

**Golder Associates Ltd.**

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December 2, 2002

022-4184

Burrard International/CRC Development •  
1030. West Georgia Street, Suite 1800  
Vancouver, BC V6E2Y3

Attention: Mr. Dan Schweers, Vice President - Development

**RE: WATER LICENSE REVIEW AND  
WATER SUPPLY ASSESSMENT (FIRST STAGE) CRC  
DEVELOPMENT PRATHER CREEK PROPERTY  
KELOWNA, BRITISH COLUMBIA**

Dear Mr. Schweers:

This letter provides Golder Associates Ltd.'s (Golder's) water license review and assessment of potential water supply from water wells at the above noted property. The purpose of the assessment was to determine the potential quantity of water available from surface water, springs and/or on-site wells, and the impacts that groundwater extraction may have on neighbouring well users. It is understood that the water will be required for potential aggregate resource development at the site, with the preliminary requirement of water estimated at 200 Imperial gallons per minute (Igpm) for wash-water.

**1.0 BACKGROUND**

Golder conducted a preliminary assessment of aggregate resources at the site in 2000, with the results of our investigation summarized in our January 11, 2001 report entitled "*Preliminary Geotechnical Assessment, Gravel Study, CRC Property Along Highway 33, Kelowna, British Columbia*". This study identified five areas (Areas A through E) where significant aggregate materials were present on the site.

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In addition, it is our understanding that there are several residents in close proximity to the site who have domestic water wells. These residents have expressed concern about the possible impacts that the operation of a new well for a potential wash plant for aggregate production would have on existing wells.

Golder provided a proposal to CRC Development on October 21, 2002 outlining our proposed workplan to assess water supply options at the site. The scope of the proposed workplan included a review of existing water licenses and a review of available water well information. No supplementary surface or subsurface investigations were included in the scope of the proposed work and none were conducted as part of the preparation of the report. This report presents the results of our review.

## **2.0 METHODOLOGY**

### **2.1 Task 1 - Review of Water Licenses**

Golder reviewed the data provided on the four existing water licences for the property. The licenses were obtained from the Ministry of Sustainable Resource Management web-site. The various springs and Lizzy pond have been previously located during the visual site reconnaissance by Mr. Gerald Imada of Golder. To assess runoff volumes in the area of the site, Golder subcontracted this aspect of the review to Mr. Peter Fearon, a hydrologist with Fearon Environmental.

### **2.2 Task 2 - Water Well Supply Assessment**

The water well supply assessment included: i) a search of the MWLAP groundwater database system for the area, and ii) a door-to-door survey.

The door-to-door survey was completed on November 8, 2002, and all properties in the area of the proposed gravel pit on both Jackpine and Goudie Roads were visited. The survey consisted of a letter outlining our purpose and an attached questionnaire form to be completed by residents. The questionnaire was designed to identify the location, construction details (depth and type of rock or soil encountered), static water level, water quality and yield for each well. If residents were not at home, the letter and questionnaire were left at the door with instructions on how to respond.

### **3.0 RESULTS**

#### **3.1 Water License Review**

It is understood that CRC is in the possession of four separate water licences related to the Prather Creek Property. These licences include:

- a Pyman Spring (separate domestic and irrigation licenses);
- a Catherine Spring (stockwater license);
- a Marshal Brook (stockwater license); and
- a Lizzy Pond (separate domestic and stockwater license).

A summary of the license number, licensee and volume of water available from each license is provided in the November 20, 2002 letter report from Fearon Environmental (Appendix I). The current licenses allow for the withdrawal of approximately 9.6 Igpm (combined) from the four sources. For the purposes of this study, we consider .the 9.6 Igpm from the licenses a maximum value, since there is no information in the licenses outlining how the licensed quantities were determined. In addition, it is unlikely that such a combined yield has been withdrawn continuously to confirm that the yields are sustainable on a long-term basis.

The total runoff for sub-watersheds in the area of the licenses was estimated by Fearon Environmental at approximately 64,000 m<sup>3</sup>/year. This is equivalent to approximately 27 Igpm. As noted in the Fearon Environmental letter, this volume of water assumes that all of the runoff over the entire sub-watersheds could be collected (which would require installation of numerous ditches and ponds). It does not account for evaporation and seepage losses. As such, it is considered likely and economically practical that only a limited fraction of the total estimated runoff could be collected.

Considering the licensed withdrawals available at the property, and that runoff will comprise some of the water accounted for in the licenses, it appears that additional surface water withdrawals (beyond that in the licenses) would be limited to that available during freshet. There is also a reported license (Claxton Spring) downgradient of the site that may have water rights to some of the runoff within the site. The license is for 10 acre-feet/year (approximately 5.2 Igpm).



### 3.2 Water Well Supply Assessment

The review of the MWLAP groundwater database indicated that no wells are listed on the property. Approximately 50 water wells are listed in the area of the site (see Table 1); however, these wells are located on neighbouring properties (on Huckleberry Road, Daves Road and Hwy 33). While the general area where these wells are located is known, the specific well locations have not been recorded by MWLAP.

The database indicates that the wells were drilled between 1963 and 1996. Based on the information given on the well logs, the wells were installed at depths varying from 8.5 m (28 feet) to 158.5 m (520 feet), with a median depth of 70.1 m (230 feet). The majority of the well logs described the subsurface materials as bedrock, with the water table located between 0.9 m (3 feet) and 71.6 m (235 feet) below ground surface (median of 19.2m (63 feet)).

Also included in the water well logs are the observed well yield, generally recorded by the drilling company. This estimate of yield is typically determined by air-lift methods over a short time period (one to two hours) and should be considered a preliminary yield estimate. Of the well yields given in the available records, the yields ranged from a minimum of 0 Igpm (for one well) to a maximum of 180 Igpm, with a median well yield of approximately 2 Igpm and an average yield of 13 Igpm.

Additional information was obtained from three residents who responded to the door-to-door survey. The results are provided in Appendix H The additional data included:

- a drilled well at 1250 Jackpine Road. This well is reportedly 55 m (180 feet) deep and yields 35 Igpm. A well log was not available.
- a dug well at 5987 Jackpine Road. This well is reportedly 3 m (10 feet) deep with an unknown yield. A well log was not available.
- a drilled well at 7319 Trapper Court. This is reportedly 122 m (400 feet) deep and yields 1.5 Igpm. A well log was not available.
- a drilled well at 6011 Goudie Road. The log for this well indicated that it is 38 m (126 feet) deep and yields 3.5 Igpm.

The additional information obtained from the door-to-door survey is consistent with the range in reported well depths and yields listed in the MWLAP database.

Based on the database search and the door-to-door survey, it appears that the predominant aquifer in the area is in the bedrock, at depths of 50 m to more than 100 m. Well yields are quite variable, with many wells reportedly having yields in the order of 1-2 Igpm, although several wells reportedly had yields of 35 to 110 Igpm. However, based on an overall review, it is our opinion that groundwater supply from wells on the property could yield approximately 2 Igpm to 10 Igpm from the bedrock aquifer. Based on boreholes drilled during the geotechnical investigation, it does not appear that an overburden (sand and gravel) aquifer is present on the site, since the gravel deposits were dry during the drilling program.

Even if a higher yielding well was encountered on the property, the sustainability of pumping at a higher rate than several gallons per minute would have to be carefully assessed, as interference with existing wells may occur. This is based on a preliminary infiltration estimate for the sub-watershed upgradient of the property. Assuming an area of approximately 10 km<sup>2</sup> and 20 mm/year of infiltration, these values result in an equivalent infiltration of approximately 80 Igpm. Considering that this infiltration to groundwater also supports existing well users, springs and baseflow to streams, it is considered Likely that significant further withdrawals from groundwater at the site could result in well interference. If withdrawals exceed the net infiltration for the sub-watershed, water levels will decline and eventually yields will decrease.

#### **4.0 DISCUSSION AND RECOMMENDATIONS**

The results of this review indicate that water supply for gravel washing on the property is limited. The existing water licenses may provide 9.6 Igpm if the springs and pond are able to sustain this yield on a continual use basis. Collection of additional runoff within the watershed is considered to be generally limited to the freshet period. Groundwater supply from wells is also limited, most likely yielding approximately 2 Igpm to 10 Igpm. Considering the limited runoff and recharge within the watershed, as well as the need for ongoing flow to existing well users and stream flow, the total available water supply from surface water and groundwater sources is considered likely to be in the order of 10 Igpm to 20 Igpm.

Given that the water supply available on the property is considerably lower than the required 200 Igpm for a gravel washing operation, consideration should be given to alternative sources. In addition, the use of lined reservoirs/lagoons and a re-circulation system would limit the water requirements for the gravel washing operation.

## **5.0 LIMITATIONS**

This report was prepared for the exclusive use of Burrard International/CRC Development to evaluate the feasibility of a gravel washing operation at the Prather Creek property. The assessment follows a standard of care expected of professionals undertaking similar work in British Columbia under similar conditions at the time the work was carried out. No other warranty expressed or implied is made.

The report is based on data and information collected from available sources. In evaluating the subject property, Golder Associates Ltd. has relied in good faith on information provided by individuals or organisations noted in the report.

The assessment of estimated water yields from springs, runoff and groundwater wells is based on 'normal' values obtained from historic climate data. Seasonal or annual variations from 'normal' climate conditions will affect the estimated yields.

Any use that a third party makes of this report, or any reliance or discussions to be made based on it, are the responsibility of such third parties. Golder Associates Ltd. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

If new information is discovered in the future during site excavations or other activities, Golder Associates Ltd. should be requested to re-evaluate the conclusions of this report and to provide changes as required prior to any reliance upon the information presented herein.

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Burrard International/CRCW Development  
Mr. Dan Schweers

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December 2, 2002  
022-4184

## 6.0 CLOSURE

We trust that this letter provides you with the information you require. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Yours very truly,

**COLDER ASSOCIATES LTD.**



W. Scott Orth, M.Sc., P.Ge.  
Associate, Office Manager

Geotechnical Engineer, P.Eng. Senior  
Geotechnical Engineer

WSO/GI/RB/jmf

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**Table 1**  
**Summary of Water Well base**  
**Search**  
**Hwy33 and Gouu. Road**  
**Kelowna, B.C.**

Well ID	Location	Depth	WellDia	GPM	GPH	Date	Static Lev	Geology
24117	Hwy 33	50	6	2	120	1970	20	0-20 cobbles/boulders, 20-45 stoney clay, fine sand (wb 40-45), 45-50 till
18184	Swainson Rd	28	48	180	10800	1963	8	0-15 till, 15-28 sand and gravel (wb)
53464	Tamarc Park	148	7	50	3000	1984	unk	0-10 clay, 10-11 fractured rock, 11-148 bedrock
56692	Tamarc Park	200	7	2	120	1986	unk	0-4 topsoil, 2-29 consol. clay&gravel, 29-30 frac bedrock, 20-200 bedrock
53166		139	7	4	240	1984	36	0-24 S&G, 24-136 consol. clay&gravel, 136-138 gravel, 138-139 bedrock
53693	Tamarc Park	260	7	2	90	1984	100	0-43 S&G, 43-140 consol. clay&gravel, 140-180 gravel, 180-235 consol clay&gravel 235-246 clay, 246-260 frac rock and bedrock, water 253
53160	Tamarc Park	128	7	4	240	1984	11	0-117 consol. clay&gravel, 117-122 sand, 122-124 clay, 124-127 gravel, 127-128 bedrock
56860	Huckleberry Rd	300	7	35	2100	1987	45	0-7 S&G&B, 7-300 bedrock
00135	Huckleberry Rd	260	7	1	30	na	36	0-4 S&G, 4-5 frac rock, 5-250 bedrock
56203	Tamarc Park	167		6	360	1986	unk	0-45 sand, 45-162 consol. clay&gravel, 162-167 S&G
58976	Huckleberry Rd	300	6	3	180	1989	10	0-96 clay&gravel, 96-300 bedrock
57064	Huckleberry Rd	300	6	2	120	1987	6	0-11 sandy clay&gravel, 11-300 bedrock
59050	1923 Huckleberry Rd	300	6	1	60	1989	28	0-1 topsoil, 1-300 bedrock
61814	Huckleberry Rd	385	6	3	180	1991	140	0-1 2 till, 12-385 bedrock, water frac 205
61815	Daves Rd	400	6	0	0	1993	235	0-10 clay&gravel, 10-400 bedrock, soft 224,230,364
61816	Daves Rd, Hwy 33	92		2	100	1992	92	P frac@140=180PSI, P frac@240=240PSI
61818	6450 Hwy 33 (9 MI), SEC 1 1/14	400	6	1	60	1991	228	3-7 clay&rocks, 7-400 bedrock, soft 182,216,233,248,335,355,water 335,255
61820	6450 Hwy 33, SEC 11/14	200	6	4	240	1994	69	0-5 clay&S&G, 5-16 S&G&C, 16-19 til, 19-200 bedrock, water 75,95,155,165
61822	6450 Hwy 33, SEC 11/14	220	6	2	120	1994	67	0-15 sandy clay&gravel, 15-260 bedrock, water/frac 131,249,252
61824	6450 Hwy 33, SEC 11/14	200	6	2	120	1994	59	0-8 sandy clay&gravel, 8-200 bedrock, water frac 95
61826	Huckleberry Rd, SEC 11/14	360	6	2	120	1994	138	0-260 -see original, 260-360 bedrock, frac 338, 340
61828	Huckleberry Rd, SEC 14/15	260	6	2	120	1992	132	0-1 topsoil, 1-260 bedrock, water/frac 243, 254
61829	8 Mile Hwy 33, Daves Road	120	6	4	210	1993	36	0-8 sandy clay&cobbles, 3-120 bedrock, water/frac 41 (0.5 GPM), 89 (3 GPM)
61830	Daves Road (8 Mile Hwy 33)	140	6	4	255	1993	50	0-10 sandy clay&cobbles, 10-140 bedrock, frac/water 106-107
61832	Daves Road (8 Mile Hwy 33)	340	6	1	45	1993	78	0-6 sandy clay&cobbles, 6-340 bedrock, soft 104,150,302
61833	Daves Road (8 Mile Hwy 33)	300	6	1	75	1993	72	0-2 sandy clay&cobbles, 2-12 S&G&C, 12-22 sand, 22-73 clay&gravel till w/ C&B, 73-300 bedrock soft 108-112,163-164,180-187,227-229, water 108,230,271
61835	Daves Road (8 Mile Hwy 33)	200	6	10	600	1993	92	0-2 sandy clay, 2-9 S&G&C, 9-35 sandy clay w/ G&C (till), 35-200 bedrock, water 161
61836	Huckleberry Rd, SEC 14/15	110	6	10	600	1987	43	0-3 soil & rocks, 3-110 rock
61837	Huckleberry Rd, SEC 14/15	200	6	1	60	1987	10	0-6 S&G, 6-200 bedrock
61838	Huckleberry Rd, Up Hwy 33	na	na	na		1989	na	na
61839	2082 Huckleberry Rd	520	6	0	20	1994	195	0-11 sandy clay&gravel, 11-520 bedrock, soft 170,339,352,422,460
61840	Huckleberry Rd	400	6	3	180	1991	58	0-4 sandy clay&rock, 4-400 bedrock, soft 17,126,182, P@200=380 psi, P@300=420PSI
61842	Huckleberry Rd	280	6	1	45	1994	28	0,10 sandy clay w/ S&G, 10-280 bedrock, soft/frac 9.5-26,39-40,83,21 1,242-245,249
61843	Huckleberry Rd, SEC 14/15	200	6	35	2100	1991	20	0-2 sandy clay&gravel, 2-200 bedrock, water/frac 41(1 GPM), 197(34 GPM)
61845	Huckleberry Rd, SEC 14/15	300	6	2	120	1991	45	0-2 sandy clay w/ rock, 2-300 bedrock, frac 227-232
61846	Huckleberry Rd, SEC 14/15	200	6	2	120	1991	70	0-10 clay & frac bedrock, 10-200 bedrock
61847	Huckleberry Rd	320	6	1	30	1992	66	0-2 topsoil, 2-5 S&G&C, 5-13 S&G w/ clay, 13-16 till, 16-320 bedrock soft 47-50,54-55,175-179,221-224, water/frac 175,229
61849	Huckleberry Rd	220	6	9	540	1991	142	-220 bedrock, water frac 208-21 1
61850	Huckleberry Rd	na	na	na		1991	na	a
61852	Huckleberry Rd (Tamarac Park)	400	6	3	180	1991	50	-400 bedrock, Pfrac@200=280PSI, Pfrac@300=150PSI
61853	Huckleberry Rd	365	6	3	150	1992	46	ock, v. loose fractures 250-300

November?

**Table 1**  
**Summary of Water Well Search**  
**Hwy 33 and Goudie Road**  
**Kelowna, B.C.**

Well ID	Location	Depth	Well Dia.	GPM	GPH	Date	Static	Geology
61854	Huckleberry Rd	240	6	15	900	1991	110	1-240 bedrock, frac@22 (1/8 GPM), frac@234 (15 GPM)
61855	Huckleberry Rd (Tamarac Park)	180	6	2	120	1991	50	0-180 bedrock, frac@70 (3/4 GPM), frac@158 (2 GPM)
61856	5615 Goudie Road	215	6	7	420	1991	84	0-2 topsoil, 2-10 S&G&C, 10-37 sand w/sandy clay, 37-50 S&G&C&B, 50-191 clay&gravel till, 191-210 clay, 210-215 frac bedrock
53158	Tamarac Park	340	7	1	60	1984	60	0-24 G&B, 24-141 consol. clay&gravel, 141-152 gravel&sandy clay, 152-340 bedrock
53164	Tamarac Park	216	7	50	3000	1984	unk	0-40 sandy clay&gravel, 40-198 consol. clay&gravel, 198-204 gravel, 204-216 consol. clay&gravel
56254	Tamarac Park	260	6	na		1986	unk	0-30 G&B, 30-50 consol. clay&gravel, 50-260 bedrock
00131	Tamarac Park	350	7	na		na	unk	0-25 G&B, 25-69 consol. clay&gravel, 69-350 bedrock
58840	Jackpine Road	92	6	4	240	1989		0-14 S&G, 14-20 sand, 20-41 S&G, 41-76 clay&gravel, 76-92 S&G (water)
61891	Tamarac Park	136	7	15	900	1991	25	0-48 S&G, 48-62 fine sand&g, 62-84 clay&gravel&boulders, 84-99 sandy clay, 99-120 silty S&G, 120-138 S&G
69277	Goudie Road	330	6	110	6600	1996	3	0-15 clay, 15-208 clay&rocks, 208-330 bedrock
69281	7540 Goudie Road	78	6	2	120	1996	3	0-15 clay, 15-50 clay&rock, 50-78 silt&sand

Notes:

1. Well ID - Ministry of Water, Land and Air Protection identification number.
2. Well Dia. - diameter of well (inches).
3. GPM - Gallons per minute (assumed Imperial).
4. GPH - Gallons per hour (assumed Imperial).

## APPENDIX I

### Revised Aggregate Resource Evaluation Study Water Availability

November 19, 2002

File: 2002-09

Golder Associates Ltd. #220,  
1755 Springfield Road,  
Kelowna, B.C., V1Y 5V5

Attention: Mr. Gerald Imada

Dear Gerald

**RE: REVISED AGGREGATE RESOURCE EVALUATION  
STUDY WATER AVAILABILITY**

Further to your instructions to proceed received November 8, 2002, the four catchment areas and respective water licenses were reviewed. The study objective was to determine if there was sufficient water within the existing water license allocations to provide water for a gravel washing operation for a proposed gravel pit.

**ADDUCTION:**

The four existing licenses are summarized in the table below.

**Table 1: Existing Water Licenses**

License Number	Stream Name	Purpose	Quantity	Catchment Area to POD (ha)	Licensee
F008790	Pyman Spring	Domestic	500 gal/day	60.7	360308 BC Ltd.
F008790	Pyman Spring	Irrigation	5 acre-feet/year	60.7	360308 BC Ltd.
C066238	Catherine Spring	Stockwater	3000 gal/day	16.6	360308 BC Ltd.
C066236	Marshall Brook	Stockwater	3000 gal/day	28.2	360308 BC Ltd.
C066237	Lizzy Pond	Stockwater	3000 gal/day	27.7	360308 BC Ltd.
C066237	Lizzy Pond	Domestic	500 gal/day	27.7	360308 BC Ltd.

**WATER  
AVAILABILITY:**

There are several issues to be examined when determining water availability, especially from runoff:

- Local catchment area;
- Normal annual precipitation;
- Annual evaporation;
- Infiltration;
- Evapotranspiration;

for the Okanagan Basin is 68 mm over the watershed. This runoff amount is the same as for Subzone "e" and slightly higher than Subzone "b".

Figure 1 shows the proposed location of the gravel pit located at an approximate elevation of 1000 m and in Subzone "b". For this study, a normal annual runoff of 48 mm (Subzone "b" for 1000 m elevation) was selected for the proposed location of the gravel pit.

An additional Water Survey of Canada gauging station was examined, Daves Creek, 08NM137. Normal annual runoff for this watershed is 104 mm with a median elevation of 1290 m. By adjusting this runoff rate for Pyman Spring, with a median elevation of 1000 m, results in a normal annual runoff of 68 mm. The use of subzone "b" runoff of 48 mm is conservative.

Four points of interest have been identified by Golden Marshall Brook, Lizzy Pond, Pyman Spring, and Catherine Spring. Applying the runoff amount to each of these basins produces the following volume of runoff.

Table 3: Potential Runoff Volumes for Each Point of Interest

Point of Interest	Annual Runoff (mm)	Potential Annual Volume (m <sup>3</sup> ) <sup>1</sup>
Marshall Brook	48	13,536
Lizzy Pond	48	13,296
Pyman Spring	48	29,136
Catherine Spring	48	7,968

Notes:

1: The above volumes assume that there is a collection system in place (interception ditches leading to a reservoir) and the entire runoff volume is captured. The calculated volume of runoff is spread over 12 months, i.e. annual volumes.

2. The month with maximum precipitation for Kelowna "A" is May with 37.5 mm. Using the same annual ratio for runoff as for subzone "b", 16%, produces a corresponding runoff of 6 mm over the watersheds of interest.

The volumes presented in Table 3 do not take into account losses due to evaporation or seepage from the reservoirs but provide an indication of order of magnitude volumes that may be available from the watershed in a normal year.

Any gravel washing operation will require sediment ponds to trap the wash water and allow suspended sediment to settle out prior to discharge into a natural stream. However, this water could also be reused for further washing operations and only require minor amounts of additional make-up water to account for seepage and evaporation losses. Further study into a closed loop system may be warranted.

**LIMITATIONS**

This report has been prepared in accordance with generally accepted hydrotechnical engineering practices in this area. No other warranty, expressed or implied, is made. The report has been prepared for the sole benefit of Colder Associates Ltd. No other party may use or rely on this report without the written consent of Fearon Environmental.

**CLOSURE**

Fearon Environmental appreciates the opportunity of assisting Colder Associates with the Aggregate Resource Evaluation study. If we can provide further input to the project, please do not hesitate to contact us.

Yours truly,  
FEARON ENVIRONMENTAL



Peter W. Fearon, P.Eng  
Water Resource Engineer