City of Flint

Department of Purchases & Supplies

Sheldon A. Neeley

TO: All Proposers
FROM: Lauren Rowley, Purchasing Manager
DATE: **March 03, 2026**
SUBJECT: **Addendum #01 – P26000527: UTAH DAM CLEANING**

This addendum has been issued to address the following vendor Q&A:

Q1.) ***Please identify the extent of shore clearing that shall be included in the scope of work on the east and west sides of the dam bridge.***
A1.) Property marked plus an overhead aerial photo was attached.

Q2.) ***Exhibit A of the proposal submittal requests "Detailed Summary of Pricing" - Will a uniform bid schedule of values be provided to break down and itemize the scope of work for all bidders?***
A2.) I'm trying, that's why I said just put down 40 tons for the quantity of debris removed so they can all bid the same amount but please add what any additional loads would cost if it runs over the projected 40 tons.

Q3.) ***Is an estimate available for the approximate volume of debris removal and/or dredged spoils to be generated as part of the scope of work?***
A3.) 40 tons of wood and no dredge spoils.

Q4.) ***During the pre-bid conference an existing sediment boom and turbidity curtain were present on the southwest end of the dam bridge adjacent to an apparent storm discharge pipe – will this remain in place during the course of the project and will successful bidder be responsible for maintaining condition during the project?***
A4.) This will remain in place and yes, the contractor is responsible for replacement it if damaged.

Q5.) ***Is any analytical data available from any prior sampling of built-up debris along the north side of the dam for waste characterization purposes?***
A5.) No

Q6.) If waste characterization is within the scope of work for the successful bidder, please identify which analytes should be tested.
A6.) It is not in the scope of work hopefully no analysis will be needed for light cleanup work.

Q7.) ***It was noted during the pre-bid conference that the pedestrian walkways on the east and west side of the dam bridge are to remain open to the public throughout the course of the project – please confirm and advise/suggest suitable means and methods to safely preform shore clearing and debris removal directly adjacent to active walkways.***
A7.) The sidewalks and bike paths can be shut down during this project.

Q8.) ***During the pre-bid conference it was noted that a low-elevation overhead line connecting a presumed former utility was still intact on the east side of the dam bridge, running north-south, tying into a utility pole on Utah Ave, will this overhead line be removed prior to the start of work or will it be the responsibility of the successful bidder to coordinate with the utility authority for verification of disconnection and removal?***
A8.) The CoF can coordinate the power shut down of both light poles during this project. The contractors will still be responsible to not damage the two light poles or they must replace them.

Q9.) ***What is the estimated timeline of the project including anticipated start date, expected duration, and any relevant deadlines?***
A9.) Since this is a critical bike path route I would like it done in a timely manner and by June 31, 2026

Q10.) ***Can the field on the east side of the Utah Dam Bridge east of the Flint River Trail be utilized for staging equipment and/or a laydown area for dredged material to drain prior to loading and hauling offsite?***
A10.) Yes, but no dredged material.

Q11.) ***Will removal, hauling and disposal of debris and/or dredged spoils be paid on a lump sum basis or on a unit rate basis, i.e. per ton or per cubic yard?***
A11.) Per ton, and payment will be when the job is done as long as it is 40 tons or less. If they hit 40 tons and there is more, they must let us know that there must be a change order so we know how much additional money is needed.

Q12.) ***Will the successful bidder be responsible for obtaining EGLE and/or USACE permits to perform the debris removal within the Flint River?***
A12.) Yes, if needed.

Q13.) ***Will City of Flint provide or require applications for permits for performing work in the Flint River?***
A13.) At this time, EGLE has not notified us that any permits are needed for this work.

Q14.) ***Will the successful bidder be responsible for any sedimentation control measures to be implemented as part of the base scope of work?***
A14.) No (waiting on EGLE for clarification on this)

Q14.) Will any third-party engineering or consulting firm be providing oversight during execution of the project?
A14.) No.

Q15.) ***Will the successful bidder be responsible for assembling and submitting a site-specific Health and Safety Plan (HASP) for this project to the City of Flint or their engineer for review and approval?***
A15.) Yes

Q16.) How will City of Flint determine substantial completion of the project's intent to restore normal water flow, are historical stream gauge or flow meter records downstream of the project area available for reference?
A16.) As long as all of the dry land has been cleared between the markings and all floating debris has been removed from the river the WTP Supervisor will approve the work has been done to the citys satisfaction.

Q17.) ***Are any records available for recent bridge/dam inspection reports for the Utah Dam Bridge?***
A17.) Yes

Q18.) ***Will we need to submit a bid bond with our bid proposal? If so, please clarify what percentage of the bid amount will be required.***
A18.) *Yes, please include a 5% bid bond in your proposal submission.*

Q19.) ***The proposal package discusses bid submission by hard copy and electronic submission on bidnet direct. It is assumed that we can submit our proposal either electronically or hard copy. Please confirm.***

A19.) Per the required specifications in the RFP, BOTH hard copies AND electronic must be submitted to be fully qualified. Electronic can be submitted directly through bidnet or to the specified email address in the RFP, and the Hard copies can either be hand-delivered to the receiving address or postal mailed.

Q20.) ***Are there existing plans available for the dam structure? If so, please provide these for our review.***
A20.) Yes. Additional drawings are attached to this Addendum.

Q21.) ***What is the depth of the water around the dam structure?***
A21.) Approximately 10-15 feet deep

Q22.) ***What is the composition of the of the debris in the water – all that is visible at the surface of the water is the fallen trees? Is there silt or other debris? If there is silt or other debris, what is the anticipated depth of this material?***
A22.) Surface floating debris is the only thing that needs to be removed, no silt or dredging under this contract.

Q23.) ***Please provide a quantity (or quantities for different types of materials) that we are to base our bid on? 40 tons of wood debris to be removed.***
A23.) The City will have a dumpster on site for debris/trash removal.

Q24.) ***Please provide the exact limits of removals in the water that we are to perform (depth of removal, lateral limits along the dam, etc.)***
A24.) Anything that you can grab by hand floating on the surface.

Q25.) ***Has the material been tested for contamination? If not, is the intent to have the contractor test the material to determine if it is contaminated? If the contractor is responsible for testing the material, how is this to be paid for this?***
A25.) No testing has been done, as far as I know there is no contamination so nothing will be tested.

Q26.) ***Should the material be determined to be contaminated, please confirm that the City of Flint will be listed as the generator of this material.***
A26.) Yes

Q27.) ***Please confirm that should the material be determined to be contaminated, the contactor will be paid for the handling and disposal of this material by change order as there is no way to assess if the material is contaminated prior to bid submission.***
A27.) Yes

Q28.) ***At the site visit there was overhead wire in the work area around the dam that may have an impact on our work. Are these wires in service? If they are in service, will they be relocated or de-energized for our work?***
A28.) Yes they are in service, the city will have consumers energy de-energize while the work is being done, but the contractor is responsible to keep both light poles in tack and if any damage is done then the contractor must replace.

Q29.) ***Are there any other known utilities in the area that could impact the work associated with this project?***
A29.) No.

Q30.) ***Are there any restrictions associated with the bike trail that is crossing the existing dam structure? Can this trail be closed during our work?***

A30.) Yes, the trail will be closed during this project.

Q31.) ***At the pre-bid site walk-through, it was discussed that the City would like to have a portion of the riverbank around the dam structure to be cleared. This scope of work was not called out in the scope provided, is this work required? If so, please define the exact limits that we are to clear.***
A31.) Yes, we marked all of the areas that need cleaning.

Q32.) ***The scope of work provided states "Must have marine-certified divers (if underwater work is expected). Is underwater work requiring divers expected? If so, please clarify the exact scope anticipated for the divers. It is suggested that you provide a line item on the bid form for a daily rate for divers.***
A32.) No, only surface floating debris will be removed.

Q33.) There was no bid form provided in the proposal package, please provide a bid form, preferably with a breakdown of bid items and quantities.
A33.) There was no specified bid form, and therefore a vendor can attach/submit any type or format of bid pricing as long as there is a grand total amount clearly indicated.

Q34.) ***Are there anticipated start dates and completion dates for this work?***
A34.) Work is to be completed by June 30, 2026.

Q35.) ***Is this project subject to EGLE permitting? If so, has the permit been applied for and approved? Please provide a copy of the permit, if available.***
A35.) At this time, EGLE has not stated that any permitting is required.

Q36.) ***Are there any in water work restrictions that we need to be aware of related to fish spawning, muscles, etc?***
A36.) No

Q37.) ***Is a turbidity curtain required to be installed during construction?***
A37.) No

Q38.) ***Will the selected contractor need to provide a survey of river bottom to verify all debris/sediment/etc. has been removed?***
A38.) No

Q39.) ***What are the limits for removal? IE 20ft upstream of the structure and to what depth is the contractor being asked to remove to? Will this include any material within the gate structure/guide slots?***
A39.) An aerial map shows the approximate area and the city has marked the property with paint and flags and anything inside the markings needs to be removed. Only floating material on top of the water needs to be removed, if you can grab it with your hand pull it out.

Q40.) ***We assume that contamination testing will be required before sending the sediment and debris to a landfill? Will this be a pass through charge or is the city expecting the contractor to guestimate this cost in their proposal?***
A40.) I do not anticipate any additional charges due to contamination but if this problem arises we will have to address it in a change order.

City of Flint

Department of Purchases & Supplies

Q41.) ***Are there any known utilities in the area? If unknown, will the city provide this information prior to the bid submittal?***
A41.) Yes there is, the city will have consumers energy de-energize them while the work is being done, but the contractor still is responsible not to damage the two light poles or they will have to replace them.

Q42.) ***After removing trees, Will stumps need to be sprayed? Or all vegetation within those limits?***
A42.) Trees that are cut down should be cut a maximum of one foot above ground**.**

Q43.) ***If all vegetation is sprayed and removed will rip rap need to be installed to meet SEC measures?***
A43.) Do not spray vegetation and no SEC.

Q44.) ***Is there any anticipated sediment removal or just the log jam and debris?***
A44.) Just log jam and debris to be removed

Q45.) ***Can equipment be stored at water treatment plant for nights/weekend?***
A45.) Yes

All other bidding terms, requirements, and conditions continue as indicated in the remaining original bid documents.
The Purchasing Manager, Lauren Rowley, is an officer for the City of Flint with respect to this RFP.
In the submission of their proposal, Proposer must acknowledge receipt of this addendum. Proposer shall acknowledge this addendum by signing and returning one copy of this notice with their submission.
Company Name: _____

Address: _____

City / State / Zip: _____

Telephone: _____Fax: _____ Email: _____

Print Name: _____Title: _____

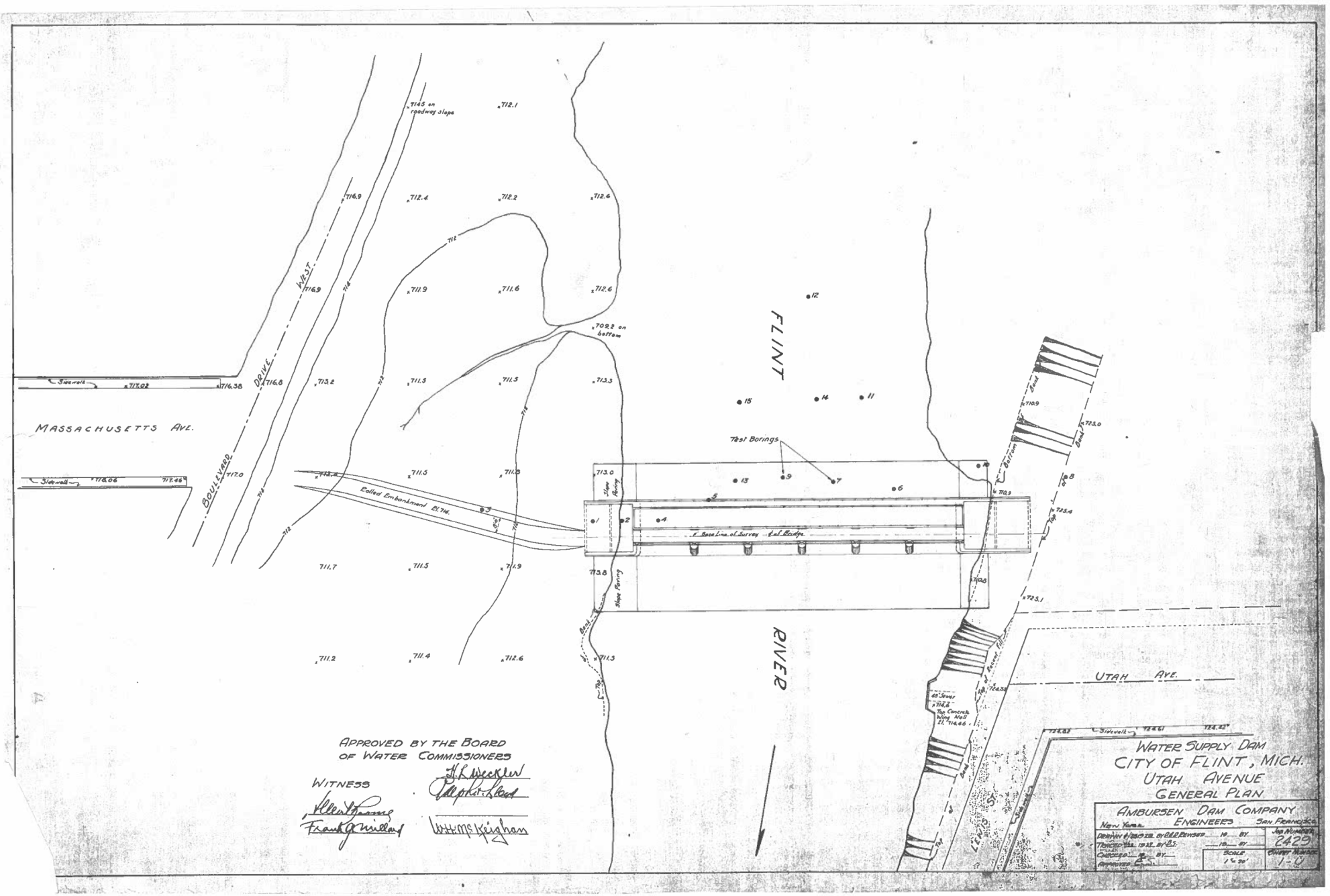
Signature: _____Date: _____

Thank you,

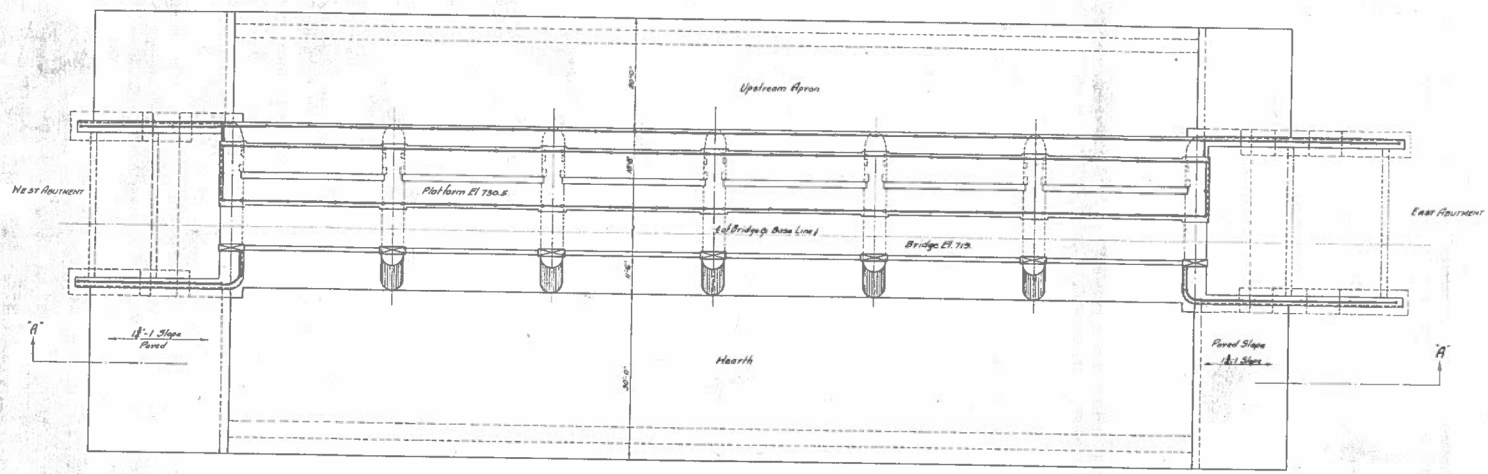
Lauren Rowley

Lauren Rowley, Purchasing Manager

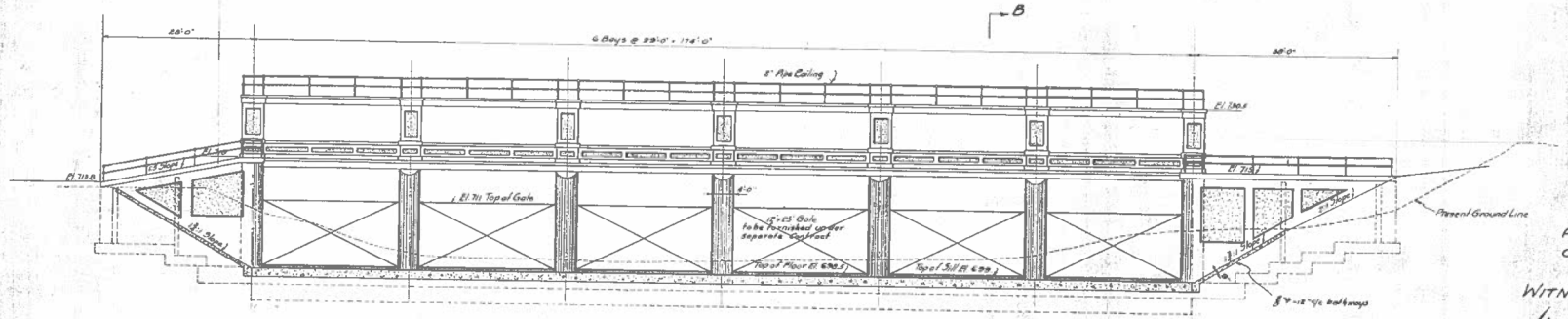
Flint River
Flint River Trl
20'
30'
Flint River Trl
Flint River Trl
Flint River Trl
Flint River
Utah Ave
Lewis St
Layers
Google Maps
Imagery ©2026 Airbus, Map data ©2026 United States Terms Privacy Send Product Feedback 20 ft



MASSACHUSETTS AVE.
BOULEVARD DRIVE WEST
FLINT RIVER
UTAH AVE.
LEWIS ST.
Test Borings
Rolled Embankment El. 714.
Base Line of Survey & of Bridge
Slope Paving
Top of Recent Fill
Top of Bank
Bottom of Bank
Sidewalk
APPROVED BY THE BOARD OF WATER COMMISSIONERS
WITNESS
H. L. Weckler
Ralph T. Lloyd
Frank G. Willard
W. H. McKeighan
WATER SUPPLY DAM
CITY OF FLINT, MICH.
UTAH AVENUE
GENERAL PLAN
AMBURSEN DAM COMPANY
ENGINEERS
NEW YORK
SAN FRANCISCO
JOB NUMBER 2429
SCALE 1" = 20'
SHEET NUMBER 1-0



PLAN



SECTION A-A THRU HEARTH
SHOWING DOWNSTREAM ELEVATION OF DAM

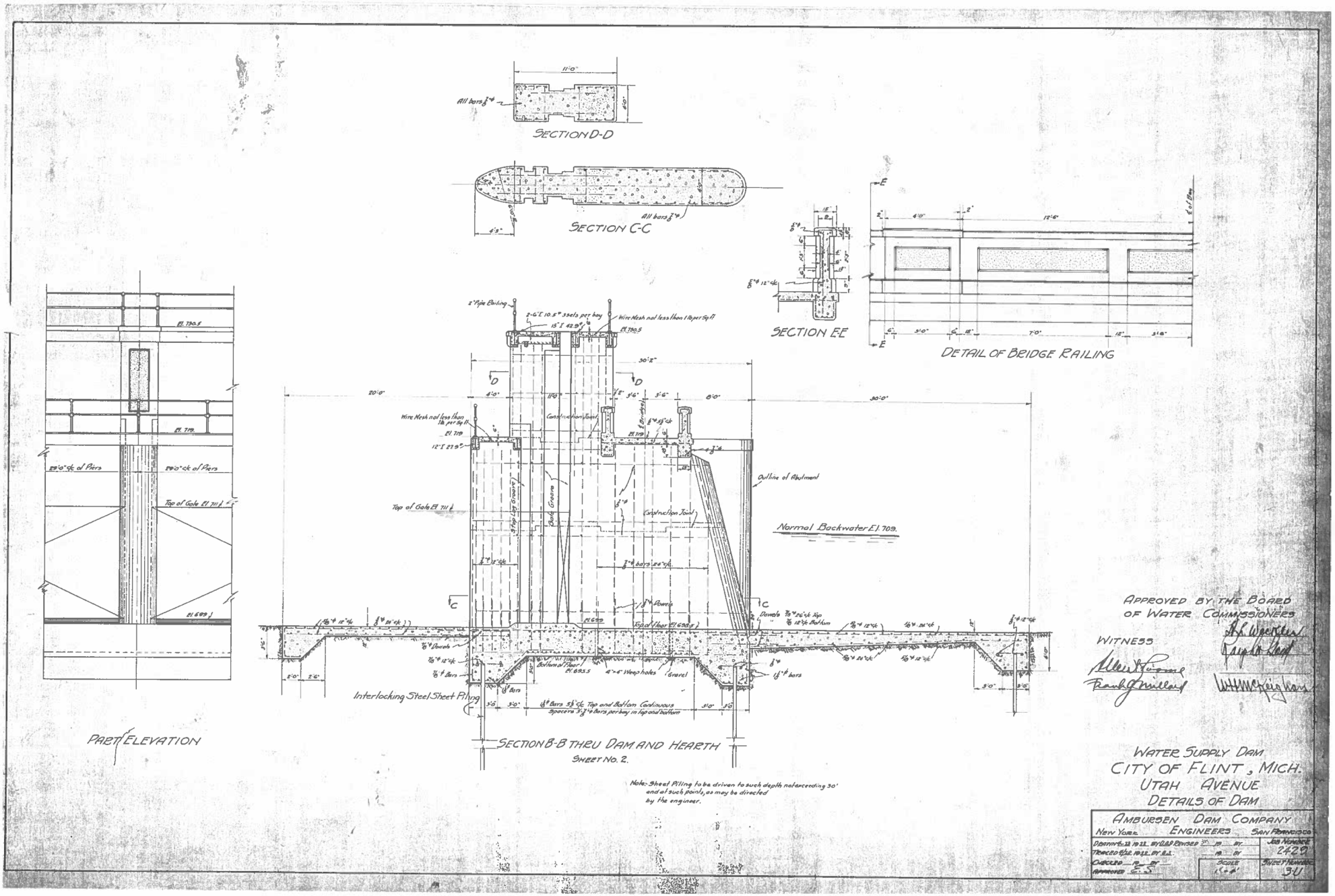
APPROVED BY THE BOARD
OF WATER COMMISSIONERS

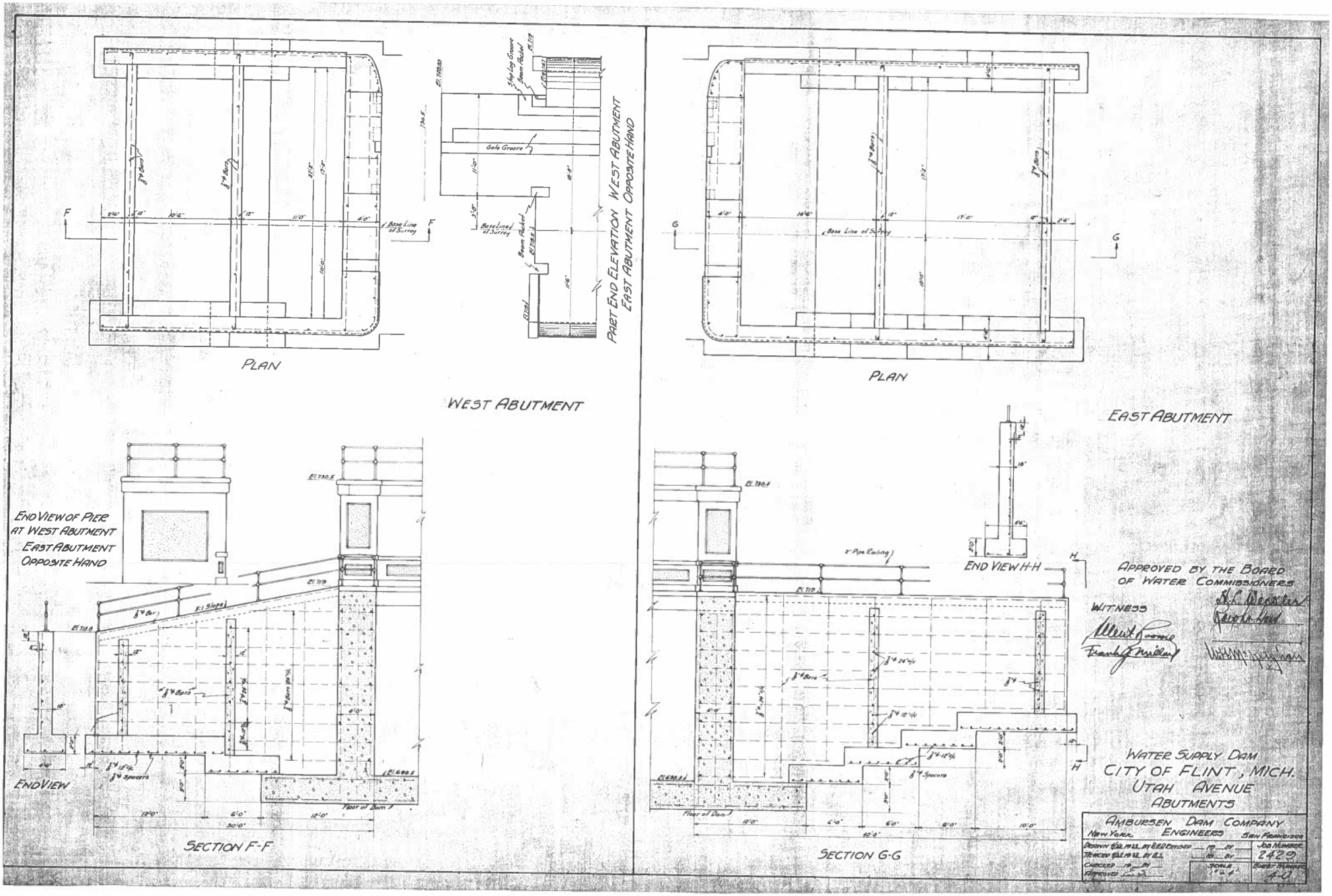
WITNESS

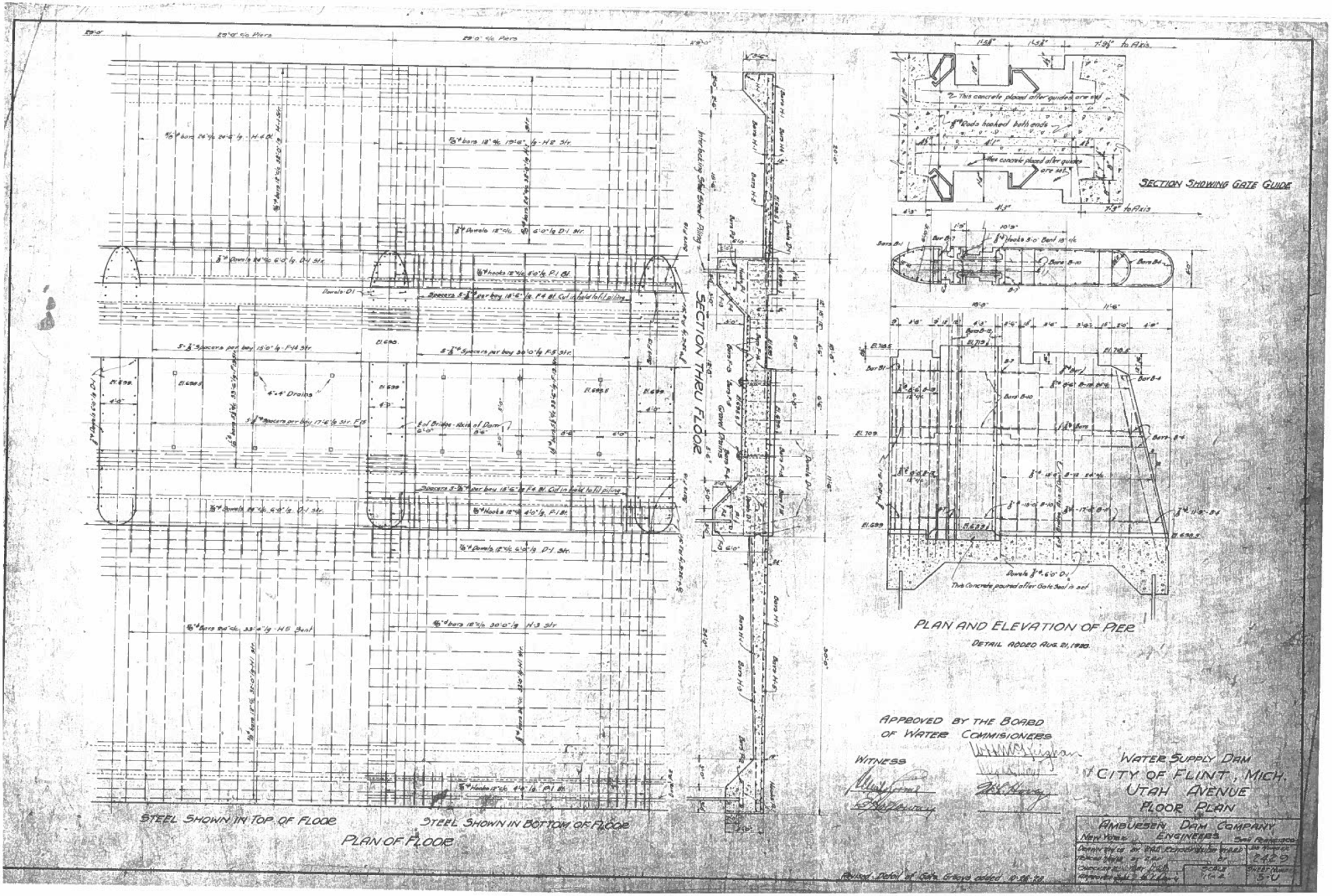
WATER SUPPLY DAM
CITY OF FLINT, MICH.
UTAH AVENUE
PLAN AND ELEVATION

AMBURSEN DAM COMPANY
NEW YORK ENGINEERS SAN FRANCISCO

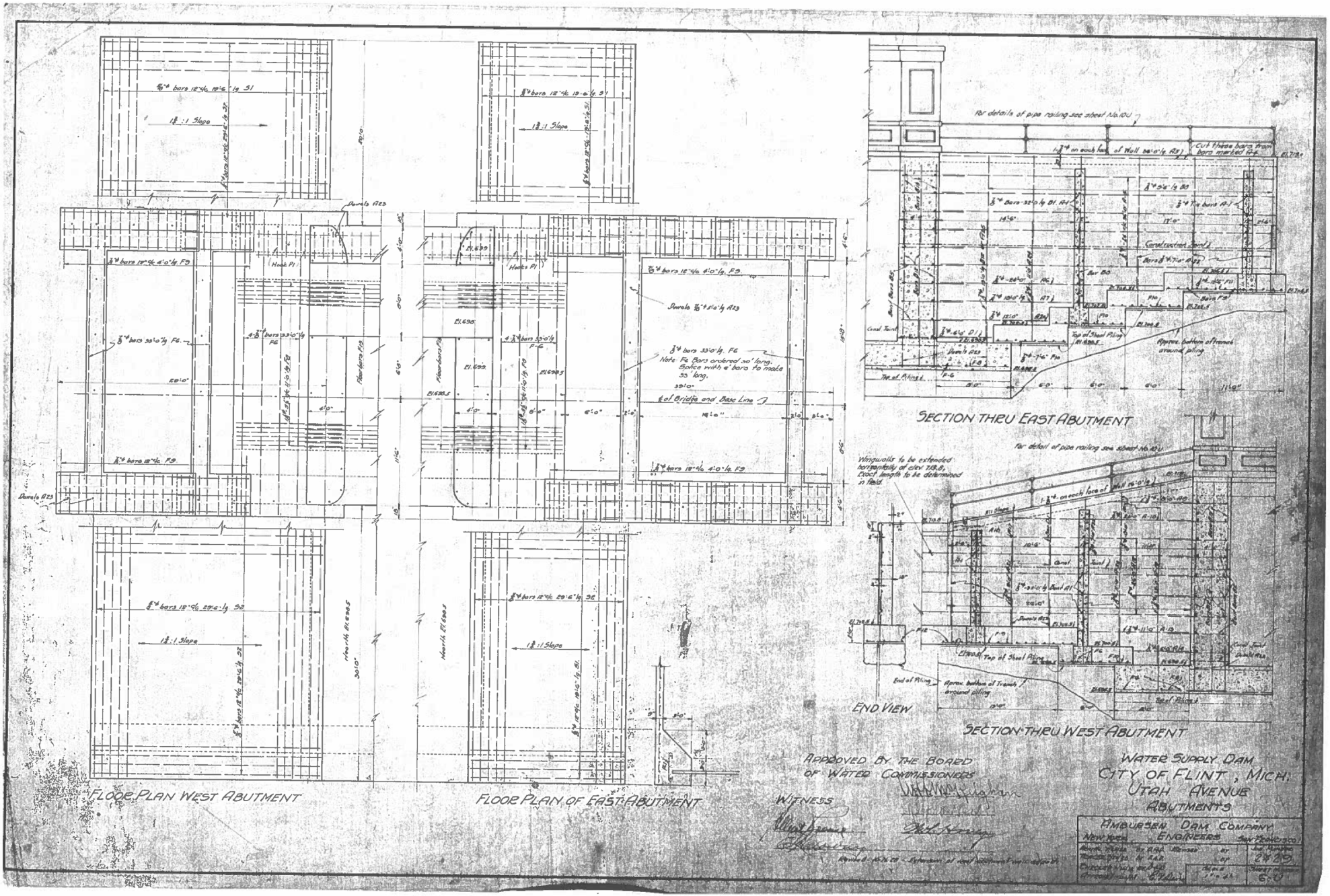
DRAWN 8/22 1922 BY R.A.D. REVISED 19 BY		JOB NUMBER 2429
TRACED 8/22 1922 BY R.A.D. 19 BY		
CHECKED 19 BY	SCALE 1" = 10'	SHEET NUMBER 2-U
APPROVED C.S.		


SECTION D-D
SECTION C-C
SECTION E-E
DETAIL OF BRIDGE RAILING
PART ELEVATION
SECTION B-B THRU DAM AND HEARTH
SHEET No. 2.
Normal Backwater El. 709.
Interlocking Steel Sheet Piling
Outline of Abutment
Top of Gate El. 711
Note: Sheet Piling to be driven to such depth not exceeding 30' and at such points, as may be directed by the engineer.
APPROVED BY THE BOARD OF WATER COMMISSIONERS
WITNESS
WATER SUPPLY DAM
CITY OF FLINT, MICH.
UTAH AVENUE
DETAILS OF DAM
AMBURSEN DAM COMPANY
NEW YORK ENGINEERS SAN FRANCISCO
JOB NUMBER 2429
SHEET NUMBER 3-U


PLAN
WEST ABUTMENT
PART END ELEVATION WEST ABUTMENT
EAST ABUTMENT OPPOSITE HAND
Base Line of Survey
Gate Groove
Beam Pocket
Stop Log Groove
END VIEW OF PIER
AT WEST ABUTMENT
EAST ABUTMENT
OPPOSITE HAND
END VIEW
SECTION F-F
Floor of Dam
PLAN
EAST ABUTMENT
END VIEW H-H
SECTION G-G
APPROVED BY THE BOARD
OF WATER COMMISSIONERS
WITNESS
WATER SUPPLY DAM
CITY OF FLINT, MICH.
UTAH AVENUE
ABUTMENTS
AMBURSEN DAM COMPANY
NEW YORK ENGINEERS SAN FRANCISCO
JOB NUMBER
2429
SCALE
SHEET NUMBER
4-0



SECTION THRU FLOOR
SECTION SHOWING GATE GUIDE
PLAN AND ELEVATION OF PIER
DETAIL ADDED AUG. 21, 1928
STEEL SHOWN IN TOP OF FLOOR
STEEL SHOWN IN BOTTOM OF FLOOR
PLAN OF FLOOR
APPROVED BY THE BOARD OF WATER COMMISIONERS
WITNESS
WATER SUPPLY DAM
CITY OF FLINT, MICH.
UTAH AVENUE
FLOOR PLAN
AMBURSEN DAM COMPANY
ENGINEERS
NEW YORK
SAN FRANCISCO
2429
5-U
Revised Detail of Gate Groove added 10-26-28


FLOOR PLAN WEST ABUTMENT
FLOOR PLAN OF EAST ABUTMENT
SECTION THRU EAST ABUTMENT
SECTION THRU WEST ABUTMENT
END VIEW
Parapet Wall
Wingwalls to be extended horizontally at elev 718.8, Exact length to be determined in field
Top of Steel Piling
Approx. bottom of trench around piling
End of Piling
Hearth El 694.5
Hearth El 695.5
Abutment Fdn
Sheet Piling
Coal Tunnel
Canal
Bridge and Base Line
Hook Pl
Dowels #23
Dowels #25
Dowels #27
Dowels #29
Dowels #31
Dowels #33
Dowels #35
Dowels #37
Dowels #39
Dowels #41
Dowels #43
Dowels #45
Dowels #47
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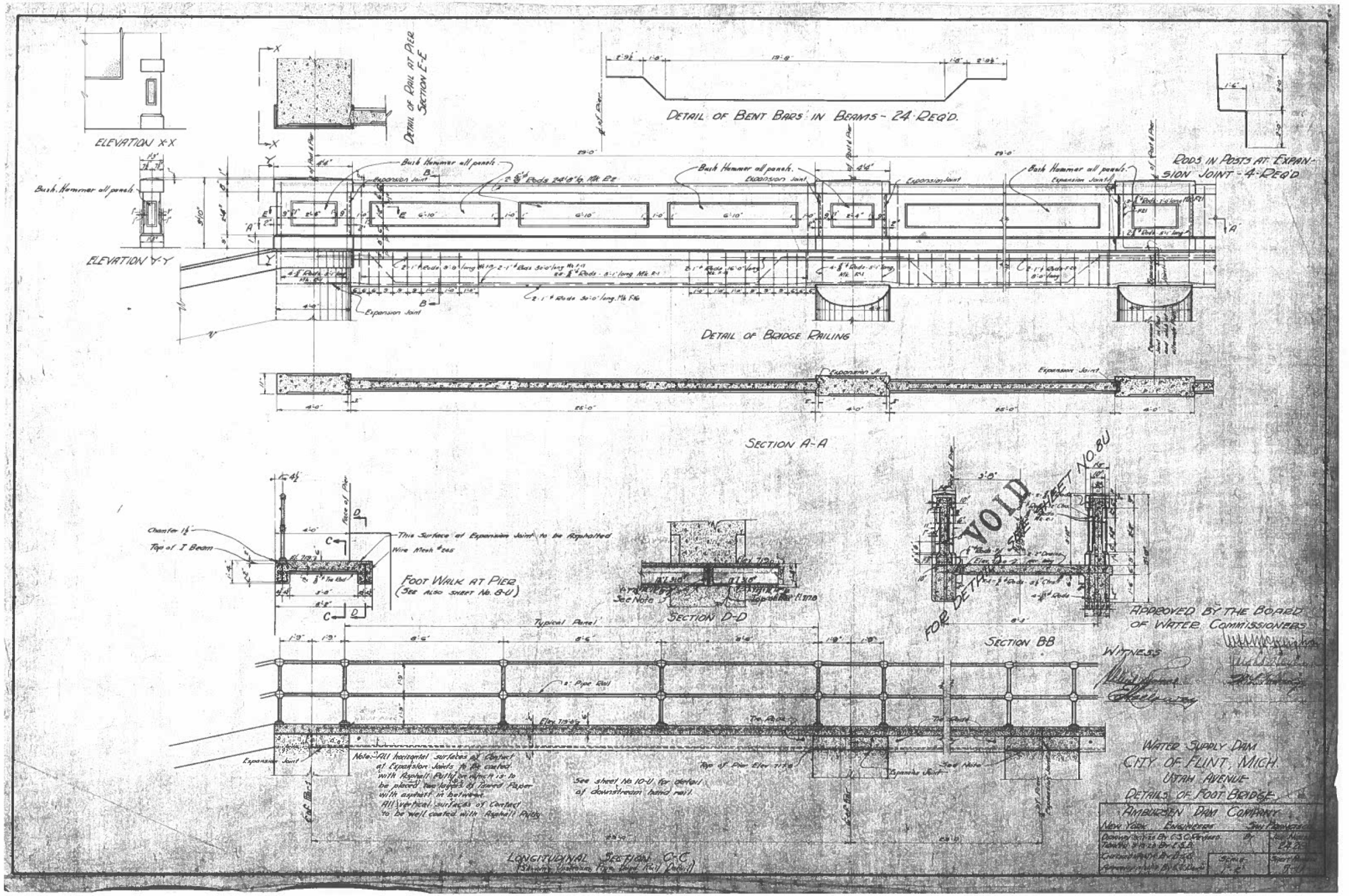
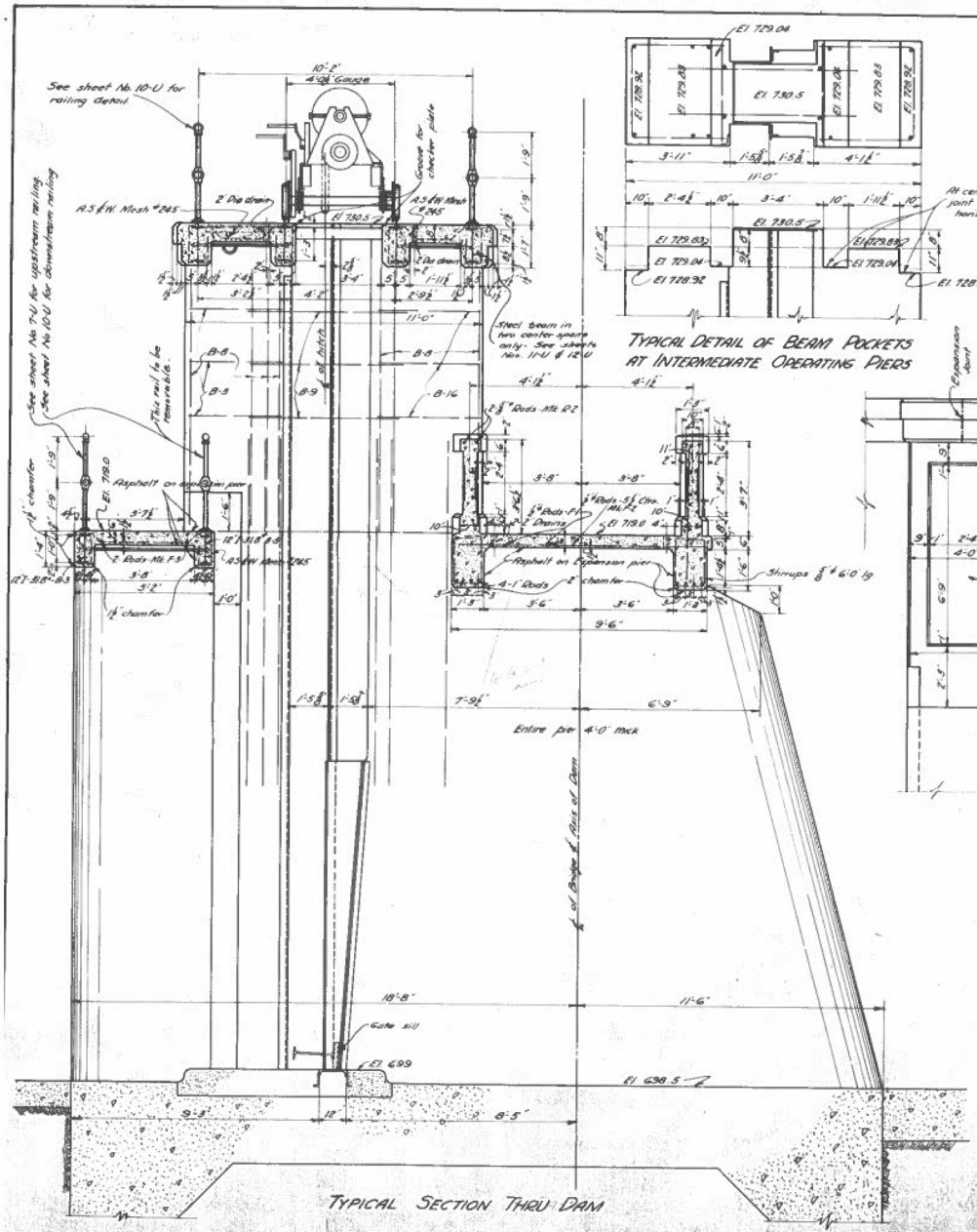
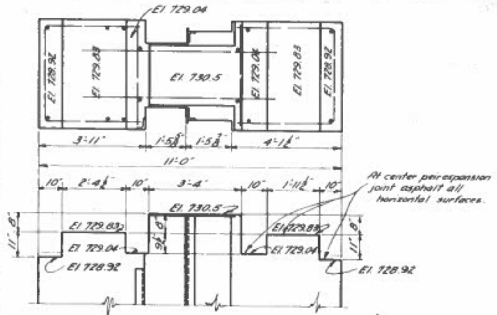
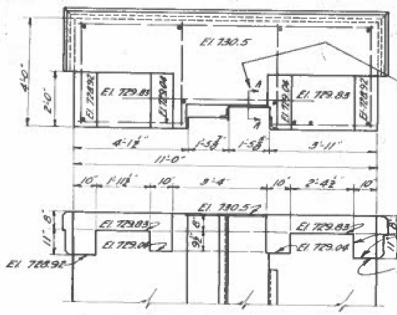
Dowels #55
Dowels #57
Dowels #59
Dowels #61
Dowels


ELEVATION X-X
DETAIL OF RAIL AT PIER SECTION E-E
DETAIL OF BENT BARS IN BEAMS - 24 REQ'D.
RODS IN POSTS AT EXPANSION JOINT - 4 REQ'D
ELEVATION Y-Y
DETAIL OF BRIDGE RAILING
SECTION A-A
FOOT WALK AT PIER (SEE ALSO SHEET No. 8-U)
SECTION D-D
SECTION BB
VOID
FOR DETAIL SEE SHEET NO. 8U
APPROVED BY THE BOARD OF WATER COMMISSIONERS
WITNESS
LONGITUDINAL SECTION C-C
WATER SUPPLY DAM
CITY OF FLINT, MICH.
UTAH AVENUE
DETAILS OF FOOT BRIDGE
AMBURSEN DAM COMPANY



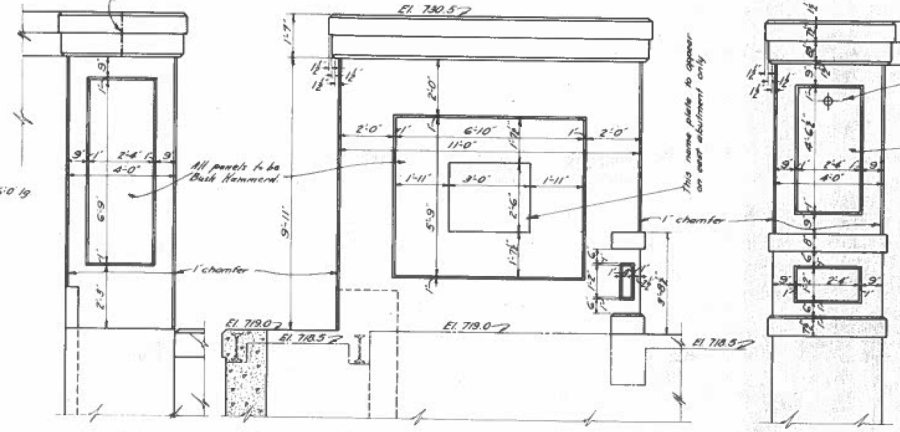


TYPICAL DETAIL OF BEAM POCKETS AT INTERMEDIATE OPERATING PIERS

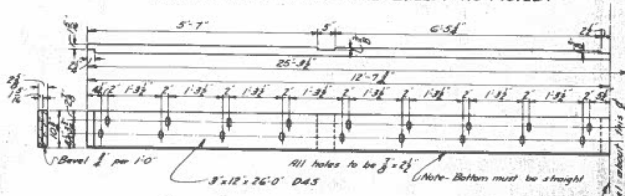


TYPICAL DETAIL OF BEAM POCKETS AT ABUTMENT OPERATING PIERS

SECTION A-A.
DETAIL OF GROOVE FOR CHECKER PLATE



OUTSIDE ELEVATION OF EAST ABUTMENT OPERATING PIERS.
WEST ABUTMENT TO BE SAME EXCEPT AS NOTED.



OAK GATE SILL
REQUIRED - 6

APPROVED BY THE BOARD OF WATER COMMISSIONERS

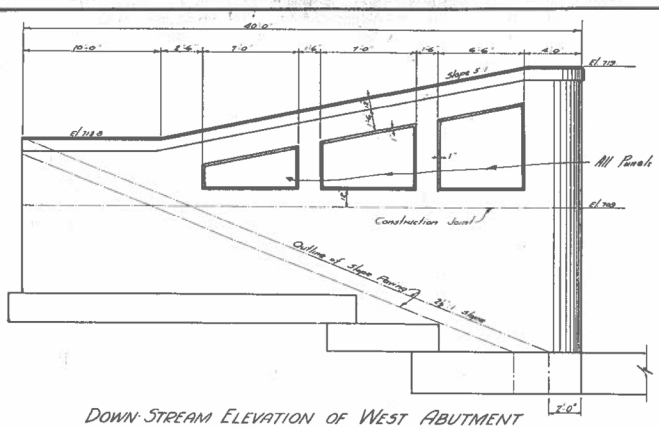
WITNESS

WATER SUPPLY DAM
CITY OF FLINT, MICH.
UTAH AVENUE
DETAILS OF OPERATING PIERS, OPERATING PLATFORM, BRIDGE AND WALKWAY

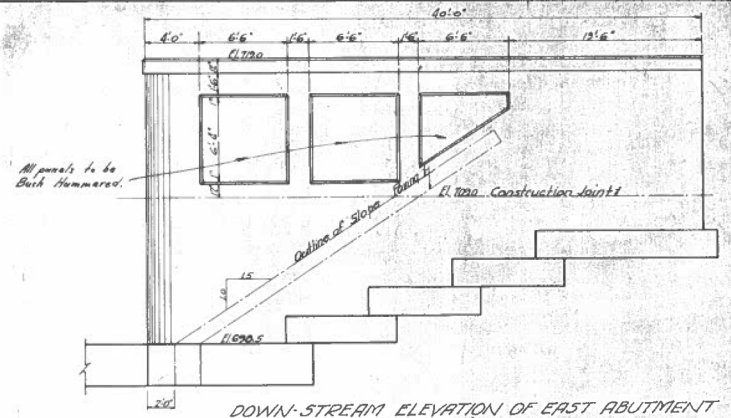
AMBURSEN DAM COMPANY
NEW YORK ENGINEERS SAN FRANCISCO

Revised as to	Rec.	Revised	by
Traced by	on	E.S.B.	
Checked by	on	D.A.S.	
Approved by	on	C.F. Uhl	

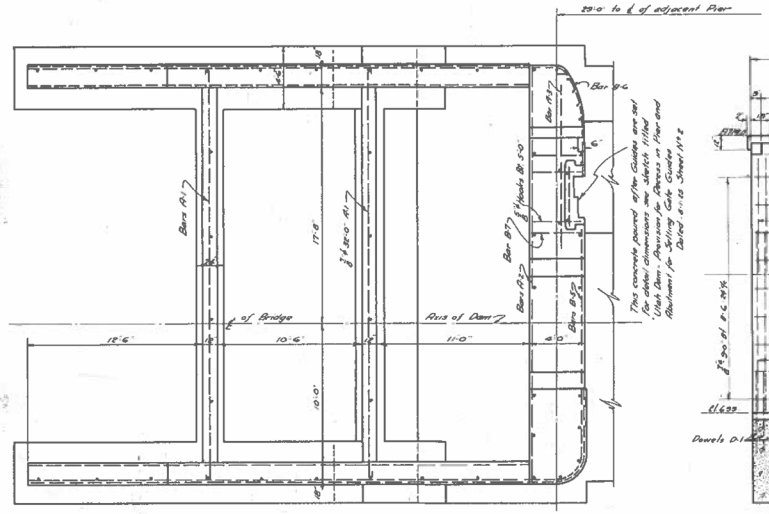
Job Number 2429
Scale 1"=2'-0"
Sheet Number 8-U



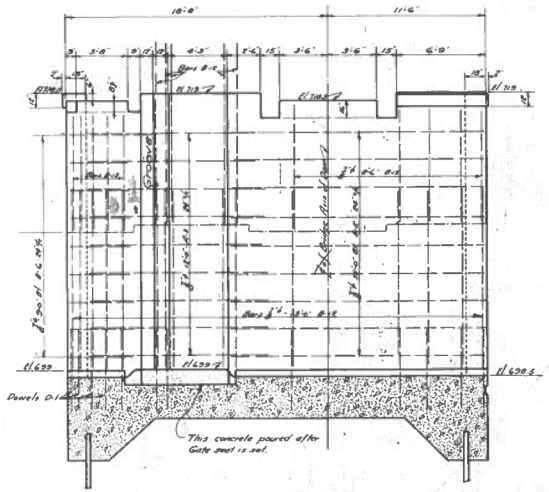
DOWN-STREAM ELEVATION OF WEST ABUTMENT
UP-STREAM ELEVATION - OPPOSITE HAND
EXCEPT FOR SLOPE PAVING



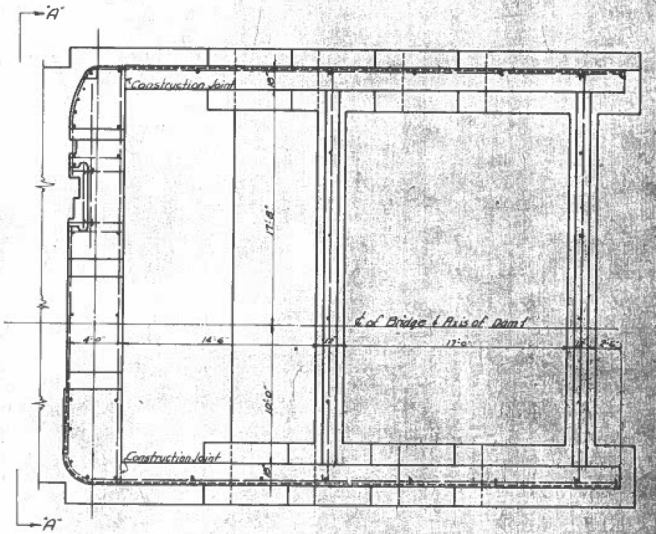
DOWN-STREAM ELEVATION OF EAST ABUTMENT
UP-STREAM ELEVATION - OPPOSITE HAND
EXCEPT FOR SLOPE PAVING



PLAN OF WEST ABUTMENT



ELEVATION OF EAST ABUTMENT A-A
WEST ABUTMENT — OPPOSITE HAND



PLAN OF EAST ABUTMENT

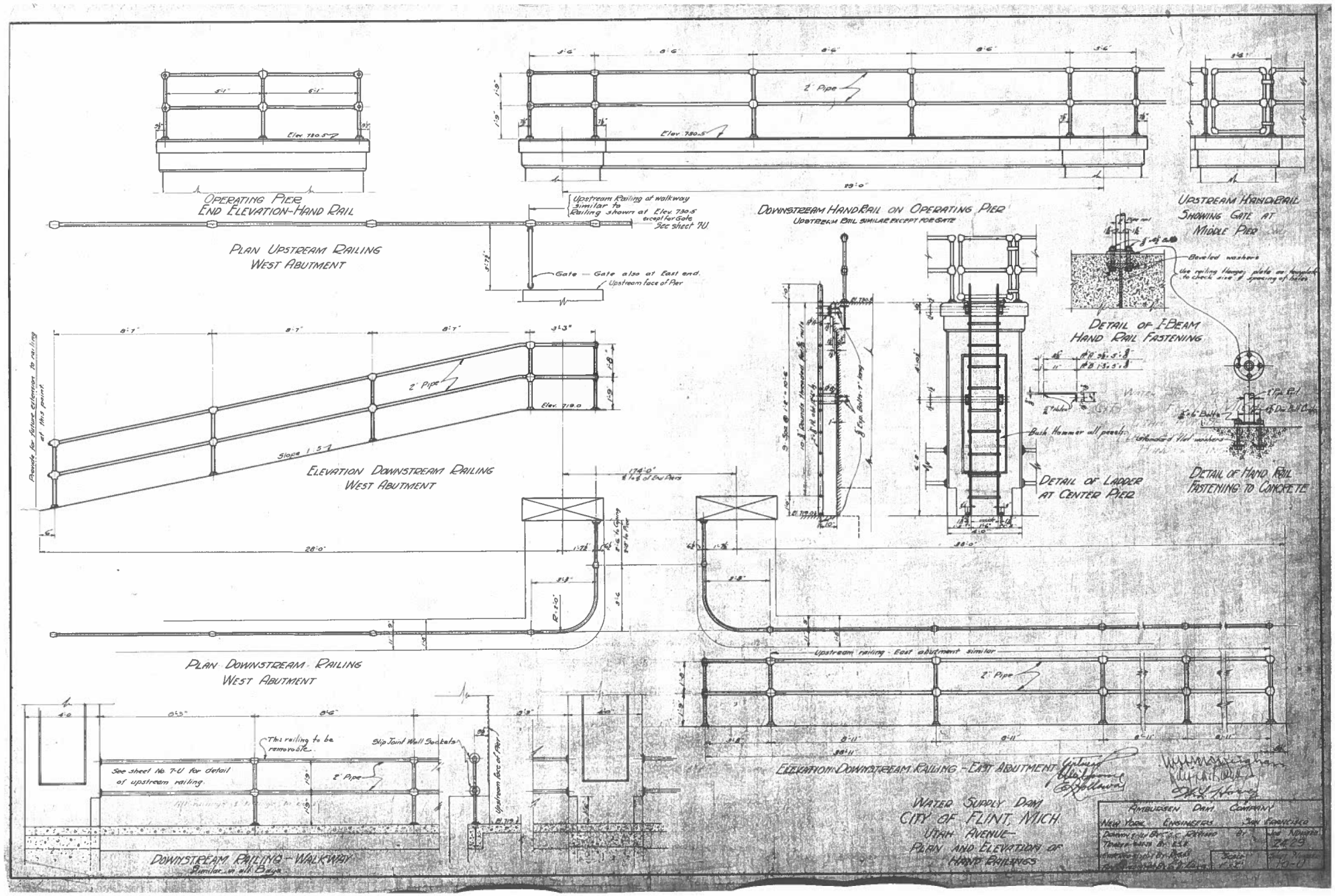
APPROVED BY THE BOARD
OF WATER COMMISSIONERS
W. W. Seymour
Mayor
W. L. Henry

WITNESS
Clerk

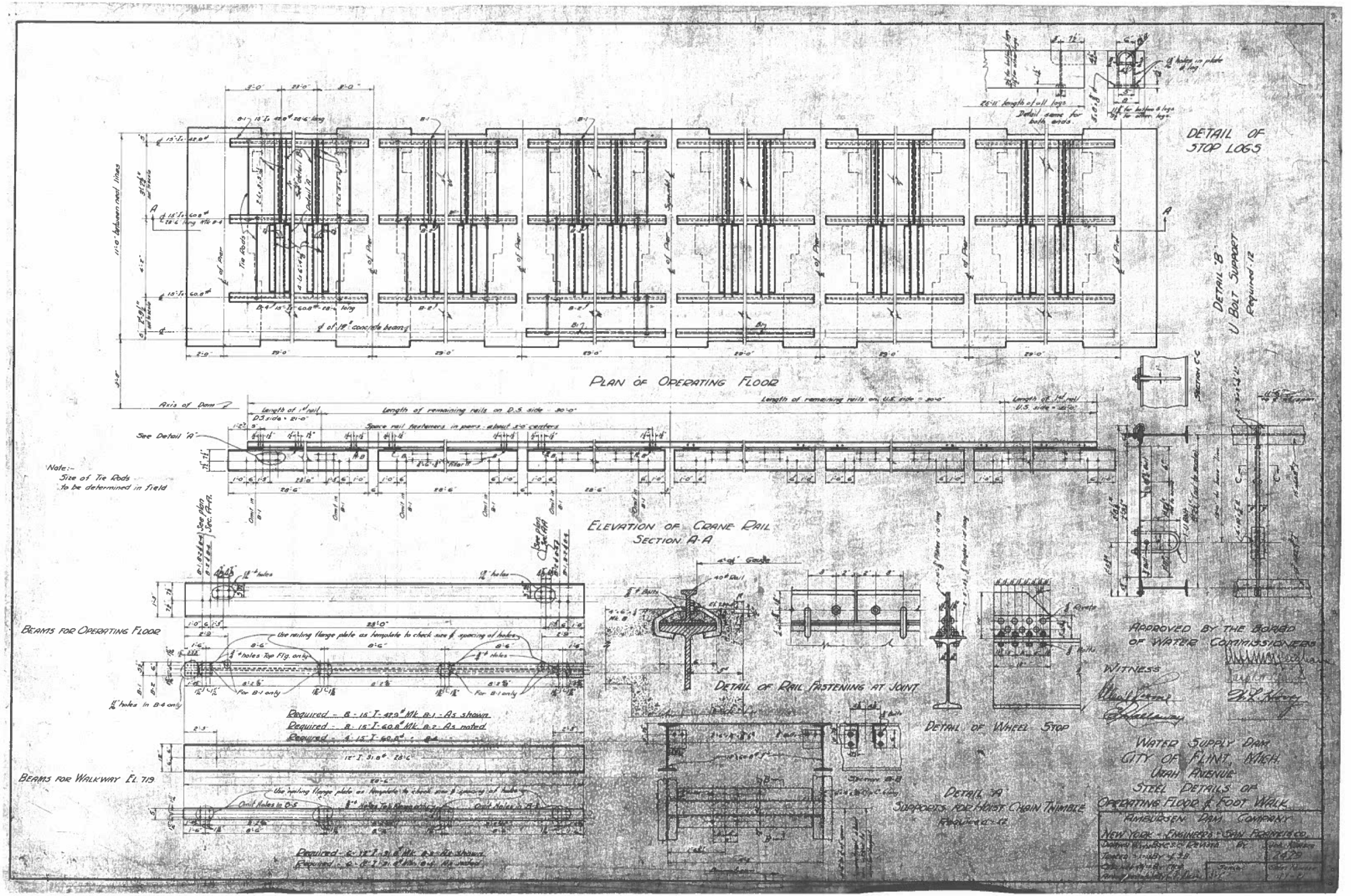
WATER SUPPLY DAM
CITY OF FLINT, MICH.
UTAH AVENUE
DETAIL OF ABUTMENTS
SUPPLEMENTING SHEET 6-U

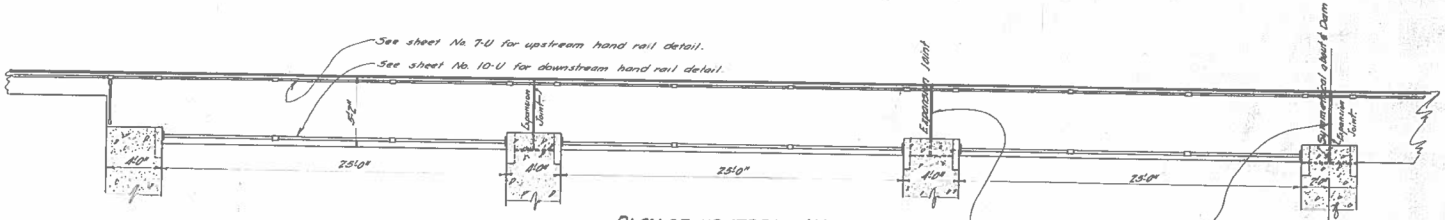
AMBURSEN DAM COMPANY
NEW YORK ENGINEERS SAN FRANCISCO

Scale 1"=1' | Sheet No. 9 of 17

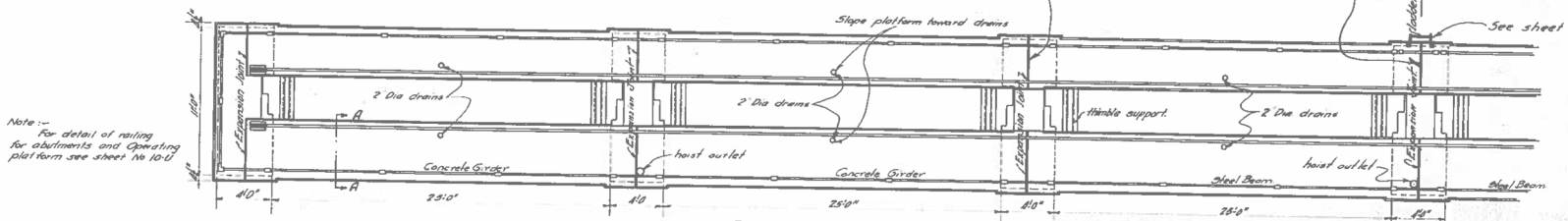


Operating Pier
End Elevation-Hand Rail
Plan Upstream Railing
West Abutment
Upstream Railing at walkway similar to Railing shown at Elev. 730.5 except for Gate See sheet 7-U
Gate — Gate also at East end.
Upstream face of Pier
Downstream Hand Rail on Operating Pier
Upstream Rail similar except for Gate
Upstream Hand Rail
Showing Gate at
Middle Pier
Detail of I-Beam
Hand Rail Fastening
Detail of Ladder
at Center Pier
Detail of Hand Rail
Fastening to Concrete
Provide for future extension to railing at this point
Elevation Downstream Railing
West Abutment
Plan Downstream Railing
West Abutment
Upstream railing - East abutment similar
Elevation Downstream Railing - East Abutment
This railing to be removable
Slip Joint Wall Sockets
See sheet No. 7-U for detail of upstream railing.
Downstream Railing - Walkway
Similar in all Bays
Water Supply Dam
City of Flint, Mich.
Utah Avenue
Plan and Elevation of
Hand Railings
Amburgen Dam Company
New York Engineers San Francisco


DETAIL OF STOP LOGS
PLAN OF OPERATING FLOOR
ELEVATION OF CRANE RAIL
SECTION A-A
DETAIL OF RAIL FASTENING AT JOINT
DETAIL OF WHEEL STOP
DETAIL 'B' U BOLT SUPPORT
DETAIL 'A' SUPPORTS FOR HOIST CHAIN THIMBLE
BEAMS FOR OPERATING FLOOR
BEAMS FOR WALKWAY EL. 719
Note:- Size of Tie Rods to be determined in field
APPROVED BY THE BOARD OF WATER COMMISSIONERS
WITNESS
WATER SUPPLY DAM
CITY OF FLINT, MICH.
UTAH AVENUE
STEEL DETAILS OF OPERATING FLOOR & FOOT WALK
ANDERSEN DAM COMPANY
NEW YORK - ENGINEERS - SAN FRANCISCO CO.

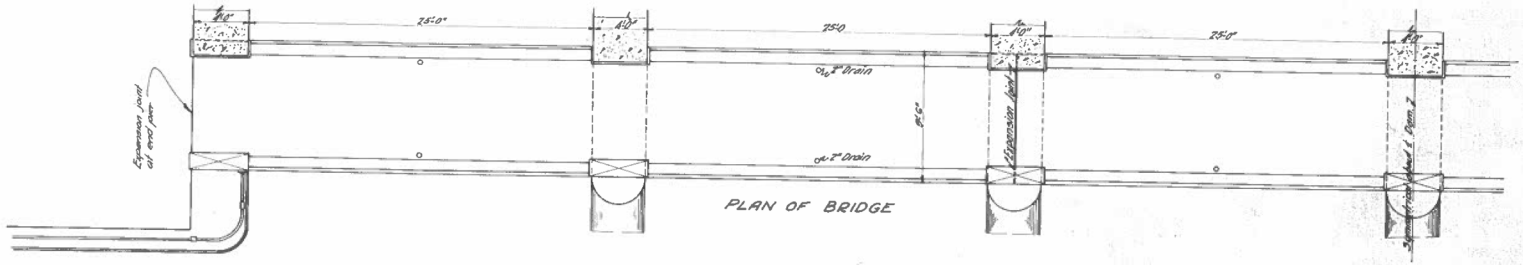


PLAN OF UP-STREAM WALKWAY

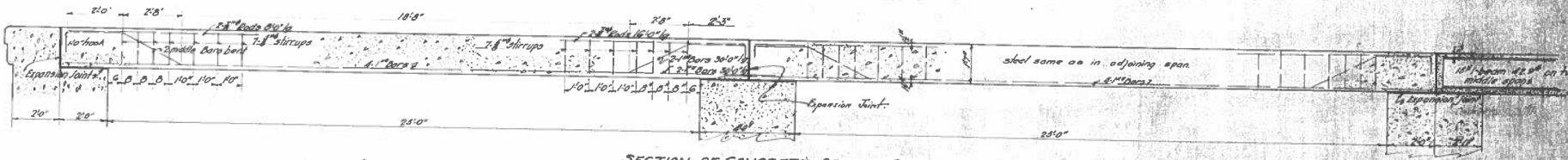


Note :-
For detail of railing for abutments and Operating platform see sheet No 10-U

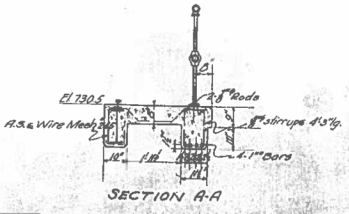
PLAN OF OPERATING PLATFORM



PLAN OF BRIDGE



SECTION OF CONCRETE BEAM IN OPERATING PLATFORM



SECTION A-A

APPROVED BY THE BOARD OF WATER COMMISSIONERS

WITNESS

WATER SUPPLY DAM
CITY OF FLINT, MICH.
UTAH AVENUE
PLAN OF BRIDGE & WALKWAY
AMBURSEN DAM COMPANY
NEW YORK ENGINEERS SAN FRANCISCO

STATE OF MICHIGAN
DEPARTMENT OF
ENVIRONMENT, GREAT LAKES, AND ENERGY
LANSING

GRETCHEN WHITMER
GOVERNOR

PHILLIP ROOS
DIRECTOR

January 30, 2024

VIA EMAIL

City of Flint
1101 South Saginaw Street
Suite N102
Flint, Michigan 48505

Dear Sir or Madam:

SUBJECT: Utah Dam, Dam ID No. 1275; Genesee County

The enclosed Dam Safety Inspection Report and recommendations for the Utah Dam, Dam ID No. 1275, located in Genesee County was conducted by the Department of Environment, Great Lakes, and Energy (EGLE) at the request of the City of Flint, as provided by Section 31518(4) of Part 315, Dam Safety (Part 315), of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA).

The purpose of this inspection was to evaluate the structural condition and hydraulic capacity of this dam, as required by Part 315 (Dam Safety), of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended.

The Utah Dam is in fair condition overall. However, the inspection report contains several recommended actions for monitoring and maintenance of deficiencies that do not currently pose a threat to the safety of the dam but should be addressed in the timeframes provided in the report. Specifically, the report recommends the following:

1. **Debris (Action: Maintenance):** Remove debris. Debris reduces the hydraulic capacity of the dam and can damage to adjacent structures due to the irregular flow patterns. Complete action as soon as possible.
    a. Principal Spillway: Upstream
    b. Principal Spillway: Gate 1
2. **Deteriorating Material (Action: Maintenance):** Remove the deteriorated concrete and install new concrete. Remove all deteriorated concrete, additional concrete may have to be removed to ensure the patch is a minimum of 3 inches thick. Roughen existing concrete surface to improve the patch bond. Install high strength concrete. If concrete deterioration is not repaired, it will continue to get worse and more expensive to repair. Complete action by December 31, 2024.
    a. Principal Spillway: Abutment - Left Wall, Right Wall
3. **Trees (Action: Maintenance):** Flush cut and/or grind stump and remove debris from embankment. The stump should be cut a maximum of one foot above

ground. Establish appropriate vegetation if stump is being grinded. We do not recommend uprooting trees for removal. Tree roots can lead to piping failure by cultivating flow paths in the embankment especially when the tree dies. Trees can also cause extensive damage and/or failure when they are uprooted from a storm. Complete action by December 31, 2025.

   a. Principal Spillway: Abutment - Left Wall, Right Wall

4. **Brush (Action: Maintenance):** Remove brush by mowing and/or herbicide. Brush should be maintained a minimum of two times per year to prevent further establishment of woody vegetation. Brush negatively impacts a dam because the brush cover invites animal activity, impedes the visual inspections of the dam, and can kill vegetation that stabilizes the soil. Complete action by December 31, 2025.
   a. Principal Spillway: Abutment - Left Wall, Right Wall
5. All the gates should be removed because they no longer serve a purpose and could induce a dam failure by reducing the spillway capacity if a gate were to fall. Complete action by December 31, 2024.
6. Review and update the Operation and Maintenance Plan (O&M Plan) regularly. Provide any updates to the Dam Safety Program.

If you have any questions or concerns regarding the inspection report or the recommendations, please contact me at 517-230-5866; ThelenM21@Michigan.gov; or EGLE, P.O. Box 30458, Lansing, Michigan 48909-7958.

Sincerely,

Mitchel Thelen, P.E., Regional Engineer
Dam Safety Unit
Water Resources Division

Enclosure

DAM SAFETY INSPECTION REPORT
UTAH DAM – DAM ID NO. 1275
FLINT RIVER
GENESEE COUNTY – SW 1/4 SECTION 32, T 08N, R 07E

OWNER(S)/OPERATOR(S): City of Flint
1101 South Saginaw Street
Suite N102
Flint, MI 48505

HAZARD POTENTIAL CLASSIFICATION: Low

INSPECTION DATE: September 22, 2023

REPORT DATE: January 30, 2024

PREPARED AND INSPECTED BY:

Mitchel K. Thelen, P.E.
Registration Number: 09306
Dam Safety Unit
Water Resources Division
Department of Environment, Great Lakes, and Energy
P.O. Box 30458
Lansing, Michigan 48909
517-280-5866

INTRODUCTION

The purpose of this inspection was to evaluate the structural condition and hydraulic capacity of the Utah Dam, as required by Part 315 (Dam Safety), of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended. This inspection was conducted by the Department of Environment, Great Lakes, and Energy (EGLE) at the request of the City of Flint, as provided by Section 31518(4) of Part 315, Dam Safety (Part 315), of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (NREPA).

The report is limited to a discussion of observations based on a visual investigation and review of any available previous inspection reports, plans, and data. This report should not be considered an in-depth engineering investigation. All references to “right” and “left” in this report are based on the observer facing downstream.

CONCLUSIONS AND RECOMMENDATIONS

The Utah Dam is in fair condition. No existing dam safety deficiencies are recognized for normal loading conditions. Rare or extreme hydrologic and/or seismic events may result in a dam safety deficiency. Risk may be in the range to take further action.

The following recommended actions are listed by priority:

1. **Debris (Action: Maintenance):** Remove debris. Debris reduces the hydraulic capacity of the dam and can damage to adjacent structures due to the irregular flow patterns. Complete action as soon as possible.
    a. Principal Spillway: Upstream
    b. Principal Spillway: Gate 1
2. **Deteriorating Material (Action: Maintenance):** Remove the deteriorated concrete and install new concrete. Remove all deteriorated concrete, additional concrete may have to be removed to ensure the patch is a minimum of 3 inches thick. Roughen existing concrete surface to improve the patch bond. Install high strength concrete. If concrete deterioration is not repaired, it will continue to get worse and more expensive to repair. Complete action by December 31, 2024.
    a. Principal Spillway: Abutment - Left Wall, Right Wall
3. **Trees (Action: Maintenance):** Flush cut and/or grind stump and remove debris from embankment. The stump should be cut a maximum of one foot above ground. Establish appropriate vegetation if stump is being grinded. We do not recommend uprooting trees for removal. Tree roots can lead to piping failure by cultivating flow paths in the embankment especially when the tree dies. Trees can also cause extensive damage and/or failure when they are uprooted from a storm. Complete action by December 31, 2025.
    a. Principal Spillway: Abutment - Left Wall, Right Wall
4. **Brush (Action: Maintenance):** Remove brush by mowing and/or herbicide. Brush should be maintained a minimum of two times per year to prevent further establishment of woody vegetation. Brush negatively impacts a dam because the brush cover invites animal activity, impedes the visual inspections of the dam, and can kill vegetation that stabilizes the soil. Complete action by December 31, 2025.

a. Principal Spillway: Abutment - Left Wall, Right Wall

5. All the gates should be removed because they no longer serve a purpose and could induce a dam failure by reducing the spillway capacity if a gate were to fall. Complete action by December 31, 2024.
6. Review and update the Operation and Maintenance Plan (O&M Plan) regularly. Provide any updates to the Dam Safety Program.

The dam's current low hazard potential rating remains appropriate.

PROJECT INFORMATION

According to our records, the Utah Dam was originally constructed in 1928 for the purpose of water supply. The dam no longer serves this purpose as all spillway gates have been abandoned in either partially to fully open positions for many years.

The Dam consists of the following parts:

Principal Spillway			
Spillway Type:	Sluice Gate	Primary Material:	Metal/Concrete
Gate 1-6			
Gate Type:	Sluice	Width:	25'
Bay Material:	Concrete	Height:	12'
Operation:	Manual	Crest Elevation:	699
Gate Material:	Metal		
Abutment			
Maintenance Deck			
Pedestrian Deck			

The Dam has the following measurements:

Structural Height (ft):	15.5	Normal Freeboard (ft):	15
Normal Head (ft):	2	Flood Freeboard (ft):	-2.7
Hydraulic Height (ft):	17.7	Normal Impoundment (acre):	0

The dam was originally inspected by MDNR engineers in 1980. It has subsequently been inspected under Part 315 by Acres International Corporation in 1993; by Ayres, Lewis, Norris, & May, Inc. in 1998; by the Spicer Group in 2003; by Stantec Consulting Michigan, Inc. in 2008, and EGLE in 2017. Copies of these inspection reports are on file with the Dam Safety Program.

SITE INVESTIGATION

The following discussion of the dam's physical condition and appurtenances is based on observations and photographs obtained on the inspection date.

In addition to the specific findings listed below, it is important to continue good maintenance practices. These practices include regular inspection of the dam embankments and hydraulic structures for any deficiencies. Some of the more common issues that are found include growth of trees and brush, development of erosion areas, and animal burrows.

If woody vegetation is allowed to mature, it could develop an extensive root system. These root systems can lead to piping failure or if the brush and trees are uprooting in a storm, can cause extensive deterioration of the embankment. Embankments should be clear of woody vegetation and mowed 10 feet past the toe of the embankment. Similarly, animal burrows and surface erosion, can propagate into increased seepage and potentially piping failure, as well as lead to slope stability issues.

The following data was collected on the date of the inspection and includes deficiencies observed during the inspection and necessary actions for remediation of the observed deficiencies.

Spillways		
Principal Spillway		
What issues are present:	*Debris, Deteriorating Material, Trees, Brush*	
Debris		
Component:		*Gate 1*
Part:	*Upstream*	
Photo:	*3, 4*	*6*
Action Required:	*Maintenance*	
Describe action required:	*Remove debris.*	
Deteriorating Material		
Component:	*Abutment*	
Part:	*Left Wall, Right Wall*	
Photo:	*19,20,21,22*	
Material:	*Concrete*	
Action Required:	*Maintenance*	
Describe action required:	*Remove the deteriorated concrete and install new concrete.*	
Trees		
Component:	*Abutment*	
Part:	*Left Wall, Right Wall*	
Action Required:	*Maintenance*	
Describe action required:	*Flush cut and/or grind stump and remove debris from*	
Brush		
Component:	*Abutment*	
Part:	*Left Wall, Right Wall*	
Action Required:	*Maintenance*	
Describe action required:	*Remove brush by mowing and/or herbicide.*	

The above monitoring and maintenance items should be addressed in accordance with the Conclusions and Recommendations section of this report.

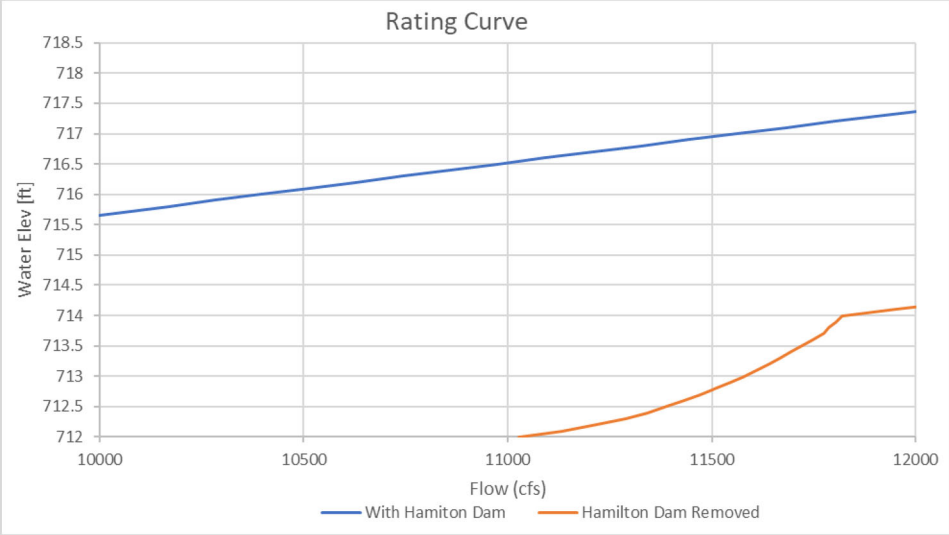
STRUCTURAL STABILITY

Based upon observations during the inspection, there were no indicators of any conditions that represent an immediate threat to the dam's stability. No remedial action is required at this time.

HYDROLOGY AND HYDRAULICS

The contributing drainage area to the Flint River at the Utah Dam is approximately 722 square miles. The design discharge for this low hazard potential dam is the 1 percent annual chance (100-year) flood discharge which is estimated to be 11,800 cubic feet per second (cfs). The Principal Spillway (Gate) has a maximum hydraulic capacity of approximately 8,630 cfs with no freeboard. The dam cannot pass the design flood inflow. The dam is overtopped by 3.9 feet during the design storm. However, the high tailwater conditions caused by the Hamilton Dam downstream prevent the dam from washing out when it overtops. Hamilton Dam is in the process of being removed. Once Hamiton Dam is removed the dam will be able to pass the design flow without overtopping.

Below are the calculated rating curves with and without the downstream effects of Hamiton Dam:



Hamiton Dam is in the process of being removed. Once Hamiton Dam is removed the dam will be able to pass the design flow without overtopping.

Hydraulic calculations and methodology used to make this determination are shown in Appendix C.

OPERATION AND MAINTENANCE

Operation and maintenance (O&M) of the dam is performed by City of Flint. A written O&M Plan is not on record with the Dam Safety Program. The Dam Safety Program recommends creating an O&M Plan to ensure proper operation and maintenance of the Dam. The Dam Safety Program should be provided any future or current O&M Plans.

EMERGENCY ACTION PLAN

An Emergency Action Plan (EAP) is not required under Part 315 for a low hazard potential dam. Our records indicate that an EAP has not been developed for the dam. **Every inspection cycle the owner shall review and update the dam's EAP and provide the updated EAP to the Dam Safety Program. An updated EAP has been overdue since December 31, 1905. Please provide this to the Dam Safety Unit as soon as possible.**

APPENDICES

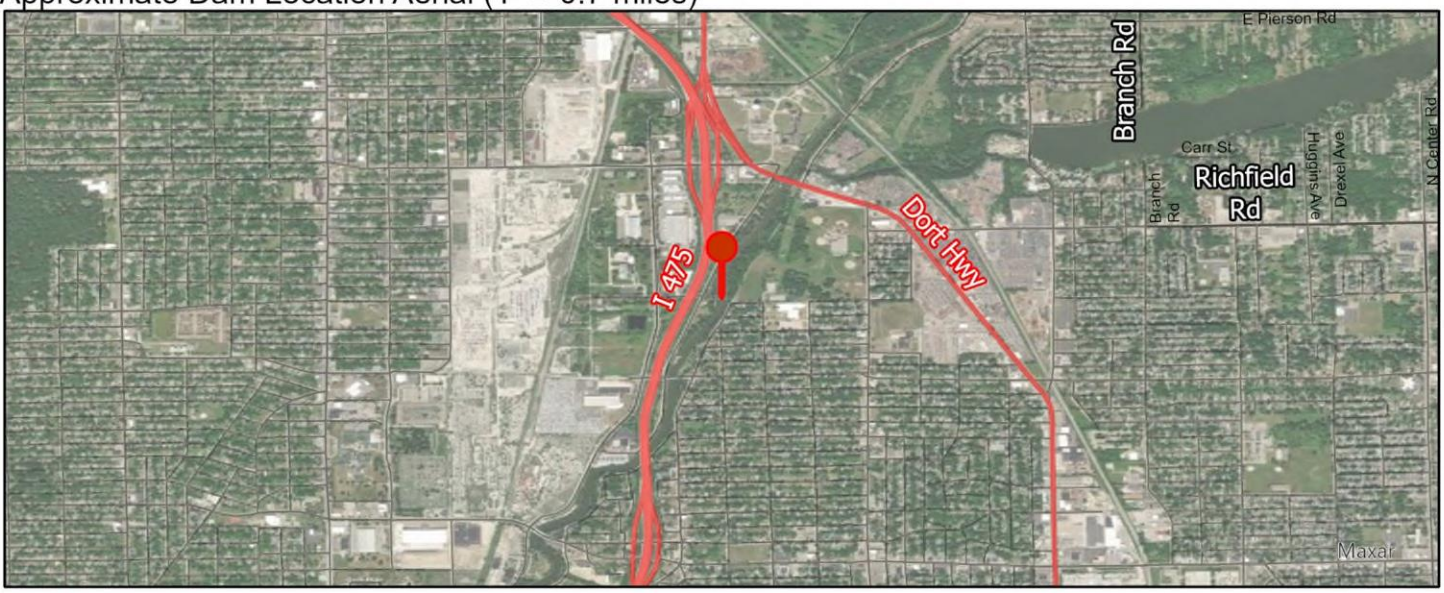
Appendix A - Location map,
Appendix B - Inspection photographs
Appendix C - Hydraulic calculations and methodology
Appendix D - Hydrologic Data

UTAH DAM
GENESEE COUNTY
DAM ID NO. 1275

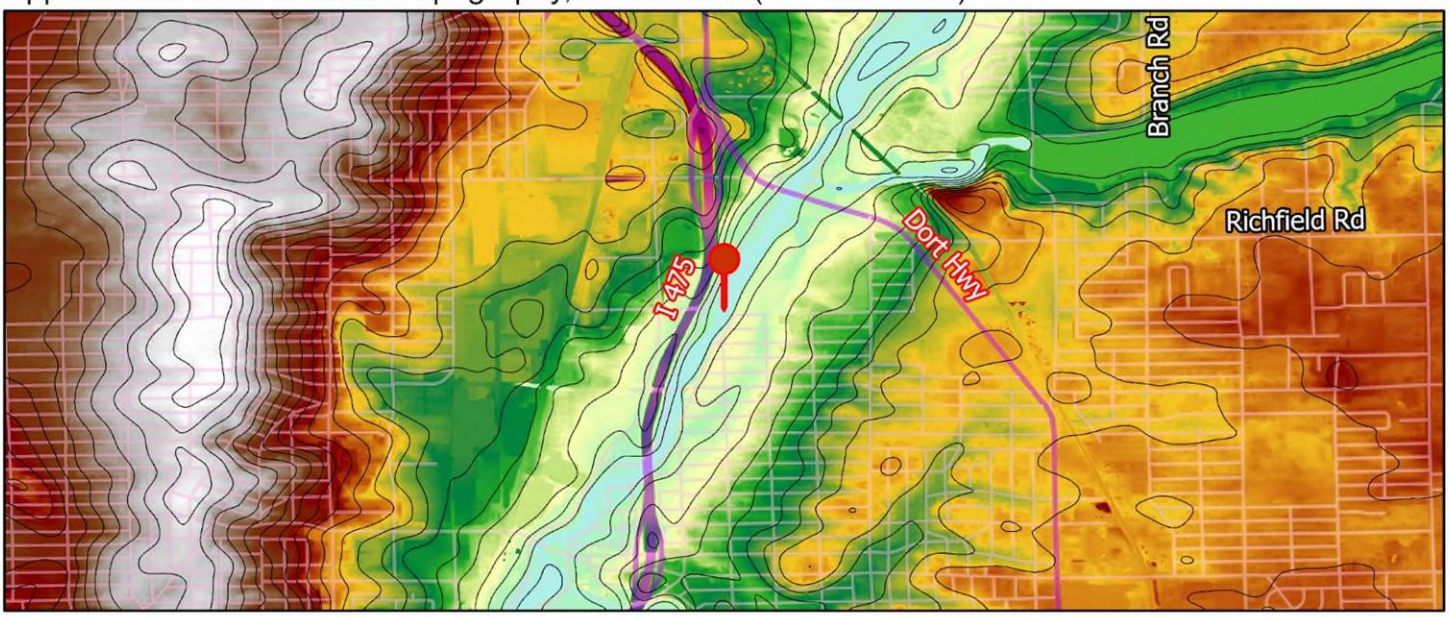
Appendix A – Location Map

Utah Dam
Dam ID No. 1,275
Section 32
T 08N
R 07E
Genesee County

Approximate Dam Location Aerial (1" = 0.7 miles)



Approximate Dam Location Topography, 5' Contours (1" = 0.7 miles)



Appendix B – Inspection Photos

Photo #1: Principal Spillway Downstream.

Photo #2: Principal Spillway Downstream.

Photo #3: Principal Spillway Upstream.
Issue: Debris, Action: Maintenance.
Severity: Moderate.

Photo #4: Principal Spillway Upstream.
Issue: Debris, Action: Maintenance.
Severity: Moderate.

Photo #5: Principal Spillway.

Photo #6: Principal Spillway Gate 1.
Issue: Debris, Action: Maintenance.
Severity: Moderate.

Photo #7: Principal Spillway Gate 1.

Photo #8: Principal Spillway Gate 1.

Photo #9: Principal Spillway Gate 2.

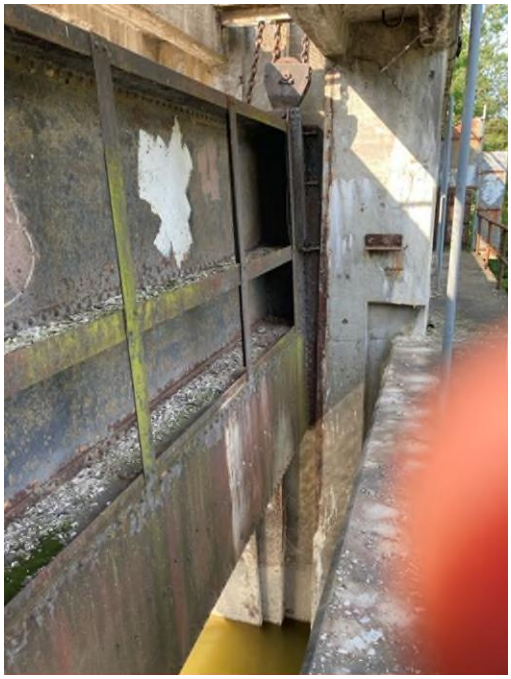


Photo #10: Principal Spillway Gate 2.

Photo #11: Principal Spillway Gate 2.

Photo #12: Principal Spillway Gate 2.

Photo #13: Principal Spillway Gate 4.

Photo #14: Principal Spillway Gate 4.

Photo #15: Principal Spillway Gate 6.

Photo #16: Principal Spillway Gate 6.

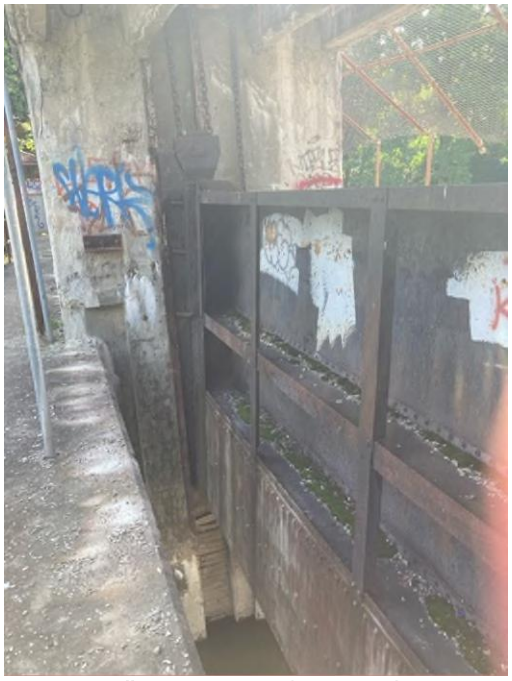


Photo #17: Principal Spillway Gate 3.

Photo #18: Principal Spillway Gate 3.

Photo #19: Principal Spillway Abutment Left Wall.
Issue: Deteriorating Material, Action: Maintenance.
Material: Concrete.

Photo #20: Principal Spillway Abutment Left Wall.
Issue: Deteriorating Material, Action: Maintenance.
Material: Concrete.

Photo #21: Principal Spillway Abutment Right Wall.
Issue: Deteriorating Material, Action: Maintenance.
Material: Concrete.

Photo #22: Principal Spillway Abutment Right Wall.
Issue: Deteriorating Material, Action: Maintenance.
Material: Concrete.

Photo #23: Principal Spillway Maintenance Deck.

Photo #24: Principal Spillway Maintenance Deck.

Photo #25: Principal Spillway Maintenance Deck.

Photo #26: Principal Spillway Maintenance Deck.

Photo #27: Principal Spillway Pedestrian Deck.

Photo #28: Principal Spillway Pedestrian Deck.

Photo #29: Principal Spillway Pedestrian Deck.

Photo #30: Principal Spillway Pedestrian Deck.

Photo #31: Impoundment.

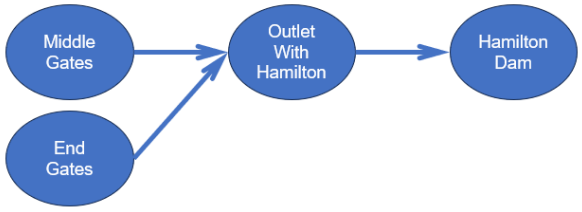
Photo #32:. 60" storm right side.

Appendix C - Hydraulic Calculations and Methodology

Terminology

Q: flow	W: water	F: flooding	n: normal condition	ot: orifice and tailwater condition
L: length	LS: loss	WP: wetter perimeter	t: tailwater condition	at: above weir and tailwater condition
E: energy	US: upstream	dN: normal depth	o: orifice condition	
A: area	DS: downstream	dC: critical depth	a: above weir condition	

Flow Diagram



Calculations

With Hamilton Dam
Rating Curve Table

id	Elev [ft]	Flow [cfs]
0	715.00	9271.07
2	715.20	9498.81
3	715.30	9610.50
4	715.40	9719.98
6	715.60	9943.58
7	715.70	10054.92
8	715.80	10169.36
9	715.90	10281.67
11	716.10	10510.97
12	716.20	10625.51
13	716.30	10742.41
15	716.50	10973.98
16	716.60	11090.32
17	716.70	11207.25
18	716.80	11324.72
20	717.00	11561.29
21	717.10	11680.38
22	717.20	11800.02
24	717.40	12040.90
25	717.50	12162.15

UTAH DAM - GENESEE COUNTY - DAM ID NO. 1275

Name:	Middle Gates	**Part Type:**	Gate	**Flow Type:**	Flow
Count:	4	**DS Part:**	Outlet With Hamilton Dam	**DS Part 2:**	
Type:	Sluice	**Shape:**	Rectangular	**Crest Type:**	Flat
Gate Height [ft]:	12.5	**Gate Thickness [ft]:**	1	**Gate Material:**	Metal
Stem Width [ft]:	0	**Top Elev [ft]:**	728	**Gate Percent Open [%]:**	80
Elevation [ft]:	699	**Width [ft]:**	25	**Contraction Type:**	None
Number of Piers:	1	**Pier Type:**	Rounded	**Depth [ft]:**	0.5
Crest Width [ft]:	5	**Front Slope [V1:H_]:**	0	**Back Slope [V1:H_]:**	0
Crest Material:	Concrete	**Trash Rack:**	None		

Part								Gate	Orifice					
Id	Q [cfs]	E(US) [ft]	W(US) [ft]	L [ft]	E(DS) [ft]	W(DS) [ft]	VH(DS) [ft]	Type	E [ft]	W [ft]	A [sft]	W(DS) [ft]	Q(t) [cfs]	L(t) [ft]
0	6180.71	715.00	715.00	0.01	714.99	713.52	0.32	DS	16.00	16.00	330.00	14.52	1545.18	0.01
2	6332.54	715.20	715.20	0.01	715.19	713.71	0.33	O	16.20	16.20	330.00	14.71	1583.14	0.01
3	6407.00	715.30	715.30	0.01	715.29	713.79	0.34	O	16.30	16.30	330.00	14.79	1601.75	0.01
4	6479.99	715.40	715.40	0.01	715.39	713.88	0.34	O	16.40	16.40	330.00	14.88	1620.00	0.01
6	6629.06	715.60	715.60	0.01	715.59	714.05	0.35	O	16.60	16.60	330.00	15.05	1657.26	0.01
7	6703.28	715.70	715.70	0.01	715.69	714.13	0.35	O	16.70	16.70	330.00	15.13	1675.82	0.01
8	6779.57	715.80	715.80	0.01	715.79	714.22	0.36	O	16.80	16.80	330.00	15.22	1694.89	0.01
9	6854.44	715.90	715.90	0.01	715.89	714.30	0.36	O	16.90	16.90	330.00	15.30	1713.61	0.01
11	7007.31	716.10	716.10	0.01	716.09	714.47	0.37	O	17.10	17.10	330.00	15.47	1751.83	0.01
12	7083.67	716.20	716.20	0.01	716.19	714.55	0.37	O	17.20	17.20	330.00	15.55	1770.92	0.01
13	7161.61	716.30	716.30	0.01	716.29	714.64	0.37	O	17.30	17.30	330.00	15.64	1790.40	0.01
15	7315.99	716.50	716.50	0.01	716.49	714.81	0.38	O	17.50	17.50	330.00	15.81	1829.00	0.01
16	7393.55	716.60	716.60	0.01	716.59	714.89	0.39	O	17.60	17.60	330.00	15.89	1848.39	0.01
17	7471.50	716.70	716.70	0.01	716.69	714.98	0.39	O	17.70	17.70	330.00	15.98	1867.88	0.01
18	7549.81	716.80	716.80	0.01	716.79	715.06	0.39	O	17.80	17.80	330.00	16.06	1887.45	0.01
20	7707.53	717.00	717.00	0.01	716.99	715.23	0.40	O	18.00	18.00	330.00	16.23	1926.88	0.01
21	7786.92	717.10	717.10	0.01	717.09	715.31	0.40	O	18.10	18.10	330.00	16.31	1946.73	0.01
22	7866.68	717.20	717.20	0.01	717.19	715.40	0.41	O	18.20	18.20	330.00	16.40	1966.67	0.01
24	8027.27	717.40	717.40	0.01	717.39	715.56	0.41	O	18.40	18.40	330.00	16.56	2006.82	0.01
25	8108.10	717.50	717.50	0.01	717.49	715.65	0.42	O	18.50	18.50	330.00	16.65	2027.02	0.01

Name:	End Gates	**Part Type:**	Gate	**Flow Type:**	Flow
Count:	2	**DS Part:**	Outlet With Hamilton Dam	**DS Part 2:**	
Type:	Sluice	**Shape:**	Rectangular	**Crest Type:**	Flat
Gate Height [ft]:	12.5	**Gate Thickness [ft]:**	1	**Gate Material:**	Metal
Stem Width [ft]:	0	**Top Elev [ft]:**	728	**Gate Percent Open [%]:**	80
Elevation [ft]:	699	**Width [ft]:**	25	**Contraction Type:**	None
Number of Piers:	0.5	**Pier Type:**	Rounded	**Depth [ft]:**	0.5
Crest Width [ft]:	5	**Front Slope [V1:H_]:**	0	**Back Slope [V1:H_]:**	0
Crest Material:	Concrete	**Trash Rack:**	None		

Part								Gate	Orifice					
Id	Q [cfs]	E(US) [ft]	W(US) [ft]	L [ft]	E(DS) [ft]	W(DS) [ft]	VH(DS) [ft]	Type	E [ft]	W [ft]	A [sft]	W(DS) [ft]	Q(t) [cfs]	L(t) [ft]
0	3090.36	715.00	715.00	0.01	714.99	713.52	0.32	DS	16.00	16.00	330.00	14.52	1545.18	0.01
2	3166.27	715.20	715.20	0.01	715.19	713.71	0.33	O	16.20	16.20	330.00	14.71	1583.14	0.01
3	3203.50	715.30	715.30	0.01	715.29	713.79	0.34	O	16.30	16.30	330.00	14.79	1601.75	0.01
4	3239.99	715.40	715.40	0.01	715.39	713.88	0.34	O	16.40	16.40	330.00	14.88	1620.00	0.01
6	3314.53	715.60	715.60	0.01	715.59	714.05	0.35	O	16.60	16.60	330.00	15.05	1657.26	0.01
7	3351.64	715.70	715.70	0.01	715.69	714.13	0.35	O	16.70	16.70	330.00	15.13	1675.82	0.01
8	3389.79	715.80	715.80	0.01	715.79	714.22	0.36	O	16.80	16.80	330.00	15.22	1694.89	0.01
9	3427.22	715.90	715.90	0.01	715.89	714.30	0.36	O	16.90	16.90	330.00	15.30	1713.61	0.01
11	3503.66	716.10	716.10	0.01	716.09	714.47	0.37	O	17.10	17.10	330.00	15.47	1751.83	0.01
12	3541.84	716.20	716.20	0.01	716.19	714.55	0.37	O	17.20	17.20	330.00	15.55	1770.92	0.01
13	3580.80	716.30	716.30	0.01	716.29	714.64	0.37	O	17.30	17.30	330.00	15.64	1790.40	0.01
15	3657.99	716.50	716.50	0.01	716.49	714.81	0.38	O	17.50	17.50	330.00	15.81	1829.00	0.01
16	3696.77	716.60	716.60	0.01	716.59	714.89	0.39	O	17.60	17.60	330.00	15.89	1848.39	0.01
17	3735.75	716.70	716.70	0.01	716.69	714.98	0.39	O	17.70	17.70	330.00	15.98	1867.88	0.01
18	3774.91	716.80	716.80	0.01	716.79	715.06	0.39	O	17.80	17.80	330.00	16.06	1887.45	0.01
20	3853.76	717.00	717.00	0.01	716.99	715.23	0.40	O	18.00	18.00	330.00	16.23	1926.88	0.01
21	3893.46	717.10	717.10	0.01	717.09	715.31	0.40	O	18.10	18.10	330.00	16.31	1946.73	0.01
22	3933.34	717.20	717.20	0.01	717.19	715.40	0.41	O	18.20	18.20	330.00	16.40	1966.67	0.01
24	4013.63	717.40	717.40	0.01	717.39	715.56	0.41	O	18.40	18.40	330.00	16.56	2006.82	0.01
25	4054.05	717.50	717.50	0.01	717.49	715.65	0.42	O	18.50	18.50	330.00	16.65	2027.02	0.01

UTAH DAM - GENESEE COUNTY - DAM ID NO. 1275

Name: Outlet With Hamilton Dam | **Part Type:** Channel | **Flow Type:** Flow
Count: 1 | **DS Part:** Hamilton Dam | **DS Part 2:**
Method: GRV | **Shape:** Trapezoidal | **Profile:** Line
N value: 0.034 | **US Elevation [ft]:** 698.5 | **DS Elevation [ft]:** 696
Length [ft]: 12000 | **Width [ft]:** 120 | **Left Side Slope [V/H]:** 1
Right Side Slope [V/H]: 1

Part									Channel				
Id	Q [cfs]	E(US) [ft]	W(US) [ft]	VH(US) [ft]	L [ft]	E(DS) [ft]	W(DS) [ft]	VH(DS) [ft]	W(US) [ft]	W(DS) [ft]	dN [ft]	dC [ft]	LS [ft]
0	9271.07	713.83	713.52	0.32	5.84	707.99	707.40	0.60	15.02	11.40	17.33	5.61	5.84
2	9498.81	714.02	713.70	0.33	5.91	708.11	707.49	0.61	15.20	11.49	17.57	5.70	5.91
3	9610.50	714.11	713.79	0.34	5.94	708.16	707.54	0.62	15.29	11.54	17.69	5.75	5.94
4	9719.98	714.19	713.87	0.34	5.98	708.21	707.58	0.63	15.37	11.58	17.81	5.79	5.98
6	9943.58	714.37	714.04	0.35	6.05	708.32	707.67	0.65	15.54	11.67	18.04	5.88	6.05
7	10054.92	714.46	714.13	0.35	6.09	708.37	707.71	0.66	15.63	11.71	18.16	5.92	6.09
8	10169.36	714.55	714.21	0.35	6.12	708.43	707.76	0.67	15.71	11.76	18.28	5.96	6.12
9	10281.67	714.63	714.30	0.36	6.16	708.48	707.80	0.68	15.80	11.80	18.39	6.01	6.16
11	10510.97	714.81	714.47	0.36	6.23	708.58	707.88	0.70	15.97	11.88	18.63	6.09	6.23
12	10625.51	714.90	714.55	0.37	6.26	708.64	707.93	0.71	16.05	11.93	18.75	6.14	6.26
13	10742.41	714.99	714.64	0.37	6.29	708.70	707.98	0.72	16.14	11.98	18.87	6.18	6.29
15	10973.98	715.16	714.80	0.38	6.36	708.80	708.06	0.74	16.30	12.06	19.10	6.27	6.36
16	11090.32	715.25	714.89	0.38	6.39	708.86	708.11	0.75	16.39	12.11	19.21	6.31	6.39
17	11207.25	715.33	714.97	0.39	6.42	708.91	708.16	0.76	16.47	12.16	19.33	6.36	6.42
18	11324.72	715.42	715.06	0.39	6.45	708.97	708.21	0.77	16.56	12.21	19.45	6.40	6.45
20	11561.29	715.60	715.22	0.40	6.51	709.09	708.30	0.78	16.72	12.30	19.68	6.49	6.51
21	11680.38	715.68	715.31	0.40	6.54	709.15	708.35	0.79	16.81	12.35	19.80	6.53	6.54
22	11800.02	715.77	715.39	0.40	6.57	709.20	708.40	0.80	16.89	12.40	19.91	6.57	6.57
24	12040.90	715.95	715.56	0.41	6.63	709.32	708.50	0.82	17.06	12.50	20.15	6.66	6.63
25	12162.15	716.03	715.64	0.42	6.65	709.38	708.55	0.83	17.14	12.55	20.26	6.71	6.65

Name: Hamilton Dam | **Part Type:** Weir | **Flow Type:** Flow
Count: 1 | **DS Part:** | **Shape:** Ogee
Contraction Type: None | **Number of Piers:** 0 | **Number of Bends:** 0
Trash Rack: None | **Elevation [ft]:** 700.8 | **Length [ft]:** 120
Height [ft]: 20 | **Depth [ft]:** 5 | **Design Head [ft]:** 5
Apron Elev [ft]: 693 | **Front Slope [V1:H_]:** 0 | **Material:** Concrete

Part							Weir					
Id	Q [cfs]	E(US) [ft]	W(US) [ft]	VH(US) [ft]	L [ft]	E(DS) [ft]	E [ft]	W [ft]	L(n) [ft]	C(n)	Q(n) [cs]	LS(n) [ft]
0	9271.19	708.00	707.40	0.60	0.67	707.32	7.20	6.60	120.00	4.10	9271.19	0.67
2	9498.86	708.10	707.49	0.61	0.66	707.45	7.30	6.69	120.00	4.11	9498.86	0.66
3	9610.69	708.16	707.54	0.62	0.66	707.51	7.36	6.74	120.00	4.11	9610.69	0.66
4	9720.25	708.21	707.58	0.63	0.65	707.56	7.41	6.78	120.00	4.12	9720.25	0.65
6	9962.09	708.32	707.67	0.65	0.63	707.69	7.52	6.87	120.00	4.13	9962.09	0.63
7	10055.05	708.37	707.71	0.66	0.63	707.74	7.57	6.91	120.00	4.13	10055.05	0.63
8	10169.55	708.43	707.76	0.67	0.63	707.80	7.63	6.96	120.00	4.13	10169.55	0.63
9	10281.96	708.47	707.79	0.68	0.62	707.86	7.67	6.99	120.00	4.14	10281.96	0.62
11	10511.26	708.58	707.88	0.70	0.60	707.97	7.78	7.08	120.00	4.15	10511.26	0.60
12	10625.69	708.64	707.93	0.71	0.60	708.03	7.84	7.13	120.00	4.15	10625.69	0.60
13	10742.60	708.69	707.98	0.72	0.60	708.09	7.89	7.18	120.00	4.15	10742.60	0.60
15	10974.16	708.80	708.06	0.74	0.59	708.21	8.00	7.26	120.00	4.16	10974.16	0.59
16	11090.51	708.86	708.11	0.75	0.59	708.27	8.06	7.31	120.00	4.16	11090.51	0.59
17	11207.43	708.91	708.16	0.76	0.58	708.33	8.11	7.36	120.00	4.16	11207.43	0.58
18	11324.90	708.97	708.21	0.77	0.58	708.39	8.17	7.41	120.00	4.16	11324.90	0.58
20	11561.47	709.09	708.30	0.78	0.58	708.51	8.29	7.50	120.00	4.16	11561.47	0.58
21	11680.56	709.14	708.35	0.79	0.58	708.57	8.34	7.55	120.00	4.16	11680.56	0.58
22	11800.20	709.20	708.40	0.80	0.58	708.63	8.40	7.60	120.00	4.16	11800.20	0.58
24	12041.08	709.32	708.50	0.82	0.57	708.75	8.52	7.70	120.00	4.16	12041.08	0.57
25	12162.33	709.38	708.55	0.83	0.57	708.80	8.58	7.75	120.00	4.16	12162.33	0.57

Hamilton Dam Removed
Rating Curve Table

id	Elev [ft]	Flow [cfs]
0	712.00	11025.99
2	712.20	11218.35
4	712.40	11342.65
5	712.50	11388.19
7	712.70	11472.73
8	712.80	11511.39
10	713.00	11580.95
11	713.10	11611.83
13	713.30	11668.07
14	713.40	11696.29
16	713.60	11745.75
18	713.80	11785.92
19	713.90	11806.77
21	714.10	11950.44
22	714.20	12074.79
24	714.40	12315.42
25	714.50	12437.40
27	714.70	12671.06
28	714.80	12788.16
30	715.00	13021.46

UTAH DAM - GENESEE COUNTY - DAM ID NO. 1275

Name:	Middle Gates	**Part Type:**	Gate	**Flow Type:**	Flow
Count:	4	**DS Part:**	Outlet	**DS Part 2:**	
Type:	Sluice	**Shape:**	Rectangular	**Crest Type:**	Flat
Gate Height [ft]:	12.5	**Gate Thickness [ft]:**	1	**Gate Material:**	Metal
Stem Width [ft]:	0	**Top Elev [ft]:**	728	**Gate Percent Open [%]:**	80
Elevation [ft]:	699	**Width [ft]:**	25	**Contraction Type:**	None
Number of Piers:	1	**Pier Type:**	Rounded	**Depth [ft]:**	0.5
Crest Width [ft]:	5	**Front Slope [V1:H_]:**	0	**Back Slope [V1:H_]:**	0
Crest Material:	Concrete	**Trash Rack:**	None		

	Part							Gate			
Id	Q [cfs]	E(US) [ft]	W(US) [ft]	L [ft]	E(DS) [ft]	W(DS) [ft]	VH(DS) [ft]	Type	Weir%	Orifice%	dC [ft]
0	7337.81	712.00	712.00	2.70	709.30			W			5.51
2	7465.62	712.20	712.20	2.78	709.42			W			5.55
4	7548.14	712.40	712.40	2.86	709.54			W			5.63
5	7578.34	712.50	712.50	2.90	709.60			W			5.64
7	7634.38	712.70	712.70	2.98	709.72			W			5.67
8	7660.01	712.80	712.80	3.03	709.77			W			5.68
10	7706.08	713.00	713.00	3.12	709.88			W			5.70
11	7726.53	713.10	713.10	3.17	709.93			W			5.71
13	7763.74	713.30	713.30	3.26	710.04			W			5.73
14	7782.41	713.40	713.40	3.31	710.09			W			5.74
16	7815.11	713.60	713.60	3.41	710.19			W			5.75
18	7841.62	713.80	713.80	3.51	710.29			W			5.76
19	7855.39	713.90	713.90	3.57	710.33			W			5.77
21	7950.76	714.10	714.10	0.66	713.44			W			5.86
22	8033.38	714.20	714.20	0.66	713.54			W			5.89
24	8194.18	714.40	714.40	0.62	714.39	712.27	0.65	TDS	0.94	0.06	
25	8276.19	714.50	714.50	0.58	714.49	712.35	0.66	TDS	0.89	0.11	
27	8433.48	714.70	714.70	0.50	714.69	712.50	0.66	TDS	0.77	0.23	
28	8512.35	714.80	714.80	0.47	714.79	712.57	0.67	TDS	0.72	0.28	
30	8669.56	715.00	715.00	0.39	714.99	712.72	0.67	TDS	0.60	0.40	

	Weir											Orifice					
Id	E [ft]	W [ft]	L(n) [ft]	C(n)	Q(n) [cs]	LS(n) [ft]	W(DS) [ft]	C(t)	Q(t) [cfs]	L(t) [ft]	BtoS	E [ft]	W [ft]	A [sft]	W(DS) [ft]	Q(t) [cfs]	L(t) [ft]
0	13.00	13.00	24.74	3.09	3580;35	1.42	12.40	0.57;0.98	2608;1283	0.57	0.4;0.6						
2	13.20	13.20	24.74	3.09	3662;41	1.41	12.54	0.6;0.98	2746;1330	0.58	0.36;0.64						
4	13.40	13.40	24.73	3.09	3745;52	1.40	12.62	0.63;0.98	2873;1371	0.59	0.32;0.68						
5	13.50	13.50	24.73	3.09	3787;59	1.39	12.65	0.63;0.97	2926;1393	0.60	0.3;0.7						
7	13.70	13.70	24.73	3.09	3871;75	1.38	12.71	0.65;0.97	3032;1439	0.61	0.26;0.74						
8	13.80	13.80	24.72	3.09	3913;84	1.38	12.74	0.66;0.97	3086;1462	0.62	0.24;0.76						
10	14.00	14.00	24.72	3.09	3997;102	1.37	12.78	0.67;0.96	3196;1507	0.64	0.2;0.8						
11	14.10	14.10	24.72	3.09	4040;113	1.36	12.80	0.68;0.96	3251;1529	0.65	0.18;0.82						
13	14.30	14.30	24.71	3.09	4126;134	1.35	12.84	0.69;0.96	3364;1575	0.67	0.14;0.86						
14	14.40	14.40	24.71	3.09	4169;146	1.35	12.86	0.7;0.96	3420;1599	0.68	0.12;0.88						
16	14.60	14.60	24.71	3.09	4255;170	1.34	12.89	0.72;0.95	3534;1646	0.69	0.08;0.92						
18	14.80	14.80	24.70	3.09	4342;196	1.33	12.92	0.73;0.95	3651;1694	0.71	0.04;0.96						
19	14.90	14.90	24.70	3.09	4386;211	1.32	12.93	0.74;0.95	3710;1718	0.72	0.02;0.98						
21	15.10	15.10	24.70	3.09	226.97	0.09	13.03	0.95	1760.72	0.73							
22	15.20	15.20	24.70	3.09	229.92	0.09	13.11	0.95	1778.43	0.73							
24	15.40	15.40	24.69	3.09	236.27	0.09	13.27	0.95	1814.59	0.73		15.40	15.40	330.00	13.27	2009.61	0.01
25	15.50	15.50	24.69	3.09	240.59	0.09	13.35	0.95	1833.29	0.73		15.50	15.50	330.00	13.35	2030.82	0.01
27	15.70	15.70	24.69	3.09	248.77	0.09	13.50	0.95	1870.11	0.72		15.70	15.70	330.00	13.50	2072.54	0.01
28	15.80	15.80	24.68	3.09	252.97	0.09	13.57	0.95	1888.75	0.72		15.80	15.80	330.00	13.57	2093.68	0.01
30	16.00	16.00	24.68	3.09	261.71	0.09	13.72	0.95	1926.19	0.72		16.00	16.00	330.00	13.72	2136.19	0.01

UTAH DAM - GENESEE COUNTY - DAM ID NO. 1275

Name:	End Gates	**Part Type:**	Gate	**Flow Type:**	Flow
Count:	2	**DS Part:**	Outlet	**DS Part 2:**	
Type:	Sluice	**Shape:**	Rectangular	**Crest Type:**	Flat
Gate Height [ft]:	12.5	**Gate Thickness [ft]:**	1	**Gate Material:**	Metal
Stem Width [ft]:	0	**Top Elev [ft]:**	728	**Gate Percent Open [%]:**	80
Elevation [ft]:	699	**Width [ft]:**	25	**Contraction Type:**	None
Number of Piers:	0.5	**Pier Type:**	Rounded	**Depth [ft]:**	0.5
Crest Width [ft]:	5	**Front Slope [V1:H_]:**	0	**Back Slope [V1:H_]:**	0
Crest Material:	Concrete	**Trash Rack:**	None		

Part								Gate			
Id	Q [cfs]	E(US) [ft]	W(US) [ft]	L [ft]	E(DS) [ft]	W(DS) [ft]	VH(DS) [ft]	Type	Weir%	Orifice%	dC [ft]
0	3688.18	712.00	712.00	2.70	709.30			W			5.53
2	3752.73	712.20	712.20	2.78	709.42			W			5.57
4	3794.52	712.40	712.40	2.86	709.54			W			5.65
5	3809.85	712.50	712.50	2.90	709.60			W			5.66
7	3838.34	712.70	712.70	2.98	709.72			W			5.69
8	3851.38	712.80	712.80	3.03	709.77			W			5.70
10	3874.86	713.00	713.00	3.12	709.88			W			5.72
11	3885.30	713.10	713.10	3.17	709.93			W			5.73
13	3904.33	713.30	713.30	3.26	710.04			W			5.75
14	3913.88	713.40	713.40	3.31	710.09			W			5.76
16	3930.64	713.60	713.60	3.41	710.19			W			5.77
18	3944.30	713.80	713.80	3.51	710.29			W			5.79
19	3951.38	713.90	713.90	3.57	710.33			W			5.80
21	3999.68	714.10	714.10	0.66	713.44			W			5.88
22	4041.41	714.20	714.20	0.66	713.54			W			5.92
24	4121.24	714.40	714.40	0.62	714.39	712.27	0.65	TDS	0.94	0.06	
25	4161.21	714.50	714.50	0.58	714.49	712.35	0.66	TDS	0.89	0.11	
27	4237.58	714.70	714.70	0.50	714.69	712.50	0.66	TDS	0.77	0.23	
28	4275.81	714.80	714.80	0.47	714.79	712.57	0.67	TDS	0.72	0.28	
30	4351.90	715.00	715.00	0.39	714.99	712.72	0.67	TDS	0.60	0.40	

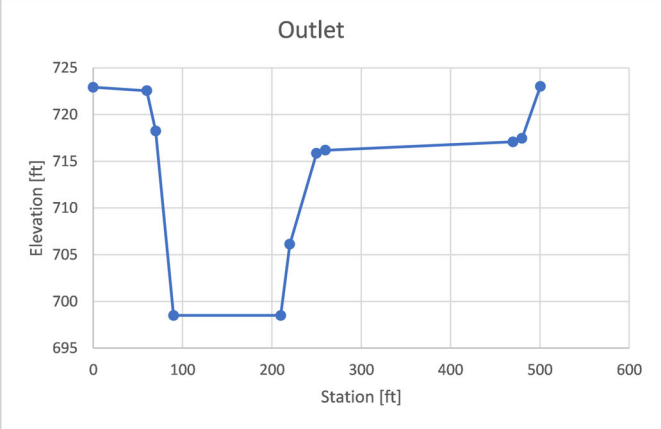
	Weir											Orifice					
Id	E [ft]	W [ft]	L(n) [ft]	C(n)	Q(n) [cs]	LS(n) [ft]	W(DS) [ft]	C(t)	Q(t) [cfs]	L(t) [ft]	BtoS	E [ft]	W [ft]	A [sft]	W(DS) [ft]	Q(t) [cfs]	L(t) [ft]
0	13.00	13.00	24.87	3.09	3599;36	1.42	12.40	0.57;0.98	2622;1290	0.57	0.4;0.6						
2	13.20	13.20	24.87	3.09	3682;42	1.41	12.54	0.6;0.98	2761;1337	0.58	0.36;0.64						
4	13.40	13.40	24.87	3.09	3765;53	1.40	12.62	0.63;0.98	2889;1378	0.59	0.32;0.68						
5	13.50	13.50	24.86	3.09	3807;60	1.39	12.65	0.63;0.97	2941;1401	0.60	0.3;0.7						
7	13.70	13.70	24.86	3.09	3892;76	1.38	12.71	0.65;0.97	3049;1447	0.61	0.26;0.74						
8	13.80	13.80	24.86	3.09	3935;84	1.38	12.74	0.66;0.97	3103;1470	0.62	0.24;0.76						
10	14.00	14.00	24.86	3.09	4020;103	1.37	12.78	0.67;0.96	3214;1515	0.64	0.2;0.8						
11	14.10	14.10	24.86	3.09	4063;113	1.36	12.80	0.68;0.96	3270;1538	0.65	0.18;0.82						
13	14.30	14.30	24.86	3.09	4149;135	1.35	12.84	0.69;0.96	3383;1584	0.67	0.14;0.86						
14	14.40	14.40	24.86	3.09	4193;146	1.35	12.86	0.7;0.96	3440;1608	0.68	0.12;0.88						
16	14.60	14.60	24.85	3.09	4280;171	1.34	12.89	0.72;0.95	3555;1656	0.69	0.08;0.92						
18	14.80	14.80	24.85	3.09	4368;198	1.33	12.92	0.73;0.95	3672;1704	0.71	0.04;0.96						
19	14.90	14.90	24.85	3.09	4412;212	1.32	12.93	0.74;0.95	3732;1728	0.72	0.02;0.98						
21	15.10	15.10	24.85	3.09	228.36	0.09	13.03	0.95	1771.48	0.73							
22	15.20	15.20	24.85	3.09	231.33	0.09	13.11	0.95	1789.37	0.73							
24	15.40	15.40	24.85	3.09	237.74	0.09	13.27	0.95	1825.91	0.73		15.40	15.40	330.00	13.27	2009.61	0.01
25	15.50	15.50	24.84	3.09	242.10	0.09	13.35	0.95	1844.80	0.73		15.50	15.50	330.00	13.35	2030.82	0.01
27	15.70	15.70	24.84	3.09	250.35	0.09	13.50	0.95	1882.00	0.72		15.70	15.70	330.00	13.50	2072.54	0.01
28	15.80	15.80	24.84	3.09	254.59	0.09	13.57	0.95	1900.84	0.72		15.80	15.80	330.00	13.57	2093.68	0.01
30	16.00	16.00	24.84	3.09	263.40	0.09	13.72	0.95	1938.67	0.72		16.00	16.00	330.00	13.72	2136.19	0.01

UTAH DAM - GENESEE COUNTY - DAM ID NO. 1275

Name:	Outlet	**Part Type:**	Channel	**Flow Type:**	Flow
Count:	1	**DS Part:**		**Method:**	Depth
Shape:	Defined	**Profile:**	Slope	**N value:**	0.034
US Elevation [ft]:	698.5	**Slope [ft/ft]:**	0.00088	**Cross Section Name:**	Outlet

Part							Channel					
Id	Q [cfs]	E(US) [ft]	W(US) [ft]	VH(US) [ft]	L [ft]	W(DS) [ft]	W(US) [ft]	A [sft]	WP [ft]	dN [ft]	dC [ft]	LS [ft]
0	11025.99	712.01	711.41	0.61	712.01	0.00	12.91	1767.14	168.07	12.91	7.87	712.01
2	11218.35	712.15	711.54	0.61	712.15	0.00	13.04	1788.26	168.69	13.04	7.96	712.15
4	11342.65	712.24	711.62	0.62	712.24	0.00	13.12	1801.74	169.08	13.12	8.02	712.24
5	11388.19	712.27	711.65	0.62	712.27	0.00	13.15	1806.70	169.22	13.15	8.04	712.27
7	11472.73	712.33	711.71	0.62	712.33	0.00	13.21	1815.89	169.49	13.21	8.08	712.33
8	11511.39	712.36	711.74	0.62	712.36	0.00	13.24	1820.07	169.61	13.24	8.10	712.36
10	11580.95	712.41	711.78	0.62	712.41	0.00	13.28	1827.59	169.82	13.28	8.13	712.41
11	11611.83	712.43	711.80	0.63	712.43	0.00	13.30	1830.92	169.92	13.30	8.14	712.43
13	11668.07	712.47	711.84	0.63	712.47	0.00	13.34	1837.00	170.10	13.34	8.17	712.47
14	11696.29	712.49	711.86	0.63	712.49	0.00	13.36	1840.05	170.19	13.36	8.18	712.49
16	11745.75	712.52	711.89	0.63	712.52	0.00	13.39	1845.39	170.34	13.39	8.21	712.52
18	11785.92	712.55	711.92	0.63	712.55	0.00	13.42	1849.71	170.47	13.42	8.22	712.55
19	11806.77	712.57	711.93	0.63	712.57	0.00	13.43	1851.95	170.53	13.43	8.23	712.57
21	11950.44	712.67	712.03	0.64	712.67	0.00	13.53	1867.41	170.98	13.53	8.30	712.67
22	12074.79	712.75	712.11	0.64	712.75	0.00	13.61	1880.76	171.37	13.61	8.36	712.75
24	12315.42	712.92	712.27	0.65	712.92	0.00	13.77	1906.37	172.09	13.77	8.47	712.92
25	12437.40	713.00	712.35	0.65	713.00	0.00	13.85	1919.35	172.46	13.85	8.52	713.00
27	12671.06	713.16	712.50	0.66	713.16	0.00	14.00	1944.08	173.17	14.00	8.63	713.16
28	12788.16	713.24	712.58	0.66	713.24	0.00	14.08	1956.40	173.52	14.08	8.68	713.24
30	13021.46	713.40	712.73	0.67	713.40	0.00	14.23	1980.94	174.22	14.23	8.79	713.40

Defined Cross Sections



Weir

$$Q = CL_e H_e^{\frac{3}{2}}$$

Where:
$Q =$ discharge
$C =$ discharge coefficient
$L_e =$ effective length of crest
$H_e =$ energy head

Design of Small Dams – Equation 3 (pg. 365)

The energy loss though a weir is calculated with the equation shown below:

$$L_w = \frac{H_e * (\frac{2}{3} * \sqrt{2g} - C)^2}{2g}$$

Where:
$H_e =$ energy head
C= discharge coefficient

Weir Length

The effective length that is calculated with the equation shown below:

$$L_e = L - (R_a + R_p + R_b) * H_e$$

Where:
L= weir length
$R_a =$ entrance reduction factor
$R_p =$ pier reduction factor
$R_b =$ bend reduction factor

Weir Entrance Factor

The entrance factor is calculated with the equation shown below:

$$R_e = N * K_e$$

Where:
$N = 1$: one side contracted and 2: both sides contracted
$K_e =$ abutment contraction coefficient

	K_e
For square abutments with headwall at 90° to direction of flow	0.2
For round abutments with headwall at 90° to direction of flow, when $0.5H_e \geq r \geq 0.15H_e$	0.1
For round abutments with headwall not more than 45° to direction of flow and $r >> 0.5H_e$	0

Design of Small Dams (pg. 368)

Weir Peir Factor

The pier factor is calculated with the equation shown below:

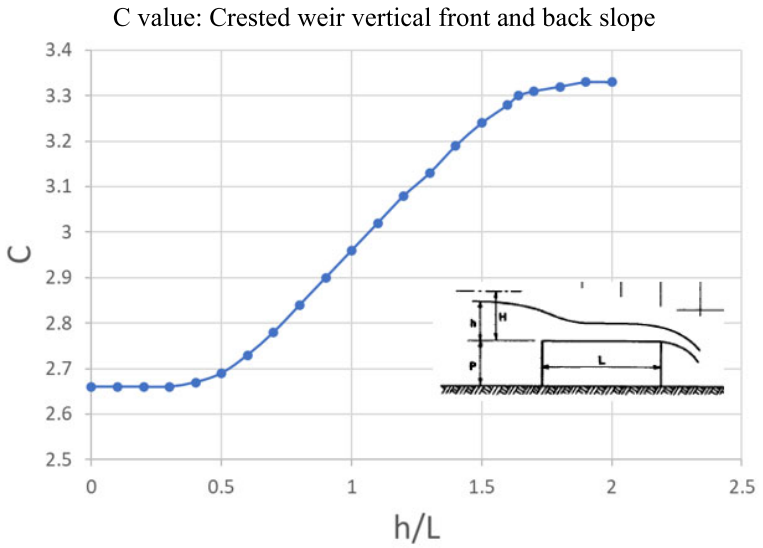
$$R_p = 2 * N * K_p$$

Where:
$N =$ number of piers
$K_p =$ abutment contraction coefficient

	K_p
For square-nosed piers with corners rounded on a radius equal to about 0.1 of the pier thickness	0.02
For round-nosed piers	0.01
For pointed-nose piers	0

Design of Small Dams (pg. 271)

Weir C Broad Vertical



Discharge Characteristics of Broad-Crested Weirs – Figure 3 (pg. 6): Coefficients of discharge for broad-crested weir with a vertical front slope and vertical back slope. C value is from the USGS test of Cornell curve.

Weir C Shallow

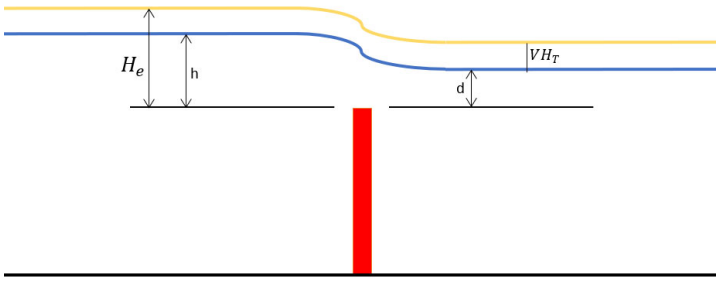
When the weir depth is shallow enough the flow behaves more like channel flow. A C value of 3.09 is used for this flow condition. The flow is considered shallow when $H > 10P$. A linear transition starts at $H > 5P$ to smooth the curve and account for some uncertainty as to when the shallow flow condition starts.

Weir Submerged Short

The section of flow that is below the tailwater depth is calculates with the equation shown below:

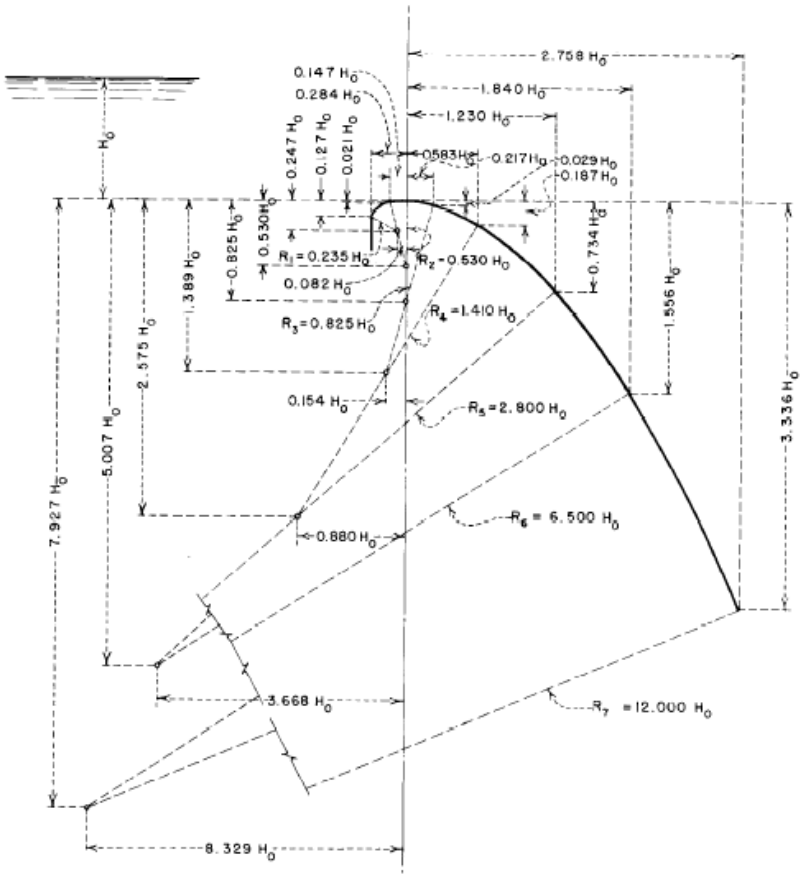
$$Q = \int_0^d L_e * \sqrt{2g} * \left(\sqrt{H_e - y} - \sqrt{d - y} + \sqrt{VH_T}\right) * dy = C' * L_e * (H_e^{1.5} - d^{1.5} - (H_e - h)^{1.5} + (d - h)^{1.5} + 1.5 * \sqrt{VH_T} * h)$$

Where:
L_e = effective length of crest
C' = submerged weir coefficient
H_e= energy head
d = tailwater head
VH_T = tailwater velocity head



Ogee

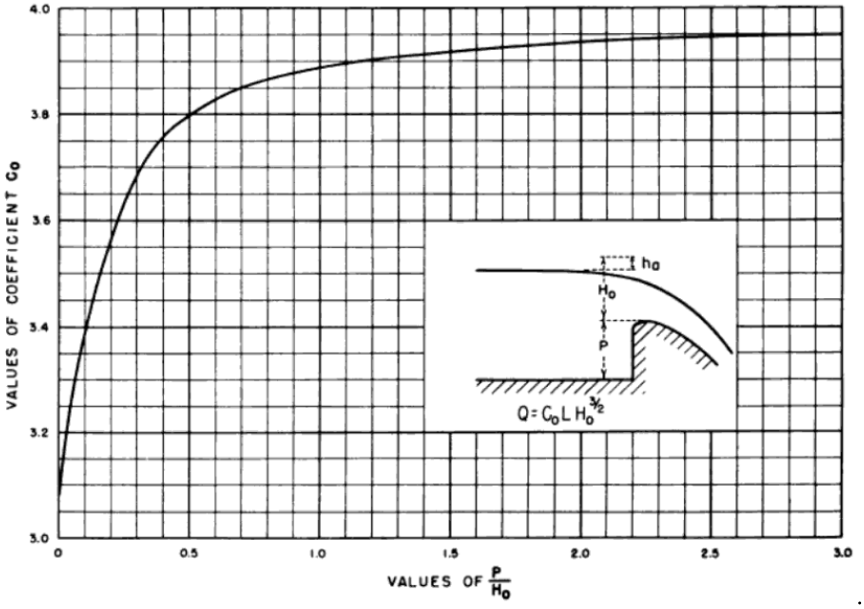
An ogee crest is shaped for a designed head. The design head is used to determine the design C value. The shape of the ogee crest is what determine the design head. The image below shows how the design head determines the shape of the ogee crest. The design head that produce a shape closet to actual ogee weir shape is what is used in our calculation.



Design of Small Dams – Figure 9-22 (pg. 368): Ogee crest shape defined by compound curves

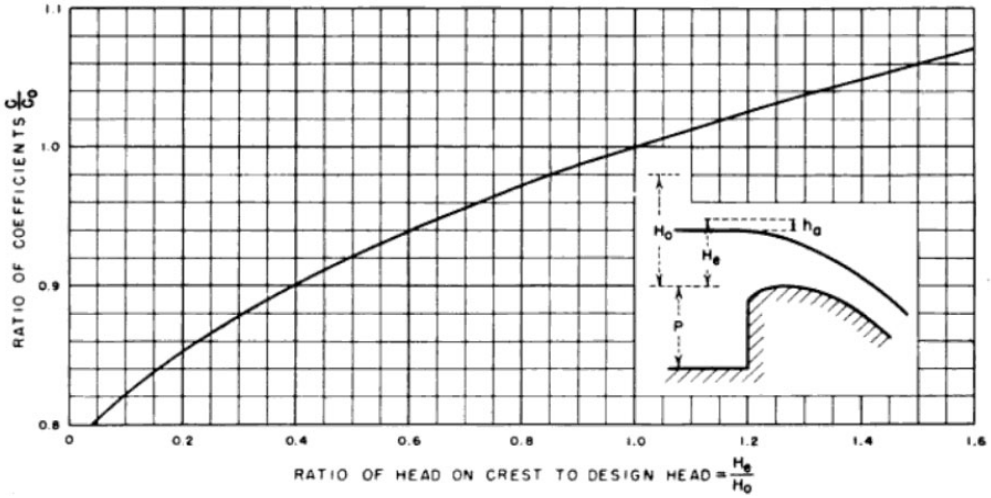
Ogee C

Figure 189, shown below, is used with the design head to find the design C value.



Design of Small Dams – Figure 9-23 (pg. 370): Discharge coefficients for vertical-faced ogee crest

When the head at the dam varies from the design head the ratio of the head to the design head is used in Figure 190, shown below, to determine the ratio of the C value to the design C value.



Design of Small Dams – Figure 9-24 (pg. 371): Coefficients of discharge for other than design head

Weir C Shallow

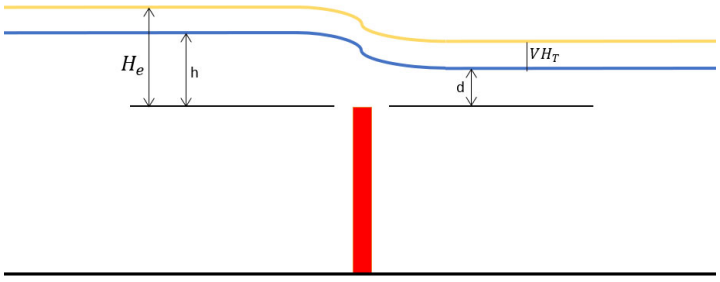
When the weir depth is shallow enough the flow behaves more like channel flow. A C value of 3.09 is used for this flow condition. The flow is considered shallow when $H > 10P$. A linear transition starts at $H > 5P$ to smooth the curve and account for some uncertainty as to when the shallow flow condition starts.

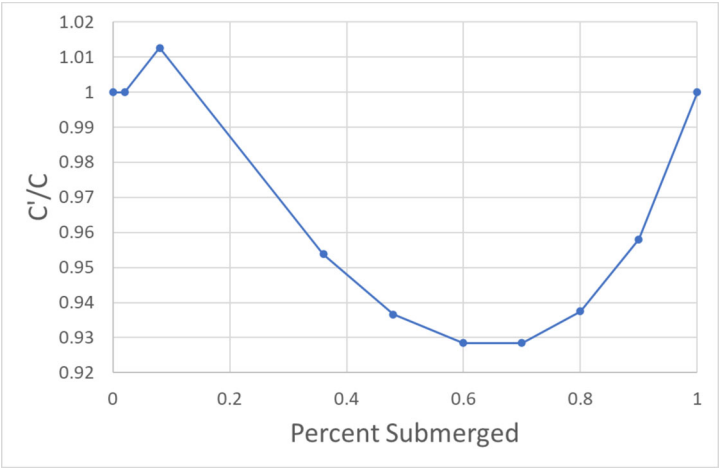
Weir Submerged Short

The section of flow that is below the tailwater depth is calculates with the equation shown below:

$$Q = \int_0^d L_e * \sqrt{2g} * \left(\sqrt{H_e - y} - \sqrt{d - y} + \sqrt{VH_T}\right) * dy = C' * L_e * (H_e^{1.5} - d^{1.5} - (H_e - h)^{1.5} + (d - h)^{1.5} + 1.5 * \sqrt{VH_T} * h)$$

Where:
L_e = effective length of crest
C' = submerged weir coefficient
H_e = energy head
d = tailwater head
VH_T = tailwater velocity head





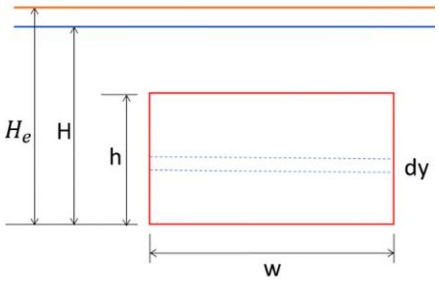
Discharge Characteristics of Broad-Crested Weirs – (pg. 139) Fieley and Sterns coefficients for submerged weirs. Table was modified to be shown as percentage.

Orifice

Orifice flow is calculated with the equation show below:

$$Q = \int_0^h C_d * w * \sqrt{2g(H_e - y)} * dy$$

$$Q = C_d * w * (H_e^{1.5} - (H_e - h)^{1.5})$$



Where:
C_d = Orifice Coefficient
w = flow area width
H_e = energy head
h = flow area height

The flow velocity is calculated with the equation shown below:

$$v = \sqrt{2gh}$$

Where:
g = gravitational acceleration
h = head of water

The table below shows the classification used to determine the orifice coefficient:

Description	C_d
Round Edge	0.98
Sharp Edge, Plate	0.62
Flat Edge, Short Tube	0.61
Flat Edge, Long Tube	0.82
Flat Edge, Short Tube, Re-entrant	0.54
Flat Edge, Long Tube, Re-entrant	0.72
Sharp Edge, Re-entrant	0.51

The energy loss though an orifice is calculated with the equation shown below:

$$L_o = \left(H_e * (1 - C_d)\right)^2$$

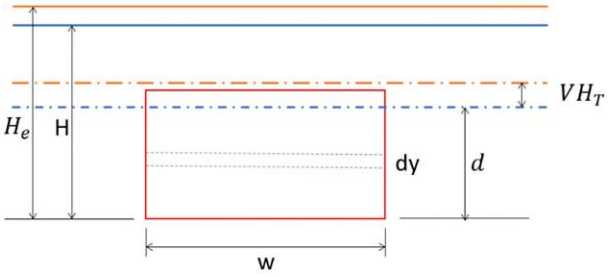
Orifice Submerged

When the tailwater elevation is above the orifice elevation, the area that is below the tailwater elevations is calculated with the equation shown below:

$$Q = \int_0^d C_d * w * \sqrt{2g} * \left(\sqrt{H_e - y} - \sqrt{d - y} + \sqrt{VH_T}\right) * dy$$

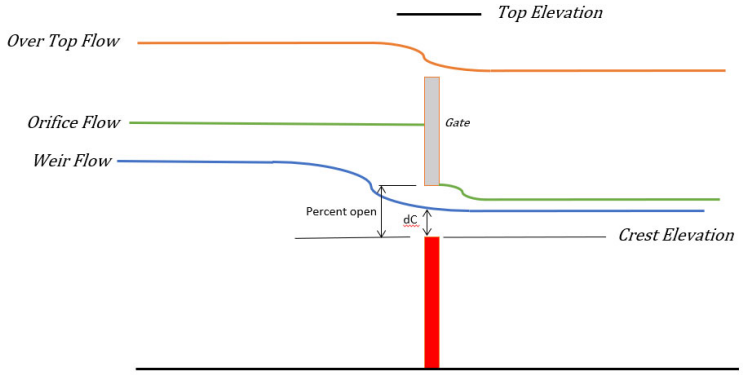
$$Q = C_d * w * (H_e^{1.5} - d^{1.5} - (H_e - d)^{1.5} + 1.5 * \sqrt{VH_T} * d)$$

Where:
d = tailwater head
VH_T = tailwater velocity head
C_d = Orifice Coefficient
w = flow area width
H_e = energy head



Gate

Gates are calculated with three different flow types as depicted in the image below.



To determine orifice flow vs weir flow the critical depth is calculated for the flow and if the critical depth is within 25 percent of the bottom of gate elevation both weir and orifice/over top flow are calculated and a linear interpolation is used with the two flows. Both are calculated and interpolated within this range to create a smoother rating curve and acknowledge that when weir flow will transition to orifice flow is uncertain.

Gate Submerged

Orifice flow can also be triggered by downstream conditions. Once the downstream elevation is above the bottom of the gate, a linear transition from weir flow to orifice flow in the range of $G_{elev} < DS_{elev} < 1.1G_{elev}$. This transition is to smooth the curve and account for uncertainty to when the flow transition from weir to orifice.

Channel

Channel Depth

If the slope of the channel is horizontal or adverse the critical depth is used for the flow depth. Otherwise, the normal depth is used for the flow depth. The water elevation and energy elevation are determined from the flow depth. The upstream and downstream sides will have the same flow depth.

Channel Profile

The flow depth in the channel will vary as calculated using the gradually varied flow (GRV) direct step method described below. If the channel slope is steep or critical the GRV starts at the upstream end. If the channel slope is mild, horizontal, or adverse the GRV starts at the downstream end.

Gradually Varied Flow

The water depth is calculated with equation shown below

$$\frac{dy}{dx} = \frac{S_o - S_f}{1 - Fr^2}$$

Where:
S_o= bottom slope, positive in the downward direction
S_f= Friction slope, positive in the downward direction
y = water depth, measured from culvert bottom to water surface
x = longitudinal distance, measured along the culvert bottom
Fr = Froude number

The friction slope is calculated with equation shown below:

$$S_f = \left(\frac{n * Q}{1.49 * A * R^{\frac{2}{3}}}\right)^2$$

Where:
n = manning's roughness coefficient
Q = flow
A = flow area
R = hydraulic radius

The Froude number is calculated with the equation shown below:

$$Fr = \frac{T * Q^2}{32.17 * A^3}$$

Where:
Q = flow
A = flow area
T = top width of water surface

The direct step method, as shown below, is used to determine the water profile. The friction slope is calculated a step is taken then a second friction slope is calculated, and the average friction slope is used to determine the change in water depth.

$$S_{f1} = \left(\frac{n * Q}{1.49 * A_1 * R_1^{\frac{2}{3}}} \right)^2$$

$$\frac{dy_1}{dx} = \frac{S_o - S_{f1}}{1 - Fr^2}$$

$$y_2 = y_1 + \frac{dy_1}{dx} * dx$$

$$S_{f2} = \left(\frac{n * Q}{1.49 * A_2 * R_2^{\frac{2}{3}}} \right)^2$$

$$\bar{S_f} = \frac{S_{f1} + S_{f2}}{2}$$

$$\frac{dy}{dx} = \frac{S_o - \bar{S_f}}{1 - Fr^2}$$

The dx is reduced when the change in depth is large or change in profile slope is large and dx is increased when the change of depth is small and change in profile slope is small.

The water surface profile can be calculated from downstream going upstream (backwater calculations) or from upstream going downstream (front water calculations). The direction depends on the classification of the water surface profile (hydraulic slope and type of curve). A backwater calculation is used for mild, critical, adverse, and horizontal slopes a backwater calculation beginning at the downstream boundary. A Front water calculation is used for steep slopes, beginning at the upstream boundary.

Routing

The flow is determined by calculating the flow from upstream to downstream. Then the flow is calculated from downstream to upstream. If the tailwater conditions are not withing 0.01 of a foot, the same process is repeated until the tailwater conditions converge. The routing ensures that the conservation of mass and energy are validated.

When a part as upstream parts, the cumulative flows and the proportional energy heads are how the final flow and energy head is used for the calculation. The part is calculated iteratively until the flow matches the flow from the upstream parts. If the energy head required for the flow is more than the energy head from the upstream parts. The tailwater conditions will increase and the upstream parts will be recalculated until the energy is conserved.

Appendix D – Hydrologic Data

We have processed the discharge request submitted by email on October 18, 2023 (Process No. 20230546), as follows:

Flint River at Utah Dam, Dam ID 1275, Section 32, T8N, R7E, City of Flint, Genesee County, has a total drainage area of 732 square miles and a contributing drainage area of 723 square miles. The design discharge for this dam is the 1% chance (100-year) flood. The 1% chance peak flow is estimated to be 11800 cubic feet per second. (Watershed Basin No. 32B Flint).

These estimates should be confirmed by our office if an application is not submitted within one year. If you have any questions concerning the discharge estimates, please contact Ms. Susan Greiner, Hydrologic Studies and Floodplain Management Unit, at 517-927-3838, or by email at: GreinerS@michigan.gov.

-----Original Message-----
From: EGLE-Automated <EGLE-Automated@michigan.gov>
Sent: Wednesday, October 18, 2023 12:42 PM
To: EGLE-wrd-qreq <EGLE-wrd-qreq@michigan.gov>
Subject: Flood or Low Flow Discharge Request

Requestor: Mitchel
Company: EGLE
Address: 525 W. Allegan
City/State: Lansing
ZIP Code: 48933
Phone: 5172305866
Date: 10/18/2023
1 percent
Contact Agency:
Contact Person:
Watercourse: Flint River
Local Name:
County: Genesee
City/Township: ?
Section: 32
Town: 08N
Range: 07E
Location: Utah Dam #1275
FFR1: Dam
Email: ThelenM21@michigan.gov