



P.O. Box 119

GJOA HAVEN, NT X0E 1J0

TEL: (867) 360-6338

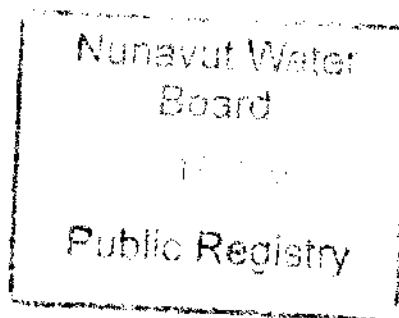
FAX: (867) 360-6369

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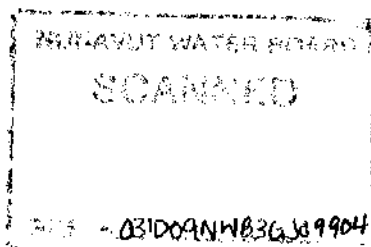
NUNAVUT WATER BOARD

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Water Licence Application Supplementary Questionnaire For Municipalities



GENERAL INFORMATION

1. Date: October 8, 2003
2. Hamlet/Town/City: Gjoa Haven

INFORMATION REQUIRED TO PROCESS THE APPLICATION

3. Current detailed map(s) and/or aerial photos will be required to process the application. Maps and/or aerial photos must show the location of the following (please check): (*see Figure 1 in Appendix A*).

- ☒ Water Source and the Water Intake Facility;
- ☒ Water Storage and Water Treatment Facilities;
- ☒ Fuel and chemical storage;
- ☒ Sewage Treatment Facilities, including discharge outlets and drainage patterns from these Facilities
- ☒ Solid Waste Disposal Facilities and drainage patterns from these Facilities;
- ☒ Hazardous Waste Disposal Facilities and drainage patterns from these Facilities;
- ☒ Transportation access routes;
- ☒ Existing water bodies/courses and any changes to these water bodies/courses that have occurred, or may occur, as a result of water use or Waste Disposal Facilities,
- ☒ Environmental monitoring sites;
- N/A Traditional use areas outlined on site map and areas around the community used for recreation, camping, fishing, etc.; and
- ☒ Abandoned and/or restored Water Treatment, Sewage, and Solid Waste Disposal Facilities.

ENGINEERED DRAWINGS AND FACILITY DESIGN PLANS REQUIRED TO PROCESS THE APPLICATION

4. WATER SUPPLY SYSTEM

Current Engineered Drawings and Facility Design Plans will be required to process the application. If Engineered Drawings and Design Plans **can not** be provided, the Applicant will be required to fill out the questions in Appendix I.

Engineered Drawing(s) should include the following (please check):

- ✓ Details of the drainage basin of the Water Source, and any proposed drainage modifications to this drainage basin;
- ✓ Details of all structures associated with the Freshwater Intake Facility;
- ✓ Details of all retaining structures (dimensions, materials of construction, etc.) associated with the Water Storage Facility;
- ✓ Details and engineered drawings of all retaining structures (dimensions, materials of construction, etc.) associated with the Water Treatment System;

5. SEWAGE TREATMENT SYSTEM

Current Engineered Drawings and Facility Design Plans will be required to process the application. If Engineered Drawings and Design Plans **can not** be provided, the Applicant will be required to fill out the questions in Appendix II. (*See Appendix II, page 15*)

Engineered Drawing(s) should include the following (please check):

- ☐ Details and engineered drawings of all retaining structures (dimensions, materials of construction, etc.) and/or the mechanical treatment system;
- ☐ Details and engineered drawings of all environmental monitoring points
- ☐ Details of the drainage basin, and any existing or proposed drainage modifications;
- ☐ Details regarding direction and path of wastewater flow from the area;
- ☐ Distance from watercourses and fish bearing waters;
- ☐ Sources of seepage presently encountered near these areas, including volumes (m³/day) and directions.

6. SOLID WASTE DISPOSAL FACILITY

Current Engineered Drawings and Facility Design Plans will be required to process the application. If Engineered Drawings and Design Plans **can not** be provided, the Applicant will be required to fill out the questions in Appendix III. (*See Appendix III, page 18*)

Engineered Drawing(s) should include the following (please check):

- ☐ Details and engineered drawings of all retaining structures (dimensions, materials of construction, etc.) and environmental monitoring points;
- ☐ Location and construction of liners;
- ☐ Details of leachate and groundwater collection systems;

- ☐ Details of the drainage basin, and existing and any proposed drainage modifications;
- ☐ Details regarding direction and path of surface water flow from the area;
- ☐ Distance from watercourses and fish bearing waters; and
- ☐ Sources of seepage presently encountered near these areas, including volumes (m³/day) and the direction of flow

WATER SUPPLY SYSTEM

7. Table I: General Information of the Water Supply System

	Satisfactory	If Unsatisfactory, please state why	Changes Planned Within Next 5 Years
Water Source Quantity	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>		Yes <input type="checkbox"/> No <input type="checkbox"/>
Water Source Quality Spring Summer Fall Winter	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	Water lake plagued by bloodworms, does not meet DOH standards with respect to water quality. New WTP will treat for bloodworms in Water Lake.	Yes <input type="checkbox"/> No <input type="checkbox"/>
Water Intake	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	20 year old pipe. Will be replaced in the new system.	Yes <input type="checkbox"/> No <input type="checkbox"/>
Water Storage Facilities	Yes <input type="checkbox"/> No <input type="checkbox"/>	Will be upgraded with the new treatment facilities.	Yes <input type="checkbox"/> No <input type="checkbox"/>
Water Treatment Facilities	Yes <input type="checkbox"/> No <input type="checkbox"/>	Proposed upgrades	Yes <input type="checkbox"/> No <input type="checkbox"/>
Water Distribution System	Yes <input type="checkbox"/> No <input type="checkbox"/>	New pipe proposed from Water Lake to WTP	Yes <input type="checkbox"/> No <input type="checkbox"/>

8. **Table III: Volume of Water Used by the Licensee**

Distribution	Estimated number of people in the community	Estimated average water consumption per person per year	Total water consumption
PIPED			
TRUCKED	1084 (2005)	112	121,408
TOTAL			

*-Conversion Factor: 1000 liters = 1 cubic metre (m³)

Water Source

9. Type of Water Source (Please check): ☒ Lake ☐ River ☐ Well ☐ Other

If other, please describe briefly.

Name of Primary Source: _____ GPS Coordinates: _____
 Name of Secondary Source: _____ GPS Coordinates: _____

If available, please attach results of recent water quality laboratory analyses.
Done, samples collected by INAC in August 2001.

10. Is water drawn from the source ☐ intermittently ☒ continuously
11. If it is drawn intermittently, during what month(s) is it drawn? _____
12. For what period is it drawn (days/weeks/months)? _____
13. What is the rate of flow (in m³/day) of source (if river) or size in cubic meters (if lake)? _____
14. At the intended rate of water usage, please describe the effects on the river or lake from which water will be drawn.

Annual consumption of water causes the lake to be drawn down significantly each year to bottom elevations. Water Lake is recharged from Swan Lake through a seasonal 3.5km pipeline with a screened intake.

15. Have any Planning or Design Assessment Studies been carried out on the Community's Water Source and main water bodies in the area? Yes ☒ No ☐

If yes, please provide a summary of program details or cite the Report's title, authors, and dates:

<u>Prepared by</u> <u>Date</u>	<u>Title</u>	<u>Completion</u>
<i>Dillon Consulting Limited</i>	<i>Water Supply for Gjoa Haven Design Brief</i>	<i>Nov. 2002</i>

If no, are such studies being planned? Yes ☐ No ☐

16. Have the Elders been consulted in the completion of any studies that have been carried out on the Community's Water Source and main water bodies in the area? Yes ☒ No ☐

If yes, specify who was consulted, how the consultation was done and when.

Band Council Meeting was held on July 30 2002.

In attendance:

Joseph Aglukkaq – Major

Councillors - Peter Akkinkanguag, Bob Konana, Mary Kamookak, Ruby Eleehetok, Ralph Potter (Senior)

Gary Strong - Dillon Consulting Limited

PW&S – Guntis Rozitis

CG&T – Sherif El-Attar

Water Storage Facility

17. What type of Water Storage Facility is used by the Community?

Reservoir/Pond ☐ Storage Tank ☒ None ☐ Other ☐

If other, please describe.

18. Does a dam or dyke used to create a reservoir affect fish migration or movement in a natural watercourse? Yes ☐ No ☒ *See letter to DFO April 2, 2002 (Appendix B)*

If yes, describe all measures undertaken to compensate for fish habitat lost due to the dam or dyke, and mitigation for fish migration or movement.

19. Is the channel of any natural watercourse changed? Yes ☐ No ☐

If yes, describe measures to maintain stream bed and bank stability.

Water Treatment Facility

20. Type of water treatment.

- ☒ Filtration and chlorination
- ☐ Chlorination only
- ☐ None
- ☐ Other _____

Description

21. Briefly describe the method of water treatment and list any chemicals used.

The system will involve coagulation and sedimentation followed by filtration then treated with chlorine in the form of calcium of sodium hypochlorite (see Figure 9a and b, Dillon report in Appendix B)

WASTE MANAGEMENT SYSTEM

22. **TABLE IV: General Information on the Waste Management System**

	Satisfactory	If Unsatisfactory, please state why	Changes Planned Within Next 5 Years
Solid Waste Disposal Facility	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	<i>Erosion that has lead to a gap in berm and decant run off</i>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Hazardous Waste Disposal Area	Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	<i>segregated</i>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Honey Bag Disposal Area (if applicable)	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Sludge Disposal (if applicable)	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>		Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Sewage Treatment Facility (including discharge area)	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	<i>Freeboard limit is unacceptable. Large breuch in berm wall causes continuous seasonal discharge</i>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>
Monitoring Program	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>	<i>INAC inspection reports ONLY</i>	Yes <input type="checkbox"/> No <input checked="" type="checkbox"/>

Sewage Treatment Facility

23. What type(s) of Sewage Treatment Facility does the Municipality operate?

- ☒ Lagoon
- ☐ Mechanical system
- ☐ Wetland
- ☐ Honey bag
- ☐ Combination/Other: describe

24. Are sludges produced? Yes ☐ No ☒

If yes, please describe how the sludges are disposed of:

25. Are there any sources of commercial or industrial liquid waste being discharged or deposited to the Sewage Treatment System that may affect the quality of the effluent produced? (The municipality should be aware that any commercial or industrial discharge has to be approved by the municipality) Yes ☐ No ☒

If yes, please indicate sources, types and quantities.

26. Are fish, shell fish and other wildlife harvested in or near the discharge area for the Sewage Treatment Facility? Yes ☐ No ☒

If yes, indicate species harvested, and level of harvest.

SOLID WASTE MANAGEMENT SYSTEM

General Information

27. Please describe the methods are used to decrease the amount of runoff water entering these areas, describing any diversions to a watercourse.

A berm has been built around the entire solid waste site to prohibit surface runoff into the site. However pooling is evident inside the berms.

28. Have any spills occurred in the past five years? Yes ☒ No ☐

If yes, please describe and show on a map the locations of the spills, indicating as well what action has been taken to clean the affected areas?

No map available. RWED spill database lists 13 spills in the last five years At various locations including the Hamlet's Tank Farm, residences and buildings. (See Appendix A)

29. Are fish, shell fish and other wildlife harvested in or near the Solid Waste Disposal Facility? Yes ☐ No ☒

If yes, please indicate the species harvested, and level of harvest.

Waste Disposal

30. Does the municipality burn garbage? Yes ☒ No ☐

31. Has the municipality considered measures for waste reduction such as recycling and/or reuse? Yes ☐ No ☒

If yes, please describe proposed activities.

32. Are any commercial or industrial wastes being discharged or deposited in the solid waste disposal area? (The municipality should be aware that any discharge of commercial or industrial waste has to be approved by the municipality)
Yes ☒ No ☐

If yes, please indicate sources, types and quantity.

A Local Northern Store and COOP drops of cardboard boxes at the landfill. Construction companies also drop off wood and building materials.

33. Does the municipality have an area for the disposal of animal carcasses? Yes ☒ No ☐

If yes, please describe the location, drainage and operation/maintenance of the site. **Figure 3, Appendix III**

34. Does the municipality have a scrap metal or bulky waste disposal area? Yes ☒ No ☐

If yes, please describe its location and operation.

Scrap metal is located outside solid waste site fence (Figure 3, Appendix III)

35. Does the municipality operate a hazardous waste disposal area? Yes ☒ No ☐

If yes, please describe its operation and maintenance (describe special handling/disposal methods for these wastes)

Yes, old oil drums are stored to the east of the Solid waste area outside of the bermed area but within fenced boundaries. The Hamlet stores batteries inside a shack near the Hamlet's shop.

INSPECTION AND MONITORING

36. When were municipal facilities last inspected by:

Indian and Northern Affairs Inspector
Environment Canada Inspector
Community Government and Transportation
Public Health
Other:

Date: 13/9/2001
Date: not applicable
Date: not available
Date: 17/07/2002
Date: _____

Please attach copies of most recent inspection reports. *Appendix C*

37. Does the Municipality have a Regular Monitoring Program in place? Yes ☒ No ☐

If No, When will the program be put in place? Please provide information on the implementation schedule.

If Yes, please answer questions a to e

a. Has the Municipality implemented a Quality Assurance/Quality Assurance Plan for its Monitoring Program? Yes ☐ No ☒

b. Briefly describe how samples are taken and sent to the laboratory.
Collection bottles are provided by Stanton Hospital. The Hamlet takes a monthly sample from one of the water trucks, and the Health Centre sends the sample along with their diagnostic specimens to Stanton for analysis. The results are sent to me for an interpretation, and I send a letter off to the SAO with the results.

c. Briefly describe any monitoring done for wastewater effluent and leachate.

The Hamlet does not monitor for wastewater effluent and leachate at this time. However, this monitoring is completed by INAC as part of regular compliance monitoring under the water licence.

d. Who is responsible for water sampling?

Name: *Hamlet of Gjoa Haven*

Position: *Foreman, Jacob Keanik*

Telephone # *(867) 360-7141*

Fax #: *(867) 360-6309*

Level of training: *Basic and Voluntary*

- e. Please provide the following contact information of the laboratory performing analysis of samples:

Name: *Stanton Regional Hospital*

Address: *550 Byrne Road, Yellowknife*

Telephone #: *Laboratory (867) 669-4162*

Fax #:

APPENDIX I

To be completed only if the Applicant is unable to provide the information requested in Question 4.

WATER SUPPLY SYSTEM

1. Describe the geological and hydrological conditions within the existing drainage basin of the Water Source. Information required will include:
 - (a) The position of water courses, water bodies and drainage features such as ditches, berms and/or dams (provide an aerial photo, a topographical map or site survey plan if possible);
 - (b) The composition of the material underlying the Facility, indicating soil composition, depth of the permafrost and the thickness of the active layer; and
 - (c) Precipitation and temperature profiles for the area.
 - (d) Describe any proposed drainage modifications to the drainage basin, including drainage ditches, berms and/or dams that have been, or may be, constructed.
2. Describe the location, details of construction and methods of operation of all structures (dimensions, materials of construction, etc.) associated with the Water Intake and Water Treatment Systems. Information required will include:
 - (a) The position of the structures associated with the Water Intake and Water Treatment Systems relative water courses, water bodies and drainage features such as ditches, berms and/or dams (provide an aerial photo, a site topographical map or site survey plan if possible);
 - (b) The dimensions and materials of construction of the any associated structures, including the size of the screens on the intake;
 - (c) The method of water treatment that is used, including a process description; and
 - (d) The type of chemicals used in the treatment process, storage locations for these chemicals and the amounts of these chemicals which are stored on site.

WATER STORAGE SYSTEM

3. Describe the location and details of construction (dimensions, materials of construction, etc.) of all buildings and water retaining structures associated with the Water Storage Facility. Information required will include:

(a) The position of the structures associated with the Water Storage System relative water courses, water bodies and drainage features such as ditches, berms and/or dams (provide an aerial photo, a site topographical map or site survey plan if possible);

(b) The dimensions and materials of construction of the any associated structures, including (if applicable) a detailed description of the Community Reservoir

(i) What is the storage capacity of the Reservoir? ____ m³

(ii) Is the Reservoir lined? Yes ☐ No ☐

If yes, what type of liner was used? _____
When was it installed? _____

(iii) If a dam or dyke used to store or alter the flow of water, what are the dimensions of the dam or dyke?

Length: _____ Width: _____ Height: _____
Upstream slope: _____ Downstream slope: _____

Please attach a diagram

MONITORING PROGRAM

Table V : Summary Information on Monitoring Activity

Monitoring Location	GPS Coordinates	Type of Monitoring Carried Out	Monitoring Frequency
		<input type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input type="checkbox"/> Annually
		<input type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input type="checkbox"/> Annually
		<input type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input type="checkbox"/> Annually
		<input type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input type="checkbox"/> Annually

APPENDIX II

SEWAGE TREATMENT SYSTEM

To be completed only if the Applicant is unable to provide the information requested in Question 5

1. Describe the geological and hydrological conditions within the existing drainage basin of the Sewage Treatment System. Information required will include:

- (a) The position of water courses, water bodies and drainage features such as ditches, berms and/or dams (provide an aerial photo, a topographical map or site survey plan if possible);

See attached Figure 2 on next page. The current sewage lagoon consists of a natural lake that was bermed around it's perimeter to contain sewage wastes. Approximately four years ago, the berm was heightened and it now reaches a height of approximately 15 feet. The berm is made out of a fine granular material.

- (b) The composition of the material underlying the Facility, indicating soil composition, depth of the permafrost and the thickness of the active layer; and

The soil composition around the lagoon berms consists of limestone lowland covered by sands and gravels. A geotechnical evaluation of the surrounding area completed in 1985 can be found in Appendix D.

- (c) Precipitation and temperature profiles for the area.

See a copy of Environment Canada's current climate data for Cambridge Bay (closest available data) in Appendix C

Daily maximum for July 12.3

Daily minimum for January -36.3

Precipitation 138.8 mm annually with 69.6 mm of rainfall and 82.1 cm snowfall

2. Describe any proposed drainage modifications to the drainage basin, including drainage ditches, berms and/or dams that have been, or may be, constructed on the geological and hydrological conditions within the existing drainage basin.

The berms may require additional height if the freeboard in the spring is not within satisfactory limits.

3. Describe all retaining structures (dimensions, materials of construction, etc.) and/or the mechanical components of the Sewage Treatment System. Please attach a diagram (*Figure 2*)



SCALE 1:4000

PUMPOUT TRUCK
ACCESS ROAD

HONEY
BUCKET
SITE

DISCHARGE



PROJECT

GJOA HAVEN
WATER WORKS & WATER SUPPLY

PROJECT NUMBER
02-0602-3000

TITLE

SEWAGE LAGOON
SITE LOCATION

DATE
SEPT 03

FIGURE NUMBER

FIG 2

- (a) The position of the structures associated with the Sewage Treatment System relative water courses, water bodies and drainage features such as ditches, berms and/or dams (provide an aerial photo, a site topographical map or site survey plan if possible);

The berm surrounding the lagoon is constructed of a fine granular material.

- (b) The dimensions and materials of construction of the any associated structures;

not available

4. Describe in detail the method of sewage treatment that is used, including a process description;

Description of Lagoon (if applicable)

- (a) Indicate the level of sewage treatment:

☒ primary ☐ secondary ☐ tertiary

Pre-treatment (if applicable): ☐ screening ☐ maceration

Lagoon type: ☒ anaerobic ☐ aerobic ☐ facultative

- (b) Indicate the capacity of the lagoon: 22,700 m³

- (c) Average depth of the wastewater lagoon N/A m.

- (d) What is the design freeboard? 1 m.

- (d) Indicate the retention time of the sewage in the treatment facility ____

The last public health audit conducted in July 2002, indicated a large breach in the berm wall permitting the effluent to continually discharge. It was recommended that the breach be repaired to increase retention and treatment time. Retention time usually begins at spring break up after winter storage. Annual discharge was recommended every fall after two to three months of treatment.

- (f) Indicate the estimated rate of discharge of wastewater _____ L/sec. (*Not applicable*)

- (g) Indicate the location of the discharge point (*see Figure 3*).

- (h) Is the discharge: seasonal ☒ continuous

If the discharge is seasonal, during what month(s) is it done?

What is the duration of the discharge (days/weeks/months)? _____

Description of Mechanical System (if applicable)

- (a) Indicate level of treatment: ☐ primary ☐ secondary ☐ tertiary
 - (b) Pre-treatment (if applicable): ☐ screening ☐ maceration
 - (c) Indicate the capacity of the sewage treatment facility _____ m³
 - (d) Indicate the estimated rate of discharge of wastewater _____ L/sec.
 - (e) Based on current population projections, the facility will meet the needs of the community until the year _____.
 - (f) Indicate the location of the discharge point _____.
5. Describe the type of chemicals used in the treatment process, storage locations for these chemicals and the amounts of these chemicals which are stored on site.
6. Describe the anticipated effects of treated effluent from the Facility on from watercourses and fish bearing waters;

7. MONITORING PROGRAM

Table VI : Summary Information on Monitoring Activity

Monitoring Location	GPS Coordinates	Type of Monitoring Carried Out	Monitoring Frequency
GJO-3 (SNP Station)	Runoff discharge from Sewage Lagoon prior to entering the ocean	<input checked="" type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input checked="" type="checkbox"/> Annually
		<input checked="" type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input type="checkbox"/> Annually
		<input checked="" type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input type="checkbox"/> Annually
		<input type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input type="checkbox"/> Annually
		<input type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input type="checkbox"/> Annually
		<input type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input type="checkbox"/> Annually

APPENDIX III

SOLID WASTE MANAGEMENT SYSTEM

To be completed only if the Applicant is unable to provide the information requested in Question 6.

1. Describe the geological and hydrological conditions within the existing drainage basin of the Solid Waste Disposal Facility. Information required will include:
 - (a) The position of water courses, water bodies and drainage features such as ditches, berms and/or dams (provide an aerial photo, a topographical map or site survey plan if possible);
See Figure 3 following. There are no water bodies within the local vicinity of the solid waste facilities except for the discharge drainage pattern from the sewage site. The household garbage is deposited inside the berm. Segregated and signed areas for animal carvasses and oil drums are found outside of the bermed area but within a fenced area. Metal, appliances, old trucks, old appliances are piled up the southwest of the bermed area outside the fence.
 - (b) The composition of the material underlying the Facility, indicating soil composition, depth of the permafrost and the thickness of the active layer; and
Same as Sewage Data
 - (c) Precipitation and temperature profiles for the area.
Same as Sewage Data
2. Describe all retaining structures (dimensions, materials of construction, etc.) associated with the Solid Waste Management System. Information required will include:
 - (a) The position of the structures associated with the Solid Waste Management System relative water courses, water bodies and drainage features such as ditches, berms and/or dams (provide an aerial photo, a site topographical map or site survey plan if possible);
See Figure 3
 - (b) The dimensions and materials of construction of the any associated structures;
The bermed section of the Solid Waste site is approximately 10,800m².
 - (c) A description of the location and construction of liners;

ANIMALS
CARCASSES

**BULK METALS
OLD APPLIANCES
TRUCKS, EQUIPMENT**

HANDFILL ACCESS

FENCE

**GJOA HAVEN
WATER WORKS & WATER SUPPLY
WASTE DISPOSAL SITE
LOCATION PLAN**

FIGURE NUMBER: FIG 3

DILLON
CONSULTING

Not applicable

- (d) A description of any leachate and groundwater collection systems that may be in place; *N/A*

3. MONITORING PROGRAM

Table VII : Summary Information on Monitoring Activity

Monitoring Location	GPS Coordinates	Type of Monitoring Carried Out	Monitoring Frequency
<i>GJO-2 (SNP Station)</i>	<i>Runoff from the Solid Waste Disposal Facilities</i>	<input checked="" type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input checked="" type="checkbox"/> Annually
		<input type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input type="checkbox"/> Annually
		<input type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input type="checkbox"/> Annually
		<input type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input type="checkbox"/> Annually
		<input type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input type="checkbox"/> Annually
		<input type="checkbox"/> Surface <input type="checkbox"/> Subsurface	<input type="checkbox"/> Monthly <input type="checkbox"/> Annually

APPENDIX A – General
Figure 1
Spill Reports
Environment Canada Climate Data
DFO Letter



DILLON
CONSULTING

PROJECT

SOLID WASTE, SEWAGE, AND WATER TREATMENT FACILITIES
GJOA HAVEN, NUNAVUT

PROJECT NUMBER
02-0602-3000

TITLE

SITE PLAN

DATE
SEPT 03

FIGURE NUMBER

FIG 1



Northwest
Territories

Resources, Wildlife and Economic Development

Hazardous Materials Spill Database

Environmental Protection Service of RWED

600, 5102-50th Avenue; Yellowknife, NT X1A 3S8

Phone: (867) 873-7654 Fax: (867) 873-0224

Wednesday, September 03, 20

Sorted by Spill Number for the year(s) : 1971-2004

Page 1 of 3

Spill No	Spill Date	Region	Location	Description	Commodity	Quantity (L or kg)	Party	Source	Agency
1974021	13-Jun-74	KIT	Gjoa Haven	Tank Farm	Heating Oil	27730	GNWT	ST>	GNWT
1987017	18-Feb-87	KIT	Gjoa Haven	Fuel Distribution Shack	Gasoline		20 Anthony's Product Shop	PL	GNWT
1987028	05-Apr-87	KIT	Gjoa Haven	Beside Town Water Lake	Transmission Fluid		100 Hamlet of Gjoa Haven	PL	GNWT
1987038		KIT	Gjoa Haven	Beside Nursing Station	Fuel Oil	600	Health & Welfare Canada	ST>	EPS
1987078	05-Jul-87	KIT	Gjoa Haven	School Fuel Tank	Heating Oil	455	DPW&H	PL	GNWT
1987117	31-Oct-87	KIT	Gjoa Haven		Diesel P-50	250	FOI	TRU	GNWT
1988037	11-Apr-88	KIT	Gjoa Haven	NCP tank Farm	Diesel P-50	2250	NCP	TRU	FPS
1988051		KIT	Gjoa Haven	North Side of Hamlet Building	Fuel Oil		0 POL	ST<	GNWT
1988106		KIT	Gjoa Haven	Co-op Bunkhouse Near RC Church	Diesel P-50		0 Kisavik Co-op Ltd	ST<	GNWT
1988141	04-Sep-88	KIT	Gjoa Haven	New School	Heating Fuel P-50	3500	Norland Construction (Winnipeg)	PL	GNWT
1988157	07-Oct-88	KIT	Gjoa Haven	House #97	Fuel Oil P-50	12	Ukuqtunnaq Fuel Delivery (	PL	GNWT
1988084		KIT	Gjoa Haven	Housing Association Yard	Machine Oil	210	Hamlet of Gjoa Haven	ST<	GNWT
1988085		KIT	Gjoa Haven	Hamlet Storage Shed	Motor Oil	20	Hamlet of Gjoa Haven	ST<	GNWT
1989173	31-Oct-89	KIT	Gjoa Haven	In Garage	Diesel P-50	150	Ukuqtunnaq Fuel Delivery (	TRU	GNWT
1991015	21-Feb-91	KIT	Gjoa Haven	Inside NWTPC Power Plant	Diesel P-50	400	NWTPC	ST<	GNWT
1991173	04-Sep-91	KIT	Gjoa Haven	POL Tank Farm	Diesel P-50	300	UFD Services (POL)	TRU	GNWT
1991225	17-Dec-91	KIT	Gjoa Haven	Ladies Group Building	Fuel Oil	70	Ladies Group (Anglican Church)	ST<	GNWT
1992035	12-Mar-92	KIT	Gjoa Haven	Hamlet Garage	Diesel Fuel	30	Hamlet of Gjoa Haven	ST<	GNWT
1992062	02-May-92	KIT	Gjoa Haven	House #4	Heating Fuel P-50	400	DPW	PL	GNWT
1992116	12-Jun-92	KIT	Gjoa Haven	House #32	Heating Oil	40	Ukuqtunnaq Fuel Delivery (	ST<	GNWT
1992158	09-Jul-92	KIT	Gjoa Haven	Quagshon School	Heating Fuel P-50	30	Ukuqtunnaq Fuel Delivery (	ST<	GNWT
1992169	24-Jul-92	KIT	Gjoa Haven	APM Construction Site	Diesel Fuel	90	APM Construction & Ukuqtunnaq	ST<	GNWT
1992181		KIT	Gjoa Haven	House #13	Heating Oil	0	DPW	ST<	GNWT
1993090	23-Jun-93	KIT	Gjoa Haven	Arena Complex	Heating Fuel P-50	91	PCL Construction	ST<	GNWT
1993139	20-Aug-93	KIT	Gjoa Haven	House #28	Heating Fuel P-50	130	Ladies Group (Anglican Church)	ST<	GNWT
1993150		KIT	Gjoa Haven	GNWT Fuel Yard	Heating Fuel P-50	0	POL Contractor	ST>	GNWT
1994043	14-Mar-94	KIT	Gjoa Haven	Renewable Resources Office	Diesel P-50	40	Ukuqtunnaq Fuel Delivery (	TRU	GNWT
1994091	03-Jun-94	KIT	Gjoa Haven	Airport Tank Farm	Heating Fuel P-50	8000	Ukuqtunnaq Fuel Delivery (	ST>	GNWT
1994101	04-Jun-94	KIT	Gjoa Haven	APM Construction Site	Transmission Fluid	60	APM Construction Ltd	OTH	GNWT
1994136	29-Jul-94	KIT	Gjoa Haven	House #2	Heating Fuel P-50	50	Hamlet of Gjoa Haven	ST<	GNWT
1994172	15-Sep-94	KIT	Gjoa Haven	House #160	Heating Fuel	35	Ukuqtunnaq Fuel Delivery (ST<	GNWT

Wednesday

November 03, 20

Sorted by Spill Number

the year(s) : 1971-2004

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Spill No	Spill Date	Region	Location	Description	Commodity	Quantity (L or kg)	Party	Source	Agency
1994180	29-Sep-94	KIT	Gjoa Haven	Tank Farm	Heating Fuel P-50	690DPW		OTH	GNWT
1994185	19-Oct-94	KIT	Gjoa Haven	On Road Outside DPW Shop	Antifreeze	20	Hamlet of Gjoa Haven	OTH	GNWT
1994185	19-Oct-94	KIT	Gjoa Haven		Hydraulic Oil	0	APM Construction Ltd	OTH	GNWT
1995032	28-Mar-95	KIT	Gjoa Haven	Tank Farm	Jet B	500	Hamlet of Gjoa Haven (FOL)	TRU	GNWT
1995055	02-May-95	KIT	Gjoa Haven	Tank Farm	Heating Fuel	720	Unknown	ST<	GNWT
1995088	13-Jun-95	KIT	Gjoa Haven	Airport Dispenser	Jet B	40	Hamlet/Petroleum Products (	ST>	GNWT
1995109	08-Jul-95	KIT	Gjoa Haven	House # 37- 019 Duplex	Heating Fuel P-50	1137	Hamlet of Gjoa Haven (POL)	IST<	GNWT
1996023	19-Feb-95	KIT	Gjoa Haven	Tank Farm	Heating Fuel P-50	400	Hamlet of Gjoa Haven (POL)	IST>	GNWT
1996104		KIT	Gjoa Haven	Housing Unit #0132	Diesel Fuel	181	Joseph Aglukkaq	TRU	GNWT
1996146		KIT	Gjoa Haven	Tank Farm	Fuel Oil P-50	182	Trimak (POL)	ST>	GNWT
1997015	13-Feb-97	KIT	Gjoa Haven	Tank Farm Facility	Fuel Oil P-50	230	Trimak (POL)	ST>	GNWT
1997081	07-May-97	KIT	Gjoa Haven	Nunavut Waterboard Office	Heating Fuel P-50	1449	Keketak Co-op	ST<	GNWT
1997147	05-Jul-97	KIT	Gjoa Haven	Outside House #91	Diesel P-50	40	Tentance Higniq	ST<	GNWT
1997151	10-Jul-97	KIT	Gjoa Haven	Gjoa Haven Nursing Station	Fuel Oil	23	Fuel Contractor (POL)	ST<	GNWT
1998167	04-Sep-98	KIT	Gjoa Haven	Gjoa Haven Elementary School	Heating Oil	0	DPW	ST>	GNWT
1999100	12-Aug-99	KIT	Gjoa Haven	Tank Farm	Jet A-1	4286	Trimak	ST>	GN
1999172	30-Dec-99	KIT	Gjoa Haven	Lot 394 Plot 2742	Diesel P-50	100	Hamlet of Gjoa Haven	ST<	GN
2000040	22-Feb-00	KIT	Gjoa Haven	Water Supply Lake	Antifreeze	1.5	Hamlet of Gjoa Haven	TRU	INAC
2000135	30-May-00	KIT	Gjoa Haven	Hamlet Garage Yard	Diesel P-50	92	Trimak - Fuel Delivery (POL)	TRU	GN
2001291		KIT	Gjoa Haven	Site 503-SK-074	Diesel Fuel Engine	0	APM Construction	UK	GN
2001292		KIT	Gjoa Haven	House 37-104	Heating Fuel P-50	0	Palaces	ST<	GN
2001313	08-Oct-01	BAF	Gjoa Haven	Fuel Farm	Fuel Oil P-50	1800	Adam Arluq & Willie Aquta	ST<	GN
2002321	13-May-02	KIT	Gjoa Haven	Keketak Co-op Storage Building	Heating Fuel P-50	1500	Gjoa Haven Fire Department	ST<	GN
2003183	19-Mar-03	KIT	Gjoa Haven	Unit 179 Public Housing	Diesel P-50	0	Unknown	ST<	GN
2003431	13-Jun-03	KIT	Gjoa Haven	Northern Staff House Fuel Tank	Heating Fuel P-50	552	Northern Store	ST<	GN
2003472	07-Jul-03	KIT	Gjoa Haven	Lot 503 SK 180	Diesel P-50	0	Canadian Mortgage and Hou	PL	GN
2003516	26-Jul-03	KIT	Gjoa Haven	Unit 0048	Diesel P-50	0	Housing Association	ST<	GN

Canadian Climate Normals 1971-2000

The minimum number of years used to calculate these Normals is indicated by a code for each element. A "+" beside an extreme date indicates that this date is the first occurrence of the extreme value. Extreme values and dates in bold indicate extremes for the station.

NOTE!!! Data used in the calculation of these Normals may be subject to further quality assurance checks. This may result in minor changes to some values presented here.

NOTE: "Days With" elements are currently unavailable due to an internal review of the data.

*** CAMBRIDGE BAY A**
NUNAVUT

Latitude: 69° 6' N **Longitude:** 105° 8' W **Elevation:** 27.40 m

Climate ID: 2400600

WMO ID: 71925

TC ID: YCB

*** This station meets WMO standards for temperature and precipitation.**

Normals from **to** [View](#)

to June 1997

June

[View](#)

January-June

January-December+Year

July-December

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Another location

Temperature:	Jan	Feb	Mar	Apr	May	Jun	Code
Daily Mean (°C)	-32.8	-33.0	-29.7	-21.4	-9.2	2.4	A
Standard Deviation	2.6	3.2	2.4	3.0	2.6	2.3	A
Daily Maximum (°C)	-29.3	-29.3	-25.7	-16.7	-5.3	5.6	A
Daily Minimum (°C)	-36.3	-36.6	-33.7	-26.0	-13.0	-0.8	A
Extreme Maximum (°C)	7.8	-9.4	-6.1	6.2	13.0	23.3	
Date (yyyy/dd)	1948/19	1941/05+	1955/20	1995/30	1993/03	1996/27	
Extreme Minimum (°C)	-52.8	-50.6	-48.3	-42.8	-35.0	-17.8	
Date (yyyy/dd)	1935/03	1955/27	1936/02+	1972/03	1935/13	1974/02	

Precipitation:									
Rainfall (mm)	0.0	0.0	0.0	0.0	0.1	1.6	9.8	A	
Snowfall (cm)	5.6	6.4	7.4	7.5	9.3	2.8	A		
Precipitation (mm)	4.6	5.1	6.0	6.5	9.4	12.5	A		
Mean Snow Depth (cm)	21	24	28	31	30	7	A		
Median Snow Depth (cm)	21	24	28	31	30	4	A		
Snow Depth at Month-end (cm)	22	26	30	32	22	0	A		
Extreme Daily Rainfall (mm)	0.2	0.0	0.0	3.8	6.8	19.4			
Date (yyyy/dd)	1993/14	1929/01+	1929/01+	1975/28	1990/29	1997/02			
Extreme Daily Snowfall (cm)	11.9	11.6	10.2	12.7	15.7	17.8			
Date (yyyy/dd)	1944/25	1991/06	1965/03	1941/12	1972/23	1929/19			
Extreme Daily Precipitation (mm)	11.9	5.6	10.2	12.7	13.5	21.1			
Date (yyyy/dd)	1944/25	1956/14	1965/03	1941/12	1965/05+	1969/02			
Extreme Snow Depth (cm)	48.0	50.0	56.0	58.0	59.0	57.0			
Date (yyyy/dd)	1993/02+	1983/22+	1958/27+	1958/29+	1993/09	2001/01			
Days with Maximum Temperature:									
<= 0 °C	31.0	28.3	31.0	29.7	25.6	3.6	A		
> 0 °C	0.0	0.0	0.0	0.30	5.4	26.4	A		
> 10 °C	0.0	0.0	0.0	0.0	0.07	5.9	A		
> 20 °C	0.0	0.0	0.0	0.0	0.0	0.27	A		
> 30 °C	0.0	0.0	0.0	0.0	0.0	0.0	A		
> 35 °C	0.0	0.0	0.0	0.0	0.0	0.0	A		
Days with Minimum Temperature:									
> 0 °C	0.0	0.0	0.0	0.0	0.20	13.7	A		
<= 2 °C	31.0	28.3	31.0	30.0	31.0	24.2	A		
<= 0 °C	31.0	28.3	31.0	30.0	30.8	16.3	A		
< -2 °C	31.0	28.3	31.0	30.0	29.5	8.1	A		
< -10 °C	31.0	28.3	31.0	29.2	20.1	0.83	A		
< -20 °C	30.7	28.0	30.2	23.7	5.5	0.0	A		
< -30 °C	27.5	24.8	24.0	9.4	0.07	0.0	A		
Days with Rainfall:									
>= 0.2 mm	0.03	0.0	0.0	0.03	1.1	5.1	A		
>= 5 mm	0.0	0.0	0.0	0.0	0.03	0.40	A		
>= 10 mm	0.0	0.0	0.0	0.0	0.0	0.13	A		
>= 25 mm	0.0	0.0	0.0	0.0	0.0	0.0	A		
Days With Snowfall:									
>= 0.2 cm	6.5	6.8	8.1	7.2	8.0	2.5	A		
>= 5 cm	0.03	0.13	0.13	0.17	0.30	0.07	A		
>= 10 cm	0.0	0.03	0.0	0.0	0.03	0.03	A		
>= 25 cm	0.0	0.0	0.0	0.0	0.0	0.0	A		
Days with Precipitation:									
>= 0.2 mm	6.3	6.5	7.3	6.6	7.8	6.8	A		
>= 5 mm	0.03	0.07	0.13	0.23	0.37	0.57	A		
>= 10 mm	0.0	0.0	0.0	0.0	0.07	0.17	A		
>= 25 mm	0.0	0.0	0.0	0.0	0.0	0.0	A		
Days with Snow Depth:									
>= 1 cm	31.0	28.3	31.0	30.0	31.0	15.7	A		
>= 5 cm	31.0	28.3	31.0	30.0	30.6	11.7	A		
>= 10	30.3	28.3	31.0	30.0	29.1	8.2	A		

>= 20	15.6	19.0	25.9	26.9	23.8	4.0	A
Wind:							
Wind Speed >= 52 km/hr	5.1	3.8	4.0	3.2	3.4	2.5	C
Wind Speed >= 63 km/hr	2.0	1.2	1.2	0.92	1.3	0.65	C
Maximum Wind Gust	108.0	109.0	97.0	102.0	102.0	120.0	
Date (YYYY/dd)	1963/09	1972/22	1970/20	1985/09	1977/15	1978/18	
Direction of Extreme Wind Gust	NW	NW	NW	N	NW	NW	
Degree Days:							
Above 24 °C	0.0	0.0	0.0	0.0	0.0	0.0	A
Above 18 °C	0.0	0.0	0.0	0.0	0.0	0.0	A
Above 15 °C	0.0	0.0	0.0	0.0	0.0	0.0	A
Above 10 °C	0.0	0.0	0.0	0.0	0.0	2.7	A
Above 5 °C	0.0	0.0	0.0	0.0	0.0	22.7	A
Above 0 °C	0.0	0.0	0.0	0.0	1.4	96.3	A
Below 0 °C	1017.0	932.2	920.3	641.2	285.4	24.2	A
Below 5 °C	1172.0	1073.5	1075.3	791.2	439.0	100.6	A
Below 10 °C	1327.0	1214.8	1230.3	941.2	594.0	230.6	A
Below 15 °C	1482.0	1356.2	1385.3	1091.2	749.0	377.9	A
Below 18 °C	1575.0	1441.0	1478.3	1181.2	842.0	467.9	A

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Precipitation:									
Rainfall (mm)	21.7	24.5	11.4	0.4	0.0	0.0	69.6	A	
Snowfall (cm)	0.0	2.2	8.9	16.2	9.3	6.3	82.1	A	
Precipitation (mm)	21.7	26.7	19.3	14.6	7.2	5.3	138.8	A	
Mean Snow Depth (cm)	0	0	1	7	14	18	15	A	
Median Snow Depth (cm)	0	0	0	8	14	18	15	A	
Snow Depth at Month-end (cm)	0	0	2	12	16	20	15	A	
Extreme Daily Rainfall (mm)	35.8	30.7	28.2	10.4	0.3	0.0			
Date (YYYY/dd)	1988/24	1949/18	1988/06	1963/16	1968/09	1930/01+			
Extreme Daily Snowfall (cm)	1.5	15.8	10.2	20.8	15.2	10.2			
Date (YYYY/dd)	1956/21	1996/21	1997/08	1962/08	1940/13	1940/12			
Extreme Daily Precipitation (mm)	35.8	30.7	28.2	20.8	15.2	10.2			
Date (YYYY/dd)	1988/24	1949/18	1988/06	1962/08	1940/13	1940/12			
Extreme Snow Depth (cm)	1.0	4.0	10.0	38.0	48.0	47.0			
Date (YYYY/dd)	1978/01	1994/31	1960/26+	1992/17	1992/08+	1992/20+			
Days with Maximum Temperature:									
<= 0 °C	0.0	0.0	9.3	29.2	30.0	31.0	248.6	A	
> 0 °C	31.0	31.0	20.7	1.8	0.0	0.0	116.7	A	
> 10 °C	21.0	12.3	0.87	0.0	0.0	0.0	40.2	A	
> 20 °C	1.3	0.24	0.0	0.0	0.0	0.0	1.8	A	
> 30 °C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	A	
> 35 °C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	A	
Days with Minimum Temperature:									
> 0 °C	30.6	26.6	8.0	0.07	0.0	0.0	79.2	A	
<= 2 °C	4.3	10.3	27.0	31.0	30.0	31.0	309.1	A	
<= 0 °C	0.40	4.4	22.0	30.9	30.0	31.0	286.1	A	
< -2 °C	0.0	0.69	14.3	30.1	30.0	31.0	264.0	A	
< -10 °C	0.0	0.0	1.8	22.6	29.7	31.0	225.6	A	
< -20 °C	0.0	0.0	0.0	7.5	24.8	30.0	180.4	A	
< -30 °C	0.0	0.0	0.0	0.37	10.0	23.6	119.7	A	
Days with Rainfall:									
>= 0.2 mm	10.1	12.1	7.1	0.45	0.03	0.0	36.0	A	
>= 5 mm	1.1	1.2	0.43	0.0	0.0	0.0	3.1	A	
>= 10 mm	0.20	0.31	0.10	0.0	0.0	0.0	0.74	A	
>= 25 mm	0.07	0.0	0.03	0.0	0.0	0.0	0.10	A	
Days With Snowfall:									
>= 0.2 cm	0.07	1.6	6.8	12.5	9.1	7.7	76.8	A	
>= 5 cm	0.0	0.07	0.30	0.43	0.21	0.13	2.0	A	
>= 10 cm	0.0	0.03	0.03	0.03	0.03	0.0	0.21	A	
>= 25 cm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	A	
Days with Precipitation:									
>= 0.2 mm	10.2	13.1	12.2	11.8	8.4	7.2	104.1	A	
>= 5 mm	1.1	1.3	0.77	0.41	0.07	0.07	5.1	A	
>= 10 mm	0.20	0.38	0.13	0.03	0.0	0.0	0.98	A	
>= 25 mm	0.07	0.0	0.03	0.0	0.0	0.0	0.10	A	
Days with Snow Depth:									
>= 1 cm	0.03	0.17	6.6	28.6	30.0	31.0	263.4	A	
>= 5 cm	0.0	0.0	1.7	19.3	28.8	31.0	243.5	A	
>= 10	0.0	0.0	0.03	9.5	22.8	27.2	216.4	A	

>= 20	0.0	0.0	0.0	1.1	5.1	10.8	132.4	A
Wind:								
Wind Speed >= 52 km/hr	2.0	3.8	3.7	5.4	4.1	3.4	44.3	C
Wind Speed >= 63 km/hr	0.46	0.67	1.1	1.7	1.5	1.0	13.8	C
Maximum Wind Gust	93.0	109.0	116.0	121.0	102.0	122.0		
Date (yyyy/dd)	1976/01	1971/13	1975/08	1974/07	1977/12	1976/23		
Direction of Extreme Wind Gust	SE	W	NE	NE	E	NW		
Degree Days:								
Above 24 °C	0.0	0.0	0.0	0.0	0.0	0.0	0.0	A
Above 18 °C	0.1	0.0	0.0	0.0	0.0	0.0	0.1	A
Above 15 °C	1.2	0.2	0.0	0.0	0.0	0.0	1.3	A
Above 10 °C	19.3	8.8	0.0	0.0	0.0	0.0	30.7	A
Above 5 °C	110.0	65.6	3.6	0.0	0.0	0.0	202.0	A
Above 0 °C	261.2	197.7	42.5	0.6	0.0	0.0	599.6	A
Below 0 °C	0.0	0.4	52.0	357.8	688.8	917.7	5836.8	A
Below 5 °C	3.8	23.4	163.2	512.2	838.8	1072.7	7265.5	A
Below 10 °C	68.1	121.5	309.5	667.2	988.8	1227.7	8920.6	A
Below 15 °C	205.0	267.9	459.5	822.2	1138.8	1382.7	10717.5	A
Below 18 °C	296.9	360.7	549.5	915.2	1228.8	1475.7	11812.1	A

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The Green Lane™,
 Environment Canada's World Wide Web Site.

Canada



April 2, 2003

Fisheries and Oceans Canada
Iqaluit District Office
PO Box 358, Iqaluit, Nunavut
Canada, X0A 0H0

Attention: Mr. Jordan Degroot, Habitat Biologist

Dear Mr. Degroot,

Re: Gjoa Haven Water Supply Intake Replacement (Dillon File # 02-0602).

This letter is to inform the Department of Fisheries and Oceans, Iqaluit District Office, that the Government of Nunavut has retained Dillon Consulting Limited to design the installation of a new intake pipe to the newly constructed Water Treatment Plant (WTP) into Water Lake, in the community of Gjoa Haven. Dillon is submitting this letter on behalf of the Government of Nunavut and the Hamlet of Gjoa Haven.

The existing WTP is not meeting the requirement of the **Department of Health** with respect to water quality in the community. The existing WTP is operated under a Water Licence issued by the Nunavut Water Board. Further the existing plant is old and reaching the end of its' useful life. Currently, there is an existing intake into Water Lake that provides water to the existing WTP. The pipe was installed over 20 years ago and it has frozen in each of the past two winters. Re-use of the existing intake for the new WTP is not an option that meets the design standards for the new WTP, or the long term needs of the community.

The new intake line (see attached plan and profile drawings) will have minimal effects, as it will be located in the same general area as the old line in Water Lake. The old line will be removed at the completion of the construction of the new WTP.

The community of Gjoa Haven presently delivers water from a truck fill station that draws water from Water Lake. Over several years, it has been noted that the quality of the water supply system has deteriorated. In the past 2 years, the Government of Nunavut has undertaken studies to determine the best long-term water supply system for the community. Based on this study the first phase of the long term solution for

Mr. Jordan Degroot
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Gjoa Haven's water problems is the construction of a new WTP, and the replacement of the existing intake pipe into Water Lake.

Water Lake was a natural small shallow pond that was enhanced through the development of side berms and developed into a man-made reservoir. Water Lake has no connectivity with any surrounding body of water. It was developed in this manner to prevent contamination of the potable water source from surface run off. It reportedly does not contain any fish species. The lake is small, and the community annual consumption of the water causes the lake to draw down significantly each winter to near bottom elevations. Each summer the community recharges Water Lake from a larger lake (Swan Lake) through a seasonal *screened* intake and approximately 3.5 km of 200 mm pipeline. The recharge volume is equal to the anticipated water usage of the community. Furthermore, the lack of fish in the Water Lake and the stagnation of water have contributed to the growth of blood worms (Midge Larvae), which has an adverse aesthetic effect on the community, and it is the fundamental reason for initiating this project. Because the Lake is drained annually, it would not be considered Fish Habitat. Erosion control measures will also be employed to ensure that shoreline works will not result in the entry of unwanted materials into the lake environment.

Therefore, we feel that the replacement of the intake pipe will not be seen as contravening *Section 35(1)* of the *Fisheries Act*, which states that no person will undergo any work or undertaking that will result in the Harmful Alteration Disruption or Destruction (HADD) of fish habitat.

In addition to the measures set out in the project proposal (see attached), the following mitigative measures will be incorporated into the project design to ensure that the pipe replacement will result in as minimal environmental impacts as possible:

1. All works shall be undertaken as per outlined in the attached plan.
2. Any deviation from attached plan or the construction schedule will not be commenced prior to receiving proper approval from DFO.
3. Silt fences will be placed around all disturbed shoreline areas during the construction phase. Erosion control measures will be maintained until all disturbed surfaces have been stabilized.
 - 3.1. Erosion control measures will be implemented prior to and maintained during the construction phase to prevent the entry of sediment into the lake.

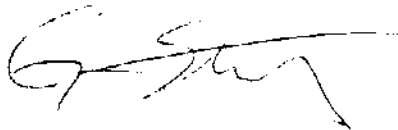
4. Vehicular maintenance and refueling will be conducted away from the shoreline to prevent the entry of unwanted materials into the lake.
5. No excavation of the lake sediments will occur as part of the proposed works.
6. Any excavated/dredged shoreline materials will be placed a minimum of 15 m above the high water mark.
7. The old intake structure shall be removed upon the completion of the new intake.

We feel that this project will not result in a HADD, for the aforementioned reasons, and a great deal of effort will also be exerted to ensure this project has no detrimental environmental impacts in Water Lake. Water Lake will be continually used as the potable water supply to the community during construction. Therefore, the protection of the water quality before, during and after construction is paramount to the successful completion of the works.

If you have any questions or concerns about the project proposal or the mitigative measures outlined above, please feel free to contact the undersigned at your earliest convenience.

Yours Sincerely

Dillon Consulting Limited



Gary Strong, P. Eng

Project Manager

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**APPENDIX B – Water Supply
Dillon 2002 Report
Population Estimates**

Water Supply for Gjoa Haven

Revision 1 Design Concept Brief
November, 2002

November 29, 2002

Water Supply for Gjoa Haven,
Design Concept Brief

Revision 1

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Government of Nunavut
Gjoa Haven, Nunavut

Submitted by

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1.0 INTRODUCTION

1.1 General

The community of Gjoa Haven is supplied water from a truck fill station that draws its water from a lake near the community, namely Water Lake. Over several years, it has been noted that the quality of the water supply system has deteriorated. In the past 2 years, the Government of Nunavut has undertaken studies to determine the best long-term water supply system for the community. The selected raw water source is Swan Lake located approximately 3.0 kilometres from the current water supply lake. To meet the requirements of the Fire Marshal with respect to Fire Flow and to meet the future community water demand, the GN plans to construct the following facilities;

- ✓ A water supply pipeline from Swan Lake to a new in-community water treatment and storage facility.
- ✓ An intake and pump station at Swan Lake
- ✓ An in town water treatment and pumphouse
- ✓ Upgrades to the access road to Swan Lake.

Figure 1 in Appendix A illustrates the location of the proposed facilities.

To complete the implementation of the project, the Government of Nunavut, Department of Public Works and Services (PW&S) retained the services of Dillon Consulting limited in July of 2002. Dillon's contract with the GN is #02-4200.

1.2 Scope of Work

The specific terms of reference for the project are included in Appendix A. Briefly, the scope of work included in this assignment is:

- To provide water to the community, which is free of health hazards, meet or exceed the Nunavut Public Health Act for Canadian Drinking water Quality, and meet all specific requirements of the community's Nunavut Water Board Licence to operate. The water must be aesthetically acceptable and of sufficient quality and quantity for domestic, commercial and industrial use. And for fire protection.
- At the 20-year design horizon the community population is 1,435 residents. The design must meet community water supply needs for 20 years but water supply planning should consider a 40-year planning period.

1.3 Scope of this Report

Report Layout

The purpose of this Design Concept Brief is to document the preliminary design process and is a decision-making document. The sections of the report describe;

- The design requirements as laid out in the terms of reference and the background documentation
- The design criteria, assumptions, and calculations
- System descriptions

- Component descriptions
- Option development and selection
- Cost estimates
- Implementation schedules and strategies

Where options exist for the design concept, these options are presented in a tabular form. The tables describe the options, list the criteria for design process, and rate the options against the criteria. The report recommends the best option. Cost estimates for all options are developed using a life cycle cost assessment model.

All figures are located in Appendix A.

Acknowledgements

Throughout the development of this report, Dillon has gratefully received the assistance of the Client Department, Community Government and Transportation, the Community of Gjoa Haven, and the representatives of the Department of Public Works and Services.

2.0 SYSTEM DESIGN STANDARDS

Design Criteria

The design criteria for this project will be completed in accordance with the parameters set out by the GN, "Water and Sewage Facilities Capital Programs". These are as follows:

Table 2.1
Design Horizons

Facility	Design Horizon (Years)	Design Economic Life (Years)	Design Expected Life (Years)
Building	20	20	40
Pumps	10	20	20
Pipelines	20	20	30

Where the:

- Design horizon is the period used to establish capacity requirements for a facility.
- Design economic life is the period used in the economic analysis to establish the present value (or equivalent capital cost) of a facility.
- Design expected life is the practical maximum expected life of a facility assuming no premature failure, destruction or obsolescence.

Design Standards

The following is a list of the design standards to be used in the development of the water supply system. These are derived from the GNWT "General Terms of Reference for Water and Sanitation" (GTR), and the "National Building Code" (NBC), and "Capital Standards Criteria, September 1993," MACA.

Table 2.2
Water Consumption Rates

Water Consumption Rates			Reference
Domestic	90 litres per capita per day		MACA
Commercial	0.00023 x population		MACA
Total Consumption per Capita	90 x (1.0 + 0.00023 x pop.)		MACA
Fire Demand	910 litres per minute. 170,000 L storage		MACA & Fire Marshal
Discount Rates	4%, 8% and 12%		MACA

**Table 2.3
Environmental Conditions**

Environmental Conditions	
Design Minimum Temp.	-41°C ¹
Degree Days (18 °C)	10751 ²
Snow Load SS	3.5 kPa ¹
SR	0.2 kPa ¹
Wind Pressures	1.20 kPa ¹

1. Supplement to the National Building Code of Canada 1996 Third Revisions and Errata.
2. Canadian Climate Normals (1961-1990). Yukon and Northwest Territories.

Design Parameters

The following are items that have been identified as design parameters for the facility:

- The facility must be simple to operate and maintain by local forces with limited equipment, and parts and materials that are available locally.
- Reliability of the facility is extremely important.
- The facility must be efficient and cost effective.
- The fire flows at truck fill arms are to have a minimum pumping capacity of 910 L/min.
- All equipment and pipes must be self-draining after each use cycle, where practical. When self-draining of any major component cannot practically be accommodated, some other means of frost protection should be incorporated.
- All major components must be capable of recovering from a frozen condition, in an operable state, if there is any possibility of freezing.
- Provisions of spares for all equipment is required, particularly components that have bulbs, fuses, relays, timers, etc.
- The first year supply of consumable, such as disinfectant, water testing packets, and cleaning supplies are to be a requirement of the construction contract.
- Fuel storage at the pumphouse must provide for spill containment (if applicable).
- Water supplied from the pumphouse must be metered.
- Provision for an alarm system which indicates loss of power and low building temperature, is required.

Cost Analysis

Throughout this document, there are cost analysis of various options. The analysis have been carried out as outlined in the GTR as described below:

Capital Cost

Cost of construction for the facility

Annual Operation and Maintenance Costs

The cost of operation, which may include manpower, energy requirements, fuel, general maintenance (light bulbs, paint), and equipment replacement.

Life Cycle Costs

The calculation of the total facility cost over a 20-Year period. This includes the capital, operations and maintenance costs. The life cycle value is shown as a present value, which is calculated at a discount rate of 4%, 8% and 12%.

3.0 COMMUNITY INFORMATION

3.1 Water Quantity Calculations

The water supply system design horizon is indicated in the previous section. Based on an implementation year of 2004, the 20 year design horizon is set at 2024. Using current population projections from the Bureau of statistics, the following table indicates the water consumption values. Also shown are the peak day demand values.

**Table 3.1
Design Water Consumption Values**

	2004	2014	2024
Water Demand per capita (litre)	112	116	122
Population (people)	1056	1272	1556
Average Day Demand (litre)	118,075	147,902	190,082
Peak Day demand (litre)	194,824	244,039	313,636

The calculation of these values is shown in Appendix B

3.2 Community Meeting

On March 21, 2002, the Hamlet council of Gjoa Haven passed a motion (Motion #54/02) choosing Swan Lake for the future water supply lake. In August of 2002, representatives from Public Works and Service, Community Government and transportation and Dillon Consulting

Limited met with the hamlet representatives to discuss the location of the proposed new facilities. These discussions were held with the community SOA, council members, the Mayor, and hamlet staff. At the conclusion of the discussions, it was felt that the parties agreed to a set of facility locations, and pipeline alignments.

4.0 SYSTEM COMPONENTS

There are 4 (four) major components in the water supply and treatment design for the community. Each system has several sub-systems. The development of the design of the individual components requires knowledge of the operation of each system and subsystem. In the sections that follow, the design development of all systems is described. In some cases, there is reference to forwarding sections, which unfortunately is unavoidable due to the interrelationship of the systems.

The four (4) major components are;

- The Intake Pump House (IPH) and back-up truck fill station located at Swan Lake
- The water supply pipeline between Swan Lake and the In-town Water Treatment Plant (WTP)
- The WTP
- The Storage tanks located adjacent to the WTP

4.1 Intake Pump House at Swan Lake

The pumphouse will have the following major components:

- Building Foundation
- Truckfill controls and metering
- Conveyance Pipes
- Power Supply
- Intake Pipe Freeze Protection
- Monitoring and Alarms
- Building Construction
- Building Layout
- Spares and Ancillary Components

The following sections will describe these components for each facility.

IPH Controls and Metering

The truckfill control has been established according to the Government of Nunavut standard for similar facilities in other small communities. The truckfill control system will have the following components:

- Truckfill control with one customer key lock. This will have a flow accumulator to record cumulative flows. The control will be on the truckfill arm, with a start and stop switch, and a timer.
- Flow rate indicator.

- Flow sensor installed in the truckfill pipe to control the flow accumulator.
- Flow switch to interlock with the pump and chlorine pump to avoid damage to the equipment or excessive chlorine injection into an empty line.
- All measurements for the metering are to be in SI units (litres).
- The accumulators, flow indicator, and miscellaneous control devices will be located in a main control panel inside the IPH.

Conveyance Piping

The process piping will consist of the following:

- An intake screen, submersible pump on 100 mm HDPE DR17 piping, contained within a 300 mm HDPE DR17 casing. The casing will be insulated with 50 mm of polyurethane foam and will be heat traced. The intake piping will enter the pumphouse and terminate with a flange connection just inside the pumphouse wall.
- Galvanized 100 mm Schedule 40 steel piping with Victaulic system connections.
- Chlorine injection diffuser, located on the galvanized steel piping within the building for back-up purposes.
- Flow switch to activate the chlorine pump.
- Flow sensor for the truckfill control system.

Prime Power

Prime power can be obtained from either Nunavut Power Corporation's power plant, or an on-site diesel electric generator.

Typically, the use of grid power generated by the Power Corporation is the source of prime power. However, the new facility is not directly next to the community, and a new power line is required to service the pumphouse. Based on estimates received from the Power Corporation, the cost to install the new lines will be approximately \$120,000 for 1200 m of overhead line. The installation of on-site power generation will require:

- A building or space within the truckfill building to house the generator.
- A generator sized to meet the power requirements of the IPH.
- Controls, monitoring and alarms for the power supply system.

The estimated steady-state power requirements of the IPH are:

	Power (kW)
Intake Pump	15.0
Building Heat	0.5
Heat Trace	1.0
Lighting	1.0
Chemical Feed Pumps	0.1
TOTAL	18 kW

This results in a minimal generation requirement of 18 kW. Start-up power for the truckfill pump is not included, but will be approximately 2 kW more for total of 20 kW. The on-site generator is assumed to run continuously for the 20-Year design horizon. Estimated daily power requirements are 72 kW/h in winter. The capital and life cycle costs of these options are as follow:

Table 4.1
Prime Power Cost Assessment

Prime Power System	Capital Cost	Operation Cost	Annual Maintenance Cost	Life Cycle Cost		
				4%	8%	12%
Power Line	360,000	5,400	0	433,000	412,000	400,000
On-site Generator	250,000	50,000	12,000	1,093,000	858,000	709,000

Power supplied by overhead line would cost significantly less than if a generator were to be used.

Standby Power

The in-town water storage provides for 8 hours of emergency storage. The water tempering system provides for freeze protection of the pipeline (see section 4.2.3). Therefore standby electrical power is not required. Should prime power be interrupted for greater than 8 hours in severer weather, there is a risk that the IPH will freeze. The system is designed to recover from freezing with minimal damage. Further, the Water Lake will provide emergency water supply for several weeks if required.

Freeze Protection

To protect the water supply system from failure due to freezing, two freeze protection systems are required:

1. IPH building heating.
2. Intake casing freeze protection.

IPH Building

Heating load calculations for the truckfill building are based upon a pre manufactured building with vapour barrier, air barrier, and sheathing. The climatic factors of 10751 degree days below 18C and -41C design temperature. Based on these factors, a 4m x 4m x 3m high truckfill building will require 3.2 kW of heat for peak load and an annual requirement of 9,400 kWh. Section 4.2.4 requires the installation of a diesel fired boiler to provide transmission main freeze protection. This boiler will be used to heat the IPH.

Intake Casing and Intake Pipe

The intake casing and intake pipe must be protected from freezing. This will be accomplished by electric heat trace cable installed adjacent to the outside of the intake pipe. The cable will be 15 W/m self-limiting, such that it will not damage the HDPE pipe. Two lengths of cable will be installed. The second cable will provide backup in case of failure of the first cable. Automatic controls will be used. The cable will be removable.

Truckfill Arm

A method must be used to protect the truckfill pipe from freezing and to recover the pipe if it freezes. Various methods have been used in past designs, including insulation and heat trace cable. A key to successfully avoiding freezing of the truckfill pipe is to ensure that it drains quickly and completely after use. The truckfill pipe will be installed with a 4% or greater slope back into the IPH. The pipe will be bare steel and not insulated or heat traced. Freezing of the pipe is unlikely, due to the draining system. In the unlikely event that the pipe freezes, a propane tiger torch can be used to thaw the pipe.

Monitoring and Alarms

The IPH building will have the following monitoring and control system. The system will have two (2) levels of alarms: major and minor. Minor alarms will cause a green alarm light to activate, and a horn to sound at the WTP. Major alarms will activate a red alarm light and sound a horn. The alarms for this system are set as follows:

Major	High building temperature alarm Power Off
Minor	Truckfill pump failure Building temperature low

Building Construction

Two types of buildings are available for this facility, namely:

- Wood frame, on-site construction.
- Pre engineered, pre fabricated construction.

The wood frame building would be constructed to the standard for pump houses used by the Government of the Nunavut Standard as follows:

- Wall construction consisting of 38 mm x 150 mm with 150 mm of fibreglass batt insulation.
- Walls with vapour barrier on the inside and air barrier on the outside of the wall studs.
- Walls with plywood sheathing on the outside face and 50 mm of rigid foam insulation.

- The interior of the walls sheathed with dry wall, plywood, and clad with metal siding. (The interior plywood is for convenient equipment installation.)
- Roofing provided by a pre-manufactured truss, or rafter system.

The pre-manufactured building would be constructed to provide the equivalent insulation value as the wood frame building. Several companies produce these structures (Bally, Cold Stream, Brytex, Butler), and each have a slightly different building design. Typically these buildings have an insulation value of RSI 5.6.

The use of on-site construction will typically add \$40,000 to \$50,000 to the total facility cost. The increase in cost is a result of the required accommodations, flights and additional man hours on-site for down time. Local involvement created by on-site construction will be approximately 10 man days, or the equivalent of \$2,000 in wages the economic benefit to the community is not justified and off-site construction is recommended.

On previous projects, the GN has had success with pre manufactured buildings (Cold Stream). This building type will be used in the final design. The type of building is well suited for the use of a skid-mounted foundation. This foundation has proven to be very economical for truckfill stations in Nuvavut.

Building Layout

A summary of the requirements for the special allowance for the building is shown below:

Intake piping

Off take piping to the water supply pipeline

Truckfill discharge piping, including allowance for intake pump removal.

Chlorination system with chlorine pump and injection point.

Control panels, electrical panels.

Truckfill control (from truckfill arm).

Storage of chemicals and spare parts.

Boilers and heat exchangers for transmission main freeze protection.

Figure 2 shows the building schematic for the IPH. **Figure 3** shows the floor plan concept for the IPH.

4.2.1 Transmission Main

4.2.1 General Configuration

The transmission pipeline starts at the wall of the IPH and terminates at the wall of the WTP. The in will have the following components;

Access Vaults

These will provide access to the main and allow for the use of a steamer to thaw the main in the event of a freeze up. Figure 7 shows the schematics of the access vaults and the midpoint heater station (to be described in a later section)

Drains

Low points on the line will require drains. There will be a total of three (3) gravity drains and two (2) pumps.

Pumps will be used in areas where the land is wet and will not allow for natural drainage.

Air Vents

High points along the transmission line require vents to allow air to escape. There will be a total of five (5) vents along the line.

4.2.2 Site Investigation and Alignment

Dillon Consulting mobilized to Gjoa Haven, NU from August 13 to August 20 of 2002, to undertake the site investigation and site survey components of the work. While on site, the tasks addressed were:

- Set control points for alignment of water transmission main for the survey work on the project.
- Determine an alignment for the water transmission line and do preliminary elevation/distance profile surveys.
- Perform bathymetric survey of Swan Lake for new water intake line.
- Perform bathymetric survey of existing water reservoir for a new intake location.
- Site topographic surveys for water treatment plant location.
- Site topographic surveys for truckfill location.

There were a number of survey control pins, established by GN, around the Hamlet and also in the area of the new transmission line. GN (GNWT) markers #5039343, #5039330 and #5039320 were used for primary control. The co-ordinates of the pins were obtained from Natural Resources Canada. Using these markers, the survey can be tied into existing surveys and mappings of the surrounding areas. Other GN/GNWT markers were also used for a system of checks. The checks confirmed the accuracy of the survey was suitable for the location, topographic and bathymetric work. All surveys were done with a total station with a labourer as the rodman.

Alignment

The transmission line alignment was determined by surface profile and avoided any possible obstacles (i.e. hills, wet spots). Refer to **Appendix A, Figures 4 to 6** view the plan view of the pipeline alignment. The line follows a path that is generally flat running northwest and avoids any sharp changes in elevations. The control points are marked with 150-mm spikes hammered into the earth and marked with a tag to identify the point. Wooden survey stakes were also placed near the control points and along various vantagepoints along the alignment. The total length of the transmission line is approximately 3.3 km long running northwest from the hamlet.

Facility Locations

A grid profile was performed to determine elevations and locations for the water treatment plant. The bathymetric survey consisted of drifting over certain areas of the water and recording depths. A boat and motor was used for this along with a computer, GPS and depth sounding equipment.

The 'deep spots' on the existing reservoir were located and marked using this equipment. An area around where the water intake line will be placed at Swan Lake was also measured. Five transects at 50m intervals were taken. These ran from shore straight out and past the drop off point. At Swan Lake, there is a gradual slope running from the shoreline out to about 50-60m, then there is a drop off that is sloped at about a 1H to 1V slope. Points after this drop off were recorded up to about 5.5m - 6.0m deep.

Other notable landmarks in the area are small cabins located around Swan Lake, summer pipeline, road, airport, radar station, reservoir, pumphouse and truckfill station.

General Terrain

The granular make up of the area is generally a mixture of sand and gravel covered with moss and lichen. No apparent bedrock outcroppings were present along the path. Rocks and boulders were avoided in the alignment. A noteworthy elevation change, that was avoided, was the hill where the Short-Range Radar Station is located. The line around this hill was determined by doubling the height of the hill and aligning it that far out from the base of the slope. Refer to Appendix C for pictures and Appendix D for air photos showing the terrain and general landscape of the area.

Site Survey and Land Profiles

Refer to **Figures 4 to 6** to see plan view of survey location as well as land profiles along the transmission line. The profile is preliminary only. There are a number of design issues to be resolved related to the development of on-line heat exchange, intermediate heating station, vault design, and other components listed in the previous sections. The alignment and profile will be adjusted slightly during the detailed design process. The plans and profile should be considered within a 60-m corridor for the final pipeline alignment.

4.2.3 Pipe Size and Heat Loss

Storage Requirements

Using the water demands calculated in **Section 2.0**, the required flow rates to meet the demand can be calculated. The flow rate is related to the size of the storage capacity. The storage is comprised of several components, which are described in the following sections.

Balancing Storage

The system operation will require the raw water supply to meet the peak day demand. To optimize the pumping system, the pumps would operate for 24 hours a day, and meet the water demands over that period. In practice, using a 20-hour pumping cycle is more the norm because this allows for some redundant capacity in the system. It is assumed that in the future years, the truckfill operation will occur 6 days a week, and will operate for 10 hours per day. The difference between the supply to the WTP and the delivery of the water over the 10-hour delivery period on a peak day, is the required balancing storage.

Fire Storage

In addition to the balancing storage, there is a requirement of the Nunavut Fire Marshal to provide water storage of 170,000 litres in Gjoa Haven (ref. FSC & TOR).

Dead Storage

In any tankage system, there is a portion of the tank that is not available for use. This is normally the bottom of the tank, located below the obvert of the tank outlet pipe. A value of 10% is used for this storage volume.

Emergency Storage

In the TOR, a value of 8 hours of discontinued service from the supply line was used as an estimate of the emergency storage. This value is carried forward in this assessment. The following table shows a summary of the above values.

Table 4.2
Summary of Required Storage volumes

Case	Equilization Storage	Fire Storage	Emergency Storage	Dead Storage	Total Storage
Existing	102,400	170,000	43,300	15,800	331,000
2024	163,000	170,000	54,200	18,800	406,000

Pipe Size

The required pumping rate is then developed to meet the peak day demand in a 20 hour pumping cycle for the year 2024. This rate is 203 l/min. Using this value, and maintaining the velocity in the pipe at an acceptable rate, the required pipe size is a 100mm pipe. Full calculations are included in Appendix B.

Heat Loss

The heat loss from the transmission main is calculated for several scenarios. These include the operation during start-up (year 2004), for operation in the design year (2024), and under the no flow condition. In addition to the heat loss calculations is the expected time for the line to freeze in a no flow situation. For comparison purposes, the heat loss value is calculated for a pipe with 50 mm insulation, and for 75 mm of insulation. Full calculations are shown in the Appendix B, and summaries are included below.

Table 4.3
Static Heat Loss
(In Watts)

	1.0m bury with 50 mm of insulation	1.0m bury with 75 mm of insulation	0.0m bury with 50 mm of insulation
Rate of Heat loss for pipeline (Watts)	8,500	6,400	32,400

Table 4.4
Temperature Loss
(In degree Celsius)

	1.0m bury with 50 mm of insulation	1.0m bury with 75 mm of insulation	0.0m bury with 50 mm of insulation
Temperature loss in the transmission main in Year 2014	0.67	0.55	2.17
Temperature loss in the transmission main in Year 2014	0.34	0.26	1.28

Table 4.5
Time to Main Freeze Up
(in Hours)

	1.0m bury with 50 mm of insulation	1.0m bury with 75 mm of insulation	0.0m bury with 50 mm of insulation
Time to complete transmission main freeze up Year 2014	224	285	55
Time to complete transmission main freeze up Year 2014	224	285	55

As can be seen from the tables above, there is little additional benefit to increasing the insulation from 50mm to 75 mm. The heat loss and the time to main freeze up do not change in any appreciable amount. It is therefore recommended to use the 50 mm insulation value indicated in the project description.

The use of an above grade pipeline was discussed while in the community. The above tables show two critical issues in the selection of an above grade pipe. Firstly, the heating requirements for the pipeline increase by nearly four fold; and secondly, the time for the main to freeze completely is decreased by nearly four fold. In the first instance, it results in operational costs that are significantly higher. Approximately an additional 12,000 kW of energy would be required on an annual basis to heat an above grade line over that of a buried line. In the second instance, the buried line would require a significant increase in response time in the event of power loss, or other failures. For these reasons it is recommended that a buried line be implemented.

4.2.4 Freeze Protection

The TOR indicates that hot water injection is to be used to provide freeze protection to the transmission main. An alternative to the use of hot water injection is to use electrical heat trace along the length of the pipe line. The use of electrical heat trace for freeze protection of transmission mains has not been found to be acceptable in other locations (Rankin Inlet, Resolute Bay, Iqaluit, Yellowknife), for the following reasons:

- High cost of electricity. Only 10% of the heat value of diesel fuel is transferred to the water using electrical heat trace, as opposed to nearly 50% when boilers and heat exchangers are used.
- High failure rates of heat trace cables. This is further complicated by the difficulty in monitoring the cables for failure.
- Lack of proportional control. An electrical heat trace is either "on" or "off".
- Difficulty in replacement in freezing month. Heat trace cables can not be readily replaced at temperatures less than -10°C.

It is recommended that hot water injection be used as the primary freeze protection method.

There are several methods used to provide water tempering with hot water injection. These are described below.

- Discrete injection points. This method uses one (1) pipeline, that being the main transmission line. Water is drawn from the main, heated through a heat exchanger, and injected back into the main. This is used in Resolute Bay.
- External water tempering line. This system used 2 pipelines; namely the main supply line and a smaller one that carries tempered water. The tempered water is injected into the main supply line at access vaults. This is used in Rankin Inlet.
- Internal water tempering line. This system is similar to the above, however the smaller line is within the main supply line. Heat transfer is continual through the pipe length. The heated water is returned to the main line at the end of the pipe. This method was used in Cambridge Bay.

In either of the latter 2 options, the tempered water can run co-current or counter current to the supply line flow. The following table illustrates the advantages and disadvantages of each approach.

	Discrete Injection	External Water Line	Internal Water Line
Boilers and heat exchangers can be part of other heating systems (tankage, building, etc.)	No	Yes	Yes
Provides for second line in event of primary line freezes up.	No	Yes	No
Maximizes heat transfer	Yes	No	Yes
Meets TOR	Yes	Yes	Yes
Successfully operated in Nunavut	Yes	Yes	Yes
Capital Cost	300,000	450,000	300,000
Annual Cost	80,000	40,000	40,000
Life Cycle Cost at 20 years at 8% discount rate	\$1,085,000	\$842,000	\$695,000

Heating must occur at the IPH. Additional heating points along the length of the line are recommended. Two "mid" point heater houses are proposed for the final design. The line will include the installation of a back up electric heat trace system, per client direction.

4.3 Water Treatment Plant

4.3.1 System Components

The water treatment plant will have the following systems:

- Building Foundation
- Raw water treatment – filtration and chlorinating
- Water tempering
- Domestic water supply
- Truckfill controls and metering
- Conveyance Pipes
- Power Supply
- Building heating and ventilating
- Intake to water Lake and intake pipe freeze protection
- Monitoring and Alarms
- Building Construction
- Building Layout
- Spares and Ancillary Components

4.3.2 Building Foundation

A desktop review of the foundation conditions in Gjoa Haven indicate that there aren't typically concerns with frost susceptible materials. The surficial geology in the Gjoa Haven area is that of well-graded granular materials. For this type of ground conditions an insulated slab on grade with a spread footing at wall and post supports is applicable. This type of foundation is the most favored for the construction of a WTP. Typically the plant components require structural support. House keeping pads, with increased re-bar will be placed under all major equipment.

Once the facility siting and size has been finalized, a site specific geo-technical study will be completed at the site. The use of a concrete slab on grade foundation is carried forth in this report.

4.3.3 Raw Water Treatment

Disinfection

The GCDWQ requires that the disinfection process for raw water also have a residual disinfection component. This is achieved through the use of chlorination. A typical residual chlorination level is 1 part per million (ppm). Many communities in the north people find the taste of chlorine unpleasant, and residual levels are often set at 0.5 ppm. Several chemicals are available for disinfection of domestic water supplies. These include:

- Gaseous Chlorine
- Sodium hypochlorite (liquid)
- Calcium hypochlorite (solid)

Gaseous chlorine requires storage in a separate room that is monitored for chlorine gas emissions. Safety equipment and training is necessary to comply with the Occupational Health and Safety Regulations when chlorine gas is used. The transport of gaseous chlorine is regulated by the Transportation of Dangerous Goods (TDG) and it cannot be transported by passenger airplane. For these reasons, the use of gaseous chlorine is not recommended.

Sodium hypochlorite is shipped and stored as a liquid. The liquid is subject to freezing, and is to be stored in a heated room (above -10 °C). Sodium hypochlorite used in water treatment is similar to household bleach. It is available at 12% available chlorine, whereas bleach is 6% available chlorine. Sodium hypochlorite loses its concentration with time. After 90 days the level of available chlorine drops slowly and may reach a level similar to bleach after 6 months. If the 12% available sodium hypochlorite is diluted to 2% available, the shelf life is significantly extended. The operation of the disinfection system using sodium hypochlorite is relatively simple. The liquid is used directly without mixing. An injection pump is used to inject the liquid into the water as it flows through the truckfill arm.

Calcium hypochlorite is shipped and stored as a powder. There is no concern with freeze protection, and heated storage is not required. Calcium hypochlorite has 65% available chlorine by weight. The powder is mixed with water to make a solution that can be used in the disinfection process. Typically the solution is mixed at a concentration similar to that of sodium hypochlorite (12% available chlorine is typical). The disinfection system for calcium hypochlorite requires a mixing tank, a solution tank, an agitator, and an injection pump.

Both calcium and sodium hypochlorite are commonly used for disinfection in small facilities. The use of calcium hypochlorite is more common in the NWT. The issues to be addressed in the selection of a disinfectant are; the cost of the optional system; the relative ease of use; and the risk of failure.

Cost of System

Sodium hypochlorite, as a liquid, requires a greater volume of disinfectant to be shipped to site than calcium hypochlorite. Based on 12% available chlorine for sodium hypochlorite and 65% available for calcium hypochlorite the required shipping weight of disinfectant and volume to be shipped to site are as follow:

Disinfectant	Year 0 (2004)	Year 20 (2024)
Calcium Hypochlorite	29 kg	53 kg
Sodium Hypochlorite	160 L (160 kg)	290 L (391 kg)

The supply and transportation costs associated with each chemical are as follow:

Disinfectant	Supply (Year 0)	Transportation (Year 0)	Total (Year 20)
Calcium Hypochlorite	\$250	\$200	\$400
Sodium Hypochlorite	\$170	\$800	\$900

Filtration

Water quality data is limited to qualitative data which characterizes the water as being of high turbidity with 'blood worms' in the source. It is reported that the bloodworms in the source water can affect the raw water quality in open water and under ice conditions. This is primarily a result of non-viable organism debris becoming suspended in the water column and entering the intake. Additional water quality data, which may affect the final treatment process configuration, was acquired for Swan Lake in November, 2002. The results are included in Appendix G.

The water treatment processes required include:

- turbidity reduction
- possibly colour and odour removal

The treatment processes which can effectively remove turbidity and suspended solids, including organic debris, include filtration, or, coagulation and sedimentation followed by filtration. The coagulation and sedimentation processes are typically used if the solids loads, or concentrations, are relatively high. High solids loads, whether organic or a combination of organic and inorganic can result in higher filter backwash frequency and possible filter clogging. This can create higher maintenance costs and manpower requirements to maintain. For that reason if filters are used, a granular media filter would be selected, based on the organic debris that will be present in the raw water. The granular media may be a uniform sized silica sand only, or a multimedia filter, comprised of gradations of silica sand and other filter media such as garnet sand and granular activated carbon.

Cartridge filters with a fibre or paper media, or a wire mesh type screen are not recommended. The paper media type filters are typically disposable and are susceptible to slime build up and frequent clogging requiring manual replacement. Wire mesh filters are not effective in the removal of small sized particulates and decaying organic matter. Pressure sand filters can be open gravity type or pressure type. Either type could be used in this application. The advantage of the pressure type filter is that they are enclosed, can be set up with automatic and manual backwash controls, and can be more readily packaged in a pre-manufactured unit. Pressure sand filters are recommended based on the water quality characterization data currently available, related to the water turbidity.

Pressure filters can also be operated with a feed of a coagulant just up stream of the filters to aid in the efficiency of the filter performance. This filter aid process does however shorten filter runs, that is the time elapsed between filter backwash cycles.

A process of coagulation, flocculation, sedimentation and final filtration (CFSF) would be considered if further testing of the water demonstrates a high level of suspended solids requiring removal. This can be accomplished through the use of packaged pre-manufactured water plants such as the WaterBoy by US Filter, and others.

If the raw water changes over time, or the community deems it to have unacceptable odour or treated water colour, a granular activated carbon process step can be provided. This process will reduce colour and odour producing organic matter in the water. If a CFSF process is used, a powdered activated carbon would be used and added in the coagulation step, to aid in dissolved organic matter adsorption. This would then be removed in the sedimentation and final filtration process.

The treated water would finally be treated with chlorine, as discussed earlier.

The filter backwash wastewater and the wastewater streams from sedimentation or GAC column backwash will contain a very low concentration of solids. However because it will be a concentrated waste stream containing water treatment residues, it will be discharged to a holding facility. A summer decant pond may be used to allow the water treatment residues to settle, prior to discharging the decant water to surface ditches. A holding tank will be provided to collect the treatment wastewater streams, which will then be truck hauled to the existing sewage lagoon facility.

The sanitary waste water, if any, will be collected in a separate holding tank, to be truck hauled to the sewage lagoon.

The treatment process will be sized to permit production of the peak day water demand in a daily 20 hour production period. An allowance of 10% for plant use is provided. The plant design capacity will be able to supply finished water at a rate of 62.4 Usgpm. The system will be able to operate.

4.3.4 Building Heat and Water Tempering

As indicated in Section 4.2.4., the primary freeze protection system for the transmission main will be by hot water injection. There is also a requirement to maintain the water temperature in the storage tanks above freezing. One set of boilers within the WTP can accomplish these two requirements and meet the heating requirements of the WTP.

Appendix E shows the heating requirement for the system. Based on these requirements a boiler with an output of 360, 000 BTU is selected. This is at the lower end of available units. The appendix indicates the heat transfer sizing and costing estimates received from suppliers.

4.3.5 Truckfill Control

The truckfill system must address the fact that there will be a positive head from the storage tanks. The system will operate as follows:

- Cycle is activated by the truck fill operator using a key lock and pressing the "start" button on the truck fill arm.
- Motor control valve #1 will open.
- Truckfill pump #1 or #2 will start.
- A flow switch activated by the water flow will energize the chlorine pump.
- Chlorine injection will occur on the truck fill arm.
- A flow sensor will record the flow volume through the plant totalizer.
- The cycle will be stopped by the expiration of the timer or the truck fill operator by pressing the "stop" button.
- The truck fill pump will be de-energized.
- The motor control valve #1 will close.
- The motor control valve #2 will open and the truck fill arm will drain into a small tank activating level switch 2.
- Pump # 3 or # 4 will pump the water back to the main storage tank.
- Level switch 2 will de-energize the pump #3 or #4.

Note: All pumps are duplexed. Only one of each set will operate in any one cycle.

4.3.6 Conveyance Piping

The process piping will consist of the following:

- An intake screen, submersible pump on 100 mm HDPE DR17 piping, contained within a 300 mm HDPE DR17 casing. The casing will be insulated with 50 mm of polyurethane foam and will be heat traced. The intake piping will enter the pumphouse and terminate with a flange connection just inside the pumphouse wall.
- Galvanized 100 mm Schedule 40 steel piping with Victaulic system connections.
- Chlorine injection diffuser, located on the galvanized steel piping within the building for back-up purposes.
- Flow switch to activate the chlorine pump.
- Flow sensor for the truckfill control system.

4.3.7 Power Supply

Prime power can be obtained from either Nunavut Power Corporation's power plant.

Stand-by Power will be provided through the use of a diesel electric power plant located within the building, but in a separate room, in compliance with the NBC requirements.

4.3.8 Intake Casing and Intake Pipe

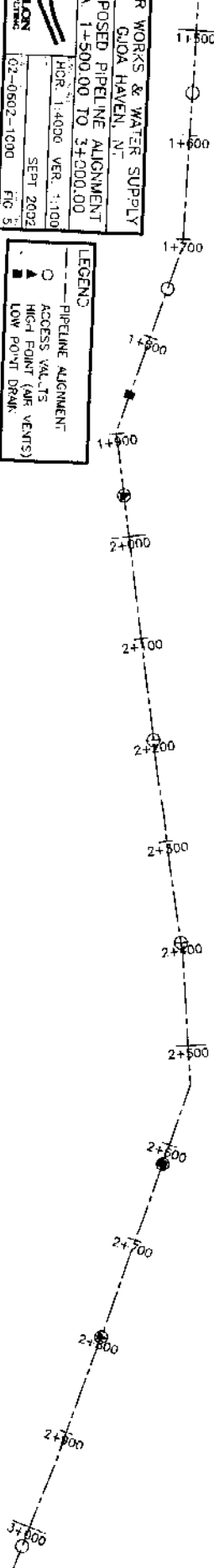
The intake casing and intake pipe must be protected from freezing. This will be accomplished by electric heat trace cable installed adjacent to the outside of the intake pipe. The cable will be 15 W/m self-limiting, such that it will not damage the HDPE pipe. Two lengths of cable will be installed. The second cable will provide backup in case of failure of the first cable. Automatic controls will be used. The cable will be removable.

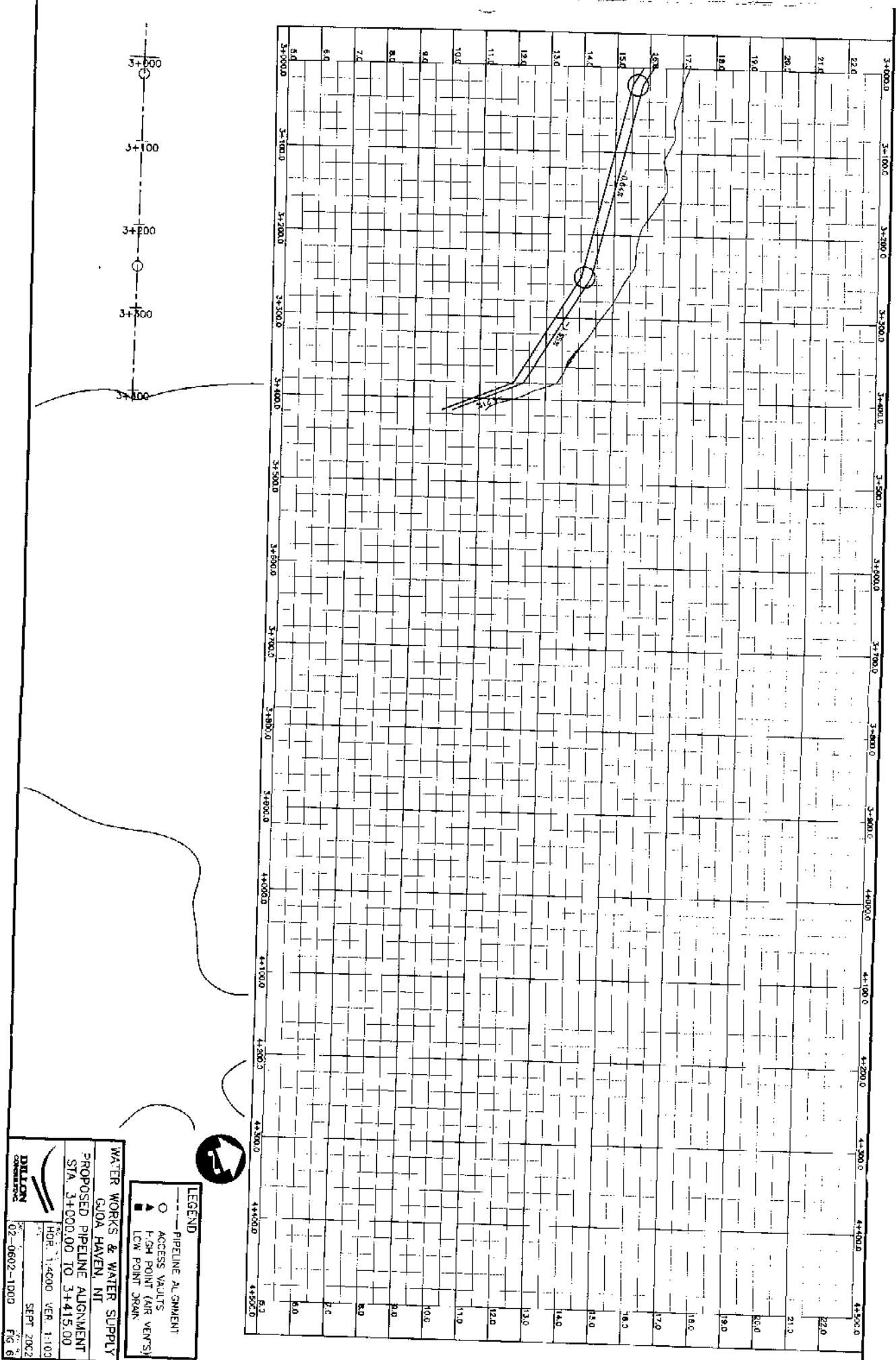
4.3.9 Truckfill Arm

A method must be used to protect the truckfill pipe from freezing and to recover the pipe if it freezes. Various methods have been used in past designs, including insulation and heat trace cable. A key to successfully avoiding freezing of the truckfill pipe is to ensure that it drains quickly and completely after use. The truckfill pipe will be installed with a 4% or greater slope back into the IPH. The pipe will be bare steel and not insulated or heat traced. Freezing of the pipe is unlikely, due to the draining system. In the unlikely event that the pipe freezes, a propane tiger torch can be used to thaw the pipe.

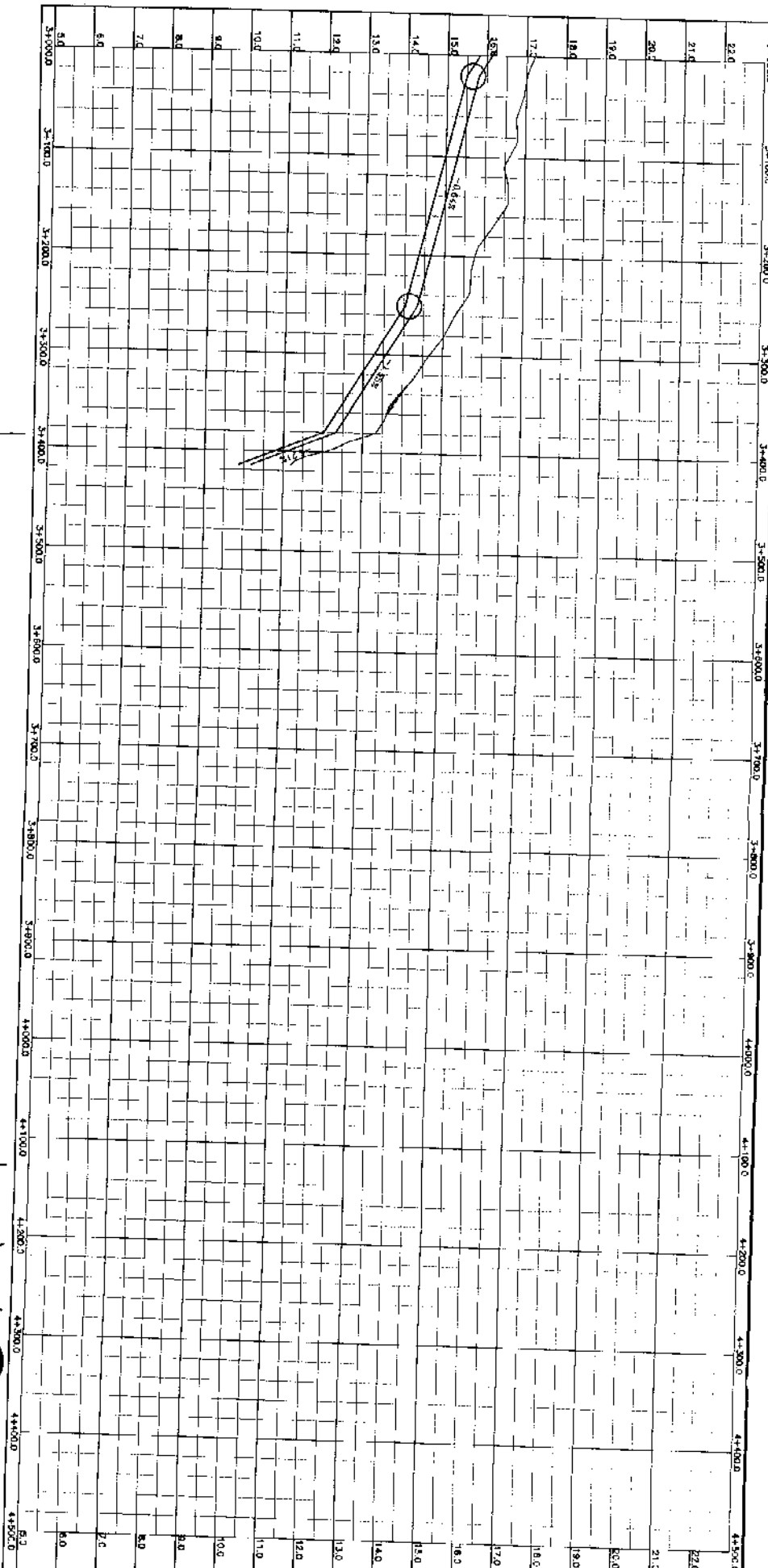
WATER WORKS & WATER SUPPLY
 6104 HAVEN, N.T.
PROPOSED PIPELINE ALIGNMENT
 STA 1+500.00 TO 3+000.00
 HOR. 1:4000 VER. 1:100
 SEPT 2002
 02-0602-1000 FIG. 3

LEGEND
 ○ PIPELINE ALIGNMENT
 ○ ACCESS VALVE
 ▲ HIGH POINT (AIR VENTS)
 ■ LOW POINT DRAIN



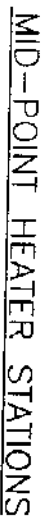
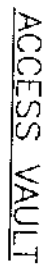


3+000
3+100
3+200
3+300
3+400



LEGEND
 --- PIPELINE ALIGNMENT
 ○ ACCESS VAULTS
 ▲ FISH POINT (AIR VENTS)
 ■ LOW POINT DRAIN

WATER WORKS & WATER SUPPLY
 G/OIA HAVEN, NT
 PROPOSED PIPELINE ALIGNMENT
 STA. 3+000.00 TO 3+415.00
 DILON
 02-0602-1000
 SEPT 2002
 FOR 1:4000 VER. 1:100
 Fig 6



VALVE (GLOBE)
NORMALLY OPEN

VALVE (GLOBE)
NORMALLY CLOSED

SOLENOID VALVE

CHECK VALVE

VALVE (BUTTERFLY)

MOTORIZED VALVE
(NORMALLY OPEN)

(NORMALLY CLOSED)

RELEASE VALVE

NORMALLY OPEN
NORMALLY CLOSED

HEAT EXCHANGE

LEVEL SWITCH

FLOW TRANSMITTER

TEMPERATURE SENSOR

TEMPERATURE CONTROL VALVE

PRESSURE INDICATOR

CUMLP

PIPE SIZE

AND BRADY ET AL.

LOW DIRECTION

10/18/02 AC-2 F - 4'10w g/cod/C2D602/C00/gica.scitem.fmg

2025-01

**WATER WORKS & WATER SUPPLY
GUAHA HAVEN, NORTHWEST TERRITORIES**

PROCESS WATER FLOW SCHEMATIC

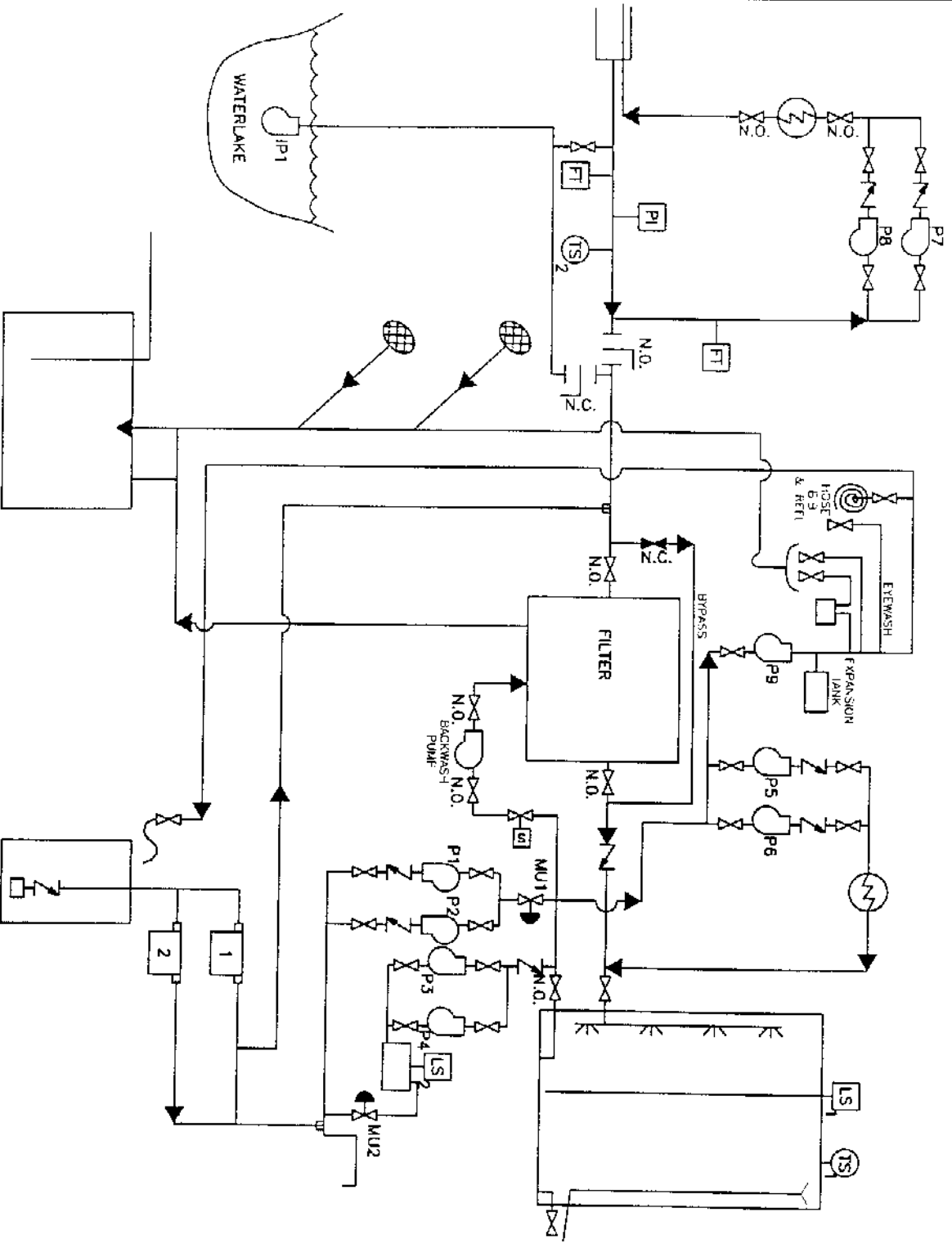
DILLON
CONSULTING

OCT 02

02-0602-1000

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FIG 7



LEGEND:

- ◇— VALVE (GLOBE)
- ◇— VALVE (GLOBE) NORMALLY OPEN
- ◇— VALVE (GLOBE) NORMALLY CLOSED
- ◇— SOLENOID VALVE
- ◇— CHECK VALVE
- ◇— VALVE (BUTTERFLY)
- ◇— MOTORIZED VALVE (NORMALLY OPEN)
- ◇— MOTORIZED VALVE (NORMALLY CLOSED)
- ◇— PRESSURE RELEASE VALVE
- ◇— N.O. NORMALLY OPEN
- ◇— N.C. NORMALLY CLOSED
- ◇— HEAT EXCHANGE
- ◇— LEVEL SWITCH
- ◇— FLOW TRANSMITTER
- ◇— TEMPERATURE SENSOR
- ◇— TEMPERATURE CONTROL VALVE
- ◇— PRESSURE INDICATOR
- ◇— PUMP
- ◇— PIPE SIZE
- ◇— REDUCER
- ◇— Y AND BLIND FLANGE
- ◇— FLOW DIRECTION

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WATER WORKS & WATER SUPPLY
GJOA HAVEN, NORTHWEST TERRITORIES

DILLON
 CONSULTING

PROCESS WATER FLOW SCHEMATIC
WATER TREATMENT PLANT

PROJECT NUMBER
 02-0602-1000

DATE
 OCT 02

FIG 8

OPTIONAL
SEASONAL
COAGULANT AID

RAW WATER

SAND
PRESSURE
FILTER

ALTERNATING
OPERATION

SAND
PRESSURE
FILTER



G.A.C.
COLUMNS

BACKWASH
TO WASTE

CHLORINATION

FLUORIDATION
OPTIONAL

TREATED WATER
STORAGE

TRUCK HAUL
TO LAGOON

BACKWASH TO
WASTEWATER
TANK

BACKWASH TO
WASTEWATER
DECANT POND

TO SURFACE
DISCHARGE

DATE: 10/15/02 FILE: 4-MB-HAF-4110w-g3-000\G00012\1000\p000-nutan.dwg PROJECT: 02



DILLON
CONSULTING

WATER WORKS & WATER SUPPLY
GUOA HAVEN, NORTHWEST TERRITORIES

PROCESS SCHEMATIC
PREFILTERS, SAND FILTERS

PROJECT NUMBER:
02--0602-1000

DATE:
OCT 02

PLANT NUMBER:
FLC

OPTIONAL
SEASONAL
COAGULANT AID

RAW WATER

COAGULATION FLOCCULATION SEDIMENTATION FILTRATION

PACKAGE PLANT

CHLORINATION

FLUORIDATION
OPTIONAL

TREATED WATER
STORAGE

TRUCK HAUL
TO LAGOON

BACKWASH TO
WASTEWATER
TANK

BACKWASH TO
WASTEWATER
DECANT POND

TO SURFACE
DISCHARGE



DILLON
CONSULTING

WATER WORKS & WATER SUPPLY
GOOA HAVEN, NORTHWEST TERRITORIES

PROCESS SCHEMATIC
COAGULATION / FILTRATION PACKAGE PLANT

PROJECT NUMBER
02-0602-1000

DATE
OCT 02

FIGURE NUMBER
FIG 9b

APPENDIX B

PIPE CALCULATIONS

Gjoe Haven Water Treatment Plant Preliminary Design
02-0602-1000

Water Demand Calcs

Assumptions:

Convert L to usgal: X by 0.2642 gal/L
 Residential Water Demand per Capita: 90 lcpd
 23.778 gcgd use of 108 usgpcd in Hfx for average day !!
 Population projection Bureau Statistics: 2000 2010 2020
 984 1172 1435
 Population % yearly increase 2000 to 2010: 1.77%
 Population % yearly increase 2010 to 2020: 2.04%

Litres

	2004	2014	2024
Population	1056	1272	1556
Water Demand per capita including additional for Industrial, commercial, institutional (lcpd):	112	116	122
Average Day Demand (lpd)	118,075	147,902	190,082
Additional Water for In-plant Use	10.0%	10.0%	10.0%
Total Average Day Demand (lpd)	129,883	162,893	209,090
Peak Day Factor	1.5	1.5	1.5
Peak Day Demand (lpd)	177,113	221,853	313,636
Total Peak Day Demand (lpd)	177,113	221,853	313,636

Gallons

	2004	2014	2024
Population	1056	1272	1556
Water Demand per capita including additional for Industrial, commercial, institutional (gcgd):	30	31	32
Average Day Demand (usgpd)	31,195	39,076	50,220
Additional Water for In-plant Use	10.0%	10.0%	10.0%
Total Average Day Demand (usgpd)	34,315	42,983	55,242
Peak Day Factor	1.5	1.5	1.5
Peak Day Demand (usgpd)	46,793	58,614	75,330
Total Peak Day Demand (usgpd)	46,793	58,614	82,863

Tank Requirements:

Case	Avg Day Demand (usgpd)	Equilization (1) US Gal	Fire Storage (2) US Gal	Emergency Storage (3) US Gal	Dead Storage (4) US Gal	Total Storage (US Gal)	Total Storage (Litres)
Existing Conditions	34,315	24,526	44,914	11,438	4,044	84,923	321,433
Future 2024 Conditions	42,983	40,000	44,914	14,328	4,962	104,204	394,413
FSC Report		59,730	44,920	15,130	6,600	126,380	478,350

- 1) Equilization Storage = storage needed for max day demand
- 2) Fire Storage = 170,000 L FSC directed by Fire Marshall
- 3) FSC used 8 hours of avg day demand so 1/3 of ADD however if the disruption is during the day then the entire ADD should be used. However under avg day conditions from 2004 to 2024, only a portion of equilization storage is used so additional for emergency.
- 4) Dead Storage is 5% of overall volume - FSC report

Flow from Truckfill:

Days Truckfill operates out of 7 days (W)

6 days /week

Truckfill hours of operation avg day (X):

8 hrs/day

Truckfill hours of operation Max day

9 hrs/day

** significantly alters the storage/pump requirement

Flow from Truckfill AVERAGE DAY:

	2004	2014	2024
Average Day Demand (gpd)	34,315	42,983	55,242
Truckfill operates W out of 7 days so daily demand is increased to:	40,034	50,147	64,449
Flow from tank to Truckfill over X hours (gpm):	83.4	104.5	134.3

Flow from Truckfill MAX DAY:

	2004	2014	2024
Max Day Demand (gpd)	46,793	56,614	82,863
Truckfill operates W out of 7 days so daily demand is increased to:	54,592	66,383	96,673
Flow from tank to Truckfill over X hours (gpm):	101.1	126.6	179.0

Pipe Size:

Pipe Hydraulic Radius Calcs:

(Large watermain with 1.5" heated pipe inside)

Pipe size:	1.5" (38 mm)	3" (75 mm)	4" (100 mm)	5" (125 mm)	6" (150 mm)
Inside Diameter (in):		0.0675	0.092		0.133
Inside Radius (ft):	0.063	0.111	0.151	0.208	0.218
Area (ft ²):	0.012	0.039	0.072	0.136	0.150
Perimeter (ft):	0.393	0.696	0.948	1.309	1.371
Flow Area subtracting 1.5" heat pipe (ft ²):	na	0.026	0.059	0.124	0.137
Wetted Perimeter including 1.5" heat pipe (ft):	na	1.088	1.341	1.702	1.764
Hydraulic Radius (ft) R:	na	0.024	0.044	0.073	0.078

Assumptions:

C Value for HDPE:	140	** significantly alters headloss
Pipe Length:	3.4	km
Pipe Length:	11154.8556	ft
max allowable Velocity:	5	ft/s
min allowable Velocity:	2	ft/s
Max Pressure:	50	psi
Min Pressure:	20	psi

Design pipe and tank for 20 yr population with pump running 20 hrs per day.

Design initial pump for 10 yr population running 20 hrs per day.

AVERAGE DAY

Pump Running Time Y.	20 hours		
Year	2004	2014	2024
Pump Flow rate needed to refill daily demand over Y hrs (gpm):	30.4	41.8	53.7
Equilization Volume for X hours based on above inflow and outflow (gal):	24,021	30,088	38,669
check pump can refill in Y X hours:	24,020.5	30,088.4	38,669.2

MAX DAY

Pump Running Time Y.	20 hours		
Year	2004	2014	2024
Pump Flow rate needed to refill daily demand over Y hrs (gpm):	45.5	67.0	80.6
Equilization Volume for X hours based on above inflow and outflow (gal):	26,689	33,432	47,262
	32,755.3	41,029.6	58,003.8

Design Pump & Pipe Based on set equilization volume rather than set pump time

Pump Flow Rate needed if used a set equilization volume for tank:

Equilization Volume: 40000 us gal

AVERAGE DAY

Year	2004	2014	2024
Pump Flow rate needed to keep up with demand and only use a set equilization volume over X hrs (gpm):	0.07	21.14	50.93
Hours to refill tank:	9350.27	31.54	13.09

MAX DAY

Year	2004	2014	2024
Pump Flow rate needed to keep up with demand and only use a set equilization volume over X hrs (gpm):	17.76	43.30	95.69
Hours to refill tank:	37.53	15.40	6.97

4.3.10 Monitoring and Alarms

The WTP building will have the following monitoring and control system. The system will have two (2) levels of alarms: major and minor. Minor alarms will cause a green alarm light to activate, and a horn to sound at the WTP. Major alarms will activate a red alarm light and sound a horn. The alarms for this system are set as follows:

Major	High building temperature Raw water low temperature Intake pump failure Low building temperature Power Off – Stand-by generator failure Low Water Level Storage Tank Stage 2 (set at the required fire storage) Low Storage tank temperature – Stage 2
Minor	Truckfill pump failure Power off – Stand-by Power on Low flow transmission line Lost contact to IPH Process plant failure High Water Storage Tank Low fuel level

4.3.11 Building Construction

The two types of building construction used in the North are pre-engineered and stick built. Pre-engineered buildings perform poorly for WTP facilities. WTP normally hang process water piping from the roof structures, which can be a concern in pre-engineered building. Secondly, WTP have high internal moisture contents due to the nature of the facility use. For a number of reasons, this results in poor performance in the pre-engineered buildings. It is recommended that a stick built approach be used.

Features of the facility construction will include:

- Minimum R-30 insulated walls.
- Minimum R-40 insulated ceilings.
- Exposed wiring.
- Plywood internal sheeting, covered by drywall, covered by wipeable metal cladding.
- Painted concrete flooring.
- Minimum ceiling height of 3.0 meters.

There will be a small office and bench area for the operators. The office will contain the necessary testing equipment, shelves for storage of manuals and reports, and a washroom.

4.3.12 System Schematics

The schematic drawing for the proposed WTP, as described below, is shown in Figure 8. The operation of the WTP and supply line is as follows:

- Level Switch (LS) 1 will indicate the first stage low water and call to energize the intake pump (IP 1/2).
- Energize pump 1 or 2 will pump water through the main supply line.
- FS (located at the IPH) will be used for monitoring the water flow volume and rate.
- Flow switch will activate chlorine pump #1 which will inject chlorine into the supply line upstream of the pressure filter plant.
- Water will be treated in the pressure filters. (See Figure 9 for filter schematics).
- Treated water will flow to the storage tanks. Diffusers will be used in the tanks to maintain circulation.
- LSI will signal high water stage 1 and de-energize the IP 1 and 2.

Temperature control of the tanks will operate as follows:

- Temperature Sensor (TS) 1 will indicate low water storage tank temperature stage 1
- P 5/6 will energize.
- Water will be pumped from the storage tank, heated through the heat exchanger and returned to the diffusers in the tank.
- Temperature Sensor 1 will indicate high water storage tank temperature Stage 1 and de-energize P 5/6.

Transmission Main temperature will be controlled as follows:

- P 7/8 will operate 24 hours per day to maintain constant water circulation in the mains.
- TS2 will monitor the water supply temperature and regulate the heat supply to the P 7/8 heat exchange

4.3.13 Spares and Ancillary Components

The following is a list of spares, replacement parts, and ancillary components that will be included.

Spare Components	Parts
Pumps (intake and process)	pump complete with power cable.
Calcium Hypochlorite Feed System	replacement part kits for chemical pump. 1 chlorine flow switch. 1 chemical feed pump. Nylon tubing.
Eyewash	1 spare container of solution.
Lighting – exterior and interior	2 spare lamps each type.
Distribution Panel	2 breakers of each size and type.
Terminal Blocks	1 set of blocks for each size and type installed including end caps, end plates, cross connectors and tear-off markers.
Fuses	Unless noted elsewhere, 12 spares for each type required in facility.
Motor Starters	6 of each type of pilot light and over load heaters. 1 of each type of coil and contact.
Control Devices	1 of each type of push button pilot light and lens. 1 spare rotational water flow paddle wheel. 1 spare flow display/totalizer. 1 spare flow switch.
Alarm Panel	1 alarm annunciator.
6 of each Fuses or Mini-breaker	2 of each relay and timer. 1 of each relay and timer base.
Valves	1 spare of each type of valve.
Thermostats	1 spare of each type of thermostat.
Heat Trace	Spare controller Spare thermostat
Miscellaneous	supply of calcium hypochlorite, and testing chemicals.

Miscellaneous Equipment

1. Fire Extinguisher: Ansul A20E, Class ABC, UL listed, 9 kg capacity, external nitrogen cartridge Foray powder with wall mounting brackets. Mount on wall near exterior door.
2. Dust masks: Fisher 11-875-54 disposable masks supply three (3) packs of 50 masks each.
3. Face Shield: One (1) Fisher 11-409-5, optically clear 1.5 mm polycarbonate shield with adjustable headband.
4. Gloves: Twelve(12) Fisher 11-394-30, large, extra long, heavyweight rubber gloves, 19 mm by 380 mm length.

5. Apron: One (1) Fisher 01-357 double coated abrasion resistant, rubberized cloth apron.
6. Push Broom: One (1) Dustbane 403089, 600 mm wide, horse hair and synthetic bristle broom with handle.
7. Mop: One (1) Dustbane 481127, Syntex Flat size #20 with handle.
8. Mop Bucket and Wringer: One (1) Dustbane No. 2024X, 27 L, round, with Cam Squeezer Wringer.
9. Dust Pan: One (1) Dustbane No. 8 Hooded 300 mm.
10. Garbage Can: One (1) 100 L, galvanized, with cover.
11. Floor Cleaner: Dustbane No. 501379 Liquid cleaner, one (1) 20 L container.
12. Lighting: Two (2) fluorescent tubes and One (1) low temperature ballasts.
13. Storage Cabinet:
 - Combination shelving/wardrobe unit.
 - Two (2) doors.
 - Four (4) half shelves.
 - Pre-finished in grey.
 - Standard of Acceptance: Par Equipment Ltd. Model No. 4273
17. Hand Winch: 1500 lbs. hand winch, 5,1:1 gear ratio.

4.4 Storage Tanks

The water storage tanks are:

- located at the WTP.
- Tank size is 2 tanks each with a capacity of 203, 000 liters.
- Tanks to have an inlet for incoming treated water and equalization pipe and valve between the tanks.
- Tanks to have an outlet for truckfill with pump & controls.
- Tanks to have an outlet to supply water for backwashing process.
- One tank to have an outlet with pump to supply water to the chlorine mixing area.
- Tanks to have an overflow that spill overflow water.

Of the potential tank construction methods, only steel tanks are suitable for this application. Concrete tanks would require a level of material supply quality control that is not available in Gjoa Haven.

Steel tanks are sized to optimize the height on 6 foot or 8 foot increments which is the supply width of steel plate. The most economical tank to operate is one that the height and diameter are equal. This relationship maximizes the storage capacity and minimum surface area, therefore minimizing the heat loss potential.

A tank size of 5.48m high (18 feet) with a diameter of 6.86m is selected.

A comparison of the Capital Costs to insulate and clad the tanks versus housing the tanks in a building is completed, see Appendix F. A summary is shown below.

Item	External	Internal
Foundation	\$120,000	\$220,000
Tanks	\$406,000	\$406,000
Insulation	\$150,000	N/A
Cladding	\$5000	N/A
Building	N/A	\$150,000
Total	\$730,000	\$775,000

The client department has selected internal tanks for this application.

5.0 IMPLEMENTATION STRATEGY

Due to funding availability, the Client will construct the WTP in 2003/2004. The installation of the transmission main and of IPH will occur in subsequent years.

A temporary (short-term use) intake will be installed from the WTP to Water Lake for use until the transmission main and the IPH is constructed. This intake will be constructed on the same concept as the Swan Lake Intake.

To facilitate the transmission main construction, and to provide access to the IPH, the existing road to Swan Lake will be re-aligned and upgraded. This is included in the cost estimate.

A project schedule is as follows:

Gjoa Haven Water Works and Water Supply

Project Award	June 21, 2002
Project Initiation and Project Management.....	July 18, 2002
Site Visit	July 29 to 31, 2002
Site Surveys and geo-technical Investigation	August 1 to 15, 2002
Siting Report Submission	September 5, 2002
Comments on Siting Submission	October 4, 2002
Final Siting Drawing Submission	October 9, 2002
Predesign Report Submission	October 18, 2002
Review Meeting.....	October 28, 2002

Final Design Brief.....	November 1, 2002
Presentation of Final Design Brief to Community	November 1, 2002
Class C Cost Estimate.....	October 18, 2002
40% Design Submission.....	December 15, 2002
Review Meeting.....	January 6, 2003
95% Design Drawings and Specifications.....	January 23, 2003
Review Meeting.....	February 9, 2003
Tender Documents.....	February 20, 2003
Construction.....	June 2003 to March 2004

6.0 COST ESTIMATE

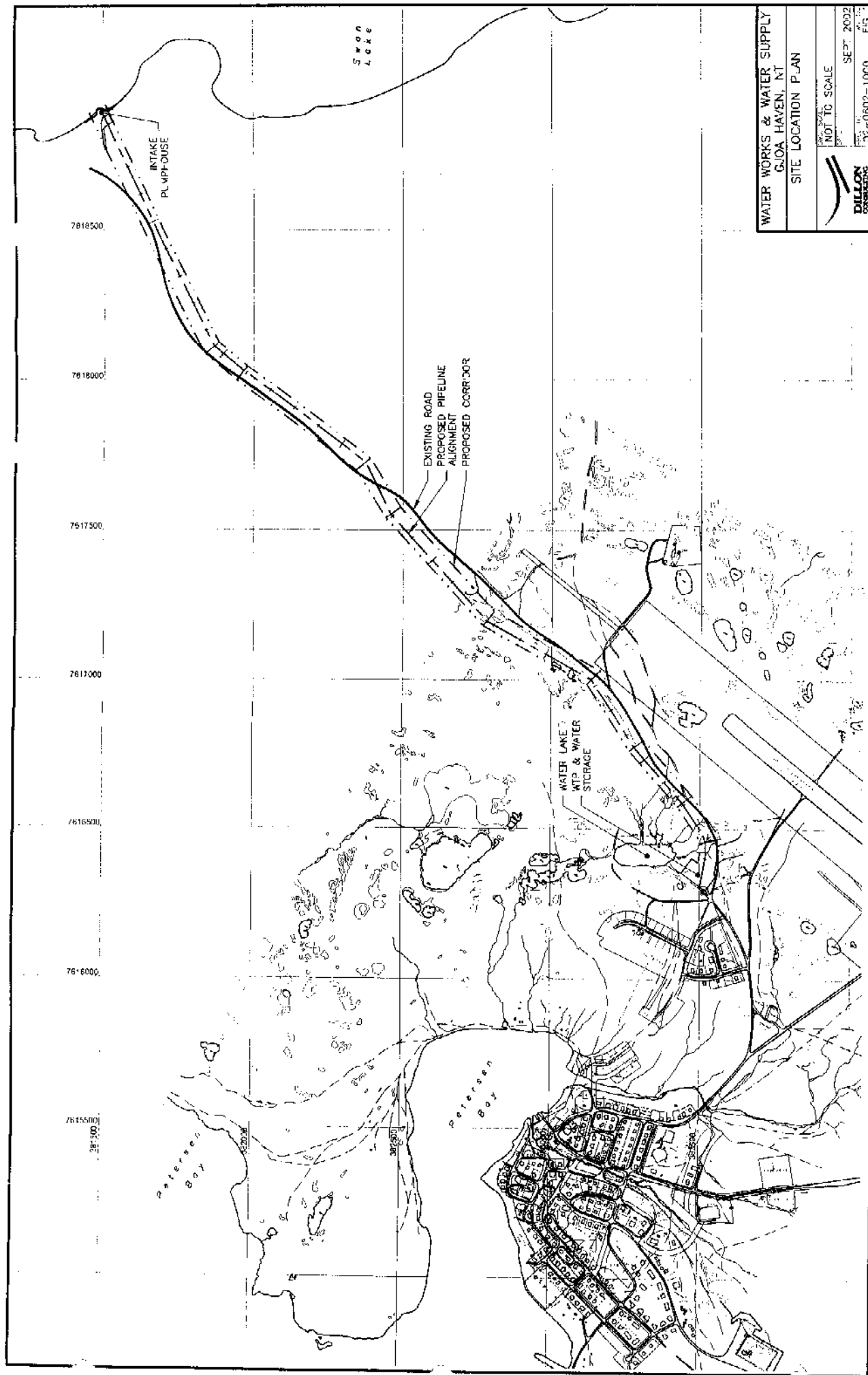
Appendix F includes the detailed estimates. This is summarized below.

Table 6.1

Item Description	Unit Cost	Units	Quantity	Extension
Swan Lake IPH	\$ 300, 000	Each	1	\$300, 000
100mm Insulated HDPE Pipe	\$300	Linear Meter	3300	\$990, 000
40mm Uninsulated HDPE Pipe	\$100	Linear Meter	3300	\$330, 000
Excavate and Backfill	\$100	Linear Meter	3300	\$330, 000
Access Vaults	\$25, 000	Each	16	\$400, 000
Drains	\$5,000	Each	5	\$25, 000
Air Release	\$5,000	Each	5	\$25, 000
Road Improvements	\$150	Linear Meter	3300	\$495, 000
WTP Building (150 m2)	2350/m2	Each	1	\$353, 000
Process Unit and Controls	\$600, 000	Each	1	\$600, 000
Foundation	\$2000	m3	30	\$60, 000
Intake	\$50, 000	Each	1	\$50, 000
Heating System	\$150, 000	Each	1	\$150, 000
Water Storage Tanks	\$1.80	litre	406, 000	\$730, 000
Sub Total				\$4, 838, 000
30% Engineering Contingency				\$1, 450, 000
Total				\$6, 288, 000

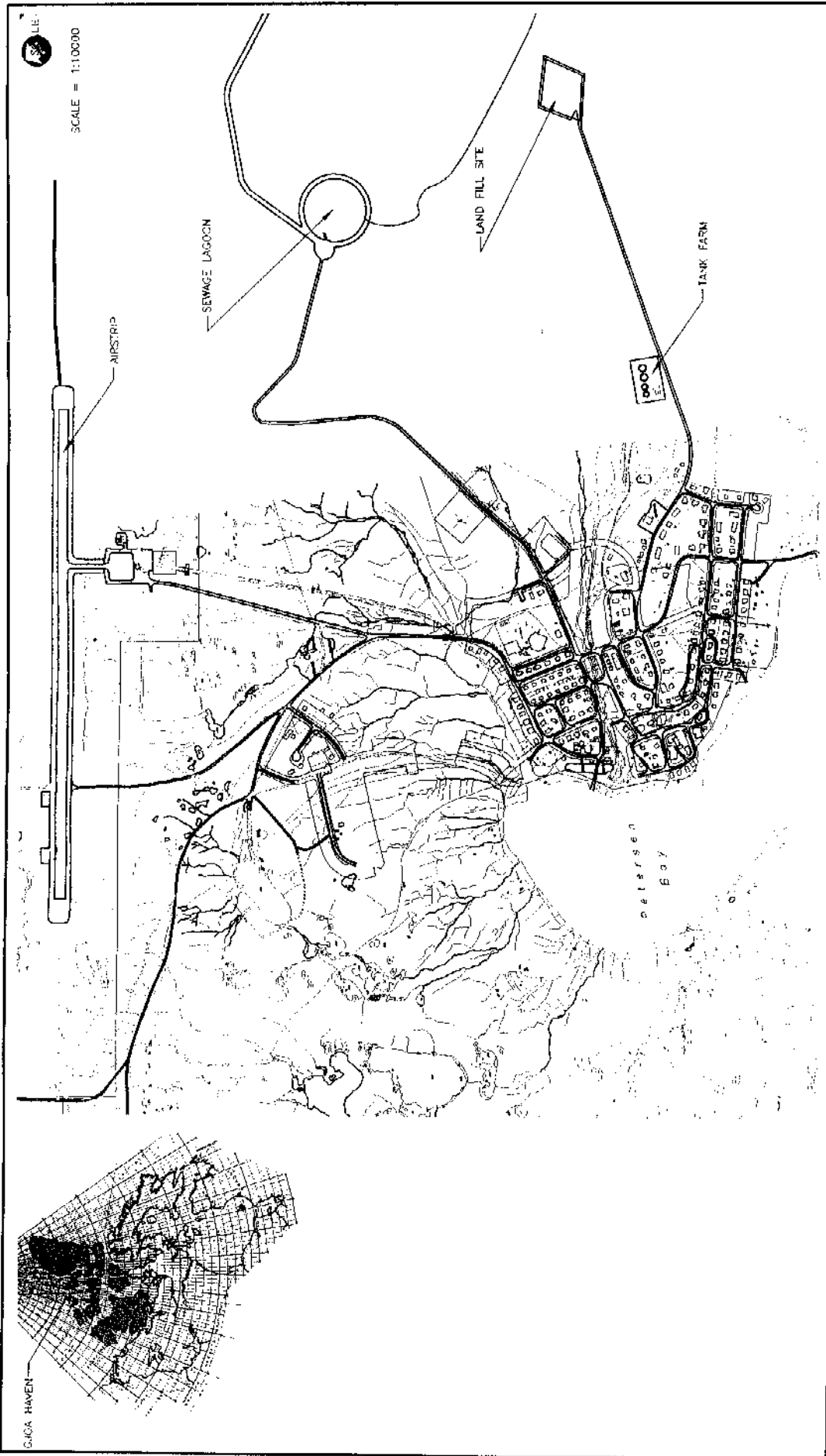
APPENDIX A

FIGURES



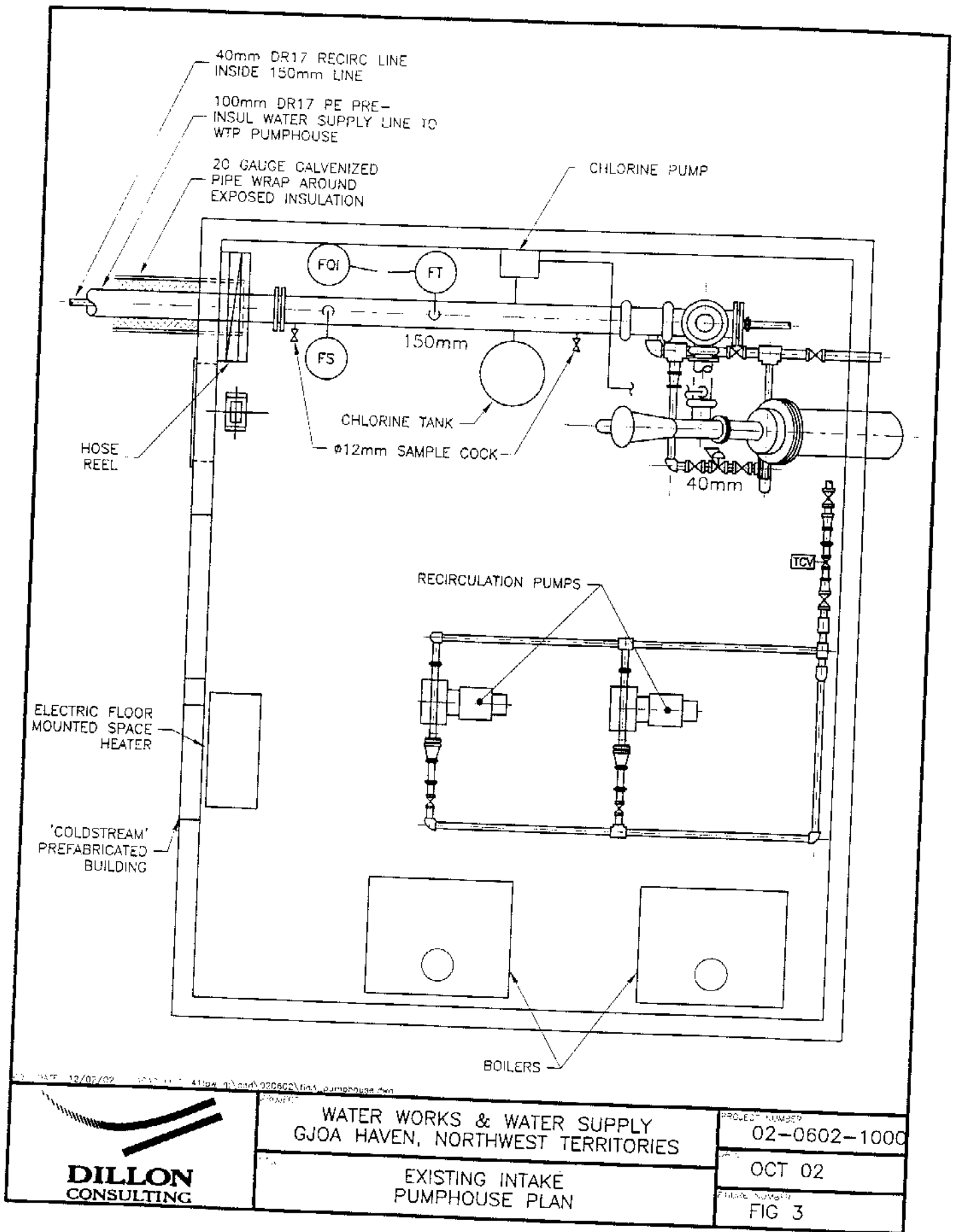
WATER WORKS & WATER SUPPLY	
GLOA HAVEN, NT	
SITE LOCATION PLAN	
NOT TO SCALE	SEPT. 2002
32-0802-1000 FIS	

DILLON
CONSULTING



PROJECT NUMBER	93-6790
DATE	MAY 2000
DRAWN BY	FIG 1
SOLID WASTE, SEWAGE AND WATER TREATMENT FACILITIES	
GUJOA HAVEN, NUNAVUT	
SITE PLAN	





DATE: 12/07/02 FILE: 41104.q3d\020602\fig3_pumphouse.dwg

DILLON
CONSULTING

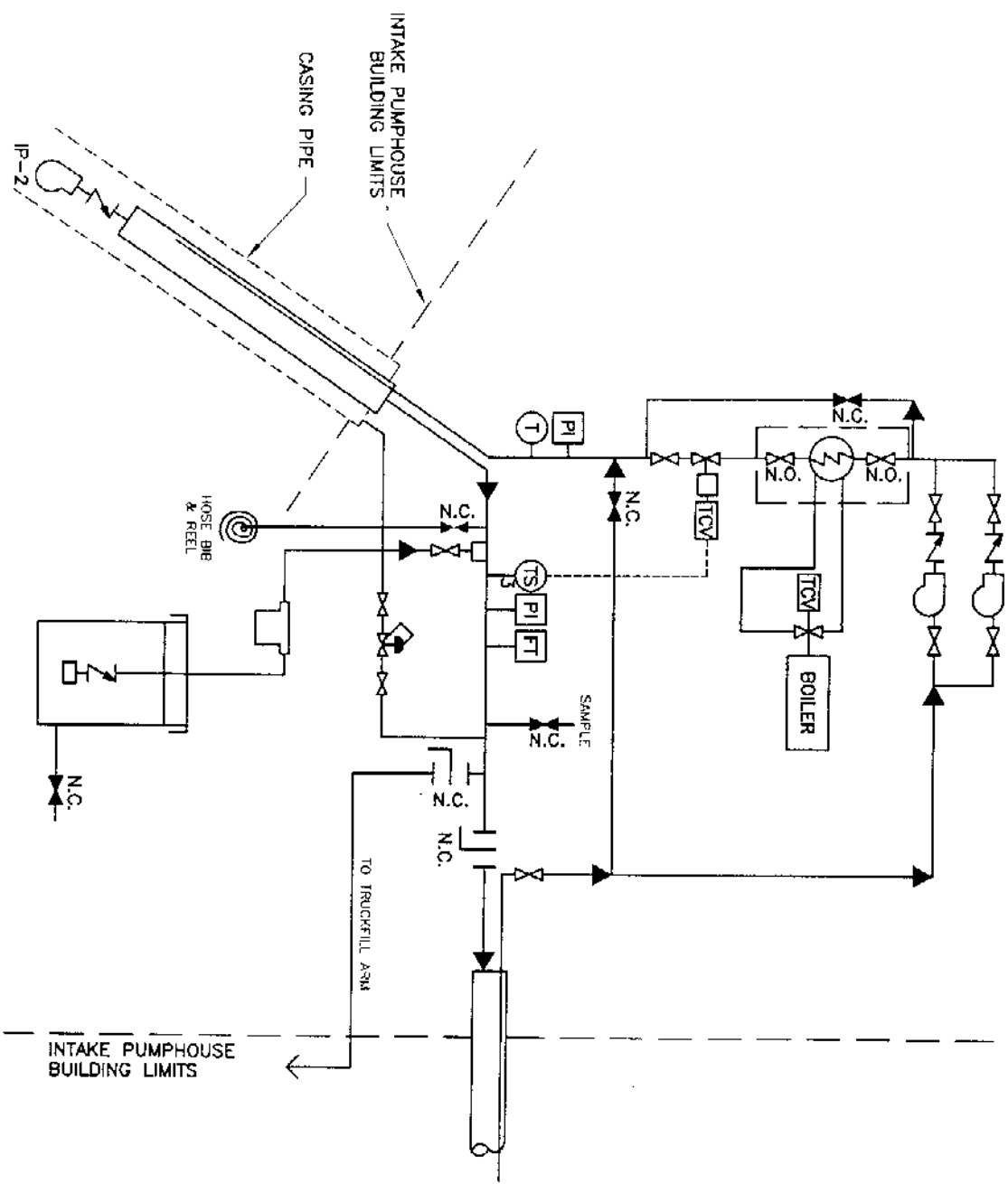
WATER WORKS & WATER SUPPLY
GJOA HAVEN, NORTHWEST TERRITORIES

EXISTING INTAKE
PUMPHOUSE PLAN

PROJECT NUMBER
02-0602-1000

OCT 02

FIG 3



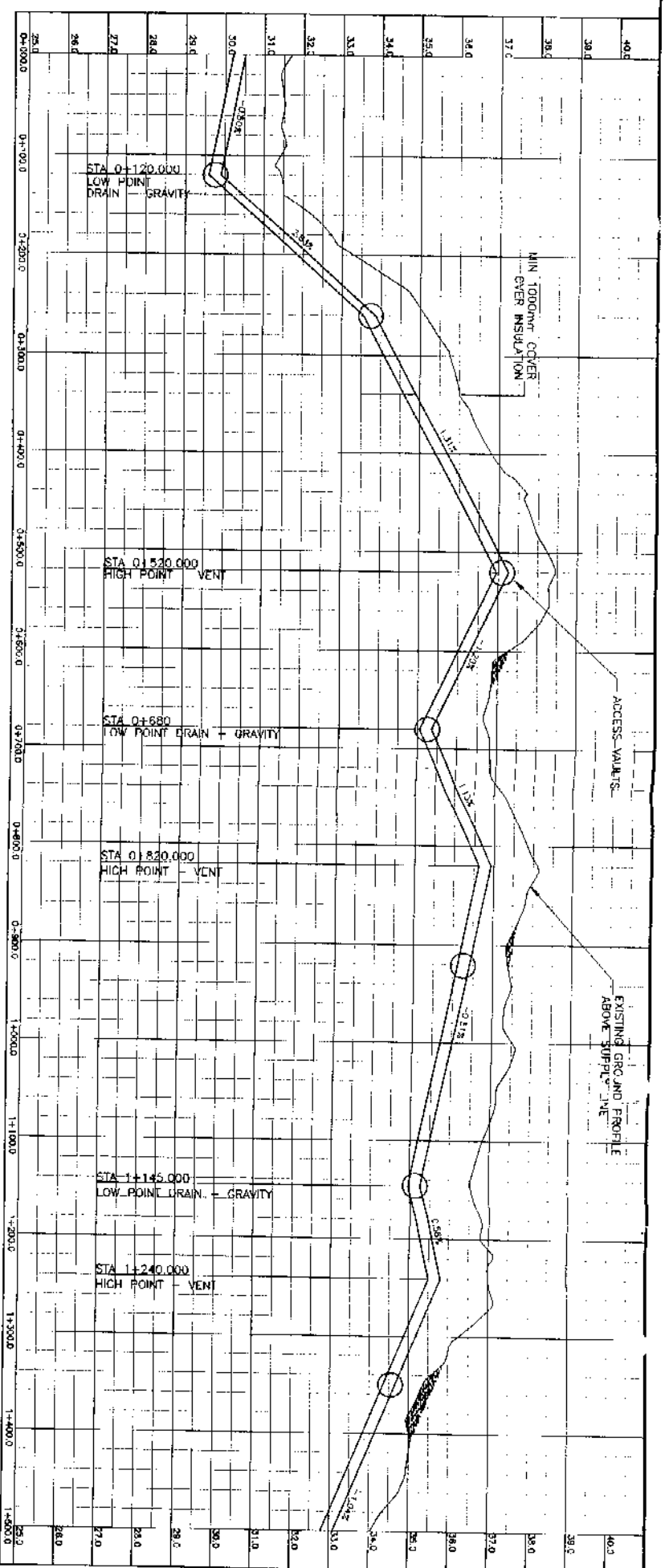
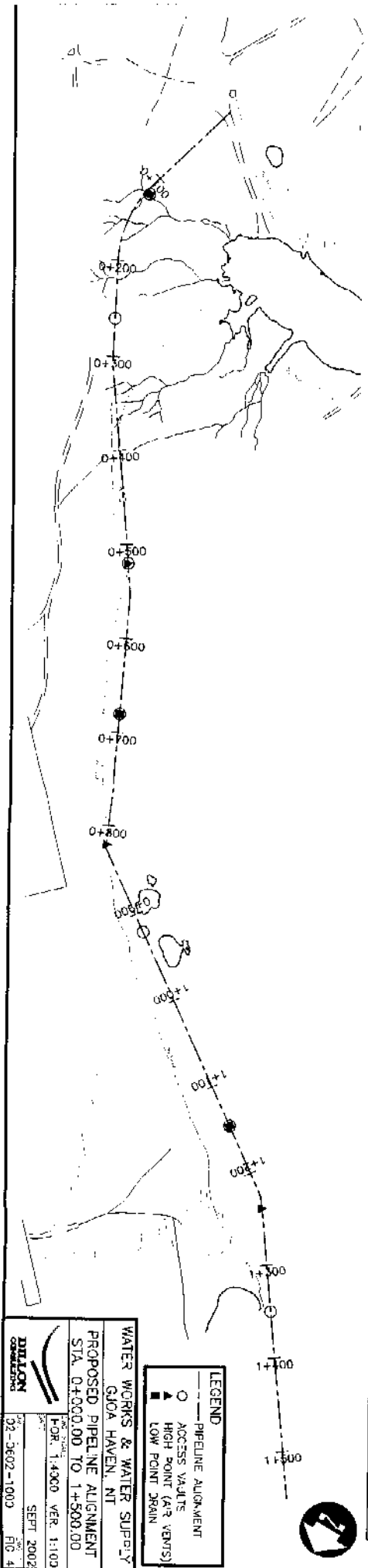
LEGEND:

- VALVE (GLOBE)
NORMALLY OPEN
- VALVE (GLOBE)
NORMALLY CLOSED
- SOLENOID VALVE
- CHECK VALVE
- VALVE (BUTTERFLY)
- MOTORIZED VALVE
(NORMALLY OPEN)
- MOTORIZED VALVE
(NORMALLY CLOSED)
- PRESSURE RELEASE
VALVE
- N.O.
N.C.
- HEAT EXCHANGE
- LEVEL SWITCH
- FLOW TRANSMITTER
- TEMPERATURE SENSOR
- TEMPERATURE
CONTROL VALVE
- PRESSURE INDICATOR
- PUMP
- PIPE SIZE
- REDUCER
- Y AND BLIND FLANGE
- FLOW DIRECTION



PROJECT NAME		02-0602-1000
DATE		OCT 02
FIG 2		

WATER WORKS & WATER SUPPLY
GJOA HAVEN, NORTHWEST TERRITORIES
PROCESS WATER FLOW SCHEMATIC
INTAKE PUMPHOUSE



LEGEND

- PIPELINE ALIGNMENT
- ACCESS VAULT
- ▲ HIGH POINT (AIR VENTS)
- LOW POINT DRAIN

WATER WORKS & WATER SUPPLY
GLORIA HAVEN, NT
PROPOSED PIPELINE ALIGNMENT
STA. 0+000.00 TO 1+500.00
 FOR 1:4000 VER. 1:100
 SEP 2002
 02-3602-1000 FIG. 4

AVERAGE DAY

Pipe size: 3 inches			
Hydraulic Radius (ft) R:	0.02411417 ft		
Flow Area subtracting 1.5" heat pipe:	0.02624649 ft ²		
	2004	2024	
Flow (gpm):	33.36	53.71	
Flow (ft ³ /s):	0.07	0.12	
Headloss Total (ft):	376.45	909.15	
Headloss (ft/1000ft):	33.75	81.50	
Velocity (ft/s):	2.83	4.56	
Pipe size: 4 inches			
Hydraulic Radius (ft) R:	0.04420932 ft		
Flow Area subtracting 1.5" heat pipe:	0.05928243 ft ²		
	2004	2024	
Flow (gpm):	33.36	53.71	
Flow (ft ³ /s):	0.07	0.12	
Headloss Total (ft):	41.05	99.14	
Headloss (ft/1000ft):	3.68	8.89	
Velocity (ft/s):	1.25	2.02	
Pipe size: 5 inches			
Hydraulic Radius (ft) R:	0.07291687 ft		
Flow Area subtracting 1.5" heat pipe:	0.124082 ft ²		
	2004	2024	
Flow (gpm):	33.36	53.71	
Flow (ft ³ /s):	0.07	0.12	
Headloss Total (ft):	5.83	14.08	
Headloss (ft/1000ft):	0.52	1.26	
Velocity (ft/s):	0.60	0.96	
Pipe size: 6 inches			
Hydraulic Radius (ft) R:	0.07783793 ft		
Flow Area subtracting 1.5" heat pipe:	0.13727017 ft ²		
	2004	2024	
Flow (gpm):	33.36	53.71	
Flow (ft ³ /s):	0.07	0.12	
Headloss Total (ft):	4.48	10.82	
Headloss (ft/1000ft):	0.40	0.97	
Velocity (ft/s):	0.54	0.87	

MAX DAY

Pipe size: 3 inches			
Hydraulic Radius (ft) R:	0.024114 ft		
Flow Area subtracting 1.5" heat pipe:	0.026246 ft ²		
	2004	2024	
Flow (gpm):	45.49	95.69	
Flow (ft ³ /s):	0.10	0.21	
Headloss Total (ft):	668.57	2649.42	
Headloss (ft/1000ft):	59.94	237.51	
Velocity (ft/s):	3.86	8.12	
Pipe size: 4 inches			
Hydraulic Radius (ft) R:	0.044209 ft		
Flow Area subtracting 1.5" heat pipe:	0.059282 ft ²		
	2004	2024	
Flow (gpm):	45.49	95.69	
Flow (ft ³ /s):	0.10	0.21	
Headloss Total (ft):	72.90	288.90	
Headloss (ft/1000ft):	6.54	25.90	
Velocity (ft/s):	1.71	3.60	
Pipe size: 5 inches			
Hydraulic Radius (ft) R:	0.072917 ft		
Flow Area subtracting 1.5" heat pipe:	0.124082 ft ²		
	2004	2024	
Flow (gpm):	45.49	95.69	
Flow (ft ³ /s):	0.10	0.21	
Headloss Total (ft):	10.36	41.04	
Headloss (ft/1000ft):	0.93	3.68	
Velocity (ft/s):	0.82	1.72	
Pipe size: 6 inches			
Hydraulic Radius (ft) R:	0.077838 ft		
Flow Area subtracting 1.5" heat pipe:	0.13727 ft ²		
	2004	2024	
Flow (gpm):	45.49	95.69	
Flow (ft ³ /s):	0.10	0.21	
Headloss Total (ft):	7.96	31.54	
Headloss (ft/1000ft):	0.71	2.83	
Velocity (ft/s):	0.74	1.55	

If set the following:

Equilization Volume (us gal):

40000

Pipe Size 3" :

Flow Description	Flow (usgpm)	Equilization Volume used (us gal)	Pump run time	Headloss (ft)	Velocity
Avg Pump Flow 2004 (usgpm)	33.36	24,021	20	376.45	2.83
Max Pump Flow 2004 (usgpm)	45.49	26,689	18	668.57	3.86
Avg Pump Flow 2014 (usgpm)	41.79	30,088	20	571.28	3.55
Max Pump Flow 2014 (usgpm)	56.99	33,432	18	1014.59	4.84
Avg Pump Flow 2024 (usgpm)	53.71	38,669	20	909.15	4.56
Max Pump Flow 2024 (usgpm)	95.69	40,000	15	2649.42	8.12

Pipe Size 4" :

Flow Description:	Flow (usgpm)	Equilization Volume used (us gal)	Pump run time	Headloss (ft)	Velocity
Avg Pump Flow 2004 (usgpm)	33.36	24,021	20	41.05	1.25
Max Pump Flow 2004 (usgpm)	45.49	26,689	18	72.90	1.71
Avg Pump Flow 2014 (usgpm)	41.79	30,088	20	82.29	1.57
Max Pump Flow 2014 (usgpm)	56.99	33,432	18	110.83	2.14
Avg Pump Flow 2024 (usgpm)	53.71	38,669	20	99.14	2.02
Max Pump Flow 2024 (usgpm)	95.69	40,000	15	288.90	3.60

Pump Flow Sizing:
Looks like 4" pipe is required.

Pump 2004 to 2014

If Size pump for 2014 running 20 hrs per day:

Avg Flow Truckfill 2014 (usgpm) 104.47
Max Flow Truckfill 2014 (usgpm) 126.63
Equalization Volume (us gal) 40000
Pump Run Time: 20 hrs/day
If 4" pipe then min flow to obtain 1.5 ft/s 40 usgpm
If pump run 20 hrs in 2014 then flow: 57
So if use set flow: 50 usgpm

Then the following equalization usage, and pipe Velocities and headlosses:

Flow Description:	Flow (usgpm)	Equalization Volume used (us gal):	Pump run time	Headloss (ft):	Velocity
Avg Pump Flow 2004 (usgpm)	50.00	16,034	13	86.84	1.88
Max Pump Flow 2004 (usgpm)	50.00	24,528	16	86.84	1.88
Avg Pump Flow 2014 (usgpm)	50.00	28,147	17	86.84	1.88
Max Pump Flow 2014 (usgpm)	50.00	36,785	20	86.84	1.88

Pump 2014 to 2024

If Size pump for 2024 running 20 hrs per day:

Avg Flow Truckfill 2024 (usgpm) 134.27
Max Flow Truckfill 2024 (usgpm) 179.02
Equalization Volume (us gal): 40000
Pump Run Time: 20 hrs/day

For set equalization volume, flow needed to

keep up on max day: 95.69 usgpm

If pump run 20 hrs in 2024 then flow:

So if use set flow: 95.69 usgpm

Then the following equalization usage, and pipe Velocities and headlosses:

Flow Description:	Flow (usgpm)	Equalization Volume used (us gal):	Pump run time	Headloss (ft):	Velocity
Avg Pump Flow 2014 (usgpm)	95.69	4,216	9	288.90	3.60
Max Pump Flow 2014 (usgpm)	95.69	14,853	11	288.90	3.60
Avg Pump Flow 2024 (usgpm)	95.69	18,517	11	288.90	3.60
Max Pump Flow 2024 (usgpm)	95.69	40,000	15	288.90	3.60

Volume of water in main pipe:

Volume in 4" (ft3): 661.29698
Volume in 4" (gal): 4946.42661

Volume in 1.5" (ft3): 136.890674
Volume in 1.5" (gal): 1023.94224

Items to be complete:

- Tank Size
- Check all work by hand
- Check all assumptions
- Pump head calcs for both pumps

APPENDIX C

PHOTO OF PIPELINE ALIGNMENT AND FACILITY LOCATION

APPENDIX D

AIR PHOTOS