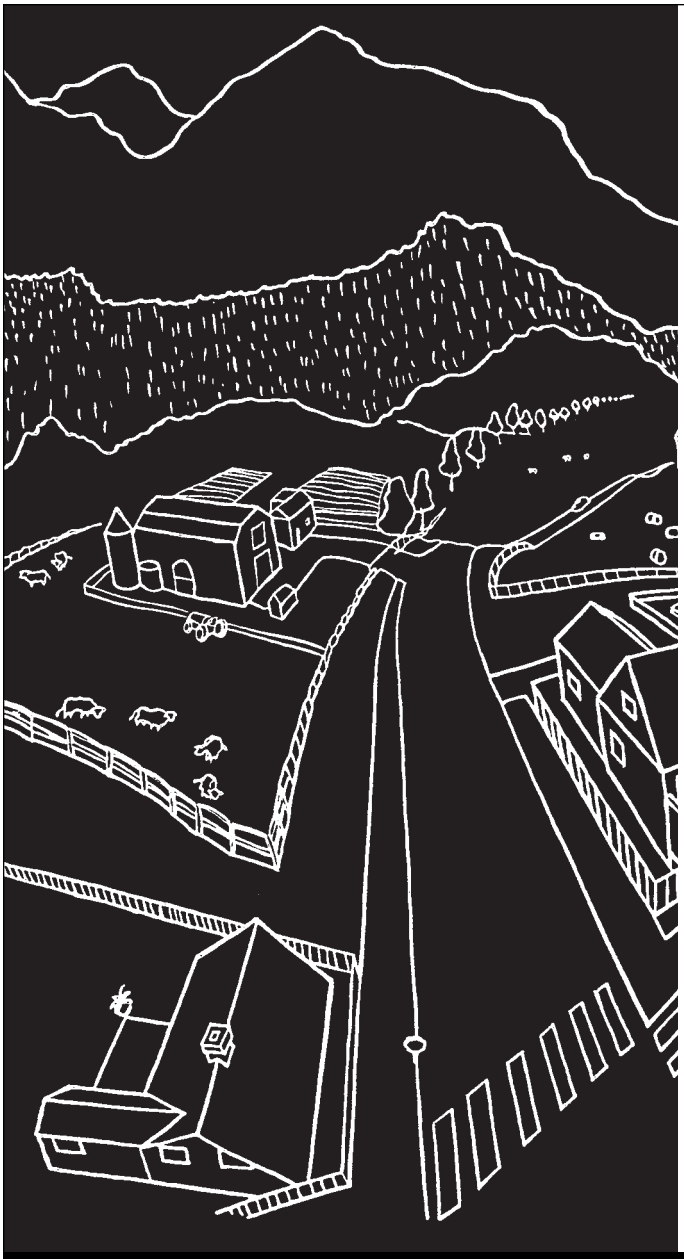

PUMPHANDLE WELL PROTECTION PLAN

BRITISH COLUMBIA

Environment Canada Environnement Canada

GROUND WATER ASSOCIATION

WELL PROTECTION PLAN
FOR PUMPHANDLE, B.C.

December 2005

Prepared by the
Pumphandle Community Planning Team

Note: This Well Protection Plan for Pumphandle, B.C. *is provided as an example only, so the reader can get an idea of what might go into a well protection plan. It is not intended to be a template where a community can take it and simply "fill in the blanks." That won't work – developing a well protection plan will take a lot of time and effort. The plan will reflect the unique conditions and data for your community; it could be simpler (or more comprehensive) than this example.*

The Pumphandle Community Team was very efficient and effective in putting together this information in a very short time frame. Do not be alarmed if your community planning team takes longer to achieve the same outcome – each community is different.

Just in case your community is unsure about developing a plan, compare the cost of replacing your well system after it has been contaminated to the cost of developing and implementing a well protection plan. A plan will be worth the effort!

Acknowledgements

The community planning team would like to thank the residents and businesses of Pumphandle for their input and help in developing the well protection plan for their community, especially:

- The Geography 12 class of Valley High School for conducting the inventory survey;
- The Valley Regional District for their support and logistical help;
- The Pumphandle Valley Chamber of Commerce for their ongoing support and assistance in distributing educational materials throughout the community;
- The Ministry of Environment and Pumphandle Valley Health Authority for technical assistance; and
- Jacqui Carboneau of Geoplan Inc. and Henrique Darcy of Hydro-Logic for their assistance in drafting the well protection plan.

Executive Summary

The *Well Protection Plan for Pumphandle, B.C.* was developed in response to rising nitrate levels in one of Pumphandle's three community wells, and the desire to protect the groundwater supply from possible contamination from a variety of sources.

In December 2004, members of the community formed a planning team to develop a well protection plan and oversee its implementation. The well protection plan takes a constructive approach to groundwater protection, focussing on prevention activities and offering solutions to current concerns. The objective of the well protection plan is to bring the community together to protect their drinking water supplies. The community planning team has identified those contaminant sources most likely to pose a risk to the water supply, and has prepared strategies to reduce the risk of groundwater contamination with input from the community. Contingency plans have also been developed to minimize the impacts of any unexpected contamination event. A program is in place to monitor water quality on a regular basis.

This initial well protection plan was developed using available financial and other resources. The results of the well protection plan will be evaluated annually, and the plan will be updated to reflect changing community needs and available funding.

For further information on the well protection planning process, please contact:

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Introduction

Pumphandle's Community Water Supply

Pumphandle, British Columbia is a small town with 650 residents, located in a valley to the east of Vancouver. Most of the drinking water is supplied from three community wells (Figure 1):

- Aiken's Well, shown as Well A, is a shallow well dug into a spring. Water from the well is supplied to the main subdivision in Pumphandle with 165 homes (500 residents), and a number of commercial users including a gas station and dry cleaner.
- The Blackwater Well, shown as Well B, supplies water to another 35 homes (100 residents), and the campground, hotel, schools and golf course.
- Charlie's Well, shown as Well C, provides water to a small new subdivision of 15 homes with approximately 50 residents.

A summary of the community wells is shown in Table 1. Note that for Aiken's Well, the demand exceeds the supply. Well assessment forms were filled out for all three wells and are included in Appendix 1.

Table 1: Summary of Pumphandle Community Wells

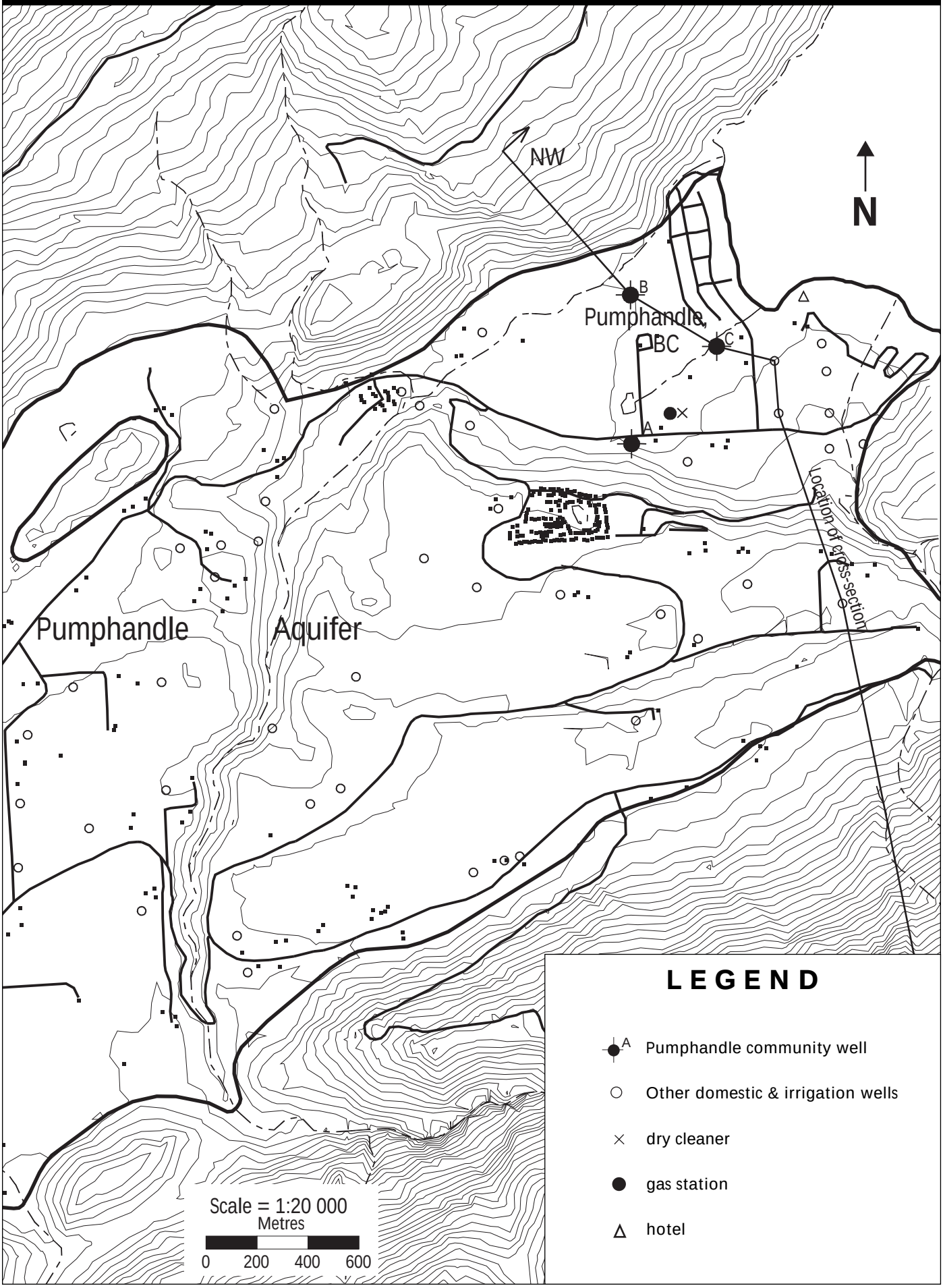
Well	Type	Depth (m)	Diameter (mm)	Rated Capacity (L/s)	Drinking Water Demand (L/s)	No. of users
Aiken	dug	2.4	915	5.10	5.26	500
Blackwater	drilled	30.5	200	22.73	1.05	100
Charlie	drilled	25.6	150	7.58	0.53	50

In rural areas around Pumphandle, and further up the valley, to the south and west of Pumphandle, residents rely on individual wells and private intakes into the nearby mountain creeks.

Water Quality Issues

In 2004, the purveyor for Aiken Waterworks discovered that the nitrate-nitrogen value for Aiken's Well had reached 7 mg/L. Nitrate-nitrogen levels in Blackwater Well and Charlie's Well were also elevated (4.2 and 3 mg/L, respectively). The regional health authority is required to shut down any well if the nitrate-nitrogen level reaches the Canadian drinking water guideline of 10 mg/L.

FIGURE 1: PUMPHANDLE'S WATER SUPPLY



Pumphandle has always relied on groundwater for its water supply. Although surface water supplies are locally abundant, both Pumphandle Lake and Pumphandle Creek would require treatment, which is expensive and undesirable to the community.

After comparing the cost of replacing their well systems to the cost of preventing contamination by developing and implementing a well protection plan, the purveyors of all three waterworks systems agreed that it would be more cost-effective to initiate a well protection plan immediately. The purveyors also agreed to lead the development of the plan.

1.0 The Community Planning Team

1.1 Membership

The three water purveyors approached Pumphandle Community Health Services Society and the Valley Regional District in October 2004 and received support to develop a well protection plan.

In December 2004, a community planning team was formed to oversee the development of the well protection plan. Membership of the team included:

- Andrew Aiken, purveyor for Aiken Waterworks' Well (team leader)
- Jenny Lowden, purveyor for Blackwater Waterworks' Well
- Eric Kowski, purveyor for Charlie's Improvement District Well
- Ian Rutherford, P.Eng., Engineer, Valley Regional District
- Simon Lee, farmer
- Jocelyne Dufour, campground owner/operator
- Devon Alexander, Pumphandle Valley Conservation Society
- Anne Jones, Drinking Water Officer, Pumphandle Health Authority

The initial terms of reference of the community planning team stated that the community planning team should have at least five and no more than ten members. Membership should include one representative from each of the three water purveyors, one representative from the local health authority and a representative from the Valley Regional District.

The community planning team met regularly to develop this *Well Protection Plan,* using the provincial government's *Well Protection Toolkit* as a guide.

1.2 Goals and Objectives

The planning team and the stakeholders in the community have agreed that protecting their well water supply is important and that clean water is beneficial to the economic viability of this community. The goals and objectives for Pumphandle's *Well Protection Plan* are:

Goal 1: To encourage public awareness of the need to protect groundwater

Objectives:

- Produce an information sheet on the well water supplies in Pumphandle;
- Hold public information meetings;
- Conduct a groundwater issues survey;
- Place signs in strategic locations informing the public that they are in a designated well protection area;
- Include groundwater information in the public school education programs; and
- Raise money to assist with publication of educational materials.

Goal 2: To develop and implement a well protection plan that will minimize the nitrate levels in the Pumphandle wells and aquifer

Objectives:

- Complete the well assessment form for each community well;
- Delineate the well protection area for all three community wells;
- Conduct a contaminants inventory for all of Pumphandle;
- Select groundwater protection measures;
- Develop and implement a contingency/emergency response plan; and
- Design and implement a monitoring and evaluation program.

Members of the community planning team were assigned tasks for meeting these objectives.

2.0 The Well Protection Area

2.1 The Pumphandle Aquifer

All three community wells and private wells in the area draw groundwater from the Pumphandle aquifer. Hydro-Logic Groundwater Consultants were hired to assess the hydrogeology of the Pumphandle area and to define the preliminary capture zones for the community wells. The hydrogeology of the local area is summarized as follows:

- The Pumphandle aquifer is a sand and gravel aquifer that underlies the community and the valley to the south-west;
- The aquifer is quite productive, able to supply groundwater to wells at rates of up to 25 L/s;
- The aquifer is highly vulnerable to contamination in the Pumphandle area because there is no clay or till layer above it (the aquifer is unconfined) and the water table is within a few metres of the land surface.

More information on the Pumphandle aquifer and the hydrogeology is contained in the consultants' report in Appendix 2.

2.2 Capture Zones

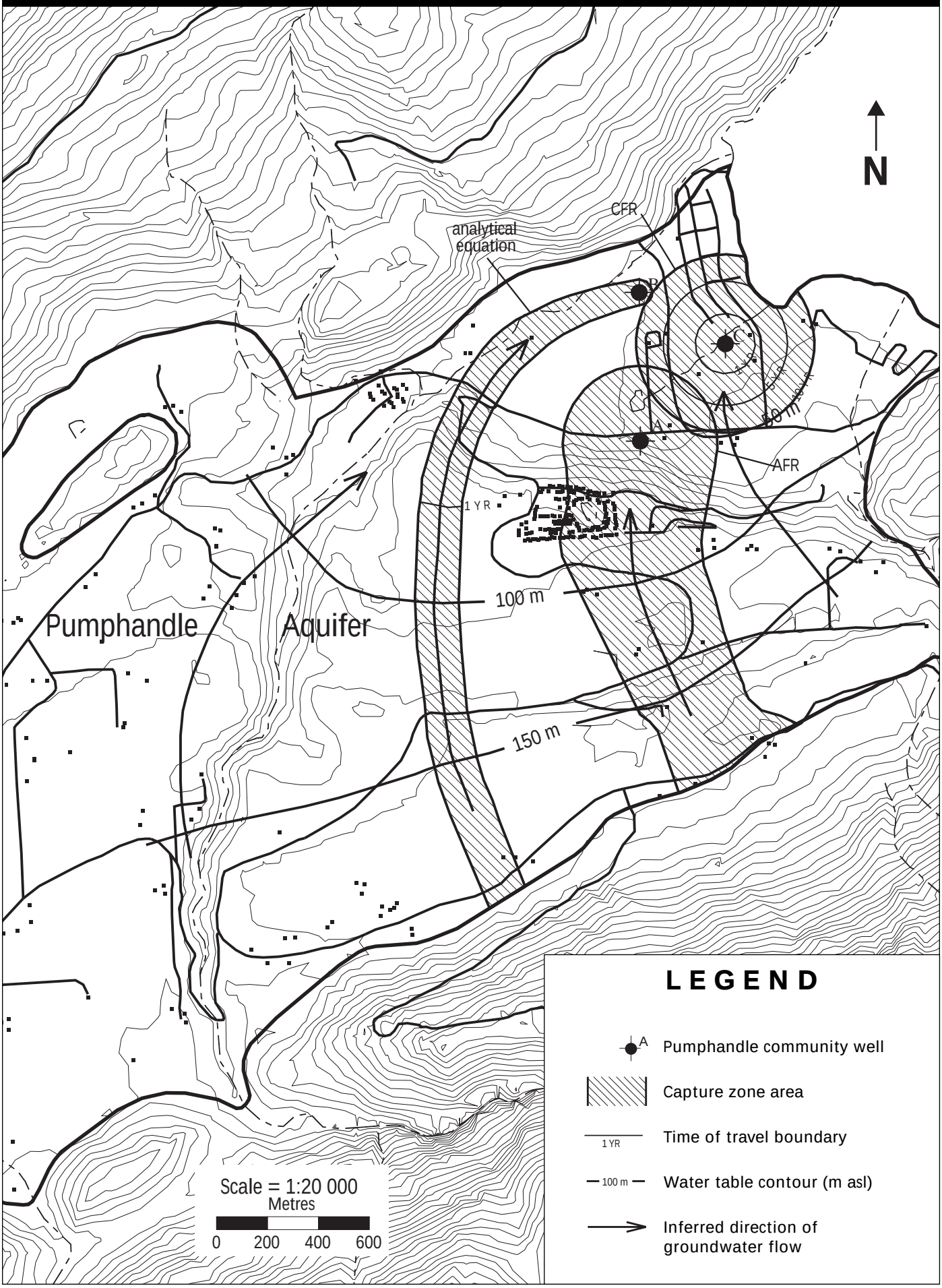
The consultants used the hydrogeologic information, along with the pump test and water consumption data from the three water districts, to define the probable capture zones for the three community wells (Figure 2 and Table 2).

Table 2: Capture Zone Areas

Community well	Capture zone area (hectares)
Aiken	80
Blackwater	46
Charlie	38

The Time of Travel (TOT) for water in the capture zones to flow to the community wells is also shown in Figure 2. The TOT for Aiken's Well could not be determined because of insufficient data. The capture zones were identified using available information and simplistic assumptions about the hydrogeology, so there is some uncertainty related to the actual size and location of the capture zones. Despite this uncertainty, the delineation of the capture zones is reasonable based on the available information and the consultants' evaluation of the data.

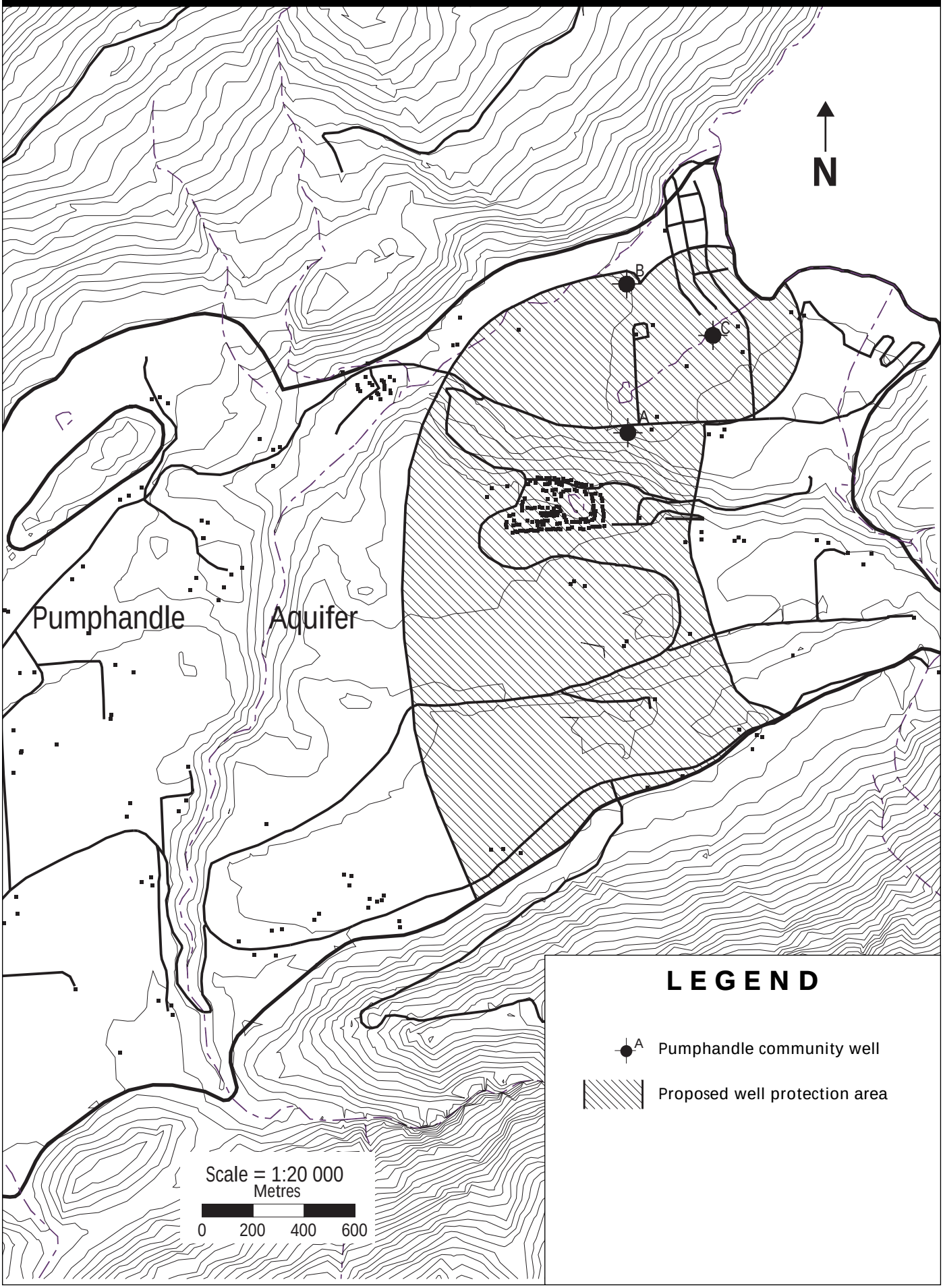
FIGURE 2: CAPTURE ZONES FOR COMMUNITY WELLS



2.3 The Well Protection Area

Because of the uncertainty related to the size and location of the capture zones, the community planning team have included the area in between the capture zones as part of the well protection area. This well protection area covers a total of 261 ha and occupies the immediate uphill area from the wells (Figure 3). Much of the well protection area lies beyond the boundary of the three water districts, in areas managed by the Regional District.

FIGURE 3: PROPOSED WELL PROTECTION AREA



3.0 Sources of Potential Contamination

3.1 Results of Surveys

The Geography 12 teacher and students from Valley High School conducted a contaminant inventory as a school science project. The students used air photos and soil maps, interviews with staff from the Ministry of Environment and the Pumphandle Health Authority, and surveys/site inspections to gather information.

The land uses and potential contamination sources were mapped on a 1:20,000 scale map (Figure 4) and land use practices were documented in an Excel spreadsheet (Appendix 3). Potential contaminant sources include:

- Fertilizers (nitrate) and pesticides from farms, residential areas, corn field and the golf course;
- The poultry barn on A-3 (nitrate);
- Septic systems (nitrate) and household hazardous wastes (solvents, paints, fertilizers and pesticides) from residential areas;
- The gas station (hydrocarbon chemicals);
- The dry cleaner (drycleaning chemicals);
- An abandoned well on A-3; and
- The main road (accidental spills).

Bacteria and viruses from septic systems are not considered a serious threat. Despite the large number of septic fields uphill of Aiken's Well, there is regular testing for bacteria and none has been found in any of the well water supplies.

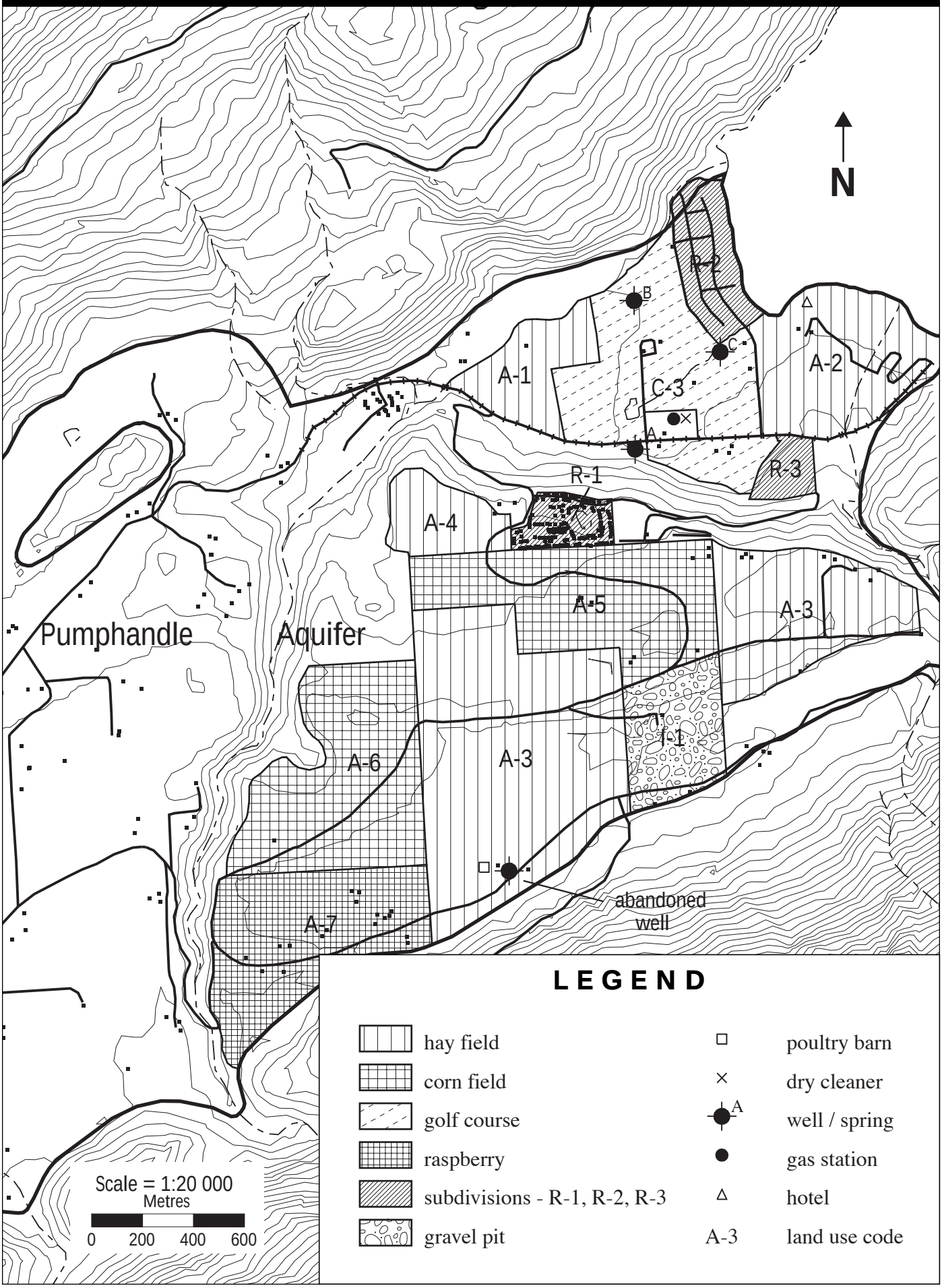
3.2 Priorities for Action

The community planning team set priorities for action according to the proximity of a source to a community well (high priority for potential sources located within the one-year time of travel from a community well) and possible consequences of contamination.

The highest priority sources include the golf course (C-3), gas station (C-1), dry cleaner (C-4) and subdivisions (R-1 and R-2), a corn field (A-5), hay fields (A-1 and A-4), and the main road (T-1).

These sites are all within the one-year time of travel zone for at least one of the wells, or are close to one of the wells. These land use activities are associated with potential sources of contamination such as septic fields, pesticide and fertilizer applications, solvents and gasoline storage, or the consequence of any contamination would be severe. The main road is also a potential contamination source from accidents or from use of de-icing chemicals in the winter.

FIGURE 4: LAND USES IN PUMPHANDLE



The lower priority sources include the other corn/hay fields (A-2, A-3, A-6), gravel pit (I-1), hotel (C-2)and the poultry barn (A-3) and abandoned well (A-3).

The corn/hay fields and gravel pit were rated as a lower priority since they are located further from the well sources. The community planning will work with the owners to promote Best Management Practices. The abandoned well and poultry barn are located beyond the one-year TOT from the community wells.

The community planning team will review the land uses and practices and update the database and land use map annually. Data from the contaminant survey were initially entered and stored in a spreadsheet in MS-Excel. The data have now been uploaded to the Valley Regional District's geographic information system (GIS).

4.0 Management Options

4.1 Assessing Options

A public meeting was held at the fire-hall on April 21st 2005, to present findings of the contaminant survey. About 30 stakeholders and members of the community planning team discussed and identified possible management options for every potential contaminant source, and listed the agencies with the authority to control activities.

The participants used the S*M*A*R*T test[1] to assess the suitability of each possible option. The options that passed the S*M*A*R*T test are shown in Appendix 4. From the list of options, a two-year implementation schedule was developed (Appendix 5). Options were also developed for some of the lower priority sources of potential contamination because solutions can be easily implemented.

4.2 Proposed Actions

The actions for the period 2005-2007 include:

4.2.1 Non-regulatory Measures

- Simon Lee (farmer) and the purveyors will meet with the other farmers and the golf course operator to promote the use of Best Management Practices (BMP) and Integrated Pest Management (IPM). This will minimize use of pesticides and fertilizers. Soil testing will be carried out to more accurately determine fertilizer requirements. Simon and the purveyors will also talk to the farmers and the golf course operator about the importance of regularly maintaining their septic systems and the requirement for maintenance under the Sewerage System Regulation of the *Health Act*.
- Anne Jones, the Drinking Water Officer, will encourage the owners of the gas station and dry cleaner to attend a spill response course in Vancouver ($400 for course and expenses). Funds could be raised by adding a 4% surcharge to customers. Anne will review the dry cleaning operations and, if required, work with the owner to identify and adopt improved practices.
- The Regional District will develop a public education program. They will work with the Pumphandle Valley Conservation Society and purveyors to prepare a two-page newsletter on the proper use, storage and disposal of garden fertilizers, pesticides, and other household hazardous wastes. This will be mailed with the water bills to all residents in the region, at a cost of $200 for production and mailing. To raise the funds to do this, the Conservation Society plans to hold two car washes.
- Anne Jones will talk to the owner of A-3 about grouting off his abandoned well to prevent contaminants from directly entering the aquifer. This is now a requirement under the *Water Act's* Groundwater Regulation.

[1] S*M*A*R*T refers to Specific, Measurable, Achievable, Realistic and Time-bound, and is a method for deciding the most effective options.

Cost for hiring a local well driller to do this is about $1,000, which the owner will have to fund.

- Valley Regional District will pay for and erect signs at two locations along the main road to advise people that they are entering a well protection area. The Regional District will allocate this amount ($600) out of next year's budget.

4.2.2 Regulatory Measures

- Staff from the local Ministry of Environment have agreed to place a priority on enforcing the Agricultural Code of Practice over the entire aquifer in the Pumphandle Valley. This includes the handling of manure and other agricultural waste for the poultry barn on A-3 and on the other farms.
- The Regional District has agreed to consider a new by-law to restrict the quantity of dry cleaning chemicals in the protection area. Staff will also work towards a second by-law, that would require that any new subdivision development in the well protection area identify and address potential impacts on the groundwater.
- Ian Rutherford will contact the Ministry of Energy, Mines and Petroleum Resources to seek their support for revisions to the permit for gravel extraction at I-1. The proponent would be required to erect a fence and put up signs around the gravel pit prohibiting the dumping of garbage.

The progress of these actions will be discussed at monthly community planning team meetings to make sure progress is being made and to identify any problems encountered.

5.0 Contingency Plans

5.1 Possible Contamination Events

The community planning team reviewed all the potential sources of contamination and the Emergency Response Plan for each of the water systems. They then developed "what if" scenarios (contingency activities).

Possible contamination events are identified in Appendix 6. The most likely events are:

- Routine monitoring detects contamination in the groundwater; or
- The planning team receives reports of chemical spills, discharge or bad practices within the well protection area (or directly into a well).

The contaminant most likely to affect any of the community wells is nitrates from either fertilizers or septic wastes.

The existing Emergency Response Plans (developed by the three purveyors) contain standard operating procedures (SOPs) that deal with such issues as the contamination of the water system through water main breaks or back flow of contaminated water, and the loss of supply either from pump breakdown or power failure. These SOPs form an integral part of the Contingency Plan. Additional SOPs have been developed to address the most likely scenarios. Local physicians and pharmacies have been asked to alert the planning team if there is an increase in physician visits for diarrhea, or in sales of anti-diarrhea medicine.

5.2 Resources Available to Respond to Spills

A list of resources required for emergency response has been developed, and the necessary supplies are stored at Blackwater Waterworks.

This listing identified several resource items that are not currently available in Pumphandle:

- Sorbent materials for dealing with spills;
- Alternate water supplies (short term supply);
- Emergency chlorinator and attachment sites;
- Protocols for fire-fighting at the dry cleaners and gas station that would minimize spread of contaminants to the aquifer;
- Access to wells for monitoring (existing private wells located between community supplies and potential contaminant sites); and
- Rental agreement with AAA Excavation Services.

The following actions have been taken in response:

- The purveyors have purchased additional sorbent materials, which are stored at the Blackwater Waterworks. These would be available to any of the water purveyors should a spill occur.
- Arrangements have been made with Barney Buhler of Barney's Bulk Water Service in Valleyview. Barney has agreed to provide priority service to Pumphandle and its residents in case of an emergency, and the volunteer fire department will help to distribute the water to the residents. Barney will also coordinate and supply bottled water from his brother's bottling plant in Valleyview.
- The three water purveyors will cost share in the purchase of a chlorinator and install fittings at each of the three well heads to allow the chlorinator to be attached should a well become contaminated with pathogens. AAA Excavation Services in Valleyview will supply equipment for excavation work in the case of an emergency. Each water purveyor has a list of pumps, sump-pumps, piping and other waterworks supplies available in case of an emergency situation. Each water purveyor has on-site generators capable of powering their pumps in case of an electrical service failure.
- Fire-fighting protocols have been developed. The local R.C.M.P. detachment, Pumphandle Volunteer Fire Department, the Ministry of Environment, and the local health authority will act as first responders to contamination events.
- Agreements are being developed with private well owners to use their wells for monitoring purposes.

Each water purveyor has:

- A copy of their emergency plan and the contingency plan for Pumphandle Valley;
- A list of resources required/available for emergency response;
- A master list of phone numbers of agencies and individuals who can respond to the various scenarios, including emergency situations; and
- A map of the distribution systems with valves locations and drawings of the well head for each water system.

5.3 Contingency Activities

The scenarios of how the well water supplies can be contaminated due to unplanned accidents or from events beyond control are listed in Appendix 6. Six short-term contingency activities have been identified:

- Contain and/or clean spill and contaminated soil;
- Determine public health significance of contaminant;
- Issue public advisories;
- Provide alternative water supply;

- Expand monitoring program to determine if other contaminants are present and to identify the source and extent of contamination; and
- Chlorinate water supply.

Public advisories have been drafted. If a public advisory is needed, any specific concern such as unsatisfactory bacteria tests or nitrate contamination can be written into the draft. When a public advisory is needed, press releases will be sent to the Pumphandle community newspaper and the Valley Radio Station, and notices delivered directly to individual homes.

5.4 Future Requirements

Contingency planning identified the need for a long-term alternate water supply (new well), and additional funding to purchase emergency equipment and supplies. These needs are beyond the ability of the planning team to arrange on a short-term basis, and the planning team will be asking the Valley Regional District for assistance.

The Blackwater Well is the least vulnerable as it is located farther from most potential contaminant sources. It is deeper than Aiken's and Charlie's Wells, and produces the greatest amount of water. One option is to connect the three community water supplies so that Blackwater Well can supply water to all residents in an emergency. This would be especially beneficial since the peak use demands on Aiken's Well already exceed supply. Some of the costs of connecting the three distribution systems would be offset by the cost saving of not drilling a new well to replace Aiken's Well. The purveyors will conduct cost-benefit analyses on connecting the Blackwater Well to the other two water systems, versus having Aiken Waterworks drill a new well close to their present source. They will apply to the Ministry of Community Services for funding for a planning grant to evaluate these options.

6.0 Monitoring and Evaluation

6.1 Monitoring Water Quality

6.1.1 Sampling Procedures

Monitoring private wells allows for the early detection of contamination before it reaches any of the community wells. Water quality monitoring will include monitoring at Pumphandle's three community wells, and at a network of private wells (Figure 5).

Samples will be collected as follows:

- Each well will be sampled once a year in the fall.
- Two teams will be established so sampling can be completed in one day.
- Sampling will be completed and shipped before Friday.
- Samples will be collected at mid-day after the pumps have been on for a few hours and shipped directly to the Chemtest Laboratory in Vancouver for analysis.
- All samples will be collected at the source in the pump houses.
- Sampling procedures for each well will be documented on the *Water Quality Sampling Form* (Appendix 7). This will be done for every well and each time a well is sampled.

The sampling team will use sampling procedures from the Ministry of Environment (see Appendix 8). The three water districts will each contribute $600 to purchase equipment for field analysis. The equipment will include a conductivity meter, nitrate kit and pocket pH meter.

Community wells: The three community wells will be sampled every fall to establish baseline data, starting in 2006. The well samples will be tested for a comprehensive list of physical, inorganic and organic constituents at a cost of $950 per sample. The parameters are listed in Appendix 9.

The three wells will continue to be sampled on a weekly basis for fecal coliforms and total bacteria. Cost of bacteriological sampling is $20 per sample. The total annual cost for water quality sampling for the three Pumphandle community wells will total $7,220, including Quality Assurance/Quality Control (QA/QC) samples (see Table 3).

Private wells: Water quality of twelve private wells in the protection area will be sampled specifically for Total Dissolved Solids, pH and nitrates at a cost of $50 per sample. If the nitrate-nitrogen levels in the wells increase beyond 8 mg/L, pesticides will be included in the analysis. Cost for sampling the private wells will total $700 per year, including one duplicate and one spiked sample (Table 3).

FIGURE 5: WATER QUALITY MONITORING SITES

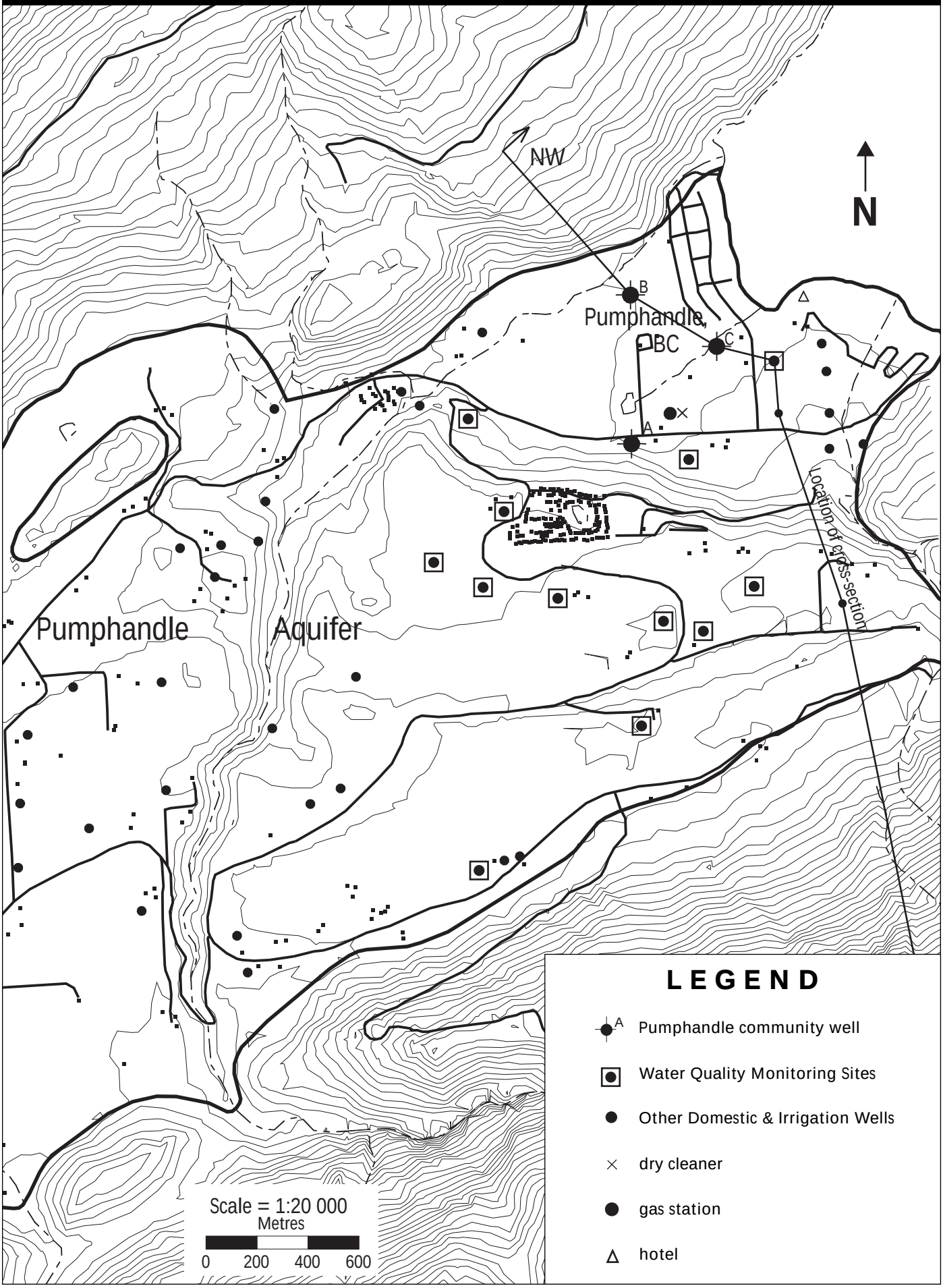


Table 3: Summary of Water Quality Sampling Costs

Wells	Number of samples	Number of QA/QC samples	Cost per sample	Total Cost	Paid by:
3 community wells	3 annual samples for comprehensive analysis	1 duplicate	$950 in first year; $250 for subsequent years	$3,800; $1,000 for subsequent years	Water districts/ Water purveyor
	156 weekly samples for bacteriological analysis	15 duplicates	$20	$3,420	Water district/ Water purveyor
12 private wells	12 annual samples for TDS, pH, & NO_3-N analysis	1 duplicate 1 spiked	$50	$700	Water districts
Total costs				$7,920 for first year, then $5,120 per year	

6.1.2 Recording Information

The Ministry of Environment has agreed to establish files for the three community wells and the twelve private wells in their Environmental Monitoring System (EMS) database. The sampling teams will record the EMS number in the requisition forms that are submitted to the laboratory with each sample. All water quality data analyzed by the laboratory will be automatically uploaded and archived into the database. The data for these wells can be downloaded at any time.

6.1.3 Quality Control/Quality Assurance

Ministry of Environment regional staff will train the sampling team. Mark Preston of the Ministry will accompany the teams during sampling to audit their technique in the first two years. Two random duplicate samples – one of a community well and one of a private well – and one spiked nitrate sample of a private well will also be collected to check the laboratory analyses as part of a minimal QA/QC program. Duplicate samples for bacteriological analysis will also be collected during weekly sampling of community wells. The total annual cost for QA/QC will be $1,350.

Upon receipt of the water chemistry results in the mail, the sampling team will immediately check for any unusual results or results greater than the value (exceedances) found in the drinking water guidelines and call the laboratory for clarification if required.

As part of the QA/QC program, one member of the sampling team will also request funding to travel to the upcoming B.C. Water and Waste Association conference in Kelowna, and attend the workshop on Water Quality Interpretation as part of their on-going training.

6.1.4 Water Quality Reporting

The sampling team, with the help of the drinking water officer, will review the data yearly and prepare an annual water quality monitoring report to summarize the results (this will be done annually). The two-page report will contain:

- a brief description of the water quality results;
- a report on any exceedances in drinking water guidelines;
- a map of the Pumphandle area showing the wells being monitored, exceedances, nitrate-nitrogen levels, or any other relevant parameter;
- a graph of the nitrate-nitrogen (and any other relevant parameter) over time; and
- a discussion of actions to address water quality issues.

The annual water quality report will be approved by the community planning team and distributed with the water bill in May. The committee will also submit an article to the local newspaper about the water quality monitoring for the year.

The cost for for photocopying 250 reports for mail-out will be about $250.

6.1.5 Funding for Water Quality Monitoring

The total cost of water quality sampling is $7,920 per year for the first year and $5,120 for subsequent years, excluding volunteer time provided by the sampling team.

The three water districts have approvals from their Boards of Trustees for a $12 per connection surcharge per year ($1 / month for every connection) to raise $3,100 annually for the water quality monitoring program. This fund will be available starting next year and will be a continued source for water quality monitoring. Funds from this will pay for the sampling and reporting.

6.2 Evaluating Well Protection Activities

There are a number of management options to be implemented in the first year of the well protection plan. All of these will be evaluated to assess whether or not they were effective.

6.2.1 Agricultural Land and Golf Course

Follow-up interviews will be conducted with all the farmers and the manager of the golf course to see if fertilizer and pesticide practices have improved. Surveyors will ask about the type and amount of fertilizer used, when it was applied, and irrigation practices. They will inspect to verify that fertilizers and pesticides are properly stored.

Jim Summer, the farmer on A-3, will notify the committee when he intends to grout the abandoned well so members of the planning team can be on site to see how the well is sealed.

Levar Bocken of the Ministry of Environment will be in the area several times in the winter and spring to inspect how poultry wastes in the Pumphandle Valley are being managed. Levar will notify the community planning team if there are any breaches of the Code of Practice on lot A-3.

6.2.2 Trailer Park and Subdivisions

The Pumphandle Valley Conservation Society will design a survey to evaluate the awareness of groundwater protection amongst the local residents. This will be distributed to the residents at the trailer park and subdivisions. The survey will also ask the residents how they store and dispose of household hazardous wastes and if they participate in recycling programs.

6.2.3 Gas Station and Dry Cleaner

Anne Jones will speak with the owner of the gas station in the fall to check the results of the testing the gasoline tanks for leaks.

Anne will also speak with the owner of the dry cleaner to see how chemicals are stored and handled and to review the Code of Practice for implementation. Anne will ask the dry clean operator and gas station owner if they have taken the spill response course in Vancouver.

6.2.4 Eco-friendly Road Maintenance Program

Ian Rutherford, the engineer for the Regional District, will work with his staff to identify alternatives for road maintenance that will require less use of chemicals. He will present these alternatives at a community planning team meeting at year end and make a proposal to the Regional District to implement practical alternatives for the following year.

6.2.5 Signage on Roads and in the Gravel Pit

The Regional District and Greg Quaig, manager of the gravel pit, will inform the community planning team when they have erected the signs about aquifer protection along two locations on Pumphandle Highway and in the gravel pit. Ian Rutherford will provide up-dates on signage on Pumphandle Highway. Ian Rutherford will also contact Greg about progress of signage at the gravel pit. The effectiveness of the road signs will be evaluated by the number of phone calls received requesting more information and by including a question in the questionnaire survey to residents about whether the sign made a difference in reminding them of what their practices can do to the underlying groundwater.

6.2.6 Public Education

The Regional District will send the Conservation Society's survey questionnaire to rural residents to check the effectiveness of the public education efforts.

6.2.7 By-law Changes

The community planning team will follow-up on the proposal made to the Regional District for a by-law to limit the quantity of drycleaning chemicals in the protection area and seek a response from the Regional District about their proposal.

6.2.8 Goals and Objectives

The community planning team will review their goals and objectives in November 2006 and prepare a summary of actions to date. At this time, the goals and objectives will be reviewed and adjusted as necessary.

*Appendix 1: Well Assessment Forms for Pumphandle Community Wells**

* Please note that this is an updated version of the Well Protection Toolkit however, this Appendix contains older forms with old Ministry names.

It is also important to note that the current terminology for "WIN No." is "Well Identification Number"

BRITISH COLUMBIA Ministry of Health and Ministry Responsible for Seniors | Ministry of Environment, Lands and Parks

WELL ASSESSMENT FORM

TO BE USED WITH THE WELL PROTECTION TOOLKIT.

IMPORTANT! Please complete one form for each ground water source used in your water system. Fill in available information. If missing information, it may be advisable to contact the Ministry of Environment, Lands and Parks' Groundwater Section [(250) 387-1115], or the local driller who drilled the well, to assist. Photocopy this form as necessary.

PART I: WELL SYSTEM INFORMATION (Refer to Step 1)

WATER SYSTEM LEGAL NAME: AIKEN'S WATERWORKS DISTRICT	LEGAL DESCRIPTION OF WELL LOCATION: PL 54914, SEC 10, TP22, NEW WEST
WATER SYSTEM LEGAL ADDRESS: 1775 PUMPHANDLE HWY., PUMPHANDLE, BC	
LATITUDE / LONGITUDE: —	HOW WERE LOCATION COORDINATES DETERMINED? ☐ GPS _____ *(specify accuracy)* ☐ survey ☐ digitized from _____ map *(specify scale)*
UTM COORDINATES: E:571900; N:5431380	HOW MANY OTHER WELLS MAKE UP THE WATER SYSTEM? 1
DOES THE WATER SYSTEM ALSO USE A SURFACE WATER SOURCE? *(describe)*: No	
NUMBER OF CONNECTIONS: Maximum 200 Actual 200	POPULATION SERVED: 500
WATER USE: ☒ domestic ☐ irrigation ☐ commercial ☐ industrial other *(specify)* _____	
WIN NO.: 52649	EMS NO.: E218117
WELL TAG NO.: —	

Contact your local Ministry of Environment, Lands and Parks office or local Health Unit for the following information:

WIN NO. = MoELP's metal tag affixed to the well for on-site identification. | EMS NO. = MoELP's site number for the water chemistry on their database. | BC WELL TAG NO. = MoELP's computer number for the well.

Bulk supply ☒ yes ☐ no | Back-up supply ☐ yes ☒ no | Emergency supply ☐ yes ☒ no | Metered ☒ yes ☐ no

WELL OWNER / OPERATOR INFORMATION

WELL OPERATOR: ANDREW AIKEN	WELL OPERATOR'S PHONE NO.: (604)853-9678
WELL OPERATOR'S ADDRESS: 1775 PUMPHANDLE HWY., PUMPHANDLE, BC	
WELL OWNER: ANDREW AIKEN	WELL OWNER'S PHONE NO.: ( ) AS ABOVE
WELL OWNER'S ADDRESS: AS ABOVE	

PART II: WELL CONSTRUCTION INFORMATION (Refer to Step 1)

WELL-DRILLER'S NAME, COMPANY AND ADDRESS: N/A	POSTAL CODE: —
WELL-DRILLER'S TELEPHONE NO.: ( ) —	DATE WELL ORIGINALLY CONSTRUCTED (YYYY MM DD): 1962 07
	DATE OF LAST RECONSTRUCTION (YYYY MM DD): 1962 07

TYPE OF WELL: ☐ drilled ☒ dug ☐ other *(specify)* _____

METHOD OF DRILLING: ☐ rotary ☐ cable tool ☐ driven ☐ jetted ☐ other *(specify)* _____

WELL LOG AVAILABLE? ☐ yes *(attach)* ☒ no

DEPTH OF WELL	DIAMETER OF WELL	SCREEN LENGTH	DEPTH TO TOP OF SCREEN
2.4 m or 7.9 ft.	1 m or 36 in.	— m or — ft.	— m or — ft.

WELL CAPACITY	LOCATION OF WATER-BEARING FRACTION(S) (for bedrock wells):	YIELD OF WATER-BEARING FRACTION(S)
5.10 L/s or 67 Igpm	—	— L/s or — Igpm

WELLHEAD ENCLOSURE: ☒ pump house ☐ manhole ☐ other *(specify)* _____ ☐ none

SURFACE SANITARY SEAL: grouted to — m or — ft. ☒ no surface seal ☐ pitless adapter

AVERAGE PUMPING RATE	HOW WAS PUMPING RATE DETERMINED?	DEPTH OF INTAKE SETTING	PUMP AGE
5.10 L/s or 67 Igpm	AVERAGED FROM ANNUAL VOLUME	2.2 m or 7.2 ft.	6

ANNUAL VOLUME OF WATER PUMPED	HOW WAS VOLUME PUMPED DETERMINED?
16083600 or 35400000	METERING RECORDS FROM 1993-1998

PUMPING CAPACITY	ANY CHANGES OR REPAIRS MADE TO THE PUMPING EQUIPMENT? *(specify)*
5.30 L/s or 70 Igpm	REPLACED PUMP IN 1992

TYPE OF STORAGE: ☒ tank(s) ☐ reservoir ☐ other *(specify)* _____

STORAGE CAPACITY: 46500 L or 10,000 Igal

COMMON INLET OR OUTLET? ☐ yes ☒ no

ATTACHED INFORMATION: ☐ well log ☐ drawings ☐ reports ☐ pump test data ☐ water quality data

NOTE: If no well log is available, please attach any other records documenting well construction (i.e., "as built" drawings, engineering reports).

PART III: HYDROGEOLOGIC INFORMATION (Refer to Steps 1 and 2)

DEPTH TO PUMPING WATER LEVEL: 1.25 m or 4.1 ft.

DEPTH TO NON-PUMPING WATER LEVEL: 0.3 m or 1 ft.

HOW WAS WATER LEVEL MEASURED? ☐ well log ☒ wetted tape ☐ probe ☐ transducer

IF WELL IS FLOWING, WHAT IS THE ARTESIAN PRESSURE HEAD AND FLOW? — m or — ft.

HOW IS PRESSURE HEAD AND FLOW MEASURED? (specify) —

IF SOURCE IS A FLOWING WELL OR SPRING, IS THERE A STORAGE IMPOUNDMENT OR RESERVOIR ASSOCIATED WITH THIS SOURCE? ☐ yes (specify) — ☐ no

WELLHEAD ELEVATION (height above mean sea level): 50 m or 164 ft.

HOW WAS ELEVATION DETERMINED? ☐ survey ☐ altimeter ☒ topographic ☐ map (specify scale and contour interval) ☐ other (specify)

TYPE OF CONFINING LAYER FROM WELL LOG (e.g., clay, till): NONE

LOCATION OF CONFINING LAYER AT DEPTH FROM WELL LOG: — m or — ft.

THICKNESS OF CONFINING LAYER FROM WELL LOG: — m or — ft.

HOW LATERALLY EXTENSIVE IS CONFINING LAYER? —

IS YOUR WELL ASSOCIATED WITH A KNOWN AQUIFER? ☒ yes ☐ no

NAME OF AQUIFER: PUMPHANDLE AQUIFER

AQUIFER CLASSIFICATION NUMBER (from MoELP): 20

AQUIFER CLASSIFICATION (from MoELP): IIB(12)

TYPE OF AQUIFER ☒ unconsolidated, unconfined ☐ unconsolidated, confined ☐ bedrock

ARE THERE OTHER HIGH-CAPACITY WELLS, 30 L/s OR 500 GAL./MIN. (agricultural, municipal and/or industrial), LOCATED WITHIN A 300-m RADIUS OF THE COMMUNITY WELL? ☐ yes How many? NONE ☒ no

ANNUAL RAINFALL: 1.52 m or 60 in.

AQUIFER TRANSMISSIVITY: 310 m^2/d or 25000 Igpd/ft.

HOW WAS TRANSMISSIVITY DETERMINED? ☐ from pumping test ☐ from specific capacity ☒ other (specify) ASSUMED FROM PUMP TEST OF CHARLIE'S WELL

HYDRAULIC GRADIENT: 0.0714

HOW WAS HYDRAULIC GRADIENT DETERMINED? ☒ from well water levels ☐ from topography ☐ other (specify) - BY HYDRO-LOGIC, FROM MELP'S (1983) REPORT

PLEASE IDENTIFY OR DESCRIBE ADDITIONAL HYDROLOGIC OR GEOGRAPHIC CONDITIONS THAT YOU BELIEVE MAY AFFECT THE SOURCE. WHERE POSSIBLE, REFERENCE THEM TO LOCATIONS ON THE MAP PRODUCED IN PART IV.

THE HILLSLOPE SOUTH OF AIKEN'S WELL SUGGESTS GROUNDWATER FLOW IS FROM THE UPHILL DIRECTION.

PART IV: ASSESSMENT OF WATER QUALITY (Refer to Step 1)

1 HOW LONG HAS THE WATER SYSTEM BEEN IN EXISTENCE? 36 YRS

2 HAS YOUR WELL EVER BEEN DEEPENED, CLEANED, NEW WELL CONSTRUCTED? ☐ yes — Why? — ☒ no

3 IN THIS TIME, HAVE THERE BEEN ANY WATER QUALITY PROBLEMS? ☐ yes ☒ no ☐ don't know

IF YES, WHEN AND WHAT WAS THE CAUSE OF THESE PREVIOUS PROBLEMS (i.e., drought, pump failure, plugging, increased usage, interference, contamination)? ELEVATED NO_3-N (>3 mg/L) IN AIKEN WELL FROM LAST SAMPLING ROUND IN 1998.

IF CONTAMINATION: • WHAT WATER QUALITY CHANGES WERE APPARENT (i.e., taste, colour, turbidity, other)? • WHAT ACTION WAS TAKEN TO OVERCOME THIS PROBLEM? • WHAT WERE THE EFFECTS OF THIS ACTION?

NOT ENOUGH DATA TO DETERMINE IF WATER QUALITY HAS CHANGED OVER TIME.

4 BACTERIAL CONTAMINATION

ANY BACTERIAL DETECTION(S) IN THE PAST 3 YEARS BASED ON SOURCE-MONITORING RECORDS?	☐ yes	☒ no	HAVE THERE BEEN SAMPLING PROTOCOLS OR QA/QC ESTABLISHED?	☐ yes ☒ no
HAS SOURCE (IN PAST 3 YEARS) HAD A BACTERIOLOGICAL CONTAMINATION PROBLEM FOUND IN DISTRIBUTION SAMPLES THAT WAS ATTRIBUTED TO THE SOURCE?	☐ yes	☒ no	IF YES, WHAT ARE THEY? COLLECT WATER SAMPLE FROM TAP IN OFFICE.	
WAS THE BACTERIOLOGICAL CONTAMINATION DUE TO THE SOURCE?	☐ yes	☒ no		
WAS THE BACTERIOLOGICAL CONTAMINATION DUE TO CROSS-CONNECTIONS?	☐ yes	☒ no		
IS THE WELL AVAILABLE FOR DIRECT SAMPLING?	☒ yes	☐ no		

SOURCE-SPECIFIC WATER QUALITY RECORDS **(Refer to Step 1)**

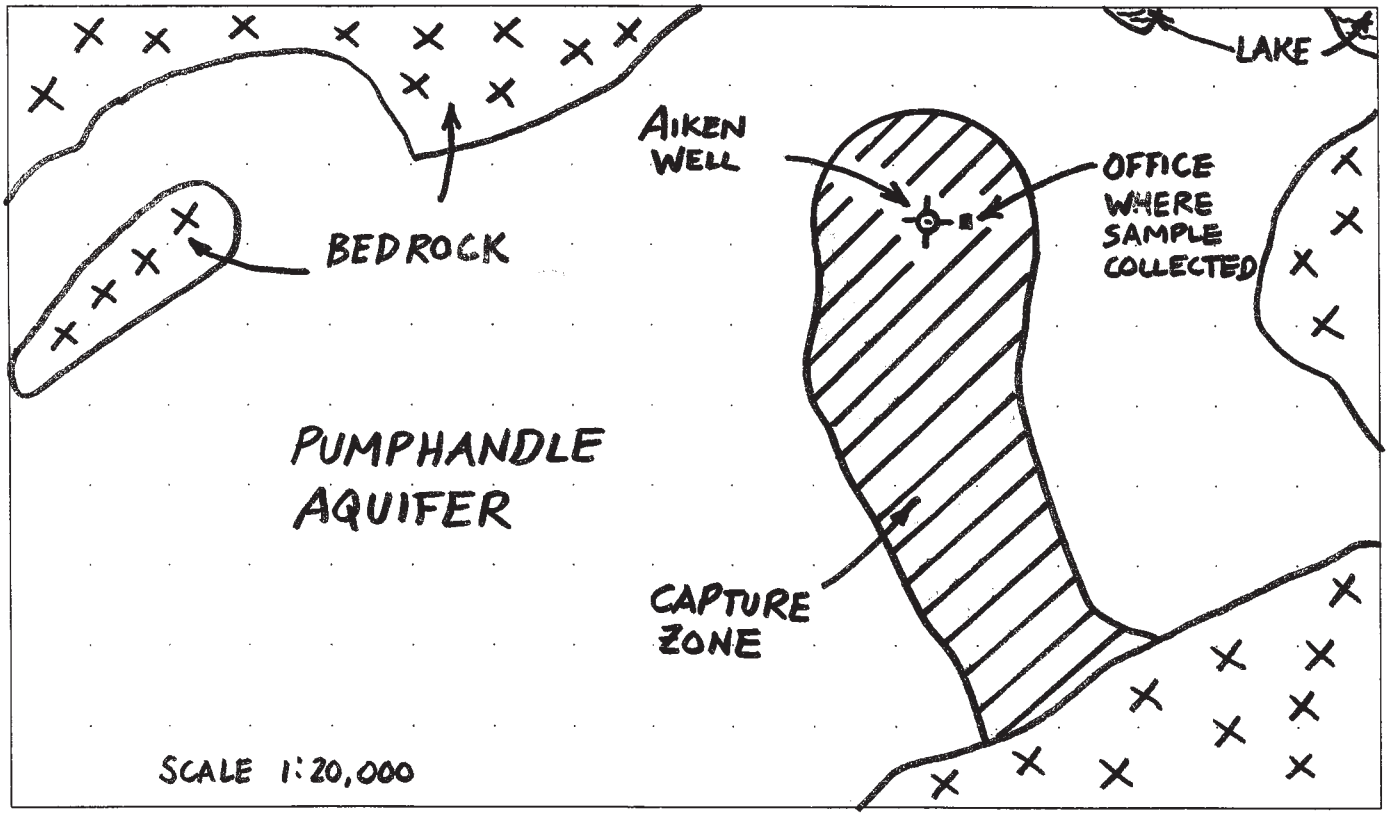
Please indicate the occurrence of any test results in the last 10 years that meet the following conditions:

PARAMETER	RECURRING PROBLEMS	TEST RESULTS	EXCEEDENCES OF CDWQG[1]
Bacteriological Total/Faecal Coliforms Background Heterotrophic plate counts Iron and Sulphate Reducers	NONE		NEVER DETECTED
Disinfection by-products Bromodichloromethane Dibromochloromethane Chloroform	NONE, WELL WATER NOT CHLORINATED		NEVER DETECTED
Physical Parameters pH, colour, alkalinity, specific conductance, hardness, total dissolved solids, total organic carbon, turbidity	NONE		
Inorganic Parameters Nitrates, fluoride, sulfate, sulphide, ammonia, chloride, nitrite, nitrogen (organic)	ELEVATED NO_3-N IN 4 OF 4 SAMPLING ROUNDS	6.2-8 mg/L	NO EXCEEDENCES
Metals* Calcium, iron, magnesium, manganese, sodium	NONE		NO EXCEEDENCES

[1] Canadian Drinking Water Quality Guidelines, 6th edition

* A metal scan is usually performed every 3 years at least, and includes aluminum, arsenic, barium, cadmium, chromium, copper, lead, molybdenum, nickel, phosphorus, silver and zinc.

Please sketch in the box below the location sampling point with respect to the well.



PART V: WATER TREATMENT INFORMATION (Refer to Step 1)

IS THIS SOURCE TREATED? ☐ yes ☒ no | IF YES, TYPE OF TREATMENT ☐ disinfection ☐ filtration ☐ carbon filter ☐ air stripper ☐ water softener ☐ other (specify) N/A

PURPOSE OF TREATMENT: N/A, SOURCE NOT TREATED

IF SOURCE IS CHLORINATED, IS A CHLORINE RESIDUAL MAINTAINED?	Total Chlorine — ppm	Free Chlorine — ppm	WHAT IS THE RESIDUAL LEVEL OF TREATMENT? —
IS THERE ANY WATER STORAGE IN THE SYSTEM? ☒ yes ☐ no			IS THE WATER TREATMENT BEFORE OR AFTER THE STORAGE UNIT? ☐ before ☐ after
WHAT IS THE TOTAL AND FREE CHLORINE IN THE DISTRIBUTION SYSTEM?	Total Chlorine — ppm	Free Chlorine — ppm	IS THERE ANY ADDITIONAL CHLORINE ADDED AFTER THE SOURCE (rechlorination)? Total Chlorine — ppm; Free Chlorine — ppm
WHAT TYPE OF CHEMICALS ARE USED IN THIS PROCESS? (specify) —			WHERE ARE CHEMICALS STORED? —
IS THERE PROPER STORAGE FOR THESE CHEMICALS? ☒ yes ☐ no			IF STORED IN PUMP HOUSE, HOW ARE CHEMICALS ISOLATED FROM THE WELL? —

PART VI: MAPPING THE CAPTURE ZONE TO YOUR COMMUNITY WELL (Refer to Step 2)

A map (1:5000 to 1:20,000 are typical scales) will be needed to complete this section. Multiple wells in the same area can be plotted on one map.

CIRCULAR CAPTURE ZONE (refer to Appendix 2.1)		
*attach calculation sheets		RADIUS (m)
Arbitrary Fixed Radius		300
Calculated Fixed Radius	(1-year travel time)*	99
	(5-year travel time)*	221
	(10-year travel time)*	312

PARABOLIC CAPTURE ZONE (refer to Appendix 2.2)*

Downgradient distance 2 m | Width of capture zone 16 m

Is there a river, lake, pond, stream or other obvious surface water body within the 6-month time of travel boundary? ☐ yes (identify on map) ☒ no

Is there a stormwater and/or wastewater facility, treatment lagoon or holding pond located within the 6-month time of travel boundary? ☐ yes (identify on map) ☒ no

PART VII: SOURCE SURVEY (Refer to Step 3)

4 REGIONAL SOURCES OF RISK TO GROUND WATER

Please indicate if any of the following potential sources of contamination within the capture zone.

ACTIVITY	T.O.T. NOT SPECIFIED	1-YEAR	5-YEAR	10-YEAR	COMMENTS
Chemical Storage *(specify)*	✓				
Injection wells					
Abandoned wells					
Landfills, dumps, disposal areas					
Commercial/industrial sites	✓				GAS STATION; DRY CLEANER
Known hazardous materials clean-up site					
Household hazardous waste					
Population density > 2 houses per hectare	✓				
On-site sewage treatment	✓				
Wastewater treatment facility					
Sites used for land application of waste					
Golf course					
Dairy or beef farms					
Poultry barns					
Hobby farms					
Fields: vegetables, hay, fruit *(specify)*	✓				
Mining operations					
Gravel pits	✓				

** Mark and identify on map any of the potential sources listed above which are located within the capture zone boundary.

SEPTIC FIELD SETBACK	GRADIENT TO SEPTIC FIELD	DENSITY OF ON-SITE SEWAGE DISPOSAL SYSTEMS	
	☐ upgrade ☒ downgrade ☐ same grade	COMMUNITY SYSTEM	SYSTEM PER LOT
90 m or 300 ft.	— % 0.4 %	NONE	1 PER LOT (23/ha)

PART V: WATER TREATMENT INFORMATION (Refer to Step 1)

IS THIS SOURCE TREATED? ☐ yes ☒ no

IF YES, TYPE OF TREATMENT ☐ disinfection ☐ filtration ☐ carbon filter ☐ air stripper ☐ water softener ☐ other (specify) N/A

PURPOSE OF TREATMENT: N/A, SOURCE NOT TREATED

IF SOURCE IS CHLORINATED, IS A CHLORINE RESIDUAL MAINTAINED?	Total Chlorine	Free Chlorine	WHAT IS THE RESIDUAL LEVEL OF TREATMENT?
	— ppm	— ppm	—

IS THERE ANY WATER STORAGE IN THE SYSTEM? ☒ yes ☐ no

IS THE WATER TREATMENT BEFORE OR AFTER THE STORAGE UNIT? ☐ before ☐ after

WHAT IS THE TOTAL AND FREE CHLORINE IN THE DISTRIBUTION SYSTEM?	Total Chlorine	Free Chlorine	IS THERE ANY ADDITIONAL CHLORINE ADDED AFTER THE SOURCE (rechlorination)?	Total Chlorine	Free Chlorine
	— ppm	— ppm		— ppm	— ppm

WHAT TYPE OF CHEMICALS ARE USED IN THIS PROCESS? (specify) —

WHERE ARE CHEMICALS STORED? —

IS THERE PROPER STORAGE FOR THESE CHEMICALS? ☒ yes ☐ no

IF STORED IN PUMP HOUSE, HOW ARE CHEMICALS ISOLATED FROM THE WELL? —

PART VI: MAPPING THE CAPTURE ZONE TO YOUR COMMUNITY WELL (Refer to Step 2)

A map (1:5000 to 1:20,000 are typical scales) will be needed to complete this section. Multiple wells in the same area can be plotted on one map.

CIRCULAR CAPTURE ZONE (refer to Appendix 2.1)

*attach calculation sheets		RADIUS (m)
Arbitrary Fixed Radius		300
Calculated Fixed Radius	(1-year travel time)*	99
	(5-year travel time)*	221
	(10-year travel time)*	312

PARABOLIC CAPTURE ZONE (refer to Appendix 2.2)*

Downgradient distance 2 m | Width of capture zone 16 m

Is there a river, lake, pond, stream or other obvious surface water body within the 6-month time of travel boundary? ☐ yes (identify on map) ☒ no

Is there a stormwater and/or wastewater facility, treatment lagoon or holding pond located within the 6-month time of travel boundary? ☐ yes (identify on map) ☒ no

PART VII: SOURCE SURVEY (Refer to Step 3)

4 REGIONAL SOURCES OF RISK TO GROUND WATER

Please indicate if any of the following potential sources of contamination within the capture zone.

ACTIVITY	T.O.T. NOT SPECIFIED	1-YEAR	5-YEAR	10-YEAR	COMMENTS
Chemical Storage (specify)	✓				
Injection wells					
Abandoned wells					
Landfills, dumps, disposal areas					
Commercial/industrial sites	✓				GAS STATION; DRY CLEANER
Known hazardous materials clean-up site					
Household hazardous waste					
Population density > 2 houses per hectare	✓				
On-site sewage treatment	✓				
Wastewater treatment facility					
Sites used for land application of waste					
Golf course					
Dairy or beef farms					
Poultry barns					
Hobby farms					
Fields: vegetables, hay, fruit (specify)	✓				
Mining operations					
Gravel pits	✓				

** Mark and identify on map any of the potential sources listed above which are located within the capture zone boundary.

SEPTIC FIELD SETBACK	GRADIENT TO SEPTIC FIELD	DENSITY OF ON-SITE SEWAGE DISPOSAL SYSTEMS	
	☐ upgrade ☒ downgrade ☐ same grade	COMMUNITY SYSTEM	SYSTEM PER LOT
90 m or 300 ft.	— % 0.4 %	NONE	1 PER LOT (23/ha)

BRITISH COLUMBIA Ministry of Health and Ministry Responsible for Seniors | Ministry of Environment, Lands and Parks

WELL ASSESSMENT FORM

TO BE USED WITH THE WELL PROTECTION TOOLKIT.

IMPORTANT! Please complete one form for each ground water source used in your water system. Fill in available information. If missing information, it may be advisable to contact the Ministry of Environment, Lands and Parks' Groundwater Section [(250) 387-1115], or the local driller who drilled the well, to assist. Photocopy this form as necessary.

PART I: WELL SYSTEM INFORMATION (Refer to Step 1)

WATER SYSTEM LEGAL NAME: BLACKWATER WATERWORKS LTD.

LEGAL DESCRIPTION OF WELL LOCATION: SEC. 10, TP22, PL 54872 NEW WEST

WATER SYSTEM LEGAL ADDRESS: 1900 PUMPHANDLE HWY, PUMPHANDLE, BC

LATITUDE / LONGITUDE: —

HOW WERE LOCATION COORDINATES DETERMINED? ☐ GPS _____ *(specify accuracy)* ☐ survey ☐ digitized from _____ map *(specify scale)*

UTM COORDINATES: E: 571 940; N: 5431980

HOW MANY OTHER WELLS MAKE UP THE WATER SYSTEM? 1

DOES THE WATER SYSTEM ALSO USE A SURFACE WATER SOURCE? *(describe)* NO

NUMBER OF CONNECTIONS: Maximum _____ Actual 35

POPULATION SERVED: 100

WATER USE: ☒ domestic ☒ irrigation ☐ commercial ☐ industrial other *(specify)* _____

WIN NO.: 45214

EMS NO.: E219651

WELL TAG NO.: —

Contact your local Ministry of Environment, Lands and Parks office or local Health Unit for the following information:

WIN NO. = MoELP's metal tag affixed to the well for on-site identification.

EMS NO. = MoELP's site number for the water chemistry on their database.

BC WELL TAG NO. = MoELP's computer number for the well.

Bulk supply ☒ yes ☐ no | Back-up supply ☐ yes ☒ no | Emergency supply ☐ yes ☒ no | Metered ☒ yes ☐ no

WELL OWNER / OPERATOR INFORMATION

WELL OPERATOR: JENNY LOWDEN

WELL OPERATOR'S PHONE NO.: (604) 853-4868

WELL OPERATOR'S ADDRESS: 1900 PUMPHANDLE HWY, PUMPHANDLE, BC

WELL OWNER: JENNY LOWDEN

WELL OWNER'S PHONE NO.: ( ) AS ABOVE

WELL OWNER'S ADDRESS: AS ABOVE

PART II: WELL CONSTRUCTION INFORMATION (Refer to Step 1)

WELL-DRILLER'S NAME, COMPANY AND ADDRESS:
A-1 DRILLING
PO BOX 83
ABBOTSFORD, BC V2S 4N7

POSTAL CODE: V2S 4N7

WELL-DRILLER'S TELEPHONE NO.: (604) 853-5231

DATE WELL ORIGINALLY CONSTRUCTED (YYYY MM DD): 1980 06 17

DATE OF LAST RECONSTRUCTION (YYYY MM DD): 19800617

TYPE OF WELL: ☒ drilled ☐ dug ☐ other *(specify)* _____

METHOD OF DRILLING: ☒ rotary ☐ cable tool ☐ driven ☐ jetted ☐ other *(specify)* _____

WELL LOG AVAILABLE? ☒ yes *(attach)* ☐ no

DEPTH OF WELL: 30.5 m or 100 ft.

DIAMETER OF WELL: 0.20 m or 8 in.

SCREEN LENGTH: 1.52 m or 5 ft.

DEPTH TO TOP OF SCREEN: 28.96 m or 95 ft.

WELL CAPACITY: 22.7 L/s or 300 Igpm

LOCATION OF WATER-BEARING FRACTION(S) (for bedrock wells): —

YIELD OF WATER-BEARING FRACTION(S): — L/s or — Igpm

WELLHEAD ENCLOSURE: ☒ pump house ☐ manhole ☐ other *(specify)* _____ ☐ none

SURFACE SANITARY SEAL: grouted to — m or — ft. ☒ no surface seal ☐ pitless adapter

AVERAGE PUMPING RATE: 4.7 L/s or 62 Igpm

HOW WAS PUMPING RATE DETERMINED? AVERAGED FROM ANNUAL VOLUME

DEPTH OF INTAKE SETTING: 27.4 m or 90 ft.

PUMP AGE: 19 YRS

ANNUAL VOLUME OF WATER PUMPED: 148,516,000 32670000

HOW WAS VOLUME PUMPED DETERMINED? METERING RECORDS FROM LAST YEAR

PUMPING CAPACITY: 25 L/s or 330 Igpm

ANY CHANGES OR REPAIRS MADE TO THE PUMPING EQUIPMENT? *(specify)* REGULAR MAINTENANCE

TYPE OF STORAGE: ☒ tank(s) ☐ reservoir ☐ other *(specify)* _____

STORAGE CAPACITY: 113650 L or 25000 Igal

COMMON INLET OR OUTLET? ☐ yes ☒ no

ATTACHED INFORMATION: ☒ well log ☐ drawings ☐ reports ☐ pump test data ☐ water quality data

NOTE: If no well log is available, please attach any other records documenting well construction (i.e., "as built" drawings, engineering reports).

PART III: HYDROGEOLOGIC INFORMATION (Refer to Steps 1 and 2)

DEPTH TO PUMPING WATER LEVEL: 13.77 m or 45.2 ft.
DEPTH TO NON-PUMPING WATER LEVEL: 12.2 m or 40 ft.
HOW WAS WATER LEVEL MEASURED? [X] well log [ ] wetted tape [ ] probe [ ] transducer

IF WELL IS FLOWING, WHAT IS THE ARTESIAN PRESSURE HEAD AND FLOW? — m or — ft.
HOW IS PRESSURE HEAD AND FLOW MEASURED? (specify) —
IF SOURCE IS A FLOWING WELL OR SPRING, IS THERE A STORAGE IMPOUNDMENT OR RESERVOIR ASSOCIATED WITH THIS SOURCE? [ ] yes (specify) — [ ] no

WELLHEAD ELEVATION (height above mean sea level): 50 m or 164 ft.
HOW WAS ELEVATION DETERMINED? [ ] survey [ ] altimeter [X] topographic [ ] map (specify scale and contour interval) [ ] other (specify)

TYPE OF CONFINING LAYER FROM WELL LOG (e.g., clay, till): CLAY
LOCATION OF CONFINING LAYER AT DEPTH FROM WELL LOG: 26.2-27.7 m or 86-91 ft.
THICKNESS OF CONFINING LAYER FROM WELL LOG: 1.5 m or 5 ft.
HOW LATERALLY EXTENSIVE IS CONFINING LAYER? UNKNOWN

IS YOUR WELL ASSOCIATED WITH A KNOWN AQUIFER? [X] yes [ ] no
NAME OF AQUIFER: PUMPHANDLE AQUIFER
AQUIFER CLASSIFICATION NUMBER (from MoELP): 20
AQUIFER CLASSIFICATION (from MoELP): IIB(12)

TYPE OF AQUIFER: [X] unconsolidated, unconfined [ ] unconsolidated, confined [ ] bedrock
ARE THERE OTHER HIGH-CAPACITY WELLS, 30 L/s OR 500 GAL./MIN. (agricultural, municipal and/or industrial), LOCATED WITHIN A 300-m RADIUS OF THE COMMUNITY WELL? [ ] yes How many? NONE [X] no
ANNUAL RAINFALL: 1.52 m or 60 in.

AQUIFER TRANSMISSIVITY: 310 m^2/d or 25000 Igpd/ft.
HOW WAS TRANSMISSIVITY DETERMINED? [ ] from pumping test [X] from specific capacity [X] other (specify) ALSO ASSUMED FROM PUMPING TEST OF CHARLIE'S WELL

HYDRAULIC GRADIENT: 0.0050
HOW WAS HYDRAULIC GRADIENT DETERMINED? [X] from well water levels [ ] from topography [ ] other (specify) FROM MELP'S (1983) REPORT

PLEASE IDENTIFY OR DESCRIBE ADDITIONAL HYDROLOGIC OR GEOGRAPHIC CONDITIONS THAT YOU BELIEVE MAY AFFECT THE SHAPE OF THE CAPTURE ZONE FOR THIS SOURCE. WHERE POSSIBLE, REFERENCE THEM TO LOCATIONS ON THE MAP PRODUCED IN PART IV.

THE IMPACT OF PUMPHANDLE CK. NEARBY IS NOT CLEAR.

PART IV: ASSESSMENT OF WATER QUALITY (Refer to Step 1)

1 HOW LONG HAS THE WATER SYSTEM BEEN IN EXISTENCE? 17 YRS

2 HAS YOUR WELL EVER BEEN DEEPENED, CLEANED, NEW WELL CONSTRUCTED? [ ] yes — Why? — [X] no

3 IN THIS TIME, HAVE THERE BEEN ANY WATER QUALITY PROBLEMS? [ ] yes [X] no [ ] don't know

IF YES, WHEN AND WHAT WAS THE CAUSE OF THESE PREVIOUS PROBLEMS (i.e., drought, pump failure, plugging, increased usage, interference, contamination)? ELEVATED NO_3-N (>3mg/L) IN LAST SAMPLING ROUND IS OF CONCERN

IF CONTAMINATION: • WHAT WATER QUALITY CHANGES WERE APPARENT (i.e., taste, colour, turbidity, other)? • WHAT ACTION WAS TAKEN TO OVERCOME THIS PROBLEM? • WHAT WERE THE EFFECTS OF THIS ACTION?

NOT ENOUGH DATA TO DETERMINE IF WATER QUALITY HAS CHANGED OVER TIME.

4 BACTERIAL CONTAMINATION

ANY BACTERIAL DETECTION(S) IN THE PAST 3 YEARS BASED ON SOURCE-MONITORING RECORDS? [ ] yes [X] no
HAVE THERE BEEN SAMPLING PROTOCOLS OR QA/QC ESTABLISHED? [ ] yes [X] no

HAS SOURCE (IN PAST 3 YEARS) HAD A BACTERIOLOGICAL CONTAMINATION PROBLEM FOUND IN DISTRIBUTION SAMPLES THAT WAS ATTRIBUTED TO THE SOURCE? [ ] yes [X] no

WAS THE BACTERIOLOGICAL CONTAMINATION DUE TO THE SOURCE? N/A [ ] yes [ ] no

WAS THE BACTERIOLOGICAL CONTAMINATION DUE TO CROSS-CONNECTIONS? N/A [ ] yes [ ] no

IS THE WELL AVAILABLE FOR DIRECT SAMPLING? [X] yes [ ] no

IF YES, WHAT ARE THEY?
COLLECT SAMPLE FROM TAP IN WATERWORKS OFFICE & DROP SAMPLE OFF AT HEALTH UNIT; NO QA/QC SAMPLES.

A-1 DRILLING

"Specializing in Water Wells, Soil Sampling, Exploration"

TELEPHONE
(604) 853-[redacted]

[redacted]
ABBOTSFORD, B.C.
V2S 4N7

INVOICE No. 725

LOG OF WELL

Sand & Gravel

36'

Clay

91'

Sand & Gravel

100'

TO ..... BLACK WATER Golf Course.....

ADDRESS ..... 1900 PUMPHANDLE HIGHWAY, PUMPHANDLE, BC .....

WELL DRILLED AT ..... Same .....

WELL COMPLETED ..... June 17/80 ..... INVOICE DATE ..... June 19, 1980 .....

---------- Machine Hours at ---------- per Hour		----------
---------- Feet of Drilling at ---------- per Foot		----------
100 Feet of Drilling & Casing at $25.00 per Foot		2,500.00
---------- Feet of ------- Casing at ---------- per Foot		----------
---------- Feet of ------- Casing at ---------- per Foot		----------
---------- Feet of ------- Casing at ---------- per Foot		----------
1. 8" Drive Shoes at ---------- each		110.00
5 Feet of 120 slot Screen		575.00
Installation of Screen ----------		----------
Pump Testing ---------- Hours at ---------- per Hour		----------
Surging and Baling ---------- Hours at ---------- per Hour		----------
Other Charges:		
Moving on Site and Setting Up ----------		----------
Blasting ----------		----------
Other 2 hrs developing well @ 60.00		120.00
----------		----------
----------		----------
Room and Board ----------		----------
Travelling and Tolls ----------		----------

TOTAL INVOICE PRICE ----------		$3,305.00

Notations Set screen from 95' to 100'.
Pumped well at approximately 300 G.P.M.
Static water level at 40 ft.

INVOIC

Account due on presentation of this invoice.
Interest at 1½% per Month (18% per Annum) on all accounts overdue 30 days.

SOURCE-SPECIFIC WATER QUALITY RECORDS **(Refer to Step 1)**

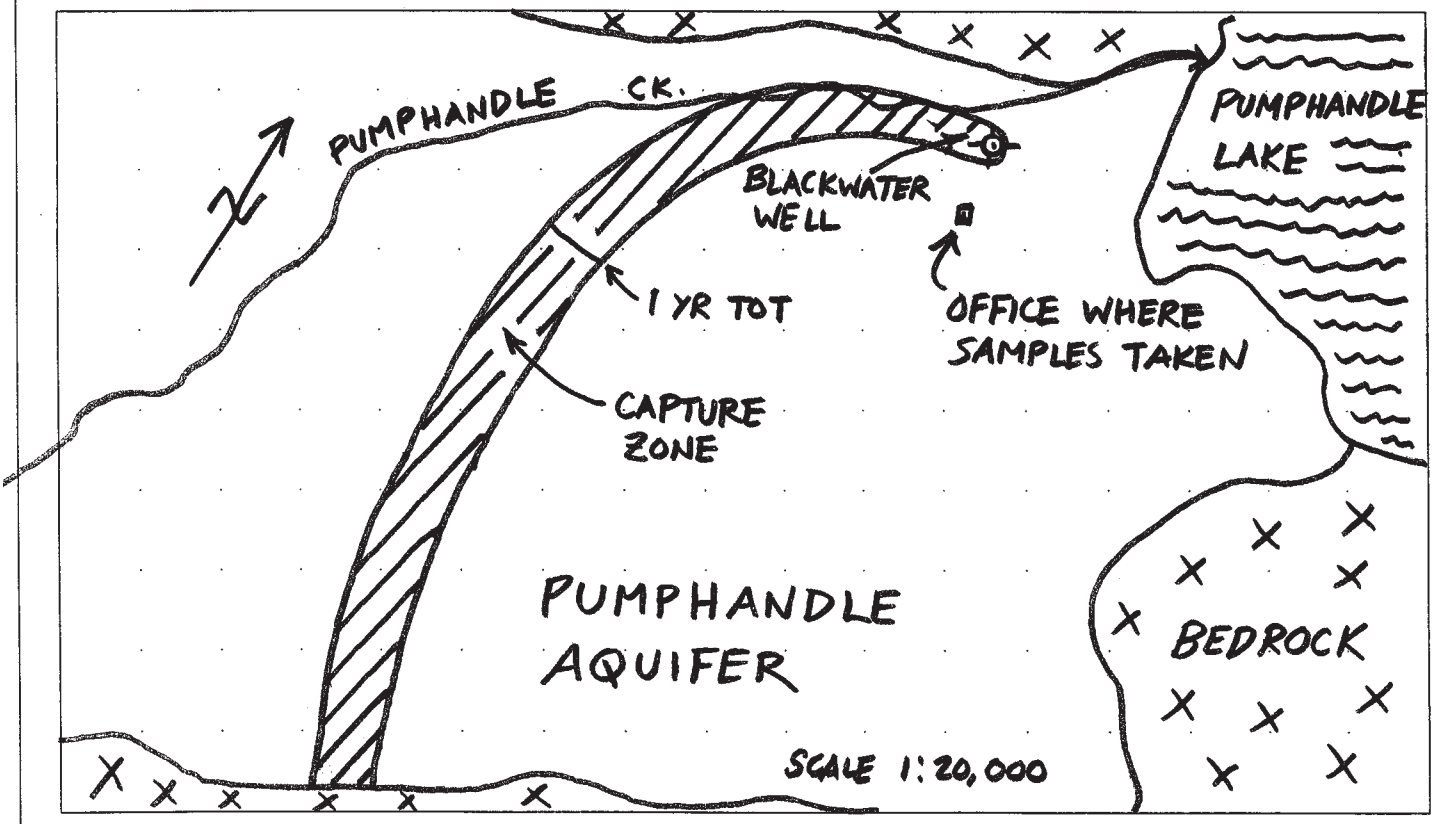
Please indicate the occurrence of any test results in the last 10 years that meet the following conditions:

PARAMETER	RECURRING PROBLEMS	TEST RESULTS	EXCEEDENCES OF CDWQG[1]
Bacteriological Total/Faecal Coliforms Background Heterotrophic plate counts Iron and Sulphate Reducers	NONE		NEVER DETECTED
Disinfection by-products Bromodichloromethane Dibromochloromethane Chloroform	NONE; WELL WATER IS NOT CHLORINATED	ALWAYS AT "ND"	NEVER DETECTED
Physical Parameters pH, colour, alkalinity, specific conductance, hardness, total dissolved solids, total organic carbon, turbidity	NONE		NO EXCEEDENCES
Inorganic Parameters Nitrates, fluoride, sulfate, sulphide, ammonia, chloride, nitrite, nitrogen (organic)	ELEVATED NO_3-N IN 3 OF 4 SAMPLING ROUNDS	2.0-5.6 mg/L	NO EXCEEDENCES
Metals* Calcium, iron, magnesium, manganese, sodium	ELEVATED Mn	0.03-0.04 mg/L Mn	NO EXCEEDENCES

[1] Canadian Drinking Water Quality Guidelines, 6th edition

* A metal scan is usually performed every 3 years at least, and includes aluminum, arsenic, barium, cadmium, chromium, copper, lead, molybdenum, nickel, phosphorus, silver and zinc.

Please sketch in the box below the location sampling point with respect to the well.



PART V: WATER TREATMENT INFORMATION (Refer to Step 1)

IS THIS SOURCE TREATED? ☐ yes ☒ no

IF YES, TYPE OF TREATMENT ☐ disinfection ☐ filtration ☐ carbon filter ☐ air stripper ☐ water softener ☐ other (specify) —

PURPOSE OF TREATMENT: SOURCE NOT TREATED

IF SOURCE IS CHLORINATED, IS A CHLORINE RESIDUAL MAINTAINED? Total Chlorine — ppm; Free Chlorine — ppm

WHAT IS THE RESIDUAL LEVEL OF TREATMENT? —

IS THERE ANY WATER STORAGE IN THE SYSTEM? ☒ yes ☐ no

IS THE WATER TREATMENT BEFORE OR AFTER THE STORAGE UNIT? N/A ☐ before ☐ after

WHAT IS THE TOTAL AND FREE CHLORINE IN THE DISTRIBUTION SYSTEM? Total Chlorine — ppm; Free Chlorine — ppm

IS THERE ANY ADDITIONAL CHLORINE ADDED AFTER THE SOURCE (rechlorination)? Total Chlorine — ppm; Free Chlorine — ppm

WHAT TYPE OF CHEMICALS ARE USED IN THIS PROCESS? (specify) —

WHERE ARE CHEMICALS STORED? A COUPLE OF LITRES OF OIL

IS THERE PROPER STORAGE FOR THESE CHEMICALS? ☐ yes ☒ no

IF STORED IN PUMP HOUSE, HOW ARE CHEMICALS ISOLATED FROM THE WELL? OIL STORED IN TOOL CABINET

PART VI: MAPPING THE CAPTURE ZONE TO YOUR COMMUNITY WELL (Refer to Step 2)

A map (1:5000 to 1:20,000 are typical scales) will be needed to complete this section. Multiple wells in the same area can be plotted on one map.

CIRCULAR CAPTURE ZONE (refer to Appendix 2.1)		
*attach calculation sheets		RADIUS (m)
Arbitrary Fixed Radius		300
Calculated Fixed Radius	(1-year travel time)*	232
	(5-year travel time)*	518
	(10-year travel time)*	733

PARABOLIC CAPTURE ZONE (refer to Appendix 2.2)*

Downgradient distance 27 m; Width of capture zone 172 m

Is there a river, lake, pond, stream or other obvious surface water body within the 6-month time of travel boundary? ☒ yes (identify on map) ☐ no

Is there a stormwater and/or wastewater facility, treatment lagoon or holding pond located within the 6-month time of travel boundary? ☐ yes (identify on map) ☒ no

PART VII: SOURCE SURVEY (Refer to Step 3)

4 REGIONAL SOURCES OF RISK TO GROUND WATER

Please indicate if any of the following potential sources of contamination within the capture zone.

ACTIVITY	T.O.T. NOT SPECIFIED	1-YEAR	5-YEAR	10-YEAR	COMMENTS
Chemical Storage *(specify)*		✓	✓		GOLF COURSE; CORN FIELD; MOTOR OIL IN PUMPHOUSE
Injection wells					
Abandoned wells			✓		
Landfills, dumps, disposal areas					
Commercial/industrial sites					
Known hazardous materials clean-up site					
Household hazardous waste					
Population density > 2 houses per hectare					
On-site sewage treatment					
Wastewater treatment facility					
Sites used for land application of waste					
Golf course					
Dairy or beef farms					
Poultry barns			✓		
Hobby farms					
Fields: vegetables, hay, fruit *(specify)*			✓		CORN FIELD
Mining operations					
Gravel pits					

** Mark and identify on map any of the potential sources listed above which are located within the capture zone boundary.

SEPTIC FIELD SETBACK >200 m or >650 ft.

GRADIENT TO SEPTIC FIELD ☐ upgrade ☐ downgrade ☒ same grade — % — %

DENSITY OF ON-SITE SEWAGE DISPOSAL SYSTEMS

COMMUNITY SYSTEM: 1 FOR GOLF COURSE

SYSTEM PER LOT: 1 PER 2-3 Ha BUT NE OF CAPTURE ZONE

BRITISH COLUMBIA Ministry of Health and Ministry Responsible for Seniors | Ministry of Environment, Lands and Parks

WELL ASSESSMENT FORM

TO BE USED WITH THE WELL PROTECTION TOOLKIT.

IMPORTANT! Please complete one form for each ground water source used in your water system. Fill in available information. If missing information, it may be advisable to contact the Ministry of Environment, Lands and Parks' Groundwater Section [(250) 387-1115], or the local driller who drilled the well, to assist. Photocopy this form as necessary.

PART I: WELL SYSTEM INFORMATION (Refer to Step 1)

WATER SYSTEM LEGAL NAME: CHARLIE'S IMPROVEMENT DISTRICT

LEGAL DESCRIPTION OF WELL LOCATION: LOT REM E, PL 23151, TP 22, NEW WEST

WATER SYSTEM LEGAL ADDRESS: 1735 SPRING CREEK DRIVE, PUMPHANDLE, BC

LATITUDE / LONGITUDE: —

HOW WERE LOCATION COORDINATES DETERMINED? ☐ GPS _____ *(specify accuracy)* ☐ survey ☐ digitized from _____ map *(specify scale)*

UTM COORDINATES: E:572270; N:5431760

HOW MANY OTHER WELLS MAKE UP THE WATER SYSTEM? 1

DOES THE WATER SYSTEM ALSO USE A SURFACE WATER SOURCE? *(describe)* NO

NUMBER OF CONNECTIONS: Maximum 15 Actual 15

POPULATION SERVED: 50

WATER USE: ☒ domestic ☐ irrigation ☐ commercial ☐ industrial other *(specify)* _____

WIN NO.: 53593

EMS NO.: E 218104

WELL TAG NO.: —

Contact your local Ministry of Environment, Lands and Parks office or local Health Unit for the following information:

WIN NO. = MoELP's metal tag affixed to the well for on-site identification.

EMS NO. = MoELP's site number for the water chemistry on their database.

BC WELL TAG NO. = MoELP's computer number for the well.

Bulk supply ☒ yes ☐ no | Back-up supply ☐ yes ☒ no | Emergency supply ☐ yes ☒ no | Metered ☒ yes ☐ no

WELL OWNER / OPERATOR INFORMATION

WELL OPERATOR: ERIC KOWSKI

WELL OPERATOR'S PHONE NO.: (604) 853-8160

WELL OPERATOR'S ADDRESS: 1735 SPRING CREEK DRIVE, PUMPHANDLE, BC

WELL OWNER: ERIC KOWSKI

WELL OWNER'S PHONE NO.: ( ) AS ABOVE

WELL OWNER'S ADDRESS: AS ABOVE

PART II: WELL CONSTRUCTION INFORMATION (Refer to Step 1)

WELL-DRILLER'S NAME, COMPANY AND ADDRESS:
A1 DRILLING
PO BOX 83
ABBOTSFORD, BC V2S 4N7

POSTAL CODE: V2S 4N7

WELL-DRILLER'S TELEPHONE NO.: (604) 853-5231

DATE WELL ORIGINALLY CONSTRUCTED (YYYY MM DD): 1984 05 24

DATE OF LAST RECONSTRUCTION (YYYY MM DD): 1984 05 24

TYPE OF WELL: ☒ drilled ☐ dug ☐ other *(specify)* _____

METHOD OF DRILLING: ☒ rotary ☐ cable tool ☐ driven ☐ jetted ☐ other *(specify)* _____

WELL LOG AVAILABLE? ☒ yes *(attach)* ☐ no

DEPTH OF WELL: 25.6 m or 84 ft.

DIAMETER OF WELL: 0.15 m or 6 in.

SCREEN LENGTH: 1.22 m or 4 ft.

DEPTH TO TOP OF SCREEN: 24.38 m or 80 ft.

WELL CAPACITY: 7.58 L/s or 100 Igpm

LOCATION OF WATER-BEARING FRACTION(S) (for bedrock wells): —

YIELD OF WATER-BEARING FRACTION(S): — L/s or — Igpm

WELLHEAD ENCLOSURE: ☒ pump house ☐ manhole ☐ other *(specify)* _____ ☐ none

SURFACE SANITARY SEAL: grouted to — m or — ft. ☒ no surface seal ☐ pitless adapter

AVERAGE PUMPING RATE: 0.53 L/s or 7 Igpm

HOW WAS PUMPING RATE DETERMINED? AVERAGED FROM ANNUAL VOLUME

DEPTH OF INTAKE SETTING: 23.8 m or 78 ft.

PUMP AGE: 14 YRS

ANNUAL VOLUME OF WATER PUMPED: 16714080 or 3679200 gal

HOW WAS VOLUME PUMPED DETERMINED? METERING RECORDS FROM 1993-1998

PUMPING CAPACITY: 1.5 L/s or 20 Igpm

ANY CHANGES OR REPAIRS MADE TO THE PUMPING EQUIPMENT? *(specify)* REGULAR MAINTENANCE

TYPE OF STORAGE: ☒ tank(s) ☐ reservoir ☐ other *(specify)* _____

STORAGE CAPACITY: 45500 L or 10000 Igal

COMMON INLET OR OUTLET? ☐ yes ☒ no

ATTACHED INFORMATION: ☒ well log ☐ drawings ☐ reports ☐ pump test data ☐ water quality data

NOTE: If no well log is available, please attach any other records documenting well construction (i.e., "as built" drawings, engineering reports).

A-1 DRILLING Ltd.

"Specializing in Water Wells, Soil Sampling, Exploration"

TELEPHONE (604) 853-[redacted]
[redacted] HWY. NO.
ABBOTSFORD, B.C.
V2S 4N7

RECEIVED
DEC 0 3 1993
LOWER MAINLAND REGION

INVOICE 941

TO Mr LENARD Kumert

ADDRESS 9354- Charles St. Chilliwack BC

WELL DRILLED AT Kindell Beach Sub-division South of Strand

WELL COMPLETED June 1984 INVOICE DATE

LOG OF WELL

Top Soil — 6'
Shale
Gravel — 58'
Clay — 64'
Shale
Gravel — 84'

	Machine Hours at	per Hour	
64' x 6"	Feet of Drilling at 25.00	per Foot	1600.00
(Surface Casing) – 20' x 8"	Feet of Drilling & Casing at 32.00	per Foot	640.00
20' x 6"	Feet of 6" Casing at 6.00 (overlap)	per Foot	120.00
	Feet of Casing at	per Foot	
	Feet of Casing at	per Foot	
1 x 6"	Drive Shoes at 86.00	each	86.00
4' x 6"	Feet of 80' Screen		440.00
Installation of Screen			
Pump Testing	Hours at	per Hour	
Surging and Baling	Hours at	per Hour	
Other Charges:			
Moving on Site and Setting Up	N/C		
Blasting			
Other Develope & Set Screen			240.00
3 hrs @ 80.00			
Room and Board			
Travelling and Tolls			
TOTAL INVOICE PRICE			3126.00

Notations Static H2O level 1'

Pumped well @ approx 100 Gallons Per Minute

INVOICE

• Account due on presentation of this Invoice. •
Interest at 1½% per Month (18% per Annum) on all accounts overdue 30 days.

PART III: HYDROGEOLOGIC INFORMATION (Refer to Steps 1 and 2)

DEPTH TO PUMPING WATER LEVEL: 1.36 m or 4.4 ft.

DEPTH TO NON-PUMPING WATER LEVEL: -0.31 m or -1 ft.

HOW WAS WATER LEVEL MEASURED? ☐ well log ☒ wetted tape ☐ probe ☐ transducer

IF WELL IS FLOWING, WHAT IS THE ARTESIAN PRESSURE HEAD AND FLOW? 0.31 m or 1 ft.

HOW IS PRESSURE HEAD AND FLOW MEASURED? *(specify)* WETTED TAPE (STICKUP IS 3')

IF SOURCE IS A FLOWING WELL OR SPRING, IS THERE A STORAGE IMPOUNDMENT OR RESERVOIR ASSOCIATED WITH THIS SOURCE? ☒ yes *(specify)* STORAGE TANK ☐ no

WELLHEAD ELEVATION (height above mean sea level): 48.5 m or 159 ft.

HOW WAS ELEVATION DETERMINED? ☐ survey ☐ altimeter ☒ topographic ☐ map *(specify scale and contour interval)* ☐ other *(specify)*

TYPE OF CONFINING LAYER FROM WELL LOG (e.g., clay, till): CLAY

LOCATION OF CONFINING LAYER AT DEPTH FROM WELL LOG: 17.7-19.5 m or 58-64 ft.

THICKNESS OF CONFINING LAYER FROM WELL LOG: 1.8 m or 6 ft.

HOW LATERALLY EXTENSIVE IS CONFINING LAYER? UNKNOWN

IS YOUR WELL ASSOCIATED WITH A KNOWN AQUIFER? ☒ yes ☐ no

NAME OF AQUIFER: PUMPHANDLE AQUIFER

AQUIFER CLASSIFICATION NUMBER (from MoELP): 20

AQUIFER CLASSIFICATION (from MoELP): IIB(12)

TYPE OF AQUIFER ☒ unconsolidated, unconfined ☐ unconsolidated, confined ☐ bedrock

ARE THERE OTHER HIGH-CAPACITY WELLS, 30 L/s OR 500 GAL./MIN. (agricultural, municipal and/or industrial), LOCATED WITHIN A 300-m RADIUS OF THE COMMUNITY WELL? ☐ yes How many? NONE ☒ no

ANNUAL RAINFALL: 1.52 m or 60 in.

AQUIFER TRANSMISSIVITY: 310 m^2/d or 25000 Igpd/ft.

HOW WAS TRANSMISSIVITY DETERMINED? ☒ from pumping test ☐ from specific capacity ☐ other *(specify)*

HYDRAULIC GRADIENT: 0.0033

HOW WAS HYDRAULIC GRADIENT DETERMINED? ☒ from well water levels ☐ from topography ☐ other *(specify)* FROM MELP's (1983) REPORT

PLEASE IDENTIFY OR DESCRIBE ADDITIONAL HYDROLOGIC OR GEOGRAPHIC CONDITIONS THAT YOU BELIEVE MAY AFFECT THE SHAPE OF THE CAPTURE ZONE FOR THIS SOURCE. WHERE POSSIBLE, REFERENCE THEM TO LOCATIONS ON THE MAP PRODUCED IN PART IV.

THE PRESENCE OF THE UNAMED SPRING CREEK & ITS IMPACT ON THE CAPTURE ZONE IS NOT CLEAR.

THE IMPACT OF TWO IRRIGATION WELLS DIRECTLY SE OF CHARLIE'S WELL IS NOT KNOWN.

PART IV: ASSESSMENT OF WATER QUALITY (Refer to Step 1)

1 HOW LONG HAS THE WATER SYSTEM BEEN IN EXISTENCE? 14 YRS

2 HAS YOUR WELL EVER BEEN DEEPENED, CLEANED, NEW WELL CONSTRUCTED? ☐ yes — Why? ☒ no

3 IN THIS TIME, HAVE THERE BEEN ANY WATER QUALITY PROBLEMS? ☐ yes ☒ no ☐ don't know

IF YES, WHEN AND WHAT WAS THE CAUSE OF THESE PREVIOUS PROBLEMS (i.e., drought, pump failure, plugging, increased usage, interference, contamination)? ELEVATED NO_3-N (>3 mg/L) FROM LAST SAMPLING ROUND IN 1998.

IF CONTAMINATION: • WHAT WATER QUALITY CHANGES WERE APPARENT (i.e., taste, colour, turbidity, other)? • WHAT ACTION WAS TAKEN TO OVERCOME THIS PROBLEM? • WHAT WERE THE EFFECTS OF THIS ACTION?

NOT ENOUGH DATA TO DETERMINE IF WATER QUALITY HAS CHANGED OVER TIME; PRESENCE OF NO_3-N IN THE WELL WATER IS A CONCERN, HOWEVER

4 BACTERIAL CONTAMINATION

ANY BACTERIAL DETECTION(S) IN THE PAST 3 YEARS BASED ON SOURCE-MONITORING RECORDS?		☐ yes	☒ no	HAVE THERE BEEN SAMPLING PROTOCOLS OR QA/QC ESTABLISHED? ☐ yes ☒ no
HAS SOURCE (IN PAST 3 YEARS) HAD A BACTERIOLOGICAL CONTAMINATION PROBLEM FOUND IN DISTRIBUTION SAMPLES THAT WAS ATTRIBUTED TO THE SOURCE?		☐ yes	☒ no	IF YES, WHAT ARE THEY? COLLECT SAMPLE FROM PUMPHOUSE
WAS THE BACTERIOLOGICAL CONTAMINATION DUE TO THE SOURCE?	N/A	☐ yes	☐ no	
WAS THE BACTERIOLOGICAL CONTAMINATION DUE TO CROSS-CONNECTIONS?	N/A	☐ yes	☐ no	
IS THE WELL AVAILABLE FOR DIRECT SAMPLING?		☒ yes	☐ no	

SOURCE-SPECIFIC WATER QUALITY RECORDS **(Refer to Step 1)**

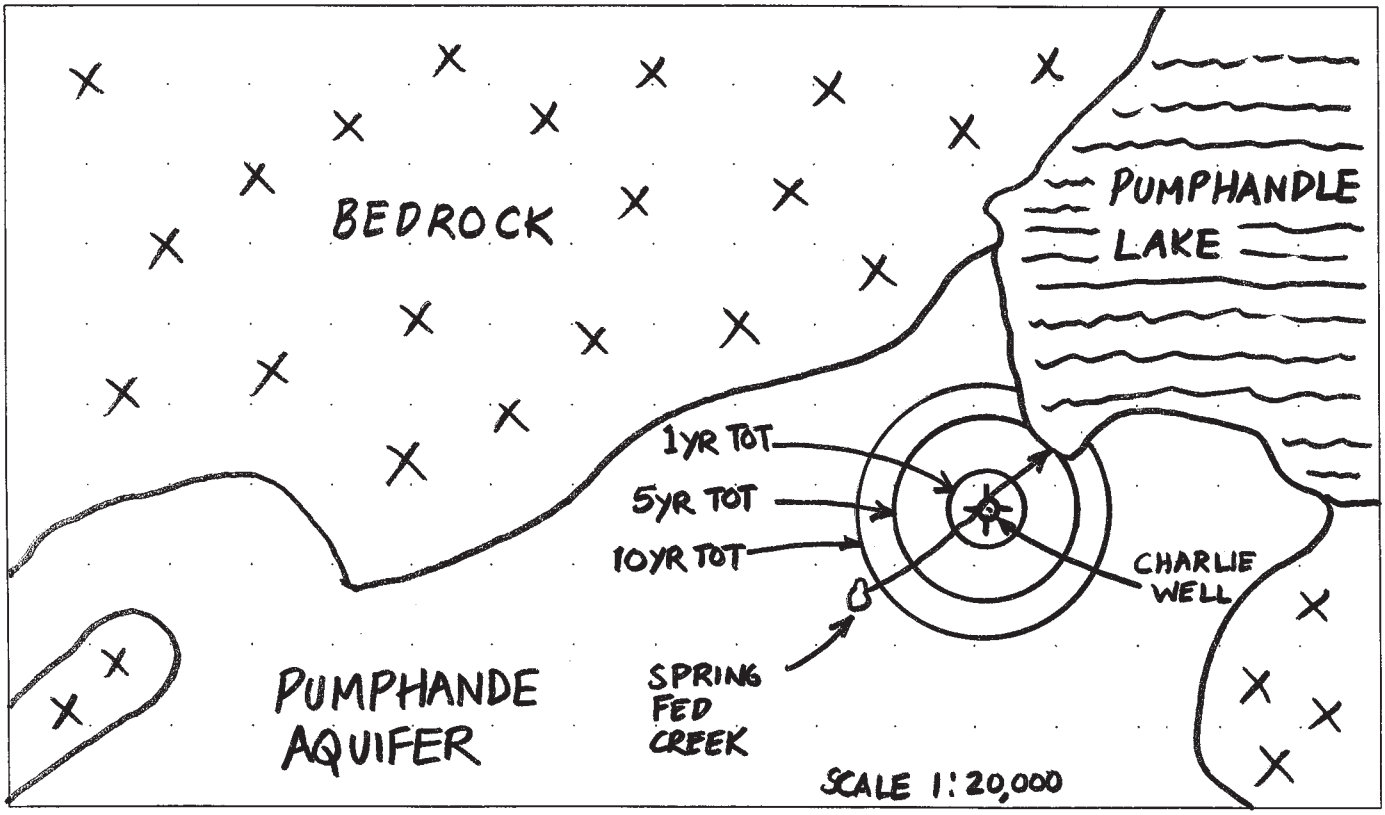
Please indicate the occurrence of any test results in the last 10 years that meet the following conditions:

PARAMETER	RECURRING PROBLEMS	TEST RESULTS	EXCEEDENCES OF CDWQG[1]
Bacteriological Total/Faecal Coliforms Background Heterotrophic plate counts Iron and Sulphate Reducers	NONE		NEVER DETECTED
Disinfection by-products Bromodichloromethane Dibromochloromethane Chloroform	NONE; WELL WATER NOT CHLORINATED		NEVER DETECTED
Physical Parameters pH, colour, alkalinity, specific conductance, hardness, total dissolved solids, total organic carbon, turbidity	NONE		
Inorganic Parameters Nitrates, fluoride, sulfate, sulphide, ammonia, chloride, nitrite, nitrogen (organic)	ELEVATED NO_3-N IN 2 OF 4 SAMPLING ROUNDS	1.6-4 mg/L	NO EXCEEDENCES
Metals* Calcium, iron, magnesium, manganese, sodium	ELEVATED Mn	0.01-0.03 mg/L	NO EXCEEDENCES

[1] Canadian Drinking Water Quality Guidelines, 6th edition

* A metal scan is usually performed every 3 years at least, and includes aluminum, arsenic, barium, cadmium, chromium, copper, lead, molybdenum, nickel, phosphorus, silver and zinc.

Please sketch in the box below the location sampling point with respect to the well.



PART V: WATER TREATMENT INFORMATION (Refer to Step 1)

IS THIS SOURCE TREATED? ☐ yes ☒ no | IF YES, TYPE OF TREATMENT ☐ disinfection ☐ filtration ☐ carbon filter ☐ air stripper ☐ water softener ☐ other (specify) N/A

PURPOSE OF TREATMENT: —

IF SOURCE IS CHLORINATED, IS A CHLORINE RESIDUAL MAINTAINED?	Total Chlorine: — ppm; Free Chlorine: — ppm	WHAT IS THE RESIDUAL LEVEL OF TREATMENT? —
IS THERE ANY WATER STORAGE IN THE SYSTEM? ☒ yes ☐ no		IS THE WATER TREATMENT BEFORE OR AFTER THE STORAGE UNIT? N/A ☐ before ☐ after
WHAT IS THE TOTAL AND FREE CHLORINE IN THE DISTRIBUTION SYSTEM?	Total Chlorine: — ppm; Free Chlorine: — ppm	IS THERE ANY ADDITIONAL CHLORINE ADDED AFTER THE SOURCE (rechlorination)? Total Chlorine: — ppm; Free Chlorine: — ppm
WHAT TYPE OF CHEMICALS ARE USED IN THIS PROCESS? (specify) —		WHERE ARE CHEMICALS STORED? —
IS THERE PROPER STORAGE FOR THESE CHEMICALS? ☒ yes ☐ no	IF STORED IN PUMP HOUSE, HOW ARE CHEMICALS ISOLATED FROM THE WELL? —	

PART VI: MAPPING THE CAPTURE ZONE TO YOUR COMMUNITY WELL (Refer to Step 2)

A map (1:5000 to 1:20,000 are typical scales) will be needed to complete this section. Multiple wells in the same area can be plotted on one map.

CIRCULAR CAPTURE ZONE (refer to Appendix 2.1)

*attach calculation sheets		RADIUS (m)
Arbitrary Fixed Radius		300
Calculated Fixed Radius	(1-year travel time)*	110
	(5-year travel time)*	247
	(10-year travel time)*	349

PARABOLIC CAPTURE ZONE (refer to Appendix 2.2)*

Downgradient distance 4 m | Width of capture zone 26 m

Is there a river, lake, pond, stream or other obvious surface water body within the 6-month time of travel boundary? ☒ yes (identify on map) ☐ no SPRING CK

Is there a stormwater and/or wastewater facility, treatment lagoon or holding pond located within the 6-month time of travel boundary? ☐ yes (identify on map) ☒ no

PART VII: SOURCE SURVEY (Refer to Step 3)

4 REGIONAL SOURCES OF RISK TO GROUND WATER

Please indicate if any of the following potential sources of contamination within the capture zone.

ACTIVITY	T.O.T. NOT SPECIFIED	1-YEAR	5-YEAR	10-YEAR	COMMENTS
Chemical Storage *(specify)*		✓			
Injection wells					
Abandoned wells					
Landfills, dumps, disposal areas					
Commercial/industrial sites					
Known hazardous materials clean-up site					
Household hazardous waste					
Population density > 2 houses per hectare		✓			
On-site sewage treatment					
Wastewater treatment facility					
Sites used for land application of waste					
Golf course					
Dairy or beef farms					
Poultry barns					
Hobby farms					
Fields: vegetables, hay, fruit *(specify)*			✓		
Mining operations					
Gravel pits					

** Mark and identify on map any of the potential sources listed above which are located within the capture zone boundary.

SEPTIC FIELD SETBACK	GRADIENT TO SEPTIC FIELD	DENSITY OF ON-SITE SEWAGE DISPOSAL SYSTEMS	
	☐ upgrade ☐ downgrade ☒ same grade	COMMUNITY SYSTEM	SYSTEM PER LOT
45 m or 150 ft.	____ % ____ %	—	1 PER LOT (2-3/ha)

Appendix 2: Hydrogeology of the Pumphandle Aquifer and Capture Zones for Pumphandle's Community Wells

Hydro-Logic Groundwater Consultants

Hydro-Logic Groundwater Consultants Ltd.
138 Alluvial Way
Delta, BC V8Z 4R6

July 15, 2005

Andrew Aiken
Aiken Waterworks Ltd.
RR 1
Pumphandle, BC
V8B 3G1

Dear Andrew Aiken:

As requested in your letter of June 16, 2005, our firm has compiled the groundwater information for the Pumphandle area and delineated the capture zones for the three community wells. We understand that your community planning team is currently in the process of developing a well protection plan for the three wells.

In this project, we have reviewed well records, surficial geology map (Armstrong, 1980), relevant groundwater reports (Carmichael, et al, 1995; Hydro-Logic, 1982; Kreye and Wei, 1994; and Mei, 1983) and air photos. We also obtained the aquifer classification map from the Ministry of Environment (2005), showing the lateral extent of the aquifer. This letter-report summarizes the hydrogeology and groundwater conditions in the Pumphandle area and presents the preliminary capture zones for the three community wells.

The Pumphandle Community Wells

The community of Pumphandle relies on three community wells operated by three separate water districts: Aiken Waterworks (Aiken's Well), Blackwater Waterworks (Blackwater Well), and Charlie's Improvement District (Charlie's Well). A summary of the three community wells is shown in Table 1.

Table 1: Summary of Pumphandle Community Wells

Well	Type	Depth (m)	Diameter (mm)	Rated Capacity (L/s)	Drinking Water Demand (L/s)	No. of users
Aiken	dug	2.4	915	5.10	5.26	500
Blackwater	drilled	30.5	200	22.73	1.05	100
Charlie	drilled	25.6	150	7.58	0.53	50

Aiken's Well is a very shallow well dug into a spring. It supplies the main subdivision in Pumphandle (165 homes – 5.26 L/s requirement) and has a rated capacity of 5.10 L/s. The water requirements exceed the maximum capacity of the shallow well, so it is likely that a new well will need to be drilled to meet future demands.

Blackwater Well supplies 35 homes (1.05 L/s requirements). However, the well is also used for irrigating the golf course and supplies the trailer campground, schools and hotels.

Charlie's Well supplies a subdivision of 15 homes (current requirements are 0.53 L/s). The well capacity has been rated at about fifteen times that amount (7.58 L/s), based on an initial pumping test conducted to prove up the water supply.

The Pumphandle Aquifer

Terraced sand and gravel deposits occupy the Pumphandle Valley and reach more than 60 m thick in the central part of the valley. The sand and gravel was deposited at the end of the last glacial period. The lower part of this permeable deposit is saturated and forms the principle aquifer – the Pumphandle Aquifer – that supplies groundwater to all the wells in the valley, including the three community wells. The aquifer rests above a layer of till of variable thickness which, in turn, rests on bedrock. The till and bedrock are less permeable and form aquitards.

Vulnerability of the Aquifer

The Ministry of Environment has designated the Pumphandle Aquifer as a moderately developed, moderately vulnerable, II B (12) aquifer. The aquifer is considered moderately vulnerable to contamination because it is unconfined, but the water table is fairly deep in most parts of the valley. Near the three community wells however, the water table is within a few metres of the surface and the aquifer is considered highly vulnerable at this location.

Groundwater Flow Direction

Mei (1983) estimated the contours of the water table from well records and showed that the water table slopes north towards the three community wells and then north-east towards the lake. It is assumed that groundwater flows the same way. The ambient hydraulic gradient (i) is about 0.1 at the side of the valley and decreases at the bottom of the valley near the three community wells. There is limited data to map the water table contour along the north-west edge of the valley so the groundwater flow direction there is not presently known.

The aquifer transmissivity near the community wells is about 3.60×10^{-3} m^2/s, based on pumping tests (Hydro-Logic, 1982). The slope of the water table suggests that recharge to the aquifer comes from precipitation falling on the aquifer and from mountain-front recharge. Groundwater in the aquifer ultimately discharges to the lake, the local creek and to pumping wells. The lake may also be a localized but significant source of recharge to the community wells during pumping.

Determining the Capture Zones for the Three Community Wells

The hydrogeological work done to date enabled the preliminary capture zones for the three community wells to be reasonably defined. Capture zones were defined using circular radius methods and analytical equations of groundwater flow. These methods are based on simple models of the aquifer and the following assumptions were made in applying the methods:

- the three community wells would pump at their maximum pumping rate,
- there is no interference between the wells, because of the low pumping rates relative to the transmissivity; the capture zones are therefore calculated separately for each well, and
- the effect of pumping of nearby private wells on the capture zone of the community wells is assumed to be insignificant.

The last assumption may be violated near large capacity irrigation wells. Significant pumping wells near the community wells will in effect result in larger capture zones. However, most of these wells are located up the valley from the community. In reality, the actual capture zones can not be known with certainty. However, the use of the maximum pumping rates will allow somewhat conservative capture zones to be defined.

Table 2 summarizes the capture zones defined for each well using the various methods. All three methods were applied to all three wells. For the Aiken well, the results from the fixed radius methods seem the most reasonable. Although a parabolic capture zone was calculated for the Aiken well, the transmissivity used for the calculation was estimated from wells elsewhere in the Pumphandle area. As such, there is a level of uncertainty associated with the capture zone determined using analytical equations. The calculated fixed radius method yields a ten-year radius of 310 m, which is about the size of an arbitrary fixed radius capture zone. However, Aiken's Well is located at the base of a terrace and it is obvious from the topography and water table contours that the flow comes directly from the higher ground to the south. The capture zone would therefore not be circular. Assuming the water table generally parallels the topography, the capture zone area for Aiken's Well would include the drainage area (about 80 ha) uphill to the edge of the aquifer boundary.

For the Blackwater Well, the parabolic capture zone determined using analytical equations seems most reasonable - it is physically based and the transmissivity value used in the calculation was based on the pump test data for that well (Hydro-Logic, 1982). Note that the parabolic capture zone is narrow and long, curving west and then south to the edge of the valley side. The narrow shape of the capture zone means that it is difficult to locate the capture zone without good control on the water table contours. In calculating the capture zone area for this well, the maximum pumping capacity was used to account for the heavy irrigation and high seasonal use.

The calculated fixed radius method was deemed most reasonable for Charlie's Well where the ambient water table is flat. The ten-year calculated fixed radius is 350 m (38 ha). The calculated fixed radius for the one-year and five-year time of travel was also calculated (Table 2). The maximum pumping capacity of the well was used to calculate the capture zone Charlie's Well, as this would account for any future growth and increased use of water for irrigation. This results in a rather larger capture zone than what it is now. Analytical equations are not accurate in this case because the water table is relatively flat and the ambient hydraulic gradient can not be determined with any accuracy. It is not clear if the ambient flow near Charlie's Well comes from the southeast or from the west-south-west. To determine this, nearby monitoring wells would be needed to provide groundwater level data to map the flow in more detail.

Table 2: Summary of Capture Zone Calculations

Well	Q	No. of users	T	b	i	AFR	CFR			Analytical Equations	
	(L/s)		(m^2/s)	(m)		(m)	r1yr (m)	r5yr (m)	r10yr (m)	Y (m)	X (m)
Aiken	5.10	500	0.0036	21	0.0917	**300**	99	221	312	8	2
Blackwater	22.73	100	0.0036	17	0.0368	300	232	518	733	**86**	**27**
Charlie	7.58	50	0.0036	25	0.0842	300	110	247	**349**	13	4

Bold text indicates the method chosen for each well.

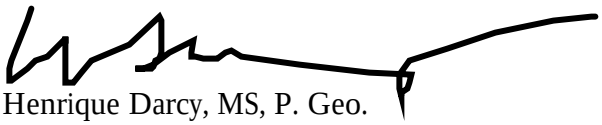
Conclusions and Recommendations

- The three Pumphandle community wells, and other wells in the Pumphandle Valley, all tap a glaciofluvial sand and gravel deposit which forms the Pumphandle Aquifer; the Ministry of Environment has classified the Pumphandle Aquifer as a moderately developed, moderately vulnerable IIB (12) aquifer.
- The Pumphandle Aquifer is unconfined and is consider highly vulnerable to contamination from the land surface at the vicinity of the three community wells because the water table is shallow at this point.
- Groundwater recharge is likely from infiltration of precipitation falling in the up-valley area and from mountain-front recharge. Groundwater flow is generally towards Pumphandle Lake.
- Preliminary capture zone areas were determined for all three community wells using fixed radius and analytical methods; times of travel were also calculated for the capture zones where possible.
- Some uncertainty regarding the size and location of these capture zones exist because of limitations in the inherent assumptions of the delineation methods and because mapping of the water table surface was based on limited data.

- Although the actual location of the capture zones can not be known for certain, the use of maximum pumping rates for the wells will result in determining the maximum areas for the capture zones and provide a margin of safety.
- It is recommended that an observation well be established to monitor the water table fluctuation in the aquifer over the long term to understand the recharge-withdraw characteristics of the aquifer.
- When funding becomes available in the future, a numerical flow model should be developed for the Pumphandle Aquifer to more accurately define the capture zones for the community wells, to assess the potential impacts on the aquifer from proposed land use activities, and to assist in planning for the expansion of the water supply systems.

If you have any questions or need any clarification about the report, please don't hesitate to call me to discuss.

Sincerely,



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Hydrogeologist

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APPENDIX 3: SOURCE ACTIVITIES AND POTENTIAL CONTAMINANTS

SOURCE ACTIVITY (AREA IN HA)	OWNER	<1-YR TIME OF TRAVEL	1-5 YR TIME OF TRAVEL	5-10 YR TIME OF TRAVEL	IN CAPTURE ZONE BUT NO TIME OF TRAVEL SPECIFIED	JUST OUTSIDE CAPTURE ZONE
1st Priority A-1 hay field (15.4)	Ed Kotischyn	Blackwater Well				
2nd Priority A-2 hay field (34.1)	Janis Lobey		Charlie's Well			
2nd Priority A-3 hay field (114.4)	Jim Summer		Blackwater Well		Aiken's Well	
2nd Priority A-3 manure storage at poultry farm	Jim Summer		Blackwater Well			
2nd Priority A-3 abandoned well	Jim Summer		Blackwater Well			
1st Priority A-4 hay field (12.3)	Simon Lee	Blackwater Well				
1st Priority A-5 corn field (44.3)	Simon Lee		Blackwater Well		Aiken's Well	
2nd Priority A-6 corn field (46.7)	Manjit Dhaliwal					Blackwater Well

FOR PUMPHANDLE WELLS

POTENTIAL CONTAMINANTS	LAND USE PRACTICE	STORAGE OF CHEMICALS	OTHER OBSERVATIONS
NO_3 from fertilizers	Grows hay for feed; broadcasts fertilizers (15-15-10) three times a year from spring to fall	Fertilizers stored on pallets on cement floor in shed; shed is 30 m from pumphandle Creek	Septic system
NO_3 from fertilizers NO_3 from former corn field?	Grows hay for grazing; broadcasts fertilizers (15-15-10) once a year from spring to fall (60 Kg/ha)	Fertilizers stored on pallets on cement floor in shed; private well is 30 m uphill (south) of shed	Septic system
NO_3 from mixing fertilizer chemicals	Grows hay for feed; broadcasts fertilizers (15-15-10) three times a year from spring to fall (55-80 Kg/ha), also uses poultry manure	Fertilizers stored on pallets on cement floor in shed; well is 10 m from shed	Septic system
NO_3 from manure leachate	15,000 leghorns; follows Code of Practice, cleans out poultry barn every spring, uses some of the manure for hayfield, sells rest to other farmers in the area	Manure stockpiled in spring but covered with tarp	
A potential pathway for contaminants dumped down the well	Well is not used, the wellhead is covered with a 5-gal pail	N/A	
NO_3 from fertilizers	Grows hay for grazing; uses poultry manure once a year (2 truckloads/ha or 50 Kg N/ha)		
Pesticides, NO_3 from fertilizers	Grows Terrific and Supersweet Jubilee variety of corn; uses poultry manure from A-3 and elsewhere (1 truckload/ha or 25 Kg N/ha) and inorganic fertilizer (15-20-25), applied in spring before and after seeding (10 Kg N/ha); uses atrazine 500 for weed control (3.5 L/ha); fertilizer application not based soil testing	Fertilizers and pesticides are stored in the shed behind the house; fertilizers on pallets and pesticides in cabinets; the private well is located 200 m to the northeast	Septic System
Pesticides, NO_3 from fertilizers	Grows Supersweet Jubilee variety of corn; uses poultry manure from A-3 and elsewhere (1 truckload/ha) and inorganic fertilizer (15-20-25), applied in spring before and after seeding (20 kg N/ha); uses atrazine 500 for weed control (3.5 to 4.5 L/ha); fertilizer application not based on soil testing	Fertilizers and pesticides are stored in the shed behind the house; fertilizers on pallets on concrete floor and pesticides on shelves; the privates well are located 200 and 350 m to the northeast	Septic system

APPENDIX 3: SOURCE ACTIVITIES AND POTENTIAL CONTAMINANTS

SOURCE ACTIVITY	OWNER	<1-YR TIME OF TRAVEL	1-5 YR TIME OF TRAVEL	5-10 YR TIME OF TRAVEL	IN CAPTURE ZONE BUT NO TIME OF TRAVEL SPECIFIED	JUST OUTSIDE CAPTURE ZONE	
2nd Priority A-7 raspberry farm (40.7)	Manjit Dhaliwal					Blackwater Well	
1st Priority C-1 gas station	Fred Kobeck			Charlie's Well	Aiken's Well		
2nd Priority C-2-hotel	Tim & Judy Sonoff					Charlie's Well	
1st Priority C-3 golf course (46.4)	Jack Sonoff	Blackwater Well and Charlie's Well			Aiken's Well		
1st Priority C-4 dry cleaner	Linda and Andrew Winters			Charlie's Well	Aiken's Well		
2nd Priority I-1-gravel pit (19.3)	Joe Mielo				Aiken's Well		
1st Priority R-1 subdivision (7.2)	Jenny Lowden strata president				Aiken's Well		
1st Priority R-2 subdivision and campground (13.5)	Jocelyne Dufour campground owner and operator	Charlie's Well					

FOR PUMPHANDLE WELLS CONTINUED

POTENTIAL CONTAMINANTS	LAND USE PRACTICE	STORAGE OF CHEMICALS	OTHER OBSERVATIONS
Pesticides, NO_3 from fertilizers	Grows Chilliwack variety of raspberry; uses poultry manure as a soil conditioner/fertilizer (1 truckload/ha) and inorganic fertilizers (10-16-18), applied in the spring (30 Kg N/ha); uses minor amounts of simazine and diazinon for weed and pest control (amounts not known); fertilizer application not based on soil testing	Fertilizers and pesticides are stored in the shed behind the house; fertilizers on pallets and pesticides on shelves; the private well is located 100 m to the north	Septic system
Gasoline, pathogens & NO_3 from septic system, oils, chemicals	The tank is 20 years old and was tested for leaks in 1987 (none were found at the time); oils and solvents were stored in 45 gallon drums and taken to the regional landfill every week for disposal	Motor oil displayed in cashier area that is indoors and contained	Septic system is 35 m from Aiken's well
Pathogens & NO_3 from septic system	Uses cleaners and some solvents; uses garden fertilizers and lime for the lawn and Round-Up on the flower beds for weed control	Cleaners and solvents are stored in the janitorial room; wash water with cleaners are poured down the drains	Septic system is 40 m from Pumphandle Lake
Pesticides, NO_3 from fertilizers, pathogens & NO_3 from septic system	Uses fertilizers (20-20-10) and pesticides; light application of slow release fertilizer in late fall (amounts not reported); application of rapid release fertilizer in spring; application based on soil testing	Fertilizers and pesticides stored in physical plant shed, shed has a concrete floor; the shed is located 100 m south of Blackwater well and 150 m west of Charlie's well	Septic system
Solvents	Uses dry cleaning chemicals	Chemicals stored in locked cabinet	Septic system
None	Extract gravel and truck off-site; no processing	Motor oil stored in office	Septic system
Pesticides, NO_3 from fertilizers, pathogens & NO_3 from septic system, degreasers	Fertilizers and pesticides (commercial products such as Round-Up) used in various amounts; amounts unknown and undocumented	Some latex paints and motor oil stored in garden shed, along with the fertilizers and pesticides	Septic system density is high (28/ha)
Pesticides, NO_3 from fertilizers, pathogens & NO_3 from septic system, degreasers	Fertilizers and pesticides (commercial products such as Round-Up) used in various amounts; amounts unknown and undocumented	Latex and oil-based paints, thinners and motor oil stored in residential garages, along with the fertilizers and pesticides;	Septic system density is moderate (2-3/ha)

APPENDIX 3: SOURCE ACTIVITIES AND POTENTIAL CONTAMINANTS

SOURCE ACTIVITY	OWNER	<1-YR TIME OF TRAVEL	1-5 YR TIME OF TRAVEL	5-10 YR TIME OF TRAVEL	IN CAPTURE ZONE BUT NO TIME OF TRAVEL SPECIFIED	JUST OUTSIDE CAPTURE ZONE	
2nd Priority R-3 subdivision (4.9)	Eric Kowski strata president					Charlie's Well	
1st Priority T-1 main road	Valley Regional District	Blackwater Well		Charlie's Well	Aiken's Well		

FOR PUMPHANDLE WELLS CONTINUED

	POTENTIAL CONTAMINANTS	LAND USE PRACTICE	STORAGE OF CHEMICALS	OTHER OBSERVATIONS
	Pesticides, NO_3 from fertilizers, pathogens & NO_3 from septic system, degreasers	Fertilizers and pesticides (commercial products such as Round-Up) used in various amounts; amounts unknown and undocumented	Some latex paints and motor oil stored in garden shed, along with the fertilizers and pesticides	Septic system density is moderate (3/ha)
	De-icing chemicals	Uses de-icing chemicals during freezing conditions (up to 20 times a year between Nov-Feb)	Chemicals stored in works yard 4 Km out of town	

SELECTED MANAGEMENT OPTIONS FOR POTENTIAL CONTAMINANT SOURCES

Activity	Management Option	Specific	Measurable	Achievable	Realistic	Time-bound	Pass-Fail S*M*A*R*T test
1 A-1 to 4 hay fields (does not address historic corn field at A2)	Encourage growers to optimize fertilizer use & implement Best Management Practices (BMPs)	Specify BMPs for fertilizer & irrigation	Record fertilizer & water use; measure crop yield	Farmer on CPT[13] is already implementing BMP at A-4	Consult MAF[14] & AC[15] on BMP	Farmer on CPT and purveyor to talk to growers at A-1, 2, & 3; implement BMPs by next year	Pass
2a. A-5, 6 corn fields	Encourage growers to optimize fertilizer use & implement BMP to reduce nitrate loading	See 1	See 1	Landowner at A-5 on CPT & is already implementing BMP	Consult MAL's environmental guidelines on field corn production	Farmer on CPT and purveyor to talk to grower at A-6; implement BMP within 2 years for A-6	Pass
2b.	Encourage growers to reduce pesticide use with IPM plan	Identify alternative pest control methods, develop IPM & implement	Reduced pesticide use; regular inspections	Technical assistance available from consultants	Consult MAL & hire pest management consultants	Farmer on CPT and purveyor to talk to grower at A-6; implement IPM by next year for A-5 & within 2 years for A-6	Pass
3a. A-7 raspberry field	Encourage growers to optimize fertilizer use & implement BMP	See 1	See 1	Landowner at A-7 was cooperative during inventory survey in Step 3	Consult MAL's environmental guidelines on berry production	Farmer on CPT and purveyor to talk to grower at A-7; implement BMP within 2 years	Pass
3b.	Encourage growers to reduce pesticide use by implementing IPM plan	See 2b	See 2b	See 2b	See 2b	As above	Pass
4a. A-3 poultry barn	Handle & dispose of manure in accordance with MOE's Code of Practice	Landowner implements Code of Practice	Periodic inspections	MOE[16] to enforce regulation	Code of Practice is regulation	Already being done; MOE to begin inspections by next year	Pass
4b.	Grower to dispose of carcasses to compost facility in accordance with MOE's Code of Practice	Temporarily hold carcasses in freezer container & regularly dispose at compost facility	Records at compost facility; periodic inspection	Nominal cost for disposal	Done elsewhere	Implement next year	Pass
5a. C-3 private golf course	Encourage owner to minimize herbicide & pesticide use through IPM plan	Develop IPM for herbicide & pesticide use & implement	Reduced quantity of herbicide & pesticide use; regular inspections	Greens can be maintained using eco-friendly maintenance techniques, training of grounds keepers required	Consult DFO[17] & EC[18] guidelines & industry association forBMP (e.g. Canadian Golf Superintendent Association)	Farmer on CPT and purveyor to talk to the golf course owner at C-3; implement within 2 years	Pass
5b.	Encourage owner to minimize fertilizer use & implement BMP	See 1	Reduced fertilizer & water use; periodic inspections	As above	As above	As above	Pass

SELECTED MANAGEMENT OPTIONS FOR POTENTIAL CONTAMINANT SOURCES CONTINUED

Activity	Management Option	Specific	Measurable	Achievable	Realistic	Time-bound	Pass-Fail S*M*A*R*T test
5c.	Encourage owner to maintain septic system as per requirement under the Sewerage System Regulation (Health Act)	Annual maintenance of septic system by owner	Septic system maintenance records	Reasonable cost (<$500)	Routinely done elsewhere	Implement by next year	Pass
6a. R-1-3 trailer park & subdivision	Include 2-page newsletter in water bill about wise use of garden fertilizers & pesticides,disposal of household hazardous waste,& water conservation	CPT produce one newsletter & mail to clients	One newsletter produced & distributed	Pumphandle Valley Conservation Society and the purveyors designs newsletter & Regional District pays for copying; advice on content from MOE & Regional District	Done in other municipalities	Implement immediately & send out in next water & pad rental bills; repeat on annual basis with up-dates & articles	Pass
6b.	Organize hazardous waste collection annually (paints, solvents/flammable liquid/pesticides)	Collect household paints & solvents; include information in two-page newsletter	Ship household wastes to depots once a year	Paint depot in Chilliwack; solvent depot to be established by 1998; call depot to set-up drop-off	Call B.C. Recycling Hotline or Paint Care Association (604-482-8686) for more information	CPT to organize collection annually	Pass
6c.	Encourage owners to maintain septic system as per requirement under the Sewerage System Regulation (Health Act)	See 5c	See 5c	See 5c	See 5c	Implement by next year	Pass
7a. hotel	Encourage owner to maintain septic system as per requirement under the Sewerage System Regulation (Health Act)	See 5c	See 5c	See 5c	See 5c	Implement by next year	Pass
8a. abandoned well	Grout well in accordance with MOE's draft Code of Practice	Hire registered driller to grout & cap abandoned well in accordance with the Ground-water Regulation	Well capped & grouted, report by driller sent to MOE	Cost ~$1K	Common industry practice	DWO to talk to owner of A-3; obtain well construction record; hire registered/ qualified driller by Fall	Pass
9a. I-1 gravel pit	Erect signs, "*No Dumping in Gravel Pit*" along the fence	Produce & erect signs (by owner)	Signs produced & erected by pit staff	$50/sign	Pit staff to do this on slow days	Regional Engineer to talk to pit owner/operator at I-1 & MEMPRs[19] District Manager; have sign erected by Fall	Pass
9b.	Educate workers on handling, storing & disposing of petroleum products & spill response	Hang poster in pit office, staff take training & post emergency phone list in office	Poster hung, course taken & phone list posted	Order poster from MOE, have manager develop safety program and deliver to staff, & compile emergency phone list with CPT	Staff well aware of groundwater protection efforts	As above	Pass

SELECTED MANAGEMENT OPTIONS FOR POTENTIAL CONTAMINANT SOURCES CONTINUED

Activity	Management Option	Specific	Measurable	Achievable	Realistic	Time-bound	Pass-Fail S*M*A*R*T test
9b.	Educate workers on handling, storing & disposing of petroleum products & spill response	Hang poster in pit office, staff take training & post emergency phone list in office	Poster hung, course taken & phone list posted	Order poster from MOE, have manager develop safety program and deliver to staff, & compile emergency phone list with CPT	Staff well aware of groundwater protection efforts	As above	Pass
10a. gas station	Test tanks for leaks & keep records on gas bought/sold	Annually test; volume bought/ sold reviewed by operator	Annual report to CPT	Operator already tracking volume of gas in tank	Common practice	Continue; DWO to discuss with owner about testing tank annually until new tank is installed	Pass
10b.	Encourage owner to replace existing tanks with newer double-lined tanks & install monitors to detect any leaks	Install new tanks	New tank installed	Company considering as part of renovation for next year	Estimated cost for 50,000 L tank is $5-10,000	DWO to discuss with owner to consider	Pass
10c.	Encourage owner to maintain septic system as per requirement under the Sewerage System Regulation (Health Act)	See 5c	See 5c	See 5c	See 5c	Implement by next year	Pass
11a. dry cleaner[20]	Encourage owner to adopt CCME[21] Code of Practice for operation	Follow CCME guidelines	Periodic inspection	Guidelines developed with industry	Guidelines available	DWO to talk to owner; adopt Code of Practice in 1 year	Pass
11b.	Encourage owner to recycle perc[22]	Volume of perc traceable	Volume perc recycled	Recycled by distributor	Being done in Ontario	Set up recycling by next year	Pass
11c.	Encourage owner to take spill response course	Take course in Vancouver	Course certificate	$200-400 for course	Owner write off as business expense	Take course in Fall	Pass
11d.	Encourage owner to join industry association (e.g. B.C. Fabricare Association) & implement BMP	Join association	Membership list	$190 for annual membership (includes membership in International Fabricare Association)	Owner write off as business expense	Join within 1 year	Pass
11e.	Pass by-law to restrict the quantity of perc in the capture zone	Enact by-law	By-law passed	Regional District is interested	Present dry cleaner in close proximity to Aiken's and Charlie's Wells	CPT to make proposal to Regional District planner; have by-law within 2 years	Pass
12a. T-1 main road	Erect signs, "*Entering Groundwater Protection Area of Pumphandle, B.C.. Please do not pollute. For more information, call 555-1234* on main road near trailer park (R3) & hay field (A1)	Produce & erect 2 signs	Signs erected; calls for more information received	$300/sign	2 signs produced by local volunteer students & erected by Regional District	Talk to school & Regional District about project; implement by next year	Pass

SELECTED MANAGEMENT OPTIONS FOR POTENTIAL CONTAMINANT SOURCES CONTINUED

Activity	Management Option	Specific	Measurable	Achievable	Realistic	Time-bound	Pass-Fail S*M*A*R*T test
12b.	Develop roadside display & put up at parking lot in front of gas station-dry cleaner	One display with map showing the aquifer & the well protection plan	One display put up; calls for more information received	As part of student project for road signs	~$1K	Erect display in May next year – in time for tourist season	Pass
12c.	Encourage Regional District to develop eco-friendly road maintenance program, including less use of herbicides & salt on road R/W	Identify eco-friendly alternatives for road maintenance & implement	Reduced use of chemicals	Practices elsewhere	Apply to 2 km of main road	Implement in 18 months	Pass

[13] CPT = Community planning team, [14] MAL = Ministry of Agriculture and Lands, [15] AC= Agriculture Canada,
[16] MOE = Ministry of Environment, [17] DFO = Department of Fisheries and Oceans, [18] EC = Environment Canada
[19] MEMPR= Ministry of Energy, Mines and Petroleum Resources, [20] Standards being developed by Environment Canada, [21] CCME = Canadian Council of the Ministers of the Environment, [22] perc = perchloroethylene, a solvent used in the dry cleaning industry

PROPOSED SCHEDULE FOR IMPLEMENTING MANAGEMENT OPTIONS

Land Use Activity	2006 Winter	Spring	Summer	Fall	2007 Winter	Spring	Summer	Fall
Hay fields (A-1 to A-4)	Talk to farmers about adopting BMPs	→	→	Implement BMPs	→	→	→	→
Corn fields (A-5, 6)	Talk to farmers about adopting BMPs & IPMs	→	→	→	→	→	→	Implement BMPs & IPMs
Raspberry field (A-7)	Talk to farmers about adopting BMPs & IPMs	→	→	→	→	→	→	Implement BMPs & IPMs
Poultry barn (A3)	Farmers to implement Code of Practice	Implement BMP for manure disposal		MOE begins inspection Implement BMP for carcass disposal	→	→	→	→
Golf course (C-3)	Talk to owner about maintaining septic system & implement BMPs & IPMs	→	→	Maintain septic system	→	→	→	Implement BMPs & IPMs
Campground & subdivision (R-1 to R-3)	Develop & send out 2-page newsletter			Maintain septic system	→	→	→	→
Hotel (C-2)				Maintain septic system	→	→	→	→
Abandoned well (A-3)		Grout off well						
Gravel pit (I-1)		Erect signs & train staff in proper waste storage & disposal						
Gas station	Talk to owner about testing tanks & installing new tanks Take course in spill response	→	→	Maintain septic system	→	→	→	→
Dry cleaner	Talk to owner about taking spill response course	Take course in spill response	→	→	→	Join industry association Adopt Code of Practice	→	→
Main road (T-1)	Identify eco-friendly methods of road maintenance	→	→	Erect signs on main road	Implement road maintenance program	→	→	→

PROPOSED SCHEDULE FOR IMPLEMENTING MANAGEMENT OPTIONS CONTINUED

Land Use Activity	2006 Winter	Spring	Summer	Fall	2007 Winter	Spring	Summer	Fall
Restricted Storage of Hazardous Chemicals By-Law	→	→	Draft by-law for consultation	→	→	→	Present by-law to elected officials	
Community Hazardous Waste Collection	Develop Household Hazardous Wastes program	→	→	Hold first Household Hazardous Wastes collection				
Public education	Develop & send out 2-page newsletter							

CONTINGENCY RESPONSES TO POTENTIAL CONTAMINANTS

Most Likely Event	Trigger	Contaminant Source/ Activity	Contingency Activity	Contact
Nitrate contamination of Aiken's, Blackwater or Charlie's Wells	Water quality monitoring Report of bad practices	Hay fields (A-1, 2, & 3) Corn fields (A-5 & 6) Golf course (C-3) Subdivision (R-1), subdivision and campground (R-2)	Issue public advisory Provide alternate source of drinking water Expand monitoring to determine source	Environmental Health Officer (EHO)/ Drinking Water Officer (DWO) Water purveyor of affected well
Pesticide contamination	Water quality monitoring Report of bad practices	Golf course (C-3)	Issue public advisory Provide alternate source of drinking water Expand monitoring to determine source	EHO/DWO Water purveyor of affected well Ministry of Environment, Lands and Parks (MOE)
Gasoline contamination	Complaint of odour in the water Water quality monitoring Spill reported	Gas station	Contact MOE Issue public advisory Provide alternate source of drinking water Expand monitoring to determine source Contain spill	EHO/DWO Water purveyor of affected well MOE
Dry cleaning liquid contamination	Water quality monitoring Spill reported	Dry cleaner	Issue public advisory Provide alternate source of drinking water Expand monitoring to determine source Contain spill	EHO/DWO Water purveyor of affected well MOE
Chemical spill or road salt contamination	Water quality monitoring Spill reported	Main road	Clean up spill Issue public advisory Provide alternate drinking water Expand monitoring to determine source Contain spill	MOE Fire department EHO/DWO Water purveyor of affected well
Contamination by household wastes	Water quality monitoring	Subdivision (R-1 and/or R-3) Subdivision and campground (R-2)	Issue public advisory Chlorinate affected well if bacteria present Provide alternate drinking water Expand monitoring	EHO/DWO Water purveyor of affected well

Appendix 7: Pumphandle Water Quality Sampling Form

CHEMISTRY REQUISITION FORM NUMBER: _____
WELL IDENTIFIER NUMBER: _____

well use: domestic ☐ community ☐

well type: unconsolidated ☐ bedrock ☐

dug ☐ sand point ☐ drilled ☐

well depth: _____ m / ft
static water level: _____ m / ft from: _____

SAMPLING METHOD

collect from tap: inside ☐ outside ☐

describe location of tap: _____

duration: _____ minutes

FIELD MEASUREMENTS / OBSERVATIONS

Time (mins.)	**Water Temp. (°C)**	**Specific Conductance (µS/cm)**	**pH**	**NO_3-N (mg/L)**	**Odour**	**Colour**	**Notes**

comments: _____

Complete and attach this form to the laboratory chemistry requisition form and keep one copy for your records.

Appendix 8: Sampling Protocol for Domestic Wells for Physical and Inorganic Chemical Analyses

Note: Prior to sampling a domestic well in the field it is necessary that you have detailed information on the specific well you are sampling! You should have a copy of the well record and well location with you. If the well is regularly monitored and is tagged with a unique *Well Identifier Plate Number*, confirm the number against your records. Establish with the well/property owner that the record you have is correct and represents the well you are about to sample. If no well record is available, obtain as much information on the well/location from the well/property owner as possible. A water quality sampling form to record information is appended. The well/property owner may also have a copy of the driller's log.

The following is a list of equipment you may require:

- coolers (large and small)
- one-litre bottles and 250-ml bottles (pre-labelled)
- sample requisition forms (filled out)
- conductivity meter, nitrate test kit and pocket pH meter
- gallon bucket and stop watch
- filtering equipment and filters

Following is the step-by-step procedure for sampling a domestic well:

1. Introduce yourself, show identification and explain to the well/property owner the reason you are requesting a water sample. Whenever possible, contact the owner to set up a time to come and sample.

2. Determine whether the inside or outside cold water tap is the preferred sampling point. Consult with the well/property owner and find out if the water is treated (e.g. does the water system have a water softener installed?) If so, obtain a sample before water goes through any treatment. Choose a tap as close as practical to the well. Describe sampling location on the sampling form (see step 7). If sampling is part of on-going monitoring, sample at the same location every time.

3. Turn the tap on full or near full flow for a minimum of three to five minutes if possible. Explain to the well/property owner that this is necessary because you need to obtain a water sample that represents as close as possible the true groundwater chemistry. Ask well/property owner if s/he has used the water recently (e.g. laundry, dishes, garden watering). If so, it may not be necessary to run the water for the full five minutes. Caution: For low yielding wells, it may not be possible to purge up to five minutes. Please consult with owner and well record. This is a judgement call by you as the sampler.

4. Monitor the water temperature (+/- 0.5° C), specific conductance (+/- 10 µS/cm), pH (+/- 0.1), and NO_3 - N (+/- 2.0 - 3.0 mg/L) during purging to check that water quality is

stable before collecting the sample. Also record any physical characteristics of the water (colour, odour etc.). If the sample point is from an outside tap direct the water into a container (e.g. bucket) if available, for plants, garden, trees etc. (don't needlessly waste the well/property owner's water!). Since you need to purge up to five minutes, pick a sample location where water discharge will not be a problem.

Bottle requirements for physical and inorganic analysis are as follows:

Physical and Inorganic sample bottle requirements		
Volume	**Preservative/Filtration**	**Parameters Analyzed for**
1 L	none (no acid wash either)/none	pH, conductivity, alkalinity, bicarbonate
250 ml	none/filtered	fluoride, chloride, sulfate, NO_2, NO_3 ammonia, dissolved metals and hardness
250 ml	nitric acid/none	total metals

Unfiltered sample: (One 1-litre bottle and one 250 ml bottle). Rinse 1 litre bottle out three times with purging water and turn water flow down to a gentle (pencil thick) stream, then collect sample. Fill one 1-litre plastic bottle. Make sure the inside of the bottle and cap are not touched. Tighten cap securely and ensure that threads are not cross threaded. Fill one 250 ml plastic bottle (Do not rinse bottle before filling). Fill to the top of the bottle allowing no head space, again ensure that the inside of the cap and bottle are not touched. Tighten cap securely and ensure that threads are not cross threaded.

Filtered sample: (One 250 ml bottle). Fill a one-litre bottle. A portion of this water is then filtered through a 45 µm disposable filter using the peristaltic pump and one 250 ml bottle filled, again allowing no head space (Do not rinse bottle before filling). Tighten cap securely and ensure that threads are not cross threaded. The peristaltic pump has the option of using 115 V and powered by the generator or clipped to the battery terminals. As another option, filter the sample manually using a filter and a filter stand. Always rinse out the filtering and pump equipment with deionized water after every sample.

5. Inform well/property owner that you will send them a copy of the chemical analysis with an explanation of the analysis when you receive results.

6. Label samples and place in cooler with ice pack. Make sure samples are placed upright or near upright in cooler. Make sure samples have proper identification (i.e. name of well, address of well, EMS number on all samples, date and time of sampling, preservation

codes; F = filtered, NF = non-filtered, P = preserved, NP = not preserved on all bottles and name and phone number of sampler). Place packing material (newspaper/foam chips) around samples to ensure they do not move in cooler during transport to laboratory. Complete chemistry requisition form (attached) and place in clear plastic zip-lock bag and place in cooler. Make sure you have the correct client code on the chemistry requisition form. Make sure you have removed the "sampler copy" of the requisition form for your records. Tape destination label on cooler lid and make sure the cooler has return address. Tape cooler shut.

7. Record all pertinent information on the *Pumphandle Water Quality Sampling* form (sample source, duration tap run prior to sample collection etc.) for future reference and attach to "sampler copy" of sample requisition form. Record the time when and place where samples or sample batches were forwarded to the laboratory. If a duplicate external QA/QC sample is collected remember to note this duplicate sample in your records.

8. Transport samples to nearest courier office as soon as possible and fill out the necessary courier form. Whenever possible, samples should be received by laboratory with a 24 hour period. Notify the laboratory that the samples have been shipped and provide any special instructions.

9. Do not sample on Fridays because the samples will sit in the laboratory on the weekend before they are analyzed.

Helpful Hints:

The secret to successful sampling is being organized !

- Have a map of the area with you showing the wells to be sampled.
- Label bottles and coolers and fill out chemistry requisition forms prior to sampling.
- Have a variety of cooler sizes with you.
- Have lots of packing material with you (e.g. newspaper, foam chips).
- Carry lots of large zip-lock bags with you.
- Carry the correct amount of bottles and coolers.
- Have all necessary information on wells to be sampled.
- Telephone well/property owners and inform them when you expect to be in the area to sample their well.
- Have a dedicated refrigerator to store samples if necessary and re-freeze ice packs.

- Try to have water sampling completed and shipped to the laboratory by Thursday morning at the latest.
- Carry stapler, paper clips, large felt pens, nylon tape, courier forms.
- Carry standard conductivity meter, thermometer, nitrate test kit and pocket pH meter with you.

Water samples are sent via courier to the address below:

CHEMTEST LABORATORY
2975 JUTLAND HIGHWAY
NORTH VANCOUVER, B.C.
V7H 1V2

Any questions from the lab?
Call Megan Lei, Head of Inorganic Chemistry Section at (604) 924-2521 or
fax at (604) 924-2555.

Good Luck !

Appendix 9: List of Parameters for Comprehensive Laboratory Analysis

Physical Parameters

Alkalinity Phen. 8.3
Alkalinity Total 4.5
Hardness Dissolved & Total
pH
Residue Filterable - 0.45 µm
Specific Conductance

Major Ions

Ammonium-Nitrogen
Bicarbonate
Calcium Dissolved & Total
Chloride Dissolved
Fluoride Dissolved
Magnesium Dissolved & Total
Nitrate and Nitrite-Nitrogen
Nitrate-Nitrogen
Nitrite-Nitrogen
Potassium Dissolved & Total
Sodium Dissolved & Total
Sulfate

Metals

Aluminum Dissolved & Total
Arsenic (low level) Dissolved & Total
Boron Dissolved & Total
Barium Dissolved & Total
Beryllium Dissolved & Total
Bismuth Dissolved & Total
Cadmium Dissolved & Total
Cobalt Dissolved & Total
Chromium Dissolved & Total
Copper Dissolved & Total
Iron Dissolved & Total
Manganese Dissolved & Total
Molybdenum Dissolved & Total
Nickel Dissolved & Total
Phosphorus Dissolved & Total
Sulfur Dissolved & Total
Silicon Dissolved & Total
Strontium Dissolved & Total
Tellerium Dissolved & Total
Thallium Dissolved & Total
Tin Dissolved & Total
Vanadium Dissolved & Total
Zinc Dissolved & Total
Zirconium Dissolved & Total

Volatile Organic Compounds

Halogenated Volatiles

Bromodichloromethane
Bromoform
Bromomethane
Carbon Tetrachloride
Chlorobenzene
Chloroethane
2-Chloroethylvinyl ether
Chloroform
Chloromethane
Dibromochloromethane
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
1,1-Dichloroethane
1,2-Dichloroethane
trans-1,2-Dichloroethylene
1,1-Dichloroethylene
1,2-Dichloropropane
1,3-Dichloropropane
cis-1,3-Dichloropropylene
trans-1,3-Dichloropropylene
Ethylene Dibromide
1,1,2,2-Tetrachloroethane
Tetrachloroethylene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
Trichlorofluoromethane
1,2,2-Trichloropropane
Vinyl Chloride

Non-Halogenated Volatiles

Benzene
Ethylbenzene
Styrene
Toluene
meta- & para-Xylene
ortho-Xylene

Pesticides

Organochlorines

Alachlor
Alpha Chlordane
Captan
Chlorothalonil
Dicofol
Endosulfan I
Endosulfan II
Endosulfan Sulfate
Gamma Chlordane
Heptachlor
Heptachlor Epoxide
Naled
op-DDE
op-DDT
pp-DDE
pp-DDT

Neutrals and Acids

EPTC
Butylate
Chlorpropham
Chlorpyrifos
Diazinon
Dimethoate
Fensulfothion
Iprodione
Malathion
Metalaxyl
Metachlor
Metribuzin
Napropamide
Oxyfluorfen
Parathion

Acids

2,3,4,6-Tetrachlorophenol
2,4,6-Trichlorophenol
2,4-D
2,4-Dichlorophenol
Dicamba
Dinoseb
MCPA
Pentachlorophenol

Neutrals

Aldicarb Sulfoxide
Atrazine
Azinophos-methyl
Carbaryl
Carbofuran
Linuron
Methomyl
Oxamyl
Simazine

List of parameters may change over time; consult your local health authority.