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April 27, 2018
File: 2016-8113.010.003

Brady Nelless
Regional Director
BC Ministry of Environment
Northern Regional Operations
Bag 5000
3726 Alfred Avenue
Smithers, BC V0J 2N0

Re: GRACE-MAR FARMS FALL 2017 WATER SAMPLING RESULTS
MINISTRY OF ENVIRONMENT FILE NO. 350101 - ACTION PLAN ITEM #14

Dear Mr. Nelless:

1 BACKGROUND

Grace-Mar Farms Ltd. (Grace-Mar) operated a feeding operation for heifers on a 121 ha property located at 5904 Salmon River Road, Armstrong, BC ("study area") from February 28, 2017 to March 2018. Grace-Mar also operated a dairy at the same location from September 2009 until February 28, 2017, when all the milking cows were moved to their Fraser Valley operation.

On May 12, 2016, the BC Ministry of Environment (MOE) issued a Pollution Abatement Order ("the Order") to Grace-Mar (File AMS#350101, MOE 2016). The Order required that Grace-Mar carry out a comprehensive monitoring program, complete an environmental impact assessment (EIA), prepare an Action Plan to detail measures to be taken to abate any environmental impacts identified in the EIA, and submit formal written summaries for three years identifying what actions from the Action Plan were undertaken.

The EIA and Action Plan were submitted to MOE on February 27, 2017 and April 6, 2017, respectively (Associated 2017a, 2017b). To meet one of the specified actions in the approved Action Plan, Action 14, Grace-Mar retained Associated Environmental Consultants Inc. (Associated) to complete groundwater and surface water sampling, and report on the findings. The sampling was conducted in May 2017 and on June 29, 2017 Associated submitted the first annual report summarising this work (Associated 2017c).

2 SCOPE OF WORK AND OBJECTIVES

To ensure continued compliance of the approved Action Plan, Grace-Mar retained Associated to complete a second round of water quality sampling followed by the 2017 annual report (this report). The objective is to meet Action #14 of the Action Plan and the related recommendations from the first annual report. The scope included sampling and testing groundwater from eight wells and from one surface water location for

nutrients and routine water quality parameters (Section 3). We understand that others are addressing the objectives of the other actions in the Action Plan.

As described in the Order, annual reports must be submitted to MOE annually for three years to confirm that certain Actions have been completed and include the following;

i) summarize in reasonable detail what actions from the Action Plan were undertaken;
ii) identify of all agriculture operational changes that occurred;
iii) summarize in reasonable detail monitoring results;
iv) summarize environmental impact assessment (first year only)[1]; and
v) recommend additional mitigation and restoration measures, if appropriate.

The scope of this report includes addressing these objectives. The report includes methods, results and discussion, quality assurance/quality control, and any additional measures and recommendations. The objectives are identified in the section headings below.

3 METHODS (OBJECTIVE I)

Water quality samples were collected by Associated, following standard BC methods (MWLAP 2013), from the locations listed in Table 1 and shown on Figure 1. Samples were collected on November 14 and 15, 2017. Field sheets from the sampling events are attached.

[1] In objective iv, our interpretation of "first year only" is the year 2016; however, because the groundwater and surface water monitoring (Action 14) only started in May 2017, we have included a section related to this objective in this report. This section of the Order will be met after the submission of this report and will not be needed in future years.

N
W
E
S

105 Top Back 14.0 ac. (5.7 ha.)

Historical burial ground

Floyd's Swamp

WT-94332

301 Matheson Rd 58.0 ac. (23.5 ha.)

WT-63160

WT-94333

WT-94334D

WT-94334

102 Bottom Back 47.3 ac. (19.1 ha.)

MW 2

Historical burial ground

Old milk house / parlour barn

104 Pasture 36.0 ac. (14.6 ha.)

Lagoon (38 m x 54 m)

202 Reserve Bottom 61.1 ac. (24.7 ha.)

Home Pivot 101 North / Bottom 61.7 ac. (25.0 ha.)

Utility room

Historical (pre 2009) garbage dump

Main dairy barn

MW3S/MW3D

WT-94331

Office

Pit

Bred heifers barn

Storage pad with concrete lock blocks

Silage bunkers

WT-82425

Shop

WT-94335

Young stock barn

Home pivot

Calf barn

Summer bred heifers barn

Silage bunkers

Fuel pumps

Hullcar Rd

WT-94337

MW 1

WT-82426

Home Pivot 101 South / Top 69.47 ac. (28.1 ha.)

104 Pasture 36.0 ac. (14.6 ha.)

201 Reserve Top 24.95 ac. (10.1 ha.)

Grace-Mar Farms road front Sign

Muster Point 5104 Salmon River Road

WPID28093

WT-48878

103 Corner 10.0 ac. (4.0 ha.)

Salmon River Rd

Heywood-Armstrong Rd

Meters
0 20 40 60 80 100

Figure1_june2017.mxd / 2/19/2018 / 2:45:57 PM

Associated Environmental

Study area

Parcel boundary

Field

MOE registerd wells with Well Tag (WT) number - * indicates location confirmed by owner

Existing

Well not found during site visit

Monitoring wells

Additional water supply well not on MOE registry

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DRAWN BY:	BdJ

FIGURE 1: CLOSE-UP OF FACILITIES

Grace-Mar Farms Ltd.

Action Plan

Table 1: Spring 2017 Sampling Locations

Sample Location[1]	Sample Description
MW1	Monitoring well (installed in 2016)
MW2	Monitoring well (installed in 2016)
MW3S	Monitoring well (installed in 2016)
MW3D	Monitoring well (installed in 2016)
WTN 94334	Well for industrial use owned by Grace-Mar Farms. Used for livestock watering and barn washing.
WTN 94335	Well for industrial use owned by Grace-Mar Farms. Used for livestock watering and barn washing.
WPID 28093[2]	Domestic, Irrigation and Industrial Use well owned by James Krebber. Used for domestic purposes (rental home) and livestock watering.
James Krebber's Well (no well tag number or well plate identifier)[2]	Domestic well owned by James Krebber. Used for domestic purposes.
Floyd's Swamp	Surface water

Note:
[1] WTN refers to well tag number, which is a number assigned to a well log that is voluntarily submitted to MOE. WPID refers to well plate identifier, which is a steel plate affixed to the top of the casing on some wells by the well driller.
[2] WPID 28093 and James Krebber's Well are included in the program in place of WTN 48878 and WTN 42426, which were originally listed in the Action Plan. However, during the spring 2017 sampling event, Associated confirmed that they either do not exist or are in a different location than shown on the BC Water Resource Atlas. Therefore, Associated recommended replacing these wells with WPID 28093 and James Krebber's Well (Associated 2017c).

Water samples were shipped under chain-of-custody protocol to CARO Analytical Services (CARO) in Kelowna, BC for analysis of the parameters specified in the Action Plan: nitrate-N, nitrite-N, ammonia-N, total Kjeldahl nitrogen (TKN), total nitrogen, chloride, and total phosphorous (Associated 2017b). A field duplicate sample[2] was also collected during the November 2017 sampling event.

The groundwater results were compared with the BC Approved and Working Water Quality Guidelines (BCAWQG/BCWWQG) for irrigation (I), livestock (L) (MOE 2018, 2017a), the BC Source Drinking Water Guidelines (BC DW) (MOE 2017b), and the Guidelines for Canadian Drinking Water Quality (GCDWQ) Maximum Acceptable Concentrations (MAC) and Aesthetic Objectives (AO) (Health Canada 2017). The

[2] Collection and analysis of duplicate samples provides information on the combined (field and analytical) precision of the sampling and the analytical program. Data are assessed by calculating the relative percent difference between the primary and duplicate sample and comparing the data to acceptable thresholds (MWLAP 2013).

results from Floyd's Swamp were compared with the same guidelines plus the BCAWQG/BCWWQG for aquatic life (AL) protection (MOE 2018, 2017a).

4 RESULTS AND DISCUSSION (OBJECTIVES III AND IV)

4.1 GROUNDWATER ELEVATION AND FLOW DIRECTION

The groundwater elevations at the monitoring well locations were measured during the May and November 2017 sampling events to assess seasonal fluctuations in groundwater levels and determine groundwater flow direction (Table 2). Spring water levels were, on average, 1.435 m higher then in the fall. The general groundwater flow direction in the May 2017 was north-northwest with a low average gradient of 0.002, indicated that some of the aquifer recharge during the spring melt is coming from the hillside to the south of the Grace-Mar Farms road front sign (Figure 1). In November 2017, when aquifer water levels are lower, the flow direction is due north with a very shallow gradient of 0.0001, suggesting that there is minimal recharge from the south during this time of year. Based on past reports, the overall flow direction for the underlying aquifer (Aquifer 103) is generally east to west with a flow divide from Parkinson's Lake to the east (Monahan 2006, Golder and Summit 2009). The reason for the difference in direction between the regional flow and the localized flow at the site is most likely a result of local aquifer recharge coming from the hillside to the south of the Grace-Mar Farms road front sign.

Table 2: Groundwater Elevations

Sample Location	Elevation of Top of Well Casing (masl)	October 2016		May 2017		November 2017		Seasonal Change (m)
		Depth to Water (mbtoc)	Ground-water Elevation (masl)	Depth to Water (mbtoc)	Ground-water Elevation (masl)	Depth to Water (mbtoc)	Ground-water Elevation (masl)	
MW1	513.48	6.62	506.86	3.58	509.90	5.79	507.69	2.21
MW2	510.01	3.38	506.63	1.34	508.67	2.38	507.63	1.04
MW3S	514.66	7.89	506.77	5.76	508.91	7.00	507.66	1.25
MW3D	514.71	7.95	506.76	5.81	508.91	7.05	507.67	1.25

mbtoc = metres below top of casing

masl = metres above sea level

4.2 WATER QUALITY DATA

The groundwater results, tabulated and compared with applicable guidelines, are presented in Table A1. Included in the tables are the results for nitrate-N, nitrite-N, ammonia-N, TKN, total nitrogen, chloride and total phosphorus from the October 2016, May 2017, and November 2017 sampling events.[3] It should be noted that October was the first round of sampling which just included sampling MW1, MW2, MW3S, MW3D and WTN 94334. Based on the results of the October sampling event James Krebber's well, WPID 28093, and WTN 94335 were also tested in May and November 2017. Table A2 presents the results from Floyd's Swamp, which includes data from the May and November 2017 sampling events. The original laboratory reports are attached.

The November 2017 groundwater quality data (Table A1) met applicable guidelines with the exception of the nitrate-N concentration in MW3S (13.3 mg/L), which exceeded the GCDWQ MAC and BC DW guideline of 10 mg/L. Field-measured conductivity in all wells also exceeded the BCWWQG I, which ranges from 700 µS/cm to 5,000 µS/cm, depending on the crop type.

Generally, results indicate the water quality varies both spatially and temporally. Seasonal variation, with higher nitrate-N concentrations in fall/early winter, are apparent in MW1, MW2, and MW3S. Nitrate-N concentrations in MW1 and MW3S exceeded the GCDWQ MAC and BCAWQG DW guidelines in October 2016 (with concentrations of 21.0 and 16.6 mg/L nitrate-N, respectively) were below detection levels in both wells in May 2017, and elevated again in the November sampling event (8.70 and 13.3 mg/L nitrate-N, respectively). In MW2, nitrate-N has remained within guidelines during all sampling events, but was also notably higher in fall/early winter sampling events (7.82 mg/L in October 2016 and 1.51 mg/L in November 2017) than in the spring (<0.010 in May 2017). Conversely, nitrate-N concentrations in James Krebber's well exceeded the DW guideline in May 2017, then dropped to 0.021 mg/L in November 2017. Wells MW3D, WPID 28093, WTN 94334, WTN 94335 all have had consistently low nitrate concentrations for all sampling events.

The water quality data from Floyd's Swamp (Table A2) met the all applicable guidelines during the November 2017 sampling event with the exception of conductivity, which exceeded the BCWWQG I. This is a change the May 2017 results, when nitrite-N exceeded the BCAWQG/BCWWQG for aquatic life guidelines.

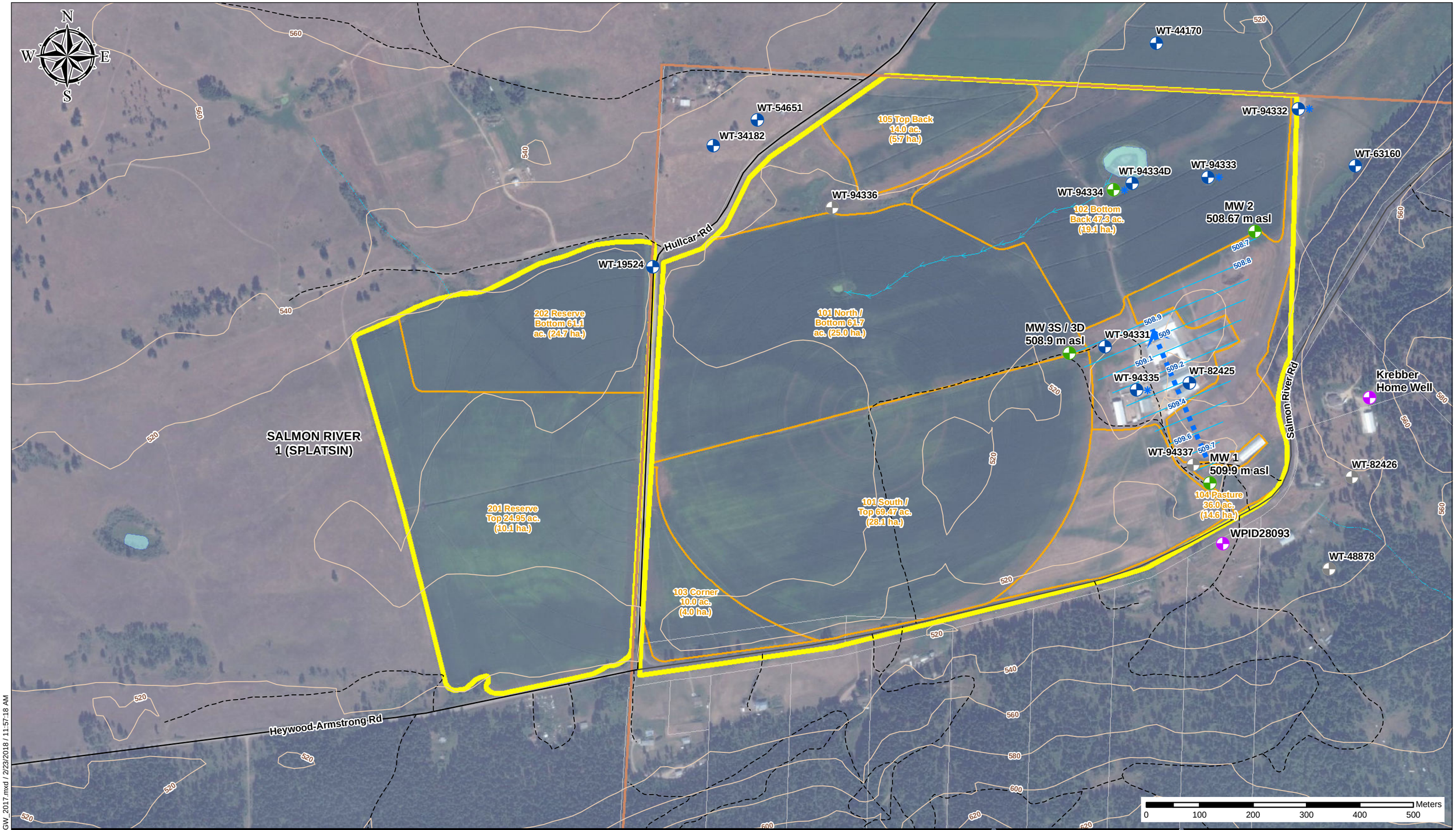
Overall, nitrate concentrations increased from May to November, but were still within guidelines with the exception of MW3S. Due to the variability and limited available data, it is still premature to determine

[3] Wells MW1, MW2, MW3S, MW3D, and WTN 94334 were tested in October 2016, May 2017, and November 2017. James Krebber's well, WPID 28093, and WTN 94335 were tested in May and November 2017.

whether or not the past or current agricultural practices are affecting the underlying groundwater. In addition, the ability to draw conclusions is limited by a lack of information on farm operations before Grace-Mar acquired the property. Furthermore, the net flux (movement) of nitrate-N through the unsaturated zone has not been estimated. Drain gauges (or sampling lysimeters), which can be used to monitor nitrate-N concentrations in pore water in the unsaturated zone, have been installed by Grace-Mar below the root zone and will help to estimate net flux of nitrate-N. In addition, we understand that the volumes of irrigation water applied are also being recorded. Additional assessment into the source of the nitrate-N in groundwater, making use of all these data, is recommended after the 2018 sampling is complete.

4.3 OPERATIONAL CHANGES TO AGRICULTURAL PRACTICES (OBJECTIVE II)

Since the Pollution Abatement Order was issued, Grace-Mar Farms as been working to reduce the number of livestock on the study area to reduce the probability of further pollution related to their farming practices. When the original POA was given, Grace-Mar Farm housed 250 head of cattle. As of February 15, 2018, a total of 75 head of cattle were still on the study area, and as of end of March 2018, all cattle were removed from the study area (J Kampman, personal communications 2018). Since then, Grace-Mar has sold the subject property, with the new owners taking possession on May 1, 2018.



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Associated Environmental

- Study area
- Field
- Indian Reserve
- Parcel boundary
- Contours
- Stream - intermittent
- Ditch
- Groundwater flow direction
- Groundwater contours
- Monitoring wells
- Additional water supply well not on MOE registry

MOE registerd wells with Well Tag (WT) number - * indicates location confirmed by owner

- Existing
- Abandoned

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FIGURE 2: LOCATIONS OF MONITORING WELLS AND GROUNDWATER FLOW DIRECTION (MAY 2017)

Grace-Mar Farms Ltd.

Environmental Assessment

N
W
E
S

WT-44170
WT-54651
WT-34182
105 Top Back
14.0 ac.
(5.7 ha.)
WT-94332
WT-63160
WT-94334D
WT-94333
WT-94334
WT-94336
102 Bottom
Back 47.3 ac.
(19.1 ha.)
MW 2
507.63 m asl
Hullcar Rd
WT-19524
202 Reserve
Bottom 61.1
ac. (24.7 ha.)
101 North /
Bottom 61.7
ac. (25.0 ha.)
507.64
507.65
MW 3S / 3D
507.66 m asl
WT-94331
507.66
WT-82425
WT-94335
507.67
507.68
WT-94337
MW 1
507.69 m asl
Salmon River Rd
Krebber
Home Well
WT-82426
104 Pasture
36.0 ac.
(14.6 ha.)
SALMON RIVER
1 (SPLATSIN)
201 Reserve
Top 24.95 ac.
(10.1 ha.)
101 South /
Top 69.47 ac.
(28.1 ha.)
WPID28093
WT-48878
103 Corner
10.0 ac.
(4.0 ha.)
Heywood-Armstrong Rd
560
540
520
580
600
620

Meters
0 100 200 300 400 500

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Associated Environmental

- Study area
- Field
- Indian Reserve
- Parcel boundary
- Contours
- Stream - intermittent
- Ditch
- Groundwater flow direction
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- Monitoring wells
- Additional water supply well not on MOE registry

MOE registerd wells with Well Tag (WT) number - * indicates location confirmed by owner

- Existing
- Abandoned

PROJECT NO.: 2016-8113.000
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FIGURE 3: LOCATIONS OF MONITORING WELLS AND GROUNDWATER FLOW DIRECTION (NOVEMBER 2017).

Grace-Mar Farms Ltd.

Environmental Assessment

4.4 QUALITY ASSURANCE/QUALITY CONTROL DATA (QA/QC)

The relative percent difference (RPD) calculations from the duplicate sample set collected from WTN 94334 in November 2017 indicated good reproducibility, suggesting acceptable precision of the analytical data. Once values less than five times their respective detection limit were removed,[4] the highest calculated RPD was 13.3%, and the average was 5.6%.

Information about the laboratory's QA/QC are provided as part of the attached laboratory reports. The laboratory used for the analysis (CARO) is accredited with the Canadian Association for Laboratory Accreditation.

5 RECOMMENDATIONS (OBJECTIVE V)

Two changes to the monitoring program are recommended as follows:

1. Continue to sample for water quality in the spring and fall of 2018, and report on the findings in a third annual report (Spring 2019). Past results indicate that high levels of nitrate-N are still present at some locations and further monitoring is needed to determine if the measures taken by Grace-Mar to reduce pollution are influencing water quality.

2. Limit the sampling in the spring and fall of 2018 to only the five monitoring locations that have been shown to have elevated nutrient levels in the past. These locations are MW1, MW2, MW3S, Krebber's Well, and Floyd's Swamp. The purpose of Action #14 is to assess whether Grace-Mar Farms practices are influencing groundwater quality. Based on Grace-Mar farms' decision to cease cattle operations at this location all together, there is little value in continuing to sample locations that have already been shown to not be affected by Grace-Mar's farming operations.

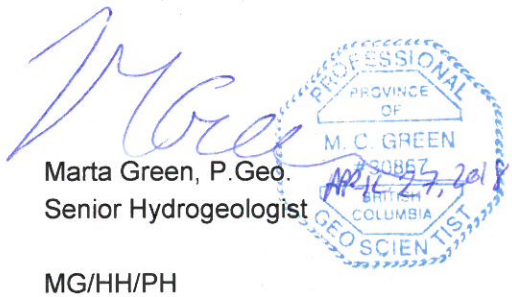
In addition, after the 2018 sampling is complete, carry out further assessment into the source of the nitrate-N in groundwater, making use of drain gauge data, nutrient management plans, soil data, and irrigation water records.

[4] RPD tends to increase as the result approaches the detection limit. Therefore, use of this threshold is restricted to duplicate pair values that are greater than five times their detection limit (MWLAP 2013).

6 CLOSURE

We trust that this report satisfactorily meets the requirements of Action Plan Item #14. Please contact the undersigned if you have any questions.

Yours truly,



Marta Green, P.Geo.
Senior Hydrogeologist

MG/HH/PH

ATTACHMENTS

Attachment 1: Table A1: Groundwater Quality Results
Attachment 2: Table A2: Surface Water Quality Results
Attachment 3: Field Sheets – November Sampling
Attachment 4: Laboratory Reports – November Sampling

REFERENCES

Associated Environmental Consultants Inc. (Associated). 2017a. Comprehensive Monitoring Program and Environmental Impact Assessment. Grace-Mar Farms Ltd. Pollution Abatement Order File AMS#350101. February 2017.

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Monahan, P.A. (2006) North Okanagan aquifer mapping project. Unpublished report prepared for BC Bulletin 46, Ministry of Energy, Mines and Petroleum Resources, 46 pp.

April 27, 2018
Brady Nelless
BC Ministry of Environment

ATTACHMENT 1: TABLE A-1: GROUNDWATER QUALITY RESULTS

Table A-1 Grace-Mar Farms Groundwater Quality Results (Action #14 Sampling)

Water Quality Results

Analyte	Unit	Guideline								Sampling Location	James Krebber Home	James Krebber Home	MW1	MW1	MW1	MW2	MW2
										Date Sampled	20-Jun-17	15-Nov-17	18-Oct-16	24-May-17	14-Nov-17	04-Oct-16	24-May-17
										Lab Sample ID	7061861-01	7111411-03	6101246-01	7052134-01	7111412-01	6100258-01	7052134-02
										Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal
		BCAWQG I	BCWWQG I	*BCAWQG L*	*BCWWQG L*	BC SDWQG MAC	BC SDWQG AO	GCDWQ MAC	GCDWQ AO								
Field Results																	
Conductivity	µS/cm	NG	700 [2.1]	NG	NG	NG	NG	NG	NG		1730	1070	1441	880	1140	1320	1080
Dissolved oxygen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG			1.78			1.54		
Oxidation reduction potential	mV	NG	NG	NG	NG	NG	NG	NG	NG		110	-18	66	13	50	34	15
pH		5.0 - 9.0 [1.1]	NG	5.0 - 9.5 [3.1]	NG	NG	NG	NG	7.0 - 10.5 [7.1]		6.95	7.52	7.17	7.5	7.46	7.06	7.3
Temperature	°C	N [1.2]	NG	N [3.2]	NG	NG	15	NG	15		12.2	8.8	10.1	7.9	10.1	12.9	8.4
Turbidity	NTU	N [1.3]	NG	N [3.3]	NG	N [4.1]	NG	N [6.1]	NG			6.34	2.02		0.51	3.6	
Lab Results																	
General																	
Chloride	mg/L	100	NG	600 [3.4]	NG	NG	250	NG	250		28.1	12.9	47.5	22.6	36.0	41.9	35.6
Nutrients																	
Ammonia (total, as N)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG		<0.020	0.042	0.031	0.030	<0.020	0.050	0.022
Nitrate (as N)	mg/L	NG	NG	100 [3.5]	NG	10	NG	10	NG		13.0	0.021	21.0	<0.010	8.70	7.82	<0.010
Nitrate + Nitrite (as N)	mg/L	NG	NG	100 [3.6]	NG	NG	NG	10 [6.2]	NG		13.0	0.0212	21.0	<0.0100	8.70	7.91	0.0420
Nitrite (as N)	mg/L	NG	NG	10 [3.7]	NG	1.0	NG	1	NG		0.028	<0.010	<0.010	<0.010	<0.010	0.094	0.042
Organic nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG		0.446	0.116	0.525		0.542	0.644	
Total nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG		13.5	0.179	21.5	0.457	9.24	8.61	0.335
Total kjeldahl nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG		0.446	0.158	0.56	0.457	0.542	0.69	0.293
Phosphorus (total, APHA 4500-P)	mg/L	NG	NG	NG	NG	NG	N [5.1]	NG	NG		<0.0020	<0.0020	0.025	0.0452	0.0512		0.0096
Phosphorus (dissolved, APHA 4500-P)	mg/L	NG	NG	NG	NG	NG	N [5.2]	NG	NG				0.019				

[1] See attachments for guideline notes.

Legend

<	Less than reported detection limit
NG	No Guideline
N	Narrative type of guideline or standard, or Result Note.
Calc	Calculated guideline. The guideline is dependent on the value of one or more other analytes, and is calculated from a formula or table.
BCAWQG I	Highlighted value exceeds the BC Approved Water Quality Guidelines for irrigation (BCAWQG I)
BCWWQG I	Highlighted value exceeds the BC Working Water Quality Guidelines for irrigation (BCWWQG I)
BCAWQG L	Highlighted value exceeds the BC Approved Water Quality Guidelines for livestock (BCAWQG L)
BCWWQG L	Highlighted value exceeds the BC Working Water Quality Guidelines for livestock (BCWWQG L)
BC SDWQG AO	BC Source Drinking Water Quality Guidelines - Aesthetic Objectives (2017 and updates)
BC SDWQG MAC	BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations (2017 and updates)
GCDWQ MAC	Highlighted value exceeds the Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentrations (GCDWQ MAC)
GCDWQ AO	Highlighted value exceeds the Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives (GCDWQ AO)

WIRELESS WATER

Table A-1 Grace-Mar Farms Groundwater Quality Results (Action #14 Sampling)

Water Quality Results

Analyte	Unit	Guideline								Sampling Location	MW2	MW3D	MW3D	MW3D	MW3S	MW3S	MW3S
										Date Sampled	14-Nov-17	05-Oct-16	24-May-17	14-Nov-17	04-Oct-16	24-May-17	14-Nov-17
										Lab Sample ID	7111412-02	6100374-01	7052134-04	7111412-04	6100258-02	7052134-03	7111412-03
										Sample Type	Normal	Normal	Normal	Normal	Normal	Normal	Normal
		BCAWQG I	BCWWQG I	*BCAWQG L*	*BCWWQG L*	BC SDWQG MAC	BC SDWQG AO	GCDWQ MAC	GCDWQ AO								
Field Results																	
Conductivity	µS/cm	NG	700 [2.1]	NG	NG	NG	NG	NG	NG		1250	1510	1280	1240	1720	1410	1400
Dissolved oxygen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG		0.95			0.52			0.98
Oxidation reduction potential	mV	NG	NG	NG	NG	NG	NG	NG	NG		14	18	24	123	83	16	17
pH		5.0 - 9.0 [1.1]	NG	5.0 - 9.5 [3.1]	NG	NG	NG	NG	7.0 - 10.5 [7.1]		7.22	7.23	7.4	7.51	6.80	7.1	7.17
Temperature	°C	N [1.2]	NG	N [3.2]	NG	NG	15	NG	15		11.9	9.4	9.1	8.9	9.7	9.0	9.3
Turbidity	NTU	N [1.3]	NG	N [3.3]	NG	N [4.1]	NG	N [6.1]	NG		1.24	6.3		5.79	0.8		0.21
Lab Results																	
General																	
Chloride	mg/L	100	NG	600 [3.4]	NG	NG	250	NG	250		45.0	30.3	30.3	35.9	54.5	50.5	62.5
Nutrients																	
Ammonia (total, as N)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG		<0.020	0.257	0.176	0.227	<0.020	0.031	0.028
Nitrate (as N)	mg/L	NG	NG	100 [3.5]	NG	10	NG	10	NG		1.51	<0.010	<0.010	0.140	16.6	<0.010	13.3
Nitrate + Nitrite (as N)	mg/L	NG	NG	100 [3.6]	NG	NG	NG	10 [6.2]	NG		1.51	<0.010	0.0147	0.140	16.7	0.0292	13.3
Nitrite (as N)	mg/L	NG	NG	10 [3.7]	NG	1.0	NG	1	NG		<0.010	<0.010	0.015	<0.010	0.016	0.029	0.069
Organic nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG		0.445	0.211		0.156	0.525		0.525
Total nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG		1.96	0.468	0.429	0.523	17.2	0.423	13.9
Total kjeldahl nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG		0.445	0.47	0.414	0.383	0.52	0.394	0.553
Phosphorus (total, APHA 4500-P)	mg/L	NG	NG	NG	NG	NG	N [5.1]	NG	NG		0.0088	0.026	0.0399	0.0690		<0.0020	0.0141
Phosphorus (dissolved, APHA 4500-P)	mg/L	NG	NG	NG	NG	NG	N [5.2]	NG	NG			0.021					

[1] See attachments for guideline notes.

Legend

<	Less than reported detection limit
NG	No Guideline
N	Narrative type of guideline or standard, or Result Note.
Calc	Calculated guideline. The guideline is dependent on the value of one or more other analytes, and is calculated from a formula or table.
BCAWQG I	Highlighted value exceeds the BC Approved Water Quality Guidelines for irrigation (BCAWQG I)
BCWWQG I	Highlighted value exceeds the BC Working Water Quality Guidelines for irrigation (BCWWQG I)
BCAWQG L	Highlighted value exceeds the BC Approved Water Quality Guidelines for livestock (BCAWQG L)
BCWWQG L	Highlighted value exceeds the BC Working Water Quality Guidelines for livestock (BCWWQG L)
BC SDWQG AO	BC Source Drinking Water Quality Guidelines - Aesthetic Objectives (2017 and updates)
BC SDWQG MAC	BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations (2017 and updates)
GCDWQ MAC	Highlighted value exceeds the Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentrations (GCDWQ MAC)
GCDWQ AO	Highlighted value exceeds the Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives (GCDWQ AO)

Table A-1 Grace-Mar Farms Groundwater Quality Results (Action #14 Sampling)

Water Quality Results

Analyte	Unit	Guideline								Sampling Location	WPID 28093	WPID 28093	WT 94335	WT 94335	WTN 94334	WTN 94334	WTN 94334
										Date Sampled	24-May-17	15-Nov-17	24-May-17	15-Nov-17	04-Oct-16	24-May-17	24-May-17
										Lab Sample ID	7052134-06	7111411-02	7052134-08	7111411-01	6100258-03	7052134-09	7052134-07
										Sample Type	Normal	Normal	Normal	Normal	Normal	Duplicate	Normal
		BCAWQG I	BCWWQG I	*BCAWQG L*	*BCWWQG L*	BC SDWQG MAC	BC SDWQG AO	GCDWQ MAC	GCDWQ AO								
Field Results																	
Conductivity	µS/cm	NG	700 [2.1]	NG	NG	NG	NG	NG	NG		1180	980	1110	700	1550	1580	1580
Dissolved oxygen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG			1.60		0.16			
Oxidation reduction potential	mV	NG	NG	NG	NG	NG	NG	NG	NG		16	-18	99	-264	38	78	78
pH		5.0 - 9.0 [1.1]	NG	5.0 - 9.5 [3.1]	NG	NG	NG	NG	7.0 - 10.5 [7.1]		7.4	7.49	8.0	8.80	7.16	7.4	7.4
Temperature	°C	N [1.2]	NG	N [3.2]	NG	NG	15	NG	15		10.0	5.1	9.5	8.9	10.9	9.7	9.7
Turbidity	NTU	N [1.3]	NG	N [3.3]	NG	N [4.1]	NG	N [6.1]	NG			73.3		9.82	0.1		
Lab Results																	
General																	
Chloride	mg/L	100	NG	600 [3.4]	NG	NG	250	NG	250		6.72	8.72	36.2	27.0	18.9	26.4	26.1
Nutrients																	
Ammonia (total, as N)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG		0.025	<0.020	0.036	0.057	0.330	0.356	0.375
Nitrate (as N)	mg/L	NG	NG	100 [3.5]	NG	10	NG	10	NG		<0.010	0.416	<0.010	0.020	<0.010	<0.010	<0.010
Nitrate + Nitrite (as N)	mg/L	NG	NG	100 [3.6]	NG	NG	NG	10 [6.2]	NG		<0.0100	0.416	<0.0100	0.0402	<0.010	<0.0100	<0.0100
Nitrite (as N)	mg/L	NG	NG	10 [3.7]	NG	1.0	NG	1	NG		<0.010	<0.010	<0.010	0.020	<0.010	<0.010	<0.010
Organic nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG			0.152		0.144	0.222		
Total nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG		0.0890	0.568	0.275	0.241	0.552	0.558	0.563
Total kjeldahl nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG		0.089	0.152	0.275	0.201	0.55	0.558	0.563
Phosphorus (total, APHA 4500-P)	mg/L	NG	NG	NG	NG	NG	N [5.1]	NG	NG		0.0027	<0.0020	0.0056	0.0074		0.0408	0.0401
Phosphorus (dissolved, APHA 4500-P)	mg/L	NG	NG	NG	NG	NG	N [5.2]	NG	NG								

[1] See attachments for guideline notes.

Legend

<	Less than reported detection limit
NG	No Guideline
N	Narrative type of guideline or standard, or Result Note.
Calc	Calculated guideline. The guideline is dependent on the value of one or more other analytes, and is calculated from a formula or table.
BCAWQG I	Highlighted value exceeds the BC Approved Water Quality Guidelines for irrigation (BCAWQG I)
BCWWQG I	Highlighted value exceeds the BC Working Water Quality Guidelines for irrigation (BCWWQG I)
BCAWQG L	Highlighted value exceeds the BC Approved Water Quality Guidelines for livestock (BCAWQG L)
BCWWQG L	Highlighted value exceeds the BC Working Water Quality Guidelines for livestock (BCWWQG L)
BC SDWQG AO	BC Source Drinking Water Quality Guidelines - Aesthetic Objectives (2017 and updates)
BC SDWQG MAC	BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations (2017 and updates)
GCDWQ MAC	Highlighted value exceeds the Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentrations (GCDWQ MAC)
GCDWQ AO	Highlighted value exceeds the Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives (GCDWQ AO)

Table A-1 Grace-Mar Farms Groundwater Quality Results (Action #14 Sampling)

Water Quality Results

Analyte	Unit	Guideline								Sampling Location: WTN 94334	Sampling Location: WTN 94334
										Date Sampled: 14-Nov-17	Date Sampled: 14-Nov-17
										Lab Sample ID: 7111412-05	Lab Sample ID: 7111412-07
										Sample Type: Normal	Sample Type: Duplicate
		BCAWQG I	BCWWQG I	*BCAWQG L*	*BCWWQG L*	BC SDWQG MAC	BC SDWQG AO	GCDWQ MAC	GCDWQ AO		
Field Results											
Conductivity	µS/cm	NG	700 [2.1]	NG	NG	NG	NG	NG	NG	1090	1090
Dissolved oxygen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	0.39	0.39
Oxidation reduction potential	mV	NG	NG	NG	NG	NG	NG	NG	NG	131	131
pH		5.0 - 9.0 [1.1]	NG	5.0 - 9.5 [3.1]	NG	NG	NG	NG	7.0 - 10.5 [7.1]	7.26	7.26
Temperature	°C	N [1.2]	NG	N [3.2]	NG	NG	15	NG	15	9.4	9.4
Turbidity	NTU	N [1.3]	NG	N [3.3]	NG	N [4.1]	NG	N [6.1]	NG	3.66	3.66
Lab Results											
General											
Chloride	mg/L	100	NG	600 [3.4]	NG	NG	250	NG	250	24.8	24.4
Nutrients											
Ammonia (total, as N)	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	0.575	0.576
Nitrate (as N)	mg/L	NG	NG	100 [3.5]	NG	10	NG	10	NG	0.045	<0.010
Nitrate + Nitrite (as N)	mg/L	NG	NG	100 [3.6]	NG	NG	NG	10 [6.2]	NG	0.0452	<0.0100
Nitrite (as N)	mg/L	NG	NG	10 [3.7]	NG	1.0	NG	1	NG	<0.010	<0.010
Organic nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	0.195	0.304
Total nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	0.815	0.880
Total kjeldahl nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	0.770	0.880
Phosphorus (total, APHA 4500-P)	mg/L	NG	NG	NG	NG	NG	N [5.1]	NG	NG	0.0583	0.0613
Phosphorus (dissolved, APHA 4500-P)	mg/L	NG	NG	NG	NG	NG	N [5.2]	NG	NG		

[1] See attachments for guideline notes.

Legend	
<	Less than reported detection limit
NG	No Guideline
N	Narrative type of guideline or standard, or Result Note.
Calc	Calculated guideline. The guideline is dependent on the value of one or more other analytes, and is calculated from a formula or table.
BCAWQG I	Highlighted value exceeds the BC Approved Water Quality Guidelines for irrigation (BCAWQG I)
BCWWQG I	Highlighted value exceeds the BC Working Water Quality Guidelines for irrigation (BCWWQG I)
BCAWQG L	Highlighted value exceeds the BC Approved Water Quality Guidelines for livestock (BCAWQG L)
BCWWQG L	Highlighted value exceeds the BC Working Water Quality Guidelines for livestock (BCWWQG L)
BC SDWQG AO	BC Source Drinking Water Quality Guidelines - Aesthetic Objectives (2017 and updates)
BC SDWQG MAC	BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations (2017 and updates)
GCDWQ MAC	Highlighted value exceeds the Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentrations (GCDWQ MAC)
GCDWQ AO	Highlighted value exceeds the Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives (GCDWQ AO)

Guideline Notes for Reports for 2016-8113.010 Grace-Mar Farms Water Quality Results

1. Notes for BC Approved Water Quality Guidelines for irrigation (BCAWQG I)

General Notes:

The Water Quality Guidelines (Criteria) Reports by BC Ministry of Environment were used as references for the guidelines. (Internet address: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html). Overview Reports (BC MOE) were used as the references for the guidelines unless the note for specific analyte indicates that the Technical Appendix (BC MOE) was

Note 1.1 for pH:

The recommended criterion for irrigation waters is a pH ranging between 5.0 and 9.0. This guideline recognizes that soil acidity, alkalinity and salinity are a concern in agriculture.

Note 1.2 for Temperature:

The recommended guideline for temperature is + or - 1 degree Celsius change from natural ambient background.

Note 1.3 for Turbidity:

Induced turbidity should not exceed 10 NTU when background turbidity is less than or equal to 50 NTU, nor should induced turbidity be more than 20 % of background when background is greater than 50 NTU.

2. Notes for Working Water Quality Guidelines for British Columbia for irrigation (BCWWQG I)

General Notes:

Reference: Working Water Quality Guidelines for British Columbia (2015). WWQG values are long-term (i.e. average) concentrations unless identified as a short-term maximum in the “Notes” for a specific analyte. Long-term WWQGs represent average substance concentrations calculated from 5 samples in 30 days. WWQG are given for total substance concentrations unless otherwise noted.

Note 2.1 for Conductivity:

The guideline varies from 700 to 5000 µS/cm depending on the type of crop. The most stringent guideline has been used for this report.

3. Notes for BC Approved Water Quality Guidelines for livestock (BCAWQG L)

General Notes:

The Water Quality Guidelines (Criteria) Reports by BC Ministry of Environment were used as references for the guidelines. (Internet address: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html). Overview Reports (BC MOE) were used as the references for the guidelines unless the note for specific analyte indicates that the Technical Appendix (BC MOE) was

Note 3.1 for pH:

pH does not interfere with the palatability of water or the health of livestock.

Note 3.2 for Temperature:

The recommended guideline for temperature is + or - 1 degree Celsius change from natural ambient background.

Note 3.3 for Turbidity:

Induced turbidity should not exceed 5 NTU when background turbidity is less than or equal to 50 NTU, nor should induced turbidity be more than 10 % of background when background is greater than 50 NTU.

Note 3.4 for Chloride:

The water quality guideline for chloride for livestock watering is 600 mg/L.

Note 3.5 for Nitrate (as N):

Overview Report Update, September 2009.

Note 3.6 for Nitrate + Nitrite (as N):

The guideline maximum for nitrate as nitrogen is 100 mg/l. Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed this value. Overview Report Update, September 2009.

Note 3.7 for Nitrite (as N):

Overview Report Update, September 2009.

4. Notes for BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations (2017 and updates) (BC SDWQG MAC)

General Notes:

The source drinking water quality guidelines presented in this document apply to the ambient water before it is treated and distributed for domestic use. The guidelines apply to drinking water sources from surface water and groundwater.
Metal guidelines are based on total concentrations.

Note 4.1 for Turbidity:

For raw drinking water with treatment for particulates, the guideline is:
Change from background of 5 NTU at any time when background is ≤ 50 NTU; and change from background of 10% when background is > 50 NTU.

For raw drinking water without treatment for particulates, the guideline is:
Change from background of 1 NTU at any time when background is ≤ 5 NTU; and change from background of 5 NTU at any time.

If natural background turbidity is > 50 NTU, the guideline is:
Induced turbidity should not exceed 10% of the background turbidity.

5. Notes for BC Source Drinking Water Quality Guidelines - Aesthetic Objectives (2017 and updates) (BC SDWQG AO)

General Notes:

The source drinking water quality guidelines presented in this document apply to the ambient water before it is treated and distributed for domestic use. The guidelines apply to drinking water sources from surface water and groundwater.
Metal guidelines are based on total concentrations.

Note 5.1 for Phosphorus (total, APHA 4500-P):

The AO for lakes is 0.01 mg/L. For lakes with residence time > 6 months, measure total P during spring overturn. For lakes with residence time < 6 months, measure mean epilimnetic total P during the growing season (ENV 1985).

Note 5.2 for Phosphorus (dissolved, APHA 4500-P):

The AO for lakes is 0.01 mg/L. For lakes with residence time > 6 months, measure total P during spring overturn. For lakes with residence time < 6 months, measure mean epilimnetic total P during the growing season (ENV 1985).

6. Notes for Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentrations (GCDWQ MAC)

Note 6.1 for Turbidity:

Waterworks systems that use a surface water source or a groundwater source under the direct influence of surface water should filter the source water to meet health-based turbidity limits, as defined for specific treatment technologies. Where possible, filtration systems should be designed and operated to reduce turbidity levels as low as possible, with a treated water turbidity target of less than 0.1 NTU at all times. Where this is not achievable, the treated water turbidity levels from individual filters should meet the requirements described in GCDWQ.
For systems that use groundwater that is not under the direct influence of surface water, which are considered less vulnerable to faecal contamination, turbidity should generally be below 1.0 NTU.
For effective operation of the distribution system, it is good practice to ensure that water entering the distribution system has turbidity levels below 1.0 NTU.

Note 6.2 for Nitrate + Nitrite (as N):

The MAC for Nitrate (as N) is 10 mg/L

7. Notes for Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives (GCDWQ AO)

Note 7.1 for pH:

The operational guideline for pH is a range of 7.0 to 10.5 in finished drinking water.

April 27, 2018
Brady Nelless
BC Ministry of Environment

ATTACHMENT 2: TABLE A-2: SURFACE WATER QUALITY REPORT

Table A-2 Grace-Mar Farms Surface Water Quality Results (Action #14 Sampling)

Analyte	Unit	Guideline										Sampling Location	Floyd's Swamp	Floyd's Swamp
												Date Sampled	24-May-17	14-Nov-17
												Lab Sample ID	7052134-05	7111412-06
												Sample Type	Normal	Normal
		BCAWQG AL	BCWWQG AL	BCAWQG I	BCWWQG I	*BCAWQG L*	*BCWWQG L*	BC SDWQG MAC	BC SDWQG AO	GCDWQ MAC	GCDWQ AO			
Field Results														
Conductivity	µS/cm	NG	NG	NG	700 [3.1]	NG	NG	NG	NG	NG	NG		1490	1040
Dissolved oxygen	mg/L	min 5 [1.1]	NG	NG	NG	NG	NG	NG	NG	NG	NG			7.28
Oxidation reduction potential	mV	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG		3	202
pH		N [1.2]	NG	5.0 - 9.0 [2.1]	NG	5.0 - 9.5 [4.1]	NG	NG	NG	NG	7.0 - 10.5 [8.1]		7.7	6.81
Temperature	°C	19 [1.3]	NG	N [2.2]	NG	N [4.2]	NG	NG	15	NG	15		15.3	1.3
Turbidity	NTU	N [1.4]	NG	N [2.3]	NG	N [4.3]	NG	N [5.1]	NG	N [7.1]	NG			4.49
Lab Results														
General														
Chloride	mg/L	600 [1.5]	NG	100	NG	600 [4.4]	NG	NG	250	NG	250		30.4	22.8
Nutrients														
Ammonia (total, as N)	mg/L	Calc [1.6]	NG	NG	NG	NG	NG	NG	NG	NG	NG		1.14	2.10
Nitrate (as N)	mg/L	32.8 [1.7]	NG	NG	NG	100 [4.5]	NG	10	NG	10	NG		<0.010	0.175
Nitrate + Nitrite (as N)	mg/L	32.8 [1.8]	NG	NG	NG	100 [4.6]	NG	NG	NG	10 [7.2]	NG		0.720	0.175
Nitrite (as N)	mg/L	Calc [1.9]	NG	NG	NG	10 [4.7]	NG	1.0	NG	1	NG		0.720	<0.010
Organic nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG			1.75
Total nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG		4.72	4.03
Total kjeldahl nitrogen	mg/L	NG	NG	NG	NG	NG	NG	NG	NG	NG	NG		4.00	3.86
Phosphorus (total, APHA 4500-P)	mg/L	N [1.10]	NG	NG	NG	NG	NG	NG	N [6.1]	NG	NG		0.410	0.513

[1] See attachments for guideline notes.

Legend	
<	Less than reported detection limit
NG	No Guideline
N	Narrative type of guideline or standard, or Result Note.
Calc	Calculated guideline. The guideline is dependent on the value of one or more other analytes, and is calculated from a formula or table.
BCAWQG AL	Highlighted value exceeds the BC Approved Water Quality Guidelines for aquatic life (BCAWQG AL)
BCWWQG AL	Highlighted value exceeds the BC Working Water Quality Guidelines for aquatic life (BCWWQG AL)
BCAWQG I	Highlighted value exceeds the BC Approved Water Quality Guidelines for irrigation (BCAWQG I)
BCWWQG I	Highlighted value exceeds the BC Working Water Quality Guidelines for irrigation (BCWWQG I)
BCAWQG L	Highlighted value exceeds the BC Approved Water Quality Guidelines for livestock (BCAWQG L)
BCWWQG L	Highlighted value exceeds the BC Working Water Quality Guidelines for livestock (BCWWQG L)
BC SDWQG AO	BC Source Drinking Water Quality Guidelines - Aesthetic Objectives (2017 and updates)
BC SDWQG MAC	BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations (2017 and updates)
GCDWQ MAC	Highlighted value exceeds the Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentrations (GCDWQ MAC)
GCDWQ AO	Highlighted value exceeds the Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives (GCDWQ AO)

1. Notes for BC Approved Water Quality Guidelines for freshwater aquatic life (BCAWQG AL)

General Notes:

The Water Quality Guidelines (Criteria) Reports by BC Ministry of Environment were used as references for the guidelines. (Internet address: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html). Overview Reports (BC MOE) were used as the references for the guidelines unless the note for specific analyte indicates that the Technical Appendix (BC MOE) was used. / For some parameters, guidelines are specified as two values: the maximum value or the acute criterion, and the 30-day average value or the chronic criterion. The maximum value was used in this report for parameters that have both guideline values.

Note 1.1 for Dissolved oxygen:

The instantaneous minimum guideline for dissolved oxygen is 5 mg/L for all life stages other than buried embryo/alevin. The instantaneous minimum guideline for dissolved oxygen in the water column is 9 mg/L for buried embryo/alevin. The instantaneous minimum guideline for dissolved oxygen in interstitial water is 6 mg/L for buried embryo/alevin.
The 30-day mean guideline (minimum) for dissolved oxygen is 8 mg/L for all life stages other than buried embryo/alevin. The 30-day mean guideline (minimum) for dissolved oxygen in the water column is 11 mg/L for buried embryo/alevin. The 30-day mean guideline (minimum) for dissolved oxygen in interstitial water is 8 mg/L for buried embryo/alevin.

Note 1.2 for pH:

pH less than 6.5: No statistically significant decrease in pH from background.
pH from 6.5 to 9.0: Unrestricted change permitted within this range.
pH over 9.0: No statistically significant increase in pH from background.
See BC MOE Overview Report for additional details.

Note 1.3 for Temperature:

The maximum daily temperature of 19 degrees Celsius is for streams with unknown fish distribution. See BC MOE Overview Report for additional details for streams with unknown fish distribution, and specific guidelines for streams with known fish distribution, and guideline for lakes and impoundments.

Note 1.4 for Turbidity:

When background is less than or equal to 8 NTU:
- Maximum Induced Turbidity of 8 NTU in 24 hours.
- For sediment inputs that last between 24 hours and 30 days (daily sampling preferred) the mean turbidity should not exceed background by more than 2 NTU.

Maximum Induced Turbidity of 5 NTU when background is between 8 and 50 NTU.
Maximum Induced Turbidity of 10% when background is greater than 50 NTU.

Note 1.5 for Chloride:

To protect freshwater aquatic life from acute and lethal effects, the maximum concentration of chloride (mg/L as NaCl) at any time should not exceed 600 mg/L.
To protect freshwater aquatic life from chronic effects, the average (arithmetic mean computed from five weekly samples collected over a 30-day period) concentration of chloride (mg/L as NaCl) should not exceed 150 mg/L.

Note 1.6 for Ammonia (total, as N):

The maximum guideline for ammonia varies as a function of pH and temperature. See Table 3 in Overview Report Update September 2009.
The 30-day average guideline for ammonia varies as a function of pH and temperature. See Table 4 in Overview Report Update September 2009. / The lab pH and field temperature results were used for determining the maximum ammonia for this report. If a lab pH result was not available then the field pH result was used.

Note 1.7 for Nitrate (as N):

The guideline maximum for nitrate (as N) is 32.8 mg/l.
The 30-day average guideline for nitrate (as N) is 3.0 mg /L. The 30-day average (chronic) concentration is based on 5 weekly samples collected within a 30-day period.
Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed these values.

Note 1.8 for Nitrate + Nitrite (as N):

The guideline maximum for nitrate (as N) is 32.8 mg/l.
The 30-day average guideline for nitrate (as N) is 3.0 mg /L. The 30-day average (chronic) concentration is based on 5 weekly samples collected within a 30-day period.
Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed these values.

Note 1.9 for Nitrite (as N):

The guideline maximum for nitrite as N is:
0.06 mg/L if chloride less than 2 mg/L
0.12 mg/L if chloride is 2 to 4 mg/L
0.18 mg/L if chloride is 4 to 6 mg/L
0.24 mg/L if chloride is 6 to 8 mg/L
0.30 mg/L if chloride is 8 to 10 mg/L
0.60 mg/L if chloride is greater than 10 mg/L.
The guideline 30-day average for nitrite as N is:
0.02 mg/L if chloride less than 2 mg/L
0.04 mg/L if chloride is 2 to 4 mg/L
0.06 mg/L if chloride is 4 to 6 mg/L
0.08 mg/L if chloride is 6 to 8 mg/L
0.10 mg/L if chloride is 8 to 10 mg/L
0.20 mg/L if chloride is greater than 10 mg/L.

Note 1.10 for Phosphorus (total, APHA 4500-P):

Streams: None proposed for streams.

Lakes: It is not possible to specify a single phosphorous concentration to achieve protection of aquatic life in lakes. A range of total phosphorous concentrations (5-15 µg/L) is suggested as the criterion which can be used as the basis for site specific water quality objectives.

2. Notes for BC Approved Water Quality Guidelines for irrigation (BCAWQG I)

General Notes:

The Water Quality Guidelines (Criteria) Reports by BC Ministry of Environment were used as references for the guidelines. (Internet address: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html). Overview Reports (BC MOE) were used as the references for the guidelines unless the note for specific analyte indicates that the Technical Appendix (BC MOE) was

Note 2.1 for pH:

The recommended criterion for irrigation waters is a pH ranging between 5.0 and 9.0. This guideline recognizes that soil acidity, alkalinity and salinity are a concern in agriculture.

Note 2.2 for Temperature:

The recommended guideline for temperature is + or - 1 degree Celsius change from natural ambient background.

Note 2.3 for Turbidity:

Induced turbidity should not exceed 10 NTU when background turbidity is less than or equal to 50 NTU, nor should induced turbidity be more than 20 % of background when background is greater than 50 NTU.

3. Notes for Working Water Quality Guidelines for British Columbia for irrigation (BCWWQG I)

General Notes:

Reference: Working Water Quality Guidelines for British Columbia (2015). WWQG values are long-term (i.e. average) concentrations unless identified as a short-term maximum in the “Notes” for a specific analyte. Long-term WWQGs represent average substance concentrations calculated from 5 samples in 30 days. WWQG are given for total substance concentrations unless otherwise noted.

Note 3.1 for Conductivity:

The guideline varies from 700 to 5000 µS/cm depending on the type of crop. The most stringent guideline has been used for this report.

4. Notes for BC Approved Water Quality Guidelines for livestock (BCAWQG L)

General Notes:

The Water Quality Guidelines (Criteria) Reports by BC Ministry of Environment were used as references for the guidelines. (Internet address: http://www.env.gov.bc.ca/wat/wq/wq_guidelines.html). Overview Reports (BC MOE) were used as the references for the guidelines unless the note for specific analyte indicates that the Technical Appendix (BC MOE) was

Note 4.1 for pH:

pH does not interfere with the palatability of water or the health of livestock.

Note 4.2 for Temperature:

The recommended guideline for temperature is + or - 1 degree Celsius change from natural ambient background.

Note 4.3 for Turbidity:

Induced turbidity should not exceed 5 NTU when background turbidity is less than or equal to 50 NTU, nor should induced turbidity be more than 10 % of background when background is greater than 50 NTU.

Note 4.4 for Chloride:

The water quality guideline for chloride for livestock watering is 600 mg/L.

Note 4.5 for Nitrate (as N):

Overview Report Update, September 2009.

Note 4.6 for Nitrate + Nitrite (as N):

The guideline maximum for nitrate as nitrogen is 100 mg/l. Where nitrate and nitrite are present, the total nitrate+nitrite nitrogen should not exceed this value. Overview Report Update, September 2009.

Note 4.7 for Nitrite (as N):

Overview Report Update, September 2009.

5. Notes for BC Source Drinking Water Quality Guidelines - Maximum Acceptable Concentrations (2017 and updates) (BC SDWQG MAC)

General Notes:

The source drinking water quality guidelines presented in this document apply to the ambient water before it is treated and distributed for domestic use. The guidelines apply to drinking water sources from surface water and groundwater.
Metal guidelines are based on total concentrations.

Note 5.1 for Turbidity:

For raw drinking water with treatment for particulates, the guideline is:
Change from background of 5 NTU at any time when background is ≤ 50 NTU; and change from background of 10% when background is > 50 NTU.
For raw drinking water without treatment for particulates, the guideline is:
Change from background of 1 NTU at any time when background is ≤ 5 NTU; and change from background of 5 NTU at any time.
If natural background turbidity is > 50 NTU, the guideline is:
Induced turbidity should not exceed 10% of the background turbidity.

6. Notes for BC Source Drinking Water Quality Guidelines - Aesthetic Objectives (2017 and updates) (BC SDWQG AO)

General Notes:

The source drinking water quality guidelines presented in this document apply to the ambient water before it is treated and distributed for domestic use. The guidelines apply to drinking water sources from surface water and groundwater.
Metal guidelines are based on total concentrations.

Note 6.1 for Phosphorus (total, APHA 4500-P):

The AO for lakes is 0.01 mg/L. For lakes with residence time > 6 months, measure total P during spring overturn. For lakes with residence time < 6 months, measure mean epilimnetic total P during the growing season (ENV 1985).

7. Notes for Guidelines for Canadian Drinking Water Quality - Maximum Acceptable Concentrations (GCDWQ MAC)

Note 7.1 for Turbidity:

Waterworks systems that use a surface water source or a groundwater source under the direct influence of surface water should filter the source water to meet health-based turbidity limits, as defined for specific treatment technologies. Where possible, filtration systems should be designed and operated to reduce turbidity levels as low as possible, with a treated water turbidity target of less than 0.1 NTU at all times. Where this is not achievable, the treated water turbidity levels from individual filters should meet the requirements described in GCDWQ.
For systems that use groundwater that is not under the direct influence of surface water, which are considered less vulnerable to faecal contamination, turbidity should generally be below 1.0 NTU.
For effective operation of the distribution system, it is good practice to ensure that water entering the distribution system has turbidity levels below 1.0 NTU.

Note 7.2 for Nitrate + Nitrite (as N):

The MAC for Nitrate (as N) is 10 mg/L

8. Notes for Guidelines for Canadian Drinking Water Quality - Aesthetic Objectives (GCDWQ AO)

Note 8.1 for pH:

The operational guideline for pH is a range of 7.0 to 10.5 in finished drinking water.

April 27, 2018
Brady Nelless
BC Ministry of Environment

ATTACHMENT 3: FIELD SHEETS - NOVEMBER SAMPLING

Field Sampling Sheet - Groundwater

Site/Facility Name:	Gracemar Farms	Client:	Gracemar Farms
Well ID:	WT94335	Project Number:	2016-8113.010.003
Date:	November 15, 2017	Sampled by:	Jesse Manna
Casing Diameter:	6"	Weather:	Cloudy 5°C
Well Stick-up:		Remarks:	Could not get pump lower than 10.12 m depth due to wiring in well.
Condition of well:	good / needs attention		
		Is the well marked/flagged?	Yes / No

DTB:	~41	m
DTW:	6.045	m
Difference:	34.955	m
X Casing volume (L/m)	6	L/m
Volume of water in well:	209.73	L/m
x 3 (for sampling) x 5 (for developing)		
Volume of water to purge:	629.19	L
Volume actually purged:	<600	L

Pressure: negative / positive / none

15cm (6") casing volume = 18L/m

10cm (4") casing volume = 8L/m

5cm (2") casing volume = 2L/m

UTM Coordinates:
Easting (6 digits)
0337774
Northing (7 digits)
5594648
Zone: 11U

Purge method: Bailer / (Pump) / Waterra / None / Other: submersible / low flow @ 10-12 m depth.

Purged to dry: Yes / (No)

Purge water disposal: (Ground) / Container

Was sheen observed during purging or sampling? Yes / (No)

Field Parameters

	Time	Volume (L)	pH	Temp °C	Cond. (µS/cm)	ORP (mv)	DO (mg/L)	Turbidity	DTW (m btoc)	Comments
1st	13:53		8.83	8.2	650	-12	1.20	37.1		
2nd	13:58		8.84	8.6	650	-58	1.06	30.0		
3rd	14:05		8.85	8.7	650	-114	1.05	30.5		
4th	14:10		8.79	8.9	670	-118	1.15	17.4		
5th	14:15		8.85	8.9	690	-129	0.25	15.2		
6th	14:20		8.83	8.9	700	-148	0.19	10.9		
7th	14:25		8.81	9.0	690	-160	0.20	11.8		
8th	14:35		8.80	8.9	700	-164	0.16	9.82		

write additional lines on the back

Sample Descriptions:

Sample date: November 15, 2017 Sample time: 14:40

Appearance: slightly cloudy w yellowish tint Sample Colour: Clearish yellow

Order of bottles collected: General, Nutrients

List any Parameters not Sampled/bottles missed:

Were Samples Filtered and Preserved? Yes / (No)

Duplicate Sample? Yes / (No) **Duplicate Sample ID:**

Additional Notes:
- site access
- hidden well location
- safety concerns
- unusual well behaviour

Associated Environmental

Field Sampling Sheet - Groundwater

Site/Facility Name:	Gracemar Farms	Client:	Gracemar Farms
Well ID:	WPID 78093	Project Number:	2016-8113.010.003
Date:	November 15 2017	Sampled by:	Jesse Manna
Casing Diameter:		Weather:	
Well Stick-up:		Remarks:	untreated GW well From hose in horse Feedlot.
Condition of well:	good needs attention		
		Is the well marked/flagged?	Yes No

DTB:		m
DTW:		m
Difference:		m
X Casing volume (L/m)		L/m
Volume of water in well:		L/m
x 3 (for sampling) x 5 (for developing)		
Volume of water to purge:		L
Volume actually purged:		L

Pressure:
negative positive none

15cm (6") casing volume = 18L/m
10cm (4") casing volume = 8L/m
5cm (2") casing volume = 2L/m

UTM Coordinates:
Easting (6 digits)
Northing (7 digits)
Zone:

Purge method: Bailer Pump Waterra None Other:
Purged to dry: Yes No
Purge water disposal: Ground Container

Was sheen observed during purging or sampling?
Yes (No)

Field Parameters

	Time	Volume (L)	pH	Temp °C	Cond. (µS/cm)	ORP (mv)	DO (mg/L)	Turbidity	DTW (m btoc)	Comments
1st	15.55		7.61	5.2	1040	-7	1.78	63.2		
2nd	16:00		7.52	5.2	1040	-16	1.16			
3rd	16:05		7.52	5.1	980	-15	1.81	82.4		
4th	16:10		7.49	5.2	980	-17	1.68	73.3		
5th	16:15		7.49	5.1	980	-18	1.60			
6th										
7th										
8th										

write additional lines on the back

Sample Descriptions:

Sample date: November 15, 2017 Sample time: 16:15

Appearance: Sample Colour: slight yellow

Order of bottles collected: General, Nutrients

List any Parameters not Sampled/bottles missed:

Were Samples Filtered and Preserved? Yes (No)

Duplicate Sample? Yes (No) **Duplicate Sample ID:**

Additional Notes:
- site access
- hidden well location
- safety concerns
- unusual well behaviour

Associated Environmental

[redacted]

Field Sampling Sheet - Groundwater

Site/Facility Name:	Gracemar Farms	Client:	Gracemar Farms
Well ID:	MW1	Project Number:	2016-8113.010.003
Date:	November 18, 2017	Sampled by:	Jesse Manna
Casing Diameter:	2"	Weather:	4°C
Well Stick-up:		Remarks:	
Condition of well:	good / needs attention		
		Is the well marked/flagged?	Yes / No

DTB:	7.820	m
DTW:	5.785	m
Difference:	2.035	m
X Casing volume (L/m)	2.0	L/m
Volume of water in well:	4.07	L/m
x 3 (for sampling) x 5 (for developing)		
Volume of water to purge:	12.21	L
Volume actually purged:	15.0	L

Pressure: negative positive none

15cm (6") casing volume = 18L/m

10cm (4") casing volume = 8L/m

5cm (2") casing volume = 2L/m ✓

UTM Coordinates:
Easting (6 digits)
0337774
Northing (7 digits)
5594648
Zone: 11U

Purge method: Bailer / Pump (Submersible) / Waterra / None / Other:

Purged to dry: Yes / No

Purge water disposal: Ground / Container

Was sheen observed during purging or sampling? Yes / No

Field Parameters

	Time	Volume (L)	pH	Temp °C	Cond. (µS/cm)	ORP (mv)	DO (mg/L)	Turbidity	DTW (m btoc)	Comments
1st	15:30		7.70	8.4	1150	29	1.66	11.6		
2nd	15:35		7.45	9.0	1140	33	1.71	11.6		
3rd	15:40		7.45	9.8	1140	38	1.71	7.14		
4th	15:45		7.46	10.0	1140	42	1.67	4.52		
5th	15:50		7.46	10.0	1140	41	1.66	0.63		
6th	15:55		7.46	10.0	1140	44	1.65	0.54		
7th	16:00		7.46	10.1	1140	50	1.54	0.34		
8th	16:05		7.46	10.1	1140	50	1.54	0.51		

write additional lines on the back

Sample Descriptions:

Sample date: November 18, 2017 Sample time: 16:10

Appearance: clear Sample Colour: clear

Order of bottles collected: General, Nutrients

List any Parameters not Sampled/bottles missed:

Were Samples Filtered and Preserved? Yes / No

Duplicate Sample? Yes / No **Duplicate Sample ID:**

Additional Notes:
- site access
- hidden well location
- safety concerns
- unusual well behaviour

Associated Environmental

Field Sampling Sheet - Groundwater

Site/Facility Name:	Gracemar Farms	Client:	Gracemar Farms
Well ID:	MW3S	Project Number:	2016-8113.010.003
Date:	November 14, 2017	Sampled by:	Jesse Manna
Casing Diameter:	2"	Weather:	4°C
Well Stick-up:		Remarks:	
Condition of well:	(good) needs attention		
		Is the well marked/flagged?	(Yes) No

DTB:	9.655	m
DTW:	7.000	m
Difference:	2.655	m
X Casing volume (L/m)	2	L/m
Volume of water in well:	5.31	L/m
(x 3) (for sampling) x 5 (for developing)		
Volume of water to purge:	15.93	L
Volume actually purged:	>16.0	L

Pressure:
negative positive none

15cm (6") casing volume = 18L/m
10cm (4") casing volume = 8L/m
5cm (2") casing volume = 2L/m ✓

UTM Coordinates:
Easting (6 digits)
0337777
Northing (7 digits)
5594647
Zone: 11 U

Submersible

Purge method: Bailer (Pump) Waterra None Other:
Purged to dry: Yes (No)
Purge water disposal: (Ground) Container

Was sheen observed during purging or sampling? Yes (No)

Field Parameters

	Time	Volume (L)	pH	Temp °C	Cond. (µS/cm)	ORP (mv)	DO (mg/L)	Turbidity	DTW (m btoc)	Comments
1st	14:30		7.17	9.3	1400	-2	1.01	3.40		
2nd	14:35		7.17	9.3	1400	7	0.98	4.06		
3rd	14:40		7.17	9.4	1400	11	0.98	4.00		
4th	14:45		7.17	9.3	1400	16	0.99	2.31		
5th	14:50		7.17	9.3	1400	17	0.98	1.37		
6th	14:55		7.17	9.3	1400	17	0.98	0.16		
7th	15:00		7.17	9.3	1400	17	0.98	0.21		
8th										

write additional lines on the back

Sample Descriptions:

Sample date: November 14, 2017 Sample time: 15:00

Appearance: clear Sample Colour: clear

Order of bottles collected: General, Nutrients

List any Parameters not Sampled/bottles missed:

Were Samples Filtered and Preserved? Yes (No)

Duplicate Sample? Yes (No) **Duplicate Sample ID:**

Additional Notes:
- site access
- hidden well location
- safety concerns
- unusual well behaviour

Associated Environmental

Field Sampling Sheet - Groundwater

Site/Facility Name:	Gracemar Farms	Client:	Gracemar Farms
Well ID:	MW3D	Project Number:	2016-8113.010.003
Date:	November 14, 2017	Sampled by:	Jesse Manna
Casing Diameter:	2"	Weather:	4°C
Well Stick-up:		Remarks:	requires well cap. Only has a plug.
Condition of well:	good (needs attention)	Is the well marked/flagged?	(Yes) No

DTB:	17.550	m
DTW:	7.050	m
Difference:	10.50	m
X Casing volume (L/m)	2.0	L/m
Volume of water in well:	21.0	L/m
(x 3) (for sampling) x 5 (for developing)		
Volume of water to purge:	63	L
Volume actually purged:	763	L

Pressure:
negative positive none

15cm (6") casing volume = 18L/m
10cm (4") casing volume = 8L/m
5cm (2") casing volume = 2L/m ✓

UTM Coordinates:
Easting (6 digits)
0337870
Northing (7 digits)
5594958
Zone: 11U

Submersible

Purge method: Bailer (Pump) Waterra None Other:
Purged to dry: Yes (No)
Purge water disposal: (Ground) Container

Was sheen observed during purging or sampling? Yes (No)

Field Parameters

	Time	Volume (L)	pH	Temp °C	Cond. (µS/cm)	ORP (mv)	DO (mg/L)	Turbidity	DTW (m btoc)	Comments
1st	13:28		7.50	8.9	1230	121	0.56	4.98		
2nd	13:35		7.51	8.9	1240	121	0.59	5.15		
3rd	13:40		7.51	9.0	1240	122	0.57	6.04		
4th	13:45		7.51	9.0	1240	122	0.56	8.29		
5th	13:50		7.51	9.0	1230	122	0.54	9.47		
6th	13:55		7.51	8.9	1250	123	0.50	8.76		
7th	14:00		7.51	8.9	1240	123	0.52	5.79		
8th										

write additional lines on the back

Sample Descriptions:

Sample date: November 14, 2017 Sample time: 14:00

Appearance: clear Sample Colour: clear

Order of bottles collected: General, Nutrients

List any Parameters not Sampled/bottles missed:

Were Samples Filtered and Preserved? Yes (No)

Duplicate Sample? Yes (No) **Duplicate Sample ID:**

Additional Notes:
- site access
- hidden well location
- safety concerns
- unusual well behaviour

Associated Environmental

Field Sampling Sheet - Groundwater

Site/Facility Name:	Gracemar Farms	Client:	Gracemar Farms
Well ID:	WT94334	Project Number:	2016-8113.010.003
Date:	November 18, 2017	Sampled by:	Jesse Manna
Casing Diameter:	6"	Weather:	4°C
Well Stick-up:		Remarks:	Purged well for 1 hr @ 0.17 L/s. See field notes for comments.
Condition of well:	good / needs attention	Is the well marked/flagged?	Yes / No

DTB:	12.345	m
DTW:	1.460	m
Difference:	10.885	m
X Casing volume (L/m)	18	L/m
Volume of water in well:	196 L	L/m
x 3 (for sampling) x 5 (for developing)		
Volume of water to purge:	588	L
Volume actually purged:	>588	L

Pressure: negative / positive / none

15cm (6") casing volume = 18L/m ✓

10cm (4") casing volume = 8L/m

5cm (2") casing volume = 2L/m

UTM Coordinates:
Easting (6 digits)
0337869
Northing (7 digits)
5594952
Zone: 11U

Submersable pump

Purge method: Bailer / (Pump) / Waterra / None / Other:

Purged to dry: Yes / (No)

Purge water disposal: (Ground) / Container

Was sheen observed during purging or sampling? Yes / (No)

Field Parameters

	Time	Volume (L)	pH	Temp °C	Cond. (µS/cm)	ORP (mv)	DO (mg/L)	Turbidity	DTW (m btoc)	Comments
1st	11:17		7.25	9.1	1090	129	0.53	8.14		
2nd	11:25		7.25	9.4	1100	131	0.44	7.22		
3rd	11:30		7.25	9.4	1100	130	0.42	6.00		
4th	11:35		7.26	9.4	1100	130	0.42	3.94		
5th	11:40		7.26	9.4	1090	130	0.40	3.57		
6th	11:45		7.26	9.4	1090	131	0.39	3.66		
7th										
8th										

write additional lines on the back

Sample Descriptions:

Sample date: November 18, 2017 Sample time: 11:45

Appearance: clear Sample Colour: clear

Order of bottles collected: General, Nutrients

List any Parameters not Sampled/bottles missed:

Were Samples Filtered and Preserved? Yes / (No)

Duplicate Sample? (Yes) / No **Duplicate Sample ID:** MW 4

Additional Notes:
- site access
- hidden well location
- safety concerns
- unusual well behaviour

Associated Environmental

Field Sampling Sheet - Groundwater

Site/Facility Name:	Gracemar Farms	Client:	Gracemar Farms
Well ID:	MW2	Project Number:	2016-8113.010.003
Date:	November 18, 2017	Sampled by:	Jesse Manna
Casing Diameter:	2"	Weather:	4°C
Well Stick-up:		Remarks:	
Condition of well:	good needs attention		
		Is the well marked/flagged?	Yes No

DTB:	8.220	m
DTW:	7.380	m
Difference:	2.840	m
X Casing volume (L/m)	2	L/m
Volume of water in well:	5.68	L/m
(x 3 (for sampling) x 5 (for developing)		
Volume of water to purge:	17.04	L
Volume actually purged:	>17.04	L

Pressure:
negative positive none

15cm (6") casing volume = 18L/m
10cm (4") casing volume = 8L/m
5cm (2") casing volume = 2L/m ✓

UTM Coordinates:
Easting (6 digits)
0338129
Northing (7 digits)
5594875
Zone: 11U

Purge method: Bailer (Pump) Waterra None Other: Peristaltic
Purged to dry: Yes (No)
Purge water disposal: (Ground) Container

Was sheen observed during purging or sampling? Yes (No)

Field Parameters

	Time	Volume (L)	pH	Temp °C	Cond. (µS/cm)	ORP (mv)	DO (mg/L)	Turbidity	DTW (m btoc)	Comments
1st	10:37		7.27	11.1	1260	18	1.43	7.38		
2nd	10:45		7.22	11.7	1258	16	1.12	4.52		
3rd	10:50		7.22	11.8	1250	16	1.07	1.42		
4th	10:55		7.22	11.9	1250	15	1.01	2.08		
5th	11:00		7.22	11.9	1260	14	0.95	1.24		
6th										
7th										
8th										

write additional lines on the back

Sample Descriptions:

Sample date: November 18, 2017 Sample time: 11:05

Appearance: clear Sample Colour: clear

Order of bottles collected: General, Nutrients

List any Parameters not Sampled/bottles missed:

Were Samples Filtered and Preserved? Yes (No)

Duplicate Sample? Yes (No) **Duplicate Sample ID:**

Additional Notes:
- site access
- hidden well location
- safety concerns
- unusual well behaviour

Associated Environmental

Field Sampling Sheet - Groundwater

Site/Facility Name:	Gracemar Farms	Client:	Gracemar Farms
Well ID:	Flowts Swamp	Project Number:	2016-8113.010.003
Date:	November 18, 2017	Sampled by:	Jesse Manna
Casing Diameter:	NA	Weather:	4°C
Well Stick-up:	NA	Remarks:	Nearly frozen over.
Condition of well:	good needs attention		
		Is the well marked/flagged?	Yes No

DTB:		m
DTW:		m
Difference:		m
X Casing volume (L/m)		L/m
Volume of water in well:		L/m
x 3 (for sampling) x 5 (for developing)		
Volume of water to purge:		L
Volume actually purged:		L

Pressure:
negative positive none

15cm (6") casing volume = 18L/m
10cm (4") casing volume = 8L/m
5cm (2") casing volume = 2L/m

UTM Coordinates:
Easting (6 digits)
Northing (7 digits)
Zone:

Surface water sample

Purge method: Bailer Pump Waterra None Other:
Purged to dry: Yes No
Purge water disposal: Ground Container

Was sheen observed during purging or sampling?
Yes (No)

Field Parameters

	Time	Volume (L)	pH	Temp °C	Cond. (µS/cm)	ORP (mv)	DO (mg/L)	Turbidity	DTW (m btoc)	Comments
1st	8:45		6.81	1.3	1040	202	7.28	4.49		
2nd										
3rd										
4th										
5th										
6th										
7th										
8th										

write additional lines on the back

Sample Descriptions:

Sample date: November 18, 2017 Sample time: 8:56

Appearance: clear Sample Colour: clear

Order of bottles collected: General, Nutrients

List any Parameters not Sampled/bottles missed:

Were Samples Filtered and Preserved? Yes (No)

Duplicate Sample? Yes (No) **Duplicate Sample ID:**

Additional Notes:
- site access
- hidden well location
- safety concerns
- unusual well behaviour

Associated Environmental

Field Sampling Sheet - Groundwater

Site/Facility Name:	Gracemar Farms	Client:	Gracemar Farms
Well ID:	Mr. Krebber's well	Project Number:	2016-8113.010.003
Date:	November 15 2017	Sampled by:	Jesse Manna
Casing Diameter:		Weather:	
Well Stick-up:		Remarks:	untreated gw from garden hose.
Condition of well:	good needs attention		
		Is the well marked/flagged?	Yes No

DTB:		m
DTW:		m
Difference:		m
X Casing volume (L/m)		L/m
Volume of water in well:		L/m
x 3 (for sampling) x 5 (for developing)		
Volume of water to purge:		L
Volume actually purged:		L

Pressure:
negative positive none

15cm (6") casing volume = 18L/m
10cm (4") casing volume = 8L/m
5cm (2") casing volume = 2L/m

UTM Coordinates:
Easting (6 digits)
Northing (7 digits)
Zone:

Sampled from garden hose.

Purge method: Bailer Pump Waterra None Other:
Purged to dry: Yes (No)
Purge water disposal: (Ground) Container

Was sheen observed during purging or sampling? Yes (No)

Field Parameters

	Time	Volume (L)	pH	Temp °C	Cond. (µS/cm)	ORP (mv)	DO (mg/L)	Turbidity	DTW (m btoc)	Comments
1st	15:00		7.61	8.5	1050	-32	1.69	43.4		
2nd	15:05		7.56	8.7	1070	-31	1.98	61.1	Needed to	
3rd	15:10		7.56	8.7	1070	-27	1.94	55.8	be re-zeroed	
4th	15:15		7.52	8.7	1060	-24	1.84	29.0		
5th	15:20		7.49	8.7	1070	-20	1.79	29.5		
6th	15:25		7.46	8.8	1070	-18	1.78	6.69		
7th	15:30		7.52	8.8	1070	-16	1.74	6.34		
8th										

write additional lines on the back

Sample Descriptions:

Sample date: November 15, 2017 Sample time: 15:30

Appearance: Sample Colour:

Order of bottles collected: General, Nutrients

List any Parameters not Sampled/bottles missed:

Were Samples Filtered and Preserved? Yes (No)

Duplicate Sample? Yes (No) **Duplicate Sample ID:**

Additional Notes:
- site access
- hidden well location
- safety concerns
- unusual well behaviour

Associated Environmental

April 27, 2018
Brady Nelless
BC Ministry of Environment

ATTACHMENT 4: LABORATORY REPORTS - NOVEMBER SAMPLING

CERTIFICATE OF ANALYSIS

REPORTED TO	Associated Environmental Consultants Inc. (Vernon) #200 - 2800 29th Street Vernon, BC V1T 9P9		
ATTENTION	Nicole Penner	**WORK ORDER**	7111412
PO NUMBER		**RECEIVED / TEMP**	2017-11-15 14:00 / 4°C
PROJECT	2016-8113.010.000 - Water	**REPORTED**	2017-11-22 16:43
PROJECT INFO	Gracemar Action 14	**COC NUMBER**	No Number

Introduction:

CARO Analytical Services is a testing laboratory full of smart, engaged scientists driven to make the world a safer and healthier place. Through our clients' projects we become an essential element for a better world. We employ methods conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts. CARO is accredited by the Canadian Association for Laboratories Accreditation (CALA) to ISO 17025:2005 for specific tests listed in the scope of accreditation approved by CALA.

Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

If you have any questions or concerns, please contact me at sgulenchyn@caro.ca

Authorized By:

Sara Gulenchyn, B.Sc, P.Chem.
Client Service Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	**WORK ORDER**	7111412
PROJECT	2016-8113.010.000 - Water	**REPORTED**	2017-11-22 16:43

Analyte	Result	RL	Units	Analyzed	Qualifier
MW1 (7111412-01) | Matrix: Fresh Water | Sampled: 2017-11-14 16:10					
Anions					
Chloride	**36.0**	0.10	mg/L	2017-11-18	
Nitrate (as N)	**8.70**	0.010	mg/L	2017-11-18	
Nitrite (as N)	< 0.010	0.010	mg/L	2017-11-18	
General Parameters					
Ammonia, Total (as N)	< 0.020	0.020	mg/L	2017-11-20	
Nitrogen, Total Kjeldahl	**0.542**	0.050	mg/L	2017-11-20	
Phosphorus, Total (as P)	**0.0512**	0.0020	mg/L	2017-11-19	
Calculated Parameters					
Nitrate+Nitrite (as N)	**8.70**	0.0100	mg/L	N/A	
Nitrogen, Total	**9.24**	0.0500	mg/L	N/A	
Nitrogen, Organic	**0.542**	0.0500	mg/L	N/A	
MW2 (7111412-02) | Matrix: Fresh Water | Sampled: 2017-11-14 11:05					
Anions					
Chloride	**45.0**	0.10	mg/L	2017-11-22	
Nitrate (as N)	**1.51**	0.010	mg/L	2017-11-18	
Nitrite (as N)	< 0.010	0.010	mg/L	2017-11-18	
General Parameters					
Ammonia, Total (as N)	< 0.020	0.020	mg/L	2017-11-20	
Nitrogen, Total Kjeldahl	**0.445**	0.050	mg/L	2017-11-20	
Phosphorus, Total (as P)	**0.0088**	0.0020	mg/L	2017-11-19	
Calculated Parameters					
Nitrate+Nitrite (as N)	**1.51**	0.0100	mg/L	N/A	
Nitrogen, Total	**1.96**	0.0500	mg/L	N/A	
Nitrogen, Organic	**0.445**	0.0500	mg/L	N/A	
MW3S (7111412-03) | Matrix: Fresh Water | Sampled: 2017-11-14 15:00					
Anions					
Chloride	**62.5**	0.10	mg/L	2017-11-18	
Nitrate (as N)	**13.3**	0.010	mg/L	2017-11-18	
Nitrite (as N)	**0.069**	0.010	mg/L	2017-11-18	
General Parameters					
Ammonia, Total (as N)	**0.028**	0.020	mg/L	2017-11-20	
Nitrogen, Total Kjeldahl	**0.553**	0.050	mg/L	2017-11-20	
Phosphorus, Total (as P)	**0.0141**	0.0020	mg/L	2017-11-19	
Calculated Parameters					

TEST RESULTS

REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	**WORK ORDER**	7111412
PROJECT	2016-8113.010.000 - Water	**REPORTED**	2017-11-22 16:43

Analyte	Result	RL	Units	Analyzed	Qualifier
MW3S (7111412-03) | Matrix: Fresh Water | Sampled: 2017-11-14 15:00, Continued					
Calculated Parameters, Continued					
Nitrate+Nitrite (as N)	**13.3**	0.100	mg/L	N/A	
Nitrogen, Total	**13.9**	0.100	mg/L	N/A	
Nitrogen, Organic	**0.525**	0.0500	mg/L	N/A	
MW3D (7111412-04) | Matrix: Fresh Water | Sampled: 2017-11-14 14:00					
Anions					
Chloride	**35.9**	0.10	mg/L	2017-11-18	
Nitrate (as N)	**0.140**	0.010	mg/L	2017-11-18	
Nitrite (as N)	< 0.010	0.010	mg/L	2017-11-18	
General Parameters					
Ammonia, Total (as N)	**0.227**	0.020	mg/L	2017-11-20	
Nitrogen, Total Kjeldahl	**0.383**	0.050	mg/L	2017-11-20	
Phosphorus, Total (as P)	**0.0690**	0.0020	mg/L	2017-11-19	
Calculated Parameters					
Nitrate+Nitrite (as N)	**0.140**	0.0100	mg/L	N/A	
Nitrogen, Total	**0.523**	0.0500	mg/L	N/A	
Nitrogen, Organic	**0.156**	0.0500	mg/L	N/A	
WT94334 (7111412-05) | Matrix: Fresh Water | Sampled: 2017-11-14 11:45					
Anions					
Chloride	**24.8**	0.10	mg/L	2017-11-18	
Nitrate (as N)	**0.045**	0.010	mg/L	2017-11-18	
Nitrite (as N)	< 0.010	0.010	mg/L	2017-11-18	
General Parameters					
Ammonia, Total (as N)	**0.575**	0.020	mg/L	2017-11-20	
Nitrogen, Total Kjeldahl	**0.770**	0.050	mg/L	2017-11-20	
Phosphorus, Total (as P)	**0.0583**	0.0020	mg/L	2017-11-19	
Calculated Parameters					
Nitrate+Nitrite (as N)	**0.0452**	0.0100	mg/L	N/A	
Nitrogen, Total	**0.815**	0.0500	mg/L	N/A	
Nitrogen, Organic	**0.195**	0.0500	mg/L	N/A	
Floyd's Swamp (7111412-06) | Matrix: Water | Sampled: 2017-11-14 08:56					
Anions					
Chloride	**22.8**	0.10	mg/L	2017-11-18	
Nitrate (as N)	**0.175**	0.010	mg/L	2017-11-18	

TEST RESULTS

REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	**WORK ORDER**	7111412
PROJECT	2016-8113.010.000 - Water	**REPORTED**	2017-11-22 16:43

Analyte	Result	RL	Units	Analyzed	Qualifier
Floyd's Swamp (7111412-06) | Matrix: Water | Sampled: 2017-11-14 08:56, Continued					
Anions, Continued					
Nitrite (as N)	< 0.010	0.010	mg/L	2017-11-18	
General Parameters					
Ammonia, Total (as N)	**2.10**	0.020	mg/L	2017-11-20	
Nitrogen, Total Kjeldahl	**3.86**	0.050	mg/L	2017-11-20	
Phosphorus, Total (as P)	**0.513**	0.0020	mg/L	2017-11-19	
Calculated Parameters					
Nitrate+Nitrite (as N)	**0.175**	0.0100	mg/L	N/A	
Nitrogen, Total	**4.03**	0.500	mg/L	N/A	
Nitrogen, Organic	**1.75**	0.500	mg/L	N/A	
MW4 (7111412-07) | Matrix: Fresh Water | Sampled: 2017-11-14 11:50					
Anions					
Chloride	**24.4**	0.10	mg/L	2017-11-18	
Nitrate (as N)	< 0.010	0.010	mg/L	2017-11-18	
Nitrite (as N)	< 0.010	0.010	mg/L	2017-11-18	
General Parameters					
Ammonia, Total (as N)	**0.576**	0.020	mg/L	2017-11-20	
Nitrogen, Total Kjeldahl	**0.880**	0.050	mg/L	2017-11-20	
Phosphorus, Total (as P)	**0.0613**	0.0020	mg/L	2017-11-19	
Calculated Parameters					
Nitrate+Nitrite (as N)	< 0.0100	0.0100	mg/L	N/A	
Nitrogen, Total	**0.880**	0.0500	mg/L	N/A	
Nitrogen, Organic	**0.304**	0.0500	mg/L	N/A	

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	**WORK ORDER**	7111412
PROJECT	2016-8113.010.000 - Water	**REPORTED**	2017-11-22 16:43

Analysis Description	Method Ref.	Technique	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2011)	Automated Colorimetry (Phenate)	Kelowna
Anions in Water	SM 4110 B (2011)	Ion Chromatography	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2011)	Block Digestion and Flow Injection Analysis	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2011)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/L	Milligrams per litre
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	**WORK ORDER**	7111412
PROJECT	2016-8113.010.000 - Water	**REPORTED**	2017-11-22 16:43

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup)**: An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS)**: A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS)**: A second aliquot of sample is fortified with with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM)**: A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B7K1329										
Blank (B7K1329-BLK1)				Prepared: 2017-11-17, Analyzed: 2017-11-17						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Blank (B7K1329-BLK2)				Prepared: 2017-11-18, Analyzed: 2017-11-18						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
LCS (B7K1329-BS1)				Prepared: 2017-11-17, Analyzed: 2017-11-17						
Chloride	15.9	0.10	mg/L	16.0		99	90-110			
Nitrate (as N)	4.11	0.010	mg/L	4.00		103	93-108			
Nitrite (as N)	1.84	0.010	mg/L	2.00		92	85-114			
LCS (B7K1329-BS2)				Prepared: 2017-11-18, Analyzed: 2017-11-18						
Chloride	15.9	0.10	mg/L	16.0		99	90-110			
Nitrate (as N)	4.27	0.010	mg/L	4.00		107	93-108			
Nitrite (as N)	1.87	0.010	mg/L	2.00		93	85-114			
Duplicate (B7K1329-DUP2)		**Source: 7111412-07**		Prepared: 2017-11-18, Analyzed: 2017-11-18						
Chloride	26.4	0.10	mg/L		24.4			8	10	
Nitrate (as N)	0.010	0.010	mg/L		< 0.010				10	
Nitrite (as N)	< 0.010	0.010	mg/L		< 0.010				6	
Matrix Spike (B7K1329-MS2)		**Source: 7111412-07**		Prepared: 2017-11-18, Analyzed: 2017-11-18						
Chloride	42.4	0.10	mg/L	16.0	24.4	112	75-125			
Nitrate (as N)	4.01	0.010	mg/L	4.00	< 0.010	100	75-125			
Nitrite (as N)	1.87	0.010	mg/L	2.00	< 0.010	93	80-120			
General Parameters, Batch B7K1389										
Blank (B7K1389-BLK1)				Prepared: 2017-11-17, Analyzed: 2017-11-20						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
Blank (B7K1389-BLK2)				Prepared: 2017-11-17, Analyzed: 2017-11-20						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	**WORK ORDER**	7111412
PROJECT	2016-8113.010.000 - Water	**REPORTED**	2017-11-22 16:43

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B7K1389, Continued										
LCS (B7K1389-BS1)				Prepared: 2017-11-17, Analyzed: 2017-11-20						
Nitrogen, Total Kjeldahl	1.14	0.050	mg/L	1.00		114	84-121			
LCS (B7K1389-BS2)				Prepared: 2017-11-17, Analyzed: 2017-11-20						
Nitrogen, Total Kjeldahl	1.14	0.050	mg/L	1.00		114	84-121			
General Parameters, Batch B7K1413										
Blank (B7K1413-BLK1)				Prepared: 2017-11-17, Analyzed: 2017-11-19						
Phosphorus, Total (as P)	< 0.0020	0.0020	mg/L							
Blank (B7K1413-BLK2)				Prepared: 2017-11-17, Analyzed: 2017-11-19						
Phosphorus, Total (as P)	< 0.0020	0.0020	mg/L							
LCS (B7K1413-BS2)				Prepared: 2017-11-17, Analyzed: 2017-11-19						
Phosphorus, Total (as P)	0.108	0.0020	mg/L	0.100		108	80-112			
General Parameters, Batch B7K1452										
Blank (B7K1452-BLK1)				Prepared: 2017-11-20, Analyzed: 2017-11-20						
Ammonia, Total (as N)	< 0.020	0.020	mg/L							
Blank (B7K1452-BLK2)				Prepared: 2017-11-20, Analyzed: 2017-11-20						
Ammonia, Total (as N)	< 0.020	0.020	mg/L							
Blank (B7K1452-BLK3)				Prepared: 2017-11-20, Analyzed: 2017-11-20						
Ammonia, Total (as N)	< 0.020	0.020	mg/L							
LCS (B7K1452-BS1)				Prepared: 2017-11-20, Analyzed: 2017-11-20						
Ammonia, Total (as N)	1.02	0.020	mg/L	1.00		102	90-115			
LCS (B7K1452-BS2)				Prepared: 2017-11-20, Analyzed: 2017-11-20						
Ammonia, Total (as N)	1.03	0.020	mg/L	1.00		103	90-115			
LCS (B7K1452-BS3)				Prepared: 2017-11-20, Analyzed: 2017-11-20						
Ammonia, Total (as N)	1.03	0.020	mg/L	1.00		103	90-115			

7111412

SERVICES .. Obviously

110-4011 Viking Way, Richmond, BC V6V 2K9
Tel: (604) 279-1499 Fax: (604) 279-1599

☒ 102-3677 Highway 97N, Kelowna, BC V1X 5C3
Tel: (250) 765-9646 Fax: (250) 765-3893

17225 109 Avenue NW, Edmonton, AB T5S 1H7
Tel: (780) 489-9100 Fax: (780) 489-9700

CARO BC COC, Rev 2015-09

CHAIN OF CUSTODY RECORD

COC# _____ PAGE OF

RELINQUISHED BY:	DATE: 08-Nov-17	RECEIVED BY: ISAAC	DATE: Nov 15
	TIME:		TIME: 14:00

PROJECT: GRACEMAR ACTION 14

PROJECT INFO: 2016-8113.010

REPORT TO:
COMPANY: Associated Environmental Consultants
ADDRESS: 200-2800 29th street, Vernon, BC., V1T 9P9
CONTACT: Nicole Penner
TEL/FAX: 250-545-3672
DELIVERY METHOD: EMAIL ☒ MAIL ☐ OTHER* ☐
DATA FORMAT: EXCEL ☐ WATERTRAX ☐ ESdat ☐ EQuIS ☐ BC EMS ☐ OTHER* ☐
EMAIL 1: pennern@ae.ca
EMAIL 2:
EMAIL 3:

INVOICE TO: SAME AS REPORT TO ☐
COMPANY:
ADDRESS:
CONTACT:
TEL/FAX:
DELIVERY METHOD: EMAIL ☒ MAIL ☐ OTHER* ☐
EMAIL 1: pennern@ae.ca
EMAIL 2: anzej@ae.ca
EMAIL 3:
PO #: 2016-8113.010

TURNAROUND TIME REQUESTED:
Routine: (5-7 Days) ☒
Rush: 1 Day* ☐ 2 Day* ☐ 3 Day* ☐
Other* ☐
*Contact Lab To Confirm. Surcharge May Apply

REGULATORY APPLICATION:
Canadian Drinking Water Quality Guidelines ☒
BC Drinking Water Protection Act / Reg. ☐
BC CSR ☐ AB TIER 1 ☐ CCME ☒ OTHER* ☐
AL ☐ PL ☐ RL ☐ CL ☐ IL ☐ AW ☐ IW ☐ LW ☐
Regs on Report? ☐

** NEW ** If you would like to sign up for ClientConnect and/or EnviroChain, CARO's online service offerings, check here: ☐

SAMPLED BY: Jesse Manna

CLIENT SAMPLE ID:	MATRIX: DRINKING WATER	OTHER WATER	SOIL	OTHER	# CONTAINERS	SAMPLING: DATE DD-MMM-YY	TIME HH:MM	COMMENTS: CHLORINATED	FILTERED	PRESERVED	(e.g. flow/volume media ID/notes)
MW1		✔			2	14-Nov-17	16:10				
MW2		✔			2	14-Nov-17	11:05				
MW3S		✔			2	14-Nov-17	15:00				
MW3D		✔			2	14-Nov-17	14:00				
WT94334		✔			2	14-Nov-17	11:45				
FLOYD's SWAMP		✔			2	14-Nov-17	8:56				
MW4		✔			2	14-Nov-17	11:50				

ANALYSES REQUESTED:

CLIENT SAMPLE ID:	BTEX ☐ VPH ☐ PHC F1 ☐	VOC ☐ VPH ☐	EPH ☐ PHC F2-F4 ☐	PAH ☐ L/HEPH ☐	PHENOLS Chlorinated ☐ Non-Chlor. ☐	PCB ☐ GLYCOLS ☐ HAA ☐	PESTICIDES ☐ ACID HERBICIDES ☐	METALS - WATER TOTAL Hg ☐	METALS - WATER DISSOLVED Hg ☐	METALS - SOIL (SALM) ☐ inc. pH ☐	pH ☐ EC ☐ ALK ☐	TSS ☐ VSS ☐ TDS ☐	BOD ☐ COD ☒	TOG ☐ MOG ☐	FECAL COLIFORMS ☐ HPC ☐	TOTAL COLIFORMS ☐ *E. coli* ☐	ASBESTOS	NITRATE-N, NITRITE-N, TOTAL N	AMMONIA, TKN	CHLORIDE	LOW DETECTION PHSOPHORUS				HOLD
MW1																		✔	✔	✔	✔				
MW2																		✔	✔	✔	✔				
MW3S																		✔	✔	✔	✔				
MW3D																		✔	✔	✔	✔				
WT94334																		✔	✔	✔	✔				
FLOYD's SWAMP																		✔	✔	✔	✔				
MW4																		✔	✔	✔	✔				

SHIPPING INSTRUCTIONS: Return Cooler(s) ☐
Supplies Needed:

SAMPLE RETENTION INSTRUCTIONS (Discarded 30 days after Report unless otherwise specified):
60 Days ☐ 90 Days ☐ Longer Date (Surcharges will Apply): _____

*** OTHER INSTRUCTIONS:**
Upload to wireless water

PAYMENT:
CHEQUE ☐
CREDIT ☐
DEBIT ☐
CASH ☐
INVOICE ☐

SAMPLE RECEIPT CONDITION:
COOLER 1 (°C): 3.6 ICE: Y ☐ N ☐
COOLER 2 (°C): _____ ICE: Y ☐ N ☐
COOLER 3 (°C): _____ ICE: Y ☐ N ☐
CUSTODY SEALS INTACT: NA ☐ Y ☐ N ☐

CERTIFICATE OF ANALYSIS

REPORTED TO	Associated Environmental Consultants Inc. (Vernon) #200 - 2800 29th Street Vernon, BC V1T 9P9		
ATTENTION	Nicole Penner	**WORK ORDER**	7111411
PO NUMBER		**RECEIVED / TEMP**	2017-11-16 11:00 / 3°C
PROJECT	2016-8113.010.000 - Water	**REPORTED**	2017-11-23 14:10
PROJECT INFO	Gracemar Action 14	**COC NUMBER**	No Number

Introduction:

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Big Picture Sidekicks

You know that the sample you collected after snowshoeing to site, digging 5 meters, and racing to get it on a plane so you can submit it to the lab for time sensitive results needed to make important and expensive decisions (whew) is VERY important. We know that too.

We've Got Chemistry

It's simple. We figure the more you enjoy working with our fun and engaged team members; the more likely you are to give us continued opportunities to support you.

Ahead of the Curve

Through research, regulation knowledge, and instrumentation, we are your analytical centre for the technical knowledge you need, BEFORE you need it, so you can stay up to date and in the know.

If you have any questions or concerns, please contact me at sgulenchyn@caro.ca

Authorized By:

Sara Gulenchyn, B.Sc, P.Chem.
Client Service Manager

CARO ANALYTICAL SERVICES

TEST RESULTS

REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	**WORK ORDER**	7111411
PROJECT	2016-8113.010.000 - Water	**REPORTED**	2017-11-23 14:10

Analyte	Result	RL	Units	Analyzed	Qualifier
WT94335 (7111411-01) | Matrix: Fresh Water | Sampled: 2017-11-15 14:40					
Anions					
Chloride	**27.0**	0.10	mg/L	2017-11-18	
Nitrate (as N)	**0.020**	0.010	mg/L	2017-11-18	
Nitrite (as N)	**0.020**	0.010	mg/L	2017-11-18	
General Parameters					
Ammonia, Total (as N)	**0.057**	0.020	mg/L	2017-11-20	
Nitrogen, Total Kjeldahl	**0.201**	0.050	mg/L	2017-11-20	
Phosphorus, Total (as P)	**0.0074**	0.0020	mg/L	2017-11-19	
Calculated Parameters					
Nitrate+Nitrite (as N)	**0.0402**	0.0100	mg/L	N/A	
Nitrogen, Total	**0.241**	0.0500	mg/L	N/A	
Nitrogen, Organic	**0.144**	0.0500	mg/L	N/A	
WPID28093 (7111411-02) | Matrix: Fresh Water | Sampled: 2017-11-15 16:15					
Anions					
Chloride	**8.72**	0.10	mg/L	2017-11-18	
Nitrate (as N)	**0.416**	0.010	mg/L	2017-11-18	
Nitrite (as N)	< 0.010	0.010	mg/L	2017-11-18	
General Parameters					
Ammonia, Total (as N)	< 0.020	0.020	mg/L	2017-11-20	
Nitrogen, Total Kjeldahl	**0.152**	0.050	mg/L	2017-11-20	
Phosphorus, Total (as P)	< 0.0020	0.0020	mg/L	2017-11-19	
Calculated Parameters					
Nitrate+Nitrite (as N)	**0.416**	0.0100	mg/L	N/A	
Nitrogen, Total	**0.568**	0.0500	mg/L	N/A	
Nitrogen, Organic	**0.152**	0.0500	mg/L	N/A	
Mr. Krebber's Well (7111411-03) | Matrix: Fresh Water | Sampled: 2017-11-15 15:30					
Anions					
Chloride	**12.9**	0.10	mg/L	2017-11-18	
Nitrate (as N)	**0.021**	0.010	mg/L	2017-11-18	
Nitrite (as N)	< 0.010	0.010	mg/L	2017-11-18	
General Parameters					
Ammonia, Total (as N)	**0.042**	0.020	mg/L	2017-11-20	
Nitrogen, Total Kjeldahl	**0.158**	0.050	mg/L	2017-11-20	
Phosphorus, Total (as P)	< 0.0020	0.0020	mg/L	2017-11-19	
Calculated Parameters					

TEST RESULTS

REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	**WORK ORDER**	7111411
PROJECT	2016-8113.010.000 - Water	**REPORTED**	2017-11-23 14:10

Analyte	Result	RL	Units	Analyzed	Qualifier
Mr. Krebber's Well (7111411-03) | Matrix: Fresh Water | Sampled: 2017-11-15 15:30, Continued					
Calculated Parameters, Continued					
Nitrate+Nitrite (as N)	**0.0212**	0.0100	mg/L	N/A	
Nitrogen, Total	**0.179**	0.0500	mg/L	N/A	
Nitrogen, Organic	**0.116**	0.0500	mg/L	N/A	

APPENDIX 1: SUPPORTING INFORMATION

REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	**WORK ORDER**	7111411
PROJECT	2016-8113.010.000 - Water	**REPORTED**	2017-11-23 14:10

Analysis Description	Method Ref.	Technique	Location
Ammonia, Total in Water	SM 4500-NH3 G* (2011)	Automated Colorimetry (Phenate)	Kelowna
Anions in Water	SM 4110 B (2011)	Ion Chromatography	Kelowna
Nitrogen, Total Kjeldahl in Water	SM 4500-Norg D* (2011)	Block Digestion and Flow Injection Analysis	Kelowna
Phosphorus, Total in Water	SM 4500-P B.5* (2011) / SM 4500-P F (2011)	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	Kelowna

Note: An asterisk in the Method Reference indicates that the CARO method has been modified from the reference method

Glossary of Terms:

RL	Reporting Limit (default)
<	Less than the specified Reporting Limit (RL) - the actual RL may be higher than the default RL due to various factors
mg/L	Milligrams per litre
SM	Standard Methods for the Examination of Water and Wastewater, American Public Health Association

General Comments:

The results in this report apply to the samples analyzed in accordance with the Chain of Custody document. This analytical report must be reproduced in its entirety. CARO is not responsible for any loss or damage resulting directly or indirectly from error or omission in the conduct of testing. Liability is limited to the cost of analysis. Samples will be disposed of 30 days after the test report has been issued unless otherwise agreed to in writing.

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	**WORK ORDER**	7111411
PROJECT	2016-8113.010.000 - Water	**REPORTED**	2017-11-23 14:10

The following section displays the quality control (QC) data that is associated with your sample data. Groups of samples are prepared in "batches" and analyzed in conjunction with QC samples that ensure your data is of the highest quality. Common QC types include:

- **Method Blank (Blk)**: A blank sample that undergoes sample processing identical to that carried out for the test samples. Method blank results are used to assess contamination from the laboratory environment and reagents.
- **Duplicate (Dup)**: An additional or second portion of a randomly selected sample in the analytical run carried through the entire analytical process. Duplicates provide a measure of the analytical method's precision (reproducibility).
- **Blank Spike (BS)**: A sample of known concentration which undergoes processing identical to that carried out for test samples, also referred to as a laboratory control sample (LCS). Blank spikes provide a measure of the analytical method's accuracy.
- **Matrix Spike (MS)**: A second aliquot of sample is fortified with with a known concentration of target analytes and carried through the entire analytical process. Matrix spikes evaluate potential matrix effects that may affect the analyte recovery.
- **Reference Material (SRM)**: A homogenous material of similar matrix to the samples, certified for the parameter(s) listed. Reference Materials ensure that the analytical process is adequate to achieve acceptable recoveries of the parameter(s) tested.

Each QC type is analyzed at a 5-10% frequency, i.e. one blank/duplicate/spike for every 10-20 samples. For all types of QC, the specified recovery (% Rec) and relative percent difference (RPD) limits are derived from long-term method performance averages and/or prescribed by the reference method.

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
Anions, Batch B7K1329										
Blank (B7K1329-BLK1)				Prepared: 2017-11-17, Analyzed: 2017-11-17						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
Blank (B7K1329-BLK2)				Prepared: 2017-11-18, Analyzed: 2017-11-18						
Chloride	< 0.10	0.10	mg/L							
Nitrate (as N)	< 0.010	0.010	mg/L							
Nitrite (as N)	< 0.010	0.010	mg/L							
LCS (B7K1329-BS1)				Prepared: 2017-11-17, Analyzed: 2017-11-17						
Chloride	15.9	0.10	mg/L	16.0		99	90-110			
Nitrate (as N)	4.11	0.010	mg/L	4.00		103	93-108			
Nitrite (as N)	1.84	0.010	mg/L	2.00		92	85-114			
LCS (B7K1329-BS2)				Prepared: 2017-11-18, Analyzed: 2017-11-18						
Chloride	15.9	0.10	mg/L	16.0		99	90-110			
Nitrate (as N)	4.27	0.010	mg/L	4.00		107	93-108			
Nitrite (as N)	1.87	0.010	mg/L	2.00		93	85-114			
General Parameters, Batch B7K1389										
Blank (B7K1389-BLK1)				Prepared: 2017-11-17, Analyzed: 2017-11-20						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
Blank (B7K1389-BLK2)				Prepared: 2017-11-17, Analyzed: 2017-11-20						
Nitrogen, Total Kjeldahl	< 0.050	0.050	mg/L							
LCS (B7K1389-BS1)				Prepared: 2017-11-17, Analyzed: 2017-11-20						
Nitrogen, Total Kjeldahl	1.14	0.050	mg/L	1.00		114	84-121			
LCS (B7K1389-BS2)				Prepared: 2017-11-17, Analyzed: 2017-11-20						
Nitrogen, Total Kjeldahl	1.14	0.050	mg/L	1.00		114	84-121			
General Parameters, Batch B7K1413										

APPENDIX 2: QUALITY CONTROL RESULTS

REPORTED TO	Associated Environmental Consultants Inc. (Vernon)	**WORK ORDER**	7111411
PROJECT	2016-8113.010.000 - Water	**REPORTED**	2017-11-23 14:10

Analyte	Result	RL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Qualifier
General Parameters, Batch B7K1413, Continued										
Blank (B7K1413-BLK1)				Prepared: 2017-11-17, Analyzed: 2017-11-19						
Phosphorus, Total (as P)	< 0.0020	0.0020	mg/L							
Blank (B7K1413-BLK2)				Prepared: 2017-11-17, Analyzed: 2017-11-19						
Phosphorus, Total (as P)	< 0.0020	0.0020	mg/L							
LCS (B7K1413-BS2)				Prepared: 2017-11-17, Analyzed: 2017-11-19						
Phosphorus, Total (as P)	0.108	0.0020	mg/L	0.100		108	80-112			
General Parameters, Batch B7K1452										
Blank (B7K1452-BLK1)				Prepared: 2017-11-20, Analyzed: 2017-11-20						
Ammonia, Total (as N)	< 0.020	0.020	mg/L							
Blank (B7K1452-BLK2)				Prepared: 2017-11-20, Analyzed: 2017-11-20						
Ammonia, Total (as N)	< 0.020	0.020	mg/L							
Blank (B7K1452-BLK3)				Prepared: 2017-11-20, Analyzed: 2017-11-20						
Ammonia, Total (as N)	< 0.020	0.020	mg/L							
LCS (B7K1452-BS1)				Prepared: 2017-11-20, Analyzed: 2017-11-20						
Ammonia, Total (as N)	1.02	0.020	mg/L	1.00		102	90-115			
LCS (B7K1452-BS2)				Prepared: 2017-11-20, Analyzed: 2017-11-20						
Ammonia, Total (as N)	1.03	0.020	mg/L	1.00		103	90-115			
LCS (B7K1452-BS3)				Prepared: 2017-11-20, Analyzed: 2017-11-20						
Ammonia, Total (as N)	1.03	0.020	mg/L	1.00		103	90-115			
Duplicate (B7K1452-DUP3)		**Source: 7111411-03**		Prepared: 2017-11-20, Analyzed: 2017-11-20						
Ammonia, Total (as N)	0.042	0.020	mg/L		0.042				15	
Matrix Spike (B7K1452-MS3)		**Source: 7111411-03**		Prepared: 2017-11-20, Analyzed: 2017-11-20						
Ammonia, Total (as N)	0.275	0.020	mg/L	0.250	0.042	93	75-125			

ERVICES *Obviously*

☐ 110-4011 Viking Way, Richmond, BC V6V 2K9
Tel: (604) 279-1499 Fax: (604) 279-1599

☒ 102-3677 Highway 97N, Kelowna, BC V1X 5C3
Tel: (250) 765-9646 Fax: (250) 765-3893

☐ 17225 109 Avenue NW, Edmonton, AB T5S 1H7
Tel: (780) 489-9100 Fax: (780) 489-9700

CARO BC COC, Rev 2015-09

CHAIN OF CUSTODY RECORD

COC# _____ PAGE OF

RELINQUISHED BY:	DATE: 08-Nov-17	RECEIVED BY:	DATE: Nov 16
	TIME:	ISAcq	TIME: 11:00

PROJECT: GRACEMAR ACTION 14

PROJECT INFO: 2016-8113.010

REPORT TO:
COMPANY: Associated Environmental Consultants
ADDRESS: 200-2800 29th street, Vernon, BC., V1T 9P9
CONTACT: Nicole Penner
TEL/FAX: 250-545-3672
DELIVERY METHOD: EMAIL ☒ MAIL ☐ OTHER* ☐
DATA FORMAT: EXCEL ☐ WATERTRAX ☐ ESdat ☐ EQuIS ☐ BC EMS ☐ OTHER* ☐
EMAIL 1: pennern@ae.ca
EMAIL 2:
EMAIL 3:

INVOICE TO: SAME AS REPORT TO ☐
COMPANY:
ADDRESS:
CONTACT:
TEL/FAX:
DELIVERY METHOD: EMAIL ☒ MAIL ☐ OTHER* ☐
EMAIL 1: pennern@ae.ca
EMAIL 2: anzej@ae.ca
EMAIL 3:
PO #: 2016-8113.010

TURNAROUND TIME REQUESTED:
Routine: (5-7 Days) ☒
Rush: 1 Day* ☐ 2 Day* ☐ 3 Day* ☐
Other* _____
*Contact Lab To Confirm. Surcharge May Apply

REGULATORY APPLICATION: Regs on Report? ☐
Canadian Drinking Water Quality Guidelines ☒
BC Drinking Water Protection Act / Reg. ☐
BC CSR ☐ AB TIER 1 ☐ CCME ☒ OTHER* ☐
AL ☐ PL ☐ RL ☐ CL ☐ IL ☐ AW ☐ IW ☐ LW ☐

** NEW ** If you would like to sign up for ClientConnect and/or EnviroChain, CARO's online service offerings, check here: ☐

SAMPLED BY: Jesse Manna

CLIENT SAMPLE ID:	MATRIX: DRINKING WATER	OTHER WATER	SOIL	OTHER	# CONTAINERS	SAMPLING: DATE DD-MMM-YY	TIME HH:MM	COMMENTS: CHLORINATED	FILTERED	PRESERVED	(e.g. flow/volume media ID/notes)
WT94335		✔			2	15-Nov-17	14:40				
WPID28093		✔			2	15-Nov-17	16:15				
MR. KREBBER's WELL		✔			2	15-Nov-17	15:30				

ANALYSES REQUESTED:

CLIENT SAMPLE ID:	BTEX ☐ VPH ☐ PHC F1 ☐	VOC ☐ VPH ☐	EPH ☐ PHC F2-F4 ☐	PAH ☐ L/HEPH ☐	PHENOLS Chlorinated ☐ Non-Chlor. ☐	PCB ☐ GLYCOLS ☐ HAA ☐	PESTICIDES ☐ ACID HERBICIDES ☐	METALS - WATER TOTAL Hg ☐	METALS - WATER DISSOLVED Hg ☐	METALS - SOIL (SALM) ☐ inc. pH ☐	pH ☐ EC ☐ ALK ☐	TSS ☐ VSS ☐ TDS ☐	BOD ☐ COD ☒	TOG ☐ MOG ☐	FECAL COLIFORMS ☐ HPC ☐	TOTAL COLIFORMS ☐ *E. coli* ☐	ASBESTOS	NITRATE-N, NITRITE-N, TOTAL N	AMMONIA, TKN	CHLORIDE	LOW DETECTION PHOSPHORUS				HOLD
WT94335																		✔	✔	✔	✔				
WPID28093																		✔	✔	✔	✔				
MR. KREBBER's WELL																		✔	✔	✔	✔				

SHIPPING INSTRUCTIONS: Return Cooler(s) ☐
Supplies Needed:

SAMPLE RETENTION INSTRUCTIONS (Discarded 30 days after Report unless otherwise specified):
60 Days ☐ 90 Days ☐ Longer Date (Surcharges will Apply): _____

*** OTHER INSTRUCTIONS:**
Upload to wireless water

PAYMENT:
CHEQUE ☐
CREDIT ☐
DEBIT ☐
CASH ☐
INVOICE ☐

SAMPLE RECEIPT CONDITION:
COOLER 1 (°C): 2.5 ICE: Y ☒ N ☐
COOLER 2 (°C): _____ ICE: Y ☐ N ☐
COOLER 3 (°C): _____ ICE: Y ☐ N ☐
CUSTODY SEALS INTACT: NA ☐ Y ☐ N ☐