Jacobs

Technical Memorandum

1100 – 112th Ave NE, Suite 500
Bellevue, WA 98004
425.453.5000

Subject	**Gatehouse Condition Assessment and Inspection Report (Task 3.2) - Final**
Project Name	Raw Water Intake Condition Assessment and Intertie Pipeline Design
Attention	Steve Day, PE / Project Manager for City of Bellingham
From	Phil Martinez, PE / Jacobs Kenny Moffat, PE / Jacobs
Date	May 20, 2024

Contents of Memorandum

Attachments:

A. Gatehouse Drawing
B. Lake Whatcom Dive Inspection (Gatehouse Content)
C. March 2024 Condition Assessment Site Photos

1. Introduction

This technical memorandum documents the findings of the March 2024 Lake Whatcom surface level Gatehouse condition assessment and the December 2023 dive inspection assessment. The Gatehouse facility and overall raw water conveyance network is owned by the City of Bellingham.

This Gatehouse condition assessment is the most recent in a history of assessments of the Gatehouse and the other main elements of the City's raw water conveyance infrastructure. The most recent previous assessment of the Gatehouse was performed in 2014. Refer to the November 7, 2014 Technical Memorandum from CH2M HILL to the City, titled: "City of Bellingham Gatehouse: Condition Assessment and Improvement Report (Task 2.3.3)," for a summary of surface level and dive assessment observations at the time of the 2014 inspection. This technical memorandum represents an update to the 2014 assessment, reflecting the most recent understanding of the Gatehouse condition. Although some deterioration was observed between this 2024 assessment and the one in 2014, some observed conditions remain similar or unchanged from 2014.

The purpose of this work is to document the condition of the Gatehouse facility, identify repair needs, and develop estimated costs for those repairs (if any repairs are identified). This information will be used by the City to decide whether to make any Gatehouse improvements at this time, and to provide insights into possible future improvements. As is the case for each of the key facilities that comprise the City's water supply system between Lake Whatcom and the Whatcom Falls Water Treatment Plant (WTP), there are no redundant facilities for the Gatehouse. As a result, its continued reliable service is essential to enabling uninterrupted supply to the City's customers.

Both the Gatehouse superstructure (above-ground cast-in-place structure) and substructure (below-ground cast-in-place structure) were assessed in order to evaluate its continued use. The other key component of the Gatehouse that was assessed is the slide gate that separates the Gatehouse wet well from the tunnel. Condition or design adequacy of other Gatehouse facility elements, such as electrical, telemetry, HVAC, windows, and code-compliance were not assessed. These other elements do not present concerns and were not considered essential to informing decisions regarding the future of the Gatehouse. A photo showing the front side of the Gatehouse is provided in Figure 1-1.

Figure 1-1: Lake Whatcom Gatehouse Facility

2. Description of Existing Facility

The Gatehouse was constructed in 1939. It was constructed during the same time frame as the adjacent downstream Lake Whatcom Tunnel, the Screenhouse, and the adjacent upstream Raw Water Intake Pipeline in Lake Whatcom. These four key facility elements comprise the Bellingham's primary water supply system. The only remaining available drawing of the Gatehouse is presented in Appendix A at the end of this document. This drawing relates to the smaller, original structure that was constructed to connect the 72-inch diameter wood intake to the similar-sized horseshoe-shaped tunnel and provide a slide gate for isolation of the tunnel. Two years later, the Gatehouse was enlarged to the south with an at-grade structure for storing and feeding gas chlorine. Historical correspondence indicates that the chlorination equipment was never used and was removed sometime in either the 1950s or 1960s. No drawings for this subsequently constructed room were available at the time of this condition assessment. Key elements of the Gatehouse that were included in this condition assessment are identified on the Appendix A drawing.

The key components of the City's current water supply system are shown in Figure 2-1, along with the pipelines that extend from the screenhouse to the City's single industrial supply user and to the City's WTP.

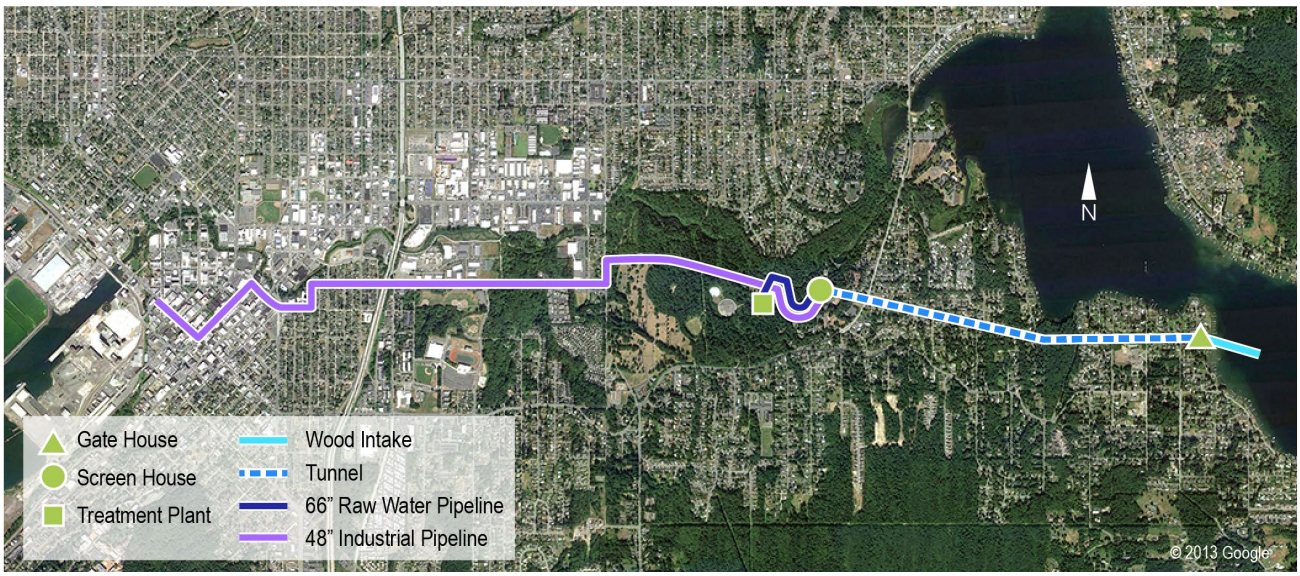


Figure 2-1. City of Bellingham Water Supply Facilities

3. Inspection Approach

The inspection of the Gatehouse was completed in two separate mobilizations, one focused on the submerged substructure by Crux Diving, and a second focused on the superstructure as part of the Screenhouse, tunnel and Gatehouse inspection.

Inspection of the Gatehouse substructure was conducted on December 8th, 2023. The inspection included the wet well structure itself, the slide gate, the stop log closure channels, and connections to the upstream wood-stave intake and the downstream tunnel. The inspection employed the use of a certified diving subcontractor, Crux Diving, experienced in underwater inspection and construction.

In addition to the Crux Diving crew, City staff and Jacobs engineers were present during the inspection. Inspection methods included:

- Visual observations of the components and appurtenances
- Hammer tap soundings of the concrete and steel
- Pit depth measurements on the steel fixtures
- Brushing and scraping of the structure to clean and expose underlying materials

Crux prepared a dive inspection report for its overall activities in December 2023. The portions of that report relating to the Gatehouse are included as Attachment B.

Inspection of the superstructure was completed on March 20th, 2024, by Jacobs representatives including a structural engineer, NACE certified corrosion engineer, a slide gate specialist, and project manager. This inspection was primarily visual in nature.

4. Summary of Gatehouse Inspections Observations

The results of the inspections are presented herein separately for the following elements of the Gatehouse: superstructure, substructure, slide gate.

4.1 Superstructure

The Gatehouse superstructure is comprised of two buildings that are connected together, as described above. The original building structure over the below-grade wet well structure and slide gate was constructed in 1939 and is approximately 12 feet by 13 feet in plan. The room to the south, which was intended as a chlorine storage and feed room, was constructed in 1941 and is approximately 13 feet by 25 feet. The architecture and construction methods of the two rooms of the Gatehouse are the same.

The superstructure is comprised of monolithic, cast-in-place, reinforced concrete walls. The interior of the superstructure has been painted and repainted over the years, which could potentially have covered any minor or moderate cracking or corrosion that might be present. That stated, no such cracking or corrosion was observed. The walls of the superstructure appear to be in satisfactory condition with no structural concerns. The floor slabs throughout appear to be in good condition and exhibited only minimal amounts of the minor cracking that would be expected for a reinforced concrete floor. Several photographs from the March 20, 2024, inspection of the superstructure and tunnel inspection are presented in Appendix C.

4.2 Substructure

The substructure includes the below-ground portions of the building structure. The key elements of the substructure include the lake level monitoring shaft, the tunnel access shaft, the wet well, the tunnel portal, and the two recessed stop log channels. With the exception of the Lake Level Monitoring Shaft, each of the substructure elements of the Gatehouse was inspected by the Crux Diving Inspector, while being directly monitored by Jacobs and City staff. Photographs of the Gatehouse substructure elements are provided in the Project Photographs section at the end of the Dive Inspection Report (Appendix B of this report). Note that this dive report has been trimmed to reflect content pertinent to the Gatehouse structure. A schematic representation of the wet well structure including the tunnel access portal, as well as the incoming intake pipe are depicted below in Figure 4-1.

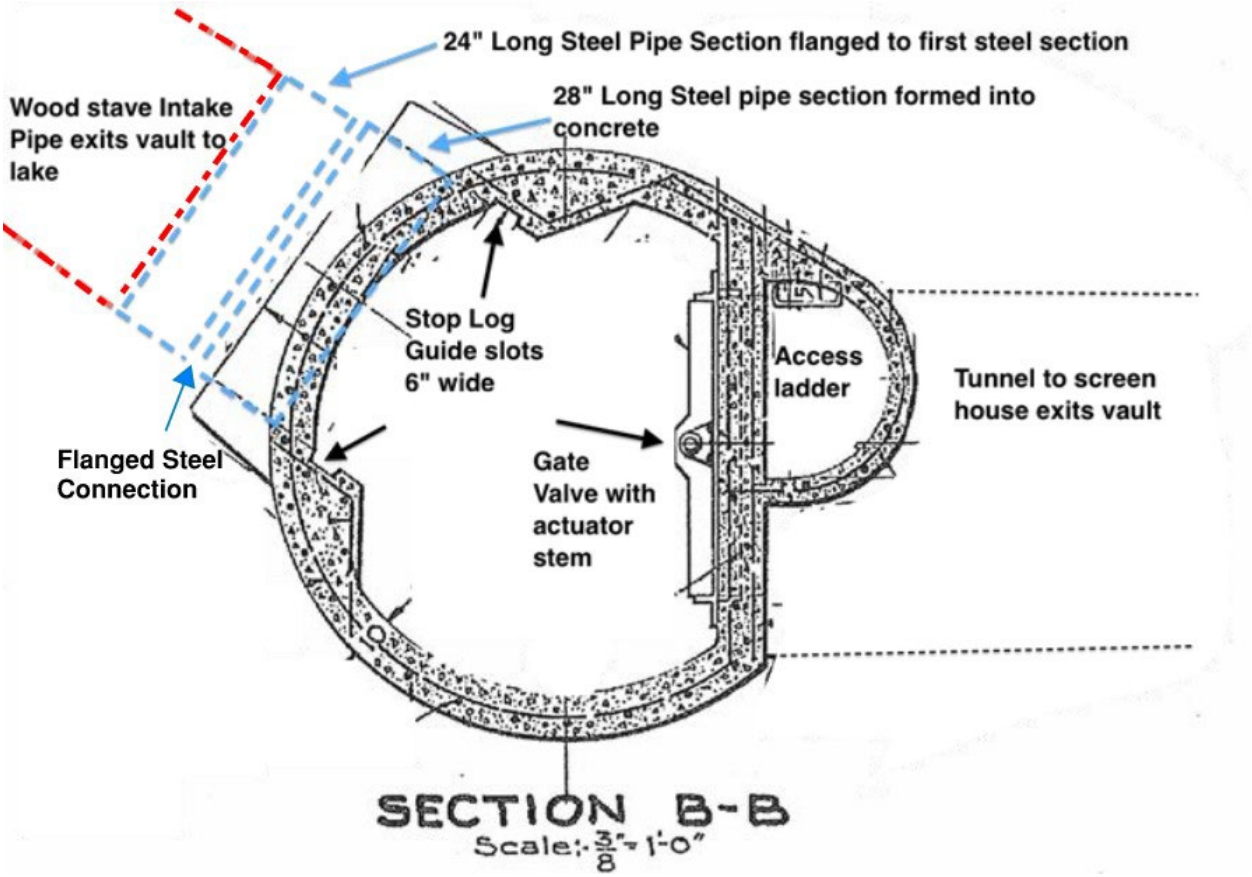


Figure 4-1. Gatehouse Wet Well Schematic

4.2.1 Lake Level Monitoring Shaft

Also constructed as part of the south expansion is a cast-in-place concrete-lined shaft below the chlorine storage building room. It was apparently designed to house level indication sensors to sense the level of the adjacent Gatehouse wet well. Two 1-inch diameter copper pipes connect this shaft to the wet well.

Because of the connection to Lake Whatcom via the 72-inch diameter wood stave intake pipeline, the water level in the Gatehouse is the same as Lake Whatcom. The City actively maintains and operates the equipment in this shaft. The water level monitoring equipment is connected to the City's supervisory control and data acquisition (SCADA) equipment.

This below-grade structure houses a sump pump connected to a level switch to keep the shaft completely dry. Entry into the lake level monitoring shaft was not performed during the course of the inspections.

4.2.2 Tunnel Access Shaft

The Gatehouse access shaft, which is always partially submerged when the Gatehouse and tunnel are in operation, appeared to be in generally good condition. Scraping and visual observations of the concrete were performed with no delamination or other apparent defects were detected. There was also no evidence of cracking in the concrete walls, nor was there any evidence of reinforcing steel corrosion.

The ladder rungs showed signs of surficial corrosion which increased in severity with the depth of the shaft. During the inspection, the rungs were tested with the buoyant weight of the diver and each rung bore the load satisfactorily. Removal of the scale revealed the rungs to have nearly ¾" of non-corroded steel

underneath. The diver noticed one small area of spalling to the right of the access ladder just below where the 2″ riser terminates. A 4″ square area showed exposed aggregate with a depth of 1/2″ at its deepest point. .Subsequently the ladder rungs were used for egress by the tunnel inspection team during the March 2024 inspection and were able to satisfactorily withstand the weight of tunnel inspection team in a dry condition. Figure 4-2 below shows the corrosion observed on the gate and ladder rungs observed during the March 2024 tunnel inspection.

Figure 4-2. Corrosion Product on Lake Whatcom Gatehouse Ladder Rungs (Photo taken from tunnel side during tunnel inspection)

4.2.3 Wet Well

The Gatehouse wet well, which is always partially submerged to the Lake Whatcom water surface elevation as presented in the drawing in Appendix A, appeared to be in generally good condition. Heavy aquatic organic buildup was observed on the walls but was able to be dislodged with hand-wiping to expose the underlying concrete. Scraping and visual observations of the concrete were taken throughout the underwater portion of the wet well and no indications of delamination were detected. There was also no evidence of cracking in the concrete walls, nor evidence of reinforcing corrosion.

The exception to this is the band between 1' and 3' below the waterline. In this area, the concrete felt soft and chipped away with scraping. No signs of cracking were noted anywhere in the vault. It is likely that this deterioration may be the result of the cyclical exposure to wet and dry periods as the water level rises and falls, contributing to some leaching and erosion of the concrete.

4.2.4 Tunnel Portal

The tunnel portal is the connection between the below-grade Gatehouse structure and the upstream end of the tunnel. This section is indicated as the "Tunnel Section" in the Appendix A drawing. This area was generally in good condition. Scraping of the concrete did not indicate any signs of delaminated concrete in this area, nor was there evidence of cracking in the concrete walls or reinforcing corrosion.

During the 2014 inspection, a cold joint between the vertical Gatehouse structure and the horizontal tunnel structure was identified. This cold joint was not explicitly observed during the 2023 dive inspection. Structural defects observed on the tunnel side of the portal can be found in the 2024 tunnel assessment report.

4.2.5 Intake Pipeline Stop Log Channel Guides

The stop log channel guides are located on the north and south walls adjacent to the wet well connection to the 72-inch wood-stave intake pipeline. The guides are recessed into the concrete wall and appear to be backed by steel plates. The guide channels were measured to be 6 inches wide and recessed 2 inches deep into the concrete wall. One wooden stop log was in place during the inspection, measuring 75¼-inches long and 7½-inches tall, fitting snugly into the 6-inch wide guide slot at the bottom of the chamber.

Condition of the steel in the guide slots shows heavy oxidation scale built up inside of the slots including the presence of tubercules. Once the scale was removed, the guide slots show 1/16" to 1/8" pitting. Buildup between this board and the end of the intake pipe is approximately 7" of 2"-minus sand and gravel. In order to get an effective seal with the stop, the stop log guides would need significant removal of the existing oxidation scale otherwise leakage and/or poor seating of the stop logs would be anticipated.

4.3 Slide Gate

The Gatehouse has a single slide gate used to isolate the wood stave intake pipe from the raw water supply tunnel. The slide gate appears to date from the original construction of the facility and be made of cast iron with a lead-based primer and a black coal-tar based coating. The gate is in fair condition; however, a significant amount of corrosion including large tubercules (mounds of corrosion product) was visible on the gate and embedded wall thimble (gate-opening frames). Pit depths measuring 1/16" up to 1/8-inch were measured on the gate face and thimble.

On the vault side of the gate, there are 4 vertical stiffeners extending 3" out from the plate of the gate itself. These stiffeners are spaced 16" on center. There are 7 horizontal stiffeners extending 6" out from the plate of the gate. These stiffeners are spaced 12" on center. The there are 4 brass/bronze wedge plates on each side of the gate that match up with 4 plates on the frame to wedge the gate into the closed position and create a tight sealing surface. The sealing surface of the frame is also made of brass/bronze material.

The gate is periodically exercised during maintenance activities; however, the gate seal appears to have degraded from the time of the 2014 inspection to present year based on the quantity of leakage observed when the gate is in a closed position. During preparation activities for the tunnel inspection, the City closed the gate to observe the status of the gate seal and the anticipated water level within the tunnel. During this closure, considerable flow was observed at the edges of the gate. The size and frequency of tubercules

within the gate frame are such that they are likely result in the uneven closure of the gate. Figure 4-3 below shows the extent of flow passing by the gate when in a closed position, with the bulk of the flow coming through the base and lower corners.

Figure 4-3. Leakage observed at Lake Whatcom Slide Gate (Photo taken from tunnel side during tunnel inspection)

During the dive inspection a wire brush was used to remove multiple tubercules within the gate frame. The underlying steel displayed minor to moderate corrosion with pitting depths up to 1/8".

The steel actuator shaft rises from the center of the top of the gate and continues above waterline through the roof of the vault. The actuator is spaced 5" off the vault wall and held in position by two steel brackets anchored to the vault wall, one below waterline, and one above. The hardware on these brackets is all in place. No signs of loose or missing hardware were noted.

5. Summary of Condition / Recommendations

A summary of the key inspection observations and recommendations is presented in the subsections below and in Table 5-1.

TABLE 5-1
Summary of Inspection Observations and Recommendations

Improvement Type	Condition / Recommendations
Superstructure	Good. Next inspection in 5 years.
Lake Level Monitoring Shaft	Notable issues not observed. Next inspection in 5 years.
Tunnel Access Shaft	Ladder corrosion and 2-foot vertical band of concrete wear. Next inspection in 5 years.
Wet Well	Overall, good. Closely monitor 2-foot vertical band of concrete wear in next inspection in 5 years.
Tunnel Portal	Fair. Monitoring of the previously identified (2014) cold joint and small area of delamination should be captured during the next inspection in 5 years. Additional discussion to be provided within tunnel inspection report.
Stop Log Channel Guides	Fair. Oxidation (tubercules) development within the stop log channel guides is thought to limit effectiveness of stop logs. Remedial action of tubercules should also include removal of sediment build-up. Repairs recommended as the use of stop logs are likely to be necessary to facilitate improvements to the Slide Gate.
Slide Gate	Fair to Poor. Oxidation (tubercules) within the gate frame have increased in presence likely contributing to the degradation in the gate seat and resulting in leakage. Improvements recommended.

5.1 Superstructure

No structural deficiencies were observed during this condition assessment. No immediate action regarding the Gatehouse superstructure is necessary. A follow-up inspection is recommended in 5 years.

5.2 Substructure

Summaries and recommendations related to the substructure elements of the Gatehouse are presented below.

5.2.1 Lake Level Monitoring Shaft

The condition of the structure of the lake level monitoring shaft appears to be good. No defects were observed.

5.2.2 Tunnel Access Shaft

The main area of deterioration in the tunnel access shaft is the gradual corrosion of the ladder rungs. Use of these ladder rungs should be avoided below the water level to the extent possible during future inspections. Also, use of these ladder rungs during future dry inspections should be avoided.

The ¼-inch deep, 2-foot vertical band of surface erosion of the concrete that is the same as in the wet well does not present a structural problem or concern for the Gatehouse structure. This is a relatively minor amount of concrete erosion after 75 years of operation. No structural improvement relative to this issue is necessary at this time. However, this condition should be regularly monitored.

5.2.3 Wet Well

As with the tunnel access shaft, the 2-foot vertical band of surface erosion does not present a structural problem and should be monitored regularly.

While this 2-foot band does not present an immediate concern, if acceleration of erosion is observed, the City could consider taking some preventative maintenance actions. Such action would be to apply a protective coating system over the area of erosion. This would be done by removing the soft concrete by sand-blasting and then applying two to three coats of a protective coating system. However, to ensure this system remains effectively adhered to the concrete, it would likely be necessary to apply an external waterstop coating product to the exterior of the wet well and tunnel access shaft in order to prevent the migration of groundwater through the concrete wall to the backside of the new coating system. This would require excavation and exposure of the exterior of the wet well down to a level below the area of erosion in order to apply the external waterstop coating product. To apply the internal coating, the wet well would need to be dewatered for a period of at least a week in order to dry and prepare the surface. It is understood this is not possible at this time. However, it may become possible in the future, if a bypass supply is developed to enable removing the Gatehouse from service for an extended period of time. If a bypass is developed, this rehabilitation should be undertaken.

5.2.4 Tunnel Portal

The tunnel portal is in relatively good condition and not in need of any immediate repair.

5.2.5 Stop Logs

The condition of the stop log channel guides is fair. Oxidation corrosion (tubercules) are projecting into the stop log channel and sediment and debris has accumulated at the base. Removal of the tubercules and overall cleaning of the stop log channel guides is anticipated to be needed to facilitate stop log seating without heavy leakage. Removal of the sediment should be included in the stop log channel improvements. These improvements are anticipated to be necessary to facilitate the eventual replacement of the slide gate.

The City may wish to consider investigating material options and supplier options for eventual purchase in the event work in the dry is necessary in the Gatehouse wet well.

5.2.6 Slide Gate

The slide gate at present is operable and in fair condition; however, the poor seating of the gate when in a closed position, and corresponding leakage, needs to be addressed prior to being able to perform tunnel improvements.

As the slide gates at the Screenhouse are identified for replacement, it seems appropriate to include improvements and/or replacement of the Lake Whatcom Gatehouse slide gate as the Contractor will already be under contract and on-site.

5.3 Estimated Capital Cost

An estimate of the capital cost for the three rehabilitation improvements cited above are presented in Table 5-2.

TABLE 5-2
Estimated Capital Costs for Lake Whatcom Gatehouse Improvements

Project Element	Cost
Construction Costs:	
Wet Well Protective Coating System	$100,000
Stop Log Channel Cleaning	$100,000
Slide Gate Replacement	$150,000
CONSTRUCTION SUBTOTAL	**$350,000**
Contingency (30%)	$105,000
Construction Overhead & Profit (30%)	$135,000
Construction w/ Sales Tax (9.0%)	$53,000
CONSTRUCTION TOTAL	**$643,000**
Non-Construction Costs:	
Permitting Allowance	$100,000
Engineering and Construction Management	$150,000
TOTAL	**$893,000**

These estimated costs were developed to the "concept level" or "Class 5" level of accuracy as defined by the Association for the Advancement of Cost Engineering International (AACEI) in 2024 dollars, except as where otherwise noted. This level of cost estimating is considered accurate to +50 to -30 percent and suitable only for project budgeting purposes.

These estimated costs were prepared for guidance in project budgeting and in evaluating which phasing and configuration alternative to pursue based on information available at the time of the estimate. The final cost of the project will depend upon the actual labor and material costs, competitive market conditions, implementation schedule, and other variable factors. As a result, the final project costs will vary from the estimates presented herein. Because of this variation, project feasibility and funding needs must be carefully reviewed prior to making specific financial decisions.

Attachment A.
Gatehouse Drawing

Lake Level Monitoring Shaft (approximate location)

Outline of South Room of Gate House

Tunnel Access Shaft

Stop Log Guide Channel

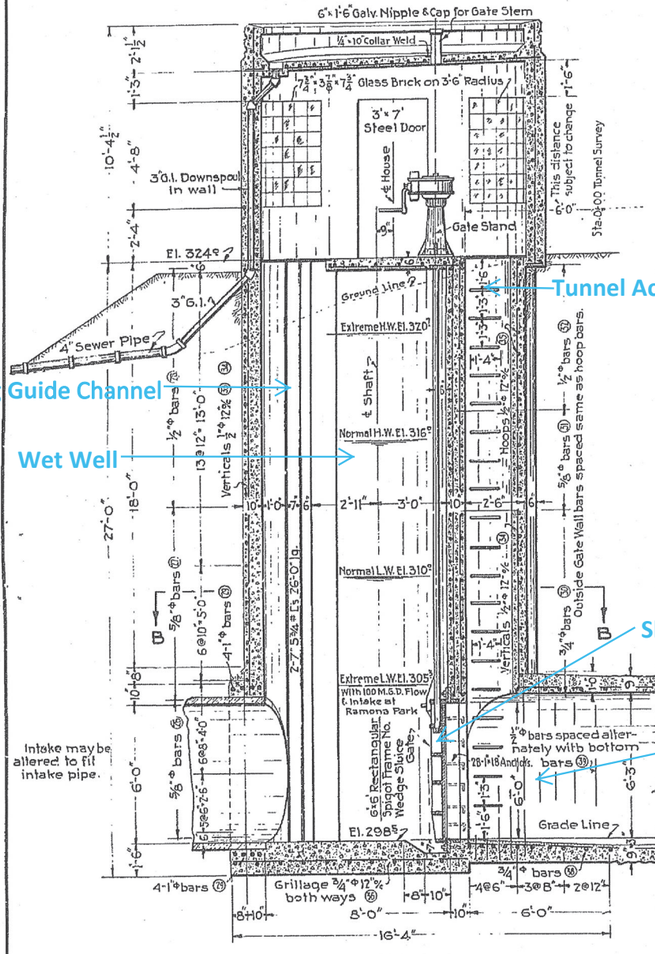
Slide Gate

Stop Log Guide Channel

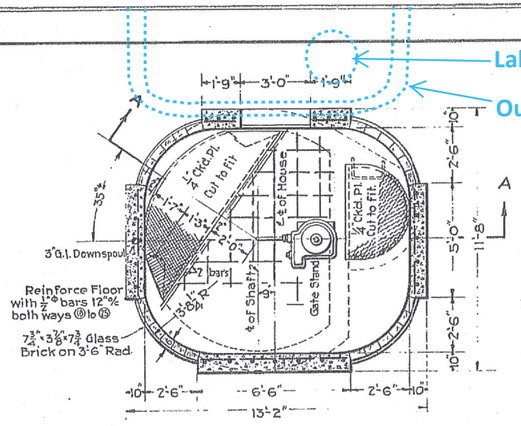
Wet Well

Slide Gate

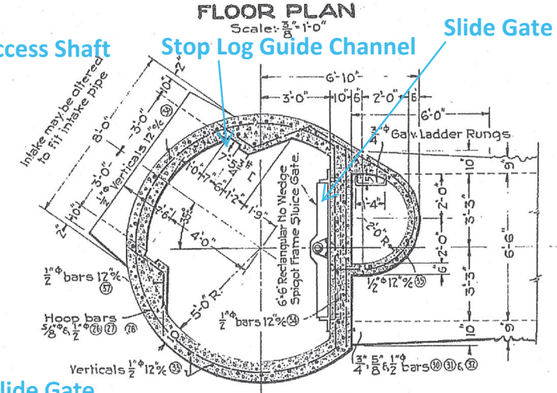
Tunnel Portal



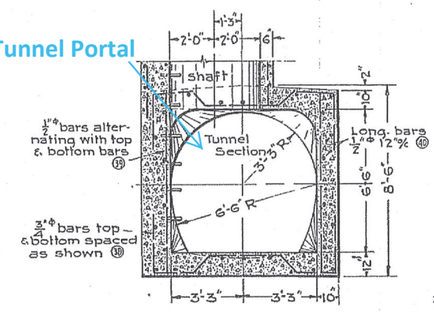
SECTION A-A
Scale:- ⅜"=1'-0"



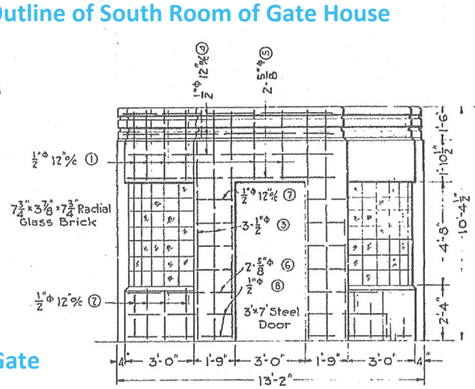
FLOOR PLAN
Scale: ⅜"=1'-0"



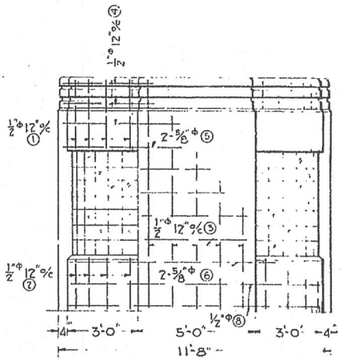
SECTION B-B
Scale:- ⅜"=1'-0"



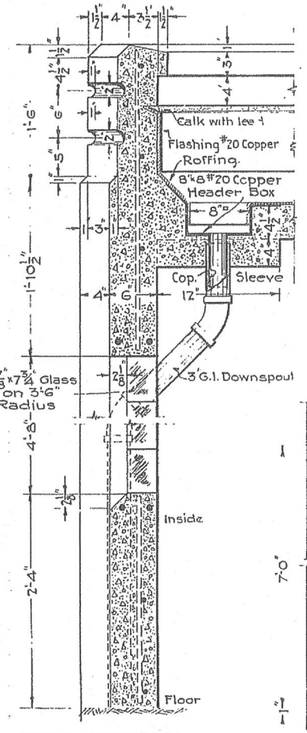
TRANSITION SECTION
Scale:- ⅜"=1'-0"



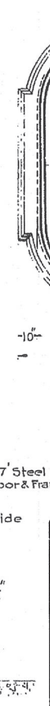
SOUTH ELEVATION
Scale:- ⅜"=1'-0"
North Elevation same but without Door



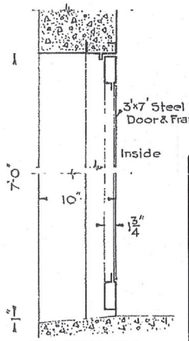
EAST & WEST ELEVATION
Scale: ⅜"=1'-0"



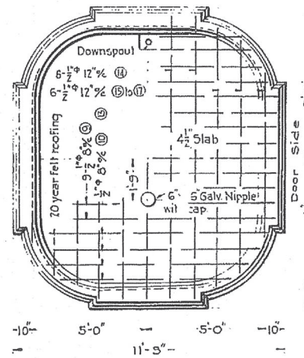
WALL SECTION
Scale:- 1½"=1'-0"



LADDER RUNGS
Scale:- 1"=1'-0"



DOORWAY
Scale: 1½"=1'-0"



ROOF PLAN
Scale:- ⅜"=1'-0"

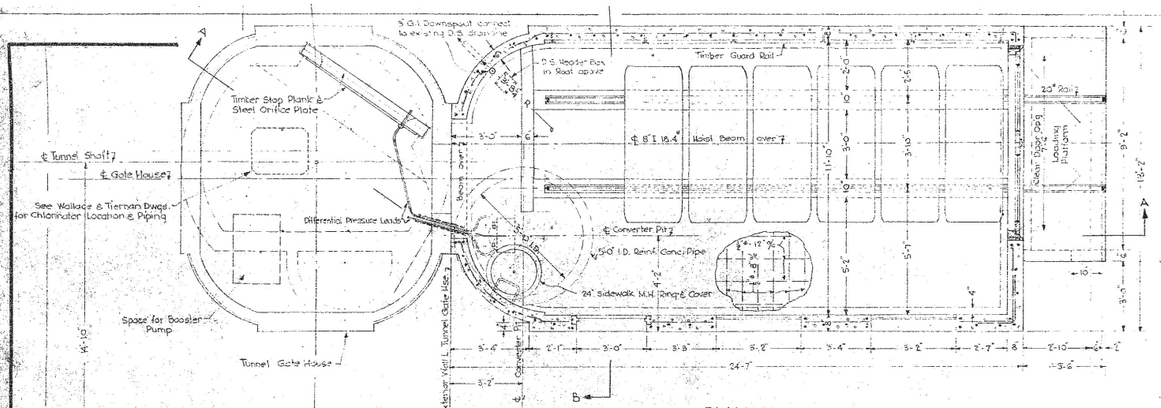
E. W. GOOCH
ACTING CITY ENGINEER
BAAR AND CUNNINGHAM
CONSULTING ENGINEERS
CITY OF BELLINGHAM, WN.
WATERWORKS IMPROVEMENT

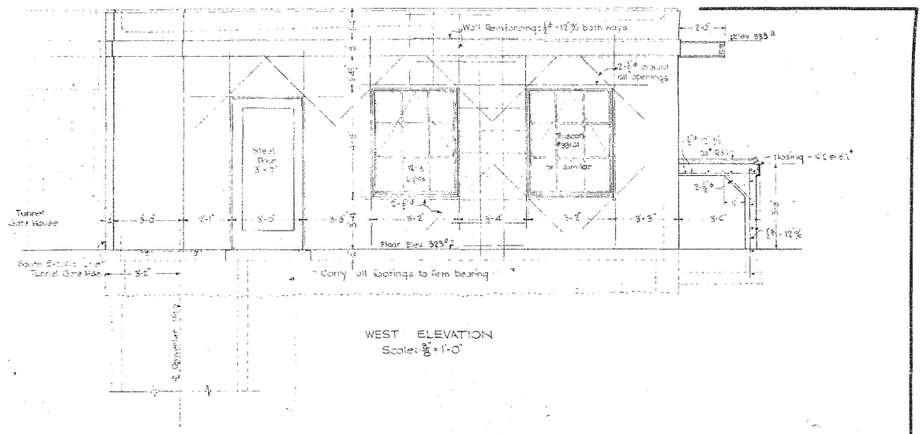
TUNNEL GATE HOUSE

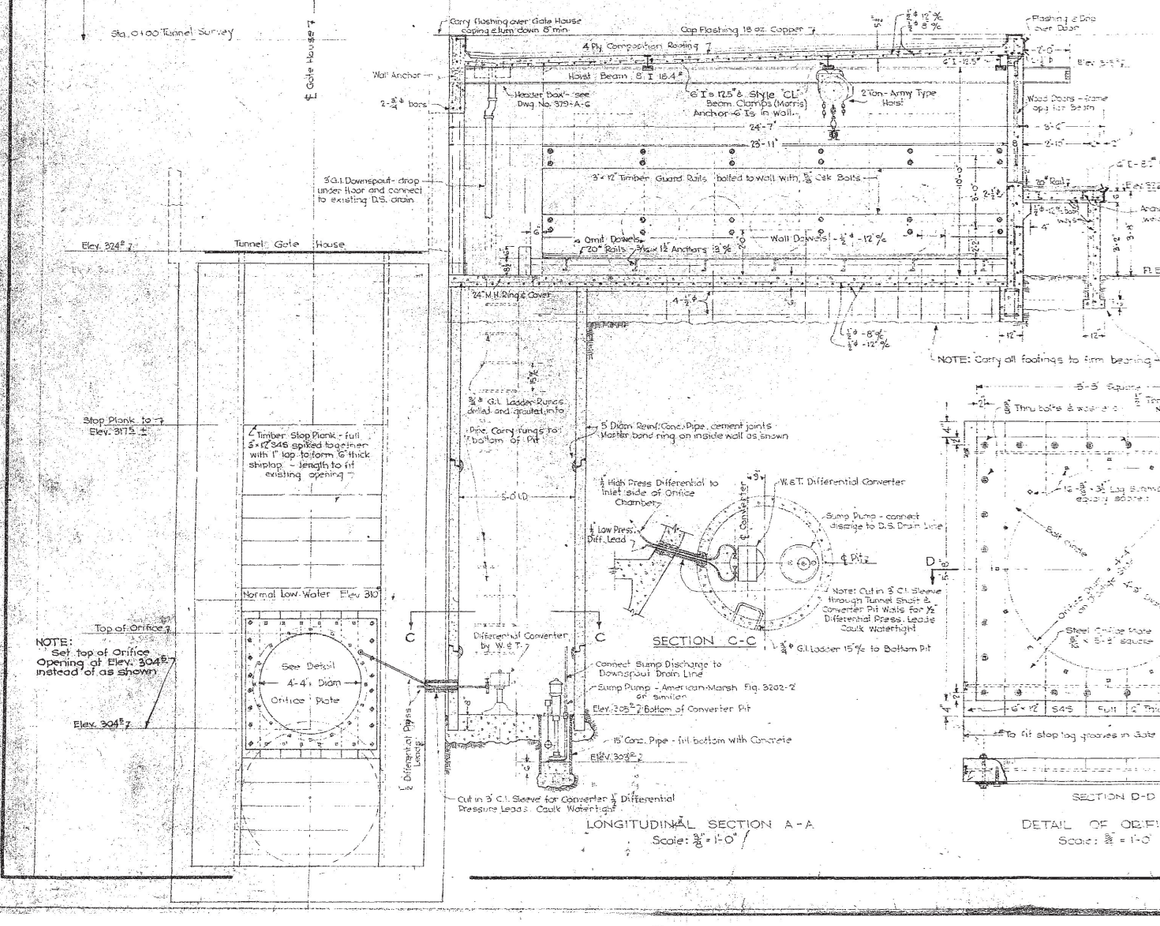
SCALE 3/:- AS NOTED

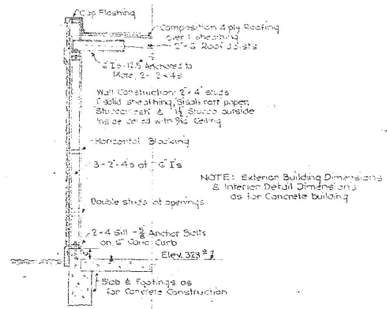
DESIGN BY	F.S.Z.	DATE: NOV. 21, 38	NO. 4 OF
DRAWN BY	F.S.Z.	REVISIONS	FILE NO.
TRACED BY	F.S.Z.		379-A-6
CHECKED BY			1405

WA-49









NOTE: Exterior Building Dimensions & Interior Detail Dimensions as for Concrete building

NOTE: For Construction Equipment and Piping see Plan & Section Dwg. No. 483-A-4 & 5
See Specifications for Electric Wiring & Fixtures

E. W. GOOCH
CITY ENGINEER
JOHN W. CUNNINGHAM & ASSOCIATES
CONSULTING ENGINEERS

CITY OF BELLINGHAM, WN.
WATERWORKS IMPROVEMENT
CHLORINE STORAGE BUILDING AND CONVERTER PIT
℄ TUNNEL GATE HOUSE

Scale as Noted

DRAWN BY	S.A.R.	JUNE 25 1941	NO. OF
DESIGN BY		REVISIONS	FILE NO.
TRACED BY		7/16 Floor Elev. to 323.8 S.A.R.	379-A-12
CHECKED BY		9/24 Elev. Top of Pit to 304.2 S.A.R.	15172

WA-92 - WA-93

Attachment B.
Lake Whatcom Dive Inspection (Crux Diving)
(Gatehouse Content)

Lake Whatcom Wood Stave Intake Inspection

Report date: 12/22/23

6805 NE 175TH STREET, KENMORE, WA 98028 | PH: 206.697.1009 | www.CRUXDIVING.com

Gate House Vault and Sluice Gate Valve Inspection

On the December 8th, 2023, Crux Diving divers mobilized to the gate house to perform the inspection of the gate house vault, access ladder, sluice gate valve, stop log slots, and the internal components of the wood stave intake pipe. The inspection of the access ladder, gate valve, stop logs and vault were performed first.

Figure 10: Gate House Vault Record Drawing

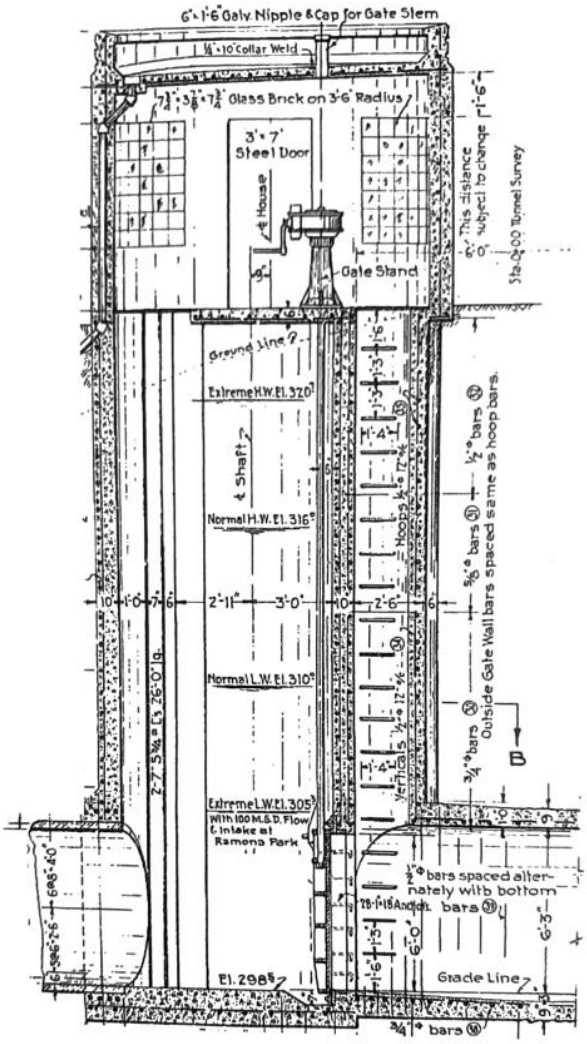
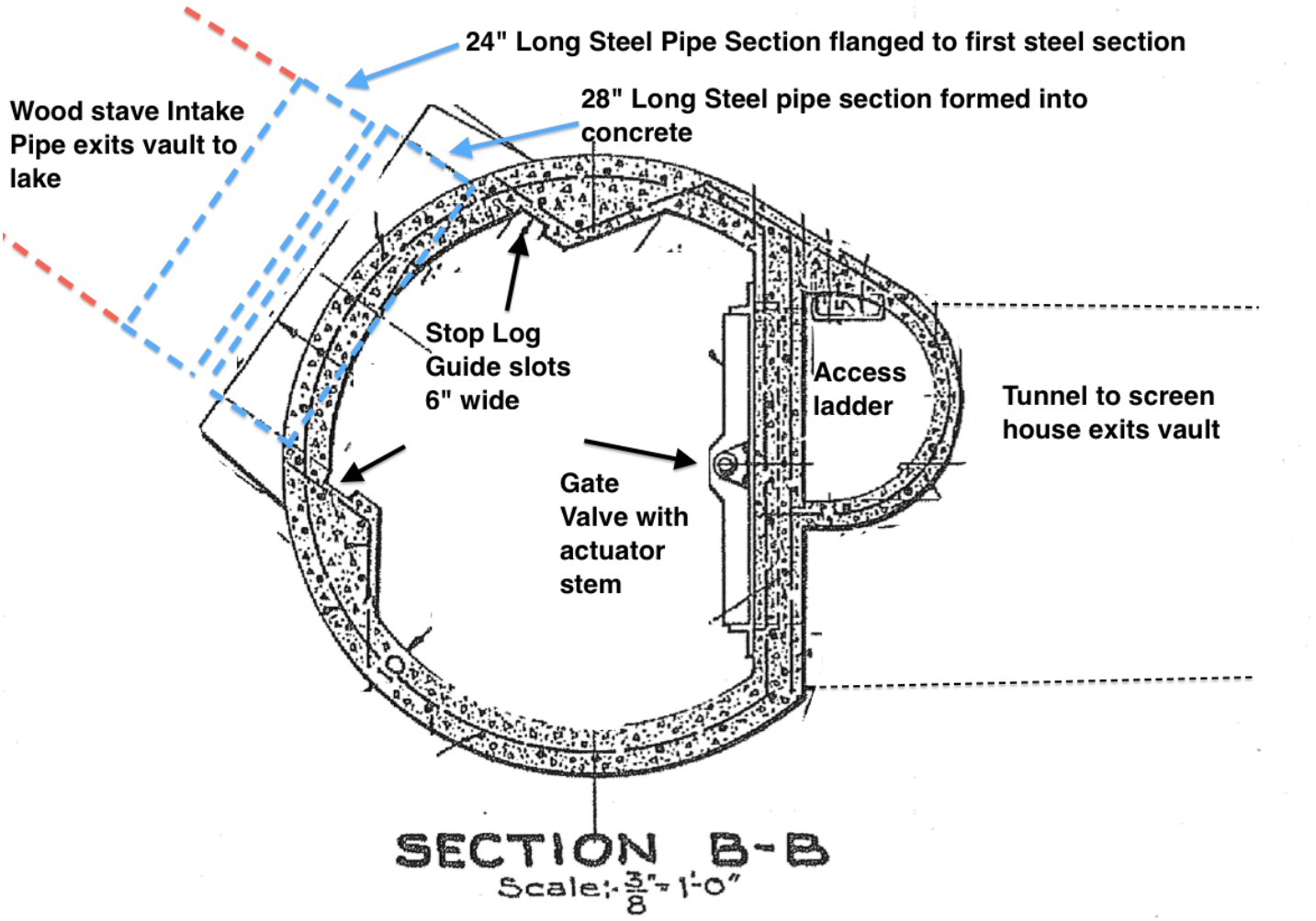


Figure 11: Top View of Gate House Vault



Access ladder condition:

Access ladder and ladder shaft appears to be in good condition. Crux Diving inspected the ladder rungs, concrete surface, and riser pipe inside ladder shaft. Ladder rungs showed some corrosion and rust scale. Removal of the scale revealed the rungs to have nearly ¾" of non-corroded steel underneath. The diver noticed one small area of spalling to the right of the access ladder just below where the 2" riser terminates. A 4" square area showed exposed aggregate with a depth of 1/2" at its deepest point. Concrete around this area showed no signs of deterioration. The ladder extends all the way to the bottom of the vault at which point it opens into the tunnel to the screen house. Light sediment observed at base of access ladder about ¼" deep.

Gate valve condition:
The gate valve consists of a 76”x 76” steel gate with a thickness of 2”, with a brass/bronze sealing surface along the sealing edges. On the vault side of the gate, there are 4 vertical stiffeners extending 3” out from the plate of the gate itself. These stiffeners are spaced 16” on center. There are 7 horizontal stiffeners extending 6” out from the plate of the gate. These stiffeners are spaced 12” on center. The gate rides up and down in a 6’ x 6’ steel frame within slots. On the vault side of the gate, there are 4 brass/bronze wedge plates on each side of the gate that match up with 4 plates on the frame to wedge the gate into the closed position and create a tight sealing surface. The sealing surface of the frame is also made of brass/bronze material. The steel actuator shaft rises from the center of the top of the gate, see Photo #30, and continues above waterline through the roof of the vault. The actuator is spaced 5” off the vault wall and held in position by two steel brackets anchored to the vault wall, one below waterline, and one above. The hardware on these brackets is all in place. No signs of loose or missing hardware were noted.

Very minor corrosion was noted to the brass/bronze components of the gate system, with pitting depths of 1/16″ or less. Once the scale was removed and oxidation was cleaned off with a wire brush, minor to moderate corrosion of the steel components was noted, with pitting to depths of 1/8” measured with a pitting gauge.

Stop log guide slots condition and measurements:
The internal dimension of the stop log guide slots is 2” deep and 6” wide. Full length of the stop log guide slots just above the bottom of the vault measured at 75.25”. Condition of the steel in the guide slots shows heavy oxidation scale built up inside of the slots, see Photo #31. Once the scale was removed, the guide slots show 1/16” to 1/8” pitting, see Photo #31. At the bottom of the guide slots, there is one board sitting on the concrete floor to a height of 7”, see Photo #33. Collected between this board and the end of the intake pipe is 7” of 2” minus cobble. In order to use the stop logs to seal off the intake, the stop log guides would likely need to have all of the oxidation scale removed. See Photo #34 for detail of the stop log guide slot above water line.

Concrete Surfaces of Gate House Vault:
The general condition of the concrete surfaces of the gate house vault appeared to be in very good condition, with very little spalling and exposed aggregate noted. The exception to this is the band between 1’ and 3’ below the waterline. In this area, the concrete felt soft and chipped away when scraped with knife. No signs of cracking were noted anywhere in the vault. The only other irregularity noted in the concrete surface of the vault were two 1” copper pipes penetrating the vault. The copper pipes were approximately 1’ long, 8’ above bottom and 18” to the South of the gate valve. The hole they penetrated through appears to have been re- finished with an epoxy or grout.

Internal Inspection of wood stave intake pipe:
Crux Diving diver inspected the wood stave intake pipe starting at the gate house entrance to the wood. The wood structure of the intake pipe appears to be in very good condition, with light algae growth covering 100% of the surfaces. The growth was removed easily by hand, and the wood underneath is consistent with all other wood components, soft for approximately 1/8” and then hard sound wood beneath. At approximately 8’ inside the wood intake, diver measured inside diameter both vertically and horizontally, 72” inside diameter recorded, good ovality. Two steel flange sections were visible on the inside of the pipe. The steel on the flanges and short sections of pipe was 3/8” thick and covered in marine growth and oxidation scale, see Photos #34 and 35.

Feet from Gate House	Growth	Sediment Depth	Notes
0	Algae	None	72” ID Steel pipe 28” long enters gate house, appears to be flanged to a second steel pipe with same ID 24” long, which then transitions to wood staves. Steel condition is heavy oxidation and scale. Wood condition is soft for the first 1/8”, then hard and sound when this soft layer is removed with a paint knife.
8’	Algae	None	Wood sound, 1/8” of soft wood, once removed with paint knife, hard wood exposed underneath. 72” x 72” ID.

Project Photographs

Lake Whatcom Gatehouse

Photo #27: Gatehouse access, gate valve actuator

Photo #28: Ladder rung underwater condition

Photo #29: Bottom flange of 2” riser where it terminates in the access ladder shaft.

Photo #30: Top of gate valve, heavy corrosion

Photo #31: Stop log guide slot, heavy corrosion

Photo #32 Stop log guide slot, pitting under corrosion, 1/8” pitting

Photo #33 Stop log 7” tall with debris behind

Photo #34 Inside of intake, steel to wood connection

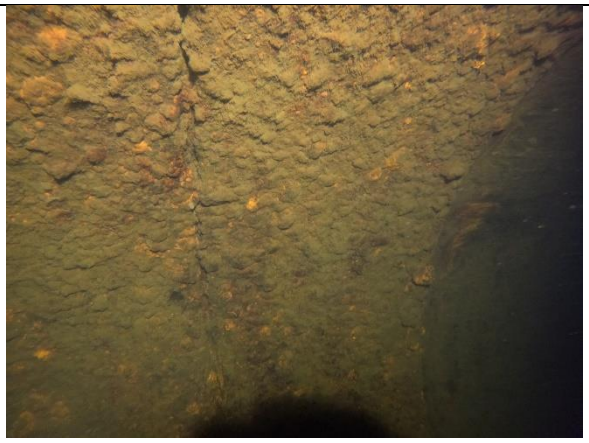
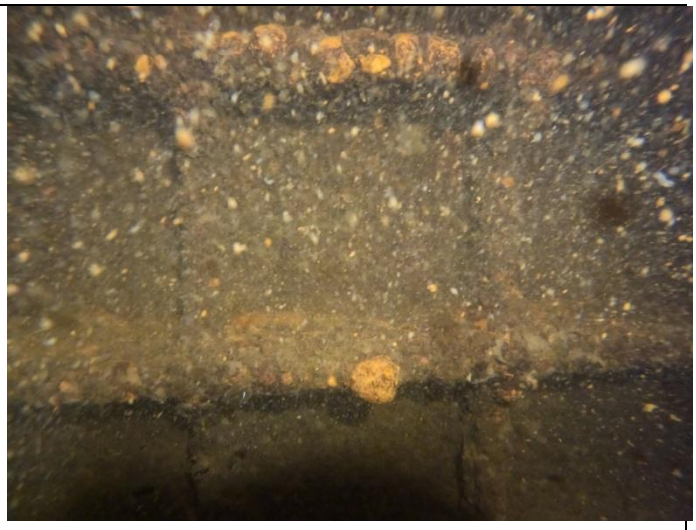


Photo #35 Inside of intake steel to wood connection

Photo #36: Brass Wedge block on frame for gate valve

	
Photo #37 2 1” Copper pipes extending approximately 1’ into vault 18” to the south of the gate and 8’ above bottom, terminated chlorination lines	Photo #38 Gate valve, heavy corrosion

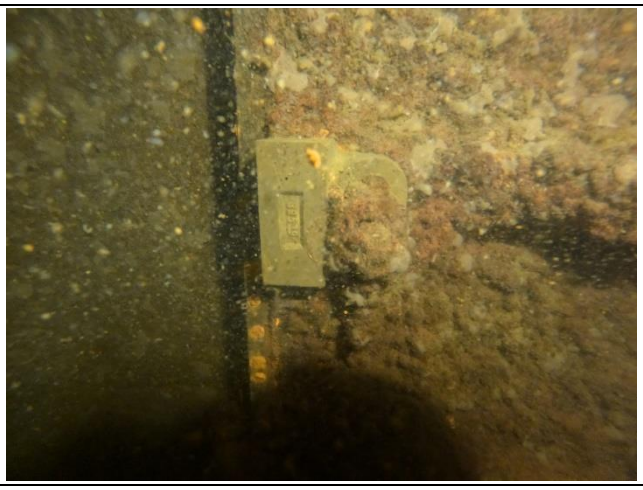



Photo #39 Gate valve seal kicker	Photo #40 Gate valve guide slot, heavy corrosion

Attachment C.
March 2024 Condition Assessment Site Photos

Gatehouse Photos

Photo #1: Side of Gatehouse (Facing North)

Photo #2: Back of Gatehouse (Facing Northwest)

Photo #3: Back of Gatehouse (Original Caisson, Facing West)

Photo #4: Delamination of Exterior Paint on North Side of Gatehouse

Photo #5: Front of Gatehouse Caisson (Facing East)

Photo #6: Gatehouse Interior (Facing Northwest)

Photo #7: Lake Level Monitoring Shaft

Photo #8: Gate Actuator (Locked out during tunnel inspection)

Photo #9: Ventilation of Tunnel Access Shaft

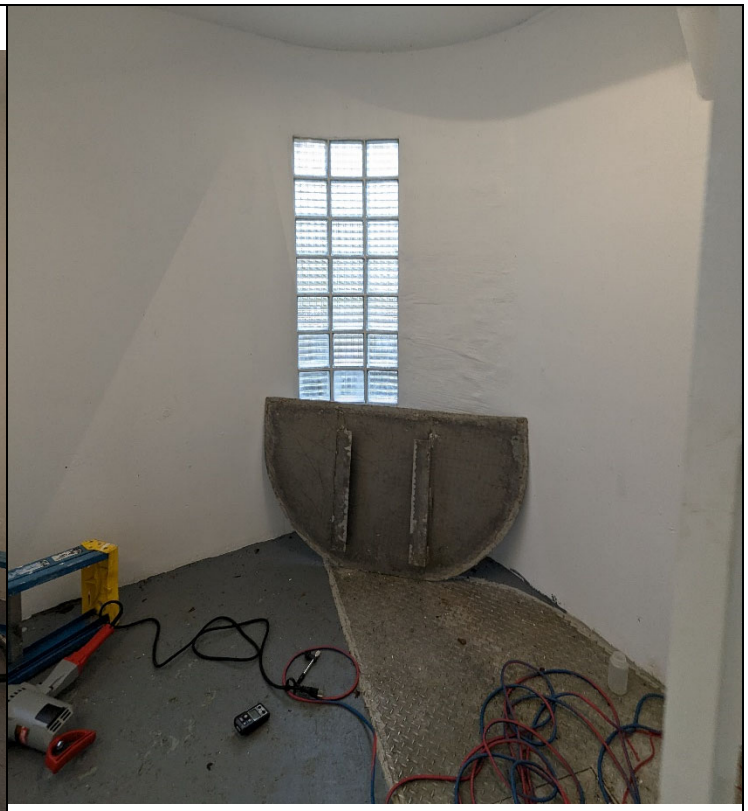


Photo #10: Gatehouse Wet Well Lid

Photo #11: Leakage at Gate (Bottom Left Corner from within Tunnel)

Photo #12: Leakage at Gate and Ladder Rung Corrosion (Right Side of Gate from within Tunnel)