

REQUEST FOR PROPOSAL

RFP # 23-13

Wastewater Treatment Plant UV Disinfection Equipment

City of Ann Arbor
Public Services/Wastewater Treatment Services Unit



Due Date: February 27, 2023 by 2:00 p.m. (local time)

Issued By:

City of Ann Arbor
Procurement Unit
301 E. Huron Street
Ann Arbor, MI 48104

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SECTION I - GENERAL INFORMATION

A. OBJECTIVE

The City of Ann Arbor, Michigan (City) Wastewater Treatment Services Unit (WWTSU) is requesting proposals from UV system suppliers (UVSS), or Bidder, to replace the existing UV disinfection system at the wastewater treatment plant (WWTP). The City intends to preselect the UVSS based upon the submitted proposals and execute an agreement with the selected UVSS for design services and secure the equipment price. The work will be separated by Early Work and the Balance of Work.

1. Early Work shall consist of the Bidder's cost for developing an equipment shop drawing submittal per the preselection documents; addressing Engineer's comments on the shop drawing; and providing a final approved shop drawing submittal.
2. Balance of Work shall consist of all costs for providing goods and services described in the Bidding Documents, other than work identified as Early Work, including, but not limited to the following:
 - a. Furnish gates as outlined in the *Open-Channel Metal Slide Gates and Weir Gates* Section.
 - b. Completion of other Division 40 and 46 sections
 - c. Delivery of equipment to site
 - d. Installation and startup assistance
 - e. Training
 - f. Equipment warranty

B. QUESTIONS AND CLARIFICATIONS / DESIGNATED CITY CONTACTS

All questions regarding this Request for Proposal (RFP) shall be submitted via e-mail. Questions will be accepted and answered in accordance with the terms and conditions of this RFP.

All questions shall be submitted on or before February 13, 2023 at 5:00 p.m., local time, and should be addressed as follows:

Scope of Work/Proposal Content questions shall be e-mailed to Anne Warrow, PE, Plant Utilities Engineer, AWarrow@a2gov.org

RFP Process and Compliance questions shall be e-mailed to Colin Spencer, Buyer, CSpencer@a2gov.org

Should any prospective Bidder be in doubt as to the true meaning of any portion of this RFP, or should the prospective Bidder find any ambiguity, inconsistency, or omission therein, the prospective Bidder shall make a written request for an official interpretation or correction by the due date for questions above.

All interpretations, corrections, or additions to this RFP will be made only as an official addendum that will be posted to a2gov.org and MITN.info and it shall be the prospective Bidder's responsibility to ensure they have received all addenda before submitting a proposal. Any addendum issued by the City shall become part of the RFP, and must be incorporated in the proposal where applicable.

C. PRE-PROPOSAL MEETING

No pre-proposal meeting will be held for this RFP. Please contact staff indicated above with general questions regarding the RFP.

D. PROPOSAL FORMAT

To be considered, each firm must submit a response to this RFP using the format provided in Section III.

E. SELECTION CRITERIA

Responses to this RFP will be evaluated based on the Proposal Evaluation Criteria presented in Section III.

All proposals submitted may be subject to clarifications and further negotiation. All agreements resulting from negotiations that differ from what is represented within the RFP or in the proposal response shall be documented and included as part of the final agreement.

F. SEALED PROPOSAL SUBMISSION

All proposals are due and must be delivered to the City on or before, February 27, 2023 at 2:00 p.m. (local time). Proposals submitted late or via oral, telephonic, telegraphic, electronic mail or facsimile **will not** be considered or accepted.

Each respondent must submit in a sealed envelope

- **one (1) original proposal**
- **one (1) digital copy of the proposal, preferably on a USB/flash drive as one file in PDF format, with bookmarks for proposal sections**

Proposals submitted should be clearly marked: **“RFP No. 23-13 – Wastewater Treatment Plant UV Disinfection Equipment”** and list the Bidder's name and address.

Proposals must be addressed and delivered to:

City of Ann Arbor
c/o Customer Service
301 East Huron Street
Ann Arbor, MI 48104

Proposals will not be publicly opened, nor will an immediate decision be rendered.

Hand delivered bids may be dropped off in the Purchasing drop box located in the Ann Street (north) vestibule/entrance of City Hall which is open to the public Monday through Friday from 8am to 5pm (except holidays). The City will not be liable to any prospective Bidder for any unforeseen circumstances, delivery, or postal delays. Postmarking on the due date will not substitute for receipt of the proposal. Bidders are responsible for submission of their proposal. Additional time will not be granted to a single prospective Bidder. However, additional time may be granted to all prospective Bidders at the discretion of the City.

A proposal may be disqualified if the following required forms are not included with the proposal:

- **Attachment C - City of Ann Arbor Non-Discrimination Declaration of Compliance**
- **Attachment D - City of Ann Arbor Living Wage Declaration of Compliance**
- **Attachment E - Vendor Conflict of Interest Disclosure Form of the RFP Document**

Proposals that fail to provide these forms listed above upon proposal opening may be deemed non-responsive and may not be considered for award.

Please provide the forms outlined above (Attachments C, D and E) within your narrative proposal

G. DISCLOSURES

Under the Freedom of Information Act (Public Act 442), the City is obligated to permit review of its files, if requested by others. All information in a proposal is subject to disclosure under this provision. This act also provides for a complete disclosure of contracts and attachments thereto.

H. TYPE OF CONTRACT

The selected Bidder shall agree to supply an ultraviolet (UV) Disinfection system as specified by the Bidding, design services, startup and commissioning, and equipment price, per the City of Ann Arbor General Terms and Conditions included in Attachment H. The agreement for design services and equipment shall be a fixed-price. This RFP and the selected Bidder's response thereto, shall constitute the basis of the scope of services in the contract by reference.

I. NONDISCRIMINATION

All Bidders proposing to do business with the City shall satisfy the contract compliance administrative policy adopted by the City Administrator in accordance with the Section 9:158 of the Ann Arbor City Code. Breach of the obligation not to discriminate as outlined in Attachment C shall be a material breach of the contract. Contractors are required to post a copy of Ann Arbor's Non-Discrimination Ordinance attached at all work locations where its employees provide services under a contract with the City.

J. WAGE REQUIREMENTS

The Attachments provided herein outline the requirements for payment of prevailing wages or of a "living wage" to employees providing service to the City under this contract. The successful Bidder must comply with all applicable requirements and provide documentary proof of compliance when requested.

K. CONFLICT OF INTEREST DISCLOSURE

The City of Ann Arbor Purchasing Policy requires that the Bidder complete a Conflict of Interest Disclosure form. A contract may not be awarded to the selected Bidder unless and until the Procurement Unit and the City Administrator have reviewed the Disclosure form and determined that no conflict exists under applicable federal, state, or local law or administrative regulation. Not every relationship or situation disclosed on the Disclosure Form may be a disqualifying conflict. Depending on applicable law and regulations, some contracts may awarded on the recommendation of the City Administrator after full disclosure, where such action is allowed by law, if demonstrated competitive pricing exists and/or it is determined the award is in the best interest of the City. A copy of the Conflict of Interest Disclosure Form is attached.

L. COST LIABILITY

The City of Ann Arbor assumes no responsibility or liability for costs incurred by the Bidder prior to the execution of the Agreement. The liability of the City is limited to the terms and conditions outlined in the Agreement. By submitting a proposal, Bidder agrees to bear all costs incurred or related to the preparation, submission, and selection process for the proposal.

M. DEBARMENT

Submission of a proposal in response to this RFP is certification that the Respondent is not currently debarred, suspended, proposed for debarment, and declared ineligible or voluntarily excluded from participation in this transaction by any State or Federal departments or agency. Submission is also agreement that the City will be notified of any changes in this status.

N. PROPOSAL PROTEST

All proposal protests must be in writing and filed with the Purchasing Manager within five (5) business days of any notices of intent. The Bidder must clearly state the reasons for the protest. If an Bidder contacts a City Service Area/Unit and indicates a desire to protest an award, the Service Area/Unit shall refer the Bidder to the Purchasing Manager. The Purchasing Manager will provide the Bidder with the appropriate instructions for filing the protest. The protest shall be reviewed by the City Administrator or designee, whose decision shall be final.

Any inquiries or requests regarding this procurement should be only submitted in writing to the Designated City Contacts provided herein. Attempts by the Bidder to initiate contact with anyone other than the Designated City Contacts provided herein that the Bidder believes can influence the procurement decision, e.g., Elected Officials, City Administrator, Selection Committee Members, Appointed Committee Members, etc., may lead to immediate elimination from further consideration.

O. SCHEDULE

The following is the schedule for this RFP process.

Activity/Event	Anticipated Date
RFP Advertisement	February 3, 2023
Written Question Deadline	February 13, 2023
Addenda Published (as needed)	February 15, 2023
Proposal Due Date	February 27, 2023
Selection/Negotiations	March 2023
Expected Agreement Authorization	March 2023
UVSS Equipment Submittal	45 Days after Agreement Authorization

The above schedule is for information purposes only and is subject to change at the City's discretion.

P. IRS FORM W-9

The selected Bidder will be required to provide the City of Ann Arbor an IRS form W-9.

Q. RESERVATION OF RIGHTS

1. The City reserves the right in its sole and absolute discretion to accept or reject any or all proposals with or without cause.
2. The City reserves the right to waive, or not waive, informalities or irregularities in of any proposal if determined by the City to be in its best interest.
3. The City reserves the right to request additional information from any or all Bidders.
4. The City reserves the right to reject any proposal that it determines to be unresponsive and deficient in any of the information requested within RFP.

5. The City reserves the right to retain all proposals submitted and to use any ideas in a proposal regardless of whether that proposal is selected. Submission of a proposal indicates acceptance by the firm of the conditions contained in this RFP, unless clearly and specifically noted in the proposal submitted.
6. The City reserves the right to disqualify proposals that fail to respond to any requirements outlined in the RFP, or failure to enclose copies of the required documents outlined within RFP.
7. The City has no obligation to sole-source the UVSS in the construction contract.
8. If the City elects to not award the future construction contract, the preselection agreement shall become void and UVSS and City have no obligations to each other.

R. ENVIRONMENTAL COMMITMENT

The City of Ann Arbor recognizes its responsibility to minimize negative impacts on human health and the environment while supporting a vibrant community and economy. The City further recognizes that the products and services the City buys have inherent environmental and economic impacts and that the City should make procurement decisions that embody, promote, and encourage the City's commitment to the environment.

SECTION II - SCOPE OF SERVICES

1. Objective

The City of Ann Arbor, Michigan (City) is requesting proposals from UV system suppliers (UVSS), or Bidder, to replace the existing UV disinfection system. The City intends to preselect the UVSS based upon the submitted proposals and execute an agreement with the selected UVSS for design services and secure the equipment price. This agreement will outline the City's intent to sole source the selected vendor during general bidding of the overall project construction.

2. Requirements

- A. Examine and carefully study the relevant documents, including any addenda, attachments, and other related data identified in this RFP.
- B. Be familiar with the Point of Destination as to the general, local, and Point of Destination conditions that may affect cost, progress, furnishing, and performance of the Goods and Special Services.
- C. Become familiar with and satisfy Bidder as to all Federal, state, and local Laws and Regulations that may affect cost, progress furnishing, and performance if the Goods and Special Services.
- D. Promptly provide City written notice of all confits, errors, ambiguities, or discrepancies that Bidder discovers in the submitted Proposal and confirm that the written resolution thereof is acceptable to UVSS.
- E. Determine the submitted Proposal and attached documents are generally sufficient to indicate and convey understanding of all terms and conditions for the furnishing of the Goods and Special Services.

3. General Description of Good and Special Services

The Goods and Special Services to be performed under these Contract Documents are generally described as follows:

The Bidder shall supply an Ultraviolet (UV) Disinfection system as specified in the Bidding Documents for equipment preselection. The Bidder's Early Work shall consist of the following:

- a. Cost for developing an equipment shop drawing submittal per the bidding documents; addressing Engineer's comments on the shop drawing; and providing a final approved shop drawing submittal.
- b. Agree to hold submitted equipment price per agreement.

4. Construction Contract

Installation work related to this RFP shall be by a construction contractor at the construction site designated herein as part of the Balance of Work. The City will sole-source the selected UVSS during general project bidding by listing the agreed upon equipment price by the selected UVSS in the general contract bid form. Purchase order of the UVSS equipment shall be between the General Contractor and the UVSS after the construction contract has been awarded. The UVSS shall hold their submitted price from the Early Work for one year from the fully executed date of the preselection agreement.

The General Terms and Conditions for the construction contract will differ from the Preselection RFP. UVSS shall includes costs in Balance of Work for items the General Contractor will require from the UVSS related to the General Contractor's Terms and Conditions. These may include but not limited to Payment Bonds, Liquidated Damages, and Insurance.

5. Alternates

The Goods and Special Services required under the Base Bid are indicated in the Specifications as Attachment A. All requirements specified or indicated also apply to each alternative selected by City except as otherwise provided. The following alternates are provided for in the Bid Form.

Alternate A: Extend standard 12-month warranty to 36 months.

Alternate B: Extend standard 12-month warranty bond to 36 months.

Alternate C: Replace NEMA 12 enclosures with NEMA 4X.

SECTION III - MINIMUM INFORMATION REQUIRED

PROPOSAL FORMAT

Bidders should organize Proposals into the following Sections:

- A. History of Installations
- B. Proposed System Design
- C. Fee Proposal, per Bid Form (see specifications)
- D. Authorized Negotiator
- E. Attachments

PROPOSAL EVALUATION CRITERIA

A selection committee will evaluate each proposal by the criteria point system described below. The City reserves the right to reject any proposal that it determined to be unresponsive and deficient in any of the information requested for evaluation. The committee may contact references to verify material submitted by the Bidders.

The following describes the elements that should be included in each of the proposal sections and the weighted point system that will be used for evaluation of the proposals.

A. History of Installations – 10 points

The written proposal must include a list of specific experience the UV manufacturer has with installations. The list shall include information on model number, UV bank quantity, installation date, start-up date, and flow conditions.

B. Proposed System Design – 15 points

System design shall be in accordance with the specifications. Proposal shall include the proposed UV System, quantity and design, headloss through the system, drawings, detailed operation and maintenance costs and tasks, equipment lead time and other information deemed relevant by the UVSS.

C. Fee Proposal – 75 points

The Fee shall include price information listed in the Bid Form (Section 00 41 63) in Attachment A. The City's Engineer will develop a 20-year life-cycle cost analysis to determine the lowest cost of the ownership and the ability to meet the project specifications provided in Attachment A of the RFP. The UVSS with the lowest lifecycle cost will be awarded the maximum allowable points. UVSSs with higher lifecycle costs will be awarded points based on percentage difference from the lowest cost, i.e. 10% higher lifecycle cost will result in 10% reduction in allowable points.

D. Authorized Negotiator

Include the name, phone number, and e-mail address of persons(s) in your organization authorized to negotiate the agreement with the City

E. Attachments

Legal Status of Bidder, Conflict of Interest Form, Living Wage Compliance Form, and the Non-Discrimination Form should be returned with the proposal. These elements should be included as attachments to the proposal submission.

PREPARATION OF PROPOSALS

Proposals should have no plastic bindings but will not be rejected as non-responsive for being bound. Staples or binder clips are acceptable. Proposals should be printed double sided on recycled paper.

Each person signing the proposal certifies that they are a person in the Bidder's firm/organization responsible for the decisions regarding the fees being offered in the Proposal and has not and will not participate in any action contrary to the terms of this provision.

ADDENDA

If it becomes necessary to revise any part of the RFP, notice of the addendum will be posted to Michigan Inter-governmental Trade Network (MITN) www.mitn.info and/or the City of Ann Arbor web site www.A2gov.org for all parties to download.

Each Bidder must acknowledge in its proposal all addenda it has received. The failure of an Bidder to receive or acknowledge receipt of any addenda shall not relieve the Bidder of the responsibility for complying with the terms thereof. The City will not be bound by oral responses to inquiries or written responses other than official written addenda.

SECTION IV - ATTACHMENTS

Attachment A – Technical Specifications

Attachment B – Legal Status of Bidder

Attachment C – Non-Discrimination Ordinance Declaration of Compliance Form

Attachment D – Living Wage Declaration of Compliance Form

Attachment E – Vendor Conflict of Interest Disclosure Form

Attachment F – Non-Discrimination Ordinance Poster

Attachment G – Living Wage Ordinance Poster

Attachment H – City of Ann Arbor General Terms and Conditions

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ATTACHMENT A
(TECHNICAL SPECIFICATIONS)

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Wastewater Treatment Plant UV Disinfection Equipment

UV PRESELECTION SPECIFICATIONS

BV Project No. 413104

February 2023



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Bid Form Preselection

SECTION 00 41 63 - BID FORM – PRESELECTION

IDENTIFICATION OF GOODS AND SPECIAL SERVICES:

1. Early Work shall consist of the Bidder's cost for developing an equipment shop drawing submittal per the preselection documents; addressing Engineer's comments on the shop drawing; and providing a final approved shop drawing submittal.
2. Balance of Work shall consist of all costs for providing goods and services described in the Bidding Documents, other than work identified as Early Work, including, but not limited to the following:
 - a. - Furnish Gates as outlined in the Open-Channel Metal Slide Gates and Weir Gates Section.
 - b. - ETC for other Div 40/46 sections
 - c. - Delivery of Equipment to Site
 - d. - Installation and startup assistance
 - e. - Training
 - f. - Equipment Warranty

Costs for Balance of Work will be the basis for an Allowance in a subsequent general construction contract. The successful general contractor (GC) will subcontract directly with the successful UV Bidder for the Balance of Work scope as part of that general contract.

ARTICLE 1 – BID RECIPIENT

1.01. This Bid is submitted to:

City of Ann Arbor
c/o Customer Service
301 East Huron Street
Ann Arbor, MI 48104

1.02. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an agreement with City in the form included in the Bidding Documents to furnish all Goods and Special Services as specified or indicated in the Bidding Documents as Early Work. The Bidder also agrees to guarantee the price for the Balance of the Work that shall be used for a General Contractor to use in a subsequent construction contract.

ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS

2.01. Bidder accepts all of the terms and conditions of the Invitation to Bid and the Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for

Bid Form Preselection

60 days after the day of Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of City. Bidder will sign and submit the Agreement with the Bonds and other documents required by the Bidding Documents to City within 15 days after the date of City's Notice of Award.

2.02. Bidder accepts the provisions of the Agreement as to liquidated damages in the event of its failure to furnish the Goods and Special Services in accordance with the schedule set forth in the Agreement.

ARTICLE 3 – BIDDER’S REPRESENTATIONS

3.01. In submitting this Bid, Bidder represents, as set forth in the Agreement, that:

A. Bidder has examined and carefully studied the Bidding Documents, the other related data identified in the Bidding Documents and the following Addenda, receipt of which is hereby acknowledged.

	<u>Addendum No.</u>		<u>Addendum Date</u>
No.	_____	Dated	_____
No.	_____	Dated	_____
No.	_____	Dated	_____
No.	_____	Dated	_____
No.	_____	Dated	_____

B. If specified, or if in Bidder’s judgment, any local condition may affect cost, progress, or the furnishing of Goods and Special Services, Bidder has visited the Point of Destination and become familiar with and is satisfied as to the local conditions that may affect cost, progress, or the furnishing of Goods and Special Services.

C. Bidder is familiar with and is satisfied as to all Federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Goods and Special Services.

D. Bidder has carefully studied and correlated the information known to Bidder, and information and observations obtained from Bidder’s visits, if any, to the Point of Destination with the Bidding Documents

E. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder.

F. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Goods and Special Services for which this Bid is submitted.

Bid Form Preselection

3.02. Bidder further represents that this Bid is genuine and is not made in the Interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization, or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any individual or entity to refrain from bidding; and Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Paragraph 3.02:

“corrupt practice” means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process;

“fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

“collusive practice” means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and

“coercive practice” means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 4 – BASIS OF BID

4.01. Bidder will furnish the Goods and Special Services in accordance with the Contract Documents for the following price(s):

Bid Form Preselection

Early Work Lump Sum Bid:

Base Bid, Early (up to \$70,000) \$_____

Balance of Work Lump Sum Bids:

Base Bid, Balance \$_____

Alternate A – Extend standard 12 month warranty to 36 months (add) \$_____

Alternate B - Extend standard 12 month warranty bond to 36 months (add) \$_____

Alternate C – Replace NEMA 12 enclosures with NEMA 4X (add) \$_____

ARTICLE 5 – TIME OF COMPLETION

5.01 Bidder agrees that the furnishing of Goods and Services will be completed and ready for final payment in accordance with the schedule defined in SECTION I, PARAGRAPH O of the Request for Proposal as part of the Early Works scope.

ARTICLE 6 - ATTACHMENTS TO THIS BID

6.01. The following documents are attached to and made a condition of this Bid:

- A. Required Bid security.
- B. Bidder shall complete Appendix A of the Bid Form for input parameters into the lifecycle evaluation.

ARTICLE 7 – DEFINED TERMS

7.01. Any questions regarding the definition of the terms used in this Bid shall be submitted to the City for clarification. Any misinterpretation of a bid term shall be at the cost of the Bidder.

ARTICLE 8 – BID SUBMITTAL

8.01. This Bid is submitted by:

Bid Form Preselection

By _____
(corporation name)

By _____

(title)

Business address _____

Phone No. _____

Date _____, _____

End of Section

ATTACHMENT A – LIFECYCLE EVALUATION INPUTS

A.1 BASE BID BREAKDOWN

Spare parts, per specifications	\$_____
Services of manufacturer representative, per specifications	\$_____
Owner training, per specifications	\$_____
Testing, per specifications	\$_____

A.2 POWER CONSUMPTION

Provide required power to operate the complete disinfection system supplied by the UVSS, which may include air compressor, hydraulic system, air conditioning, cooling fan, etc.

Power at peak flow of 54.0 mgd	_____kW
Number of lamps “on” at peak flow and lamp percent turndown	_____
Power at average flow of 25.0 mgd	_____kW
Number of lamps “on” at peak flow and lamp percent turndown	_____

A.3 SYSTEM CONFIGURATION

Provide the following requested information.

Total Number of Channels	_____
Total Number of Banks per Channel	_____
Total Number of Modules per Bank	_____
Total Number of Modules	_____
Total Number of Lamps per Module	_____
Total Number of Lamps	_____
Total Number of Ballast or Drivers	_____

Bid Form Preselection

Confirm a dimensioned figure showing the proposed UV system was provided for estimating structural requirements of the system. Figure should show length, width, and depth of proposed channels and required areas for maintenance activities. Additionally, the proposed fixed weirs shall be shown as well and required weir length.

A.4 REPLACEMENT COSTS

Provide guaranteed replacement parts costs for the following.

Component	Individual Replacement Cost (\$/unit)	Lot Replacement Cost (\$/lot)	Quantity per Lot
Lamp			
Ballast/Driver			
Quartz Sleeve			
Wiper			

Provide other acceptable replacement parts suppliers/manufacturers of spare parts.

UV Lamp -----
 Ballast/Driver -----
 Wiper -----

A.5 EXPECTED PART LIFE

Lamp (hours) -----
 Ballast/Driver (hours) -----
 Wiper (wipes) -----
 Recommended wipes per day -----
 Quartz Sleeves (years) -----

Bid Form Preselection

A.6 CHEMICAL CLEANING

Provide estimated annual chemical consumption for cleaning the system based on average flow conditions.

Chemical consumption (gallons/month) -----
Chemical Cost (\$/gallon) -----
Chemical Product Name -----

A.7 HYDRAULICS

Provide headloss through UV system. As appropriate, clarify the number of channels that are operational for each scenario

Headloss through UV modules at peak flow ----- inches
----- channels in operation
Headloss through UV modules at average flow ----- inches
----- channels in operation
Maximum water level fluctuation through system ----- inches

A.8 EQUIPMENT DELIVERY

The preselection of a UVSS will allow an approved shop drawing to be developed during design. The approved shop drawings will be provided to the apparent low bidder during general bidding. Provided this information, the equipment shall be delivered Freight on Board (FOB) job site ----- weeks after a general contractor is issued a notice to proceed.

A.9 UV DOSE DURING EQUIPMENT OUTAGE

Calculate the maximum UV dose to be delivered at the peak flow condition and other defined design criteria from Section 46 66 56 with one UV module in each channel out of service.

Dose at peak flow of 54.0 mgd ----- mJ/cm2
Power at peak flow of 54.0 mgd ----- kW
Number of lamps "on" at design condition and lamp percent turndown -----

Submittal Procedures

Section 01 33 00 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SHOP DRAWINGS AND ENGINEERING DATA.

A. General.

1. The Project has been designed by Engineer and Engineer will perform design-intent reviews of submittals. Owner, Engineer, and Bidder may develop a protocol for the transmittal of shop drawings, samples, and other submittals.
2. Shop Drawings and engineering data (submittals) covering all equipment and all fabricated components and building materials which will become a permanent part of the Work under this Contract shall be submitted to Engineer for review, as required. Submittals shall verify compliance with the Contract Documents, and shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and the operation of component materials and devices; the external connections, anchorages, and supports required; the performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.
3. Each submittal shall cover items from only one section of the specification unless the item consists of components from several sources. Bidder shall submit a complete initial submittal including all components. When an item consists of components from several sources, Bidder's initial submittal shall be complete including all components.
4. All submittals, regardless of origin, shall be approved by Bidder and clearly identified with the name and number of this Contract, Bidder's name, and references to applicable specification paragraphs and Contract Drawings. Each copy of all submittals, regardless of origin, shall be stamped or affixed with an approval statement of Bidder. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified and inapplicable data crossed out. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.
5. All deviations from the requirements of the Contract Documents shall be identified as deviations on each submittal and shall be tabulated in Bidder's letter of transmittal using Figure 2-01300. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by Bidder (including modifications to other facilities that may be a result of the deviation) and all required piping and wiring diagrams.

Submittal Procedures

6. Bidder shall submit shop drawings in either hard copy or electronically. All submittals shall be made with the selected method, and Bidder shall inform Engineer by letter within seven days after award of the Contract the method that has been selected. Submittals made by any method other than that selected by Bidder, will be returned without review.
7. For hard copy submittals five copies of each drawing and the necessary data shall be submitted to Engineer. Engineer will return two marked copies (or one marked reproducible copy) to Bidder. Facsimile (fax) or electronic copies will not be acceptable. Submittals will not be accepted from anyone but Bidder. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.
8. For electronic submittals, drawings and the necessary data shall be submitted electronically to Engineer as specified below. Submittal documents shall be in color to facilitate use of red line markups.
 - a. All electronic files shall be in Portable Document Format (PDF) as generated by Adobe Acrobat Professional Version 7.0 or higher.
 - b. The PDF file(s) shall be fully indexed using the Table of Contents, searchable with thumbnails generated. PDF images must be at a readable resolution.
 - c. For most documents, they should be scanned or generated at 300 dots per inch (dpi). Use of higher resolution is acceptable with Owner and Engineer approval.
 - d. Optical Character Recognition (OCR) capture must be performed on these images so that text can be searched, selected and copied from the generated PDF file.
 - e. The PDF documents shall have a bookmark created in the navigation frame for each major entry (“Section” or “Chapter”) in the Table of Contents.
 - f. Thumbnails shall be generated for each page or graphic in the PDF file.
 - g. The opening view for each PDF document shall be as follows:
 - 1) Initial View: Bookmarks and Page
 - 2) Magnification: Fit In Window
 - 3) The file shall open to Bidder’s transmittal letter, with bookmarks to the left. The first bookmark shall be linked to the Table of Contents.
 - h. PDF document properties shall include the submittal number for the document title and Bidder’s name for the author.
 - i. Electronic submittal file sizes shall be limited to 10 MB. When multiple files are required for a submittal the least number of files possible shall be created.

Submittal Procedures

9. Bidder shall submit submittals electronically to the Engineer. Engineer's submittal review comments will be returned electronically to the Bidder. Instruction on procedures for posting and retrieving submittals will be provided after award of the Contract.
 - a. Bidder shall provide a copy of the shop drawing submittal to the General Contractor as part of the Balance of Work during general construction.
10. Facsimiles (fax) will not be acceptable. Submittals will not be accepted from anyone but Bidder. Submittals shall be consecutively numbered in direct sequence of submittal and without division by subcontracts or trades.

B. Engineer's Review of Submittals.

1. Engineer's review of submittals covers only general conformity to the Drawings and Specifications, external connections, and dimensions that affect the layout; it does not indicate thorough review of all dimensions, quantities, and details of the material, equipment, device, or item covered. Engineer's review shall not relieve Bidder of sole responsibility for errors, omissions, or deviations in the drawings and data, nor of Bidder's sole responsibility for compliance with the Contract Documents.
2. Engineer's submittal review period shall be 21 consecutive calendar days and shall commence on the first calendar day following receipt of the submittal or resubmittal in Engineer's office.
3. The time required to mail the submittal or resubmittal back to Bidder shall not be considered a part of the submittal review period.
4. When the drawings and data are returned with review status "NOT ACCEPTABLE" or "RETURNED FOR CORRECTION", the corrections shall be made as instructed by Engineer .
 - a. If submittals are made in hard copy, five corrected copies shall be resubmitted.
 - b. If submittals are made electronically, the corrected drawings and data shall be resubmitted through the Project website.
 - c. Resubmittals by facsimile or e-mail will not be accepted. When the drawings and data are returned with review status "EXCEPTIONS NOTED", "NO EXCEPTIONS NOTED", or "RECORD COPY", no additional copies need be furnished unless specifically requested by Engineer .

C. Resubmittal of Shop Drawings and Data.

1. Bidder shall accept full responsibility for the completeness of each resubmittal. Bidder shall verify that all corrected data and additional information previously

Submittal Procedures

requested by Engineer are provided on the resubmittal. Resubmittals shall be in an organized and consistent format.

2. When corrected copies are resubmitted, Bidder shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by Engineer on previous submittals. Requirements specified for initial submittals shall also apply to resubmittals. Resubmittals shall bear the number of the first submittal followed by a letter (A, B, etc.) or a unique identification that indicates the initial submittal and correct sequence of each resubmittal.
3. If more than one resubmittal is required because of failure of Bidder to provide all previously requested corrected data or additional information, Bidder shall reimburse Owner for the charges of Engineer for review of the additional resubmittals. This does not include initial submittal data such as shop tests and field tests that are submitted after initial submittal.
4. Resubmittals shall be made within 21 days of the date of the letter returning the material to be modified or corrected, unless within 7 days Bidder submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time.
5. Resubmittals shall be made within 21 days of the date of the letter returning the material to be modified or corrected, unless within 7 days Bidder submits an acceptable request for an extension of the stipulated time period, listing the reasons the resubmittal cannot be completed within that time.
6. The need for more than one resubmittal, or any other delay in obtaining Engineer's review of submittals, will not entitle Bidder to extension of the Contract Times unless delay of the Work is the direct result of a change in the Work authorized by a Change Order or failure of Engineer to review and return any submittal to Bidder within the specified review period.

1.2 OPERATION AND MAINTENANCE DATA AND MANUALS.

- A. O&M manual requirements are provided below for development of price and the costs for this should be included within the Balance of Work.
- B. Adequate operation and maintenance information shall be supplied for all equipment requiring maintenance or other attention. The equipment Supplier shall prepare a Project specific operation and maintenance manual for each type of equipment indicated in the individual equipment sections or the equipment schedule.
- C. Unless otherwise agreed by Engineer, the operation and maintenance manual for each type of equipment shall only be submitted for review following completion of review of all shop drawings and engineering data pertaining to that equipment.

Submittal Procedures

- D. Parts lists and operating and maintenance instructions shall be furnished for other equipment not listed in the individual equipment sections or the equipment schedule.
- E. Operation and maintenance manuals shall include the following:
 - 1. Equipment function, normal operating characteristics, and limiting conditions.
 - 2. Assembly, installation, alignment, adjustment, and checking instructions.
 - 3. Operating instructions for startup, routine and normal operation, regulation and control, shutdown, and emergency conditions.
 - 4. Lubrication and maintenance instructions.
 - 5. Guide to troubleshooting.
 - 6. Parts lists and predicted life of parts subject to wear.
 - 7. Outline, cross section, and assembly drawings; engineering data; and wiring diagrams.
 - 8. Test data and performance curves, where applicable.
- F. The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered, or which may be required by Bidder.
- G. Hard copy and Electronic Manuals
 - 1. One electronic copy of the manual shall be submitted to Engineer prior to the date of shipment of the equipment.
 - 2. When the O&M manuals are returned with the review status "RETURNED FOR CORRECTION", the corrections shall be made as instructed by Engineer , and one complete corrected copy of the O&M manual returned to Engineer.
 - 3. After review by Engineer , is complete three hard and one electronic copy of each operation and maintenance manual shall be prepared and delivered to Engineer not later than 30 days prior to placing the equipment in operation. The electronic copy of the O&M manual shall be delivered on USB thumb drive to Engineer.
 - 4. Procedures for submission of the electronic copy will be provided after award of the Contract.
 - 5. The completed O&M manual shall also be filed to the Project website.
- H. All material shall be marked with Project identification, and inapplicable information shall be marked out or deleted.

Submittal Procedures

- I. Shipment of equipment will not be considered complete until all required manuals and data have been received.
- J. Hard Copy Operation and Maintenance Manual Requirements.
 1. Where reduction is not practicable, larger drawings shall be folded separately and placed in envelopes, which are bound into the manuals. Each envelope shall be suitably identified on the outside.
 2. Each volume containing data for three or more items of equipment shall include a table of contents and index tabs.
 3. The final hard copy of each manual shall be prepared and delivered in substantial, permanent, three-ring binders with heavy paper covers and include a table of contents and suitable index tabs.
- K. Electronic Operation and Maintenance Manual Requirements.
 1. Electronic manuals shall be in Adobe Acrobat's Portable Document Format (PDF), and shall be prepared at a resolution between 300 and 600 dots per inch (dpi), depending on document type.
 2. Optical Character Recognition (OCR) capture shall be performed on these documents. OCR settings shall be performed with the "original image with hidden text" option in Adobe Acrobat Exchange.
 3. File size shall be limited to 10 MB. A single PDF file greater than 10 MB may only be submitted if acceptable to Owner. When multiple files are required the least number of files possible shall be created.
 4. File names shall be in the format OMXXXXX-YYYZ-V.pdf, where XXXXX is the five digit number corresponding to the specification section, YYY is a three digit O&M manual number, e.g. 001, Z is the letter signifying a resubmittal, A, B, C, etc., and V is a number used only when more than one 10 MB file is required for an O&M manual.
 5. Documents prepared in PDF format shall be processed as follows:
 - a. Pages shall be searchable (processed for optical character recognition) and indexed when multiple files are required.
 - b. Pages shall be rotated for viewing in proper orientation.
 - c. A bookmark shall be provided in the navigation frame for each entry in the Table of Contents.
 - d. Embedded thumbnails shall be generated for each completed PDF file.
 - e. The opening view for PDF files shall be as follows:
 - 1) Initial View: Bookmarks and Page
 - 2) Page Number: Title Page (usually Page 1)

Submittal Procedures

- 3) Magnification: Set to Fit in Window
- 4) Page: Single Page
- f. Where the bookmark structure is longer than one page the bookmarks shall be collapsed to show the chapter headings only.
- g. When multiple files are required the first file of the series (the parent file) shall list every major topic in the Table of Contents. The parent file shall also include minor headings bookmarked based on the Table of Contents. Major headings, whose content is contained in subsequent files (children) shall be linked to be called from the parent to the specific location in the child file. The child file shall contain bookmark entries for both major and minor headings contained in the child file. The first bookmark of any child file shall link back to the parent file and shall read as follows "Return to the *Equipment Name* Table of Contents", e.g. Return to the Polymer Feed System Table of Contents.
- h. Drawings shall be bookmarked individually.
- i. Files shall be delivered without security settings to permit editing, insertion and deletion of material to update the manual provided by the manufacturer.

L. Labeling

1. As a minimum, the following information shall be included on all final O&M manual materials, including CD-ROM disks, jewel cases, and hard copy manuals:
 - a. Equipment name and/or O&M title spelled out in complete words.
 - b. Project Name.
 - c. Owner Project/Contract Number.
 - d. Specification Section Number. Example: "Section 01 15500"
 - e. Manufacturer's name.
 - f. File Name and Date.

2. Label example:

Backwash Pump Operation and Maintenance Manual
Somewhere Plant Expansion
Project/Contract No. ____
Specification Section 01 1110
Manufacturer
OM11110-001.pdf, 5/05/07

Submittal Procedures

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

End of Section

General Equipment Stipulations

Section 01 61 00 - GENERAL EQUIPMENT STIPULATIONS

PART 1 - GENERAL

1.1 SCOPE.

- A. When an equipment specification section in this Contract references this section, the equipment shall conform to the general stipulations set forth in this section, except as otherwise specified in other sections.

1.2 COORDINATION.

- A. Contractor shall coordinate all details of the equipment with other related parts of the Work, including verification that all structures, piping, wiring, and equipment components are compatible. Contractor shall be responsible for all structural and other alterations in the Work required to accommodate equipment differing in dimensions or other characteristics from that contemplated in the Drawings or Specifications.

1.3 MANUFACTURER'S EXPERIENCE.

- A. Unless specifically named in the Specifications, a manufacturer shall have furnished equipment of the type and size specified which has been in successful operation for not less than the past 5 years.

1.4 WORKMANSHIP AND MATERIALS.

- A. Contractor shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.
- B. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall not have been in service at any time prior to delivery, except as required by tests.
- C. Except where otherwise specified, structural and miscellaneous fabricated steel used in equipment shall conform to AISC standards. All structural members shall be designed for shock or vibratory loads. Unless otherwise specified, all steel which will be submerged, all or in part, during normal operation of the equipment shall be at least 1/4 inch thick. When dissimilar metal components are used, consideration shall be given to prevention of galvanic corrosion.

General Equipment Stipulations

1.5 STRUCTURAL DESIGN REQUIREMENTS.

- A. All equipment, including non-structural components and non-building structures as defined in ASCE 7, and their anchorage, shall be designed and detailed in accordance with the Meteorological and Seismic Design Criteria section.

1.6 LUBRICATION.

- A. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during startup or shutdown and shall not waste lubricants.
- B. Lubricants of the types recommended by the equipment manufacturer shall be provided in sufficient quantities to fill all lubricant reservoirs and to replace all consumption during testing, startup, and operation prior to acceptance of equipment by Owner. Lubricants for equipment where the lubricants may come in contact with water before or during a potable water treatment process or with potable water, shall be food grade lubricants. This includes lubricants for equipment not normally in contact with water, but where accidental leakage of the lubricants may contaminate the water.
- C. Lubrication facilities shall be convenient and accessible. Oil drains and fill openings shall be easily accessible from the normal operating area or platform. Drains shall allow for convenient collection of waste oil in containers from the normal operating area or platform without removing the unit from its normal installed position.

1.7 ELEVATION.

- A. The elevation of the site shall be as indicated in the Meteorological and Seismic Design Criteria section. All equipment furnished shall be designed to meet stipulated conditions and to operate satisfactorily at the specified elevation.

1.8 ELECTRIC MOTORS.

- A. Unless otherwise specified, motors furnished with equipment shall meet the requirements specified in Common Motor Requirements for Process Equipment section or specified in specific equipment sections.

1.9 DRIVE UNITS.

- A. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor. Drive units shall be designed for 24 hour continuous service.

General Equipment Stipulations

- B. Gearmotors.
 - 1. The use of gearmotors sharing an integral housing or cutgears into the motor output shaft, or that require removal of lubricant from the gear reducer to change out the motor will not be acceptable.
- C. Gear Reducers.
 - 1. Each gear reducer shall be a totally enclosed unit with oil or grease lubricated, rolling element, antifriction bearings throughout.
- D. Unless superseded by individual specification requirements each helical, spiral bevel, combination bevel-helical, and worm gear reducers shall have a service factor of at least 1.50 based on the nameplate horsepower of the drive motor. Cycloidal gear reducers shall have a service factor of at least 2.0 based on the nameplate horsepower of the drive motor. Shaft-mounted and flange-mounted gear reducers shall be rated AGMA Class III. Helical gear reducers shall have a gear strength rating to catalog rating of 1.5. Each gear reducer shall be designed and manufactured in compliance with applicable most current AGMA standards, except the L₁₀ bearing life shall be 200, 000 hours.
- E. The thermal horsepower rating of each unit shall equal or exceed the nameplate horsepower of the drive motor. During continuous operation, the maximum sump oil temperature shall not rise more than 100°F above the ambient air temperature in the vicinity of the unit and shall not exceed 200°F .
- F. Each grease lubricated bearing shall be installed in a bearing housing designed to facilitate periodic regreasing of the bearing by means of a manually operated grease gun. Each bearing housing shall be designed to evenly distribute new grease, to properly dispose of old grease, and to prevent overgreasing of the bearing. The use of permanently sealed, grease lubricated bearings will not be acceptable in large sized reducers. In small reducers, similar to basin equipment, permanently sealed grease lubricated bearings rated L₁₀ 200,000 hour life may be provided at the manufacturer's option. An internal or external oil pump and appurtenances shall be provided if required to properly lubricate oil lubricated bearings. A dipstick or a sight glass arranged to permit visual inspection of lubricant level shall be provided on each unit.
- G. Gear reducers which require the removal of parts or the periodic disassembly of the unit for cleaning and manual regreasing of bearings will not be acceptable.
- H. Certification shall be furnished by the gear reducer manufacturer indicating that the intended application of each unit has been reviewed in detail by the manufacturer and that the unit provided is fully compatible with the conditions of installation and service.
- I. Adjustable Speed Drives.
 - 1. Each mechanical adjustable speed drive shall have a service factor of at least 1.75 at maximum speed based on the nameplate horsepower of the drive motor. A spare belt shall be provided with each adjustable speed drive unit employing a

General Equipment Stipulations

belt for speed change. Unless specifically permitted by the detailed equipment specifications, bracket type mounting will not be acceptable for variable speed drives.

J. V-Belt Drives.

1. Each V-belt drive shall include a sliding base or other suitable tension adjustment. V-belt drives shall have a service factor of at least 1.75 at maximum speed based on the nameplate horsepower of the drive motor.

1.10 SAFETY GUARDS.

- A. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 USS gage thick or thicker galvanized, aluminum-clad sheet steel, or stainless sheet steel or from 1/2 inch mesh galvanized expanded metal, or pultrusion molded UV resistant materials. Each safety guard shall be reinforced or shaped to provide suitable strength to prevent vibration and deflection and shall comply with OSHA. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water.

1.11 ANCHOR BOLTS.

- A. Equipment suppliers shall design and detail suitable anchor bolts for each item of equipment. Anchor bolts shall be designed for all operating conditions of the equipment, including wind and seismic loadings when applicable. Wind and seismic loads shall be as indicated in the Meteorological and Seismic Design Criteria section.
- B. Contractor shall furnish anchor bolts under the construction contract and be responsible for coordination with equipment suppliers for correct design and details.
- C. Requirements for anchor bolt type, material, and minimum diameter shall be as indicated in the Anchorage in Concrete and Masonry section.
- D. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete or masonry grout is placed.
- E. Unless otherwise indicated or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit 1-1/2 inches of grout beneath the baseplate and to provide adequate anchorage into structural concrete.

General Equipment Stipulations

1.12 EQUIPMENT BASES.

- A. Unless otherwise indicated or specified, all equipment shall be installed on concrete bases at least 6 inches . Cast iron or welded steel baseplates shall be provided for pumps, compressors, and other equipment. Each unit and its drive assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components, and adequate grout holes. Baseplates for pumps shall have a means for collecting leakage and a threaded drain connection. Baseplates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with grout as specified in the Grouting section.

1.13 SPECIAL TOOLS AND ACCESSORIES.

- A. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

1.14 SHOP PAINTING.

- A. All iron and steel surfaces of the equipment shall be protected with suitable protective coatings applied in the shop. Surfaces of the equipment that will be inaccessible after assembly shall be protected for the life of the equipment. Coatings shall be suitable for the environment where the equipment is installed. Exposed surfaces shall be finished, thoroughly cleaned, and filled as necessary to provide a smooth, uniform base for painting. Electric motors, speed reducers, starters, and other self-contained or enclosed components shall be shop primed or finished with an epoxy or polyurethane enamel or universal type primer suitable for top coating in the field with a universal primer and aliphatic polyurethane system.
- B. Surfaces to be coated after installation shall be prepared for painting as recommended by the paint manufacturer for the intended service, and then shop painted with one or more coats of a universal primer.
- C. Machined, polished, and nonferrous surfaces which are not to be painted shall be coated with rust-preventive compound as recommended by the equipment manufacturer.

1.15 PREPARATION FOR SHIPMENT.

- A. Equipment shall be prepared for shipment as specified in the Product Delivery Requirements section.

General Equipment Stipulations

1.16 STORAGE.

- A. Handling and storage of equipment shall be as specified in the Product Storage and Handling Requirements section.

1.17 INSTALLATION AND OPERATION.

- A. Installation and operation shall be as specified in respective equipment sections and the Startup Requirements section.
- B. Unless otherwise indicated in other sections, installation and operation/startup is by the General Contractor under a separate contract. Any specific work or installation assistance from the UVSS is outlined in other sections.

1.18 OBSERVATION OF PERFORMANCE TESTS.

- A. Where the Specifications require the presence of Engineer, initial tests shall be observed or witnessed by Engineer. Owner shall be reimbursed by Contractor for all costs of subsequent visits by Engineer to witness or observe incomplete tests, retesting, or subsequent tests.

1.19 PROGRAMMING SOFTWARE.

- A. Programming software shall be provided for any equipment which includes a programmable logic controller (PLC) or other digital controller that is user-programmable.
- B. The software shall be suitable for loading and running on a laptop personal computer operating with a Windows-based operating system.
- C. A copy of the manufacturer's original operating logic program shall be provided for use in maintaining and troubleshooting the equipment.
- D. Where multiple pieces of equipment, from the same or different vendors, use the same programming software, only one copy of the software need be provided.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

End of Section

Product Delivery Requirements

Section 01 65 00 - PRODUCT DELIVERY REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE.

- A. This section covers packaging and shipping of materials and equipment.
- B. Costs to comply with this section are to be included in the Balance of the Work.

1.2 PREPARATION FOR SHIPMENT.

- A. All equipment shall be suitably packaged to facilitate handling and to protect against damage during transit and storage. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept dry at all times.
- B. Painted and coated surfaces shall be protected against impact, abrasion, discoloration, and other damage. Painted and coated surfaces which are damaged prior to acceptance of equipment shall be repainted to the satisfaction of Engineer.
- C. Grease and lubricating oil shall be applied to all bearings and similar items.

1.3 SHIPPING.

- A. Before shipping each item of equipment shall be tagged or marked as identified in the delivery schedule or on the Shop Drawings. Complete packing lists and bills of material shall be included with each shipment.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

End of Section

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Product Storage and Handling Requirements

Section 01 66 00 - PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 - GENERAL

1.1 SCOPE.

- A. This section covers delivery, storage, and handling of materials and equipment.
- B. Costs to comply with this section are to be included in the Balance of the Work.
- C. The UVSS is only responsible for shipment to site and coordination of shipping dates with the General Contractor. Unloading and storage will be by the General Contractor.
- D.

1.2 DELIVERY.

- A. Contractor shall bear the responsibility for delivery of equipment, spare parts, special tools, and materials to the site and shall comply with the requirements specified herein and shall provide required information concerning the shipment and delivery of the materials specified in this Contract. These requirements also apply to any subsuppliers making direct shipments to the Site.
- B. Contractor shall, either directly or through contractual arrangements with others, accept responsibility for the safe handling and protection of the equipment and materials furnished under this Contract before and after receipt at the port of entry. Acceptance of the equipment shall be made after it is installed, tested, placed in operation and found to comply with all the specified requirements.
- C. All items shall be checked against packing lists immediately on delivery to the site for damage and for shortages. Damage and shortages shall be remedied with the minimum of delay.
- D. Delivery of portions of the equipment in several individual shipments shall be subject to review of Engineer before shipment. When permitted, all such partial shipments shall be plainly marked to identify, to permit easy accumulation, and to facilitate eventual installation.

1.3 STORAGE.

- A. Upon delivery, all equipment and materials shall immediately be stored and protected until installed in the Work.

Product Storage and Handling Requirements

- B. Stacked items shall be suitably protected from damage by spacers or load distributing supports that are safely arranged. No metalwork (miscellaneous steel shapes and reinforcing steel) shall be stored directly on the ground. Masonry products shall be handled and stored in a manner to hold breakage, chipping, cracking, and spalling to a minimum. Cement, lime, and similar products shall be stored off the ground on pallets and shall be covered and kept completely dry at all times. Pipe, fittings, and valves may be stored out of doors, but must be placed on wooden blocking. PVC pipe, geomembranes, plastic liner, and other plastic materials shall be stored off the ground on pallets and protected from direct sunlight.
 - C. Pumps, motors, electrical equipment, and all equipment with antifriction or sleeve bearings shall be stored in weathertight structures maintained at a temperature above 60°F. Electrical equipment, controls, and insulation shall be protected against moisture and water damage. All space heaters furnished in equipment shall be connected and operated continuously.
 - D. Equipment having moving parts, such as gears, bearings, and seals, shall be stored fully lubricated with oil, grease, etc., unless otherwise instructed by the manufacturer. Manufacturer's storage instructions shall be carefully followed by Contractor.
 - E. When required by the equipment manufacturer, moving parts shall be rotated a minimum of twice a month to ensure proper lubrication and to avoid metal to metal "welding". Upon installation of the equipment, Contractor shall, at the discretion of Engineer, start the equipment at one-half load for an adequate period of time to ensure that the equipment does not deteriorate from lack of use.
 - F. When required by the equipment manufacturer, lubricants shall be changed upon completion of installation and as frequently as required thereafter during the period between installation and acceptance. New lubricants shall be put into the equipment by Contractor at the time of acceptance.
 - G. Equipment and materials shall not show any pitting, rust, decay, or other deleterious effects of storage when installed in the Work.
 - H. In addition to the protection specified for prolonged storage, the packaging of spare units and spare parts shall be for export packing and shall be suitable for long-term storage in a damp location. Each spare item shall be packed separately and shall be completely identified on the outside of the container.
- 1.4 HANDLING.
- A. Stored items shall be laid out to facilitate their retrieval for use in the Work. Care shall be taken when removing the equipment for use to ensure the precise piece of equipment is removed and that it is handled in a manner that does not damage the equipment.
 - B. During handling, carbon steel constructed material including chains, straps, and forks on lifting equipment shall not directly contact any equipment or material constructed of

Product Storage and Handling Requirements

stainless steel. It shall be the Contractor's responsibility to correct any carbon steel contamination of stainless steel.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

End of Section

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SECTION 01 67 00 - METEOROLOGICAL AND SEISMIC DESIGN CRITERIA

PART 1 - GENERAL

1.1 SCOPE

- A. Buildings, non-structural components and non-building structures shall be designed in accordance with this section. In the event of conflict with requirements in other sections, the more stringent criteria shall be followed.

1.2 DESIGN CRITERIA.

- A. Buildings, non-structural components, non-building structures including anchorage of such items, shall be designed in accordance with the following criteria.

1. General Design Data		
	Building code and references	IBC 2018, ASCE 7-16 “Minimum Design Loads and Associated Criteria for Buildings and Other Structures”, AISC 360 “Specification for Structural Steel Buildings”, AISC 341 “Seismic Provisions for Structural Steel Buildings”
	Site elevation, above mean sea level (ft)	740
	Design flood elevation (100-year) (ft)	738.8
	Design groundwater elevation (ft)	To be defined during design
2. Wind Design Data		
	Basic (Ultimate) design wind speed, V (mph)	120
	Allowable Stress (Nominal) design wind speed, V _{asd} (mph)	93
	Exposure category	B
	Ground elevation factor, K _e	To be defined during design
	Risk Category	IV
3. Snow Design Data		
	Ground snow load, P _g (psf)	20
	Importance factor (snow loads), I	1.2
	Exposure factor (C _e)	1.0

	Thermal factor (C_t)	To be defined during design
4. Ice Design Data		
	Nominal ice thickness, t (in)	1
	Concurrent wind speed, V_c (mph)	40
	Importance factor (ice loads – ice thickness), I_i	1.25
	Importance factor (ice loads – concurrent wind), I_w	1.00
5. Seismic Design Data		
	Mapped MCE short period spectral response acceleration, S_s	0.104
	Mapped MCE one second period spectral response acceleration, S_1	0.048
	Design short period spectral response acceleration, S_{DS}	0.111
	Design one second period spectral response acceleration, S_{D1}	0.076
	Risk Category	IV
	XXX Building Importance factor, I	To be defined during design
	XXX Building Seismic Design Category	To be defined during design
	YYY Building Importance factor, I	To be defined during design
	YYY Building Seismic Design Category	To be defined during design
	ZZZ Building Importance factor, I	To be defined during design
	ZZZ Building Seismic Design Category	To be defined during design
	Non-Structural Components Importance Factor, I_p	As indicated in the Non-Structural Components Schedule, to be defined during design
	Non-Structural Components Seismic Design Category	To be defined during design
	Non-Building Structures Importance Factors, I	As indicated in the Non-Building Structure Schedule or in the applicable reference documents, whichever is greater.

1.3 WIND ANCHORAGE

- A. Equipment that is to be located outdoors shall have anchor bolts designed for the effects of wind forces, as determined in accordance with ASCE 7, Chapters 26-31.

- B. Design of anchorage shall be in accordance with the Anchorage in Concrete and Masonry section.

1.4 SEISMIC DESIGN

A. General.

- 1. Structural systems shall provide continuous load paths, with adequate strength and stiffness to transfer all seismic forces from the point of application to the point of final resistance.

B. Pre-Engineered Buildings

- 1. Pre-engineered buildings shall have sufficient strength and ductility to resist the specified seismic effects defined for buildings and shall meet all of the design, proportioning, detailing, inspection, and quality assurance provisions of the specified building code.
- 2. "W" for buildings shall include the total dead load, the total operating weight of permanent equipment and the effective contents of vessels, and applicable portions of other loads, as required by the specified building code.

C. Non-Structural Components.

- 1. Non-structural components are architectural, mechanical, and electrical items that are permanently attached to and supported by a structure but are not part of the structural system, as indicated in Chapter 13 of ASCE 7. The Non-Structural Components Schedule identifies the components that require seismic design. The requirements of this paragraph are applicable only to the items listed in the Non-Structural Components Schedule.

2. General

- a. Design of non-structural components shall be in accordance with all applicable provisions of ASCE 7, Chapter 13.
- b. "W_p" shall include the total operating weight of the component or system, including, but not limited to, any insulation, fluids, and concentrated loads such as valves, condensate traps, and similar components.

3. Submerged Components

- a. Components that are to be submerged in water shall be designed to withstand loads from the effects of water sloshing during the seismic event.
- b. The calculation of the sloshing effects shall be in accordance with the latest edition of ACI 350.3.

4. Anchorage Design
 - a. Every component in the Non-Structural Components Schedule shall have its anchorage to the supporting structure designed in accordance with ASCE 7, Chapter 13.
 - b. Design of anchorage shall be in accordance with the Anchorage in Concrete and Masonry section.
 - c. Components shall be attached so that seismic forces are transferred to the structural system. Curbs that support roof-mounted equipment shall be designed to transfer forces from the equipment into the main structural roof members. All structural attachments shall be bolted, welded, or otherwise positively fastened. Frictional resistance due to gravity shall not be considered in evaluating the required resistance to seismic forces.

5. Component Design
 - a. Every component in the Non-Structural Components Schedule shall be designed for seismic conditions in accordance with ASCE 7, Chapter 13.
 - b. Components shall have sufficient strength and ductility to resist the specified seismic effects, and shall meet all of the design, proportioning, detailing, inspection, and quality assurance provisions of the specified building code and other referenced codes. Components shall be designed to be operable during and following a design level seismic event without collapsing, breaking away from supports, creating an ignition hazard, or releasing any contents.
 - c. Seismic effects that shall be analyzed in the design of piping systems include the dynamic effects of the piping system, contents, and supports. The interaction between piping systems and the supporting structures, including other mechanical and electrical equipment, shall also be considered. Where pipe supports are to be designed by Contractor, as required by the Pipe Supports section, both the piping and support systems shall be designed to meet the applicable requirements of ASCE 7, Chapter 13.

6. Seismic Certification
 - a. Design of components and their anchorage shall be certified by one of the following methods.
 - 1) Analysis and design by a design professional registered in the state of the project. Certification by analysis shall be permitted only for nonactive components, and shall be based on seismic demand considering R_p/I_p equal to 1.0.
 - 2) Shake table testing based upon a nationally recognized testing standard procedure, such as ICC-ES AC 156, acceptable to the authority having jurisdiction.
 - 3) Experience data, based upon nationally recognized procedures acceptable to the authority having jurisdiction.
 - b. Components indicated in the Non-Structural Components Schedule to require special seismic certification shall be certified only by methods 2 or

3 above, except that certification for containment of hazardous materials may be by any of the three methods.

7. Construction Documents

- a. Construction documents (fabrication or shop drawings) of non-structural components shall be sealed by a design professional that is registered in the state of the project.
- b. Documents shall be sealed whether the basis for certification is analysis and design, shake table testing, or experience data.
- c. The sealing method shall clearly indicate that the component and its anchorage have been designed for the code required seismic forces.

8. Submittals

- a. The construction documents, structural design calculations, shake table certification, and experience data certification, as applicable, shall be submitted in accordance with the Submittal Procedures section.

D. Non-Building Structures

1. Non-building structures are the items described as such in Chapter 15 of ASCE 7. The Non-Building Structures Schedule identifies the items that require seismic design.
2. The requirements of this paragraph are applicable only to the items listed in the Non-Building Structures Schedule.
3. General
 - a. Design of non-building structures shall be in accordance with all applicable provisions of ASCE 7, Chapter 15.
 - b. Design of anchorage shall be in accordance with the Anchorage in Concrete and Masonry section.
 - c. "W" shall include the total dead load and shall also include all normal operating contents of tanks, vessels, bins, and piping.
 - d. Non-building structures shall provide sufficient strength and ductility to resist the specified seismic effects, and shall meet all of the design, proportioning, detailing, inspection, and quality assurance provisions of the specified building code and other referenced codes.
 - e. The seismic design of non-building structures shall provide sufficient stiffness, strength and ductility to resist the effects of seismic ground motions during the design level earthquake.
 - f. Non-building structures shall be designed to be operable during and following a design level seismic event, without collapsing, breaking away from supports, creating an ignition hazard, or releasing any contents.

Meteorological and Seismic Design Criteria (IBC 2018 + 2021)

4. Construction Documents
 - a. Construction documents (fabrication or shop drawings) depicting all seismic force resisting elements of non-building structures shall be sealed by a design professional that is registered in the state of the project.
5. Submittals
 - a. The construction documents shall be submitted in accordance with the Submittal Procedures section.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

End of Section

Equipment and Valve Identification

Section 01 68 00 - EQUIPMENT AND VALVE IDENTIFICATION

PART 1 - GENERAL

1.1 SCOPE.

- A. This section covers the furnishing and installation of nameplates and tags for identification of equipment, valves, panels, and instruments.

1.2 GENERAL.

- A. Except as otherwise specified in equipment, valve, and instrumentation sections, nameplates and tags shall be as specified herein. Nameplates or tags shall be provided for all equipment, valves, operator interfaces, control and electrical panels, cabinets, instruments, and instrument racks that have been named and/or tagged on the Drawings.

1.3 SUBMITTALS.

- A. Drawings and Data
 - 1. Drawings and data shall be submitted in accordance with the requirements of the Submittals Procedures section for each type of tag provided including materials, colors, sizes, letter sizes, and installation instructions.

PART 2 - PRODUCTS

2.1 EQUIPMENT NUMBER PLATES.

- A. All equipment tagged on the drawings, except for submerged equipment shall be provided with number plates bearing the equipment tag number identified on the Drawings.
- B. Number plates shall be bevelled, 1/8th inch thick laminated black phenolic plastic engraving stock with white core. Lettering on number plates shall be capitalized block letters $\frac{3}{4}$ inch high.
- C. Number plate height shall be twice the letter height. Number plate length shall be as needed, with suitable margins all around.
- D. Lettering shall be placed in one row where practicable; however, where necessary due to excessive length, lettering shall be placed on more than one row and centered.

Equipment and Valve Identification

- E. Number plates shall be attached with stainless steel panhead screws, rivets, or drive screws.
- F. When a number plate cannot be installed due to the physical size, space, or mounting surface geometry of the equipment, the Contractor shall provide a 12 gauge stainless steel tag with engraved or imprinted equipment tag number. Lettering on tags shall be ¼ inch high. Tags shall be rectangular with smooth edges and shall be fastened to the equipment with stainless steel mechanical fasteners or with a stainless steel chain.

2.2 EQUIPMENT INFORMATION PLATES.

- A. Equipment shall be provided with engraved or stamped equipment information plates securely affixed with mechanical fasteners to the equipment in an accessible and visible location.
- B. Equipment information plates shall be in addition to the number plates specified.
- C. Equipment information plates shall indicate the manufacturer's name, address, product name, catalog number, serial number, capacity, operating and power characteristics, labels of tested compliances, and any other pertinent design data.
- D. Equipment information plates listing the distributing agent only will not be acceptable.

2.3 VALVE AND GATE TAGS.

- A. Temporary Tags.
 - 1. Each valve and gate with an identifying number indicated on the Drawings or listed in the valve or gate schedule, shall be tagged or marked in the factory with the identifying number.
- B. Permanent Tags.
 - 1. All valves and gates, except buried or submerged valves, that have been assigned a number on the Drawings or in the valve or gate schedule, shall be provided with a permanent number plate.
 - 2. Tags shall be permanently attached to valves and gates with stainless steel mechanical fasteners or with stainless steel chains. Numerals shall be ¾ inch 20 mm high and shall be black baked enamel on an anodized aluminum plate.
- C. All buried valves shall be tagged with a brass plate cast into a 6-inch by 6 inch concrete pad at grade next to the valve box. The valve number shall be engraved in the brass plate with lettering and numerals at least 1 inch high.

Equipment and Valve Identification

2.4 PANEL NAMEPLATES.

- A. Nameplates shall be provided on the face of each panel and cabinet. Panel identification nameplates shall be mounted at the top of the panel shall include the panel descriptive name and tag number as indicated on the Drawings, in two or three lines of text. Lettering shall be $\frac{3}{4}$ inch high.
- B. Nameplates for devices mounted on or in the panel shall be inscribed with the text as indicated on the Drawings. Where nameplate information is not indicated on the Drawings, inscriptions shall be in accordance with information in the supplier's submittal drawings as guided by information in the relevant specification section. Panel device nameplates shall have engraved letters $\frac{3}{16}$ inch high.
- C. Nameplate material and size shall be as specified above for equipment number plates. Nameplates shall be secured to the panel with stainless steel panhead screws.

2.5 INSTRUMENT TAGS.

- A. Temporary Tags.
 - 1. Where instruments are not provided with permanent tags furnished from the factory, instruments shall be tagged or marked in the factory with the instrument tag number indicated on the Drawings.
- B. Permanent Tags.
 - 1. Instruments shall be tagged with the instrument tag number indicated on the Drawings. Tags shall be 12 gauge stainless steel with engraved or imprinted symbols. Lettering on tags shall be $\frac{1}{4}$ inch high. Tags shall be rectangular with smooth edges, and shall be fastened to the instrument with stainless steel mechanical fasteners or with a stainless steel chain.

PART 3 - EXECUTION (NOT USED)

End of Section

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Demonstration and Training

Section 01 79 00 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 DESCRIPTION.

- A. This section contains requirements for training the Owner's personnel in the proper operation and maintenance of the equipment and systems installed under this contract.

1.2 GENERAL.

- A. Where indicated in the Equipment Schedule section and as required by the specifications, the manufacturer's representative shall provide on-the-job training of the Owner's personnel. The training sessions shall be conducted by qualified, experienced, factory trained representatives of the various equipment manufacturers. Training shall include instruction in both operation and maintenance of the subject equipment.

1.3 SUBMITTALS.

A. General

1. Costs to comply with this section are to be included in the Balance of the Work.
2. The following information shall be submitted to the Engineer in accordance with the provisions of the Submittals Procedures section. The material shall be submitted not less than 4 weeks prior to the provision of training.
3. Lesson plans, training manuals, handouts, visual aids, and other reference materials for each training session to be conducted by the manufacturer's representatives.
4. Subject of each training session, identity and qualifications of individuals to be conducting the training, and tentative date and time of each training session.

PART 2 - PRODUCTS

2.1 GENERAL.

- A. Where specified, the Contractor shall conduct training sessions for the Owner's personnel to instruct staff on the proper operation, care, and maintenance of the equipment and systems installed under this contract. Training shall take place at the site of the work and under the conditions specified in the following paragraphs.

Demonstration and Training

Approved operation and maintenance manuals shall be available at least 30 days prior to the date schedule for the individual training session.

2.2 LOCATION.

- A. Training sessions shall take place at the site of the work at a location designated by the Owner.

2.3 LESSON PLANS.

- A. Formal written lesson plans shall be prepared for each training session. Lesson plans shall contain an outline of the material to be presented along with a description of the visual aids to be utilized during the sessions. Each plan shall contain time allocation for each subject.
- B. One complete set of originals of the lesson plans, training manuals, handouts, visual aids and reference materials shall be the property of the Owner and shall be suitable bound for proper organization and easy reproduction. The Contractor shall furnish up to twenty copies of necessary training manuals, handouts, visual aids, and reference materials at least 1 week prior to each training session.

2.4 FORMAT AND CONTENT.

- A. Each training session shall include classroom and time at the location of the subject equipment or system. As a minimum, training sessions shall cover the following subjects for each item of equipment or system:
 - 1. Familiarization
 - a. Review catalog, parts lists, drawings, etc, which have been previously provided for the plan files and operation and maintenance manuals.
 - b. Guided inspection of the subject equipment.
 - c. Demonstration of the subject equipment and how operation in accordance with the specified requirements.
 - 2. Safety
 - a. Review and demonstration of safety procedures and related documentation.
 - b. Inspection and discussion of hazardous components of the subject equipment.
 - 3. Operation
 - a. Review of subject equipment operations literature and theory of operation.
 - b. Overview of equipment operation and function.

Demonstration and Training

- c. Explanation and demonstration of all modes of operation including start up, shut down, normal, and emergency operation, and manual and automatic operation through the plant control system.
 - d. Explanation of all hardwired interlocks.
 - e. Explanation and demonstration of equipment related valves and their purpose.
 - f. Explanation of all equipment related instruments including primary element, instrument indicator, purpose, and interpretation of information.
 - g. Check out of Owner's personnel on proper use of the equipment.
4. Preventive maintenance
 - a. Review preventative maintenance documentation and discussion of maintenance require at various intervals; e.g. daily, weekly, monthly, annually.
 - b. Demonstrate performance of each preventive maintenance task.
 - c. Identification of indicators of equipment problems.
 - d. Discussion of corrosion protection and lubrication requirements.
 - e. Requirements for periodic exercise of equipment and demonstration of equipment exercise where required.
 - f. Identification of inspection points and demonstration of inspection covers removal and routine disassembly and assembly of equipment.
5. Corrective Maintenance and Equipment Repair
 - a. Discussion of common repairs and identification of special problems.
 - b. Explanation and demonstration of equipment inspection and troubleshooting.
 - c. Demonstration of calibration procedures.
 - d. Demonstration of repair procedures where practical.
6. Parts
 - a. Discussion of the parts list and ordering of parts.
 - b. Review of spare parts provided with the equipment and identification of other recommended spare part.
7. Local Representatives
 - a. Name, address, telephone of local representative.
 - b. Review of contact information for providers of routine and emergency repair and operational assistance.
8. Operation and Maintenance Manuals
 - a. Review of O&M manual content and organization.
 - b. Update O&M material as required.

Demonstration and Training

2.5 VIDEO RECORDING.

- A. The Contractor shall record each training session and shall give the Owner exclusive rights to each training session recording. The Contractor shall advise all manufacturers providing training sessions that the material will be recorded.

PART 3 - EXECUTION

3.1 General

- A. Training shall be conducted in conjunction with the operational testing and commissioning periods. Classes shall be scheduled so that training is performed when equipment is available for operation. The Contractor shall arrange to have the training conducted on consecutive days, with no more than 6 hours of class scheduled for any one day. Concurrent classes will not be permitted.

End of Section

Commissioning

Section 01 91 00 - Commissioning

PART 1 - GENERAL

1.1 SCOPE.

- A. The UVSS shall support commissioning requirements outlined herein and include costs in the Balance of Work. Requirements for the General Contractor are included for reference to the UVSS.
- B. This section includes the requirements for startup and testing all items of equipment and systems that form a part of this Contract.
- C. The purpose of this section is to define the requirements for bringing individual equipment, systems, and facilities online and for proving proper operation and performance of that Work.
- D. Contractor is required to develop, submit, and maintain detailed plans, including designation of management and staff, for these activities as specified herein.
- E. Additional requirements such as training are specified in other sections.
- F. The Contractor will be required to startup, test, and commission equipment preselected by the Owner. The Contractor shall refer to the Preselection Documents furnished by the Owner and coordinate with the Supplier of the equipment regarding startup and testing activities.
- G. The startup, testing, and commissioning services referenced or specified herein include the following:
 - 1. Startup and Testing
 - a. Startup checks
 - b. Functional testing
 - 2. Functional acceptance testing
 - 3. Commissioning
 - 4. Operation acceptance testing
 - 5. Performance testing
- H. Definitions.

Commissioning

1. Startup and Testing is the transitional phase between completion of construction and start of commissioning and includes the following:
 - a. Pre-Startup Activities and Checks - Inspections, tests and other activities necessary to determine that equipment, systems and subsystems have been properly manufactured and installed. Pre-startup activities shall include an audit of all factory testing of equipment and compiling the results for comparison to startup and commissioning testing.
 - b. Functional Testing – Initial limited operation of equipment, to demonstrate capability of installed components to perform their intended functions, respond to controls, and safely interface with external systems, followed by operation of individual systems in manual and automatic mode to test full functionality of individual systems.
 - c. Commissioning - The establishment of the treatment processes for the plant.
 - d. Operational acceptance testing - Continuous testing of complete the treatment processes under specified operating conditions in accordance with the technical Specifications and applicable regulations to demonstrate proper performance of the facility.
 - e. Performance testing - When specified, continuous testing in accordance with the requirements of the Contract Documents.

1.2 GENERAL.

- A. The Contractor shall be responsible for and furnish all labor, materials, instruments, incidentals, and equipment required for startup, testing, and commissioning.
- B. Temporary facilities required to carry out the specified testing, including temporary pipe, pumps, and other appurtenances, shall be furnished and installed, and removed when no longer required for startup, testing, and commissioning. Refer to the Temporary Facilities section for requirements concerning water and power for startup and testing.
- C. Chemicals required for startup and testing shall be provided by the Contractor except as otherwise specified herein.
- D. Wastewater, including treated or test water that cannot be delivered to the plant effluent for any reason, shall be disposed of at the expense of the Contractor, in a manner acceptable to the Owner, and in accordance with all laws, regulations, and permits.
- E. Startup and testing shall be conducted during normal working hours during the workweek of Monday through Friday, unless otherwise approved by the Owner.
- F. Where continuous long-term testing is required, testing may continue over the weekends and holidays with prior approval from the Owner.

Commissioning

1.3 CONSTRAINTS.

- A. Startup and testing shall be conducted in a manner that does not compromise operation of the existing facilities or the quality of treated products released from the facility.
- B. Any startup and testing activities affecting operation of the existing facilities shall be coordinated with the Owner and shall be shown on the Progress Schedule. The Owner will cooperate with the Contractor to the extent possible, but will have sole authority in decisions affecting existing operations.

1.4 STARTUP MANAGER, STARTUP TEAM, AND MANUFACTURER'S FIELD SERVICES REPRESENTATIVES.

- A. The Contractor shall maintain a dedicated startup team led by a startup manager. The individual to be designated as startup manager shall be identified within 45 days of the Notice to Proceed and will be reviewed by Owner and Engineer. Once accepted, the Contractor shall not change the startup manager throughout the full period of performance of the Work without written permission of the Owner. Once engaged in the Project, the startup manager shall attend regular construction progress meetings. No startup activities shall begin until the startup manager has arrived at the jobsite.
- B. The startup manager shall be on Site full time at least 30 days prior to any field startup and testing activities and shall remain on site until all startup, testing, and commissioning activities are complete.
- C. Startup Manager.
 - 1. The startup manager shall be a startup and testing expert with a minimum of 5 years of experience starting up equipment and systems of similar type, size, capacity, and complexity to the equipment and systems included in this Project. The startup manager shall have the necessary experience to fully understand all startup requirements, to manage the Contractor's resources providing the startup services, and to prepare all startup documentation, as specified. The startup manager may be self-performed by the Contractor, provided they meet the requirements of this section. The startup manager's assigned duties and responsibilities are those specifically related to planning, supervising, and executing startup activities and shall include, but shall not be limited to the following:
 - a. Coordinating all testing and startup activities.
 - b. Preparing all startup and field testing plans, documentation, and forms.
 - c. Liaising between the Contractor, Engineer, and Owner for all startup and testing activities.
 - d. Developing a comprehensive schedule for all startup activities and providing regular schedule updates. The startup and testing schedule shall be incorporated into the Progress Schedule.

Commissioning

- e. Scheduling and leading startup, testing, and commissioning planning meetings.
- f. Conducting coordination meetings during startup, testing, and commissioning at least weekly.
- g. Coordinating manufacturers' services and their certification of proper installation and/or operation of equipment as required by the Specifications.
- h. Overseeing and administering all startup, testing, and commissioning activities, including either direct participation in the activities and/or oversight and monitoring of activities. It shall be the startup manager's responsibility to assure that all tests have been completed in accordance with accepted testing procedures.
- i. Ensuring readiness for and coordinating maintenance, repair, and adjustment of equipment and systems during startup testing, and commissioning.
- j. Conducting or overseeing pre-test checks to ensure readiness for testing.
- k. Verify all piping hydrostatic testing and flushing has been completed prior to field testing connected equipment.
- l. Ensuring all testing equipment is in proper working order and has been calibrated to appropriate standards.
- m. Developing safe work policies and procedures including lockout/tagout procedures and personal protective equipment policies, that will be followed during all field startup and testing activities. At a minimum the Contractor shall comply with OSHA and the Owner's established safety guidelines. It shall be the startup manager's responsibility to assure all safety procedures are followed at all times.
- n. Reviewing and approving all equipment training sessions prior to submission to Engineer, to assure that the training is compliant with the requirements of the Specifications and includes all applicable operation, maintenance, safety, functional, performance, and startup and testing information.
- o. Organizing teams made up of qualified representatives of Suppliers, Subcontractors, and others, as appropriate, to efficiently and expeditiously startup and test the equipment and systems installed and constructed under this Contract. The objective of this program shall be to demonstrate to the Engineer and Owner that the structures, systems, and equipment constructed and installed under this Contract meet all performance requirements and the facility is ready for operation as intended. In addition, the testing program shall produce baseline operating conditions for the Owner to use in a preventive maintenance program.
- p. Ensuring the development and maintenance of records documenting all startup, testing, and commissioning activity. The records shall be organized by major process system into organized files/binders and turned over to the Owner prior to applying for final payment. Testing records shall be accessible to the Engineer and Owner at all times to allow monitoring of the progress.
- q. Ensuring the startup team is equipped and ready to make emergency repairs and adjustments to equipment installed and modified as part of the Project.

Commissioning

- r. Scheduling and conducting a one day workshop with the Owner and Engineer to resolve submittal review comments to the Contractor's startup, testing, and commissioning plan submittal.
- s. Notifying the Owner and all respective equipment manufacturers at least 21 days prior to the date when each equipment system is scheduled for pre-startup activities and checks.
- t. Organize International Electrical Testing Association (NETA) acceptance testing in accordance with the Electrical Equipment Installation section.

D. Startup Team.

1. The startup team shall include the startup manager and all staff deemed necessary for successful completion of startup, testing, and commissioning. This will typically include engineers, major equipment vendors, operators, and representatives from the Instrumentation and Control System Supplier. Additional trade representatives may be included as project requirements dictate.

E. Manufacturer's Field Services Representative.

1. The manufacturers shall provide a technically qualified field-service representative for the installation, startup, and testing of equipment furnished, as specified in the equipment sections and the Procurement Documents.
2. The manufacturer shall submit qualifications and experience records for all key personnel to be involved in startup activities.
3. The manufacturer's field services representative shall be employed full-time in installation, startup, and testing of similar equipment and facilities and work directly for the manufacturer.
4. The representative shall have conducted startup activities similar to those required herein on at least two other projects of similar complexity.
5. The Owner or Engineer shall have the right to reject the manufacturer's field services representative at any time, for immediate replacement by the manufacturer, if the accepted qualifications are not representative of the actual experience or abilities of the representative, as determined by the Owner or Engineer.

1.5 SUBMITTALS.

A. Startup Manager Qualifications

1. Startup manager's qualifications and past project experience including contact names, addresses and current telephone numbers of owner representatives that can

Commissioning

be used to verify the accuracy of the information. Submittal shall be made at the preconstruction conference.

B. Manufacturer Representative Qualifications

1. Manufacturers' field services representative's qualifications and past project experience including contact names, addresses and current telephone numbers that can be used to verify the accuracy of the information. Qualification submittals shall be made 3 weeks before the manufacturer's representative is scheduled to be on Site.

C. Installation Certifications

1. Manufacturer's certification of proper installation of all equipment as specified in the equipment sections.

D. Plans and Schedules

1. Equipment and system startup, testing, and commissioning plans and schedule in accordance with the requirements of this section. Startup manager shall coordinate with Subcontractors and include their information in the startup and testing plan.

E. Field Calibration Results

1. Unless otherwise specified in the equipment sections, preliminary copies of field calibration results. Submittal shall be made prior to the start of each test for associated systems.

F. Daily logs.

G. General

1. Submittals shall be provided in accordance with the requirements of the Submittals Procedures section.

1.6 STARTUP AND TESTING REQUIREMENTS.

A. Startup Checks.

1. Prior to field testing of all equipment, the Contractor shall perform the following:
 - a. Inspect and clean equipment, devices, and connected piping so they are free of foreign material.
 - b. Lubricate equipment in accordance with manufacturer's instructions.
 - c. Turn rotating equipment by hand.
 - d. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.

Commissioning

- e. Test and commission related electrical system components in accordance with the requirements specified in the Electrical and the Electrical Equipment Installation sections.
 - f. Calibrate all instruments associated with the equipment.
 - g. Check for proper rotation, adjustment, alignment, balancing, mechanical and electrical connections, and any other conditions that may damage or impair equipment from functioning properly.
 - h. Inspect and verify proper anchorage.
 - i. Obtain manufacturer's certification of proper installation where specified in the equipment sections.
2. All equipment shall be confirmed ready to test by the Engineer based on the following:
- a. Acceptance of Contractor's startup and testing plan.
 - b. Notification in writing by the startup manager that each piece of equipment or system is ready for testing.
 - c. Verification by the Engineer and Owner that all lubricants, tools, maintenance equipment, spare parts and approved equipment operation and maintenance manuals have been furnished as specified.
 - d. Cleanliness of equipment, devices, and connected work.
 - e. Adequate completion of work adjacent to or interfacing with equipment to be tested.
 - f. Confirmation of manufacturer's representative's availability to assist with testing, where specified, and satisfactory fulfillment of all other manufacturers' responsibilities as specified.
 - g. Engineer's inspection of all related civil construction, mechanical, and electrical installations.
 - h. Confirmation of completion of acceptable testing of all adjacent piping, duct work and other affected Work.

B. Functional Testing.

1. All startup checks shall be completed prior to functional testing. Functional testing shall be in accordance with relevant standards and in accordance with instructions of the manufacturers.
2. Ancillary and/or temporary facilities necessary to recycle, control, or discharge water, air, chemical, or gas from facilities being tested, shall be operational.
3. Functional testing shall include the functional operation of each piece of equipment. All moving parts of equipment and machinery shall be tested and adjusted so that they move freely and function satisfactorily. Functional testing shall demonstrate correct operation of all hardwired interlocks and controls.
4. Functional testing of power actuated valves shall include at least 4 full open-close operations. Testing shall demonstrate the maximum number of operations per hour as recommended by the actuator manufacturer without overheating.

Commissioning

5. Once functional testing of individual pieces of equipment is completed, individual systems functional testing shall commence. Individual system functional testing shall include startup of the complete system of mechanical, electrical, and instrumentation and control equipment as a functional process system. Field inspection prior to startup as specified in the Instrumentation and Control System section, other testing by the Instrumentation and Control System Supplier required to verify readiness for automatic operation of the individual system, shall be completed before commencement of individual system functional testing.
6. Individual system functional testing shall include operation in manual and automatic modes, startup operation, and shutdown in normal and emergency modes. Individual systems shall be tested over their entire operating range and for sufficient time to demonstrate the intended functionality of each piece of equipment and the system. If any part of a system shows evidence of unsatisfactory or improper operation during the test period, correction or repairs shall be made and the functional testing shall be repeated until satisfactory results are obtained.
7. Functional testing of all process and pumping equipment and drive motors, including auxiliary equipment, shall be in accordance with the appropriate and approved test codes, such as those specified by the American Society of Mechanical Engineers, Hydraulic Institute Standards, and IEEE.
8. Qualified personnel from the electrical and mechanical trades responsible for installation of the equipment, shall be available during functional testing involving electrically operated equipment. Where appropriate, a representative of the Instrumentation and Control System Supplier shall also be available.

C. Functional Acceptance Testing.

1. Once the Contractor's functional testing is complete and associated documentation has been submitted and accepted by the Engineer, the Contractor shall conduct functional acceptance testing of each complete process system, to demonstrate individual systems meet the specified requirements. Acceptance testing shall include the successful demonstration of all operating functions and conditions that are specified for the equipment, system, and controls. The manufacturer's representative shall be on Site during acceptance testing when specified in the equipment specifications.
2. The Functional Acceptance Testing shall include the following submissions prior to commencement:
 - a. Prerequisite checklist, to be acknowledged by the Engineer prior to initiating the test, that demonstrates that all testing and other Work required to be completed prior to the test is complete.
 - b. Listing of Owner's personnel necessary to operate the system and conduct any related monitoring of performance.

Commissioning

- c. A listing of Contractor's personnel designated to supervise and direct the Owner's operators as required herein.
 - d. Listing of standby personnel, equipment, and materials that will be available if needed during the test period.
 - e. Step-by-step procedures for operation of the facility showing how local and remote control of equipment will be demonstrated.
 - f. Description of all data and other information to be reported in support of the completed test. Include any blank data logs that may be used for recording results.
 - g. Descriptions of all necessary calculations that must be completed to verify the specified results are being achieved, including formulas.
 - h. Blank sign-off form for the test acknowledging the Contractor's, Engineer's, Owner's, and the equipment manufacturer's acceptance of the test.
3. Contractor shall provide Owner and Engineer 14 days notice prior to testing of any individual system.
 4. Individual system acceptance testing shall continue for 48 hours without interruption for each system, and all parts shall operate satisfactorily in all respects under a range of conditions to simulate the full operating range of the equipment or system. If there are multiple parallel components or trains, then the testing duration will be 48 hours for each individual train.
 5. If any part of a system shows evidence of unsatisfactory or improper operation during the testing period, correction or repairs shall be made and the test repeated until the test is successfully completed. Testing interrupted by power failure will not be required to be repeated, but the test shall be continued upon restoration of power and extended to the specified duration at no additional cost to the Owner.
 6. During this testing period the Contractor shall operate all equipment.

1.7 COMMISSIONING.

- A. Once startup and testing is complete; documentation of all startup and testing activities in the form of a report shall be submitted for reviewed and accepted by the Engineer. The report shall include a table of contents and be clearly organized.
- B. After acceptance, commissioning of the constructed facilities shall be conducted by the Contractor working with the Owner and Engineer.
- C. The facility shall be operated in accordance with the operating permit, laws, and regulations.
- D. The Contractor shall provide mechanics, electricians, and controls technicians during commissioning as required for troubleshooting and repair.

Commissioning

1.8 OPERATION ACCEPTANCE TESTING.

- A. At the completion of the Individual System Acceptance Tests and when the overall process has stabilized sufficiently as determined by the Engineer, operational acceptance testing of the complete facility constructed or modified under the Contract shall be conducted. Operational acceptance testing shall not be conducted concurrently with other individual system acceptance or performance tests.
- B. The test shall run at least 7 days with the entire facility operating in the intended manner. The test shall demonstrate to the satisfaction of the Engineer that the facilities are complete and meet all specified requirements and can be continuously operated for their full intended function. During the testing period, the plant shall operate under all control modes, including manual, remote-manual, and automatic. The Owner's staff shall operate the facility.
- C. Duty and standby equipment shall be alternated so that all equipment is selected for duty operation for a period of at least 2 days during the test. Unless indicated otherwise, if any item malfunctions or a defect is found during the test, the item shall be repaired and the test either extended a duration to be determined by the Engineer and Owner depending on the severity of the malfunction or defect, or restarted at time zero with no credit given for the operating time before the malfunction or the defect was found. Malfunctions or defects meeting both of the following conditions may, at the Engineer's discretion, be considered grounds for not requiring restarting the test at time zero:
 - 1. Malfunctions that do not cause an interruption to the operation of the facility because standby equipment can be placed into service.
 - 2. Malfunctions that are corrected within four (4) hours of the time the malfunction is detected. Correction of a malfunction or defect will be considered complete only after the affected equipment is placed back into service and is operating as intended for a continuous period of 24 hours without additional failure.
- D. All malfunctions, defects in materials or workmanship, or other flaws, which appear during this test period, shall be immediately corrected by the Contractor. If spare parts from the specified spare parts inventory are used to make repairs, they shall be replaced immediately and must be replaced prior to application for final payment.
- E. The Contractor shall supply all oil, grease, lubricants, and ancillary equipment required for operational acceptance testing.
- F. All plant control system coordination issues shall be resolved and data trending requirements shall be functional during this period.
- G. During operational acceptance testing, plant effluent meeting permit requirements as determined by the Owner, will be discharged to the outfall.

Commissioning

1.9 PERFORMANCE TESTING.

- A. Performance testing shall be conducted in accordance with requirements specified in the specification sections and contract documents listed below.

1. 46 66 56 Open Channel UV Disinfection System

- B. The Owner will provide chemicals, water, and power required during performance testing of the new facilities. Contractor shall notify the Engineer 45 days prior to any testing activities to allow the Owner time to order process chemicals and have them delivered to the site for testing. Contractor shall furnish all additional chemicals necessary to complete the test.

1.10 STARTUP SCHEDULE AND STARTUP AND COMMISSIONING PLANS.

- A. Plans and schedules shall be developed to facilitate coordinated and efficient startup, testing, and commissioning of the Project equipment and systems.
- B. The Contractor shall submit a startup, testing, and commissioning plan and schedule to the Engineer no later than 90 calendar days prior to the commencement of startup and testing. A minimum of 21 days shall be allowed for review by Engineer and Owner. The schedule and plan must be accepted a minimum of 30 days prior to commencement of startup and testing. The schedule and plan shall include sections for startup checks, functional testing, functional acceptance testing, commissioning, operational acceptance testing, and performance testing.
- C. Forms for startup and testing shall include identification of equipment or system, startup/test date, nature of startup/test, startup/test objectives, startup/test prerequisites, startup/test results, instruments employed for the startup/test and signature spaces for the Engineer's witness (where applicable) and the Contractor's startup manager.
- D. Startup Schedule.
1. A startup schedule that provides an overall sequence and duration for all startup, testing and commissioning activities, shall be prepared and maintained.
2. This schedule shall serve as a companion to but shall not be a replacement for the startup plan. The startup schedule described in this section shall be integrated into the overall Progress Schedule and shall be prepared as specified for the Progress Schedule in the Construction Progress Schedule section.
3. The Startup Schedule shall be updated weekly to during the startup, testing, and commissioning period.
- E. Startup Plan.
1. The Startup Plan shall include the following:

Commissioning

- a. Introduction with a narrative description of the overall testing and startup program. The description shall include all contractual or regulatory treatment requirements to be demonstrated.
 - b. A summary of the objectives and approach for startup checks, functional testing, functional acceptance testing, commissioning, operational acceptance testing, and Performance Testing.
 - c. List of the instruments, equipment, and systems that will undergo startup and testing with references to the appropriate PIDs, equipment tags/identification numbers, Specification number and standards for testing procedures.
 - d. Schedule for startup and field testing for each instrument, piece of equipment (including redundant equipment), and system.
 - e. Safety and emergency response plan including a list of emergency and non-emergency contacts (email and phone).
 - f. Organization chart for Contractor's startup and testing personnel with assigned responsibilities for each.
 - g. Startup and testing record keeping plan.
 - h. Plan for reuse and disposal of water/wastewater from startup, testing, commissioning including information on any required regulatory permits/approvals.
 - i. Description of temporary facilities that will be provided.
 - j. List of chemicals to be provided by the Owner.
2. Within 7 to 14 days of initial submittal of the startup plan, the Contractor shall schedule a workshop with the Owner and Engineer to present the plan. The Contractor shall submit minutes of the workshop, including action items and a schedule for updating the startup plan, to the Engineer within 3 days of the workshop.
 3. Individual plans for each phase of startup, testing, and commissioning can be assembled as chapters in the startup plan or submitted as individual documents but should be correlated to ensure there is not disagreement between chapters or separate documents.

F. Startup Checks Plan.

1. The startup checks plan shall be subdivided into plans for each system and major component. Each system/major component plan shall include but not be limited to the following:
 - a. Identification of information for each component or piece of equipment to be inspected as part of the system. All applicable tag numbers shall be included.
 - b. Specific activities to be completed on each component, piece of equipment, or system as required to demonstrate proper installation and connection.
 - c. A tracking checklist of prerequisites for the checks and each step of the checking procedure, including any temporary facilities or utility requirements.

Commissioning

- d. Listing of manufacturer's representative(s) to be on site during the check.
- e. Sign off forms for the Contractor's startup manager.

G. Functional Testing and Functional Acceptance Testing Plans.

- 1. The functional testing plan shall include procedures and reporting for functional testing. The functional testing plan shall be subdivided into testing plans for each system. Each system test plan shall include but not be limited to the following:
 - a. A narrative description of the purpose and goals of the test for each component, piece of equipment, or system, which should include all activities (including those required by vendors/suppliers) necessary to verify proper equipment and system functionality.
 - b. Identification of each component or piece of equipment to be tested as part of the system. All applicable tag numbers shall be included.
 - c. Schedule and duration for the tests.
 - d. Prerequisites for each test, including any temporary facilities or utility requirements.
 - e. Pass/fail criteria for the test.
 - f. A checklist for tracking testing progress which includes prerequisites for the test and each step of the testing procedure. The check list shall include specified performance criteria that are to be met.
 - g. A description of test apparatus required to conduct the test.
 - h. Identification of all temporary facilities and chemicals require during startup.
 - i. Listing of manufacturer's representative(s) to be on site during the test.
 - j. Certificates of proper installation, as applicable to the test.
 - k. Step-by-step detailed procedure of the test. The level of detail shall be sufficient for a witness to be able to follow the steps during the test and be confident that the test is being performed as planned. All steps required to proceed through the test in an orderly manner are considered significant and each of these steps shall be included in the procedure.
 - l. Copies of the data recording forms that will be used during the test.
 - m. Calculation methodologies to be used to evaluate the data and/or test criteria for the test.
 - n. Sample computations or analyses for the test with results in the same format as the final report. This item is intended to demonstrate how data collected will be used to generate final results. A sample shall be included for each type of computation required for the test and analysis of results.
 - o. Blank sign-off forms for the test acknowledging the startup manager's, Engineer's, Owner's, and equipment manufacturer's acceptance of the test where applicable.

1.11 REPORTS AND RECORDS.

- A. Records of all startup and testing shall be compiled by the Contractor and submitted to the Engineer.

Commissioning

- B. Prior to being submitted to the Engineer, the startup manager shall certify that the results recorded and the tested systems comply with the Contract requirements.
- C. Records shall include all documentation assembled for each piece of equipment or system involved in the startup and testing, including all certifications, forms, and check lists completed during the startup and test, and sign-off forms.
- D. Records of all startup and testing shall be compiled as separate documents for each system tested, and shall be submitted within 48 hours of completion of the startup and testing for each system.
- E. Testing samples that require analysis periods greater than 48 hours shall be clearly defined in the startup plan but shall not preclude delivery of the balance of the records within the 48 hour timeframe.
- F. The Contractor shall provide formal reporting and documentation of failures, malfunctions or defects, and repairs made during the startup and/or testing activities.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

End of Section

SECTION 05 81 00 - ANCHORAGE IN CONCRETE AND MASONRY

PART 1 - GENERAL

1.1 SCOPE

- A. This section covers the design of anchors in concrete and masonry. It includes cast-in-place anchor bolts and anchor rods, adhesive anchors for both threaded rods and reinforcing bars, expansion anchors, and undercut anchors.
- B. Design costs to comply with this section are to be included in the Early Work.
- C. Costs to coordinate with the Contractor for furnishing of anchor bolts should be included in the Balance of the Work. Refer to General Equipment Stipulations section.

1.2 GENERAL

A. Anchors Designed by Contractor's Suppliers

- 1. Contractor's material suppliers shall be responsible for design of anchors for railings, ladders, equipment, pre-engineered structures, and other manufactured items, as indicated in the Drawings and Specifications. Anchors shall be designed for all operating conditions, including wind and seismic loadings when indicated in the Meteorological and Seismic Design Criteria section.
- 2. Cast-in-place anchors shall be used unless post-installed types are indicated on the Drawings or accepted by Engineer. Post installed anchors into concrete or masonry shall be designed in accordance with the anchor manufacturer's research report.
- 3. Adhesive anchors used in vibrating applications shall only be used if the anchor manufacturer submits documentation indicating that the product is suitable for the anticipated service conditions.
- 4. Seismic anchorage design for non-structural components shall include the overstrength factors indicated in ASCE 7, Tables 13.5-1 and 13.6-1, when applicable.
- 5. Design of anchorage into concrete shall be in accordance with ACI 318 Chapter 17, shall consider concrete to be cracked, and shall not include the strengthening effects of supplementary reinforcement or anchor reinforcement unless approved by Engineer.
- 6. Design of anchorage into masonry shall be in accordance with TMS 402.
- 7. Shop drawings for anchor bolts, anchor rods, and post-installed anchors shall include full details and shall be sealed by a professional engineer licensed in the state of the project. Calculations shall be furnished when requested by Engineer.

B. Materials

Anchorage in Concrete and Masonry

1. Unless otherwise indicated, anchors of structural steel members connected to concrete shall have a diameter of at least 3/4 inch, and structural members connected to masonry shall have a diameter of at least 5/8 inch. Anchors for ladders and equipment shall have a diameter of at least 1/2 inch. Anchors for pedestrian railing systems shall have a diameter of at least 3/8 inch.
2. Unless otherwise indicated on the Drawings, anchors used in the following locations and applications shall be of the indicated materials.

Cast-In-Place Anchor Bolts and Anchor Rods

Submerged locations	Stainless steel.
Locations subject to splashing	Stainless steel.
Buried locations	Stainless steel.
Anchorage of structural steel columns	Galvanized steel.
Other exterior locations	Galvanized steel.
Interior locations not subject to corrosion	Carbon steel.

Adhesive, Expansion, and Undercut Anchors

Submerged locations	Stainless steel.
Locations subject to splashing	Stainless steel.
Buried locations	Stainless steel.
Anchorage of structural steel columns	Stainless steel.
Other exterior locations	Stainless steel.
Interior locations not subject to corrosion	Carbon steel.

1.3 SUBMITTALS

A. Drawings and Data

1. Data, catalog cuts, and manufacturer's research reports (from independent organizations such as ICC-ES or IAPMO UES) indicating the manufacturer and types of adhesive anchors, expansion anchors, and undercut anchors to be supplied shall be submitted in accordance with the Submittal Procedures section.

B. Calculations

1. If Contractor requests use of products other than those indicated herein, calculations may be required as part of the submittal package. Calculations shall be prepared by a professional engineer licensed in the state of the project, using methods and procedures required by the building code. Contractor shall demonstrate that the proposed substitute anchors are equivalent in all necessary criteria, including strength, spacing and edge distance limitations, embedment depth limitations, temperature limitations, and any other criteria required by Engineer.

Anchorage in Concrete and Masonry

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Materials shall be handled, transported, and delivered in a manner which will prevent damage or corrosion. Damaged materials shall be promptly replaced. Materials shall be shipped and stored in original manufacturer's packaging.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Unless otherwise indicated on the drawings, materials shall be as indicated below.

Cast-In-Place Anchor Bolts and Anchor Rods

Carbon steel	ASTM F1554, Grade 36 with compatible nuts.
Galvanized steel	ASTM F1554, Grade 36 with compatible nuts; hot-dip galvanized, ASTM F2329.
Stainless steel	Bolts, ASTM F593, Alloy Group 1 or 2 (minimum yield strength of 45 ksi); nuts, ASTM F594, Alloy Group 1 or 2.
Flat Washers	ANSI B18.22.1; of the same material as anchor bolts and nuts.

Expansion Anchors in Concrete

Products shall be single component anchors tested in accordance with ICC AC193, and shall have a manufacturer's research report in compliance with the applicable building code. The anchors shall be approved for use in cracked concrete, and for resisting seismic forces. Hilti "Kwik-Bolt TZ2" Simpson "Strong-Bolt 2", or DeWalt "Power-Stud+SD2" (carbon steel), "Power-Stud+SD4" (304 stainless steel), and "Power-Stud+SD6" (316 stainless steel).

Expansion Anchors in Grouted Concrete Masonry Units

Products shall be single component anchors tested in accordance with ICC AC01, and shall have a manufacturer's research report in compliance with the applicable building code. Hilti "Kwik-Bolt 1," Simpson "Wedge-All," or DeWalt "Power-Stud+ SD1."

Undercut Anchors in Concrete

Products shall be tested in accordance with ICC AC193, and shall have a manufacturer's research report in compliance with the applicable building code. Hilti "HDA Undercut Anchor" (carbon steel) and "HDA-R Undercut Anchor" (stainless steel), or DeWalt "Atomic+ Undercut Anchor" (A36 carbon steel).

Adhesive Anchors in Concrete

Products shall be tested in accordance with ICC AC308, and shall have a manufacturer's research report in compliance with the applicable building code. The anchors shall be approved for use in cracked concrete, and for resisting seismic forces.

Threaded Rods and Nuts (Carbon Steel)

ASTM A307 or ASTM F1554 Grade 36.

Anchorage in Concrete and Masonry

Threaded Rods and Nuts (Stainless Steel)	ASTM F593, CW.
Reinforcing Bars	ASTM A615, Grade 60, deformed.
Reinforcing Bars, weldable	ASTM A706, Grade 60, deformed.
Adhesive	Hilti "HIT-HY 200," or DeWalt "Pure 110+."
Adhesive Anchors in Grouted Concrete Masonry Units	Products shall be tested in accordance with ICC AC58, and shall have a manufacturer's research report in compliance with the applicable building code.
Threaded Rods and Nuts (Carbon Steel)	ASTM A307 or ASTM F1554 Grade 36.
Threaded Rods and Nuts (Stainless Steel)	ASTM F593 CW (Hilti or Powers systems), or ASTM A193 Grades B6, B8, or B8M (for Simpson system).
Adhesive	Hilti "HIT-HY 270," DeWalt "AC100+ Gold," or Simpson "SET XP."
Adhesive Anchors in Hollow Concrete Masonry Units	Products shall be tested in accordance with ICC AC58, and shall have a manufacturer's research report in compliance with the applicable building code.
Threaded Rods and Nuts (Carbon Steel)	ASTM A307 or ASTM F1554 Grade 36.
Threaded Rods and Nuts (Stainless Steel)	ASTM F593 CW (Hilti or Powers systems), or ASTM A193 Grades B6, B8, or B8M (for Simpson system).
Adhesive	Hilti "HIT-HY 270," DeWalt "AC100+ Gold," or Simpson "SET XP."
Screen Tubes	As recommended by the manufacturer.
Adhesive Anchors in Unreinforced Brick Masonry	Products shall be tested in accordance with ICC AC60, and shall have a manufacturer's research report in compliance with the applicable building code.
Threaded Rods and Nuts	ASTM A307.
Adhesive	Hilti "HIT-HY 270," DeWalt "AC100+ Gold," or Simpson "SET."
Screen Tubes	As recommended by the manufacturer.

2.2 ANCHORS

A. Cast-in-Place Anchor Bolts and Anchor Rods

1. Cast-in-place anchor bolts and anchor rods shall have forged heads or embedded nuts and washers. Anchors shall be delivered in time to permit setting prior to the placing of structural concrete or masonry grout. Anchor sleeves shall not be used unless acceptable to Engineer. Unless installed in sleeves, anchor bolts and anchor rods shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete

Anchorage in Concrete and Masonry

form or the supporting template. Two nuts, a jam nut, and a washer shall be furnished for cast-in-place anchor bolts and anchor rods indicated on the Drawings to have locknuts; two nuts and a washer shall be furnished for cast-in-place anchor bolts and anchor rods without locknuts.

B. Adhesive, Expansion, and Undercut Anchors

1. When adhesive, expansion, or undercut anchors are indicated on the Drawings, only acceptable systems shall be used. Acceptable systems shall include only those systems and products specified or specifically indicated by product name on the Drawings. Alternative anchoring systems may be used only when specifically accepted by Engineer.
2. Unless otherwise noted, single nuts and washers shall be provided with adhesive anchors, expansion anchors, and undercut anchors. Adhesive anchors shall be free of coatings that would weaken the bond with the adhesive.
3. Adhesive anchors in hollow CMU masonry and unreinforced brick masonry shall utilize screen tubes as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

- A. Contractor will install anchor bolts as part of the construction contract.

End of Section

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Gate Installation

SECTION 40 05 51.16 - GATE INSTALLATION

PART 1 - GENERAL

1.1 SCOPE

- A. This section covers the installation of new gates and actuators furnished by UVSS for installation by Contractor.
- B. The following specification sections are applicable to gates to be installed under this contract:
 - 1. Open-Channel Metal Slide Gates and Weir Gates
- C. UVSS shall include costs specific to installation and commissioning of the gates in the Balance of Work.

1.2 GENERAL

- A. Equipment installed under this section shall be erected and placed in proper operating condition in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.
- B. Any gates and actuators identified as being provided by others will be furnished complete for installation by Contractor. Technical specifications under which the equipment will be purchased are available.
- C. Coordination
 - 1. When installation check services are provided by the gate manufacturer, Contractor shall coordinate the services with the gate manufacturer. Contractor shall give Engineer written notice at least 30 days prior to the need for manufacturer's installation check services.
 - 2. Submittals for equipment furnished by others under each procurement contract will be furnished to Contractor upon completion of review by Engineer. Contractor shall review equipment submittals and coordinate with the requirements of the Work and the Contract Documents. Contractor accepts sole responsibility for determining and verifying all quantities, dimensions, and field construction criteria.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Materials shall be as follows:

Gate Installation

1. Grout As specified in the Grouting section.

PART 3 - EXECUTION

3.1 INSPECTION

- A. All gates and accessories shall be inspected for damage and cleanliness before being installed. Any material damaged or contaminated in handling on the job shall not be used unless it is repaired and recleaned to the original requirements by Contractor. Such material shall be segregated from the clean material and shall be inspected and approved by Owner or his representative before its use.

3.2 INSTALLATION.

A. General

1. Gates and appurtenances shall be installed with sufficient clearance for proper operation of any external mechanisms, and with sufficient clearance to dismantle the gate for maintenance. Installation shall be in accordance with the manufacturer's recommendations and the requirements specified herein.
2. All bolts shall be tightened and all items requiring lubrication, including pivot pins, shall be lubricated. Anti-seize thread lubricant shall be liberally applied to the threaded portion of stainless steel anchor bolts during the installation and tightening of nuts. Excess lubricant shall be thoroughly removed following final tightening.
3. The threaded portion of each plastic stem cover shall be wrapped in at least two layers of teflon thread tape, and the threaded portion of steel pipe stem covers shall be coated with teflon thread sealer immediately prior to installation of the cover on the actuator.
4. Each gate shall be adjusted so that it does not bind or leak in excess of specified requirements. After installation, each gate shall be operated through at least two complete open-close cycles, re-adjusted and re-operated as necessary, and left in a condition acceptable to Engineer.

B. Installation Checks

1. When specified in the gate sections, the gate manufacturer will provide installation checks. For installation checks, the manufacturer's field representative will inspect the gate installation immediately following installation by Contractor. The manufacturer's representatives will revisit the site as often as necessary to ensure installation satisfactory to Owner.
2. Contractor shall perform no Work related to the installation or operation of materials or equipment furnished by others without direct observation and guidance of the field representative, unless Engineer and manufacturer furnishing such materials concur otherwise.

Gate Installation

C. Open-Channel Metal Slide Gates and Weir Gates

1. Each open-channel slide gate or weir gate shall be carefully installed and adjusted for proper operation. Care shall be taken to avoid deformation of the gate frames and to maintain tolerances between seating faces.
2. Each embedded frame shall be carefully braced in the forms before concrete is placed, or a space shall be boxed out and the frame shall be grouted in place later. Care shall be exercised to ensure that frame members and anchor bolts do not rest upon or contact steel reinforcing bars.
3. Components of aluminum open-channel slide gates or weir gates installed in contact with concrete, shall be coated with epoxy in accordance with the Protective Coatings section prior to installation. Damaged areas of shop-applied coatings shall be re-coated and allowed to cure before placement of concrete or grout. Anchor bolts shall be carefully set using a template.

3.3 GATE ACTUATORS

- A. Gate actuators and accessories shall be installed in accordance with the equipment manufacturer's recommendations.

3.4 FIELD QUALITY CONTROL

A. Field Testing

1. After installation, all gates shall be pressure tested for leakage at the hydrostatic heads specified. Leakage exceeding the specified limits which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of Contractor.
2. Upon successful field testing, equipment supplier shall submit a written report of testing, results, modifications, and certification that the gates were installed correctly and full adhere to the contract documents.

B. Fabricated Stainless Steel Slide Gates

1. For the maximum seating and unseating heads, the leakage shall not exceed 0.1 gpm per foot of seating perimeter.

3.5 ADJUSTING

- A. After installation, the opening and closing time shall be adjusted as needed for each pneumatic, hydraulic, or electric actuated gate.

End of Section

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SECTION 40 05 57 - VALVE AND GATE ACTUATORS

PART 1 - GENERAL

1.1 SCOPE.

- A. This section covers furnishing manual and powered valve and gate actuators and accessories as specified herein.

1.2 GENERAL.

- A. Equipment provided under this section shall be fabricated and assembled in full conformity with Drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.
- B. Actuators shall be furnished with all necessary parts and accessories indicated on the Drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of actuators.
- C. General Equipment Stipulations.
 - 1. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.
- D. Governing Standards.
 - 1. Except as modified or supplemented herein, cylinder and vane type actuators shall conform to applicable requirements of ANSI/AWWA C541.
 - 2. Except as modified or supplemented herein, electric motor actuators shall conform to applicable requirements of ANSI/AWWA C542.
 - 3. Except as modified or supplemented herein, actuators for butterfly and eccentric plug valves shall conform to the applicable requirements of ANSI/AWWA C504.
 - 4. Except as modified or supplemented herein, manual actuators for ball valves shall conform to the applicable requirements of ANSI/AWWA C507.
 - 5. Except as modified or supplemented herein, actuators for stainless steel slide gates shall conform to the applicable requirements of ANSI/AWWA C561.
 - 6. Except as modified or supplemented herein, actuators for composite slide gates shall conform to the applicable requirements of ANSI/AWWA C563.
- E. Power Supply.

Valve and Gate Actuators

1. Power supply to electric actuators will be as indicated in the valve and gate schedules.

F. Marking.

1. Each actuator shall be marked with the manufacturer's name, model number, and the country of origin. An identifying serial number shall be stamped on a corrosion-resistant plate attached to the actuator.

G. Temporary Number Plates.

1. Each actuator shall be factory tagged or marked to identify the actuator and the applicable valve or gate by number or service as indicated in the valve or gate schedule. Refer to Equipment and Valve Identification Section for requirements.

1.3 SUBMITTALS.

- A. Complete drawings, details, and specifications covering the actuators and their appurtenances shall be submitted in accordance with the Submittal Procedures section. Submittal drawings shall clearly indicate the country of origin of each actuator and its components.
- B. Submittal drawings shall include separate wiring diagrams for each electrically operated or controlled actuator and the electrical control equipment. Each actuator drawing shall be identified with the respective valve number or name.
- C. For networked valve actuators, information on the available input and output assemblies shall be submitted for the protocol(s) specified to be provided. The submittal shall identify the version of the selected network protocol for which the device has been tested and certified.
- D. For electric or cylinder actuators, certified copies of reports covering proof-of-design testing of the actuators as set forth in Section 5 of ANSI/AWWA C541 or ANSI/AWWA C542 respectively, together with an affidavit of compliance as indicated in Section 6.3 of ANSI/AWWA C541 or ANSI/AWWA C542 respectively, shall be submitted to Engineer before the actuators are shipped.

PART 2 - PRODUCTS

2.1 PERFORMANCE AND DESIGN REQUIREMENTS.

A. General.

1. Actuators and appurtenances shall be designed for the conditions and requirements as indicated in the respective valve and gate sections.
2. Liberal factors of safety shall be used throughout the design, especially in the design of parts subject to intermittent or alternating stresses. In general, working

Valve and Gate Actuators

stresses shall not exceed one-third of the yield point or one-fifth of the ultimate strength of each material.

B. Valve Actuators.

1. Each actuator shall be designed to open or close the valve under all operating conditions. Actuators shall be designed for the maximum pressure differential across the valve and maximum velocities through the valve where indicated in the respective valve schedules.
2. Valve actuators shall be provided and adjusted by the valve manufacturer. Actuator mounting arrangements and positions shall facilitate operation and maintenance and shall be determined by the valve manufacturer unless indicated otherwise on the Drawings or directed by Engineer.

C. Gate Actuators.

1. Actuators shall be sized to produce the torque or thrust required to operate the gate when subject to the seating and unseating operating heads as indicated in the respective gate schedules.
2. Both the design head and the operating head shall be measured from the surface of the liquid to the center line of the gate.

D. Limit Switches.

1. Limit switches shall be provided as indicated on the Drawings or in the valve and gate schedules.
2. Limit switches for intelligent and standard electric actuators shall be as indicated in their respective paragraphs.

2.2 MATERIALS.

- A. Except as modified or supplemented herein, materials used in the manufacture of actuators shall conform to the requirements of the applicable governing standard(s).

2.3 VALVE MANUAL ACTUATORS. (NOT USED).

2.4 GATE MANUAL ACTUATORS. (NOT USED).

2.5 INTELLIGENT ELECTRIC ACTUATORS.

A. General.

1. Intelligent electric actuators as listed in the valve and gate schedules shall be provided by the valve or gate manufacturer.
2. All other intelligent electric actuators for open-close service shall be multi-turn type and shall be Rotork "IQ Series", without exception.
3. Intelligent electric actuators produced by other manufacturers are not acceptable.
4. Intelligent electric actuators shall be capable of non-intrusive configuration without requiring removal of any actuator covers. Configuration of actuator functions shall be by use of a hand held infrared linked device, laptop or PDA with compatible wireless communication capability, or by local control switches and 32-character LCD display mounted on the actuator housing. The display language shall be English .
5. Each intelligent electric actuator shall be furnished complete with a motor, gearing, handwheel, configurable output relays, torque sensors, lubricants, wiring, and terminals. Each actuator shall be constructed as a self-contained unit with a ductile iron or aluminum alloy housing, of a type as indicated in the valve and gate schedules, and shall be integrally assembled on the applicable valve or gate by the valve or gate manufacturer. Housings shall have two O-ring seals, one on the controls compartment and one on the terminal cover.
6. Actuators shall be designed to cycle the valve or gate from the fully open to the fully closed position or the reverse in approximately 60 seconds or as indicated in the valve and gate schedules.
7. Actuator motors may be mounted horizontally adjacent to or vertically above the reduction gearing. All gearing shall be oil or grease lubricated.

B. Motors. Motors shall be totally enclosed, high torque design made expressly for valve and gate actuator service, capable of operating the valve or gate under full differential pressure for two complete strokes or one complete cycle of travel without overheating. Motors shall be designed in accordance with NEMA standards and shall operate successfully at any voltage within 10 percent above or below rated voltage. Motor bearings shall be permanently lubricated. Motors shall be provided with stall, temperature, loss of phase, and reverse phase protection. Actuators shall be capable of indicating phase loss. Motors for open-close service shall be rated for a minimum of 60 starts per hour.

C. Power Gearing. Power gearing shall consist of hardened steel spur or helical gears and alloy bronze or hardened steel worm gear, all suitably lubricated, designed for 100 percent overload, and effectively sealed against entrance of foreign matter. Steel gears shall be hardened to at least 350 Brinell. Planetary or cycloidal gearing, aluminum, mild steel, or nonmetallic gears will not be acceptable. Gearing shall be

designed to be self-locking so that actuation of a torque switch or electronic torque protection device by a torque overload condition will not allow the actuator to restart until the torque overload has been eliminated. If a secondary gearbox is required, it shall be designed to withstand the locked rotor torque of the actuator.

- D. Handwheel Mechanism. The handwheel shall not rotate during motor operation. During handwheel operation the motor shall not affect the actuator operation. The actuator shall be responsive to electrical power and control at all times and, when under electrical control, shall instantly disengage the handwheel. The handwheel shall rotate counterclockwise to open the valve. An arrow indicating the opening direction and the word "Open" shall be cast on the handwheel. The force required to operate the handwheel shall not exceed 80 lbs [350 N]. The handwheel shall have a padlockable declutch lever.
- E. Torque Sensing. Torque and thrust loads in both closing and opening directions shall be limited by a torque sensing device. Torque settings shall be adjustable and shall be indicated locally. The adjustment shall permit a variation of 40 to 100 percent of rated torque.
- F. Terminal Facilities. Terminal facilities for connection to motor leads, switches, and control and indication signals shall be provided in a readily accessible terminal compartment. The terminal compartment shall have at least two openings for external electrical conduits, one sized at least 3/4 inch [19 mm] and the other at least 1-1/4 inches [31 mm]. Each terminal compartment shall be large enough to allow easy routing and termination of fifteen 12 AWG [4 mm²] conductors.
- G. Controls Compartment.
 - 1. Each actuator shall be furnished with a sealed compartment containing a reversing controller, multi tap transformer, electronic controls, and monitoring and protection modules. Reversing controllers shall be both mechanically and electrically interlocked and provided with the necessary direct-operated auxiliary contacts for required interlocking and control. The multi tap transformer shall provide power for all internal circuits, and shall provide 24 VDC supply for remote controls as indicated in the valve and gate schedules, or in the schematics on the Drawings.
 - 2. Where not networked, actuators for valves or gates listed for modulating service in the valve and gate schedules shall be provided with a control module for position modulating type service. The control module shall be mounted within the controls compartment. The module shall accept a standard 4-20 mA dc analog input signal with a load impedance of not greater than 400 ohms. The control module shall contain adjustments for span, zero, gain, and deadband. Non-networked modulating actuators shall have a 4 to 20 mA output signal proportional to valve or gate position.
- H. Local Controls. Each actuator shall have controller devices mounted on the actuator as indicated in the valve and gate schedules.
- I. Remote Indication and Controls.

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1. Valve or gate position and actuator status indication for non-networked valves shall be provided by four configurable output relay contacts which can be selected to indicate any position of the valve or gate. Relays shall be configurable to the normally open or normally closed states. Relays shall maintain and update position indication during handwheel operation. Contacts shall be rated 5 A, 250 VAC, 30 VDC. When not used for position indication, any of the four configurable relays shall be selectable to signal one of the following:
 - a. Valve or gate opening, closing, or moving.
 - b. Thermostat tripped, phase loss.
 - c. Motor tripped on torque in mid travel, motor stalled.
 - d. Remote mode selected.
 - e. Local mode selected.
- 2.6 STANDARD ELECTRIC ACTUATORS. (NOT USED).
- 2.7 HYDRAULIC CYLINDER ACTUATORS. (NOT USED.)
- 2.8 AIR CYLINDER ACTUATORS. (NOT USED).
- 2.9 VANE TYPE PNEUMATIC ACTUATORS. (NOT USED).
- 2.10 AIR-OIL CYLINDER ACTUATORS. (NOT USED).
- 2.11 PORTABLE ELECTRIC ACTUATORS. (NOT USED).
- 2.12 PORTABLE HYDRAULIC ACTUATORS. (NOT USED).
- 2.13 ACTUATOR ACCESSORIES.
- A. Extension Stems.
 1. Extension stems and stem guides shall be furnished when indicated in the respective valve schedules, indicated on the Drawings, or otherwise required for proper valve operation. Extension stems shall be of solid steel and shall be not smaller in diameter than the stem of the actuator shaft. Extension stems shall be connected to the actuator with a single Lovejoy "Type D" universal joint with grease-filled protective boot. All stem connections shall be pinned.
 2. At least two stem guides shall be furnished with each extension stem, except for buried valves. Stem guides shall be of cast iron, bronze bushed, and adjustable in two directions. Stem guide spacing shall not exceed 100 times the stem diameter or 10 feet [3 m], whichever is smaller. The top stem guide shall be designed to

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carry the weight of the extension stem. The extension stem shall be provided with a collar pinned to the stem and bearing against the stem thrust guide.

3. Extension stems for chemical resistant butterfly valves located in drainage sumps shall be the two-piece type with stainless steel stem, PVC housing, wall support, and collar. Unless otherwise indicated on the Drawings, the length of the stem extension shall be as necessary to position the valve operator 12 inches above the maximum liquid level in the immediate area.
4. Extension stems for buried valve actuators shall extend to within 6 inches of the ground surface, shall be centered in the valve box using spacers, and shall be equipped with a wrench nut.
5. Extension stems for buried valve actuators shall be provided with position indicators as specified in the valve schedules.

B. Position Indicators for Buried Actuators. (Not used).

C. Floor Boxes.

1. Openings through concrete slabs provided for key operation of valves shall be provided with a cast iron floor box complete with cover. The floor box shall be of the depth indicated on the Drawings. Where the operating nut is in the slab, the stem shall have a guide to maintain the nut in the center of the box; where the nut is below the slab, the opening in the bottom of the box shall accommodate the operating key.
2. Each floor box and cover shall be shop coated with manufacturer's standard coating.

D. Torque Tubes.

1. Torque tube shall utilize pipe rather than solid shafting between the valve input shaft and the output shaft of the valve floorstand operator. An adjustment of 2 inches shall be provided in the torque tube installation. Torque tube shall be coated with the same material as the submerged valve.

E. Valve Boxes. (Not Used)

2.14 SHOP PAINTING.

1. All ferrous metal surfaces, except bearing and finished surfaces and stainless steel components of valve actuators and accessories, shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field painting.
2. The following surfaces shall be painted:

Polished or Machined Surfaces	Rust-preventive compound.
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Valve and Gate Actuators

Other Surfaces	Epoxy.
Actuators and Accessories	Universal primer.

PART 3 - EXECUTION

3.1 INSTALLATION.

- A. Actuators will be installed on the valves in accordance with the Valve Installation section and on gates in accordance with the Gate Installation section. If actuators are installed on the gates prior to shipment costs shall be included in Balance of Work. If the actuators are shipped loose and field installed this cost will be by General Contractor.

3.2 NETWORK SETUP.

- A. A manufacturer's representative for the intelligent electric actuator manufacturer shall inspect all network terminations for conformity with the manufacturer's recommended methods of terminating the network to each actuator, and shall notify the UVSS of any wiring modifications required. The manufacturer's representative shall also set addresses for each valve and prove communication over the network. The valve manufacturer shall furnish the required information to the control system supplier that will allow the specified control and monitoring for each intelligent electric actuator.
- B. The Contractor shall coordinate these activities under the construction contract between the UVSS, actuator manufacturer and the control system supplier.

End of Section

Section 40 05 59.13 - OPEN-CHANNEL METAL SLIDE GATES AND WEIR GATES

PART 1 - GENERAL

1.1 SCOPE.

- A. This section covers furnishing slide gates and actuators as specified herein and as indicated in the Open Channel Metal Slide Gate and Weir Gate Schedule. Slide gates shall be furnished complete with frames, slides, seals, actuators, operating stems, and appurtenances as specified herein, as indicated in the schedule and as specified in the Valve and Gate Actuator section.

1.2 GENERAL.

- A. Equipment furnished under this section shall be fabricated and assembled in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.
- B. Gates and actuators shall be furnished with all necessary parts and accessories indicated on the Drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest products of a manufacturer engaged in the production of slide gates.
- C. General Equipment Stipulations.
 - 1. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.
- D. Governing Standard.
 - 1. Except as modified or supplemented herein, all slide gates shall conform to the applicable requirements of ANSI/AWWA C561 and ANSI/AWWA C562.
- E. Identification.
 - 1. Slide gates specified herein shall be tagged as specified in the Equipment and Valve Identification section.

1.3 SUBMITTALS.

- A. Complete drawings, construction details, anchorages, and specifications covering the slide gates and appurtenances shall be submitted in accordance with the Submittals Procedures section. Each drawing shall be identified with the slide gate designation.

- B. Drawings shall include separate wiring diagrams for each electrically actuated gate and related electrical control equipment. Electric actuators with identical service may submit a single wiring diagram.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS.

2.2 Slide gates will be required on the upstream and downstream side of the UV equipment of each channel to provide isolation of the equipment. PERFORMANCE AND DESIGN REQUIREMENTS.

- A. Slide gates shall be designed for the conditions and requirements indicated in the Slide Gate Schedule.

- B. Design.

- 1. Liberal factors of safety shall be used throughout the design, especially in the design of parts subject to intermittent or alternating stresses. In general, working stresses shall not exceed one-third of the yield point or one-fourth of the ultimate strength of each material.
- 2. Gates shall be designed for the seating and unseating heads indicated in the Slide Gate Schedule.
- 3. Gates shall be designed to fit into the structures indicated on the Drawings.

2.3 ACCEPTABLE MANUFACTURERS.

- A. For slide gates, acceptable manufacturers are Hydro Gate, RW Gate, Rodney Hunt, and Whipps.

2.4 MATERIALS.

Frames, Guides, Slides, Reinforcing Members, and Yoke Beams	Stainless steel, ASTM A276, 304L or 316L and ASTM A240, 304L or 316L.
Flush Bottom Closure Seal	Compressible neoprene.
Hollow Bulb J-Seals	Compressible neoprene.
Seal Retainer Bar	Aluminum, ASTM B211 or B221, Alloy 6061-T6.
Slide Seats and Bearing Bars	UHMW polyethylene.
Operating Stems	Stainless steel, AISI Type 304 or 316.

Assembly Fasteners	Stainless steel, AISI Type 302, 303, or 304.
Epoxy Enamel	PPG-Amercoat "Amercoat 385 Epoxy", Carboline "Carboguard 890", Sherwin-Williams "Macropoxy 646" or Tnemec "Series N69 Hi-Build Epoxoline II".
Epoxy Enamel (NSF Certified Systems)	PPG-Amercoat "Amerlock 400 High-Solids Epoxy Coating", Carboline "Carboguard 891", Sherwin-Williams "Macropoxy 646NSF" or Tnemec "Series N140 Pota-Pox Plus"; immersion service.
Anchor Bolts	As indicated in the Anchorage in Concrete and Masonry Section.

2.5 CONSTRUCTION.

A. Frames.

1. Each frame shall be an integral unit of extruded or welded structural shapes at least 1/4 inch thick. Frames shall be designed for embedment in concrete or installation on the face of concrete walls as indicated in the Slide Gate Schedule. Embedded frames shall be recessed so that the waterway is not obstructed.
2. Guides shall be provided on each side of each frame. Guides shall be sufficiently strong to require no further reinforcing where they extend above the operating floor, and shall support the entire height of the slide in all positions.
3. Full-length plastic slide seats or bearing bars shall be provided on the downstream side of the slide on gates subject to seating pressure from one direction. Gates subject to seating pressure from either direction shall be provided with plastic seats or bearing bars on both faces of the slide. Seats and bars shall be mechanically retained in the frame.
4. Self-contained gates shall be equipped with a yoke, shop welded to the top of vertical frame members to support the actuator. Yokes shall be fabricated from a pair of rolled or extruded channels or angles and shall be designed to deflect not more than 1/360 of the span when the gate is operated at the maximum actuator thrust with the safety factor as indicated in the governing standard. Each yoke shall be designed to permit vertical removal of the slide. Actuators shall be mounted so that no eccentric loads are transmitted to the yoke.

B. Slides.

1. Slides shall be at least 1/4 inch [6 mm] thick and shall be provided with welded stiffeners to limit deflection to 1/360 under the maximum seating or unseating

head indicated in the Slide Gate Schedule. Slides shall be adequately reinforced to withstand, without permanent distortion, the maximum thrust which can be transmitted by the operating stem. Each slide shall have a reinforced pocket or an internally threaded nut welded to the slide for connection of the stem. The pocket or nut shall be designed to withstand the maximum thrust which can be transmitted by the operating stem.

C. Closures.

1. The bottom of each slide gate frame shall be recessed so that the waterway is not obstructed. A compressible seal shall be securely attached to the bottom of the slide or to the frame invert. The seal shall be of sufficient length to seal the bottom corners of each slide.
2. Where indicated in the Slide Gate Schedule, gates shall be provided with resilient hollow bulb J-seals attached to the frame members.
3. Each J-seal shall be provided with a full-length retainer bar which shall compress the seal and prevent leakage between the seal and the frame member. The method of attachment of J-seals to frame members shall permit replacement of the seals without disassembling or removing the gate.
4. An acceptable alternative to J-seal is a UHMW polyethylene seal/seat. A UHMW polyurethane seat/seal extruded shape shall fit into a dovetail groove in the guide section, and shall seal on both upstream and downstream sides of the slide. The seat/seal system shall act as both a bearing surface and as a seal, and the seal system shall be self-adjusting. The seat/seals shall be easily replaced without removing the gate from the wall. For flush bottom application, the invert shall have a replaceable resilient neoprene seal mounted on the frame invert.

D. Operating Stems.

1. Operating stems shall conform to the requirements of Section 4.3.6 of the governing standard. Contact surfaces of threads shall be rolled or machined to a 63 micromach [1600 nm] finish, or smoother. Each stem shall be securely attached to the slide.
2. Dual stems shall be provided where listed in the Slide Gate Schedule or where required for proper operation of the gate.

E. Stainless Steel.

1. All stainless steel shall be pickled in accordance with ASTM A380 at the mill before being shipped. Pickling shall produce a modest etch and shall remove all embedded iron and heat tint. After fabrication, pickled surfaces shall be subjected to a 24 hour water test or a ferroxyl test to detect the presence of residual embedded iron. All pickled surfaces damaged during fabrication including welded areas shall be repickled or passivated in accordance with ASTM A380 as needed to remove all traces of iron contamination. All stainless steel surfaces shall be adequately protected during fabrication, shipping,

handling, and installation to prevent contamination from iron or carbon steel objects or surfaces.

2.6 ACTUATORS.

- A. Actuators and their accessories shall be the type as indicated in the Slide Gate Schedule and as specified in the Valve and Gate Actuator section.
- B. Stem covers for manual actuators shall be UV resistant clear plastic, polycarbonate, or steel pipe as indicated in the Slide Gate Schedule and as specified in the Valve and Gate Actuator section.

2.7 SHOP PAINTING.

- A. All surfaces of aluminum which will be in contact with concrete, mortar, grout, or dissimilar metals shall be given a coat of epoxy enamel or coal tar epoxy. The epoxy coating shall be NSF certified for gates installed in a potable water facility.

2.8 SHOP TESTING.

- A. Gates shall be completely assembled in the shop to ensure that all parts fit together properly.

PART 3 - EXECUTION

3.1 INSTALLATION.

- A. Slide gates and appurtenances shall be installed in accordance with the Gate Installation section by the Contractor as part of the construction contract.
- B. Installation Check.
 - 1. An experienced, competent, and authorized representative of the manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. The representative shall be present when the equipment is placed in operation in accordance with Startup Requirements section, and shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.
 - 2. The manufacturer's representative shall furnish a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.
 - 3. All costs for these services shall be included in the contract price.

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4. Manufacturer shall include a minimum of 2 day(s) and 1 trip(s) to the site.

End of Section

SECTION 46 66 56.12 - OPEN CHANNEL ULTRAVIOLET DISINFECTION SYSTEM

PART 1 - GENERAL

1.1 SCOPE.

- A. This section covers the general design requirements, materials, and product data, installation assistance, startup, and commissioning for an open channel Ultraviolet (UV) disinfection system. The UV disinfection system will be preselected by the OWNER to be installed at a later date by an installation or general contractor. The selected UV System Supplier (UVSS) scope of services as well as items described in the contract documents, including price will be sole-sourced during general bidding. Additional requirements for equipment and performance testing are specified in other sections.
- B. The UVSS shall provide all parts (sensors, probes, controls), equipment, slide gates and electric actuators, materials, components, installation assistance and performance testing required for a complete and functional system with an integrated cleaning system.
- C. The UVSS shall coordinate requirements for system installation with the Installation Contractor and Engineer including the following:
 - 1. Channel dimensions
 - 2. UV system headloss
 - 3. UV system installation instructions
 - 4. UV control system requirements for integration into the Plant Control System
 - 5. Performance testing requirements
- D. The UVSS shall submit the specified information to the Engineer for the design of the facilities associated with the supply of the UV system. Installation Contractor will be responsible for providing all data/communication cables/wires/communication modules/media converters required for the connection of the UV system to the Plant Control System.
- E. The UV system shall be an open channel, gravity flow system utilizing a staggered arrangement, low pressure, high intensity lamps. The UV system shall include but not limited to the following principal required components:
 - 1. UV lamp modules with quartz sleeves
 - 2. Lamp assemblies on removable modules
 - 3. Low pressure high output lamps
 - 4. Automatic quartz sleeve cleaning system

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5. Influent and effluent channel isolation gates, with electric actuators
6. UV system effluent level control
7. Online UV intensity measurement
8. Integrated lifting device for UV modules
9. Drivers to operate UV lamps
10. Ballast (Driver) Cabinets
11. Interconnecting power cables between UV modules and UV power/control equipment. Data cables will be provided by the UVSS and installed by Installation Contractor
12. System instrumentation and controls including programmable logic controller (PLC)
13. On-line UV transmittance sensor, UVT monitor, submersible probe with mounting kit, controller, and 75 ft of cable between the probe and controller.
14. UV eye shields and personnel safety equipment
15. Accessories
16. Spare parts
17. Special tools, whether specifically mentioned in this section or not, as required for a complete system
18. Control panel

1.2 GENERAL.

A. Coordination.

1. Equipment furnished and installed under this section and the associated sections shall be fabricated, assembled, erected, placed in proper operating condition, and tested in full conformity with Drawings, Specifications, engineering data, instructions, and recommendations of the equipment provided by the UVSS. The Contractor shall execute this coordination under the construction contract.

B. General Equipment Stipulations.

1. The General Equipment Stipulations shall apply to all equipment furnished under this section. If requirements in this specification differ from those in the General Equipment Stipulations, the requirements specified herein shall take precedence.

C. Seismic Design Requirements.

1. Seismic Design requirements for products specified herein shall be as indicated in the Meteorological and Seismic Design Criteria section. UVSS shall utilize a licensed Professional Engineer in Michigan, as necessary, to meet these requirements.

D. Governing Standards.

1. Except as modified or supplemented herein, all work covered by this section shall be performed in accordance with all applicable municipal codes and ordinances, laws, and regulations which pertain to such work. In case of a conflict between these specifications and any state law or local ordinance, the latter shall govern.
2. All work shall comply with Underwriters' Laboratories (UL) safety requirements.

E. Power Supply.

1. The UV system shall be rated for a 480 / 277 volt, 3 phase, 4 wire + ground, and a 60 Hz power supply. Power supply to the UV system will be provided via 480V switchgear connections distributed to the UV System via 150kVA isolation transformers, and local disconnects. If additional power supply adjustments are needed, Engineer's Approval is required and UVSS shall state this requirement with their submittal.
2. Control system shall be a 120 volt, 1 phase, 60 Hz supply.
3. A hydraulic or electric cleaning system shall be acceptable.
4. Installation Contractor is responsible for cable and raceway supplying electrical power and control to the UV equipment. Lamp drivers are located in the Ballast (Driver) Cabinets located beside the UV channel. UVSS is responsible for providing the electrical design supply and construction from the external power and control interconnections to the equipment and accessories specified herein.

F. Tagging and Identification.

1. Each item of equipment and each part shipped separately shall be tagged and identified with indelible markings for the intended service. Tag number shall be clearly marked on all shipping labels and on the outside of all containers.
2. Equipment specified herein and in associated sections shall be identified in accordance with the Equipment and Valve Identification section.

G. Definitions.

1. The following terms are used in this section and associated sections:
 - a. UV Dose – The total radiant energy incident from all directions onto an infinitesimally small sphere of area dA , divided by dA , for a given contact time in seconds. The unit of UV dose shall be millijoules per square centimeter (mJ/cm^2) and shall be calculated as follows:

$$= I \times t$$

Where: D = UV Dose, mW-s/cm² (mJ/cm²)
I = average intensity or irradiance, mW/cm²
t = average exposure time, s

- b. UV Transmittance (UVT) – The transmittance of ultraviolet light at a wavelength of 254 nm through the water across a pathlength of 1 cm. UV transmittance shall be calculated from UV absorbance (A) at 254 nm by the following equation:

$$\text{Percent transmittance} = 100 \times 10^{-A}$$

- c. Intensity or Irradiance – The total radiant power incident from all directions onto a infinitesimally small sphere of cross-sectional area dA, divided by dA. The units of intensity shall be milliwatts per square centimeter (mW/cm²).
- d. Validated Reactor – A reactor that has been validated under the following conditions.
- 1) The validated flow range contains the design flow range per reactor as stated in this section.
 - 2) The validated UVT range contains the operational UV transmittance range as stated in this section.
 - 3) The validated dose range contains the operational germicidal UV dose range as stated in this section.
- e. Equivalent Dose – The maximum dose necessary for a full-scale UV system to achieve a level of inactivation of a specific organism equivalent to the level of inactivation for the same organism achieved in a laboratory using a collimated beam apparatus with a low pressure lamp producing UV energy at a wavelength of 254 nm to test a water sample collected at the same time.
- f. Low Pressure High Output (LPHO) Lamp – A lamp with input power equal to two to three times the input power of a LP lamp, primarily at 254 nm, with a pressure of approximately 0.2 psi.
- g. Guaranteed Life – The UVSS’s warranted life of the lamp, sleeve, ballast, and sensor.
- h. Expected Lamp Life – The UVSS’s estimated life of the lamp based on the operating conditions described in this section.
- i. Prorated Start Time – The time beginning after at least 20 percent of the guaranteed life has lapsed.
- j. Guaranteed Maximum Total System Energy Use – A calculated value based on UVSS data reflecting energy use in kilowatt-hours per year.
- k. Guaranteed Maximum Head Loss – The head loss in inches of water column allowed through the UV channel with all restrictions, including fouling, influent gate, and level control at peak flow rate.
- l. Gallon – U.S. gallon.

1.3 SUBMITTALS.

- A. The engineering data submitted by the UVSS and included herein will be verified during the performance testing of the system and prior to the acceptance of the equipment by the Owner. Any exceptions or deviations to these specifications shall be listed and fully described in the submittal. The Engineer's final decision regarding the acceptance or denial of any deviations or exceptions shall be just cause for the rejection of the proposed equipment and require that the UVSS provide the disinfection equipment as specified herein.
- B. Unless otherwise noted submittals required herein are considered part of the Early Works cost.
- C. Drawings and Data.
 - 1. Complete fabrication, assembly, foundation, and installation drawings, together with detailed specifications and data covering materials, parts, devices, and accessories forming a part of the equipment furnished, were submitted by the UVSS. Data and specifications include the following:
 - a. Complete description in sufficient detail to permit an item-by-item comparison with the Specification.
 - b. Dimensions and installation requirements of all required elements.
 - c. P&IDs of the system, detailing the equipment supplied by the UVSS and showing equipment to be provided by others that will interface with the system. The UVSS shall identify tag numbering for the units and the system that is coordinated with the Owner's established tag numbering scheme. An electronic copy of the PLC input/output listings in an Excel spreadsheet shall also be submitted to the Owner for programming of the SCADA interface. Input/output listing shall include all local alarms, and shall identify which alarms indicate that the UV system has been shut down.
 - d. Descriptive information, including catalog cuts and UVSS's specifications for major components. Information shall include weight and dimensions of major equipment and materials.
 - e. Bill of Materials after shop drawings are accepted, for all tagged devices and components supplied with the UV System including component original part numbers identifying each furnished component. For all tagged devices supplied, the UVSS shall develop a "Cross Reference Schedule" that matches the Tag to the appropriate equipment manual. The equipment schedule shall include the pertinent information associated with the equipment including tag number, description, functional name location, component equipment model, part number, size, materials, accessories and range. The Cross-Reference Schedule shall be provided in the form of a Microsoft Excel spreadsheet.
 - f. Electrical schematics, wiring diagrams and plan layouts. Drawings shall provide details for all field-wiring requirements between the UV system control panels and externally mounted equipment.
 - g. Detailed, site specific narrative information on how the UV system will operate and list of maintenance requirements.
 - h. The UVSS will provide documentation of previous experience with municipal UV disinfection systems in wastewater applications with variable output electronic drivers and automatic cleaning system.

- i. Calculations showing power required to achieve the disinfection requirements specified herein. The UVSS shall state the power per lamp (including lamp driver loss) and the system peak power consumption (including lamp driver loss), for both new lamps and end of lamp life.
 - 1) UVSS shall calculate and submit for Engineer review the maximum UV dose able to be delivered at peak flow condition and other design criteria defined herein with one UV module in each channel out of service.
 - j. Independent third party certified test results for power (kW), power factor, and apparent power (kVA) for the entire system.
 - 1) This costs shall be provided under the Balance of the Work costs.
 - k. Hydraulic calculations demonstrating compliance with the specified head loss through the channel with all restrictions, weirs, and controls factored in at all flow conditions specified herein.
 - l. Minimum UV254 transmission of the quartz sleeves and their guaranteed useful life as based on third party certification.
 - m. Certification from UV lamp and lamp driver output report prepared by an independent testing laboratory for the UVSS's current lamp technology. The report shall certify the output of the lamp and ballast at various operating conditions.
 - n. Guaranteed operating life of lamps in hours and lamp driver in years.
 - o. Certification of the specified guaranteed cost of replacement lamps for five years.
 - p. Certification dose response curve, bioassay test information transmittance measurements, and all supporting documentation utilized in submittals based on effluent samples where collected by the UVSS for system design.
 - q. UVSS commissioning test protocol, included in the Early Works cost. Additionally costs for updates in the Balance of the Work shall be included.
 - r. UVSS's project specific performance testing protocol that is in conformance with this Specification.
 - s. Description of disinfection performance guarantee
 - t. Temperature rise versus time table
 - u. Data on Shop Coating
2. Values submitted for headloss and power consumption will be verified during the performance and commissioning testing of the equipment, and prior to acceptance of the equipment by the Owner.

D. Operation and Maintenance Manuals.

1. One electronic copy of the operation and maintenance (O&M) manuals shall be submitted with the delivery of the equipment to the Owners treatment plant. The O&M manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered. In addition to requirements specified in the operation and maintenance manuals shall include but not limited to the following:
 - a. General description of the UV system as required by the UVSS.
 - b. UVSS contact information.
 - c. Recommended routine and preventive maintenance schedules.
 - d. Step-by-step procedure for cleaning lamps, sensors, and reactors, including the volume of cleaning chemical required to clean one reactor and expected cleaning

frequency given the water quality constituents. Procedure for maintaining lamps, sensors, lamp drive, and reactor.

- e. Guide to troubleshooting.
- f. Upon completion of installation and startup of the equipment, electronic copies of the PLC control programs and OIT programs shall be submitted to the Owner.

1.4 QUALITY ASSURANCE.

A. Qualification Requirements.

1. The UVSS shall be regularly engaged in the manufacture of UV systems and shall have at least five Low Pressure High Intensity (LPHI) systems of the same model of 30 mgd or greater capacity, installed and operating in the United States.
2. The UVSS shall have 3 years of operational experience for UV systems of the same model proposed.
3. All equipment furnished under this specification shall be new and shall be the standard product of a supplier who is regularly engaged in the supply of the equipment to be furnished.

B. Performance Requirements Guarantee.

1. The performance of the UV system in accordance with the requirements specified herein shall be guaranteed by the UVSS.
2. The UV validated dose produced by the system shall be in accordance with the specified requirements and shall be verified by a bioassay conducted according to either NWRI Ultraviolet Disinfection Guidelines for Drinking Water and Reuse Water (2012) or Ultraviolet Disinfection Guidance Manual (2006) procedures. A copy of this certification letter showing approval by the State of California shall be submitted. Cost of any additional validation work required to meet the requirements of this specification shall be at UVSS cost.

1.5 DELIVERY, STORAGE, AND HANDLING.

- A. Shipping shall be in accordance with the Product Delivery Requirements section. Handling and storage shall be in accordance with the Product Storage and Handling Requirements section.

1.6 SPARE PARTS.

- A. A set of spare parts shall be furnished and delivered with the system. UVSS shall provide spare parts for one UV module or 10% of the overall installed system, whichever is greater. Spare parts should include but not limited to lamps, wipers, sleeves, and ballasts.
- B. Spare parts shall be delivered to Owner as directed. All spare parts shall be in waterproof packages suitable for export service, labeled with the description and part numbers. Each item or set of parts expected to be installed at one time shall be in an individual package.

- C. If any of the above spare parts are used during the installation process, they shall be replaced at no cost to the Owner.

1.7 WARRANTY.

- A. The equipment furnished under this section shall be free from defects in materials and workmanship, including damage that may occur during shipping, for a period of 1 year from the date of Substantial Completion for the construction contract regardless of the date the equipment is manufactured or delivered to the site.
- B. Lamps shall be warranted for a guaranteed lamp life of 15,000 hours based on actual operating hours, to produce a delivered dose as indicated by the control system provided by the UVSS, to achieve compliance with permit requirements. Replacement cost will be prorated after 9,000 hours. On/Off cycles are limited to an average of four (4) per day accumulate over the guaranteed life of the lamp.
- C. Lamp drivers shall be warranted for a guaranteed life of 5 years from Substantial Completion regardless of the power output and operating hours. The UVSS shall provide replacement of failed lamp drivers within 30 days after written notification from the Owner, at no additional cost to the Owner. Replacement shall be prorated cost after two years from the date of Substantial Completion.
- D. Quartz sleeves shall be warranted for a minimum of 10 years from Substantial Completion. If 20 percent of the quartz sleeves fail to maintain a minimum transparency factor of 0.92 during the 10 year period, the UVSS shall replace all quartz sleeves within 30 days after written notification from the Owner, at no additional cost to the Owner. The full replacement of quartz sleeves does not apply if the failures can be shown to be no fault of the manufacturer or if they are a result of the system not being operated in accordance with the UVSS operation and maintenance manual. Shipping of quartz sleeves will be at UVSS expense.
- E. Intensity sensors shall be warranted for a minimum of 5 years from Substantial Completion prorated after 1 year. The full replacement of the intensity sensors does not apply if the failures can be shown to be no fault of the manufacturer or if they are a result of the system not being operated in accordance with the UVSS operation and maintenance manual.
- F. The warranty for lamps, lamp drivers, sensors, and quartz sleeves shall include all parts and freight for replacement during the warranty period. A written warranty acceptable to Engineer and Owner shall be provided.

PART 2 - PRODUCTS

2.1 SERVICE CONDITIONS.

- A. The ultraviolet disinfection modules shall be installed within concrete channels. The UV system will be used to disinfect wastewater which has undergone screening, grit removal, primary clarification, activated sludge treatment, final clarification, and under most conditions, filtration.

- B. All electrical and control equipment enclosures will be installed outdoors. The ambient temperature where the equipment will be installed will be between 33 and 104 degrees F. The operating ambient relative humidity is expected to be between 5% and 95%.
- C. Seismic design requirements shall be in accordance with the Meteorological and Seismic Design Criteria section.

2.2 PERFORMANCE AND DESIGN REQUIREMENTS.

- A. The equipment shall be designed for installation in concrete channels with dimensions as indicated on the Drawings.
- B. The end of lamp life UV dose produced by the system shall not be less than the value specified herein, as measured after the guaranteed lamp life indicated by UVSS has passed, in an effluent with UV transmittance as indicated in the design requirements at 253.7 nm at peak flow with fouled sleeves at the end of lamp life.
- C. The UV system shall be designed for the following performance and design requirements:

Peak flow (with all channels in service)	54	mgd
Average daily flow	25	mgd
Minimum daily flow	10	mgd
Minimum number of channels	2	
Estimated UV Transmittance (at 253.7 nm through 1 cm deionized water) through flow tubes, for design sizing	60	%
Min. UV validated dosage, at design conditions, after minimum number of hours (as indicated by guaranteed lamp life of operation and adjusted for organism) based on MS2 phage	30 ¹	mJ/cm ²
Lamp Output at End of lamp life,	80 ²	%
Fouling factor	80 ²	%
Maximum daily effluent CBOD, permit	30	mg/L
Influent plant <i>E Coli</i> coliforms/100 mL	unknown	cfu/100 mL
Monthly effluent fecal coliform/100 mL, permit (based on 30-day geometric mean)	200	cts/100 mL

7-Day effluent fecal coliform/100 mL, permit (based on geometric mean)	400	cts/100 mL
Wastewater temperature range	10 to 30	°C
Maximum Monthly Effluent TSS, permit	30	mg/L
Maximum Weekly Effluent TSS, permit	(7-day avg.) 45	mg/L
Bioassay required to verify validated dose	Yes	
Maximum allowable headloss from furthest upstream UV module to top of the weir	8	Inches

Notes:

1. *The UV system shall be designed to deliver a minimum UV dose specified at peak flow, in effluent having the specified UV transmittance, at end of lamp life (EOLL) after reductions for quartz sleeve fouling.*
2. *The UV Dose shall be adjusted using the end of lamp life factor as specified in the design requirements table to compensate for lamp output reduction over the time period corresponding to the manufacturer’s lamp warranty. Any change to specified EOLL shall be provided to the Engineer for approval at a minimum of 15 days before bidding for acceptance. Documentation of EOLL will be provided by the UVSS.*

D. Redundancy

1. The UV system does not require a redundant module or channel for redundancy.

2.3 EQUIPMENT BASIS OF DESIGN.

- A. This specification section describes a complete operational system to be furnished by a single responsible UVSS.
- B. Quality Assurance.

1. The products covered by this specification are intended to be the standard equipment, as modified by these specifications, of proven ability, and as manufactured by a single manufacturer, having long experience in the production of such equipment. UVSS shall be manufactured by Trojan Technologies of London, Ontario, Xylem Wedeco of Herford, Germany, or Suez Treatment Solutions Inc. of Leonia, New Jersey, without exception.

2.4 CONSTRUCTION.

- A. The following paragraphs specify general requirements.

- B. No tools or special equipment shall be required for module removal.
- C. All wetted parts shall be AISI Type 316 stainless steel, quartz glass, Teflon, or plastics not susceptible to UV or chemical degradation, including oxidants. All metal components above the water surface shall be AISI Type 316 stainless steel. All wiring exposed to UV light shall be insulated with UV-resistant material and warranted for 5 years from Substantial Completion for both parts and labor. All material exposed to UV light shall be Type 316 stainless steel, Type 214 quartz, Teflon, or other material acceptable to the Engineer.
- D. UV Lamps.
 - 1. The UV system shall utilize low pressure, high-intensity, mercury amalgam lamps capable of variable control of power output from a minimum of 50 to 100 percent installed in a staggered arrangement. Each lamp shall be protected from contact with the fluid by a quartz sleeve. Lamp filaments shall withstand shock and vibration.
 - 2. Electrical connections for the lamp will consist of four pins at one end of the lamp only. Lamp wiring shall be Teflon insulated stranded wire. Lamps without maintenance coating or that do not have four pins are considered instant-start and are not acceptable due to reduced reliability and increased maintenance and operating costs. The lamp shall withstand an average of four on/off cycles per day without reducing lamp life, warranty or causing any damage to the lamp.
 - 3. Lamp bases shall be resistant to UV, ozone, chlorine, and chloramines. UV lamps shall not require a long cool down period prior to re-start should the power to the UV system fail or be interrupted for a short period of time.
 - 4. The UV system lamps shall be available from the UVSS and preferably at least two lamp suppliers. No modifications to the system shall be required for lamp installation. Lamp replacement costs shall be guaranteed for a minimum of 10 years from the date of Substantial Completion for the Project. During these 10 years, the price shall be adjusted annually by the Producer Price Index – Industrial Commodities (where the base is 1982 = 100) published by the United States Department of Labor, Bureau of Labor Statistics, applicable on the anniversary of the date for Substantial Completion.
 - 5. The UVSS shall provide independent laboratory certification that lamps will provide a minimum of 35 percent of input power emitted as UV light at a wavelength of 254 nm after 100 hour burn-in period, and at the maximum lamp operating temperature. The lamp temperature shall not exceed the maximum operating temperature under full scale, full power conditions for this Project.
 - 6. Lamp output shall not fluctuate more than 3 percent with water temperature variations over the specified range. The operating skin temperature of the lamp shall not exceed 130° C. UV lamp maximum arc shall be as defined by each supplier. The lamps shall be capable of operating in a “No Flow” condition while submerged in water at the maximum specified process temperature, for a period of 60 minutes without causing any damage to the lamps.
 - 7. Lamps will be operated by electronic lamp drivers with variable output capabilities ranging from a minimum of 50% to 100% of normal power. The lamp assembly shall incorporate active filament heating to maintain a minimum lamp efficiency of 35 % across the varying water temperatures and between the minimum and maximum stated lamp power levels.

E. UV Banks.

1. UV Banks shall consist of UV lamps mounted on a heavy gauge Type 316 stainless steel frame. Lamp sleeves shall be provided around each UV lamp to prevent the lamps and electrical connections from coming in contact with the wastewater effluent. Lamp sleeves shall be single piece clear fused quartz circular tubing. Each lamp will be enclosed in its individual quartz sleeve, one end of which will be closed and the other end sealed by a lamp end seal. The closed end of the quartz sleeve will be held in place by a retaining O-ring. The quartz sleeve will not meet any steel in the frame. Sleeves will have minimum UV transmittance at 254nm of 90%. Sleeves will be open at one end only and domed at the other end. Quartz sleeves shall be clear fused quartz circular tubing containing 99.9% silicon dioxide.
2. The ends of lamp sleeves shall not protrude beyond the stainless steel frame of the UV module. Type 316 stainless steel spacer/reflector panels shall be provided so that no UV light is emitted from the channel when the UV modules are installed, and the lamps are energized. Each bank will be Type 6P or IP 67 rated.

F. Electronic Lamp Driver.

1. The electronic lamp driver shall drive one or a pair of lamps with independent control and monitoring circuits, and provide independent lamp status to the UV system PLC. The lamp driver shall be electronic microprocessor controlled.
2. The lamp driver shall produce an earth free lamp power supply operating at above supply frequency and optimized to preserve lamp life. The lamp driver will be programmed start type utilizing filament preheat followed by a high voltage pulse to ignite the lamp.
3. The lamp driver shall have a power factor correction circuit to ensure a maximum 99% power factor and less than 5% total harmonic distortion (THD) current at the maximum power level and nominal input voltage. The lamp driver electrical efficiency shall be a minimum 95 % at maximum power level.
4. The lamp driver shall detect lamp failure and automatically initiate a re-start sequence. The lamp driver shall attempt at least three re-starts before shutting off. The lamp driver shall incorporate a galvanic separation of the circuits for the two lamps served. In case of the secondary circuit operating in abnormal conditions regarding voltage and/or amperage, the lamp driver shall shut the affected lamp off.
5. The lamp driver shall be held in a standby mode when not in operation to reduce start-up time and minimize stress on electronic components. Local visual diagnostic will be provided with LEDs for lamp drive status, lamp status (on, idle, preheat, fault) power and communications status. Lamp driver shall be UL, CE, and RoHS compliant.

G. Cleaning System.

1. An automatic and integral lamp cleaning system shall be provided as part of the UV system. The cleaning system shall be designed to effectively and completely remove deposits from the lamp sleeves. The cleaning system shall be fully operational without requiring either lamps or modules to be removed from service.

2. The cleaning system will be provided with the required solutions to provide adequate cleaning, if capable of chemical and mechanical in-situ cleaning.
3. The wipers shall travel the full length of UV lamp arc. Cleaning system servicing will be provided so that servicing can be conducted while the system is operational. Wiping sequence will be automatically initiated with capability for manual override.
4. The UV intensity sensor shall be cleaned utilizing the same mechanical cleaning method as that of the lamp quartz sleeves. The cleaning system shall be parked out of the effluent when not in service.
5. The materials used for the wiper shall be resistant to high intensity UV radiation, wastewater, chemicals in the wastewater, and fluctuations in temperature.

H. Channel Level Control.

1. Level in the UV channel shall be controlled by fixed weirs provided by the UVSS. The intent is to provide a similar setup to the existing fixed weirs, see Sheet M2 of record drawings included in Appendix A. If additional weir length is required, UVSS shall provide proposed layout to increase weir length while minimizing modifications to the outer concrete walls. The weirs shall be constructed from AISI Type 304 stainless steel or be provided with Type 304 stainless steel weir plate for mounting to concrete. Installation Contractor will be responsible for all leveling of the weirs during installation.

I. Equipment Tags.

1. All equipment provided by the UVSS shall have a unique tag number. UVSS shall coordinate tag numbers with the Engineer and Owner.

2.5 ACCESSORIES.

- A. Lifting Eyes. All equipment weighing more than 100 pounds shall be provided with lifting eyes. Where a special lifting sling is required, it shall be furnished.
- B. Safety Equipment. Safety equipment consisting of 10 personnel goggles/face shields for protection against UV energy between 200 to 400 nm wavelength shall be provided. Eight UV area warning signs shall be provided. Refer to Owner requirements for warning sign locations.
- C. Electrical and Control Equipment Enclosure(s) Cooling. Where required by the UVSS's equipment when installed in the ambient conditions specified herein, the UVSS shall provide an air conditioning system, that will adequately cool the system electrical and control equipment enclosures. The air conditioning system components outside of the enclosure shall be constructed of corrosion resistant materials and provided with a phenolic epoxy coating. The air conditioning equipment shall be sized to accommodate any reduction in cooling capacity caused by the coating. Under no circumstances shall the panel cooling or heating equipment compromise the NEMA rating of the panel.

2.6 ELECTRICAL.

- A. The UVSS shall provide harmonic order and harmonic generation data of the UV system. UVSS shall also provide the data regarding harmonic transferred to primary side of UV power supply isolation transformer.
- B. The UV disinfection system shall be divided into electrical sub-systems. Each sub-system shall be powered from the Ballast (Driver) Cabinet by means of waterproof cable interfacing with a watertight strain relief. Electrical supply to each Ballast (Driver) Cabinet shall be 480/277 volts, 3 phase, 4 wire + ground, 60 Hz.
- C. Ballast (Driver) Cabinet enclosure shall be Type NEMA 4X construction, AISI Type 316 stainless steel. All internal components will be sealed from the environment. All Ballast (Driver) Cabinets shall be UL approved or equivalent. An internal heater shall be provided in the Ballast (Driver) Cabinet to prevent condensation when the external temperature drops below the dew point. Each Ballast (Driver) Cabinet shall be able to electrically isolate each bank of lamp drivers and safely replace a lamp driver without de-energizing any other operating banks.
- D. The control cabinet required to operate the automatic cleaning system and integrated lifting device shall be Type NEMA 4X, AISI Type 316 Stainless. If a hydraulic system center (HSC) is utilized, it will contain hydraulic power unit complete with pump, fluid reservoir, manifolds, valves and filter.
- E. General Wiring and Connections Requirements.
 - 1. All wiring and electrical connections shall be protected against moisture to prevent electrical shorts or failure. All electrical components, installation, wiring, and controls on or within the UV disinfection system as a whole shall be designed, constructed, and installed by the UVSS and in accordance with the current edition of the National Electrical Code and all applicable state and local electrical codes.
 - 2. The UV system modules shall be completely wired, requiring only an external connection for a single external power supply and monitoring and control wiring.
 - 3. External wiring to and from the control panel, except as noted, and power disconnect and alarm circuits shall be furnished and installed under the Electrical section by the Contractor under the construction contract. Wiring between the Ballast (Driver) Cabinet and the ballast and lamp enclosures will be provided under this section. UVSS shall provide the wiring from the ballasts to the lamps. If terminations are needed in the field between the lamps and ballasts, they shall be performed by the Installation Contractor and tested by the UVSS.

2.7 CONTROL AND INSTRUMENTATION.

- A. General.
 - 1. The UV system shall be provided with a Master Control Panel furnished by the UVSS. The panel shall be a NEMA 4X, Type 316 Stainless Steel, front opening, free standing panel with a full length door hinge and three point latch. The panel shall be designed for top and bottom entry of field wiring.

B. Power Supply.

1. The Master Control Panel shall accept a 120 volt, 60 Hz, single phase power supply. The panel shall be protected by a circuit breaker with an interrupting rating of 10,000 amps.

C. Power and Control Wiring.

1. The UVSS shall furnish all power and data cabling between the UV modules and the Ballast (Driver) Cabinets. The incoming power supply, conduit, and all field terminations and interconnections for power and data cables will be the responsibility of the Installation Contractor. Cables shall be installed by the Installation Contractor.
2. Conduit for all power, data, control, and instrumentation field wiring and cable shall be provided and installed by Installation Contractor.

D. Diagnostics Port.

1. The Master Control Panel shall include a ethernet port connected to the PLC that will allow the UVSS to access the PLC program for troubleshooting.

E. Programmable Logic Controller.

1. A programmable logic controller (PLC) shall be provided in the Master Control Panel for control of the UV system. The PLC shall be programmed for the functional control described herein, and incorporating sequences and safety and equipment protective interlocks as recommended by the UVSS. The PLC shall conform to Programmable Logic Controllers section.
2. The PLC shall be connected to the Plant Control System Ethernet network, and shall be provided with the required communication modules and media converters. The UVSS shall coordinate requirements with the plant control system supplier for communication between the UV system PLC and the Plant Control System. The plant SCADA system is a Rockwell FactoryTalk Version 12 (network distributed system). It uses PlantPax 3.0 (Built in PLC program file) which is pop-up screen for each device (pumps, valves and analog signals). The UV PLC shall be an Allen-Bradley ControlLogix controller model 1756-L73 with minimum 8MB of memory and RSLogix 5000 software (latest version) compatible with plant SCADA

F. Operator Interface Terminal.

1. An operator interface terminal (OIT) with a nominal diagonal display dimension of at least 15 inches with a minimum resolution of 640x480, 256 K colors, and a luminance of 400 cd/m² shall be provided. The OIT shall be NEMA 4X, and shall be mounted on the Master Control Panel face. The OIT shall display indications and alarms as recommended by the UVSS and as specified herein. A touch screen with pop up keyboard shall be provided for operator entry of commands and setpoints.

G. UPS.

1. A UPS shall be provided within the control panel to provide backup power to the PLC, OIT, and Ethernet switch for at least 30 minutes when power is lost to the control panel.

The UVSS shall be responsible for providing a properly sized UPS, installing the UPS in the control panel, and providing all necessary hardware and wiring to ensure a fully functional UPS backup system. Upon restoration of incoming power, the UPS shall recharge the batteries and return its connected loads to the incoming power source.

2. The UPS shall maintain a temperature-compensated, float charge voltage on the batteries when utility power is available to the UPS. Overcurrent protection when utility power is available shall be from a circuit breaker internal to the UPS. The UPS shall be intrinsically current-limiting when the unit is on battery.

3. The UPS shall meet the following requirements.

Capacity, minimum	1500 VA
Filtering and surge Protection (on utility power)	Meets UL 1449
Operating environment	0 to 40°C; 0 to 95 percent relative humidity, non-condensing
Recharge time, maximum (from 50% battery state of charge)	8 hours

4. The UPS shall have a visual status indicator for low (or faulty) battery, incoming power failure, on battery, and overload conditions. The UPS shall emit an audible signal when the UPS is operating on battery power. UPS alarms shall also be available and annunciated in the PLC.

H. Programmable Logic Controller and Operator Interface Terminal Configuration.

1. The UV control system shall be configured and commissioned by the UVSS for operation of the system as specified herein and as required by the UVSS.
2. The UVSS shall be responsible for programming all pseudo-I/O or transfer registers plus providing memory for 25% spare pseudo-I/O. All pseudo-I/O plus the 25% spare shall be located in a contiguous block of data registers for communication to the Plant Control System.
3. All control mode status, control set points, equipment status, bank elapsed time, alarm and data points in the UV system shall be made available on OIT screen. Full control of the UV system shall be provided through the OIT.
4. The OIT display should include, but not be limited to the following:
 - a. UV system in LOCAL ON
 - b. UV system in LOCAL OFF
 - c. UV system in REMOTE OFF
 - d. UV system in REMOTE ON
 - e. UV system in REMOTE AUTO

- f. UV bank on (each bank)
 - g. UV bank elapsed time
 - h. Lead and lag UV bank (each unit)
 - i. Lead and lag channel
 - j. Channel inlet gate open-closed position (each gate)
 - k. Channel inlet gate in REMOTE
 - l. Channel inlet gate fail (each gate)
 - m. UV intensity (each bank)
 - n. UV power (each bank)
 - o. Channel level
 - p. UV dose in each channel
 - q. Flow
5. The UVSS shall provide complete electronic copies of all PLC, OIT database and graphics, I/O, and configuration program data before shipment of the equipment for use in configuring the Plant Control System, and shall provide updated versions of this information during the field commissioning start up and testing including final version before acceptance of the system.

I. Controls.

- 1. The UVSS PLC will utilize an isolated 4-20 mA flow pacing signal to adjust the power supply to the lamps. The UVSS OIT and the plant SCADA system shall be designed to allow the operator to adjust the flow rate setting manually or to use the automatic flow rate from the effluent flow monitoring device. The UV control system shall automatically turn on and off or dim appropriate lamps and automatically turn on and off individual channels in relation to variations in plant flow.
- 2. The UV system shall be capable of automatically adjusting the output of the lamps in relation to variations in plant flow.
- 3. The UV system design shall allow the operator an option to operate the UV system in either manual or automatic modes.

J. Alarms.

- 1. Details of all alarms shall be displayed on the OIT. Alarms shall be categorized as critical, major, and minor.
- 2. Non-critical alarms shall be displayed to indicate that maintenance attention is required and shall include the following:
 - a. Maximum end of lamp life hours exceeded.
 - b. Individual lamp failure indicated by address system.
 - c. Individual ballast failure indicated by address system.
 - d. Low UV intensity factory set to alarm at 45 percent of the intensity after 100 hours burn in of the lamps, adjustable at the OIT.
- 3. Lamps and ballasts shall be addressed by bank number, module number, and lamp or lamp pair number.

4. Critical alarms shall be displayed to indicate an alarm condition in which the UV disinfection performance may be jeopardized. Critical alarms shall be defined by the UVSS, however, as a minimum the following shall be included:
 - a. Low UV intensity alarm, based on using a dynamic deviation set point alarm based on USEPA UVDGM .
 - b. Critical Instrument Failure. Failure of a critical instrument or communications link resulting in a control signal being lost. This condition shall initiate a default routine in the PLC control to put all available UV lamps on to ensure that disinfection will be achieved if physically possible. Critical instrument failure should be identified by UVSS. Personnel and plant safety shall be maintained at all times.
 - c. Loss of flow signal.
 - d. Failure to meet minimum UV Dose.
 - e. PLC failure.
 - f. Multiple lamp driver failure indicated by address.
 - g. Multiple lamp failure indicated by address.
 - h. Water level below lamp submergence level.
 - i. Water level above high water/ballast protection level
 - j. UV transmittance below design level.
 - k. High temperature for each bank.
 - l. UV system power failure.
 - m. Any condition that has initiated a UV system shutdown
5. An alarm history shall be maintained by the UV control system, and at a minimum, the 100 most recent alarms shall be displayed on the OIT when prompted. Mode of operation for UV banks shall be on, automatic, or off. Elapsed time of each bank shall be recorded and displayed on the display screen when prompted.

K. Data Exchange With Plant Control System.

1. The UV control system shall exchange information with the existing Plant Control System over a direct digital ethernet TCP/IP datalink. The UVSS shall coordinate the UV control system, programming, and installation to provide a system that works with the Plant Control System. The UVSS shall coordinate the data transfer with the Owner by providing a list of available signals, ranges, and addresses of the status and alarm data and attending a coordination meeting via teleconference with the Owner.
2. In order to confirm that there are no issues with the communication link between the UV PLC and the Plant Control System, the UVSS shall program control logic that sets and resets a heartbeat bit between the control systems. If this logic fails, an alarm shall be generated to alert the operator of a failed communication link with the UV PLC. The UVSS shall coordinate the required logic for this communication heartbeat with the System Supplier and/or Owner.
3. At a minimum, the following information shall be communicated between the UV system PLC and the Plant Control System.
 - a. Discrete Data Sent To Plant Control System
 - 1) UV system in LOCAL-ON
 - 2) UV system in LOCAL-OFF

- 3) UV system in REMOTE -AUTO
- 4) UV bank on (each bank)
- 5) Lead and lag UV bank (each unit)
- 6) Lead and lag channel
- 7) Channel inlet gate open-closed position (each gate)
- 8) Channel inlet gate in REMOTE
- 9) Channel inlet gate fail (each gate)
- 10) UV system major alarms
- 11) UV system critical alarms
- 12) Failure to meet minimum UV dose (each unit)*
- 13) Water level below UV lamp submergence level (each channel)*
- 14) UV system PLC failure*
- 15) Maximum lamp hours exceeded (each lamp)
- 16) Lamp failure (each lamp)
- 17) Lamp driver failure (each driver)

*The identified alarms are examples of critical alarms to be communicated to the plant control system. All alarms in the system shall be available to be communicated to the Plant Control System.

b. Discrete Data Sent From Plant Control System

- 1) Command UV system or module to REMOTE-ON
- 2) Command UV system or module to REMOTE-AUTO
- 3) Command UV bank on (each bank)
- 4) Command UV channel gate open/close
- 5) Vendor to provide additional data points required from Plant Control System for remote supervisory control.

c. Analog Data Sent To Plant Control System

- 1) UV bank elapsed time
- 2) UV intensity (each bank)
- 3) UV power (each bank)
- 4) Channel level (each channel)
- 5) UV dose in each channel
- 6) UV Disinfection Effluent Channel Level

d. Analog Data Sent From Plant Control System

- 1) UV bank power (each bank)
- 2) RED dose, mJ/cm²

4. In addition to the data exchange noted above, it is anticipated that there will be many other signals of value to the plant operator to be available across the plant control system network link. The additional signals shall be as recommended by the UV System Supplier and Engineer and coordinated with the System Integrator during construction.

L. Instrumentation.

1. Instruments for monitoring and control of the UV system shall be provided and shall include UV intensity sensors for each bank, a position switch to monitor position of each bank at the Ballast (Driver) Cabinet of associated UV channel, a transmittance analyzer for measurement of UV transmittance in the common inlet to the UV channels, ultrasonic level

metering system for measuring level in the common inlet channel, and electrode conductance level switches for low-low and high water level for each UV channel.

2. All instrumentation used in the UV disinfection system for control or monitoring shall be individually fused or circuit breaker protected to minimize the effects of any single point of failure. Instrumentation shall be installed in accordance with UVSS's instructions.
3. Intensity Sensor.
 - a. The intensity sensor shall be compliant with either UVDGM, DVGW, or ONORM standards. Each UV bank shall be provided with a UV intensity sensor, mounted in the top third of lamp vertical distance of each UV module and connected to the UV control system. The UV intensity sensor shall have at least 95 percent sensitivity to only the germicidal portion of the spectrum (253.7 nm). The sensor shall not use a filter or degrade after prolonged exposure to UV light. The sensor shall be automatically cleaned at the same frequency as the lamp sleeves to prevent fouling of the sensor and hence spurious false alarms for low intensity. The UV intensity sensor shall be factory calibrated to US National Institute for Standards and Technology. Sensor must be digitally calibrated to ensure calibration accuracy. Sensor will be turned off during low flow operation.
 - b. The sensor shall be digitally calibrated to ensure calibration accuracy. To ensure continuous disinfection, the sensor shall be accessible without shutting down the system, lifting a bank/module or removing lamps. Sensors will be designed to provide UV intensity data for dose monitoring and control functions. Dose pacing program may enable use of measured UV intensity along with flow rate and UVT to determine the delivered dose during operation. Sensors will be designed such that reference sensor readings can be taken without interrupting disinfection and without removing UV lamps, banks sleeves.
 - c. An intensity monitor in a UV unit which has been turned off for low flow operation shall also be turned off so as to prevent the alarm from activating on the main control panel. An adjustable time delay (variable from 0-20 minutes) to bypass the alarm on start and warm-up of the lamps and system shall be provided if required to prevent nuisance alarms.
4. On-Line UV Transmittance (UVT) Sensor.
 - a. A new UVT analyzer will be provided based on UVSS standard offering. The unit will need to be capable of being integrated into the control system for the UV system.
5. Ultrasonic Level Transmitters.
 - a. Acceptable manufacturer shall be Siemens, Hydromat, no exceptions.
 - b. If required for monitoring water level in UV channel, each UV channel shall have a dedicated ultrasonic level transmitter shall be a microprocessor-based electronic unit consisting of a sensor assembly, a signal converter/transmitter, and an interconnecting cable. The sensor shall be encapsulated in a chemical and corrosion-resistant material such as kynar or CPVC and shall be suitable for operation over a temperature range of -20° to +150°F and a relative humidity of 10 to 100 percent. The sensor shall be compatible with the process media being measured. Sensors mounted in areas subject to freezing shall be provided with

- special transducers or protected against icing by heaters. Sensors mounted in direct sunlight shall be provided with sunshades.
- c. The supplier shall coordinate the sensor mounting requirements and furnish drawings complete with dimensions and elevations
 - d. The ultrasonic level transmitter shall have automatic compensation for changes in air temperature at the sensor location. If separate temperature sensing probes are provided, they shall be mounted with or adjacent to the ultrasonic sensor, as recommended by the manufacturer. The transmitter shall have a four-digit LCD display scaled to read in engineering units. Digit height shall be approximately 1/2 inch. The transmitter shall be designed to ignore momentary level spikes, false targets, or momentary loss-of-echo. A loss-of-echo condition shall be indicated on the transmitter unit and shall be available as an alarm contact output. The transmitter output shall be an isolated 4-20 mA dc signal linearly proportional to the measured level range, or where indicated on the drawings or in the Instrument Device Schedule, shall be characterized to be proportional to the tank volume. Calibration parameters shall be entered through a keypad on the unit and shall be stored in nonvolatile EEPROM memory. Accuracy of the transmitted signal shall be ± 0.5 percent of the level range.
 - e. A sufficient length of sensor-to-transmitter signal cable (25 feet) shall be furnished with the instrument to locate the sensor 25 to 200 feet from the signal converter.
 - f. The signal converter electronics shall be housed in a weatherproof, corrosion-resistant NEMA Type 4X enclosure suitable for wall or pipestand mounting and for operating temperatures of -5° to $+122^{\circ}\text{F}$ and a relative humidity of 10 to 100 percent. A thermostatically controlled strip heater shall be provided in the signal converter enclosure.
 - g. The signal converter shall be of the ac-powered type.
6. Electrode/Conductance Relay Level Switches.
- a. If required by the UVSS, Electrodes shall be rigid AISI Type 316 stainless steel solid rod type with a PVC outer sheath or flexible wire suspension type with shielded stainless steel electrode tips, as indicated on the drawings or in the Instrument Device Schedule. PVC spacers shall be provided at 4-foot intervals of electrode length. Electrode holders shall be 4-inch ANSI Class 125 flange type.
 - b. Electrode relays shall be dual-coil or solid-state relay type with single-pole, double-throw output contacts rated not less than 5 amperes at 120 V ac. The relay primary power shall be 120 V ac, 60 Hz, single phase. Intrinsically safe solid-state relays shall be utilized whenever the electrodes are located in a hazardous area.
 - c. Relays shall be mounted in the UV Master Control Panel. Electrodes and conductance relays shall be manufactured by Endress + Hauser without exception.
7. Bench Photometer.
- a. The bench photometer shall be a single beam UV photometer with front panel and 100 percent transmittance control adjustment. The range shall be 0-100 percent transmittance with a wavelength accuracy of ± 0.16 half band width. Accessories shall include two matched quartz cuvettes, 100 percent T standard solution, and cuvette cleaning solution.
 - b. Manufacturer shall be RealTech.

2.8 FABRICATION.

A. Fasteners.

1. All anchors, bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel.
2. Refer to General Equipment Stipulations and Anchorage in Concrete and Masonry sections.

B. Surface Preparation.

1. All ferrous metal surfaces, except stainless steel, shall be shop cleaned by sandblasting or equivalent, conforming to the UVSS recommendation. All mill scale, rust, and contaminants shall be removed before shop primer is applied.

C. Shop Painting.

1. All ferrous metal surfaces, except stainless steel, shall be shop painted in accordance with the General Equipment Stipulations. Each UV disinfection system shall be factory prepared, primed, and finish-coated with the UVSS standard protective coating system. Sharp corners of all rolled edges and all cut or sheared edges shall be ground to a radius as required to ensure paint adherence.

D. Stainless Steel Cleaning.

1. All stainless steel shall be cleaned and passivated at the mill in accordance with ASTM A380 before being shipped. Vat dipping, paste, and other electrical/liquid techniques will be acceptable forms of passivation as acceptable to the Engineer. All stainless steel surfaces shall be adequately protected during fabrication, shipping, handling, and installation to prevent contamination by contact with iron or carbon steel objects or surfaces. Blast cleaning of stainless steel will not be acceptable. Any field welds or repairs may be cleaned and passivated using hand powered tools equipped with clean stainless steel brushes and grindery.
2. Alternative techniques during the manufacturing process to prevent contamination of stainless steel may be acceptable to the Engineer provided that the intent of the paragraph above is met. Manufacturer shall submit a certification stating that the alternative techniques will meet the requirements described herein.

2.9 FACTORY TESTS.

- A. All components of the UV system shall be factory tested by operating all lamps, monitoring equipment, and controls prior to shipment. The UV intensity monitor shall be calibrated to the UVSS specifications. Defective equipment and controls disclosed by such tests shall be replaced and the equipment package placed in satisfactory operating condition before shipping. The UVSS shall provide written certification following factory testing. This test may be witnessed by the Owner at the expense of the Owner. The factory test report shall be submitted to the Engineer within 15 days after completion of the testing.

PART 3 - EXECUTION

3.1 INSTALLATION.

- A. Equipment shall be installed and operated, or with the guidance of an authorized representative of the UVSS. The UVSS representative shall have 5 years of experience commissioning UV systems of similar design. All equipment installed under this Contract shall be placed into successful operation according to the written instructions of the UVSS or the instructions of the UVSS's field representative.

3.2 FIELD QUALITY CONTROL.

A. Installation Check.

1. An experienced, competent, and authorized representative of the UVSS shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the UVSS's representative shall be present when the equipment is placed in operation in accordance with the Commissioning section and as specified herein, and shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.
2. The UVSSs field representative shall furnish a written report certifying that the equipment has been properly installed, is level and in accurate alignment, and has been operated satisfactorily both in manual and automatic modes.
3. All costs for these services shall be included by the UVSS.
4. Pre-Commissioning. The Installation Contractor will coordinate commissioning with the UVSS and Engineer. The UVSS shall include costs in Balance of Work for supporting Installation Contractor. A commissioning plan will be submitted to the Engineer one month before commissioning begins, and shall include, but not be limited to:
 - a. Initial Start Up Activities
 - b. Verification of tags
 - c. Verification of connections
 - d. Instrumentation and control system checks
 - e. Verification of UV control system with Plant Control System
 - f. Verification of communication to Ballast (Driver) Cabinets and cleaning system
 - g. Verification of OIT operation
5. Commissioning.
 - a. Commissioning shall include, but not be limited to:
 - 1) Testing electrical connections
 - 2) Testing control signal connections to the UVSS control panel
 - 3) Testing level controls
 - 4) Testing and calibration of instruments including:
 - a) Level switches
 - b) UV transmittance analyzers

- c) UV intensity transmitter
 - d) Level transmitters
 - e) Temperature transmitter
 - 5) Manual and automatic reactor/bank operation
 - 6) Start up sequence
 - 7) Normal and emergency mode shut down sequence
 - 8) Testing of process, equipment protective, and safety interlocks
 - b. The UVSS's field representative shall startup and operate all UVSS systems in coordination with the Installation Contractor's overall startup plan and under the direction of the Installation Contractor's Startup Manager. The UVSS shall furnish materials, instruments, and incidental and expendable equipment required for commissioning the equipment.
6. Engineer's Discretionary Testing and Evaluation.
- a. The Engineer will direct that discretionary tests be performed to determine if the equipment is operating properly. The Engineer may require the Installation Contractor initiate alarm conditions to determine if the control system is functioning properly. UVSS shall support as necessary.
 - b. The Engineer will identify any equipment that has not been properly installed and malfunctions which will require rectification before performance testing.
- B. Installation Supervision.
1. The UVSS shall furnish a qualified field installation supervisor during the equipment installation.
 2. The UVSS is responsible for the execution services and shall include a minimum of 5 days and 2 trips to the site for Installation Supervision.
 3. Startup and field services will only be scheduled upon written request and in coordination with the Installation Contractor's overall startup plan. Installation Contractor shall notify UVSS of schedule requirements at least 10 working days in advance. Upon arrival to commission the equipment, if the UVSS field representative determines the Installation Contractor work is not complete and the start-up cannot be completed in the allotted time, a return visit will be scheduled at the Installation Contractor's expense.
 4. UVSS's field representative will observe, instruct, guide, and direct the Installation Contractor's erection or installation procedures. Supervision shall include overseeing the installation the UV lamps by the Installation Contractor.
 5. The Installation Contractor shall provide the UVSS with written notification 10 days prior to the need for such services.

3.3 FIELD PERFORMANCE TESTING.

- A. Prior to equipment acceptance, performance tests shall be conducted on each UV reactor/bank to demonstrate the equipment meets requirements specified in this section. The tests shall be conducted after the equipment installation has been approved by the UVSS and the UV lamps

have been operated for at least a 100 hour burn-in period. The UV banks shall be manually operated as needed before testing to meet this requirement.

- B. Performance tests shall be conducted based on conditions for flow, UV transmittance, and dose as specified, and considering degradation such as equipment aging and wear, fouling, and cleaning efficiency.
- C. Performance test scheduling shall be coordinated with the Owner and Engineer in coordination with the Installation Contractor's Startup Manager.
- D. Performance testing of the UV disinfection units shall be successfully completed and written test results accepted by the Engineer before the date of Substantial Completion of the construction contract.
- E. Performance testing shall be at the expense of the UVSS.
- F. The Owner will provide the wastewater effluent to the UV system during start up and testing. All reasonable efforts will be made by the Owner to approximate the specified flow conditions at a steady state for the duration required to allow samples to be taken.
- G. The performance tests shall be under the direct supervision of the UVSS's field representative. Installation Contractor shall supply personnel and equipment necessary to conduct the performance test.
- H. The UVSS's field representative shall prepare a report on the test results. Five copies of the report shall be submitted to the Engineer within 15 days of testing. The information collected will be used as a basis for determining UV system acceptance.
- I. Field Testing.
 - 1. Each channel shall be tested separately. Testing shall be at the design dose at conditions to simulate reduced power simulating end of lamp life UV output. Testing performed with the UV dose in excess of 10% of the design UV dose will require re-testing at the UVSS expense.
 - 2. The lamps shall be cleaned as recommended by the UVSS for the duration of the test. Manual cleaning will not be allowed during the performance testing period.
 - 3. UV channels shall be tested at the peak and average daily flow rates. Testing shall be as follows:
 - a. Each channel shall be tested individually at the design flow rate and at the average daily flow.
 - 4. Adjustment shall be made to power output of lamps for variations in transmittance so that the design dose is delivered during the test. Test durations at each flow rate shall be approximately 2 hours. Samples shall be collected every 30 minutes at the influent and effluent of the system tested, with the first sample taken after the system warm up period. The microbial results for all samples collected from the tests on all UV channels, will serve as the basis for determination of acceptance of the equipment. All test results shall be less

than performance requirements described in Open Channel Ultraviolet Disinfection System section.

5. Owner reserves the right to conduct additional sampling and testing at any time at Owner's expense without providing advance notification to the UVSS.
6. Data for each sample shall include, but not limited to the following:
 - a. The flow and detention time through the UV disinfection unit at the time of sampling. Detention time shall be calculated from flow and volume of the UV channel minus the volume occupied by the submerged UV equipment.
 - b. Headloss through the UV system.
 - c. The number of UV lamps in operation at the time of testing.
 - d. The measured UV dose in $\text{mW}\cdot\text{sec}/\text{cm}^2$.
 - e. The microbial count per 100 mL in the UV system influent and effluent.
 - f. The total suspended solids concentration in the UV system influent.
 - g. The percent transmittance at a wavelength of 254 nm in the UV system effluent.
 - h. The UV lamp intensity measured by on line instrumentation in $\mu\text{W}\cdot\text{cm}^2$ at a distance of 1 centimeter and as a percentage of UV intensity range.
 - i. Water surface elevations in each channel upstream and downstream of the reactor.
7. Additional data shall be obtained as necessary to demonstrate compliance with requirements in this section.
8. The following data shall be collected on the first UV system influent sample on the first day of testing:
 - a. pH.
 - b. Hardness.
 - c. Calcium.
 - d. Total dissolved solids (TDS).
 - e. Iron.
 - f. Water temperature.
9. Electrical power consumption shall be measured and recorded continuously during performance testing for verification of the power consumption of the UV system. Power will be measured at each bank in each channel. Power consumption shall be measured by a temporary recording watt meter or data logging system. Plot of system power consumption (kWh operating and kW demand) versus flow rate (mgd) during the previous 24-hour period shall be prepared by the UVSS.
10. Data recorded shall be provided to the Engineer in a Microsoft Excel spreadsheet in hard copy.

J. Sample Collection and Analysis.

1. Sample collection and analysis shall be by an independent, state-certified, Owner-approved testing laboratory. Costs for the testing laboratory shall be included in the UVSS Balance of Work costs. Sample collection, handling, and analysis shall be in accordance with the procedures described in the latest edition of "Standard Methods for the Examination of Water and Wastewater" and 40 CFR Part 136 procedures for effluent testing. In any event,

the temperature of samples shall be held below 4°C during a maximum transport time of 2 hours. Samples shall be refrigerated upon receipt in the laboratory and processed within 2 hours.

2. The Engineer and Owner will review the performance test report and will notify the UVSS in writing of UV system acceptance.
3. If after the second, and any subsequent retests allowed, the equipment does not meet the performance requirements, the Owner will select one of the following courses of action:
 - a. Allow the UVSS to make additional modifications and retesting.
 - b. Accept the UV equipment without conditions and issue a written notice that the UV equipment is acceptable.
 - c. Reject the equipment and require the UVSS to remove all equipment from the site, with the UVSS refunding all payments received and compensating Owner for cost of a replacement system.

3.4 TRAINING.

- A. An experienced, competent, and authorized representative of the UVSS shall train the Owner's personnel in operating, maintaining, and repairing the equipment specified in this section. All training shall be conducted at the Owner's location. Training shall commence as mutually agreed to by the Owner, Engineer, Installation Contractor, and UVSS. The scheduled hours for training shall be coordinated with the Owner. The UVSS shall maintain a record of the individuals that have completed training and provide information required for the documentation of Professional Development Hours required by the Owner.
- B. Training sessions may be videotaped by the Owner at the Owner's expense.
- C. The UVSS shall provide required materials, texts, handouts, and supplies. Training material shall be provided to the Owner in written and electronic format. Training materials shall be submitted for review with the O&M manuals.
- D. The UVSS shall provide a combination of classroom and hands-on training. The following training shall be provided.

Type of Training	<u>Number of Shifts</u>	<u>Number of Participants</u>	<u>Classroom Training (Hours)</u>	<u>Hands-On Training (Hours)</u>
UV Disinfection System	2	16	2	4
Mechanical Equipment	2	16	2	4

Open Channel UV Disinfection System

Type of Training	<u>Number of Shifts</u>	<u>Number of Participants</u>	<u>Classroom Training (Hours)</u>	<u>Hands-On Training (Hours)</u>
Electrical, Instrumentation, and Control Equipment	1	4	2	2

E. Hands-on training shall reinforce classroom training through a demonstration of equipment operation and maintenance procedures. There will be a minimum of 2 training visits, for 3 days each.

F. Types of training specified above shall include the following:

1. UV Disinfection System
 - a. UV disinfection theory
 - b. UV disinfection system overview
 - c. UV disinfection reactors, banks, modules and lamps
 - d. UV disinfection processes (start up, shut down, flow and dose pacing)
 - e. Maintenance
2. Mechanical Equipment Training
3. Electrical, Instrumentation, Control System
 - a. Electrical equipment operation and maintenance
 - b. Control system equipment
 - c. OIT operation
 - d. Instrumentation calibration and maintenance

End of Section

ATTACHMENT B
LEGAL STATUS OF BIDDER

(The Respondent shall fill out the provision and strike out the remaining ones.)

The Respondent is:

- A corporation organized and doing business under the laws of the state of _____, for whom _____ bearing the office title of _____, whose signature is affixed to this proposal, is authorized to execute contracts on behalf of respondent.*

*If not incorporated in Michigan, please attach the corporation's Certificate of Authority

- A limited liability company doing business under the laws of the State of _____, whom _____ bearing the title of _____ whose signature is affixed to this proposal, is authorized to execute contract on behalf of the LLC.
- A partnership organized under the laws of the State of _____ and filed with the County of _____, whose members are (attach list including street and mailing address for each.)
- An individual, whose signature with address, is affixed to this RFP.

Respondent has examined the basic requirements of this RFP and its scope of services, including all Addendum (if applicable) and hereby agrees to offer the services as specified in the RFP.

Signature Date: _____,

(Print) Name _____ Title _____

Firm: _____

Address: _____

Contact Phone _____

Fax _____

Email _____

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ATTACHMENT C
CITY OF ANN ARBOR DECLARATION OF COMPLIANCE

Non-Discrimination Ordinance

The "non discrimination by city contractors" provision of the City of Ann Arbor Non-Discrimination Ordinance (Ann Arbor City Code Chapter 112, Section 9:158) requires all contractors proposing to do business with the City to treat employees in a manner which provides equal employment opportunity and does not discriminate against any of their employees, any City employee working with them, or any applicant for employment on the basis of actual or perceived age, arrest record, color, disability, educational association, familial status, family responsibilities, gender expression, gender identity, genetic information, height, HIV status, marital status, national origin, political beliefs, race, religion, sex, sexual orientation, source of income, veteran status, victim of domestic violence or stalking, or weight. It also requires that the contractors include a similar provision in all subcontracts that they execute for City work or programs.

In addition the City Non-Discrimination Ordinance requires that all contractors proposing to do business with the City of Ann Arbor must satisfy the contract compliance administrative policy adopted by the City Administrator. A copy of that policy may be obtained from the Purchasing Manager

The Contractor agrees:

- (a) To comply with the terms of the City of Ann Arbor's Non-Discrimination Ordinance and contract compliance administrative policy.
- (b) To post the City of Ann Arbor's Non-Discrimination Ordinance Notice in every work place or other location in which employees or other persons are contracted to provide services under a contract with the City.
- (c) To provide documentation within the specified time frame in connection with any workforce verification, compliance review or complaint investigation.
- (d) To permit access to employees and work sites to City representatives for the purposes of monitoring compliance, or investigating complaints of non-compliance.

The undersigned states that he/she has the requisite authority to act on behalf of his/her employer in these matters and has offered to provide the services in accordance with the terms of the Ann Arbor Non-Discrimination Ordinance. The undersigned certifies that he/she has read and is familiar with the terms of the Non-Discrimination Ordinance, obligates the Contractor to those terms and acknowledges that if his/her employer is found to be in violation of Ordinance it may be subject to civil penalties and termination of the awarded contract.

Company Name

Signature of Authorized Representative Date

Print Name and Title

Address, City, State, Zip

Phone/Email address

Questions about the Notice or the City Administrative Policy, Please contact:

Procurement Office of the City of Ann Arbor
(734) 794-6500

Revised 3/31/15 Rev. 0

NDO-2

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**ATTACHMENT D
CITY OF ANN ARBOR LIVING WAGE ORDINANCE DECLARATION OF COMPLIANCE**

The Ann Arbor Living Wage Ordinance (Section 1:811-1:821 of Chapter 23 of Title I of the Code) requires that an employer who is (a) a contractor providing services to or for the City for a value greater than \$10,000 for any twelve-month contract term, or (b) a recipient of federal, state, or local grant funding administered by the City for a value greater than \$10,000, or (c) a recipient of financial assistance awarded by the City for a value greater than \$10,000, shall pay its employees a prescribed minimum level of compensation (i.e., Living Wage) for the time those employees perform work on the contract or in connection with the grant or financial assistance. The Living Wage must be paid to these employees for the length of the contract/program.

Companies employing fewer than 5 persons and non-profits employing fewer than 10 persons are exempt from compliance with the Living Wage Ordinance. If this exemption applies to your company/non-profit agency please check here No. of employees

The Contractor or Grantee agrees:

- (a) To pay each of its employees whose wage level is not required to comply with federal, state or local prevailing wage law, for work covered or funded by a contract with or grant from the City, no less than the Living Wage. The current Living Wage is defined as \$14.82/hour for those employers that provide employee health care (as defined in the Ordinance at Section 1:815 Sec. 1 (a)), or no less than \$16.52/hour for those employers that do not provide health care. The Contractor or Grantor understands that the Living Wage is adjusted and established annually on April 30 in accordance with the Ordinance and covered employers shall be required to pay the adjusted amount thereafter to be in compliance with Section 1:815(3).

Check the applicable box below which applies to your workforce

Employees who are assigned to any covered City contract/grant will be paid at or above the applicable living wage without health benefits

Employees who are assigned to any covered City contract/grant will be paid at or above the applicable living wage with health benefits

- (b) To post a notice approved by the City regarding the applicability of the Living Wage Ordinance in every work place or other location in which employees or other persons contracting for employment are working.
- (c) To provide to the City payroll records or other documentation within ten (10) business days from the receipt of a request by the City.
- (d) To permit access to work sites to City representatives for the purposes of monitoring compliance, and investigating complaints or non-compliance.
- (e) To take no action that would reduce the compensation, wages, fringe benefits, or leave available to any employee covered by the Living Wage Ordinance or any person contracted for employment and covered by the Living Wage Ordinance in order to pay the living wage required by the Living Wage Ordinance.

The undersigned states that he/she has the requisite authority to act on behalf of his/her employer in these matters and has offered to provide the services or agrees to accept financial assistance in accordance with the terms of the Living Wage Ordinance. The undersigned certifies that he/she has read and is familiar with the terms of the Living Wage Ordinance, obligates the Employer/Grantee to those terms and acknowledges that if his/her employer is found to be in violation of Ordinance it may be subject to civil penalties and termination of the awarded contract or grant of financial assistance.

Company Name

Street Address

Signature of Authorized Representative

Date

City, State, Zip

Print Name and Title

Phone/Email address

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VENDOR CONFLICT OF INTEREST DISCLOSURE FORM

All vendors interested in conducting business with the City of Ann Arbor must complete and return the Vendor Conflict of Interest Disclosure Form in order to be eligible to be awarded a contract. Please note that all vendors are subject to comply with the City of Ann Arbor’s conflict of interest policies as stated within the certification section below.

If a vendor has a relationship with a City of Ann Arbor official or employee, an immediate family member of a City of Ann Arbor official or employee, the vendor shall disclose the information required below.

1. No City official or employee or City employee’s immediate family member has an ownership interest in vendor’s company or is deriving personal financial gain from this contract.
2. No retired or separated City official or employee who has been retired or separated from the City for less than one (1) year has an ownership interest in vendor’s Company.
3. No City employee is contemporaneously employed or prospectively to be employed with the vendor.
4. Vendor hereby declares it has not and will not provide gifts or hospitality of any dollar value or any other gratuities to any City employee or elected official to obtain or maintain a contract.
5. Please note any exceptions below:

Conflict of Interest Disclosure*	
Name of City of Ann Arbor employees, elected officials or immediate family members with whom there may be a potential conflict of interest.	<input type="checkbox"/> Relationship to employee <hr/> <input type="checkbox"/> Interest in vendor’s company <input type="checkbox"/> Other (please describe in box below)

*Disclosing a potential conflict of interest does not disqualify vendors. In the event vendors do not disclose potential conflicts of interest and they are detected by the City, vendor will be exempt from doing business with the City.

I certify that this Conflict of Interest Disclosure has been examined by me and that its contents are true and correct to my knowledge and belief and I have the authority to so certify on behalf of the Vendor by my signature below:		
Vendor Name	Vendor Phone Number	
Signature of Vendor Authorized Representative	Date	Printed Name of Vendor Authorized Representative

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ATTACHMENT F
CITY OF ANN ARBOR NON-DISCRIMINATION ORDINANCE

Relevant provisions of Chapter 112, Nondiscrimination, of the Ann Arbor City Code are included below.
You can review the entire ordinance at www.a2gov.org/humanrights.

Intent: It is the intent of the city that no individual be denied equal protection of the laws; nor shall any individual be denied the enjoyment of his or her civil or political rights or be discriminated against because of actual or perceived age, arrest record, color, disability, educational association, familial status, family responsibilities, gender expression, gender identity, genetic information, height, HIV status, marital status, national origin, political beliefs, race, religion, sex, sexual orientation, source of income, veteran status, victim of domestic violence or stalking, or weight.

Discriminatory Employment Practices: No person shall discriminate in the hire, employment, compensation, work classifications, conditions or terms, promotion or demotion, or termination of employment of any individual. No person shall discriminate in limiting membership, conditions of membership or termination of membership in any labor union or apprenticeship program.

Discriminatory Effects: No person shall adopt, enforce or employ any policy or requirement which has the effect of creating unequal opportunities according to actual or perceived age, arrest record, color, disability, educational association, familial status, family responsibilities, gender expression, gender identity, genetic information, height, HIV status, marital status, national origin, political beliefs, race, religion, sex, sexual orientation, source of income, veteran status, victim of domestic violence or stalking, or weight for an individual to obtain housing, employment or public accommodation, except for a bona fide business necessity. Such a necessity does not arise due to a mere inconvenience or because of suspected objection to such a person by neighbors, customers or other persons.

Nondiscrimination by City Contractors: All contractors proposing to do business with the City of Ann Arbor shall satisfy the contract compliance administrative policy adopted by the City Administrator in accordance with the guidelines of this section. All city contractors shall ensure that applicants are employed and that employees are treated during employment in a manner which provides equal employment opportunity and tends to eliminate inequality based upon any classification protected by this chapter. All contractors shall agree not to discriminate against an employee or applicant for employment with respect to hire, tenure, terms, conditions, or privileges of employment, or a matter directly or indirectly related to employment, because of any applicable protected classification. All contractors shall be required to post a copy of Ann Arbor's Non-Discrimination Ordinance at all work locations where its employees provide services under a contract with the city.

Complaint Procedure: If any individual believes there has been a violation of this chapter, he/she may file a complaint with the City's Human Rights Commission. The complaint must be filed within 180 calendar days from the date of the individual's knowledge of the allegedly discriminatory action or 180 calendar days from the date when the individual should have known of the allegedly discriminatory action. A complaint that is not filed within this timeframe cannot be considered by the Human Rights Commission. To file a complaint, first complete the complaint form, which is available at www.a2gov.org/humanrights. Then submit it to the Human Rights Commission by e-mail (hrc@a2gov.org), by mail (Ann Arbor Human Rights Commission, PO Box 8647, Ann Arbor, MI 48107), or in person (City Clerk's Office). For further information, please call the commission at 734-794-6141 or e-mail the commission at hrc@a2gov.org.

Private Actions For Damages or Injunctive Relief: To the extent allowed by law, an individual who is the victim of discriminatory action in violation of this chapter may bring a civil action for appropriate injunctive relief or damages or both against the person(s) who acted in violation of this chapter.

THIS IS AN OFFICIAL GOVERNMENT NOTICE AND
MUST BE DISPLAYED WHERE EMPLOYEES CAN READILY SEE IT.

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CITY OF ANN ARBOR LIVING WAGE ORDINANCE

RATE EFFECTIVE APRIL 30, 2022 - ENDING APRIL 29, 2023

\$14.82 per hour

If the employer provides health care benefits*

\$16.52 per hour

If the employer does **NOT** provide health care benefits*

Employers providing services to or for the City of Ann Arbor or recipients of grants or financial assistance from the City of Ann Arbor for a value of more than \$10,000 in a twelve-month period of time must pay those employees performing work on a City of Ann Arbor contract or grant, the above living wage.

ENFORCEMENT

The City of Ann Arbor may recover back wages either administratively or through court action for the employees that have been underpaid in violation of the law. Persons denied payment of the living wage have the right to bring a civil action for damages in addition to any action taken by the City.

Violation of this Ordinance is punishable by fines of not more than \$500/violation plus costs, with each day being considered a separate violation. Additionally, the City of Ann Arbor has the right to modify, terminate, cancel or suspend a contract in the event of a violation of the Ordinance.

* Health Care benefits include those paid for by the employer or making an employer contribution toward the purchase of health care. The employee contribution must not exceed \$.50 an hour for an average work week; and the employer cost or contribution must equal no less than \$1/hr for the average work week.

The Law Requires Employers to Display This Poster Where Employees Can Readily See It.

**For Additional Information or to File a Complaint contact
Colin Spencer at 734/794-6500 or cspencer@a2gov.org**

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ATTACHMENT H

If a contract is awarded, the selected Firm(s) will be required to adhere to a set of general contract provisions which will become a part of any formal agreement. These provisions are included in the attached General Terms and Conditions.

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City of Ann Arbor: General Terms and Conditions

The following General Terms and Conditions shall apply to all purchases by or on behalf of the City of Ann Arbor unless specifically provided otherwise on the front of this Document:

Tax Exemption: The City of Ann Arbor is tax exempt, ID# 38-6004534.

Acceptance of Contract: This order is the City's contract to purchase the goods and services described on the reverse front side of this document from the Vendor. The City's placement of this order is expressly conditioned upon the Vendor's acceptance of all the terms and conditions of purchase contained on or attached to this purchase order. All specifications, drawings, and data submitted to the Vendor with this order are hereby incorporated and made part hereof.

Amendments: No agreement or understanding to modify this contract shall be binding upon the City unless in writing and signed by the City's authorized agent.

Delivery: All prices must be F.O.B. delivery point. Time is of the essence on this contract. If delivery dates cannot be met, the Vendor agrees to advise the City, in writing of the earliest possible shipping date. The City reserves the right to cancel or purchase elsewhere and hold the Vendor accountable.

Risk of Loss: Regardless of F.O.B. point, the Vendor agrees to bear all risk of loss, injury, or destruction of goods and materials ordered herein which may for any reason occur prior to delivery or acceptance by the City, whichever is later. No such loss, injury, or destruction shall release the Vendor from any obligations hereunder.

Inspection: Goods and materials must be properly packaged. Damaged goods and materials will not be accepted. The City reserves the right to inspect the goods at a reasonable time subsequent to delivery where circumstances or conditions prevent effective inspection of the goods at the time of delivery. All rejected goods shall be returned to the Vendor at no cost to the City, whether the damage is readily apparent at the time of delivery or later. The City's acceptance is conditioned on such inspection.

Patents and Copyrights: If an article sold and delivered to the City hereunder shall be protected by any applicable patent or copyright, the Vendor agrees to indemnify and save harmless the City, from and against any and all suits, claims, judgments, and costs instituted or recovered against it by any person whomsoever on account of the use or sale of such articles by the City in violation or right under such patent or copyright.

Uniform Commercial Code: All applicable portions of the Michigan Uniform Commercial Code shall govern contracts for goods with the City of Ann Arbor; except as modified by contract documents.

Non-waiver of Rights: No failure of either party to exercise any power given to it hereunder or to insist upon strict compliance by the other party with its obligations hereunder, and no custom or practice of the parties at variance with the terms hereof, nor any payment under this agreement shall constitute a waiver of either party's right to demand exact compliance with the terms hereof.

Material Safety Data Sheets: Applicable Material Safety Data Sheets, in compliance with OSHA/MIOSHA hazard communication regulations/standards, must be provided by the Vendor to the City at the time of purchase.

Assignments: The Vendor agrees not to assign or transfer this contract or any part thereof without the written consent of the City of Ann Arbor, acting through its authorized representative. Any unauthorized assignment may subject the contractor to immediate termination.

Laws Governing, Severability: This contract shall be governed by and construed according to the laws of the State of Michigan. Vendor agrees to submit to the jurisdiction and venue of the Circuit Court of Washtenaw County, MI, or if original jurisdiction is established, the U.S. District Ct. for Eastern District of MI, Southern Division. The Vendor stipulates venues referenced are convenient and waives any claim of non-convenience. If any term herein is found to be ineffective, unenforceable or illegal under any present or future laws, such term shall be fully severable, and the remaining terms shall not be affected and shall remain full force and effect.

Prevailing Wage: It shall be the responsibility of the Vendor to comply, when applicable, with the prevailing wage requirements and/or the Davis-Bacon Act as amended.

Living Wage: It shall be the responsibility of the Vendor to comply, when applicable, with the City of Ann Arbor's Living Wage Ordinance as defined in Chapter 23, Section 1:811-1:821.

Non-Discrimination: It shall be the responsibility of the Vendor to comply, when applicable, with, all State, Federal and Local non-discrimination laws, including MCL 37.2209 and Section 9:158 of the City Code.

Indemnification: To the fullest extent permitted by law the Vendor shall indemnify, defend and hold the City, its officers, employees and agents harmless from all suits, claims, judgments and expenses including attorney's fees resulting or alleged to result from any act or omission, associated with the performance of this contract by the Vendor or anyone acting on the Vendor's behalf under this contract. The Vendor shall not be responsible to indemnify the City for losses or damages caused by or resulting from the City's sole negligence. This indemnity survives delivery and acceptance of the Vendor's goods and services.

Warranty: The Vendor warrants to the City that all goods and services furnished hereunder will conform in all respects to the terms of this contract, including any drawings, specifications and standards incorporated herein. In addition, the Vendor warrants the goods and services are suitable for and will perform in accordance with the purposes for which they were intended.

Payment Terms: The City of Ann Arbor's payment terms are net 30. The payment date will be calculated based on the invoice receipt date or delivery date, whichever is later.

Payments: All invoices for goods and services shall be emailed to accountspayable@a2gov.org. Mailed invoices shall be addressed to the City of Ann Arbor, Accounts Payable, P.O. Box 8647, Ann Arbor, MI 48107, as indicated on the front of this purchase order. Invoices must include the Vendor's name, phone number, and clearly listed item descriptions, quantities and units of measure. The Vendor acknowledges and understands that invoices not addressed as stated above shall have the net 30 begin once the invoice is received by Accounts Payable.

Compliance with Laws: The Vendor certifies that in performing this contract it will comply with all applicable provisions of Federal, State and Local laws, regulations, rules and orders.

Termination for Cause: In the event the Vendor fails, at any time, to comply with, fully perform or strictly adhere to any covenant, condition or representation contained within the contract, the City shall have the right to give written notice to Vendor of such failure. If such failure is not cured to the City's satisfaction within ten (10) business days from the time of delivery to Vendor of such notice, the City shall have the right to terminate immediately without the requirement of a further notice.

I. EXTENT OF AGREEMENT

This Agreement, together Exhibits A, B, and C, constitutes the entire understanding between the City and the Bidder with respect to the subject matter of the Agreement and it supersedes, unless otherwise incorporated by reference herein, all prior representations, negotiations, agreements or understandings whether written or oral. Neither party has relied on any prior representations, of any kind or nature, in entering into this Agreement. No terms or conditions of either party's invoice, purchase order or other administrative document shall modify the terms and conditions of this Agreement, regardless of the other party's failure to object to such form. This Agreement shall be binding on and shall inure to the benefit of the parties to this Agreement and their permitted successors and nothing in this Agreement, express or implied, is intended to or shall confer on any other person or entity any legal or equitable right, benefit, or remedy of any nature whatsoever under or by reason of this Agreement. This Agreement may only be altered, amended or modified by written amendment signed by the Bidder and the City. This Agreement may be executed in counterparts, each of which shall be deemed an original, but all of which together shall be deemed to be one and the same agreement.

II. ELECTRONIC TRANSACTION

The parties agree that signatures on this Agreement may be delivered electronically in lieu of an original signature and agree to treat electronic signatures as original signatures that bind them to this Agreement. This Agreement may be executed and delivered by facsimile and upon such delivery, the facsimile signature will be deemed to have the same effect as if the original signature had been delivered to the other party.

III. EFFECTIVE DATE

This Agreement will become effective when all parties have signed it. The Effective Date of this Agreement will be the date this Agreement is signed by the last party to sign it.

REMAINDER OF PAGE LEFT BLANK; SIGNATURE PAGE FOLLOWS

SIGNATURE PAGE:

FOR _____
Contractor Name

By _____

Name: _____

Title: _____

Date: _____

FOR THE CITY OF ANN ARBOR

By _____
Christopher Taylor, Mayor

By _____
Jacqueline Beaudry, City Clerk

Date: _____

Approved as to substance

Service Area Administrator Type Name

Milton Dohoney Jr., City Administrator

Approved as to form and content

Atleen Kaur, City Attorney

EXHIBIT A
SCOPE OF SERVICES

(To be inserted after UVSS is selected)

**EXHIBIT B
COMPENSATION**

General

Contractor shall be paid for those Services performed pursuant to this Agreement inclusive of all reimbursable expenses (if applicable), in accordance with the terms and conditions herein. The Compensation Schedule below/attached states nature and amount of compensation the Contractor may charge the City:

(insert/Attach Negotiated Fee Arrangement)

EXHIBIT C
INSURANCE REQUIREMENTS

From the earlier of the Effective Date or the Commencement Date of this Agreement, and continuing without interruption during the term of this Agreement, Contractor shall have, at a minimum, the following insurance, including all endorsements necessary for Contractor to have or provide the required coverage.

A. *The Contractor shall have insurance that meets the following minimum requirements:*

1. *Professional Liability Insurance or Errors and Omissions Insurance protecting the Contractor and its employees in an amount not less than \$1,000,000.*

2. *Worker's Compensation Insurance in accordance with all applicable state and federal statutes. Further, Employers Liability Coverage shall be obtained in the following minimum amounts:*

Bodily Injury by Accident - \$500,000 each accident
Bodily Injury by Disease - \$500,000 each employee
Bodily Injury by Disease - \$500,000 each policy limit

3. *Commercial General Liability Insurance equivalent to, as a minimum, Insurance Services Office form CG 00 01 04 13 or current equivalent. The City of Ann Arbor shall be an additional insured. There shall be no added exclusions or limiting endorsements that diminish the City's protections as an additional insured under the policy. Further, the following minimum limits of liability are required:*

<i>\$1,000,000</i>	<i>Each occurrence as respect Bodily Injury Liability or Property Damage Liability, or both combined</i>
<i>\$2,000,000</i>	<i>Per Project General Aggregate</i>
<i>\$1,000,000</i>	<i>Personal and Advertising Injury</i>

4. *Motor Vehicle Liability Insurance equivalent to, as a minimum, Insurance Services Office form CA 00 01 10 13 or current equivalent. Coverage shall include all owned vehicles, all non-owned vehicles and all hired vehicles. The City of Ann Arbor shall be an additional insured. There shall be no added exclusions or limiting endorsements that diminish the City's protections as an additional insured under the policy. Further, the limits of liability shall be \$1,000,000 for each occurrence as respects Bodily Injury Liability or Property Damage Liability, or both combined.*

5. *Umbrella/Excess Liability Insurance shall be provided to apply in excess of the Commercial General Liability, Employers Liability and the Motor Vehicle coverage enumerated above, for each occurrence and for aggregate in the amount of \$1,000,000.*

- B. *Insurance required under A.3 and A.4 above shall be considered primary as respects any other valid or collectible insurance that the City may possess, including any self-insured retentions the City may have; and any other insurance the City does possess shall be considered excess insurance only and shall not be required to contribute with this insurance. Further, the Contractor agrees to waive any right of recovery by its insurer against the City for any insurance listed herein.*
- C. *Insurance companies and policy forms are subject to approval of the City Attorney, which approval shall not be unreasonably withheld. Documentation must provide and demonstrate an unconditional and unqualified 30-day written notice of cancellation in favor of the City of Ann Arbor. Further, the documentation must explicitly state the following: (a) the policy number(s); name of insurance company; name(s), email address(es), and address(es) of the agent or authorized representative; name and address of insured; project name; policy expiration date; and specific coverage amounts; (b) any deductibles or self-insured retentions, which may be approved by the City in its sole discretion; (c) that the policy conforms to the requirements specified. Contractor shall furnish the City with satisfactory certificates of insurance and endorsements prior to commencement of any work. If any of the above coverages expire by their terms during the term of this Agreement, the Contractor shall deliver proof of renewal and/or new policies and endorsements to the Administering Service Area/Unit at least ten days prior to the expiration date.*

**APPENDIX A – EXISTING UV SYSTEM RECORD DRAWINGS,
1999**

DRAFT

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DRAFT

CITY OF ANN ARBOR, MICHIGAN

WATER UTILITIES DEPARTMENT

WASTEWATER TREATMENT PLANT

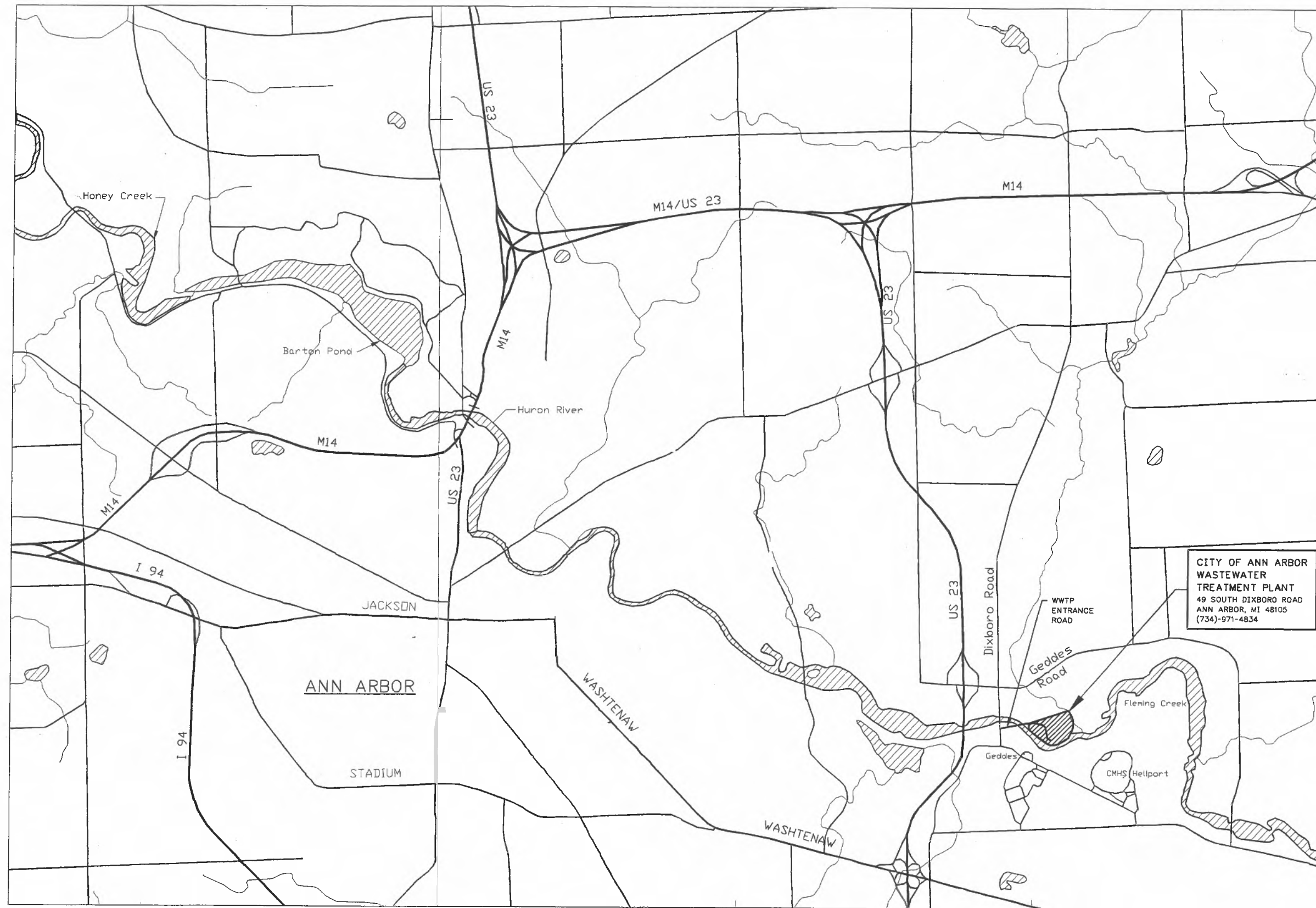
DISINFECTION FACILITIES UPGRADE

GREELEY AND HANSEN
211 WEST FORT STREET, SUITE 710
DETROIT, MICHIGAN 48226-3202

OCTOBER 1999

RECORD DRAWING

THIS RECORD IS NOT WARRANTED BUT IS BELIEVED TO REPRESENT CONDITIONS
UPON COMPLETION OF CONSTRUCTION WITHIN REASONABLE TOLERANCES,
BASED UPON THE INFORMATION FURNISHED TO THE ENGINEER PERTAINING TO
CHANGES MADE DURING CONSTRUCTION.



CITY OF ANN ARBOR
 WASTEWATER
 TREATMENT PLANT
 49 SOUTH DIXBORO ROAD
 ANN ARBOR, MI 48105
 (734)-971-4834

NOTE:

1. ADHERE TO LOAD LIMITS ON ALL ROADWAYS AND BRIDGES.

AREA MAP

RECORD DRAWING

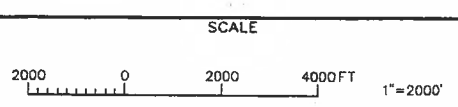
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FILE: 201AG02 1: 10/26/99 11:31 GH-A

GREELEY AND HANSEN
 ENGINEERS
 211 WEST FORT STREET, SUITE 710
 DETROIT, MICHIGAN 48226-3202

DESIGNED NBJ
 DRAWN RPN
 CHECKED PJR

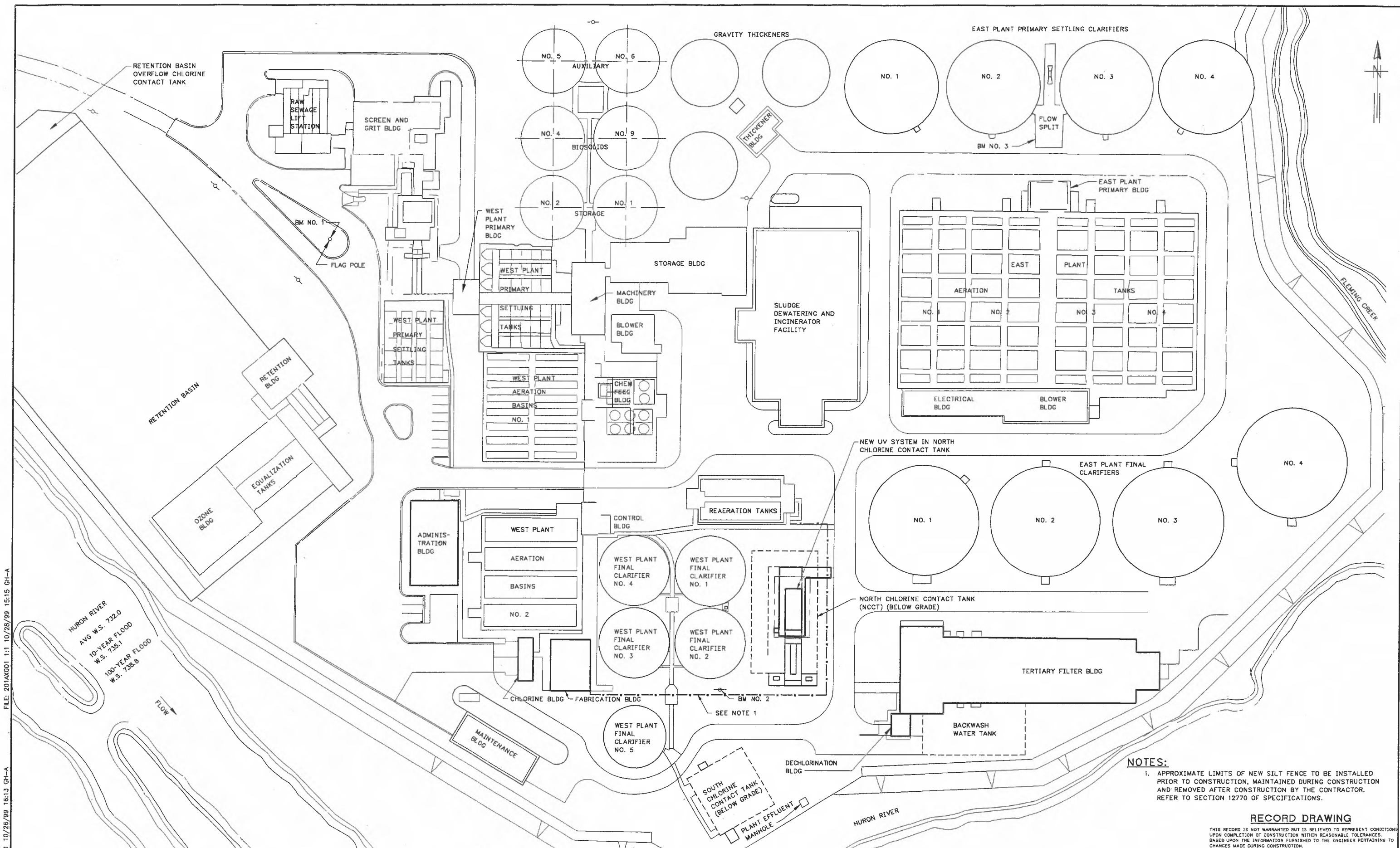
NO.	DATE	APPO	REVISION
	06/04/01	PJV	RECORD DRAWING



CITY OF ANN ARBOR, MICHIGAN
 WATER UTILITIES DEPARTMENT
 WASTEWATER TREATMENT PLANT
 DISINFECTION FACILITIES UPGRADE

GENERAL
 VICINITY MAP
 AND SITE LOCATION

PROJ	02012
DWG	G2
SHEET	2 OF 28
DATE	OCTOBER 1999
REV	1



FILE: 201AXG01 1:1 10/28/99 15:15 GH-A
 FILE: 201AXG03 1:1 10/26/99 16:13 GH-A

HURON RIVER
 AVG W.S. 732.0
 10-YEAR FLOOD
 W.S. 735.1
 100-YEAR FLOOD
 W.S. 738.8

RETENTION BASIN

RETENTION BASIN OVERFLOW CHLORINE CONTACT TANK

NOTES:
 1. APPROXIMATE LIMITS OF NEW SILT FENCE TO BE INSTALLED PRIOR TO CONSTRUCTION, MAINTAINED DURING CONSTRUCTION AND REMOVED AFTER CONSTRUCTION BY THE CONTRACTOR. REFER TO SECTION 12770 OF SPECIFICATIONS.

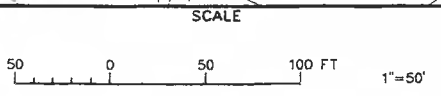
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GREELEY AND HANSEN
 ENGINEERS
 211 WEST FORT STREET, SUITE 710
 DETROIT, MICHIGAN 48226-3202

DESIGNED NBJ
 DRAWN RPN
 CHECKED PJR

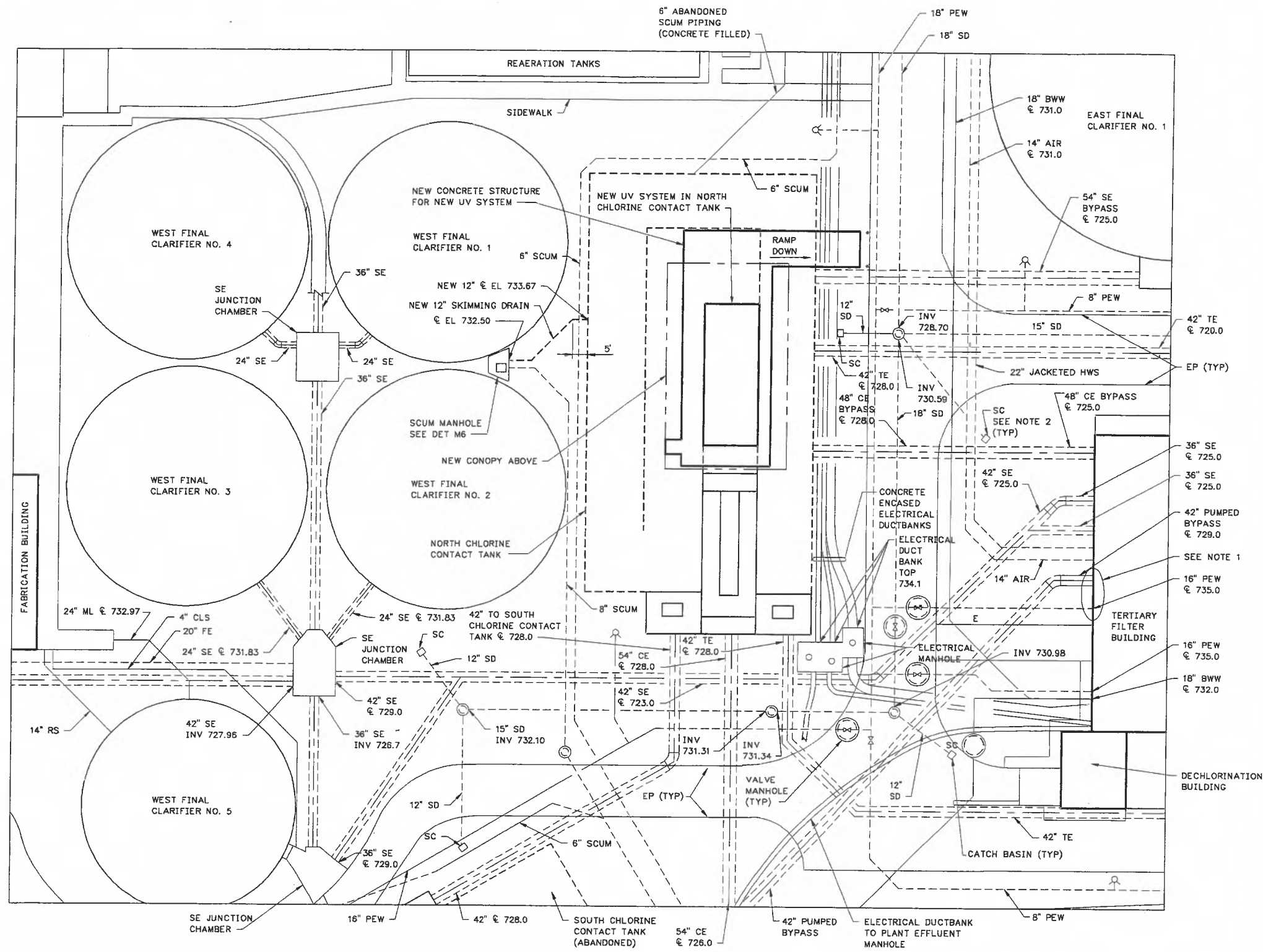
NO.	DATE	APPD	REVISION
06/04/01		PJV	RECORD DRAWING



CITY OF ANN ARBOR, MICHIGAN
 WATER UTILITIES DEPARTMENT
 WASTEWATER TREATMENT PLANT
 DISINFECTION FACILITIES UPGRADE

GENERAL
 SITE PLAN

PROJ	02012
DWG	G3
SHEET	3 OF 28
DATE	OCTOBER 1999
REV	1



PLAN

NOTES:

1. FIELD VERIFY LOCATION OF SAMPLE, CHLORINE SOLUTION AND SULFUR DIOXIDE SOLUTION PIPING IN THIS AREA PRIOR TO INSTALLATION OF ELECTRICAL DUCTBANK.
2. FURNISH, INSTALL AND MAINTAIN DURING THE WORK MICHIGAN UNIFIED KEYING SYSTEM EROSION AND SEDIMENTATION CONTROL MEASURE NUMBER 3B (STRAW BALES WITH GEOTEXTILE FABRIC FILTER SURROUNDING BALES) AT ALL CATCH BASINS AND MANHOLES DESIGNATED SC. REFER TO SECTION 02270 OF SPECIFICATIONS.

RECORD DRAWING

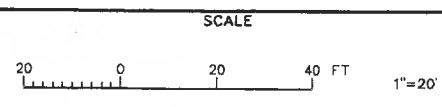
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FILE: 201A604 1:1 10/27/99 08:20 GH-A

GREELEY AND HANSEN
ENGINEERS
211 WEST FORT STREET, SUITE 710
DETROIT, MICHIGAN 48226-3202

DESIGNED BYD
DRAWN JFC
CHECKED PJR

NO.	DATE	APPD	REVISION
06/04/01		PJV	RECORD DRAWING

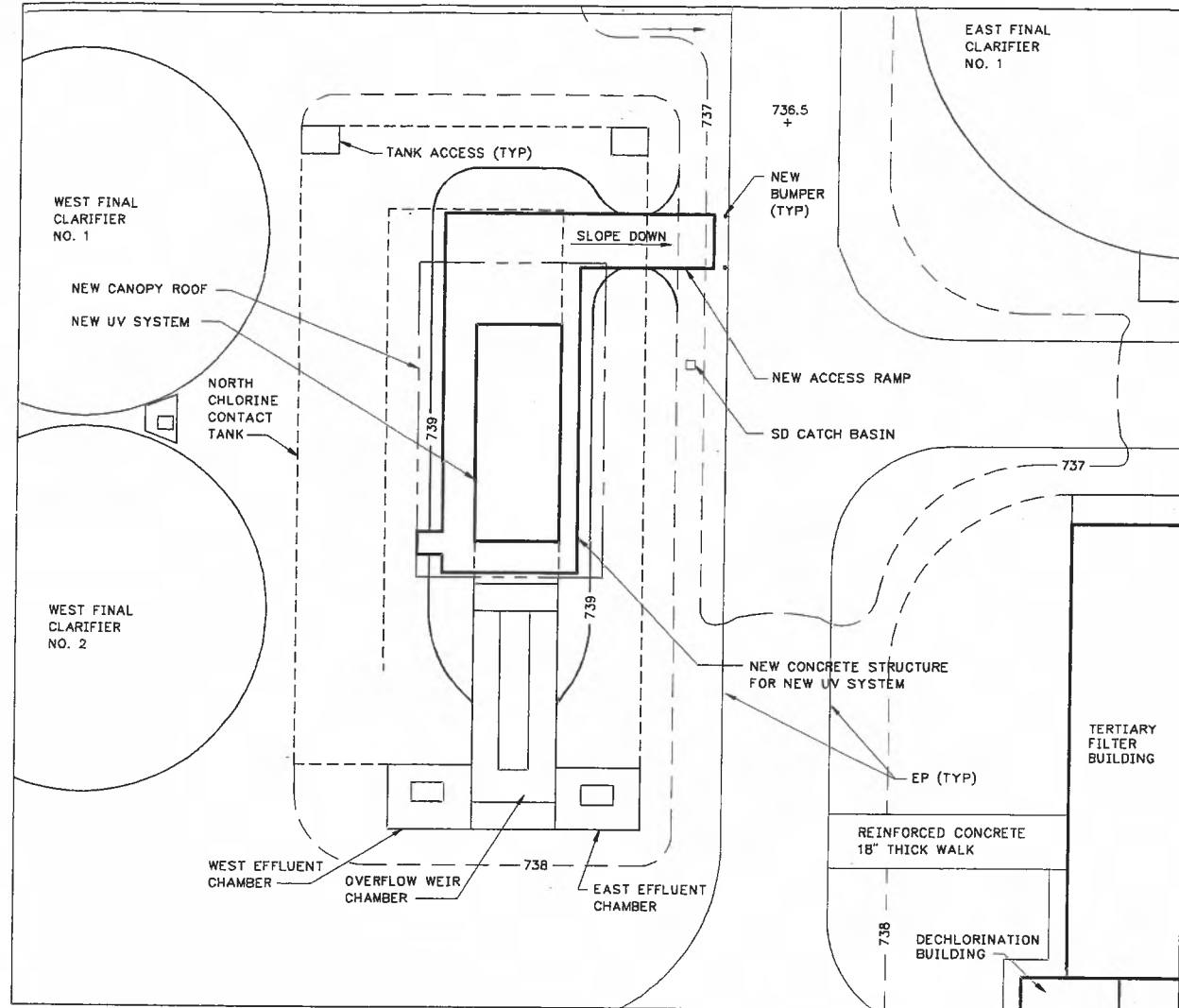


CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

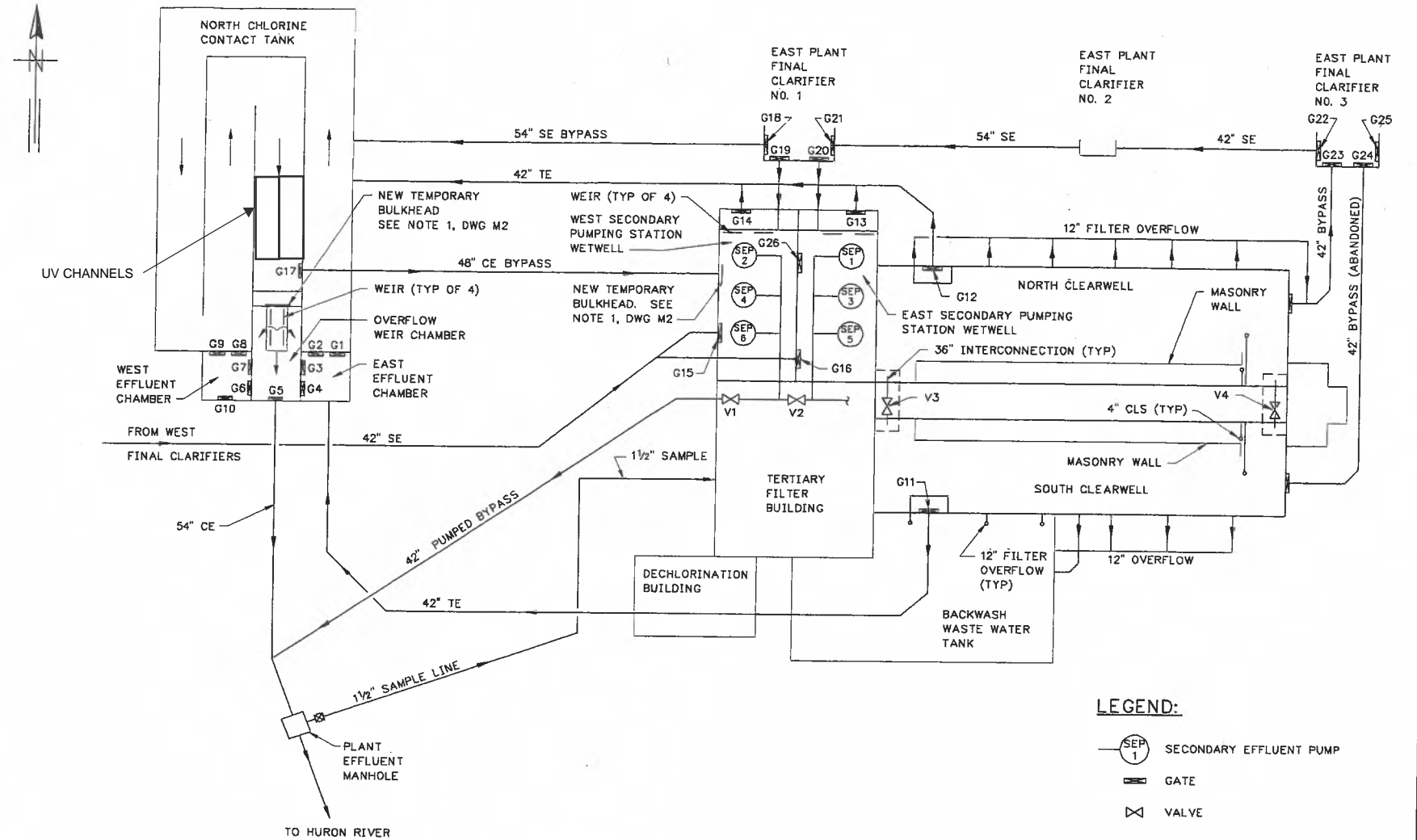
GENERAL
NORTH CHLORINE CONTACT TANK
YARD PIPING PLAN

PROJ	02012
DWG	G4
SHEET	4 OF 28
DATE	OCTOBER 1999
REV	1

FILE: 201AXG02 1:1 10/28/99 14:36 GH-A
 FILE: 201AXG01 1:1 10/28/99 15:15 GH-A
 FILE: 201AXG01 1:1 10/28/99 16:37 GH-A



GRADING PLAN
 SCALE: 1"=20'



EFFLUENT FLOW DIAGRAM
 SCALE: NOT TO SCALE

LEGEND:
 (SEP 1) SECONDARY EFFLUENT PUMP
 GATE
 VALVE

- NOTES:**
1. A DASHED LINE (---) INDICATES EXISTING CONTOUR. A HEAVY SOLID LINE (—) INDICATES NEW CONTOUR.
 2. FIELD VERIFY EXISTING TOPOGRAPHIC CONDITIONS.
 3. SLOPE WALK FROM EL 743.00 TO MATCH EXISTING ELEVATION AT ROAD.

GATE AND VALVE IDENTIFICATION TABLE					
Identification Number	Contract 77-S-7 ID Numbers	Process Information and Control System ID Numbers	Gate or Valve	Type	Centerline Elevation
G1	S-12-1	S-52-1	Gate	Sluice	42" x 42"
G2	S-12-2	S-52-2	Gate	Sluice	42" x 42"
G3	S-14-1	S-54-1	Gate	Sluice	36" x 36"
G4	S-14-2	S-54-2	Gate	Sluice	36" x 36"
G5	S-15-1	S-55-1	Gate	Sluice	54" dia.
G6	S-14-4	S-54-4	Gate	Sluice	36" x 36"
G7	S-14-3	S-54-3	Gate	Sluice	36" x 36"
G8	S-13-1	S-53-1	Gate	Sluice	42" x 42"
G9	S-13-2	S-53-2	Gate	Sluice	42" x 42"
G10	S-16-1	S-56-1	Gate	Sluice	42" dia.
G11	S-5-1	---	Gate	Sluice	42" dia.
G12	S-4-1	---	Gate	Sluice	42" dia.
G13	S-1-2	---	Gate	Sluice	42" dia.
G14	S-1-1	---	Gate	Sluice	42" dia.
G15	S-2-1	---	Gate	Sluice	36" dia.
G16	S-2-2	---	Gate	Sluice	36" dia.
G17	S-11-1	S-51-1	Gate	Sluice	48" dia.
G18	S-7-1	S-47-1	Gate	Sluice	54" dia.
G19	S-6-1	S-46-1	Gate	Sluice	48" dia.
G20	S-6-2	S-46-2	Gate	Sluice	48" dia.
G21	S-7-2	S-47-2	Gate	Sluice	54" dia.
G22	S-9-1	S-49-1	Gate	Sluice	42" dia.
G23	S-8-1	S-48-1	Gate	Sluice	42" dia.
G24	S-8-2	S-48-2	Gate	Sluice	42" dia.
G25	S-10-1	S-50-1	Gate	Sluice	42" dia.
G26	S-3-1	---	Gate	Sluice	36" x 36"
V1	B-3-1	---	Valve	Butterfly	42" dia.
V2	B-2-1	---	Valve	Butterfly	48" dia.
V3	B-9-1	---	Valve	Butterfly	36" dia.
V4	B-9-2	---	Valve	Butterfly	36" dia.

NEW GATES IDENTIFICATION TABLE			
New Gate ID	Type	Size	Centerline Elevation
S-57-1	Slide	72" x 72"	727.65
S-57-2	Slide	72" x 72"	727.65
S-57-3	Slide	72" x 72"	727.05
S-57-4	Slide	72" x 72"	727.05
S-58-1	Sluice	12" x 12"	732.33

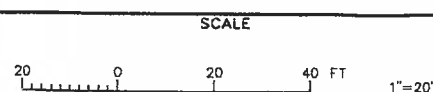
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GREELEY AND HANSEN
 ENGINEERS
 211 WEST FORT STREET, SUITE 710
 DETROIT, MICHIGAN 48226-3202

DESIGNED NBJ
 DRAWN GSD
 CHECKED PJR

NO.	DATE	APPD	REVISION



CITY OF ANN ARBOR, MICHIGAN
 WATER UTILITIES DEPARTMENT
 WASTEWATER TREATMENT PLANT
 DISINFECTION FACILITIES UPGRADE

GENERAL
 NORTH CHLORINE CONTACT TANK
 GRADING PLAN AND DIAGRAM

PROJ 02012
 DWG **G5**
 SHEET 5 OF 28
 DATE OCTOBER 1999 REV 1

VALVE SYMBOLS			
DESCRIPTION	SCHEMATIC	THREE LINE	SINGLE LINE
GATE			
BUTTERFLY			
PLUG			
CHECK (SWING)			
CONE			
BALL			
DIAPHRAGM			
GLOBE			
ANGLE			
THREE WAY			
FOUR WAY			
FLAP			
PRESSURE RELIEF			
AUTO AIR AND VACUUM RELEASE			
AUTO AIR RELEASE			
AUTO VACUUM RELEASE			
PRESSURE REDUCING			
HOSE			
STOP AND DRAIN			

PIPE FITTINGS			
DESCRIPTION	SCHEMATIC	THREE LINE	SINGLE LINE
CROSS	NA		
CROSS	NA		
TEE	NA		
TEE	NA		
TEE	NA		
SIDE OUTLET TEE	NA		
SIDE OUTLET TEE	NA		
LATERAL	NA		
90° ELBOW	NA		
90° ELBOW	NA		
90° ELBOW	NA		
90° ELBOW (LONG RADIUS)	NA		
45° ELBOW	NA		
45° ELBOW	NA		
45° ELBOW	NA		
45° ELBOW (LONG RADIUS)	NA		
SIDE OUTLET ELBOW	NA		
SIDE OUTLET ELBOW	NA		
BASE ELBOW	NA		

PIPE FITTINGS			
DESCRIPTION	SCHEMATIC	THREE LINE	SINGLE LINE
UNION (SCREWED)			
REDUCER			
REDUCER - ECCENTRIC (OFFSET VIEW)	NA		
BLIND FLANGE			
SLEEVE TYPE COUPLING			
SLEEVE TYPE COUPLING (HARNESSED)			
GROOVED TYPE COUPLING			
EXPANSION JOINT RUBBER BELLOWS TYPE			
EXPANSION JOINT METAL BELLOWS TYPE			
VENTURI METER			
METER			
STRAINER			
DUPLEX STRAINER			
LUBE OIL FILTER		NA	
MOISTURE SEPARATOR		NA	
SCALE TRAP		NA	
FLAME TRAP			
VENT			
THERMOSTAT (TEMPERATURE REGULATOR)			
PRESSURE GAUGE			
THERMOMETER			
WATER LEVEL ALARM			
DIFFERENTIAL PRESSURE GAUGE			

PIPE JOINTS			
DESCRIPTION	SCHEMATIC	THREE LINE	SINGLE LINE
FLANGE	NA		
MECHANICAL JOINT	NA		
MECHANICAL JOINT (RESTRAINED)	NA		
PUSH ON OR BELL AND SPIGOT	NA		
PUSH ON OR BELL AND SPIGOT (RESTRAINED)	NA		
WELDED	NA		NA
SCREWED	NA		
JOINT IN CONCRETE PIPE	NA		NA

WALL FITTINGS			
DESCRIPTION	SCHEMATIC	THREE LINE	SINGLE LINE
WALL SLEEVE (CAULKED)	NA		
WALL SLEEVE (ANNULAR TYPE SEAL)	NA		
WALL SLEEVE (MECHANICAL JOINT)	NA		
FLANGE AND FLANGE WALL PIPE WITH INTERMEDIATE COLLAR (F x F x F)	NA		
BELL AND BELL WALL PIPE WITH INTERMEDIATE COLLAR (B x F x B)	NA		
MECHANICAL JOINT AND MECHANICAL JOINT WALL PIPE WITH INTERMEDIATE COLLAR (MJ x F x MJ)	NA		
BELL AND FLANGE WALL PIPE WITH INTERMEDIATE COLLAR (B x F x F)	NA		
MECHANICAL JOINT AND FLANGE WALL PIPE WITH INTERMEDIATE COLLAR (MJ x F x F)	NA		
STEEL WALL RING FOR MECHANICAL JOINT AND CONCRETE PIPE (RUBBER AND STEEL)	NA		NA

- NOTES:**
1. THIS IS A GENERAL LEGEND PROVIDED TO FACILITATE USE OF THE DRAWINGS. REFER TO THE DRAWINGS AND SPECIFICATIONS FOR ITEMS REQUIRED.
 2. VALVES AND PIPE FITTINGS ARE SHOWN WITH FLANGED JOINTS. ITEMS ARE AVAILABLE WITH VARIOUS JOINTS AND ARE SHOWN AS REQUIRED.
 3. NA MEANS NOT APPLICABLE.

VALVE OPERATORS

- * PLACE KEY FOR OPERATOR IN PLACE OF *
- NONE
- MANUAL
- C CHAINWHEEL
- D DIAPHRAGM
- F FLOAT
- G GEAR
- H HYDRAULIC CYLINDER
- M MOTOR (ELECTRIC)
- P PNEUMATIC CYLINDER
- S SOLENOID
- A AIR MOTOR
- N NUT

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SCALE
NOT TO SCALE

GREELEY AND HANSEN
ENGINEERS
211 WEST FORT STREET, SUITE 710
DETROIT, MICHIGAN 48226-3202

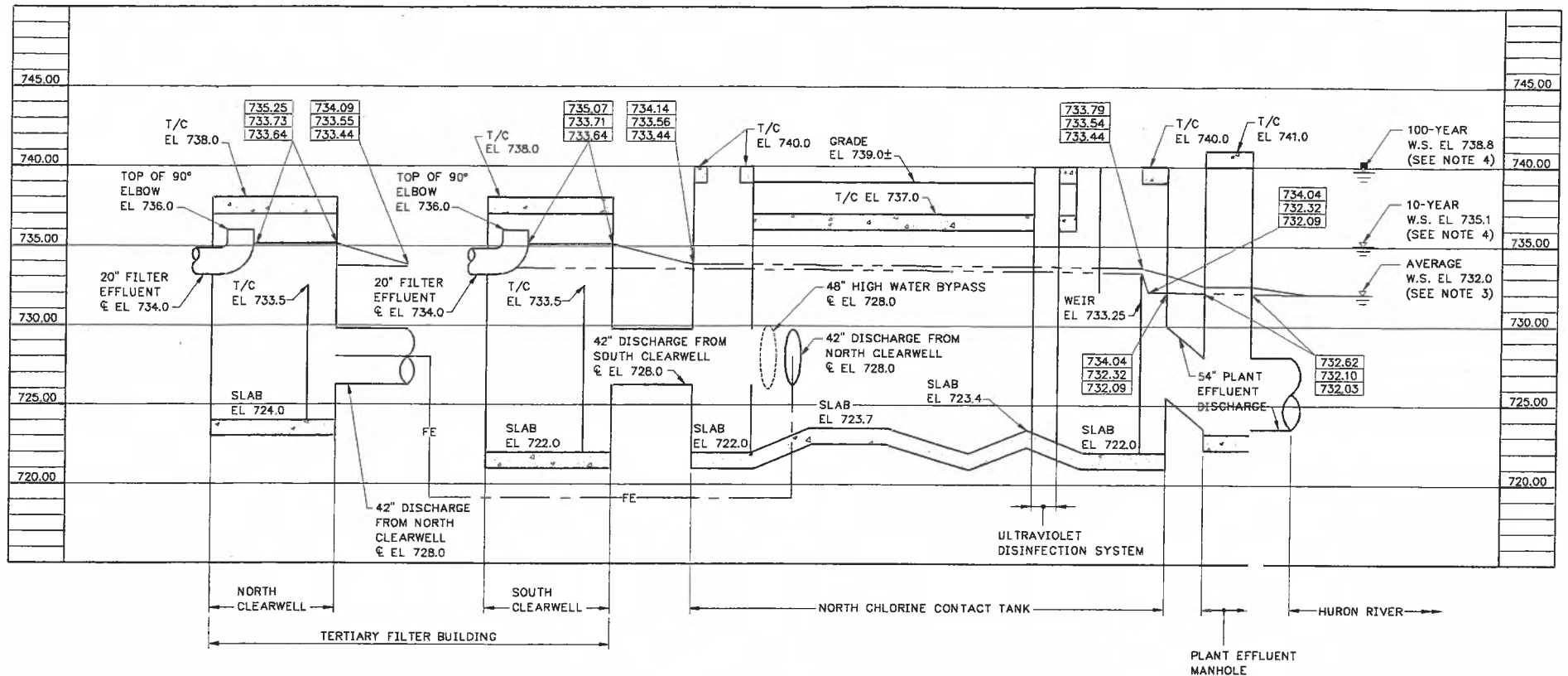
DESIGNED LCC
DRAWN RPN
CHECKED PJV

CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

PIPING AND EQUIPMENT
PIPING SYMBOLS

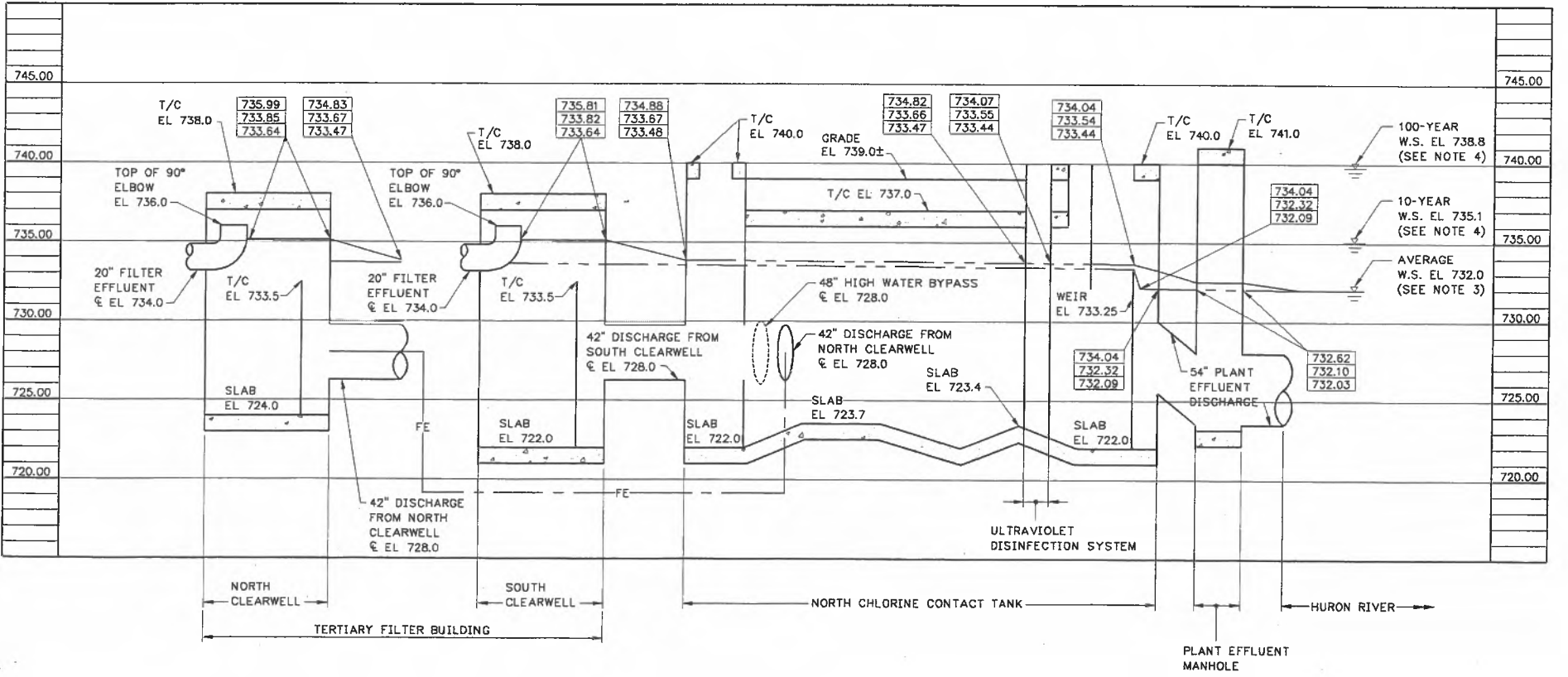
PROJ	02012
DWG	G6
SHEET	6 OF 28
DATE	OCTOBER 1999
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FILE: 201AC06 1:1 10/26/98 11:42 GH-A



HYDRAULIC PROFILE OF EXISTING CONDITIONS

HORZ: NO SCALE
VERT: 1"=5'



HYDRAULIC PROFILE INCLUDING ULTRAVIOLET DISINFECTION SYSTEM

HORZ: NO SCALE
VERT: 1"=5'

NOTES:

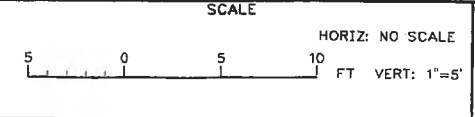
- ELEVATIONS SHOWN REFER TO NGVD OF 1929 OF THE U.S.G.S. DATUM.
- VALUE SHOWN [XXX.XX] IN UPPER BOX DENOTES WATER SURFACE AT PEAK HOUR FLOW OF 48 MGD BASED ON AVERAGE RIVER WATER SURFACE ELEVATION.
- VALUE SHOWN [XXX.XX] IN MIDDLE BOX DENOTES WATER SURFACE AT AVERAGE FLOW OF 19 MGD BASED ON AVERAGE RIVER WATER SURFACE ELEVATION.
- VALUE SHOWN [XXX.XX] IN LOWER BOX DENOTES WATER SURFACE AT LOW FLOW OF 10 MGD BASED ON AVERAGE RIVER WATER SURFACE ELEVATION.
- AVERAGE RIVER WATER SURFACE ELEVATION FROM WASHTENAW COUNTY, DEPARTMENT OF PUBLIC WORKS, CITY OF ANN ARBOR, MICHIGAN WASTEWATER TREATMENT PLANT IMPROVEMENTS, CONTRACT 77-5-7, C26 2539 05, VOLUME II DRAWINGS, DATED JULY 1977.
- 10- AND 100-YEAR RIVER WATER SURFACE ELEVATIONS FROM THE NATIONAL FLOOD INSURANCE PROGRAM FLOOD BOUNDARY AND FLOODWAY MAP FOR TOWNSHIP OF ANN ARBOR, MICHIGAN, PANEL 5 OF 10, DATED JUNE 18, 1980.

FILE: 201A607 1:1 10/26/99 11:30 GH-A

GREELEY AND HANSEN
ENGINEERS
211 WEST FORT STREET, SUITE 710
DETROIT, MICHIGAN 48226-3202

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CHECKED PJV

NO.	DATE	APPD	REVISION



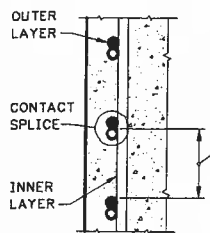
CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

GENERAL
HYDRAULIC PROFILES

RECORD DRAWING
THIS RECORD IS NOT WARRANTED BUT IS BELIEVED TO REPRESENT CONDITIONS UPON COMPLETION OF CONSTRUCTION WITHIN REASONABLE TOLERANCES, BASED UPON THE INFORMATION FURNISHED TO THE ENGINEER PERTAINING TO CHANGES MADE DURING CONSTRUCTION.

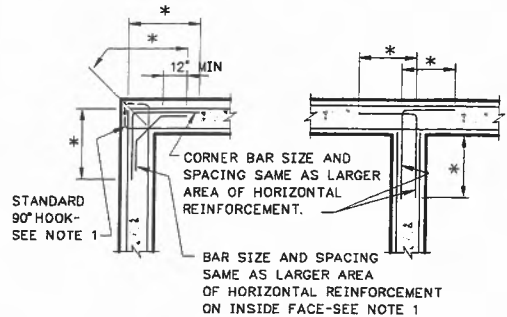
PROJ	02012
DWG	G7
SHEET	7 OF 28
DATE	OCTOBER 1999
REV	1

REINFORCING-LAP SPLICE TABLE		GRADE 60 REINF. - 4000 PSI CONC.									
BAR SIZE		3	4	5	6	7	8	9	10	11	
TOP BARS		2'-0"	2'-8"	3'-4"	4'-0"	5'-10"	6'-8"	7'-7"	8'-6"	9'-5"	
OTHER BARS		1'-7"	2'-1"	2'-7"	3'-1"	4'-6"	5'-2"	5'-10"	6'-7"	7'-3"	



- TOP BARS ARE ALL HORIZONTAL BARS SO PLACED THAT MORE THAN 12" OF CONCRETE IS PLACED IN THE MEMBER BELOW THE BAR. THIS INCLUDES HORIZONTAL WALL REINFORCEMENT.
- FOR EPOXY COATED BARS:
FOR TOP BARS - MULTIPLY THE TABULATED VALUES BY 1.70.
FOR OTHER BARS - MULTIPLY THE TABULATED VALUES BY 1.50.
- WHERE CLEAR BAR SPACING IS LESS THAN 2 BAR DIAMETERS IN BEAMS AND COLUMNS AND LESS THAN 3 BAR DIAMETERS AT OTHER LOCATIONS MULTIPLY THE TABULATED VALUES BY 1.50.
- WHERE BARS OF DIFFERENT SIZES ARE LAP SPICED USE LAP LENGTH OF SMALLER BAR.

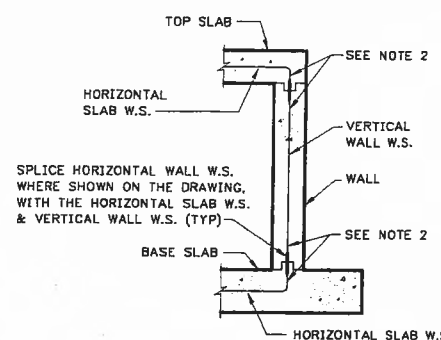
1



- NOTES:
- REQUIRED ONLY WHERE WALLS ARE SUBJECT TO FLUID PRESSURE FROM INSIDE.
 - * - SEE SPLICE TABLE.

HORIZONTAL CORNER BAR DETAIL

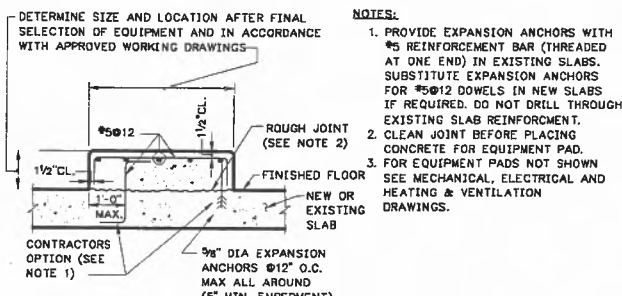
2



- NOTES:
- W.S. DENOTES WATERSTOP
 - SPLICE & EXTEND VERTICAL WALL W.S. 6" PAST HORIZONTAL WALL W.S. OR SPLICE WITH HORIZONTAL SLAB W.S. WHERE REQUIRED.
 - PROVIDE CONTINUOUS WATERSTOPS. SHOP SPLICE AT ALL INTERSECTIONS & FIELD SPLICE AT STRAIGHT RUNS ONLY.

WATERSTOP PLACING DETAIL

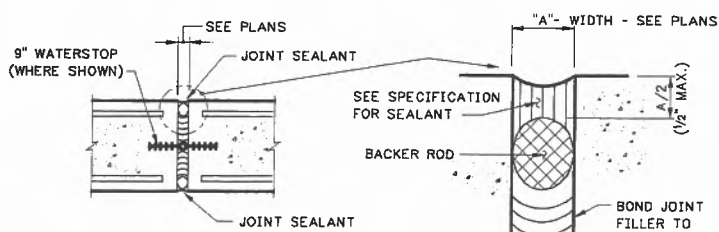
3



- NOTES:
- PROVIDE EXPANSION ANCHORS WITH #5 REINFORCEMENT BAR (THREADED AT ONE END) IN EXISTING SLABS. SUBSTITUTE EXPANSION ANCHORS FOR #5@12 DOWELS IN NEW SLABS IF REQUIRED. DO NOT DRILL THROUGH EXISTING SLAB REINFORCEMENT.
 - CLEAN JOINT BEFORE PLACING CONCRETE FOR EQUIPMENT PAD.
 - FOR EQUIPMENT PADS NOT SHOWN SEE MECHANICAL, ELECTRICAL AND HEATING & VENTILATION DRAWINGS.

EQUIPMENT PAD DETAIL

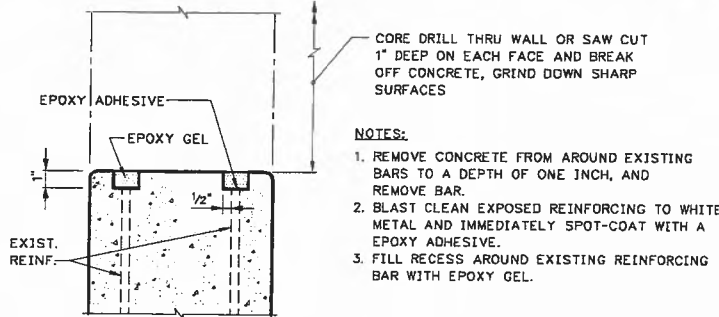
4



- NOTES:
- BACKER ROD AND JOINT SEALANT AT BOTTOM OF SLAB ON GRADE NOT REQUIRED.

EXPANSION JOINT DETAIL AT WALLS AND SLABS

5



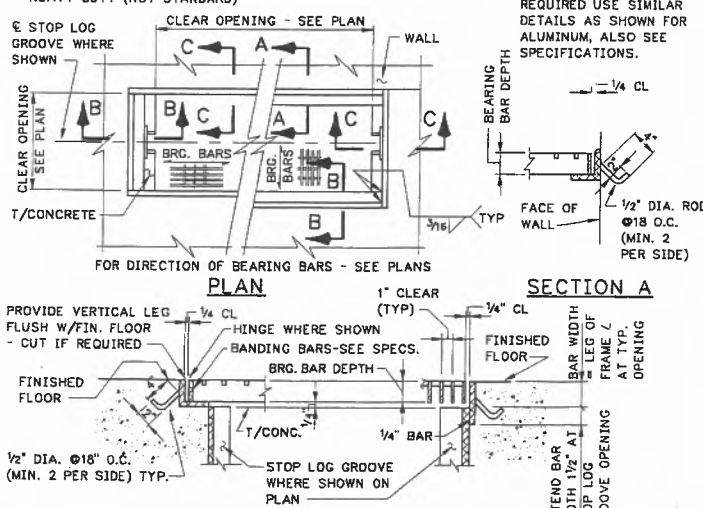
- NOTES:
- REMOVE CONCRETE FROM AROUND EXISTING BARS TO A DEPTH OF ONE INCH, AND REMOVE BAR.
 - BLAST CLEAN EXPOSED REINFORCING TO WHITE METAL AND IMMEDIATELY SPOT-COAT WITH AN EPOXY ADHESIVE.
 - FILL RECESS AROUND EXISTING REINFORCING BAR WITH EPOXY GEL.

DETAIL FOR NEW OPENING IN EXISTING CONCRETE SLAB (WET)

6

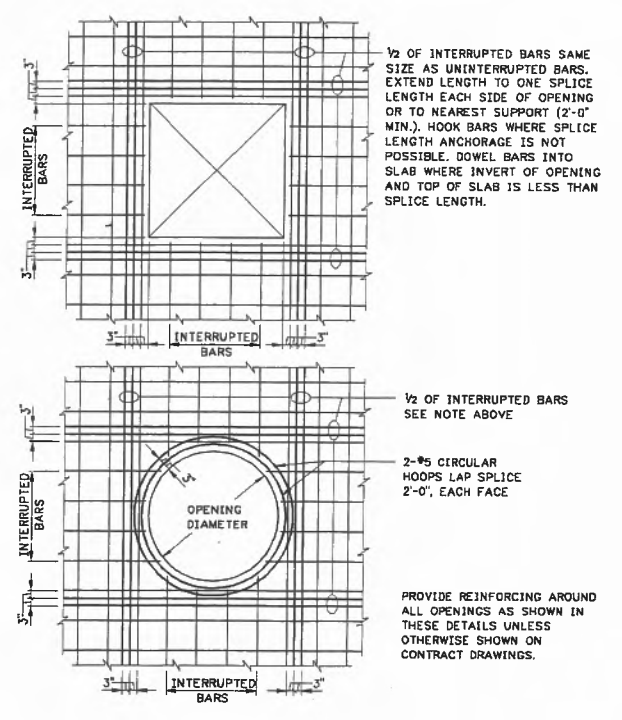
SPAN	ALUMINUM (SERRATED)		STAINLESS STEEL OR GALVANIZED (SERRATED)	
	BRG. BARS	FRAME	BRG. BARS	FRAME
4'-0" OR LESS	1 3/4 x 3/16	L 2X2X1/4	1 1/2 x 3/16	L 2X2X1/4
4'-1" TO 5'-0"	2 1/4 x 3/16	L 2 1/2X2X1/4	1 3/4 x 3/16	L 2X2X1/4
5'-1" TO 6'-0"	2 1/2 x 3/16	L 3X2X1/4	2 x 3/16	L 2 1/2X2X1/4
6'-1" TO 7'-0" *	3 x 3/16	L 3 1/2X2 1/2X1/4	2 1/4 x 3/16	L 2 1/2X2X1/4
7'-1" TO 8'-0" *	3 1/4 x 1/4	L 3 1/2X2 1/2X1/4	2 1/2 x 1/4	L 3X2 1/2X1/4

- NOTES:
- FOR GRATING MATERIAL SEE PLAN OR SECTIONS.
 - SIZE OF GRATING AS SHOWN IN SCHEDULE UNLESS NOTED OTHERWISE ON PLAN.
 - PAINT ALL ALUMINUM SURFACES IN CONTACT WITH CONCRETE, SEE SPECIFICATIONS.
 - PROVIDE ANGLES, BARS & ANCHOR BOLTS OF THE SAME MATERIAL AS THE GRATING.
 - WHERE FRP GRATING IS REQUIRED USE SIMILAR DETAILS AS SHOWN FOR ALUMINUM, ALSO SEE SPECIFICATIONS.



GRATING DETAILS

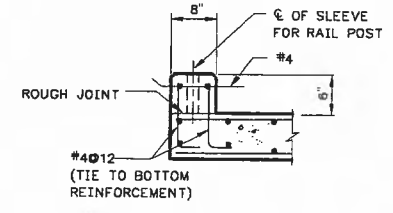
7



- 1/2 OF INTERRUPTED BARS SAME SIZE AS UNINTERRUPTED BARS. EXTEND LENGTH TO ONE SPLICE LENGTH EACH SIDE OF OPENING OR TO NEAREST SUPPORT (2'-0" MIN.). HOOK BARS WHERE SPLICE LENGTH ANCHORAGE IS NOT POSSIBLE. DOWEL BARS INTO SLAB WHERE INVERT OF OPENING AND TOP OF SLAB IS LESS THAN SPLICE LENGTH.
- 1/2 OF INTERRUPTED BARS SEE NOTE ABOVE
- 2-#5 CIRCULAR HOOPS LAP SPLICE 2'-0", EACH FACE
- PROVIDE REINFORCING AROUND ALL OPENINGS AS SHOWN IN THESE DETAILS UNLESS OTHERWISE SHOWN ON CONTRACT DRAWINGS.

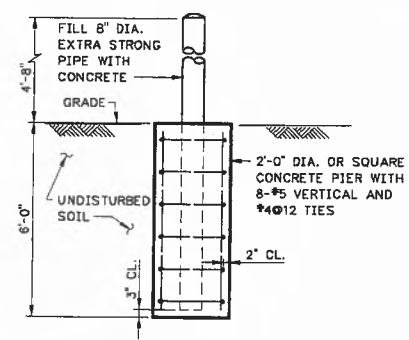
ADDITIONAL REINFORCING AT OPENINGS IN WALLS AND SLABS

8



CURB DETAIL

9



BUMPER DETAIL

10

GENERAL STRUCTURAL NOTES

- THE FOLLOWING GENERAL NOTES ARE SHOWN FOR CONVENIENCE AND ARE SUPPLEMENTAL TO THE SPECIFICATIONS:
- ALL SECTIONS, DETAILS AND NOTES ARE TYPICAL UNLESS OTHERWISE INDICATED. PREPARE WORKING DRAWINGS TO SHOW THE APPLICATION OF TYPICAL SECTIONS AND DETAILS FOR SIMILAR SITUATIONS.
 - PROVIDE A 3/4" CHAMFER AT EXPOSED CORNERS AND PROVIDE A 3/4" FLAT FILLET AT RE-ENTRANT CORNERS UNLESS OTHERWISE NOTED.
 - OBTAIN ENGINEER'S APPROVAL FOR USE OF CONSTRUCTION JOINTS AT LOCATIONS NOT SHOWN ON THE DRAWINGS.
 - VERIFY LOCATION OF ALL OPENINGS, EMBEDDED ITEMS AND CONCRETE CONFIGURATIONS WITH DRAWINGS AND SPECIFICATIONS FROM ALL OTHER DISCIPLINES. LOCATE AND SHOW ALL THESE ITEMS ON APPROVED WORKING (SHOP) DRAWINGS.
 - DO NOT PLACE BACKFILL AGAINST SUBSTRUCTURE WALLS UNTIL FLOOR SLABS SUPPORTING TOP AND BOTTOM OF THE WALLS HAVE ATTAINED A MINIMUM COMPRESSIVE STRENGTH OF 3,000 PSI. PLACE BACKFILL EVENLY AGAINST EACH SIDE OF SUBSTRUCTURES TO PRODUCE EQUAL AND OPPOSITE LATERAL PRESSURES. THE DIFFERENCE IN ELEVATION NOT TO EXCEED ONE FOOT.
 - COMPRESSIVE STRENGTH OF CONCRETE: CAST-IN-PLACE CONCRETE (EXCEPT CONCRETE WORKMATS) F_c = 4,000 PSI AT 28 DAYS AND CONCRETE WORKMATS F_c = 2,000 PSI AT 28 DAYS.
 - PROVIDE ASTM A615, GRADE 60 REINFORCING STEEL AND DETAIL ACCORDING TO THE ACI DETAILING MANUAL 1994 PUBLICATION SP-86.
 - PROVIDE THE FOLLOWING CONCRETE PROTECTION FOR REINFORCEMENT, UNLESS OTHERWISE INDICATED ON THE PLANS OR ORDERED BY THE ENGINEER.

SLABS	
A) FOR DRY CONDITIONS:	
a) SLABS 8" THICK OR LESS	1"
b) SLABS OVER 8" THICK	2"
B) EXPOSED TO EARTH, WATER OR WEATHER AND FOR BOTTOMS BEARING ON WORKMATS	2"
BEAMS AND COLUMNS	
A) FOR DRY CONDITIONS:	
a) STIRRUPS AND TIES	1 1/2"
b) PRINCIPAL REINFORCEMENT	2"
B) EXPOSED TO EARTH, WATER OR WEATHER:	
a) STIRRUPS AND TIES	2"
b) PRINCIPAL REINFORCEMENT	2 1/2"
WALLS	
A) FOR DRY CONDITIONS:	
a) WALLS 8" THICK OR LESS	1"
b) WALLS OVER 8" THICK	2"
B) EXPOSED TO EARTH, WATER OR WEATHER:	
a) CIRCULAR TANKS WITH RING TENSION	2 1/2"
b) ALL OTHERS	2"
FOOTINGS AND BASE SLABS	
A) TOP OF FOOTING OR BASE SLAB	2"
B) ALL FORMED SIDES AND ENDS, AND BOTTOMS BEARING ON CONCRETE WORKMAT	2"
C) AT UNFORMED SIDES AND ENDS, AND BOTTOMS IN CONTACT WITH EARTH	3"
D) OVER TOP OF PILES	2"
 - DETAIL, FABRICATE AND ERECT STRUCTURAL STEEL IN ACCORDANCE WITH THE AISC SPECIFICATION FOR STRUCTURAL STEEL BUILDINGS, ALLOWABLE STRESS DESIGN AND PLASTIC DESIGN, JUNE 1, 1989 AND CONFORM TO ASTM A36 UNLESS OTHERWISE SHOWN OR SPECIFIED. PROVIDE 3/4" DIAMETER, HIGH STRENGTH BOLTS CONFORMING TO ASTM A325 IN SLIP CRITICAL CONNECTIONS, UNLESS NOTED OTHERWISE. PROVIDE E70XX ELECTRODES FOR WELDING, COMPLYING WITH AWS D1.1, DESIGN OF NEW BUILDINGS (SECTION 8).
 - ALL ABBREVIATIONS SHOWN ON DRAWINGS CONFORM TO ANSI / ASME - Y1.1-1989. THE FOLLOWING LEGEND SHOWS ABBREVIATIONS AND SYMBOLS COMMONLY USED IN THE STRUCTURAL DETAILING AND CONSTRUCTION INDUSTRY:

LEGEND:

§	CONSTRUCTION JOINT	L	ANGLE
W.S.	WATERSTOP	PL	PLATE
EXP. JT.	EXPANSION JOINT	A.B.	ANCHOR BOLT
C.G.	CONTROL GROOVE	S.S.	STAINLESS STEEL
H.P.	HIGH POINT	F.R.P.	FIBERGLASS REINFORCED PLASTIC
L.P.	LOW POINT		
W.P.	WORK POINT	M.C.	MECHANICAL CONNECTIONS
E.P.	EQUIPMENT PAD	N.T.S.	NOT TO SCALE
E.E.P.	ELECTRICAL EQUIPMENT PAD	U.N.O.	UNLESS NOTED OTHERWISE
P.S.	PIPE SUPPORT	*	DIMENSIONS OR ELEVATION TO BE DETERMINED OR VERIFIED AFTER FINAL SELECTION OF EQUIPMENT
CL	CENTER LINE		
C/C	CENTER TO CENTER		
O.C.	ON CENTER		

RECORD DRAWING

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KLEIN AND HOFFMAN, INC.
CONSULTING ENGINEERS
100 SOUTH WACKER DRIVE
CHICAGO, ILLINOIS 60606

FILE: 201AS01.1:1 10/28/99 16:14 GH-A

GREELEY AND HANSEN
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211 WEST FORT STREET, SUITE 710
DETROIT, MICHIGAN 48226-3202

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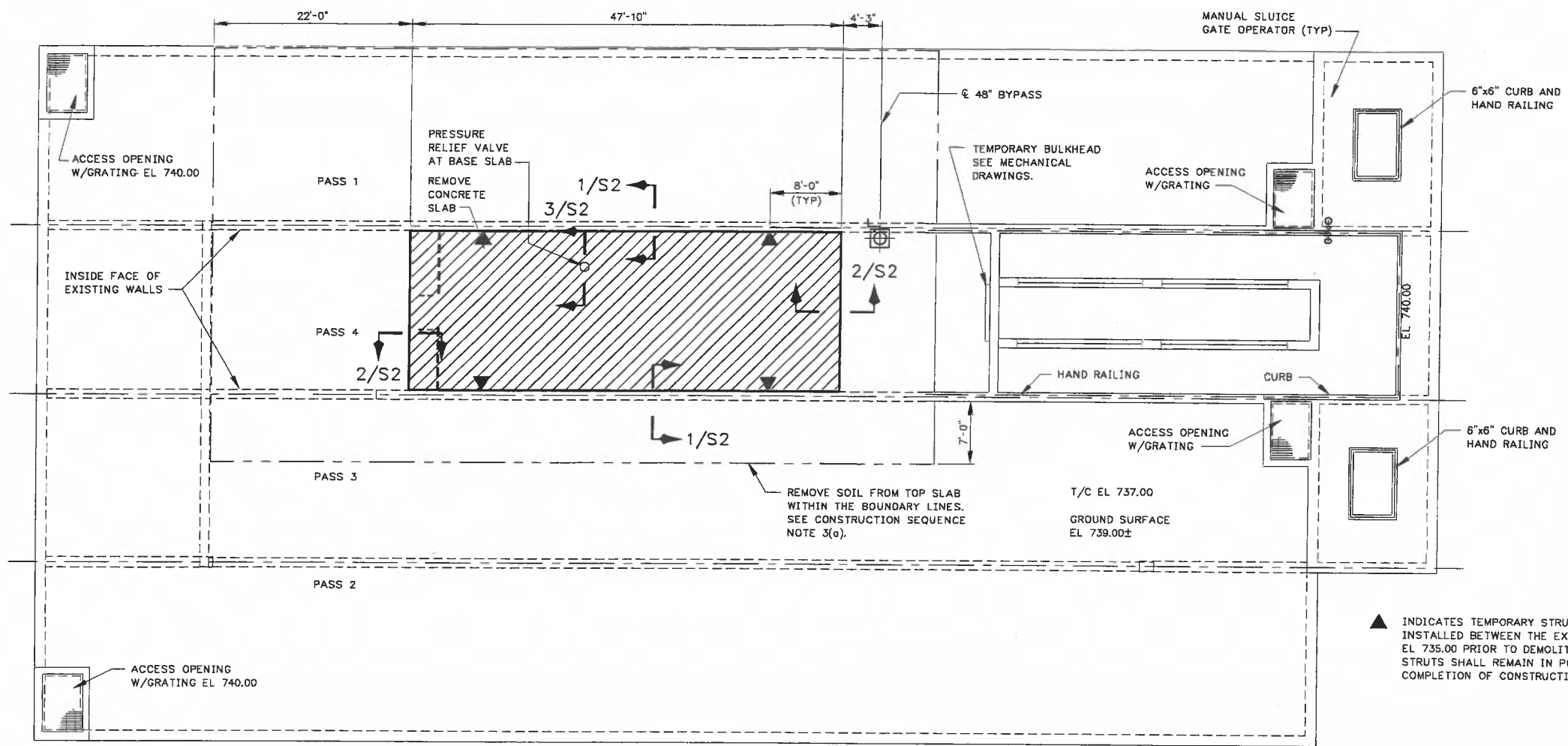
NO.	DATE	APPD	REVISION
	06/04/01	PJV	RECORD DRAWING

SCALE
NOT TO SCALE

CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

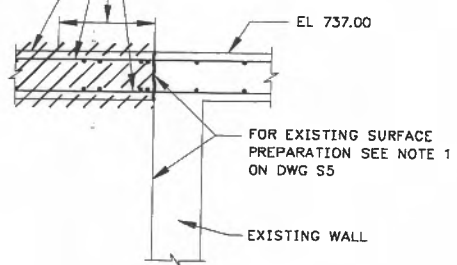
STRUCTURAL
TYPICAL DETAILS AND
GENERAL NOTES

PROJ	02012
DWG	S1
SHEET	8 OF 28
DATE	OCTOBER 1999
REV	1



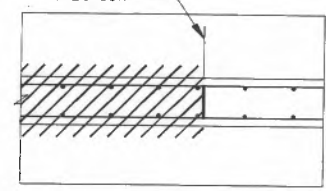
DEMOLITION PLAN AT EL 737.00
SCALE: 1/8"=1'-0"

DEMOLISH TOP SLAB. SAVE EXISTING REINFORCING. CLEAN REINFORCING THOROUGHLY. CUT AND BEND TO SUIT EMBEDMENT IN NEW WALL. SEE SECTION 2/S5



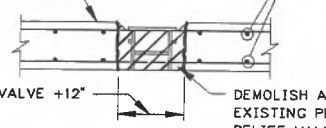
SECTION 1/S2
SCALE: 1/2"=1'-0"

SAWCUT & REMOVE CONCRETE SLAB SEE TYP DETAIL 6/AS1 FOR EXISTING REINFORCEMENT PROTECTION



SECTION 2/S2
SCALE: 1/2"=1'-0"

EXISTING BASE SLAB



SECTION 3/S2
SCALE: 1/2"=1'-0"

▲ INDICATES TEMPORARY STRUTS. STRUTS TO BE INSTALLED BETWEEN THE EXISTING WALLS AT EL 735.00 PRIOR TO DEMOLITION OF TOP SLAB. STRUTS SHALL REMAIN IN POSITION UNTIL THE COMPLETION OF CONSTRUCTION.

CONSTRUCTION NOTES:

1. INSTALL DEWATERING AND GROUND WATER MONITORING SYSTEMS, ALL AROUND THE NORTH CHLORINE CONTACT TANK.
2. THROUGHOUT THE CONSTRUCTION PERIOD, MONITOR GROUND WATER TABLE AND WATER IN THE TANK PASSES EXCEPT THE WORK AREA BETWEEN TEMPORARY BULK HEADS IN PASS NO. 4. TO PREVENT HYDROSTATIC UPLIFT OF THE TANK DURING CONSTRUCTION, TABLE BELOW INDICATING GROUND WATER ELEVATION AND CORRESPONDING WATER DEPTH NEEDED IN THE TANKS, IS PROVIDED FOR GUIDANCE OF THE CONTRACTOR.

GROUND WATER EL	MINIMUM HEIGHT OF WATER IN TANK PASSES MEASURED AT H.P. OF EXISTING BASE SLAB TOP
BELOW OR UP TO 731.0	TANK EMPTY
733.0	3.5'
735.0	7.0'
737.0	10.75'
740.0 (100 YEARS FLOOD EL)	FLOOD ENTIRE TANK

3. REMOVAL OF SOIL FROM TOP OF EXISTING TOP SLAB BEFORE CONSTRUCTION AND RE-GRADING AFTER COMPLETION OF THE CONSTRUCTION:
 - a) PRIOR TO COMMENCEMENT OF DEMOLITION OF TOP SLAB, REMOVE SOIL FROM THE TOP SLAB (EL 737.00) IN THE AREA MARKED ON THE DEMOLITION PLAN WITH THE HELP OF LIGHT EQUIPMENT/MACHINERY.
 - b) RE-GRADE THE AREA AS PER THE GRADING PLAN AFTER COMPLETION OF CONSTRUCTION.
4. THE MACHINERY OR EQUIPMENT USED OVER THE TANK TOP SLAB TO REMOVE SOIL OR FOR OTHER GENERAL CONSTRUCTION PURPOSES SHOULD NOT PRODUCE LIVE LOADS MORE THAN 100 PSF.
5. DO NOT PLACE ANY HEAVY EQUIPMENT OR CRANES PRODUCING MORE THAN 300 PSF VERTICAL LOAD WITHIN 3'-0" FROM OUTER EDGES OF THE TANK.

NOTE:

1. SEE DRAWING S1 FOR GENERAL NOTES AND TYPICAL DETAILS.

RECORD DRAWING

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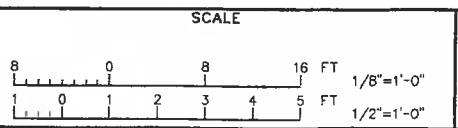
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CONSULTING ENGINEERS
100 SOUTH WACKER DRIVE
CHICAGO, ILLINOIS 60606

GREELEY AND HANSEN ENGINEERS
211 WEST FORT STREET, SUITE 710
DETROIT, MICHIGAN 48226-3202

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CHECKED	SKC

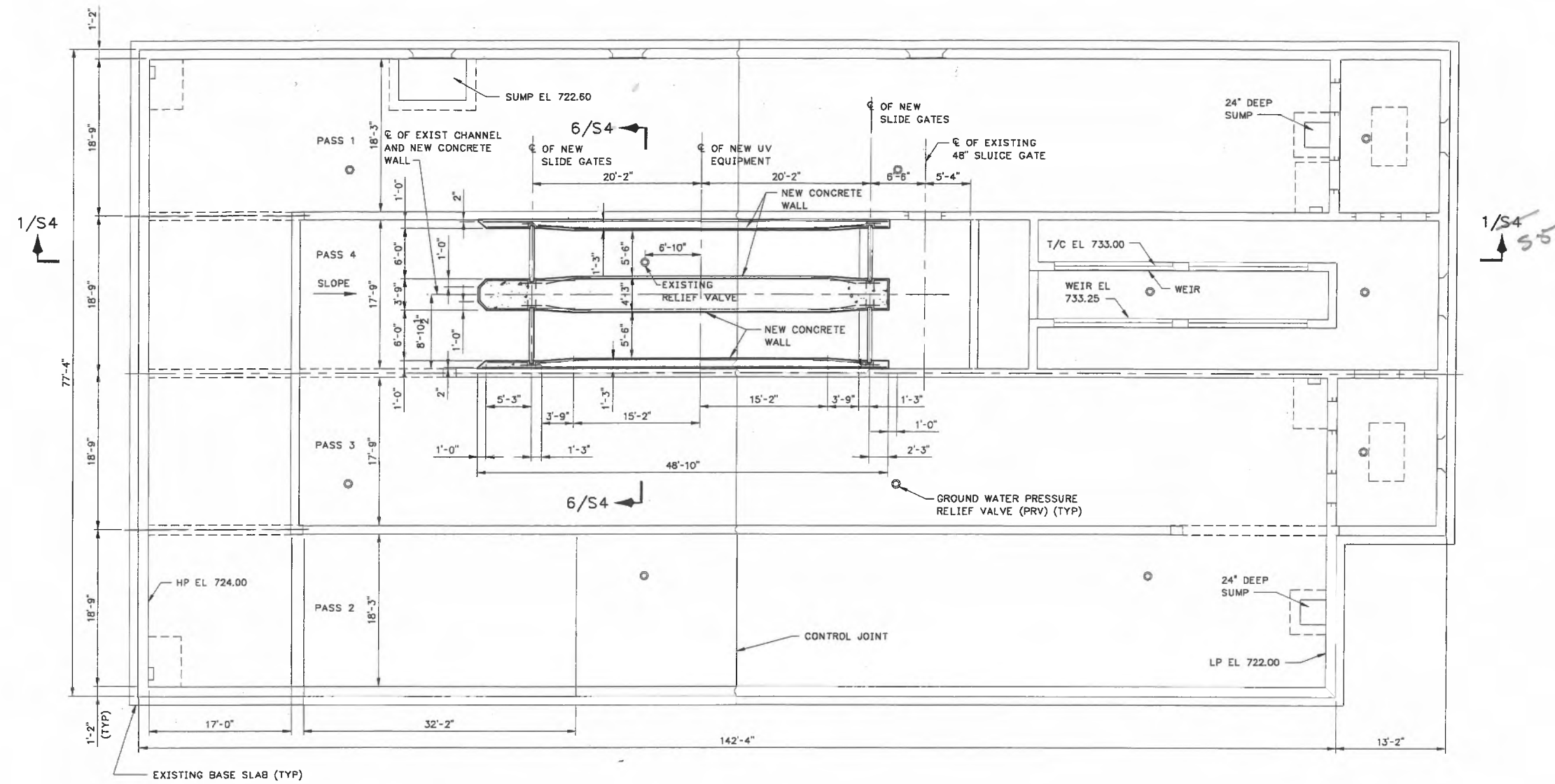
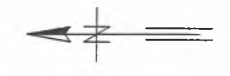
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08/04/01	PJV		RECORD DRAWING



CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

STRUCTURAL
NORTH CHLORINE CONTACT TANK
DEMOLITION -- TOP PLAN,
SECTIONS AND DETAILS

PROJ	02012
DWG	S2
SHEET	9 OF 28
DATE	OCTOBER 1999
REV	1



PLAN AT EL 727.00

NOTE:
1. SEE DRAWING S1 FOR GENERAL NOTES AND TYPICAL DETAILS.

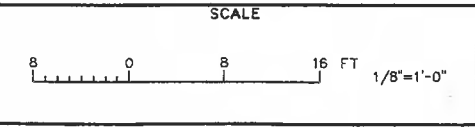
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CONSULTING ENGINEERS
100 SOUTH WACKER DRIVE
CHICAGO, ILLINOIS 60606

GREELEY AND HANSEN
ENGINEERS
211 WEST FORT STREET, SUITE 710
DETROIT, MICHIGAN 48226-3202

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06/04/01	PJV		RECORD DRAWING



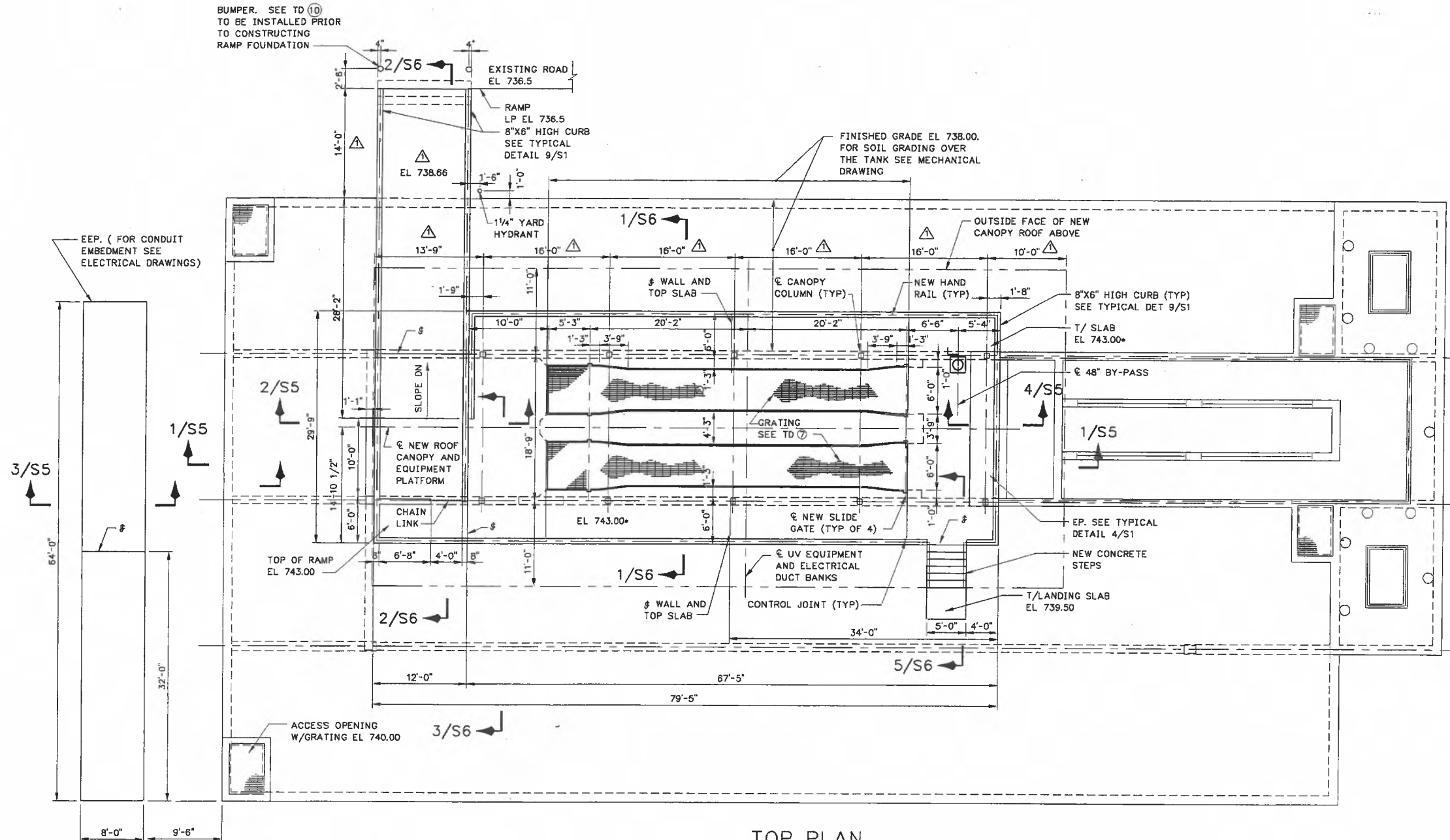
CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

STRUCTURAL
NORTH CHLORINE CONTACT TANK
PLAN AT EL 727.00

PROJ 02012
DWG **S3**
SHEET 10 OF 28
DATE OCTOBER 1999 REV 1

RECORD DRAWING
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BUMPER. SEE TD 10
TO BE INSTALLED PRIOR
TO CONSTRUCTING
RAMP FOUNDATION



TOP PLAN

LIVE LOADS

PLATFORM AND GRATINGS AT EL 743* = 150 PSF.
RAMP: 150 PSF.

OR

VEHICLE LOADS AS BELOW:
750 LBS EACH OF FRONT & REAR AXLE WHEELS W/IMPACT (TOTAL 4 WHEELS).
AXLE CENTERS = 5'-10"
WHEEL CENTERS = 4'-0"
EXISTING TANK TOP SLAB = 100 PSF.

CANOPY COLUMN LOADS ON PLATFORM AT EL 743'-0" (FOR EACH COLUMN)

VERTICAL P: DL = 11,600 LBS ↓
LL = 9,030 LBS ↓
WIND = 6,000 LBS (UPLIFT)
HORIZONTAL H: DL = 100 LBS (TRANSVERSE)
LL = 90 LBS (TRANSVERSE)
WIND = 1,100 LBS (TRANSVERSE/LONGITUDINAL)

NOTE:

1. SEE DRAWING S1 FOR GENERAL NOTES AND TYPICAL DETAILS.

FILE: 201XAS01 1:1 11/17/99 14:02 GH-A

FILE: 201XAS04 1:1 11/19/99 08:52 GH-A

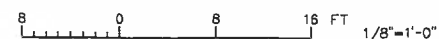
KLEIN AND HOFFMAN, INC.
CONSULTING ENGINEERS
100 SOUTH WACKER DRIVE
CHICAGO, ILLINOIS 60606

GREELEY AND HANSEN
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211 WEST FORT STREET, SUITE 710
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DRAWN GNG
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NO.	DATE	APPD	REVISION
1	11/19/99	PJV	ADDENDUM NO. 1 REVISION
2	06/04/01	PJV	RECORD DRAWING

SCALE



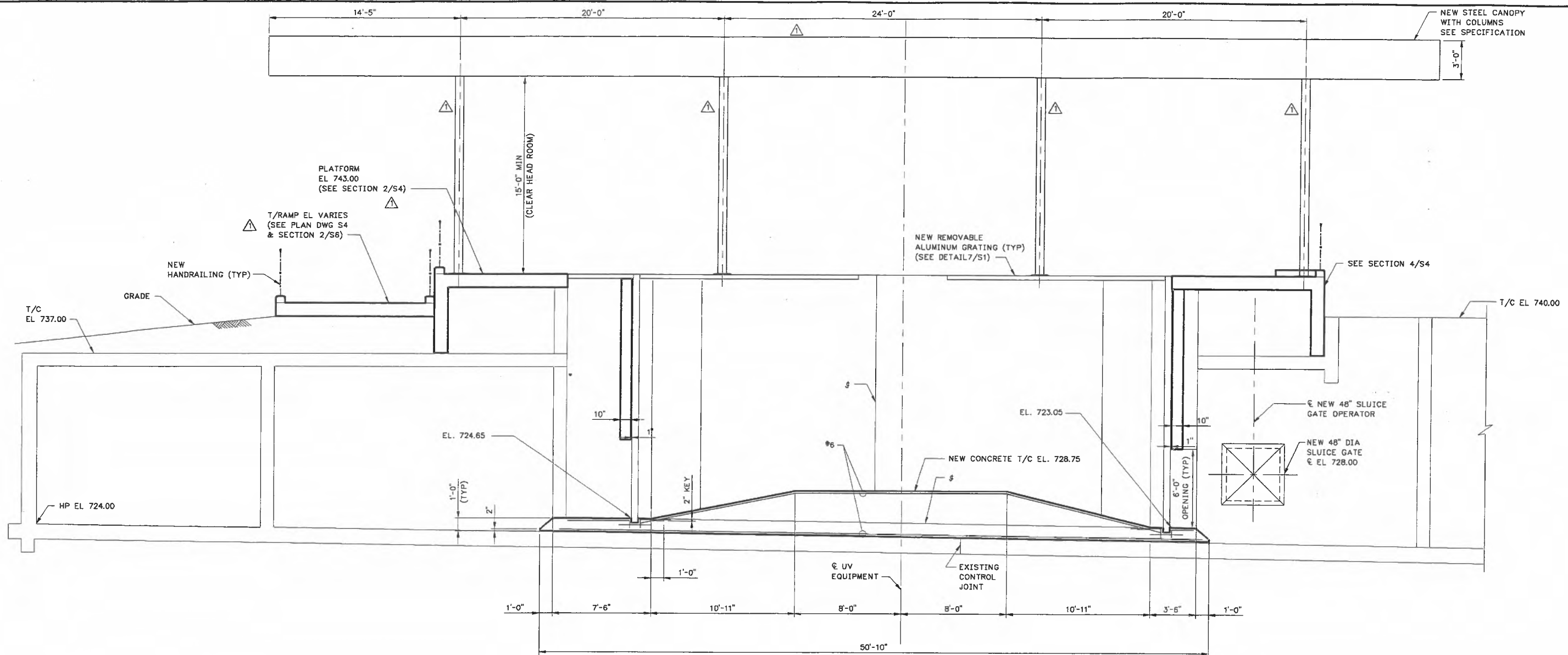
CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

STRUCTURAL
NORTH CHLORINE CONTACT TANK
TOP PLAN

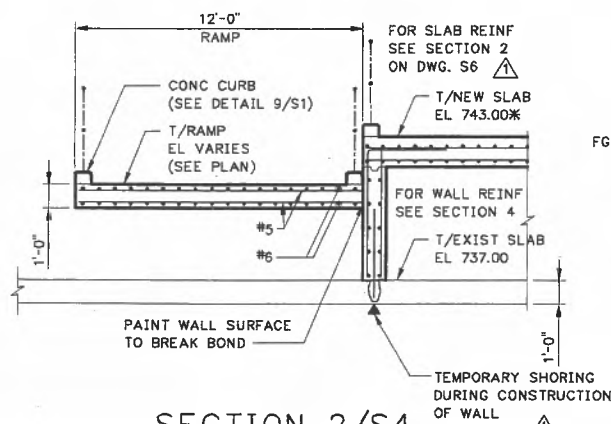
RECORD DRAWING

THIS RECORD IS NOT WARRANTED BUT IS BELIEVED TO REPRESENT CONDITIONS UPON COMPLETION OF CONSTRUCTION WITHIN REASONABLE TOLERANCES, BASED UPON THE INFORMATION FURNISHED TO THE ENGINEER PERTAINING TO CHANGES MADE DURING CONSTRUCTION.

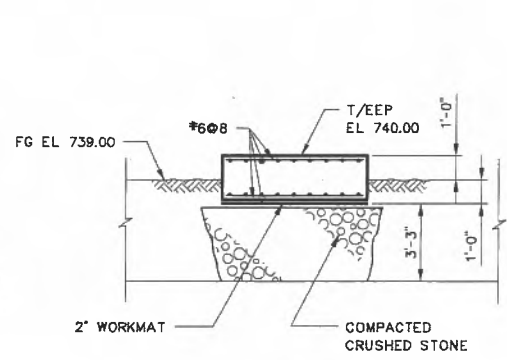
PROJ	02012
DWC	S4
SHEET	11 OF 28
DATE	OCTOBER 1999 REV 2



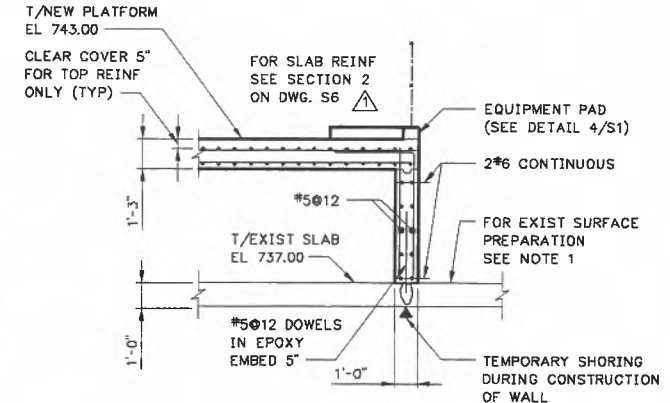
SECTION 1/S3, S4
SCALE: 1/4"=1'-0"



SECTION 2/S4
SCALE: 1/4"=1'-0"



SECTION 3/S4
SCALE: 1/4"=1'-0"



SECTION 4/S4
SCALE: 1/4"=1'-0"

- NOTES:**
- EXISTING SURFACE PREPARATION FOR PLACING NEW CONCRETE AGAINST IT:
 - CLEAN THOROUGHLY TO REMOVE DIRT & MUCK AND EXPOSE CONCRETE SURFACE.
 - ROUGHEN THE SURFACE TO 1/4" AMPLITUDE.
 - FOR CONSTRUCTION NOTES SEE DWG NO. S2.
 - FOR GENERAL STRUCTURAL NOTES AND TYPICAL DETAILS SEE DWG NO. S1.

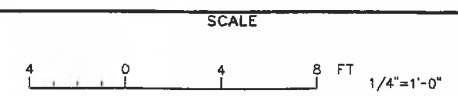
FILE: 201AS06 1:1 11/18/99 09:56 GH-A

KLEIN AND HOFFMAN, INC.
CONSULTING ENGINEERS
100 SOUTH WACKER DRIVE
CHICAGO, ILLINOIS 60606

GREELEY AND HANSEN
ENGINEERS
211 WEST FORT STREET, SUITE 710
DETROIT, MICHIGAN 48226-3202

DESIGNED	SKC
DRAWN	GNG
CHECKED	SKC

NO.	DATE	APPD	REVISION
1	11/19/99	PJV	ADDENDUM NO. 1 REVISION
2	06/04/01	PJV	RECORD DRAWING



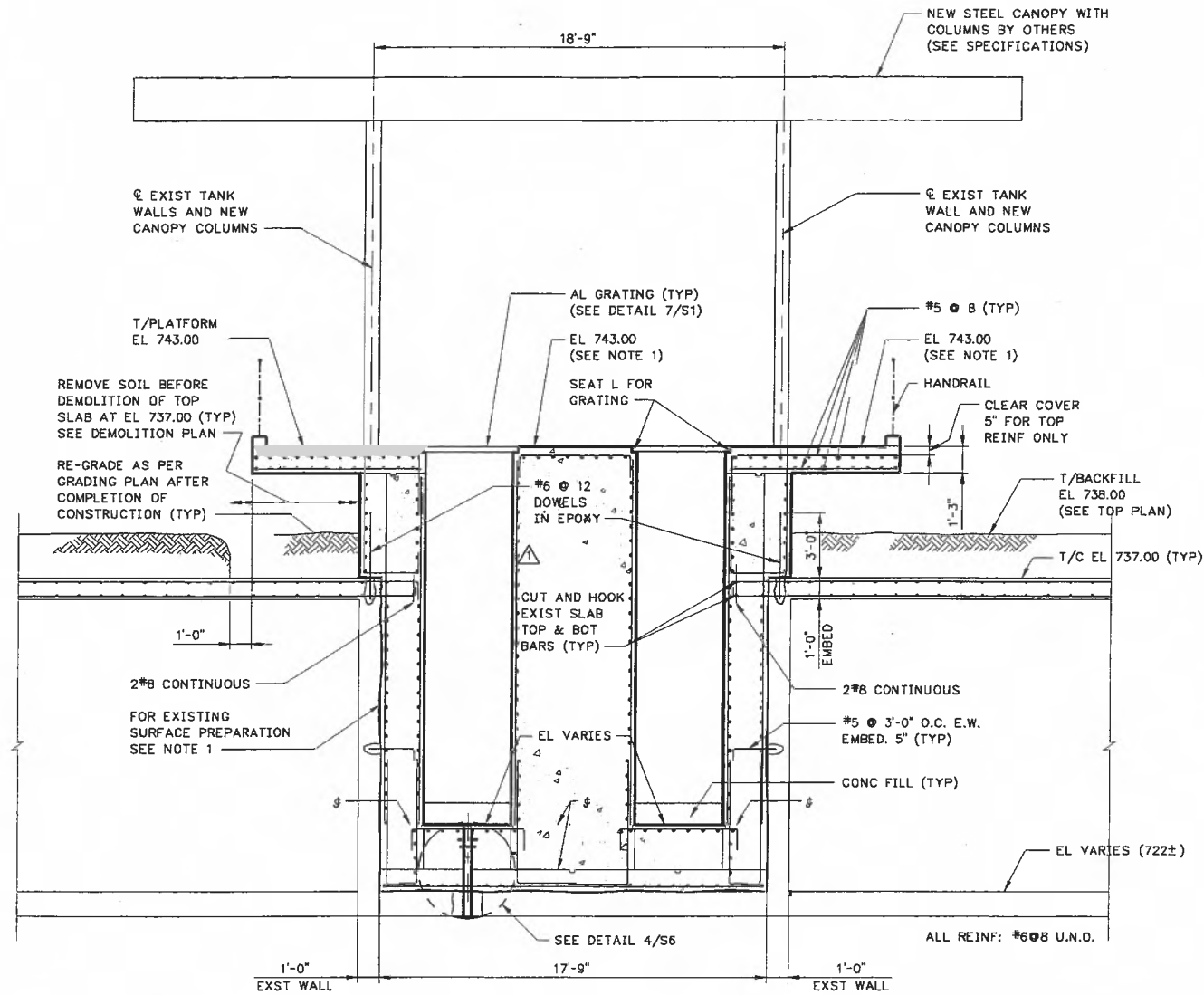
CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

STRUCTURAL
NORTH CHLORINE CONTACT TANK
SECTIONS

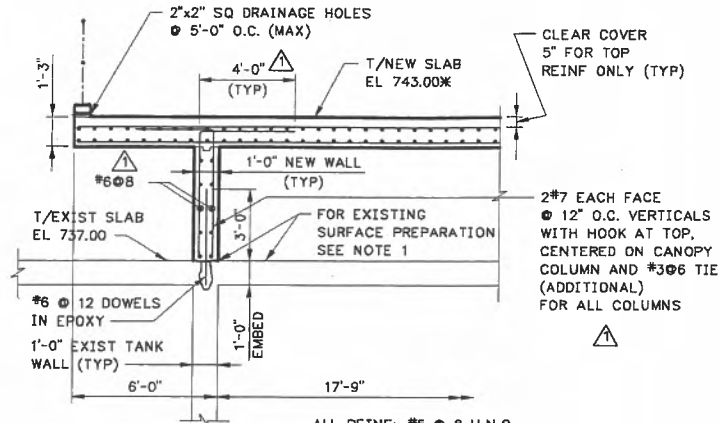
RECORD DRAWING

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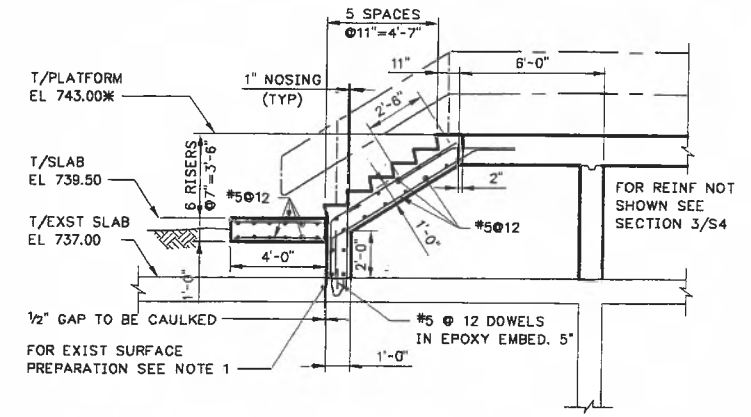
PROJ	02012
DWG	S5
SHEET	12 OF 28
DATE	OCTOBER 1999 REV 2



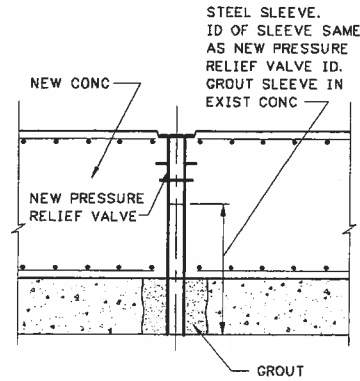
SECTION 1/S3, S4
SCALE: 1/4"=1'-0"



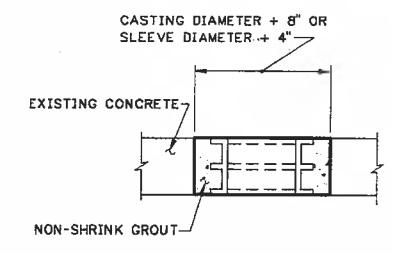
SECTION 3/S4
SCALE: 1/4"=1'-0"



SECTION 5/S4
SCALE: 1/4"=1'-0"

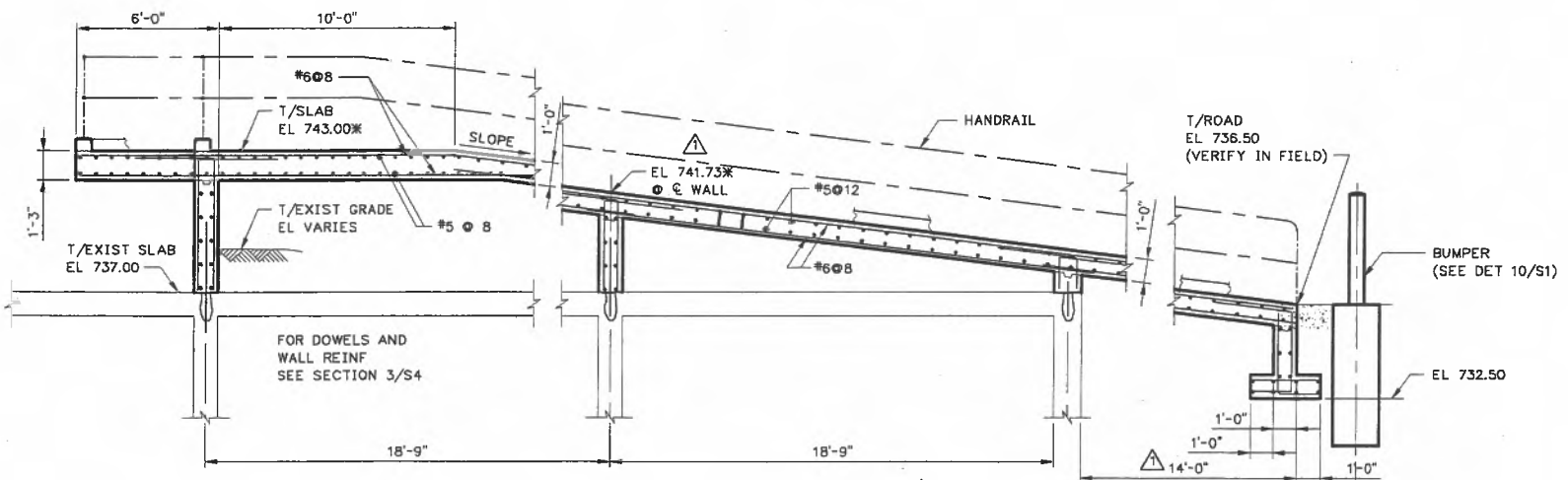


DETAIL 4/S6
SCALE: 1/2"=1'-0"

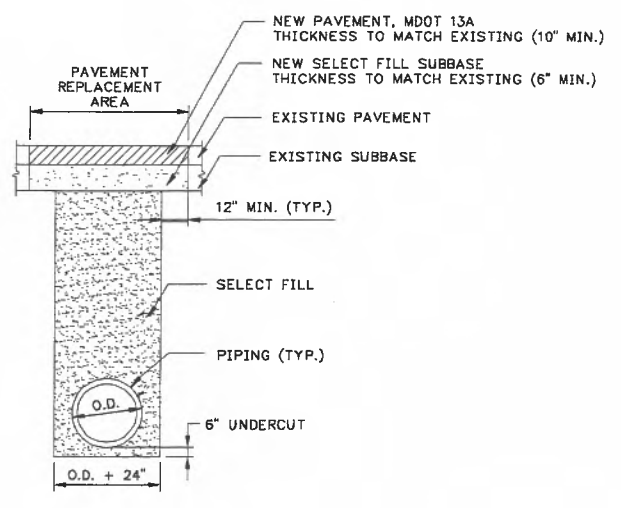


NEW WALL PIPE IN EXISTING WALL - DETAIL
NOT TO SCALE

- NOTES:**
1. OVERCUT EXISTING CONCRETE AS SHOWN.
 2. SAVE EXISTING REINFORCEMENT- CUT ONLY AS REQUIRED.
 3. ROUGHEN AND CLEAN SURFACES AND COAT WITH CEMENT-SAND (1:1) GROUT PRIOR TO PLACING NON-SHRINK GROUT.



SECTION 2/S4
SCALE: 1/4"=1'-0"



PIPE TRENCH IN ROADWAY DETAIL
NOT TO SCALE

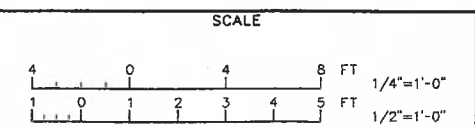
- NOTES:**
1. EXISTING SURFACE PREPARATION FOR PLACING NEW CONCRETE AGAINST IT:
 - a) CLEAN THOROUGHLY TO REMOVE DIRT & MUCK AND EXPOSE CONCRETE SURFACE.
 - b) ROUGHEN THE SURFACE TO 1/4" AMPLITUDE.
 2. FOR CONSTRUCTION NOTES SEE DWG NO. S2.
 3. FOR GENERAL STRUCTURAL NOTES AND TYPICAL DETAILS SEE DWG NO. S1.

KLEIN AND HOFFMAN, INC.
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100 SOUTH WACKER DRIVE
CHICAGO, ILLINOIS 60606

GREELEY AND HANSEN ENGINEERS
211 WEST FORT STREET, SUITE 710
DETROIT, MICHIGAN 48226-3202

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CHECKED	SKC

NO.	DATE	APPD	REVISION
11/19/99	PJV		ADDENDUM NO. 1 REVISION
06/04/01	PJV		RECORD DRAWING



CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

STRUCTURAL
NORTH CHLORINE CONTACT TANK
SECTIONS AND DETAILS

PROJ	02012
DWG	S6
SHEET	13 OF 28
DATE	OCTOBER 1999
REV	2

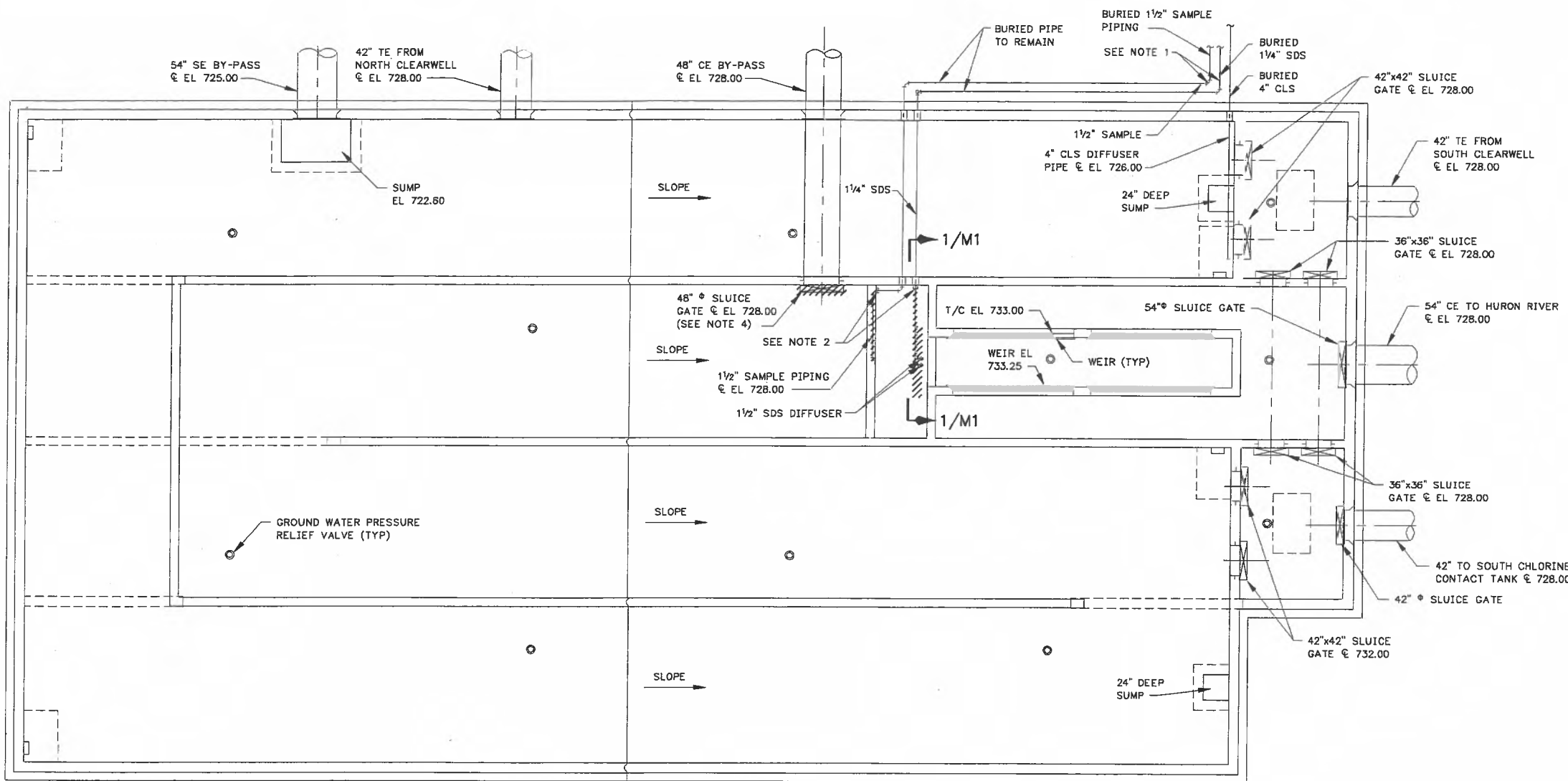
RECORD DRAWING
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FILE: 201AS08 1:1 06/15/01 15:45 GH-A

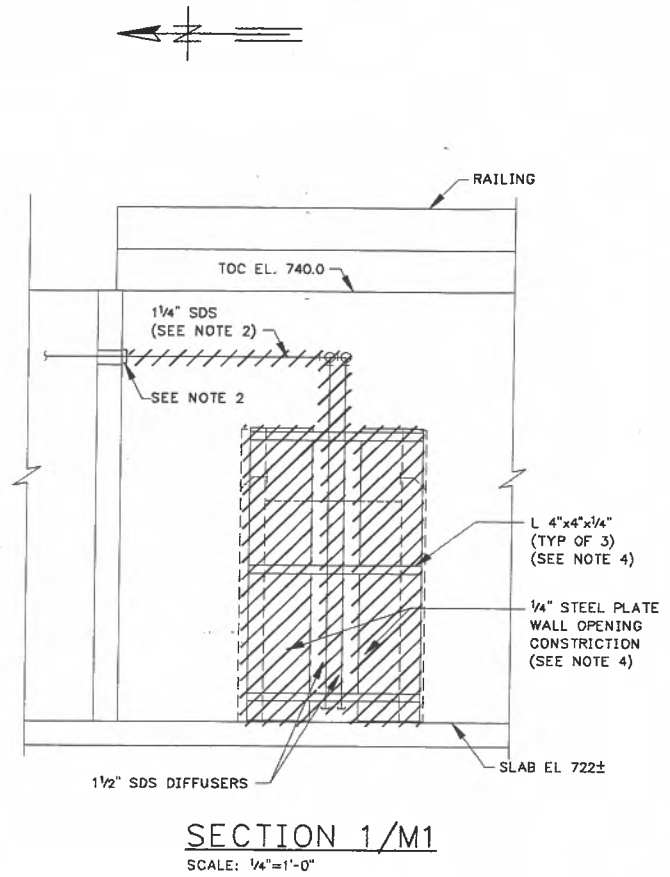
FILE: 201AXM01 1:1 10/28/99 13:33 GH-A

FILE: 201AXS01 1:1 11/17/99 14:02 GH-A

FILE: 201AM01 1:1 06/26/01 16:28 GH-A



PLAN AT EL 736.00
SCALE: 1/8"=1'-0"



SECTION 1/M1
SCALE: 1/4"=1'-0"

- NOTES:**
- NOTE REMOVED.
 - 1 1/2" SAMPLE PIPING AND 1 1/4" SDS PIPING CAPPED.
 - REMOVE ALL 1/4" STEEL PLATES, 4"x4"x1/4" ANGLE AND ALL ASSOCIATED HARDWARE FROM STEEL PLATE WALL OPENING CONSTRICTION.
 - REMOVE EXISTING 48" SLUICE GATE STEM, OPERATOR STAND AND MOTOR OPERATOR, EXISTING WALL THIMBLE TO REMAIN.

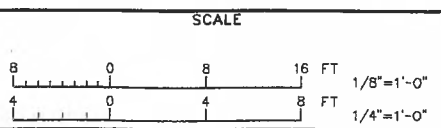
RECORD DRAWING

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GREELEY AND HANSEN
ENGINEERS
211 WEST FORT STREET, SUITE 710
DETROIT, MICHIGAN 48226-3202

DESIGNED NBJ
DRAWN RPN
CHECKED PJR

NO.	DATE	APPD	REVISION
	06/04/01	PJV	RECORD DRAWING

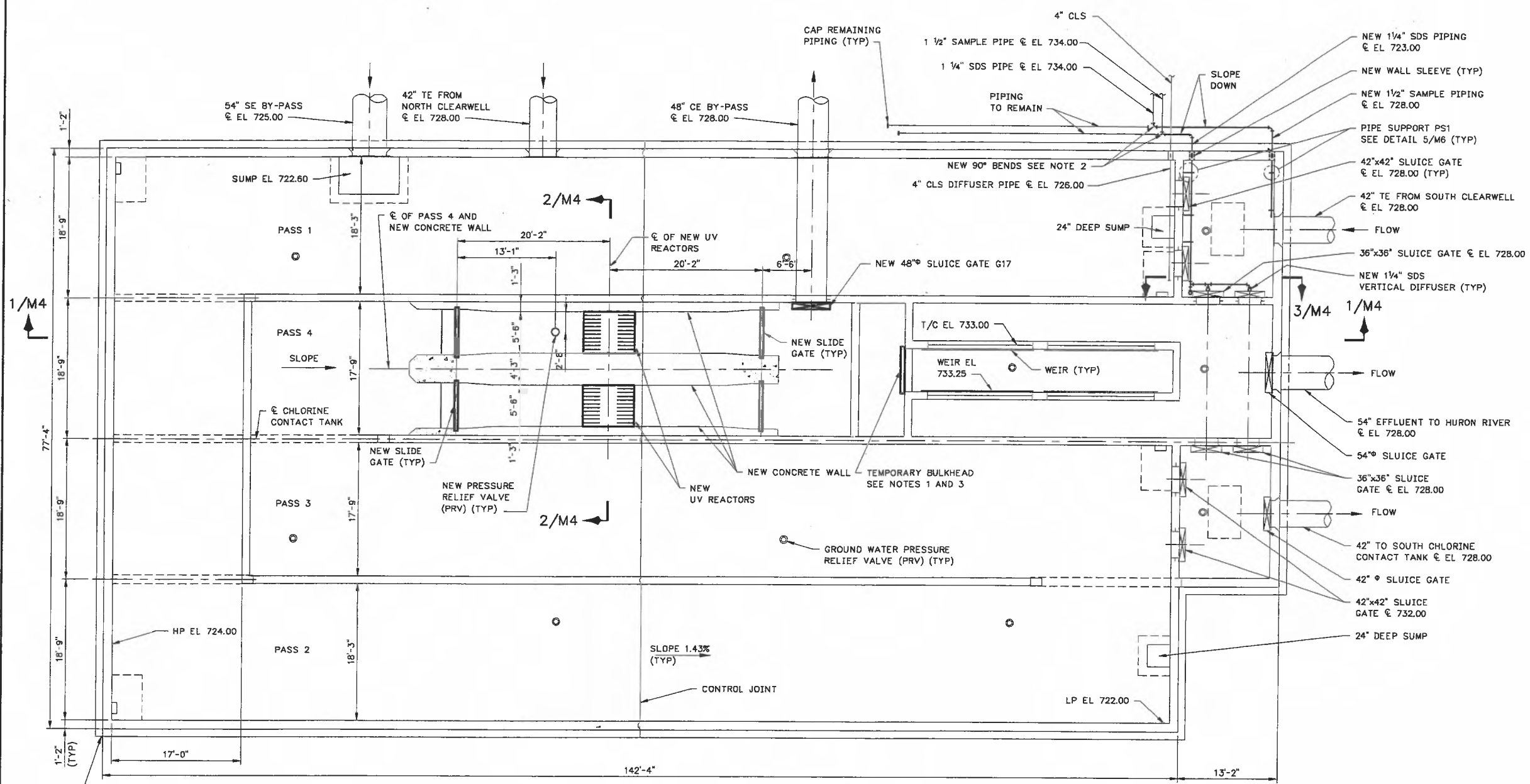


CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

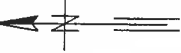
PIPING AND EQUIPMENT
NORTH CHLORINE CONTACT TANK
DEMOLITION
PLAN AT EL 736.00

PROJ	02012
DWG	M1
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DATE	OCTOBER 1999
REV	1

FILE: 201AXM01 1:1 10/28/99 13:33 GH-A
 FILE: 201AXS01 1:1 11/17/99 14:02 GH-A
 FILE: 201AM02 1:1 10/28/99 16:30 GH-A



PLAN AT EL 727.00



NOTES:

- CONTRACTOR TO DESIGN AND CONSTRUCT TEMPORARY BULKHEAD PRIOR TO ISOLATION AND DEWATERING OF NORTH CHLORINE CONTACT TANK IN ACCORDANCE WITH CONSTRAINTS IN SPECIFICATION SECTION 01010. DESIGN BULKHEAD TO WITHSTAND A WATER ELEVATION OF 740' ON THE OVERFLOW WEIR CHAMBER SIDE OF THE BULKHEAD WHILE THE NCCT SIDE OF THE BULKHEAD IS ELEVATED DOWN TO THE BASE SLAB. BULKHEAD DESIGN TO BE PERFORMED BY A PROFESSIONAL ENGINEER REGISTERED IN THE STATE OF MICHIGAN.
- INSTALL NEW 1/4" 90° BEND ON EXISTING 1/4" SDS PIPING TO CONNECT TO NEW 1/4" SDS PIPING. INSTALL NEW 1/2" 90° BEND ON EXISTING 1/2" SAMPLE PIPING TO CONNECT TO NEW 1/2" SAMPLE PIPING.
- CONTRACTOR TO DESIGN AND CONSTRUCT TEMPORARY BULKHEAD PRIOR TO REPLACEMENT OF GATE G17 IN ACCORDANCE WITH SPECIFICATION SECTION 01010.

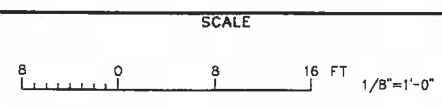
RECORD DRAWING

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GREELEY AND HANSEN
 ENGINEERS
 211 WEST FORT STREET, SUITE 710
 DETROIT, MICHIGAN 48226-3202

DESIGNED PJR
 DRAWN RPN
 CHECKED PJR

05/04/01	PJV	RECORD DRAWING
NO.	DATE	APPD
		REVISION

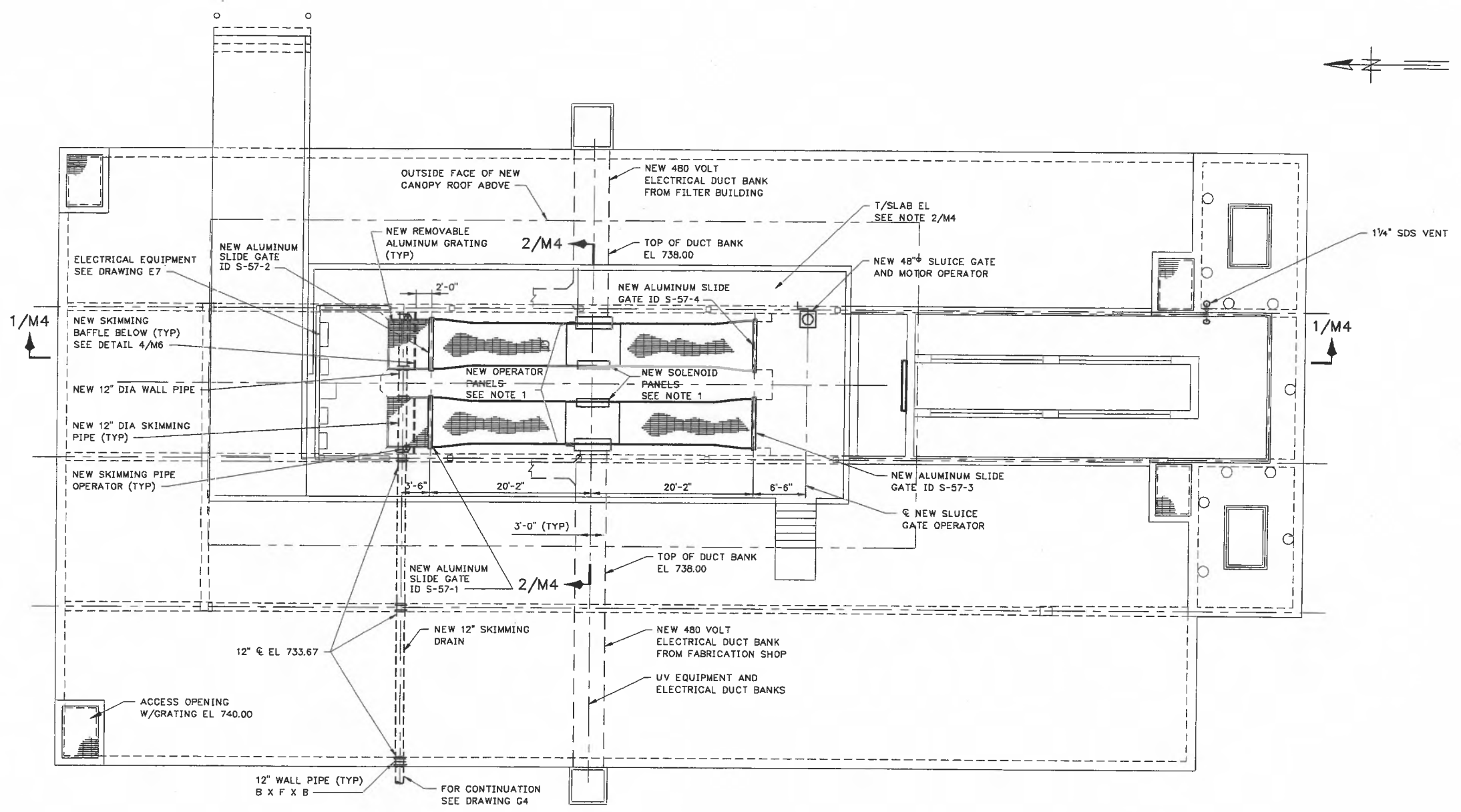


CITY OF ANN ARBOR, MICHIGAN
 WATER UTILITIES DEPARTMENT
 WASTEWATER TREATMENT PLANT
 DISINFECTION FACILITIES UPGRADE

PIPING AND EQUIPMENT
 NORTH CHLORINE CONTACT TANK
 PLAN AT EL 727.00

PROJ	02012	
DWG	M2	
SHEET	15	OF 28
DATE	OCTOBER 1999	REV 1

FILE: 201AM03 1:1 10/28/99 13:41 GH-A
 FILE: 201AM01 1:1 11/17/99 14:02 GH-A
 FILE: 201AM01 1:1 10/28/99 13:33 GH-A
 FILE: 201AM01 1:1 06/28/01 10:37 GH-A



TOP PLAN

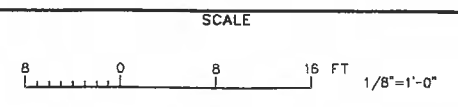
RECORD DRAWING

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GREELEY AND HANSEN
 ENGINEERS
 211 WEST FORT STREET, SUITE 710
 DETROIT, MICHIGAN 48226-3202

DESIGNED PJR
 DRAWN GD
 CHECKED PJR

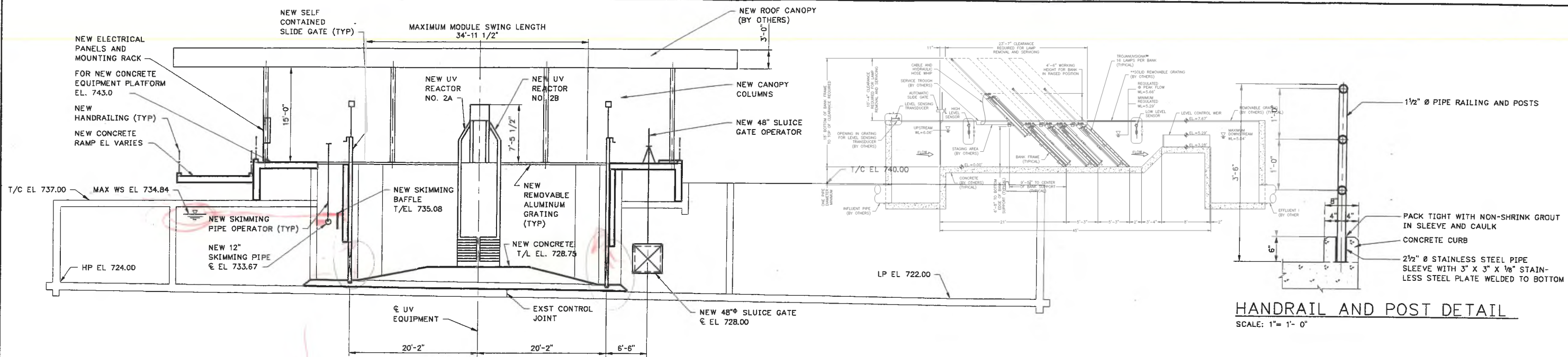
NO.	DATE	APPD	REVISION
	06/04/01	PJV	RECORD DRAWING



CITY OF ANN ARBOR, MICHIGAN
 WATER UTILITIES DEPARTMENT
 WASTEWATER TREATMENT PLANT
 DISINFECTION FACILITIES UPGRADE

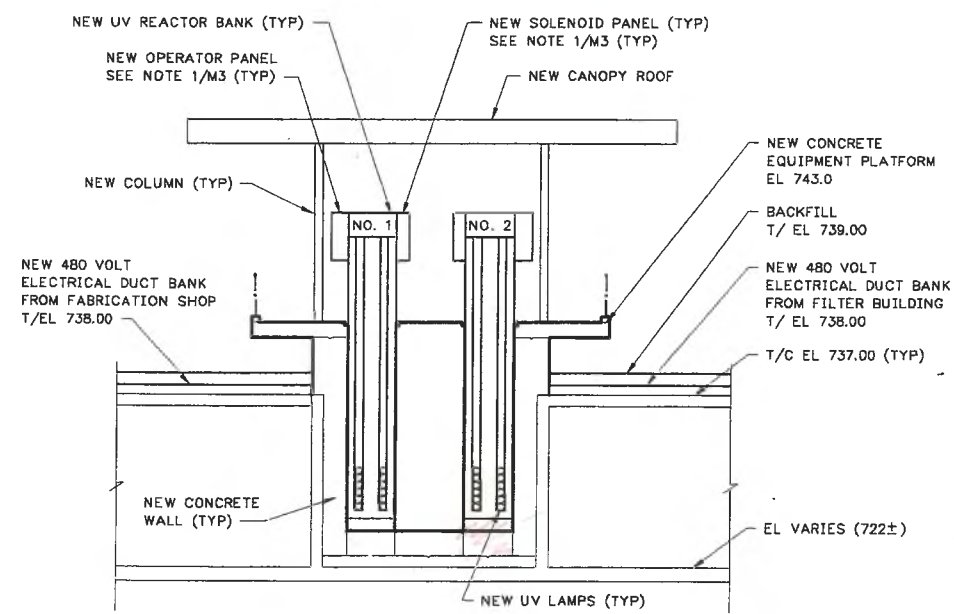
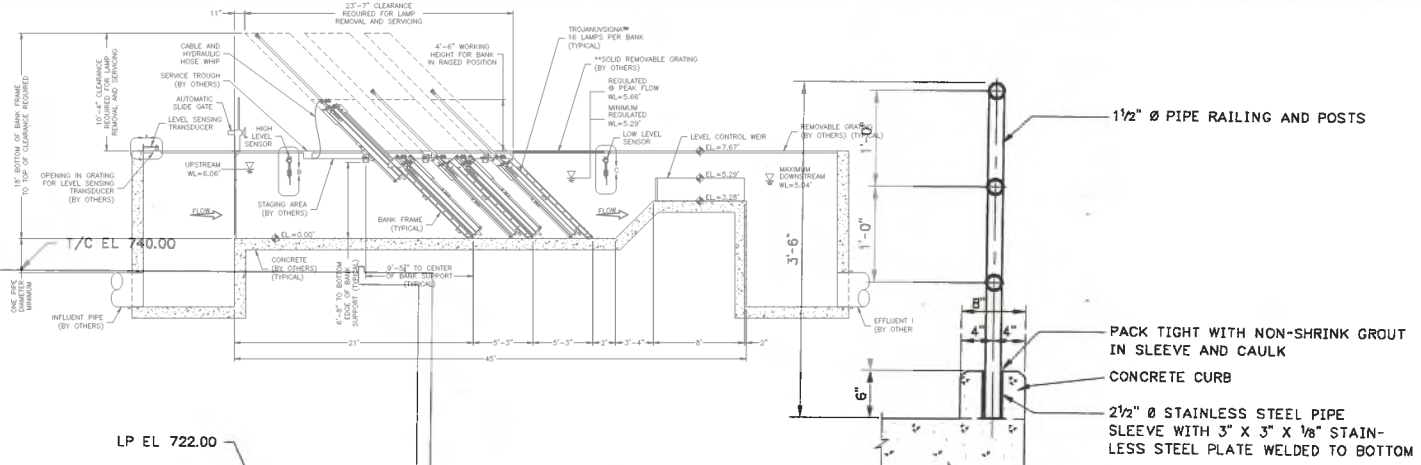
PIPING AND EQUIPMENT
 NORTH CHLORINE CONTACT TANK
 TOP PLAN

PROJ	02012
DWG	M3
SHEET	16 OF 28
DATE	OCTOBER 1999
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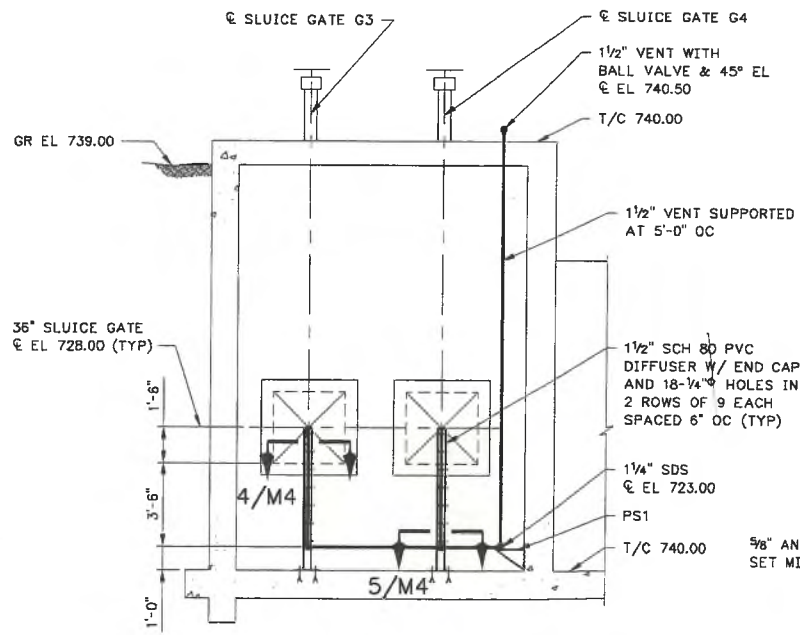


SECTION 1/M2, 3
SCALE: NOT TO SCALE

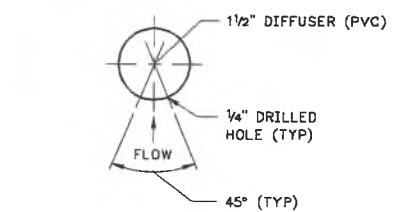
HANDRAIL AND POST DETAIL
SCALE: 1" = 1'-0"



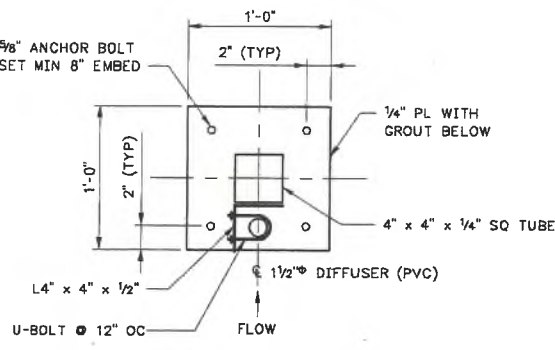
SECTION 2/M2, 3
SCALE: 1/8" = 1'-0"



SECTION 3/M2, 3
SCALE: 1/4" = 1'-0"

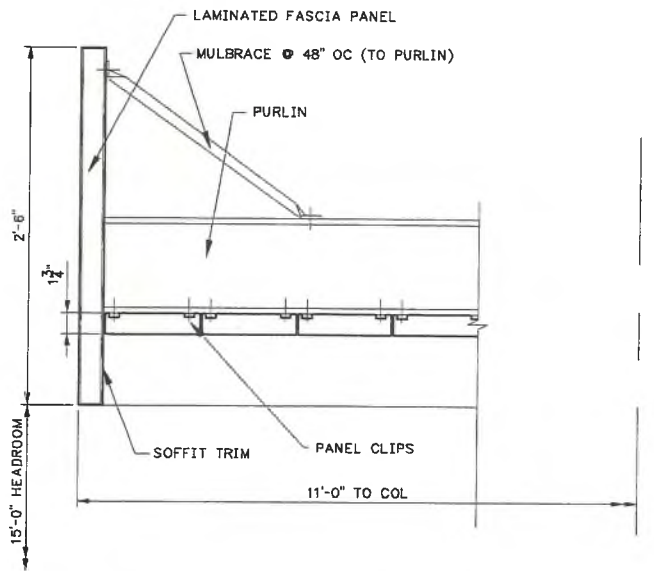


SECTION 4/M4
SCALE: 1/2" = 1"



NOTE: ALL METAL MATERIALS TYPE 316 L SST.

SECTION 5/M4
SCALE: 1/2" = 1'-0"



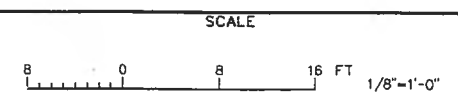
CANOPY FASCIA / SOFFIT DETAIL
SCALE: 3/4" = 1'-0"

FILE: 201AM04 1:1 04/23/01 10:20 GH-A

GREELEY AND HANSEN
ENGINEERS
211 WEST FORT STREET, SUITE 710
DETROIT, MICHIGAN 48226-3202

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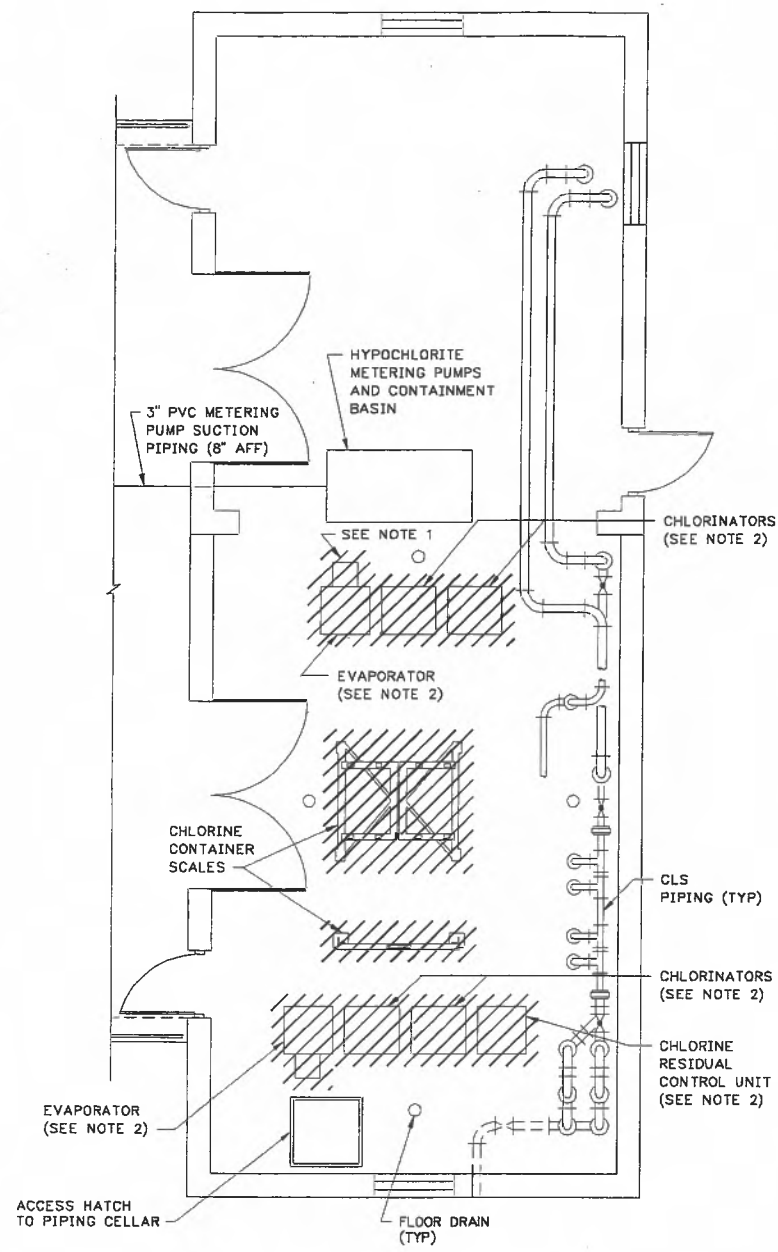
NO.	DATE	APPD	REVISION
06/04/01	PJV		RECORD DRAWING



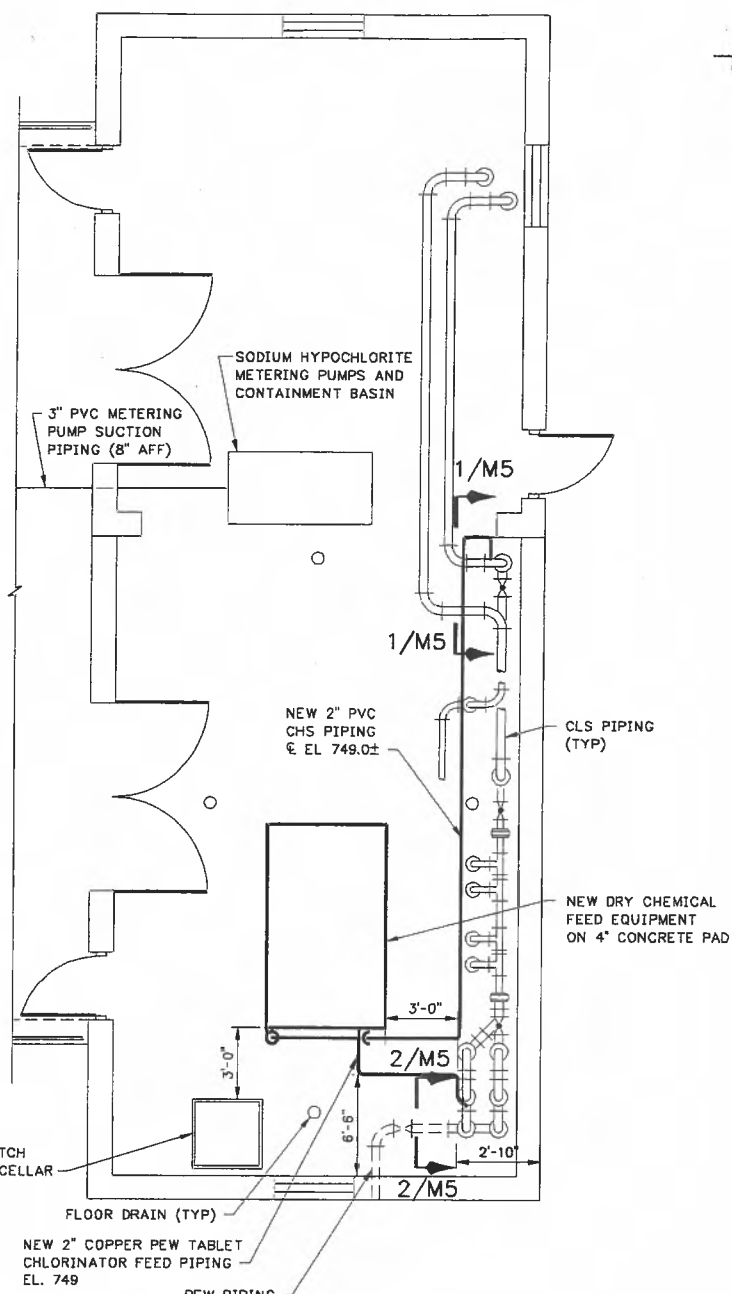
CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

PIPING AND EQUIPMENT
NORTH CHLORINE CONTACT TANK
SECTIONS AND DETAILS

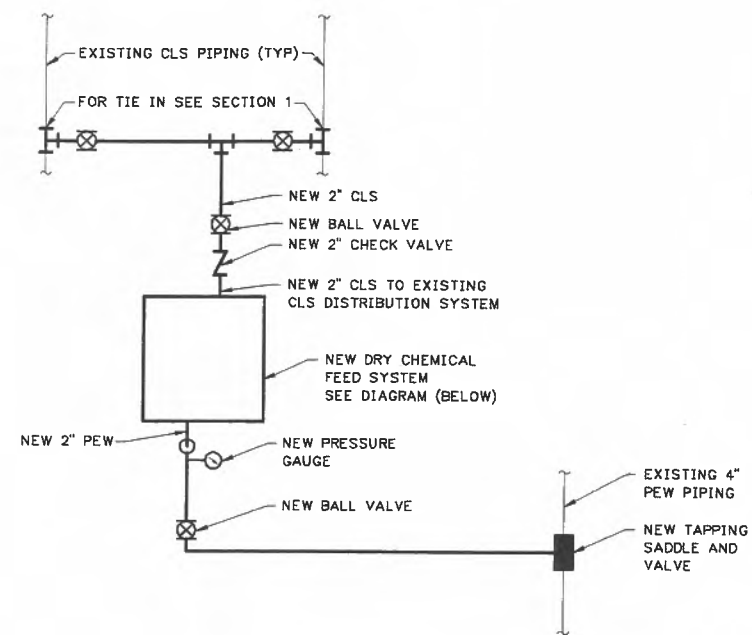
RECORD DRAWING	
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PROJ	02012
DWG	M4
SHEET	17 OF 28
DATE	OCTOBER 1999 REV 1



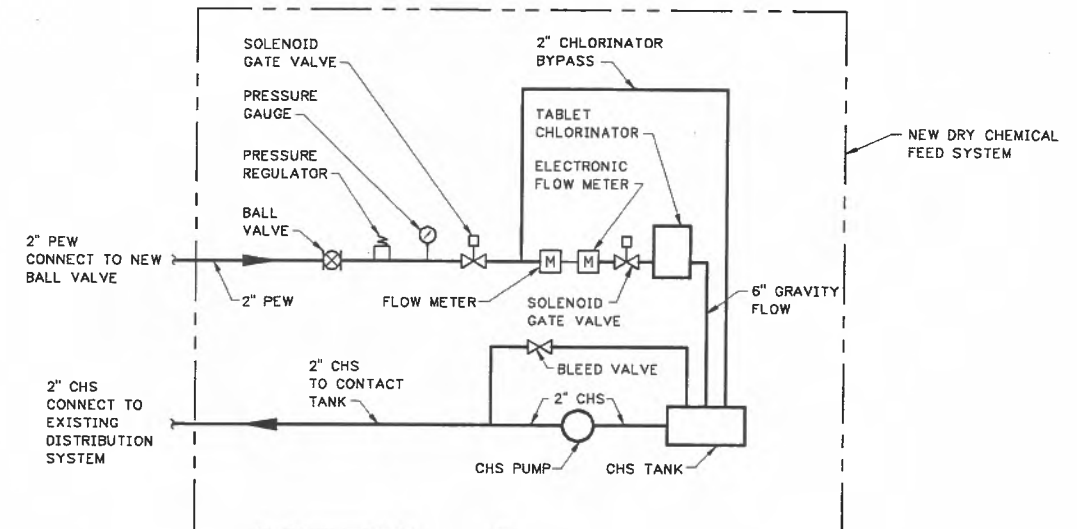
EXISTING PLAN FL EL 742.0
SCALE: 1/4"=1'-0"



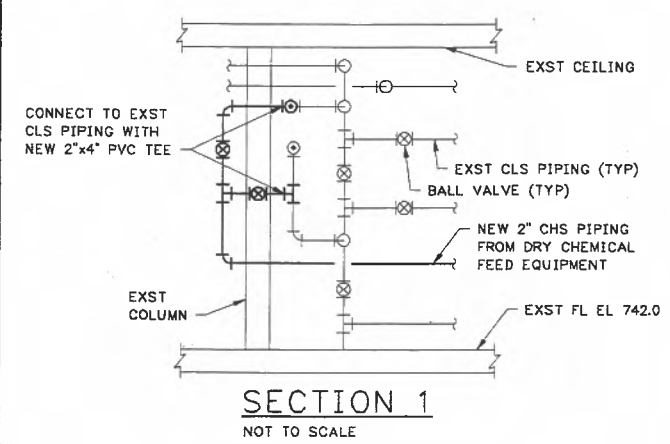
NEW PLAN FL EL 742.0
NOT TO SCALE



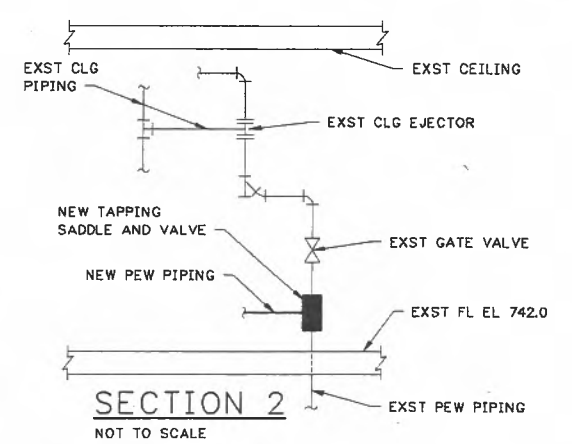
NEW DRY CHEMICAL FEED DIAGRAM
NOT TO SCALE



NEW DRY CHEMICAL FEED SYSTEM
NOT TO SCALE



SECTION 1
NOT TO SCALE

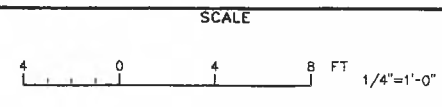


SECTION 2
NOT TO SCALE

- NOTES:**
- CROSS HATCHING INDICATES REMOVAL OF ALL GAS CHLORINATION AND EVAPORATION EQUIPMENT, INCLUDING CHLORINE GAS PIPING AND FITTINGS, ELECTRICAL WIRING AND CONDUIT, CONTROLS AND ALL APPURTENANCES RELATED TO THE EXISTING GAS CHLORINATION AND EVAPORATION SYSTEM. EQUIPMENT REMOVAL DOES NOT INCLUDE REMOVAL OF EXISTING PEW AND CLS PIPING. PROVIDE PIPE PLUGS AND CAPS AS NEEDED WHERE REMOVED PIPING IS DISCONNECTED FROM PIPING WHICH WILL REMAIN. PROVIDE PIPE SUPPORTS AS NEEDED TO SUPPORT REMAINING PIPING. COORDINATE ALL REMOVAL OPERATIONS WITH CITY SUCH THAT EXISTING LIQUID SODIUM HYPOCHLORITE SYSTEM REMAINS IN OPERATION.
 - EXISTING EQUIPMENT IS LOCATED ON A CONCRETE EQUIPMENT PAD. REMOVE EXISTING PAD TO 1" BELOW EXISTING FLOOR ELEVATION. PATCH REMAINING DEPRESSION FLUSH WITH EXISTING FLOOR.

RECORD DRAWING

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GREELEY AND HANSEN
ENGINEERS
211 WEST FORT STREET, SUITE 710
DETROIT, MICHIGAN 48226-3202

DESIGNED BYD
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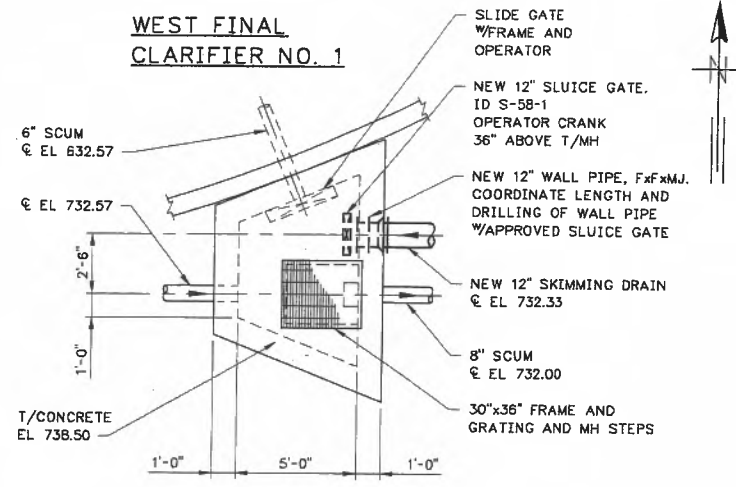
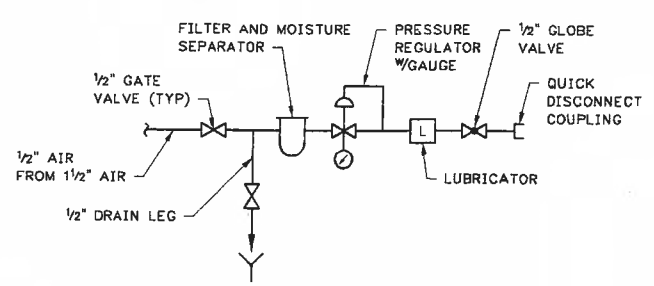
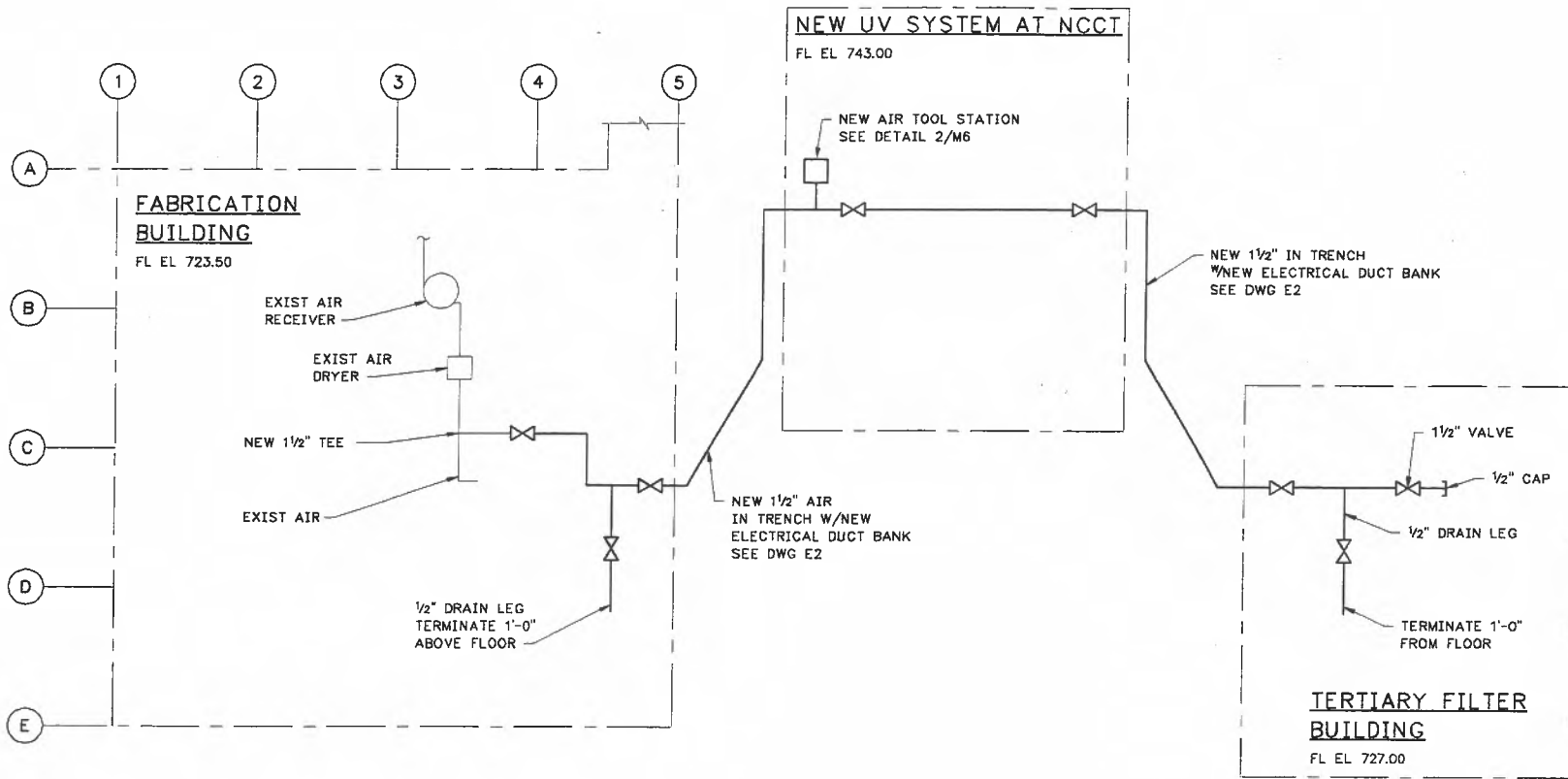
NO.	DATE	APPD	REVISION
	06/04/01	PJV	RECORD DRAWING

CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

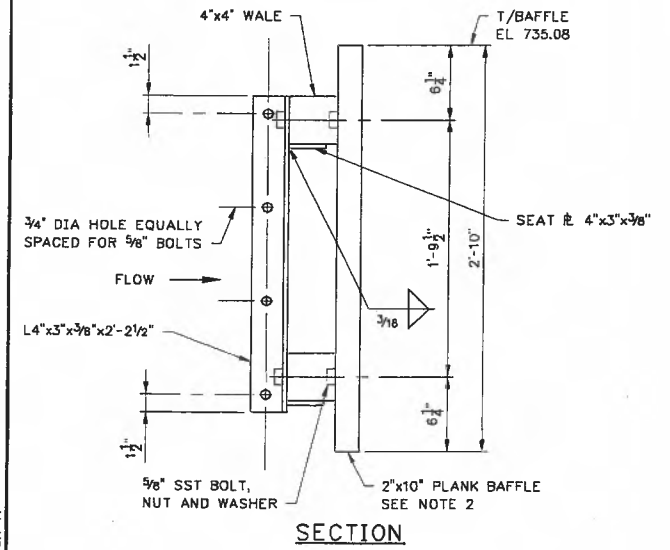
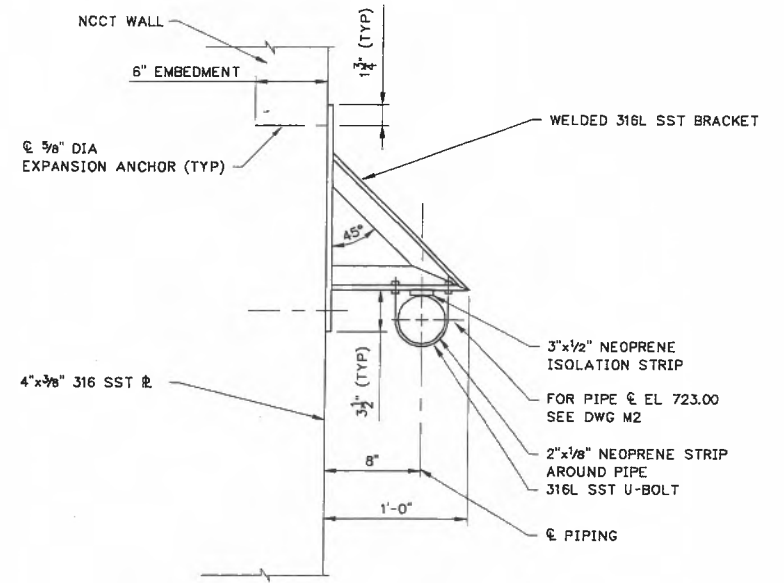
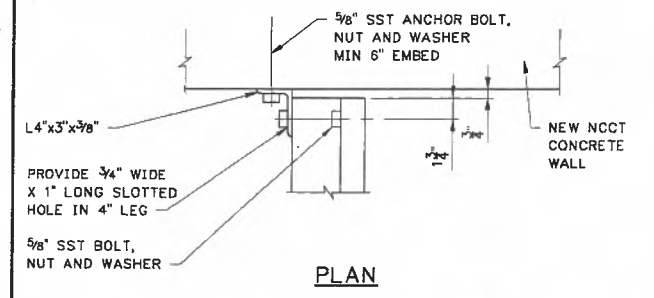
PIPING AND EQUIPMENT
CHLORINE BUILDING
PLANS, SECTIONS
AND DIAGRAMS

PROJ	02012
DWG	M5
SHEET	18 OF 28
DATE	OCTOBER 1999
REV	1

FILE: 201AMG05 11 10/28/99 1620 CH-A



DETAIL 1
AIR DIAGRAM
NOT TO SCALE



- NOTES:**
1. ALL AIR PIPING, VALVES, FITTINGS, AND APPURTENANCES TO BE PROVIDED.
 2. PROVIDE 1/8" GAP BETWEEN 2"x10" VERTICAL PLANKS. FASTEN EACH PLANK TO DOUGLAS FIR-LARCH TREATED WOOD 4"x4" WALES WITH (4) 1/2" S&T LAG SCREWS AND WASHERS. UTILIZE TYPE 316L S&T PLATES, ANGLES, BARSTOCK, BELT ASSEMBLIES AND SCREWS.

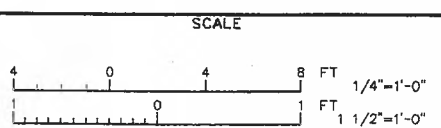
RECORD DRAWING

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GREELEY AND HANSEN
ENGINEERS
211 WEST FORT STREET, SUITE 710
DETROIT, MICHIGAN 48226-3202

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NO.	DATE	APPD	REVISION
	06/04/01	PJV	RECORD DRAWING



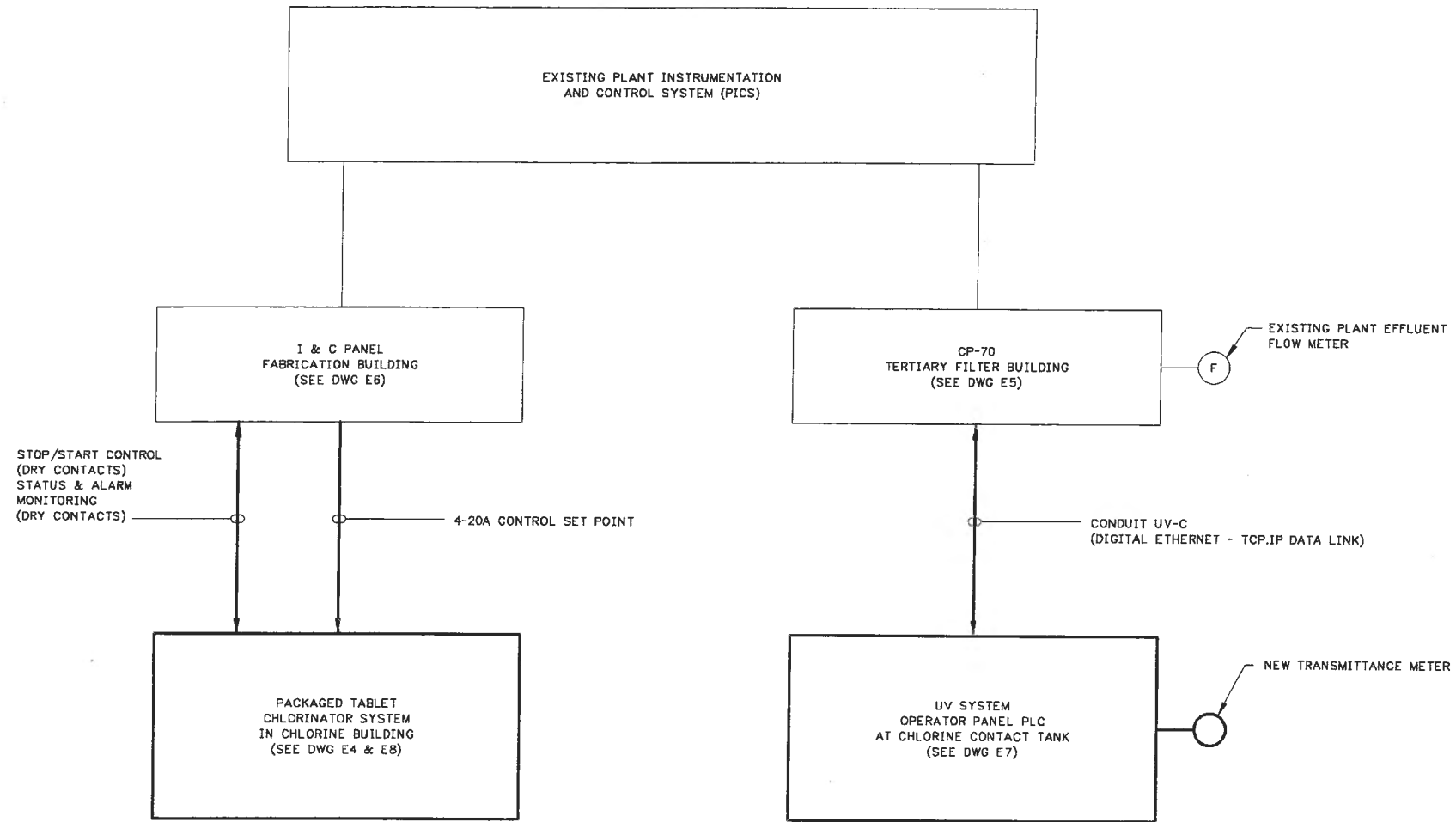
CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

PIPING AND EQUIPMENT

DIAGRAMS AND DETAILS

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SHEET	19 OF 28
DATE	OCTOBER 1999
REV	1

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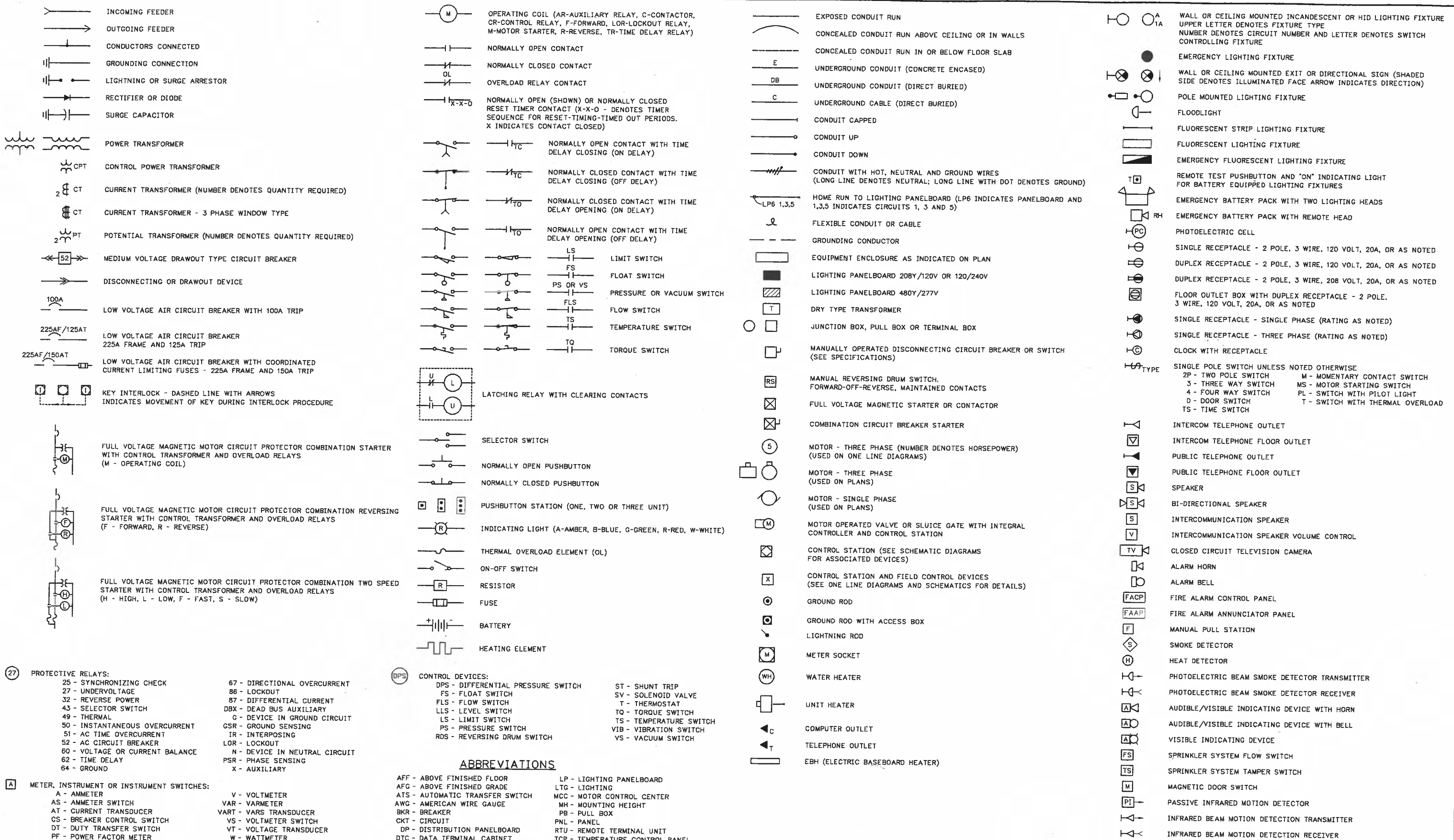
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CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

INSTRUMENTATION
INSTRUMENTATION
AND CONTROL DIAGRAMS

PROJ	02012
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SHEET	20 OF 28
DATE	OCTOBER 1999
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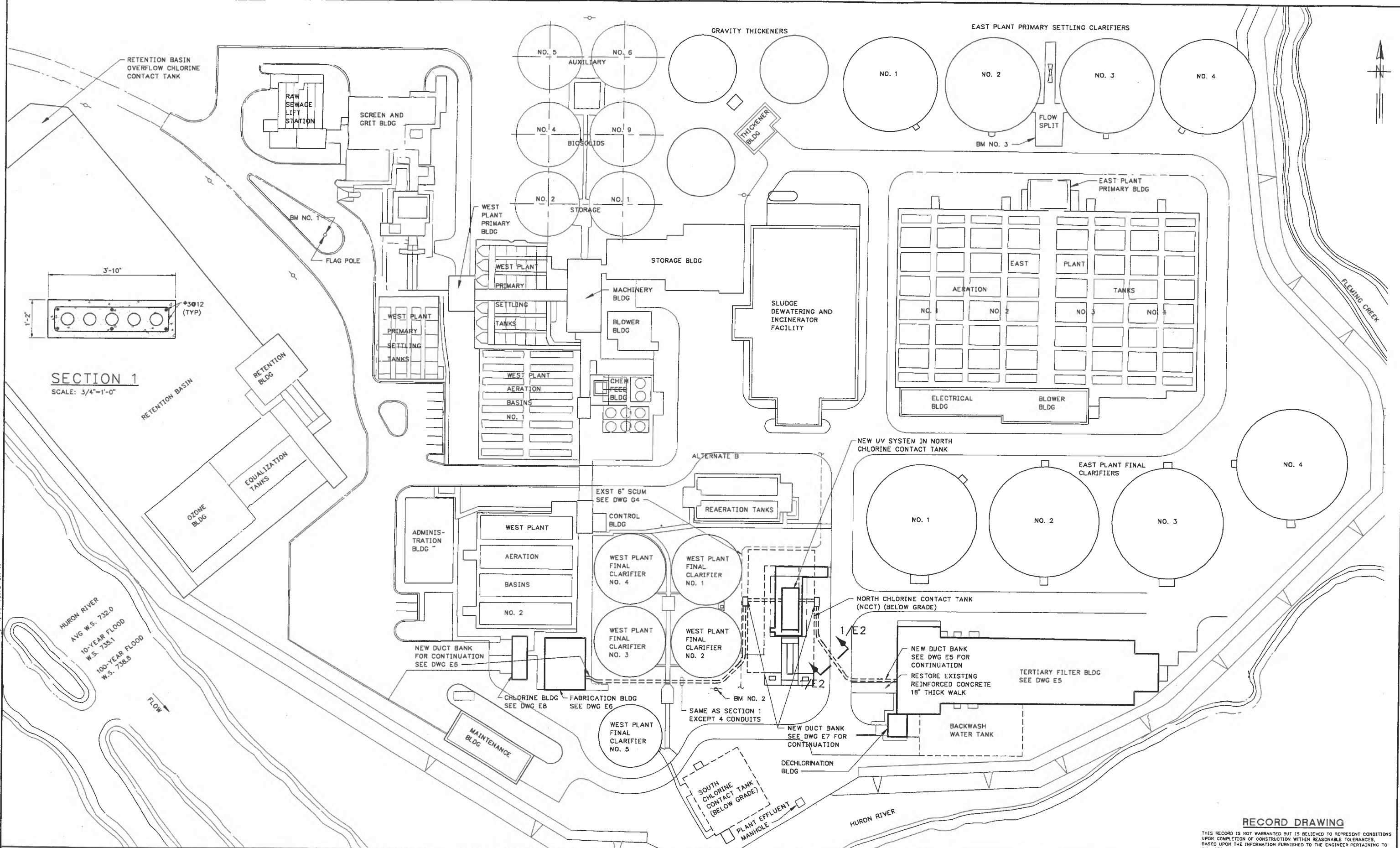


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NOTE:
 THIS IS A GENERAL LEGEND PROVIDED TO FACILITATE USE OF THE ELECTRICAL DRAWINGS. ALL SYMBOLS MAY NOT BE USED IN THIS SET OF ELECTRICAL DRAWINGS. REFER TO THE DRAWINGS AND SPECIFICATIONS FOR ITEMS REQUIRED.

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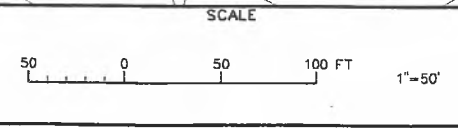


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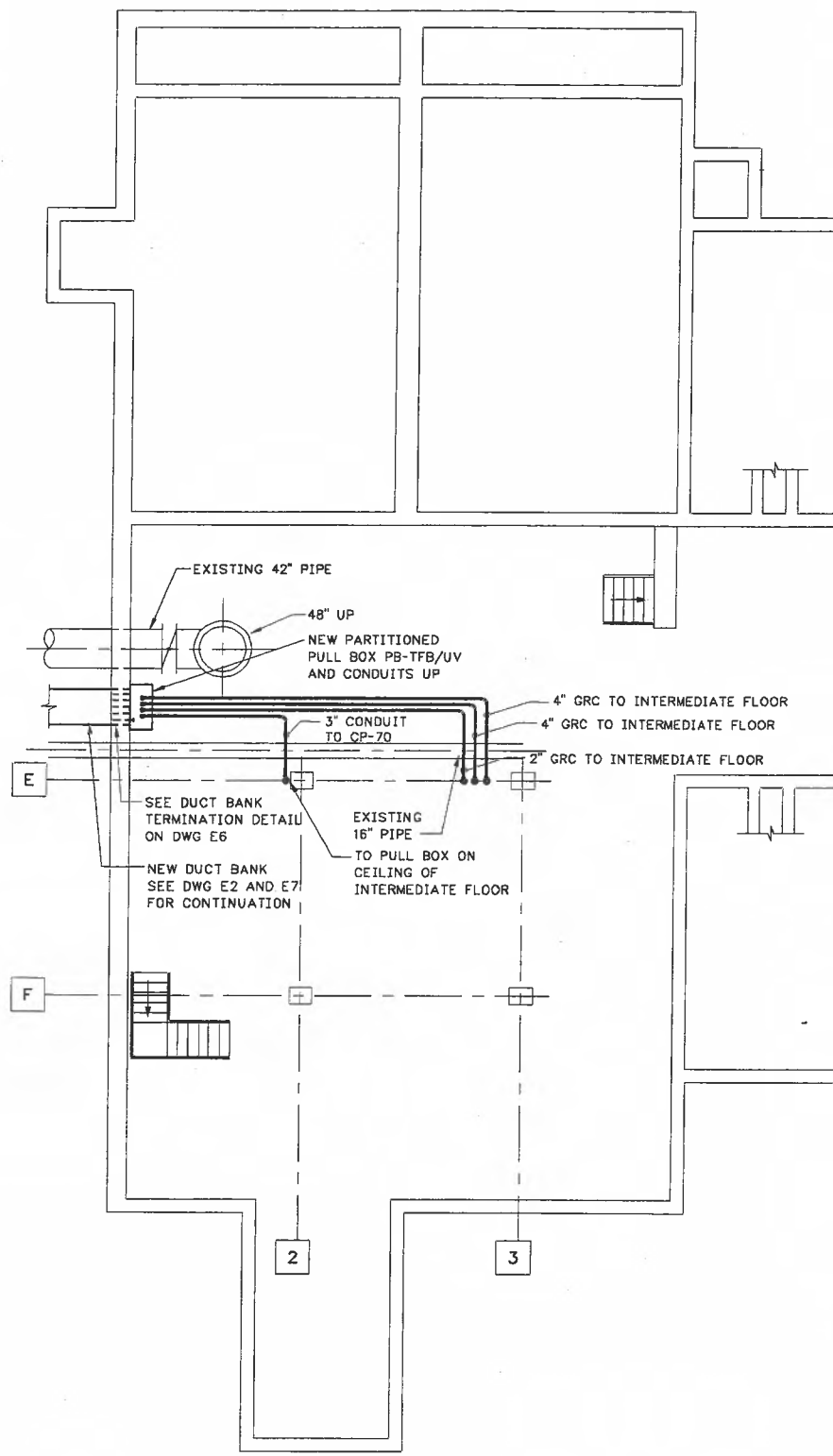
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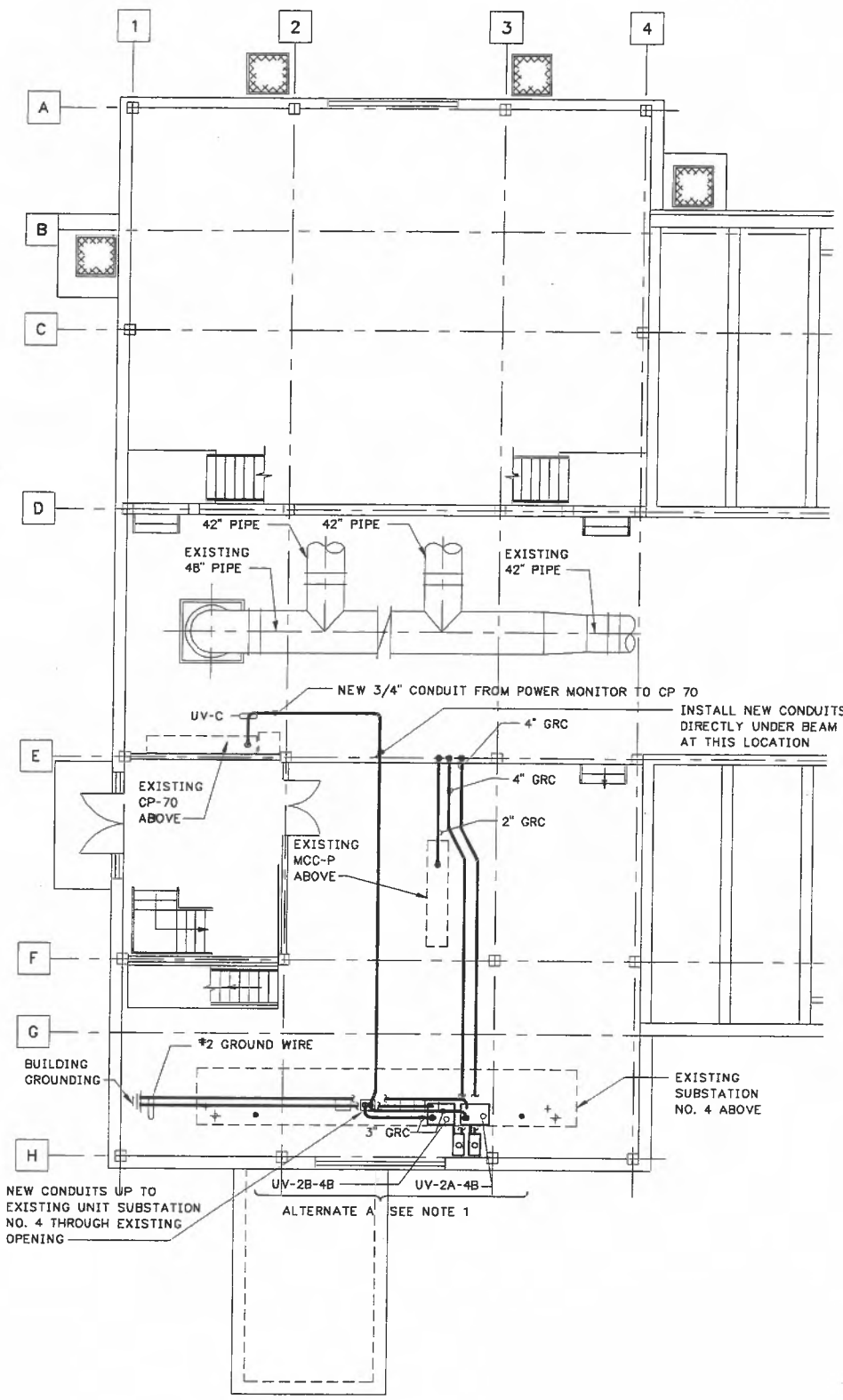
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 WASTEWATER TREATMENT PLANT
 DISINFECTION FACILITIES UPGRADE

ELECTRICAL
 SITE PLAN

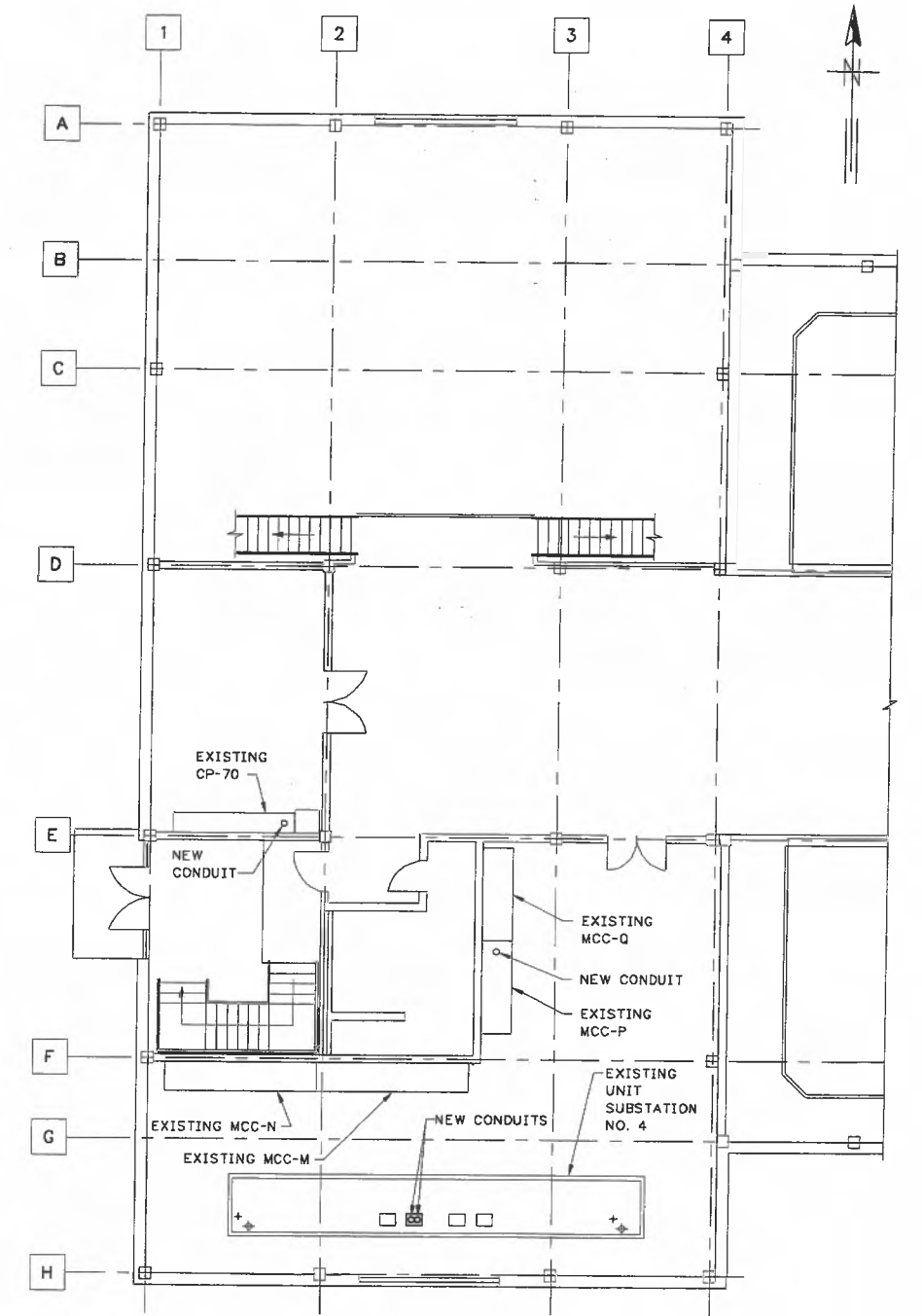
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 PROJ 02012
 DWG **E2**
 SHEET 22 OF 28
 DATE OCTOBER 1999 REV 1



BASEMENT FLOOR PLAN EL 727.00



INTERMEDIATE FLOOR PLAN EL 743.00



MAIN FLOOR PLAN EL 753.00

NOTE:
1. IF REQUIRED BY THE UV EQUIPMENT, PROVIDE A 480-VOLT DELTA 480/277 VOLT WYE ISOLATION TRANSFORMER WITH SECONDARY BREAKER FOR EACH UV UNIT POWER SUPPLY. TRANSFORMERS SHALL BE FLOOR MOUNTED, RATED A MINIMUM OF 125% OF MAXIMUM LOAD, AIR-COOLED WITH CLASS H COPPER WIRING. SECONDARY BREAKERS SHALL BE WALL MOUNTED, 600 VOLT, MOLDED CASE, WITH ELECTRONIC TRIP UNIT AND NEMA 12 ENCLOSURE WITH EXTERNAL OPERATING MECHANISM. PROVIDE ALL CONDUIT AND WIRING FOR UNITS AND GROUND THE SECONDARY WYE CONNECTION TO THE EXISTING BUILDING ELECTRICAL GROUND SYSTEM WITH NEC SIZED BARE COPPER GROUND CABLES.

RECORD DRAWING

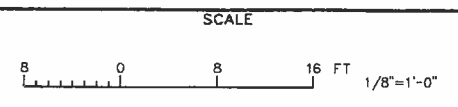
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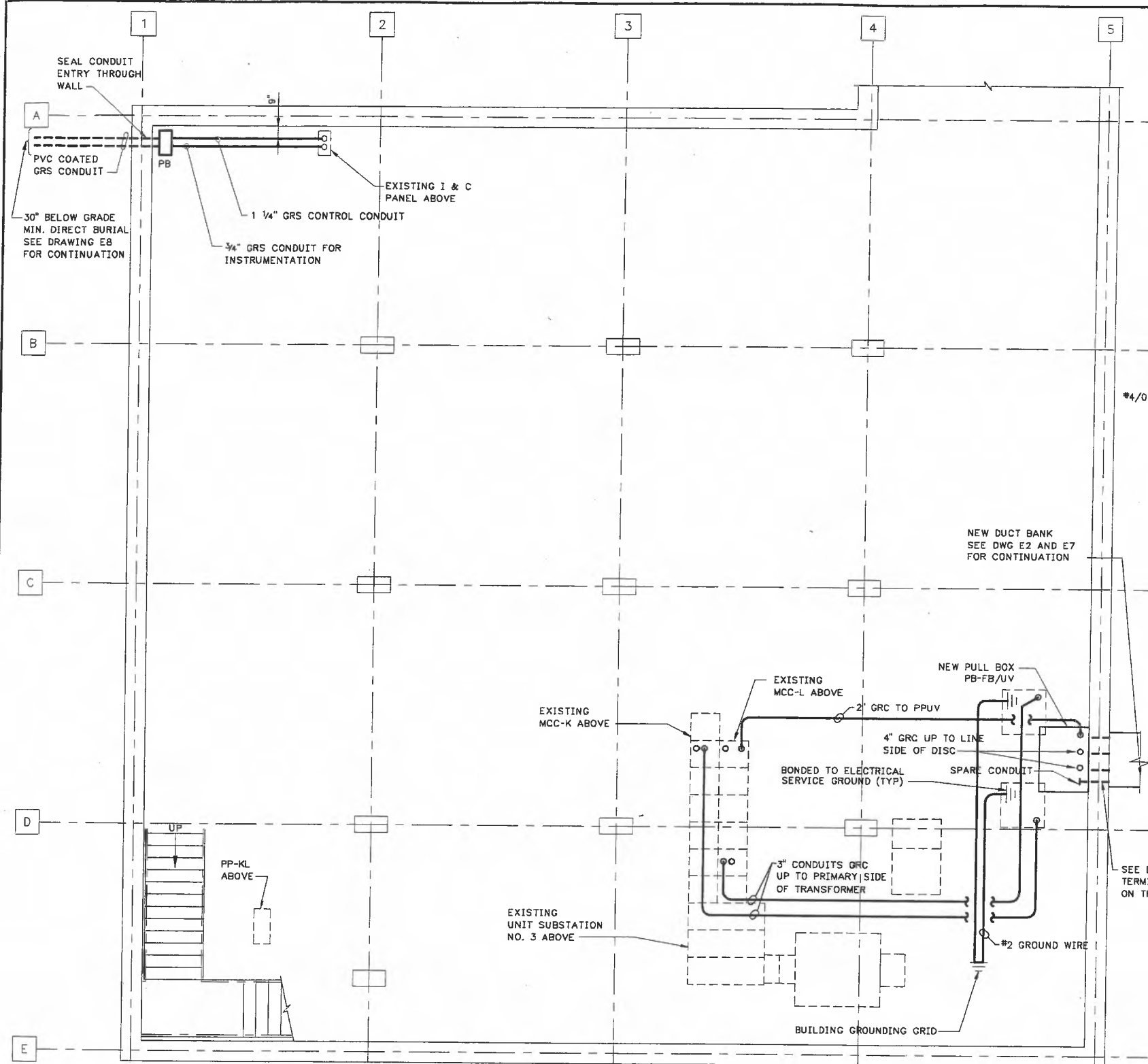


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WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

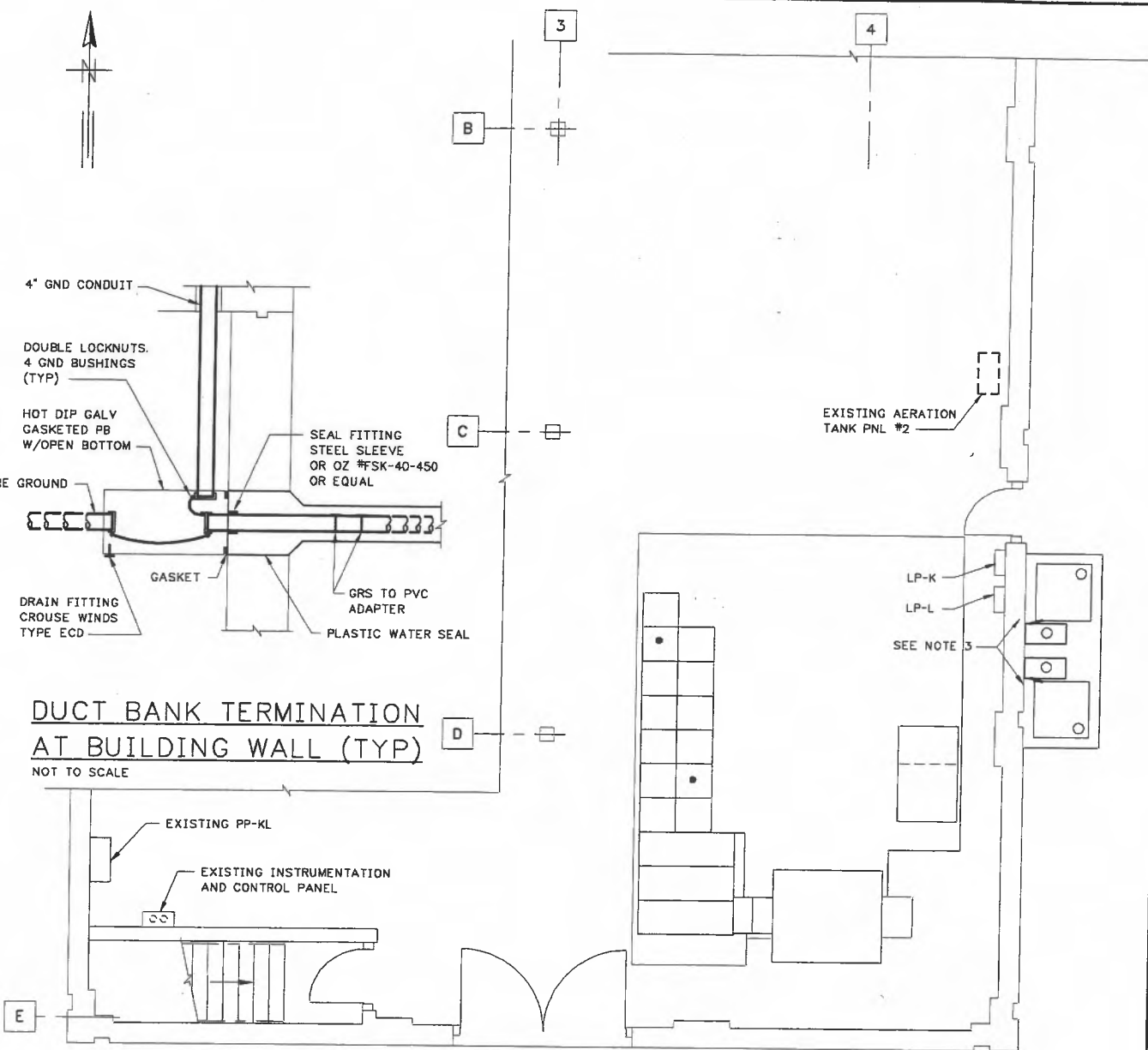
ELECTRICAL
TERTIARY FILTER BUILDING
PLANS

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BASEMENT PLAN



PARTIAL MAIN FLOOR PLAN

NOTES:

1. THERE ARE 4" CONDUITS FROM MCC-K AND MCC-L IN THE LOWER LEVEL OF THE FABRICATION BUILDING THAT FED BLOWERS NOS. 1 AND 2. CUT UN-NEEDED PORTIONS OF THESE CONDUITS, THREAD ENDS AND PROVIDE NEW RGS CONDUIT AS REQUIRED FOR FEEDERS TO UV-1A AND UV-1B. PROVIDE NEW CONDUIT FROM MCC-L AS REQUIRED FOR THE FEEDER TO PP-UV.
2. MODIFY MCC-K AND MCC-L AS SPECIFIED AND AS SHOWN ON DWG E4.
3. PROVIDE A 480-VOLT DELTA - 480/277 VOLT WYE ISOLATION TRANSFORMER WITH SECONDARY BREAKER FOR EACH UV UNIT POWER SUPPLY. TRANSFORMERS SHALL BE FLOOR MOUNTED, RATED A MINIMUM OF 125% OF MAXIMUM LOAD, AIR-COOLED WITH CLASS H COPPER WIRING. SECONDARY BREAKERS SHALL BE WALL MOUNTED, 600 VOLT, MOLDED CASE, WITH ELECTRONIC TRIP UNIT AND NEMA 12 ENCLOSURE WITH EXTERNAL OPERATING MECHANISM. PROVIDE ALL CONDUIT AND WIRING FOR UNITS AND GROUND THE SECONDARY WYE CONNECTION TO THE EXISTING BUILDING ELECTRICAL GROUND SYSTEM WITH NEC SIZED BARE COPPER GROUND CABLES.

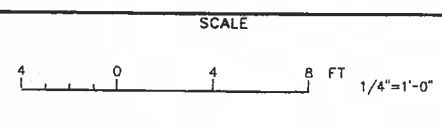
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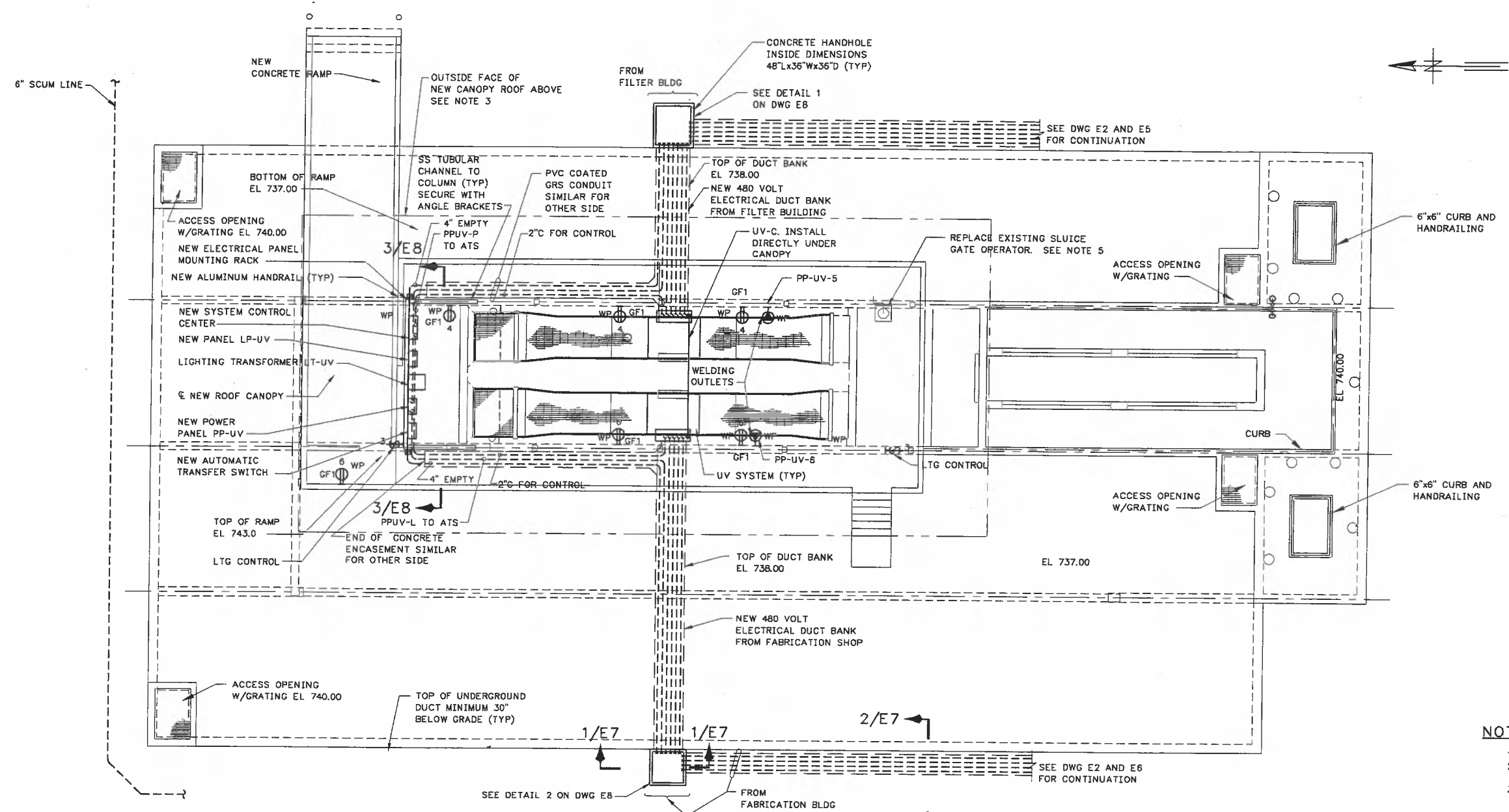


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 WASTEWATER TREATMENT PLANT
 DISINFECTION FACILITIES UPGRADE

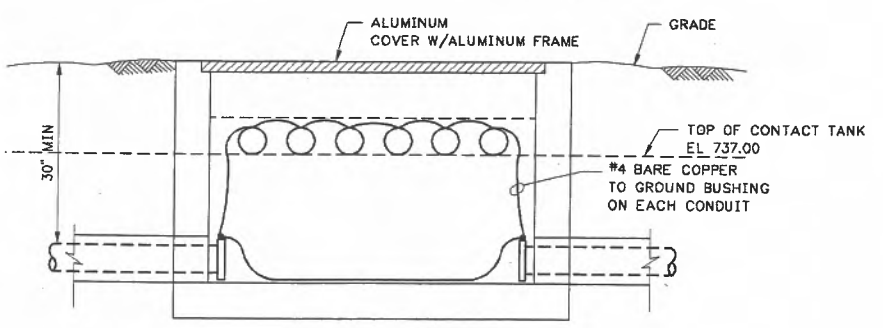
ELECTRICAL
FABRICATION BUILDING
PLANS

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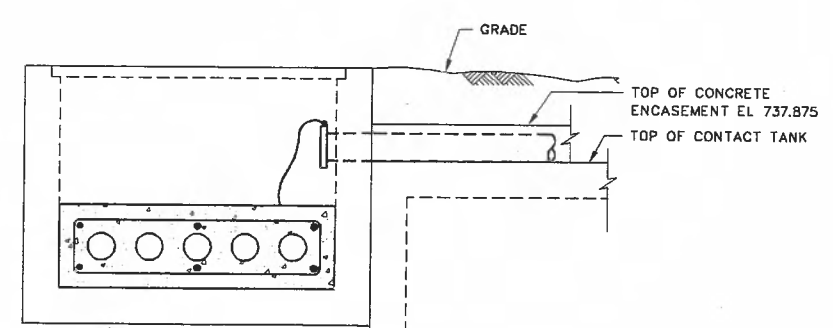
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 FILE: 201AE07 1:1 10/28/99



TOP PLAN
SCALE: 1/8"=1'-0"



SECTION 1
NOT TO SCALE



SECTION 2
NOT TO SCALE

- NOTES:**
- FOR DIMENSION SEE DWG M5.
 - REMOVED
 - UNDERNEATH NEW CANOPY OVER CONTACT TANK, INSTALL TWENTY SEVEN (27) NEW FLUORESCENT LIGHTING FIXTURES (TYPE A) AND TWO (2) NEW METAL HALIDE LIGHTING FIXTURES (TYPE B). INSTALL THREE ROWS OF NINE TYPE A FIXTURES ALONG THE LONG AXIS OF THE CANOPY. INSTALL THE TWO METAL HALIDE FIXTURES ABOVE AND IN FRONT OF EACH NEW UV SYSTEM. SEE PANEL LP-UV SCHEDULE ON DWG E8 FOR LIGHTING CIRCUITS. PROVIDE 3/4 INCH CONDUIT, 5#12, 1#12 GROUND FOR CIRCUITING. PROVIDE A PHOTOCELL ON NORTH EDGE OF CANOPY FACING NORTH FOR THE AUTOMATIC CONTROL OF THE METAL HALIDE FIXTURES. PROVIDE A SIX POLE CONTACTOR IN A NEMA 4X CONTROL CABINET FOR MANUAL CONTROL OF FLUORESCENT AND METAL HALIDE FIXTURES THROUGH TWO-THREE WAY SWITCHES.
 - REMOVED
 - DISCONNECT CONDUIT AND WIRE FROM EXISTING SLUICE GATE OPERATOR AND RECONNECT TO THE NEW SLUICE GATE OPERATOR IN THE SAME LOCATION. PROVIDE ANY NEW PVC COATED GRS CONDUIT, WIRING, ACCESSORIES AND DEVICES REQUIRED. RECONNECT CONTROL WIRING AS REQUIRED.

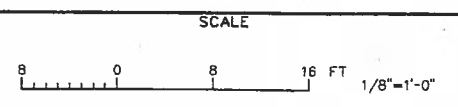
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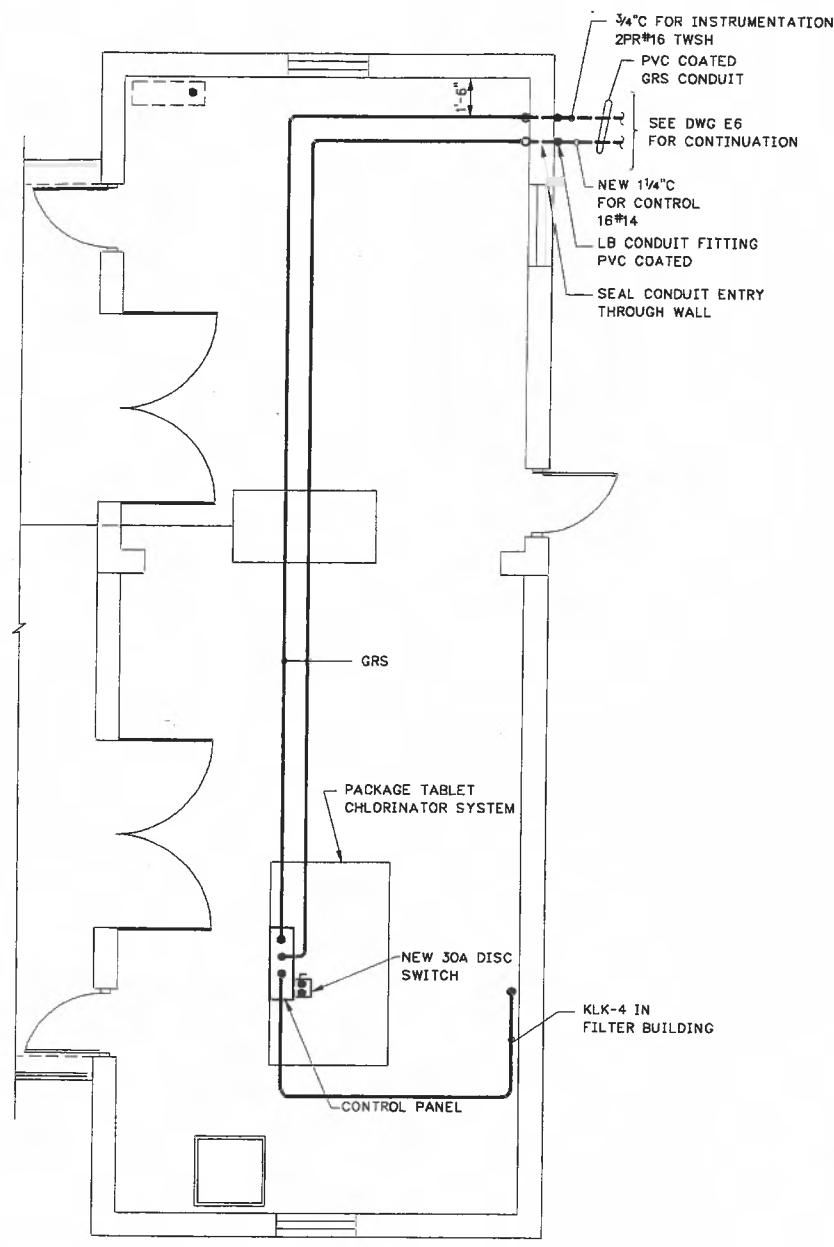
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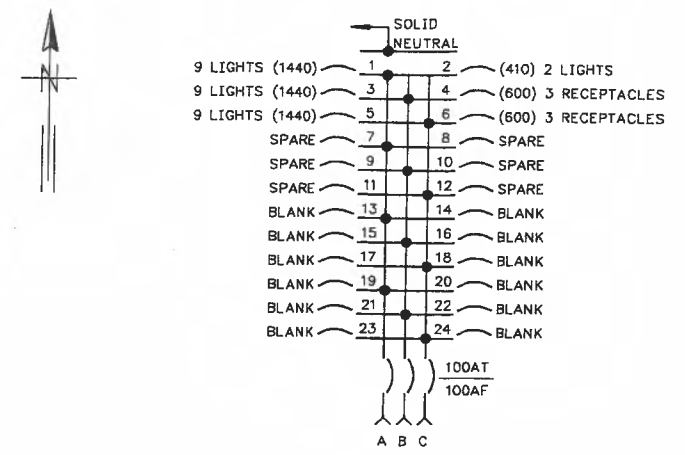
CITY OF ANN ARBOR, MICHIGAN
WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

ELECTRICAL
CHLORINE CONTACT TANK
PLANS AND SECTIONS

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DATE	OCTOBER 1999
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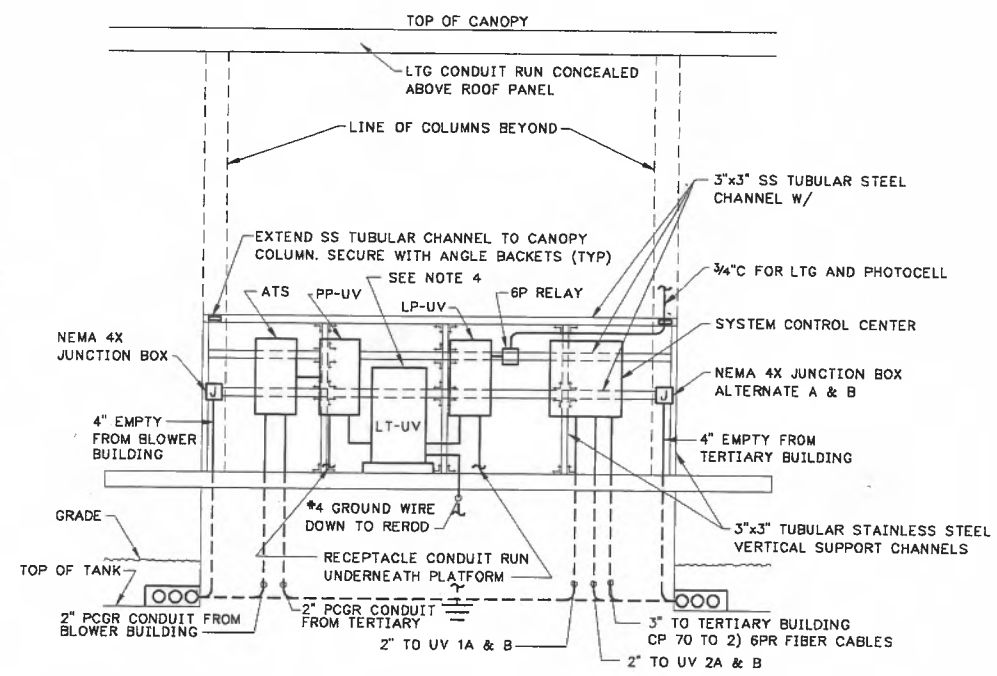
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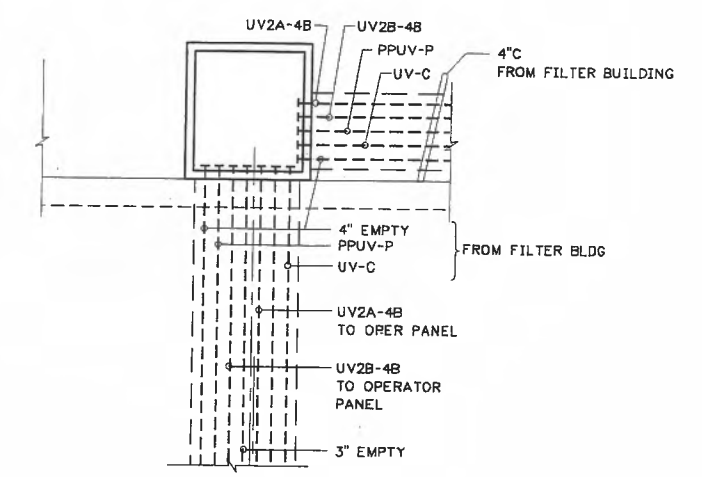
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	AN	BN	CN	AB	BC	CA	
SUB TOT	1850	2040	2040				
TOTAL	5930						

PANEL LP-UV
(208Y/120V, 3 ϕ , 4W, 225A BUS)
100A GND BUS

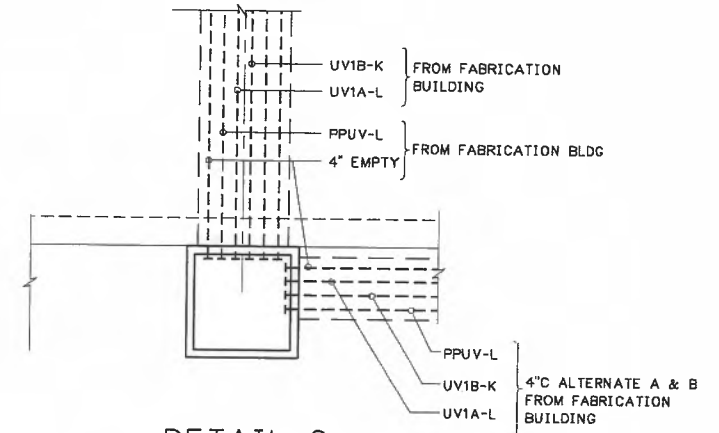
ALTERNATE B
NOT USED



SECTION 3/E7
SCALE: 1/4"=1'-0"
SEE NOTE 5



DETAIL 1
NOT TO SCALE



DETAIL 2
NOT TO SCALE

NOTES:

1. PROVIDE GROUND BUSHINGS AND LUGS ON ALL CONDUITS TERMINATING IN HANDHOLES. LOOP 1-#4/0 GROUND CONDUCTOR TO EACH CONDUIT GROUND LUG.
2. PROVIDE CAST IRON FRAME AND LID FOR HANDHOLES.
3. SS SUPPORT CHANNELS SHALL BE SECURED TO CONCRETE WITH ANGLE BRACKETS AND EMBEDDED ANCHORS. SUBMIT DETAILED DESIGN SHOP DRAWING.
4. TRANSFORMER SHALL BE OUTDOOR WEATHERPROOF EPOXY ENCAPSULATED TYPE WITH ENCLOSURE PAINTED WITH CORROSION RESISTANT FINISH. COORDINATE WITH STRUCTURAL AND ARCHITECTURAL FOR PAINT FINISH TYPE.
5. ALL ELECTRICAL ENCLOSURES SHALL BE NEMA 4X. ALL METAL SUPPORT CHANNELS, ANGLES BRACKETS, NUTS, BOLTS, WASHERS AND ACCESSORIES SHALL BE STAINLESS STEEL.

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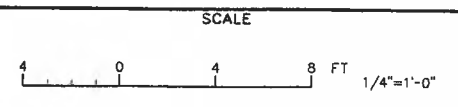
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WATER UTILITIES DEPARTMENT
WASTEWATER TREATMENT PLANT
DISINFECTION FACILITIES UPGRADE

ELECTRICAL
CHLORINE BUILDING
PLAN, DETAILS AND SCHEDULE

PROJ	02012
DWG	E8
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**APPENDIX B – EXISTING WWTP OPERATION & MAINTENANCE
MANUAL**

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CITY OF ANN ARBOR, MICHIGAN
Water Utilities Department
Wastewater Treatment Plant

OPERATION AND MAINTENANCE MANUAL

FOR

DISINFECTION FACILITIES UPGRADE

August 2001

Prepared By

GREELEY AND HANSEN LLP

211 West Fort Street, Suite 710
Detroit, Michigan 48226-3202

GREELEY AND HANSEN

ENGINEERS

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August 17, 2001

Mr. Michael D. Amicangelo, Utilities Engineer
Ann Arbor Water Utilities Department
Ann Arbor Wastewater Treatment Plant
49 S. Dixboro Road
Ann Arbor, Michigan 48105-9405

Subject: Disinfection Facilities Upgrade
Operation and Maintenance Manual

Dear Mr. Amicangelo:

Please find enclosed seven (7) paper copies and one (1) electronic copy of the Operation and Maintenance Manual for the subject project. This Operation and Maintenance Manual has been provided in accordance with Task 2.1 of our Contract, Amendment No. 2 to the Agreement for Professional Services between Greeley and Hansen and the City of Ann Arbor dated February 8, 2000.

It is suggested that this Operation and Maintenance Manual be inserted into the WWTP's existing Operation and Maintenance Manual.

Yours very truly,

GREELEY AND HANSEN LLP


Nicole B. Spieles

Enclosures

c. Detroit Office File

CITY OF ANN ARBOR, MICHIGAN
 Water Utilities Department
 Wastewater Treatment Plant

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1.0 Introduction

The Ann Arbor Wastewater Treatment Plant (WWTP) treats wastewater collected from the City of Ann Arbor, Pittsfield Township and Scio Township which is ultimately discharged to the Huron River. As required by the WWTP National Pollutant Discharge Elimination System (NPDES) permit, the treated water is disinfected prior to being discharged to the Huron River. The Disinfection Facilities Upgrade (DFU) project involved design and construction of an ultraviolet disinfection system retrofitted into the existing North Chlorine Contact Tank, removal of the existing gaseous chlorine system and decommissioning of the sulfur dioxide system.

In addition to installation of an ultraviolet disinfection system, other equipment is provided for operational flexibility and to maintain the performance of the ultraviolet disinfection equipment, including slide and sluice gates, dry chemical feed equipment, skimmings removal equipment and associated electrical components.

This Operation and Maintenance Manual describes modifications made at the WWTP and provides a brief synopsis of the purpose, operating scenarios, periodic inspection and maintenance and safety issues related to the new equipment installed as part of the DFU project. Detailed information regarding the new equipment is provided in the Equipment Operation and Maintenance (O&M) Manual dated June 2001. The following individual equipment O&M Manuals are included in the Equipment O&M manual dated June 2001:

- Trojan UV 4000 Ultraviolet Disinfection Equipment
- US Filter Skimmings Removal Equipment
- Waterman 72-inch x 72-inch Slide Gates, 12-inch x 12-inch Sluice Gate and 48-inch x 48-inch Sluice Gate
- Hammonds Table Chlorinator Dry Chemical Feed Equipment
- Electrical Equipment

2.0 Ultraviolet Disinfection Equipment

2.1 General

The existing North Chlorine Contact Tank (NCCT) is an underground concrete structure located west of the Tertiary Filter Building (See Figure A) that is modified allowing for the installation of new Trojan Technologies, Inc. UV4000 disinfection equipment (See Figure B).

2.1.1 Description

The new ultraviolet disinfection (UV4000) equipment is designed to disinfect up to 48 million gallons per day (mgd) to the WWTP NPDES permit disinfection standards. The final pass of the NCCT, immediately upstream of the weir chamber, is reconfigured. A concrete structure is built into the existing pass dividing it into two channels, each sized for installation of a UV4000 Reactor. Filtered effluent enters the NCCT and, subsequently, the two new channels that house the UV4000 equipment. Each of the two Reactors is comprised of two Banks, each Bank with six modules, each module with six medium pressure, high intensity mercury vapor lamps and quartz sleeves.

The new concrete structure extends above the finished grade over the NCCT to accommodate the height of the UV4000 equipment. The UV4000 equipment is installed such that the "suitcase" ballast enclosures on each module arm are above the 100-year flood elevation of 738.80. A concrete platform, built at the finished elevation of 743.00 of the UV4000 module arms, is accessible by a ramp and stairs. Above the equipment and platform, a canopy is installed which overhangs the platform entirely, including portions of the ramp to minimize collection of precipitation on the platform and equipment and provide shelter from the sun. Level with the new concrete platform, grating is installed in each channel to protect against unintentional access to the channel below. Portions of the grating is removable to allow for raising of the module arms for inspection and repairs.

To improve hydraulic characteristics through the NCCT, the existing steel plates, sulfur dioxide diffusers and sampling piping immediately upstream of the weir were removed. The sulfur dioxide piping and sample piping are capped on the west side of the wall which separates the first pass of the NCCT from the last pass of the NCCT.

The quartz sleeves that encase the lamps require periodic cleaning to maintain optimal transmittance of UV light to the effluent. The UV4000 equipment utilizes an automatic mechanical/chemical cleaning system. A combination of Lime-A-Way solution and mechanical wipers are used to clean the quartz sleeves. The period of time between automatic cleanings can be adjusted from 1 to 500 hours. During startup of the UV4000 system, Trojan recommended and set the cleaning frequency to once every 4 hours for all Banks. During a cleaning cycle, neither the lamps nor the modules need to be placed out of service.

A portable emergency shower and eyewash with cart is housed in the Tertiary Filter Building. It is recommended that the portable emergency shower and eyewash be at the UV4000 system platform during operations that require use of Lime-A-Way solution.

2.1.2 Purpose

The purpose of the UV4000 equipment is to disinfect WWTP effluent flows up to 48 mgd to meet the WWTP NPDES permit standards.

2.1.3 Design

Lamp Type	High intensity, medium pressure
Maximum Flow Capacity	48 mgd (24 mgd per Reactor)
Minimum Flow Capacity	10 mgd (5 mgd per Reactor)
Maximum Equipment Power Draw	605 KW
Headloss @ 24 mgd per reactor	< 9.00 inches
UV Dose @ 253.7 nm	> 22,000 $\mu\text{W}\cdot\text{s}/\text{cm}^2$
Fecal Coliform concentrations	< 200 MPN/100mL, 30-day geometric mean; < 400 MPN/100mL, 7-day geometric mean

2.1.4 Inspection and Maintenance

Take all necessary precautions to prevent exposure to UV light including the following:

- a. Wear protective eyewear which protects against UVA, UVB and UVC light.
- b. Refer to the MSDS for Lime-A-Way solution in the UV4000 O&M Manual.

- c. Prior to disconnecting power to a Bank, ensure the other Bank in the Reactor is powered and operating.
- d. Prior to working on any portion of a module arm or Bank, disconnect the power and follow lockout procedures for the module arm or Bank.

Perform the following inspection and associated maintenance daily:

- a. Check cleanliness of the cuvette in the UV transmittance (UVT) Sensor/Sampler Panel. Follow the manufacturer's procedures for cleaning the cuvette.
- b. Check the level of 0% Transmittance solution in the reservoir bottle in the Sensor/Sampler Panel. Refill with distilled water as necessary.
- c. Check the System Control Center (SCC) Panelview for current and recent alarms. Follow appropriate actions described in the UV4000 O&M manual for the alarm displayed.

On a monthly basis, verify proper operation of the potable emergency shower and eyewash. Following operation of the portable emergency shower and eyewash, check the water level and refill as needed. Perform a visual inspection, preferably during the lowest flow period, of the structural components of the system once per year.

Follow the manufacturer's suggested daily, weekly, monthly and annual inspection and maintenance requirements provided in Trojan Technologies, Inc.'s UV4000 Operation and Maintenance Manual.

If disinfected effluent is found to violate the NPDES permit required water quality standards for disinfection, isolate and inspect the disinfection system. Additionally, during the use of the on site diesel engine generators, ensure that the immunity of electronic loads to line frequency is not exceeded.

2.2 Modes of Operation

The UV4000 equipment can be operated in either manual or automatic mode. In automatic mode, the level of disinfection by ultraviolet (UV) light is calculated utilizing the effluent flow rate and the UV transmittance of the effluent. The effluent flow rate is metered in the Plant Effluent Manhole downstream of the NCCT using an existing Accusonics flow meter. The flow rate is transmitted to the UV4000 SCC via the plant Process Information Control System (PICS) telemetry system. Samples of the

effluent are taken immediately downstream of the UV 4000 equipment by a sample pump. The UVT of the samples is measured by a spectrophotometer and transmitted to the SCC via control wiring.

In automatic mode, based on the effluent flowrate, the effluent UVT and the age of the UV lamps in service, the SCC adjusts the power to the UV4000 equipment ballasts which, in turn, adjusts the intensity of the light emitted by the lamps. A UV intensity probe is installed in each Bank. The SCC uses the measured UV intensity to adjust the UV dosage as the lamp age increases and transmission of light from the lamp decreases due to fouling between lamp cleanings.

2.2.1 Normal operation

Under normal conditions, water flows from the Tertiary Filter Building Clearwells to the NCCT. At the NCCT, flow enters both channels that house the skimmings removal equipment and, subsequently, the UV4000 system. Normal operation of the UV4000 system is in automatic mode and with one Bank of lamps operating in each Reactor. The UV4000 equipment is designed to provide the required disinfection at design peak flow with one module out of service and all lamps at the end of their lamp life.

2.2.1.1 Gate and Valve Positions

Refer to Table 2 and Figure C for position of the gates and valves in the NCCT and Tertiary Filter Building during normal operation.

2.2.2 High River Level

Under normal operating conditions, the disinfected effluent flows by gravity to the Huron River. As the water surface level of the Huron River rises, due to precipitation or operational changes to the dams upstream and downstream of the plant, the ability to discharge disinfected effluent by gravity is affected. When flow by gravity cannot be achieved, the disinfected effluent is pumped to the Huron River using the west Secondary Effluent Pumps in the Tertiary Filter Building.

2.2.2.1 Gate and Valve Positions

During high river levels, gate and valve positions are affected as follows:

- a. The 48-inch sluice gate (ID S-58-1), also referred to as the Bypass Gate, is opened.

- b. The 54-inch sluice gate (ID S-55-1), also referred to as the River Gate, is closed.
- c. The 36-inch sluice gate (ID S-2-1) in the west Secondary Effluent Pump wetwell is closed
- d. The 48-inch butterfly valve (ID B-2-1) is closed.
- e. The 42-inch butterfly valve (ID B-3-1) is opened.

Refer to Figure C for location of the affected gates.

2.2.3 Restricting Flow to One Channel

If one of the two UV4000 Reactors requires isolation, operation of the ultraviolet disinfection system and gate positions are affected.

2.2.3.1 Equipment Operation

During isolation of a channel, disable or de-energize the Reactor in the isolated channel. The capacity of each channel is limited hydraulically to 24 mgd. Attempting to direct greater than 24 mgd through one channel will ultimately raise the water surface elevations in the Tertiary Filter Building and the Secondary Clarifiers.

2.2.3.2 Gate and Valve Positions

To isolate a channel the slide gates on the upstream and downstream ends of the channel are placed in the closed position. Refer to Table 2 and Figure C for the position and location of the gates in the NCCT affected during isolation of a channel.

2.2.4 Multiple Lamp/Ballast Failures

The control program in the SCC is programmed so that up to six lamps or ballasts may fail in one Bank before a Multiple Lamp Failure alarm for that Bank is displayed. When a Multiple Lamp Failure alarm is triggered in a Bank, that Bank will not operate in automatic mode until the failed lamps and/or ballasts are replaced.

2.2.4.1 Gate and Valve Positions

The gate positions in the NCCT are not directly affected by a multiple lamp/ballast failures. If a Multiple Lamp Failure is triggered in both banks of a Reactor, the affected channel should be isolated during repair of the

failed lamps and/or ballasts. Refer to Section 2.2.3 for channel isolation procedures.

2.2.5 Loss of Power

A loss of power to the WWTP from the Detroit Edison power source will cause the UV4000 system to de-energize. Upon restoration of the power, the Banks that were energized at the time of the power loss will time off for 7 minutes before re-energizing. The Banks, if any, that were de-energized during the power loss, will energize to 88% intensity for 9 minutes prior to being adjusted to the required dosage, upon restoration of power to the UV4000 equipment.

2.2.5.1 Equipment Operation

If power to the entire UV4000 system is lost, no equipment operation is possible until the power is restored. If power to only one of the Reactors is lost, the channel with the de-energized Reactor should be isolated until the lost power is restored.

Power to the SCC is fed through an automatic transfer switch (ATS) fed from both the Tertiary Filter Building and Fabrication Building. The power to the ATS is normally fed from the Tertiary Filter Building. If power to the Tertiary Filter Building is lost, then the ATS switches to emergency power from the Fabrication Building to the SCC.

2.2.5.2 Gate and Valve Positions

If power is lost to one of the two Reactors, isolation of a channel is required. Refer to Section 2.2.3 for channel isolation procedures.

2.2.5.3 Alternative Disinfection

As was the case with the gaseous chlorination system, there is no backup disinfection system for the UV4000 equipment. In emergency cases, chlorine solution from the dry chemical feed equipment can be directed to the Tertiary Filter Building clearwells utilizing the existing chlorination system piping (See Figure D). Dechlorination of the effluent would occur in the southeast corner chamber of the NCCT if sulphur dioxide is available. It should be noted that the dry chemical feed equipment is not sized for effluent disinfection. Refer to Section 5.0 for operation of the dry chemical feed equipment.

3.0 Slide and Sluice Gates

Four new 72-inch by 72-inch slide gates, one new 12-inch by 12-inch sluice gate and a replacement 48-inch by 48-inch sluice gate were installed as part of the disinfection facilities upgrade.

3.1 12-inch Sluice Gate

3.1.1 Description

One new 12-inch by 12-inch sluice gate, manufactured by Waterman Industries, Inc., is installed in the existing scum junction chamber in the West Plant. Skimming drain piping connects the skimming troughs located upstream of the UV4000 equipment to the existing scum junction chamber in the West Plant. The position of the 12-inch by 12-inch sluice gate is manually adjusted using the floor mounted manual operator. The 12-inch by 12-inch sluice gate is not connected to the PICS telemetry system.

It is suggested that the 12-inch by 12-inch sluice gate be normally maintained in the closed position. The 12-inch by 12-inch sluice gate is opened during skimmings removal procedures described in Section 4.1.

3.1.2 Purpose

The purpose of this sluice gate is to preclude tertiary effluent from flowing into the scum junction chamber from the NCCT during high flow events when the skimmings removal equipment is submerged.

3.1.3 Design

Size	12-inch x 12-inch
Direction	Unseating
Head	10 feet
Operator	Floor standing, manual crank
Fitting	Flange mounted with wall thimble

3.2 48-inch Sluice Gate

3.2.1 Description

In the final pass of the existing NCCT, a 48-inch by 48-inch sluice gate is used to direct disinfected effluent to the Secondary Effluent Pumping Station wetwell for pumping effluent to the Huron River during high river level conditions. The 48-

inch by 48-inch sluice gate is maintained in the closed position during normal operation. During high river level conditions, the 48-inch by 48-inch sluice gate is opened.

The 48-inch sluice gate position can be adjusted using the floor mounted manual crank or utilizing the motor operator. The new 48-inch sluice gate operator is connected to the PICS. Identification of gate position and remote operation of the operator are accessible using the PICS telemetry system.

3.2.2 Purpose

The new 48-inch sluice gate is utilized to bypass flows to the Secondary Effluent Pumping Station wetwell for pumping disinfected effluent to the Huron River.

3.2.3 Design

Size	48-inch x 48-inch
Direction	Seating and unseating
Head	12 feet
Operator	Floor mounted, non-modulating electric motor

3.3 72-inch Slide Gates

3.3.1 Description

Four manually operated 72-inch by 72-inch slide gates were installed in the new Reactor channels. One slide gate is installed upstream of each channel and one is downstream down stream of the UV4000 equipment (see Figure C). The slide gates are not designed to be watertight, there may be leakage requiring the use of a dewatering pump to maintain a dewatered channel.

The 72-inch by 72-inch slide gates are maintained in the open position. During isolation of a channel two of the 72-inch by 72-inch slide gates are closed.

3.3.2 Purpose

The 72-inch by 72-inch gates can be used to offer some operational flexibility or when one of the UV Reactors is taken out of service for a short duration.

3.3.3 *Design*

Material	Type 6061-T6 aluminum alloy
Style	Self-contained, flush bottom
Size	72-inches x 72-inches
Direction	Seating and unseating
Head	14 feet
Operator	Manual with removable crank

4.0 Skimmings Removal Equipment

4.1 Description

The skimmings removal equipment consists of two worm-gear operated troughs. Each trough consists of 12-inch diameter steel pipe with a 60-degree slot cut symmetrically about the vertical axis of the pipe. One trough is installed immediately upstream of each new Reactor within the new channels. Operation of the worm gear operator rotates the trough about its centerline. As the trough is rotated, material floating on the water surface enters the trough. The skimmings troughs are connected together and to 12-inch skimmings drain piping which discharges the skimmings to the scum junction chamber connected to the West Plant Secondary Clarifiers. Ultimately, the skimmings are collected and combined with scum and directed to the scum concentrator. A wooden baffle wall is mounted immediately downstream of each trough to minimize the floating material passing over the troughs during high flow events.

Remove collected skimmings during average plant flows. Do not operate the skimmings removal equipment during high plant flows. Utilize the following procedures to remove skimmings from upstream of the UV4000 equipment:

- a. Open the 12-inch by 12-inch sluice gate in the scum junction chamber in the West Plant.
- b. Rotate the wheel on the worm-gear operator to rotate the troughs about their centerline until effluent enters the troughs.
- c. Maintain the trough in its rotated position until all skimmings are collected in the troughs.
- d. Rotate the wheel on the worm-gear operator to rotate the troughs until the trough slot is parallel to the water surface.
- e. Close the 12-inch by 12-inch sluice gate in the scum junction chamber in the West Plant.

4.2 Purpose

The purpose of the skimmings removal equipment is to aid in maximizing the disinfection system by removing materials that could adversely affect the performance of the system.

4.3 Design

Trough Diameter	12-inch
Wall Thickness Schedule	20
Operator	Worm-gear

4.4 Inspection and Maintenance

Follow USFilter/Link-Belts's inspection and maintenance program, provided in the skimmings removal equipment Operation and Maintenance Manual.

5.0 Dry Chemical Feed Equipment

5.1 General

Although effluent disinfection no longer requires the use of gaseous chlorine, there remain operations at the Wastewater Treatment Plant that require the use of chlorine solution. The primary use of chlorine solution is disinfection of overflows from the Retention Basin. Other uses at the plant include odor control in the Gravity Thickeners. To supply the necessary chlorine solution without storing gaseous chlorine on-site, a dry chemical feed system was installed.

5.1.1 Description

The dry chemical feed equipment installed is a Model 30600L-FP Tablet Chlorinator System (TCS) manufactured by Hammonds Technical Services, Inc. The TCS can be operated either manually or automatically.

Calcium hypochlorite tablets, which are placed in a tank on the TCS, are dissolved using plant effluent water to form a chlorine solution that flows by gravity to a storage tank, also on the TCS. The chlorine solution is then pumped from the storage tank to the existing chlorine solution piping in the Chlorine Building. A bypass line is present to prevent the pump from cycling on and off.

Caution must be taken to prevent direct human contact with the calcium hypochlorite tablets or the chlorine solution generated by the TCS. Wear protective eyewear, clothing and gloves while operating the TCS. Refer to the MSDS for calcium hypochlorite in the TCS O&M Manual.

5.1.2 Purpose

The purpose of this new equipment is to provide a means to produce a chlorine solution. The primary purpose of the chlorine solution is for disinfection of Retention Basin overflows. The secondary purpose for this equipment is to provide a chlorine solution for odor control at the Gravity Thickeners. It must be noted that the TCS is not designed to be used as backup protection to the UV4000 system.

5.1.3 Design

Tablet Chlorinator Storage Capacity	1,100 lb
Solution Tank Capacity	120 gallons
Free Chlorine Flow Rate	1,200 lb/day
Electrical service	480V, 3Ø, 60 Hz
Minimum Pump Capacity	150 gpm
Discharge Pressure	40 psig

5.1.4 Inspection and Maintenance

Inspection and maintenance of the TCS includes the following procedures:

- a. Follow Hammonds Technical Services, Inc.'s suggested inspection and maintenance program, provided in the Tablet Chlorinator System Operation and Maintenance Manual.
- b. Verify operation of the TCS monthly. Replace tablets, as necessary.
- c. Flush all chlorine solution lines following operation of the TCS.

5.2 Modes of Operation

5.2.1 Normal Operation

The primary purpose of the TCS is for disinfection of overflows from the Retention Basin using chlorine solution.

5.2.1.1 System Settings

The automatic mode program in the TCS was set by the manufacturer's representative to provide the required chlorine solution concentration for disinfection of Retention Basin overflows. WWTP Staff programmed the PICS program to trigger operation of the TCS when the Retention Basin overflows to the Retention Basin Chlorine Contact Tank.

5.2.1.2 Valve Positions in Chlorine Building

By virtue of the PICS program being set up to automatically transmit a trigger signal to the TCS when the Retention Basin overflows, the TCS should be maintained in automatic mode and the valve positions in the chlorine solution piping should be such that the chlorine solution is directed to the Retention Basin Chlorine Contact Tank. Refer to Figure D for location and position of chlorine solution piping and valves associated with distribution to the Retention Basin. Verify the correct positions for the associated valves on the chlorine solution piping to the Retention

outside of the Chlorine Building to allow flow to reach the required location.

5.2.2 Alternative Operation (Gravity Thickener Chlorination)

The secondary purpose of the TCS is to provide chlorine solution to the gravity thickeners for odor control. Ultimately, chlorine solution can be carried to anywhere in the plant that existing chlorine solution piping is installed.

5.2.2.1 System Settings

To adjust the chlorine solution concentration for odor control, the TCS must be placed in manual mode. Using the procedure provided in Hammonds Technical Services, Inc.'s TCS Operation and Maintenance Manual, adjust the flowrate and chlorine solution concentration as needed.

5.2.2.2 Valve Positions in Chlorine Building

The valve positions in the Chlorine Building must be adjusted to direct the chlorine solution to the desired location before starting the TCS. Following use of the TCS for uses other than its primary purpose, the valve positions must be adjusted for distribution of chlorine solution to the Retention Basin Chlorine Contact Tank.

6.0 Power Monitoring Equipment

6.1 Description

Four Allen-Bradley Bulletin 1403 Power Monitor II's were installed to monitor power usage of each of the Banks of the UV4000 equipment. Each power monitor has an IP address and is connected to the PICS telemetry system. The IP addresses of the power monitors are as follows:

<u>IP Address</u>	<u>Bank</u>
192.168.12.76	1A
192.168.12.77	1B
192.168.12.78	2A
192.168.12.79	2B

The power monitors for Banks 1A and 1B are installed in MCC's K and L, respectively, in the Fabrication Building. The power monitors for Banks 2A and 2B are installed in Unit Substation 4B in the Tertiary Filter Building.

6.2 Purpose

The purpose of the power monitors is for logging power usage and associated power quality parameters for each Bank. The associated software, RS Power, installed on a workstation in the operator's room in the Administration Building, can be configured to record events that are triggered by changes in the power quality to the UV4000 equipment.

7.0 Miscellaneous Other Equipment

7.1 Compressed Air Equipment

The compressed air piping in the Fabrication Building was extended to the Tertiary Filter Building to provide redundant compressed air piping in the Tertiary Filter Building and a compressed air tool station at the UV4000 platform.

The compressed air piping is 1½-inch Type K copper piping. The piping was laid in the same trench as the east and west electrical ductbanks. At the UV4000 platform, the compressed air piping extends above the platform and traverses the channels at the underside of the canopy. The air tool station is mounted on a canopy column on the east side of the platform. The air tool station consists of a pressure regulator, filter and moisture separator, lubricator, and quick disconnect coupling.

Verify the valves on the compressed air piping in the basement of the Fabrication Building and at the UV4000 platform are open prior to operating the air tool station.

7.2 Yard Hydrant

To provide Plant Effluent Water (PEW) to the UV4000 platform, a 1½-inch HDPE line was laid in the east electrical ductbank between the Tertiary Filter Building and the UV4000 platform. A 1¼-inch frost-free yard hydrant was installed adjacent to the UV4000 platform next to the access ramp.

7.3 Electrical System Upgrade

Two electrical ductbanks were installed which contain the conduit and cables to power the UV4000 system. One ductbank is installed between the west side of the Tertiary Filter Building and the east side of the UV4000 platform and the other ductbank is installed between the east side of the Fabrication Building and the west side of the UV4000 platform (See Figure A). Power for Reactor 1 of the UV4000 equipment (See Figure C) is fed from the Fabrication Building, specifically, Banks UV-1A and UV-1B are fed from the Motor Control Centers MCC-K and MCC-L, respectively. Power for Reactor 2, Banks 2A and 2B, of the UV4000 equipment is fed from Substation No. 4B in the Tertiary Filter Building. Each power feed has a disconnect located on the primary side of the isolations transformers, a k-4 rated transformer, and a secondary disconnect switch located at the UV4000 platform.

The existing motor starters in the units which feed the power to Banks 1A and 1B were removed and replaced with 400-amp frame, 200-amp trip, 3 pole, 600 volt rated, stab-

on molded case circuit breakers. New 800-amp frame, 200-amp trip, 3 pole, 600 volt rated, drawout, steel frame air circuit breakers were installed in the units in Unit Substation No. 4B in the Tertiary Filter Building which feed power to Banks 2A and 2B. Additionally, a new 100-amp frame, 60-amp trip, 3 pole, 600 volt rated, drawout, steel frame air circuit breaker was installed in the unit in MCC-P in the Tertiary Filter Building which feeds the new PP-UV at the UV4000 platform.

At the UV4000 platform, a new lighting panel, LP-UV, a new lighting transformer, LT-UV, a new power panel, PP-UV and a new automatic transfer switch were installed mounted on an electrical mounting rack at the north end of the UV4000 platform.

TABLE 2

CITY OF ANN ARBOR, MICHIGAN
 Water Utilities Department
 Wastewater Treatment Plant

*Disinfection Facilities Upgrade
 Operation and Maintenance Manual*

Gate and Valve Positions

Greeley and Hansen LLP
 August 2001

Gate and Valve ID Numbers	Normal Operation	High River Level Operation	Flow Through One Channel ¹
S-2-1	N.O.	N.C.	N.O.
B-3-1	N.C.	N.O.	N.C.
B-2-1	N.O.	N.C.	N.O.
S-11-1	N.C.	N.O.	N.C.
S-55-1	N.O.	N.C.	N.O.
F-20-1	N.O.	N.O.	N.C.
F-20-2	N.O.	N.O.	N.O.
F-20-3	N.O.	N.O.	N.C.
F-20-4	N.O.	N.O.	N.O.

¹ Configuration for isolation of Reactor 1. For isolation of Reactor 2, positions of slide gates for F-20-1 through F-20-4 are reversed.

Note: N.O. = Normally Open
 N.C. = Normally Closed

TABLE 1

CITY OF ANN ARBOR, MICHIGAN
Water Utilities Department
Wastewater Treatment Plant

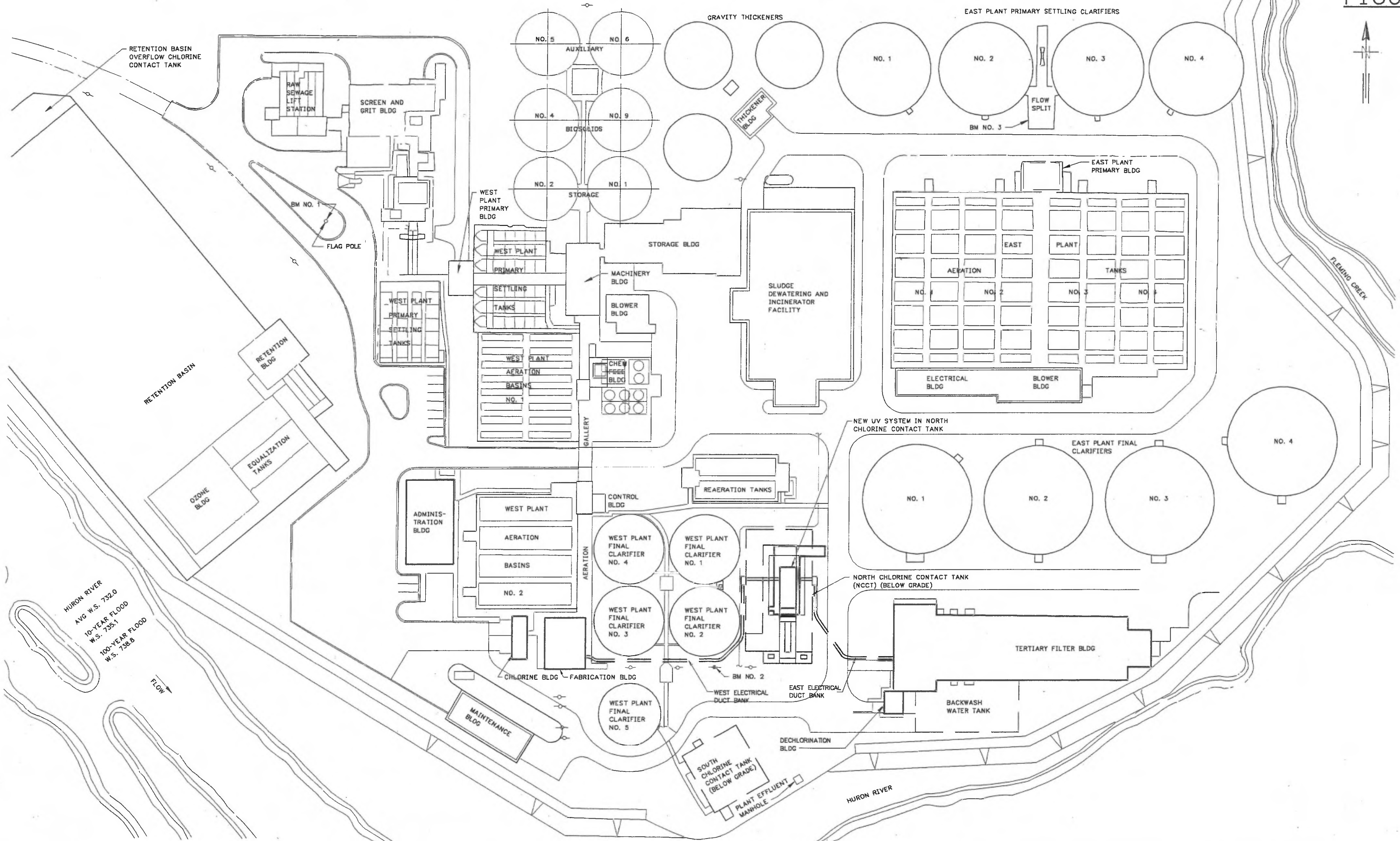
*Disinfection Facilities Upgrade
Operation and Maintenance Manual*

Gate and Valve Identification Numbers

Greeley and Hansen LLP
August 2001

Diagram Number	Contract 77-S-7 ID Numbers	Process Information and Control System ID Numbers	Gate or Valve	Type	Size	Centerline Elevation
G1	S-12-1	S-52-1	Gate	Sluice	42" x 42"	728
G2	S-12-2	S-52-2	Gate	Sluice	42" x 42"	728
G3	S-14-1	S-54-1	Gate	Sluice	36" x 36"	728
G4	S-14-2	S-54-2	Gate	Sluice	36" x 36"	728
G5	S-15-1	S-55-1	Gate	Sluice	54" dia.	728
G6	S-14-4	S-54-4	Gate	Sluice	36" x 36"	728
G7	S-14-3	S-54-3	Gate	Sluice	36" x 36"	728
G8	S-13-1	S-53-1	Gate	Sluice	42" x 42"	732
G9	S-13-2	S-53-2	Gate	Sluice	42" x 42"	732
G10	S-16-1	S-56-1	Gate	Sluice	42" dia.	728
G11	S-5-1	---	Gate	Sluice	42" dia.	728
G12	S-4-1	---	Gate	Sluice	42" dia.	728
G13	S-1-2	---	Gate	Sluice	42" dia.	726
G14	S-1-1	---	Gate	Sluice	42" dia.	726
G15	S-2-1	---	Gate	Sluice	36" dia.	725
G16	S-2-2	---	Gate	Sluice	36" dia.	725
G17	S-11-1	S-51-1	Gate	Sluice	48" dia.	728
G18	S-7-1	S-47-1	Gate	Sluice	54" dia.	725
G19	S-6-1	S-46-1	Gate	Sluice	48" dia.	725
G20	S-6-2	S-46-2	Gate	Sluice	48" dia.	725
G21	S-7-2	S-47-2	Gate	Sluice	54" dia.	725
G22	S-9-1	S-49-1	Gate	Sluice	42" dia.	725
G23	S-8-1	S-48-1	Gate	Sluice	42" dia.	725
G24	S-8-2	S-48-2	Gate	Sluice	42" dia.	725
G25	S-10-1	S-50-1	Gate	Sluice	42" dia.	725
G26	S-3-1	---	Gate	Sluice	36" x 36"	725
V1	B-3-1	---	Valve	Butterfly	42" dia.	729.5
V2	B-2-1	---	Valve	Butterfly	48" dia.	747.5
V3	B-9-1	---	Valve	Butterfly	36" dia.	725
V4	B-9-2	---	Valve	Butterfly	36" dia.	725
---	---	F-20-1	Gate	Slide	72" x 72"	727.65
---	---	F-20-2	Gate	Slide	72" x 72"	727.05
---	---	F-20-3	Gate	Slide	72" x 72"	727.65
---	---	F-20-4	Gate	Slide	72" x 72"	727.05
---	---	S-60-1	Gate	Sluice	12" x 12"	732.33

FIGURE A



HURON RIVER
 AVG W.S. 732.0
 10-YEAR FLOOD
 W.S. 735.1
 100-YEAR FLOOD
 W.S. 738.6

FLOW

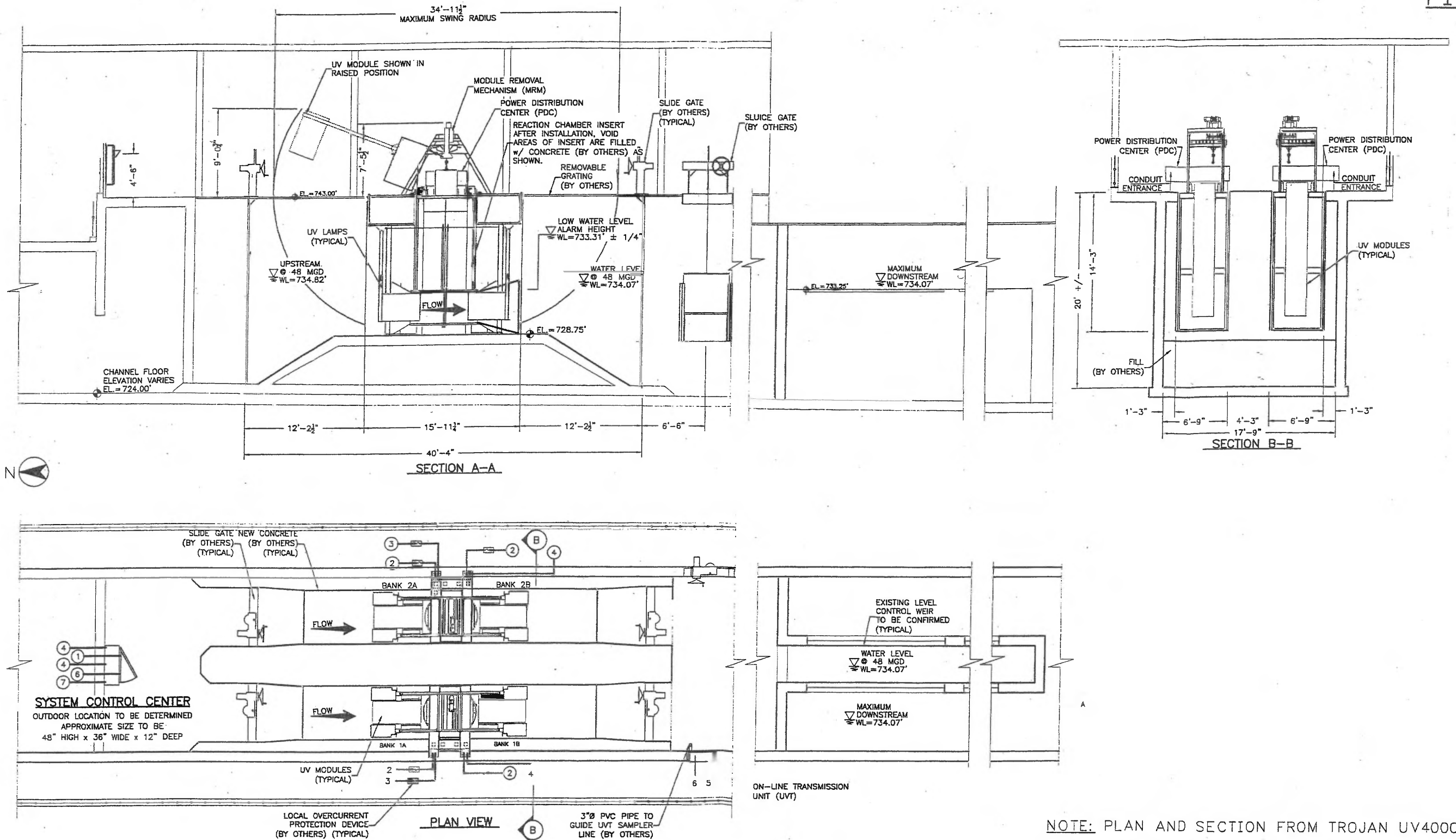
GREELEY AND HANSEN LLP
 AUGUST 2001

SITE PLAN
 NOT TO SCALE

DISINFECTION FACILITIES UPGRADE
 OPERATION AND MAINTENANCE MANUAL

FILE: 021LG02 1:1 08/17/01 13:40 GH-A

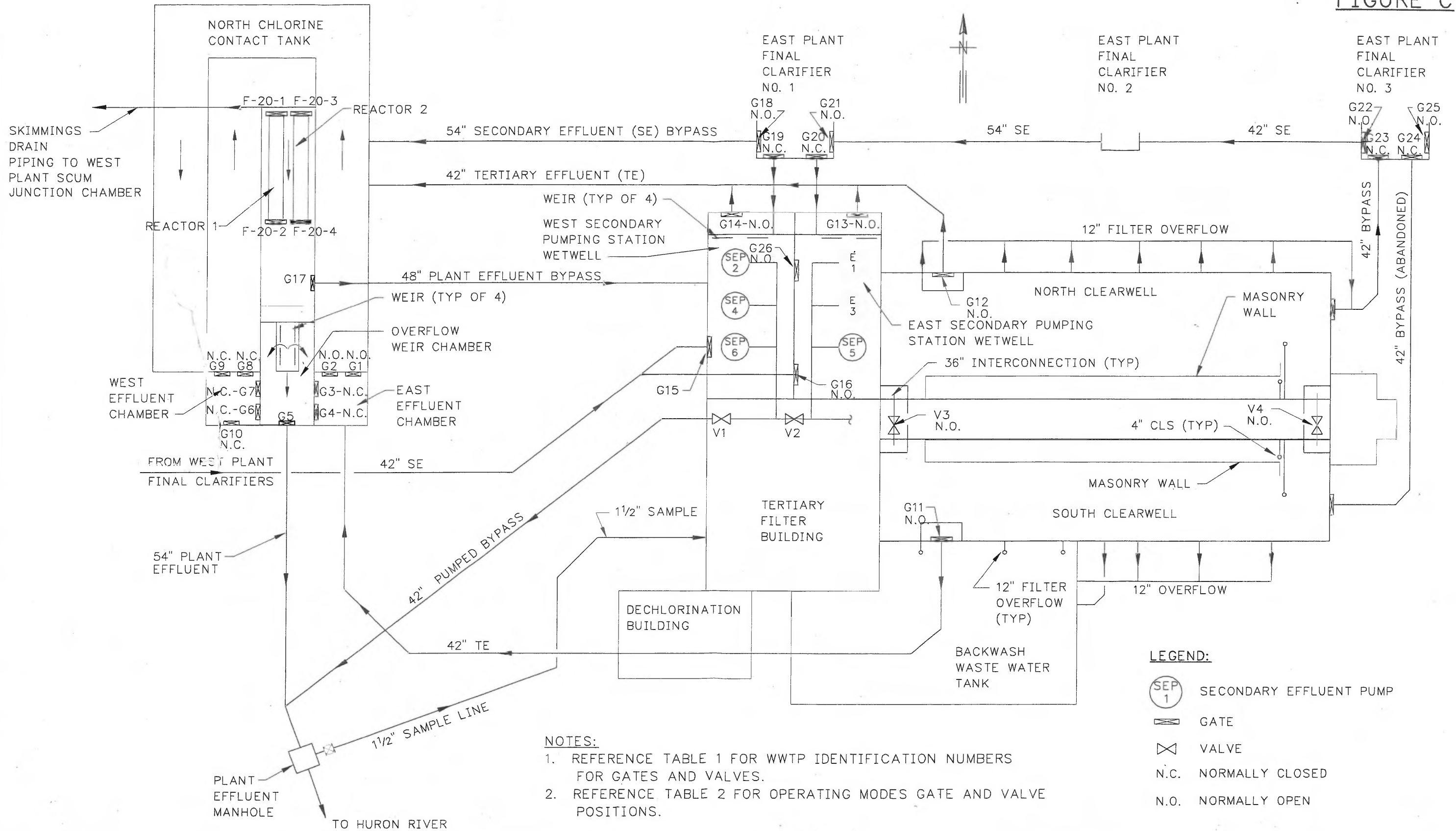
FIGURE B



NOTE: PLAN AND SECTION FROM TROJAN UV4000 OPERATION AND MAINTENANCE MANUAL FOR ANN ARBOR WWTP DATED OCTOBER 2000.

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FIGURE C



NOTES:

1. REFERENCE TABLE 1 FOR WWTP IDENTIFICATION NUMBERS FOR GATES AND VALVES.
2. REFERENCE TABLE 2 FOR OPERATING MODES GATE AND VALVE POSITIONS.

LEGEND:

- SECONDARY EFFLUENT PUMP
- GATE
- VALVE
- N.C. NORMALLY CLOSED
- N.O. NORMALLY OPEN

EFFLUENT FLOW DIAGRAM

NOT TO SCALE

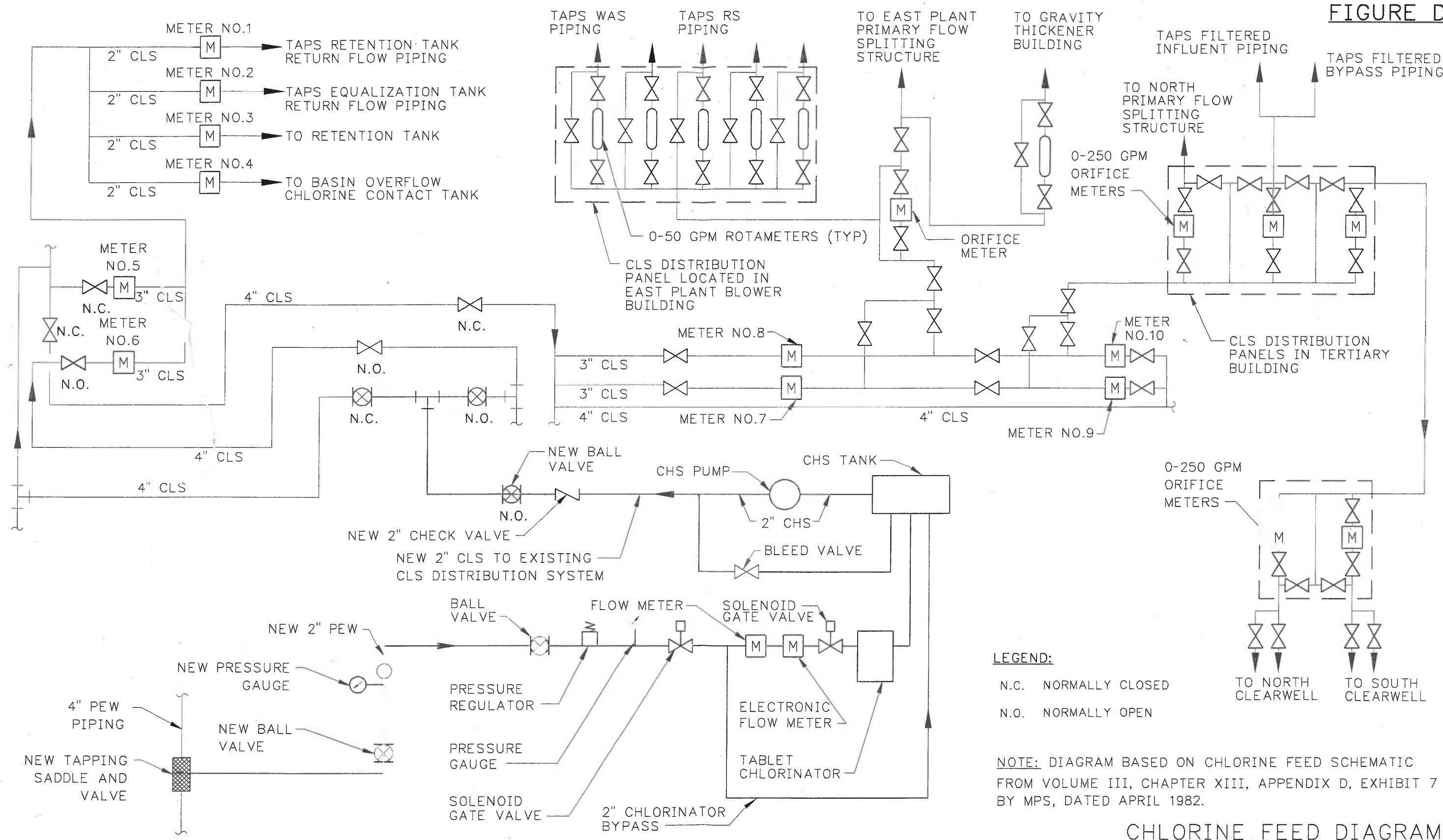
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AUGUST 2001

DISINFECTION FACILITIES UPGRADE
OPERATION AND MAINTENANCE MANUAL

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FIGURE D



LEGEND:

- N.C. NORMALLY CLOSED
- N.O. NORMALLY OPEN

NOTE: DIAGRAM BASED ON CHLORINE FEED SCHEMATIC FROM VOLUME III, CHAPTER XIII, APPENDIX D, EXHIBIT 7 BY MPS, DATED APRIL 1982.

CHLORINE FEED DIAGRAM
DISINFECTION FACILITIES UPGRADE
OPERATION AND MAINTENANCE MANUAL

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August 17, 2001

Mr. Michael D. Amicangelo, Utilities Engineer
Ann Arbor Water Utilities Department
Ann Arbor Wastewater Treatment Plant
49 S. Dixboro Road
Ann Arbor, Michigan 48105-9405

Subject: Disinfection Facilities Upgrade
Operation and Maintenance Manual

Dear Mr. Amicangelo:

Please find enclosed seven (7) paper copies and one (1) electronic copy of the Operation and Maintenance Manual for the subject project. This Operation and Maintenance Manual has been provided in accordance with Task 2.1 of our Contract, Amendment No. 2 to the Agreement for Professional Services between Greeley and Hansen and the City of Ann Arbor dated February 8, 2000.

It is suggested that this Operation and Maintenance Manual be inserted into the WWTP's existing Operation and Maintenance Manual.

Yours very truly,

GREELEY AND HANSEN LLP


Nicole B. Spieles

Enclosures

c. Detroit Office File