# ATTACHMENT 10

## Lake Geraldine Intake Replacement Conceptual Design

Rev 1
April 24, 2026

CITY OF IQALUIT

WSP PROJECT NO. CA0023312.3294

# LONG-TERM WATER PROJECT OWNERS ENGINEER

## LAKE GERALDINE INTAKE VALVE CHAMBER

FINAL REPORT
PREPARED FOR CITY OF IQALUIT


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WSP PROJECT NO. CA0023312.3294

# LONG-TERM WATER PROJECT OWNERS ENGINEER

## LAKE GERALDINE INTAKE ACCESS VAULT TECHNICAL REPORT

April 29, 2024

FINAL REPORT

City of Iqaluit
PO Box 460
Iqaluit, Nunavut
X0A 0H0

**Attention:** **Tamilore Adeleke, Acting Director of Engineering**

**Subject:** **Long-Term Water Project Owner's Engineer - Lake Geraldine Access Vault**

Dear City of Iqaluit,

WSP Canada Inc. (WSP) is pleased to submit our attached Report for the Iqaluit Long-Term Water Project Owners Engineer regarding technical information about the Lake Geraldine Intake Access Vault.

The contents of this Report include commentary of the existing condition of the Intake Access Vault, and some preliminary indicative design information for planning the replacement of the Intake Valve and relocating it to a more accessible location. We understand the criticality of the access vault and the valves within, and hope these findings help with future design of a new Intake Valve Assembly.

If you have any questions regarding the contents of this Report, please reach out to me at Neil.Noble-Pattinson@wsp.com or (204) 259-1600.

Yours sincerely,

Neil Noble-Pattinson, B.Sc., BA, P.Eng., PMP

Project Manager, WSP Canada Inc.

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# REVISION HISTORY

| REV | DESCRIPTION | PREPARED BY | REVIEWED BY | APPROVED BY | DATE |
|---|---|---|---|---|---|
| 0 | Issued as Draft | Ian Moran<br>Technical Project Manager | Alex Green<br>Utilities Design Engineer | Neil Noble-Pattinson<br>Project Manager | 2024-04-19 |
| 1 | Issued as Final | Ian Moran<br>Technical Project Manager | Neil Noble-Pattinson<br>Utilities Design Engineer | Neil Noble-Pattinson<br>Project Manager | 2024-04-29 |
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April 29, 2024

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## APPENDICES

# 1 INTRODUCTION

## 1.1 COMMUNITY BACKGROUND

Iqaluit is the capital of the Nunavut Territory and is located at the south end of Baffin Island near the end of Frobisher Bay (63°45’N latitude and 68°31’W longitude). Access to Iqaluit is provided by regular scheduled commercial aircraft year-round, snowmobile trails from other Baffin Island communities in the winter, and sealift from the port of Montreal and Valleyfield in the summer.

### 1.1.1 GEOLOGY AND TERRAIN

Iqaluit’s location is above the tree line and within the permafrost zone of Canada. The region generally consists of glacially scoured igneous/ metamorphic terrain. In some locations, a thin layer of organic material is found.

### 1.1.2 CLIMATE

Iqaluit has a tundra climate typical of the Arctic region, although it is well outside the Arctic Circle. The city features long, cold winters and brief, cool summers. Average monthly temperatures are below freezing for eight months of the year. Iqaluit has an Arctic climate with an average January temperature of -21.5°C and July average temperature of 8°C. The annual precipitation is made up of 19.2 cm of rainfall and 255.0 cm of snowfall for a total of 43.0 cm of precipitation. The prevailing winds are northwest at 16.7 km/hr.

### 1.1.3 CITY GROWTH AND POPULATION

Iqaluit is the newest Capital City in Canada, and as a result has experienced a period of rapid development and growth. Iqaluit is the seat of government for the Territory of Nunavut and is the home base of many federal and territorial government departments. The City is rapidly developing into a regional center for the territory with many northern businesses and Inuit organizations making it their base of operations. In the recent 2021 Census, the population of Iqaluit was estimated at about 7,500 people with an average annual growth rate between three and four percent.

### 1.1.4 LAND OWNERSHIP SYSTEM

Iqaluit has a unique land ownership system. The major landowners in Iqaluit are the Commissioner of Nunavut, the City of Iqaluit (the City), and the regional Inuit associations. These entities in turn lease land to individuals, corporations, and other government departments. The City land is administered by a land acquisition by-law and by a Territorial Statute. Generally speaking, there is no private ownership of land.

## 1.2 PROJECT DESCRIPTION

### 1.2.1 PROJECT OBJECTIVES

Given the unreliable nature of annual precipitation for replenishing the sole reservoir, it is imperative to establish a sustainable, long-term water source to mitigate the looming risk of water shortages. Correspondingly, the City has undertaken several projects in recent years to prepare for the further development of their raw water supply and is currently seeking consulting services to advance the overall project.

#### LONG-TERM WATER PROJECT

In line with the existing Infrastructure Canada funding agreement through the Disaster Mitigation and Adaptation Fund (DMAF), the three main goals of this Project are:

- Replace and Modernize the Existing Piped Infrastructure
- Develop a New Long-Term Water Source and Supporting Infrastructure
- Construct a New Raw Water Reservoir

To achieve these objectives, the Project is broken down into the following five phases:

1. Water Model Development
2. Scope of Work Packages
3. Water Model Maintenance
4. Resiliency Study
5. Specialized Services

The Lake Geraldine Dam Intake Valve Replacement scope is to be completed as part of the *long-term water project.*

#### LAKE GERALDINE INTAKE VALVE REPLACEMENT

The purpose of the Lake Geraldine Dam Intake Valve Replacement is to upgrade the old infrastructure inside the inlet valve chamber (located at the base of the Lake Geraldine Dam). These assets (valve and adjacent pipework) are critical and facilitate connection and isolation of raw water between Lake Geraldine and the Water Treatment Plant (WTP).

The priority short-term objectives of the Project are to:

- Relocate and replace the existing valve in the intake valve chamber identified to be in poor condition.
- Install a new permanent/secure/solid valve piping assembly along the intake pipeline to a 50-year design lifespan with redundancies.
- Abandon the existing intake valve chamber, modify it as necessary to have ease of access for this work.

- Carry out and complete the works by Fall 2024.
- Minimize WTP downtime directly as a result of the associated works and minimize disruption risks to the community.
- Provide a backup/mitigation plan to ensure emergency water supply to the WTP.

The secondary objectives of the Project are to:

- Allow for ease of access to the shutoff valve assembly by moving valve assembly away from the existing enclosed intake valve chamber which is usually inaccessible to City staff and covered by snow in the winter months.
- Fall under the KPIs of the DMAF Funding requirements.
- Consider future modifications including:
  - Construction of a building around the new isolation valve.
  - Electrical tie-ins for building power.
  - Addition of a power-operated actuator for the isolation valve.

# 2 BACKGROUND AND HISTORICAL DOCUMENTATION REVIEW

Lake Geraldine is currently the primary reservoir for the City of Iqaluit's potable water supply located approximately 1 km north of the Iqaluit population center (**Figure 1**).

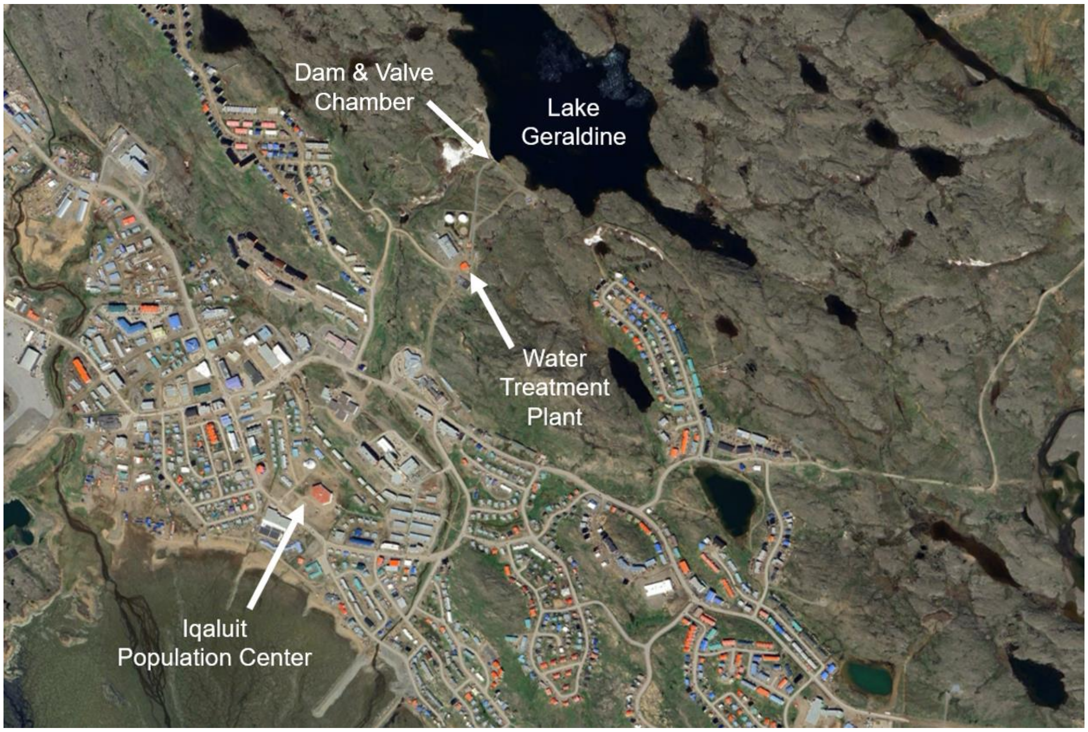


**Figure 1: Aerial View of Iqaluit and Project Location**

Condition assessment & analysis reports were prepared by Concentric Associates International Incorporated (Concentric) on the Lake Geraldine Valve Chamber and associated components in 2022 (**Appendix A**). The report indicated that all nearly all components (piping & valving, electrical, mechanical) were severely corroded and required replacement.

Considering the intake valve has not been exercised for an indeterminate amount of time (likely 10+ years), the City has firmly expressed that the valve is not to be exercised any circumstances to mitigate the risks and potentially substantial consequences of failure.

The Lake Geraldine Dam is comprised of a concrete section with integral spillway, and three earth berm sections, designated north, central, and south. The Dam was constructed in the late 1950s and has been expanded to increase the reservoir capacity over the years (**Figure 2**).

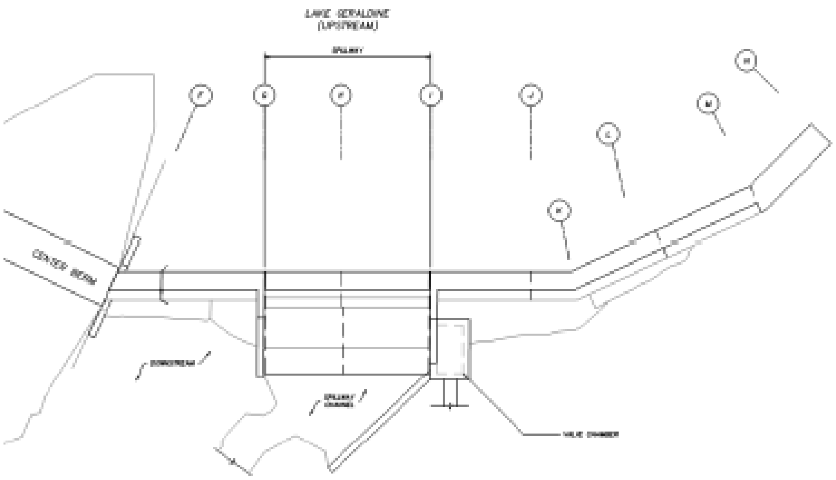


**Figure 2: Plan view – Lake Geraldine Concrete Dam and Spillway**

The intake valve chamber construction is unknown but is estimated to have taken place between the 1950s and 1995. The valve chamber is a concrete structure located on the south side of the spillway and contains piping and valves critical for the supply of drinking water (**Figure 3**).

**Figure 3: Lake Geraldine Dam Structure**

The Lake Geraldine Access Vault is located at the base of the Lake Geraldine Dam which is located on the south side of Lake Geraldine. A gated access roadway connects the WTP to the dam (**Figure 4**). Along the west side of the access roadway is a corrugated metal casing structure that contains insulated piping that conveys raw water from Lake Geraldine to the WTP and heated water from the WTP to a connection point within the Access Vault to mitigate the risk of the intake pipe freezing.

**Figure 4: Access road between the WTP and Lake Geraldine Access Vault**

The Lake Geraldine Access Vault is a rectangular structure, is constructed of concrete, and attached directly to the side of the dam (**Figure 5**). Entrance to the Access Vault is granted via the manhole at the top of the structure.

**Figure 5: Lake Geraldine Access Vault**

# 3 SITE INVESTIGATION & CONDITION ASSESSMENT

Given the tight scheduling limitations, a formal site investigation of the Lake Geraldine Access Vault and surrounding site has not yet been performed and this report relies on existing information in its development. The available photographic information is both recent and detailed. It is our understanding the referenced information is sufficient for supporting our indicative design presented in **Section 4**.

Matterport scans of the interior and exterior of the Lake Geraldine Access Vault were collected by WSP in September 2023. At the time of this investigation, the bottom of the Access Vault was covered with a layer of standing water limiting visual inspection of the lower components. Photos from an August 2023 Lake Geraldine Access Vault inspection report prepared by others was used in supplement of the assessment of such components.

## 3.1 SITE ACCESS

Site access is granted via an access roadway between the WTP and the Lake Geraldine Dam structure (**Figure 4** above). As of the most recent September 2023 site investigation, the access roadway appeared to be free of obstructions or obstacles that might limit or hinder vehicle access to the Dam. Of the numerous visual intake inspections conducted by WSP since 2020, the lack of obstructions and obstacles has remained unchanged.

Previous site investigations including City operational staff have indicated that the security gate (for vehicular traffic) and corresponding locking mechanisms are in good working order. The width of the gravel roadway is consistent across its length at approximately 3.65 m (12 ft) – a standard single traffic lane in Canada.

The access road mildly expands in approach of the Dam (**Figure 6**). The gravel portion of the roadway widens to as much as 9.1 m (30 ft) and may be able to facilitate vehicle turn-around and additional vehicular parking at the Project site.

**Figure 6: Matterport Aerial Rendering of Access Road approaching Lake Geraldine Dam (2023)**

## 3.2 GENERAL SITE CONDITIONS

The access roadway appears to be relatively level across the full length, with a minor grading to the west in approach of the Dam (**Figure 6** above). Large Canadian Shield outcrops are present on the east side of the access road and small brook is present to the immediate west of the intake piping (**Figure 7**). Water over the Dam's spillway is diverted to the west via a large concrete wall. An unknown metal structure, possibly a weir, is located to the immediate south of the spillway, is not connected to anything on either end, and is not believed to serve any current functional purpose.

**Figure 7: Existing site features near the Lake Geraldine Dam, as viewed from atop the Access Vault**

The insulated intake piping appears to be shallow-buried from the Access Vault for approximately 18.3 m (60 ft) to the corrugated metal casing.


Figure 8: Intake Piping from Access Vault

## 3.3 ACCESS VAULT INTERIOR

The existing piping within the intake valve chamber is heavily corroded and it appears as though the valves have not been regularly exercised. Redundant piping has been left in place from previous work in the chamber and there is a substantial amount of debris (wood, rocks, garbage) around the chamber.

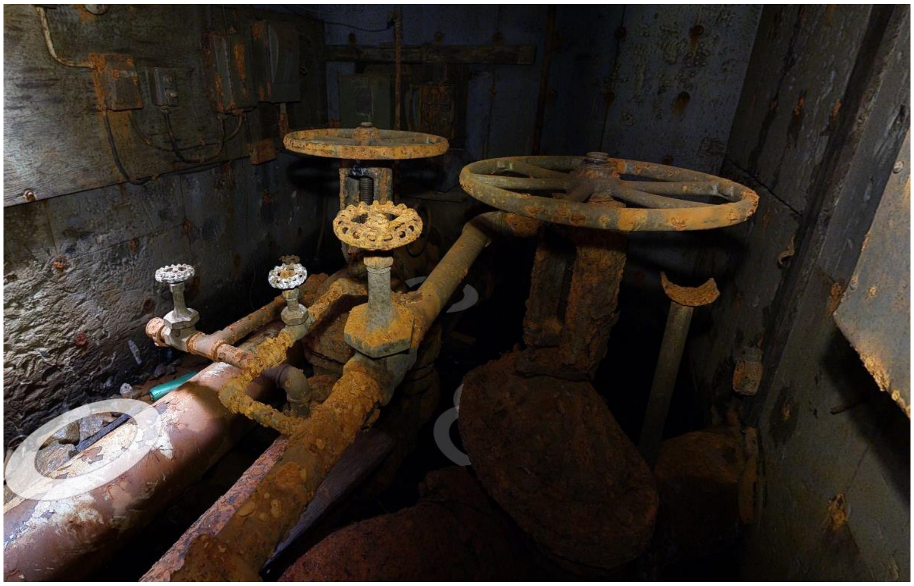

Figure 9: Example of Heavily Corroded Piping and Valves

There is a corroded and unidentifiable sensor installed on the heated water piping prior to its connection to the raw water line (Figure 10). Given the condition of the services, it is assumed unlikely to be functioning properly.

**Figure 10: Corroded Sensor on Heated Water Line**

There is a sump pit within the southwest of the intake valve chamber and what appears to rusted and inoperable components of a pump. The depth of the sump pit is not known.

**Figure 11: Sump pump and pit in the southwest corner of the Access Vault (VR Associates Inc., 2023)**

Electrical services, including switches and disconnects are mounted on the south and east wall of the chamber and are heavily damaged by corrosion (**Figure 12**).

**Figure 12: Electrical System Components Along South and East Walls**

There is an electric heater mounted on the west interior wall near the ceiling. It is not known whether this unit still functions.

**Figure 13: Existing Electrical Radiant Heater Along West Wall**

A review of the existing electrical panel labeling at the WTP was not able to identity any breaker that was clearly or obviously marked for its connection to the Access Vault or its components. In light of this, it is not currently known whether the electrical service is connected to the WTP, what size the cabling is and what capacity the breaker(s) have.

# 4 INDICATIVE DESIGN

## 4.1 DESIGN SUMMARY

The City's design preferences for the new intake valves, piping, and associated infrastructure was solicited during a virtual meetings on April 8th and April 16th 2024 and written correspondence during the same time period. WSP understands that the City's stated preferences to be as follows:

- The identification (and pre-construction trial run, if permissible) of a method to plug the existing intake pipe on the Lake side of the dam.
- The removal of piping components in the existing Lake Geraldine Access Vault, the abandonment of the existing Lake Geradine Access Vault, and the construction of a new isolation valve location approximately 9.1 m (30 ft) to the south of the existing structure or in a suitable location that is safe and accessible during all seasons of the year.
- Provide a new valve piping assembly that will be solid/permanent/secure that can be operated safely for normal maintenance and operational purposes. The modifications to the line must maintain freeze protection for the full intake line with redundancy to meet a 50-year design lifespan.
- The City recognizes the tight timeline for completion and, in light of this, expects, at a minimum, that a new valve be installed by end of the 2024 construction season with provisions (i.e., tee connections with blind flanges, location suitable for a building, space for electrical upgrades) for further expansion in 2025.
- Develop, implement, and manage a backup/mitigation plan to ensure emergency water supply to the WTP.

## 4.2 ADDITIONAL DESIGN RECOMMENDATIONS

WSP provides the following additional design recommendations for the City's consideration:

- The new intake valve enclosure is constructed as an accessible building with a man door rather than a majority below-grade structure accessible via a manhole or similar opening. Such a structure will enhance serviceability, be more suitable for further adaptation (electrical, mechanical, automation, etc.) and will eliminate the risks and challenges associated with an otherwise confined space-like structure. Construction of such a structure may not be feasible in 2024, however, consideration must be given for it in the 2024 design/construction activities.

## 4.3 PROPOSED INDICATIVE DESIGN

In alignment with the accepted recommendations from previous studies the City's design preferences, and our additional design recommendations, WSP has prepared an indicative design.

### 4.3.1 GEOTECHNICAL CONSIDERATIONS

Iqaluit's location is above the tree line and within the permafrost zone of Canada. The region generally consists of glacially scourfed igneous/ metamorphic terrain. In some locations, a thin layer of organic material is found. At or around the proposed construction site, the natural topography slopes downward to the west and south. A ~9.1 m (30 ft) wide and approximately-level gravel pad is situated at the end of the access road that should be used to facilitate the new structure.

Sub-surface conditions will need to be considered and confirmed as in accordance with the structural loading of the proposed building.

### 4.3.2 STRUCTURAL CONSIDERATIONS

Accountment must be made for the elevations of the existing piping, which are approximately at-grade at the proposed location. Due to the assumed shallow depth of bedrock at the proposed site and the depth of the slab foundation & insulation, the floor of the building structure is likely to be above the existing grade and thus incompatible with the existing pipe elevation. It is not recommended to elbow the piping upwards above the elevation of the dam inlet as this can limit the usable Lake Geraldine water elevation. In light of this, it is recommended to maintain the existing backfill material as a ground support structure for the piping and construct the building envelope around the extents of the serviceable piping components (Building Considerations).

No building is required for the initial phase to be completed in 2024. Instead, the isolation valve and associated assembly are to be designed and winterized as required for exterior operation. The following considerations are for a future building.

It is recommended that the primary structure be set on piles at each of the four corners of the building with walls supported on grade beams. Heating inside the building will be negligible so as to not affect the permafrost layer.

Design is to be in accordance with requirements of following codes and standards, and to requirements of local authority having jurisdiction. Where conflict occurs, the most stringent shall apply.

- National Building Code of Canada 2015 edition, errata, revisions and supplements.
- CSA-A23.1-14/A23.2-14, Concrete Material and Methods of Concrete Construction / Methods of Test for Concrete.
- CSA-A23.3-14, Design of Concrete Structures.

- CSA-S16-14, Limit States Design of Steel Structures.
- CAN/CSA-S136-16, North American Specification for the Design of Cold Formed Steel Structural Members.
- Good Building Practice Guidelines, Gov. of Nunavut, 2nd Edition, 2005.
- Good Engineering Practice for Northern Water and Sewer Systems, 2nd Edition, 2017.

## BUILDING STRUCTURE

Design loads are to be in accordance with the 2015 edition of the National Building Code of Canada (NBCC) for Iqaluit. The Importance Category = 'Post Disaster'.

The building structure will be a steel framed system which is well suited and commonly used in the north. It is proposed that the framing will consist of metal roof deck supported by steel frames spanning the narrow dimension of the building which will support insulated metal roof panels. The wall structure will consist of horizontal cold formed girts supporting insulated metal exterior wall panels. The lateral load resisting system will consist of braced steel frames.

## BUILDING ENVELOPE

For the purposes of the schematic design, the following building envelope components have been proposed. Further development of these components will be completed over the course of the detailed design.

**Walls**

- RSI 8.13/R46 Pre-finished insulated metal panels.
- Structural cold formed girts.

**Roof**

- RSI 8.13/R46 Pre-finished insulated metal panels.

### 4.3.3 BUILDING MECHANICAL CONSIDERATIONS

For the purposes of the schematic design, the following section proposes preliminary mechanical components. Further development of these components will be completed over the course of the detailed design. At a minimum, the following codes and practice standards are to be incorporated into the design:

- National Fire Code of Canada, 2015.
- National Plumbing Code of Canada, 2015.
- Installation Code for Oil Burning Equipment – CSA 139 Series.
- Ventilation for Acceptable Indoor Air Quality – ASHRAE 62.1 – 2016.
- Good Building Practice Guidelines, Gov. of Nunavut, 2nd Edition, 2005.
- Good Engineering Practice for Northern Water and Sewer Systems, 2nd Edition, 2017.

### FIRE PROTECTION

The building will be equipped with portable fire extinguishers as required by code. No sprinkler system will be provided.

### PLUMBING

As the building is not expected to be used for frequent or regular use, no potable water will be supplied to the building. Correspondingly, no sanitary drainage will be required.

Chemicals are to be neither stored nor handled in the building. As such, an emergency shower/eyewash station is not required.

### HEATING

A new electrical radiant heater could be added to maintain above freezing temperatures within the chamber or for use when an operator is present in the chamber. The radiant heater is not intended as a primary pipe-freeze protection measure, and will have to be evaluated against heat penetration through the structural slab to ensure no impact on permafrost.

### VENTILATION & AIR CONDITIONING

No ventilation or air conditioning is expected to be installed, but louvers or vents should be used to reduce condensation build up during temperature changes.

## 4.3.4 ELECTRICAL CONSIDERATIONS

For the purposes of the schematic design, the following section proposes preliminary electrical components. Further development of these components will be completed over the course of the detailed design.

The building is to be designed to meet the electrical requirements of the following standards:

- Canadian Electrical Code Cdn.1-2015.
- Institute of Electrical and Electronics Engineers (IEEE).
- National Building Code of Canada 2015 (NBC).
- National Electrical Manufacturer’s Association (NEMA).
- Electrical and Electronic Manufacturer’s Association of Canada (EEMAC).
- Illuminating Engineering Society (IES).

The electrical design is to be done in close cooperation with other disciplines, the City, and WSP in accordance with all local laws, rules and regulations.

### ELECTRICAL SERVICE

The primary electrical source for the new building will be from the WTP. The power/breaker should be updated to include a SCADA alarm. An existing power supply is provided to the existing Access Vault (it is assumed that this power supply is fed along the intake piping) however its connectivity, capacity, condition, and compliance with current codes is not known. In light of this, it is recommended to plan for the installation of new wiring. The new building will require a 120/208V, 3 Ø power supply.

### SERVICE ENTRANCE EQUIPMENT AND DISTRIBUTION

It is recommended to install a 100A, 120/208V, wall-mounted, fused main disconnect. This disconnect will supply power to the entire facility. The equipment will include the following:

- One (1) 120/208V, 100A, 3 Ø panel board

The panel board is expected to supply power to lights, receptacles, heating systems and provided sufficient spares for future monitoring and control devices.

### EMERGENCY POWER SYSTEMS

No critical systems are expected be installed in the building. Therefor, an emergency power system is not required.

### LIGHTING

Lighting in the WTP will be 120V LED type. Vapour-proof 1 x 4 LED fixtures are to be used throughout the interior of the building. LED wall pack type fixtures will be used on the exterior of the building. Exterior building entrances and building interior are to be illuminated to IES standards. Sufficient capacity will be built into the size of the 120/208V panel board to accommodate additional site lighting, if required.

Emergency egress lighting is to be provided as required by the latest edition of the National Building Code. Emergency egress lighting will automatically come on if normal power fails. Exterior lighting should be included for site safety. If the building enclosure is not constructed in 2024, temporary exterior lighting should be included.

Exit lighting is to be provided as required by the National Building Code 2015. These are to have LED type, metallic housing and be supplied from emergency back-up battery inverter power.

## 4.3.5 CONVEYANCE CONSIDERATIONS

The new piping is to be conveyed through the new site with all valves, appurtenances, and other serviceable components to be contained within a space suitable for a future building.

The new piping assembly must be fully winterized although it will be outside. Freeze protection is required for the valve assembly and the full length of the intake. The valving assembly must have redundancy and be designed for a 50-year lifespan and be able to accept automatic actuators for future use and ease of maintenance.

Design shall not reduce flow to the WTP.

The primary means of freeze protection comes from heated raw water which is re-injected into the intake line. The line is to be rerouted downstream of the isolation valve. The section of the intake between the dam and the isolation valve must also have freeze protection, and it is recommended that the design optimize considerations for both utilizing the heated recirculation line and heat tracing.

Sufficient service area must be provided around the components (lateral and vertical) for general operation & maintenance activities. A process flow diagram (PFD) for the proposed piping arrangement is shown in **Figure 16** and provided in a conceptual drawing package in **Appendix B.**

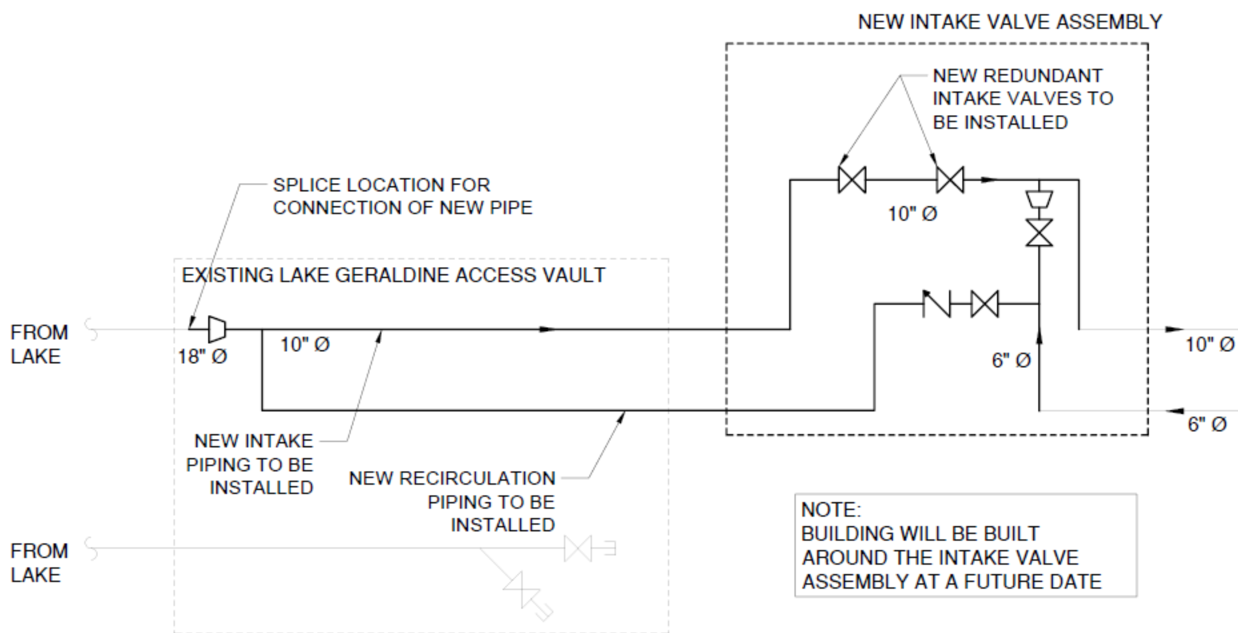


**Figure 14: Process Flow Diagram**

## 4.3.6 BUILDING FOOTPRINT

For the purposes of this indicative design, a building footprint has been conservatively estimated at 5 m x 5 m to account for piping, valving, service areas, and light equipment storage.

# Appendix A

## Concentric Assembly & Analysis Reports

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Toronto, ON M9B 6B7
**T** 647.351.0095 **F** 647.351.0069

**COQUITLAM, BRITISH COLUMBIA**
1900B Brigantine Drive
Coquitlam, BC V3K 7B5
**T** 1.866.919.4531

Our File: 22-9638

August 28, 2023

Colliers Project Leaders
Suite 700, Isabella Street
Ottawa, ON
K1A 1V7

**Attn: Jared Wright, B.Eng., LEED Green Associate**

**Re: City of Iqaluit Lake Geraldine Dam Intake Vault Options Analysis – Final Report**

Dear Jared,

Pursuant to your request, and in accordance with our fee proposal dated June 28, 2022, Concentric Associates International Incorporated (Concentric) was retained by Colliers Project Leaders (Colliers) to review and report on the existing condition of the Lake Geraldine (LG) Dam intake valve chamber and intake valves including an options analysis to determine the requirements for the valve chamber function and operational redundancy.

## BACKGROUND

Lake Geraldine is currently the primary reservoir for the City of Iqaluit's potable water supply. The LG Dam is comprised of a concrete section with integral spillway, and three earth berm sections, designated north, central, and south. The valve chamber is a concrete structure located on the south side of the spillway and contains piping and valves critical for the supply of drinking water.

The Dam was constructed in the late 1950s and has been expanded to increase the reservoir capacity over the years. The valve chamber construction is unknown but is estimated to have taken place between the 1950s and 1995.

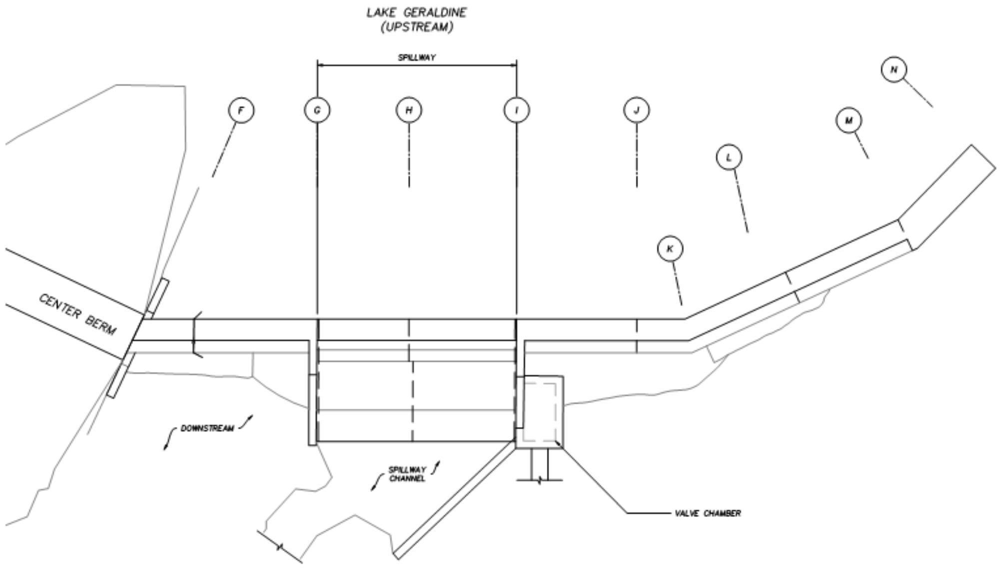



Figure 1: Plan View – Concrete Dam and Spillway

The City's priority is long-term asset management, which involves a rational approach to safety and serviceability to ensure near uninterrupted service to the end users. Asset management includes inspection, monitoring, repair, upgrades, and replacements, based on performance, asset priority, and available resources. As a result of the involvement of Concentric and various other consultants, numerous recommendations have been made for required repair/upgrade to the LG Dam. Some of these recommendations date back a number of years and involve safety concerns. Given the dam classification, the extreme nature of possible failure scenarios, and the outstanding recommendations, the City has elected to proceed with select projects, including assessment and reporting of the condition of the intake valve chamber and equipment.

Concentric staff have a long history of inspection and assessment of, reporting on, and design of repairs to the LG Dam dating back to 1997 including several Dam Safety Reports and numerous Dam Safety Inspections. During the time that Concentric has been involved with the assessment of the LG Dam, the exercising and testing of the valves within the valve chamber has been a recurring recommendation in our reporting. Exercising and testing of the valves within the valve chamber is required as part of preventative measures. The condition of the valves within the valve chamber has previously been identified as being in an advanced state of corrosion. To our knowledge, no maintenance or testing has been completed on the control valves in the last ten years or more. There is a significant potential for the valves to fail and not operate correctly when needed in an emergency.

The City has requested this analysis to determine the requirements for the valve chamber function and operational redundancy in order to establish the basis of design and determine whether:

.1 All valves should be replaced within the existing chamber.
.2 All valves and associated piping and plumbing should be replaced within the existing chamber.
.3 If an entirely new chamber and valve system will need to be fabricated.
.4 Or any other solution proposed by the consultant and accepted by the City.

As part of this analysis, Concentric will:

.1 Perform an on-site assessment to confirm existing conditions, any new issues and/or limitations, review the vault itself, its contents, general arrangement, and function.
.2 Conduct an option analysis that will establish the most appropriate renewal option, which may range from select repair/replacement to a new vault and equipment.
.3 Lead review meetings with Colliers/City to discuss our options analysis and draft report, and then issue a final document.

Vanderwesten & Rutherford Associates Limited (V&R) were retained to review and report on the mechanical and electrical components. Cameron McDonald, of Concentric, and Nawar Almadi, of V&R, conducted a visual review of the existing conditions on October 3rd, 2022. Nunavut Excavating were retained to provide confined space access and rescue services.

**OPTIONS ANALYSIS**

The following options were reviewed during this analysis:

.1 Option No. 1: Replacement of valves within the existing chamber.
.2 Option No. 2: Replacement of all valves and associated piping and plumbing within the existing chamber.
.3 Option No. 3: Replacement of valve chamber and valve system.

Based on the condition of the existing services and the importance of the system to Iqaluit's drinking water supply, Option No. 3 is recommended. Several configurations were reviewed by VR to determine which would have the least impact on the overall valve chamber footprint. VR's report and findings can be found in *Appendix A.*

Six (6) piping configurations are presented in VR's report, three (3) configurations utilizing gate valves and three (3) utilizing butterfly valves. All the presented configurations require the enlargement of the existing valve chamber. Based on the existing configuration and location of the valve chamber, it is recommended that Drawing No. M2 (*Option 2 – Valve Chamber Layout – Gate Valve*) be considered. This configuration requires expansion of the valve chamber vertically and is the most economical from a civil perspective. The cost estimate below reflects the configuration shown in Drawing No. M2.

**COST ESTIMATE**

Based on the recommendations of this report, the following costs have been evaluated as a Class D cost estimate:

| | |
|---|---|
| Mobilization/demobilization/site set-up/confined space/removals/EPP | $275,000 |
| Temporary bypass | $150,000 |
| Valve chamber replacement – M&E | $225,100 |
| Valve chamber replacement – Civil | $165,000 |
| New electric radiant heater | $19,500 |
| Scan pipeline | $15,500 |
| Install backflow at plant | $70,000 |
| Divers in for underwater work | $100,000 |
| Subtotal | $1,020,100 |
| 20% Contingency | $204,020 |
| **Total** | **$1,224,120** |

Engineering design costs, permit costs, supervision costs, applicable taxes are not included in the construction cost estimate.

Preparation of a construction cost estimate requires making a number of assumptions as to actual conditions that may be encountered on site. Factors over which we have little, or no control include the contractor's methodology and schedule economic volatility, the construction season, inclement weather, and the supply and demand of raw materials, finished goods, and labour.

The construction costs represent an estimate of probably costs and are based on industry standards for cost estimating and previous related project experience. The actual costs of construction may vary considerably from what has been established.

**LIMITATIONS**

This report has been prepared for the sole use of Colliers Project Leaders.

This report was prepared exclusively for the purposes, project, and site locations outlines in the report. The report is based on information provided to, or obtained by, Concentric as indicated in the report, and applies solely to site conditions existing at the time of the site investigations. Concentric's report represents a review of available information within an established work scope, schedule, and budget.

The material in this report reflects Concentric's judgment in light of the information available to it at the time of preparation. Any uses that a third party makes of this report, or any reliance on decisions made based on it, are the responsibilities of such this parties. Concentric accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made based on this report.

Should there be any questions, please contact the undersigned.

Yours sincerely,

**Concentric**

Kathleen Perry-Theriault, P.Eng.
Project Manager

Steve Parker, P.Eng., Partner
Production Lead

**Appendix A**
**V&R City of Iqaluit Lake Geraldine Dam Valve Chamber Replacements**

Vanderwesten & Rutherford Associates Inc.
Mechanical & Electrical Engineers
London . Windsor . Ottawa
www.vreng.ca
ENGINEERING FORWARD

# CITY OF IQALUIT
# LAKE GERALDINE DAM
# VALVE CHAMBER REPLACEMENTS

FINAL REPORT

Iqaluit, NU

**Prepared By:**
Vanderwesten & Rutherford Associates Inc.
Consulting Mechanical & Electrical Engineers
1130 Morrison Drive, Suite 140
Ottawa, ON, K2H 9N6

**Prepared For:**
Concentric Associates Inc. & The City of Iqaluit

V&R Project No. 22-120
August 28, 2023

# Table of Contents

# 1. General

## 1.1 Project Summary

Vanderwesten & Rutherford Associates (VR) was retained by Concentric Associates Inc. to review site conditions of the existing piping and components within the valve chamber at the dam at Lake Geraldine. This report will outline the recommended mechanical and electrical replacements and configuration of new intake water piping running to the water treatment plant.

It should be noted that VR was unable to enter the valve chamber, as confined space training is required to do so. Trained personnel were engaged to sketch out the piping configuration and mechanical/electrical services within the chamber.

The following three options were reviewed during this analysis:

- Option No 1: Replacement of valves within the existing chamber
- Option No 2: Replacement of all valves and associated piping and plumbing within the existing chamber
- Option No 3: Replacement of valve chamber and valve system

Option No. 3 is recommended based on the condition of the existing services. Several configurations were reviewed to determine which would be the least impact on overall valve chamber footprint. Gate valves versus butterfly valves was also reviewed. The recommendation based on these preliminary layouts is gate valve, Option 2. Refer to Appendix for layouts.

## 1.2 Building Summary

Lake Geraldine Dam was constructed in the late 1950s and has been expanded to increase the reservoir capacity over the years. The valve chamber construction is unknown but is estimated to have taken place between the 1950s and 1995.

## 1.3 Project Documentation

- Technical Analysis & Risk Assessment, July 16, 2020 (MECO)
- Appendix A Heating System P&ID and Boiler Room Layout, June 2021 (WSP)

## 1.4 Codes and Standards

The system descriptions contained in this brief reflect the state of the installation at the present stage. This assessment is based on basic proven design principles and applicable codes and standards including:

- National Building Code of Canada 2015
- CSA 64.10-11 - Selection and Installation of Backflow Preventers

# 2. Existing Conditions

## 2.1 Mechanical

The existing piping within the valve chamber is heavily corroded and it appears as though the valves have not been regularly exercised. Redundant piping has been left in place from previous work in the chamber. There appears to be some sort of sensor, either temperature or flow, installed on the piping prior to it leaving the chamber and heading towards the water treatment plant. Given the condition of the services, it is assumed unlikely to be functioning properly.

Photo 2.1.1: Example of heavily corroded piping and valves.

Photo 2.1.2: Example of heavily corroded piping and valves

Photo 2.1.3: top stem of sensor

There are pieces of scrap material wedged between piping and the piping is resting on wooden blocks and rocks. No proper pipe supports were used.

Photo 2.1.4: example of scrap metal propping up piping

There is a pit within the valve chamber for what appears to be a pump. It is in a state of disrepair and requires replacement. Depth of the pit is unknown.

Photo 2.1.5: Sump pump and pit

## 2.2 Electrical

Electrical services, including switches and disconnects are mounted on the wall of the chamber and are also heavily damaged by corrosion. There is an electric heater mounted on the wall. It is not known whether this unit still functions.

It is unknown whether the electrical service is connected to the water treatment plant, what size the cabling is and what capacity the breaker(s) have.

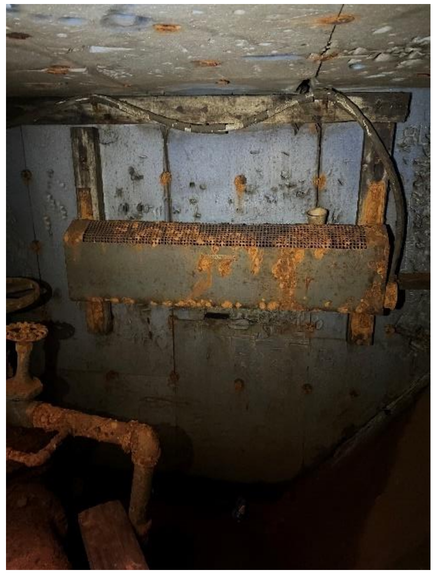


Photo 2.2.1: existing electrical radiant heater

Photo 2.1.2: overall view of existing electrical services

Photo 2.1.3: motor starter, assumed to be wired to sump pump

## 3. Options Analysis

For all three options, given that the system is critical for the supply of drinking water, it is recommended that temporary piping be installed to bypass the valve chamber, allowing water to be supplied to the water treatment plant while replacement of the valve chamber components is underway.

Installation of the temporary bypass will require a short shutdown of water supply to carry out tie-ins to the main lines. A specialized contractor may be able to use hot-tapping to perform tie-ins without disrupting the supply, but this would require ensuring there is a way to trap any filings and debris created by the procedure. It is recommended that a planned shutdown be scheduled instead.

Once the temporary bypass is in place, the remainder of the work can be carried out. Refer to Appendix for configuration options. Gate valves or butterfly valves may be used. Gate valves, although larger than butterfly, are recommended for this application as they do not obstruct flow in the pipe when open.

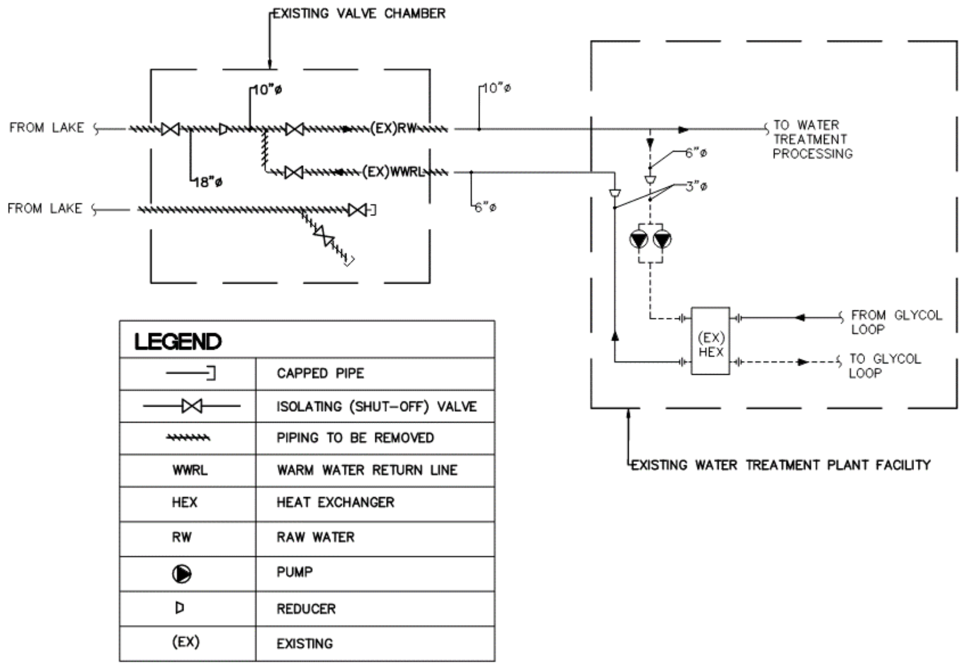



*Figure 3.1: Schematic of existing piping to be removed*

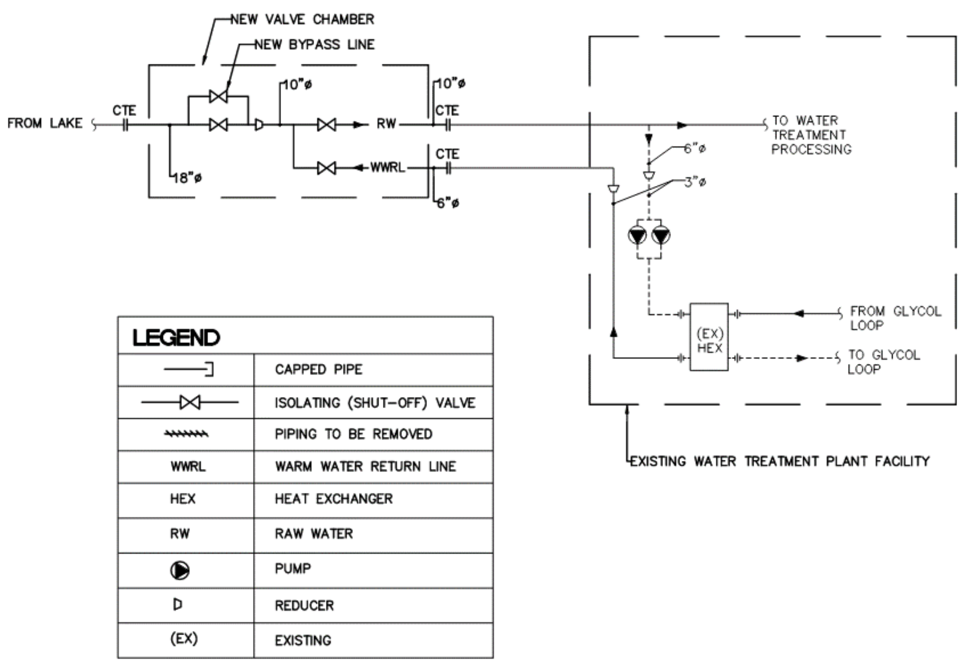



*Figure 3.2: Schematic of new piping*

**Option No. 1 – Replacement of Valves**

The existing system is in very poor condition with significant damage from corrosion. Removing the existing valves in order to replace with new while attempting to maintain the existing piping is not feasible. Pipe walls have undergone a large amount of deterioration and pipe wall integrity will be compromised further once valves are disconnected from the system. Proper seals will not be achieved when new valves are installed.

Replacement of valves without replacement of piping will not provide any level of redundancy in system.

Option No. 1 is not recommended.

***Opinion of Probable Cost: $69,380.00***

**Option No. 2 – Replacement of Valves, Piping and Plumbing**

This option involves replacement of all components associated with the water intake. Replacement can be achieved if exact routing is replicated; however, no redundancy can be provided given the current dimensions of the valve chamber.

Option No. 2 is not recommended given that redundancy is critical for the continued delivery of water to the municipality.

***Opinion of Probable Cost: $100,615.00***

**Option No. 3 – Replacement of Valve Chamber and Entire Piping Assembly**

This option allows for a complete replacement of the system, with provision for a bypass line complete with valve. Chamber shall be reworked to ensure there is sufficient space for regular maintenance by City Staff. Refer to Appendix for sketches of potential piping configurations. Concrete work is required to facilitate this option.

***Opinion of Probable Cost: $225,110.00***

## 4. Other work

Electrical equipment should be removed during the demolition stage, reusing feeds from water treatment plant to serve new equipment. The valve chamber should be cleared of all loose rubble and scrap material and the ground should be levelled so that proper pipe supports can be installed.

A new sump pump system should be installed in the valve chamber to prevent excessive water levels within the structure. The existing sump pump is non-operational.

New lighting is recommended to meet minimum lighting levels for maintenance staff. Fixtures shall be rated for outdoor/industrial conditions.

A new electrical radiant heater is recommended to maintain above freezing temperatures within the chamber.

***Opinion of Probable Cost: $19,500.00***

Condition of the pipeline between the valve chamber and the water treatment plant is unknown. It is recommended that the piping be scanned or scoped to determine if there is any corrosion or deterioration.

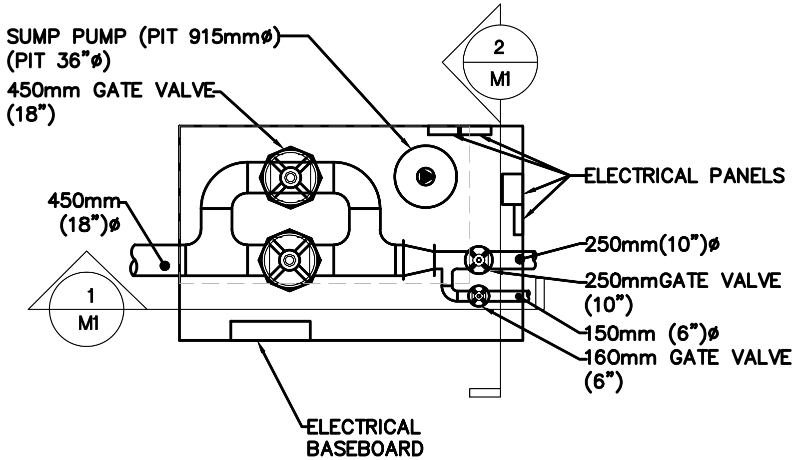
***Opinion of Probable Cost: $15,500.00***

Since water treatment plants are considered a severe hazard application under CSA B64.10, a reduced pressure (RP) zone assembly backflow preventer should be installed on the intake piping; however, CSA indicates that RP assemblies cannot be installed in a vault. Backflow prevention should be installed within the water treatment plant.

Photo 3.1: Proposed location for new RP backflow preventer

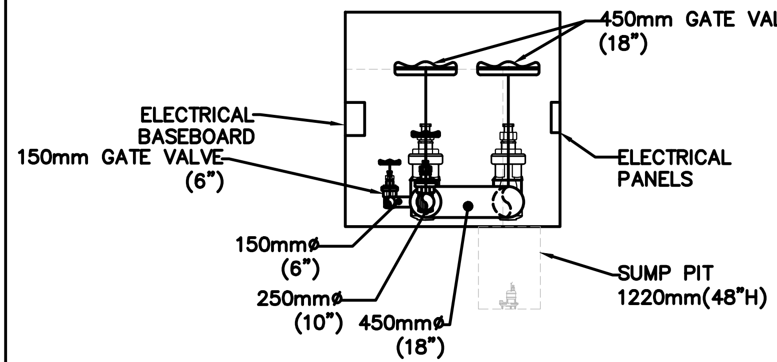
***Opinion of Probable Cost: $70,000.00***

## APPENDIX: SKETCHES OF PIPING CONFIGURATIONS



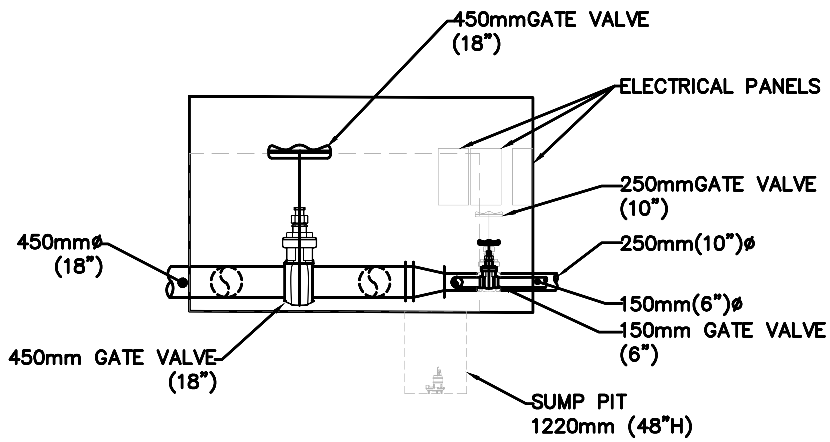

PLAN VIEW

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER




2/M1 FRONT VIEW PLAN

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER




1/M1 SIDE VIEW PLAN

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER

APPROXIMATE CHAMBER DIMENSIONS: 200"L X 125"W X 125"H

VR ENGINEERING FORWARD
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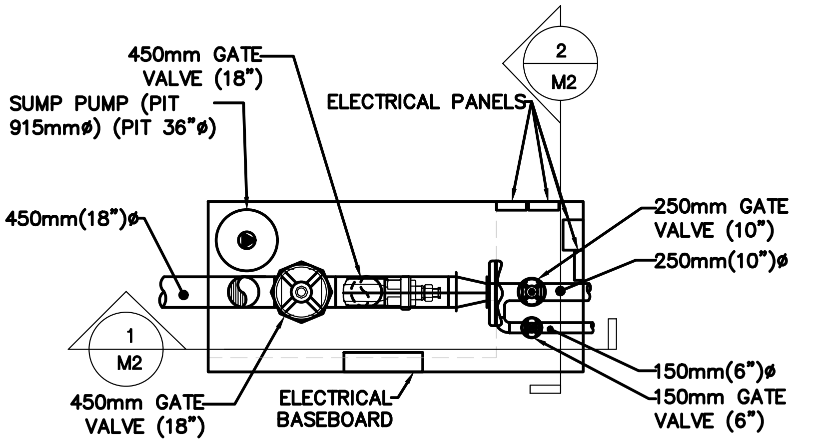
22-120

| | |
|---|---|
| Drawn By: A.A. | Checked By: I.F |
| Date: 14/04/2023 | Scale: NTS |

Project: CITY OF IQALUIT - LAKE GERALDINE DAM VALVE CHAMBER STUDY

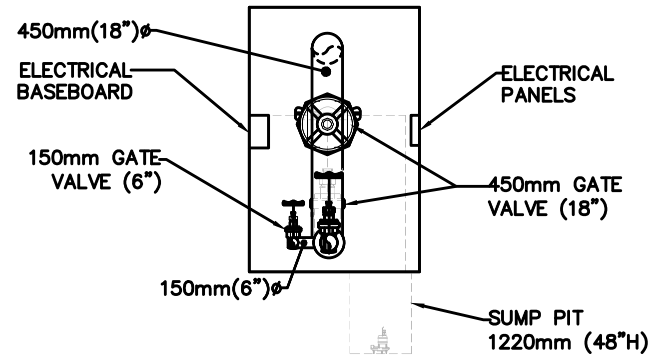
Drawing Title: Option 1 - Valves Chamber Layout - Gate Valve

Drawing No.: M1



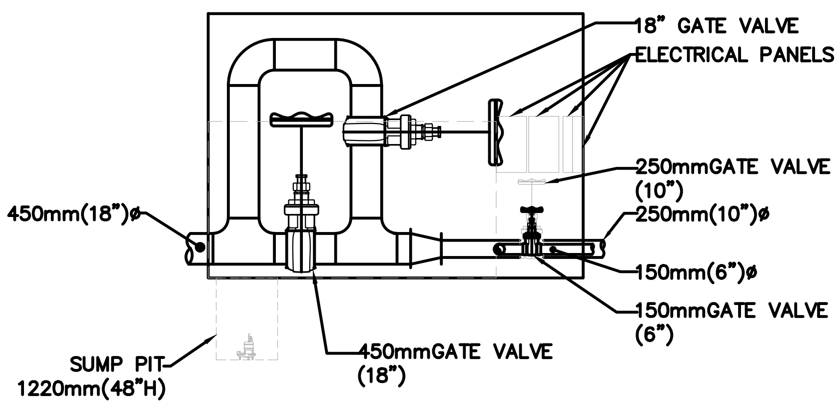

PLAN VIEW

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER




2/M2 FRONT VIEW PLAN

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER




1/M2 SIDE VIEW PLAN

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER

APPROXIMATE CHAMBER DIMENSIONS: 220"L X 100"W X 155"H

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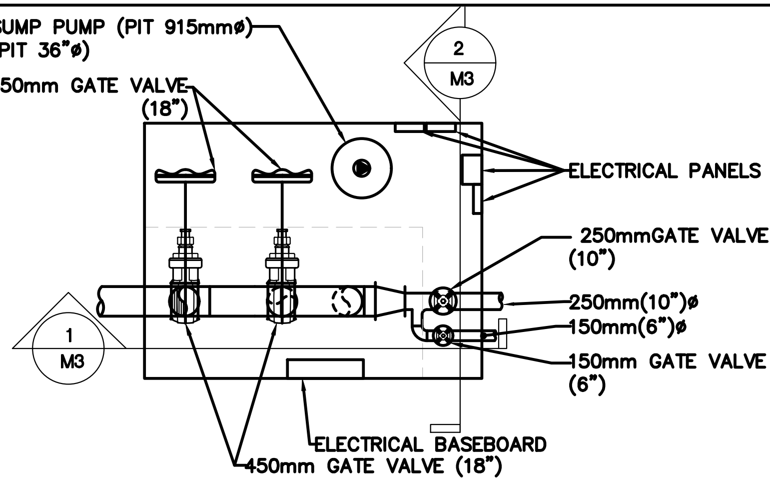
| Date: 14/04/2023 | Scale: NTS |

**Project:** CITY OF IQALUIT - LAKE GERALDINE DAM VALVE CHAMBER STUDY

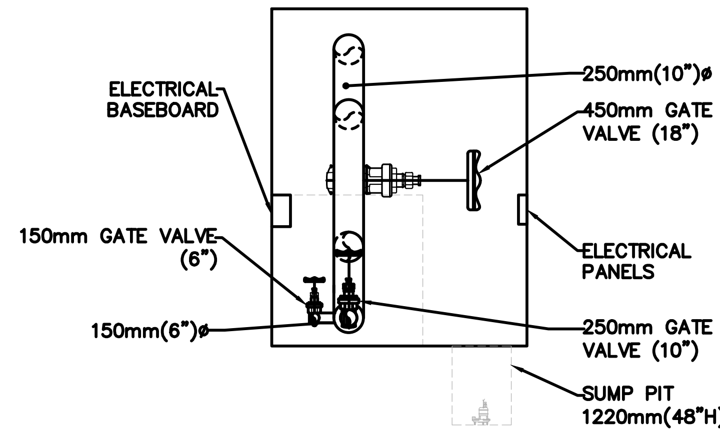
**Drawing Title:** Option 2 - Valves Chamber Layout - Gate Valve

**Drawing No.:** M2



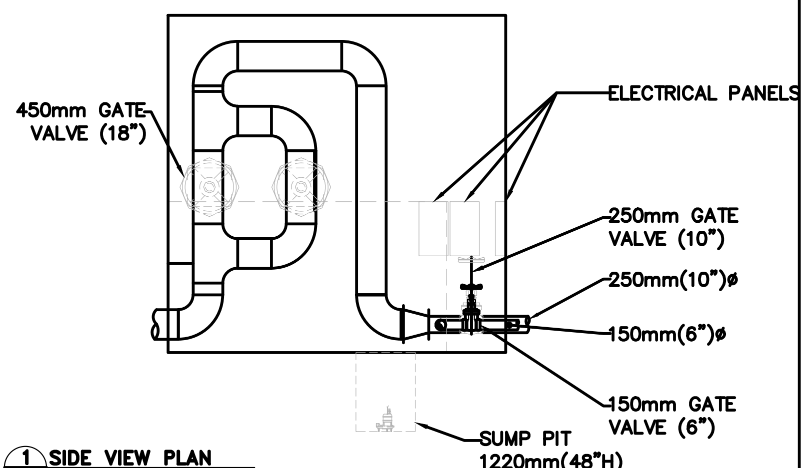

PLAN VIEW

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER




2 M3 FRONT VIEW PLAN

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER




1 M3 SIDE VIEW PLAN

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER

APPROXIMATE CHAMBER DIMENSIONS: 205"L X 155"W X 205"H

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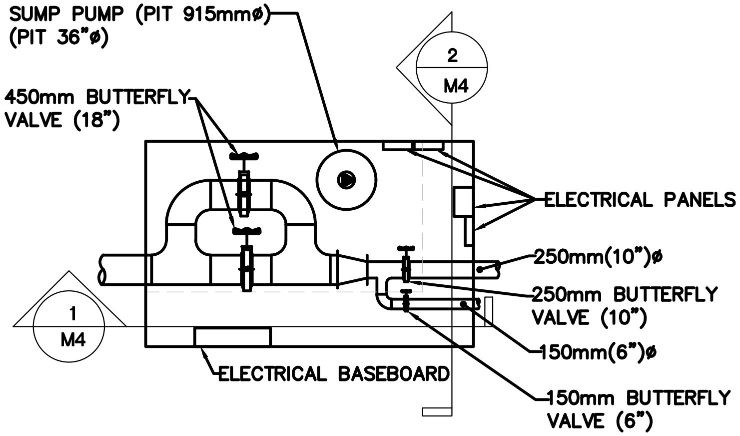
|---|---|
| A.A. | I.F |
| Date: | Scale: |
| 14/04/2023 | NTS |

Project:
CITY OF IQALUIT - LAKE GERALDINE DAM VALVE CHAMBER STUDY

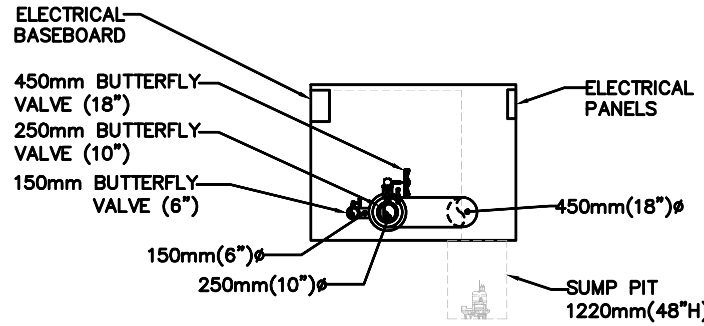
Drawing Title:
Option 3 - Valves Chamber Layout - Gate Valve

Drawing No.:
M3



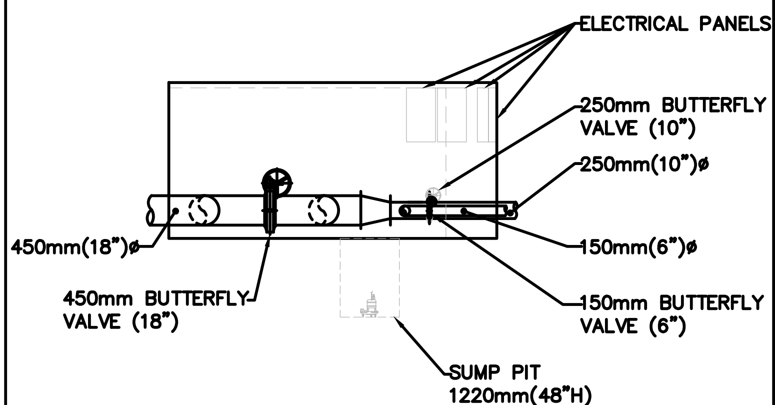

PLAN VIEW

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER




2/M4 FRONT VIEW PLAN

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER




1/M4 SIDE VIEW PLAN

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER

APPROXIMATE CHAMBER DIMENSIONS: 200"L X 125"W X 95"H

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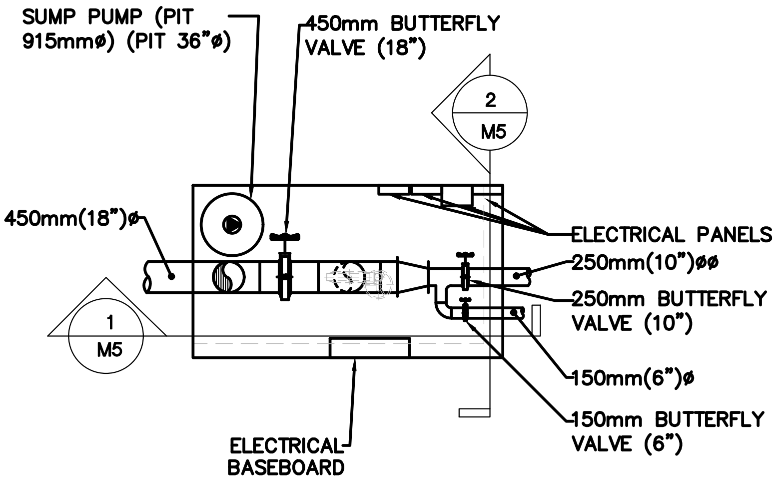
| Date: 14/04/2023 | Scale: NTS |

Project: CITY OF IQALUIT - LAKE GERALDINE DAM VALVE CHAMBER STUDY

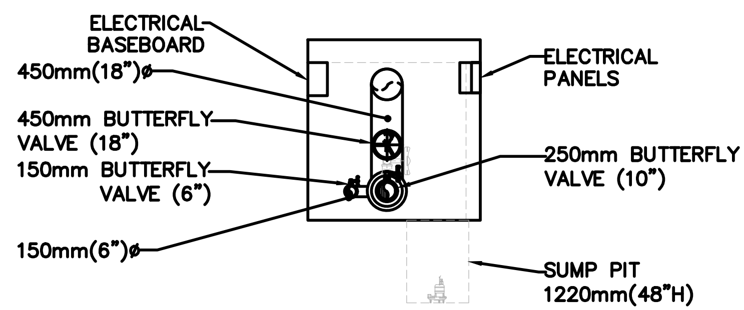
Drawing Title: Option 1 - Valves Chamber Layout - Butterfly Valve

Drawing No.: M4



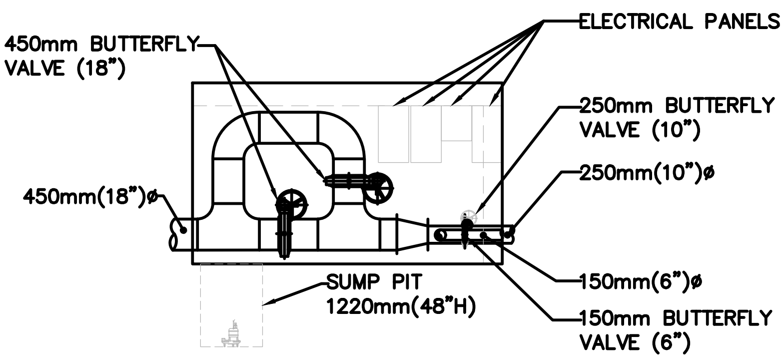

PLAN VIEW

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER




2/M5 FRONT VIEW PLAN

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER




1/M5 SIDE VIEW PLAN

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER

APPROXIMATE CHAMBER DIMENSIONS: 180"L X 100"W X 105"H

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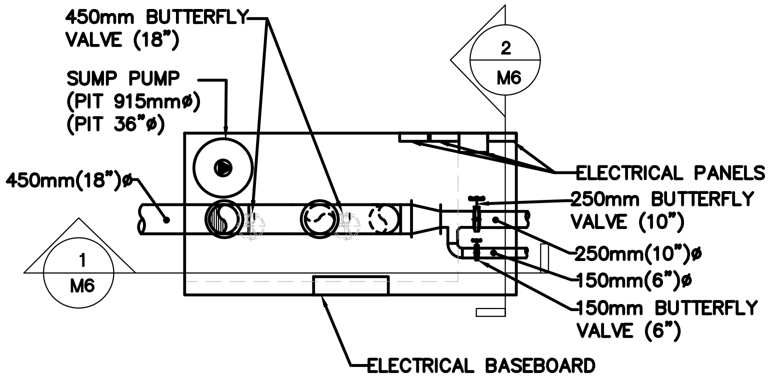
|---|---|
| Drawn By: A.A. | Checked By: I.F |
| Date: 14/04/2023 | Scale: NTS |

**Project:** CITY OF IQALUIT - LAKE GERALDINE DAM VALVE CHAMBER STUDY

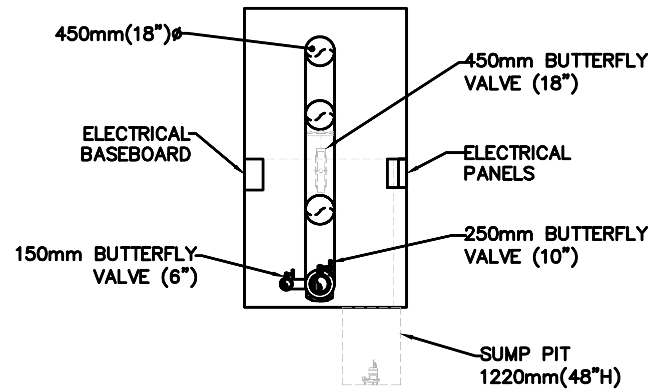
**Drawing Title:** Option 2 - Valves Chamber Layout - Butterfly Valve

**Drawing No.:** M5



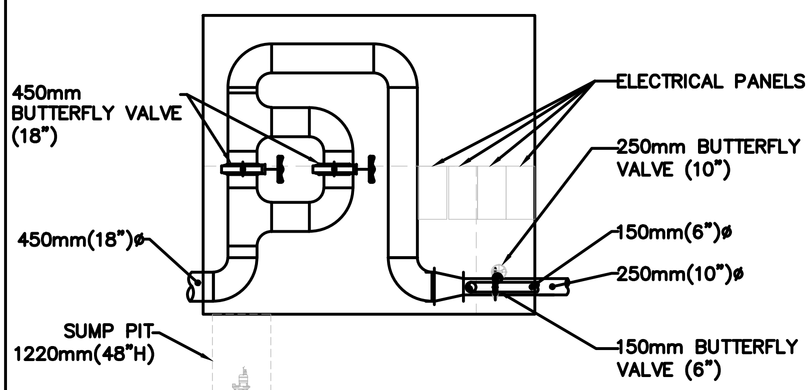

PLAN VIEW

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER




2/M6 FRONT VIEW PLAN

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER




1/M6 SIDE VIEW PLAN

NOTE: DASHED LINES INDICATE BOUNDARY OF EXISTING VALVE CHAMBER

APPROXIMATE CHAMBER DIMENSIONS: 205"L X 100"W X 185"H

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22-120

Drawn By: A.A.
Checked By: I.F
Date: 14/04/2023
Scale: NTS

Project: **CITY OF IQALUIT - LAKE GERALDINE DAM VALVE CHAMBER STUDY**

Drawing Title: **Option 3 - Valves Chamber Layout - Butterfly Valve**

Drawing No.: M6

Vanderwesten & Rutherford Associates Inc.
Mechanical & Electrical Engineers
London . Windsor . Ottawa
www.vreng.ca

# CITY OF IQALUIT
# LAKE GERALDINE DAM
# VALVE CHAMBER REPLACEMENTS

DRAFT REPORT

Iqaluit, NU


**Prepared By:**

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1130 Morrison Drive, Suite 260
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**Prepared For:**

Concentric Associates Inc. & The City of Iqaluit

V&R Project No. 22-120
December 22, 2022

## Table of Contents

# 1. General

## 1.1 Project Summary

Vanderwesten & Rutherford Associates (VR) was retained by Concentric Associates Inc. to review site conditions of the existing piping and components within the valve chamber at the Dam at Lake Geraldine. This report will outline the recommended mechanical and electrical replacements and configuration of new intake water piping running to the water treatment plant.

It should be noted that VR was unable to enter the valve chamber, as confined space training is required to do so. Trained personnel were engaged to sketch out the piping configuration and mechanical/electrical services within the chamber.

## 1.2 Building Summary

Lake Geraldine Dam was constructed in the late 1950s and has been expanded to accommodate reservoir depths over the years. The valve chamber construction is unknown but is estimated to have taken place between the 1950s and 1995.

## 1.3 Project Documentation

- Technical Analysis & Risk Assessment, July 16, 2020 (MECO)
- Appendix A Heating System P&ID and Boiler Room Layout, June 2021 (WSP)

## 1.4 Codes and Standards

The system descriptions contained in this brief reflect the state of the installation at the present stage. This assessment is based on basic proven design principles and applicable codes and standards including:

National Building Code of Canada 2015
CSA 64.10-11 Selection and Installation of Backflow Preventers

# 2. Existing Conditions

## 2.1 Mechanical

The existing piping within the valve chamber is heavily corroded and it appears as though the valves have not been regularly exercised. Redundant piping has been left in place from previous work in the chamber. There appears to be some sort of sensor, either temperature or flow, installed on the piping prior to it leaving the chamber and heading towards the water treatment plant. Given the condition of the services, it is assumed unlikely to be functioning properly.

Photo 2.1.1: Example of heavily corroded piping and valves.

Photo 2.1.2: Example of heavily corroded piping and valves

Photo 2.1.3: top stem of assumed sensor

There are pieces of scrap material wedged between piping and the piping is resting on wooden blocks and rocks. No proper pipe supports were used.

Photo 2.1.4: example of scrap metal propping up piping

There is a pit within the valve chamber for what appears to be a pump. It is in a state of disrepair and no piping was noted as being connected to the system.

Photo 2.1.5: Sump pump and pit

## 2.2 Electrical

Electrical services, including switches and disconnects are mounted on the wall of the chamber and are also heavily damaged by corrosion. There is an electric heater mounted on the wall. It is not known whether this unit still functions.

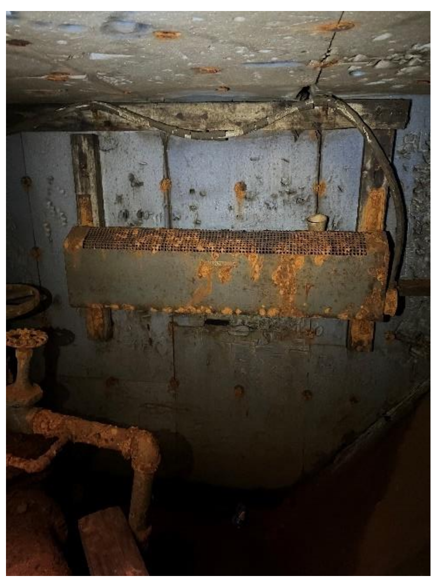


Photo 2.2.1: existing electrical radiant heater

Photo 2.1.2: overall view of existing electrical services

Photo 2.1.3: motor starter, assumed to be wired to sump pump

## 3. Recommendations

The conditions of the mechanical and electrical services within the valve chamber are in very poor condition and beyond simple repair. Given that the system is critical for the supply of drinking water, it is recommended that a temporary set of lines be installed to bypass the valve chamber, allowing water to be supplied to the water treatment plant while replacement of the valve chamber components is underway.

Installation of the temporary bypass will require a short shutdown of water supply to carry out tie-ins to the main lines. A specialized contractor may be able to use hot-tapping to perform tie-ins without disrupting the supply, but this would require ensuring there is a way to trap any filings and debris created by the procedure. It is recommended that a planned shutdown be scheduled instead.

Once the temporary bypass is in place, the piping within the valve chamber can be removed. Electrical equipment should also be removed at this time, leaving feeds to serve new equipment. The valve chamber should be cleared of all loose rubble and scrap material and the ground should be levelled so that proper pipe supports can be installed.

Since water treatment plants are considered a severe hazard application under CSA B64.10, a reduced pressure (RP) zone assembly backflow preventer should be installed on the intake piping; however, CSA indicated that RP assemblies cannot be installed in a vault. Backflow prevention should be installed within the water treatment plant.

Photo 3.1: Proposed location for new RP backflow preventer

A new sump pump system should be installed in the valve chamber to prevent excessive water levels within the structure.

New lighting is recommended to meet minimum lighting levels for maintenance staff. Fixtures shall be rated for outdoor/industrial conditions.

A new electrical radiant heater is recommended to maintain above freezing temperatures within the chamber.

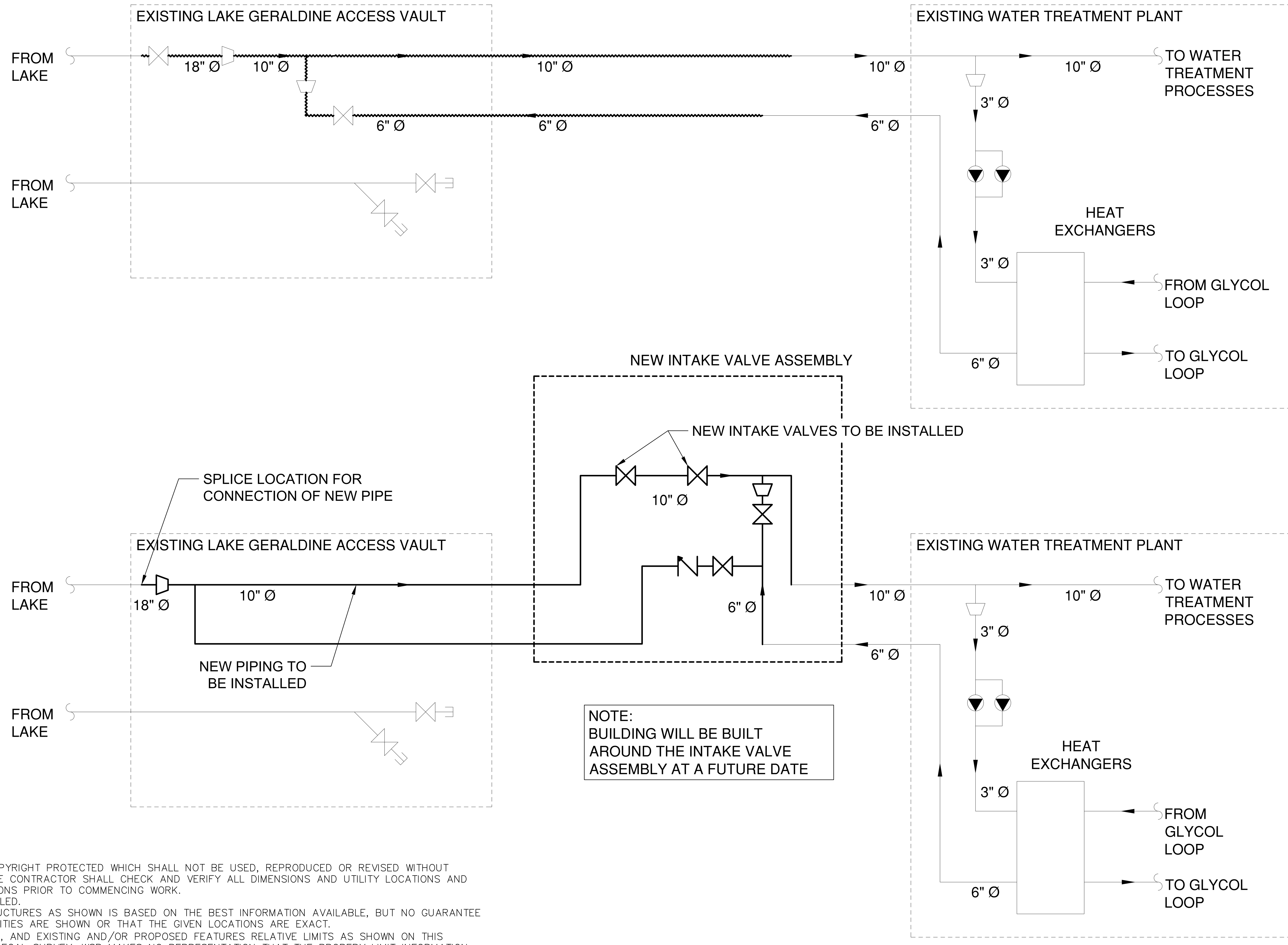
Refer to Section 4 for sketches.

***Opinion of Probable Cost: TBD***

## 4. Sketches

# Appendix B

## Conceptual Drawing Package

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CLIENT: CITY OF IQALUIT

CLIENT REF. #:

PROJECT: LAKE GERALDINE INTAKE VALVE REPLACEMENT

PROJECT NO: CA0023312.3294

DATE: 2024/04/16


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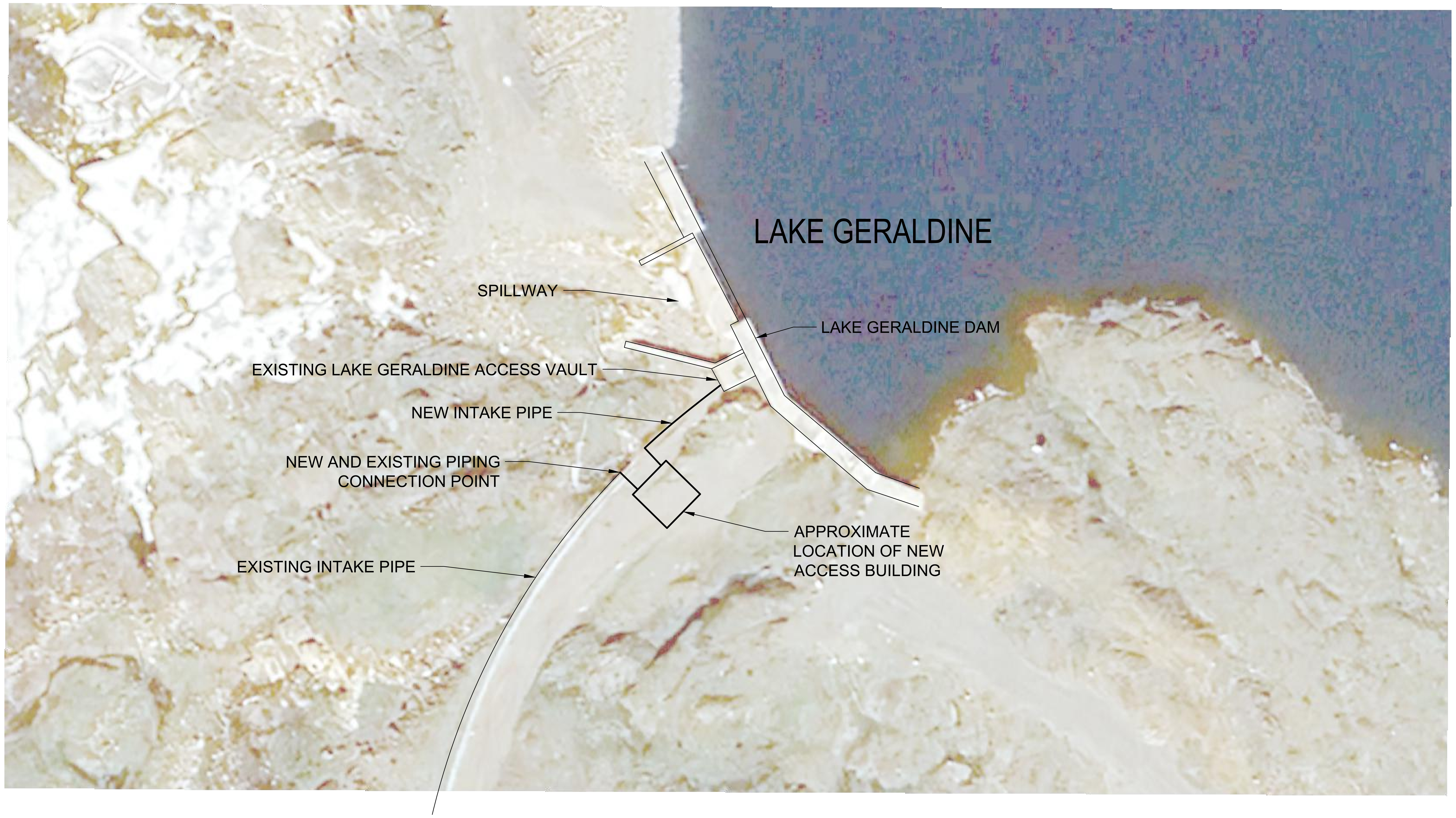


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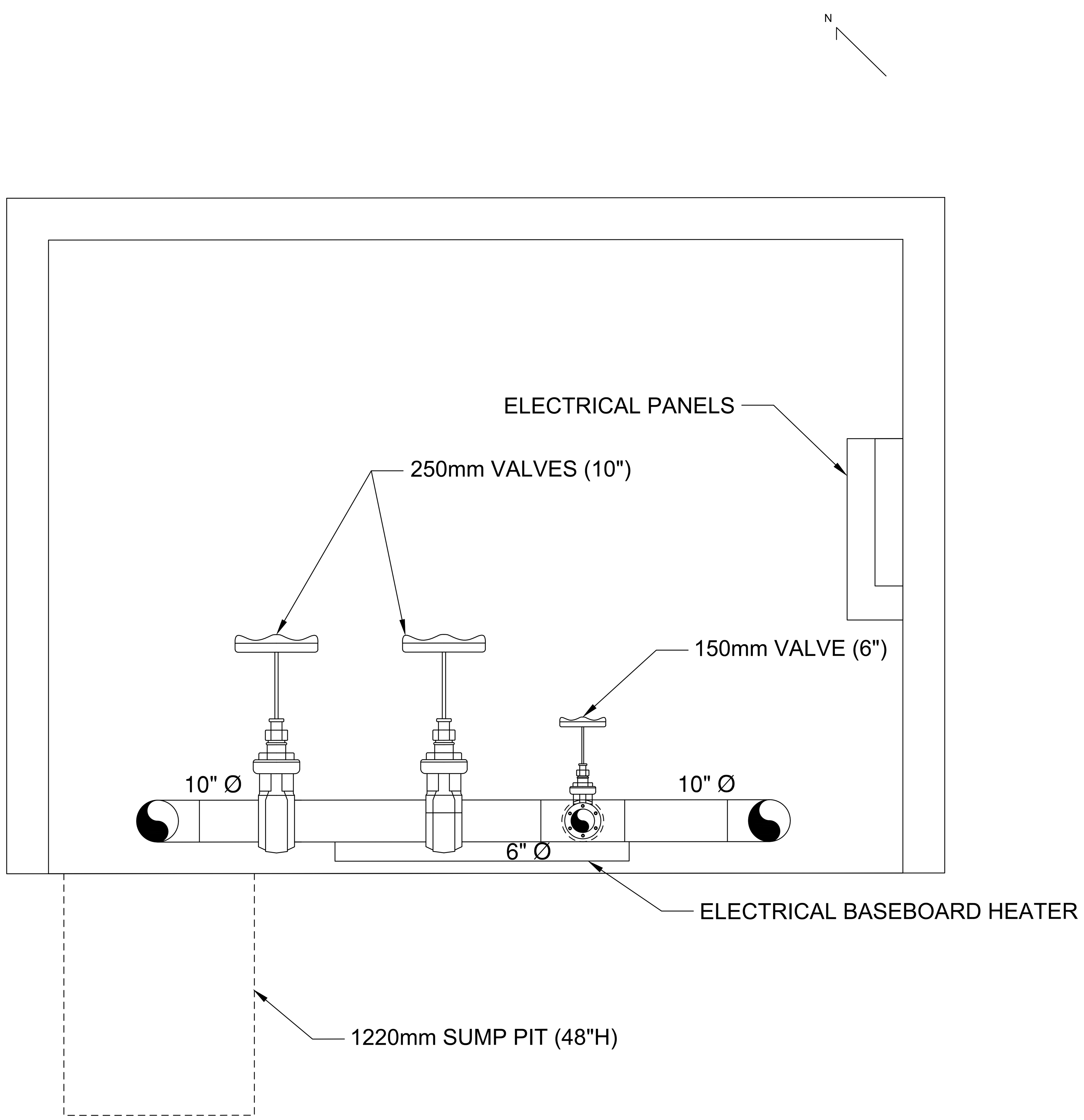


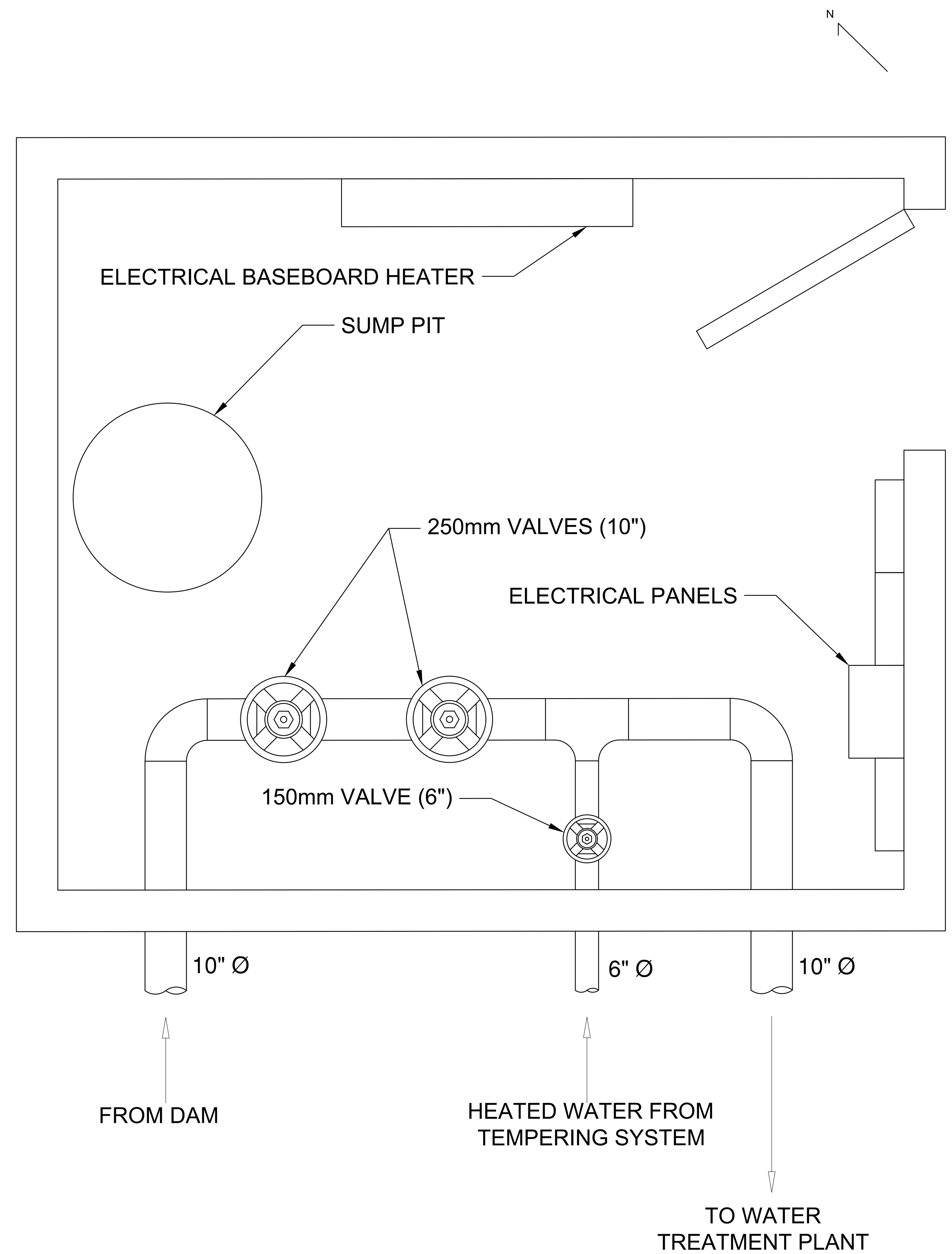




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