

April 3, 2008

Reference: 7010-005.01

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Via email: rhrasko@shaw.ca

Re: Preliminary Groundwater Feasibility Assessment – Fintry Delta Groundwater Supply for Regional District of Central Okanagan

Dear Mr. Hettinga:

At your request Summit Environmental Consultants Ltd. (Summit) has prepared this letter report of a preliminary groundwater feasibility assessment to use groundwater as the potable water supply for a new water system to be constructed to serve residential developments in the Fintry area along the Westside of Okanagan Lake.

Project Background and Objectives

Based on the water servicing report prepared by Agua Consulting (2007) for RDCO, the estimated ultimate buildout of 492 single-family equivalent (SFE) lots in the potential service area will require groundwater source capacity of 41 L/sec, or approximately 650 US gpm to meet maximum day demand. Conceptually, this might comprise a two-well system with individual well capacities in the range of 21 L/sec or 330 US gpm. The most probable source for this volume of groundwater will be found the aquifer formed in the Shorts Creek alluvial fan, otherwise known as the Fintry Delta. This aquifer (No. 358) is mapped by the B.C. Ministry of Environment, and is classified as highly productive, moderately vulnerable (to contamination) with moderate demand (use). The aquifer is composed of sand and gravel that is interbedded with finer-grained deposits of silt and silty sand and gravel, typical of alluvial fans in the B.C.

Interior. This study focuses on a technical evaluation of water supply options that may be pursued by using groundwater wells developed in Aquifer No. 358.

Report Organization

The report is organized into the following sections:

- Project Objectives and Scope of Work
- Study area description and field reconnaissance
- Hydrogeologic data review
- Area well summary and previous groundwater studies
- Groundwater occurrence and flow
- Groundwater supply development feasibility
- Recommended next steps

Project Objectives

As with most groundwater development projects, the process is expected to involve in two or more phases, with Phase I, the subject of this report, consisting primarily of a desktop study to confirm groundwater supply feasibility and to identify suitable well locations and Phase II consisting of test-production well installation, aquifer testing, and further hydrogeologic analysis. Assuming test drilling results are favourable, a hydrogeologic report would be prepared at the conclusion of Phase II. The information in the Phase II report would be submitted to Interior Health as part of their regular waterworks approval process, and would also provide the key hydrogeologic information needed for final groundwater supply system design (e.g. sustainable well capacities, recommended pump design parameters, water quality, and source protection).

The Phase I study objectives listed below are intended to provide the information necessary to support moving ahead with well drilling, testing and IHA permitting. Phase II detailed scope, schedule and budget will be developed following Phase I.

Phase I Objectives

1. Assess potential developable groundwater yield, and determine whether or not 41 L/sec is feasible and if so, the probability of obtaining this flow from two wells;
2. Assess the potential water quality issues with respect to groundwater, including but not limited to aesthetic parameters such as hardness, iron and manganese, as well as health concerns such as potential groundwater under direct influence of surface water (GUDI) that have a significant bearing on treatment and total project (life cycle) costs;
3. Identify potential well sites; assess each potential well site as to its suitability based on hydrogeologic, land tenure, and engineering factors, as well as source protection considerations; and
4. Assuming groundwater capacity of 41 L/sec is considered feasible, recommend a minimum of two target drilling locations, well design details (e.g. diameter and depth)



and provide detailed cost estimates for the next phase of groundwater development program.

5. Provide sufficient technical information that could be used in the Phase II to obtain IHA public health engineering approval to construct test / production wells at the recommended locations.

To address the above objectives, Summit conducted the following tasks.

Scope of Work

Summit's scope of work consisted of the following:

Task 1 Initial Review

- Conducted a one-half day site visit and reconnaissance;
- Reviewed reports prepared for the proposed water system project that were prepared by Aqua Consulting, Inc.;

Task 2 Conceptual Model Development and Identification of Potential Well Sites

- Assembled climate, topography, geology, and water well information and conduct a hydrogeologic data review;
- Requested meeting with B.C. Parks staff to discuss possible test well sites;
- Assessed the feasibility of using groundwater as the water supply source for the development;

Task 3 Prepare Hydrogeologic Report with Recommendations and Costs

- Prepared this Phase I groundwater supply feasibility report with recommendations.

Study Description and Field Reconnaissance

The study area comprises the low-lying Fintry Delta area, most of which is now part of Fintry Provincial Park, which is bordered on the south by a residential development area known as Fintry Estates.

The 360 hectare Class A park facility was formed in partnership between the Regional District of Central Okanagan and the B.C. Ministry of Environment. The 1998 Management Plan for Fintry Park (BC Parks 1998) states that the 1995 purchase was a joint investment by RDCO and the province of B.C. and included four large parcels of land. District Lot 2921 (129.5 ha) was contributed by RDCO.

In February 2008 Summit contacted B.C. Parks regarding a site visit, specifically requesting that a representative from Parks staff attend. This request was declined by Blake Dixon of B.C. Parks, who cited concerns with locating wells on Parks property. This concern was forwarded to the Regional District for followup.



After the Park re-opened for the season on 1 April, Doug Geller, P.Geo, a hydrogeologist with Summit, made a brief site visit on 2 April 2008. The objective of the field reconnaissance was to examine areas on the Fintry Delta that might be suitable for domestic wells. The factors considered included: proximity to surface water (e.g. Okanagan Lake and Shorts Creek), location with respect to existing wells (e.g. B.C. Parks wells), general ease of access, the potential to minimize visual impacts within the park area, and potential contamination sources, such as septic systems. For the purposes of this report, we organized the delta into four discussion areas, which are labeled on Figure 1 as N (Northern Area), C (Central Area), W (Western Area) and S (South Area) and discussed below.

Northern Area

The northern section of Fintry Park contains most of the development including day use areas, the Manor House, the campground, and other facilities. Consequently, this is probably the most heavily used area of the park and also where most of the park infrastructure is located. There are a number of buildings in this area including washrooms, the Manor House, and other accessory buildings including a new well house (see photos). One possible area where wells could be developed would be in the general proximity of the Manor House parking area, perhaps in between the parking area and the adjoining day use / picnic area. This location should be sufficiently set back from septic fields and the existing Parks well (see photo), and visual impacts could potentially be mitigated because the area is partially forested.

Central Area

The central portion of the park is comprised mainly of a large field, with a few trails, the cannery building along the lakefront, and the riparian corridor of Shorts Creek. The drawback with attempting to locate a well in this area would be mitigating the visual impacts, and much of the area is grassland.

Southern Area (S. of Shorts Creek)

The southern portion of the park includes the area south of Shorts Creek, which borders the residential development area at lower Fintry. It is possible that wells could be located south of the Creek. Due to the number of existing homes, and the number of potential homes once available lots are developed, suggests a potential risk of septic system contamination that should be further assessed if this area is to be explored further. The other reported high capacity (Parks) well is shown to be in this area (Figure 1), however, we were not able to field-locate this well during our visit.

The Western Area

This area is defined generally as the lands abutting the bottom of the steep slopes below Westside Road, including the octagonal barn and other heritage buildings west of the access road leading to the campground areas. This area is located near the edge of the alluvial aquifer and thus may not be suitable from a hydrogeologic standpoint. Due to the high heritage value of this area, it is also not a good candidate to consider for wells.



Hydrogeologic Data Review

In addition to the site visit, information assembled and reviewed for this study included the following:

- ◆ Climate normal data for Westbank maintained by Environment Canada
- ◆ Forest zone information from BC Forests
- ◆ B.C. 1:50,000 topographic map 082L (1:250,000) and 082L04 (1:50,000)
- ◆ B.C. Geological Survey online mapping
- ◆ Available well reports for nearby wells obtained from BC Water Resources Atlas online well search

Climate

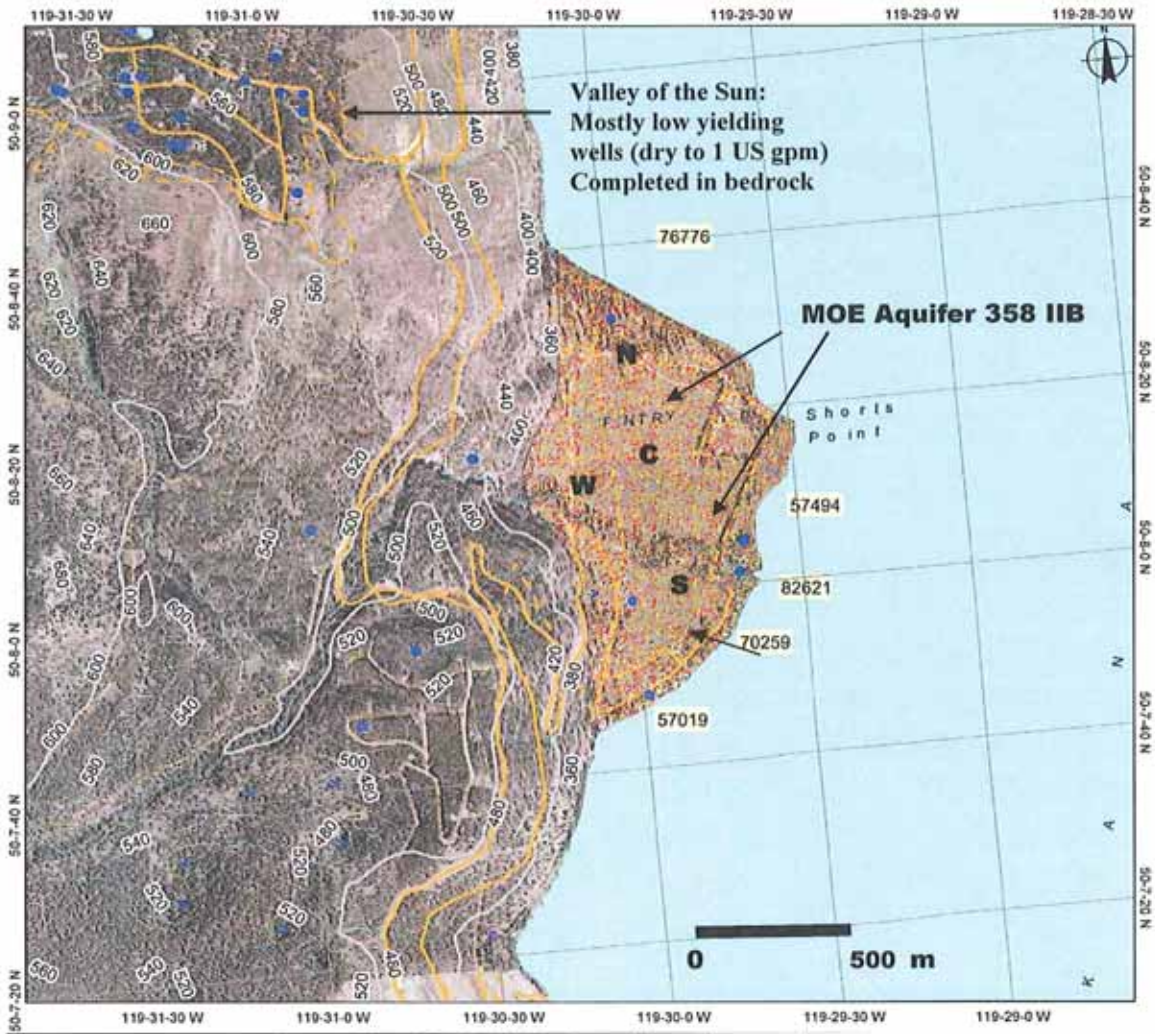
The nearest climate station Fintry is in Westbank (elevation 502 m). The station reports annual temperature averages (between 1971 and 2000) of 8.5°C, and 284.7 mm of precipitation, of which 103.5 mm fell as snow (Environment Canada 2007). There are 245 frost free days on average, in which the minimum temperature was greater than 0°C. July is the hottest month reported with a monthly average of 19.9°C and an average daily maximum of 26.5°C. January is the coldest month with a monthly average temperature of -3.1°C and an average daily minimum of -5.4°C. Annual potential evapotranspiration generally exceeds precipitation, and summer soil moisture deficit is common (Lloyd et al. 1990).

The study area occurs within the Interior Douglas-fir biogeoclimatic zone, Okanagan Very Dry Hot variant (IDFxh1). This biogeoclimatic zone experiences relatively short, cool winters and are characterized by a mix of grassland and forests habitats, often on low-elevation south-facing slopes (Meidinger and Pojar 1991).

Topography

The study site is defined herein as the entire low-lying alluvial delta area of Shorts Creek as shown on Figure 1. The site is east of Terrace Mountain, on a steep eastern-facing slope. Shorts Creek, which transects the southern half of the site from west to east, is a perennial stream, and is the watercourse that deposited the alluvial materials underlying the site. Refer to the Hydrology discussion below for further information on Shorts Creek and its relationship to groundwater.





Note: N, C, W, S refer to discussion areas in text

Figure 1. Well and Aquifer Map

Source: B.C. Water Resources Atlas
Approximate scale shown



Geology

The bedrock geology of the region surrounding Okanagan Lake is dominated by one or several large bodies of middle Jurassic unnamed granodioritic intrusive rocks formed 181 (+/- 5) million years ago (Ministry of Energy and Mines 2007). Field inspection indicates that outcrops of bedrock composed of coarse-grained (phaneritic) granite and quartz monzonite, with darker coloured intrusions of basaltic composition. These crystalline rocks are mapped as a Jurassic Period undivided plutonic series by the British Columbia Geological Survey (MOE 2007). Figure 2 shows the subject site in the context of geology of the area.

Surficial geology is dominated by the fan-delta complex of Shorts Creek. This alluvial complex is a distributary fan, indicative of the main stream channel migrating back and forth across the delta, transporting sediment across a relatively wide area. Unlike most fans, the Fintry delta has a greater width than length. The surficial deposits consist of interbedded sand, gravel, and silt, and are believed to be at least 30 m (100 ft) thick under most of the delta.

Hydrology

Shorts Creek has its headwaters in the plateau region approximately 18 km west of Okanagan Lake and drains an area of approximately 185 km² (Dobson Engineering 1990). Flow in Shorts Creek was previously monitored at a gauging site (08NM151) near its mouth (1969-1982). A summary hydrograph based on these historical flow data appears in Figure 2. The Shorts Creek hydrograph is typical of the Okanagan, characterized by a relatively long low-flow period extending from late summer through late winter, a six to eight week peak flow season (freshet), which starts in late April and ends in late June, and considerable variability in total annual discharge. Mean daily flows range from 0.1 m³/sec in January and February to more than 6 m³/sec in May (Dobson Engineering 1990). The 08NM151 data show that total annual discharge ranges from approximately 15,000 dam³ in drier years to more than 40,000 dam³.

It should be noted that the regional climate has changed since 08NM151 monitoring ended in the early 1980s. Consequently, the peak runoff period in Okanagan creeks now occurs two to three weeks earlier than 20 or 30 years ago.

A report on Shorts Creek prepared by the Ministry of Environment (1969) indicates that near its mouth, in some years, there is no surface flow in the creek bed, even when there is still some flow in the uplands to the west. This is due to the permeable nature of the fan materials, where seepage losses to the ground are greater than creek discharge.



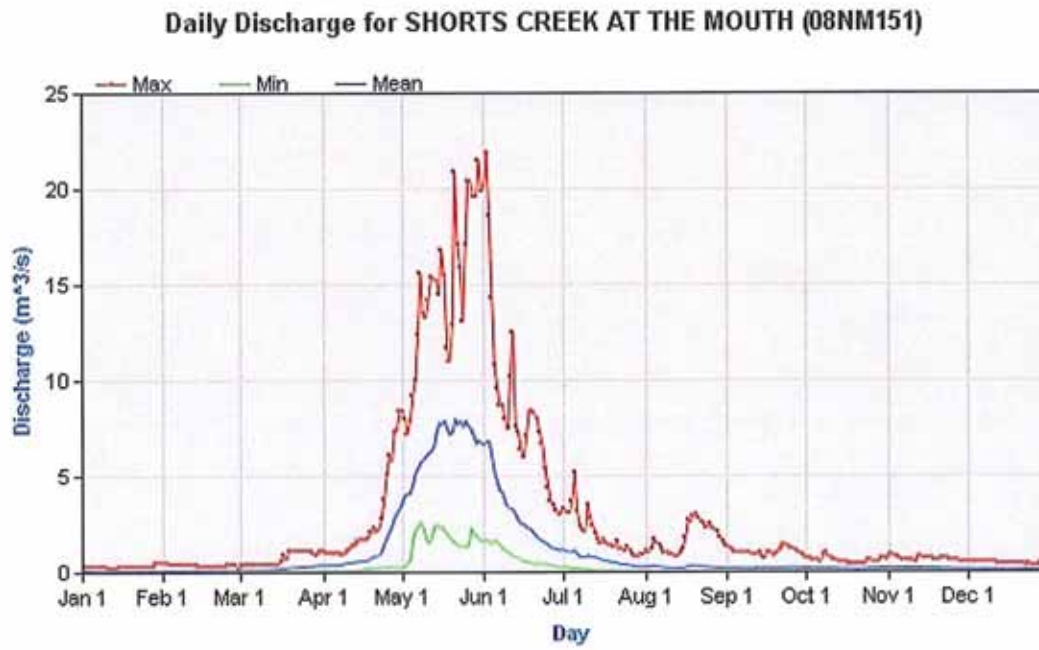


Figure 2. Shorts Creek Flow Data (1969-1982)

source: Water Survey Canada



Area Well Summary and Water Users

As indicated on Figure 1, there are five known or reported wells on the delta. Table 1 shows construction information for these wells. All wells appear to be completed in alluvial sand and gravel.

Table 1. Well Summary

Well Tag Number	General Location on Fintry Delta	Depth to bottom of well		Driller's Estimated Yield		Static Water level reported on driller's log		Comments
		(ft)	(m)	US gpm	L/min	(ft)	(m)	
76775	North	76	23	100	378	17	5.2	B.C. Parks well, test pumped in 1999. Field located by Summit
57494	East – Central	18	5.5	20	76	6	2	Not field located by Summit
82621	East-Central	ND	ND	ND	ND	ND	ND	Not field located by Summit
70259	East - Central	75	23	525	1,985	21	6.4	B.C. Parks well. Not field located.
57019	South	40	12	150	567	6	2	

ND denotes no data

According to Aqua (2007) the Lower Fintry residential development consists of approximately 70 homes that utilize Okanagan Lake water as the source. The Park uses groundwater for domestic supply and lake water for irrigation (using the former domestic supply intake). Other residential developments in the area are topographically above the Fintry Delta. These include Upper Fintry and the Valley of the Sun subdivisions, which reportedly rely on trucked bulk water delivery.

Although groundwater usage at Fintry is currently limited to a few wells, we note that the area is well protected from potential sources of contamination due to the relatively sparse development and park setting. The aquifer underlying the Delta has already been identified for protection, as evidenced by the “Entering Groundwater Protection Zone” signage on the access road (see photos).



Previous Groundwater Studies

Kala Groundwater Consulting Ltd (Kala 1999) conducted a hydrogeologic investigation for a new well in Fintry Provincial Park installed for B.C. Parks. The report documents the completion of a 150 mm (6-in) diameter well, a pumping test, and water sampling and analysis results for the new well and an existing well (probably Tag# 70259). For purposes of the discussion we will refer to the 1999 well as Park Well 2 and the older well as Park Well 1. Locations are shown on Figure 1.

Well 2 was installed to a depth of 23 m (76 ft), with a well screen placed in the lower 2.5 m (8 ft), and was test pumped for 24 hours at a rate of 190 m³/day (35 US gpm). Less than 1 cm of drawdown was observed during the pumping test, indicating a very high specific capacity (more than 190 US gpm per foot of drawdown) and consequently a highly productive aquifer. The base of the aquifer was not penetrated by the borehole. Water quality results from both wells, based on samples collected in July 1999 indicate high quality, with relatively low dissolved solids concentrations, low iron and manganese and typical hardness levels for groundwater. The data are summarized in Table 2 below.



Table 2. Summary of Groundwater Quality Data – Fintry Park Wells

Parameter and units	Units	Well 1 (S. of Shorts Creek)	Well 2 (near Manor House and Park campground)	GCDWQ (MAC or Aesthetic Objective)
Bacteriological				
Total coliform	#/100 mL	0	0	0
Fecal coliform	#/100 mL	0	0	0
Conventionals and inorganics				
Alkalinity Total	mg/L	158	161	None
Aluminum	mg/L	<0.2	<0.2	0.2
Arsenic	mg/L	<0.01	<0.01	0.01
Barium	mg/L	0.01	0.01	1
Boron	mg/L	<0.1	<0.1	None
Cadmium	mg/L	<0.0002	<0.0002	None
Calcium Total	mg/L	46.6	48.0	None
Chloride Dissolved	mg/L	0.9	0.7	<250
Chromium	mg/L	<0.01	<0.01	0.05
Copper	mg/L	<0.01	<0.01	<1.0
Cyanide	mg/L	<0.010	<0.01	0.2
Colour True	Units	<5	<5	<15
Dissolved solids - total	mg/L	183	190	<500
Fluoride	mg/L	0.3	0.2	1.5
Hardness - total	mg/L	152	157	None
Iron	mg/L	<0.03	<0.03	0.3
Lead	mg/L	<0.001	<0.001	0.01
Magnesium	mg/L	<0.005	<0.005	None
Manganese		<0.005	<0.005	0.05
Mercury	mg/L	<0.00005	<0.00005	0.001
Molybdenum	mg/L	<0.03	<0.03	None
Nitrate	mg/L	0.17	0.18	10
pH	pH units	7.9	8.0	6.5 – 8.5
Potassium Dissolved	mg/L	1.5	1.55	None
Sodium Dissolved	mg/L	6.2	6.15	<200
Sulfate Dissolved	mg/L	8	7	<500
Turbidity	NTU	0.3	0.1	See note
Uranium	mg/L	0.00240	0.00258	0.02
Zinc Total	mg/L	<0.005	0.009	<5.0

GCDWQ = Guidelines for Canadian Drinking Water Quality (Mar 2007)

Note: no turbidity guideline for groundwater sources



Currently, a UBC-Okanagan graduate student (Natasha Neumann) is researching surface water and groundwater interactions at three creeks in the basin, including Shorts Creek. At a January 2007 symposium on Okanagan groundwater held in Penticton, B.C. some preliminary results of this research were presented (Neumann, Wei and Curtis 2007), which included an estimated 20 to 85% of Shorts Creek low flows typically recharge groundwater. Additional information obtained from Ms. Neumann is discussed below.

Groundwater Occurrence and Flow (Conceptual Model)

Existing hydrogeologic information indicates the aquifer is highly productive and consists of at least 12 m (40 ft) of coarse sand and gravel. Due to low permeability granodioritic bedrock mapped within the lower Shorts Creek watershed, the bedrock component of groundwater flow toward Okanagan Lake and the delta is believed to be very low.

The alluvial fan aquifer on the delta is recharged principally by losses from Shorts Creek, and also by runoff from the adjacent uplands along the valley wall (contact between alluvium and bedrock), and by direct infiltration of precipitation on the surface of the delta. Other (smaller) forms of incidental recharge include: irrigation and septic system discharges. Although irrigation was formerly practiced on a larger scale in the past using diverted Shorts Creek water, the current park areas are not extensively irrigated.

In this section, we will assess two useful indicators of the potential for sustainable groundwater development:

- Recharge sources (mainly surface water)
- Natural groundwater flow through the aquifer

Recharge sources including Shorts Creek losses

Losses from Shorts Creek have been estimated by Neumann (2008) on the basis of a series of creek flow measurements made during 2006. Neumann estimates, in preliminary (unpublished) form (pers comm. 2008) that creek losses to groundwater average 38 % of flow throughout the year, with higher losses during high-flow periods. In general, this means that Shorts Creek is a losing stream throughout most of the year as it flows across the Fintry delta.

On the basis of the creek hydrology, therefore, we would expect that significant groundwater recharge likely occurs in April, May and June each year coinciding with peak runoff. To put this groundwater recharge process in perspective, we can consider two scenarios: a “dry” year when total creek discharge is 15,000 dam³ and a “wet” year when total creek discharge is 40,000 or more dam³. If we assume potential groundwater recharge from creek losses is 38% of average flows and we also assume that actual recharge is one-half of this value (due to groundwater evapotranspiration or other losses),



then the creek contribution to groundwater recharge could range from approximately 2,800 to 8,500 dam³ per year. This translates to an average daily value of 7,800 to 23,400 m³. More than half of this recharge likely occurs in the months of April, May and June.

Considering the availability of recharge from the creek, and also from Okanagan Lake (which can recharge the aquifer when water levels are depressed by pumping), it appears that there is considerable recharge available to sustain groundwater pumping.

Darcy Groundwater Flow Analysis

Another useful indicator of the potential for sustainable groundwater development is to assess the natural groundwater flow through the aquifer using Darcy's Law. In the case of Fintry Delta, this is a much better indicator than an estimate of the natural areal recharge due to infiltration of precipitation, because this recharge mechanism is not as important as Shorts Creek bed losses and pumping - induced recharge from the lake.

The Darcy analysis estimates the volume of water passing through the aquifer (on average) as follows:

Using Darcy's Law $Q = K * I * A$ where

Q = Groundwater discharge in m³/day

K = hydraulic conductivity of aquifer in m/day, assumed to average 15 m/day

I = hydraulic gradient, assumed to approximate the topographic gradient between westernmost edge of fan/delta deposit and the lake level

A = approximate cross-section area of aquifer based on Width x Thickness (1200 m x 12 m)

Applying the above equation indicates an annual average flow rate as follows:

$$Q = (15 \text{ m/day}) (.016) (14,400 \text{ m}^2) = 3,460 \text{ m}^3/\text{day}$$

The estimated value is in the same order of magnitude as the lower-bound estimate of potential groundwater recharge from Shorts Creek losses, which we consider to be the primary source of recharge to the aquifer.

The above analysis provides an order-of-magnitude estimate of groundwater flow through the aquifer of 3,500 m³/day. This volume of groundwater exits the aquifer along the shore of Okanagan Lake. Under pumping conditions, the aquifer would be recharged by Okanagan Lake and/or additional Shorts Creek losses. The amount of groundwater



recharge from direct infiltration of precipitation is small by comparison to these two recharge sources.

The combination of creek bed losses and (under pumping conditions) induced recharge from Okanagan Lake suggests that the above natural groundwater discharge value of 3,500 m³/day is a lower-bound estimate of the sustainable yield of the aquifer. The fact that the aquifer is surrounded on three sides by Okanagan Lake suggests that depletion of the aquifer by pumping is not likely to occur.

Groundwater Development Potential in Bedrock Uplands

As noted earlier in this report, we focused our assessment on the alluvial sand and gravel aquifer system present beneath the Fintry Delta (Aquifer No. 358). This was primarily due to the stated water system capacity requirement of 41 L/sec. It is our opinion that it is highly unlikely that wells drilled into the bedrock in the upland areas (for example, west of Westside Road near the Valley of the Sun community) would be capable of sustaining this flow. We understand some of the wells in this area have gone dry or are very low-yielding. Examples include a well drilled to a depth of over 300 m (1000 ft) that was reportedly dry (tag#36690) and a 90 m (300 ft) deep well with a reported yield of 0.1 US gpm (tag#49784). It is our understanding that many residents in Valley of the Sun are without water and rely upon bulk water deliveries.

The low well yields in the upland area is due to the geology, which is not conducive to high-capacity groundwater development. As part of our work on the Okanagan Basin Water Supply and Demand Project groundwater study, our assessment indicated that the bedrock in this area is likely to receive very little annual recharge and is also composed primarily of low-permeability granodiorite that has a limited capacity to store and transmit useful quantities of groundwater.

While it is possible that there may be pockets of local groundwater in the bedrock uplands, existing information indicates that there is not enough groundwater to sustain the required flows in the water system. However, it is possible that a smaller amount of groundwater from the uplands could be used as a supplemental water source (e.g. to augment flows in the higher pressure zone). It is suggested that if RDCO becomes aware of any drilled wells with a reported yield of 10 US gpm or more, then the potential could be assessed further with a pumping test program, assuming the well(s) are located in a suitable area and could be used by RDCO.

Groundwater Development Feasibility Findings

Quantity

Present groundwater use during high demand periods, based on five wells, is not known but is probably on the order of 500 m³/day or less. Our analysis and the existing well



information suggests that 41 L/sec could be developed in Aquifer No. 358 from two wells, subject to the results of further investigation, well drilling, aquifer testing and analysis. As with most alluvial aquifer systems, the potential well yield will vary from place to place, but in general well yields between 100 and 1,000 US gpm (6.3 and 63 L/sec) should be possible given properly designed and constructed wells.

Quality

Based on the data from the two B.C. parks wells as reported by Kala (1999), it appears that groundwater quality is very good and should not require treatment other than disinfection, assuming a suitable well location and design resulting in classifying the source as not under direct surface water influence. This finding should be confirmed on the basis of further analysis during Phase II of the project.

Locations and Source Protection

With regard to locations to target for test well drilling, we provide the following general recommendations:

Setbacks:

- Exceed the minimum 30 m setback from septic ground disposal fields in the health regulations by using the Ministry of Environment municipal sewage minimum setbacks of 90 m (confined aquifer) or 300 m (unconfined aquifer), if the aquifer is found to be locally unconfined;
- Avoid areas within 100 m of known existing wells to minimize risk of well interference issues; and
- To minimize the risk of GUDI and/or general surface contamination concerns, setback wells at least 50 m from surface water (either Shorts Creek or Okanagan Lake) and stay above the mapped 200 year floodplain.

Other considerations:

- Avoiding potential well sites that are too close to the western limits of the alluvial aquifer due to potential boundary effects that could limit long-term sustainable well yield; and
- Target locations that are acceptable to B.C. Parks and within reasonable proximity to possible groundwater transmission pipelines.

Our summary recommendation on potential well locations is to target an area where existing infrastructure exists, such as near the B.C. Parks campground on the north side of the delta, or south of Shorts Creek, in the undeveloped area between Shorts Creek and the Lower Fintry housing development. Additional recommendations will be provided separately regarding locations of potential wells in public right of way and not on park property.



Recommended Next Steps


1. Meet with B.C. Parks personnel and identify a minimum of two test well sites, and develop pre-drilling mitigation plans to minimize site disturbance during drilling and visual impacts of water infrastructure (such as well buildings).
2. Depending on the number of sites that can be identified on park property, assess potential well sites on the southern part of the delta that could potentially be constructed in public right of way.
3. After selecting test well sites, obtain permit to construct test wells from Interior Health Authority.
4. Complete well installation, development and aquifer testing (it is suggested this work be completed outside the peak season park and residential use).
5. Proceed with design and construction of water system if well quantity and quality are acceptable.

With regard to test well design, based on the projected water needs of approximately 330 US gpm per well, we advise that the test wells be constructed with 200 mm (8 in) diameter well casing and that they be "fully designed" (i.e. on the basis of formation sample sieve analysis) well screens. This is because if successful, the 200 mm wells could be converted to permanent production wells, whereas conventional 150 mm diameter test water wells would not have sufficient diameter to accommodate 330 US gpm pumps. Although 200 mm wells will cost about 20-25% more to construct than 150 mm, we believe the added cost is worthwhile because a) it is likely that groundwater quality and quantity will be acceptable if good well sites are chosen and tested and b) it eliminates the need for a second round of well drilling for production wells.

We trust that the foregoing meets RDCO's needs at this time. Please feel free to contact Doug Geller if you have any comments or questions.

Yours truly,

Summit Environmental Consultants Ltd.


Douglas Geller, P.Geo.
Senior Hydrogeologist



Reviewed by:

Marta Green, P.Geo.
Project Hydrogeologist

Attachments: References
Photos



References

- Agua Consulting Inc. 2007. Northwest Side Water Report. Prepared for Regional District of Central Okanagan.
- BC Water Resources Atlas, 2008. online water well search
<http://srmapps.gov.bc.ca/apps/wrbc>
- B.C. Geological Survey, online surficial geology map.
http://webmap.em.gov.bc.ca/maplace/maps/minpot/OF_13.MWF
- BC Geological Survey Bedrock online map
<http://webmap.em.gov.bc.ca/maplace/maps/minpot/bcgs.MWF>
- Dobson Engineering 1990. Shorts Creek: Assessment of Alternatives to Enhance Okanagan Lake Fishery. September 1990.
- Environment Canada. 2007. Atmospheric Environment Service, Canadian Climate Normals Website, 1971-2000. www.weatheroffice.ec.gc.ca.
- Health Canada 2007. Guidelines for Canadian Drinking Water Quality – Summary Table March 2007.
- Kala Groundwater Consulting Ltd 1999. Fintry Provincial Park – New Well Water Well Completion and Evaluation Results. Report prepared for Urban Systems Ltd.
- Lloyd, D., K. Angove, G. Hope and C. Thompson. 1990. A guide to site identification and interpretation for the Kamloops forest region. Land Management Handbook 23. Ministry of Forests. Victoria, B.C.
- Ministry of Land Water and Air Protection, June 16, 2004. *Drinking Water Protection Act*, S.B.C. 2001, c.9, sections 48 and 105, *Water Act*, R.S.B.C. 1996, c483, section 101.
- Neumann, N. 2008. Personal communication with Doug Geller, P.Geo. Graduate Student at University of B.C. Okanagan.
- Neumann, N., A. Wei, and J. Curtis, 2007. “Groundwater Interactions in the Okanagan Basin” presentation at the January 2007 Symposium on Okanagan Groundwater, Penticton, B.C.





Photo 1. Looking northeast across the southern part of Fintry Delta, showing undeveloped area south of Shorts Creek (possible well location)

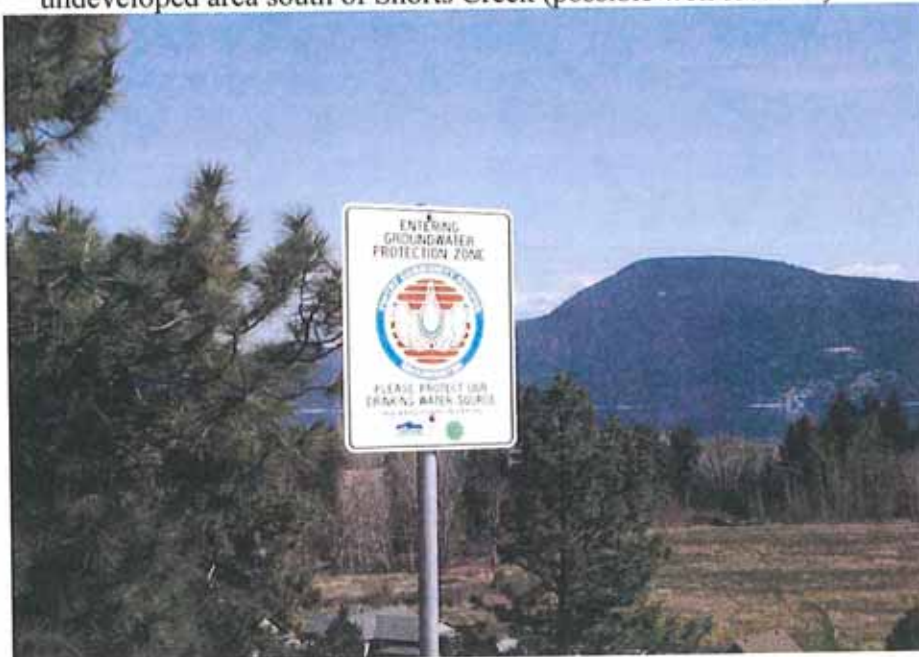


Photo 2. Existing Groundwater Protection Zone sign on Fintry access road.

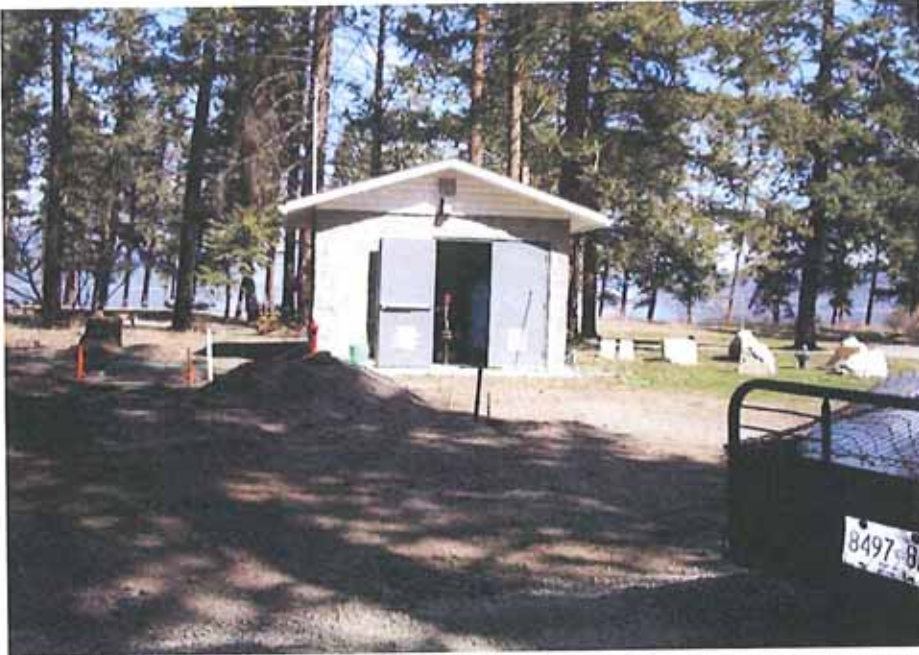


Photo 3. New well building for B.C. parks water source near campground



Photo 4. Shorts Creek approximately 300 m from its mouth, 2 April 2008



Photo 5. Photo looking west, in the vicinity of the Manor House parking area (possible well location)