THE CORPORATION OF THE
DISTRICT OF SUMMERLAND
COUNCIL REPORT

DATE: April 21, 2017 File: 2016-1787

TO: Dave Svetlichny, Acting Chief Administrative Officer

FROM: Dean Strachan, MCIP, RPP, Director of Development Services
Kris Johnson, P.Eng., Director of Works and Utilities

SUBJECT: OCP Amendment and Rezoning – 13610 Banks Crescent - Update

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STAFF RECOMMENDATION:

That Council pass the following resolution:

> *THAT the update report dated April 21, 2017 from the Director of Development Services in relation to the OCP Amendment and Rezoning for 13610 Banks Crescent be received.*

PURPOSE:

To receive a progress update on review and study components related to the OCP Amendment and Rezoning for 13610 Banks Crescent.

BACKGROUND and DISCUSSION:

These following items remain under study and review:

1. Letter received from Freshwater Fisheries Society of BC dated February 24, 2017.
   a. Additional correspondence dated April 12, 2017 (**see Schedule A**) was received from the Freshwater Fisheries Society of BC in relation to the subject application.
   b. A background report on the Shaughnessy Spring Aquifer was identified as publicly available online, was circulated to Council and has been included as reference material (**see Schedule B**).
   c. The applicant continues to engage their professionals and have stated they continue to be open to reviewing options with the District and Freshwater Fisheries Society of BC. The applicants have reviewed their data in relation to questions on nitrate levels and provided additional data on the Spring water source (**see Schedule C**).
   d. District staff continue to communicate with both the applicants and Freshwater Fisheries Society of BC and continue to participate and if requested facilitate discussions between the parties as per Council's request.
   e. District staff have been advised by the applicant that they intend to submit an additional letter; however, it had not arrived at the time of preparation of

this report. If it arrives prior to the Monday meeting, it will be added to the information for Council.

f. The applicant has submitted the Sediment and Erosion plan. District staff have reviewed the plan and will provide comments to the applicant next week.

2. Letter received from the Penticton Indian Band (PIB) dated January 26, 2017.
   a. District staff met with PIB Development Services staff on March 14, 2017. Good discussion between staff occurred on both the Banks Crescent application and development in general. PIB staff requested additional information on the Banks Crescent application, that has been provided by staff. PIB staff indicated they would be preparing a further response for Councils consideration. Staff to staff correspondence has continued. Through email the District was notified that further correspondence would be submitted, which has not yet been received.
   b. The RDOS committee on referral protocol was scheduled to have a meeting in March, to date a meeting time and date has not yet been confirmed. District staff followed up with RDOS staff and were informed that they plan to contact the Committee and schedule this meeting in the next few weeks.

3. Revised and updated Environment Assessment Reporting in accordance with the District of Summerland Terms of Reference for Environmental Reports.
   a. The applicant has engaged a consulting biologist to conduct a review of the report previously provided, review the Terms of Reference, and prepare a revised report.
   b. The consulting biologist has had communication with the District's Environmental Planner, Alison Peatt, RPBio and completed a revised report that was received on April 10, 2017. The District's Environmental Planner has completed her review and has technical items she is corresponding with the consulting biologist on in advance of submitting her review. It is hoped that these discussions will be completed this week and that both the report and review will be added to the Council update report prior to the Council meeting.

4. District Revenue Analysis.
   a. The District has received the required information from the applicant and is preparing an analysis report for the May 8, 2017 Council Meeting.

5. High level plan for upgrades required for road sections determined through the traffic study to be upgraded from local roads restricting truck use to collector roads permitting truck use.
   a. The applicant's Engineering Consultant has submitted a revised traffic study for review. District staff have reviewed the plan and will provide comments to the applicant next week.
   b. Road modifications and/or improvements are to be identified in the traffic study and detailed design drawings are to be prepared following finalization of the traffic study.

6. Sanitary sewer service modelling for full build out of lift station and mains in service catchment area.
   a. The applicant has engaged their Engineering Consultant and provided updated sanitary sewer data output from the proposed development.

b. Staff have conducted preliminary modelling and will complete updated modeling which considers the new data.

7. Identify the preferred water service option and what off site works would be required.
   a. The applicant's Engineering Consultant have now selected a preferred water service option and have submitted a preliminary design drawing. District staff have reviewed the drawing and will provide comments to the applicant next week.

8. Additional storm water design including off site line routing plan.
   a. The storm water management plan has been submitted. District staff have reviewed the plan and will provide comments to the applicant next week.

9. Additional electrical design and modelling for onsite construction purposes as well as potential off site upgrades required.
   a. District Staff is currently completing a review of the electrical design.

As previously noted, additional areas of review and study may be identified through the information gathering process.

Once the above noted study and review is completed a summary report will be prepared including a summary of the community consultation comments and questions received with responses and answers provided where possible and/or applicable.

It is anticipated that the additional information gathered would likely result in more detailed additional and/or alternate amenity provisions being recommended.

It is noted that several outstanding items are outside of District Staff control. We continue to correspond and seek timeline updates.

LEGISLATION and POLICY:

The Bylaws related to the subject application have received second reading, however, a Public Hearing has not yet been scheduled.

The mechanism proposed to be used for addressing concerns, requirements, conditions and bonding security would be a Development Agreement. The Development Agreement would be completed, presented to Council and would need to be approved in advance of the Rezoning Bylaw being adopted. As the proposed development would not be constructed all at once the Development Agreement would include provisions to be addressed at each construction phase. As part of this process, a No-Build and No-Disturb 219 Restrictive Covenant would be registered prior to adoption of the Rezoning Bylaw. This covenant would only be released for each phase once the detailed designs are approved and/or provisions are completed and bonding security is in place.

FINANCIAL IMPLICATIONS:

There are no financial implications anticipated to result from the subject recommendation.

CONCLUSION:

The study and review continues to progress. The applicant has engaged professionals in the necessary fields to complete the studies and reviews requested. Staff continue to

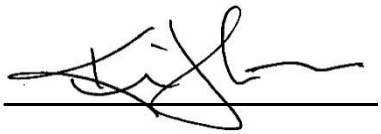
review the information provided, monitor progress on all components and will continue to regularly update Council on progress.

OPTIONS:

1. Move the motion as recommended by Staff.
2. Request additional information on one or more updates provided.

Submitted by,

Dean Strachan, MCIP, RPP
Director of Development Services



Kris Johnson, P.Eng.
Director of Works and Utilities

Approved for Agenda

Dave Svetlichny, Acting CAO

Additional Info
Item 11.3

LARK GROUP
DEVELOP BUILD MANAGE

April 24th, 2017

iCasa Resort Living, Summerland BC
at Shaughnessy Green (the "Project")

ATT: District of Summerland Mayor and Council
RE: Shaughnessy Springs Aquifer

REF: APPLICATION TO AMEND OFFICIAL COMMUNITY PLAN AND ZONING BYLAW – 13610 BANKS CRESCENT

Dear Mayor and Council,

We are in receipt of the FFSBC's letter to Mayor and Council dated April 12th in which the FFSBC states they have withdrawn from the City's collaborative review process of the Project. It is further our understanding that the Project review process will continue between the Applicant and the District directly. To this end, we wish to provide a brief but positive update.

There were three items requested in the FFSBC's letter and we are working towards the resolution of all three as follows:

1. A contingency, in the event of impacts to Shaughnessy Spring water quality, to provide an alternative water source for the hatchery that meets the requirements of the Society;

The Lark development team includes Bruce Nidle, PGL's Senior Fisheries Specialist. Bruce has been working with us to ensure all aspects of the FFSBC's concerns are addressed and will continue to provide recommendations and industry standards for the new water source as to be suitable for fish production.

2. The provision of construction-phase and post-construction water quality monitoring of the aquifer and spring that meets the requirements of the Society;

The Lark development team will develop the capacity for on-site construction-phase water quality monitoring. This ability will remain in place post-construction.

3. Submission of an Erosion and Sediment Control Plan and associated Environmental Monitoring Plan from the Lark Group to the District for review by an independent Qualified Professional.

The referenced plans have been submitted to the City with the Applicant receiving conceptual approval of the same as of the date of this letter.

Suite 1500, 13737 96 Avenue, Surrey, B.C. Canada V3V 0C6 TEL: 604-576-2935 FAX: 604-576-2936

LARK GROUP
DEVELOP BUILD MANAGE

We are pleased to be moving forward with the development concept of a new water source to be provided to the FFSBC. We believe this amenity contribution to the District of Summerland responds to a stronger community desire than the previously proposed stairwell connecting McDonald Place to McDonald Street.

Sincerely,

Lark Enterprises Ltd.
Malek Tawashy,
Development Project Manager

Suite 1500, 13737 96 Avenue, Surrey, B.C. Canada V3V 0C6 TEL: 604-576-2935 FAX: 604-576-2936

Schedule A

Freshwater Fisheries Society of BC

April 12, 2017

Mayor Waterman and Council
District of Summerland
Box 159
Summerland BC
V0H 1Z0

Dear Mayor Waterman and Council,

In May of 2016, the Freshwater Fisheries Society of BC was informed by the District of Summerland of a development application for the Banks Crescent Property. We were asked to participate as a stakeholder in the information gathering component for the development application decision process. Since that time we have had multiple discussions and correspondence with the Lark Group, District of Summerland staff, and other stakeholders. Despite these discussions, our concerns for the protection and maintenance of the Summerland Trout Hatchery's sole water source – Shaughnessy Spring – have yet to be addressed. Our concerns and requirements continue to be:

1. A contingency, in the event of impacts to Shaughnessy Spring water quality, to provide an alternative water source for the hatchery that meets the requirements of the Society;
2. The provision of construction-phase and post-construction water quality monitoring of the aquifer and spring that meets the requirements of the Society;
3. Submission of an Erosion and Sediment Control Plan and associated Environmental Monitoring Plan from the Lark Group to the District for review by an independent Qualified Professional; and
4. The three above noted items are to be in place and verified prior to construction beginning on the subject property.

Since the beginning of this process, we have clearly stated our concerns that the development poses for the hatchery, and have accepted every available opportunity to either restate or clarify those concerns. However, in a March 30, 2017 letter to the District, the Lark Group has misstated our position, misinterpreted the rationale for requiring a contingency water supply, and misrepresented the Society and our consultant. Therefore, we are formally withdrawing from this component of the process as it is quite clear our contributions to the information gathering process are not being appropriately considered by the developer.

Summerland Trout Hatchery | 13405 Lakeshore Drive South Summerland BC V0H 1Z1 Canada
T: 250.494.0491 | F: 250.494.3046 | E: Summerland@gofishbc.com | gofishbc.com

It is our expectation that the development application process will continue to recognize the Freshwater Fisheries Society of BC as a stakeholder and, accordingly, that our concerns related to Shaughnessy Spring water quality will be seriously considered and addressed by the District. Given the Lark Group's recent misrepresentation of the Society and the requirements of our hatchery, it is not clear to us that they take our concerns seriously. As such, we have come to the conclusion that the only means of ensuring the viability of our hatchery and the recreational fisheries it supports is to remain on record as being officially opposed to this development.

Sincerely,

Kyle Girgan
Summerland Trout Hatchery Manager, FFSBC

CC: Jon Pew, FFSBC Board Chair
Andrew Wilson, FFSBC President
Tim Yesaki, FFSBC VP Operations

Schedule B

MINISTRY OF ENVIRONMENT
PROVINCE OF BRITISH COLUMBIA

WATER QUALITY ASSESSMENT
SUMMERLAND TROUT HATCHERY

L.G. Swain, P.Eng.
Resource Quality Section
Water Management Branch
May 1986

SUMMARY

The water supply for the Summerland Trout Hatchery has been deteriorating in terms of increased nitrate levels for the past several years. The water supply to the hatchery is an artesian ground water supply, known as Shaughnessy Springs.

Nitrate nitrogen levels in Shaughnessy Springs have increased from 0.8 mg/L in 1951 to about 7.0 mg/L in 1985. These levels are well below a proposed working water quality criterion of 40 mg/L to protect freshwater aquatic life.

Nitrogen enters groundwater from anthropogenic activities within the recharge area of the spring. The recharge area to Shaughnessy Springs has seen increased residential activities, with a population increase of over 100% since 1951. The groundwater at Shaughnessy Springs is less than thirty years old, based upon a 1984 analysis for tritium.

The contribution of agriculture to nitrogen entering the groundwater diminished between 1970 and 1980 in comparison to that from septic tanks. Nitrogen from septic tanks enters the groundwater on a year-round basis compared to nitrogen loading from agriculture, which would be more sporadic.

Increasing nitrogen values after 1974 presumably reflect the increasing population in the recharge area, first seen in 1961. As well, there seems to be about a thirteen-year lag time between population and nitrate increases.

An alert level of 13 mg/L nitrate nitrogen is proposed for Shaughnessy Springs since existing concentrations are well below the working water quality criterion. This alert level is meant to indicate a nitrate concentration at which appropriate measures should be taken to stop increasing nitrate levels, or to determine conclusively if a real concern exists for

the water supply. Present nitrate levels are about one-half the proposed alert level. The alert level probably will not be reached for at least twenty years, given past and projected trends in nitrate levels and population.

A concern existed that other contaminants, such as pesticides, might also be present in the water. Analyses conducted in November 1985 could not detect pesticides in Shaughnessy Springs, while a toxicity test using Daphnia magna showed 0% toxicity at 100% concentration for 48 hours. All other characteristics in the water supply were at low levels, and would be of no concern.

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ACKNOWLEDGEMENTS

The cooperation of Mr. Stan Hush, public health inspector in Summerland, in searching for historic data on nitrogen, is greatly appreciated. Several people reviewed drafts of this document, which were typed by Ms. L. Rounds.

To these people, our thanks are extended.

1. INTRODUCTION

Summerland is located 18 kilometres northwest from Penticton. The water supply for the Summerland Trout Hatchery apparently has been deteriorating over the past several years. In late 1985, the Resource Quality Section of the Water Management Branch was asked to carry out a water quality assessment of the problem by the Planning and Assessment Branch.

The water supply to the hatchery is an artesian groundwater supply, known as Shaughnessy Springs. Nitrate values in the water supply apparently have increased over the last decade. A concern was expressed about whether other contaminants, such as pesticides, might also be entering the ground water supply. The area near Summerland has seen intense agricultural pressure (orchards) and increased residential development, with subsequent use of septic tanks and disposal to ground. If the source of the increasing nitrate values could be identified, the concern related to other contaminants might be addressed.

The suspected recharge area for Shaughnessy Springs is shown in Figure 1. It includes Eneas and Prairie Creeks. The water quality of Prairie Creek will be addressed in a separate report[9]. The population in the recharge area is projected to increase from 3 745 in 1976 to 5 280 in 1996.

2. WATER QUALITY CRITERIA FOR NITRATE IN HATCHERY WATER

In order to protect freshwater aquatic life in British Columbia, Nordin and Pommen[1] tentatively have recommended that nitrate nitrogen should not exceed 40 mg/L. However, due to the confined nature of the hatchery environment and the extreme sensitivity of different fish species at early life stages to different contaminants, a lower nitrate value may be needed for fish hatcheries. The Department of Fisheries and Oceans did not propose a criterion for nitrate at fish hatcheries since nitrate levels normally "found in freshwater are of no harm to fish"[5].

Westin[2] did extensive tests to address the problem of acceptable nitrate levels in hatchery water. Some of Westin's[2] more important findings were:

1. Nitrate is statistically ($p=0.05$) more active in saltwater at 15 parts per thousand than in freshwater. After a 96-hour exposure period, the factors for toxicity between fresh and salt water were from 1.24 to 1.38 for chinook salmon and 1.14 to 1.41 for rainbow trout.

2. The maximum allowable nitrate concentration should be 370 ppm NO_3 (83.5 mg-N/L) to protect chinook salmon and 250 ppm NO_3 (56.14 mg-N/L) to protect rainbow trout. These criteria were based on several extraordinary factors: (a) 7-day tests, as opposed to 96-hour toxicity tests; (b) a mortality rate of 10% as opposed to the more common 50% level; and (c) concentrations found for the salt-water situation, as opposed to freshwater. To convert the salt-water limits to comparable freshwater limits, the activity ratios for each species (from point 1 above) can be used. Using a conservative approach wherein the lowest ratio is applied, comparable freshwater limits become 103.5 mg-N/L (83.5 mg/L x 1.24) to protect chinook salmon and 64.3 mg-N/L (56.4 mg/L x 1.14) to protect rainbow trout.

3. Standard 96-hour LC_{50} tests showed that maximum non-toxic concentrations in freshwater were 5800 ppm NO_3 (1300 mg-N/L) for chinook and 6000 ppm NO_3 (1345 mg-N/L) for rainbow trout.

4. An application factor of 0.01 was used to calculate appropriate maxima. This factor is low compared to more commonly used factors of 0.05 to 0.10.

Westin[2] reasoned that a 10% mortality rate in a hatchery is acceptable, therefore an LC_{10} should be used. However, with the other large safety factors which Westin used to calculate a maximum allowable concentration, such a conservative approach is difficult to justify. Thus the values for 96-hour LC_{50} tests in freshwater, described in 3 above, are more appropriate departure points from which to calculate allowable concentrations.

It is also considered appropriate that an application factor of 0.05 should be applied to define average conditions, while a factor of 0.10 should be applied to determine maximum acceptable conditions. Using these factors and the lower 96-hour LC_{50} value of 1300 mg-N/L, the average acceptable nitrate nitrogen value is calculated to be 65 mg/L and the maximum acceptable level, 130 mg/L.

Since the criterion for nitrate proposed by Nordin and Pommen[1] for a non-hatchery situation is lower than the one developed here, it should also be deemed as appropriate for hatcheries. Thus, the maximum nitrate concentration should not exceed 40 mg-N/L.

However, an "alert" level likely also should be proposed for this particular hatchery since nitrate values are well below these criteria. When nitrate levels consistently reach the "alert" level, appropriate measures should be taken to correct the situation or to determine conclusively if a real concern exists for the water supply. This level is derived using the 96-hour LC_{50} of 1 345 mg-N/L and the application factor of 0.01, favoured by Westin. The alert level for nitrate is calculated to be 13 mg-N/L.

3. WATER QUALITY ASSESSMENT

An assessment of water quality requires an examination of point and non-point sources in the recharge area, as well as an assessment of the water quality of Eneas Creek, located to the north of Shaughnessy Springs.

3.1 WASTE DISCHARGES

Only those operations in the recharge area which use soil disposal systems or which discharge effluents to creeks in the recharge area are discussed. As well, non-point sources discussed are those in the recharge area.

3.1.1 COMMERCIAL SOURCES

A cannery (PE 3471) located beside the hatchery, and the Summerland Hatchery itself (PE 1585), discharge wastewater directly to Okanagan Lake. These effluents are not discussed further.

Four other facilities discharge wastewater in the recharge area, all to the ground. These are the Summerland Hospital (PE 169), Summerland Peach Orchard Park (PE 3471), Parkdale Home (PE 5125), and Ye Olde Inn (PE 5649). An apartment/mobile home complex (PE 6489) has been proposed since the early 1980's, but is not yet built. A refuse site (PR 2501) is located near the western boundary of the recharge area.

The Summerland Hospital (PE 169) recently began using a rotating biological contactor (RBC) and sand filters to provide treatment prior to disposal to a tile field. Data in Table 1 relate to treatment which was provided to the wastewater before use of the RBC and sand filters. Ammonia nitrogen levels were measured at about 20 mg/L. These nitrogen levels potentially can be oxidized to nitrate, which subsequently can enter the groundwater.

Summerland Peach Orchard Park (PE 3471) is a 100-unit tent and trailer park. Two sets of washrooms use two separate septic tanks and tile dis-

posal fields. The permit allows the discharge of 45.4 m^3/d from one septic tank and 22.7 m^3/d from the second septic tank. The data in Table 2 indicate that no forms of nitrogen have been tested in the effluent from either system.

Parkdale Home (PE 5125) is an intermediate and personal care home which now uses a septic tank and tile field to dispose of laundry wastewater and a secondary package treatment plant and tile field to dispose of other domestic-type wastewater. The data in Table 3 relate to wastewater quality prior to the wastewater being separated, and when all wastewater was treated solely in the package treatment plant. No data exist on levels of nitrogen discharged from either system.

Ye Olde Inn (PE 5649) is an 18-room hotel with a restaurant, lounge and tavern. Wastewater is treated in a septic tank followed by pressurized sand and anthracite filters, with ultimate disposal by pressure injection into two deep wells. The data in Table 4 indicate an ammonia nitrogen level of 28.6 mg/L for one sample. This ammonia can be oxidized to nitrate.

The Corporation of the District of Summerland operates a refuse site to the west from Summerland. Permit PR 2051 allows for the disposal on a maximum daily average basis of 46 m^3/d of municipal-type solid waste. Nitrogen levels expected in the leachate from this site could vary from 10 to 500 mg/L, depending upon the age of the refuse and the quantity of water which percolates through the wastes.

The average precipitation which could affect the amount of leachate is shown below.

Mean Monthly Precipitation (mm) at Summerland[11]

Jan	32.3	May	26.2	Sept	19.5
Feb	17.6	June	29	Oct	15.9
Mar	15.1	July	19.9	Nov	21.8
Apr	18.7	Aug	28.5	Dec	32

Since most months have less than about 25 mm of precipitation, it is likely that very little leachate from the refuse site would enter the groundwater. However, any leachate which did reach the groundwater could contain elevated nitrate concentrations, although these flows would receive considerable dilution between the western edge of the recharge area and Shaughnessy Springs.

Thus, commercial sources of wastewater could be adding from 20 to 30 mg/L of nitrate nitrogen to the groundwater from disposal fields, and 10 to 500 mg/L nitrogen from the refuse site.

3.1.2 RESIDENTIAL AND NON-POINT SOURCES

Major non-point sources of nitrate in the recharge area are fertilizer, irrigation water and livestock wastes. Residential sources of nitrate would originate in tile disposal fields associated with private dwellings.

The Ministry of Agriculture and Food recommends the use of the following quantities of fertilizer: 80 kg-N/ha for apples, 170 kg-N/ha for cherries, and 200 kg-N/ha for peaches[13]. The average usage was estimated to be 100-110 kg-N/ha, although it was felt that the actual application rate would likely be even less[13]. It might generally be expected that one- quarter to one-third of the fertilizer would be applied in the autumn, with the remainder in the spring[13]. Actual quantities of fertilizer applied would depend upon a leaf analysis, shoot growth, and the grower's experience[13].

The application of irrigation water would occur from late May to late September, according to need. A "scheduling system" is in use in the Summerland area, which accounts for evaporation, rainfall, and soil type. This information is broadcast on the radio, so that individual growers can regulate the application of irrigation water. This probably results in very little leachate being generated[13]. On gravelly soils, it is estimated that irrigation would take place every 8 to 12 days[13].

If fertilizer were applied in the autumn, the potential exists for more of it to reach the groundwater than if it were applied in the spring, since plant uptake is less. Using an application rate of one-third of 110 kg-N/ha, assuming the fertilizer was on the land from November through February, that it was uniformly available to all precipitation which fell in those months (see Section 3.1.1), and that all nitrate enters the groundwater, the calculated maximum nitrate nitrogen concentration would be 35.3 mg/L. If only one-quarter of an application rate of 110 kg N/ha were applied, the calculated concentration would be 24.1 mg/L. Both these values are of the same magnitude as for point sources. In reality, the majority of the orchards in the recharge area are apple orchards. At an application rate of one-third of 80 kg-N/ha, the maximum resulting concentration would be 25.7 mg/L.

Nutrient loadings to Okanagan Lake from non-point sources via ground and surface water were estimated for the Okanagan Basin study[3]. Estimated nitrate loadings from these non-point sources to Okanagan lake are presented below.

	Estimated Annual Loads (kg/year)			
	Total Nitrogen		Total Phosphorus	
	1970	1980	1970	1980
Irrigation	329	391	13	5
Livestock	142	-	1	-
Fertilizer	8 164	6 306	76	21
Sub-total: Agriculture[1]	8 635	6 697	90	26
Septic Tanks[2]	5 681	5 795	824	841
Total	14 316	12 492	914	867

[1] From Table A-8, reference 3, for area 5D1 (Eneas and Prairie Creeks)

[2] From Table A-9, reference 3, for area 5D1 (Eneas and Prairie Creeks)

These calculated loadings indicate that the relative contribution of agriculture has diminished from 1970 to 1980 in comparison to that from septic tanks. As well, the total nutrient load has decreased in the same period. It was also the general feeling of the Ministry of Agriculture and Food representative in Summerland, that the number of hectares devoted to agricultural production had diminished[13].

However, the validity of the magnitude of these estimates is not known. A recent report[4] speculated that the actual nutrient load from non-point sources could be as much as five times greater than estimated for the Okanagan Basin study. The rationale for this speculation was that the 1980 calculated loads were simple extrapolations of the 1970 data base, which contained errors.

Regardless, the basic conclusion that the importance of agricultural non-point sources is decreasing while that of septic tanks is increasing, is still likely valid.

3.2 AMBIENT WATER QUALITY

3.2.1 SHAUGHNESSY SPRINGS

3.2.1.1 General Water Chemistry

A summary of data collected at the intake to the fish hatchery is in Table 5. The water is well buffered to acidic inputs, with a median pH of 8.0 and mean alkalinity of about 240 mg/L. The water would be classified as being hard, with an average hardness value of 265 mg/L. This high hardness would reduce the potential for acute toxicity from any metals which may be present.

Metals have been analyzed infrequently. All were below varying detection limits, depending upon the metal, except for the following. An aluminum value of 0.1 mg/L is equal to the criterion of 0.1 mg/L for federal fish hatcheries[5]. The barium concentration of 0.05 mg/L, and that of boron of 0.07 mg/L, were well below criteria for marine waters (the only available criteria), of 0.5 to 1.0 mg/L and 5.0 mg/L, respectively[6]. Molybdenum at 0.03 mg/L, was well below the recently proposed criteria of 1 to 2 mg/L to protect aquatic life in British Columbia[7].

Dissolved oxygen levels were naturally high ($\geq$8.0 mg/L). These can be altered, as required, in the hatchery. However, these high levels ensure

that any ammonia which is discharged from point or non-point sources will be converted to nitrate, which is considerably less toxic than ammonia.

All phosphorus values were less than 0.05 mg/L. The mean dissolved orthophosphorus was 0.010 mg/L, the mean total dissolved phosphorus was 0.012 mg/L, and the mean total phosphorus was 0.016 mg/L. The short water retention time in hatchery troughs, and the fact that many of the troughs are inside the hatchery building, would result in no concern related to subsequent algal blooms.

Dissolved solids ranged from about 355 to 380 mg/L. The mean suspended solids value was 3 mg/L, a level which would ensure excellent protection to aquatic life. Turbidity was low, less than 1 NTU.

Concentrations of chlorides and sulphates "found in freshwater are of no harm to fish"[5]. "Salmonids can tolerate high concentrations (50 to 500 mg/L) of sodium and potassium ions"[5], concentrations which are not approached at the Summerland Trout Hatchery.

Temperature values ranged from 6° to 14°C. Temperature is controlled at the hatchery so that the timing of a hatch can be controlled.

Most of the nitrogen in the Shaughnessy Springs water is in the form of nitrate. All nitrite nitrogen values have been <0.005 mg/L. Ammonia nitrogen has been as high as 0.02 mg/L, however the mean value was 0.008 mg/L. For the range of ammonia, temperature and pH values measured at the hatchery, all un-ionized ammonia (toxic fraction) nitrogen values were calculated to be ≤0.001 mg/L, well below the criterion of 0.007 mg/L[8].

Nitrate (or nitrate/nitrite) nitrogen values ranged from 4.2 to 6.7 mg/L. These values are well below the criterion of 40 mg/L cited in Section 1.1, and still at least about one-half the "alert" level.

A sample collected in November 1985 was analyzed for several of the aforementioned characteristics, plus organo-chlorine pesticides, organo-

phosphorus pesticides and solvent soluble herbicides. No pesticides or herbicides were detectable in the sample. In addition, a LT_{50} using Daphnia magna was conducted. There was 0% mortality at 100% concentration after 48 hours.

These results reveal that although nitrogen values in Shaughnessy Springs are continuing to rise, there apparently is no cause for alarm in terms of toxicity or the presence of pesticides or herbicides.

3.2.1.2 Trends in Nitrate Concentrations

Trends were not apparent for any water quality characteristic in Shaughnessy Springs, except for nitrate.

Total nitrogen values determined for Shaughnessy Springs have been plotted as Figure 2 for the period 1974 to 1985, and by five-year increments in Figure 2a. An assessment of the data set (n=53) indicated that, in the springs, nearly 97% of the total nitrogen was in the form of nitrate nitrogen. It has thus been assumed that total nitrogen in the spring water is all in the form of nitrate nitrogen.

Values of nitrate have risen from about 4.4 mg/L in 1974 to about 7.0 mg/L by the end of 1984. This is an increase of 0.24 mg/L per year (2.6 mg/L/11 years). An assumption that such a straightline relationship exists for the period of record is apparent in Figures 2 and 2a.

To determine if this apparent trend has changed through time, historical records for nitrate for both the hatchery and the water supply were searched. One value of 0.82 mg-N/L was recorded in November 1951 for the hatchery water. The intervening 22 years (1952-1973) has seen an increase, assuming a straight line relationship, of 0.16 mg/L per year ((4.4-0.8)÷22). Of interest was a nitrate value of 3.8 mg/L, recorded in May 1970[14]. The predicted value for November 1970, using the straight line relationship, would have been 3.86 mg/L. Increases in the last decade have been 50% more

than those in the preceding two decades. However, the exact time that the greater increases in nitrate nitrogen occurred (0.24 mg/L per year compared to 0.16 mg/L per year) has not been determined.

A larger continuous data base existed for nitrate in the effluent from the hatchery (1969 to 1984) than in the spring water (1974-1984). The effluent values were plotted in Figures 3 and 3a. If the period of record of 1974 to 1984 is used as a reference point for the data in Figure 3, an increasing trend of nitrate for the effluent is apparent, similar to that for the Shaughnessy Spring water. However, prior to 1974, nitrate values in the effluent, although fluctuating greatly, remained relatively constant at approximately 4.25 mg/L.

This implies that there have been at least two significant increases in nitrate to the groundwater since 1951. One occurred sometime before 1974, and was only reflected in increasing values in Shaughnessy Springs after that time. A second occurred probably sometime after 1951 but before 1969 (the first year of data for the effluent). The second increase was reflected itself in an increase in nitrate in the Springs sometime in the same period.

It is likely that all increases evident were due to land use changes in the recharge area within recent time. "The presence of significant levels of tritium in water arises due to the thermonuclear testing carried out primarily in the northern hemisphere between the years 1953 and 1962. ... Groundwater recharged prior to 1953 is relatively low in tritium but post 1953 waters can contain several hundreds or thousands of tritium units"[15]. A sample of Shaughnessy Springs water collected in October 1984 indicated that a large portion of the water originally entered the groundwater zone sometime after 1953 [15].

Trends of increasing nitrate values may therefore be related to an increasing population base in the recharge area. The population in the Summerland area and the recharge area has increased, and is projected to increase, as follows[16]:

Year	Population Summerland Region	Populated Recharge Area
1951	3 807	2 120*
1961	4 692	2 613*
1971	6 074	3 383*
1976	6 724	3 745**
1981	7 473	4 138**
1985	8 190	4 510**
1991	8 900	4 890**
1996	9 650	5 280**

* Estimated by the Author, based upon proportional increases in population in Summerland Region.

** Estimated by Planning and Assessment Branch from Summerland Region population, with rates of population growth applied.

The increases in nitrogen between 1951 and 1974 and 1974 and 1985 are shown in Figure 4, in comparison to projected populations in the catchment area during the same period. Between 1961 and 1974, the slopes of both variables in Figure 4 are virtually the same. Between 1974 and 1985, the slope of the population graph decreases slightly, while that of the nitrogen values in Shaughnessy Springs increases. Population is estimated to increase at this more gradual rate between 1985 and 1995.

If increased nitrogen values in Shaughnessy Springs arose from residential development alone, the information in Figure 4 could lead to the following possibilities:

1. Increasing nitrogen values after 1974 reflect the increased population first seen in the recharge area in 1961. This would mean that there is a thirteen-year lag time between population and groundwater impacts.

2. The population in the catchment area increased at about the same rate for twenty years, from 1961 to 1981. If the finding from point 1 (above) is correct, nitrogen values can be expected to increase at the current rate until 1994. Thereafter, values could increase again for another five years (corresponding to 1976-1981 population increase) before increases would become less pronounced.

It also is possible that due to dilution of wastewater entering the groundwater by other low-nitrate sources, a plateau would be reached above which the nitrogen values would not increase. This plateau would not exceed the concentration of total nitrogen in septic tank effluents. However, this can only occur if the recharge to the catchment area comes solely from septic tank discharges.

Thus, the alert level of 13 mg/L (Section 2.0) should not be reached for a significant time period, probably in the order of twenty years. This assumes that past increases in nitrogen in Shaughnessy Springs are due in the most part to the increased population in the recharge area.

3.2.2 ENEAS CREEK

The water quality of Eneas Creek has been sampled at two sites since 1974, Site 0500326, above Summerland and Site 0500324, at the creek mouth (Figure 1). These data are summarized in Table 6.

Eneas Creek is highly buffered to acidic discharges, with a mean alkalinity of over 200 mg/L at both sites and a median pH of 8.3. Clark and Peppin revealed a trend of decreasing pH values, measured in the field, at the mouth[10]. Mean total hardness values were over 200 mg/L, which would help to prevent acute toxicity to aquatic life from metals. Most metal values were low and below criteria for the protection of aquatic life.

Total phosphorus values ranged from 0.011 to 0.133 mg/L at Site 0500326, upstream from Summerland. Values at Site 0500324 at the mouth were about the same. Suspended solids were generally low, although some high

maximum values did occur, presumably associated with runoff and/or freshet. Turbidity values were all less than 5 NTU at Site 0500326, with the maximum value at Site 0500324 at the mouth increasing to 8.3 NTU. These data imply that runoff is the most likely source of solids.

This is further implied by data for fecal coliforms. The median value increased from 50 MPN/100 mL at Site 0500326 to 130 MPN/100 mL at Site 0500324. The conclusion related to runoff being an important source of contaminants in the creek has important implications when nitrate and total nitrogen values are examined at the two sites.

The percentage of nitrate (or nitrate/nitrite) nitrogen to total nitrogen increases from 62.1% (standard deviation:17.6) at Site 0500326 to 87.4% (standard deviation: 5.7) at Site 0500324, at the mouth. This implies that large quantities of nitrate are entering Eneas Creek from surface and groundwater sources. Since nitrate and total nitrogen values at Site 0500324 are always higher than at Site 0500326 (Figure 5), and since the data were collected at times when surface runoff was and was not occurring, it is likely that groundwater is recharging Eneas Creek and increasing nitrate levels.

The data in Figure 5 tend to confirm this conclusion. The data for nitrate at Sites 0500326 and 0500324 show little or no increase in concentration over the period of record (Figure 5a). If the first and last data points for Site 0500324 at the mouth are joined, one can infer that nitrate nitrogen values have slowly increased at this site. This implied increase is only 1 mg/L in a period of eight years, about one-half that seen for nitrate in Shaughnessy Springs or the hatchery effluent. It implies that possibly one of two of the following processes is happening:

1. The groundwater which recharges Eneas Creek has a lower nitrate concentration than that groundwater which feeds Shaughnessy Springs, or

2. A large quantity of low nitrate water, possibly such as surface runoff, enters Eneas Creek downstream from Site 0500326, thereby diluting the effect of the groundwater.

In reality, probably both of these processes are taking place, to some degree.

4. DISCUSSION

Nitrogen is not sorbed or taken up by soils. Therefore all nitrogen which enters the soil mantle potentially can enter groundwater, unless it is taken up by plants.

The change of land use in the recharge area from agricultural to residential is extremely important when looking at nitrate entering groundwater. Applied fertilizers, or wastes from livestock, can either enter the soil mantle or be washed off the soil surface as runoff, eventually entering lakes or streams. If the nitrogen from these sources enters the soil mantle, it potentially can be taken up by plants with a root zone in the upper soil horizon. Precipitation or irrigation waters are required to transmit the nitrogen into the soil.

A different situation applies to disposal of wastewater by septic tank and tile fields. In this situation, a constant water supply provides nitrogen on a fairly constant basis, year round. By design, the field provides for downward movement of the wastewater, towards the groundwater. In fact, the Ministry of Health regulations (577/75) require 0.23 m of gravel in the bottom of the trench (and 0.33 m to 0.58 m of cover material). The depth of burial of the field is within the root zone of grass, the usual plant cover for a field. Therefore some of the applied wastewater and its nitrogen components could be lost to the grass cover through such action as capillary rise. However, a certain portion would be lost on a year-round basis, with the amount increasing in the winter months when requirements of the plant cover are reduced.

It has been shown in earlier sections that except for the refuse site, commercial sources contribute from 20 to 30 mg/L nitrate to the soil systems. A similar range is applicable to non-point septic tank sources, as documented below.

A study of several rural Wisconsin families revealed the following ammonia and nitrate levels in wastewater generated from their homes[12]:

Source	Percentage Contribution to Waste (1) %	(2) Adjusted %	Concentration (mg/L) (3) NH_3-N	(4) NO_3-N	(5) NO_3+NH_3-N	(6) Septic Tank
Toilet	21.5	22.9	111	2	113	25.9
Garbage Disposal	12.7	13.1	0.9	0.0	0.9	0.1
Dishes	11.4	12.2	10.5	0.6	11.1	1.4
Laundry	24.7	26.3	1.1	1	2.1	0.6
Bath/Shower	23.5	25.1	2	0.4	2.4	0.6
Total	93.8	99.6				28.6

Notes: (1) Values in Column (2) are calculated by multiplying values in column (1) by 100/93.8

(2) Values in Column (5) are calculated by adding values in columns (3) and (4)

(3) Values in Column (6) are calculated by multiplying column (2) by column (5), and dividing by 100.

These data indicate that septic tanks contribute approximately 30 mg/L of nitrate nitrogen to the groundwater, assuming all the ammonia is oxidized to nitrate. Thus, there are approximately equal contributions of nitrate to the groundwater from commercial sources and residential sources.

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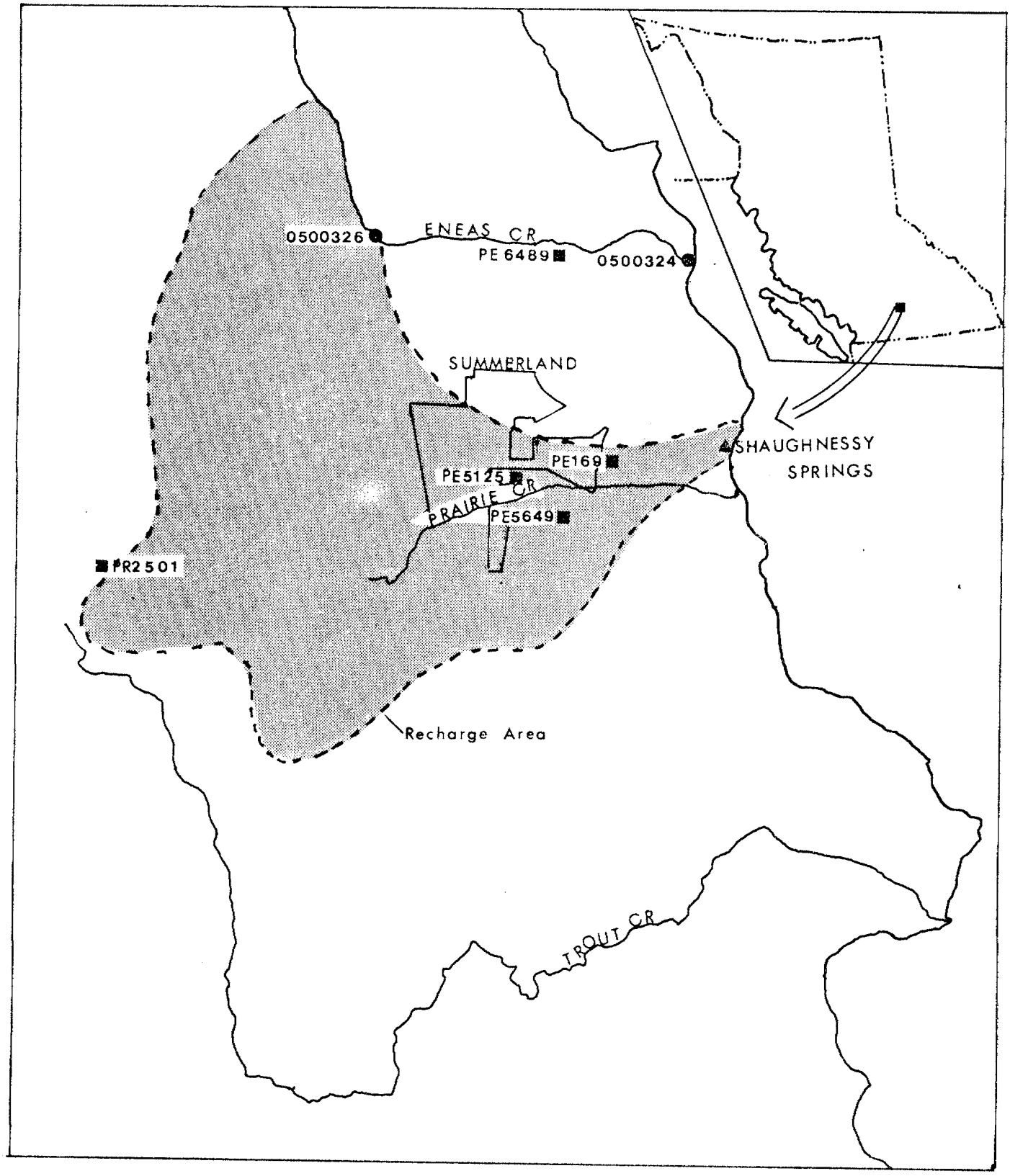


FIGURE 1 LOCATION MAP

FIGURE 2
TOTAL NITROGEN IN SHAUGHNESSY SPRINGS

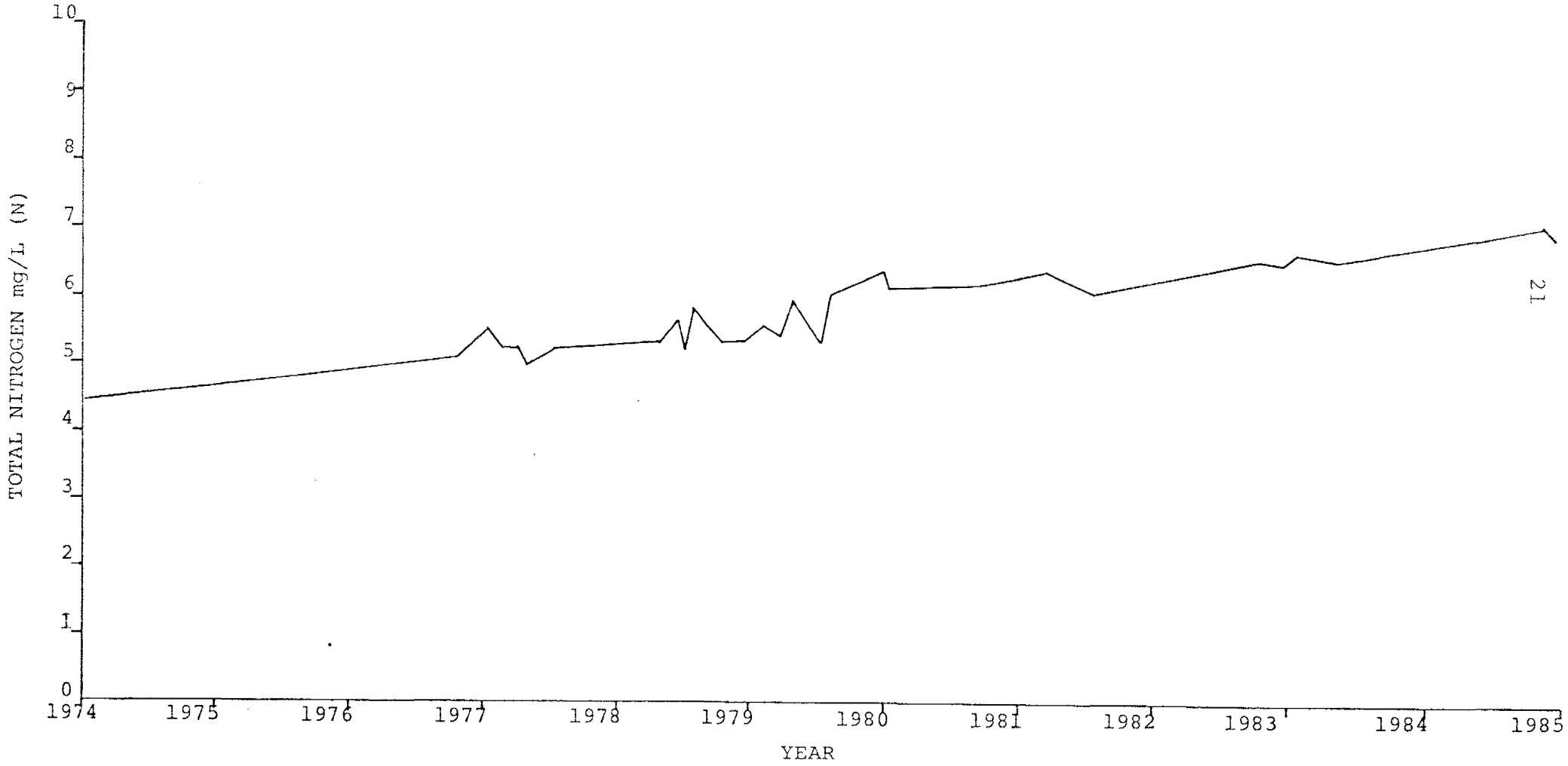
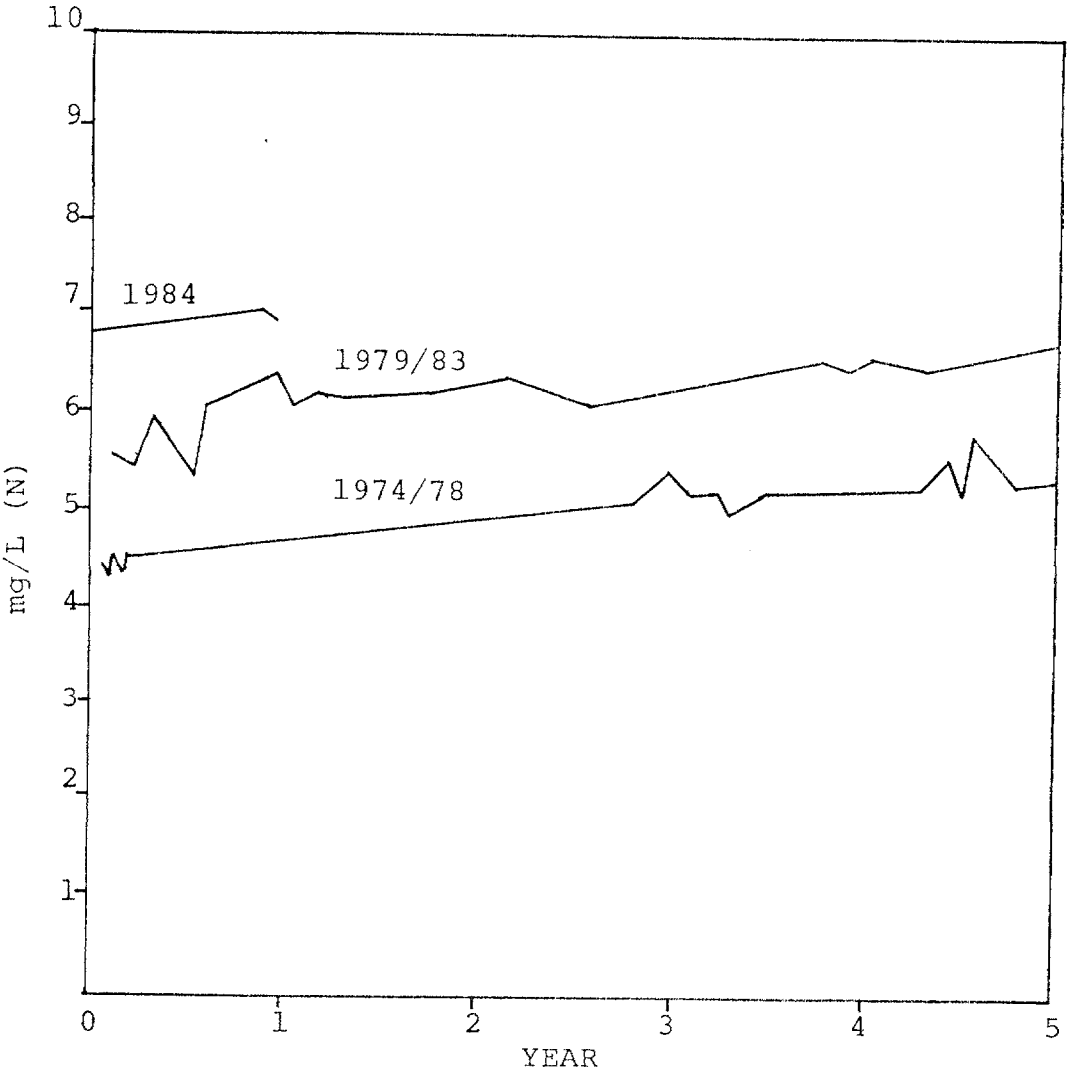


FIGURE 2(A)
NITRATEIN SHAUGHNESSY SPRINGS
BY FIVE-YEAR INCREMENTS



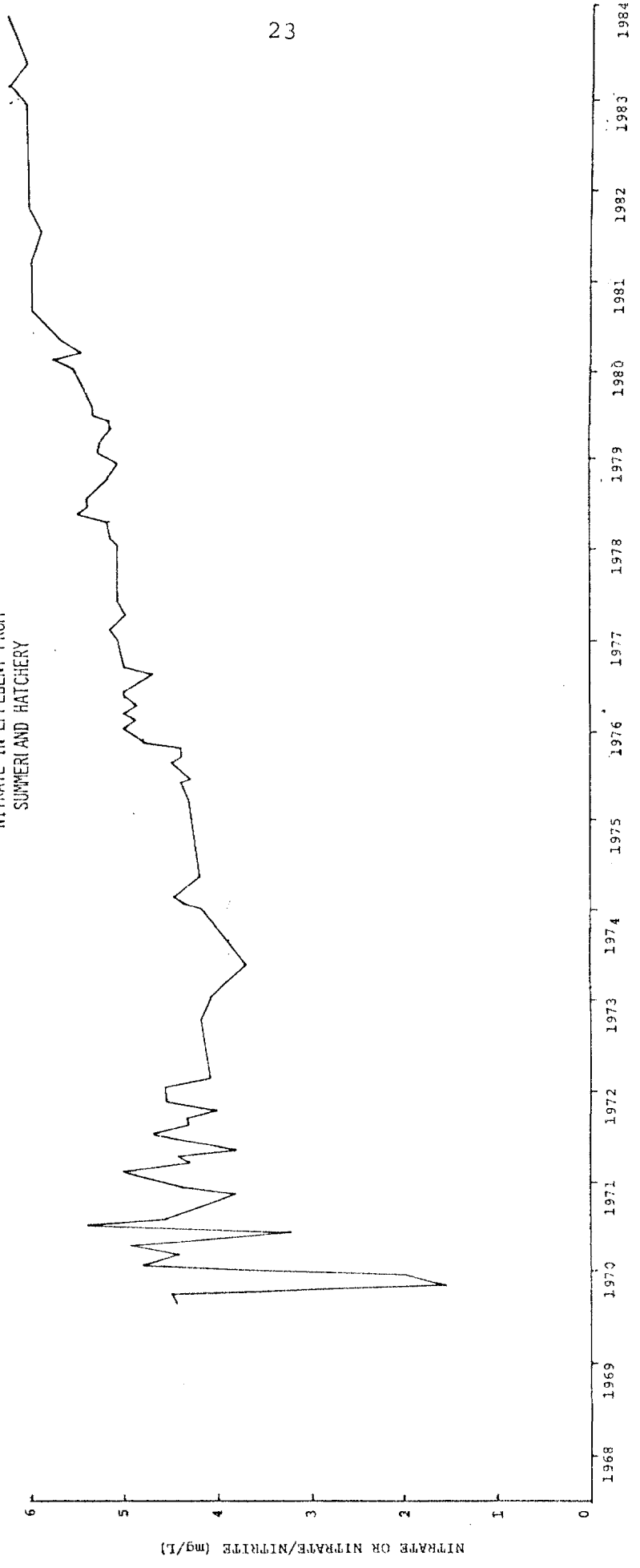


FIGURE 3
NITRATE IN EFFLUENT FROM
SUMMERLAND HATCHERY

FIGURE 3 (A)
NITRATE IN EFFLUENT FROM SUMMERLAND TROUT HATCHERY
BY FIVE-YEAR INCREMENTS

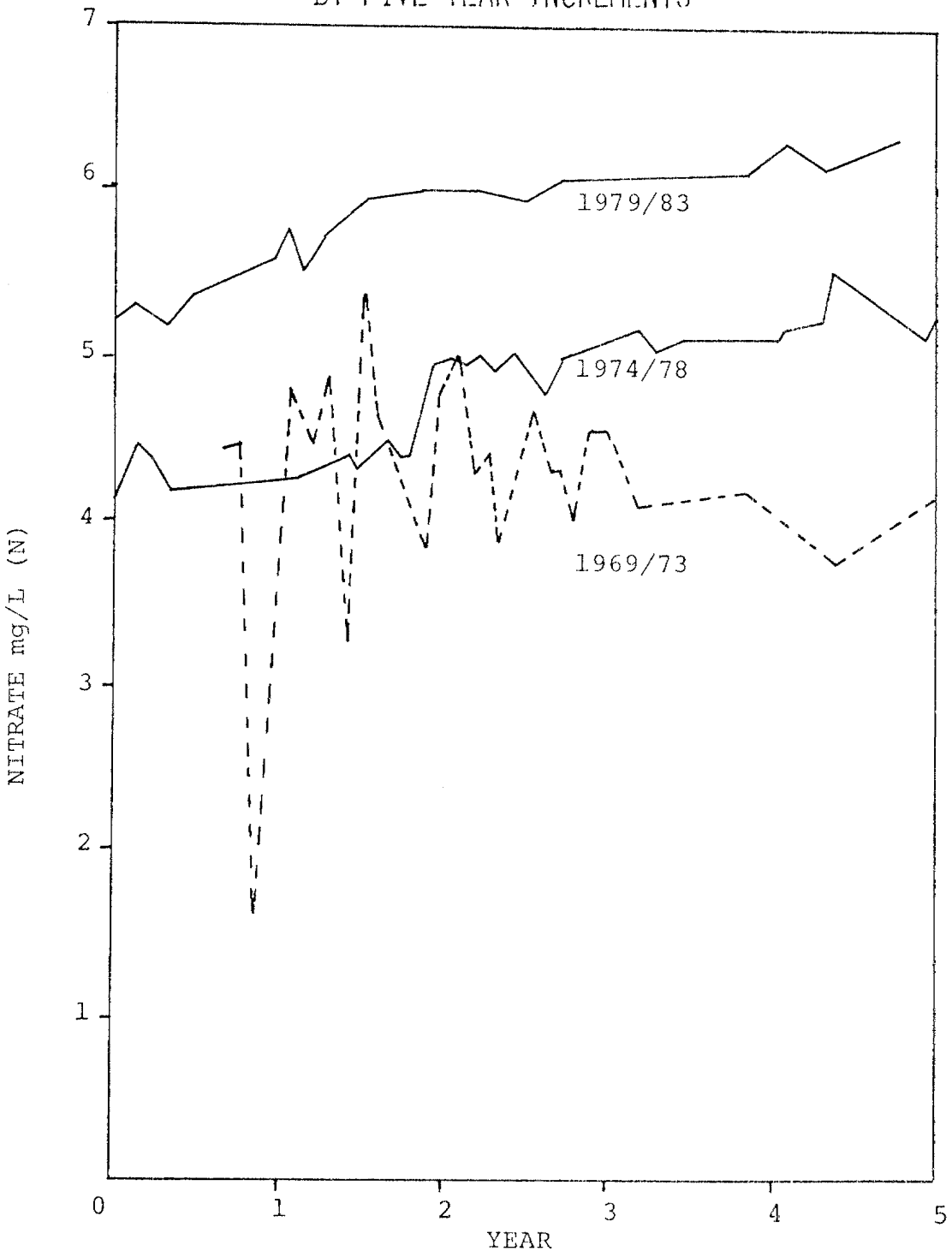


FIGURE 4
INCREASING NITROGEN IN SHAUGHNESSY SPRINGS
AND IN POPULATION IN CATCHMENT AREA , WITH TIME

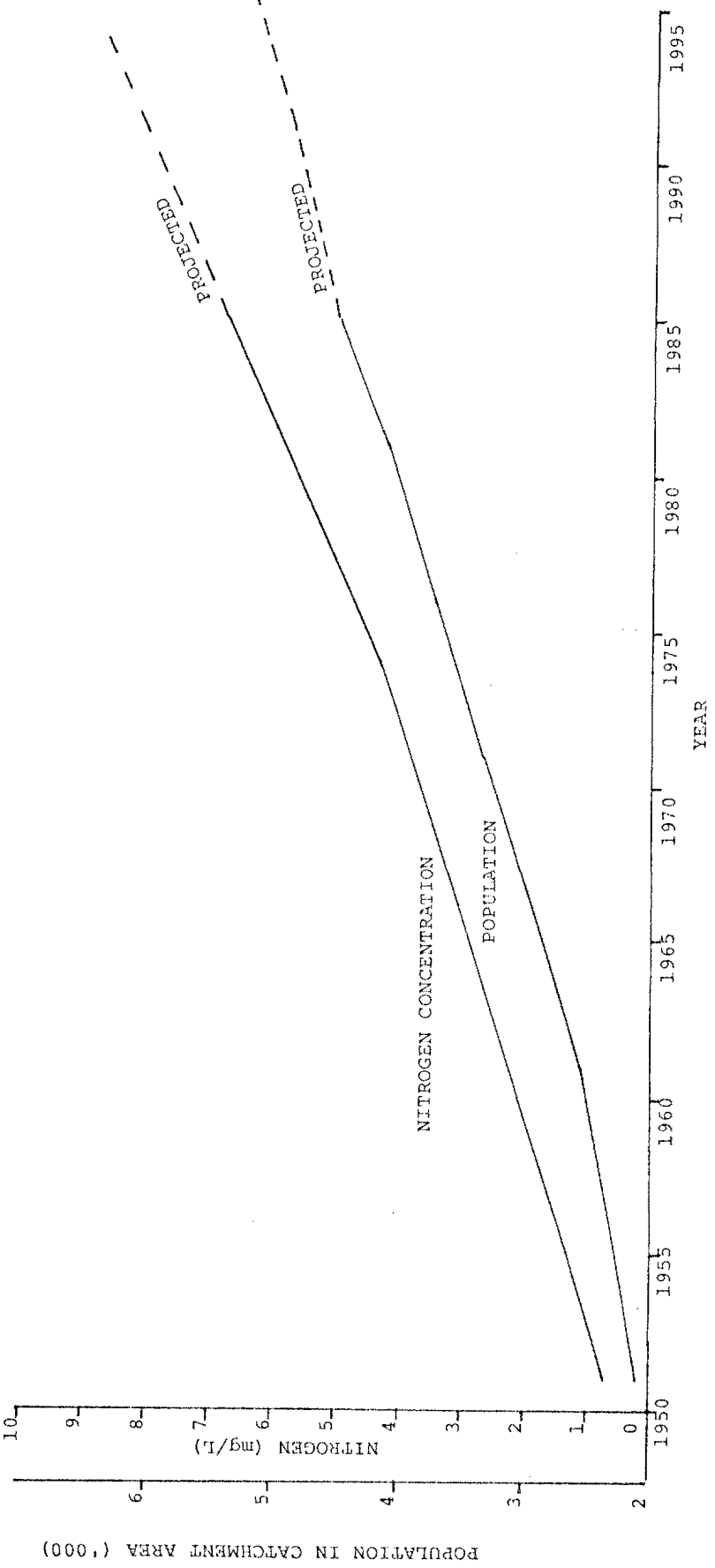


FIGURE 5
NITROGEN IN ENEAS CREEK

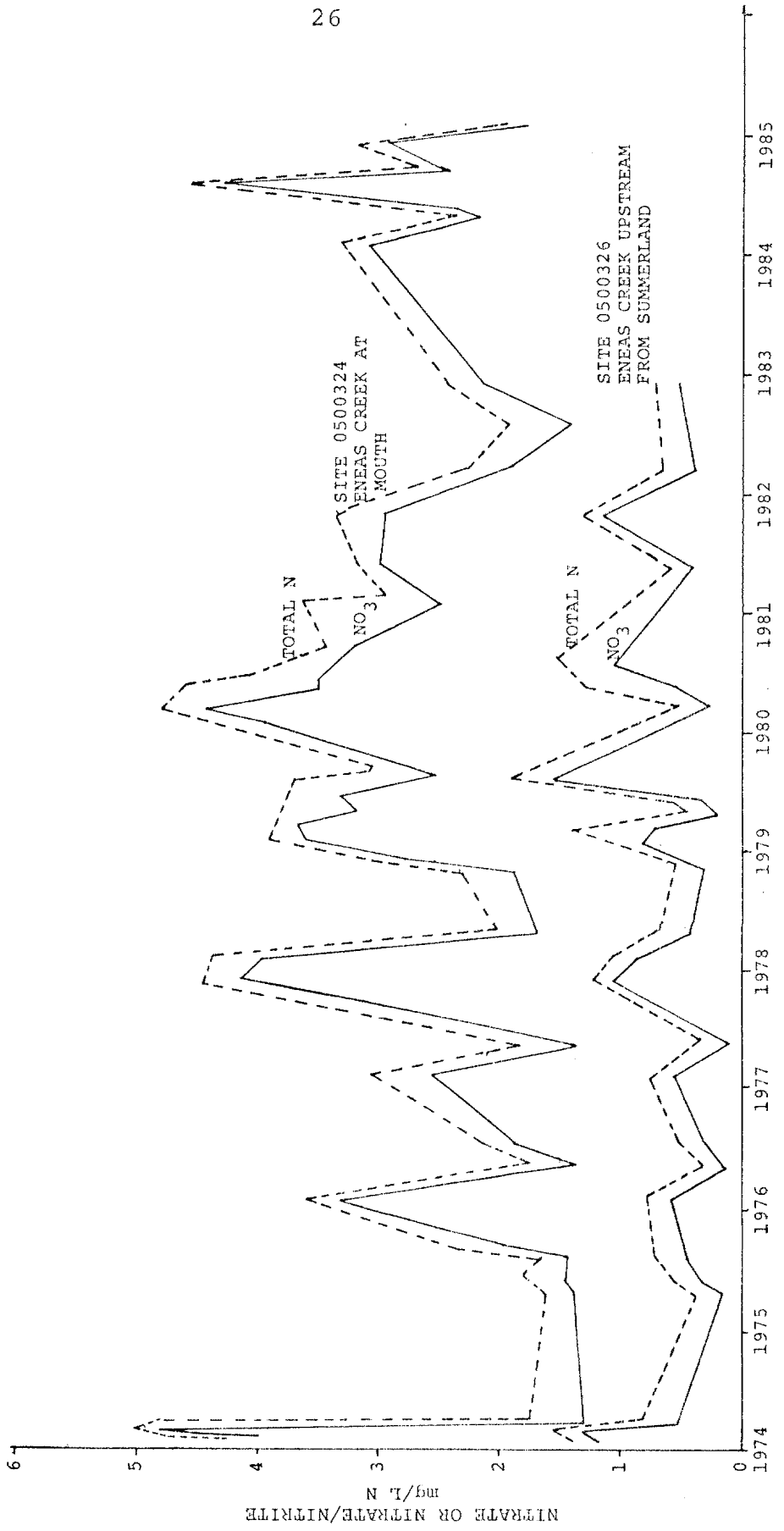


FIGURE 5 (A)

NITRATE IN ENEAS CREEK
BY FIVE-YEAR INCREMENTS

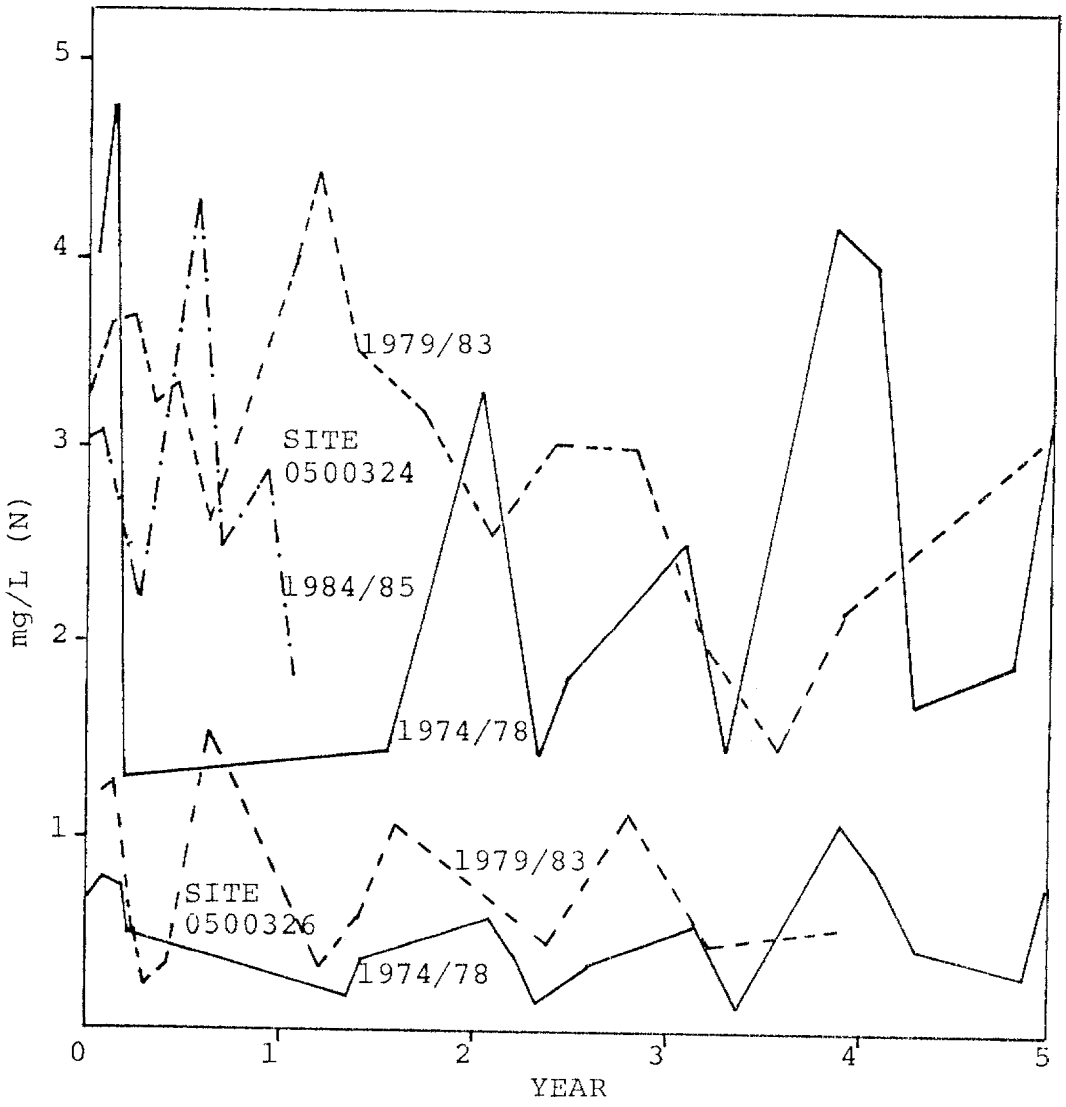


Table 1
Effluent Data Summary
Summerland Hospital (PE 169)

Characteristic	Number	Values*		
		Maximum	Minimum	Mean
Arsenic	1	0.013	-	-
Coliforms- fecal	21	>24 000 000	>2 400	>240 000+
Nitrogen - ammonia	2	21.2	20	-
- nitrate	2	0.05	0.04	-
- nitrite	2	0.01	<0.005	-
Oil and Grease	1	22.3	-	-
Oxygen - BOD_5	40	338	54	-
- dissolved	22	7.2	0.5	2.0
pH	28	7.8	6.7	7.2+
Phosphorus - total dissolved	1	13	-	-
- total	1	13.9	-	-
Solids - suspended	41	179	16	56
- total	41	588	296	438
Temperature	35	31	12	22.5
Turbidity	2	68	27	-

+ Median Value
* Values are as mg/L except:
(1) Coliforms as MPN/100 mL
(2) pH
(3) Temperature as °C
(4) Turbidity as NTU

Data Source: B.C. Ministry of Environment Computerized Data Storage and Retrieval System

Table 2
Effluent Data Summary
Corporation of the District of Summerland
Summerland Peach Orchard Park
(PE 3471)

Characteristic	July 15, 1982	
	Septic Tank 1	Septic Tank 2
BOD_5 (mg/L)	155	354
pH	8.2	8.2
Solids - suspended (mg/L)	83	250
- total (mg/L)	402	772
Specific Conductivity (µS/cm)	1050	1700

Data Source: B.C. Ministry of Environment Computerized Data Storage and Retrieval System.

Table 3

Effluent Data Summary

Parkdale Home (PE 5125)

Characteristic	Number	Values*		
		Maximum	Minimum	Mean
Coliforms - total	1	>2400	-	-
Oxygen - BOD_5	18	140	<10	33.2
- dissolved	12	5.8	1.0	3.3
pH	22	7.7	7.1	7.4+
Solids - dissolved	3	270	178	229
- suspended	22	232	9	53
- total	13	388	210	308
Temperature	14	28	15	22

+ Median Value
* Values are as mg/L except:
  (1) Coliforms as MPN/100 mL
  (2) pH
  (3) Temperature as °C

Data Source: B.C. Ministry of Environment Computerized Data Storage and Retrieval System

Table 4

Effluent Data Summary

Ye Olde Inn (PE 5649)

Characteristic	Number	Values*		
		Maximum	Minimum	Mean
Chlorine Residual	5	3	0	0.6
Nitrogen - ammonia	1	28.6	-	-
- nitrate	1	<0.02	-	-
- nitrite	1	0.01	-	-
Oxygen - BOD_5	9	330	170	219
- dissolved	7	11.2	4.6	6.8
pH	8	6.8	2.8	4.95+
Phosphorus - ortho dissolved	1	<0.003	-	-
- total	1	1.1	-	-
Solids - suspended	8	98	3	38
- total	5	1010	584	777
Temperature	8	25	13	19

+ Median Value
* Values are as mg/L except:
(1) pH
(2) Temperature as °C

Data Source: B.C. Ministry of Environment Computerized Data Storage and Retrieval System

Table 5
Ambient Water Quality Data Summary
Site 0500323
Shaughnessy Springs

Characteristic	Number	Values*		
		Maximum	Minimum	Mean
Alkalinity	19	249	217	239
Arsenic	2	<0.25	<0.005	-
Carbon - organic	17	10	<1	2
- inorganic	3	65	64	64.7
Chloride	14	7	5.1	6.2
Coliforms - fecal	42	79	<2	<2+
- total	42	130	<2	12+
Colour - true	5	5	<5	5
Hardness - calcium	13	89.5	77	83.5
- magnesium	7	15.6	13	14.8
- total	6	273	254	265
Metals (dissolved)				
- aluminum	1	0.1	-	-
- barium	1	0.05	-	-
- boron	1	0.07	-	-
- cobalt	1	<0.1	-	-
- cadmium	3	<0.01	<0.0005	0.0006+
- chromium	2	<0.01	<0.005	-
- copper	3	<0.01	0.001	0.003+
- iron	2	<0.1	<0.01	-
- lead	3	<0.1	<0.001	<0.001+
- manganese	2	<0.02	<0.01	-
- mercury	2	<0.00005	<0.00005	-
- molybdenum	1	0.03	-	-
- nickel	2	<0.05	<0.01	-
- vanadium	1	<0.01	-	-
- zinc	1	<0.01	-	-
Nitrogen - ammonia	24	0.02	<0.005	0.008
- nitrate/nitrite	40	6.7	4.3	5.5
- nitrate	19	5	4.2	4.6
- nitrite	29	<0.005	<0.005	<0.005
- organic	30	0.34	0.02	0.15
- total	57	6.76	4.34	5.38
Oxygen - BOD_5	19	<10	<10	<10
- dissolved	42	12.8	8.0	9.8
pH	59	8.3	7.6	8.0+
Phosphorus - ortho dissolved	20	0.018	0.008	0.010
- total dissolved	11	0.014	0.007	0.012
- total	55	0.049	0.011	0.016
Potassium	7	3.8	3.7	3.7
Sodium	13	21	17.8	19.5
Solids - dissolved	2	386	380	383
- suspended	55	34	<1	3
- total	53	414	356	385

Table 5 Continued

Characteristic	Number	Values*		
		Maximum	Minimum	Mean
Specific Conductivity	62	628	540	590
Sulphate	19	58.9	47.2	53.2
Temperature	50	14	6	11
Turbidity	7	0.5	0.2	0.3

+ Median Value
* All values are as mg/L except:
  1. Coliforms as MPN/100 mL
  2. Colour
  3. pH
  4. Specific Conductivity as µS/cm
  5. Temperature as °C
  6 Turbidity as NTU

Data Source: B.C. Ministry of Environment Computerized Data Storage and Retrieval System.

1975 - Oct' 83

TABLE 6
AMBIENT WATER QUALITY DATA SUMMARY

Characteristic	Eneas Creek at Mouth Site 0500324				Eneas Creek above Summerland Site 0500326			
	Number	Values*			Number	Values*		
		Maximum	Minimum	Mean		Maximum	Minimum	Mean
Alkalinity	24	260	136	224	20	297	79.5	215.5
Carbon: - organic	21	10	<1	3.8	18	10	<1	5
Chloride	28	4.3	2.1	3.4	23	4.7	1.2	2.8
Coliforms - fecal	17	>24 000	46	130+	10	>2400	<2	50+
Colour TAC	14	15	<5	7.5	13	40	<5	11.9
Hardness - calcium	21	91.3	45.3	74	16	80	23.5	60.5
- magnesium	21	18.6	8.6	13.7	16	23.3	4.8	13.3
- total	20	297	149	241	16	289	78.4	205.8
METALS: - aluminum (d)	1	0.02	-	-	-	-	-	-
- arsenic (d)	1	<0.25	-	-	-	-	-	-
- barium	1	0.06	-	-	-	-	-	-
- boron (d)	1	0.04	-	-	-	-	-	-
- Cadmium (d)	13	<0.0005	<0.0005	<0.0005	10	<0.0005	<0.0005	<0.0005
- Cadmium (t)	3	0.0015	<0.0005	<0.0005+	1	<0.0005	-	-
- Chromium (d)	3	<0.005	<0.005	<0.005	3	<0.005	<0.005	<0.005
- Copper (d)	12	<0.01	<0.001	<0.001+	9	0.007	<0.001	0.002
- Copper (t)	2	0.002	0.001	0.0015	1	0.002	-	-
- iron (d)	11	0.2	<0.01	0.10	8	0.1	0.01	0.09
- iron (t)	3	0.3	0.2	0.23	1	0.1	-	-
- lead (d)	10	0.002	<0.001	<0.001+	8	0.004	<0.001	0.002
- lead (t)	2	<0.001	<0.001	<0.001	1	<0.001	-	-
- manganese (d)	10	0.02	<0.01	0.018	9	0.02	<0.01	0.02
- mercury (t)	10	0.00015	<0.00005	<0.00005+	9	0.00019	<0.00005	<0.00005
- molybdenum (d)	2	0.02	<0.01	-	1	0.0053	-	-
- molybdenum (t)	3	0.02	0.008	0.01	1	0.01	-	-
- nickel (d)	7	<0.01	<0.01	<0.01	7	0.01	<0.01	<0.01
- zinc (d)	8	0.006	<0.005	<0.005+	9	<0.005	<0.005	<0.005
- zinc (t)	2	0.009	<0.005	-	1	<0.005	-	-
Nitrogen: - ammonia	23	0.02	<0.005	0.011	17	0.059	<0.005	0.018
- nitrate	21	4.5	1.44	2.92	14	1.53	0.11	0.64
- nitrite	30	0.006	<0.005	<0.005	23	0.01	<0.005	<0.005
- Kjeldahl	32	0.64	0.18	0.37	25	0.72	0.19	0.30
Oxygen - BOD_5	5	<10	<10	<10	3	<10	<10	<10
- dissolved	26	14.4	7	10.9	22	16	8.2	11.8
pH	38	8.5	8.1	8.3+	31	8.7	8	8.3+
Phosphorus-ortho dissolved	15	0.018	0.003	0.012	-	-	-	-
-total dissolved	15	0.026	0.01	0.016	9	0.102	0.008	0.030
-total	37	0.125	0.017	0.037	31	0.133	0.011	0.034
Solids: - dissolved	11	396	300	361	4	368	300	336
- suspended	24	89	2	19	20	58	1	7
- total	23	434	232	355	20	370	126	291

TABLE 6
AMBIENT WATER QUALITY DATA SUMMARY

Characteristic	Eneas Creek at Mouth Site 0500324				Eneas Creek above Summerland Site 0500326			
	Number	Values*			Number	Values*		
		Maximum	Minimum	Mean		Maximum	Minimum	Mean
Specific Conductivity	41	619	329	526	33	575	180	458
Temperature	37	16.5	3	9.4	32	18	0.5	7.5
Turbidity	12	8.3	1.8	3.4	8	3.9	0.8	2.6
Uranium (d)	1	0.015	-	-	1	0.018	-	-

+ Median Value
* Values are as mg/L except:
(1) Coliforms as MPN/100 mL
(2) Colour TAC
(3) pH
(4) Specific Conductivity as µS/cm
(5) Temperature as °C
(6) Turbidity as NTU

From: Matt Cleary <MCleary@piteau.com>
Sent: Tuesday, April 18, 2017 2:52 PM
To: Malek Tawashy
Cc: Matt Cameron
Subject: RE: 16028-ICASSA

Malek,

From our 2016 report, "BC Ministry of Environment (MOE) collected 57 water samples from Shaughnessy Springs for various parameters between 1973 and 1984; the results of which were presented in a BC MOE (1985) memorandum . Concentrations of total nitrogen ranged from 4.34 to 6.76 mg/L, and averaged 5.38 mg/L. Total nitrogen for the October 4, 1984 sample measured 7.1 mg/L (NO2 + NO3).

The results from the 2016 testing at MW-1 and the Spring are within the above range, indicating that the levels have stabilized. I wouldn't state that they are decreasing, as there are only two samples collected during this time frame.

Matt

MATTHEW L. CLEARY, B.Sc., P.Geo.
Senior Hydrogeologist, Associate
Email: mcleary@piteau.com
Tel: +1.778.484.1777 - Ext. 7123
Fax: +1.604.985.7286
Direct: +1.778.738.0994

-----Original Message-----
From: Malek Tawashy [mailto:mtawashy@larkgroup.com]
Sent: April-18-17 2:47 PM
To: Matt Cleary <MCleary@piteau.com>
Cc: Matt Cameron <mcameron@ctqconsultants.ca>
Subject: Re: 16028-ICASSA

Ok so the 1986 report predicting the alarm levels (13mg/L) would be breached by 2006, was incorrect.
in fact it's likely gone down since the 1986 report.
Any disagreements?

Sent from my iPhone

On Apr 18, 2017, at 2:42 PM, Matt Cleary <MCleary@piteau.com> wrote:

Hey Malek,

We sampled for nitrate during our 2016 assessment, with a concentration of 6.17 mg/L at MW-1. The nitrate concentration in the Spring (sampled by the Hatchery) was 3.83 mg/L. I've attached both analytical reports.

As for information regarding any new wells that might have been drilled for the Hatchery, as of February 29, 2016, drillers were required to file well logs with the Ministry. This information is provided in a geo-spatial database, which

indicates no well within 250m of the Hatchery. This doesn't mean they didn't drill a well, it just means there is no reported information on it within the database. Best way would be to ask FFSBC directly, although who knows if you'll get an answer from them.

Cheers,
Matt

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Senior Hydrogeologist, Associate
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Tel: +1.778.484.1777 - Ext. 7123
Fax: +1.604.985.7286
Direct: +1.778.738.0994

From: Malek Tawashy [mailto:mtawashy@larkgroup.com]
Sent: April-18-17 1:32 PM
To: Matt Cleary <MCleary@piteau.com>; Matt Cameron <mcameron@ctqconsultants.ca>
Subject: RE: 16028-ICASSA

Matt Cleary,
Is there any way we can identify the Nitrate Levels of the Aquifer?
The attached report indicated that by 2006 the nitrate levels could have reached the "alarm level"

Malek Tawashy
T: 604-576-2935
C: 250-213-8185

From: Malek Tawashy
Sent: April-18-17 1:20 PM
To: 'Matt Cleary'; Matt Cameron
Subject: RE: 16028-ICASSA

Thank you.
Matt, in speaking with Dean today he said the hatchery tried to drill a well a year ago and that failed.

Can you find out if this is true?

Malek Tawashy
T: 604-576-2935
C: 250-213-8185

From: Matt Cleary [mailto:MCleary@piteau.com]
Sent: April-18-17 10:05 AM
To: Matt Cameron; Malek Tawashy
Subject: RE: 16028-ICASSA

What are the monitoring wells for? If you are referring to the two existing monitoring wells on our site, those have been surveyed and I will send you the DXF drawing.

Cheers,
Matt

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Direct: +1.778.738.0994

From: Matt Cameron [mailto:mcameron@ctqconsultants.ca]
Sent: April-18-17 8:26 AM
To: Malek Tawashy <mtawashy@larkgroup.com<mailto:mtawashy@larkgroup.com>>; Matt Cleary <MCleary@piteau.com<mailto:MCleary@piteau.com>>
Subject: 16028-ICASSA

Malek and Matt.

Malek I was thinking yesterday that if we are going to propose that the alternative water source is from the Districts water system then we should take that service closer to the actual Hatchery so as not to disturb the existing spring infrastructure. As discussed we would need to include a de-chlorination but that is doable.

With regard to the monitoring wells to be shown on a drawing where shall we show those. Matt can you help here please.

Thanks,
Matt.

Matt Cameron, P.Eng., FEC

[cid:image003.jpg@01CFCE68.934866B0]
CTQ Consultants Ltd.

1334 St. Paul Street
Kelowna, BC V1Y 2E1
Tel: 250.979.1221 ext. 113
Cell: 250.212.2238
web: www.ctqconsultants.ca<http://www.ctqconsultants.ca/>
[cid:image001.jpg@01D256F7.E63F3AA0]

<image001.jpg>
<image002.jpg>
<6061747_1 RPT_CARO-M0 2016 06 29 1544.pdf> <B643286V2R-R2016-06-30_10-39-10_R006.pdf>

From: Matt Cleary <MCleary@piteau.com>
Sent: Tuesday, April 18, 2017 2:41 PM
To: Malek Tawashy; Matt Cameron
Subject: RE: 16028-ICASSA
Attachments: 6061747_1 RPT_CARO-M0 2016 06 29 1544.pdf; B643286V2R-R2016-06-30_10-39-10_R006.pdf

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Subject: 16028-ICASSA

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Matt.

Matt Cameron, P.Eng., FEC

CTQ Consultants Ltd.

1334 St. Paul Street
Kelowna, BC V1Y 2E1
Tel: 250.979.1221 ext. 113
Cell: 250.212.2238
web: **www.ctqconsultants.ca**

OQM Organizational Quality Management Program

CERTIFICATE OF ANALYSIS

REPORTED TO	Piteau Associates Engineering Ltd. (Kelowna) #304 - 1912 Enterprise way Kelowna, BC V1Y 9S9	**TEL** **FAX**	(778) 484-1777 (778) 484-3901
ATTENTION	Matt Cleary	**WORK ORDER**	6061747
PO NUMBER		**RECEIVED / TEMP**	2016-06-21 15:24 / 14°C
PROJECT	3583	**REPORTED**	2016-06-29
PROJECT INFO	Summerland	**COC NUMBER**	B40038

General Comments:

CARO Analytical Services employs methods which are conducted according to procedures accepted by appropriate regulatory agencies, and/or are conducted in accordance with recognized professional standards using accepted testing methodologies and quality control efforts, except where otherwise agreed to by the client.

The results in this report apply to the samples analyzed in accordance with the Chain of Custody or Sample Requisition 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.

Work Order Comments:

This is a revised report. Refer to Appendix 3 for details

Revision 1 - Please note the change in sample ID as per client's request - SG

Authorized By: **Ed Hoppe, B.Sc., P.Chem.**
Division Manager, Kelowna

If you have any questions or concerns, please contact your Account Manager:
Sara Gulenchyn, B.Sc, P.Chem. (sgulenchyn@caro.ca)

Locations:

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

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Kelowna, BC V1X 5C3
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17225 109 Avenue
Edmonton, AB T5S 1H7
Tel: 780-489-9100 Fax: 780-489-9700

www.caro.ca

ANALYSIS INFORMATION

REPORTED TO	Piteau Associates Engineering Ltd. (Kelowna)	**WORK ORDER**	6061747
PROJECT	3583	**REPORTED**	2016-06-29

Analysis Description	Method Reference	Technique	Location
Alkalinity in Water	APHA 2320 B*	Titration with H2SO4	Kelowna
Ammonia, Total in Water	APHA 4500-NH3 G*	Automated Colorimetry (Phenate)	Kelowna
Anions by IC in Water	APHA 4110 B	Ion Chromatography with Chemical Suppression of Eluent Conductivity	Kelowna
Conductivity in Water	APHA 2510 B	Conductivity Meter	Kelowna
Dissolved Metals by ICPMS in Water	APHA 3030 B / APHA 3125 B	0.45 µm Filtration / Inductively Coupled Plasma Mass Spectrometry (ICP-MS)	Richmond
Hardness (as CaCO3) in Water	APHA 2340 B	Calculation: 2.497 [diss Ca] + 4.118 [diss Mg]	N/A
Mercury, dissolved by CVAFS in Water	EPA 245.7*	BrCl2 Oxidation / Cold Vapor Atomic Fluorescence Spectrometry (CVAFS)	Richmond
Nitrogen, Total Kjeldahl in Water	APHA 4500-Norg D*	Block Digestion and Flow Injection Analysis	Kelowna
pH in Water	APHA 4500-H+ B	Electrometry	Kelowna
Phosphorus, Total by Colorimetry in Water	APHA 4500-P B.5* / APHA 4500-P F	Persulfate Digestion / Automated Colorimetry (Ascorbic Acid)	Kelowna
Solids, Total Dissolved in Water	APHA 2540 C*	Gravimetry (Dried at 103-105C)	Kelowna
Solids, Total Suspended in Water	APHA 2540 D*	Gravimetry (Dried at 103-105C)	Kelowna

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

Method Reference Descriptions:

APHA	Standard Methods for the Examination of Water and Wastewater, 22nd Edition, American Public Health Association/American Water Works Association/Water Environment Federation
EPA	United States Environmental Protection Agency Test Methods

Glossary of Terms:

MRL	Method Reporting Limit
<	Less than the Reported Detection Limit (RDL) - the RDL may be higher than the MRL due to various factors such as dilutions, limited sample volume, high moisture, or interferences
mg/L	Milligrams per litre
pH units	pH < 7 = acidic, ph > 7 = basic
µS/cm	Microsiemens per centimetre

REPORTED TO	Piteau Associates Engineering Ltd. (Kelowna)	**WORK ORDER**	6061747
PROJECT	3583	**REPORTED**	2016-06-29

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: MW-1 (6061747-01) [Water] Sampled: 2016-06-21 12:30						
Anions						
Bromide	< 0.10	0.10	mg/L	N/A	2016-06-22	
Chloride	**37.6**	0.10	mg/L	N/A	2016-06-22	
Nitrate (as N)	**6.17**	0.010	mg/L	N/A	2016-06-22	
Nitrite (as N)	< 0.010	0.010	mg/L	N/A	2016-06-22	
Phosphate (as P)	**0.03**	0.01	mg/L	N/A	2016-06-22	
Sulfate	**42.8**	1.0	mg/L	N/A	2016-06-22	
General Parameters						
Alkalinity, Total (as CaCO3)	**225**	2	mg/L	N/A	2016-06-22	
Alkalinity, Phenolphthalein (as CaCO3)	< 1	2	mg/L	N/A	2016-06-22	
Alkalinity, Bicarbonate (as CaCO3)	**225**	2	mg/L	N/A	2016-06-22	
Alkalinity, Carbonate (as CaCO3)	< 1	2	mg/L	N/A	2016-06-22	
Alkalinity, Hydroxide (as CaCO3)	< 1	2	mg/L	N/A	2016-06-22	
Ammonia, Total (as N)	**0.023**	0.020	mg/L	N/A	2016-06-24	
Conductivity (EC)	**674**	2	µS/cm	N/A	2016-06-22	
Nitrogen, Total Kjeldahl	**0.39**	0.05	mg/L	2016-06-24	2016-06-27	
pH	**7.79**	0.01	pH units	N/A	2016-06-22	HT2
Phosphorus, Total (as P)	**0.161**	0.002	mg/L	2016-06-23	2016-06-24	
Solids, Total Dissolved	**387**	10	mg/L	N/A	2016-06-23	
Solids, Total Suspended	**144**	2	mg/L	N/A	2016-06-22	
Calculated Parameters						
Hardness, Total (as CaCO3)	**287**	5.0	mg/L	N/A	N/A	
Nitrate+Nitrite (as N)	**6.17**	0.010	mg/L	N/A	N/A	
Nitrogen, Total	**6.56**	0.050	mg/L	N/A	N/A	
Nitrogen, Organic	**0.366**	0.050	mg/L	N/A	N/A	
Dissolved Metals						
Aluminum, dissolved	< 0.05	0.05	mg/L	N/A	2016-06-24	
Antimony, dissolved	< 0.001	0.001	mg/L	N/A	2016-06-24	
Arsenic, dissolved	< 0.005	0.005	mg/L	N/A	2016-06-24	
Barium, dissolved	**0.12**	0.05	mg/L	N/A	2016-06-24	
Beryllium, dissolved	< 0.001	0.001	mg/L	N/A	2016-06-24	
Bismuth, dissolved	< 0.001	0.001	mg/L	N/A	2016-06-24	
Boron, dissolved	**0.04**	0.04	mg/L	N/A	2016-06-24	
Cadmium, dissolved	< 0.0001	0.0001	mg/L	N/A	2016-06-24	
Calcium, dissolved	**86.4**	2.0	mg/L	N/A	2016-06-24	
Chromium, dissolved	< 0.005	0.005	mg/L	N/A	2016-06-24	
Cobalt, dissolved	< 0.0005	0.0005	mg/L	N/A	2016-06-24	
Copper, dissolved	< 0.002	0.002	mg/L	N/A	2016-06-24	
Iron, dissolved	**0.18**	0.10	mg/L	N/A	2016-06-24	
Lead, dissolved	< 0.001	0.001	mg/L	N/A	2016-06-24	
Lithium, dissolved	**0.009**	0.001	mg/L	N/A	2016-06-24	
Magnesium, dissolved	**17.3**	0.1	mg/L	N/A	2016-06-24	
Manganese, dissolved	**0.016**	0.002	mg/L	N/A	2016-06-24	
Mercury, dissolved	< 0.00002	0.00002	mg/L	2016-06-23	2016-06-28	
Molybdenum, dissolved	**0.020**	0.001	mg/L	N/A	2016-06-24	

REPORTED TO	Piteau Associates Engineering Ltd. (Kelowna)	**WORK ORDER**	6061747
PROJECT	3583	**REPORTED**	2016-06-29

Analyte	Result / *Recovery*	MRL / *Limits*	Units	Prepared	Analyzed	Notes
Sample ID: MW-1 (6061747-01) [Water] Sampled: 2016-06-21 12:30, Continued						
Dissolved Metals, Continued						
Nickel, dissolved	**0.003**	0.002	mg/L	N/A	2016-06-24	
Phosphorus, dissolved	< 0.2	0.2	mg/L	N/A	2016-06-24	
Potassium, dissolved	**4.8**	0.2	mg/L	N/A	2016-06-24	
Selenium, dissolved	< 0.005	0.005	mg/L	N/A	2016-06-24	
Silicon, dissolved	**10**	5	mg/L	N/A	2016-06-24	
Silver, dissolved	< 0.0005	0.0005	mg/L	N/A	2016-06-24	
Sodium, dissolved	**27.2**	0.2	mg/L	N/A	2016-06-24	
Strontium, dissolved	**0.81**	0.01	mg/L	N/A	2016-06-24	
Sulfur, dissolved	**10**	10	mg/L	N/A	2016-06-24	
Tellurium, dissolved	< 0.002	0.002	mg/L	N/A	2016-06-24	
Thallium, dissolved	< 0.0002	0.0002	mg/L	N/A	2016-06-24	
Thorium, dissolved	< 0.001	0.001	mg/L	N/A	2016-06-24	
Tin, dissolved	< 0.002	0.002	mg/L	N/A	2016-06-24	
Titanium, dissolved	< 0.05	0.05	mg/L	N/A	2016-06-24	
Uranium, dissolved	**0.0171**	0.0002	mg/L	N/A	2016-06-24	
Vanadium, dissolved	< 0.01	0.01	mg/L	N/A	2016-06-24	
Zinc, dissolved	< 0.04	0.04	mg/L	N/A	2016-06-24	
Zirconium, dissolved	< 0.001	0.001	mg/L	N/A	2016-06-24	

Sample / Analysis Qualifiers:

HT2 The 15 minute recommended holding time (from sampling to analysis) has been exceeded - field analysis is recommended.

REPORTED TO	Piteau Associates Engineering Ltd. (Kelowna)	**WORK ORDER**	6061747
PROJECT	3583	**REPORTED**	2016-06-29

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)**: Laboratory reagent water is carried through sample preparation and analysis steps. Method Blanks indicate that results are free from contamination, i.e. not biased high from sources such as the sample container or the laboratory environment
- **Duplicate (Dup)**: Preparation and analysis of a replicate aliquot of a sample. Duplicates provide a measure of the analytical method's precision, i.e. how reproducible a result is. Duplicates are only reported if they are associated with your sample data.
- **Blank Spike (BS)**: A known amount of standard is carried through sample preparation and analysis steps. Blank Spikes, also known as laboratory control samples (LCS), are prepared from a different source of standard than used for the calibration. They ensure that the calibration is acceptable (i.e. not biased high or low) and also provide a measure of the analytical method's accuracy (i.e. closeness of the result to a target value).
- **Standard Reference Material (SRM)**: A material of similar matrix to the samples, externally certified for the parameter(s) listed. Standard Reference Materials ensure that the preparation steps in the method are 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 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	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Anions, Batch B6F1457										
Blank (B6F1457-BLK1)				Prepared: 2016-06-22, Analyzed: 2016-06-22						
Bromide	< 0.10	0.10	mg/L							
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							
Phosphate (as P)	< 0.01	0.01	mg/L							
Sulfate	< 1.0	1.0	mg/L							
Blank (B6F1457-BLK2)				Prepared: 2016-06-23, Analyzed: 2016-06-23						
Bromide	< 0.10	0.10	mg/L							
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							
Phosphate (as P)	< 0.01	0.01	mg/L							
Sulfate	< 1.0	1.0	mg/L							
LCS (B6F1457-BS1)				Prepared: 2016-06-22, Analyzed: 2016-06-22						
Bromide	4.06	0.10	mg/L	4.00		102	85-115			
Chloride	16.3	0.10	mg/L	16.0		102	90-110			
Nitrate (as N)	4.27	0.010	mg/L	4.00		107	93-108			
Nitrite (as N)	2.03	0.010	mg/L	2.00		101	83-110			
Phosphate (as P)	1.00	0.01	mg/L	1.00		100	85-115			
Sulfate	15.8	1.0	mg/L	16.0		99	91-109			
LCS (B6F1457-BS2)				Prepared: 2016-06-23, Analyzed: 2016-06-23						
Bromide	4.17	0.10	mg/L	4.00		104	85-115			
Chloride	16.3	0.10	mg/L	16.0		102	90-110			
Nitrate (as N)	4.12	0.010	mg/L	4.00		103	93-108			
Nitrite (as N)	2.03	0.010	mg/L	2.00		101	83-110			
Phosphate (as P)	1.09	0.01	mg/L	1.00		109	85-115			
Sulfate	15.9	1.0	mg/L	16.0		99	91-109			
Duplicate (B6F1457-DUP1)		**Source: 6061747-01**		Prepared: 2016-06-22, Analyzed: 2016-06-22						
Bromide	< 0.10	0.10	mg/L		< 0.10				10	

REPORTED TO Piteau Associates Engineering Ltd. (Kelowna)
PROJECT 3583

WORK ORDER 6061747
REPORTED 2016-06-29

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Anions, Batch B6F1457, Continued										
Duplicate (B6F1457-DUP1), Continued		**Source: 6061747-01**		Prepared: 2016-06-22, Analyzed: 2016-06-22						
Chloride	37.7	0.10	mg/L		37.6			< 1	10	
Nitrate (as N)	6.08	0.010	mg/L		6.17			1	10	
Nitrite (as N)	< 0.010	0.010	mg/L		< 0.010				6	
Phosphate (as P)	0.03	0.01	mg/L		0.03				20	
Sulfate	42.6	1.0	mg/L		42.8			< 1	6	
Matrix Spike (B6F1457-MS1)		**Source: 6061747-01**		Prepared: 2016-06-22, Analyzed: 2016-06-22						
Bromide	4.18	0.10	mg/L	4.00	< 0.10	103	75-125			
Chloride	55.8	0.10	mg/L	16.0	37.6	114	75-125			
Nitrate (as N)	10.2	0.010	mg/L	4.00	6.17	102	75-125			
Nitrite (as N)	2.01	0.010	mg/L	2.00	< 0.010	100	75-125			
Phosphate (as P)	1.12	0.01	mg/L	1.00	0.03	109	75-125			
Sulfate	59.0	1.0	mg/L	16.0	42.8	101	75-125			
Dissolved Metals, Batch B6F1569										
Blank (B6F1569-BLK1)				Prepared: 2016-06-23, Analyzed: 2016-06-28						
Mercury, dissolved	< 0.00002	0.00002	mg/L							
Reference (B6F1569-SRM1)				Prepared: 2016-06-23, Analyzed: 2016-06-28						
Mercury, dissolved	0.00374	0.00002	mg/L	0.00456		82	50-150			
Dissolved Metals, Batch B6F1583										
Blank (B6F1583-BLK1)				Prepared: 2016-06-24, Analyzed: 2016-06-24						
Aluminum, dissolved	< 0.05	0.05	mg/L							
Antimony, dissolved	< 0.001	0.001	mg/L							
Arsenic, dissolved	< 0.005	0.005	mg/L							
Barium, dissolved	< 0.05	0.05	mg/L							
Beryllium, dissolved	< 0.001	0.001	mg/L							
Bismuth, dissolved	< 0.001	0.001	mg/L							
Boron, dissolved	< 0.04	0.04	mg/L							
Cadmium, dissolved	< 0.0001	0.0001	mg/L							
Calcium, dissolved	< 2.0	2.0	mg/L							
Chromium, dissolved	< 0.005	0.005	mg/L							
Cobalt, dissolved	< 0.0005	0.0005	mg/L							
Copper, dissolved	< 0.002	0.002	mg/L							
Iron, dissolved	< 0.10	0.10	mg/L							
Lead, dissolved	< 0.001	0.001	mg/L							
Lithium, dissolved	< 0.001	0.001	mg/L							
Magnesium, dissolved	< 0.1	0.1	mg/L							
Manganese, dissolved	< 0.002	0.002	mg/L							
Molybdenum, dissolved	< 0.001	0.001	mg/L							
Nickel, dissolved	< 0.002	0.002	mg/L							
Phosphorus, dissolved	< 0.2	0.2	mg/L							
Potassium, dissolved	< 0.2	0.2	mg/L							
Selenium, dissolved	< 0.005	0.005	mg/L							
Silicon, dissolved	< 5	5	mg/L							
Silver, dissolved	< 0.0005	0.0005	mg/L							
Sodium, dissolved	< 0.2	0.2	mg/L							
Strontium, dissolved	< 0.01	0.01	mg/L							
Sulfur, dissolved	< 10	10	mg/L							
Tellurium, dissolved	< 0.002	0.002	mg/L							
Thallium, dissolved	< 0.0002	0.0002	mg/L							
Thorium, dissolved	< 0.001	0.001	mg/L							
Tin, dissolved	< 0.002	0.002	mg/L							

REPORTED TO Piteau Associates Engineering Ltd. (Kelowna)
PROJECT 3583

WORK ORDER 6061747
REPORTED 2016-06-29

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
Dissolved Metals, Batch B6F1583, Continued										
Blank (B6F1583-BLK1), Continued				Prepared: 2016-06-24, Analyzed: 2016-06-24						
Titanium, dissolved	< 0.05	0.05	mg/L							
Uranium, dissolved	< 0.0002	0.0002	mg/L							
Vanadium, dissolved	< 0.01	0.01	mg/L							
Zinc, dissolved	< 0.04	0.04	mg/L							
Zirconium, dissolved	< 0.001	0.001	mg/L							
Matrix Spike (B6F1583-MS1)		**Source: 6061747-01**		Prepared: 2016-06-24, Analyzed: 2016-06-24						
Antimony, dissolved	0.395	0.001	mg/L	0.400	< 0.001	99	71-112			
Arsenic, dissolved	0.209	0.005	mg/L	0.200	< 0.005	104	82-112			
Barium, dissolved	1.13	0.05	mg/L	1.00	0.12	102	80-109			
Beryllium, dissolved	0.103	0.001	mg/L	0.100	< 0.001	103	75-111			
Cadmium, dissolved	0.103	0.0001	mg/L	0.100	< 0.0001	103	84-109			
Chromium, dissolved	0.415	0.005	mg/L	0.400	< 0.005	103	87-115			
Cobalt, dissolved	0.405	0.0005	mg/L	0.400	< 0.0005	101	85-118			
Copper, dissolved	0.420	0.002	mg/L	0.400	0.002	105	84-121			
Iron, dissolved	2.03	0.10	mg/L	2.00	0.18	93	71-129			
Lead, dissolved	0.174	0.001	mg/L	0.200	< 0.001	87	81-111			
Manganese, dissolved	0.379	0.002	mg/L	0.400	0.016	91	66-125			
Nickel, dissolved	0.411	0.002	mg/L	0.400	0.003	102	85-115			
Selenium, dissolved	0.111	0.005	mg/L	0.100	< 0.005	109	77-113			
Silver, dissolved	0.102	0.0005	mg/L	0.100	< 0.0005	102	52-131			
Thallium, dissolved	0.107	0.0002	mg/L	0.100	< 0.0002	107	82-111			
Vanadium, dissolved	0.45	0.01	mg/L	0.400	< 0.01	111	85-111			
Zinc, dissolved	0.61	0.04	mg/L	0.600	< 0.04	101	85-115			
Reference (B6F1583-SRM1)				Prepared: 2016-06-24, Analyzed: 2016-06-24						
Aluminum, dissolved	0.20	0.05	mg/L	0.233		87	58-142			
Antimony, dissolved	0.048	0.001	mg/L	0.0430		113	75-125			
Arsenic, dissolved	0.447	0.005	mg/L	0.438		102	81-119			
Barium, dissolved	3.64	0.05	mg/L	3.35		109	83-117			
Beryllium, dissolved	0.219	0.001	mg/L	0.213		103	80-120			
Boron, dissolved	1.75	0.04	mg/L	1.74		100	74-117			
Cadmium, dissolved	0.237	0.0001	mg/L	0.224		106	83-117			
Calcium, dissolved	7.6	2.0	mg/L	7.69		98	76-124			
Chromium, dissolved	0.456	0.005	mg/L	0.437		104	81-119			
Cobalt, dissolved	0.135	0.0005	mg/L	0.128		106	76-124			
Copper, dissolved	0.928	0.002	mg/L	0.844		110	84-116			
Iron, dissolved	1.24	0.10	mg/L	1.29		96	74-126			
Lead, dissolved	0.103	0.001	mg/L	0.112		92	72-128			
Lithium, dissolved	0.112	0.001	mg/L	0.104		108	60-140			
Magnesium, dissolved	6.6	0.1	mg/L	6.92		95	81-119			
Manganese, dissolved	0.322	0.002	mg/L	0.345		93	84-116			
Molybdenum, dissolved	0.448	0.001	mg/L	0.426		105	83-117			
Nickel, dissolved	0.892	0.002	mg/L	0.840		106	74-126			
Phosphorus, dissolved	0.4	0.2	mg/L	0.495		75	68-132			
Potassium, dissolved	3.1	0.2	mg/L	3.19		96	74-126			
Selenium, dissolved	0.035	0.005	mg/L	0.0331		107	70-130			
Sodium, dissolved	17.8	0.2	mg/L	19.1		93	72-128			
Strontium, dissolved	0.98	0.01	mg/L	0.916		107	84-113			
Thallium, dissolved	0.0429	0.0002	mg/L	0.0393		109	57-143			
Uranium, dissolved	0.243	0.0002	mg/L	0.266		91	85-115			
Vanadium, dissolved	0.89	0.01	mg/L	0.869		103	87-113			
Zinc, dissolved	0.91	0.04	mg/L	0.881		103	72-128			
General Parameters, Batch B6F1364										

REPORTED TO Piteau Associates Engineering Ltd. (Kelowna)
PROJECT 3583

WORK ORDER 6061747
REPORTED 2016-06-29

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
General Parameters, Batch B6F1364, Continued										
Blank (B6F1364-BLK1)				Prepared: 2016-06-22, Analyzed: 2016-06-22						
Alkalinity, Total (as CaCO3)	< 1	2	mg/L							
Alkalinity, Phenolphthalein (as CaCO3)	< 1	2	mg/L							
Alkalinity, Bicarbonate (as CaCO3)	< 1	2	mg/L							
Alkalinity, Carbonate (as CaCO3)	< 1	2	mg/L							
Alkalinity, Hydroxide (as CaCO3)	< 1	2	mg/L							
Conductivity (EC)	< 2	2	µS/cm							
LCS (B6F1364-BS1)				Prepared: 2016-06-22, Analyzed: 2016-06-22						
Alkalinity, Total (as CaCO3)	99	2	mg/L	100		99	96-108			
LCS (B6F1364-BS2)				Prepared: 2016-06-22, Analyzed: 2016-06-22						
Conductivity (EC)	1390	2	µS/cm	1410		99	95-104			
Reference (B6F1364-SRM1)				Prepared: 2016-06-22, Analyzed: 2016-06-22						
pH	6.95	0.01	pH units	7.00		99	98-102			
General Parameters, Batch B6F1366										
Blank (B6F1366-BLK1)				Prepared: 2016-06-24, Analyzed: 2016-06-24						
Ammonia, Total (as N)	< 0.020	0.020	mg/L							
Blank (B6F1366-BLK2)				Prepared: 2016-06-24, Analyzed: 2016-06-24						
Ammonia, Total (as N)	< 0.020	0.020	mg/L							
LCS (B6F1366-BS1)				Prepared: 2016-06-24, Analyzed: 2016-06-24						
Ammonia, Total (as N)	1.00	0.020	mg/L	1.00		100	86-111			
LCS (B6F1366-BS2)				Prepared: 2016-06-24, Analyzed: 2016-06-24						
Ammonia, Total (as N)	1.04	0.020	mg/L	1.00		104	86-111			
General Parameters, Batch B6F1456										
Blank (B6F1456-BLK1)				Prepared: 2016-06-22, Analyzed: 2016-06-22						
Solids, Total Suspended	< 1	2	mg/L							
LCS (B6F1456-BS1)				Prepared: 2016-06-22, Analyzed: 2016-06-22						
Solids, Total Suspended	49	2	mg/L	50.0		98	85-110			
Reference (B6F1456-SRM1)				Prepared: 2016-06-22, Analyzed: 2016-06-22						
Solids, Total Suspended	430	2	mg/L	459		94	80-120			
General Parameters, Batch B6F1558										
Blank (B6F1558-BLK1)				Prepared: 2016-06-23, Analyzed: 2016-06-24						
Phosphorus, Total (as P)	< 0.002	0.002	mg/L							
Blank (B6F1558-BLK2)				Prepared: 2016-06-23, Analyzed: 2016-06-24						
Phosphorus, Total (as P)	< 0.002	0.002	mg/L							
Blank (B6F1558-BLK3)				Prepared: 2016-06-23, Analyzed: 2016-06-24						
Phosphorus, Total (as P)	< 0.002	0.002	mg/L							
LCS (B6F1558-BS1)				Prepared: 2016-06-23, Analyzed: 2016-06-24						
Phosphorus, Total (as P)	0.092	0.002	mg/L	0.100		92	75-112			

REPORTED TO Piteau Associates Engineering Ltd. (Kelowna)
PROJECT 3583

WORK ORDER 6061747
REPORTED 2016-06-29

Analyte	Result	MRL	Units	Spike Level	Source Result	% REC	REC Limit	% RPD	RPD Limit	Notes
General Parameters, Batch B6F1558, Continued										
LCS (B6F1558-BS2)				Prepared: 2016-06-23, Analyzed: 2016-06-24						
Phosphorus, Total (as P)	0.096	0.002	mg/L	0.100		96	75-112			
LCS (B6F1558-BS3)				Prepared: 2016-06-23, Analyzed: 2016-06-24						
Phosphorus, Total (as P)	0.099	0.002	mg/L	0.100		99	75-112			
General Parameters, Batch B6F1568										
Blank (B6F1568-BLK1)				Prepared: 2016-06-23, Analyzed: 2016-06-23						
Solids, Total Dissolved	< 10	10	mg/L							
Reference (B6F1568-SRM1)				Prepared: 2016-06-23, Analyzed: 2016-06-23						
Solids, Total Dissolved	228	10	mg/L	240		95	85-115			
General Parameters, Batch B6F1642										
Blank (B6F1642-BLK1)				Prepared: 2016-06-24, Analyzed: 2016-06-27						
Nitrogen, Total Kjeldahl	< 0.05	0.05	mg/L							
Blank (B6F1642-BLK2)				Prepared: 2016-06-24, Analyzed: 2016-06-27						
Nitrogen, Total Kjeldahl	< 0.05	0.05	mg/L							
LCS (B6F1642-BS1)				Prepared: 2016-06-24, Analyzed: 2016-06-27						
Nitrogen, Total Kjeldahl	10.8	0.05	mg/L	10.0		108	80-120			
LCS (B6F1642-BS2)				Prepared: 2016-06-24, Analyzed: 2016-06-27						
Nitrogen, Total Kjeldahl	10.4	0.05	mg/L	10.0		104	80-120			
Duplicate (B6F1642-DUP2)			**Source: 6061747-01**	Prepared: 2016-06-24, Analyzed: 2016-06-27						
Nitrogen, Total Kjeldahl	0.44	0.05	mg/L		0.39			13	16	
Matrix Spike (B6F1642-MS2)			**Source: 6061747-01**	Prepared: 2016-06-24, Analyzed: 2016-06-27						
Nitrogen, Total Kjeldahl	1.04	0.05	mg/L	1.00	0.39	65	65-135			

APPENDIX 3: REVISION HISTORY

REPORTED TO	Piteau Associates Engineering Ltd. (Kelowna)	**WORK ORDER**	6061747
PROJECT	3583	**REPORTED**	2016-06-29

Sample ID	Changed	Change	Analysis	Analyte(s)
6061747-01	2016-06-29	Sample ID	N/A	N/A

Maxxam
A Bureau Veritas Group Company

Success Through Science®

Your Project #: STH WELL MONITORING
Site Location: SUMMERLAND TROUT, HATCHERY SPRING
Requisition Form # .
Client Code # ty
Your C.O.C. #: 08422768

Attention:KIRSTIN GALE

FRESHWATER FISHERIES SOCIETY OF BC
ABBOTSFORD (ty)
34345 VYE ROAD
ABBOTSFORD, BC
CANADA V2S 7P6

Report Date: 2016/06/30
Report #: R2208672
Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B643286
Received: 2016/06/02, 11:30

Sample Matrix: Water
Samples Received: 1

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Alkalinity - Water	1	2016/06/03	2016/06/03	BBY6SOP-00026	SM 22 2320 B m
Temperature at Arrival	1	N/A	2016/06/03		
Chloride by Automated Colourimetry	1	N/A	2016/06/06	BBY6SOP-00011	SM 22 4500-Cl- E m
Conductance - water	1	N/A	2016/06/03	BBY6SOP-00026	SM 22 2510 B m
Hardness Total (calculated as CaCO3)	1	N/A	2016/06/06	BBY WI-00033	Auto Calc
Hardness (calculated as CaCO3)	1	N/A	2016/06/07	BBY WI-00033	Auto Calc
Bromide as Bromine (Br) by ICPMS	1	N/A	2016/06/06	BBY7SOP-00002	EPA 6020B R2 m
Na, K, Ca, Mg, S by CRC ICPMS (diss.)	1	N/A	2016/06/07	BBY7SOP-00002	EPA 6020B R2 m
Elements by ICPMS Low Level (dissolved)	1	N/A	2016/06/06	BBY7SOP-00002	EPA 6020B R2 m
Na, K, Ca, Mg, S by CRC ICPMS (total)	1	N/A	2016/06/06	BBY7SOP-00003,	BCLM2005,EPA6020bR2m
Elements by ICPMS Low Level (total)	1	N/A	2016/06/04	BBY7SOP-00003,	BCLM2005,EPA6020bR2m
Nitrogen (Total)	1	2016/06/06	2016/06/07	BBY6SOP-00016	SM 22 4500-N C m
Ammonia-N (Preserved)	1	N/A	2016/06/03	BBY6SOP-00009	SM 22 4500-NH3- G m
Nitrate+Nitrite (N) (low level)	1	N/A	2016/06/03	BBY6SOP-00010	SM 22 4500-NO3- I m
Nitrite (N) (low level)	1	N/A	2016/06/03	BBY6SOP-00010	SM 22 4500-NO3- I m
Nitrogen - Nitrate (as N)	1	N/A	2016/06/03	BBY6SOP-00010	SM 22 4500-NO3- I m
Nitrogen (Organic) (Cal. TKN, NH4,N/N)	1	N/A	2016/06/07	BBY WI-00033	Auto Calc
Filter and HNO3 Preserve for Metals	1	N/A	2016/06/06	BBY7 WI-00004	BCMOE Reqs 08/14
pH Water (1)	1	N/A	2016/06/03	BBY6SOP-00026	SM 22 4500-H+ B m
Orthophosphate by Konelab (low level)	1	N/A	2016/06/03	BBY6SOP-00013	SM 22 4500-P E m
Sulphate by Automated Colourimetry	1	N/A	2016/06/06	BBY6SOP-00017	SM 22 4500-SO42- E m
Sampling Range	1	N/A	2016/06/03		
Total Dissolved Solids (Filt. Residue)	1	2016/06/04	2016/06/06	BBY6SOP-00033	SM 22 2540 C m
TKN (Calc. TN, N/N) total	1	N/A	2016/06/07	BBY WI-00033	Calculation
Phosphorus-P (LL Tot, dissolved) - UF/UP	1	2016/06/04	2016/06/04	BBY6SOP-00013	SM 22 4500-P E m
Total Phosphorus - unpreserved	1	N/A	2016/06/04	BBY6SOP-00013	SM 22 4500-P E m
Total Suspended Solids	1	2016/06/06	2016/06/07	BBY6SOP-00034	SM 22 2540 D

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Your Project #: STH WELL MONITORING
Site Location: SUMMERLAND TROUT, HATCHERY SPRING
Requisition Form # .
Client Code # ty
Your C.O.C. #: 08422768

Attention:KIRSTIN GALE

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ABBOTSFORD (ty)
34345 VYE ROAD
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Report Date: 2016/06/30
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Version: 2 - Revision

CERTIFICATE OF ANALYSIS – REVISED REPORT

MAXXAM JOB #: B643286

Received: 2016/06/02, 11:30

(1) The BC-MOE and APHA Standard Method require pH to be analysed within 15 minutes of sampling and therefore field analysis is required for compliance. All Laboratory pH analyses in this report are reported past the BC-MOE/APHA Standard Method holding time.

Encryption Key

Please direct all questions regarding this Certificate of Analysis to your Project Manager.
Morgan Melnychuk, Burnaby Project Manager
Email: MMelnychuk@maxxam.ca
Phone# (604)638-8034 Ext:8034

==========

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

Maxxam Job #: B643286
Report Date: 2016/06/30

FRESHWATER FISHERIES SOCIETY OF BC
Client Project #: STH WELL MONITORING
Site Location: SUMMERLAND TROUT, HATCHERY SPRING
Sampler Initials: LC

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		OT0696		
Sampling Date		2016/06/01 11:25		
COC Number		08422768		
	UNITS	STH SPRING (EMS 0500323)	RDL	QC Batch
Field Parameters				
Sample End Date	N/A	20160601	N/A	8286950
Sample End Time	N/A	11:25	N/A	8286950
Sample Start Date	N/A	20160601	N/A	8286950
Sample Start Time	N/A	11:25	N/A	8286950
Temperature at Arrival	C	7		8286944
Calculated Parameters				
Filter and HNO3 Preservation	N/A	LAB	N/A	8287146
Total Hardness (CaCO3)	mg/L	281	0.50	8286176
Nitrate (N)	mg/L	3.83	0.0020	8286242
Misc. Inorganics				
Dissolved Hardness (CaCO3)	mg/L	284	0.50	8286070
Alkalinity (Total as CaCO3)	mg/L	218	0.50	8287646
Alkalinity (PP as CaCO3)	mg/L	<0.50	0.50	8287646
Bicarbonate (HCO3)	mg/L	266	0.50	8287646
Carbonate (CO3)	mg/L	<0.50	0.50	8287646
Hydroxide (OH)	mg/L	<0.50	0.50	8287646
Anions				
Orthophosphate (P)	mg/L	0.0088	0.0010	8288171
Dissolved Sulphate (SO4)	mg/L	42.6	0.50	8289911
Dissolved Chloride (Cl)	mg/L	31	0.50	8289694
Nutrients				
Total Kjeldahl Nitrogen (Calc)	mg/L	<0.10	0.10	8286288
Total Organic Nitrogen (N)	mg/L	<0.10	0.10	8286664
Dissolved Phosphorus (P)	mg/L	0.0097	0.0020	8288630
Total Ammonia (N)	mg/L	0.012	0.0050	8288155
Nitrate plus Nitrite (N)	mg/L	3.83	0.0020	8288055
Nitrite (N)	mg/L	<0.0020	0.0020	8288058
Total Nitrogen (N)	mg/L	3.79 (1)	0.10	8290016

RDL = Reportable Detection Limit
N/A = Not Applicable
(1) Detection limits raised due to dilution to bring analyte within the calibrated range.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B643286
Report Date: 2016/06/30

FRESHWATER FISHERIES SOCIETY OF BC
Client Project #: STH WELL MONITORING
Site Location: SUMMERLAND TROUT, HATCHERY SPRING
Sampler Initials: LC

RESULTS OF CHEMICAL ANALYSES OF WATER

Maxxam ID		OT0696		
Sampling Date		2016/06/01 11:25		
COC Number		08422768		
	UNITS	**STH SPRING (EMS 0500323)**	**RDL**	**QC Batch**
Total Phosphorus (P)	mg/L	0.0115	0.0020	8288632
Physical Properties				
Conductivity	uS/cm	634	1.0	8287644
pH	pH	8.15		8287641
Physical Properties				
Total Suspended Solids	mg/L	<4.0	4.0	8289331
Total Dissolved Solids	mg/L	350	10	8288507
RDL = Reportable Detection Limit				

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B643286
Report Date: 2016/06/30

FRESHWATER FISHERIES SOCIETY OF BC
Client Project #: STH WELL MONITORING
Site Location: SUMMERLAND TROUT, HATCHERY SPRING
Sampler Initials: LC

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		OT0696		
Sampling Date		2016/06/01 11:25		
COC Number		08422768		
	UNITS	STH SPRING (EMS 0500323)	RDL	QC Batch
ANIONS				
Bromide (Br)	mg/L	<0.10 (1)	0.10	8281440
Dissolved Metals by ICPMS				
Dissolved Aluminum (Al)	ug/L	1.19	0.50	8287481
Dissolved Antimony (Sb)	ug/L	0.036	0.020	8287481
Dissolved Arsenic (As)	ug/L	0.786	0.020	8287481
Dissolved Barium (Ba)	ug/L	92.5	0.020	8287481
Dissolved Beryllium (Be)	ug/L	<0.010	0.010	8287481
Dissolved Bismuth (Bi)	ug/L	<0.0050	0.0050	8287481
Dissolved Boron (B)	ug/L	37	10	8287481
Dissolved Cadmium (Cd)	ug/L	0.0690	0.0050	8287481
Dissolved Chromium (Cr)	ug/L	0.62	0.10	8287481
Dissolved Cobalt (Co)	ug/L	0.0410	0.0050	8287481
Dissolved Copper (Cu)	ug/L	1.51	0.050	8287481
Dissolved Iron (Fe)	ug/L	<1.0	1.0	8287481
Dissolved Lead (Pb)	ug/L	0.0260	0.0050	8287481
Dissolved Lithium (Li)	ug/L	7.80	0.50	8287481
Dissolved Manganese (Mn)	ug/L	0.228	0.050	8287481
Dissolved Molybdenum (Mo)	ug/L	16.6	0.050	8287481
Dissolved Nickel (Ni)	ug/L	0.392	0.020	8287481
Dissolved Selenium (Se)	ug/L	1.22	0.040	8287481
Dissolved Silver (Ag)	ug/L	<0.0050	0.0050	8287481
Dissolved Strontium (Sr)	ug/L	766	0.050	8287481
Dissolved Thallium (Tl)	ug/L	0.0030	0.0020	8287481
Dissolved Tin (Sn)	ug/L	<0.20	0.20	8287481
Dissolved Uranium (U)	ug/L	21.9	0.0020	8287481
Dissolved Vanadium (V)	ug/L	1.29	0.20	8287481
Dissolved Zinc (Zn)	ug/L	1.88 (2)	0.10	8287481
Dissolved Calcium (Ca)	mg/L	86.4	0.050	8286317
Dissolved Magnesium (Mg)	mg/L	16.6	0.050	8286317

RDL = Reportable Detection Limit
(1) RDL raised due to sample matrix interference.
(2) Dissolved greater than total. Reanalysis yields similar results.

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Maxxam Job #: B643286
Report Date: 2016/06/30

FRESHWATER FISHERIES SOCIETY OF BC
Client Project #: STH WELL MONITORING
Site Location: SUMMERLAND TROUT, HATCHERY SPRING
Sampler Initials: LC

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		OT0696		
Sampling Date		2016/06/01 11:25		
COC Number		08422768		
	UNITS	**STH SPRING (EMS 0500323)**	**RDL**	**QC Batch**
Dissolved Potassium (K)	mg/L	4.25	0.050	8286317
Dissolved Sodium (Na)	mg/L	24.3	0.050	8286317
Total Metals by ICPMS				
Total Aluminum (Al)	ug/L	13.1	0.50	8287232
Total Antimony (Sb)	ug/L	0.041	0.020	8287232
Total Arsenic (As)	ug/L	0.823	0.020	8287232
Total Barium (Ba)	ug/L	85.9	0.020	8287232
Total Beryllium (Be)	ug/L	<0.010	0.010	8287232
Total Bismuth (Bi)	ug/L	0.0120	0.0050	8287232
Total Boron (B)	ug/L	41	10	8287232
Total Cadmium (Cd)	ug/L	0.0570	0.0050	8287232
Total Chromium (Cr)	ug/L	0.62	0.10	8287232
Total Cobalt (Co)	ug/L	0.0550	0.0050	8287232
Total Copper (Cu)	ug/L	1.34	0.050	8287232
Total Iron (Fe)	ug/L	21.1	1.0	8287232
Total Lead (Pb)	ug/L	0.0470	0.0050	8287232
Total Lithium (Li)	ug/L	7.13	0.50	8287232
Total Manganese (Mn)	ug/L	0.654	0.050	8287232
Total Molybdenum (Mo)	ug/L	16.5	0.050	8287232
Total Nickel (Ni)	ug/L	0.388	0.020	8287232
Total Selenium (Se)	ug/L	1.29	0.040	8287232
Total Silver (Ag)	ug/L	<0.0050	0.0050	8287232
Total Strontium (Sr)	ug/L	709	0.050	8287232
Total Thallium (Tl)	ug/L	0.0020	0.0020	8287232
Total Tin (Sn)	ug/L	<0.20	0.20	8287232
Total Uranium (U)	ug/L	21.1	0.0020	8287232
Total Vanadium (V)	ug/L	1.38	0.20	8287232
Total Zinc (Zn)	ug/L	1.26	0.10	8287232
Total Calcium (Ca)	mg/L	87.4	0.050	8286663
Total Magnesium (Mg)	mg/L	15.1	0.050	8286663
Total Potassium (K)	mg/L	3.86	0.050	8286663
RDL = Reportable Detection Limit				

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Maxxam Job #: B643286
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FRESHWATER FISHERIES SOCIETY OF BC
Client Project #: STH WELL MONITORING
Site Location: SUMMERLAND TROUT, HATCHERY SPRING
Sampler Initials: LC

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

Maxxam ID		OT0696		
Sampling Date		2016/06/01 11:25		
COC Number		08422768		
	UNITS	**STH SPRING (EMS 0500323)**	**RDL**	**QC Batch**
Total Sodium (Na)	mg/L	23.1	0.050	8286663
RDL = Reportable Detection Limit				

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Maxxam Job #: B643286
Report Date: 2016/06/30

FRESHWATER FISHERIES SOCIETY OF BC
Client Project #: STH WELL MONITORING
Site Location: SUMMERLAND TROUT, HATCHERY SPRING
Sampler Initials: LC

GENERAL COMMENTS

Revised report V2 (2016/06/29): Per client request, report includes Total and Dissolved Sodium and Potassium (MM4).

Results relate only to the items tested.

Maxxam Analytics International Corporation o/a Maxxam Analytics Burnaby: 4606 Canada Way V5G 1K5 Telephone(604) 734-7276 Fax(604) 731-2386

Maxxam Job #: B643286
Report Date: 2016/06/30

QUALITY ASSURANCE REPORT

FRESHWATER FISHERIES SOCIETY OF BC
Client Project #: STH WELL MONITORING
Site Location: SUMMERLAND TROUT, HATCHERY SPRING
Sampler Initials: LC

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8281440	Bromide (Br)	2016/06/06	96	78 - 120	97	80 - 120	<0.010	mg/L	NC	20
8287232	Total Aluminum (Al)	2016/06/03	112	80 - 120	110	80 - 120	<0.50	ug/L	NC	20
8287232	Total Antimony (Sb)	2016/06/03	107	80 - 120	104	80 - 120	<0.020	ug/L	NC	20
8287232	Total Arsenic (As)	2016/06/03	109	80 - 120	110	80 - 120	<0.020	ug/L	NC	20
8287232	Total Barium (Ba)	2016/06/03	107	80 - 120	103	80 - 120	<0.020	ug/L	NC	20
8287232	Total Beryllium (Be)	2016/06/03	112	80 - 120	111	80 - 120	<0.010	ug/L	NC	20
8287232	Total Bismuth (Bi)	2016/06/03	104	80 - 120	106	80 - 120	<0.0050	ug/L	NC	20
8287232	Total Boron (B)	2016/06/03	108	80 - 120	109	80 - 120	<10	ug/L	NC	20
8287232	Total Cadmium (Cd)	2016/06/03	107	80 - 120	106	80 - 120	<0.0050	ug/L	NC	20
8287232	Total Chromium (Cr)	2016/06/03	107	80 - 120	108	80 - 120	<0.10	ug/L	NC	20
8287232	Total Cobalt (Co)	2016/06/03	108	80 - 120	108	80 - 120	<0.0050	ug/L	NC	20
8287232	Total Copper (Cu)	2016/06/03	108	80 - 120	109	80 - 120	<0.050	ug/L	NC	20
8287232	Total Iron (Fe)	2016/06/03	115	80 - 120	114	80 - 120	<1.0	ug/L	NC	20
8287232	Total Lead (Pb)	2016/06/03	104	80 - 120	106	80 - 120	<0.0050	ug/L	NC	20
8287232	Total Lithium (Li)	2016/06/03	97	80 - 120	97	80 - 120	<0.50	ug/L	NC	20
8287232	Total Manganese (Mn)	2016/06/03	103	80 - 120	105	80 - 120	<0.050	ug/L	NC	20
8287232	Total Molybdenum (Mo)	2016/06/03	103	80 - 120	104	80 - 120	<0.050	ug/L	NC	20
8287232	Total Nickel (Ni)	2016/06/03	107	80 - 120	108	80 - 120	<0.020	ug/L	NC	20
8287232	Total Selenium (Se)	2016/06/03	110	80 - 120	104	80 - 120	<0.040	ug/L	NC	20
8287232	Total Silver (Ag)	2016/06/03	107	80 - 120	97	80 - 120	<0.0050	ug/L	NC	20
8287232	Total Strontium (Sr)	2016/06/03	99	80 - 120	100	80 - 120	<0.050	ug/L	NC	20
8287232	Total Thallium (Tl)	2016/06/03	106	80 - 120	109	80 - 120	<0.0020	ug/L	NC	20
8287232	Total Tin (Sn)	2016/06/03	107	80 - 120	108	80 - 120	<0.20	ug/L	NC	20
8287232	Total Uranium (U)	2016/06/03	102	80 - 120	103	80 - 120	<0.0020	ug/L	NC	20
8287232	Total Vanadium (V)	2016/06/03	107	80 - 120	107	80 - 120	<0.20	ug/L	NC	20
8287232	Total Zinc (Zn)	2016/06/03	115	80 - 120	113	80 - 120	<0.10	ug/L	NC	20
8287481	Dissolved Aluminum (Al)	2016/06/06	109	80 - 120	111	80 - 120	<0.50	ug/L	1.8	20
8287481	Dissolved Antimony (Sb)	2016/06/06	102	80 - 120	103	80 - 120	<0.020	ug/L	NC	20
8287481	Dissolved Arsenic (As)	2016/06/06	104	80 - 120	105	80 - 120	<0.020	ug/L	1.9	20
8287481	Dissolved Barium (Ba)	2016/06/06	NC	80 - 120	103	80 - 120	<0.020	ug/L	1.1	20
8287481	Dissolved Beryllium (Be)	2016/06/06	99	80 - 120	101	80 - 120	<0.010	ug/L	NC	20

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Maxxam Job #: B643286
Report Date: 2016/06/30

QUALITY ASSURANCE REPORT(CONT'D)

FRESHWATER FISHERIES SOCIETY OF BC
Client Project #: STH WELL MONITORING
Site Location: SUMMERLAND TROUT, HATCHERY SPRING
Sampler Initials: LC

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8287481	Dissolved Bismuth (Bi)	2016/06/06	102	80 - 120	105	80 - 120	<0.0050	ug/L	NC	20
8287481	Dissolved Boron (B)	2016/06/06	NC	80 - 120	97	80 - 120	<10	ug/L	2.5	20
8287481	Dissolved Cadmium (Cd)	2016/06/06	101	80 - 120	101	80 - 120	<0.0050	ug/L	NC	20
8287481	Dissolved Chromium (Cr)	2016/06/06	101	80 - 120	102	80 - 120	<0.10	ug/L	NC	20
8287481	Dissolved Cobalt (Co)	2016/06/06	100	80 - 120	103	80 - 120	<0.0050	ug/L	NC	20
8287481	Dissolved Copper (Cu)	2016/06/06	100	80 - 120	104	80 - 120	<0.050	ug/L	4.0	20
8287481	Dissolved Iron (Fe)	2016/06/06	NC	80 - 120	110	80 - 120	<1.0	ug/L	0.74	20
8287481	Dissolved Lead (Pb)	2016/06/06	101	80 - 120	102	80 - 120	<0.0050	ug/L	3.8	20
8287481	Dissolved Lithium (Li)	2016/06/06	NC	80 - 120	102	80 - 120	<0.50	ug/L	5.9	20
8287481	Dissolved Manganese (Mn)	2016/06/06	NC	80 - 120	103	80 - 120	<0.050	ug/L	0.75	20
8287481	Dissolved Molybdenum (Mo)	2016/06/06	NC	80 - 120	100	80 - 120	<0.050	ug/L	1.7	20
8287481	Dissolved Nickel (Ni)	2016/06/06	100	80 - 120	104	80 - 120	<0.020	ug/L	0.99	20
8287481	Dissolved Selenium (Se)	2016/06/06	97	80 - 120	100	80 - 120	<0.040	ug/L	NC	20
8287481	Dissolved Silver (Ag)	2016/06/06	119	80 - 120	97	80 - 120	<0.0050	ug/L	NC	20
8287481	Dissolved Strontium (Sr)	2016/06/06	NC	80 - 120	98	80 - 120	<0.050	ug/L	3.6	20
8287481	Dissolved Thallium (Tl)	2016/06/06	105	80 - 120	109	80 - 120	<0.0020	ug/L	NC	20
8287481	Dissolved Tin (Sn)	2016/06/06	104	80 - 120	106	80 - 120	<0.20	ug/L	NC	20
8287481	Dissolved Uranium (U)	2016/06/06	99	80 - 120	98	80 - 120	<0.0020	ug/L	0.83	20
8287481	Dissolved Vanadium (V)	2016/06/06	NC	80 - 120	101	80 - 120	<0.20	ug/L	1.1	20
8287481	Dissolved Zinc (Zn)	2016/06/06	NC	80 - 120	111	80 - 120	<0.10	ug/L	3.1	20
8287641	pH	2016/06/03			102	97 - 103			0.13	N/A
8287644	Conductivity	2016/06/03			100	80 - 120	<1.0	uS/cm	0	20
8287646	Alkalinity (PP as CaCO3)	2016/06/03					<0.50	mg/L	NC	20
8287646	Alkalinity (Total as CaCO3)	2016/06/03	NC	80 - 120	95	80 - 120	<0.50	mg/L	2.0	20
8287646	Bicarbonate (HCO3)	2016/06/03					<0.50	mg/L	2.0	20
8287646	Carbonate (CO3)	2016/06/03					<0.50	mg/L	NC	20
8287646	Hydroxide (OH)	2016/06/03					<0.50	mg/L	NC	20
8288055	Nitrate plus Nitrite (N)	2016/06/03	107	80 - 120	106	80 - 120	<0.0020	mg/L	4.5	25
8288058	Nitrite (N)	2016/06/03	101	80 - 120	99	80 - 120	<0.0020	mg/L	NC	25
8288155	Total Ammonia (N)	2016/06/03	95	80 - 120	99	80 - 120	<0.0050	mg/L	NC	20
8288171	Orthophosphate (P)	2016/06/03	90	80 - 120	90	80 - 120	<0.0010	mg/L	NC	20

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Maxxam Job #: B643286
Report Date: 2016/06/30

QUALITY ASSURANCE REPORT(CONT'D)

FRESHWATER FISHERIES SOCIETY OF BC
Client Project #: STH WELL MONITORING
Site Location: SUMMERLAND TROUT, HATCHERY SPRING
Sampler Initials: LC

			Matrix Spike		Spiked Blank		Method Blank		RPD	
QC Batch	Parameter	Date	% Recovery	QC Limits	% Recovery	QC Limits	Value	UNITS	Value (%)	QC Limits
8288507	Total Dissolved Solids	2016/06/06	103	80 - 120	100	80 - 120	<10	mg/L	4.9	20
8288630	Dissolved Phosphorus (P)	2016/06/04	91	80 - 120	108	80 - 120	0.0022, RDL=0.0020	mg/L	NC	20
8288632	Total Phosphorus (P)	2016/06/04	87	80 - 120	108	80 - 120	0.0022, RDL=0.0020	mg/L	NC	20
8289331	Total Suspended Solids	2016/06/07	100	80 - 120	95	80 - 120	<4.0	mg/L	NC	20
8289694	Dissolved Chloride (Cl)	2016/06/06	104	80 - 120	98	80 - 120	<0.50	mg/L	4.4	20
8289911	Dissolved Sulphate (SO4)	2016/06/06	NC	80 - 120	96	80 - 120	0.58, RDL=0.50	mg/L	1.5	20
8290016	Total Nitrogen (N)	2016/06/07	NC	80 - 120	96	80 - 120	<0.020	mg/L	0.63	20

N/A = Not Applicable

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

Spiked Blank: A blank matrix sample to which a known amount of the analyte, usually from a second source, has been added. Used to evaluate method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spiked amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than 2x that of the native sample concentration).

NC (Duplicate RPD): The duplicate RPD was not calculated. The concentration in the sample and/or duplicate was too low to permit a reliable RPD calculation (one or both samples < 5x RDL).

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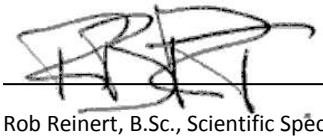
FRESHWATER FISHERIES SOCIETY OF BC
Client Project #: STH WELL MONITORING
Site Location: SUMMERLAND TROUT, HATCHERY SPRING
Sampler Initials: LC

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by the following individual(s).



Rob Reinert, B.Sc., Scientific Specialist

Maxxam has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per section 5.10.2 of ISO/IEC 17025:2005(E), signing the reports. For Service Group specific validation please refer to the Validation Signature Page.

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A Bureau Veritas Group Company

Burnaby: 4606 Canada Way, Burnaby, BC V5G 1K5. Toll Free (800) 665-8566

CHAIN OF CUSTODY RECORD

COC 08422768

BBY FCD-00077/05

Page 1 of 1

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: Freshwater Fisheries	Company Name:	Quotation #: B50557	X Regular TAT 5 days (Most analyses)
Contact Name: Kirstin Gale	Contact Name:	P.O. #/ AFE#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address: 34345 Vye Road	Address:	Project #: STH WELL MONITORING	Rush TAT (Surcharges will be applied)
Abbotsford, BC PC: V2S 7P6	PC:	Site Location: Summerland Trout Hatchery Spring	Same Day / 2 Days / 1 Day / 3 Days
Phone: (604) 855-4720	Phone:	Site #:	Date Required:
Email: kirstin.gale@gofishbc.com	Email:	Sampled By: Laine Cosens	Rush Confirmation #:

Regulatory Criteria

- BC CSR Soil
- BC CSR Water
- CCME (Specify)
- Other (Specify)
- Drinking Water
- BC Water Quality

Special Instructions

- Return Cooler
- Ship Sample Bottles (Please Specify)

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO MAXXAM

	Sample Identification	Lab Identification	Date Sampled (YYYY/MM/DD)	Time Sampled (HH:MM)	Matrix	Alkalinity, Conductivity, pH	Ammonia	Bromide, Chloride, Sulphate	Ammonia	Low Level Total Metals	Low Level Dissolved Metals	Nitrate + Nitrite - Low Level	Nitrite - Low Level	Nitrate - Low Level	Total Nitrogen, TKN, Organic Nitrogen	Orthophosphorus - Low Level	Dissolved Phosphorus - Low Level	Total Phosphorus - Low Level	TDS	TSS - Regular Level		# OF CONTAINERS SUBMITTED	HOLD - DO NOT ANALYZE
1	STH SPRING (EMS 0500323)		2016/06/01	11:25	FW	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		8	
2	SKAHA SPRING (EMS E265402)				FW	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	
NA		7.6, 7.1

COOLING MEDIA PRESENT Y / N

COMMENTS

B643286_COC

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	MAXXAM JOB #
Laine Cosens	2016/06/01	11:31	Laurel Berthier	2016/06/02	11:30	~~B642173~~ B643286

OFFICE REVIEW

WITHOUT PREJUDICE AND NOT TO BE CONSTRUED AS CONSULTATION

April 15, 2017

Lark Enterprises Ltd
Suite 1500, 13737 96 Avenue
Surrey, BC V3V 0C6
lel@larkgroup.com

and

City of Summerland Mayor and Council
13211 Henry Avenue
Summerland BC V0H 1Z0
council@summerland.ca

Re: Banks Crescent proposed development in Summerland

The syilx (Okanagan) Nation holds unextinguished aboriginal title to the land and resources within our Territory[1]. The proposed development is within the vicinity of *ackthtepus*, within Okanagan Territory and the Penticton Indian Band's Area of Responsibility (AOR). As such, the proposed development is subject to Okanagan Title, jurisdiction, Rights, interests, and PIB decision making and responsibility. The proposed activity also falls within the Penticton Indian Band's Commonage Land Claim; all proposed activities within the PIB AOR and throughout syilx Territory are taken very seriously and carefully considered by PIB. The province has notice of our Title and Rights.

As highlighted within our March 20, 2017 letter, the proposed development is located in an area where the potential to impact PIB Cultural Heritage is considered high. The proposed development falls adjacent to *ackthtepus,* a culturally important area for the Penticton Indian Band. Current and past use of this area has been identified by PIB. Legends and Knowledge depicting specific activities that have occurred within the vicinity of the proposed development indicate that the area is highly significant; any activities in this area must be carefully considered by PIB.

To assess archaeological potential PIB generally employs a four step process. The initial component (step 1) is focused on a Cultural Overview Assessment (COA). This process is primarily office and consultation-based. Using existing data, PIB assesses the likelihood of impact within proposed development area(s). As per the information above, PIB has undertaken this step and determined that the potential for adverse impact is high.

The second step in the process requires in-field observation. A Preliminary Field Reconnaissance (PFR) undertaken by qualified PIB technicians accompanied by, in some cases, an archaeologist or PIB Elder/Knowledge Keeper assess the proposed development area via pedestrian survey noting specific landforms, potential cultural use areas and archaeological features.

A PFR report is produced which recommends important next steps (step 3). Recommendations can include: the avoidance of identified cultural areas or features, an

Archaeological Impact Assessment (AIA), and Environmental Impact Assessment (EIA) or a Cultural Impact Assessment (CIA). A final, fourth step, may be required dependent upon the results of steps 1-3; this step is focused on monitoring (during construction) and/or auditing (to ensure that recommendations were followed).

Please contact Natural Resource Department Manager, James Pepper, at 250-493-0411 to further discuss the steps identified above and timelines for moving forward.

Limləmt,

James Pepper MSc. RPBio.
Director
PIB Natural Resource Department

CC: PENTICTON INDIAN BAND COUNCIL

Dean Strachan

From: Malek Tawashy <mtawashy@larkgroup.com>
Sent: Friday, April 21, 2017 3:37 PM
To: Dean Strachan
Cc: jpepper@pib.ca
Subject: RE: Banks Crescent

Thanks Dean,

We will reach out to James Pepper of the Penticton Indian Band.

Thank you,

Malek Tawashy
T: 604-576-2935
C: 250-213-8185

From: Dean Strachan [mailto:dstrachan@summerland.ca]
Sent: April-21-17 2:48 PM
To: Malek Tawashy
Subject: FW: Banks Crescent

Hi Malek, this letter was received today from the Penticton Indian Band, give me a shout when you have a chance and we can discuss.

Dean

Dean Strachan, MCIP, RPP
Director of Development Services

DISTRICT OF SUMMERLAND

Ph: 250 404-4048 Fax: 250 494-1415
PO Box 159, 13211 Henry Avenue
Summerland BC V0H 1Z0
www.summerland.ca

From: James Pepper [mailto:jpepper@pib.ca]
Sent: Friday, April 21, 2017 2:34 PM
To: Dean Strachan <dstrachan@summerland.ca>
Cc: referrals@pib.ca
Subject: RE: Banks Crescent

Good Afternoon Dean,

I have attached a second letter from PIB with regards to the Banks Crescent development. This letter is signed by myself as opposed to Chief Eneas given that the discussion is focused on technical matters.

Please let me know if you have any questions/comments.

Regards,

James Pepper MSc. RPBio.
Director
PIB Natural Resource Department

Penticton Indian Band | 200 Westhills Drive | Penticton | B.C.
V2A6J7 | T: 250-469-3183 | F: 250-493-2882

From: Dean Strachan [mailto:dstrachan@summerland.ca]
Sent: April 19, 2017 4:11 PM
To: James Pepper <jpepper@pib.ca>
Subject: RE: Banks Crescent

Hi James,

Just touching base on the noted letter, we are reporting again to Council and wondering if it may be ready for inclusion in our next report.

Thank you!

Dean Strachan, MCIP, RPP
Director of Development Services

DISTRICT OF SUMMERLAND

Ph: 250 404-4048 Fax: 250 494-1415
PO Box 159, 13211 Henry Avenue
Summerland BC V0H 1Z0
www.summerland.ca

Dean Strachan

From: Malek Tawashy <mtawashy@larkgroup.com>
Sent: Friday, April 21, 2017 3:37 PM
To: Dean Strachan
Cc: jpepper@pib.ca
Subject: RE: Banks Crescent

Thanks Dean,

We will reach out to James Pepper of the Penticton Indian Band.

Thank you,

Malek Tawashy
T: 604-576-2935
C: 250-213-8185

From: Dean Strachan [mailto:dstrachan@summerland.ca]
Sent: April-21-17 2:48 PM
To: Malek Tawashy
Subject: FW: Banks Crescent

Hi Malek, this letter was received today from the Penticton Indian Band, give me a shout when you have a chance and we can discuss.

Dean

Dean Strachan, MCIP, RPP
Director of Development Services

DISTRICT OF SUMMERLAND

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