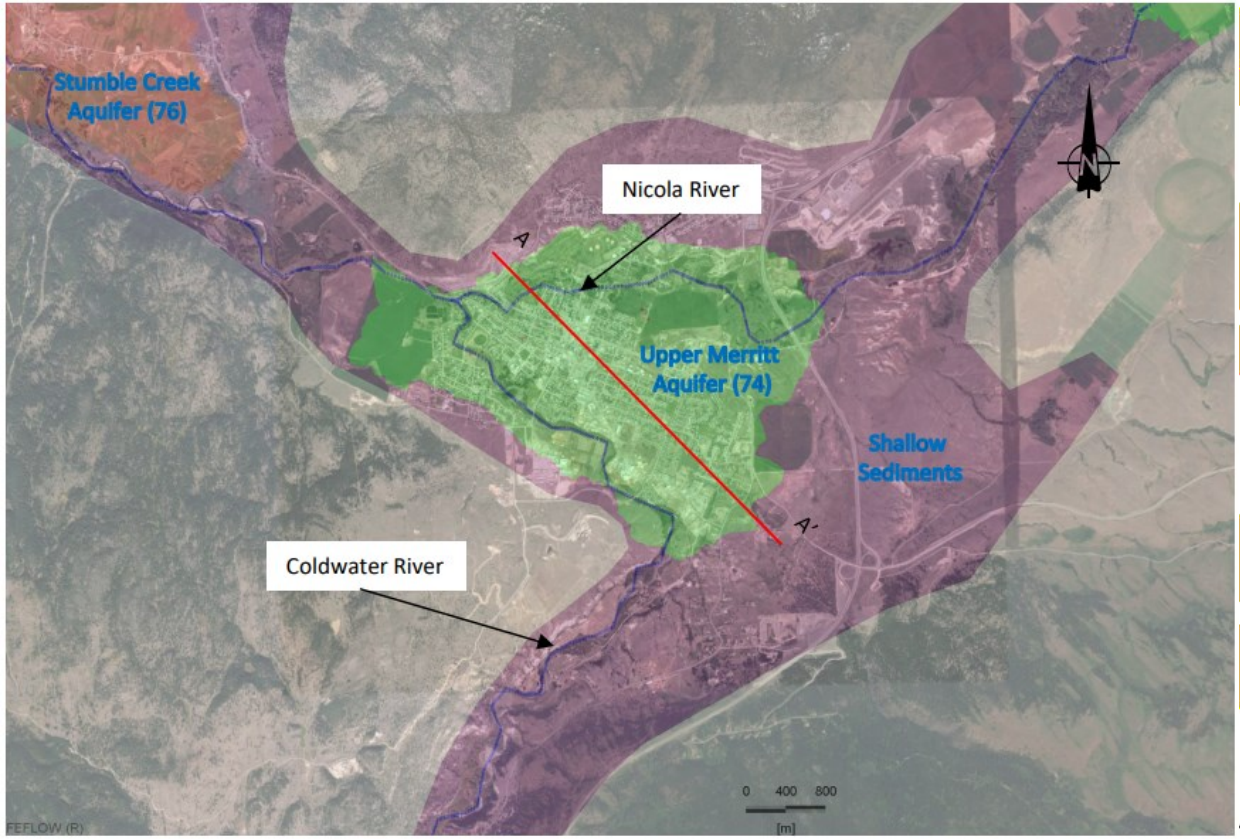
YYYY-MM-DD	2018-05-22
PREPARED	NGG
DESIGNED	NGG
REVIEWED	KB
APPROVED	JAS

PROJECT
NICOLA WATERSHED AQUIFER MAPPING AND CLASSIFICATION

TITLE
MERRITT – NICOLA LAKE AQUIFERS
MERRITT BASIN – PLAN VIEW

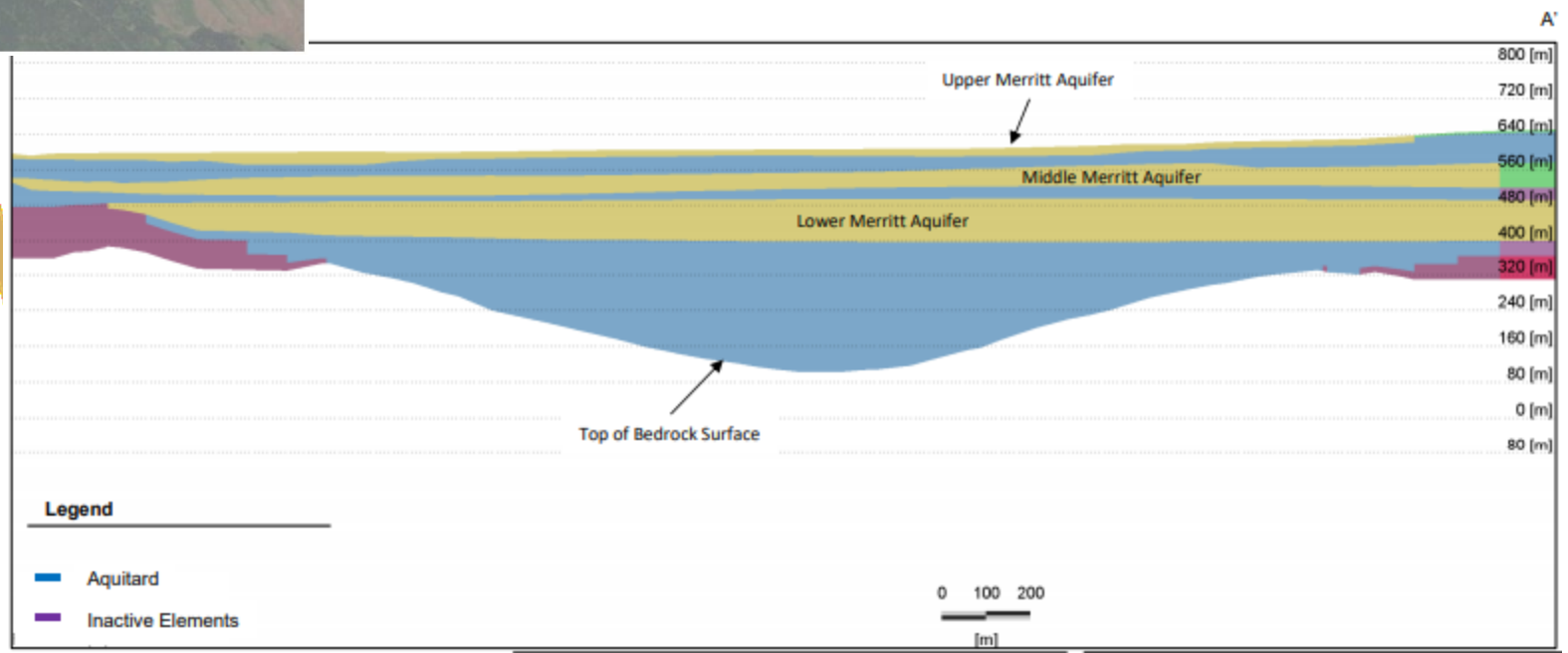
PROJECT NO.	PHASE	REV.	FIGURE
1772201	4000	1	2

Hydrogeological Modelling



The figure to the right shows hydrostratigraphy for the three Merritt aquifers. The cross section runs along the red line on the figure above, from A to A'.

B. Cross-Section AA' (looking North-East)

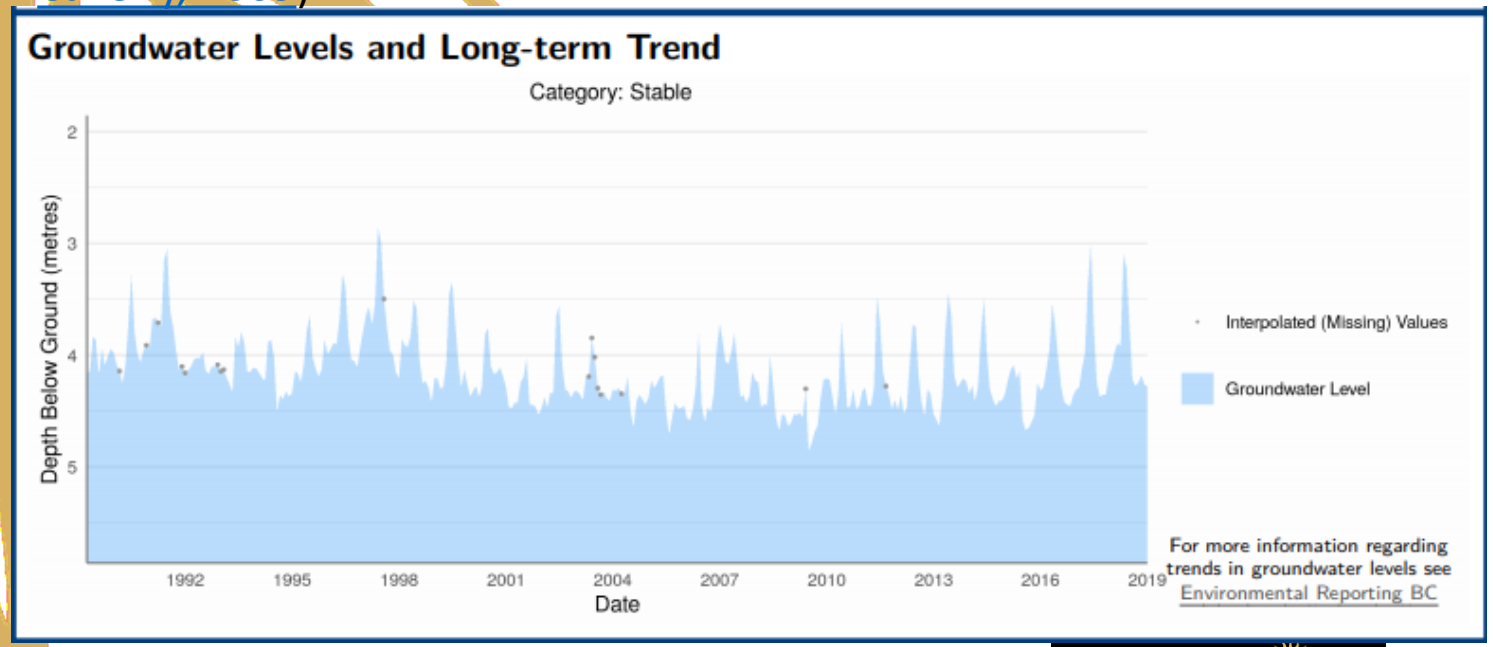


Upper Merritt Aquifer - #74

- The Upper Merritt Aquifer has an area of ~7.0km^2 and ranges from ~2m - 50m in depth. The thickest portions run sub-parallel to the Coldwater River. *Source Aquifer Protection Plan (2002)*
- The Upper Merritt Aquifer is classified as IA (Heavily developed, high vulnerability aquifer).
- For more specific information about the Upper Merritt Aquifer, see the linked fact sheets:
  - Aquifer #74 Factsheet
  - Aquifer 0074 – Classification Worksheet
- The major source of recharge to the aquifer is infiltration from river loss from the Coldwater River as it flows through Merritt (Bennett and Caverly, 2009).

City Wells in this Aquifer:

1. Voght Park #1
2. Voght Park #2
3. Collettville
4. Fairley Park

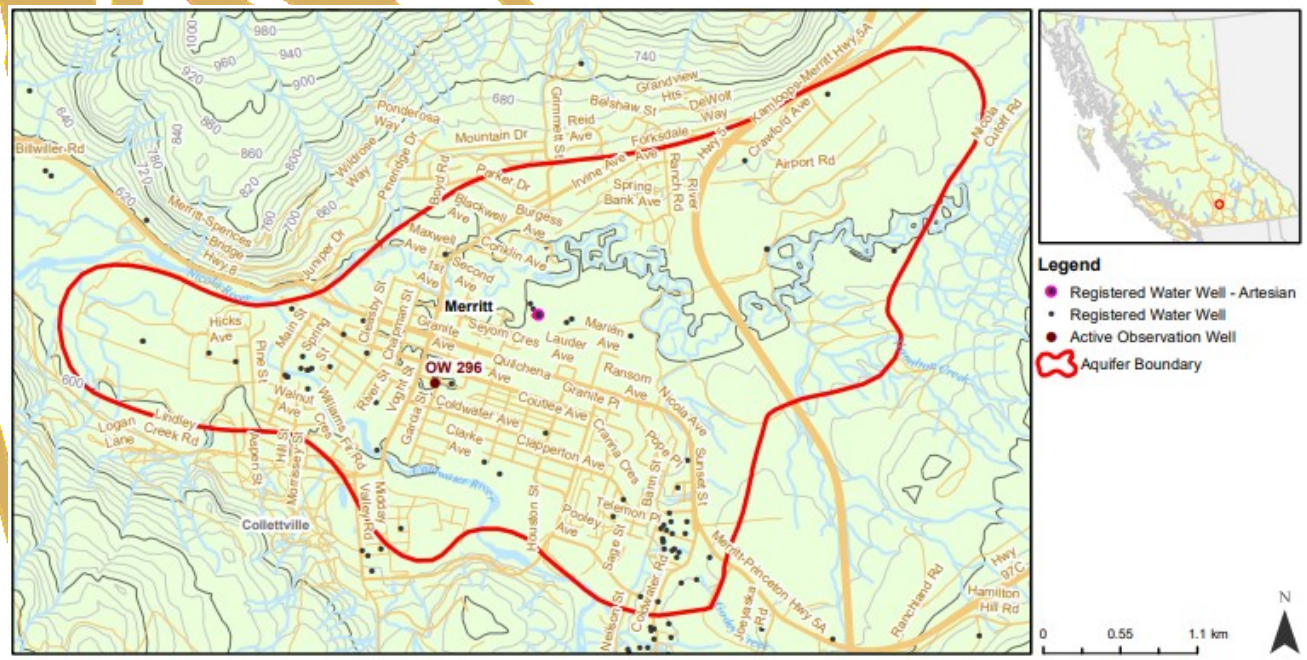


Middle Merritt Aquifer - #1168

- This aquifer is typically intersected between 45-65 meters below ground surface and at an estimated 13km^2 is believed the be the largest aquifer in the City (by area, not volume).
- There are few wells in this aquifer, so relatively little is known about recharge and potential productivity of this aquifer.
- The aquifer is classified as IIC (moderately developed, low vulnerability).
- For more specific information about the Middle Merritt Aquifer, see the linked fact sheets:
  - Aquifer #1168 Factsheet
  - Aquifer 1168 – Classification Worksheet

- Preliminary research indicated that this is a confined aquifer with limited connection to the Nicola and Coldwater rivers, though that finding is uncertain.

City production wells in this Aquifer:
None



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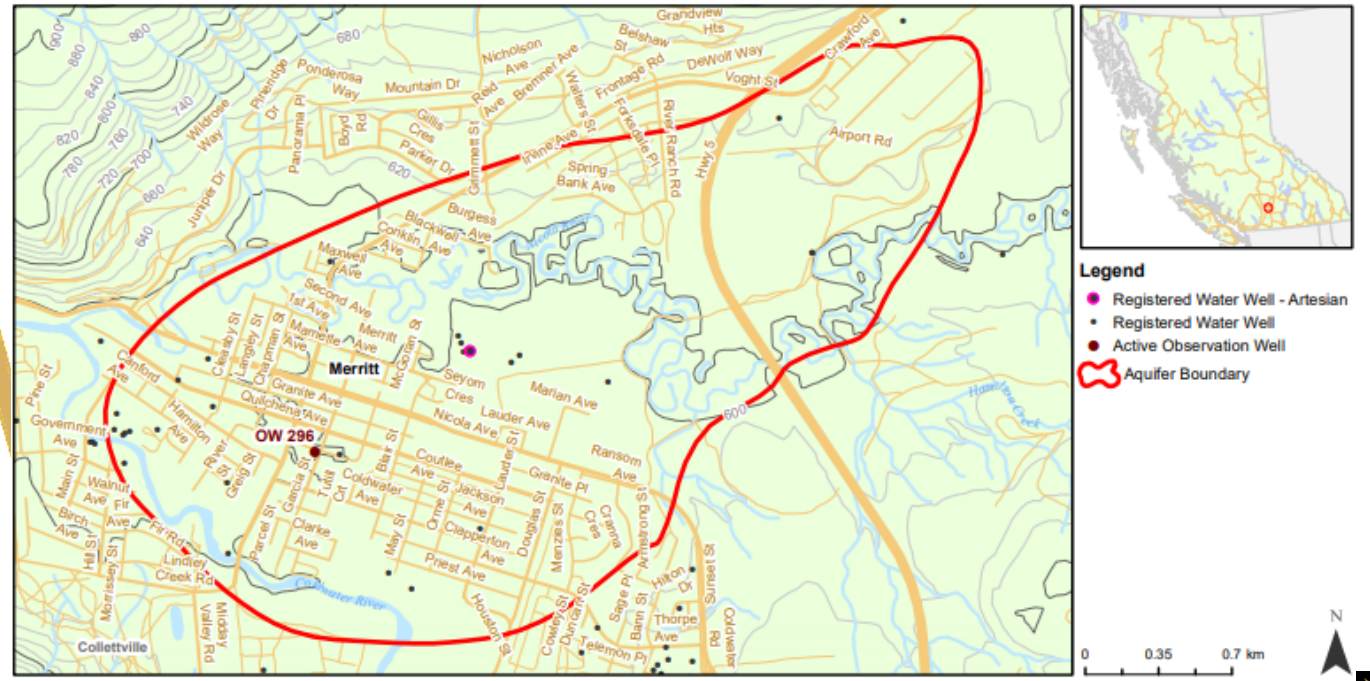
Lower Merritt Aquifer - #1167

- The Lower Merritt aquifer has an area of ~ 6.8km^2 and is typically intersected between 75-95 meters below ground surface.
- The aquifer is classified as IIC (moderately developed, low vulnerability).
- This aquifer is the largest by water volume, and is likely extremely productive. However, further study would be required to determine specific rates that could be drawn while maintaining recharge
- For more specific information about the Lower Merritt Aquifer, see the linked fact sheets:
  - Aquifer #1167 Factsheet
  - Aquifer 1167 – Classification Worksheet

- Similar to the Middle Aquifer, this is still presumed to be confined aquifer with limited connection to the Nicola and Coldwater rivers, though that finding is uncertain.

City production wells in this Aquifer:
1. Kengard



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Part 4 – Coldwater River connection to Upper Merritt Aquifer

Excerpts from *Review of Ground Water/Surface Water Interactions Within the City of Merritt – Final Report (2009), prepared by the Ministry of Environment*

Conclusions

- Ground water and river temperature and elevation data indicate that the reach of the Coldwater River from the May Street well to Voght Park was a losing reach during the entire monitoring period of April 2007 to April 2008.

- Rivers losses are the greatest source of recharge to the Merritt aquifer under both pre-development and pumping conditions

- MOE estimated that annual average river losses to the Merritt aquifer have increased by approximately 0.07 m3 /sec due to an average annual ground water withdrawal of 0.10 m3 /sec.

    - Staff Comment: An additional loss of 0.07m3/sec seems like a drop in the bucket when you consider that during freshet in 2020, the Coldwater ran as high as ~90 m3/sec. However, a little more than three months later, Coldwater flows fell as low as 0.311 m3/sec (well below the critical fish rearing threshold).

New Ground Water/Surface Water Study Underway

- On June 16, 2020, Council resolved to provide the Fraser Basin Water Council with $25,000 from Gas Tax reserves to preform a more in depth ground water/surface water study than what was conducted in 2009.

- The Ministry of Forests, Lands, Natural Resource Operations and Rural Development provided a matching contribution.

- Fraser Basin Water Council contracted with Golder Associates Ltd. to complete this study. The Phase 1 report associated with that study has been made public. *Coldwater River Groundwater / Surface Water Interaction Study – Phase 1*

- One of the primary goals of that study is to better understand and estimate the impact that the City's groundwater withdrawals have on the Coldwater River, which will directly impact Council's direction on how best the City can support the issue of low Coldwater flows during summer months.

Part 5 – Potential options to support higher Coldwater flows

There are (at least) three broad categories that could be explored to address or support the issue of low Coldwater flows, which regularly trigger watering restrictions in the City of Merritt:

1. Draw from sources less hydrologically connected to the Coldwater River
    i. Kengard well (lower aquifer)
    ii. Upper or middle aquifer wells closer to the Nicola River
    iii. Nicola Lake

2. Implementation of alternate water management techniques
    i. Pumping water directly from the upper aquifer to the Coldwater River
    ii. Aquifer storage and recovery (actively storing water in aquifer during wet periods, for recovery during dry periods)
    iii. Creation of reservoir

3. Reduce water consumption
    i. Water metering