DISTRICT OF LAKE COUNTRY

WINFIELD OKANAGAN CENTRE WATER SYSTEM ASSESSMENT AND RESPONSE PLAN

APRIL 2004

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District of Lake Country

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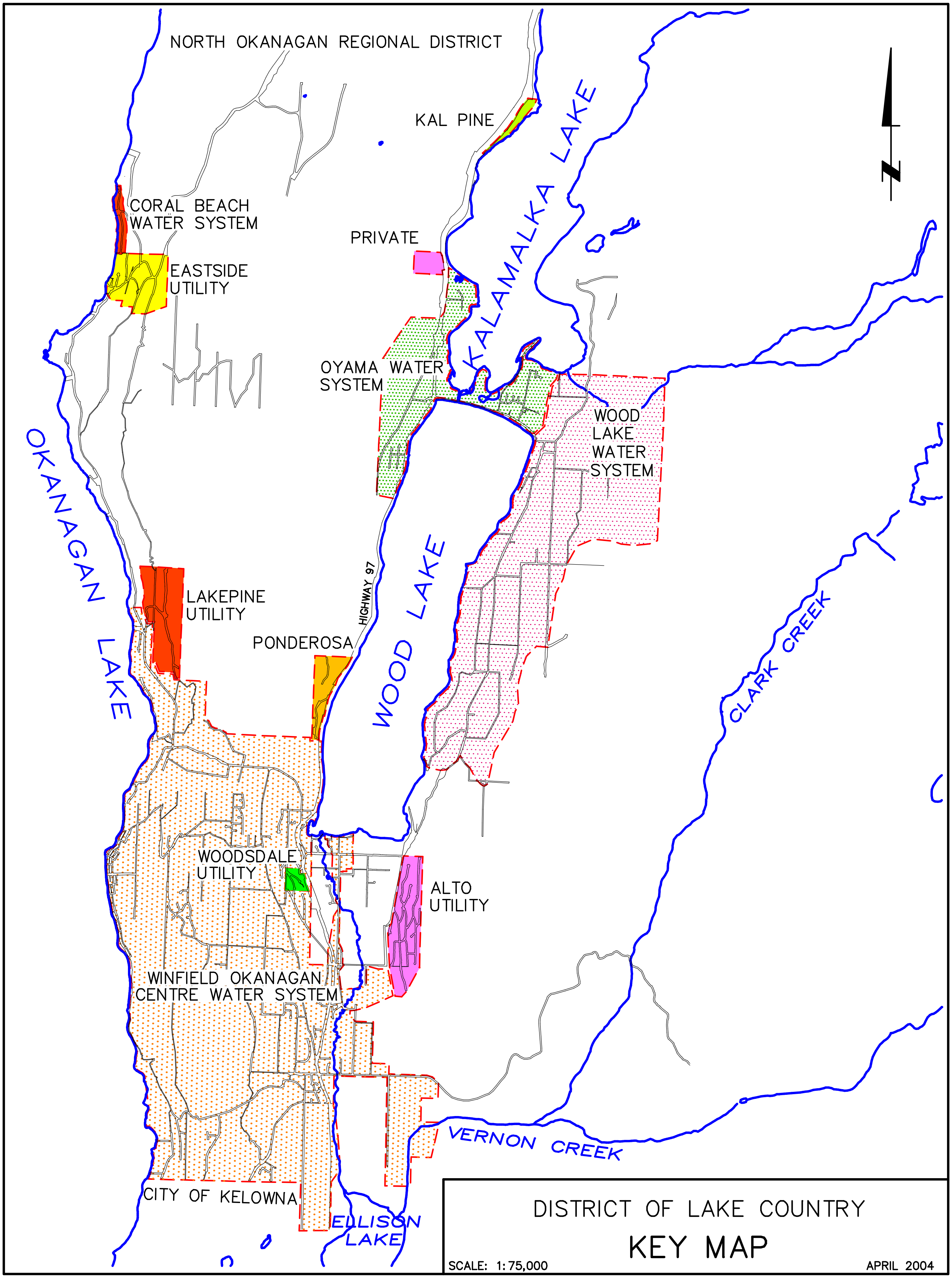
NORTH OKANAGAN REGIONAL DISTRICT
KAL PINE
CORAL BEACH WATER SYSTEM
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KEY MAP
SCALE: 1:75,000
APRIL 2004

District of Lake Country

WINFIELD OKANAGAN CENTRE WATER SYSTEM ASSESSMENT AND RESPONSE PLAN

1. Introduction

This Assessment and Response Plan has been commissioned by the District of Lake Country for the purpose of establishing a long-term plan for the Winfield Okanagan Centre Water System. A condition of the District's Permit to Operate, issued by Interior Health, is to **"Provide long-term plans for source treatment, and distribution system improvements"** Further, the purpose of the plan is to determine the water works needed to supply the growth projected in the Official Community Plan, and to submit an application for funding assistance from the Federal/Provincial Infrastructure Program.

Contents of the plan include: a brief description of the Vernon Creek hydrology, the quantity and quality of the water sources, and an assessment and description of the improvements recommended over the next 20 year period. Cost estimates have been prepared for the proposed works, and expenses to be borne by the existing users as, well as new development, have been outlined. The estimated costs for the water quality improvements are outlined separately in order to aid the District of Lake Country in applying for funding assistance from the Federal/Provincial Infrastructure Program.

The principal source of supply for the Winfield Okanagan Centre Water System is Vernon Creek with storage on Swalwall (Beaver) and Crooked Lakes. Water quality concerns have been expressed by landowners and Town Centre commercial establishments, as the creek water often contains high turbidity, colour, coliforms, and suspended solids, particularly during the spring and fall months. The Medical Health

Officer has issued boil water advisories to the District for the past nine consecutive years. A significant alternate source to Vernon Creek is Okanagan Lake via a large pump station purchased from Hiram-Walker Distilleries in 1994. Good water quality is available from Okanagan Lake, and the objective is to utilize this source to its potential.

Many components of the distribution system are over 30 years old and in need of repair or replacement. Hydraulic instability in the mainline exists due to high pressures, high velocities, and numerous PR stations located downstream. Funds have been provided for routine annual maintenance items, but planning for larger scale capital replacement works has not been addressed. Objectives in reviewing the existing works include stabilizing the pressure fluctuations in the mainline, simplifying daily operation by removing unnecessary works, and identifying water quality improvement projects that will meet Interior Health's requirements.

2. SERVICE AREA

The Winfield Okanagan Centre Water System (WOCWS) is located within the southern portion of the District of Lake Country. It is bound by the City of Kelowna to the South, Okanagan Lake to the West, and elevated lands to the East. Wood Lake bounds a portion of the service area to the north. The location of the WOCWS within the DLC is shown on the Key Map opposite Page i.

The service area includes: approximately 1,880 residential services (a population of 5,000), 930 hectares (2,298 ac) of irrigated land; the Winfield Town Centre; and an industrial park within the City of Kelowna. This is the largest system within the District, and it supplies approximately three times the volume of the next largest Wood Lake Water System.

The terrain over which water is supplied is quite sloped, and results in many pressure zones within the system. Okanagan Lake represents the lowest extremity at an elevation of about 342 m. Wood Lake is 49 m higher, and the ridge that runs in a north south direction between the two lakes reaches an elevation of 650 m within the service area. A cross section of the valley is shown in Figure 12 opposite Page 27.

Lake Country is a rural area on the outskirts of Kelowna with many lake view properties. Historically, the area has been agriculturally based, but a Town Centre is developing along Highway 97, and there is strong residential development pressure.

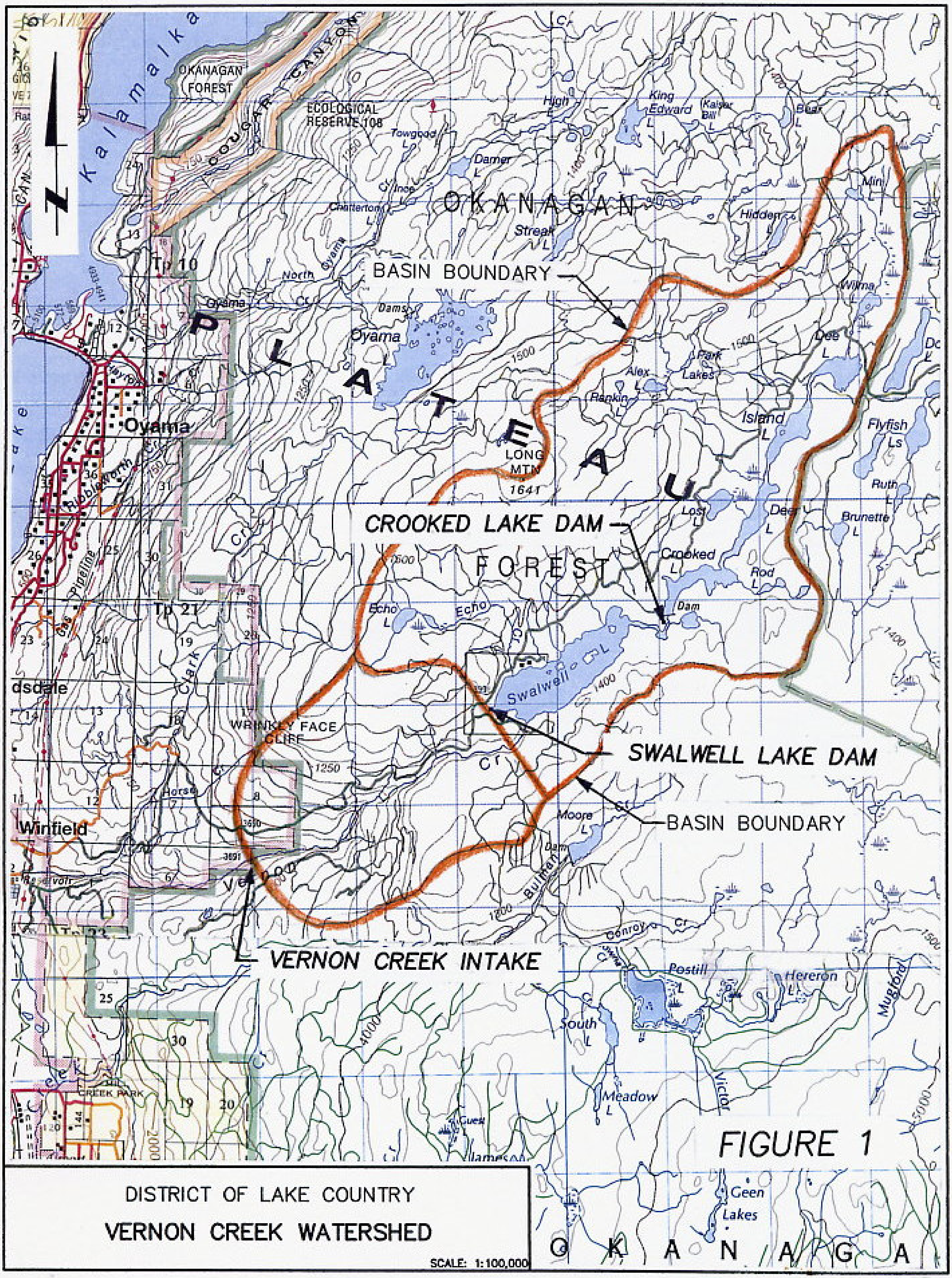


FIGURE 1

DISTRICT OF LAKE COUNTRY
VERNON CREEK WATERSHED

3. SOURCES OF SUPPLY

The WOCWS is supplied from two sources. The largest source is Vernon Creek with storage on Crooked and Swalwell Lakes, and the secondary source is Okanagan Lake, which supplies a much smaller amount. Water from Vernon Creek is supplied by gravity, whereas Okanagan Lake water is pumped. Okanagan Lake water is also supplied to the City of Kelowna North End Industrial Park.

3.1. VERNON CREEK WATERSHED

The Vernon Creek Watershed, shown in Figure 1 opposite, lies east of Winfield, and has a watershed area above the intake of 84.5 km^2. Elevation of the watershed ranges from a maximum of 1,450 m to 1,340 m at Swalwell Lake down to 820 m at the District's diversion pond on Vernon Creek. Swalwell Lake is located at the headwaters of Vernon Creek approximately 16 km (10 mi) east of the Lake Country Town Centre, Crooked Lake is another 4 km (2.5 mi) east of Swalwell Lake dam. The dams impound runoff from a catchment area of 63.0 km^2 (24.3 mi^2). Water is released from Swalwell Lake Reservoir into Vernon Creek, which flows to a diversion pond and intake/screening structure some 6 km (4 mi) downstream. Below the intake, Vernon Creek flows through District and City of Kelowna lands to its confluence with Ellison (Duck) Lake. From Ellison Lake, the creek is known as Middle Vernon Creek, and flows north through a section of First Nations land on its way to Wood and Kalamalka Lakes.

3.1.1. Hydrology

Swalwell Lake impounds 11,880 da m^3 (9,629 ac-ft) of water and, Crooked Lake, a chain of lakes, including Deer, Island, and Dee Lakes, contains 2,939 da m^3 (2,383 ac-ft) of water.

Watershed runoff is stored in the lakes and releases are closely controlled for water conservation. Runoff from the lower sub-basin cannot be stored, and although the water quality is often very poor, it can be used to meet demand which allows the reservoir contents to be retained for later use. Since reservoir operation is manual, and there is a significant time delay between releases from storage and water use in the system, there is a "wastage" of water because reservoir outflow cannot be controlled quickly enough to avoid spill over the downstream diversion works.

A detailed hydrology study was conducted in 1977 by the BC Ministry of Environment. The conclusion of the study was that "***the results indicate that a total annual demand of 8,000 acre-feet*** [9,868 da m^3] ***could be supplied in 49 out of 50 years on the average***". The report further states that "***Because of the difficulty in making efficient use of inflows to the lower sub-basin, the annual demand would best be supplied from the reservoirs only, with sub-basin inflow considered as a safety factor to offset wastage due to delays in adjusting the reservoir outflow in response to changing demand***."

Concern has been expressed by operations staff and by a number of landowners in Lake Country about the accuracy of these estimates. The estimates were based on data from the 1960s and '70s, and the amount of runoff from the watershed today may be less than estimated in 1977. In particular, the low water level in Swalwell (Beaver) Lake at the end of the summer of 2003 was noted to be a particular concern. A further concern was expressed by members of the Oceola Fish and Game Club that flows in Middle Vernon Creek, between Duck and Wood Lakes, were too low in 2003 for successful kokanee spawning. The Fish and Game Club would like to see significantly more water made available for fish.

3.1.2. Water Licenses

The District has Water Licenses on Vernon Creek authorizing diversion of water as follows:

		Imp. Units	Metric Units
1.	Irrigation	6,047ac-ft	7,459 da m^3
2.	Waterworks (Domestic)	1,603 ac-ft	1,977 da m^3
3.	Total	7,650 ac-ft	9,436 da m^3

Flows for fish are discussed further in Section 5, but it should be noted that water licenses exceed the amount of water available in a dry year if downstream fish flows are considered. A summary of the Water Licenses held by the District is contained in Annex 4.

3.2. OKANAGAN LAKE

The secondary source is water pumped from Okanagan Lake near the south boundary of the District. A rebowled 350 hp pump, capable of pumping approximately 105 lps, supplies the current water demand on the Okanagan Lake system. In Year 2003, a total of 808 da m^3 (655 ac-ft) was pumped. The original design capacity of the Okanagan Lake Pump Station is 464 lps (7,350 USgpm). Due to age, upgrading is required to reach the original design capacity, as discussed in Section 11.2.

3.2.1. Water Licenses

The District's authorized diversion from Okanagan Lake Pump Station is 10,993 da m^3 (2,418,125,000 Imp. Gallons) per year. This represents the total of two licenses for this facility, the most recent being issued in 1994. Not only is this volume well in excess of the estimated amount that can be pumped with current equipment, it is more than needed to supply growth within the District for the next 20 years. Details of future water requirements are provided in Section 10.

4. EXISTING WATER CONSUMPTION

4.1. ANNUAL USE

During a high-use year, the annual water requirements for the current commitments is estimated at 7,877 da m^3 (6,386 ac-ft). The calculation is shown in the following table.

Table 1

Annual Water Requirements

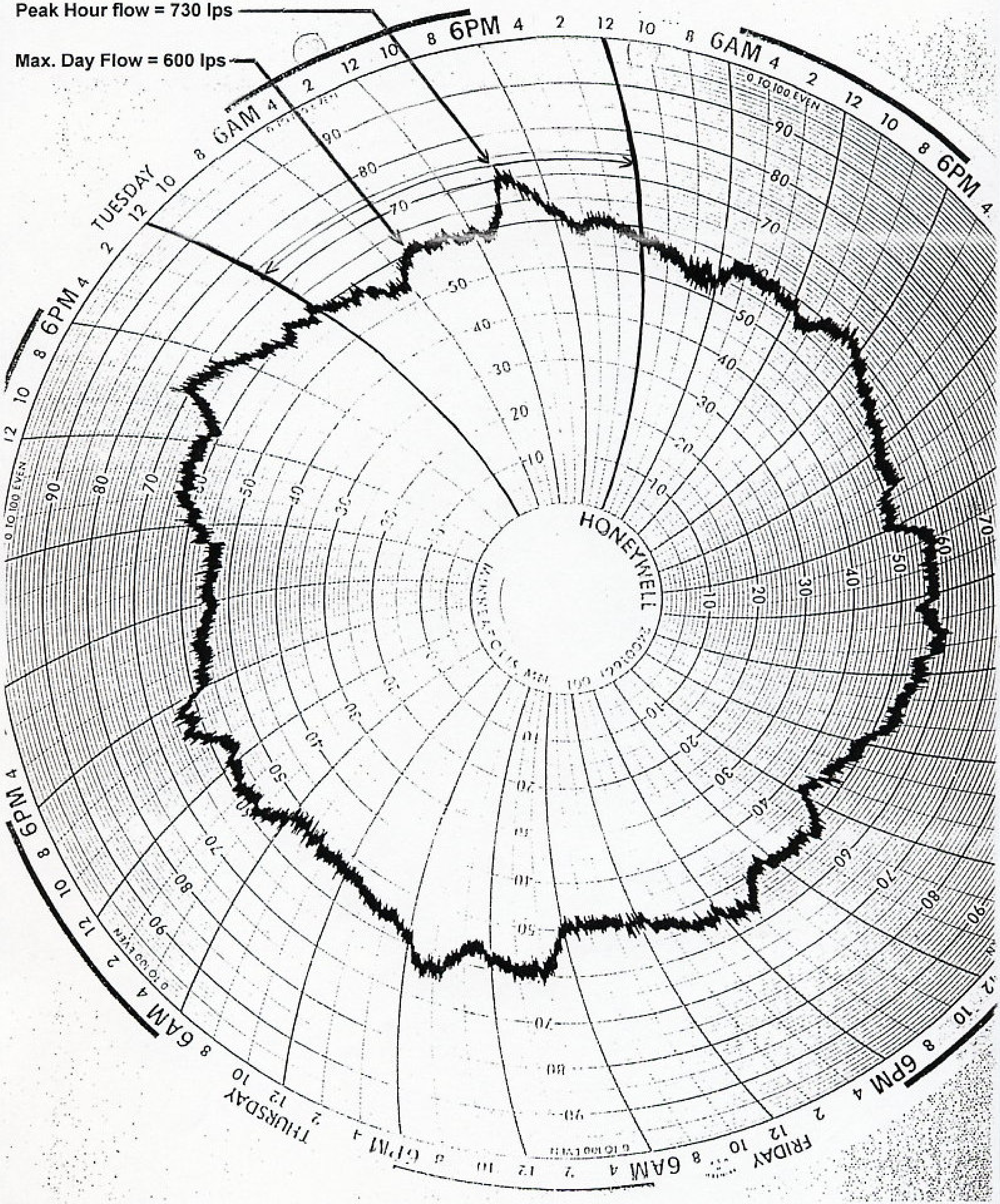
1. **VERNON CREEK**		
.1	Irrigated Grade 'A' Land, 870 ha @ *6.9 da m^3/ha	6,003 da m^3
.2	Rural Residential, 750 conn. @ 0.17 da m^3	128 da m^3
.3	Urban Residential, 800 conn @ 0.75 da m^3	600 da m^3
.4	Multi-family & Strata's, 30 Units @ 0.17 da m^3	5 da m^3
Total Estimated Annual Use from Vernon Creek		***6,736 da m^3***
2. **OKANAGAN LAKE**		
.1	Irrigated Grade 'A' Land, 60 ha @ *6.9 da m^3/ha	414 da m^3
.2	Urban Residential, 200 conn @ 0.75 da m^3	150 da m^3
.3	Multi Family & Strata's, 100 Units @ 0.17 da m^3	17 da m^3
.4	Commercial, Industrial & Institutional, 60 Conn. @ 0.17 da m^3	10 da m^3
.5	City of Kelowna Industrial Area, 80 ha @ 6.9 da m^3/ha	550 da m^3
Total Estimated Annual Use from Okanagan Lake		***1,141 da m^3***
TOTAL		***7,877 da m^3***

NOTES:

1. * Estimated annual irrigation requirements are based on the *Irrigation Design Manual* prepared by the British Columbia Ministry of Agriculture
2. The Grade 'A' land serviced area of 930 ha includes the irrigated areas within the Rural Residential, Multi-Family & Strata's, and Commercial, Industrial & Institutional developments.
3. Domestic water use on Urban Residential Lots under 0.2 ha in size includes irrigation of lawns and gardens.

FIGURE 2

FLOW DATA FOR WEEK OF JULY 24, 1998



The estimated peak annual water use of 7,877 da m^3 is based on the assumption that all lands the District was committed to supplying in Year 2003 are using water. The actual water use in Year 2003, a high water use year, was only 5,808 da m^3 (4,709 ac-ft), which is significantly less than the estimated peak use. Actual water use on the Vernon Creek system alone was 5,000 da m^3, which is also less than estimated. This difference is partly due to some lands not using their allotted water in 2003, particularly the City of Kelowna Industrial Park, and partly because the estimates are conservative.

As outlined in Section 3.1.2, water licenses total 9,436 da m^3 (7,650 ac-ft) on Vernon Creek. Table 1 shows the estimated annual water requirements from Vernon Creek to be 6,736 da m^3, therefore the licences are sufficient. The licenses on Okanagan Lake are also more than adequate.

4.2. PEAK FLOW RATE

The summer of 1998 was the longest and hottest recorded by Environment Canada during the past 140 years. On July 24, 1998 a flow of 730 lps (11,570 USgpm) was recorded in the mainline, as shown in Figure 2 opposite. The volume supplied from the Okanagan Lake pumped source during this time was only about 20 lps, equating a total system peak hour demand of 750 lps. Figure 2 shows seven days of flow records, and it is evident that 750 lps is a peak hour value. A maximum day value of 600 lps has been interpolated. The maximum day to peak hour ratio is 1.2, which is low for typical water systems. This is a result of the irrigation demand being relatively constant throughout the day. Based on the area being serviced, and the design flow rates outlined in Table 5, the irrigation portion of the maximum day flow is about 70% with the domestic component being 30%.

It should be noted that while the above flows are for a peak year, higher flows could occur based on the current water supply commitments. A survey completed during the summer of 2001 indicates there is an estimated additional volume of 52 lps, which is allocated to landowners but not being utilized. This was also likely the case for 1998. As well, water use within the City of Kelowna Industrial Park is well below the current water supply agreements.

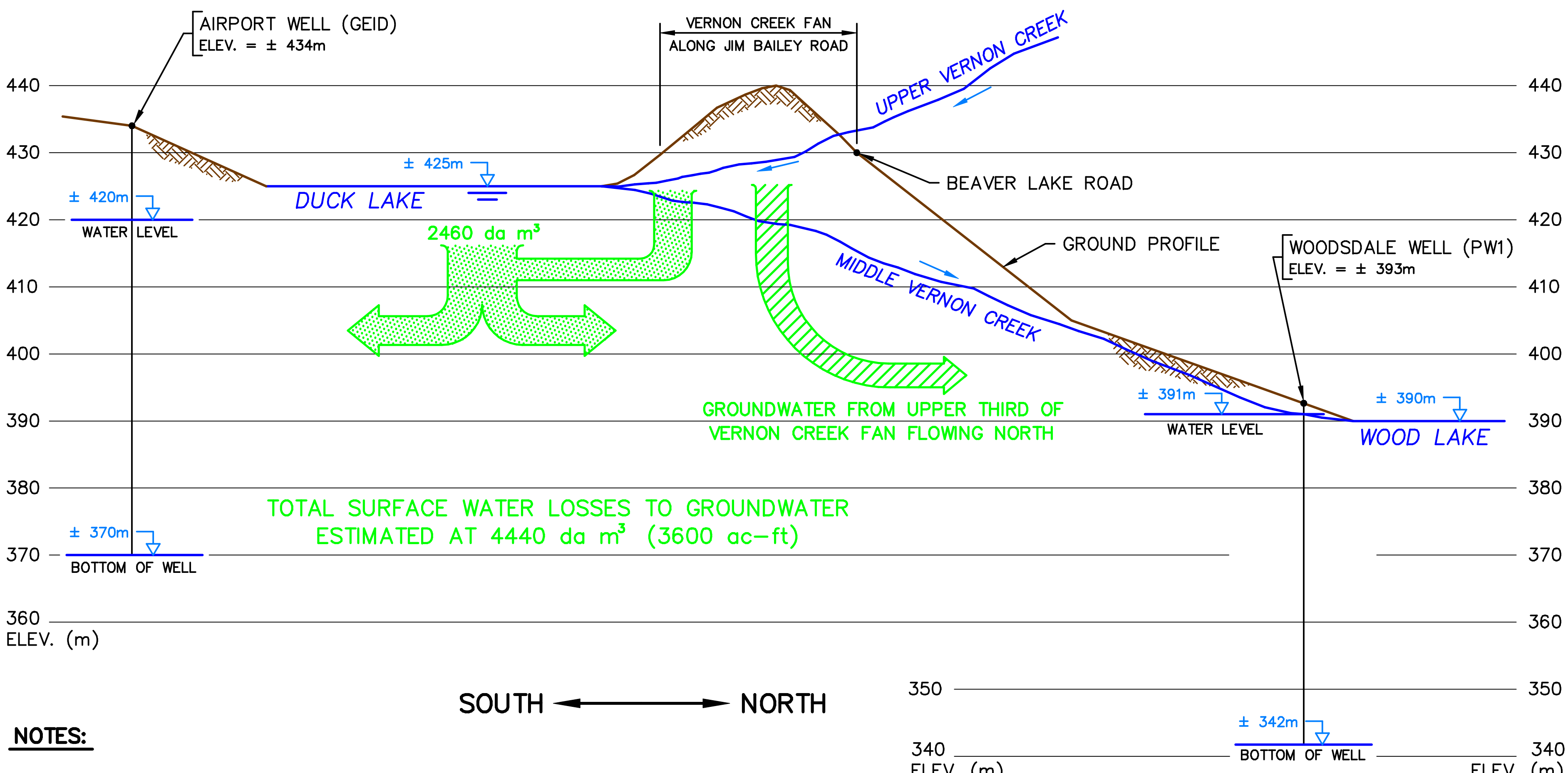
4.3. CITY OF KELOWNA BULK WATER AGREEMENT

The supply to the City of Kelowna Industrial Park is metered and covered by two agreements. The first is for a 20 ha parcel southeast of the intersection of Beaver Lake and Jim Bailey Roads. It states the District must supply potable water at a maximum day flow rate of 21 lps as well as a fire flow of 190 lps for a duration of three hours. The second agreement covers parcels farther south along the east side of Jim Bailey Road that have a combined water allocation of 60 ha. A maximum day flow rate of 98 lps and a fire flow of 227 lps for a duration of three hours must be provided to this site. The City representatives have recently signed this agreement. The combined maximum day flow committed to the City is 119 lps (1,885 USgpm). The agreement indicates potable water can be supplied from either the District's gravity or pumped source.

The water servicing requirements for the City Industrial Park can be satisfied by the District, however, it must be noted that Okanagan Lake reservoir is not large enough to meet the fire flow duration requirement. Backup from the Vernon Creek source is required.

DISTRICT OF LAKE COUNTRY

UPPER VERNON CREEK & DUCK LAKE HYDROLOGY
SOUTH/NORTH CROSS–SECTION



NOTES:

1. DATA ON SURFACE WATER LOSSES TO GROUNDWATER WAS DETERMINED BY FOWERAKER ET AL IN 1974 AND REITERATED IN THE MIDDLE AND UPPER VERNON CREEK HYDROLOGICAL ANALYSIS FINAL REPORT PREPARED BY NORTHWEST HYDRAULIC CONSULTANTS AND DATED MAY 2003.
2. THEORY THAT PORTION OF THE GROUNDWATER FLOWS SOUTH COINCIDES WITH CURRENT WORK IN PROGRESS ON THE SUBJECT.
3. WELL DATA FROM BEL MK'S REPORT FOR WOODSDALE RANCH AND KALA GROUNDWATER REPORT FOR GEID.

FIGURE 3

5. WATER AVAILABILITY

The only limitation on water availability from Okanagan Lake is the amount authorized for diversion under water licenses, as well as the pumping rate. Vernon Creek, however, is nearly at capacity. Using runoff estimates from the 1977 report, and estimates of peak annual requirements from Table 1 on page 7, an estimate of water availability from the Vernon Creek Watershed was made.

Table 2
Vernon Creek Watershed
Water Availability

	Imp. Units	Metric Units
1. Watershed Yield, 49 yrs in 50	8,000 ac-ft	9,868 da m^3
2. Fish Flows (8 months)	1,200 ac-ft	1,480 da m^3
3. Operational Waste	560 ac-ft	690 da m^3
4. Estimated Water Use – Year 2003	5,461 ac-ft	6,736 da m^3
5. Surplus	779 ac-ft	962 da m^3

The estimated surplus of 962 da m^3 (779 ac-ft) is partially the result of transferring significant areas of service (Town Centre, Bottom Wood Lake Road, McCarthy Road, etc.) from Vernon Creek to the Okanagan Lake System.

It is beyond the scope of this report to determine the impact, if any, of global warming and the amount of water that should be reserved for fish in Middle Vernon Creek. An important complication in estimating the amount of water required to assure a minimum fish flow in Middle Vernon Creek is the volume lost to groundwater. Foweraker et al (BC Water Resources) determined in 1974 that the combined losses to groundwater from Upper Vernon Creek (between Duck Lake and Vernon Creek Intake) and from Duck Lake is approximately 4.5 cfs or 4,400 da m^3 (3,600 ac-ft) per year. Figure 3 opposite shows the water lost to groundwater as well as the suspected direction of groundwater flow. Thus, the releases of water from Swalwell/Crooked Lakes to support kokanee spawning in Middle Vernon Creek are considerable, and well beyond the current amount of water available in a dry year.

In 2003, staff from the BC Ministry of Water, Land, and Air Protection stated that a flow of 75 lps was adequate for fish in Upper Vernon Creek recognizing that this could result in very low flows in Middle Vernon Creek. The 75 lps flow can be supplied by the sub-basin below the Vernon Creek Intake for about 4 months of the year, so this amount only needs to be provided from the Swalwell/Crooked watershed for 8 months. The District has made a commitment to supply the minimum Upper Vernon Creek fish flow in those years when sufficient water is available.

Other than for agricultural growth stated in Section 9.2, it is recommended that the District not make an allocation of water to new users from the Vernon Creek Watershed until the 1977 hydrology study has been updated using current data.

6. WATER QUALITY

Of increasing concern to domestic water users is the issue of water quality. The District of Lake Country has received many complaints regarding poor water quality supplied from the Winfield Okanagan Centre Water System. The system is required to supply good water quality to: a population of 5,000, an industrial park within the City of Kelowna, as well as the Winfield Town Centre, which includes motels, restaurants, commercial establishments, and institutional and industrial users.

Improvements in water quality are not necessary for irrigation use, and approximately 65% the peak summer flow is conveyed for irrigation purposes. However, growth projections indicate domestic use will nearly double in the next twenty years, while irrigation demand may increase at a slower rate. Should this occur, the peak flow will be more evenly distributed between domestic and irrigation use.

The principal source of supply, Vernon Creek, contains high turbidity, colour, and coliforms, particularly during spring runoff and storm events. The water consistently fails to meet the Guidelines for Canadian Drinking Water Quality (GCDWQ) for these parameters. Good water quality is available from the secondary source, Okanagan Lake, via an existing pumping facility. The objective is to utilize this source to improve water quality for domestic use.

The Medical Health Officer has issued eleven boil water advisories to the District over the past nine years. Enclosed in Annex 5 is correspondence from the Okanagan Similkameen Health Region. An analysis of the drinking water bacteriological report from 1994 to 2000, indicates 3 samples contained fecal coliforms, 23 samples contained total coliforms, and 8 samples contained more then ten coliforms per 100 ml. According to GCDWQ, disinfection of the water supply is to provide the following maximum acceptable coliform results:

- Zero Fecal Coliforms
- Less than 10 Total Coliforms per 100 ml

Table 3
Water Quality Comparison

Parameters	GCDWQ Maximum Recommended Values	Okanagan Lake Pump Station Sample	Vernon Creek Intake Sample
Depth		30 m	
MO Alkalinity as $CaCO_3$		122.0	49.8
Aluminum			0.06
Ammonia			0.005
Arsenic	0.025		<0.06
Barium	1.0		0.006
Bicarbonate		148.84	
Calcium		31.2	8.3
Total Carbon			14.4
Total Inorganic Carbon			7.9
Total Organic Carbon			4.2
Carbonate (equivalent to HCO_3)		73.32	
Carbon Dioxide Calculated		2.2	
Chloride	250	2.8	
Chromium	0.05		0.006
Color	15 TCU	5 TCU	28 TCU
Copper	1.0		0.006
Total Hardness as $CaCO_3$	<500	120.0	
Non-Carbonate Hardness as $CaCO_3$		-2.0	
Dissolved Iron		0.02	
Total Iron	0.3	0.03	
Magnesium		10.2	
Dissolved NO_3 + NO_2	45		0.048
Nitrate – Nitrogen	10	0.170	
Nitrite	1.0	0.002	
Chemical Oxygen Demand (COD), Unfiltered		10.0	
Dissolved Oxygen (measured at site)		11.0	10.0
PH	6.5 (min) to 8.5 (max)	8.2	7.6
Ortho Phosphate		0.01	
Total Phosphate		0.01	0.03
Potassium		1.0	
Non-Filterable Residues			5.6
Silica		5.40	
Specific Conductance	700 µS/cm		72.5 µS/cm
Sodium	20.0	10.0	
Dissolved Solids	500	155	
Suspended Solids		5.0	
Total Solids		160.0	
Volatile Solids		32.0	
Sulphates	500	14.0	
Temperature	15°C	4.6°C (at 31 m depth)	July/Aug. ave. 19°C Annual ave. 10ºC
Turbidity	1 NTU	0.1 NTU	2.28 NTU

NOTES: 1 - Unless otherwise noted, all values are milligrams/litre, µg/l = micrograms per litres.
2 – Okanagan Lake Data is from one sample taken April 15, 1970
3 – Vernon Creek data is a 4-year average, 1997 - 2000

The recent replacement of the chlorination equipment will assist the District in meeting these disinfection objectives for the quantity and quality of water being utilized from the Vernon Creek source.

Interior Health representatives have stated in recent discussions and presentations that water purveyors' minimum goals for proposed treatment, in conjunction with disinfection, should provide the following results:

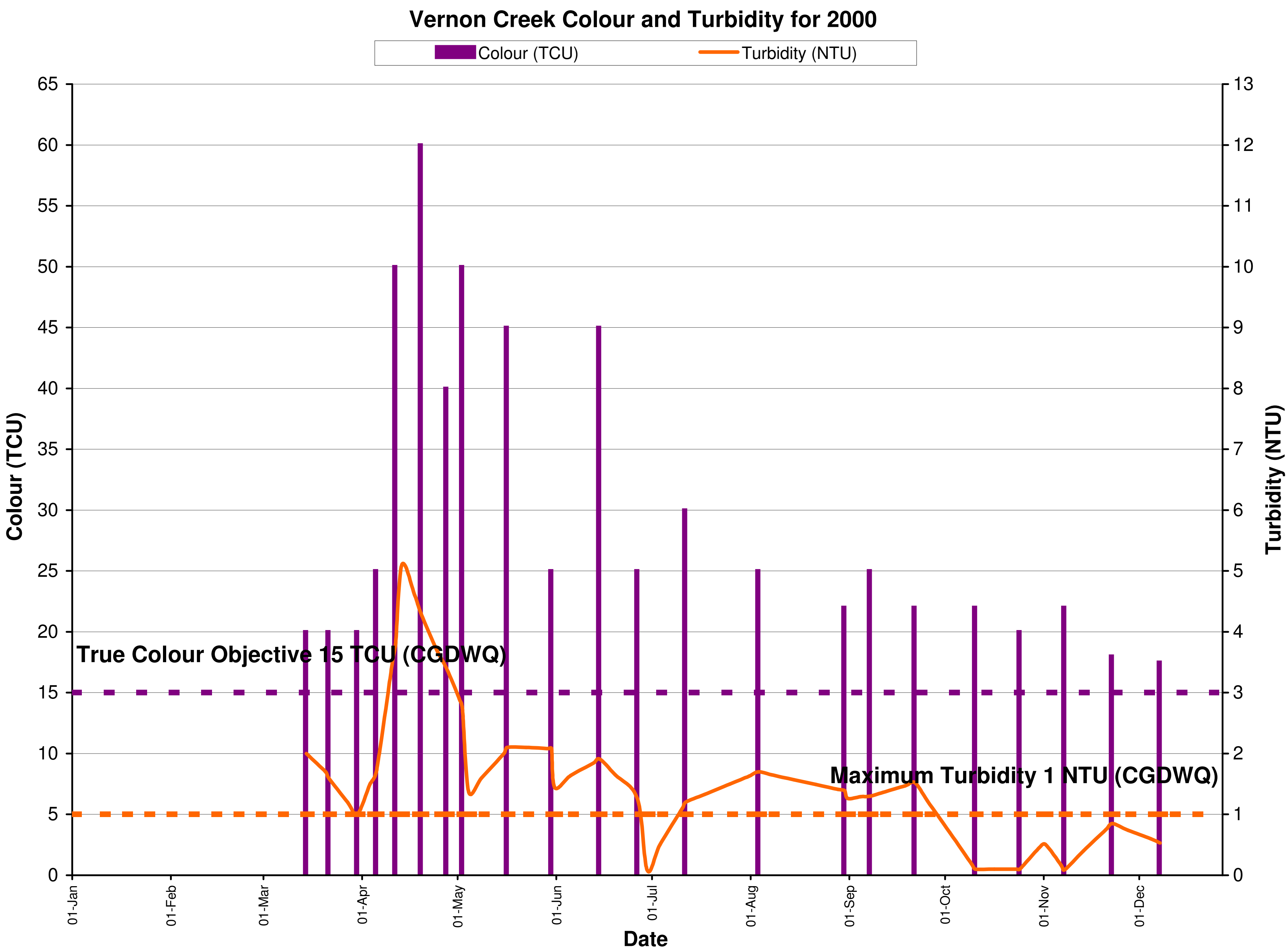
- Dual Disinfection Barrier
- 2 log (99.00%) Cryptosporidium Reduction
- 3 log (99.90%) Giardia Reduction
- 4 log (99.99%) Viruses Reduction

Millions of dollars in water treatment facilities are required to meet these objectives.

6.1. VERNON CREEK WATER QUALITY

Water quality data on Vernon Creek has been recorded since 1996. A water quality monitoring program was undertaken by Summitt Environmental Consultants Ltd. in 1996 and 1997 as part of a larger watershed assessment program funded by Forest Renewal BC. Samples were taken at the intake and results are shown in Annex 6. A continuous monitoring program has also been conducted by the Ministry of Water, Land, and Air Protection from 1997 to 2000, and a draft report has been prepared, titled *Water Quality Assessment and Objectives for Vernon Creek Community Watershed*. In conjunction with this program, grab samples were taken approximately every two weeks. Portions of the data are included in Annex 6 with further data included in the Ministry draft report.

FIGURE 4



Vernon Creek Colour and Turbidity for 2000
Colour (TCU)
Turbidity (NTU)
Colour (TCU)
Turbidity (NTU)
True Colour Objective 15 TCU (CGDWQ)
Maximum Turbidity 1 NTU (CGDWQ)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
0
1
2
3
4
5
6
7
8
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11
12
13
01-Jan
01-Feb
01-Mar
01-Apr
01-May
01-Jun
01-Jul
01-Aug
01-Sep
01-Oct
01-Nov
01-Dec
Date

Data has been analyzed for the year 2000, as this is considered a typical year for water quality. As shown in Figure 4, opposite, grab sample data for colour and turbidity in Vernon Creek usually exceeds the GCDWQ. As well, temperature in the creek during the summer months often exceeds the recommended maximum value.

6.1.1. Colour and Temperature

Colour and temperature are important water quality parameters mainly for aesthetic reasons. However, the presence of both organics (colour) and chlorine will form disinfection by-products, as discussed below in Section 6.1.3. The public perception is that coloured and/or warm water may not be safe. Although warm water does have increased potential for algae and bacterial growth, it does not generally compromise chlorine disinfection. For aesthetic reasons, the GCDWQ stipulate a maximum colour of 15 TCU and a maximum water temperature of 15° Celsius. The data recorded from 1996 to 2000 indicates a minimum colour of 8 TCU, a maximum of 65 TCU and an average of 35 TCU. Water temperature in the creek typically exceeds 15° Celsius during the months of July and August.

6.1.2. Turbidity

Turbidity, however, is both an aesthetic and health problem, and the CGDWQ maximum is set at 1 NTU, as suspended particulate matter shields pathogens from the disinfection process. The lower section of Vernon Creek is situated in a steep-walled valley susceptible to slides, particularly during spring runoff. The high velocity and volume of water in the creek through the spring and summer months lead to high turbidity. The grab sample data every two weeks shows a minimum of 0.08 NTU, a maximum of 29 NTU, and an average of 3.3 NTU.

The continuous monitoring data is a more accurate representation of turbidity, as the sampling frequency occurred at one-hour intervals, thereby including data during storm and poor quality events. A summary of the data frequency distribution for 2000 is shown in Table 4 below.

Table 4

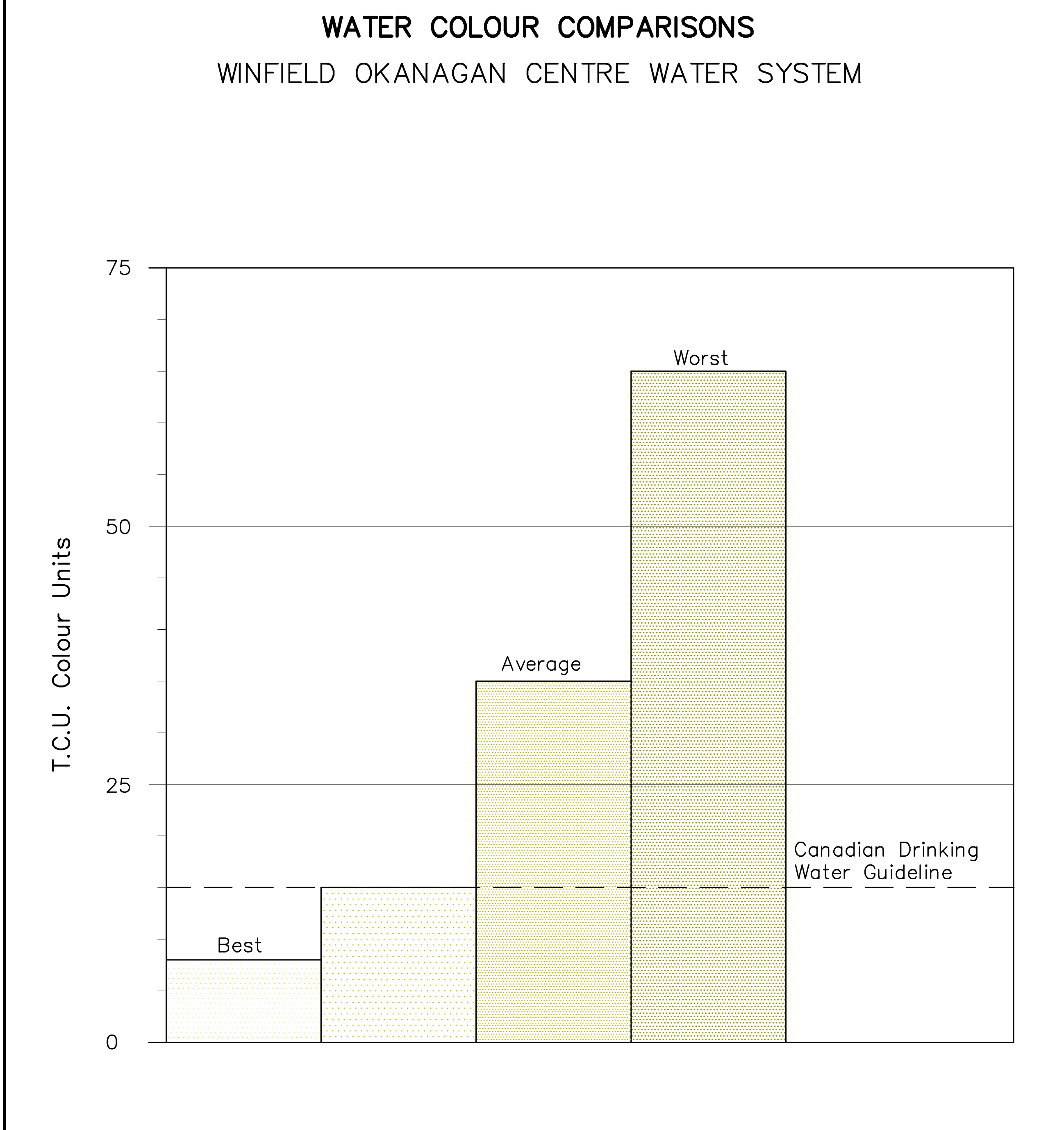
Automated Turbidity Values

Apr. 6 to Nov. 10, 2000

	Turbid Flow Period (Apr. 1 – Jun. 30, 2000)		Clear Flow Period (Jul. 1 – Nov. 10, 2000)	
Sample Distribution	**Frequency**	**Percentage**	**Frequency**	**Percentage**
<1	708	39.4	1,821	39.9
1 – 5 NTU	904	50.3	1,838	40.3
> 5 – 10 NTU	91	5.1	380	8.3
> 10 – 50 NTU	94	5.2	511	11.2
> 50 NTU	0	0.0	9	0.2
Total	1,797	100.0	4,559	100.0

It is interesting to note during both the Clear Flow and Turbid Flow periods, approximately only 40% of the water is less than maximum 1 NTU turbidity. This can be contributed to the late (April) installation of the equipment, which resulted in the early omission of season turbidity events associated with low-elevation snow melt. High turbidity measurements in 2000 were 67.4 NTU in October with the fall rain events, 44.0 NTU in April, and 46.0 NTU during the later spring freshet snowmelt. Even during the months of July and August, maximum values in the mid 20s were recorded. This indicates that turbidity events on Vernon Creek are not confined solely to spring freshet.

FIGURE 5



NOTE: Colour data is based on the grab samples.

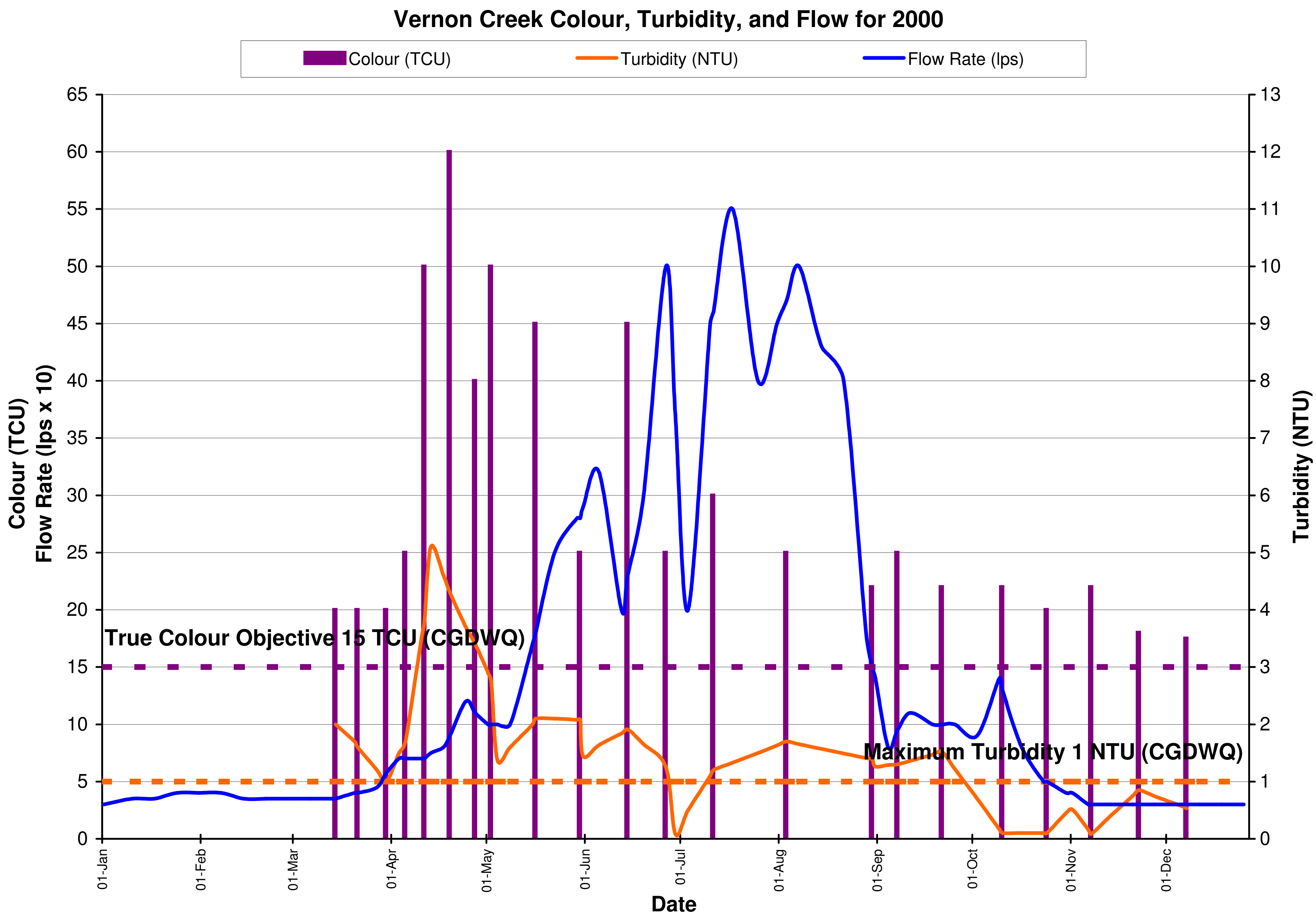
6.1.3. Trihalomethanes (THMs)

Disinfection by-products are the result of reactions between chlorine and precursor material, such as organic matter present in water. Although it has not been confirmed, studies suggest that ingested THMs are carcinogenic. Trihalomethanes are only one class of currently known disinfection by-products. THMs consist of four species: chloroform, dichlorobromomethane, dibromochloromethane, and bromoform. The most prevalent of these in chlorinated surface water is chloroform as is the case with WOCWS.

Trihalomethanes are volatile compounds that generally increase in concentration with prolonged residence time in the distribution system. Monitoring for THMs within the District's system occurred on October 7, 2003. One sample was taken at the Cooney Drain, and had a value of 88µg/l, and another sample was taken at the Fire Hall, and had a value of 71 µg/l. These levels are under the CGDWQ interim maximum allowable concentration of 100µg/l. Additional THM samples should be taken, some near the extremities of the distribution system, to ensure the levels are below the GCDWQ.

Year round high colour in Vernon Creek stems from the runoff water filtering through the leaves, pine needles, plants, and soils on the forest floor. The soils are rich in organic content giving a tea-like colour to the water. Figure 5, opposite, gives a visual representation of the water colour.

FIGURE 6



Vernon Creek Colour, Turbidity, and Flow for 2000
Colour (TCU)
Turbidity (NTU)
Flow Rate (lps)
Colour (TCU)
Flow Rate (lps x 10)
Turbidity (NTU)
True Colour Objective 15 TCU (CGDWQ)
Maximum Turbidity 1 NTU (CGDWQ)
0
5
10
15
20
25
30
35
40
45
50
55
60
65
0
1
2
3
4
5
6
7
8
9
10
11
12
13
01-Jan
01-Feb
01-Mar
01-Apr
01-May
01-Jun
01-Jul
01-Aug
01-Sep
01-Oct
01-Nov
01-Dec
Date

6.2. *OKANAGAN LAKE WATER QUALITY*

Okanagan Lake water is drawn into the pump station from 31 m (102 feet) below the lake surface. This intake depth is below the thermocline zone, which results in excellent water quality throughout the seasons. As well, there are no significant creek discharges in the area, which sometimes deteriorate water quality. A representative sample, shown in Table 3, opposite page 13, indicates Okanagan Lake water falls well within the GCDWQ.

6.3. *CORRELATION BETWEEN WATER QUALITY AND WATER USE*

The purpose of this section is to outline the relationship between Vernon Creek water quality and the water use within the system. Understanding the relationship will assist in prioritizing and establishing water quality improvement projects.

Figure 6, on the opposite page, plots water demand versus grab sample data for colour and turbidity during Year 2000. The prolonged colour and turbidity events in Vernon Creek occur during the spring when there is low demand in the water system. Periods of June and the beginning of July can be characterized with an increase in rainfall, and the graph shows that colour rises while water use declines. The continuous monitoring data indicates April, June, and October to be the poorest quality months. If Year 2000 is considered a typical year, good water quality at the rate of 300 lps is sufficient to supply the entire water system through spring freshet turbidity events. Water demand typically exceeds 300 lps from mid-June to the end of August.

7. DESIGN PARAMETERS

The criteria used to analyze the water system includes both standard design values and values obtained from experience with other Irrigation and Improvement Districts. Applicable criteria are shown in the table below, and it should be noted that some values vary, or are not shown in the District of Lake Country Subdivision and Development Servicing Bylaw.

Table 5

Design Parameters

	Imperial Units	Metric Units	DLC Bylaw
1. Maximum Day Demand			
a. Agricultural	*5.0 – 6.5 USgpm/acre	*47-61 lpm/ha	
b. Rural Residential	3.8 USgpm/conn. (0.5-1.0 acre lot)	14.4 lpm/conn (0.2 – 0.4 ha lot)	
	1.9 USgpm/conn. (<0.5 acre lot)	7.2 lpm/conn (<0.2 ha lot)	6.2 lpm/conn.
c. Multi-Family Residential	1.0 USgpm/conn.	3.8 lpm/conn	
d. Commercial, Ind. & Institutional	10 USgpm/ac	94 lpm/ha	
2. Peak Hour Demand			
a. Rural Residential	6.0 USgpm/conn. (0.5-1.0 acre lot)	22.7 lpm/conn.(0.2 –0.4 ha lot)	
	3.0 USgpm/conn. (<0.5 acre lot)	11.4 lpm/conn. (<0.2 ha lot)	10.4 lpm/conn.
b. Multi-Family Residential	1.6 USgpm/conn.	6.0 lpm/conn.	
c. Commercial, Ind., & Institutional	16.0 USgpm/ac	150 lpm/ha	
3. Water Disinfection Time			
a. Minimum Contact for Lake Water	20 minutes		
b. Minimum Contact for Creek Water	60 minutes		
4. Fire Flow			
a. Volume determined by	Fire Underwriters Survey Guidelines		
b. Minimum Rural Residential	950 USgpm	60 lps	
5. Reservoir Storage			
a. Fire Flow	Largest Fire Flow x Duration		
b Balancing	25% of Residential Maximum Day Demand		
c. Emergency	25% of a.) and b.)		
6. System Pressures			
a. Maximum	140 psi	965 kPa	1,000 kPa
b. Minimum at probable bldg main floor	36 psi	250 kPa	250 kPa
during Peak Hour Demand	20 psi	140 kPa	140 kPa
d. Minimum at Hydrant during fire			
7. Maximum Pipeline Velocity			
a. Peak Hour	6.5 ft/s	2.0 m/s	2.0 m/s
b. Peak Day plus Fire Flow	13 ft/s	4.0 m/s	4.0 m/s
8. Maximum PRV Velocities			
a. Peak Hour	20 ft/s	6.0 m/s	
b. Peak Day plus Fire Flow	25 ft/s	7. 6 m/s	

*The agricultural water demand is based on the soil duty maps prepared by the Ministry of Agriculture.

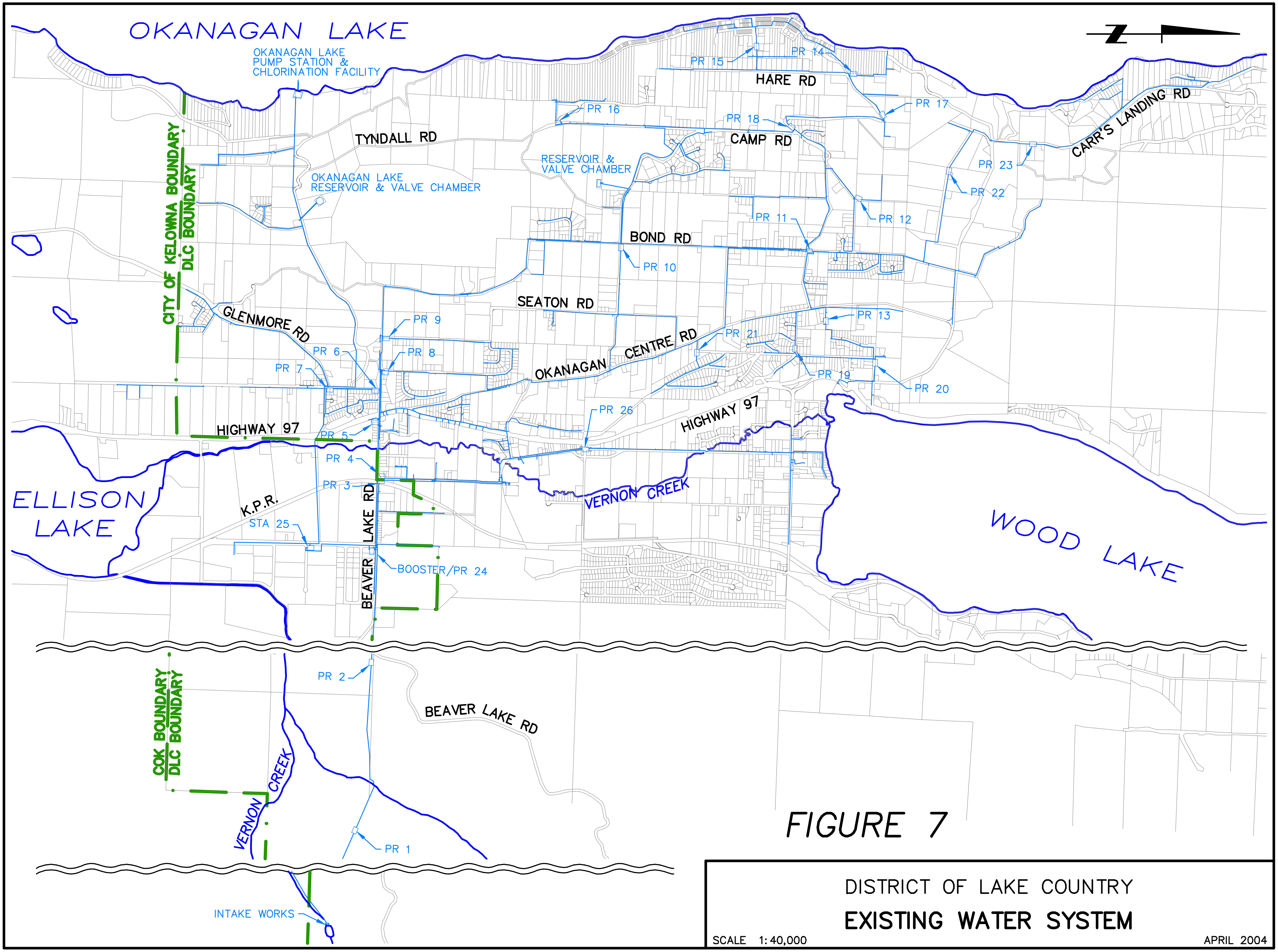


FIGURE 7

DISTRICT OF LAKE COUNTRY

EXISTING WATER SYSTEM

SCALE 1:40,000

APRIL 2004

8. ASSESSMENT OF SYSTEM COMPONENTS

Aside from the two upland reservoirs, the main components of the Winfield Okanagan Centre Water System are shown in Figure 7, opposite. The majority of the distribution system supplied by Vernon Creek was installed under the Agricultural and Rural Development Act (ARDA) program in the late 60's and early 70's. The Okanagan Lake pump station and concrete balancing reservoir were constructed in 1970 by Hiram-Walker Distillery. These works were purchased by Lake Country in 1994.

In summary, the Winfield Okanagan Centre Water System consists of the following components: Okanagan Lake pump station, Vernon Creek intake works, two balancing reservoirs, 25 pressure reducing stations, approximately 71 km of pipe, and approximately 155 fire hydrants.

Numerous site inspections of the pertinent water system works have been completed over the past couple of years, and following is a brief description of the components and their functions. Also outlined are deficiencies, as well as operating and maintenance problems. Distribution system improvements are discussed in Section 11.1.

8.1. DAMS & RESERVOIRS

Swalwell (Beaver) and Crooked Lake Dams and Reservoirs are utilized for the purpose of storing watershed runoff water. Water storage is discharged through control gates to augment Vernon Creek flows during periods when the water demand exceeds the base creek flow.

Dams typically consist of three main components, including the dam itself, plus an outlet gate structure, and a spillway. The Swalwell Lake Dam is an impervious earthfill embankment, 7.1 m in height with a crest length and width of 187 m and 3.7 m respectively. Originally constructed around 1907, replaced in 1944, and raised in 1964, the dam exists today as shown in the lower photo on Figure 8, opposite page 20. The vertical outlet gate tower was constructed in 1944, rehabilitated in 1984, and leaks were repaired again in 2002. The spillway, shown

FIGURE 8

Swalwell (Beaver)Lake Dam

Spillway

Tower Outlet Structure

in the right-hand side of the upper photo, is a 21.3 m wide concrete sill, and a .04 m vertical step-log arrangement.

Deficiencies of this facility include: the stop log arrangement, lack of spillway leadwalls making it impossible to measure the volume of water spilled, and the gate tower design which must withstand considerable force from drifting ice. This force is the most likely cause of the cracks and leaks that have occurred over the years.

The Crooked Lake Dam, constructed in 1931, is also an impervious earthfill embankment, 5.2 m in height with a crest length of 226 m. Ancillary works include a 0.6 x 0.6 m reinforced concrete outlet sluice and an 8.6 m wide concrete spillway. The spillway photo shown at the top of Figure 9, opposite page 21, was taken in the spring of 2002, which was a high runoff year.

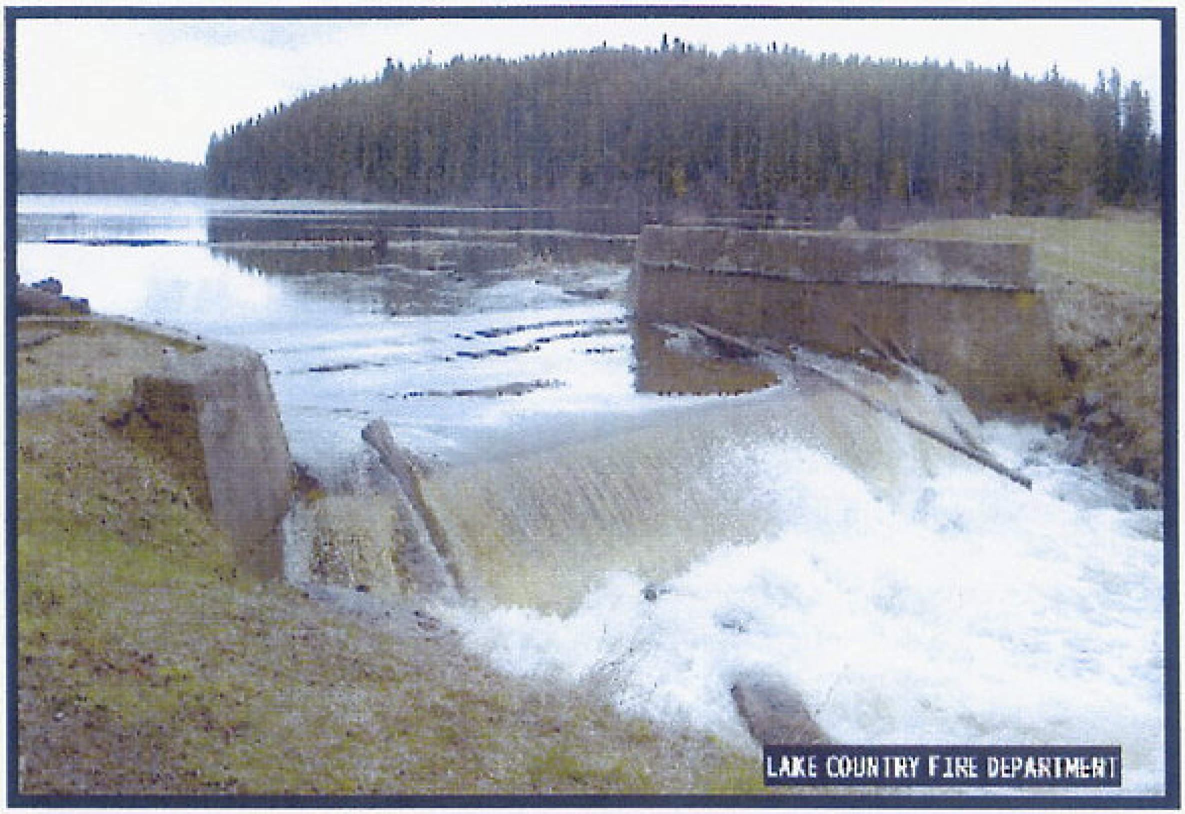
8.2. VERNON CREEK INTAKE

An earth fill dam and concrete spillway have been constructed across Vernon creek to create a small settling/head pond. A 20 m wide concrete spillway, sloped concrete chute, and energy dissipator allows the creek flows to pass from the pond back down to the creek channel. A concrete block building houses the intake works and screens, as well as a solar powered, automated water quality monitoring station that was installed by the Provincial Government.

Considerable improvements to the building were completed in early spring of 2002 in order to replace the old screens that were submerged approximately 4.0 m below the pond level. New 20 and 40 mesh inclined screens, with a total area of 12 m^2, were installed at approximately 0.6 m below the spillway elevation. The intake gates were relocated to the exterior of the building, which now allow water to flow over the screens from just below the pond surface versus the bottom of the pond. Water flowing onto and through the screens is shown in the lower photo on Figure 9. The main objectives achieved with the improvements include: reduced screen cleaning maintenance costs, increased screening area to comply with

FIGURE 9

Crooked Lake Dam



Spillway Spring 2002 Freshet

Vernon Creek Intake

Inclined Screens

Ministry regulations, and provided a safe working environment which allows a single staff member to complete the required maintenance tasks. Minor safety measures could still be implemented, and as detailed in previous correspondence, the District could achieve numerous benefits from automating the opening and closing procedure of a single intake gate.

It should be noted that in order to complete the screening building improvements, a 100 hp booster pump was installed in PR 24 located at the intersection of Beaver Lake and Jim Bailey Roads. It was required to supply the Vernon Creek distribution system with Okanagan Lake water during construction. The upper photo in Figure 10, opposite page 22, shows a portion of the works. While Vernon Creek mainline instability and current Okanagan Lake Pump Station capacity restrict the quantity and time of year that the booster pump can be utilized, it has provided the entire WOCWS with Okanagan Lake water quality during spring freshet.

8.3. VERNON CREEK MAINLINE

An 800 mm diameter steel mainline conveys water from the Vernon Creek intake, down the eastern hillside and along Beaver Lake Road to Highway 97, a distance of 6.4 km. The steel mainline, mostly 700 mm diameter, continues another 2.6 km to the intersection of Chase and Camp Roads. Pressures are within the design parameters of the mainline, reaching 250 to 300 psi upstream of PR 2 and across the valley bottom. Water velocities are moderate in the 800 mm mainline reaching 1.0 m/s during an average year (500 lps), and peaking at 1.5 m/s during 1998 (730 lps). The combination of these velocities, the mainline length, and the high pressure drop across PR stations 1 and 2, results in serious pressure surges. Pressure relief valves located at Clark and Vernon Creeks may also have magnified the pressure surge problem, and therefore they were isolated from the mainline. Regardless of the reason for isolating the relief stations, they must remain closed as chlorinated water cannot be discharged into the creek due to fishery concerns.

FIGURE 10

PR 2 & BOOSTER / PR 24

PR 2

Booster / PR 24

The steel mainline has a cathodic protection system in place, but a check of the system by Southwest Corrosion Control Ltd. in September 2002 indicated there are large sections of pipeline where there is no electrical continuity between the rectifiers and anode beds. Broken grounding straps at pipe joints almost certainly cause the lack of continuity. The pipe joint is a bell and spigot type with a rubber gasket. The rubber gasket isolates each length of pipe electrically, so a metal strap was installed across the joint to maintain continuity. It is likely the strap has broken at several locations due to pipe movement causing the discontinuity.

In addition to the electrical continuity problem, it is likely that the 30 year-old anode beds are near the end of their service life and should be replaced. Lack of an effective cathodic protection system can result in serious external corrosion problems with associated high cost repairs on complete pipe replacement. It is recommended that the system be put into operating condition. A report on the cathodic protection system was prepared by Southwest Corrosion Control Ltd. in September 2002, and is available in District files.

8.4. PRESSURE REGULATING STATIONS

The head works of the system are located at a much higher elevation than the distribution system, therefore, PR Stations 1 and 2 provide vital pressure reduction in the mainline. Pressure regulating (PR) stations 1 and 2 are located in series on the mainline, and each is equipped with four PR valves in parallel to cover the wide flow range. The lower photo shown on figure 10, opposite, depicts PR 2. PR 2 houses one tonne chlorine cylinders along with the auxiliary works required for disinfecting the water by chlorination. The elevation drop from Vernon Creek intake to the valley bottom is 412 m, requiring pressure reduction at PR 1 from 165 psi to 60 psi and pressure reduction at PR 2 from 275 psi to 90 psi.

The PR stations are poorly designed, showing their age, and are not considered safe to enter under peak flow conditions during a pressure surge in the mainline. Several major problems are listed below:

- Important thrust restraint measures were missed at some point during the original project so cables are being used to hold the piping together. The cables are corroded, clutter the station, and give the appearance of a safety hazard.

- Hydraulic instability exists due to the large number of PR stations downstream, high velocities, as well as having to reduce pressure across a large range. Pressure surges are common and severe, imposing great stress on the aging infrastructure.

- The chlorine disinfection facility at PR 2 is housed in a building constructed above the valve chamber. Should a chlorine leak occur, hazardous and highly corrosive gas would fill the cramped valve chamber.

- Chlorine contact time to the first users during peak flow conditions is only about 20 minutes, which is deficient by at least 40 minutes.

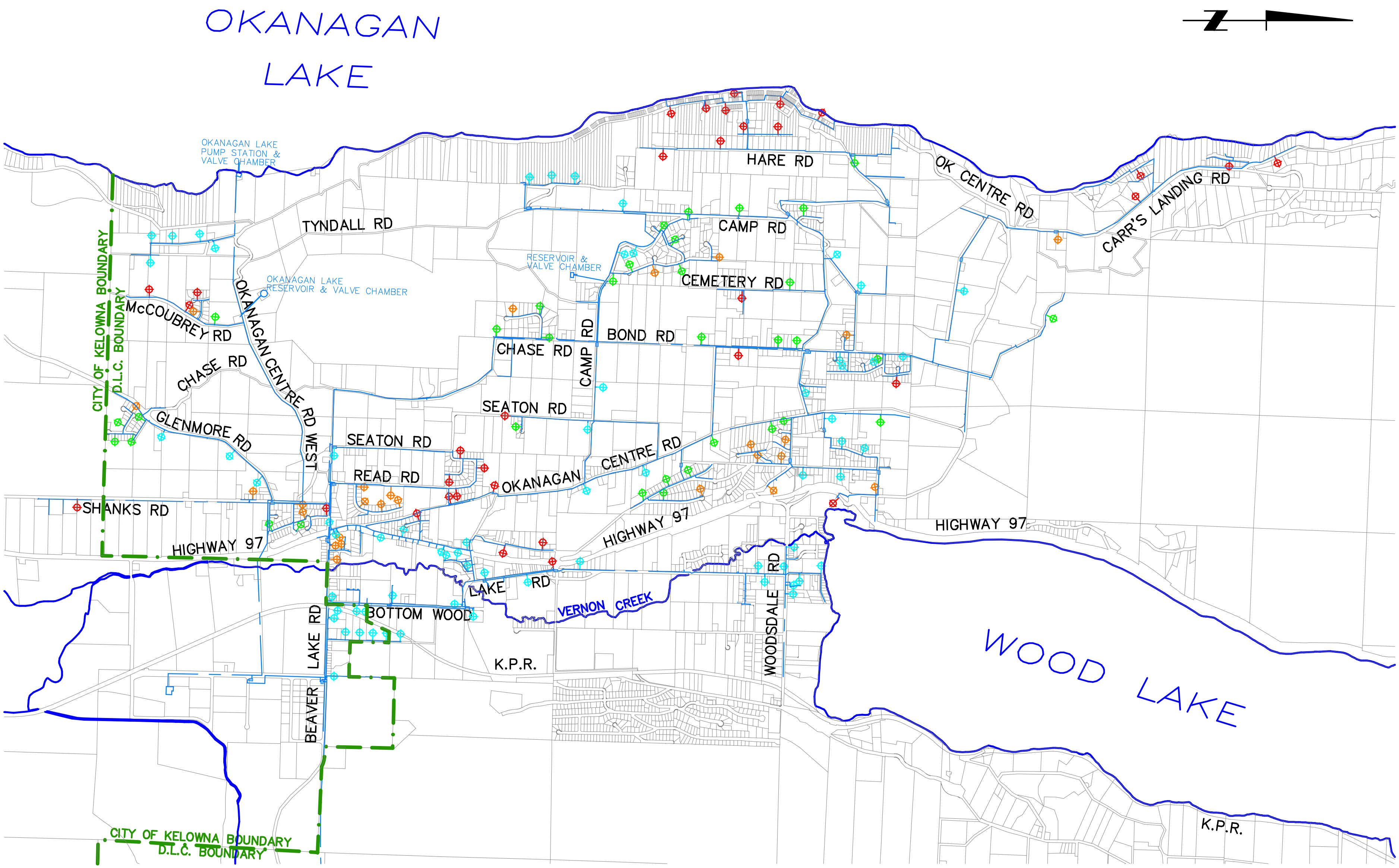
Numerous pressure regulating stations are also required within the distribution system as water is supplied over a wide range of elevations. However, many of the 25 PR's currently on the system are not required, are inefficiently placed or not optimally operated. This causes some unnecessary dead-end pipelines, plus the long lengths of pipe and large number of fast acting valves increase hydraulic instability in the mainline. Water races through PR stations 5 (Kobayashi), 15 (6th street), 19 (Robinson/Pretty Rds.), and 23 (McFarlane) during some conditions, adding to the instability. Most of the chambers have manhole entries, which creates a confined space. Some are located on the pavement edge of busy roads, thereby adding hazard to entry and servicing of the stations. In general, the stations are dark, cramped, and some do not meet Workers Compensation Board requirements.

8.5. *Distribution System Computer Model*

To analyze the hydraulics of the system, a computer model of the distribution system was developed using Waterworks for AutoCAD R14. The assessment roll showing the land entitled to water, in conjunction with the design values outlined in Table 4 on page 15, were entered into the computer model to determine the peak hourly flow. A value of 1,200 lps was obtained, which is considerably higher than the 1998 peak of 750 lps (Section 4.2 on page 8). This was expected as some landowners are not consuming water at all, and it is highly unlikely the remaining users require their peak demand simultaneously. A scaling factor of 75% has been used to reduce the computer model demand to a peak hour flow of 900 lps. This is a realistic value that could possibly be seen with the existing water supply commitments. A copy of the computer printout is enclosed in Annex 7. The scaling factor of 75% is in line with other Irrigation Districts in the Okanagan.

The model was calibrated against a variety of flow regimes observed during the summer of 2001. The calibration data consisted of field pressures measured at each PR station and other critical areas. The model simulated field conditions accurately (±3% on average) under both high and low flow conditions. The calibration printout for a flow of 428 lps in the Vernon Creek mainline is also included in Annex 7.

An accurate computer model is a very useful tool and has been used extensively to determine available fire flows, review looping options in order to eliminate dead-end pipes, investigate the removal of PR stations, and to determine the impact of growth on the water system..



LEGEND

WATERMAIN

D.L.C. BOUNDARY

< 32 lps (< 500 US gpm)

< 60 lps (< 950 US gpm)

60 – 95 lps (950 – 1500 US gpm)

> 95 lps (1500 US gpm)

FIGURE 11

DISTRICT OF LAKE COUNTRY

WINFIELD OKANAGAN CENTRE WATER SYSTEM

FIRE HYDRANT FLOW CAPACITIES

SCALE 1:40,000

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8.6. DISTRIBUTION SYSTEM

Excluding the mainlines, the distribution network consists of approximately 57 km of pipe ranging in size from 600 mm to 50 mm diameter. The majority of the distribution piping is asbestos cement (AC), some concrete cylinder (CC), with more recent installations being polyvinyl chloride (PVC) and high-density polyethylene (HDPE). Approximately 12 km of pipe is 100 mm diameter asbestos cement, which is more susceptible to breakage in comparison to larger pipe diameters. There is also some galvanized and PVC piping in the smaller diameters. In general, there have been few leaks considering the high pressures in the system so the piping seems to be in good condition. However, there is corrosion of service connections creating some leaks, and pressure surges are causing the leaks to appear sooner than would naturally occur.

The distribution piping is generally well sized to supply the current peak hour demand. The only two pipelines where velocities exceed the design parameters during peak flow are Seaton Road (100 mm AC) and Hare Road (150 mm AC). As a result, these pipes restrict flow to the downstream users.

Approximately forty percent of the District's 155 hydrants are located on or downstream of small diameter (100 mm) pipe, and cannot supply the minimum fire flow of 60 lps. The computer model was used to determine the available flow at every hydrant on the system. Figure 11 opposite is a hydrant map illustrating available capacities, and a larger version, Drawing No. DLC-105, is enclosed.

As mentioned, many PR stations are not optimally placed or operated, which results in several high and low pressure areas. Exceeding recommended values, pressures reach 180 psi on Pow, Oceola, Robinson, Lang, and Goldie Roads. The low-pressure areas are on McCoubrey, Wilson, Long Roads, and the south ends of Cemetery and Shanks Roads. Additional results of the computer model analysis include the recommendation to abandon 15 PR chambers and construction of seven new chambers, resulting in the removal of eight chambers. These works, as well as looping possibilities, are shown in the Existing System and Water Quality Improvements Sections.

8.7. CAMP ROAD RESERVOIR

Constructed in 1983, the Camp Road Reservoir is located on the hillside behind the works yard. The reservoir is 1500 cubic metres (400,000 USgal) in size with a high water elevation of 588.4 m. The reservoir is supplied by the mainline pressure from PR 2, however, the hydraulic grade line (HGL) is 29 m higher than the reservoir. This renders the facility ineffective, even when considering pressure losses that occur during peak hour conditions with a fire flow of 60 lps. The purpose of the reservoir is limited to providing a short term backup supply in the event of a mainline break, or to provide control and balancing capacity when operating the recently installed booster pump at PR 24. The only immediate concern is that an adequate volume of water be flushed through the piping and reservoir to ensure the water will be fresh when needed. If major repair or maintenance of these works is needed in the future, consideration should be given to abandonment of the installation.

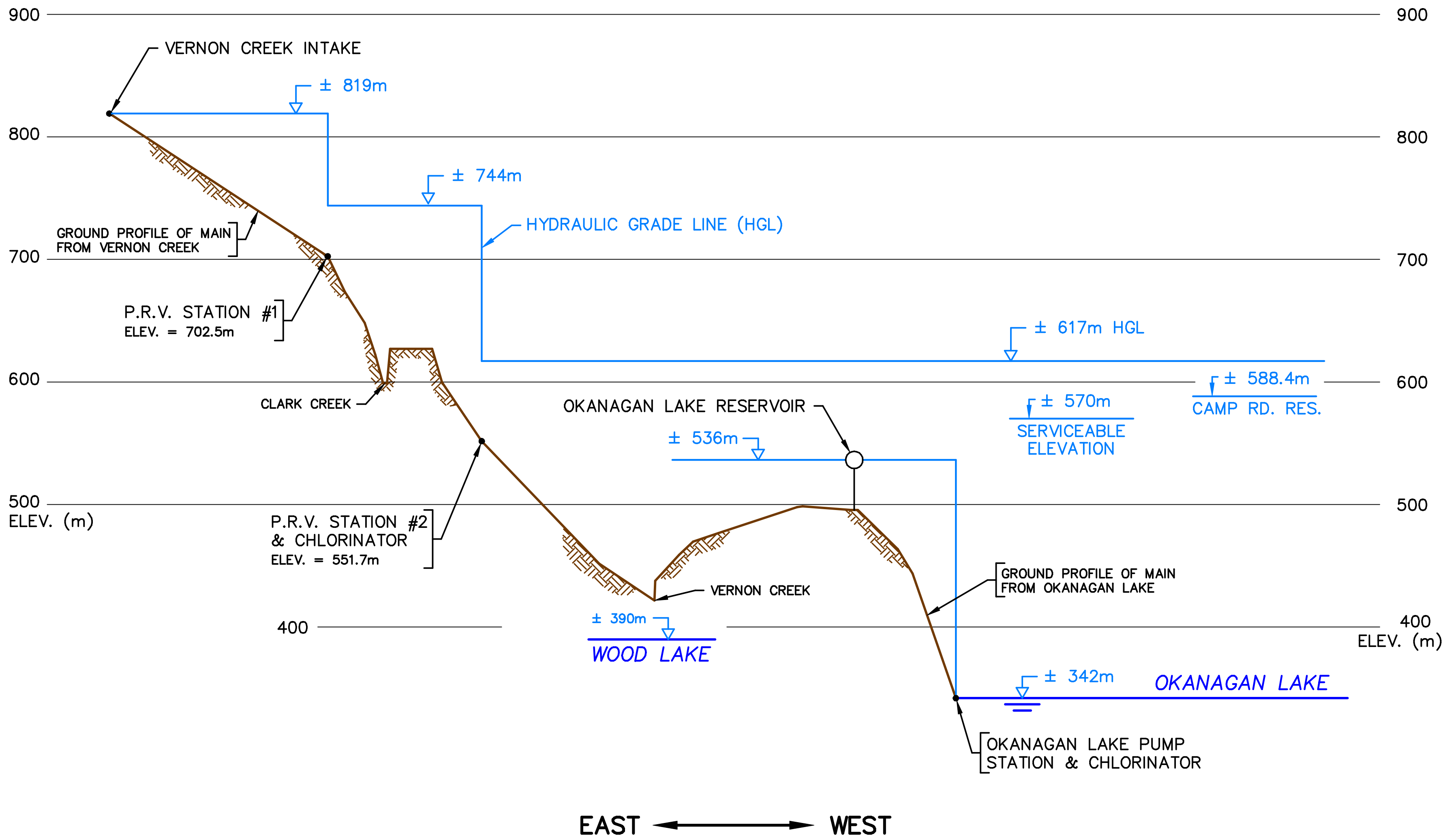
8.8. OKANAGAN LAKE PUMP STATION

These works are located near the southwestern boundary of Lake Country. The Okanagan Lake Pump Station consists of two 750 hp pumps and motors, and a third 750 hp motor operating as a 350 hp. The original bowl assembly on the third pump was replaced with a smaller unit in 1996. The rebowl was completed following closure of the Hiram Walker Distillery to reduce the electrical demand charges and power costs.

The old telemetry system was faulty and alarming frequently, so a new system has recently been installed. Although the design pumping rate of the facility is 464 lps (7350 USgpm) with two 750 hp units operating, only the 350 hp unit (105 lps) will operate in automatic mode. New pump control works are required before the

FIGURE 12

WINFIELD OKANAGAN CENTRE WATER SYSTEM
EAST/WEST CROSS-SECTION



750 hp units can be considered useful. The pump station wet well is fed by a 1200 mm diameter pipe with the intake situated 31 m below the Okanagan Lake surface. Fish screens, with an area of 11.8 m^2, are located at the head of the wet well. Also present are one tonne chlorine cylinders and the auxiliary works required to disinfect the water.

The Okanagan Lake pumped system has considerable surplus capacity that could be utilized to improve water quality and supply growth demands, however, a few deficiencies and concerns need to be addressed (refer to Section 11.2, Water Quality Improvements).

8.9. OKANAGAN LAKE RESERVOIR

A 2270 cubic metre (600,000 USgal) reservoir situated near McCoubrey Road, with a high water elevation of 536.4 m, is used for controlling starting and stopping of pumps within the Okanagan Lake facility. The reservoir also provides balancing for fluctuations in demand. The difference in elevation between the Okanagan Lake Reservoir and the hydraulics of the Vernon Creek distribution system is shown in Figure 12, opposite, which is an East/West Cross Section of the valley.

8.10. OKANAGAN LAKE MAINLINE

The mainline is an 850 mm diameter steel pipe extending a total of 5 km to the reservoir and beyond to Jim Bailey Road and the decommissioned Hiram-Walker Distillery. This pipeline crosses IR #7 and the agreement for its location is to be renegotiated by Year 2008. A check of the cathodic protection system on the steel mainline was also conducted by Southwest Corrosion Control Consultants Ltd.

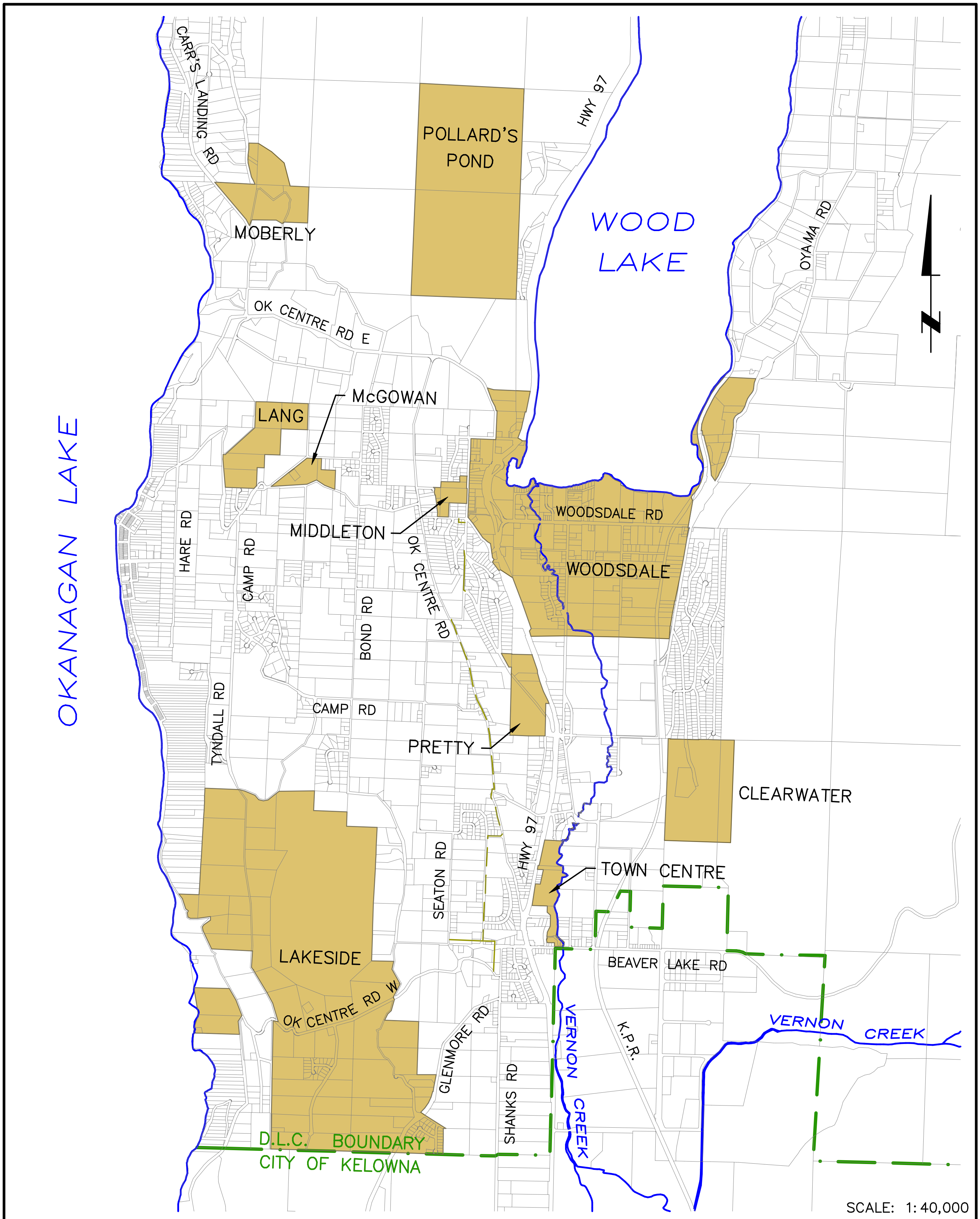


FIGURE 13

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DISTRICT OF LAKE COUNTRY

DEVELOPMENT AREAS

9. GROWTH ESTIMATES

The District of Lake Country has experienced significant, consistent growth for many years and according to the Official Community Plan (OCP), the trend is expected to continue. The area is desirable with numerous lakes and lake view properties.

The existing service area is primarily within the Agricultural Land Reserve, which results in the majority of the residential growth being located beyond the existing infrastructure. Growth is dependent on the economy and land use policies, two variables that are difficult to predict. Therefore, the timing of required works is somewhat uncertain and the plan must be flexible.

9.1. POPULATION GROWTH

According to the most recent OCP, dated February 19th, 2002, the average growth rate in the area over the past 25 years has been 3% with only a slight decline in the last two years. Most of the Neighbourhood Plans are based on 3% growth and the District expects its overall population to increase by at least 3% in the next five years, therefore, this figure has been used as the basis for calculating future water demands. The OCP estimates the population of the District in 2001 was 9,844 and with an increase of 3% annually, the population in 2024 is estimated to be 19,400. The District further estimates approximately 4,200 new housing units will be built by 2020; however, this figure is in error as it only represents approximately 1.7 persons/unit. Discussions with District representatives indicate a value of 2.7 persons/unit is more accurate, which means approximately 3,200 new housing units will be built by 2024.

As outlined in the OCP, growth is expected in pockets throughout the District of Lake Country and this plan is based on 70% of new development (2,240 housing units) being serviced from the WOCWS. An estimate for commercial, industrial, and institutional growth of 19 ha has also been included. The majority of the remaining growth will be supplied by the Oyama and Wood Lake Water Systems.

Table 6
Projected Growth

Development Area	Projected Growth Year 2024 Units	Year 2024 Total (SFE)	Full Build-Out Units	Full Build-Out Total (SFE)
Town Centre				
Multi-Family (MF) Commercial, Industrial & Institutional	50 10 ha	153	50 20 ha	285
Woodsdale				
Single Family (SFR) Multi-Family Commercial, Industrial & Institutional	738 126 6 ha	882	883 126 30 ha	1,340
Clearwater Extension				
Single Family Multi-Family Commercial, Industrial & Institutional	80 19 3 ha	130	80 220 3 ha	235
Middleton Road				
Single Family Multi-Family	50 19	60	140 20	150
Pretty Road				
Single Family Multi-Family	50 19	60	186 27	200
Moberly Road				
Single Family	20	20	25	25
Lakeside Properties				
Single Family Multi-Family	300 76	340	1,581 226	1,700
Pollard's Pond				
Single Family Multi-Family Commercial, Industrial & Institutional	532 76 1 ha	585	800 100 1 ha	865
Lang Road				
Single Family	40	40	150	150
McGowan Road				
Single Family	50	50	70	70
TOTAL	**2,240 20 ha**	**2,320**	**4,684 54 ha**	**5,020**

Currently, the OCP does not predict an increase above the existing commitments to the City of Kelowna Industrial Park.

The OCP and Figure 13, opposite page 28, outline the expected areas of growth to be serviced by the WOCWS. Infill of the Woodsdale and Town Centre areas is particularly being encouraged. It is expected growth will occur first in the Town Centre and Woodsdale areas as these are nearest to water and sewer services. Table 6, opposite, lists the estimated number and type of units each development may have by Year 2024 and under Full Build-Out conditions. Also listed are Single Family Equivalent (SFE) units for each development on which the water demands have been based. Using SFE units to project water demands gives the plan flexibility by allowing the number and type of units in each development to vary from the OCP's 90% single and 10% multi-family split without affecting the overall estimated demand.

9.2. AGRICULTURE GROWTH

In Section 3 (Agriculture) of the Official Community Plan, Item 3.3.8 states that *"The District will ensure that water supply is reserved for agricultural use"*. The OCP does not provide an estimate of the amount of water that should be 'reserved', and does not specify whether the water must be supplied from Vernon and Oyama Creek Watersheds or Okanagan Lake. Discussions with DLC Planning and Engineering staff suggest that the economics of agriculture are such that the costs of pumping water from Okanagan Lake for agricultural land use are too high to consider, so agricultural water reservation must be made on Vernon and Oyama Creeks. The amount of 'dry' agricultural land within the WOCWS that can benefit from irrigation is somewhat limited, so an amount of 690 da m^3 (100 ha of land) over the next 20 years is considered reasonable.

Table 7

Projected Annual Water Requirements – Year 2024

1.	**VERNON CREEK**		
	.1	Irrigated Grade 'A' Land, 905 ha @ *6.9 da m^3/ha	6,245 da m^3
	.2	Rural Residential, 700 conn. @ 0.17 da m^3	119 da m^3
	.3	Urban Residential, 630 conn @ 0.75 da m^3	473 da m^3
	.4	Multi-family & Strata's, 50 Units @ 0.17 da m^3	9 da m^3
	Total Estimated Annual Use from Vernon Creek		***6,846 da m^3***
2.	**OKANAGAN LAKE**		
	.1	Irrigated Grade 'A' Land, 145 ha @ *6.9 da m^3/ha	1001 da m^3
	.2	Rural Residential, 50 conn. @ 0.17 da m^3	9 da m^3
	.3	Urban Residential, 2230 conn @ 0.75 da m^3	1673 da m^3
	.4	Multi Family & Strata's, 485 Units @ 0.17 da m^3	82 da m^3
	.5	Commercial, Industrial & Institutional, 20 ha @ 6.9 da m^3/ha	
		Plus 60 Conn. @ 0.17 da m^3	148 da m^3
	.6	City of Kelowna Industrial Area, 80 ha @ 6.9 da m^3/ha	550 da m^3
	Total Estimated Annual Use from Okanagan Lake		***3,463 da m^3***
	TOTAL		***10,309 da m^3***

NOTES:

1. * Estimated annual irrigation requirements are based on the *Irrigation Design Manual* prepared by the British Columbia Ministry of Agriculture
2. The Grade 'A' land serviced area of 1050 ha includes the irrigated areas within the Rural Residential, Multi-Family & Strata's, and Commercial, Industrial & Institutional developments.
3. Domestic water use on Urban Residential Lots under 0.2 ha in size includes irrigation of lawns and gardens.

10. PROJECTED WATER DEMAND AND AVAILABILITY

Water demand projections have been made for the Year 2024, as well as full build-out conditions. Full build-out projections are included since a 20 year horizon is a short time frame for planning large capital expenditures on works that are expected to last at least 40 years. This section outlines the effect that increased water demands will have on the capacity of the WOCWS. Two objectives are: To ensure the existing users are not negatively impacted by growth, and to outline a phased plan to supply the new developments with superior water quality in a timely manner.

10.1. ANNUAL USE

Considering a drought year, the annual water requirements from Okanagan Lake and Vernon Creek have been calculated for the Year 2024, and are shown in Table 7, opposite. The quantity from each source assumes the recommended Water Quality Improvements described in Section 11.2 have been completed. It should be noted that a value for the proposed Glenmore Road Booster Station, discussed in Section 11.2, has not been considered. The station will pump water from the Okanagan Lake system into the Vernon Creek system in order to improve water quality to all WOCWS users. Quantities pumped will vary and could be as low as 100 lps during the peak months by year 2024. Usage of this station will reduce the annual requirements on the Vernon Creek watershed.

As shown, annual water requirements from Vernon Creek are 6,846 da m^3 (5,550 ac-ft), which are well under the total water licenses of 9,436 da m^3 (7,650 ac-ft). The annual water requirements from Okanagan Lake are 3,463 da m^3 (2,807 ac-ft); also well under the licenced volume. Therefore, the District of Lake Country has sufficient licenses to meet Year 2024 requirements and beyond. However, as stated on page 6 and shown in Table 2, Vernon Creek water licences exceed the amount of water available in a dry year if downstream fish flows are considered. Therefore, Table 8 below shows the water available from the Vernon Creek watershed based on the 1977 hydrology and considering the projected annual water requirements for 2024 depicted in Table 7.

Table 8

Vernon Creek Watershed
Projected Water Availability – Year 2024

	Imp. Units	Metric Units
1. Watershed Yield, 49 yrs in 50	8,000 ac-ft	9,868 da m^3
2. Fish Flows (8 months)	1,200 ac-ft	1,480 da m^3
3. Operational Waste	560 ac-ft	690 da m^3
4. Estimated Water Use – Year 2024	5,550 ac-ft	6,846 da m^3
5. Surplus	690 ac-ft	852 da m^3

The surplus should be retained until more recent runoff data has been reviewed.

10.2. MAXIMUM DAY USE

Maximum day figures are used to determine the size of major supply works. The resulting facilities will be utilized to near capacity daily throughout the summer months.

The number and type of new dwellings, as well as the use per connection are important factors in projecting future peak flow rates. Table 6 outlines the housing distribution estimates for the development areas. Water demand for the various types of development are outlined in Table 5 on page 18. The following table shows the current and projected maximum day demands in relation to the existing supply capabilities of the WOCWS.

Table 9

Maximum Day Demand Versus Supply

Demand Scenario	**Present Demand (lps)**	**Projected Demand (lps)**	**Vernon Creek Mainline (Max. Velocity) (lps)**	**OK Lake Pumped Supply (lps)**	**Surplus / *(Deficit)* (lps)**
YEAR 2024	750	360	837	464	**191**
Full Build-Out	750	694	837	464	**(143)**

NOTES: Year 2024 projected demand has been reduced by 11 lps, as a portion of the growth is expected to occur on irrigated land.

Maximum capacity of the Vernon Creek gravity system is based on a velocity of 2.0 m/s in the mainline (1,004 lps), divided by a 1.2 factor (as determined in Section 4.2) to achieve maximum day demand.

The table indicates WOCWS has sufficient capacity to supply the District's water needs for many years. By Year 2024, the domestic component will represent approximately 45% of the maximum day demand, in comparison to the irrigation flow at 55%.

10.3. WATER CONSERVATION

The figures used in Sections 10.1 and 10.2 to determine annual and maximum day demands are present values and do not take into consideration possible water conservation measures. Presently, most of the connections within the areas supplied with Okanagan Lake water are metered. The agriculture use is based on a flat-rate allocation system that is purchased for the property. During drought years, water restrictions can be imposed but a formal water conservation program has not been adopted.

11. RECOMMENDED IMPROVEMENTS

The Capital projects and estimated costs for the Water Quality Improvements are outlined separately in Section 11.2, in order to aid in applying for funding assistance from the Federal/Provincial Infrastructure Program. Works required to supply new development are described in Section 11.3, and have also been separated for the purposes of establishing Development Cost Charges (DCCs).

11.1. EXISTING SYSTEM IMPROVEMENTS

This section provides solutions for the existing system deficiencies outlined in Section 8. The subsections are generally listed from the source to the distribution system and are not shown in order of priority.

11.1.1. Dams & Reservoirs

Crooked Lake Dam is generally in good condition and only miscellaneous improvements are expected over the next 20 year period.

The Swalwell Lake outlet gate tower constructed in 1944 has served its purpose and should be replaced when considerable maintenance work is required. It is believed the previous rehabilitation works are a result of ice force against the structure. This likely occurs in early spring when ice melts around the perimeter of the lake enabling ice movement. An inclined gate and stem parallel to the face of the dam is a preferred design. A building could then be constructed on the dam to house an automated gate actuator and telemetry equipment. This will allow operation of the gate from the District office. Sensors could also be installed to monitor reservoir water levels without a site visit.

The concrete spillway and stop logs do not meet current standards and were not likely designed to pass maximum probable floods using US Bureau of Reclamation Criteria. As the spillway does not have wing walls and a measuring gage, the volume of water spilled cannot be determined. This value is useful in assessing whether a higher dam and spillway would store additional water on an annual basis.

Estimated Cost: $ 570,000

11.1.2. Vernon Creek Intake

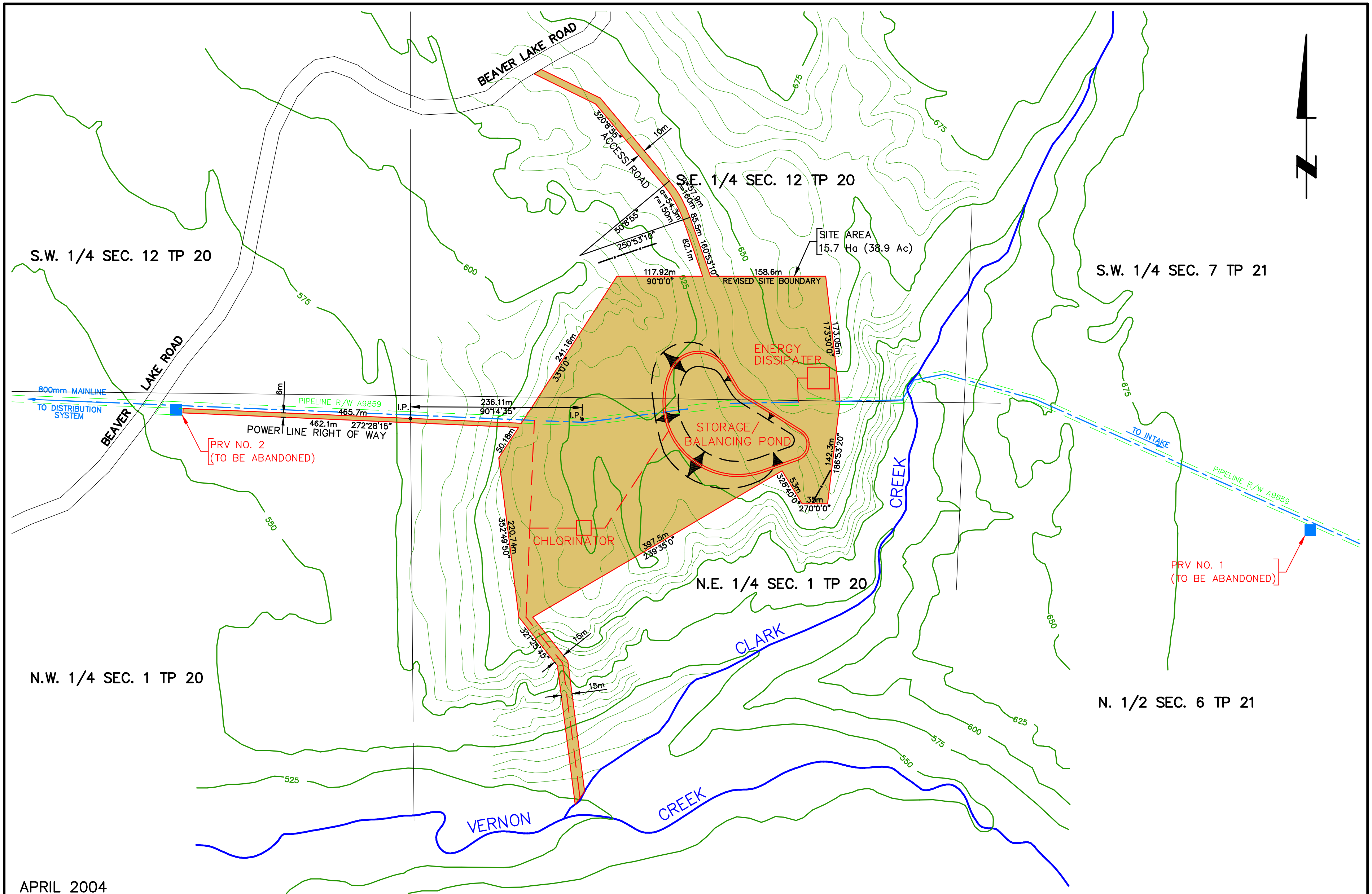
New screening works were constructed inside the existing Vernon Creek Intake building during the spring of 2002. Minor works are required to improve operating convenience and safety measures. Also, the District would notice numerous benefits from automating the gate operations. An automated gate via telemetry to the District's office will control flow into the intake building. Additional water could be retained in the upland reservoirs if a level sensor was installed at the intake screening building and used to control an automated gate at the Swalwell Lake outlet structure. It is assumed the Ministries solar panels and batteries at the intake building are no longer available to the District as they have not been reinstalled.

Estimated Cost: $ 75,000

11.1.3. Mainline Corrosion Protection

The steel mainlines within the system are adequately sized and no leaks are obvious so upgrading is not necessary. The only work required is to ensure the mainlines are protected against external corrosion, as replacement costs will be extremely high if corrosion exists.

For purposes of this report, the mainline was separated into the four following sections:



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DISTRICT OF LAKE COUNTRY

ELDORADO STORAGE / BALANCING POND & DISINFECTION FACILITY

SCALE: 1:7,500

FIGURE 14

Section A - Intake to PR No. 2

Section B - PR No. 2 to Railway R/W Rectifier

Section C - Railway R/W to Read Road Rectifier

Section D - Read Road Rectifier to Camp Road

Details of the cost estimate to repair the cathodic protection system for each section are outlined in Annex 1.

The number and locations of missing connecting straps are unknown and it will be difficult to locate them. The procedure will be to expose the main at several locations and check for continuity between each test location. Any section where discontinuity is evident will be further split in half until the exact location(s) are found. The repair will consist of welding a flexible wire to the pipe to electrically connect the ball and spigot.

For purposes of preparing an estimate of the cost, we have estimated that 20% of the joints will have to be exposed for testing and 5% will need new straps. The repair program can be done over several years and more accurate cost estimates can be made after the first section is completed.

Estimated Cost: $ 200,000

11.1.4. Eldorado Storage/ Balancing Pond & Disinfection Facility

The construction of Vernon Creek Reservoir and Disinfection Facility is fundamental to the removal of PR stations 1 and 2, and the stabilization of mainline pressures. The site is shown on Figure 14, opposite, located on a bench above PR 2 at an elevation of approximately 627 m. The mainline pressure will increase by about 14 psi, as the current HGL below PR No. 2 is 617 m. The initial facility is proposed to be an earth fill embankment containing approximately 30 000 m^3 (25 ac-ft) of water.

Vernon Creek is the main source of supply and a large reservoir is recommended, as a result of the numerous landslide areas immediately upstream of the intake. Some remedial work of the slide areas has been completed, however, large unstable banks remain which will result in further landslides, thereby jeopardizing the water supply. The proposed reservoir will be capable of supplying the Winfield system for at least one day during maximum flow conditions. With proper management, this reservoir will also reduce operating costs by decreasing the number of manual gate changes required at both the Vernon Creek Intake and Swalwall Lake. As well, the volume of mountain storage water discharged past the intake should be reduced, as the reservoir can balance the demand fluctuations from the distribution system.

There will be noticeable water quality benefits as a result of the construction of this reservoir. The reservoir will allow high turbidity events in Vernon Creek to be circumvented. This can be achieved by installing a turbidity meter at the intake structure, and connecting it to a system that will close the gate to the mainline should turbidity exceed a pre-set threshold. The system will be equipped with low-level sensors at the reservoir to override the mainline closure during a sustained turbidity event.

Other works involved with this project include: construction of an energy dissipater on the mainline prior to the reservoir, removal of the works at PR stations 1 and 2, and construction of a new chlorination facility. Additional works recommended at this site, to further improve water quality, are outlined in Section 11.2.

Estimated Cost: $ 2,090,000

TABLE 10

PR Number	PR Station Name / Location	Valve Sizes (in)	Ex. D/S Pressure (psi)	Ex. D/S HGL (m)	New D/S Pressure (psi)	New D/S HGL (m)	Comments
Pressure Regulating Stations Existing System & Water Quality Improvements							
1	Upper Range	12, 10, 8, 4	59	744			To be abandoned
2	Lower Range (Beaver Lake Rd)	12, 10, 8, 4, 4	93	617			To be abandoned
3	Beaver Lake / Bottom Wood Lake Rds (East)	6, 2	90	486			To be abandoned
4	Beaver Lake / Bottom Wood Lake Rds (West)	6, 2	70	472			To be abandoned
5	Kobayashi - Beaver Lake Rd	4, 2	75	491	37	496	To be relocated, larger valve required
6	Glenmore Rd / Beaver Lake Rd	6, 2.5	133	554	120	554	To be relocated. Summer setting.
					105	544	Winter setting
7	Harwood Rd (Glenmore Rd)	6, 2	80	523			To be abandoned
8	Read Rd / Dyck Rd	3, 2	80	527			To be abandoned
9	Seaton Rd / Dyck Rd	4, 2	75	531	85	530	To be relocated, larger valve required
10	Bond Rd / Camp Rd	8, 3	56	572			
11	Tepper - Bond Rd / Davidson Rd	8, 6, 3	60	577			
12	Amundsen - McGowan Rd	4, 2	44	559	75	585	To be relocated, larger valve required
13	Brew Rd	4, 2	30	506	25	502	Change after reconfiuration of PR 19
14	Camp Rd / Hare Rd	4, 2	50	426			
15	6th Street	4, 2	58	421			Larger valve required
16	Tyndall Rd	4, 2	40	553			
17	Dobson - Camp Rd	6, 2	70	478			
18	Davidson Rd / Camp Rd	6, 2, 1.5	41	527			
19	Robinson Rd / Pretty Rd	3, 2	77	506			To be reconfigured. Larger valve required
20	Pretty Rd / Middleton Rd	2, 2	57	463			
21	Jardine Rd	4, 2	60	537			To be abandoned
22	Hikichi - Goldie Rd	6, 2	40	479			
23	McFarlane - Carrs Landing Rd	4, 1.5	83	450	60	445	To be relocated / larger valve required
24	Jim Bailey Rd / Beaver Lake Rd, 100 hp Booster/PR	10	90	496	87	494	Change after relocation of PR 5
		8, 2	82	491			Fire flow backup
25	HRI - Jim Bailey Rd						Meter Chamber
26	Taiji Ct	8, 2	OPEN				To be abandoned
27	Camp Rd / Tyndall Rd	N/A			85	588	NEW
28	Bond Rd / Lacresta Rd	N/A			40	528	NEW

NOTE: Red text indicates change upon completion of new works

11.1.5. Distribution System Pressure Regulating Stations

The existing PR station locations and settings cause several high and low pressure areas, as well as unnecessary dead end watermains. The PR stations are vital to the performance and longevity of the distribution system. The following are recommended changes in PR station works, also illustrated on Drawing No. DLC-107A and Table 10 opposite. The distribution system is complicated and several of the recommended adjustments and works must be completed simultaneously.

- In general, it was concluded that PR stations 3, 4, and 26 could be abandoned, PR stations 12 and 23 are best relocated, and two new PR's should be installed. Also, PR valves in stations 5, 15, 19 and 23 need to be upsized in order to slow velocities during peak flows.

- The supply to Read and Seaton Roads, PR stations 8 and 9, should be revised to provide better service. The two systems are segregated, however, it is possible to loop the two by simply opening a valve and adjusting the PR settings as shown in the Table. Linking the two systems provides the users with increased fire protection with the fire hydrants supplied from both directions.

- The industrial park within the City of Kelowna, and the Town Centre / Woodsdale regions are in a topographically simple area and changes should be made to simplify operations. The area is fed by PR stations 3, 4, 5, and 24 with PR 26 creating another pressure zone within the area. PR stations 3, 4, and 5 supply from the Vernon Creek mainline and PR station 24 supplies from the Okanagan Lake system.

- PR station 18 experiences excessively high upstream pressures, and the valve is required to reduce the pressure over a large range. To remedy this situation and allow for future looping options (Amundsen Road to Bond Road), PR station 12 should be relocated upstream of the Davidson / Amundsen Roads intersection. The move will also require upgrading of the main PR valve. In conjunction with this move, a new PR station is required at the intersection of Camp / Tyndall Roads, and should be constructed prior to relocating PR 12.

- The remaining PR stations require new access hatches, ladders, miscellaneous equipment, and painting. A program needs to be established for maintenance and replacement of PR valves, isolating valves, corroded piping, strainers, and pressure gauges. The maintenance portion of the program is essential in identifying potential equipment and operational problems, thereby minimizing the risk of large repair projects.

Estimated Cost: $ 375,000

11.1.6. Distribution System

The District has approximately 12 km of 100 mm diameter AC pipe. Approximately 7 km of length results in inadequate hydrant capacities and funds should be set aside to replace sections annually. In most cases, 150 mm diameter pipe is adequate. However, each project should be reviewed, as future growth or other considerations may dictate larger diameter pipe. As well, the pipeline on Hare Road is an inadequately sized 150 mm AC pipe with velocities exceeding the maximum rate of 2.0 m/s. This pipeline should be upgraded to 200 mm diameter PVC.

As problems occur, small-diameter, galvanized, and PVC pipe may also need to be replaced. However, individual projects should be reviewed, as considerable lengths of pipe could be abandoned. Replacement of this small-diameter piping has not been included in the cost estimate.

Estimated Cost: $ 1,590,000

11.2. WATER QUALITY IMPROVEMENTS

This section includes recommendations to reduce the water quality deficiencies. The works will meet Interior Health's objectives and the GCDWQ for existing users. As existing users should not be expected to bear costs for future residents, the works have not been sized to allow for growth.

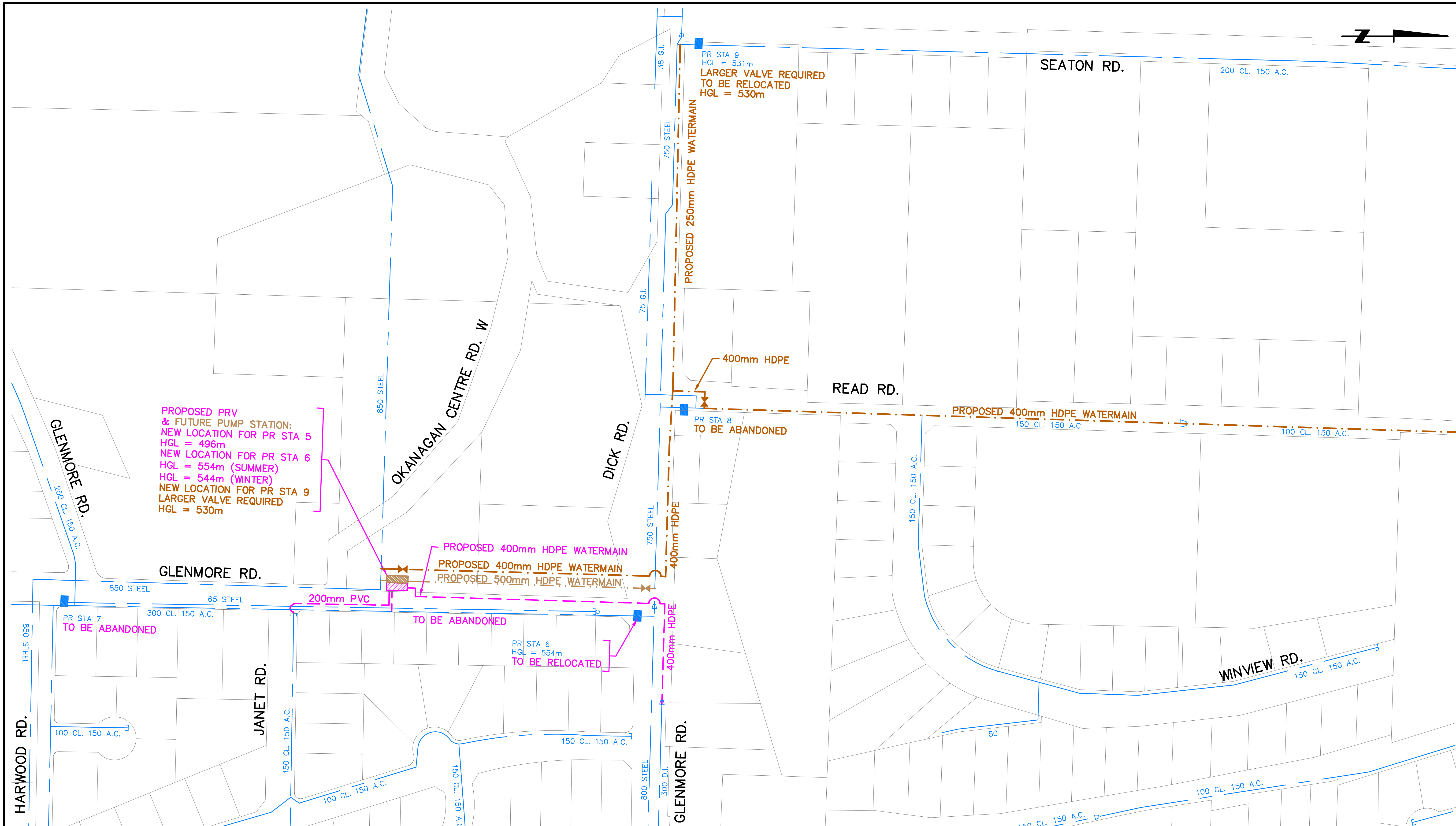
Included in this section are improvements to the Okanagan Lake pump station, an ultraviolet (UV) disinfection facility, and a booster pump station on Glenmore Road. The location of the works are shown on Drawing No. DLC-107A. Increasing the capacity of the pumping facility above the original design value of 464 lps is not recommended and will be discussed in Section 11.3.1.1.

In general, the water quality improvement plan includes utilizing the capacity of the Okanagan Lake Pump Station to improve water quality. The full capacity of the facility is 464 lps. However, this value must be reduced to a maximum day value of 290 lps and the existing Okanagan Lake Reservoir will supply the peak hour component of the demand. To meet Interior Health's dual disinfection barrier objective, an ultraviolet facility is recommended at the Okanagan Lake Reservoir site. Maximum day demand for the existing WOCWS is 750 lps. Therefore, to meet water quality objectives, a water treatment facility capable of 460 lps (750 lps – 290 lps) will be constructed at the Eldorado Storage/Balancing Pond site. This scheme optimizes the use of the current sources and provides supply redundancy in the event of facility failure. An Eldorado Water Treatment Facility of this size will be capable of supplying the entire WOCWS flow except during July and August. It should be noted that following implementation of the water quality recommendations, only 460 lps of the total water available at Vernon Creek will be treated to meet the GCDWQ for the present users. Therefore, additional water to supply growth is available, but treatment is required. Reservoir upgrades are also required to ensure peak hour commitments are met.

11.2.1. Okanagan Lake Pump Station

The Okanagan lake pump station will require upgrading prior to servicing additional areas. The rebowled 350 hp pump in Okanagan Lake Pump Station supplies the entire current water demands. The two 750 hp pumps are rarely used. In order to use the station to its full capacity, components installed in the 1970's will require upgrading to current standards. This will include replacement of the pump station control panel, main disconnects, and possibly transformers. As well, the intake screens located inside the station do not meet current Ministry of Water, Land and Air Protection standards. The screens are too coarse, do not provide sufficient surface area, and should likely be situated at the intake entrance, rather than in the wet well.

The second 750 hp pump (Pump #2) in the station is not equipped with a pump control valve, resulting in the entire volume of water being immediately directed into the mainline at start up. The resulting water hammer stresses the system unnecessarily and although the pump station is well built, some facilities could be damaged over time. It is recommended a variable frequency drive be installed on Pump #2 to gradually engage and disengage the motor on start-up and shutdown. As well, the 750 hp pumps should be removed, cleaned and serviced prior to full time use.



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DISTRICT OF LAKE COUNTRY

WATER QUALITY IMPROVEMENTS PROPOSED PRV/PUMP STATION

SCALE 1:2500

FIGURE 15

LEGEND

- EXISTING WATERMAIN
- WATER QUALITY IMPROVEMENTS–PHASE 1
- WATER QUALITY IMPROVEMENTS–PHASE 2
- WATER TREATMENT FACILITY

Furthermore, chlorine contact time provided during full capacity will be only nine minutes at the first distribution lateral, Stubbs Road. It is recommended the chlorine injection point be relocated from the wet well to the entrance of the intake pipe, which will increase the chlorine contact time to 15 minutes.

Estimated Cost: $ 500,000

11.2.2. Gravity Supply from Okanagan Lake Reservoir

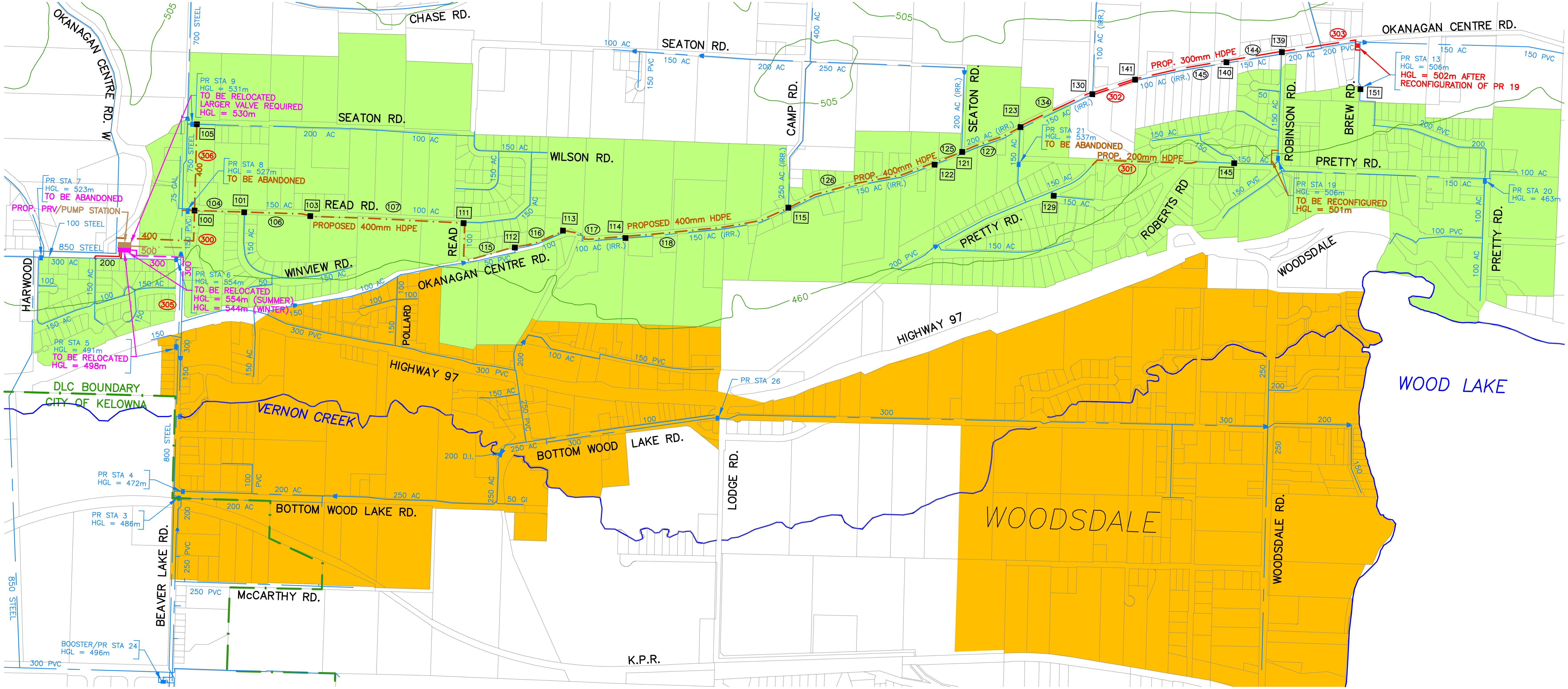
The Town Centre/Woodsdale and Okanagan Centre Road areas could receive a gravity or pressure reduced supply from the Okanagan Lake Reservoir. Following is a phased plan to supply these areas.

11.2.2.1. Phase 1 – Town Centre / Woodsdale

An additional supply route is required to provide the Town Centre/Woodsdale areas with Okanagan Lake water during peak demand periods. Vernon Creek water via PR Station 5 currents augments the supply. The deficiency is a result of pressure losses that occur through the single supply provided by the Jim Bailey Road pipeline.

Phase 1, as shown on Figure 15 opposite, involves the construction of a PR station on Glenmore Road near Okanagan Centre Road West. A pipeline will be installed from the 850 mm diameter Okanagan Lake mainline to the 300 mm diameter pipe on Glenmore Road. These works will allow the abandonment of PR Stations 5 and 6; the PR valves will be relocated to a new PR station. The new station will be large enough to house all works proposed at this location.

In addition to supplying the Town Centre / Woodsdale areas, approximately 90 users on Shanks and Glenmore Roads could also receive Okanagan Lake water. However, superior water quality can be



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WATER QUALITY IMPROVEMENTS
ANNUAL SUPPLY AREAS

FIGURE 16

SCALE: 1:10,000

LEGEND

- EXISTING WATERMAIN
- PHASE 1 PROPOSED WORKS
- PHASE 2 PROPOSED WORKS
- FULL WATER TREATMENT
- DEVELOPER FUNDED
- 105 NODE
- (105) PIPE
- TOWN CENTRE/WOODSDALE AREA
- OKANAGAN CENTRE RD. SUPPLY AREA

provided for only eight or nine months of the year. This duration should be long enough to avoid supplying Vernon Creek water during spring freshet events. When the demand for irrigation supply occurs, Vernon Creek water must be provided to Shanks and Glenmore Road (via PR 6) in order to maintain minimum pressures.

Estimated Cost: $ 340,000

11.2.2.2. Phase 2 – Okanagan Centre Road

The Okanagan Lake reservoir is well situated to supply this area year round without requiring pump or pressure reducing works on Glenmore Road. The Okanagan Centre Road area encompasses approximately 530 domestics, and is shaded in green on Figure 16, opposite. Thirty percent of the total domestic connections are accounted for in this phase.

Required works include installing a large diameter pipe along Read and Okanagan Centre Roads, from the Okanagan Lake mainline to Jardine Road. Portions of the existing pipeline along Okanagan Centre Road will remain in service to supply the irrigation demand. Nine PR stations presently supply the area, of which four will be eliminated. A back up supply from Vernon Creek will be provided at two locations to ensure fire flow requirements are met. The proposed works and PR station changes are outlined in Figure 16 and Table 10.

The total length of pipeline to be installed is 3.6 kilometres, which includes the looping of segregated areas. The first of these is a 250 mm diameter pipe along Dyck Road between Read and Seaton Roads. It is a necessary installation for the removal of PR station 9 and provides additional capacity to Seaton Road. The second looping project is along Pretty Road, south of Roberts Road. A 200 mm diameter pipe installation will eliminate two dead-end watermains, and improve water quality and fire flow to the surrounding area.

Estimated Cost: $ 1,120,000

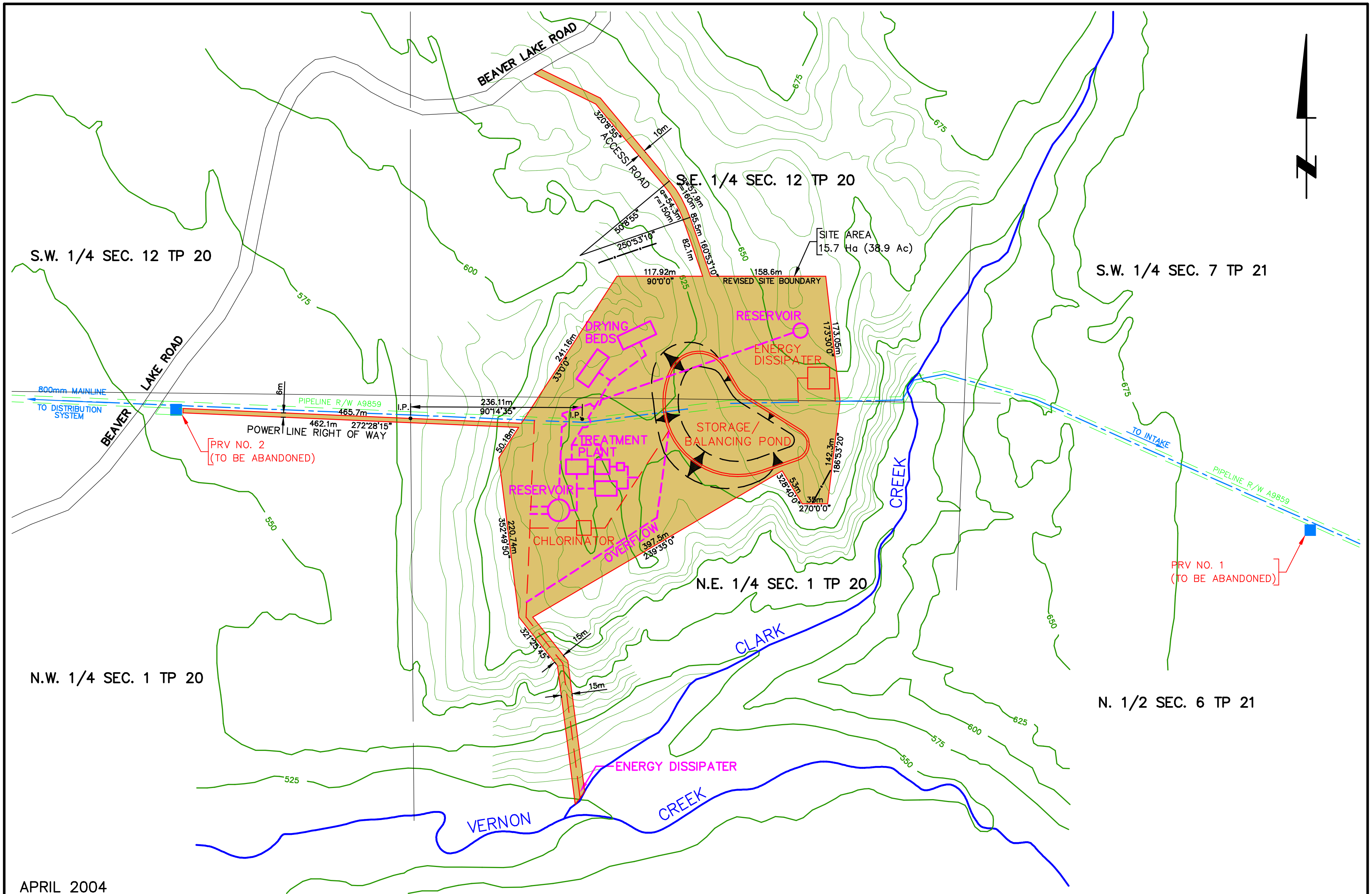
11.2.3. Ultraviolet Disinfection Facility

In order to meet Interior Health's objectives and qualify for Federal/Provincial Infrastructure funding, proposed water treatment facilities must achieve 2 log reduction of cryptosporidium, 3 log reduction of giardia cysts, and 4 log reduction of viruses and bacteria. This requirement is not currently met by the Okanagan Lake Pump Station chlorine disinfection facility. Proposed is a UV disinfection facility at the Okanagan Lake Reservoir, which will meet these requirements and achieve a multi-barrier approach to disinfection. UV disinfection is relatively inexpensive, no additional chemicals are needed, and the exceptional clarity of Okanagan Lake water makes this a possible solution.

Estimated Cost: $ 1,000,000

11.2.4. Glenmore Road Booster Pump Station

The purpose of this installation is to supply Okanagan Lake water to the upper pressure zones of the Winfield system. The booster pumps total 350 hp and will be housed in the proposed PR station on Glenmore Road near Okanagan Centre Road West. The pump and electrical works from PR 24 will be relocated to this facility. Sized for a maximum flow of 200 lps (3,200 USgpm), the facility will be able to meet the water demands of the WOCWS for approximately 8 months, from mid-September to mid-May. The pumps will boost into the mainline and operation will be controlled by the proposed Eldorado Storage/Balancing Pond discussed in Section 11.1.4. The pumping facility will provide many operating options, and act as a secondary source in times of emergency or maintenance.



DISTRICT OF LAKE COUNTRY

PROPOSED WATER TREATMENT FACILITY

FIGURE 17

SCALE: 1:7,500

The pump station could be increased in size to 300 lps (4,800 USgpm), which will add capital and operating costs, but will supply the upper pressure zones for approximately four additional weeks each year. However, if growth occurs as expected in the Town Centre / Woodsdale areas, the supply to the pump station will slowly diminish to 100 lps over approximately 20 years.

Estimated Cost: $ 740,000

11.2.5. Eldorado Water Treatment Facility

In conjunction with the preceding projects, a water treatment facility is needed on the Vernon Creek supply main to provide superior water quality year round. The proposed water treatment facility meets the requirements to obtain Federal/Provincial Infrastructure funding.

The facility will be designed to supply 460 lps (7,290 USgpm) and will be located at the Eldorado Storage/Balancing Pond site, as shown on Figure 17, opposite. As already discussed in Section 6.3, a facility of this size could supply the entire demand of the WOCWS for all but the months of July and August.

The treatment process involves flocculation, clarification, and filtration. Additional required works include construction and operation of a pilot plant; a treated water reservoir; a backwash water storage reservoir, and sludge storage ponds. Pilot studies are needed to determine the best treatment process. The cost estimate outlined in Annex 2 is based on a dissolved air flotation or settling process. A schematic of the processes is enclosed in Annex 10.

Estimated Cost: $ 8,900,000

11.2.6. Water Conservation

A number of demand management initiatives could be considered and it is recommended that a study of the options and their related costs be prepared. The previous two summers have been dry and hot and the forecast is similar for the upcoming year. The District should initiate a public information program to provide users with water conservation tips. Soil moisture probes could also be installed in order to begin collecting background data on the soil duty requirements.

Estimated Cost: $ 200,000

11.3. Infrastructure for New Development

Infrastructure for new development and their associated costs have been determined and form the basis for a new Development Cost Charge (DCC) bylaw. Options for increasing the source of water supply are outlined, and the computer model of the distribution system has been analysed to determine the pipe sizes needed to supply the increased demand. This section of the Assessment and Response Plan is not eligible for Federal/Provincial Infrastructure funding and must be solely funded by DCCs levied on new development.

11.3.1. Water Quality Improvements for Development

Two options are presented for increasing the supply of superior water quality for growth. Table 9 on page 32 shows that an additional maximum day demand of 360 lps is required by Year 2024. The first option reviewed is the possibility of increasing the capacity of the Okanagan Lake Pump Station. The second option is to increase the capacity of the proposed Eldorado Water Treatment Facility on the Vernon Creek system.

11.3.1.1. Okanagan Lake Pump Station and Ancillary Works

The pump system design and operating conditions were reviewed in some detail to determine whether the pumping rate could be increased over the original design flow of 464 lps (7350 USgpm). The pump station is well built and there was some thought the pumping rate could be increased at a relatively low cost. In particular, using all three 750 hp (restoring the 350 hp to 750 hp) pumps simultaneously was an obvious area worth investigation even though it was realized that the third pump would not be sufficient to supply the Year 2024 growth.

Although the analysis indicates the pump station design is conservative and most components are capable of an increased pumping rate, there are several areas of concern.

1. The pump station and other facilities along the mainline are susceptible to water hammer, or pressure surges, and the higher the pumping rate the more severe the surges. The worst case scenario occurs during a power failure, causing the pumps to stop suddenly, rather than slowly powering down. The calculated pressure surge with three pumps running is 1,700 kPa (250 psi) compared to 1,200 kPa (180 psi) with two pumps in operation. The pressure surge is over and above the normal operating pressure. Some protection is provided by surge relief valves in the pump station, but these valves are not completely reliable and take some time to open. It is difficult to predict the degree of damage with any surety, but a 1,700 kPa (250 psi) pressure surge has the potential to cause very serious damage to the pump station and other facilities. It is possible to dampen surges by adding a surge tank(s), however, the cost of a surge tank(s) for a facility of this size would be high.

2. The electrical equipment is specifically designed to allow only two pumps to operate at the same time. Upgrading of the electrical system is needed in order to operate the three pumps simultaneously. In addition, transformers on the power supply, which are owned by the District, are only large enough for the operation of two pumps and would have to be upsized. Because the equipment is nearly 30 years old, upgrading the entire electrical system would be quite expensive.

3. The current Ministry of Water, Land and Air Protection's specifications for fish screens on water intakes call for a screening area of 35.7 m^2/cms. The existing screen area is 11.8 m^2, which calculates to be 25 m^2/cms with two pumps running, or 17 m^2/cms with three pumps in operation. The cost of upgrading the existing screens to allow three pumps to operate must be considered.

4. Increasing the pumping rate by using all three pumps reduces the reliability of the pump station and the facility would not meet fire protection standards. The Fire Underwriter's Guidelines for reliability of pumping capacity states *"the system must be able to meet peak day demands with the largest pump out of service"*. The pump station cannot easily be expanded to accommodate a standby pump, and 2,600 m^3 of extra reservoir capacity would be required to compensate for the lack of pumping redundancy.

5. Another important factor against increasing the pump station capacity is its location at the south end of the District. A large portion of the new developments to be supplied with water are at the north end of the service area. Future distribution system costs would be less if the source of supply were closer to the areas of use.

In our opinion, the costs required to increase the pumping rate of the existing facility are better spent at a water treatment facility on Vernon Creek or by adding another pumping facility further North on Okanagan Lake. The Okanagan Lake pump station should remain at the design pumping rate of 464 lps (7,350 USgpm).

11.3.1.2. Eldorado Ultraviolet Disinfection Facility

The recommended option to increase the quantity of water for growth is to construct an ultraviolet disinfection facility at the proposed Eldorado Water Treatment Facility. Vernon Creek water, even following the proposed storage/balancing pond discussed in Section 11.1.4, will not likely be suitable for ultraviolet disinfection. However, if the water is blended with the product from the full treatment facility discussed in Section 11.2.5, the resulting quality may be suitable for ultraviolet disinfection. Piloting is required and if successful, benefits to the District include significant chemical cost savings.

Estimated Cost: $ 750,000

11.3.2. Okanagan Lake Reservoir Expansion

Additional reservoir balancing capacity will be required to supply the peak hour component of the increased demand. The majority of the growth will likely occur in the gravity and pressure reduced areas from the Okanagan Centre Reservoir, therefore, the additional reservoir capacity will be required at this location. A proposed reservoir size of 2.5 million litres will be situated at the same elevation as the existing structure.

Estimated Cost: $ 810,000

11.3.3. Distribution System Improvements

Waterworks for AutoCAD R14 was used extensively to investigate supply options for new development. Two key design parameters were maintaining the existing standard of water service for existing users, and adhering to the water system design parameters outlined in Table 5. The proposed distribution system works have been designed to supply peak hour demands. Drawing number DLC-111A is a schematic of the computer model showing pipes and nodes and the corresponding computer printout is enclosed in Annex 9. Drawing number DLC-110A shows the proposed infrastructure required to supply new development and identifies Developer versus DCC funded projects.

The proposed works described below assume the Existing System Improvements and Water Quality Improvements described in Sections 11.1 and 11.2 respectively, will be implemented prior to or in conjunction with these projects. Each development must be analyzed on an individual basis but the following provides a general outline of the service possibilities.

1. McCoubrey Road

   Significant development is slated to occur in the McCoubrey Road area, and although existing users receive low pressures from the Okanagan Lake pumped supply, this will not be permitted for future development. It is therefore recommended that a pipeline from the Vernon Creek mainline, including a PR station, be extended over to this area to ensure adequate pressure, especially during a fire.

2. Town Centre and Woodsdale Areas

   Several new pipelines and pipeline upgrades are required to ensure this area does not exceed maximum pipeline velocities and maintain sufficient pressure to all users. Amongst these upgrades, PR 5 will be relocated to a new location on Glenmore Road as outlined in Section 11.2. Dead-end watermains will be looped when possible, to minimize the extent of existing watermain upsizing.

3. Clearwater Development

   A simple pipeline extension from the Okanagan Lake pumped supply main on Jim Bailey Road is required to service the Clearwater development. The proposed works will loop to a proposed pipeline on Lodge Road via a PR station to eliminate the long dead-end pipeline associated with servicing. All works to be installed will be developer funded.

4. Moberly, Pretty and Middleton Roads Developments

   Servicing the **Moberly Road** development with high quality water within the time frame of their expected development is very costly. Therefore, it is proposed to primarily service the development from the existing Vernon Creek source, and expect that the expansion to the Eldorado Water Treatment Facility or other water quality improvements will be implemented.

   The **Pretty Road** development has the advantage of partially being within the Town Centre / Woodsdale pressures zones and nearby existing watermains that service this area. It is possible to service a portion of the development with Okanagan Lake water and the remaining portion with Vernon Creek water until the Okanagan Centre Road works are completed.

   The **Middleton Road** development lies predominantly in an intermediate pressure zone above the Town Centre / Woodsdale pressure zone, best serviced by existing infrastructure with Vernon

Creek water. A small portion of the development could be serviced by an even higher-pressure zone. The long term supply for this development will be Okanagan Lake water via the Okanagan Centre Road works.

5. Pollard's Pond

   Water servicing plans for the Pollard's Pond development have proceeded to another level. The plan involves supplying the first 200 units with Vernon Creek water via the existing infrastructure. This can be facilitated as demand along Okanagan Centre Road will be transferred to the Okanagan Lake system. An on-site booster station, as well as a booster station at the intersection of Okanagan Centre and Jardine Roads are included in the works required to supply the entire development. Several on-site PR stations are also required to reduce pressures in the lower sections of the development. The associated works will be developer funded and are not included in the attached cost estimates.

6. Lakeside Properties

   This development has the advantage of being situated beside the Okanagan Lake Reservoir. The development area is primarily located north and above the balancing reservoir and will be serviced via a booster pump station supplied from the Okanagan Lake Reservoir. The booster station will then feed another higher reservoir within the development for on-site growth. All the required works would be developer-funded.

Table 11

Water DCC Capital Expenditure Program
Infrastructure for New Development

DCC Eligible Capital Expenditures	YEAR										TOTAL
	2004 2005	2006 2007	2008 2009	2010 2011	2012 2013	2014 2015	2016 2017	2018 2019	2020 2021	2022 2023	
Eldorado Ultraviolet Disinfection Facility							100,000	650,000			750,000
Okanagan Lake Reservoir Expansion									110,000	700,000	810,000
McCoubrey Road - Dick Road - 970 m South				290,000							290,000
Jim Bailey Road - Okanagan Lake Mainline to Beaver Lake Road			235,000								235,000
Beaver Lake Road - Jim Bailey Road to McCarthy Road				180,000							180,000
McCarthy Rd. - Bottom Wood Lake Road - 500 m South on McCarthy		170,000									170,000
Bottom Wood Lake / Konshuh / Meadow Roads - McCarthy to Lodge Road							330,000				330,000
Main Street - South of Grant Road Intersection					65,000						65,000
Berry Road - Grant Road to Bottom Wood Lake Road					110,000						110,000
Lodge Road - Highway 97 to Sherman Road								230,000	250,000		480,000
Oceola Road - Highway 97 to Pretty Road						170,000					170,000
Miscellaneous PR Reconfigurations, Pipelines, and Upsizing	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	30,000	300,000
Existing Debt Repayment	263,000	263,000	134,000								660,000
Planning and Engineering	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	35,000	350,000
INFRASTRUCTURE FOR NEW DEVELOPMENT	328,000	498,000	434,000	535,000	240,000	235,000	495,000	945,000	425,000	765,000	4,900,000

6. Lang and McGowan Roads

   These relatively small developments are close together and near existing watermains, and sewer extensions are currently being planned despite the relatively long distances involved.

Estimated Cost: $ 2,030,000

11.3.4. Miscellaneous PR Reconfigurations, Pipelines, and Upsizing

As development occurs, the District may have to upgrade various pipelines to meet the water demands. It is recommended the District set aside the following contingency value to account for minor pipe upgrades not accounted for in this plan.

Estimated Cost: $ 300,000

11.3.5. Planning and Engineering

An amount is included for miscellaneous planning and engineering that may be required for review of small development applications. This is a preventative measure that helps keep problems from compounding and creating deficiencies that cost large sums of money to solve. As well, an amount is included for updating and expanding the Assessment and Response Plan to include additional sections.

Estimated Cost: $ 350,000

The above works are meant to be phased as development occurs. It should be noted that predicting the where and when of new development is not an exact science, and there will likely be several supply options depending on the extent, location and timing of development. For planning purposes, Table 11, opposite, breaks down the above work into an estimated time frame for construction.

12. Capital Cost Estimates

12.1. *Existing System Improvements*

12.1.1. Capital Cost Summary

The estimated cost of the works required to upgrade the Existing System are summarized below. Details of the estimates are contained in Annex 1. It should be noted that these projects are capital works and annual operation and maintenance projects are not included. The cost estimates do not include land acquisition, and are based on limited design and fieldwork. The estimates should therefore be considered preliminary. Subsurface materials, such as bedrock or groundwater that may be encountered during construction, have not been included in the estimates.

Existing System Improvements

1.	Dams & Reservoirs	$ 570,000
2.	Vernon Creek Intake	75,000
3.	Mainline Corrosion Protection	200,000
4.	Eldorado Storage/Balancing Pond & Disinfection Facility*	2,090,000
5.	Distribution System PR Stations	375,000
6.	Distribution System	1,590,000
	TOTAL	**$ 4,900,000**

* It should be noted that this facility has a number of purposes, including stabilization of flows and pressures, water conservation, and short-term storage. The short-term storage will provide a water supply so that flows from the intake can be shut-off for intake or mainline maintenance or during very poor water quality events in the creek.

12.1.2. Monthly and Annual Rates

The estimated costs outlined are for necessary system improvements that must be undertaken within the next 20 years. Details of project financing will be completed by the District, and the following points should be taken into consideration.

1. A considerable portion of the operating, maintenance and repair expenses can be contributed directly to PR stations 1 and 2, and the pressure surges that occur in the mainline. Construction of the Eldorado Storage/Balancing Pond Disinfection Facility will reduce these expenses and eliminate the need for an immediate capital expenditure of approximately $250,000. This is the estimated capital needed to upgrade the critical components at PR stations 1 and 2 but would not resolve the major problem

2. Besides the abandonment of PR stations 1 and 2, the system improvements outline four other stations to be removed. Fewer stations will simplify system operations, reduce operating and maintenance costs, and remove old infrastructure, which needs to be replaced.

3. An important consideration is the annual cost to be borne by the existing users. If the entire estimated cost of $4,900,000 is financed, the annual cost for repayment of debt will be $419,000. This assumes financing through a Municipal Finance Authority debenture, amortized over twenty years at an interest rate of 6%. The current water rate is $340 for the typical household and $153 per ha. for Grade ‘A’ land.

12.2. *WATER QUALITY IMPROVEMENTS*

12.2.1. Capital Cost Summary

The estimated cost of the works required to improve the water quality to meet Interior Health's objectives and the GCDWQ is summarized below. Details of the estimates are contained in Annex 2. The cost estimates do not include land acquisition, are based on limited design and fieldwork, and should therefore be considered preliminary.

Water Quality Improvements

1. Okanagan Lake Pump Station		$ 500,000
2. Gravity Supply From Okanagan Lake Reservoir		
2.1	Phase 1 – Town Centre / Woodsdale	340,000
2.2	Phase 2 – Okanagan Centre Road	1,120,000
3. Ultraviolet Disinfection Facility		1,000,000
4. Glenmore Road Pump Station		740,000
5. Eldorado Storage/Balancing Pond & Disifnection Facility		8,900,000
6. Water Conservation		200,000
TOTAL		**$ 12,800,000**

12.2.2. Annual Costs

The estimated annual costs of constructing, operating and maintaining the Glenmore Road Pumping facility, plus the additional costs required to operate the Okanagan Lake Pump Station are shown in Table 12 on page 57. Only the power costs for the Okanagan Lake station are shown, as the maintenance and operating costs will essentially be the same as current costs. The costs of operating the Okanagan Lake and Glenmore Road

Pump Stations will vary widely from one year to another, as pumping rates are dependent on weather and water quality. For the purposes of calculating the power rates, Year 2000 flow values shown in Figure 6 have been used, as it is considered an average year. The annual costs have not been estimated for the Vernon Creek water treatment facility, as the most economical treatment process is unknown at this time.

Annual debt payments assume the capital cost will be financed through a Municipal Finance Authority debenture issue, amortized over 20 years with an interest rate of 5%. Following are two options for which the annual costs have been estimated.

- **Option 1**

Install the works required at the Okanagan Lake Pump Station and those needed to provide gravity supply from the Okanagan Lake Reservoir, other than the Phase 4 Interconnect and the Ultraviolet Disinfection Facility ($2,700,000 capital cost). Operate the pump stations to supply through April, May, and June (approximately 90% demand).

- **Option 2**

Same works as Option 1 ($2,700,000 capital cost) but operate the pump stations to supply as much demand as possible.

Table 12

Annual Costs – Year 2004

Option Number	**1**	**2**
1. Okanagan Lake		
a) Increased Power	$46,000	$140,600
2. Glenmore Road		
a) Power	18,400	50,600
b) Maintenance	800	3,200
c) Operations	1,200	4,800
3. Annual Debt Payment	212,900	212,900
4. Total	***279,300***	***412,100***
5. Equivalent Rural Residential Connections	1,845	1,845
6. Increased Annual Cost per Connection	151	223

12.3. INFRASTRUCTURE FOR NEW DEVELOPMENT

12.3.1. Capital Cost Summary

The estimated cost of the works required to supply growth to the Year 2024 is summarized below. Details of the estimates are contained in Annex 3. The cost estimates should be considered preliminary as they are based on limited design and fieldwork.

Infrastructure for New Development

1.	Eldorado Ultraviolet Disinfection Facility	$ 750,000
2.	Okanagan Lake Reservoir Expansion	810,000
3.	Distribution System Improvements	2,030,000
4.	Miscellaneous PR Reconfigurations, Pipelines, & Upsizing	300,000
5.	Existing Debt Repayment	660,000
6.	Planning and Engineering	350,000
	TOTAL	**$ 4,900,000**

12.3.2. Development Cost Charges

The calculation of Development Cost Charges (DCCs) for all service provided by the District of Lake Country (ie: water, roads, parks, sewer, etc.) are being completed by another Consultant. Therefore this section is not considered complete. A complete list of the water related projects for the WOCWS, and their capital costs, will be submitted to the Consultant for the calculation of new DCC rates. Although the District maintains and operates numerous water systems, only the costs from the WOCWS will be used to form the new rates levied on developments serviced from the Winfield system. It is expected that rates will be set for the development types of use shown in the following table. The existing rates are shown below and when the new rates are available, they will be included in the table.

Table 13

Development Cost Charges

Land Development Type		**Cost Per Unit**
1. Residential		
Irrigated Land to Residential		
	Single Family	
	Multi Family	
Dry Land to Residential		
	Single Family	$ 3,200 per unit
	Multi Family	$ 2,200 per unit
2. Irrigation		$ 9,884 per ha.
3. Commercial, Institutional, & Industrial (Dependent on building floor area)		
Basic		
	First 250 m^2 (minimum Charge)	
	Over 250 m^2 (Per m^2)	
Building with Approved Sprinkler System		
	First 250 m^2 (minimum Charge)	
	Over 250 m^2 (Per m^2)	

13. Conclusions & Recommendations

13.1. Existing System Summary

These conclusions and recommendations are made following an analysis of the existing system. The items have not been listed in order of priority.

1. The Winfield Okanagan Centre Water System was installed under the ARDA program in the late 60s and early 70s, and a few of the critical facilities are in need of repair or replacement. Most notable, are PRs 1 and 2 that contribute to serious pressure surges in the mainline, as well as elevated annual operating and maintenance expenditures. The surges have resulted in damage to the infrastructure and private property in the past. The District has purchased a site for a storage/balancing pond that will allow the removal of these PR stations. The existing chlorinator will also be relocated as the contact time supplied to the first users can be as low as 20 minutes, which does not meet Ministry of Health Requirements.
2. Water licenses and hydrology of the Vernon Creek Watershed have been reviewed, and it is determined that sufficient capacity is available to meet the annual drought year requirement of the current users. Okanagan Lake also has adequate licenses to meet the current annual demands.
3. Improvements are recommended at the Swalwell Lake Dam within the next 20 years including a new outlet gate and spillway. An automated actuator could be installed at the Dam, in conjunction with level sensors at the Vernon Creek Intake, to retain additional water in the upland reservoirs.

4. Approximately 40 % of the fire hydrants do not meet minimum flow requirements outlined in the Servicing Bylaw.

5. Numerous capital work projects, ranging from corrosion protection on the steel mainlines to removal of PR stations, are required to upgrade the system to meet the Servicing Bylaw and current water system standards. The estimated cost is $4,900,000.

6. During the spring of 2002, the District upgraded the screening facility on Vernon Creek, and installed a booster pump at PR 24 to provide water from the Okanagan Lake System into the Vernon Creek System. Both facilities work well, and to date, the District has avoided a Boil Water advisory being issued for the first time in the past nine years.

7. The cost estimates are based on limited design and fieldwork, do not include land acquisition, or bedrock and groundwater expenses that may be encountered. Therefore, costs must be considered preliminary and further work should be completed prior to financial commitments.

13.2. WATER QUALITY SUMMARY

The conclusions and recommendations made following an analysis of the water quality within the Winfield system are:

.1 The Vernon Creek water quality consistently fails to meet the Guidelines for Canadian Drinking Water Quality (GCDWQ), while the Okanagan Lake source always meets the criteria.

.2 The worst water quality problems in Vernon Creek occur in the Spring, or during major storm events. During this period, the demand in the system is low. Colour and turbidity are the main problems, with colour averaging 35 TCU over the year and turbidity averaging 3.3 NTU. Colour is an aesthetic problem, but turbidity is both an aesthetic and a health problem as suspended particulate matter shields pathogens from the disinfection process.

.3 The Health Officer has issued 11 Boil Water Advisories on the Winfield System over the past 9 years. An analysis of the drinking water bacteriological reports for the years 1994 to 2000, indicate three samples contained faecal coliforms, 23 samples contained total coliforms, and 8 samples contained more than 10 coliforms per 100 millilitres.

.4 Good water quality is available from Okanagan Lake and the existing pumping facility has surplus capacity, however, only enough to supply 40 % (290 lps) of the maximum day demand. It is recommended this source be used to improve water quality for domestic use.

.5 The theoretical peak hour demand of all users is 900 lps, of which approximately 70% is the irrigation component, and 30% is the domestic component. The irrigation demand occurs from approximately June to August. The demand for the remainder of the year could be supplied from Okanagan Lake via the proposed pumping and gravity supply works. The estimated cost of these works is $3,700,000.

6. The proposed PR / pumping facility on Glenmore Road is a key component in the Master Plan. It is recommended the District of Lake Country representatives begin negotiations to secure a suitable site for the facility.

7. In order to provide the entire maximum day demand (750 lps) of the Winfield system with superior water quality, a treatment facility is required on the Vernon Creek mainline to treat a volume of 460 lps (750 less 290 lps). Treatment of the source is required in order to meet Interior Health's objective for water purveyors to

provide: a dual disinfection barrier, 2 log cryptosporidium, 3 log giardia, and 4 log viruses reduction. The facility will be located at the site of the proposed Eldorado Storage/Balancing Pond and is estimated to cost $8,900,000.

8. Prior to determining the final treatment process for the Vernon Creek water source, pilot studies must be completed. Piloting should be conducted for a duration of three to six months, and should include a spring freshet event.

13.3. Infrastructure for New Development Summary

These conclusions and recommendations are made following an analysis of the water system infrastructure required to service new development within the WOCWS service area.

1. The District of Lake Country growth estimates indicate there may be 2,320 single-family equivalent units, and 100 ha of irrigated agriculture developed by Year 2024, which will increase maximum day demand increase by 360 lps. The existing water sources can meet this annual and maximum day demand and still have a surplus. By Year 2024, the domestic component will represent approximately 45% of the maximum day demand, with the irrigation component at 55%.

2. The plan to supply new development is complicated as the characteristics of the Vernon Creek and Okanagan Lake sources are very different from both a quality and hydraulic point of view. The general concept to supply new development is to service the lower lands from the Okanagan Lake source and service the upper lands from the Vernon Creek source. Two critical items that must be understood when utilizing the Vernon Creek source are:

.3 Superior water quality will not be available in the interim, however, improvement plans are being implemented.

.4 A minimum quantity of water equal to the proposed development demand must be transferred from the Vernon Creek mainline to the Okanagan Lake mainline.

This being said, each development has a different effect on the system and funds in addition to the DCC contributions may be necessary to facilitate growth in order to not negatively impact existing users. Each application for water servicing must be assessed in detail before approval can be given.

.5 The recommended improvements include a Eldorado Ultraviolet Disinfection Facility, an Okanagan Lake Reservoir expansion, and numerous distribution system installations for a total estimated cost of $4.9 million.

.6 The existing Okanagan Lake Pump Station cannot be upgraded to allow all three pumps to run due to hydraulic limitations.

.7 It is recommended that new Development Cost Charges be calculated and a 2004/5 DCC Bylaw be authorized for the expenditures to be incurred in these years, as outlined in the Assessment and Response Plan.

LEGEND

WATERMAIN

DISTRICT OF LAKE COUNTRY BOUNDARY

FIRE HYDRANTS

- < 32 lps (< 500 US gpm)
- < 60 lps (< 950 US gpm)
- 60 – 95 lps (950 – 1500 US gpm)
- > 95 lps (1500 US gpm)

NO.	DATE	BY	REVISION
A	MAY 2002	R.J.	GENERAL REVISIONS
B	APRIL 2004	R.J.	BASE, BRUN RD W/M, WOODSDALE RD W/M, BEAVER LAKE RD. W/M EXTENSION UPDATED

Mould Engineering
206 – 437 Glenmore Road, Kelowna, B.C. V1V 1Y5
Telephone 868-2072

DRAWN	R.J.
DESIGN	
APPROVED	
DATE	FEB. 2002
SCALE	1:12,500

DISTRICT OF LAKE COUNTRY

WINFIELD OKANAGAN CENTRE WATER SYSTEM
FIRE HYDRANT FLOW CAPACITIES

DRAWING NO. DLC–105

REV. NO. B

LEGEND
WATERMAIN
DISTRICT OF LAKE COUNTRY BOUNDARY
EXISTING WATER SYSTEM
TOWN CENTRE/WOODSDALE AREA
OKANAGAN CENTRE ROAD AREA
WATER QUALITY IMPROVEMENTS-PHASE 1
WATER QUALITY IMPROVEMENTS-PHASE 2
WATER TREATMENT FACILITY

NO.	DATE	BY	REVISION	CH'KD
A	APRIL 04	R.P.	ADDED DETAILS FROM DLC-109 PLUS GENERAL UPDATES	

Mould Engineering
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DRAWN R.J.
DESIGN J.G.
APPROVED
DATE FEB. 2002
SCALE 1:12,500

DISTRICT OF LAKE COUNTRY

WINFIELD OKANAGAN CENTRE WATER SYSTEM
EXISTING SYSTEM &
WATER QUALITY IMPROVEMENTS

DRAWING NO. DLC–107
REV. NO. A

LEGEND

- EXISTING WATERMAIN
- 95 PIPE
- 95 NODE
- 95 SOURCE
- PRESSURE REDUCING VALVE

NO.	DATE	BY	REVISION	CH'KD
A	APRIL 2004	RJ	MODEL UPDATE, PR 24 & STA 25, BRUN RD W/M, WOODSDALE RD W/M, BEAVER LAKE RD W/M EXTENSION	

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DRAWN	J.B.
DESIGN	R.W.
APPROVED	J.G.
DATE	JAN. 2002
SCALE	1:12,500

DISTRICT OF LAKE COUNTRY

EXISTING WATER SYSTEM
COMPUTER MODEL SCHEMATIC

DRAWING NO. DLC–108

REV. NO. A


OKANAGAN LAKE
WOOD LAKE
VERNON CREEK
CLARK CREEK
LAKESIDE
LANG
McGOWAN
MOBERLY
MIDDLETON
POLLARD'S POND
PRETTY
TOWN CENTRE
WOODSDALE
CLEARWATER
STUBBS RD
TYNDALL RD
McCOUBREY RD
OK CENTRE RD WEST
CHASE RD
GLENMORE RD
SHANKS RD
SEATON RD
HWY 97
HILL RD
MAIN ST
NEWENE RD
BOTTOM WOOD LAKE RD
McCARTHY RD
JIM BAILEY RD
BEAVER LAKE RD
BEAVER LAKE RD.
LODGE RD
SHERMAN RD
REISWIG RD
WOODSDALE RD
HARE RD
CAMP RD
CEMETERY RD
BOND RD
OK CENTER RD
PRETTY RD
OKANAGAN CENTRE RD
OK CENTRE RD W
OK CENTRE RD EAST
GOLDIE RD
OCEOLA RD
CARR'S LANDING RD
MOBERLY RD
OYAMA RD
MIDDLE BENCH ROAD
CITY OF KELOWNA D.L.C. BOUNDARY
OKANAGAN LAKE PUMP STATION AND CHLORINATION FACILITY
OKANAGAN LAKE RESERVOIR AND VALVE CHAMBER ELEV. 536.4m
PROPOSED BOOSTER STATION
PROP. 2.5 MILLION LITRE RESERVOIR ELEV. = 536.4m
PROPOSED PR STA 29 HGL = 500m
RESERVOIR & VALVE CHAMBER ELEV. 588.4m
PROPOSED BOOSTER
TO BE ABANDONED
TO BE ABAND.
TO BE RECONFIGURED
PROPOSED PRV
STA 25 METERING CHAMBER
BOOSTER/PR STA 24
STORAGE/BALANCING POND
LEGEND
EXISTING WATERMAIN
DLC BOUNDARY
FUTURE DEVELOPMENT AREAS
PROPOSED WORKS – DEVELOPER FUNDED
PROPOSED WORKS – DCC FUNDED
PROPOSED WORKS – WATER QUALITY IMPROVEMENTS WHICH WILL ALLOW GROWTH
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DRAWN J.B.
DESIGN J.G.
APPROVED
DATE JAN. 2004
SCALE 1:12,500
DISTRICT OF LAKE COUNTRY
DEVELOPMENT GROWTH AREAS
PROPOSED WATER SYSTEM – 2024
DRAWING NO. DLC–110
REV. NO. A

LEGEND

- EXISTING WATERMAIN
- PIPE
- NODE
- SOURCE
- PRESSURE REDUCING VALVE
- BOOSTER STATION
- PROPOSED WORKS – DEVELOPER FUNDED
- PROPOSED WORKS – DCC FUNDED
- PROPOSED WORKS – WATER QUALITY IMPROVEMENTS WHICH WILL ALLOW GROWTH

NO.	DATE	BY	REVISION	CH'KD
A	APRIL 04	J.B.	GENERAL REVISIONS	J.G.

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DRAWN	R.J.
DESIGN	J.G.
APPROVED	
DATE	JULY 2002
SCALE	1:12,500

DISTRICT OF LAKE COUNTRY

PROPOSED WATER SYSTEM FOR YEAR 2024
COMPUTER MODEL SCHEMATIC

DRAWING NO. DLC–111

REV. NO. A