

REQUEST FOR PROPOSALS
MATERIALS TESTING SERVICES

LOGAN HYDRO NO. 2
3rd DAM and SURGE TANK IMPROVEMENTS
LOGAN, UTAH

March 30, 2018

Proposals Due:

April 13, 2018, 5:00 p.m.

Logan City Hall
Attn: Lori Mathys, Purchasing Agent
290 North 100 West
Logan, Utah 84321

Questions Due:

April 9, 2018, 5:00 p.m.

Submitted to: lori.mathys@loganutah.org
Answers posted at: http://www.loganutah.org/bid_detail_T11_R109.php

Scope: To provide all labor, supplies, equipment, tools, and supervision to provide field and laboratory construction materials testing services, including publication and distribution of reports as required by the project documents, including all referenced standards. The project documents are defined as the drawings and specifications for the Logan Hydro No. 2 – 3rd Dam and Surge Tank Improvements Project prepared by Stantec Consulting Services, Inc. and dated July 2017 and all updates thereto. Included with this RFP are selected General, Civil, and Structural Drawings as well as the concrete and earthwork specification sections from the project documents.

Proposal Requirements and Content:

- A. **Basic Qualifications:** Provide basic data relative to firm's size, history, personnel, special expertise and general credits. Individual resumes, awards, associations, etc., may be included. At a minimum, the firm must have an office in the local area, have a geotechnical engineer on staff, and be accredited to provide the required services. Provide a list of inspection and testing services in addition to those listed below along with a rate sheet.

- B. Specific Qualifications:** List the team and office (laboratory facility) expected to accomplish this work. Describe who will perform the various tasks, the amount of their involvement and responsibilities, and give their qualifications. Provide a list of at least five (5) projects, with brief descriptions that show ability to complete projects of this scope.

At a minimum, the local office/laboratory facility must be ISO 17025 accredited to ASTM E-329 for soils and concrete. At a minimum technicians must be American Concrete Institute (ACI) Grade 1 certified.

- C. Past Performance:** Submit reference letters from prior clients or client representatives. Letters from projects listed in item B are preferable. In addition, past performance comments will be obtained from City and the City's consultant firm staff.
- D. Insurance Compliance:** Proof of ability to comply with insurance requirements as shown on Exhibit A.
- E. Contract Acceptance:** Acceptance of or requested changes to the Standard Professional Services Agreement included as Exhibit B.
- F. Claim of Business Confidentiality:** The Government Records Access and Management Act (GRAMA), Utah Code Ann., Subsection 63G-2-305, provides in part that certain records are protected if properly classified. Proposers are responsible for determining which pages, if any, should be classified as protected under a Claim of Business Confidentiality, and are responsible for taking appropriate action to do so.

To protect information under a Claim of Business Confidentiality, the Proposer must:

- 1) Provide a written Claim of Business Confidentiality at the time the proposal is provided to Logan City; and
- 2) Include a concise statement of reasons supporting the Claim of Business Confidentiality (Subsection 63G-2-305). See Exhibit C.

To ensure the information is properly protected, the City asked the Proposer to clearly identify in the body of the proposal (by clearly marking the applicable pages as confidential) any specific information for which a Proposer claims business confidentiality protection as "PROTECTED". If no statement is provided, it is assumed that the information is not protected.

- G. Format:** To assist evaluation it is desirable to format the proposal similar to the headings listed above. The proposals should be clear and to the point. Emphasis should be placed on specific qualifications of the people to actually perform work on the project. Performance on past projects with the City of Logan and/or FERC-licensed projects is a highly important factor. The proposal shall not exceed 12 pages excluding resumes, Insurance Compliance, Contract Acceptance, and Claim of Business Confidentiality.
- H. Submittal:** Four (4) bound copies of the proposal shall be delivered by the time and place specified above. The submittal shall clearly identify the point of contact regarding

the submittal, with e-mail and phone number listed. Failure to do so could make the proposal unresponsive.

- I. **Evaluation and Award:** An evaluation committee consisting of persons from the City of Logan and an independent professional will evaluate the proposals and select a materials testing firm and begin contract negotiations. Final selection is contingent upon the successful negotiation of a contract.
- J. **Miscellaneous:** The contents of the statement of qualifications may be used in a legal contract or agreement. Proposers should be aware that methods and procedures proposed could become contractual obligations. The City of Logan reserves the right to reject any or all statements of qualifications received as a result of this request. The City may also negotiate separately with any source in any manner necessary to serve the best interests of the City. Awards will be made on the basis of the proposals received as a result of this request and subsequent interviews.

The successful materials testing firm must agree to abide by the following conditions which shall be included in their proposed rates:

1. The General Contractor/Construction Manager (GC/CM) will generally provide 24-hour notice for testing services, however, the Owner and/or GC/CM will not pay premiums for short notice calls for service.
2. All field personnel will be equipped with cell phone while on site.
3. All field personnel providing testing services must notify the GC/CM Project Superintendent upon arrival at the project and prior to leaving the project site. A written Daily Field Report documenting the testing activities, results of field testing and observations regarding the testing must be provided to the GC/CM Project Superintendent prior to the field personnel leaving the site.
4. At the completion of the project, a final summary report documenting the testing will be provided to the Owner, Engineer, FERC, and the Utah Office of Dam Safety at no additional charge.
5. Testing procedures will be in compliance with all applicable codes and laws, as well as the project drawings and specifications.
6. The materials testing company will have technicians and special inspectors certified by the American Concrete Institute (ACI), as applicable to the items be tested. The testing company will provide copies of certifications.
7. Current calibration certificates of the various testing apparatuses and appurtenances used by the materials testing firm shall be provided.

8. Costs of all equipment, tools, vehicles, mileage, travel, scheduling, supervision, administration, document preparation, distribution of test results, and management are to be included in the unit rates provided.
9. The quantities provided below are to be used as a guideline and are not guaranteed in any matter as the entire scope of the testing services required may vary depending on the means and methods of the contractor.
10. All testing will be performed on a time and expense basis in accordance with the unit rates provided. The Owner will pay for actual hours onsite (rounded to the nearest 0.5 hour) and charges for travel. Hourly minimums, undocumented hours, hours not requested by the Field Engineer or required by the project documents will not be paid.

The primary intent of the following rate table is to standardize the proposal format. The anticipated quantities are based on the Baseline Construction Schedule generated by Gerber Construction, Inc.; the approximate volume of construction materials requiring testing; and the testing requirements and frequencies established in the project drawings and specifications (Exhibit D) and the IBC, including referenced standards. It is the responsibility of the Bidder to develop a knowledge and understanding of the construction materials testing required on this project. The project plans, specifications, and applicable codes and standards will be the basis of the materials testing services provided, not this table. This table is posted separately at http://www.loganutah.org/bid_detail_T11_R109.php for use in an RFP response.

RATE TABLE				
DESCRIPTION	QTY	UNIT	RATE	TOTAL
A - PRECONSTRUCTION MEETING				
Project Manager – Assumes one meeting of two hours at the Logan Light and Power Department Offices.	2	hours		
B - GEOTECHNICAL OBSERVATION AND TESTING				
Technician – Includes observation and compaction / density testing during backfilling of utility trenches, site clearing and grubbing, building pad construction, foundation excavation, fine grading at SOG and parking lot areas. Assumes 12 site visits of 3 hours each.	60	hours		
Nuclear Densometer	60	hours		
Moisture Density Relationship Curves (ASTM D-1557) Includes one for the native on-site material at the surge tank site, two for the native on-site material at the 3 rd Dam Spillway site, one for structural fill, and one for the proposed aggregate base material.	5	each		
Sieve Analysis (ASTM D-422) – Includes a total of 9 trips, 1 for the proposed aggregate base material, 4 samples of native material, 2 samples of proposed	9	each		

<i>filter material, and 2 samples of the proposed drain rock material.</i>				
C - SAMPLING, & TESTING OF CONCRETE – PER SPECIFICATION				
Concrete Testing Technician – <i>Testing of concrete required during placement of all structural concrete including unit weight, air content, slump, and temperature. Assumes the following concrete placement events: Surge Tank – 2 placements 2 @ 5 hrs each 3rd Dam Spillway and Control House – 40 placements @ 5 hrs each</i>	210	hours		
Concrete Compression Test Specimens - <i>The project specifications require sampling and testing of concrete for every 50 cubic yards (CY) placed, this includes two field- cured specimens tested at 7 days and two laboratory cured specimens tested at 28 days. The unit rate shall include all labor, supplies, tools, and equipment to cast, store, transport, cure, test, and report results of specimens in accordance with ASTM C-31 and ASTM C-39 and the project specifications.</i>	42	each		
D – TRAVEL CHARGES				
Hourly Rate (assumes 1 hr per trip)	54	hours		
Mileage (assumes 20 miles per trip)	1,260	mile		
TOTAL PROPOSED PROJECT FEE (Subtotal of A through D):				

- Exhibit A: Insurance and Bond Requirements
- Exhibit B: Standard Contract Terms and Conditions for Professional Services
- Exhibit C: Claim of Business Confidentiality
- Exhibit D: Drawings
- Exhibit E: Concrete and Earthwork Specs

Exhibit A

CITY OF LOGAN INSURANCE AND BOND REQUIREMENTS

**FOR: Materials Testing Services – Logan Hydro No. 2
3rd Dam and Surge Tank Improvements
March 2018**

The Contracting party shall procure and maintain for the duration of the contract insurance and bonds against claims or liability which arises out of or in connection with the performance of the work hereunder by the Contracting party, his agents, representatives, employees or subcontractors. The cost of such insurance and bonds shall be included in the Contracting party's bid or proposal.

A. MINIMUM LIMITS OF INSURANCE

Contracting party shall maintain limits not less than:

1. **GENERAL LIABILITY:** \$2,000,000 combined single limit per occurrence, personal injury and property damage, \$3,000,000 aggregate. Broad Form Commercial General Liability is required. (ISO 1993 or better) to include Products - Comp/OP aggregate of \$2,000,000. Limits to apply to this project individually.
2. **PROFESSIONAL LIABILITY:** \$2,000,000 per occurrence.
3. **AUTOMOBILE LIABILITY:** \$2,000,000 per occurrence. "Any Auto" coverage is required.
4. **WORKERS' COMPENSATION and EMPLOYERS LIABILITY:** Workers' Compensation statutory limits as required by the Workers Compensation Act of the State of Utah and Employers Liability limits at a minimum of \$100,000 per occurrence.
5. **PAYMENT and PERFORMANCE BONDS:** Not applicable.

B. ACCEPTABILITY OF INSURERS

Insurance and bonds are to be placed with insurers admitted in the State of Utah with an A. M. Best rating of not less than A-: IX, and in the limits as listed in this document, unless approved by the City's Risk Manager, or his designee, **a minimum of five (5) business days prior to bid or proposal deadline.**

C. DEDUCTIBLES AND SELF-INSURED RETENTIONS

Any deductibles or self-insured retention exceeding 5% of the policy limits must be declared to and approved by Logan City. At the option of Logan City, either (1) the insurer may be required to reduce or eliminate such deductibles or self-insured retention as respects Logan City, its officers, officials and employees; or (2) the Contracting party may be required to procure a bond guaranteeing payment of losses and related investigations, claim distribution and defense expenses.

D. NOTICE OF INCIDENT OR ACCIDENT

Contracting party shall agree to promptly disclose to Logan City, all incidents or occurrences of accident, injury, and/or property damage covered by the insurance policy or policies.

E. OTHER INSURANCE PROVISIONS

The policies are to contain, or be endorsed to contain, the following provisions:

I. General Liability and Automobile Liability Coverages

A. Logan City, its officers, officials, employees and volunteers are to be covered as additional insureds as respects: liability arising out of activities performed by or on behalf of the contracting party; products and completed operations of the Contracting party; premises owned, leased, hired or borrowed by the Contracting party. The coverage shall contain no special limitations on the scope of protection afforded to Logan City, its officers, officials, employees or volunteers.

B. The Contracting party's insurance coverage shall be a primary insurance as respects to Logan City, its officers, officials, employees and volunteers. Any insurance or self-insurance maintained by Logan City, its officers, officials, employees or volunteers shall be in excess of the Contracting party's insurance and shall not contribute with it.

C. Any failure to comply with reporting provisions of the policies shall not affect coverage provided to Logan City, its officers, officials, employees or volunteers.

D. The Contracting party's insurance shall apply separately to each insured against whom claim is made or suit is brought, except with respects to the limits of the insurer's liability.

F. VERIFICATION OF COVERAGE

Contracting party shall furnish Logan City with certificates of insurance and with original endorsements effecting coverage required by this clause. The certificates and endorsements are to be signed by a person authorized by that insurer to bind coverage on its behalf. The certificates and endorsements are to be on forms acceptable to Logan City before work commences. Logan City reserves the right to require complete, certified copies of all required insurance policies, with all endorsements, at any time.

G. SUBCONTRACTORS

Contracting party shall include all subcontractors as insureds under its policies or shall furnish separate certificates and endorsements for each subcontractor. All coverages for subcontractors shall be subject to all of the requirements stated herein.

Exhibit B

CITY OF LOGAN Standard Contract Terms and Conditions for Professional Services

Project: Materials Testing Services – Logan Hydro No. 2
3rd Dam and Surge Tank Improvements

1. **PARTIES:** This agreement is made and entered into as of the _____ day of _____, 2018, by and between the City of Logan, a Utah municipal corporation, hereinafter referred to as the “CITY”, and _____, hereinafter referred to as “CONTRACTOR”.
2. **CONTRACT DOCUMENTS:** This agreement incorporates by reference the Request for Proposal, which includes Insurance and Bond Requirements, dated _____ and the Proposal dated _____.
3. **AUTHORITY:** Provisions of this contract (“Contract”) are pursuant to the authority set forth in Logan Municipal Code 3.04, and related statutes which permit the City of Logan to purchase certain specified services, and other approved purchases for the City of Logan.
4. **CONTRACT JURISDICTION, CHOICE OF LAW, AND VENUE:** The provisions of this Contract shall be governed by the laws of the State of Utah. The parties will submit to the jurisdiction of the courts of the State of Utah for any dispute arising out of this Contract or the breach thereof. Venue shall be in Logan, in the First Judicial District Court for Cache County.
5. **LAWS AND REGULATIONS:** The person or entity contracting with the City of Logan under this Contract (“Contractor”) and any and all supplies, services, equipment, and construction furnished under this Contract will comply fully with all applicable Federal, and State, and local laws, codes, rules, regulations, and ordinances, including applicable licensure and certification requirements.
6. **RECORDS ADMINISTRATION:** The Contractor shall maintain, or supervise the maintenance of, all records necessary to properly account for the payments made to the Contractor for costs authorized by this Contract. These records shall be retained by the Contractor for at least four years after the Contract terminates, or until all audits initiated within the four years, have been completed, whichever is later. The Contractor agrees to allow State and Federal auditors, and City of Logan staff, access to all the records to this Contract, for audit and inspection, and monitoring of services. Such access will be during normal business hours, or by appointment.
7. **TIME:** The Contractor shall complete the scope of services work in a manner to achieve any milestones identified in the procurement documents related to this Contract and the attachments to this Contract. The full scope of services work shall be completed by any applicable deadline stated in the solicitation.
8. **TIME IS OF THE ESSENCE:** For all work and services under this Contract, time is of the essence and Contractor shall be liable for all damages to the City of Logan and anyone for whom the City of Logan may be liable, as a result of the failure to timely complete the scope of work required under this Contract.
9. **PAYMENT:**

9.1 Payments are normally made within 30 days following the date the order is delivered or the date a correct invoice is received, whichever is later. After 60 days from the date a correct invoice is received by the appropriate City official, the Contractor may assess interest on overdue, undisputed account charges up to a maximum of the interest rate paid by the IRS on taxpayer refund claims, plus two percent, computed similarly as the requirements of Utah Code Annotated Section 15-6-3. The IRS interest rate is adjusted quarterly, and is applied on a per annum basis, on the invoice amount that is overdue.

9.2 The contract total may be changed only by written amendment executed by authorized personnel of the parties. Unless otherwise stated in the Contract, all payments to the Contractor will be remitted by mail or electronic funds transfer.

9.3 The acceptance by the Contractor of final payment without a written protest filed with the City of Logan within ten (10) working days of receipt of final payment shall release the City of Logan from all claims and all liability to the Contractor for fees and costs of the performance of the services pursuant to this Contract.

10. PROMPT PAYMENT DISCOUNT: Offeror may quote a prompt payment discount based upon early payment; however, discounts offered for less than 30 days will not be considered in making the award. Contractor shall list Payment Discount Terms on invoices. The date from which discount time is calculated will be the date a correct invoice is received or receipt of shipment, whichever is later; except that if testing is performed, the date will be the date of acceptance of the merchandise.

11. CHANGES IN SCOPE: Any changes in the scope of the services to be performed under this Contract shall be in the form of a written amendment to this Contract, mutually agreed to and signed by duly authorized representatives of both parties, specifying any such changes, fee adjustments, any adjustment in time of performance, or any other significant factors arising from the changes in the scope of services.

12. DOCUMENT OWNERSHIP: Contractor agrees that any work/services and all Deliverables prepared for City of Logan, to the extent to which it is eligible under copyright law in any county, shall be deemed a work made for hire, such that all right, title and interest in the work and Deliverables reside with the City of Logan. To the extent any work or Deliverable is deemed not to be, for any reason whatsoever, work made for hire, Contractor agrees to assign and hereby assigns all right, title, and interest, including but not limited to, copyright, patent, trademark, and trade secret, to such work and Deliverables, and all extensions and renewals thereof, to the City of Logan. Contractor further agrees to provide all assistance reasonably requested by City of Logan in the establishment, preservation and enforcement of its rights in such work and deliverables, or subsequent amendments or modifications to such work and deliverables, without any additional compensation to Contractor. Contractor agrees to waive, and hereby, to the extent permissible, waives, all rights relating to such work and deliverables, or subsequent amendments or modifications to such work and deliverables, including without limitation any and all rights of identification of authorship and any and all rights of approval, restriction or limitation on use.

13. CERTIFY REGISTRATION AND USE OF EMPLOYMENT "STATUS VERIFICATION SYSTEM": The Status Verification System, also referred to as "E-verify," only applies to contracts issued through a Request for Proposal process, and to sole sources that are included within a Request for Proposal. It does not apply to Invitation to Bids nor to the Multi-Step Process.

13.1 Status Verification System

(1) Contractor certifies as to its own entity, under penalty of perjury, that the named Contractor has registered and is participating in the Status Verification System to verify the work eligibility status of the Contractor's new employees that are employed in the State of Utah in accordance with applicable immigration laws including Utah Code Ann. Section 63G-12-302.

(2) The Contractor shall require that the following provision be placed in each subcontract at every tier: "The subcontractor shall certify to the main (prime or general) contractor by affidavit that the subcontractor has verified through the Status Verification System the employment status of each new employee of the respective subcontractor, all in accordance with applicable immigration laws including Utah Code Ann. Section 63G-12-302 and to comply with all applicable employee status verification laws. Such affidavit must be provided prior to the notice to proceed for the subcontractor to perform the work."

(3) The City of Logan will not consider a proposal for award, nor will it make any award, where there has not been compliance with this Section.

(4) Manually or electronically signing the Proposal is deemed the Contractor's certification of compliance with all provisions of this employment status verification certification required by all applicable status verification laws, including Utah Code Ann. Section 63G-12-302.

13.2 Indemnity Clause for Status Verification System

Contractor (includes, but is not limited to any Contractor or Consultant) shall protect, indemnify and hold harmless, the City of Logan and its officers, employees, agents, representatives and anyone that the City of Logan may be liable for, against any claim, damages or liability arising out of or resulting from violations of the above Status Verification System Section whether violated by employees, agents, or contractors of the following: (a) Contractor; (b) Contractor's subcontractor or subconsultant at any tier; and/or (c) any entity or person for whom the Contractor or Subcontractor may be liable.

14. CONFLICT OF INTEREST: Contractor represents that none of its officers or employees are officers or employees of the City of Logan, unless disclosure has been made. Contractor also represents that it has no conflict of interest in performing the services for the City of Logan under this Contract, unless such conflict of interest has been disclosed to the City of Logan and approval to proceed, notwithstanding the conflict, has been obtained from the City of Logan in writing.

15. CONTRACTOR AN INDEPENDENT CONTRACTOR: The Contractor shall be an independent contractor, and as such, shall have no authorization, express or implied, to bind the City of Logan to any agreements, settlements, liability, or understanding whatsoever, and agrees not to perform any acts as agent for the City of Logan, except as herein expressly set forth. Compensation stated herein shall be the total amount payable to the Contractor by the City of Logan. The Contractor shall be responsible for the payment of all income tax and Social Security amounts due as a result of payments received from the City of Logan for these Contract services. Persons employed by the City of Logan and acting under the direction of the City of Logan shall not be deemed to be employees or agents of the Contractor.

16. INDEMNITY CLAUSE: The Contractor agrees to indemnify, save harmless, and release the City of Logan, and all its officers, agents, volunteers, and employees from and against any and all claims, loss, damages, injury, liability, suits, and proceedings arising out of the performance of this Contract which are caused in whole or in part by the wrongful acts or negligence of (a) the Contractor, (b) the Contractor's officers, agents, volunteers, or employees, (c) the Contractor's subcontractors or subconsultants at any tier, or (d) anyone for whom Contractor may be liable but not for claims arising

from the City of Logan's sole negligence. The parties agree that if there are any Limitations of the Contractor's Liability, including a limitation of liability for anyone for whom the Contractor is responsible, such Limitations of Liability will not apply to injuries to persons, including death, or to damages to property.

- 17. EMPLOYMENT PRACTICES CLAUSE:** The Contractor agrees to abide by the provisions of Title VI and VII of the Civil Rights Act of 1964 (42 USC 2000e) which prohibits discrimination against any employee or applicant for employment or any applicant or recipient of services, on the basis of race, religion, color, or national origin; and further agrees to abide by Executive Order No. 11246, as amended, which prohibits discrimination on the basis of sex; 45 CFR 90 which prohibits discrimination on the basis of age; and Section 504 of the Rehabilitation Act of 1973, or the Americans with Disabilities Act of 1990 which prohibits discrimination on the basis of disabilities. Also, the Contractor agrees to abide by Utah's Executive Order, dated December 13, 2006, which prohibits sexual harassment in the work place. Contractor also agrees to abide by any laws and policies of the City of Logan regarding any of the above mentioned prohibitions in this paragraph.
- 18. PERFORMANCE EVALUATION:** The City of Logan may conduct a performance evaluation of the Contractor's services, including specific personnel of the Contractor. References in the Contract to Contractor shall include Contractor, Contractor's subcontractors, or subconsultants at any tier, if any. Results of any evaluation will be made available to the Contractor.
- 19. WAIVERS:** No waiver by the City of Logan or Contractor of any default shall constitute a waiver of the same default at a later time or of a different default.
- 20. SEPARABILITY CLAUSE:** A declaration by any court, or any other binding legal authority, that any provision of this Contract is illegal and void shall not affect the legality and enforceability of any other provision of this Contract, unless the provisions are mutually dependent.
- 21. RENEGOTIATION OR MODIFICATIONS:** This Contract may be amended, modified, or supplemented only by written amendment to this Contract, executed by authorized persons of the parties hereto, and attached to the original signed copy of this Contract. Automatic renewals will not apply to this Contract.
- 22. SUSPENSION/DEBARMENT:** The Contractor certifies that neither it nor its principals are presently or have ever been debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction (Contract), by any governmental department or agency in the United States, including any federal, state or local agency. If the Contractor cannot certify this statement, attach a written explanation for review by the City of Logan. The Contractor must notify the Purchasing Agent within 30 days if suspended or debarred by any governmental entity during the Contract period.

23. TERMINATION:

23.1 Unless otherwise stated in the Additional Terms and Conditions of the City of Logan, if applicable, this Contract may be terminated, with cause by either party, in advance of the specified termination date, upon written notice being given by the other party. The party in violation will be given ten (10) working days after notification to correct and cease the violations, after which this Contract may be terminated for cause. This Contract may be terminated without cause, in advance of the specified expiration date, by either party, upon sixty (60) days prior written notice being given to

the other party. On termination of this Contract, all accounts and payments will be processed according to the financial arrangements set forth herein for approved services rendered to date of termination.

23.2 In the event of such termination, the Contractor shall be compensated for services properly performed under this Contract up to the effective date of the notice of termination. The Contractor agrees that in the event of such termination for cause or without cause, Contractor's sole remedy and monetary recovery from the City of Logan is limited to full payment for all work properly performed as authorized under this Contract up to the date of termination as well as any reasonable monies owed as a result of the Contractor having to terminate contracts necessarily and appropriately entered into by the Contractor pursuant to this Contract. Contractor further acknowledges that in the event of such termination, all work product, which includes but is not limited to all manuals, forms, contracts, schedules, reports, and any and all documents produced by Contractor under this Contract up to the date of termination are the property of the City of Logan and shall be promptly delivered to the City of Logan.

24. INSURANCE:

24.1 To protect against liability, loss and/or expense in connection with the performance of services described under this Contract, the Contractor shall obtain and maintain in force during the entire period of this Contract without interruption, at its own expense, insurance as listed below from insurance companies authorized to do business in the State of Utah and with an A.M. Best rating as approved by the City of Logan Risk Manager.

24.2 The following are minimum coverages that may be supplemented by additional requirements contained in the solicitation for this Contract or provided in an Attachment to this Contract:

- (1) Worker's Compensation Insurance and Employers' Liability Insurance. Worker's compensation insurance shall cover full liability under the worker's compensation laws of the jurisdiction in which the service is performed at the statutory limits required by said jurisdiction.
- (2) Professional liability insurance in the amount as described in the solicitation for this Contract, if applicable.
- (3) Any other insurance described in the solicitation for this Contract, if applicable.

24.3 Any type of insurance or any increase of limits of liability not described in this Contract which the Contractor requires for its own protection or on account of any statute, rule, or regulation shall be its own responsibility, and shall be provided at Contractor's own expense.

24.4 The carrying of insurance required by this Contract shall not be interpreted as relieving the Contractor of any other responsibility or liability under this Contract or any applicable law, statute, rule, regulation, or order.

25. STANDARD OF CARE: The services of Contractor and its subcontractors and subconsultants at any tier, if any, shall be performed in accordance with the standard of care exercised by licensed members of their respective professions having substantial experience providing similar services which similarities include the type, magnitude and complexity of the services that are the subject of this Contract. The Contractor shall be liable to the City of Logan for claims, liabilities, additional burdens, penalties, damages or third party claims (i.e. another Contractor's claim against the City of Logan), to the extent caused by wrongful acts, errors or omissions that do not meet this standard of care.

- 26. CITY OF LOGAN REVIEWS, LIMITATIONS:** The right of the City of Logan to perform plan checks, plan reviews, other reviews and/or comment upon the services of the Contractor, as well as any approval by the City of Logan, shall not be construed as relieving the Contractor from its professional and legal responsibility for services required under this Contract. No review by the City of Logan or any entity/user, approval or acceptance, or payment for any of the services required under this Contract shall be construed to operate as a waiver by the City of Logan of any right under this Contract or of any cause of action arising out of the performance or nonperformance of this Contract, and the Contractor shall be and remain liable to the City of Logan in accordance with applicable law for all damages to the City of Logan caused by the wrongful acts, errors and/or omissions of the Contractor or its subcontractors or subconsultants at any tier, if any.
- 27. NONAPPROPRIATION OF FUNDS:** The Contractor acknowledges that the City of Logan cannot contract for the payment of funds not yet appropriated by the City Council. If the Council does not appropriate funds for paying the City of Logan's obligations on this Contract, or if funding to the City of Logan is reduced due to an order by the Mayor, or is required by State law, or if Federal funding (when applicable) is not provided, the City of Logan may terminate this Contract or proportionately reduce the services and purchase obligations and the amount due from the City of Logan upon 30 days written notice to Contractor. If this Contract is terminated, or services and purchase obligations are reduced due to nonappropriation of funds or reduction in funding, as described in the preceding sentence, the City of Logan will pay Contractor for services properly performed, and will reimburse Contractor for expenses incurred, as authorized under this Contract, through the date of cancellation or reduction, and this payment shall be Contractor's sole remedy, and the City of Logan will not be liable for any future commitments, penalties, or liquidated damages.
- 28. SALES TAX EXEMPTION:** The City of Logan's sales and use tax exemption number is 12238772-002-STC. The tangible personal property or services being purchased are being paid from City of Logan funds and used in the exercise of that entity's essential functions.
- 29. PUBLIC INFORMATION:** Contractor agrees that this Contract, related sales orders, and invoices shall be public documents, and shall be available for distribution. Contractor gives the City of Logan express permission to make copies of this Contract, related sales orders, and invoices in accordance with the State of Utah Government Records Access and Management Act (GRAMA). Contractor also agrees that the Contractor's response to the solicitation, if applicable, will be a public document, and copies may be given to the public under GRAMA laws. This permission to make copies as noted will take precedence over any statements of confidentiality, proprietary information, copyright information, or similar notation.
- 30. PATENTS, COPYRIGHTS, ETC.:** The Contractor will release, indemnify and hold the City of Logan, its officers, agents and employees harmless from liability of any kind or nature, including the Contractor's use of any copyrighted or un-copyrighted composition, secret process, patented or un-patented invention, article or appliance furnished or used in the performance of this Contract.
- 31. ASSIGNMENT/SUBCONTRACT:** Contractor will not assign, sell, transfer, subcontract or sublet rights, or delegate responsibilities under this Contract, in whole or in part, without the prior written approval of the City of Logan.
- 32. DEFAULT AND REMEDIES:**

32.1 Any of the following events will constitute cause for the City of Logan to declare Contractor in default of this Contract:

- (1) Nonperformance of contractual requirements; or
- (2) A material breach of any term or condition of this Contract.

32.2 Should Contractor be in default under any of the provisions under Subsection 32.1 above, the City of Logan will issue a written notice of default providing a ten (10) day period in which Contractor will have an opportunity to cure. Time allowed for cure will not diminish or eliminate Contractor's liability for damages. If the default remains after Contractor has been provided the opportunity to cure, the City of Logan may do one or more of the following: (1) Exercise any remedy provided by law; (2) Terminate this Contract and any related contracts or portions thereof; (3) Impose liquidated damages, if liquidated damages are listed in the Contract; or (4) Suspend Contractor from receiving future solicitations.

33. FORCE MAJEURE: Neither party to this Contract will be held responsible for delay or default caused by fire, riot, acts of God and/or war which is beyond that party's reasonable control. The City of Logan may terminate this Contract after determining such delay or default will reasonably prevent successful performance of this Contract.

34. PROCUREMENT ETHICS: The Contractor understands that a person who is interested in any way in the sale of any supplies, services, construction, or insurance to the City of Logan is violating the law if the person gives or offers to give any compensation, gratuity, contribution, loan or reward, or any promise thereof to any person acting as a procurement officer on behalf of the City of Logan, or who in any official capacity participates in the procurement of such supplies, services, construction, or insurance, whether it is given for their own use or for the use or benefit of any other person or organization.

35. CONFLICT OF TERMS: In order for any terms and conditions of the Contractor to apply to this Contract, they must be in writing and attached to this Contract. No other terms and conditions of the Contractor will apply to this Contract, including terms listed or referenced on a Contractor's website, terms listed in a Contractor quotation/sales order, etc.

36. ENTIRE CONTRACT: This Contract including all attachments and documents incorporated hereunder, and the related City of Logan solicitation documents, if any, constitutes the entire Contract between the parties with respect to the subject matter, and supersedes any and all other prior and contemporaneous agreements and understandings between the parties, whether oral or written. The terms of this Contract shall supersede any additional or conflicting terms or provisions that may be set forth or printed on the Contractor's work plans, cost estimate forms, receiving tickets, invoices, or any other related standard forms or documents of the Contractor that may subsequently be used to implement, record, or invoice services hereunder from time to time, even if such standard forms or documents have been signed or initialed by a representative of the City of Logan. The parties agree that the terms of this Contract shall prevail in any dispute between the terms of this Contract and the terms printed on any such standard forms or documents, and such standard forms or documents shall not be considered written amendments of this Contract.

37. DISPUTE RESOLUTION: In the event of any dispute under this Contract prior to any filing in any judicial proceedings, the parties agree to participate in good faith in the mediation of the dispute. The City of Logan, after consultation with the Contractor, may appoint an expert or panel of experts to assist in the resolution of the dispute. If the City of Logan appoints such an expert or panel, City of

Logan and Contractor agree to cooperate in good faith in providing information and documents to the expert or panel in an effort to resolve the dispute.

OWNER:

CONTRACTOR:

City of Logan

By: _____

By: _____

Attest: _____

Attest: _____

Address for giving notices:

Address for giving notices:

290 North 100 West

Logan UT 84321

END OF DOCUMENT

SAMPLE

Exhibit C

CLAIM OF BUSINESS CONFIDENTIALITY

Any person who provides a proposal (or information contained in any record) that he or she believes should be protected under UCA Subsection 63G-2-305 (1 - 4) shall provide with the proposal a written claim of business confidentiality and a concise statement of reasons supporting the claim of business confidentiality. The guidelines used by Logan City to grant business confidentiality are as follows:

- Trade secrets – if the submitted information includes a formula, pattern, compilation, program, device, method, technique, or process, that has actual or potential value by its non-disclosure to the general public, and is the subject of efforts that are reasonable under the circumstances to maintain its secrecy;
- Commercial information or non-individual financial information- if the submitted information contains commercial information or non-individual financial information the disclosure of which could reasonably be expected to result in unfair competitive injury to the person submitting the information, or would impair the ability of Logan City to obtain necessary information in the future, and the person submitting the information has a greater interest in prohibiting access than the public in obtaining access.

I, _____ do hereby claim that the pages identified below, which are contained within this submission as required by Logan City are confidential.

Signature _____

Date _____

The following pages of this Proposal are protected under a Claim of Business Confidentiality:



City of Logan, Utah

Volume III - Construction Drawings

**HYDRO NO. 2 - LOGAN 3RD DAM
AND SURGE TANK
IMPROVEMENTS PROJECT**

July 2017



ALL WORK UNDER THIS CONTRACT SHALL BE UNDERTAKEN BETWEEN SEPTEMBER 1, 2018 AND APRIL 30, 2019 UNLESS APPROVED OTHERWISE.

DRAWING INDEX

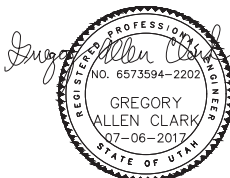
DRAWING No.	DESCRIPTION
GENERAL	
G-1	COVER SHEET
G-2	LOCATION MAP, VICINITY MAP AND DRAWING INDEX
G-3	SYMBOLS
G-4	RATING CURVE, STAGE VS VOLUME CURVE, WATER RIGHTS
G-5	FERC BOUNDARY MAP
DEMOLITION	
D-1	UPPER DEMOLITION PLAN
D-2	LOWER DEMOLITION PLAN
D-3	SECTIONS - I
D-4	SECTIONS - II
D-5	SECTIONS - III
D-6	SURGE TANK - DEMOLITION PLAN AND SECTIONS
CIVIL	
GC-1	STANDARD EROSION CONTROL NOTES
GC-2	STANDARD DETAILS - I
GC-3	STANDARD DETAILS - II
C-1	LOGAN THIRD DAM IMPROVEMENTS OVERALL SITE PLAN
C-2	BANK ARMORING PLAN
C-3	GRADING SECTIONS - I
C-4	GRADING SECTIONS - II
C-5	MISCELLANEOUS DETAILS
C-6	CIVIL DETAILS
C-7	TRAIL CLOSURE, RE-ROUTING, AND SIGNAGE
ARCHITECTURAL PLANS HAVE BEEN DELETED	
STRUCTURAL	
GS-1	GENERAL NOTES AND DESIGN CRITERIA
GS-2	STANDARD DETAILS - I
GS-3	STANDARD DETAILS - II
GS-4	STANDARD DETAILS - III
GS-5	STANDARD DETAILS - IV
GS-6	STANDARD DETAILS - V
GS-7	NOTES, BUILDING CODE DATA, SCHEDULES AND DETAILS
S-1	FOUNDATION PLAN - I
S-2	FOUNDATION PLAN - II
S-3	FOUNDATION PLAN - III
S-4	UPPER PLAN - I
S-5	UPPER PLAN - II
S-6	UPPER PLAN - III
S-7	SECTIONS AND DETAILS - I
S-8	SECTIONS AND DETAILS - II
S-9	SECTIONS AND DETAILS - III
S-10	SECTIONS AND DETAILS - IV
S-11	SECTIONS AND DETAILS - V
S-12	SECTIONS AND DETAILS - VI
S-13	SECTIONS AND DETAILS - VII
S-14	SECTIONS AND DETAILS - VIII
S-15	SECTIONS AND DETAILS - IX
S-16	SECTIONS AND DETAILS - X
S-17	TRASH RACK DETAILS - I
S-18	TRASH RACK DETAILS - II
S-19	PEDESTRIAN BRIDGE PLAN AND SECTIONS
S-20	SURGE TANK - TOP PLAN
S-21	SURGE TANK - SECTION AND DETAILS - I
S-22	FLOOR AND ROOF PLANS, EXTERIOR ELEVATIONS, AND WALL SECTION
MECHANICAL	
GM-1	SCHEDULES
GM-2	STANDARD DETAILS
M	
M-1	PLAN
M-2	PNEUMATIC CREST GATE PLAN AND SECTION
M-3	GATE HOUSE EQUIPMENT PLAN AND SECTIONS
M-4	SECTIONS - I
M-5	SECTIONS - II
ELECTRICAL	
GE-1	SYMBOLS
GE-2	NOTES AND ABBREVIATIONS
GE-3	DETAILS - I
E-1	ONE-LINE DIAGRAM - I
E-2	GATE HOUSE PLAN



LOCATION MAP



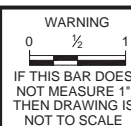
VICINITY MAP



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REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE
NO SCALE



DESIGNED_K_VO
DRAWN_K_VO
CHECKED_G_CLARK

ISSUED FOR CONSTRUCTION - JULY 2017
ANY PRINT NOT BEARING THIS STAMP MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.



HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT
ADDENDUM 1

LOGAN CITY
GENERAL
LOGAN 3RD DAM
LOCATION MAP, VICINITY MAP AND DRAWING INDEX

SHEET
G-2

EROSION CONTROL NOTES:

- OBTAIN NATIONAL POLLUTION DISCHARGE AND ELIMINATION SYSTEM (NPDES) PERMIT COVERAGE UNDER THE CONSTRUCTION STORMWATER GENERAL PERMIT FROM THE UNITED STATES ENVIRONMENTAL PROTECTION AGENCY FOR THIS PROJECT. THE CONTRACTOR SHALL FILE A NOTICE OF INTENT (NOI) AND APPLY FOR A PERMIT 60 DAYS PRIOR TO DISCHARGING STORMWATER. THE CONTRACTOR SUBMIT THE PERMIT APPLICATION ON LINE FROM THE UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY WEBSITE AT: <http://www.deq.utah.gov/Permits/water/updes/stormwatercon.htm#noi>.
- THE MEASURES SHOWN ON THESE PLANS ARE THE MINIMUM THAT ARE REQUIRED FOR THE ANTICIPATED SITE CONDITIONS. THE CONTRACTOR SHALL PROVIDE ADDITIONAL MEASURES AS NEEDED DUE TO WEATHER AND/OR FIELD CONDITIONS, AND/OR CONSTRUCTION ACTIVITIES, AND/OR AS DIRECTED BY THE ENGINEER.
- THE CONTRACTOR SHALL SUBMIT AND HAVE ACCEPTED BY THE OWNER A DETAILED STORM WATER POLLUTION PREVENTION PLAN (SWPPP). THE SWPPP SHALL FOLLOW THE UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY SWPPP TEMPLATE FOUND ONLINE AT: <http://www.deq.utah.gov/Permits/water/updes/stormwatercon.htm>
- INSTALL ALL TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES PRIOR TO PERFORMING ANY CLEARING OR OTHER EARTH DISTURBING ACTIVITIES.
- THE CONTRACTOR SHALL USE ALL REASONABLE MEASURES TO MINIMIZE THE IMPACTS OF CONSTRUCTION ACTIVITY ON WATERS OF THE STATE. WATER QUALITY CONSTITUENTS OF PARTICULAR CONCERN ARE TURBIDITY, SUSPENDED SEDIMENTS, SETTLEABLE SOLIDS.
- THE CONTRACTOR SHALL USE PROPER EROSION AND SEDIMENT CONTROL PRACTICES ON THE CONSTRUCTION SITE AND ADJACENT CONSTRUCTION STAGING AREAS TO PREVENT EROSION IN AND DOWNHILL OF DISTURBED AREAS, AND TO PREVENT THE DISCHARGE OF UPLAND SEDIMENTS OR SEDIMENT-LADEN WATER INTO THE WETLANDS, WATER BODIES, AND LOCAL DRAINAGE DITCHES. EXCEPT FOR TEMPORARILY SIDECAST OR TRENCH EXCAVATION, ALL STOCKPILES SHALL BE LOCATED NO CLOSER THAN 100 FEET FROM THE BOUNDARY OF ANY CRITICAL AREA AND SHALL NOT BE PLACED IN ANY UNDISTURBED AREA.
- THE CONTRACTOR SHALL FOLLOW AND IMPLEMENT ALL SPECIFICATIONS FOR EROSION AND SEDIMENT CONTROL SPECIFIED IN THE CONTRACT DOCUMENTS AND IN ACCORDANCE WITH THE UTAH GENERAL CONSTRUCTION PERMIT (UGCP). ADJUSTMENTS TO PLANNED EROSION AND SEDIMENT CONTROL MAY BE NECESSARY TO SUCCESSFULLY CONTROL SILTATION FROM THE SITE WHICH IS NOT COVERED UNDER THIS TEMPORARY EROSION AND SEDIMENT CONTROL PLAN.
- THE CONTRACTOR SHALL NOT DISCHARGE TURBID WATER GENERATED FROM CONSTRUCTION ACTIVITIES, INCLUDING TURBID DEWATERING WATER, DIRECTLY TO, AND/OR TO ANY OF THE DRAINAGE DITCHES THAT DRAIN TO THE CREEK OR RIVERS BEFORE THE SOLIDS HAVE SETTLED OUT OF THE WATERS. ALL SURFACE WATER FLOWS IN DITCHES, OR CULVERTS SHALL BE MAINTAINED, SUCH THAT FLOW IS NOT DISRUPTED DURING OR AFTER CONSTRUCTION.
- RESTORE, PLANT AND HYDROSEED ALL DISTURBED WETLAND, WETLAND BUFFER, STREAM, AND STREAM BUFFER AREAS AS SHOWN ON THE DRAWINGS AND PER THE SPECIFICATIONS. WHERE NO SPECIFIC SEED MIX IS INDICATED, HYDROSEED DISTURBED AREA WITH EROSION CONTROL SEED MIX.
- THE TESC'S SHALL REMAIN IN PLACE THROUGHOUT THE WORK. INSTALLED EROSION AND SEDIMENT CONTROL MEASURES SHALL ONLY BE REMOVED UPON STABILIZATION OF DISTURBED AREAS AND WITH THE APPROVAL OF THE ENGINEER.
- THE CONTRACTOR SHALL SEED, PLANT, COVER WITH PLASTIC, MULCH, OR PROVIDE SOME OTHER EQUIVALENT TYPE OF PROTECTION AGAINST EROSION TO ALL EARTHEN AREAS DISTURBED OR NEWLY CREATED BY THE PROJECT CONSTRUCTION.
- THE CONTRACTOR SHALL PROVIDE REGULAR INSPECTION AND MAINTENANCE OF ALL SEDIMENT CONTROL STRUCTURES. SEDIMENT CONTROL MEASURES SHALL BE IN WORKING CONDITION AT ALL TIMES. THE CONTRACTOR SHALL REPAIR, REPLACE, AND INSTALL ADDITIONAL MEASURES SO THAT THEY ARE EFFECTIVE IN PREVENTING EROSION AND SEDIMENTATION.
- AFTER ANY SIGNIFICANT RAINFALL, THE CONTRACTOR SHALL INSPECT SEDIMENT CONTROL STRUCTURES FOR INTEGRITY. ANY DAMAGED DEVICES SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER AND REPAIRED IMMEDIATELY.
- FOLLOWING CONSTRUCTION, THE CONTRACTOR SHALL RESTORE TO ORIGINAL CONDITION, THE DISTURBED AREAS, AND ACHIEVE AN ADEQUATE VEGETATIVE COVER BEFORE REMOVING ANY SEDIMENT TRAPS OR SETTLING BASINS AND THEIR ASSOCIATED TEMPORARY DIVERSION DITCHES. THE CONTRACTOR SHALL CLEAN OUT TEMPORARY SETTLING BASINS (SEDIMENT TRAPS) AND REMOVE THE SETTLED SEDIMENTS OR HYDROSEED THE AREA (IF IN BARE PASTURE LAND) BEFORE REMOVING THE SETTLING BASINS. SETTLED SEDIMENTS SHALL NOT BE ALLOWED TO ENTER ANY STREAM OR DITCH AS A RESULT OF RUNOFF THAT MAY OCCUR AFTER CONSTRUCTION IS COMPLETED.
- THE IMPLEMENTATION OF THESE EROSION AND SEDIMENT CONTROL PLANS AND THE CONSTRUCTION, MAINTENANCE, REPLACEMENT, AND UPGRADING OF THESE ESC FACILITIES IS THE RESPONSIBILITY OF THE CONTRACTOR UNTIL ALL CONSTRUCTION IS COMPLETED AND APPROVED AND VEGETATION/LANDSCAPING IS ESTABLISHED.
- THE BOUNDARIES OF THE CLEARING LIMITS SHALL BE CLEARLY FLAGGED IN THE FIELD PRIOR TO CONSTRUCTION. DURING THE CONSTRUCTION PERIOD, NO DISTURBANCE BEYOND THE FLAGGED CLEARING LIMITS SHALL BE PERMITTED. THE FLAGGING SHALL BE MAINTAINED BY THE CONTRACTOR FOR THE DURATION OF CONSTRUCTION.
- THE ESC FACILITIES SHOWN ON THIS PLAN MUST BE CONSTRUCTED IN CONJUNCTION WITH ALL CLEARING AND GRADING ACTIVITIES, AND IN SUCH A MANNER AS TO INSURE THAT SEDIMENT AND SEDIMENT LADEN WATER DO NOT ENTER THE DRAINAGE SYSTEM, ROADWAYS, OR VIOLATE APPLICABLE WATER STANDARDS.
- THE ESC FACILITIES SHOWN ON THIS PLAN ARE THE MINIMUM REQUIREMENTS FOR ANTICIPATED SITE CONDITIONS. DURING THE CONSTRUCTION PERIOD, THESE ESC FACILITIES SHALL BE UPGRADED AS NEEDED FOR UNEXPECTED STORM EVENTS AND TO INSURE THAT SEDIMENT AND SEDIMENT-LADEN WATER DO NOT LEAVE THE SITE.

- THE ESC FACILITIES SHALL BE INSPECTED DAILY BY THE CONTRACTOR AND MAINTAINED AS NECESSARY TO ENSURE THEIR CONTINUED FUNCTIONING.
- THE ESC FACILITIES SHALL BE INSPECTED AND MAINTAINED IN ACCORDANCE WITH UGCP.
- AT NO TIME SHALL MORE THAN 1 FOOT OF SEDIMENT BE ALLOWED TO ACCUMULATE WITHIN A TRAPPED CATCH BASIN. ALL CATCH BASINS AND CONVEYANCE LINES SHALL BE CLEANED PRIOR TO PAVING. THE CLEANING OPERATION SHALL NOT FLUSH SEDIMENT LADEN WATER INTO THE DOWNSTREAM SYSTEM.
- STABILIZED CONSTRUCTION ENTRANCES SHALL BE INSTALLED AT THE BEGINNING OF CONSTRUCTION AND MAINTAINED FOR THE DURATION OF THE PROJECT. ADDITIONAL MEASURES MAY BE REQUIRED TO INSURE THAT ALL PAVED AREAS ARE KEPT CLEAN FOR THE DURATION OF THE PROJECT.
- ON-SITE EROSION CONTROL MEASURES SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. ANY PROBLEMS OCCURRING BEFORE FINAL ACCEPTANCE OF THE STORM SYSTEM BY THE OWNER/AGENCY SHALL BE CORRECTED BY THE CONTRACTOR.
- IN CASE EROSION OR SEDIMENTATION OCCURS TO ADJACENT PROPERTY, ALL CONSTRUCTION WORK WITHIN THE DEVELOPMENT THAT WILL AGGRAVATE THE SITUATION MUST CEASE AND THE CONTRACTOR SHALL IMMEDIATELY COMMENCE RESTORATION OR MITIGATION MEASURES. RESTORATION ACTIVITY SHALL CONTINUE UNTIL SUCH TIME AS THE PROBLEM IS RECTIFIED.
- ALL EROSION AND SEDIMENTATION CONTROL DEVICES SHOWN ON CONTRACT DOC SHALL BE INSTALLED PRIOR TO OR AS THE FIRST STAGE OF SITE PREPARATION.
- SHOULD THE TEMPORARY EROSION AND SEDIMENTATION CONTROL MEASURES AS SHOWN ON THIS DRAWING NOT PROVE ADEQUATE TO CONTROL EROSION AND SEDIMENTATION, THE CONTRACTOR SHALL INSTALL ADDITIONAL FACILITIES AS NECESSARY TO PROTECT ADJACENT PROPERTIES, SENSITIVE AREAS, NATURAL WATER COURSES, AND/OR STORM DRAINAGE SYSTEMS.
- IN ANY AREA WHICH HAS BEEN STRIPPED OF VEGETATION OR EXPERIENCED LAND DISTURBING ACTIVITIES AND WHERE NO FURTHER WORK IS ANTICIPATED FOR A PERIOD EXCEEDING VERIFY, ALL DISTURBED AREAS MUST BE IMMEDIATELY STABILIZED WITH MULCHING, GRASS PLANTING, OR OTHER APPROVED EROSION CONTROL TREATMENT APPLICABLE TO THE TIME OF YEAR IN QUESTION. GRASS SEEDING ALONE WILL BE ACCEPTABLE ONLY DURING THE MONTHS OF VERIFY THROUGH SEPTEMBER, INCLUSIVE. SEEDING MAY PROCEED, HOWEVER, WHENEVER IT IS IN THE INTEREST OF THE CONTRACTOR, BUT MUST BE AUGMENTED WITH MULCHING, NETTING, OR OTHER TREATMENT.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR FIELD LOCATING THE CLEARING LIMITS AND ESTABLISHING THOSE BOUNDARIES WITH BRIGHT COLORED FLAGGING. THE CONTRACTOR SHALL CLEAR TO THE LIMITS AS ESTABLISHED IN THE CONTRACT DOCUMENTS AND AS APPROVED.
- A QUALIFIED PERSON AS DEFINED IN THE UGCP SHALL BE RESPONSIBLE FOR THE INSPECTION AND ACCEPTANCE OF ALL CLEARING AND GRADING WORK AND EROSION AND SEDIMENTATION CONTROL FACILITIES. THE APPLICANT AND/OR CONTRACTOR SHALL NOTIFY THE OWNER FORTY-EIGHT HOURS IN ADVANCE OF EACH REQUIRED EROSION AND SEDIMENT CONTROL INSPECTION.

- | | |
|--------------------|---|
| INSPECTION NO. 1 - | INSTALLATION OF EROSION CONTROL FACILITIES/PRIOR TO CLEARING. |
| INSPECTION NO. 2 - | COMPLETION OF CLEARING. |
| INSPECTION NO. 3 - | UPON COMPLETION OF EXCAVATION, FILLING, AND EARTHWORK. |
| INSPECTION NO. 4 - | COMPLETION OF PROJECT. |
| INSPECTION NO. 5 - | AS NEEDED TO DETERMINE COMPLIANCE WITH APPROVED PLANS AND/OR SPECIFICATIONS. (DOES NOT REQUIRE ADVANCE NOTICE.) |

ALL WORK ASSOCIATED WITH STABILIZING THE DISTURBED AREAS SHALL BE IN ACCORDANCE WITH UTAH DEPARTMENT OF ENVIRONMENTAL QUALITY STANDARDS.

- ALL NECESSARY FACILITIES SHALL BE MAINTAINED ON SITE TO PREVENT DEBRIS, DUST, AND MUD FROM ACCUMULATING ON THE PUBLIC RIGHT-OF-WAY.
- THE CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING HIS OWN QUANTITIES FOR BIDDING PURPOSES AND SHALL NOT HOLD THE ENGINEER OR OWNER/DEVELOPER RESPONSIBLE FOR ANY ERRORS IN HIS BID QUANTITIES FOR EXCAVATION.
- SOILS MUST NOT REMAIN EXPOSED AND UNWORKED FOR MORE THAN THE TIME PERIODS SET FORTH IN THE UGCP.
- STABILIZE SOILS AT THE END OF THE SHIFT BEFORE A HOLIDAY OR WEEKEND IF NEEDED BASED ON THE WEATHER FORECAST.

MULCHING NOTES:

- MULCH MATERIALS USED SHALL BE HAY OR STRAW AND SHALL BE APPLIED AT A RATE OF 75-100 POUNDS PER 1000 SQUARE FEET, OR 90-120 BALES PER ACRE TO A MIN. DEPTH OF 2 INCHES.
- MULCHES SHALL BE APPLIED IN ALL AREAS WITH EXPOSED SLOPES GREATER THAN 2:1.
- MULCHING SHALL BE USED IMMEDIATELY AFTER SEEDING OR IN AREAS WHICH CANNOT BE SEEDED BECAUSE OF THE SEASON.
- ALL AREAS NEEDING MULCH SHALL BE COVERED BY NOVEMBER 1 IN ACCORDANCE WITH UGCP.

TEMPORARY EROSION CONTROL SEEDING NOTES:

- EROSION CONTROL SEED MIXTURE SHALL BE IN ACCORDANCE WITH UGCP.
- SEED BEDS PLANTED BETWEEN MAY 1 AND OCTOBER 31 WILL REQUIRE IRRIGATION AND OTHER MAINTENANCE AS NECESSARY TO FOSTER AND PROTECT THE ROOT STRUCTURE.
- FOR SEED BEDS PLANTED BETWEEN OCTOBER 31 AND APRIL 30, ARMORING OF THE SEED BED WILL BE NECESSARY. (E.G., GEOTEXTILES, JUTE MAT, CLEAR PLASTIC COVERING).
- BEFORE SEEDING, INSTALL NEEDED SURFACE RUNOFF CONTROL MEASURES SUCH AS GRADIENT TERRACES, INTERCEPTOR DIKES, SWALES, LEVEL SPREADERS AND SEDIMENT BASINS.
- THE SEEDBED SHALL BE FIRM WITH A FAIRLY FINE SURFACE, FOLLOWING SURFACE ROUGHENING. PERFORM ALL OPERATION ACROSS OR AT RIGHT ANGLES TO THE SLOPE.
- FERTILIZERS ARE TO BE USED ACCORDING TO SUPPLIERS RECOMMENDATIONS. AMOUNTS USED SHOULD BE MINIMIZED, ESPECIALLY ADJACENT TO WATER BODIES AND WETLANDS.
- EROSION CONTROL SEEDING SHALL NOT BE USED IN AREAS SUBJECT TO WEAR BY CONSTRUCTION TRAFFIC.
- EROSION CONTROL SEEDING MAY BE USED IN ALL AREAS OF 5% OR LESS SLOPE. IN AREAS BETWEEN 5 AND 10% SLOPE, EROSION CONTROL SEEDING MAY BE USED FOR A MAXIMUM HORIZONTAL DISTANCE OF 100 FEET. USE MULCH OR NETTING OR OTHER TREATMENTS FOR STEEPER AND LONGER SLOPES.

MAINTENANCE STANDARDS

- INSPECT STABILIZED AREAS REGULARLY, ESPECIALLY AFTER LARGE STORM EVENTS PER UGCP.
- CRUSHED ROCK, GRAVEL BASE, HOG FUEL, ETC. SHALL BE ADDED AS REQUIRED TO MAINTAIN A STABLE DRIVING SURFACE AND TO STABILIZE ANY AREAS THAT HAVE ERODED.
- FOLLOWING CONSTRUCTION, THESE AREAS SHALL BE RESTORED TO PRECONSTRUCTION CONDITION OR BETTER AND STABILIZED TO PREVENT FUTURE EROSION IN ACCORDANCE WITH UGCP.

SEDIMENT FENCE NOTES:

- FILTER FABRIC SHALL BE PURCHASED IN A CONTINUOUS ROLL AND CUT TO THE LENGTH OF THE BARRIER TO AVOID USE OF JOINTS. WHEN JOINTS ARE NECESSARY, FILTER CLOTH SHALL BE SPLICED TOGETHER ONLY AT A SUPPORT POST, WITH A MINIMUM 6-INCH OVERLAP, AND SECURELY FASTENED AT BOTH ENDS TO POSTS.
- POSTS SHALL BE SPACED A MAXIMUM OF 6 FEET APART AND DRIVEN SECURELY INTO THE GROUND (MINIMUM OF 30 INCHES).
- A WIRE MESH SUPPORT FENCE SHALL BE FASTENED SECURELY TO THE UPSLOPE SIDE OF THE POSTS USING HEAVY-DUTY WIRE STAPLES AT LEAST 1 INCH THE TRENCH A MINIMUM OF 4 INCHES AND SHALL NOT EXTEND MORE THAN 24 INCHES ABOVE THE ORIGINAL GROUND SURFACE.
- THE FILTER FABRIC SHALL BE STAPLED OR WIRED TO THE FENCE, AND 20 INCHES OF THE FABRIC SHALL BE EXTENDED INTO THE TRENCH. THE FABRIC SHALL NOT EXTEND MORE THAN 24 INCHES ABOVE THE ORIGINAL GROUND SURFACE. FILTER FABRIC SHALL NOT BE STAPLED TO EXISTING TREES.
- FILTER FABRIC FENCES SHALL NOT BE REMOVED BEFORE THE UPSLOPE AREA HAS BEEN PERMANENTLY STABILIZED.
- FILTER FABRIC FENCES SHALL BE INSPECTED IMMEDIATELY AFTER EACH RAINFALL AND AT LEAST DAILY DURING PROLONGED RAINFALL. ANY REQUIRED REPAIRS SHALL BE MADE IMMEDIATELY.
- SILT FENCES WILL BE INSTALLED PARALLEL TO ANY SLOPE CONTOURS.
- CONTRIBUTING LENGTH TO FENCE WILL NOT BE GREATER THAN 100 FEET.
- DO NOT INSTALL BELOW AN OUTLET PIPE OR WIRE.
- INSTALL DOWNSLOPE OF EXPOSED AREAS.
- DO NOT DRIVE OVER OR FILL OVER SILT FENCES.

CONSTRUCTION ENTRANCE NOTES:

- MATERIAL SHALL BE 4 INCH TO 8 INCH QUARRY SPALLS AND MAY BE TOP-DRESSED WITH 1 INCH TO 3 INCH ROCK. (STATE STANDARD SPECIFICATIONS, SECTION 8-15)
- THE ROCK PAD SHALL BE AT LEAST 12 INCHES THICK AND 100 FEET LONG. WIDTH SHALL BE THE FULL WIDTH OF THE VEHICLE INGRESS AND EGRESS AREA. THE 100 FOOT MINIMUM LENGTH MAY BE REDUCED TO THE MAXIMUM PRACTICABLE SIZE WHEN THE SIZE OR CONFIGURATION OF THE SITE DOES NOT ALLOW CONSTRUCTION ENTRANCE(S) TO BE 100 FEET LONG.
- ADDITIONAL ROCK SHALL BE ADDED PERIODICALLY TO MAINTAIN PROPER FUNCTION OF THE PAD.
- IF THE PAD DOES NOT ADEQUATELY REMOVE THE MUD FROM THE VEHICLE WHEELS, THE WHEELS SHALL BE HOSED OFF BEFORE THE VEHICLE ENTERS A PAVED STREET. THE WASHING SHALL BE DONE ON AN AREA COVERED WITH CRUSHED ROCK AND WASH WATER SHALL DRAIN TO A SEDIMENT RETENTION FACILITY OR THROUGH A SILT FENCE.

TEMPORARY DIKES AND SWALES:

- SEED AND MULCH SHALL BE APPLIED WITHIN 5 DAYS OF DIKE CONSTRUCTION (SEE VEGETATION).
- THE UPSLOPE SIDE OF THE DIKE SHALL PROVIDE POSITIVE DRAINAGE TO THE DIKE OUTLET.
- NO EROSION SHALL OCCUR AT THE DIKE OUTLET. PROVIDE ENERGY DISSIPATION MEASURES AS NECESSARY.
- SEDIMENT LADEN RUNOFF MUST BE RELEASED THROUGH A SEDIMENT TRAPPING FACILITY SUCH AS A POND, TRAP, OR SILT FENCE AS APPROPRIATE TO DRAINAGE AREA SIZE.

INSPECTION SEQUENCE:

TEMPORARY EROSION AND SEDIMENT CONTROL MEASURES REQUIRING INSPECTION FOR THIS PROJECT:

- CLEARING AND GRADING LIMITS
- TEMPORARY CONSTRUCTION ENTRANCE
- TEMPORARY SILTATION FENCING
- VEGETATION AND STABILIZATION OF EXPOSED SURFACES

INSPECTION SCHEDULE:

- SILTATION FENCE - INSPECT: PRIOR TO CLEARING, AFTER MAJOR STORM EVENTS, MONTHLY
- TEMPORARY CONSTRUCTION ENTRANCE - INSPECT: PRIOR TO CLEARING, AFTER MAJOR STORM EVENTS, MONTHLY
- STOCKPILES - INSPECT: MONTHLY AND AFTER MAJOR STORM EVENTS FOR RIPPING AND LOOSE SEAMS
- CATCH BASINS AND STORM DRAINAGE PIPES - INSPECT: MONTHLY AND AFTER MAJOR STORM EVENTS
- INSPECTIONS SHALL CONTINUE UNTIL SITE HAS STABILIZED.

THE ESC LEAD FOR THIS PROJECT WILL BE DECIDED BY THE CONTRACTOR.

SOIL STOCKPILE NOTES:

- STOCKPILES SHALL BE STABILIZED (WITH PLASTIC COVERING OR OTHER APPROVED DEVICE) DAILY.
- IN ANY SEASON, SEDIMENT LEACHING FROM STOCK PILES MUST BE PREVENTED.
- STOCKPILES MUST BE LOCATED MORE THAN 50 FEET FROM ALL DRAINAGE FEATURES.

PLASTIC COVERING NOTES:

- PLASTIC SHEETING SHALL HAVE A MINIMUM THICKNESS OF 6 MILS AND SHALL MEET THE REQUIREMENTS OF WSDOT STANDARD SPECIFICATIONS SECTION 9-14.5.
- COVERING SHALL BE INSTALLED AND MAINTAINED TIGHTLY IN PLACE BY USING SANDBAGS OR TIRES ON ROPES WITH A MAXIMUM 10-FOOT GRID SPACING IN ALL DIRECTIONS. ALL SEAMS SHALL BE TAPED OR WEIGHTED DOWN FULL LENGTH AND THERE SHALL BE A LEAST A 12 INCH OVERLAP OF ALL SEAMS.
- CLEAR PLASTIC COVERING SHALL BE INSTALLED IMMEDIATELY ON AREAS SEEDED BETWEEN NOVEMBER 1 AND MARCH 31 AND REMAIN UNTIL VEGETATION IS FIRMLY ESTABLISHED.
- WHEN THE COVERING IS USED ON UN-SEEDED SLOPES, IT SHALL BE KEPT IN PLACE UNTIL THE NEXT SEEDING PERIOD.
- PLASTIC COVERING SHEETS SHALL BE BURIED TWO FEET AT THE TOP OF SLOPES IN ORDER TO PREVENT SURFACE WATER FLOW BENEATH SHEETS.
- PROPER MAINTENANCE INCLUDES REGULAR CHECKS FOR RIPS AND DISLODGED ENDS.

ADDITIONAL REQUIREMENTS:

- SEE SPECIFICATIONS FOR ADDITIONAL INFORMATION AND REQUIREMENTS.

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12-22-17	GAC
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	DESCRIPTION

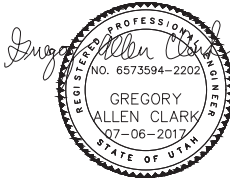
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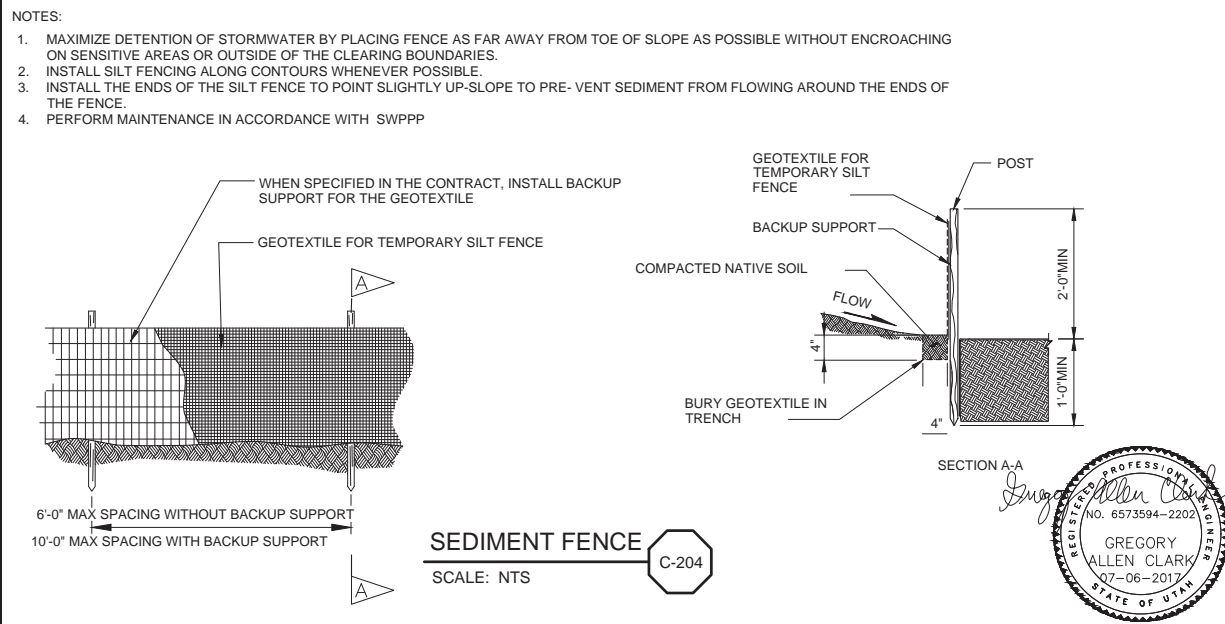
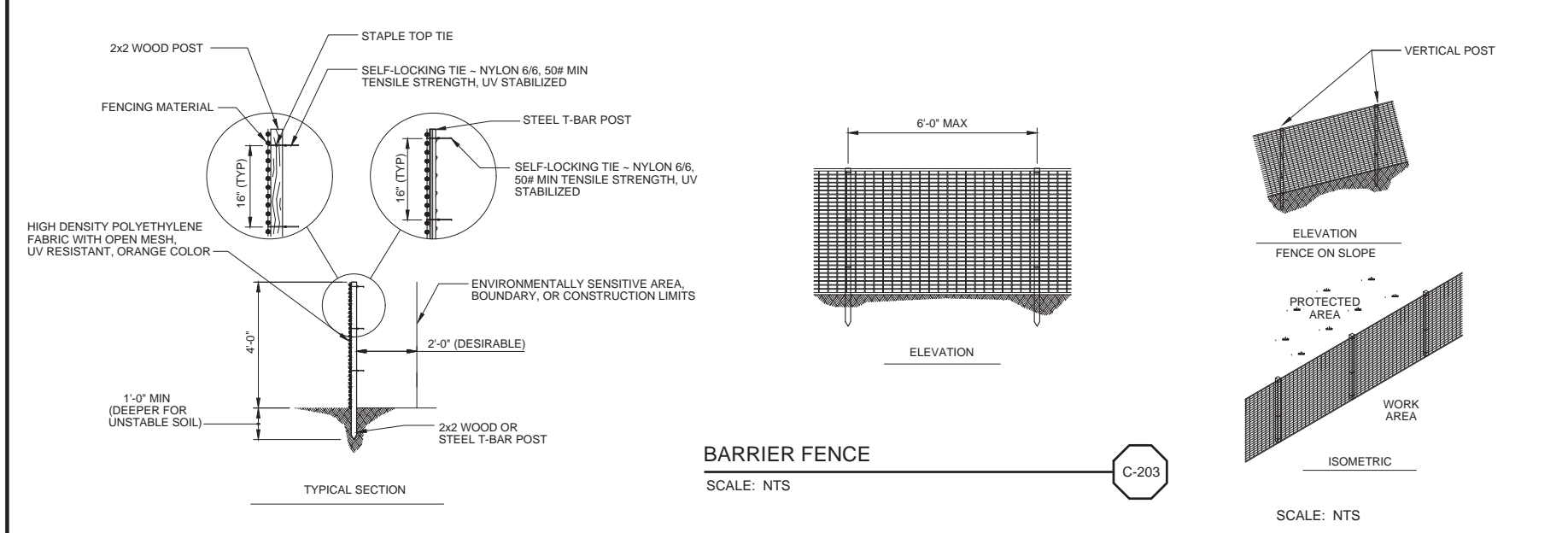
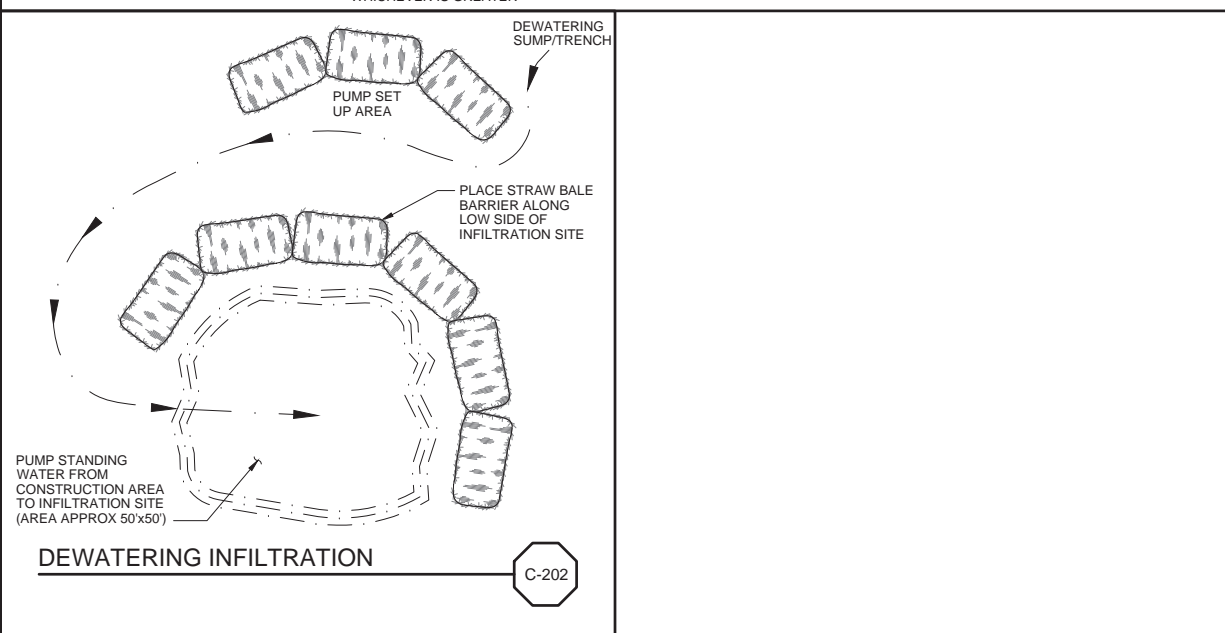
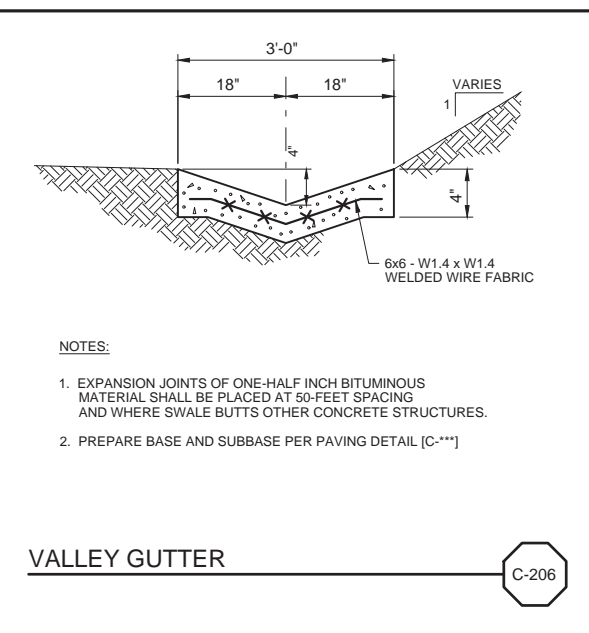
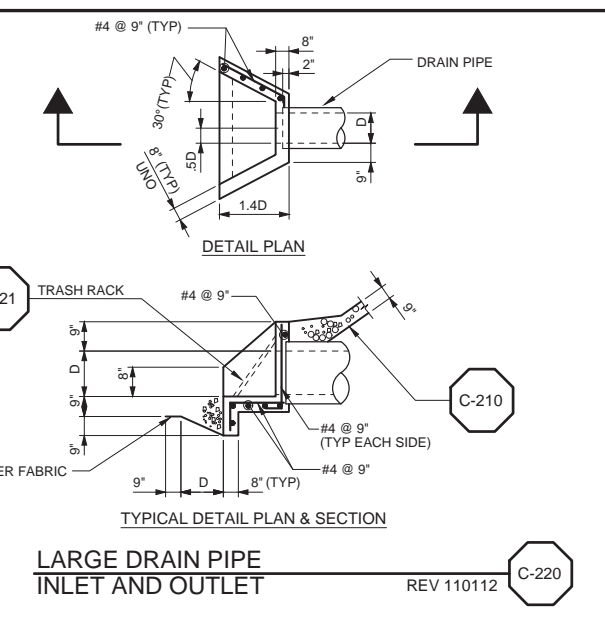
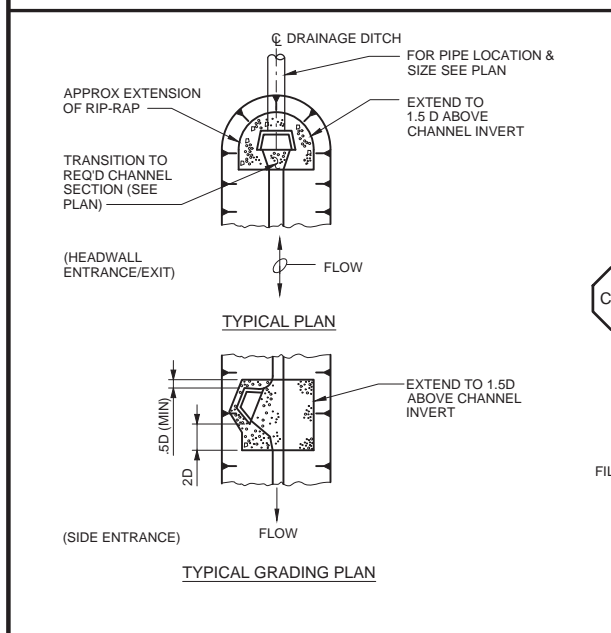
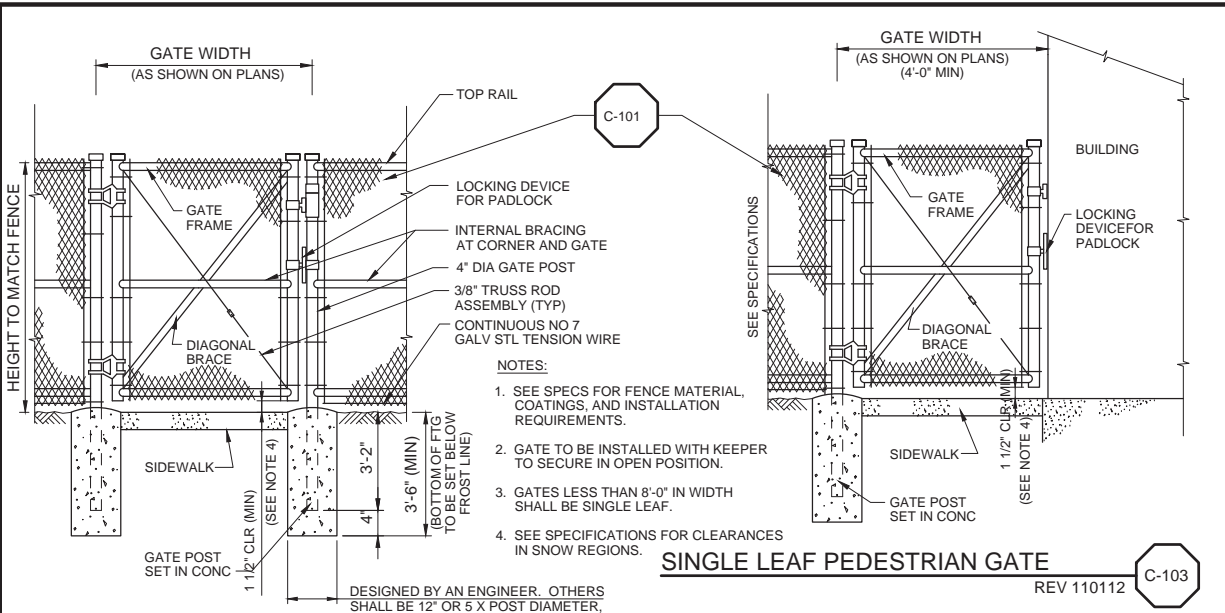
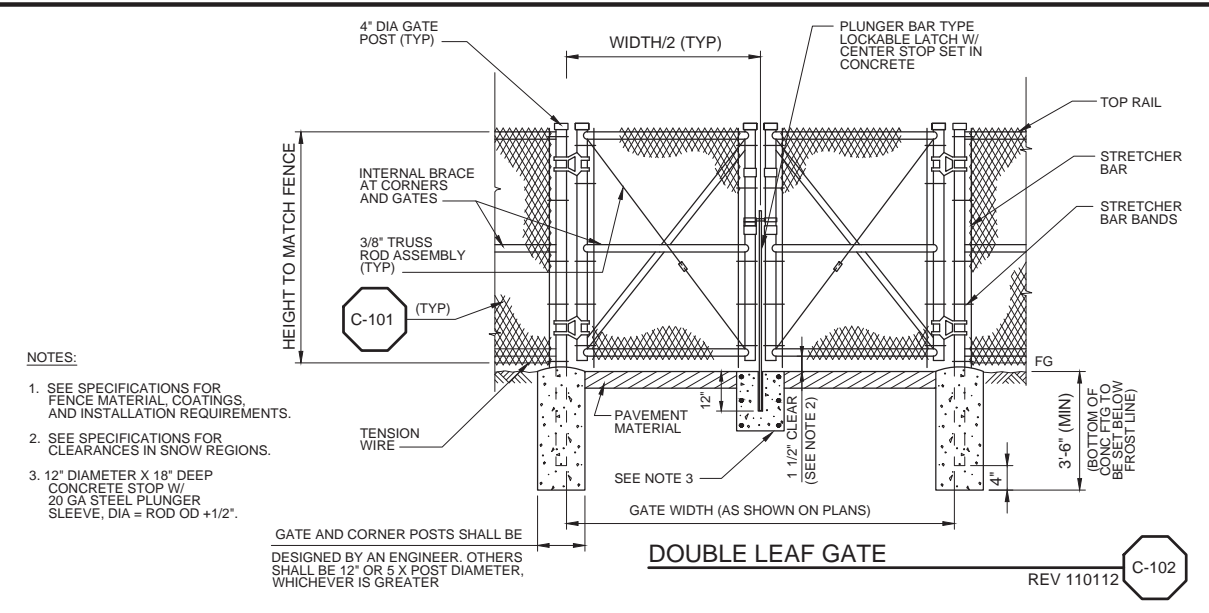
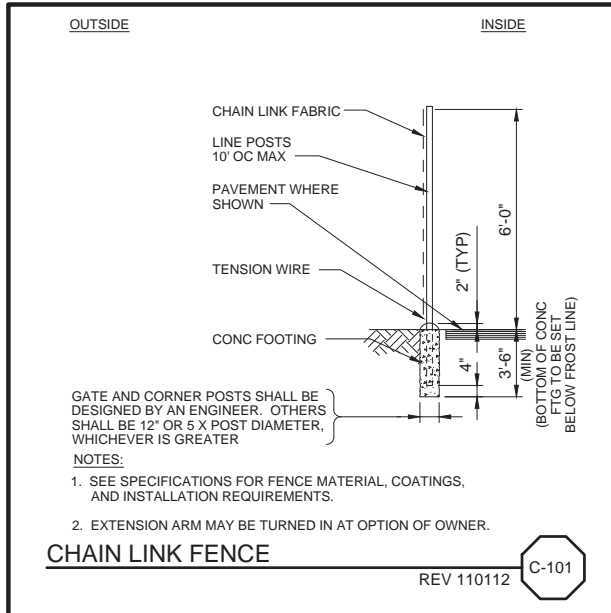
LOGAN CITY
GENERAL CIVIL
STANDARD ERC NOTES



HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT
ADDENDUM 1

LOGAN CITY GENERAL CIVIL STANDARD ERC NOTES	SHEET GC-1
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REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE	NO SCALE
WARNING	IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE
DESIGNED	D WHITBECK
DRAWN	S STARK
CHECKED	T ARNOLD

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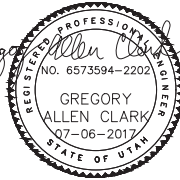


HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT
ADDENDUM 1

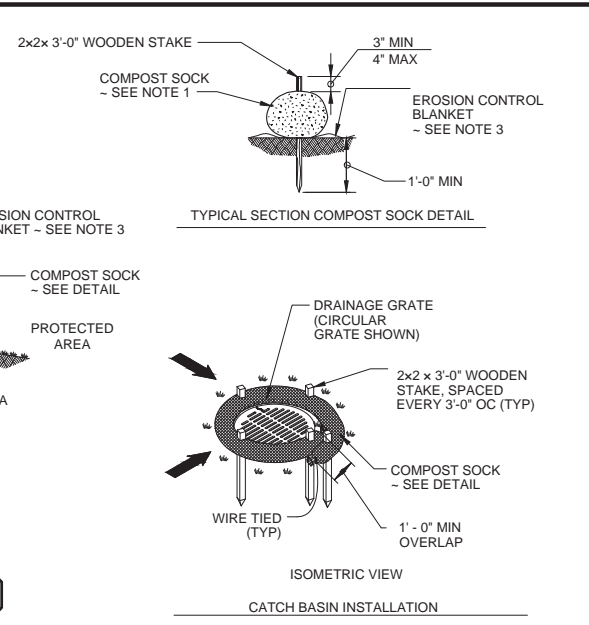
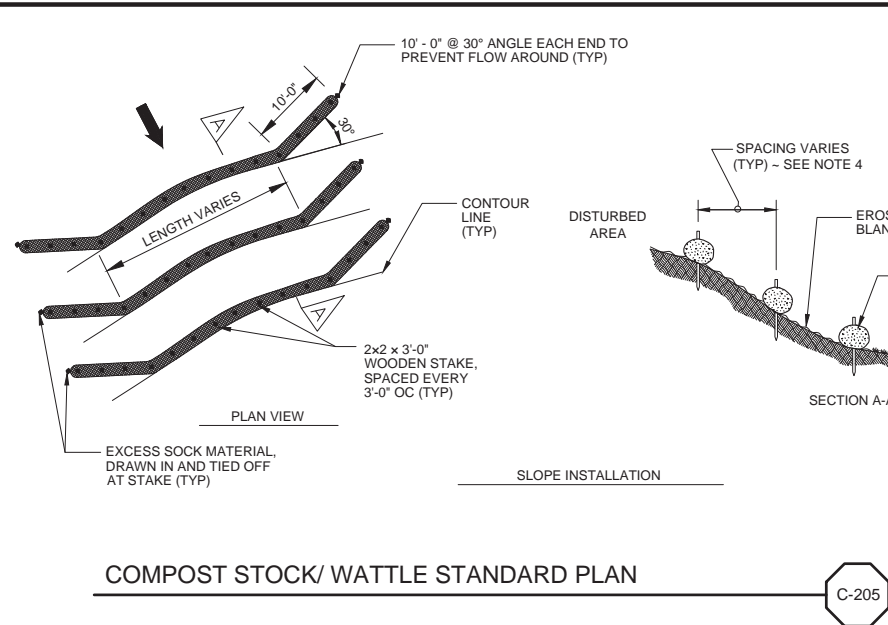
LOGAN CITY
GENERAL CIVIL

STANDARD DETAILS - I

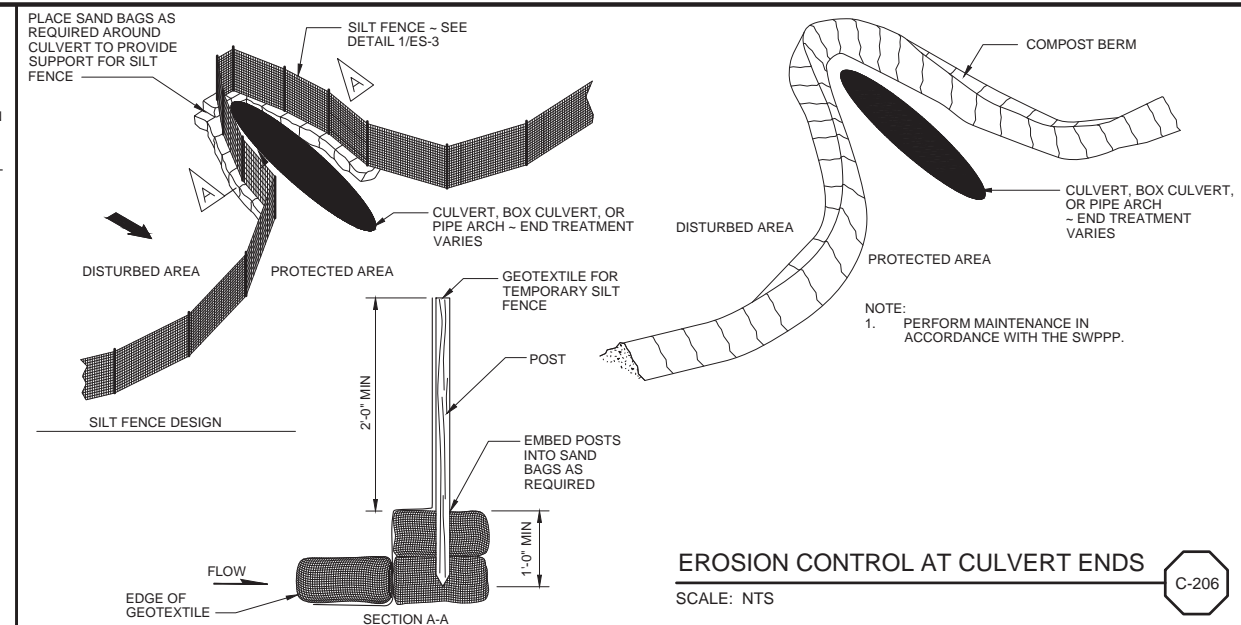
SHEET
GC-2



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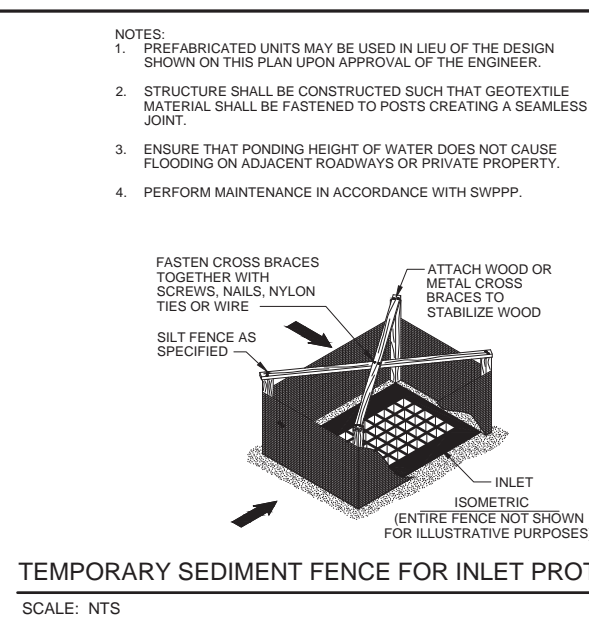
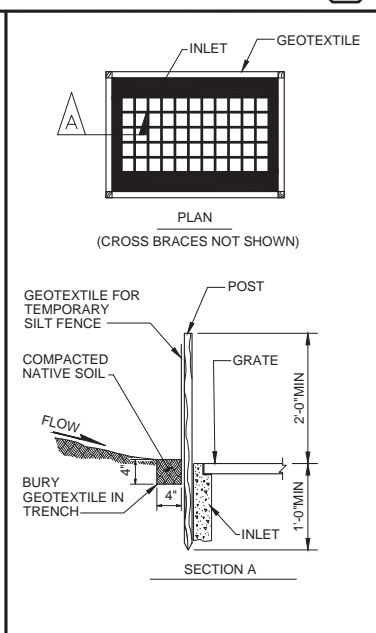
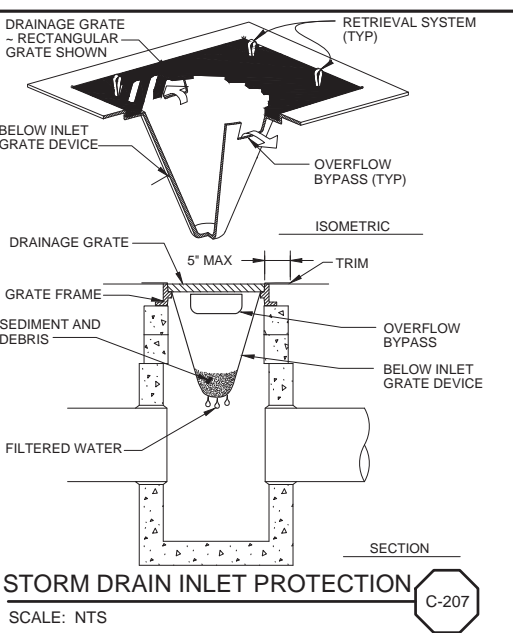


NOTES:
 1. COMPOST SOCK/WATTLE SHALL BE A MINIMUM OF 8" IN DIAMETER OR SIZED TO SUIT CONDITIONS AS SPECIFIED BY THE ENGINEER OF CONTRACT.
 2. COMPOST MATERIAL TO BE DISPERSED ON SITE, AS DETERMINED BY THE ENGINEER.
 3. WHEN PLACING COMPOST SOCK ON SLOPES, USE EROSION CONTROL BLANKET IF SPECIFIED BY THE ENGINEER AND IN ACCORDANCE WITH SWPPP.
 4. ALWAYS INSTALL COMPOST SOCK PERPENDICULAR TO SLOPE AND ALONG CONTOUR LINES.
 5. REMOVE SEDIMENT FROM THE UP SLOPE SIDE OF THE COMPOST SOCK WHEN ACCUMULATION REACHED 1/2 OF EFFECTIVE HEIGHT OF THE COMPOST SOCK.



COMPOST STOCK/ WATTLE STANDARD PLAN C-205

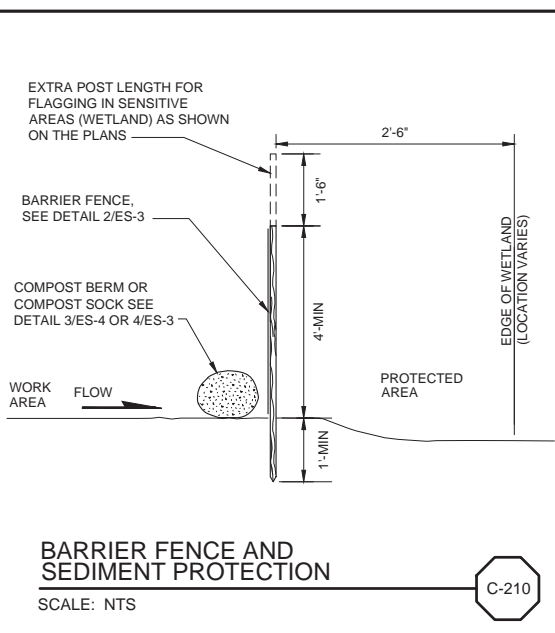
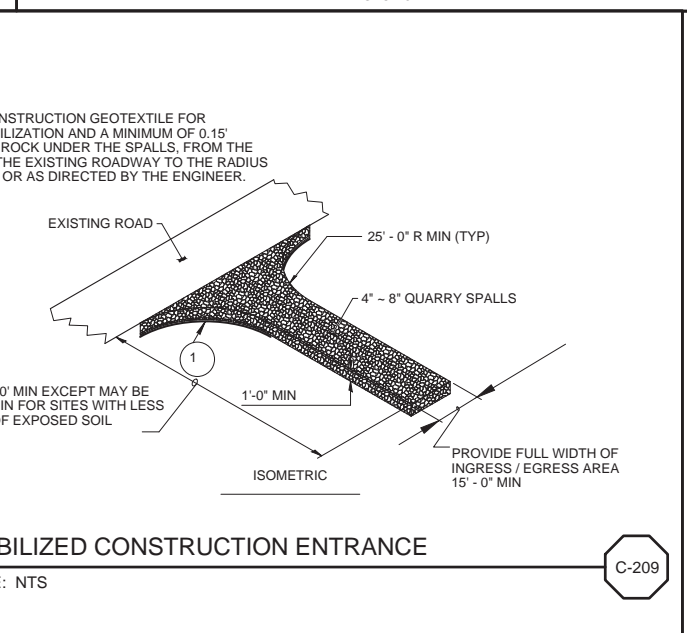
EROSION CONTROL AT CULVERT ENDS C-206
SCALE: NTS



NOTES:
 1. PREFABRICATED UNITS MAY BE USED IN LIEU OF THE DESIGN SHOWN ON THIS PLAN UPON APPROVAL OF THE ENGINEER.
 2. STRUCTURE SHALL BE CONSTRUCTED SUCH THAT GEOTEXTILE MATERIAL SHALL BE FASTENED TO POSTS CREATING A SEAMLESS JOINT.
 3. ENSURE THAT PONDING HEIGHT OF WATER DOES NOT CAUSE FLOODING ON ADJACENT ROADWAYS OR PRIVATE PROPERTY.
 4. PERFORM MAINTENANCE IN ACCORDANCE WITH SWPPP.

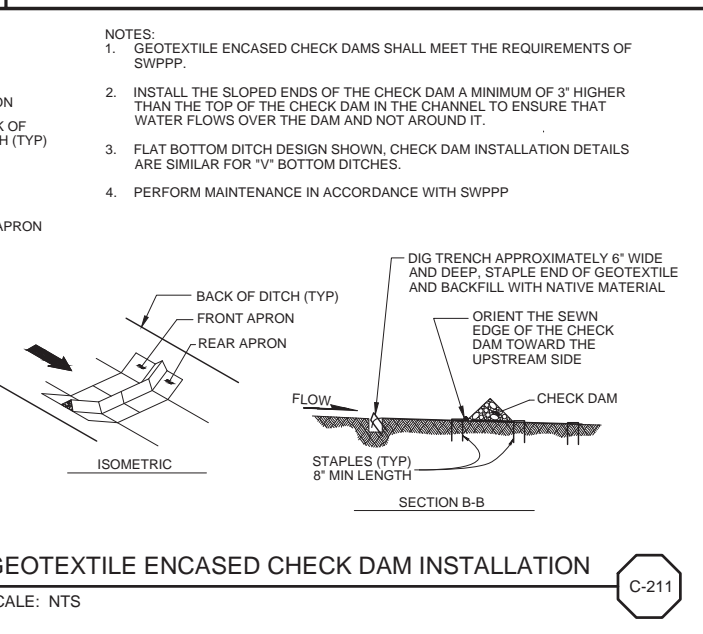
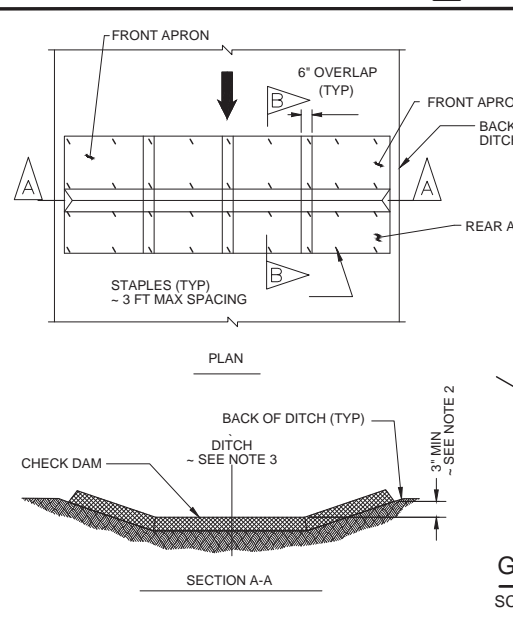
STORM DRAIN INLET PROTECTION C-207
SCALE: NTS

TEMPORARY SEDIMENT FENCE FOR INLET PROTECTION C-208
SCALE: NTS



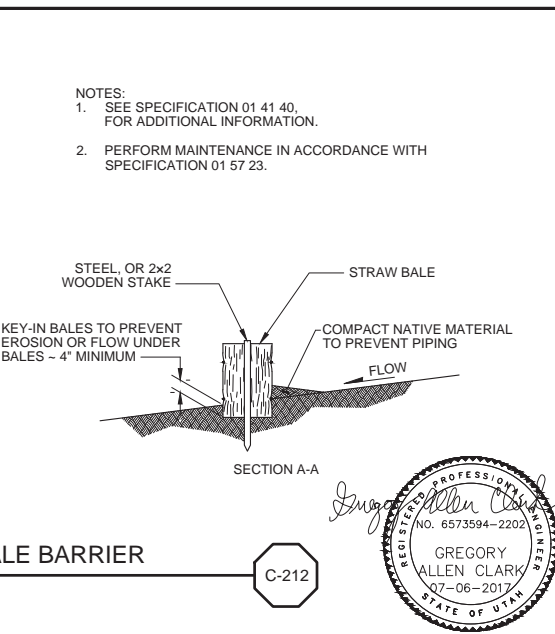
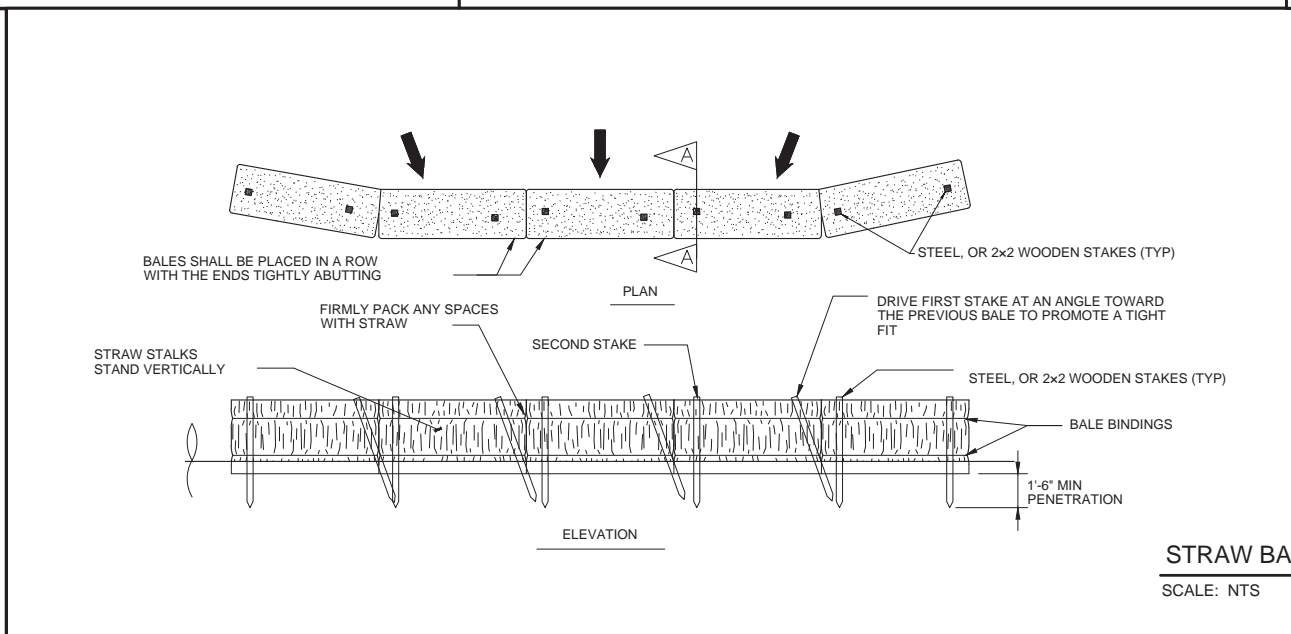
STABILIZED CONSTRUCTION ENTRANCE C-209
SCALE: NTS

BARRIER FENCE AND SEDIMENT PROTECTION C-210
SCALE: NTS



NOTES:
 1. GEOTEXTILE ENCASED CHECK DAMS SHALL MEET THE REQUIREMENTS OF SWPPP.
 2. INSTALL THE SLOPED ENDS OF THE CHECK DAM A MINIMUM OF 3' HIGHER THAN THE TOP OF THE CHECK DAM IN THE CHANNEL TO ENSURE THAT WATER FLOWS OVER THE DAM AND NOT AROUND IT.
 3. FLAT BOTTOM DITCH DESIGN SHOWN, CHECK DAM INSTALLATION DETAILS ARE SIMILAR FOR "V" BOTTOM DITCHES.
 4. PERFORM MAINTENANCE IN ACCORDANCE WITH SWPPP

GEOTEXTILE ENCASED CHECK DAM INSTALLATION C-211
SCALE: NTS



NOTES:
 1. SEE SPECIFICATION 01 41 40, FOR ADDITIONAL INFORMATION.
 2. PERFORM MAINTENANCE IN ACCORDANCE WITH SPECIFICATION 01 57 23.

STRAW BALE BARRIER C-212
SCALE: NTS

REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE	NO SCALE
WARNING	IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE
DESIGNED	D WHITBECK
DRAWN	S STARK
CHECKED	T ARNOLD

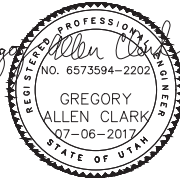
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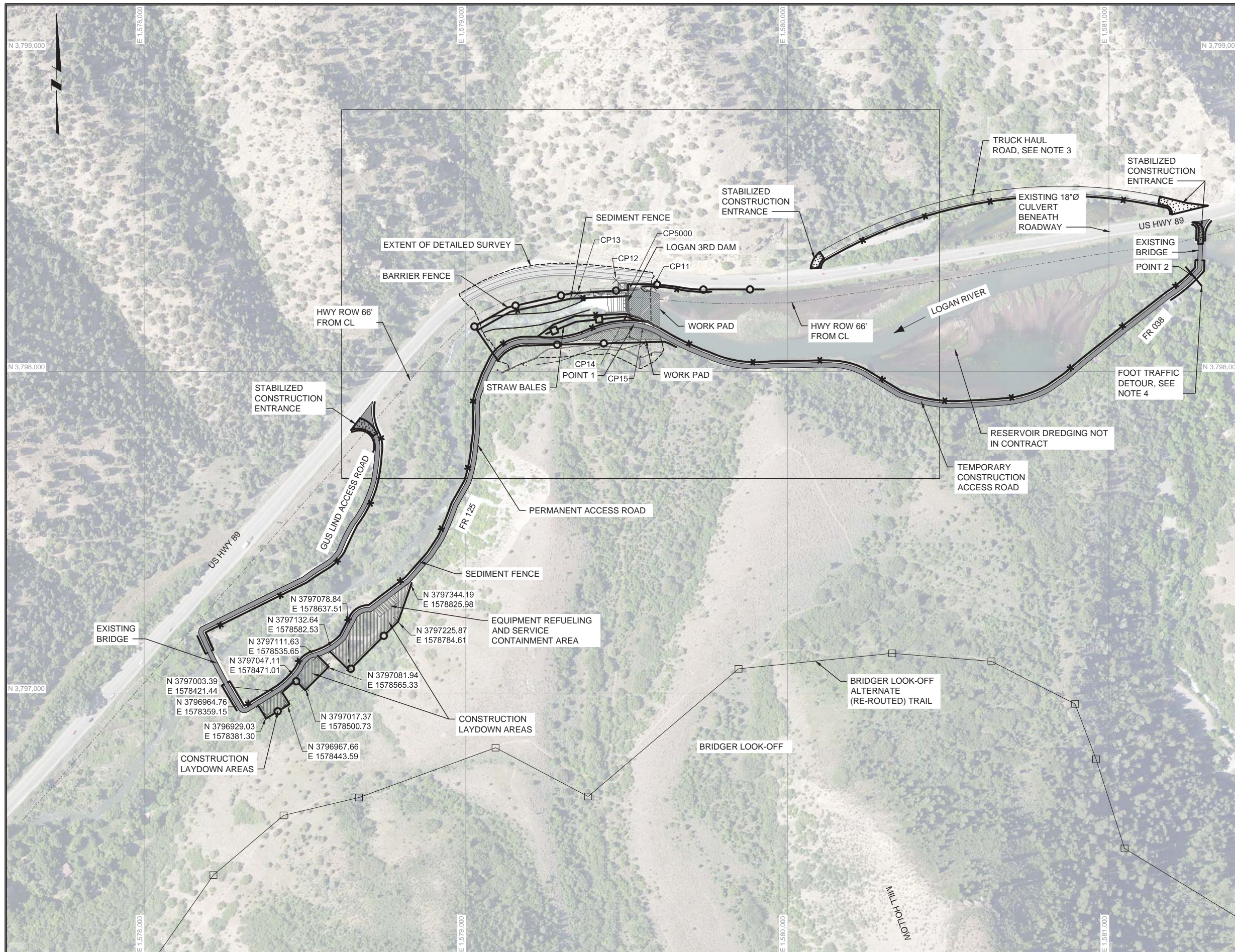


HYDRO NO. 2
 LOGAN 3RD DAM AND SURGE TANK
 IMPROVEMENT PROJECT
 ADDENDUM 1

LOGAN CITY
 GENERAL CIVIL
 STANDARD DETAILS - II
 SHEET
 GC-3

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- ### GENERAL SHEET NOTES
1. TOPOGRAPHIC INFORMATION OUTSIDE OF BORDER INDICATED IS APPROXIMATE. CONTRACTOR SHALL REFER TO SPECIFICATION 31 10 00 - SITE PREPARATION AND 31 35 28 - EROSION CONTROL (VEGETATIVE) FOR INFORMATION PERTAINING TO ADDITIONAL SITE PREPARATION REQUIREMENTS. CONTRACTOR SHALL SUBMIT A TEMPORARY EROSION AND SEDIMENT CONTROL PLAN (SIMILAR TO SHOWN ON THIS SHEET) FOR REVIEW AND APPROVAL BY THE US FOREST SERVICE AND ENGINEER.
 2. DETAILED SURVEY TOPOGRAPHY PROVIDED BY MCNEIL ENGINEERING
8610 SANDY PARKWAY, SUITE 200
SANDY, UT 84070
THE HORIZONTAL DATUM IS NAD83 AND THE VERTICAL DATUM IS NAVD 88.
 3. TRUCK HAUL ROAD TO BE USED FOR SEDIMENT DEWATERING AND LOADING OF MATERIALS DREDGED FROM THE RESERVOIR. RESERVOIR DREDGING NOT IN CONTRACT.
 4. AS NEEDED DURING CONSTRUCTION. CONTRACTOR TO POST SIGNAGE TO DETOUR FOOT TRAFFIC TO BRIDGER LOOK-OFF TRAIL.
 5. A TEMPORARY CONSTRUCTION ACCESS ROAD SHALL BE CONSTRUCTED BETWEEN POINTS 1 AND 2 AS SHOWN ON THIS DRAWING. THE TEMPORARY ROADWAY SHALL BE USED FOR CONSTRUCTION ACCESS ONLY AND SHALL BE COMPLETELY REMOVED AND REVEGETATED FOLLOWING CONSTRUCTION. IMPROVEMENTS MADE THROUGH THE GUS LIND CAMPING AREA (BETWEEN HWY 89 AND LOGAN 3RD DAM) FOR CONSTRUCTION ACCESS ARE CONSIDERED PERMANENT FEATURES AND SHOULD NOT BE REMOVED FOLLOWING CONSTRUCTION. TYPICAL SECTIONS FOR EACH ACCESS ROADWAY ARE PROVIDED IN THE CONTRACT DRAWINGS.

LEGEND

- SEDIMENT FENCE DETAIL C-204/GC-2
- STRAW BALES DETAIL C-212/GC-3
- BARRIER FENCE DETAIL C-203/GC-2
- STABILIZED CONSTRUCTION ENTRANCE

SURVEY CONTROL POINTS

POINT	NORTHING	EASTING	ELEVATION (FT)	DESCRIPTION
11	3798261.76	1579582.57	5026.75	CP11
12	3798284.01	1579467.74	5026.89	CP12
13	3798241.58	1579346.19	5011.62	CP13
14	3798185.52	1579505.81	5024.61	CP14
15	3798147.38	1579553.26	5026.78	CP15
5000	3798247.81	1579504.15	5024.74	CP5000

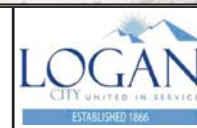
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WARNING
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DESIGNED G CLARK
DRAWN D WEEKS
CHECKED T ARNOLD

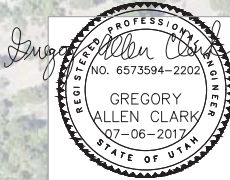
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HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT
ADDENDUM 1

LOGAN CITY
CIVIL
LOGAN 3RD DAM
LOGAN THIRD DAM IMPROVEMENTS OVERALL SITE PLAN
CONSTRUCTION ACCESS PLAN

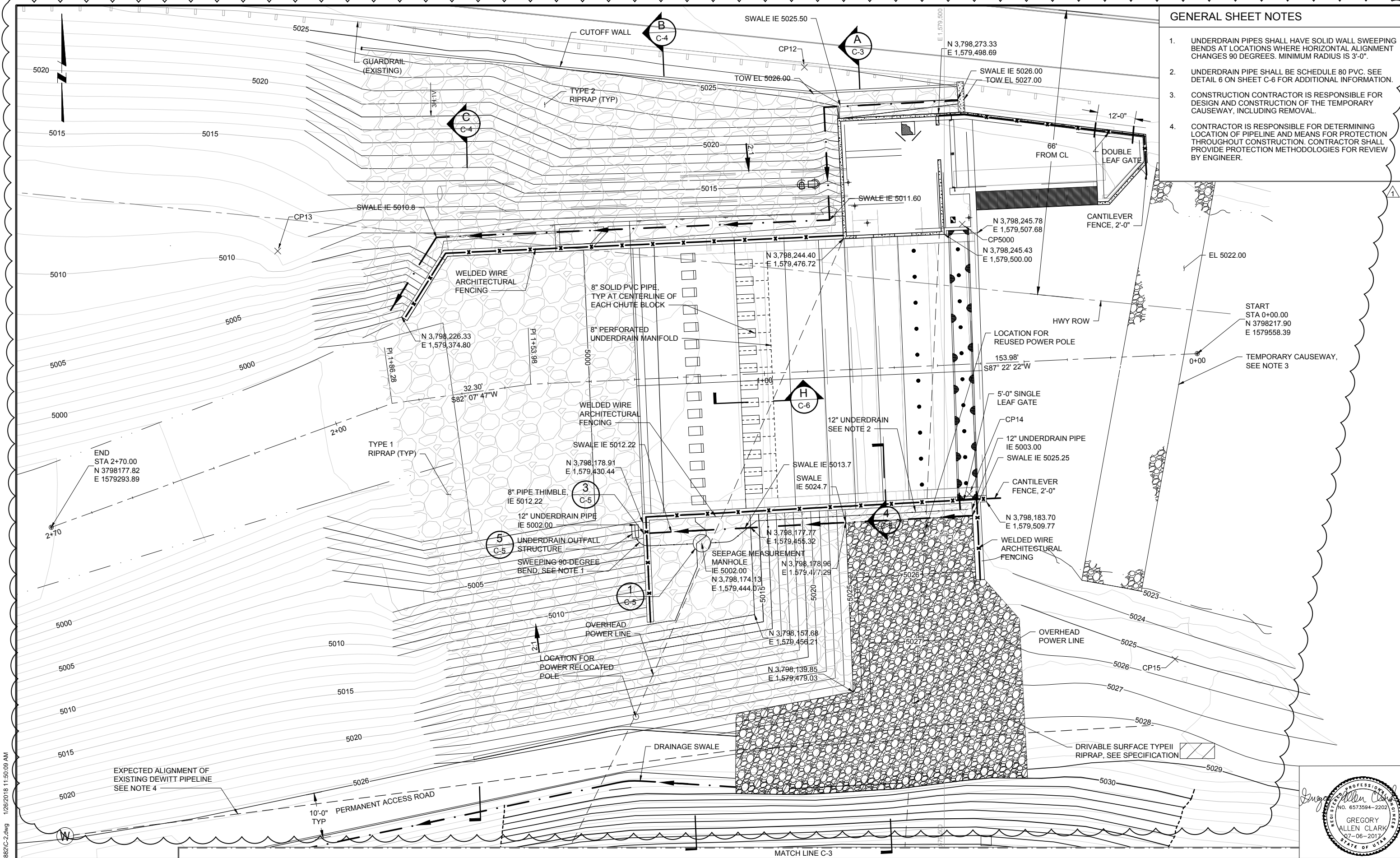
SHEET
C-1



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GENERAL SHEET NOTES

1. UNDERDRAIN PIPES SHALL HAVE SOLID WALL SWEEPING BENDS AT LOCATIONS WHERE HORIZONTAL ALIGNMENT CHANGES 90 DEGREES. MINIMUM RADIUS IS 3'-0".
2. UNDERDRAIN PIPE SHALL BE SCHEDULE 80 PVC. SEE DETAIL 6 ON SHEET C-6 FOR ADDITIONAL INFORMATION.
3. CONSTRUCTION CONTRACTOR IS RESPONSIBLE FOR DESIGN AND CONSTRUCTION OF THE TEMPORARY CAUSEWAY, INCLUDING REMOVAL.
4. CONTRACTOR IS RESPONSIBLE FOR DETERMINING LOCATION OF PIPELINE AND MEANS FOR PROTECTION THROUGHOUT CONSTRUCTION. CONTRACTOR SHALL PROVIDE PROTECTION METHODOLOGIES FOR REVIEW BY ENGINEER.



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			DESCRIPTION

SCALE
1" = 10'

WARNING
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED D.WHITBECK
DRAWN S.STARK
CHECKED T.ARNOLD

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HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT
ADDENDUM 1

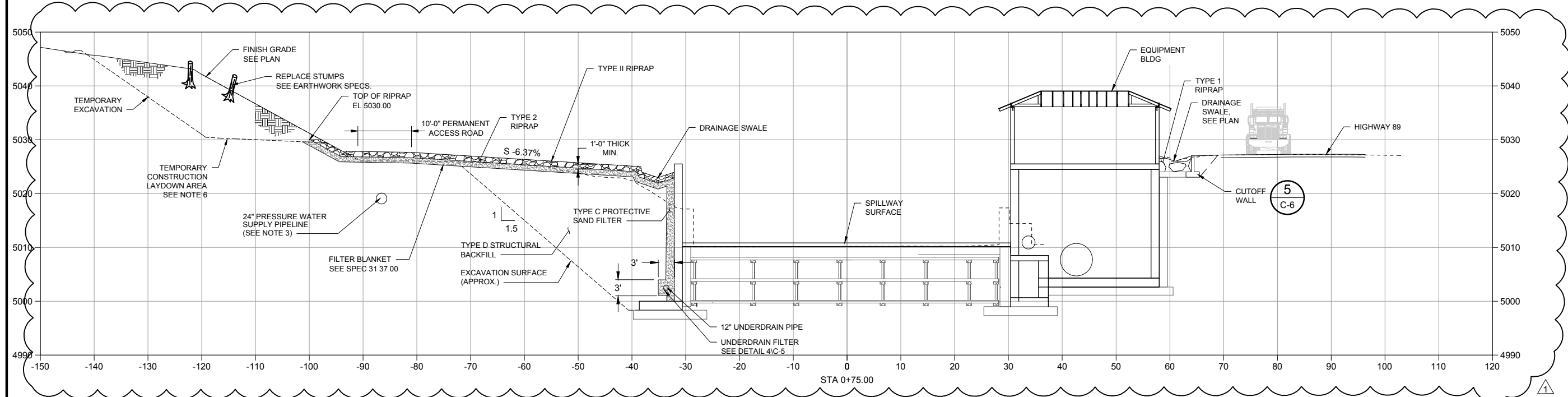
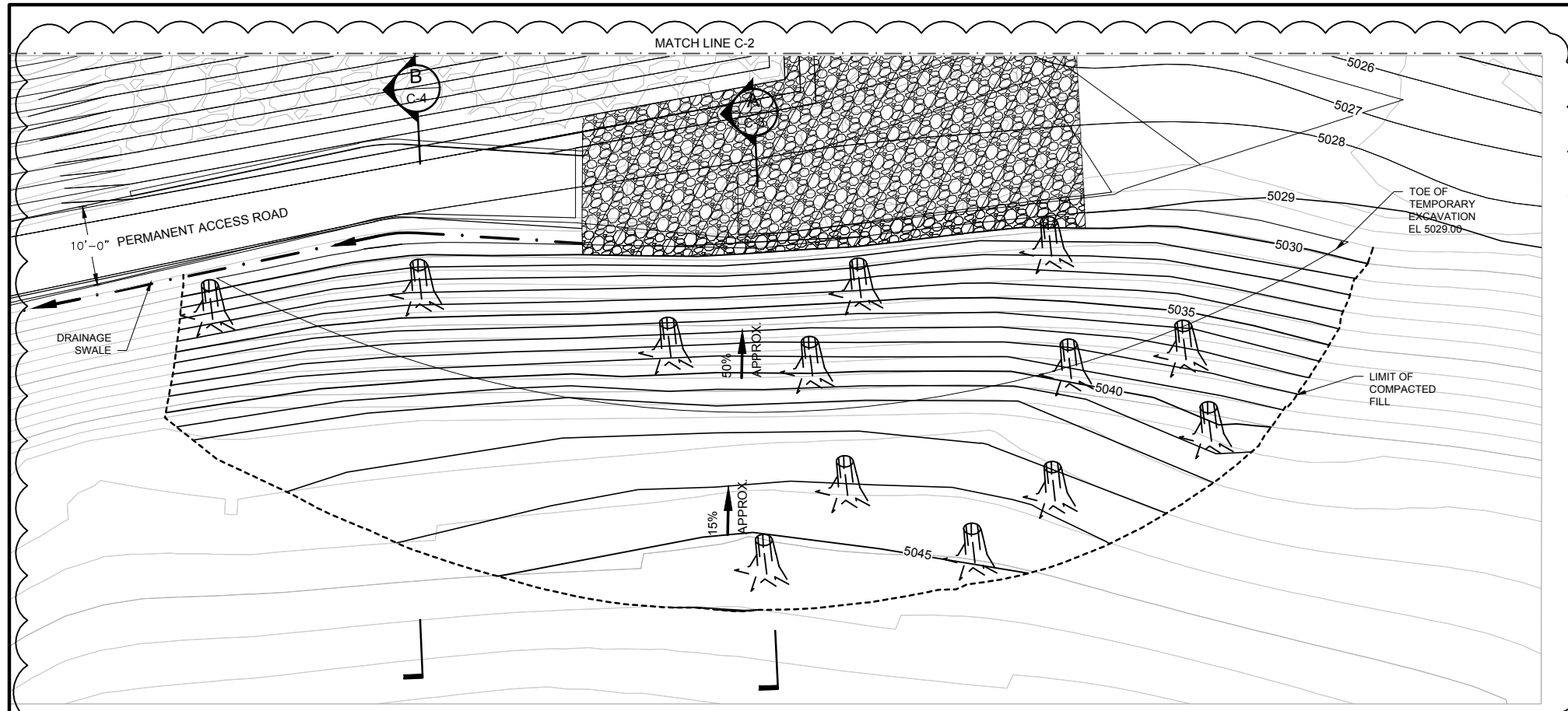
LOGAN CITY
CIVIL
LOGAN 3RD DAM
BANK AMORING PLAN

SHEET
C-2



GENERAL SHEET NOTES

- EXISTING GRADE SLOPES SHOWN ARE APPROXIMATE. CONTRACTOR TO FIELD VERIFY ELEVATIONS.
- LOCATION SHOWN FOR BURIED PENSTOCK IS APPROXIMATE. CONTRACTOR TO POTHOLE PRIOR TO EXCAVATING FOR RCC SURFACE PREPARATION.
- LOCATION SHOWN FOR BURIED WATER SUPPLY PIPELINE IS APPROXIMATE. CONTRACTOR TO POTHOLE PRIOR TO EXCAVATING FOR RCC SURFACE PREPARATION.
- UNDERDRAIN PIPE SHALL BE SCHEDULE 80 PVC PIPE. SEE DETAIL 6 ON SHEET C-6.
- SOIL TIEBACK SYSTEM NOT SHOWN FOR CLARITY.
- TEMPORARY CONSTRUCTION LAYDOWN AREA SHALL BE EXCAVATED TO EL 5029.00. MATERIAL SHALL BE STOCKPILED AND USED FOR COMPACTED FILL. ROOT WADS SHALL BE STOCKPILED AND RE-USED FOLLOWING CONSTRUCTION FOR PERMANENT FILL. SEE SPEC 31 30 00 FOR ADDITIONAL REQUIREMENTS.



A SECTION
C-2 SCALE: 1:10

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SCALE: 1" = 10'

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DRAWN D.WHITBECK
CHECKED T.ARNOLD

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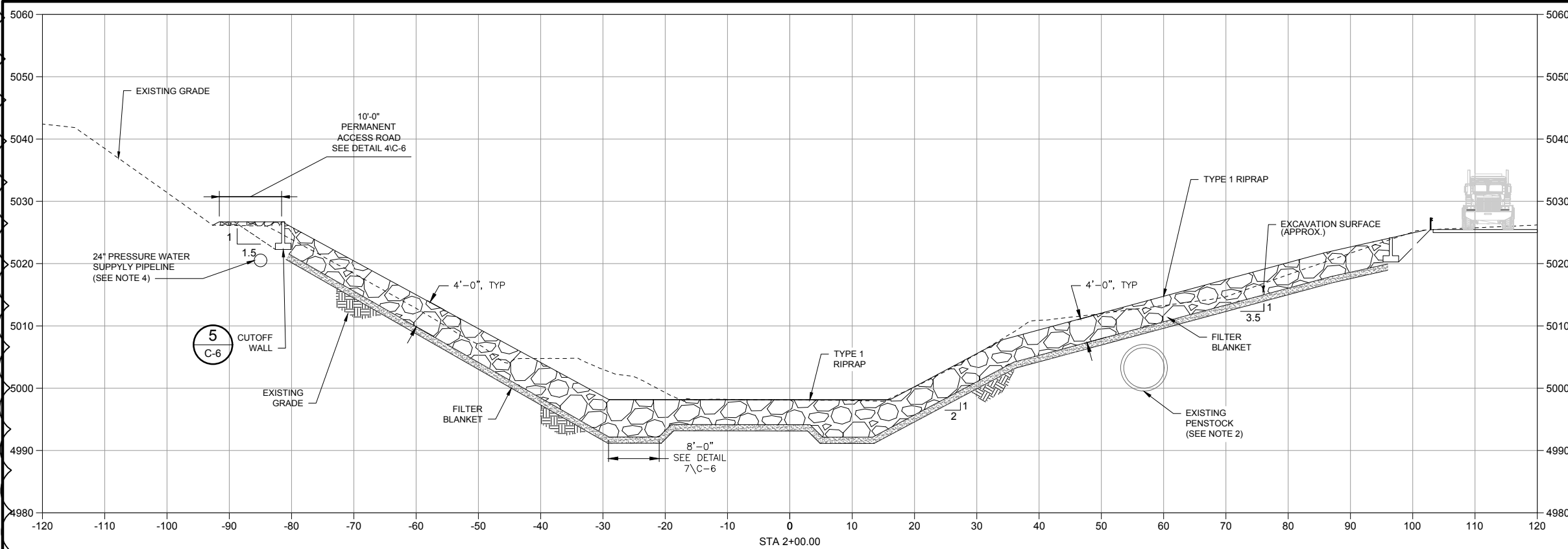


HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT
ADDENDUM 1

LOGAN CITY
CIVIL
LOGAN 3RD DAM
GRADING SECTIONS - I

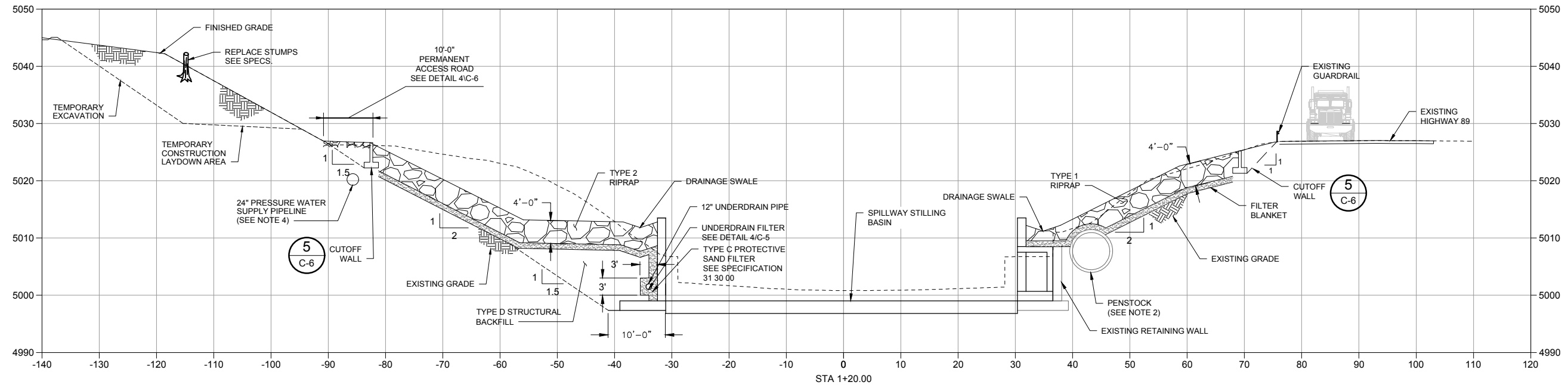


SHEET
C-3

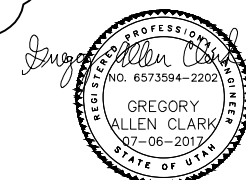


C SECTION
C-2 SCALE: 1:10

- GENERAL SHEET NOTES**
- EXISTING GRADE SLOPES SHOWN ARE APPROXIMATE. CONTRACTOR TO FIELD VERIFY ELEVATIONS.
 - LOCATION SHOWN FOR BURIED PENSTOCK IS APPROXIMATE. CONTRACTOR TO VERIFY PRIOR TO EXCAVATING FOR RCC SURFACE PREPARATION.
 - UNDERDRAIN PIPE SHALL BE SCHEDULE 40 PVC PIPE. SEE DETAIL ON SHEET C-6.
 - LOCATION SHOWN FOR BURIED WATER SUPPLY PIPELINE IS APPROXIMATE. CONTRACTOR TO POTHOLE PRIOR TO EXCAVATING FOR RCC SURFACE PREPARATION.



B SECTION
C-2 SCALE: 1:10



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DRAWN D.WHITBECK
CHECKED T.ARNOLD

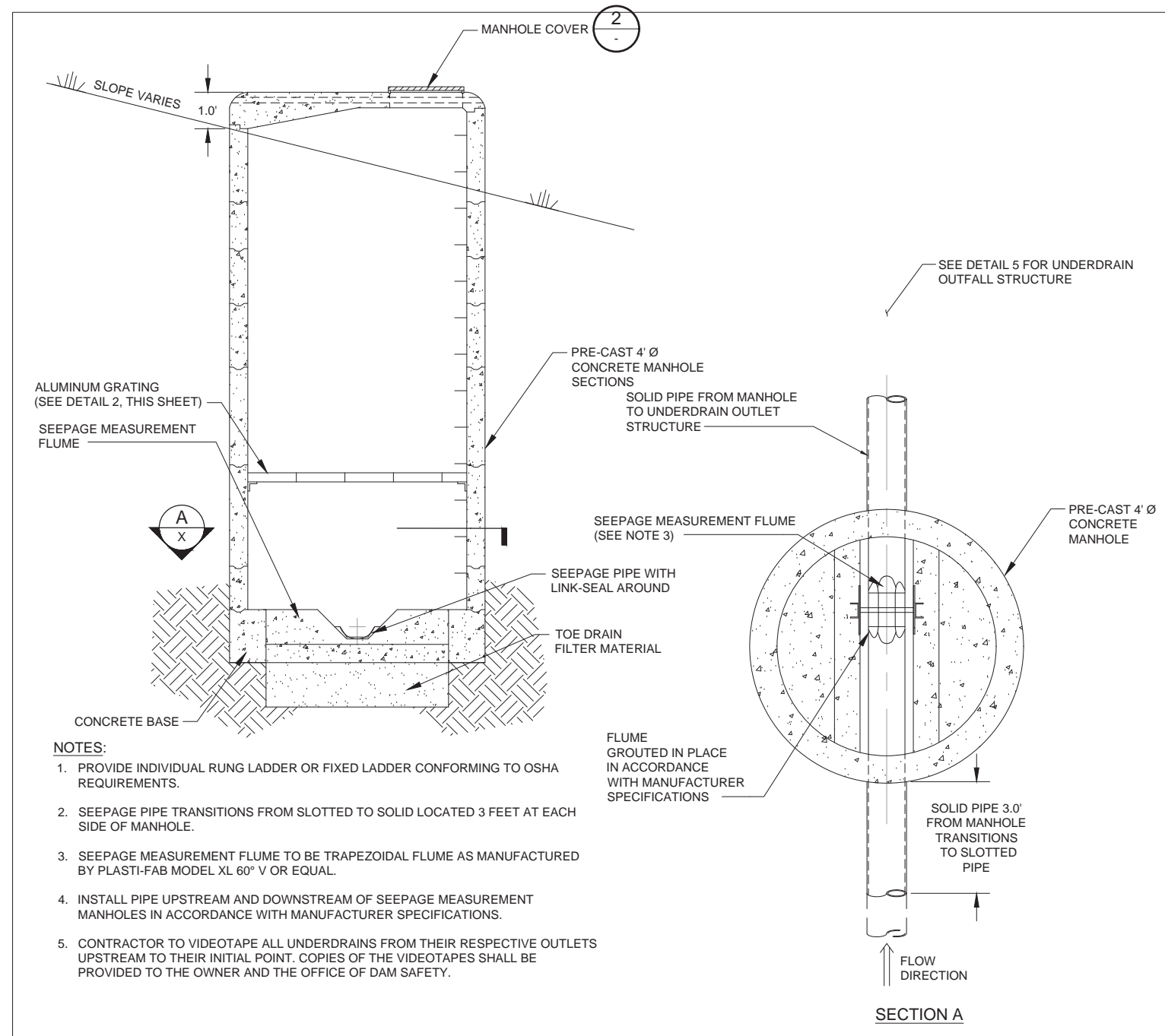
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HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT
ADDENDUM 1

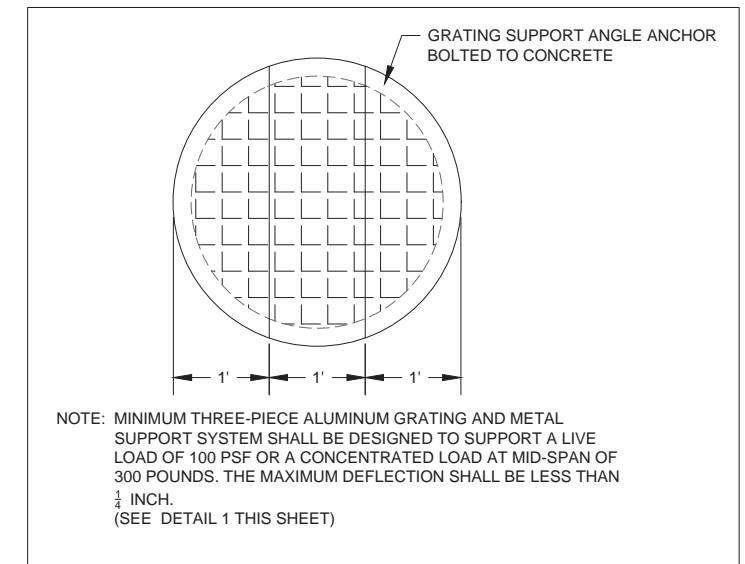
LOGAN CITY
CIVIL
LOGAN 3RD DAM
GRADING SECTIONS - II

SHEET
C-4

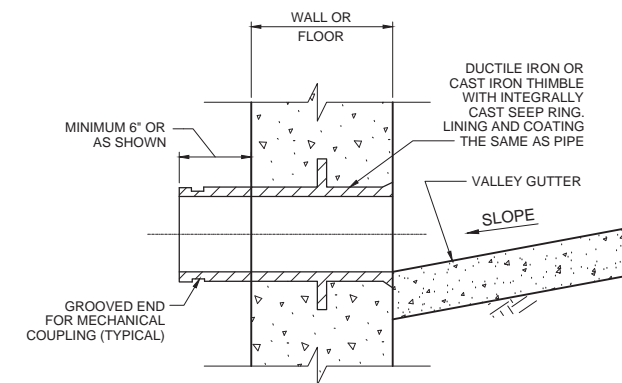


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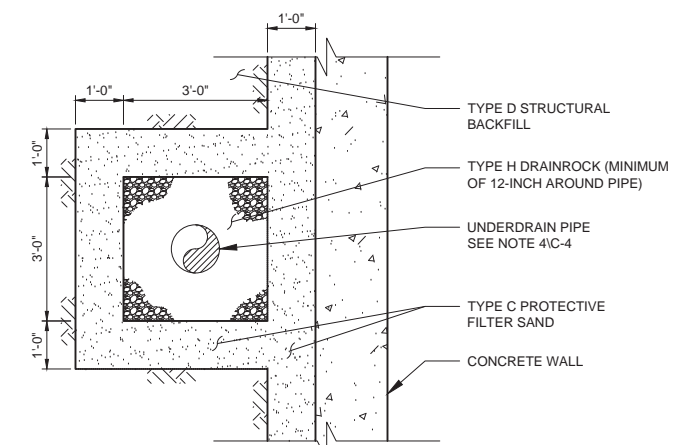
1. PROVIDE INDIVIDUAL RUNG LADDER OR FIXED LADDER CONFORMING TO OSHA REQUIREMENTS.
2. SEEPAGE PIPE TRANSITIONS FROM SLOTTED TO SOLID LOCATED 3 FEET AT EACH SIDE OF MANHOLE.
3. SEEPAGE MEASUREMENT FLUME TO BE TRAPEZOIDAL FLUME AS MANUFACTURED BY PLASTI-FAB MODEL XL 60° V OR EQUAL.
4. INSTALL PIPE UPSTREAM AND DOWNSTREAM OF SEEPAGE MEASUREMENT MANHOLES IN ACCORDANCE WITH MANUFACTURER SPECIFICATIONS.
5. CONTRACTOR TO VIDEOTAPE ALL UNDERDRAINS FROM THEIR RESPECTIVE OUTLETS UPSTREAM TO THEIR INITIAL POINT. COPIES OF THE VIDEOTAPES SHALL BE PROVIDED TO THE OWNER AND THE OFFICE OF DAM SAFETY.



2 DETAIL
NO SCALE

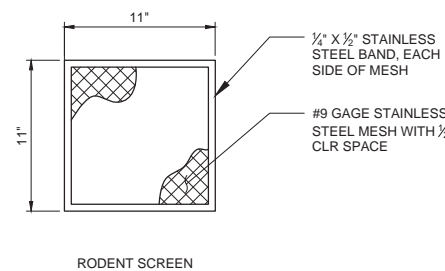


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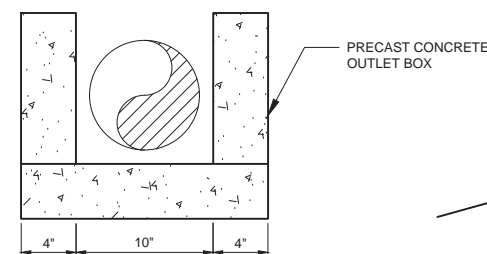


4 UNDERDRAIN FILTER
NO SCALE

1 DETAIL
NO SCALE

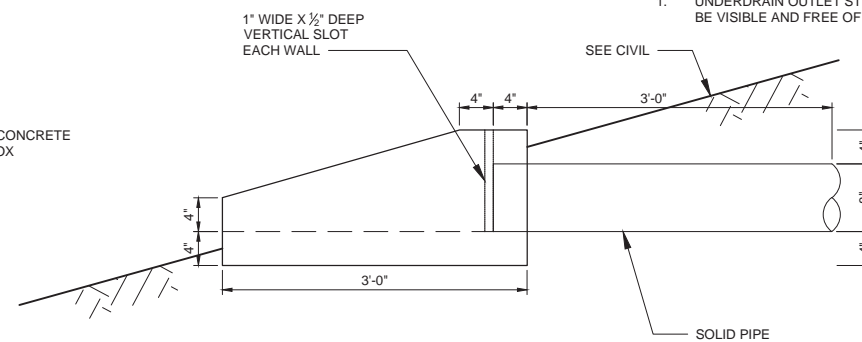


5 UNDERDRAIN OUTFALL STRUCTURE
NO SCALE



NOTES:

1. UNDERDRAIN OUTLET STRUCTURE SHALL BE VISIBLE AND FREE OF OBSTRUCTIONS.



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WARNING	0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE	

DESIGNED	D. WHITBECK
DRAWN	D. WHITBECK
CHECKED	T. ARNOLD

ISSUED FOR CONSTRUCTION - JULY 2017

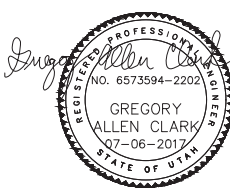
ANY PRINT NOT BEARING THIS STAMP MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.

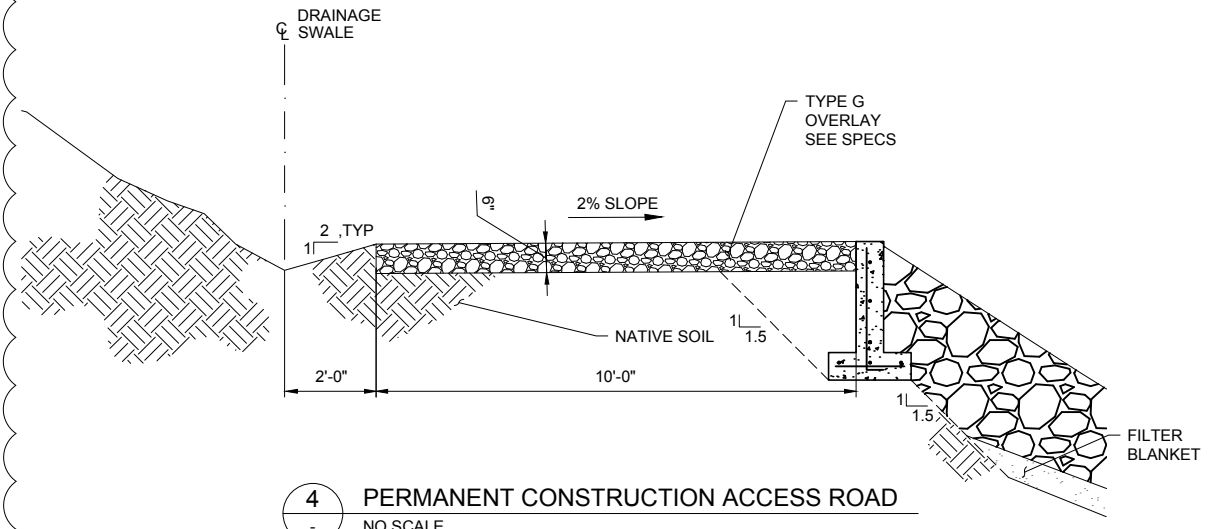


HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT
ADDENDUM 1

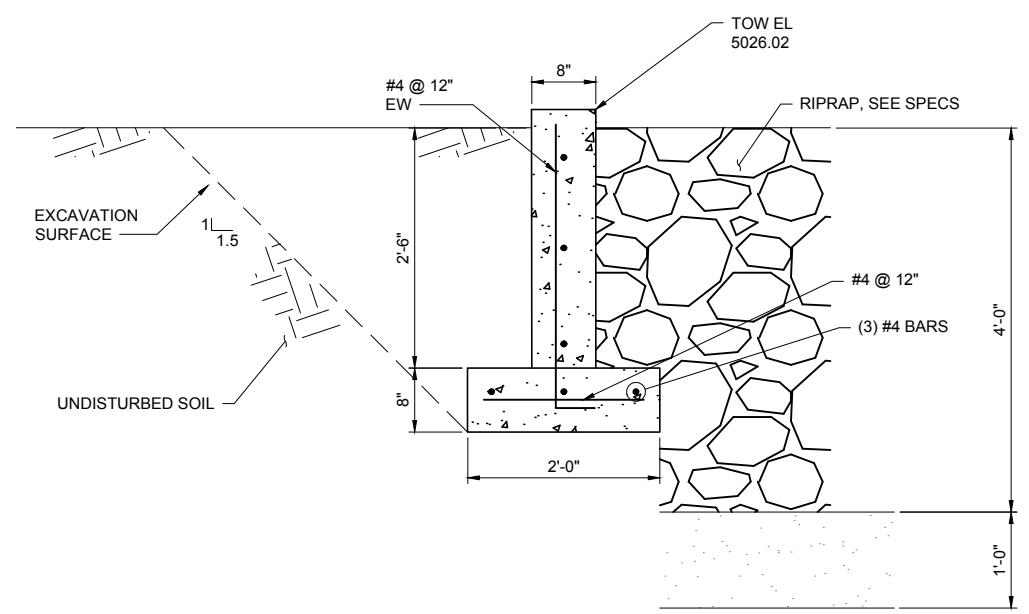
LOGAN CITY
CIVIL
LOGAN 3RD DAM
MISCELLANEOUS DETAILS

SHEET
C-5

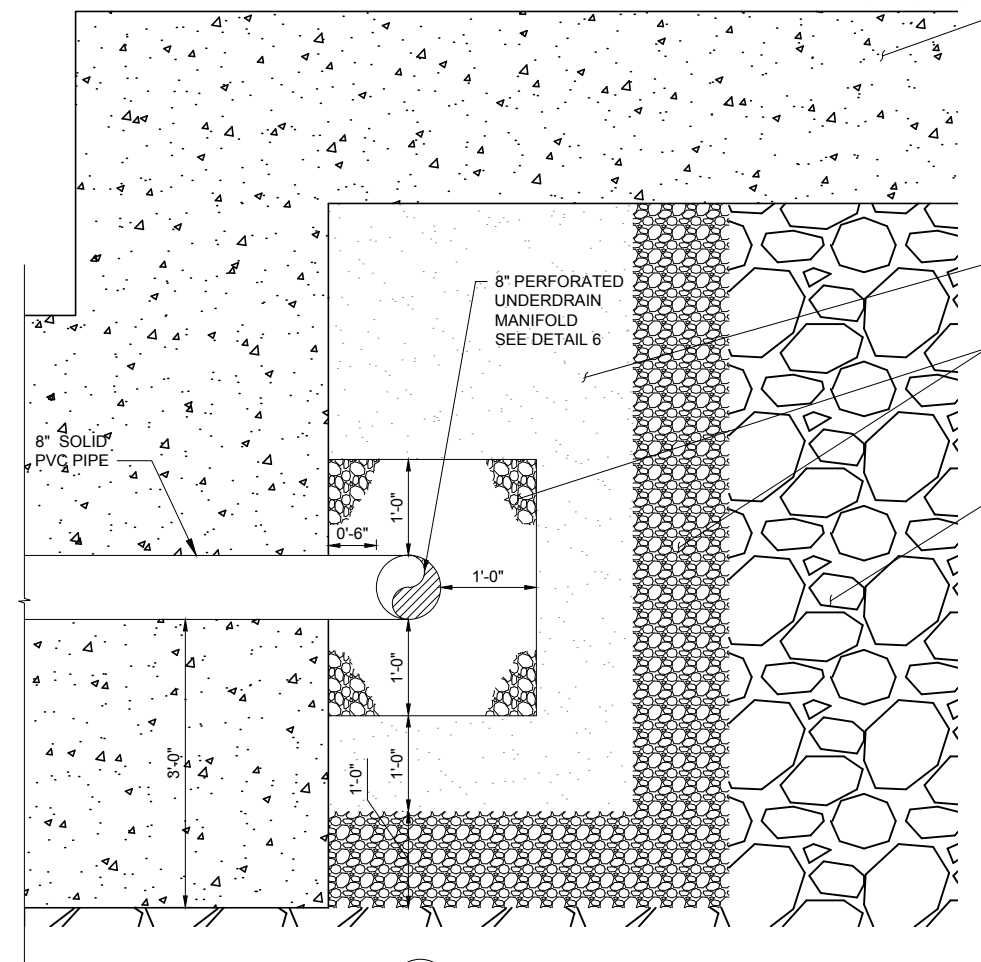




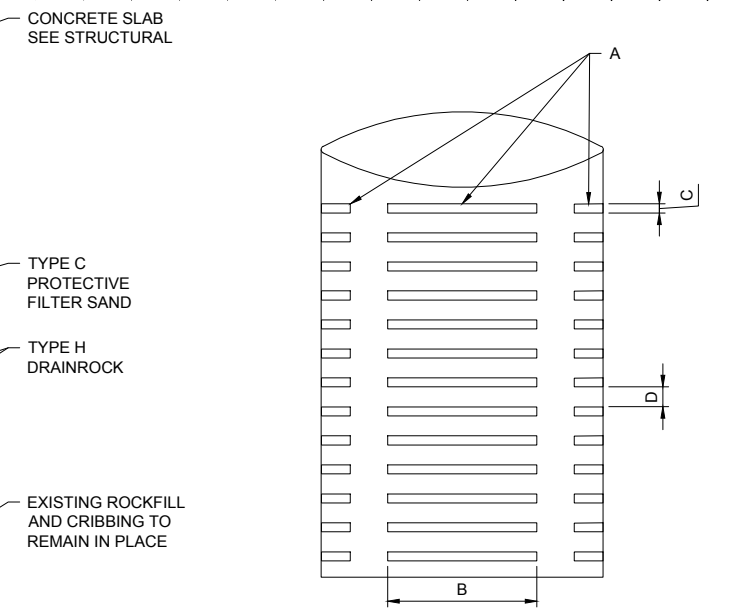
4 PERMANENT CONSTRUCTION ACCESS ROAD
 NO SCALE
 NOTE: LOCATION DOWN STREAM FROM LOGAN 3RD DAM TO GUS LINT CAMPGROUND



5 CUTOFF WALL
 SCALE: 1" = 1'-0"

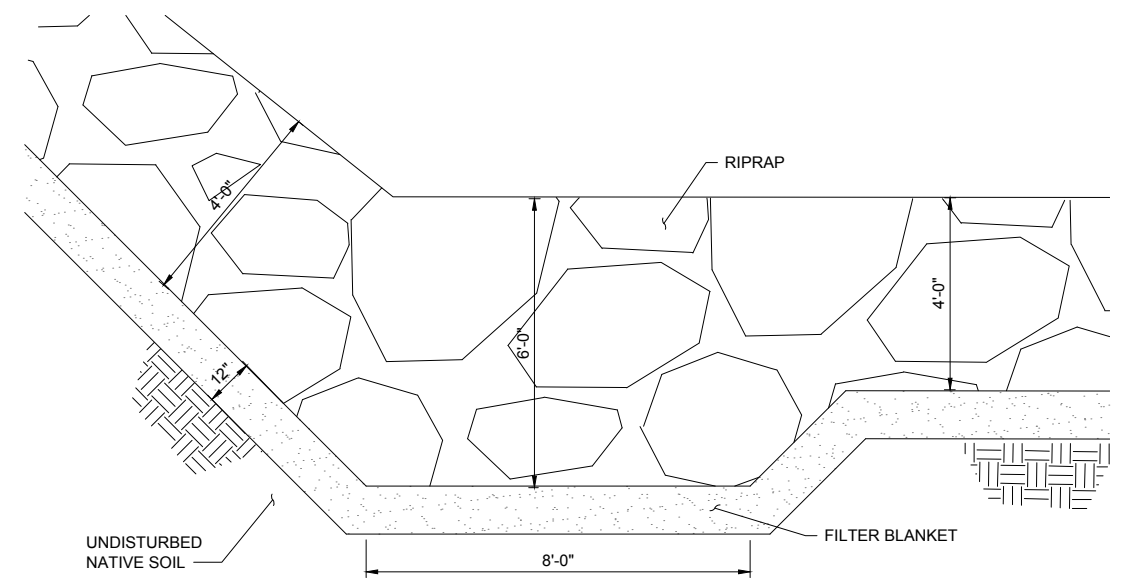


H SECTION
 C-2
 SCALE: 1" = 1'-0"
 NOTE: SEE SPECIFICATION 31 30 00 FOR MATERIAL REQUIREMENTS



PIPE SIZE	OUTSIDE DIAMETER	SLOT WIDTH "C"	ROWS "A"	SLOT LENGTH "B"	SPACING "D"
8"	8.625"	1/8"	6	1.60"	3"
12"	12.75"	1/8"	8	2.20"	3"

6 UNDERDRAIN PIPE
 NO SCALE
 NOTE: PIPE SHALL BE SCHEDULE 80 PVC



7 DETAIL
 NO SCALE

C:\pwworking\140882\C-5.dwg 1/26/2018 1:41:25 PM

REV	DATE	BY	DESCRIPTION
1	01-25-18	GAC	DCN 1

SCALE	1" = 50'
WARNING	IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED	S. RADFORD
DRAWN	S. STARK
CHECKED	T. ARNOLD

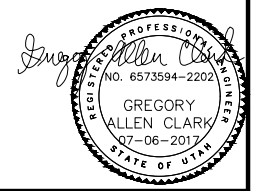
ISSUED FOR CONSTRUCTION - JULY 2017
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HYDRO NO. 2
 LOGAN 3RD DAM AND SURGE TANK
 IMPROVEMENT PROJECT
 ADDENDUM 1

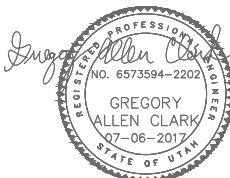
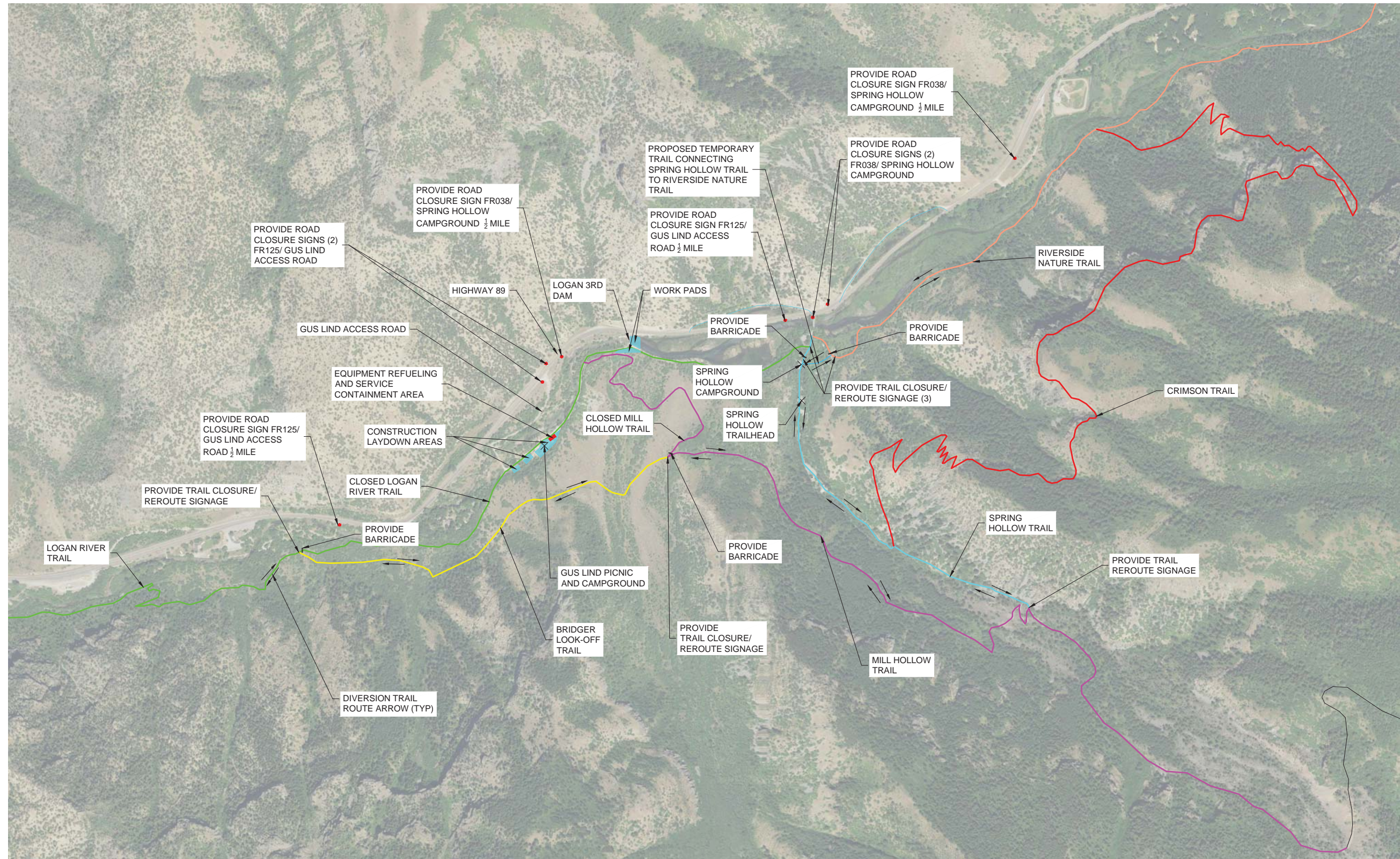
LOGAN CITY
 CIVIL
 LOGAN 3RD DAM
 CIVIL DETAILS

SHEET
 C-6



GENERAL SHEET NOTES

1. PROVIDED ROAD CLOSURE SIGNAGE ON HIGHWAY PER UDOT REQUIREMENTS.
2. TRAIL CLOSURE/REOUT SIGNAGE SHALL BE TYPE I BARRICADES WITH LAMINATED GRAPHICS ON PLYWOOD BACKING, ATTACHED TO THE BARRICADE.



T:\Shaffer\1.0 Projects\LOGAN 3RD DAM\7 TRAIL CLOSURE, RE-ROUTING, AND SIGNAGE.dwg 9/27/2017 10:32:08 AM

REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE
1" = 500'

WARNING
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED G. CLARK
DRAWN K. SHAFFER
CHECKED J. LARSEN

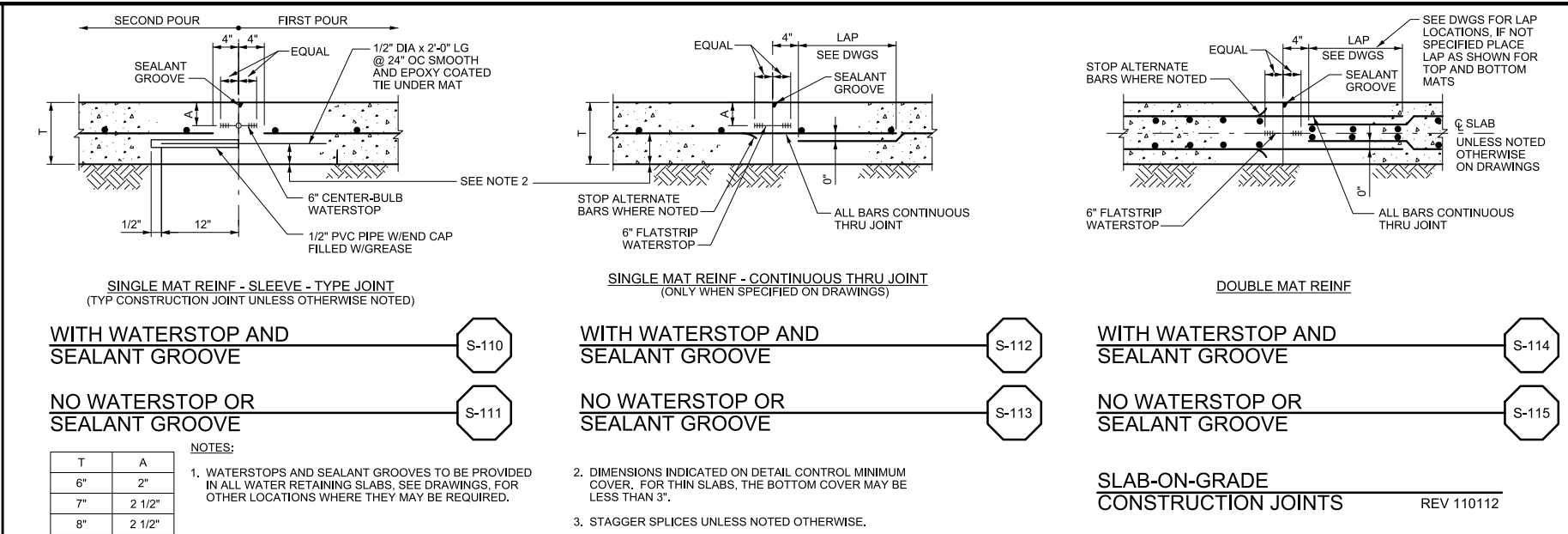
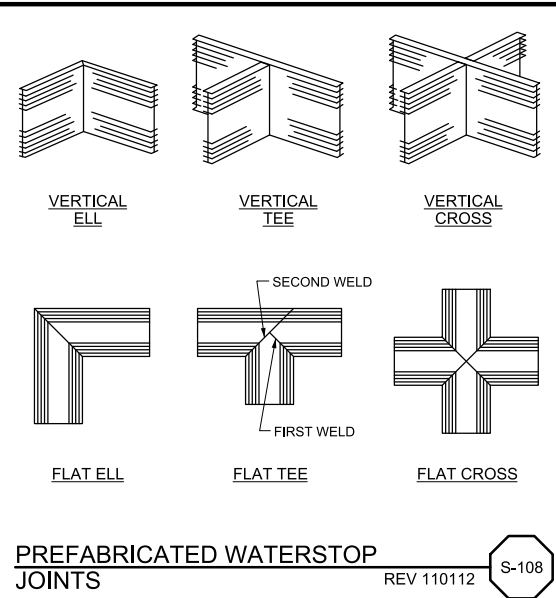
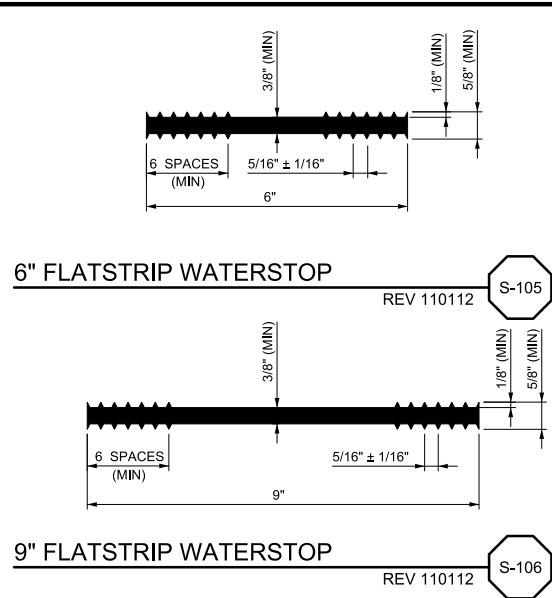
ISSUED FOR CONSTRUCTION - JULY 2017
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HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT
ADDENDUM 1

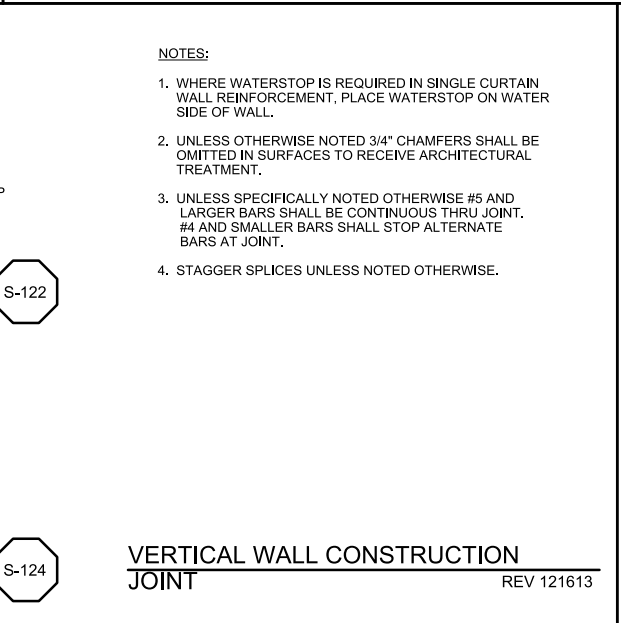
LOGAN CITY
CIVIL
TRAIL CLOSURE, RE-ROUTING, AND SIGNAGE

SHEET
C-7

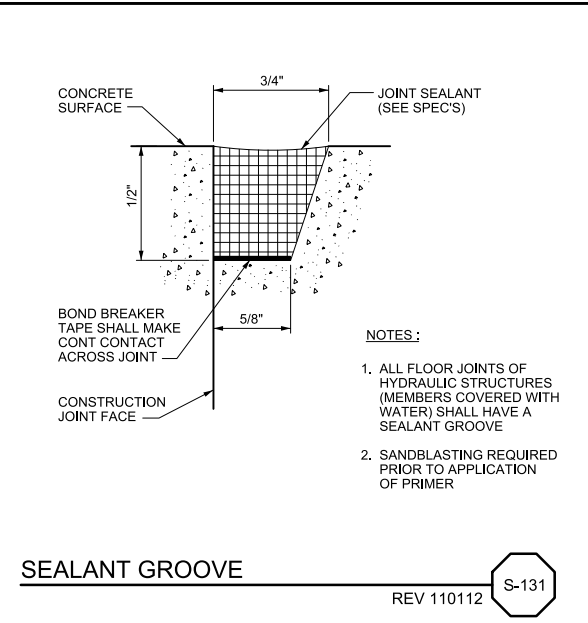


T	A
6"	2"
7"	2 1/2"
8"	2 1/2"

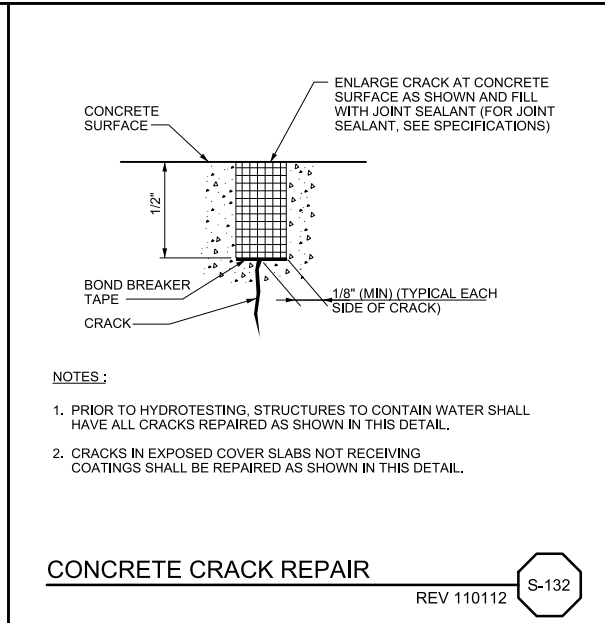
- NOTES:**
1. WATERSTOPS AND SEALANT GROOVES TO BE PROVIDED IN ALL WATER RETAINING SLABS, SEE DRAWINGS, FOR OTHER LOCATIONS WHERE THEY MAY BE REQUIRED.
 2. DIMENSIONS INDICATED ON DETAIL CONTROL MINIMUM COVER. FOR THIN SLABS, THE BOTTOM COVER MAY BE LESS THAN 3".
 3. STAGGER SPLICES UNLESS NOTED OTHERWISE.



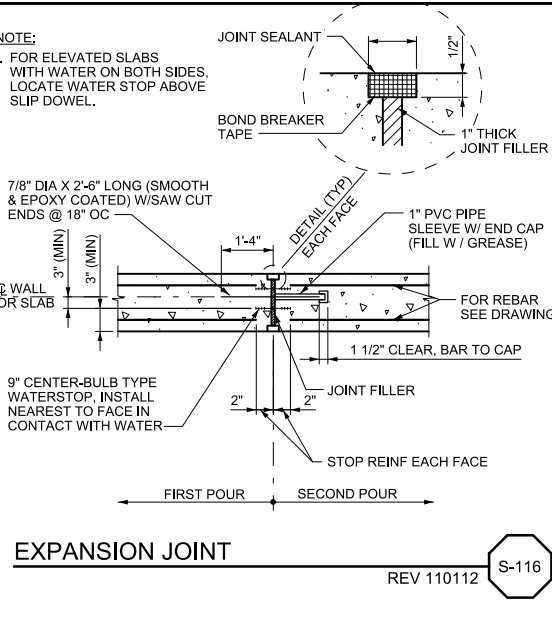
- NOTES:**
1. WHERE WATERSTOP IS REQUIRED IN SINGLE CURTAIN WALL REINFORCEMENT, PLACE WATERSTOP ON WATER SIDE OF WALL.
 2. UNLESS OTHERWISE NOTED 3/4" CHAMFERS SHALL BE OMITTED IN SURFACES TO RECEIVE ARCHITECTURAL TREATMENT.
 3. UNLESS SPECIFICALLY NOTED OTHERWISE #5 AND LARGER BARS SHALL BE CONTINUOUS THRU JOINT. #4 AND SMALLER BARS SHALL STOP ALTERNATE BARS AT JOINT.
 4. STAGGER SPLICES UNLESS NOTED OTHERWISE.



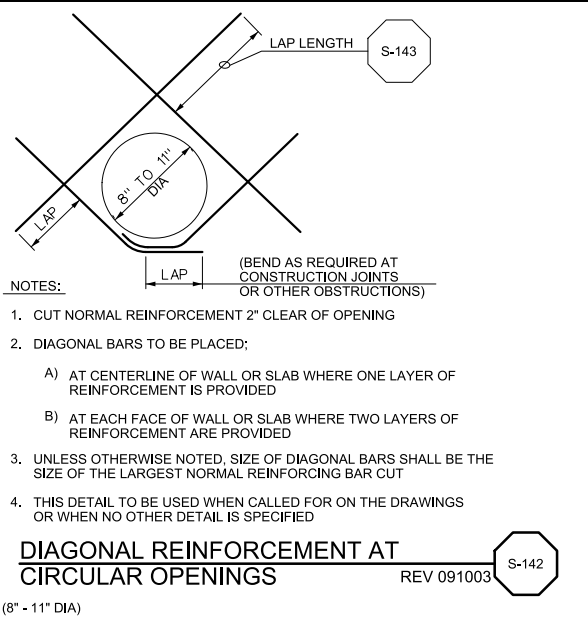
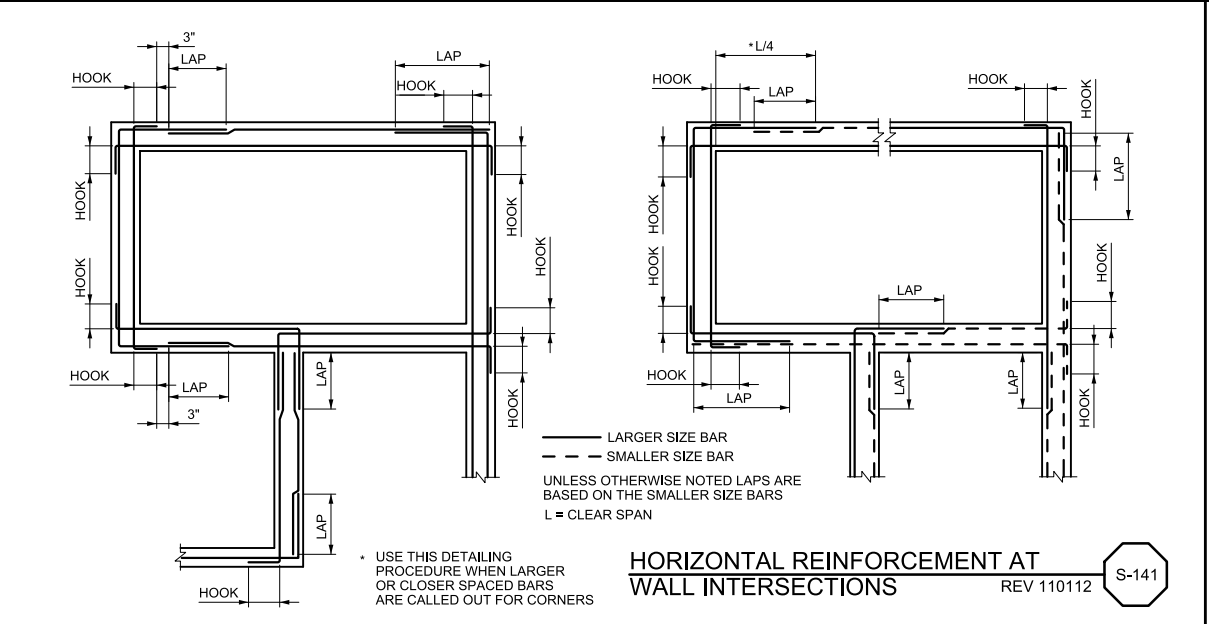
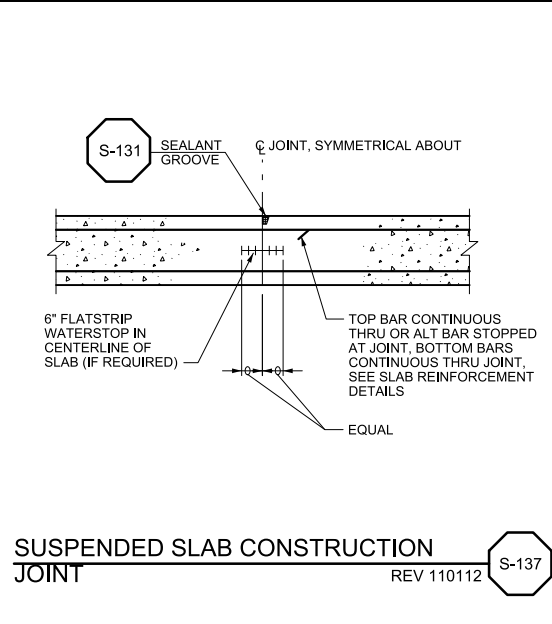
- NOTES:**
1. ALL FLOOR JOINTS OF HYDRAULIC STRUCTURES (MEMBERS COVERED WITH WATER) SHALL HAVE A SEALANT GROOVE
 2. SANDBLASTING REQUIRED PRIOR TO APPLICATION OF PRIMER



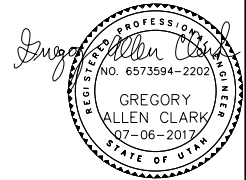
- NOTES:**
1. PRIOR TO HYDROTESTING, STRUCTURES TO CONTAIN WATER SHALL HAVE ALL CRACKS REPAIRED AS SHOWN IN THIS DETAIL.
 2. CRACKS IN EXPOSED COVER SLABS NOT RECEIVING COATINGS SHALL BE REPAIRED AS SHOWN IN THIS DETAIL.



- NOTE:**
1. FOR ELEVATED SLABS WITH WATER ON BOTH SIDES, LOCATE WATER STOP ABOVE SLIP DOWEL.
- 7/8" DIA X 2'-6" LONG (SMOOTH & EPOXY COATED) W/SAW CUT ENDS @ 18" OC
- 1" THICK JOINT FILLER
- 1" PVC PIPE SLEEVE W/ END CAP (FILL W/ GREASE)
- 9" CENTER-BULB TYPE WATERSTOP, INSTALL NEAREST TO FACE IN CONTACT WITH WATER
- STOP REINF EACH FACE
- 1 1/2" CLEAR, BAR TO CAP
- FOR REBAR SEE DRAWINGS
- DETAIL (TYP) EACH FACE
- 1/2" CLEAR
- 1/2"
- 3"
- 3"
- 3"
- 1-4"
- 1/2"
- 1/2"
- 2"
- 2"
- FIRST POUR
- SECOND POUR



- NOTES:**
1. CUT NORMAL REINFORCEMENT 2" CLEAR OF OPENING
 2. DIAGONAL BARS TO BE PLACED:
 - A) AT CENTERLINE OF WALL OR SLAB WHERE ONE LAYER OF REINFORCEMENT IS PROVIDED
 - B) AT EACH FACE OF WALL OR SLAB WHERE TWO LAYERS OF REINFORCEMENT ARE PROVIDED
 3. UNLESS OTHERWISE NOTED, SIZE OF DIAGONAL BARS SHALL BE THE SIZE OF THE LARGEST NORMAL REINFORCING BAR CUT
 4. THIS DETAIL TO BE USED WHEN CALLED FOR ON THE DRAWINGS OR WHEN NO OTHER DETAIL IS SPECIFIED



REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE	NONE
WARNING	IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE
DESIGNED	G. CLARK
DRAWN	D. WEEKS
CHECKED	T. ARNOLD

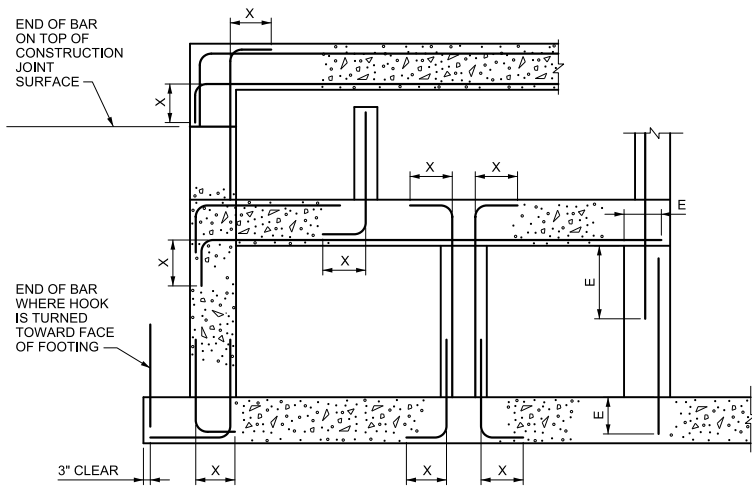
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HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY GENERAL STRUCTURAL LOGAN 3RD DAM STANDARD DETAILS - I	SHEET GS-2
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LENGTH (*)			
BAR SIZE	HOOK X	LAP	EMBEDMENT E
#3	6"	16" (21")	12" (16")
#4	8"	16" (21")	12" (16")
#5	10"	20" (26")	15" (20")
#6	12"	28" (37")	22" (28")
#7	14"	48" (62")	37" (48")
#8	16"	62" (81")	48" (62")
#9	19"	79" (102")	61" (79")
#10	22"	100" (130")	77" (100")
#11	24"	123" (160")	95" (123")

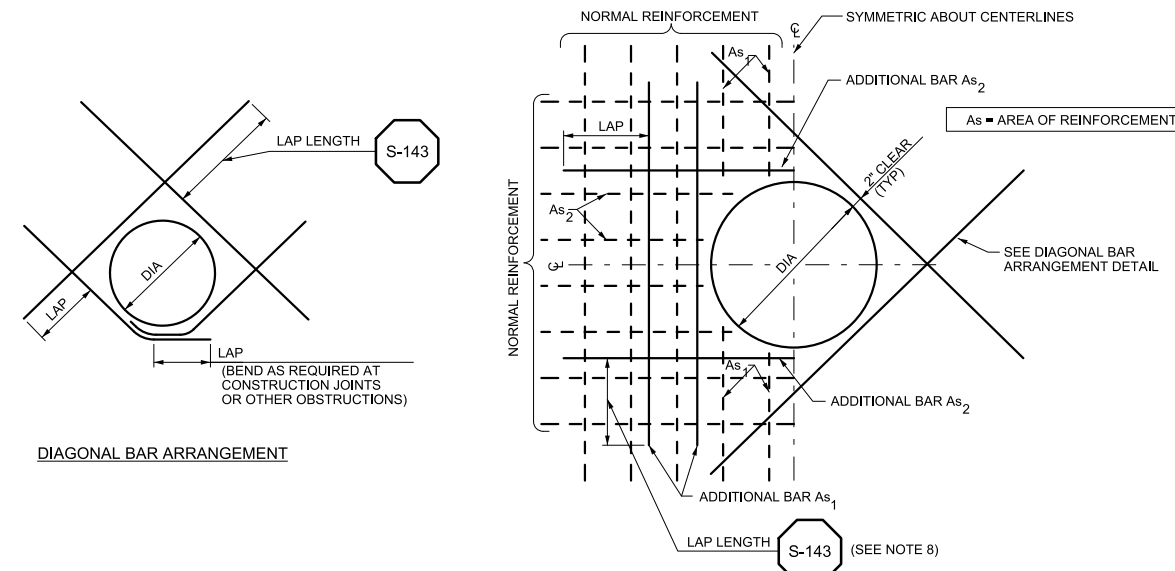
NOTES:

- USE LAP LENGTHS AS DETERMINED FROM THESE TABLES UNLESS SHOWN OTHERWISE.
- THE TABLES SHOWN ARE FOR $f_c=4000$ psi, $f_y=60,000$ psi, 1.5" MIN CONCRETE COVER AND 3" MIN BAR SPACING.
- MULTIPLY THE LAP AND E SHOWN IN THESE TABLES BY 1.5 FOR EPOXY COATED REINFORCING.
- WHEN BARS OF DIFFERENT SIZES ARE LAP SPLICED, LAP LENGTH SHALL BE THE LARGER OF:
EMBEDMENT LENGTH OF LARGER BAR
LAP LENGTH OF SMALLER BAR
- UNLESS NOTED OTHERWISE USE REBAR COUPLERS FOR SPLICES OF #11 AND LARGER BARS.
- ALL DOWEL BARS SHALL EXTEND AN EMBEDMENT LENGTH E INTO ANOTHER MEMBER OR ACROSS A CONSTRUCTION JOINT UNLESS SHOWN TO SPLICE WITH OTHER BARS OR TO EXTEND TO THE FAR FACE OF THE MEMBER AND END WITH A STANDARD HOOK.

* USE LENGTH IN PARENTHESIS FOR WALL HORIZONTAL REBARS AND SLAB BARS WITH 12" OR MORE OF FRESH CONCRETE UNDERNEATH

STANDARD 90° BAR HOOKS, EMBEDMENT LENGTHS AND LAP LENGTHS

REV 110112 S-143

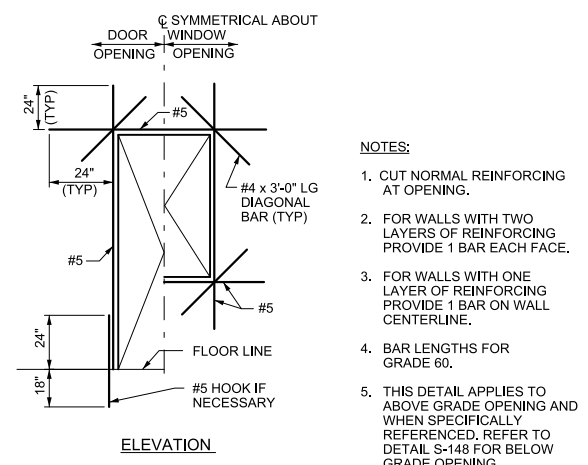


NOTES:

- THIS DETAIL TO BE USED AT ALL CIRCULAR OPENINGS EXCEPT WHEN OTHER DETAILING IS INDICATED ON THE DRAWINGS.
- CUT NORMAL REINFORCEMENT 2" CLEAR OF OPENING.
- CUT NORMAL REINFORCEMENT AT OPENINGS:
A. As_1 AND $As_2 = 1/2$ AREA OF TOTAL CUT BARS TO BE ADDED ON EACH SIDE OF OPENING.
- DIAGONAL AND ADDITIONAL BARS As_1 AND As_2 TO BE PLACED:
A. AT CENTERLINE OF WALLS OR SLABS WHERE ONE LAYER OF REINFORCEMENT IS PROVIDED.
B. AT EACH FACE OF WALLS OR SLABS WHERE TWO LAYERS OF REINFORCEMENT ARE PROVIDED.
- UNLESS OTHERWISE NOTED, SIZE OF DIAGONAL BARS SHALL BE THE SIZE OF THE LARGEST NORMAL REINFORCING BAR CUT.
- INCREASE SIZE OF ADDITIONAL BARS AS NEEDED TO FIT WITHIN A DISTANCE OF 2X WALL/SLAB THICKNESS FROM OPENING, PROVIDE 2" MIN CLEAR BETWEEN BARS.
- WHERE A SLAB OR INTERSECTING WALL CONNECTS WITHIN ONE WALL THICKNESS OF THE OPENING, ADDITIONAL BARS ON THAT SIDE OF THE OPENING MAY BE OMITTED.
- WHEN THE LAP LENGTH OF THE ADDITIONAL BARS CANNOT BE ACHIEVED DUE TO AN ADJACENT WALL OR SLAB, ADDITIONAL CORNER BARS OR SLAB DOWELS, RESPECTIVELY, MATCHING THE CUT BARS, ARE TO BE INCLUDED IN THE ADJACENT WALL OR SLAB TO LAP WITH THE ADDITIONAL BARS.

ADDITIONAL REINFORCEMENT AT CIRCULAR OPENINGS

REV 080513 S-144

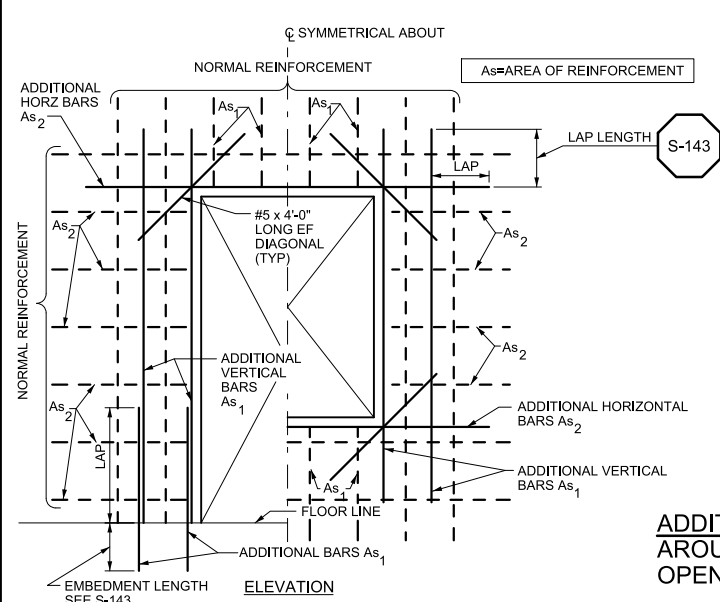


NOTES:

- CUT NORMAL REINFORCING AT OPENING.
- FOR WALLS WITH TWO LAYERS OF REINFORCING PROVIDE 1 BAR EACH FACE.
- FOR WALLS WITH ONE LAYER OF REINFORCING PROVIDE 1 BAR ON WALL CENTERLINE.
- BAR LENGTHS FOR GRADE 60.
- THIS DETAIL APPLIES TO ABOVE GRADE OPENING AND WHEN SPECIFICALLY REFERENCED, REFER TO DETAIL S-148 FOR BELOW GRADE OPENING.

REINFORCEMENT AROUND RECTANGULAR WALL OPENING

REV 110112 S-147

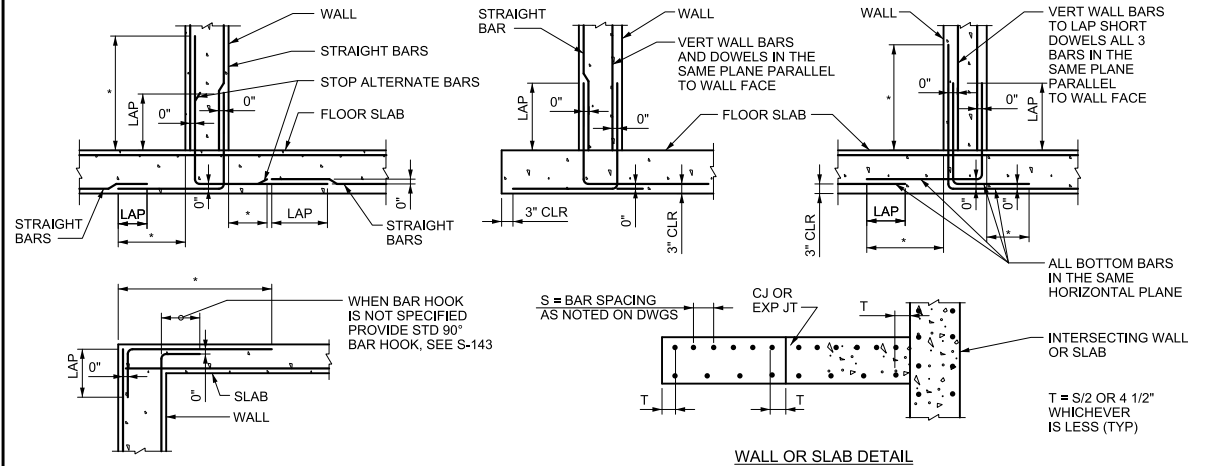


NOTES:

- CUT NORMAL REINFORCEMENT AT OPENING: As_1 AND $As_2 = 1/2$ AREA OF CUT BARS TO BE ADDED ON EACH SIDE OF OPENING.
- ADDITIONAL BARS As_1 AND As_2 TO BE PLACED:
A) AT CENTERLINE OF WALLS OR SLABS WHERE ONE LAYER OF REINFORCEMENT IS PROVIDED.
B) AT EACH FACE OF WALLS OR SLABS WHERE TWO LAYERS OF REINFORCEMENT ARE PROVIDED.
- INCREASE SIZE OF ADDITIONAL BARS AS NEEDED TO FIT WITHIN A DISTANCE OF 2X WALL / SLAB THICKNESS FROM OPENING. PROVIDE 2" MIN CLEAR BETWEEN BARS.
- THIS DETAIL TO BE USED ONLY WHEN NO OTHER DETAIL IS INDICATED ON THE DRAWINGS.
- WHERE A SLAB OR INTERSECTING WALL CONNECTS WITHIN ONE WALL THICKNESS OF THE OPENINGS, ADDITIONAL BARS ON THAT SIDE MAY BE OMITTED.
- THIS DETAIL APPLIES TO BELOW GRADE OPENINGS AND WHEN SPECIFICALLY REFERENCED, REFER TO DETAIL S-147 FOR ABOVE GRADE OPENINGS.

ADDITIONAL REINFORCEMENT AROUND RECTANGULAR OPENING

REV 110112 S-148



STANDARD FOR REINFORCING BAR DETAILING

REV 110112 S-149

REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE	NONE
WARNING	IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED	G. CLARK
DRAWN	D. WEEKS
CHECKED	T. ARNOLD

ISSUED FOR CONSTRUCTION - JUNE 2017

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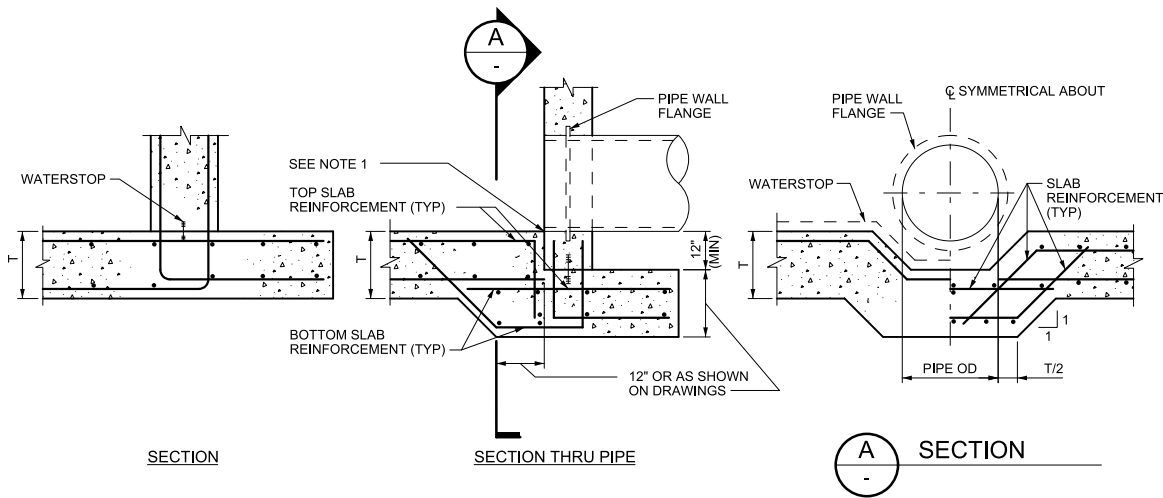


HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY
GENERAL STRUCTURAL
LOGAN 3RD DAM
STANDARD DETAILS - II

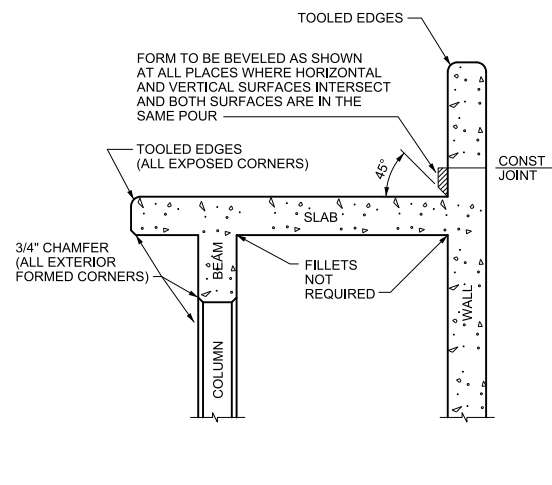
SHEET
GS-3



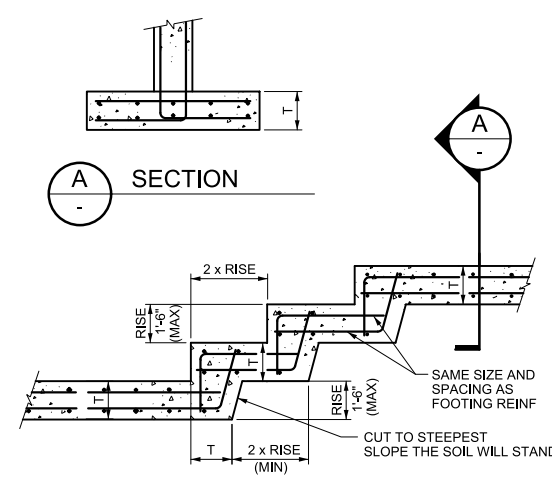


- NOTES:
1. SET PIPE INVERT FLUSH WITH SLAB
 2. DETAIL IS SIMILAR FOR RCP

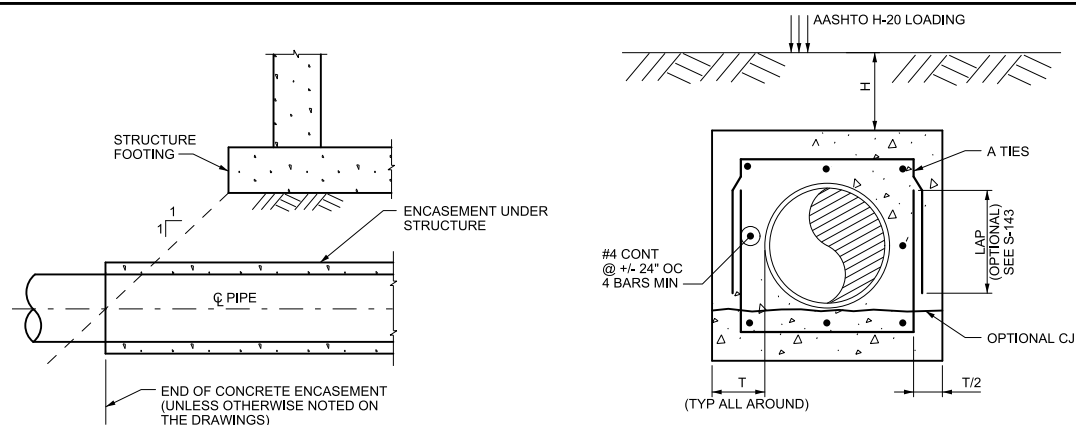
FOOTING AT WALL PIPE CONNECTION REV 110112 S-150



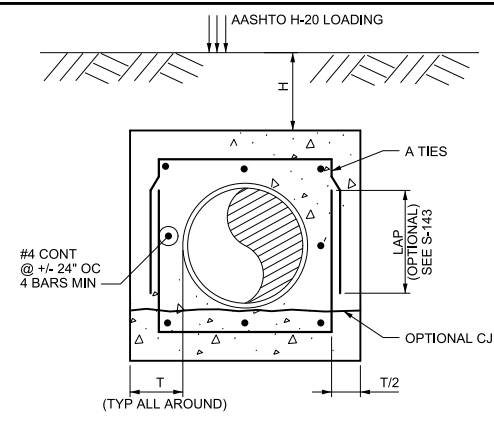
FORMING DETAILS REV 110112 S-150



STEPPED FOOTING REV 110112 S-155



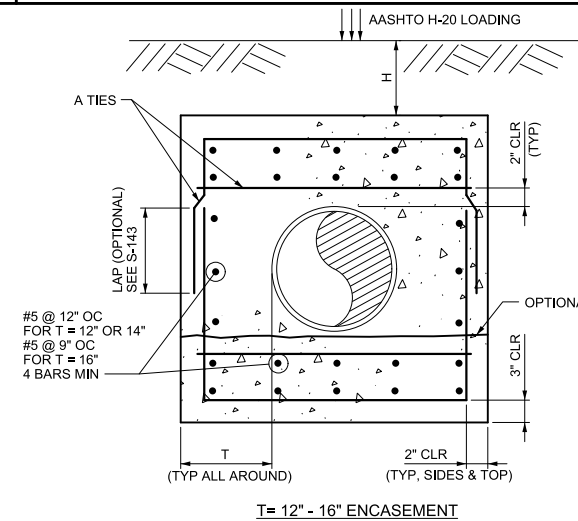
END OF ENCASUREMENT BEYOND STRUCTURE



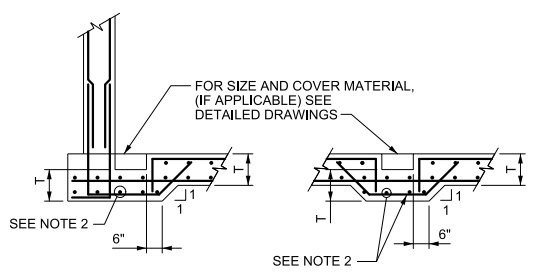
T= 6" OR 8" ENCASUREMENT

COVER H	PIPE OUTSIDE DIAMETER											
	8"-24"		30"-32"		36"		42"-54"		60"-72"			
	A	T	A	T	A	T	A	T	A	T	A	T
2' MIN	#4@12"	6"	#4@12"	6"	#4@9"	6"	#5@12"	8"	#4@9"	12"	#4@9"	12"
3'					#4@12"		#4@9"		#5@12"		#5@10"	
4'							#4@12"		#5@10"		#5@10"	
5'							#4@12"		#5@10"		#5@10"	
6'							#4@9"		#5@10"		#5@10"	
7'							#4@9"		#5@10"		#6@12"	
8'			#4@12"		#4@9"		#5@12"		#6@10"		#6@10"	8"
9'			#4@9"	6"	#4@9"	6"	#5@10"		#4@9"	12"		
10'			#4@12"	8"	#4@9"	8"	#5@10"	8"	#5@12"			
12'			#4@12"	12"	#4@12"	12"	#4@9"	12"	#5@10"	12"		
14'			12"		#4@12"		#4@9"		#6@12"			
16'					#4@12"		#5@12"		#6@10"			12"
18'			#4@12"	12"	#4@9"	12"	#5@10"	12"	#6@10"	14"		
20'	#4@12"	12"	#4@9"	12"	#4@9"	14"	#6@12"	14"	#6@10"	16"		

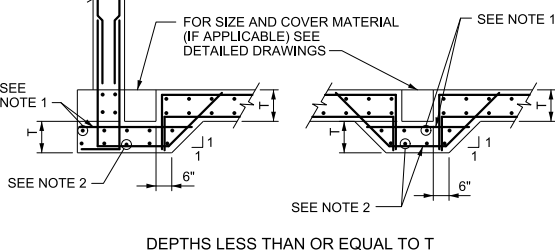
- NOTES:
1. WHERE ENCASEMENT PASSES UNDER SPREAD FOOTING OR MAT FOUNDATION, USE H=20' UNO
 2. ALL ENCASEMENTS UNDER STRUCTURES SHALL BE SEPARATED FROM THE STRUCTURE FOUNDATIONS BY BACKFILL OR 2 LAYERS OF 40# FELT UNO
 3. WHEN ENCASEMENTS TERMINATE @ STRUCTURE, ENCASEMENT REINFORCING SHALL BE DOWELED INTO THE STRUCTURE
 4. CONTINUE ENCASEMENT ALONG VERTICAL RUNS OF PIPE. UNO FOR T = 12" TO 16" ENCASEMENTS, PROVIDE 2 MATS OF REINF ON ALL FOUR SIDES OF ENCASEMENT. EXTEND VERT REINF FULL DEPTH INTO HORIZ ENCASEMENT AND TERMINATE BARS WITH STD HOOKS.



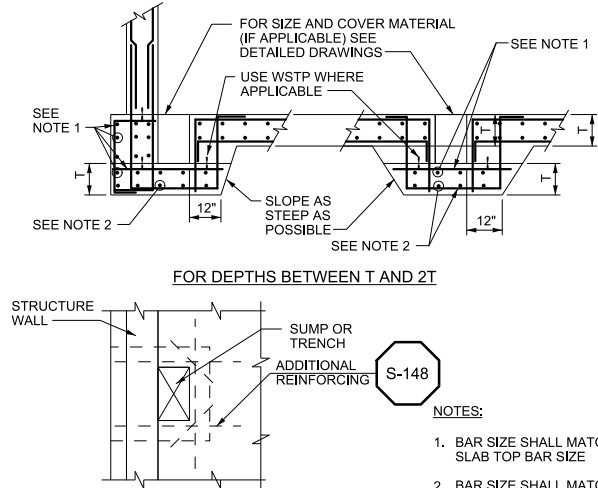
PIPE ENCASEMENT REV 110112 S-171



DEPTHS LESS THAN OR EQUAL TO T



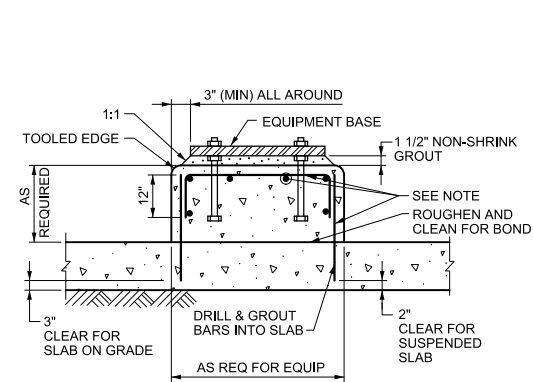
DEPTHS LESS THAN OR EQUAL TO T



FOR DEPTHS BETWEEN T AND 2T

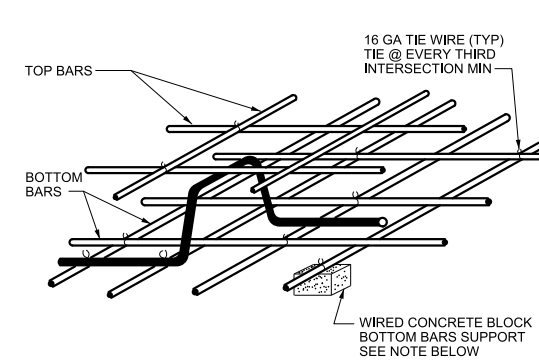
REINFORCING AT SUMPS AND TRENCHES REV 110112 S-177

- NOTES:
1. BAR SIZE SHALL MATCH SLAB TOP BAR SIZE
 2. BAR SIZE SHALL MATCH SLAB BOTTOM BAR SIZE



EQUIPMENT BASE REV 110112 S-192

- NOTE:
- #5@12" OR AS REQUIRED TO DEVELOP ANCHOR BOLTS



REINFORCEMENT SUPPORT REV 110112 S-204

- NOTE:
- METAL BAR SUPPORTS, IF USED IN SLABS NOT ON GROUND, SHALL NOT MAKE CONTACT WITH FORMS

REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE
NONE

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED G. CLARK
DRAWN D. WEEKS
CHECKED T. ARNOLD

ISSUED FOR CONSTRUCTION - JUNE 2017
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HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY
GENERAL STRUCTURAL
LOGAN 3RD DAM
STANDARD DETAILS - III

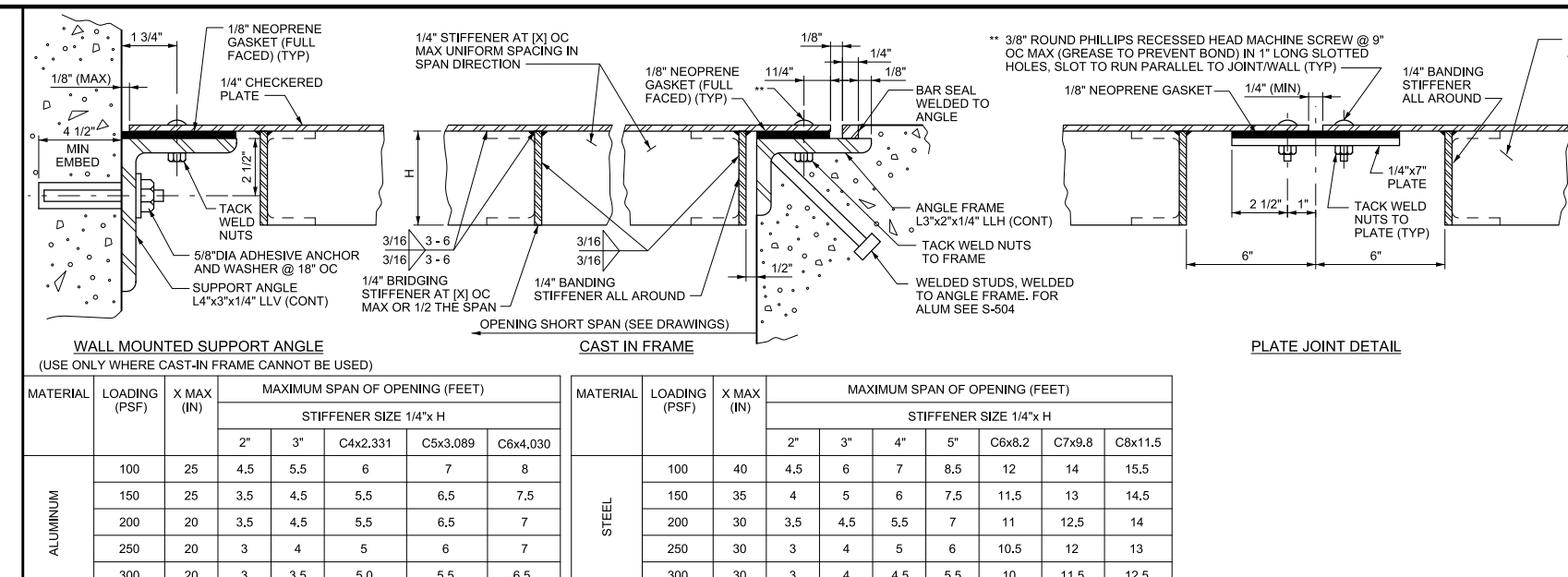
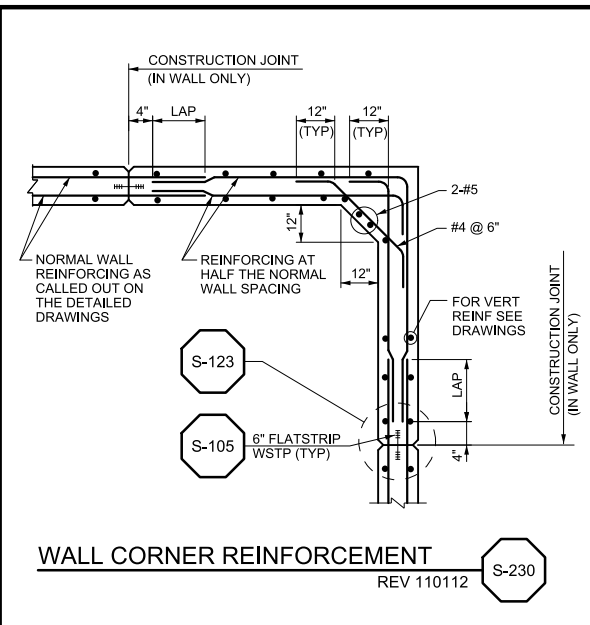


SHEET
GS-4

PHI Date: 21-DEC-2017 15:09

User: gdark

File: GS-5.dgn Model: Layout1 ColorTable: hv.ctb DesignScript: MWH_Ibdt_PentTable_20121.pen PlotScale: 0.166667:1



NOTES:

- CHKD PLATE COVERS SHALL BE ALUMINUM UNLESS INDICATED OTHERWISE.
- MAX WEIGHT OF PLATE COVER = 80 LBS.
- MATERIALS:

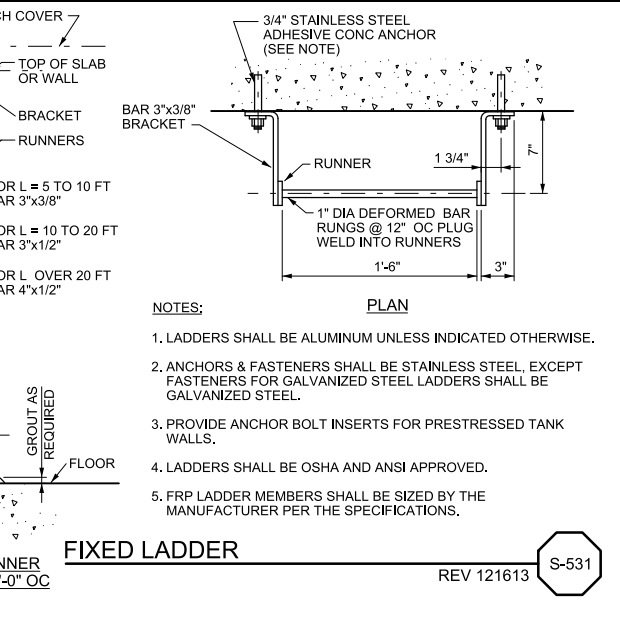
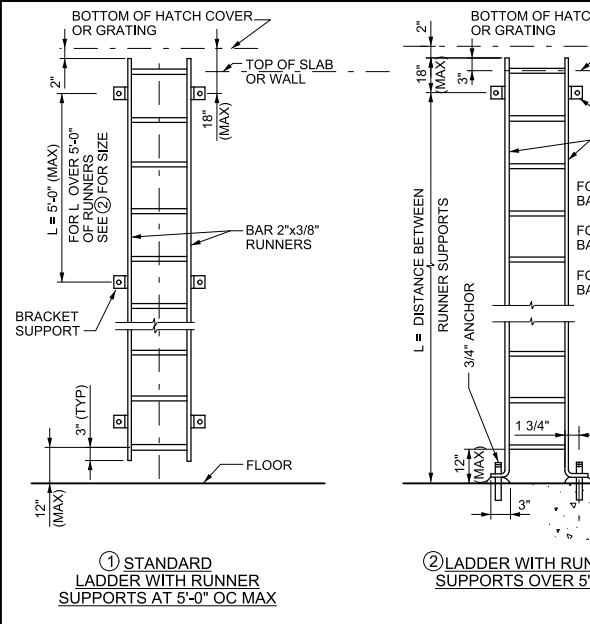
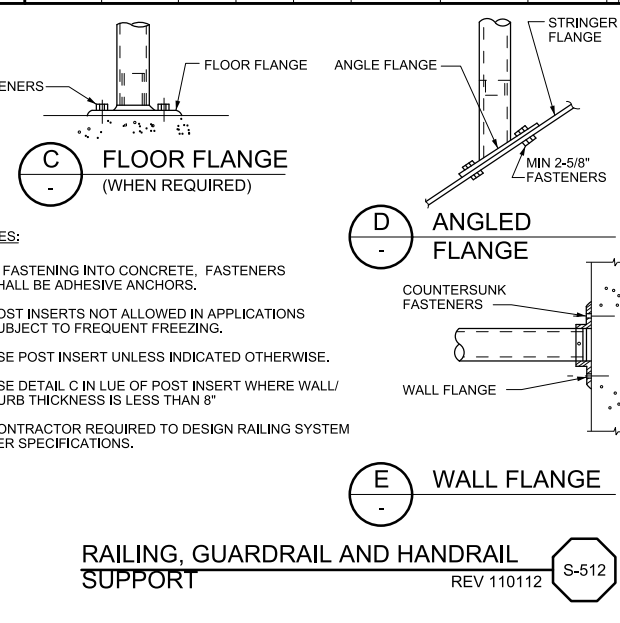
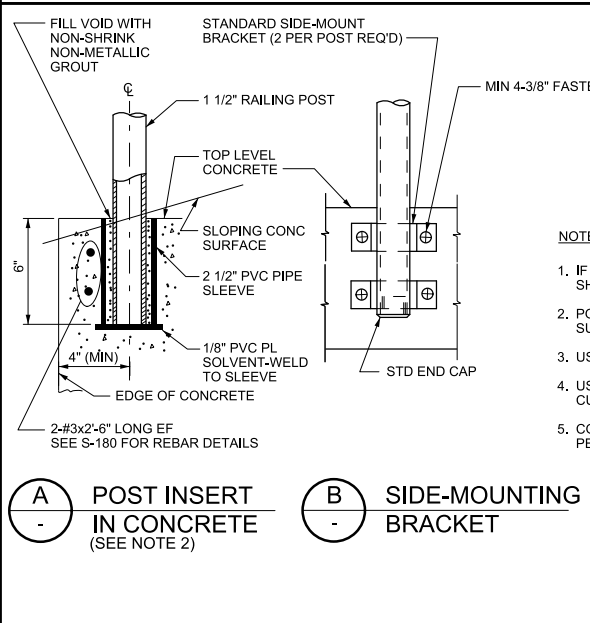
PLATE COVER MATERIAL	SUPPORT ANGLE	ANGLE FRAME	WELDED STUDS	ADHESIVE ANCHORS	SPLICE PLATE	NUTS AND BOLTS
ALUMINUM	ALUMINUM	ALUMINUM	ALUMINUM PER S-504	TYPE 316 SS	ALUMINUM	ALUMINUM
GALV STEEL	GALV STEEL	GALV STEEL	GALV STEEL, 1/2" DIA x4" @12" OC MAX	ASTM F1554 GR 36, GALV	GALV STEEL	GALV STEEL
STAINLESS STEEL	TYPE 316L SS	TYPE 316L SS	TYPE 316L SS, 1/2" DIA x4" @12" OC MAX	TYPE 316 SS	TYPE 316L SS	TYPE 316 SS

- ALL GALVANIZED MATERIAL TO BE GALVANIZED AFTER FABRICATION.
- SEE S-504 FOR ALUMINUM WELDED STUD DETAIL.
- ALUMINUM IN CONTACT WITH CONCRETE SHALL BE COATED PER THE PROTECTIVE COATING SPECIFICATIONS.
- NOT ALL MATERIAL TYPES MAY BE USED ON A SINGLE PROJECT.
- "X" = MAXIMUM SPAN OF UNSTIFFENED PLATE COVER.

MATERIAL	LOADING (PSF)	X MAX (IN)	MAXIMUM SPAN OF OPENING (FEET)					
			STIFFENER SIZE 1/4"x H					
			2"	3"	C4x2.331	C5x3.089	C6x4.030	
ALUMINUM	100	25	4.5	5.5	6	7	8	
	150	25	3.5	4.5	5.5	6.5	7.5	
	200	20	3.5	4.5	5.5	6.5	7	
	250	20	3	4	5	6	7	
	300	20	3	3.5	5.0	5.5	6.5	

MATERIAL	LOADING (PSF)	X MAX (IN)	MAXIMUM SPAN OF OPENING (FEET)							
			STIFFENER SIZE 1/4"x H							
			2"	3"	4"	5"	C6x8.2	C7x9.8	C8x11.5	
STEEL	100	40	4.5	6	7	8.5	12	14	15.5	
	150	35	4	5	6	7.5	11.5	13	14.5	
	200	30	3.5	4.5	5.5	7	11	12.5	14	
	250	30	3	4	5	6	10.5	12	13	
	300	30	3	4	4.5	5.5	10	11.5	12.5	

PLATE COVERED OPENING
REV 123014 S-502



REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE	NONE
WARNING	IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE
DESIGNED	G. CLARK
DRAWN	D. WEEKS
CHECKED	T. ARNOLD

ISSUED FOR CONSTRUCTION - JUNE 2017

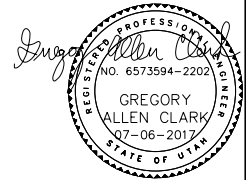
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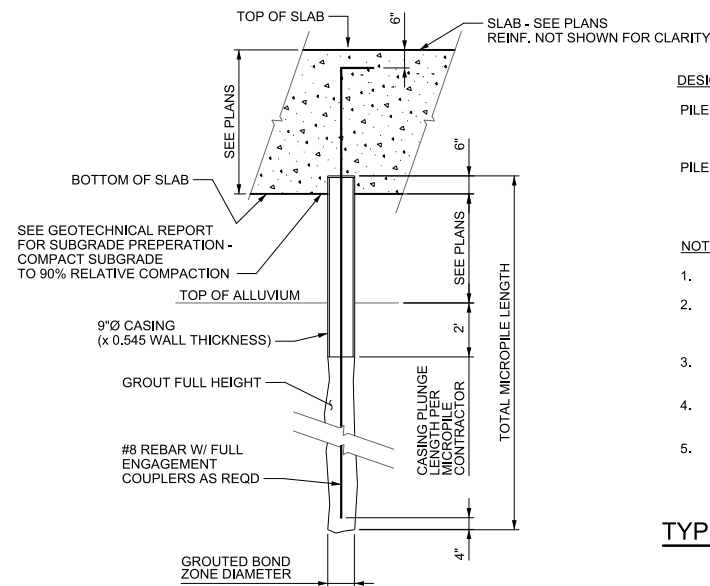


HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY
GENERAL STRUCTURAL
LOGAN 3RD DAM
STANDARD DETAILS - IV

SHEET
GS-5





TYPICAL MICROPILE

S-901

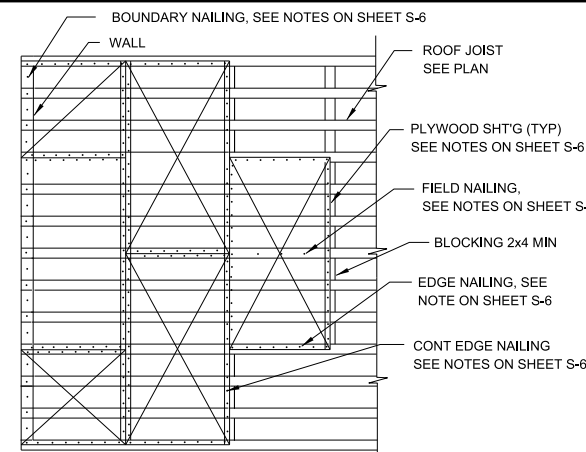
DESIGN COMPRESSIVE LOADS (SLD)

PILE TYPE P1:
9" DIA
C = 47K

PILE TYPE P2:
9" DIA
BATTERED @ 30° OR 23° SEE DRAWINGS
C = 111K

NOTES:

1. FOR ADDITIONAL REQUIREMENTS, SEE SPECIFICATION 31 63 33
2. REINFORCING BARS SHALL CONFORM TO ASTM A615 WITH A MINIMUM YIELD STRENGTH OF 60 KSI, WITH DOUBLE CORROSION PROTECTION, OR APPROVED EQUAL.
3. GROUT SHALL HAVE A MINIMUM 28-DAY COMPRESSIVE STRENGTH OF 4,000 PSI.
4. STEEL CASING SHALL CONFORM TO API 5 CT N-80 WITH A MINIMUM YIELD STRENGTH OF 80 KSI.
5. FULL ENGAGEMENT ROD COUPLERS AND HEX NUTS SHALL CONFORM TO ASTM A29.



TYPICAL ROOF DIAPHRAGM

S-902

NOTES:

1. EDGE OF PLYWOOD ROOF OPENINGS SHALL BE BOUNDARY NAILING.
2. EACH PLYWOOD SHEET SHALL SPAN THREE BEARINGS MIN.
3. ALL EDGES OF PLYWOOD SHEET SHALL BE BLOCKED.

REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE
NONE

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED G. CLARK
DRAWN D.WEEKS
CHECKED T. ARNOLD

ISSUED FOR CONSTRUCTION - JUNE 2017

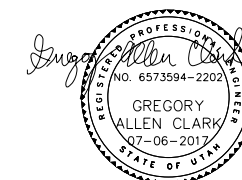
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HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY
GENERAL STRUCTURAL
LOGAN 3RD DAM
STANDARD DETAILS - V

SHEET
GS-6



Pht Date: 21-DEC-2017 15:10
User: gcbk

GENERAL SHEET NOTES

- REFER TO G SHEETS FOR ABBREVIATIONS.
- NOT ALL EQUIPMENT IS SHOWN FOR CLARITY. REFER TO APPROPRIATE DISCIPLINE DRAWINGS FOR SPECIFIC EQUIPMENT LAYOUT AND OTHER REQUIREMENTS.
- PROFILE OF DOOR / WINDOW FRAMES MAY VARY DEPENDING ON MODEL SCHEDULED AND SPECIFIED. GLASS THICKNESS MAY ALSO VARY. SEE SCHEDULES AND SPECIFICATIONS.
- SEE SPEC 099600 - PAINTING WHERE GENERAL NOTES REFER TO FIELD PAINTING.
- ALL EXPOSED INTERIOR AND EXTERIOR STRUCTURAL STEEL, JOISTS, STEEL COLUMNS, SECONDARY FRAMING MEMBERS, METAL DECK, STEEL LINTELS, STEEL GUARDRAILS AND HANDRAILS, AND ASSOCIATED CONNECTIONS SHALL BE FIELD PAINTED, (UNLESS OTHERWISE INDICATED).
- ALL INTERIOR CONCRETE WALLS SHALL BE PAINTED. SEE SPECIFICATIONS.

ACCESSIBILITY NOTES

HANDICAPPED ACCESSIBILITY:
THIS BUILDING IS EXEMPT FROM AMERICANS WITH DISABILITIES ACT (ADA) BASED ON THE FOLLOWING STATEMENT: "GENERAL EXCEPTIONS MACHINERY SPACES; SPACES FREQUENTED ONLY BY PERSONNEL FOR MAINTENANCE, REPAIR OR MONITORING OF EQUIPMENT SHALL NOT BE REQUIRED TO COMPLY WITH THESE REQUIREMENTS OR TO BE ON AN ACCESSIBLE ROUTE. MACHINERY SPACES INCLUDE, BUT ARE NOT LIMITED TO, MECHANICAL, ELECTRICAL OR COMMUNICATIONS EQUIPMENT ROOMS; PIPING OR EQUIPMENT CATWALKS; WATER OR SEWAGE TREATMENT PUMP ROOMS AND STATIONS; ELECTRICAL SUBSTATIONS AND TRANSFORMER VAULTS; AND HIGHWAY AND TUNNEL UTILITY FACILITIES." (2010 ADA STANDARDS FOR ACCESSIBLE DESIGN FOR TITLES II AND III FACILITIES: 2004 ADAAG, PART 203.5)

EXCEPT FOR REGULAR MONITORING AND MAINTENANCE OF EQUIPMENT, THIS BUILDING IS NOT INTENDED FOR HUMAN OCCUPANCY FOR EXTENDED PERIODS OF TIME. THIS BUILDING'S PRIMARY PURPOSE IS TO HOUSE PROCESSING EQUIPMENT FOR WATER CONVEYANCE.

BUILDING CODE DATA

BUILDING CODE: 2015 INTERNATIONAL BUILDING CODE (IBC)
 ENERGY CODE: 2015 INTERNATIONAL ENERGY CONSERVATION CODE (IECC)*
 ACCESSIBILITY CODE: ANSI 117.1 2009 EDITION
 OCCUPANCY: F-2
 BUILDING HEIGHT: 13'-6"
 BUILDING AREA: 667 SF
 CONSTRUCTION TYPE: IIB
 AUTOMATIC FIRE SPRINKLERS: NOT REQUIRED
 FIRE ALARM SYSTEM: NOT REQUIRED
 EXIT ACCESS TRAVEL DISTANCE: 400 FT (TABLE 1016.2)
 ALLOWABLE BUILDING HEIGHT AND AREA: (TABLE 503)
 ACTUAL FLOOR AREA: 587 SF
 OCCUPANT LOAD: PER TABLE 1004.1.2
 1 PER 100 SF
 OCCUPANT LOAD = 6

*THIS BUILDING IS EXEMPT FROM COMPLYING WITH BUILDING THERMAL ENVELOPE PROVISIONS BASED ON IECC SECTION C402.1.1 LOW-ENERGY BUILDINGS. INSULATION IS NOT REQUIRED.

DOOR SCHEDULE

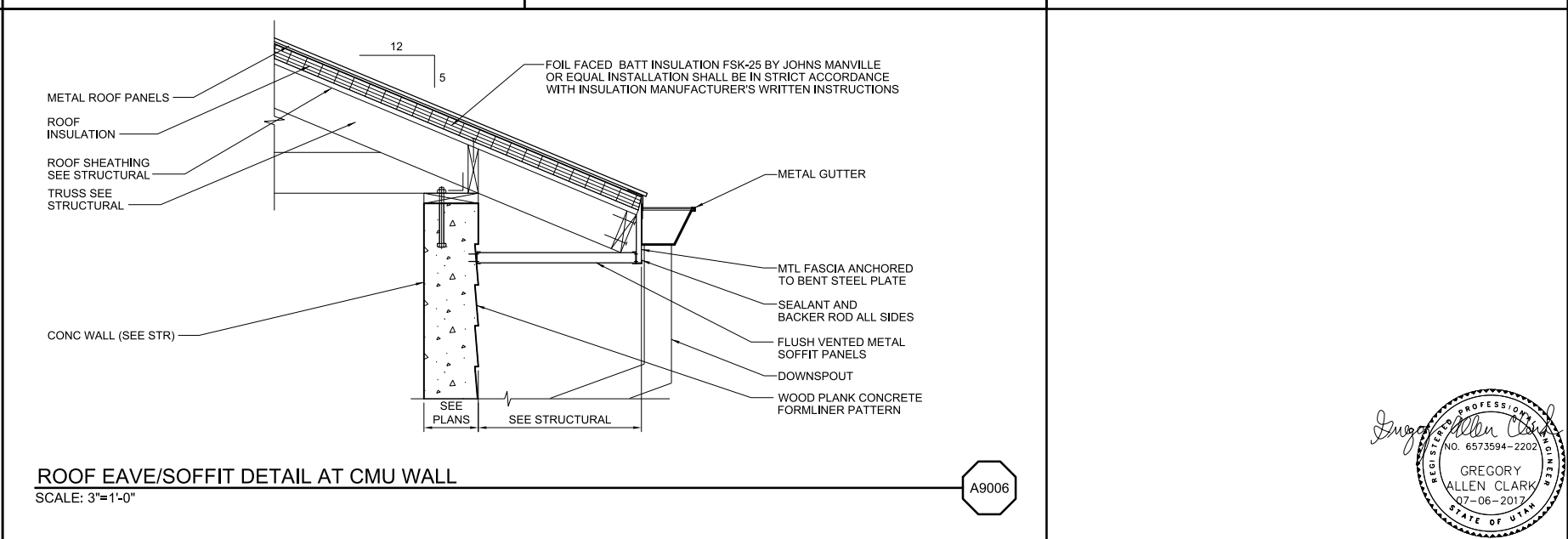
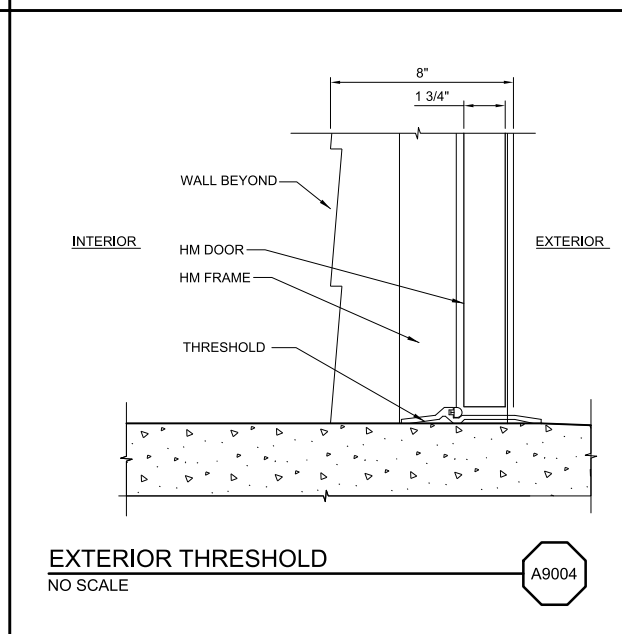
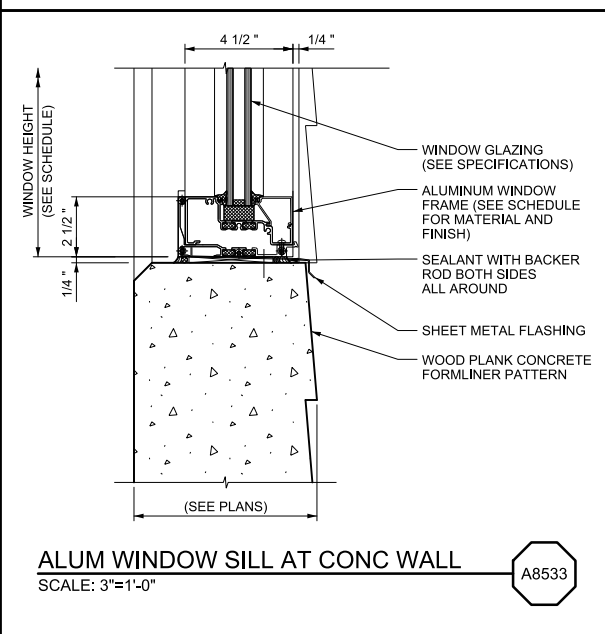
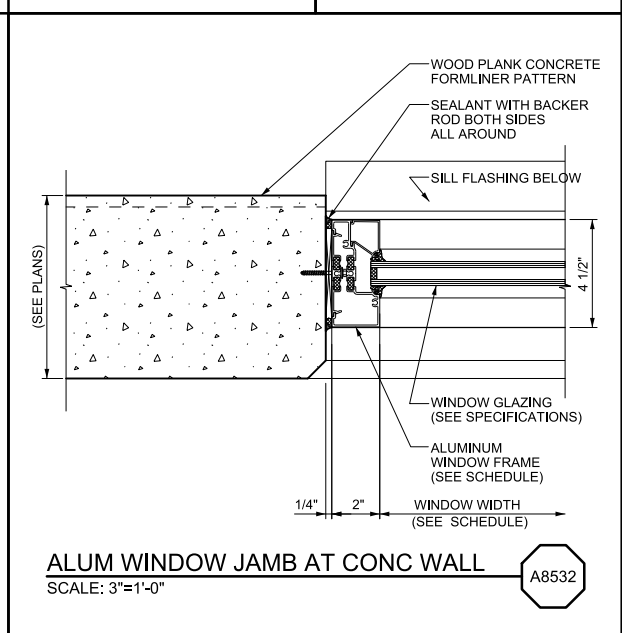
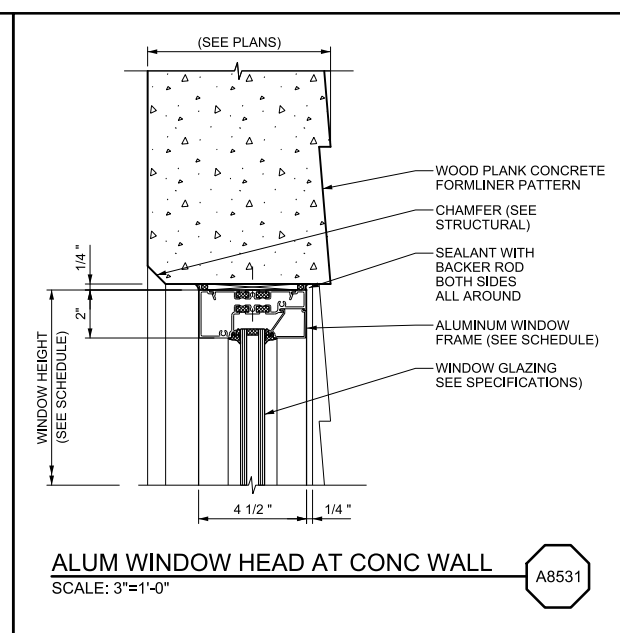
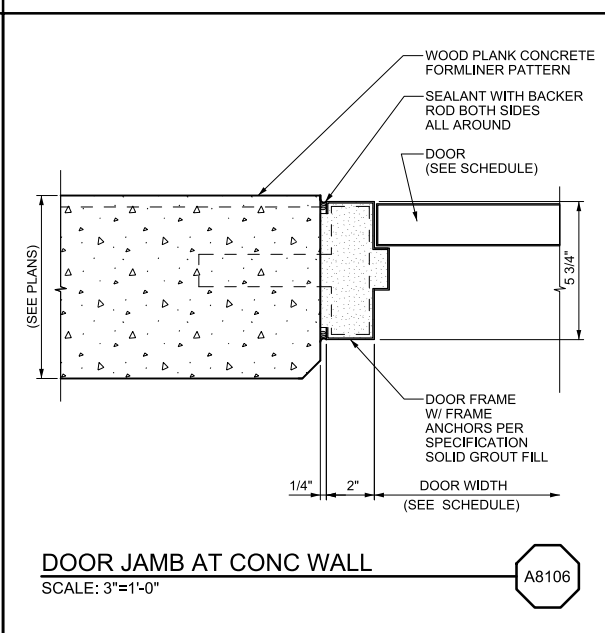
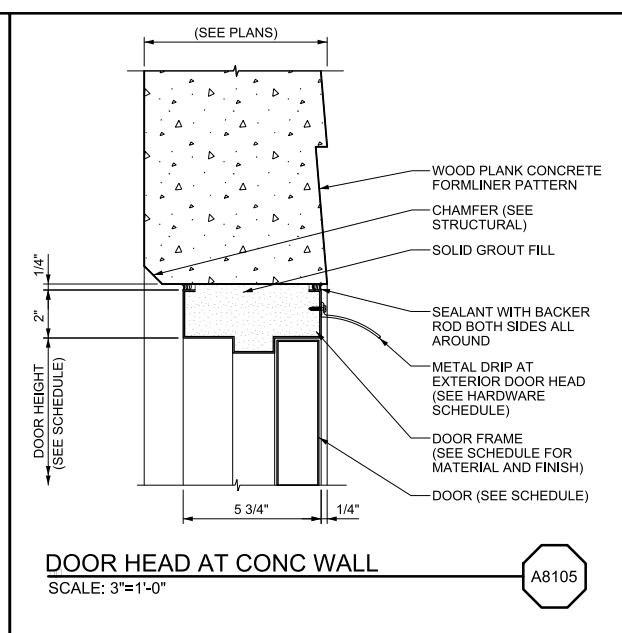
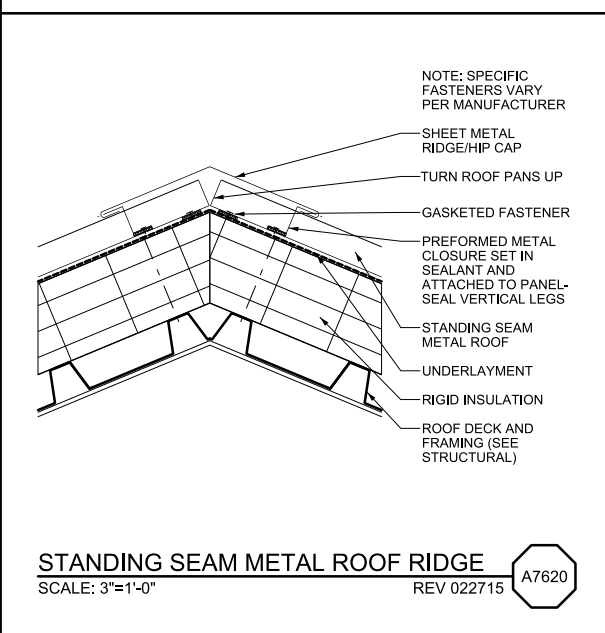
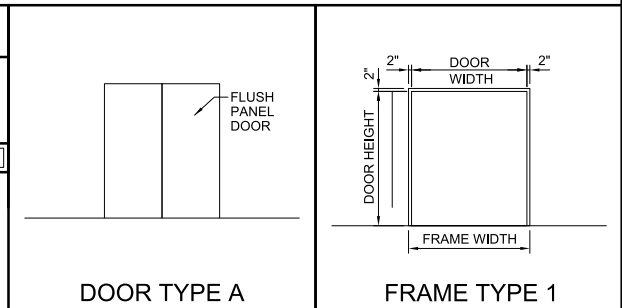
BLDG	DOOR NO	DOOR					FRAME					DETAILS					HOW SET (1)	FIRE RATING	
		WIDTH	HEIGHT	TYPE	MATERIAL	FINISH(2)	WIDTH	HEIGHT	TYPE	THICK	MATERIAL	FINISH(2)	HEAD	TRANSOM	JAMB	THRESHOLD			DRAWING
	101	(2) 3'-10"	7'-0"	A	HM	PAINTED	8'-0"	7'-2"	1	1 3/4"	HM	PAINTED	A8105	-	A8106	A9004	-	ED	

1. SEE SPECIFICATION 087100 DOOR HARDWARE FOR HARDWARE SET SCHEDULE UNLESS OTHERWISE NOTED.
 2. SEE SPECIFICATION 081113 STEEL DOORS AND FRAMES FOR FACTORY FINISH SYSTEM.

ROOM FINISH SCHEDULE

BLDG	ROOM NO	ROOM NAME	FLOOR	NORTH, EAST, SOUTH, AND WEST WALLS				CEILING/INSIDE OF ROOF/TRUSSES		ROOM NO		
				MATERIAL	FINISH	FINISH SYSTEM	WAINSCOT	HT	MATERIAL		BASE	
	101	PUMP ROOM	CONCRETE	CONCRETE	PAINTED					10'-3"	EXPOSED STR	100

1. SEE SPECIFICATION 099600 PROTECTIVE COATING FOR FINISH SYSTEM UNLESS OTHERWISE NOTED.



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REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

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

WARNING: IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED: G. CLARK
 DRAWN: G. CLARK
 CHECKED: -

ISSUED FOR CONSTRUCTION - JUNE 2017

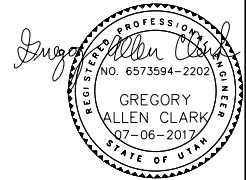
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HYDRO NO. 2
 LOGAN 3RD DAM AND SURGE TANK
 IMPROVEMENT PROJECT

LOGAN CITY
 GENERAL STRUCTURAL
 LOGAN 3RD DAM
 NOTES, BUILDING CODE DATA, SCHEDULES, AND DETAILS

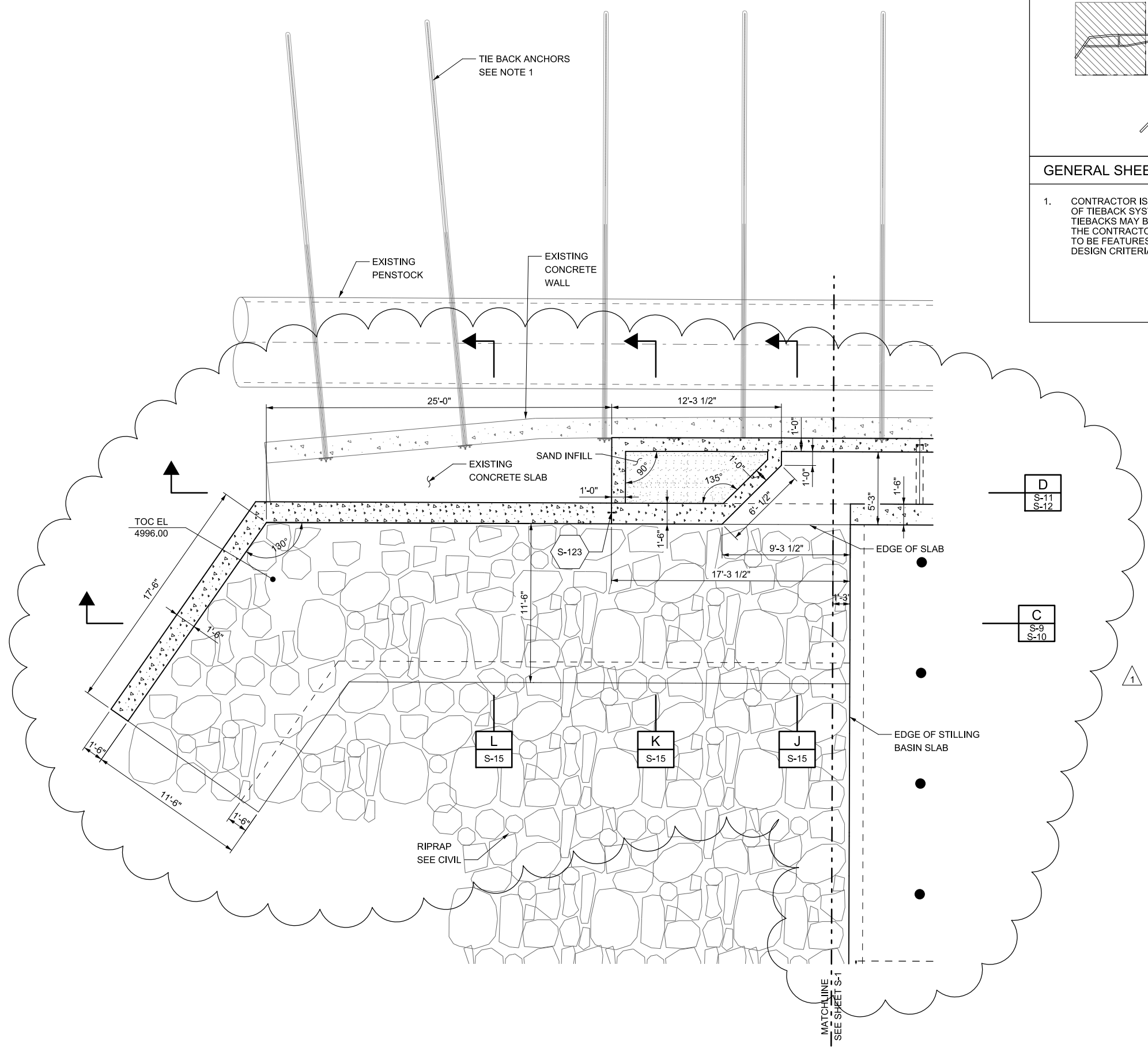
SHEET
 GS-7



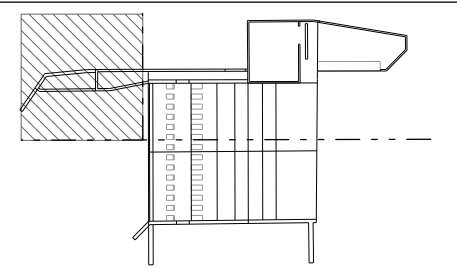
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User: gdark

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KEY PLAN



GENERAL SHEET NOTES

- CONTRACTOR IS RESPONSIBLE FOR DESIGN AND INSTALLATION OF TIEBACK SYSTEM FOR SOIL STABILITY IN ADJACENT HIGHWAY. TIEBACKS MAY BE INSTALLED AT THE DISCRETION OF THE CONTRACTOR AND ARE NOT CONSIDERED PERMANENT TO BE FEATURES. REFER TO GEOTECHNICAL REPORT FOR DESIGN CRITERIA AND OTHER GEOTECHNICAL CONDITIONS.

REV	DATE	BY	DESCRIPTION
1	1-25-18	GAC	DCN 1

SCALE
1/4" = 1'-0"

WARNING
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED G. CLARK
DRAWN K. CRICK
CHECKED T. ARNOLD

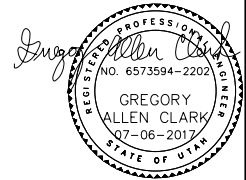
ISSUED FOR CONSTRUCTION - JUNE 2017
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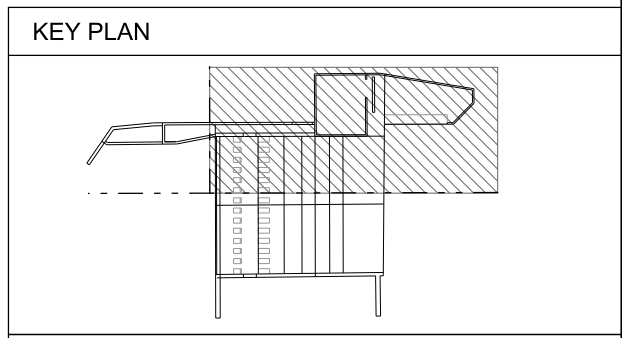
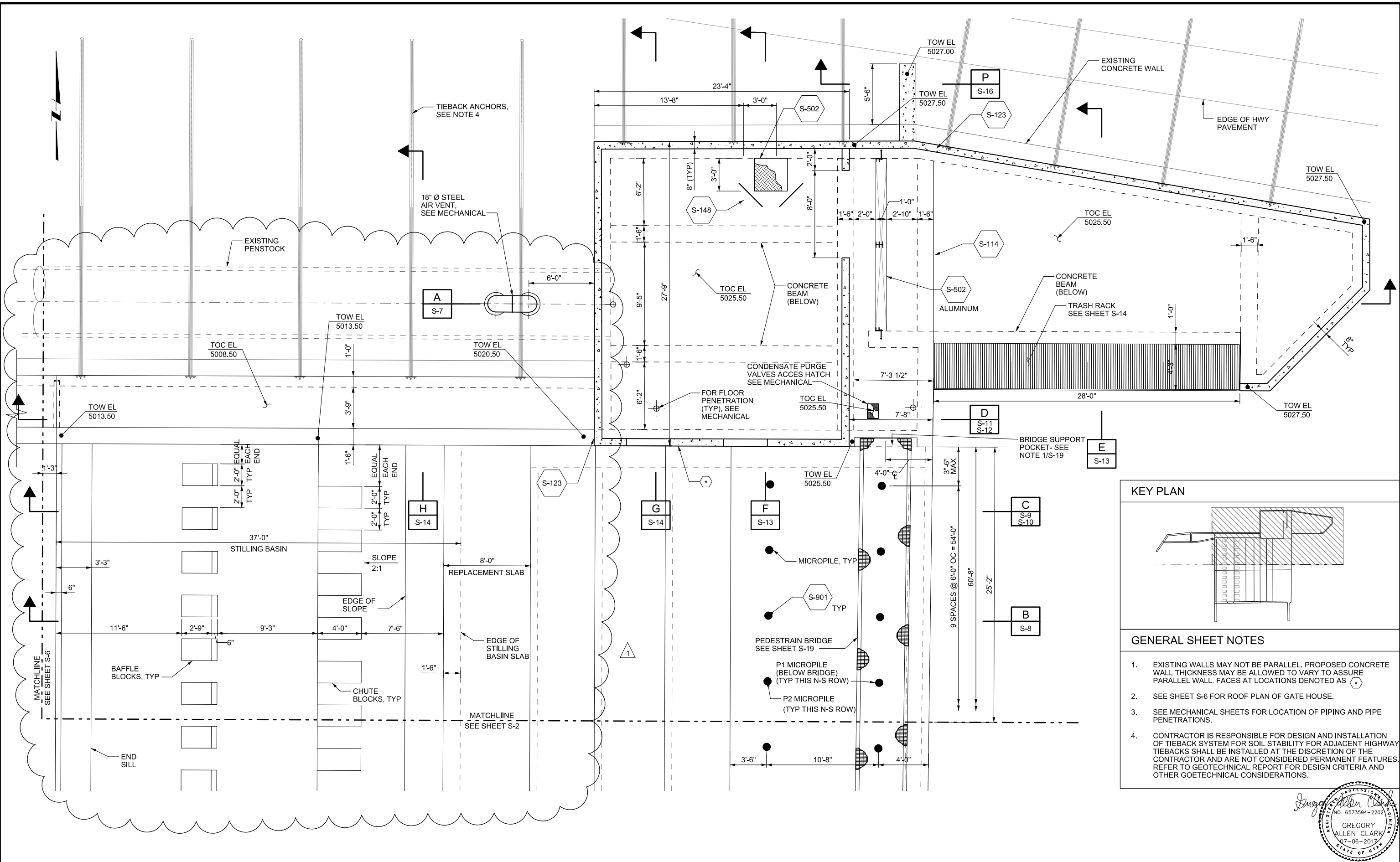


HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

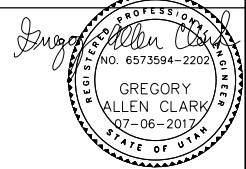
LOGAN CITY
STRUCTURAL
LOGAN 3RD DAM
FOUNDATION PLAN - III

SHEET
S-3

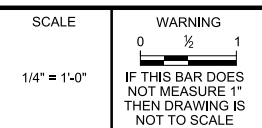




- ### GENERAL SHEET NOTES
- EXISTING WALLS MAY NOT BE PARALLEL. PROPOSED CONCRETE WALL THICKNESS MAY BE ALLOWED TO VARY TO ASSURE PARALLEL WALL. FACES AT LOCATIONS DENOTED AS *
 - SEE SHEET S-6 FOR ROOF PLAN OF GATE HOUSE.
 - SEE MECHANICAL SHEETS FOR LOCATION OF PIPING AND PIPE PENETRATIONS.
 - CONTRACTOR IS RESPONSIBLE FOR DESIGN AND INSTALLATION OF TIEBACK SYSTEM FOR SOIL STABILITY FOR ADJACENT HIGHWAY. TIEBACKS SHALL BE INSTALLED AT THE DISCRETION OF THE CONTRACTOR AND ARE NOT CONSIDERED PERMANENT FEATURES. REFER TO GEOTECHNICAL REPORT FOR DESIGN CRITERIA AND OTHER GEOTECHNICAL CONSIDERATIONS.



REV	DATE	BY	DESCRIPTION
1	1-25-18	GAC	DCN 1



DESIGNED: G. CLARK
 DRAWN: K. CRICK
 CHECKED: T. ARNOLD

ISSUED FOR CONSTRUCTION - JUNE 2017

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HYDRO NO. 2
 LOGAN 3RD DAM AND SURGE TANK
 IMPROVEMENT PROJECT

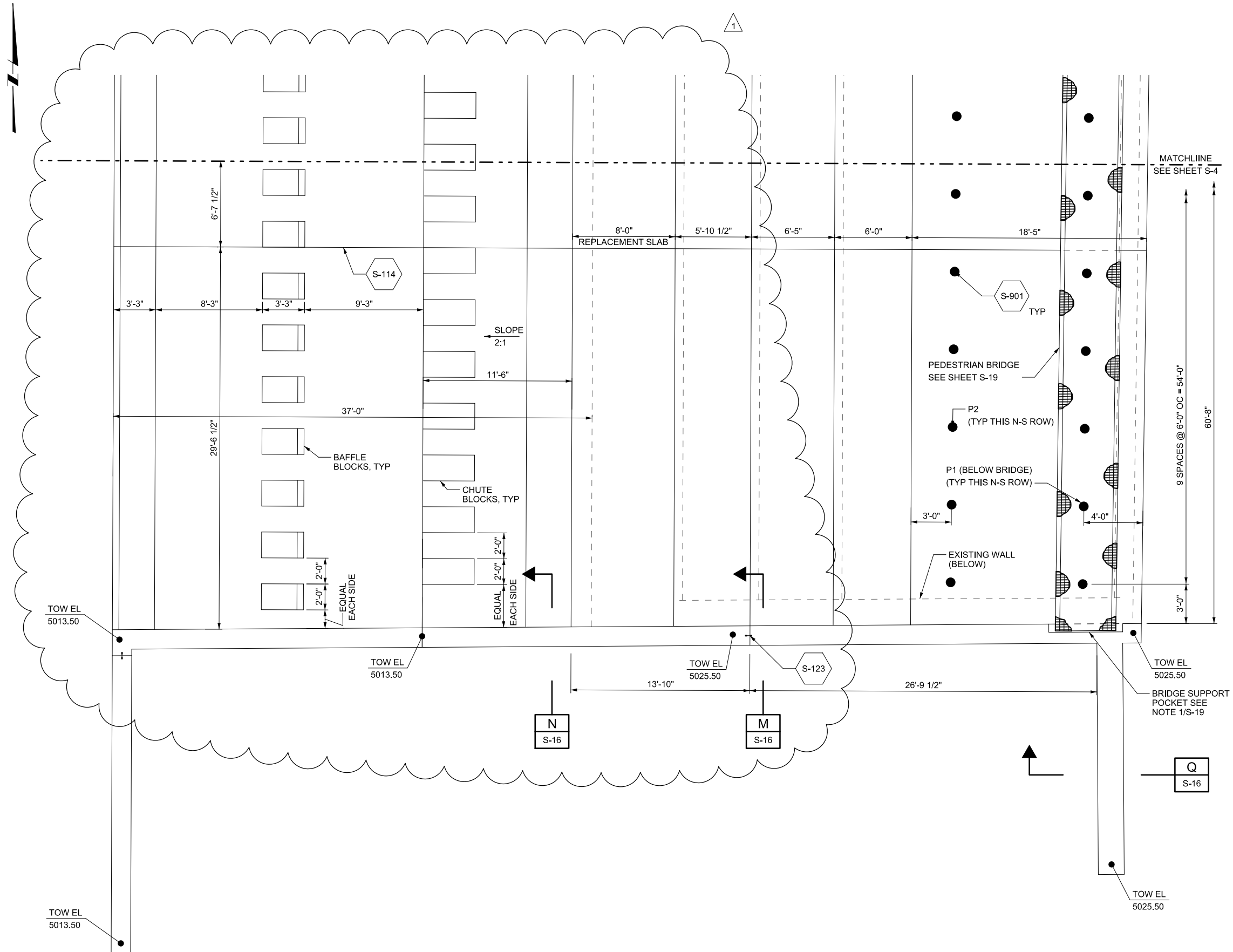
LOGAN CITY
 STRUCTURAL
 LOGAN 3RD DAM
 UPPER PLAN - I

SHEET S-4

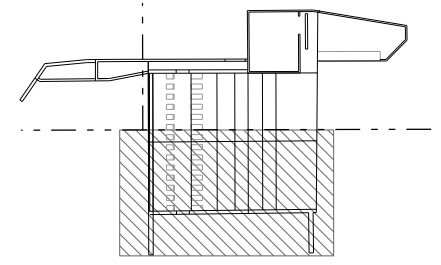
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User: gdark

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KEY PLAN



GENERAL SHEET NOTES

- COORDINATE LOCATION OF AIR HOSE POCKETS AND RELATED CONCRETE FEATURES WITH MECHANICAL DRAWINGS.

REV	DATE	BY	DESCRIPTION
1	1-25-18	GAC	DCN 1

SCALE
1/4" = 1'-0"

WARNING
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED G. CLARK
DRAWN K. CRICK
CHECKED T. ARNOLD

ISSUED FOR CONSTRUCTION - JUNE 2017

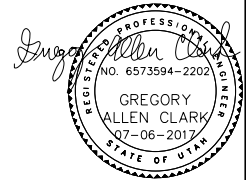
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HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY
STRUCTURAL
LOGAN 3RD DAM
UPPER PLAN - II

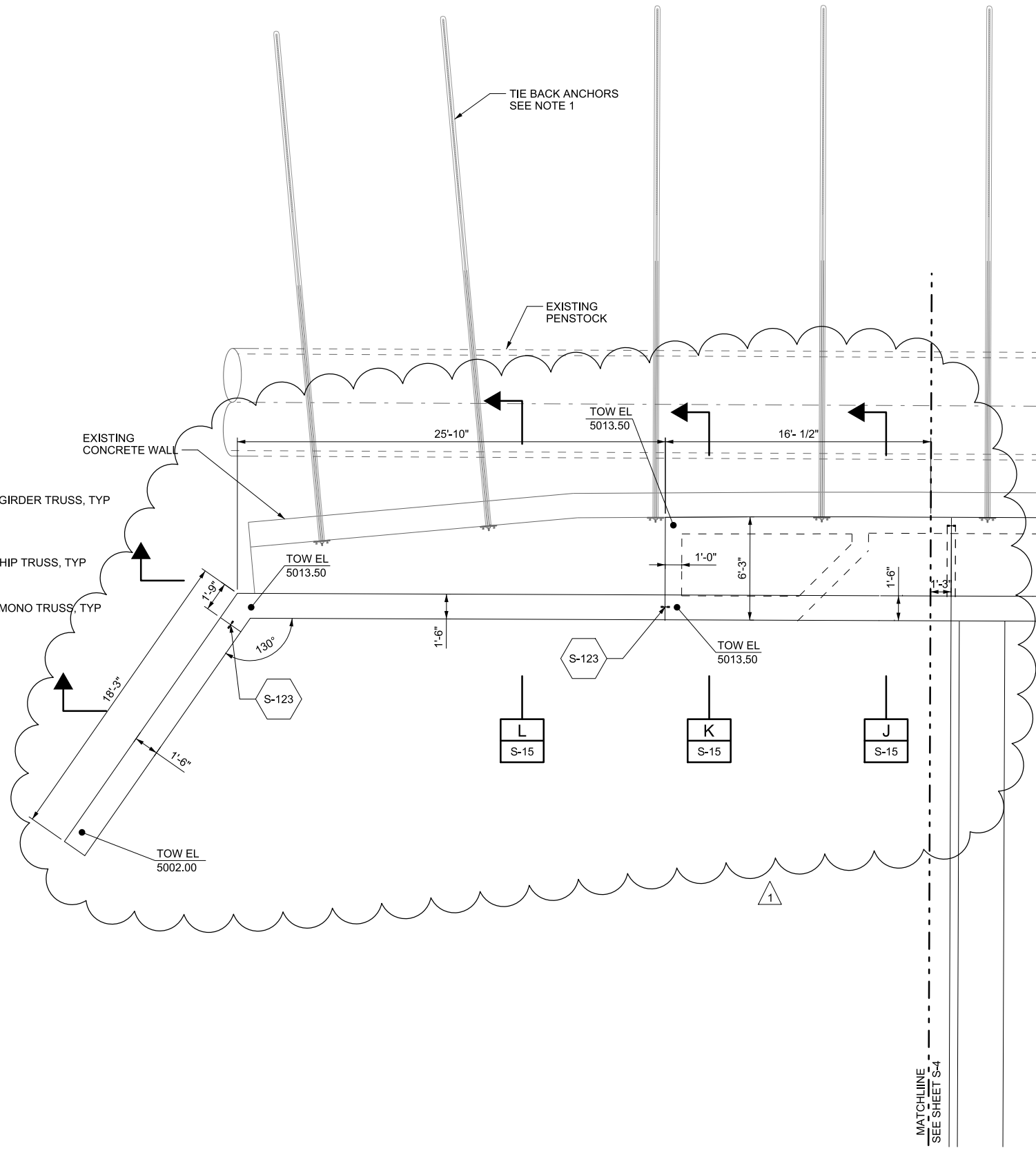
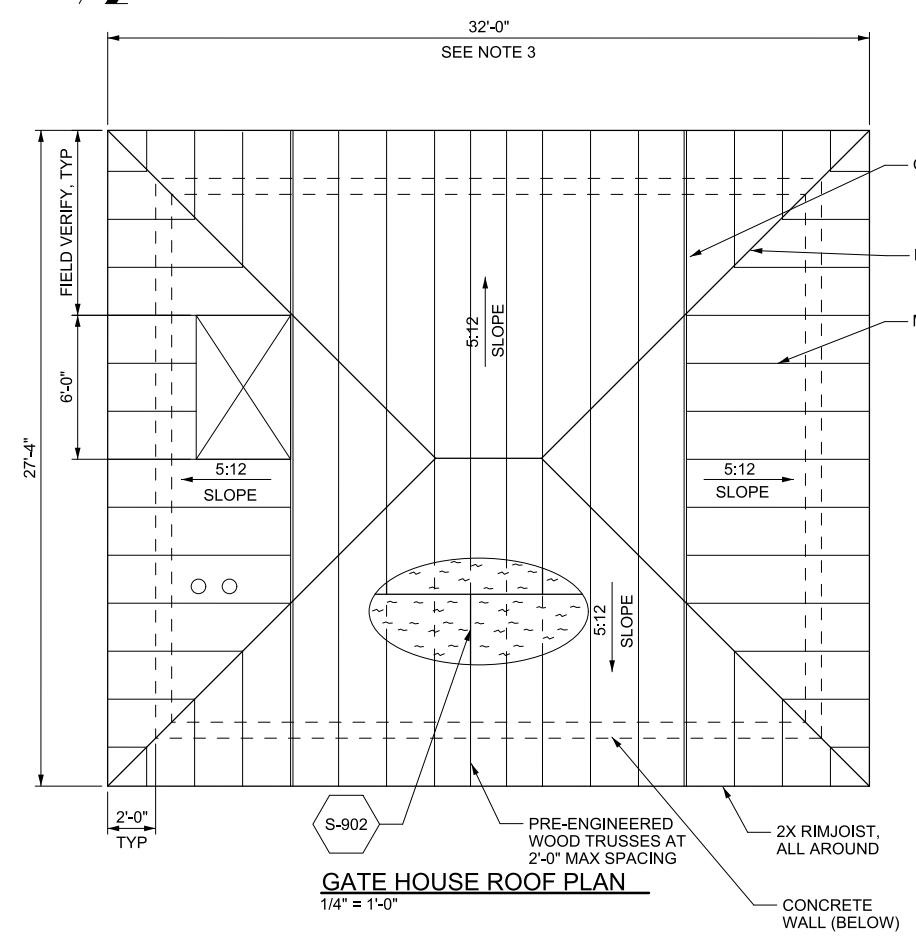
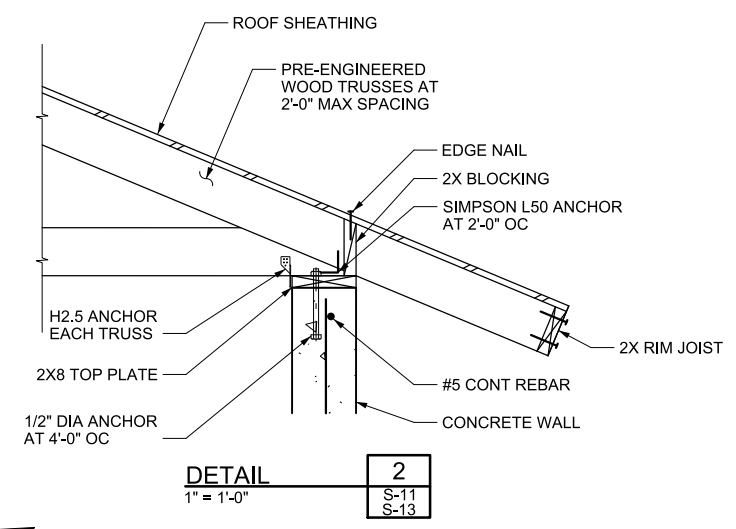
SHEET
S-5



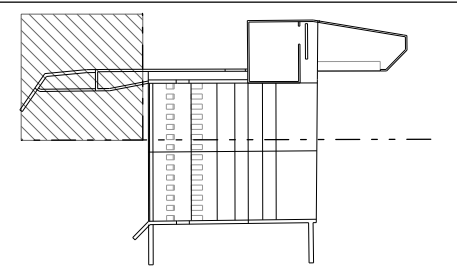
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User: gclark

File: S-06.dgn Model: Layout1 ColorTable: bw.ctb DesignScript: MWH_Iplot_PenTable_20121.dgn PlotScale: 0.166667:1



KEY PLAN



GENERAL SHEET NOTES

1. CONTRACTOR IS RESPONSIBLE FOR DESIGN AND INSTALLATION OF TIEBACK SYSTEM FOR SOIL STABILITY IN ADJACENT HIGHWAY. TIEBACKS ARE NOT CONSIDERED PERMANENT FEATURES. REFER TO GEOTECHNICAL REPORT FOR DESIGN CRITERIA AND OTHER GEOTECHNICAL CONDITIONS.
2. SEE GENERAL STRUCTURAL NOTES FOR ADDITIONAL INFORMATION PERTAINING TO THE ROOF SYSTEM OF THE GATE HOUSE.
3. CONTRACTOR TO VERIFY BUILDING DIMENSION BASED ON LOCATION OF EXISTING EXTERIOR CONCRETE WALLS (BELOW).
4. COORDINATE LOCATION OF ALL ROOF PENETRATIONS WITH ARCHITECTURAL DRAWINGS.

ROOF SYSTEM NOTES

1. ROOF SHEATHING SHALL BE 3/4" STRUCTURAL 1 EXTERIOR PLYWOOD NAILED DIRECTLY TO THE TRUSSES. ROOF NAILING SHALL BE WITH 10d NAILS AT 4" OC AT EDGE AND BOUNDARY AND 12" OC FIELD. BLOCKING IS REQUIRED AT ALL PANEL EDGES. SEE S-902 FOR ADDITIONAL INFORMATION.
2. TRUSSES SHALL BE DOUGLAS FIR AND DESIGNED BY THE TRUSS MANUFACTURER FOR THE LOADINGS PROVIDED ON SHEET GS-1.

REV	DATE	BY	DESCRIPTION
1	1-25-18	GAC	DCN 1

SCALE	1/4" = 1'-0"
WARNING	IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE
DESIGNED	G. CLARK
DRAWN	K. CRICK
CHECKED	T. ARNOLD

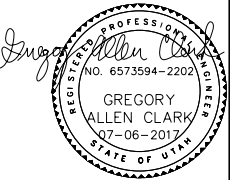
ISSUED FOR CONSTRUCTION - JUNE 2017

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HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY STRUCTURAL LOGAN 3RD DAM UPPER PLAN - III	SHEET S-6
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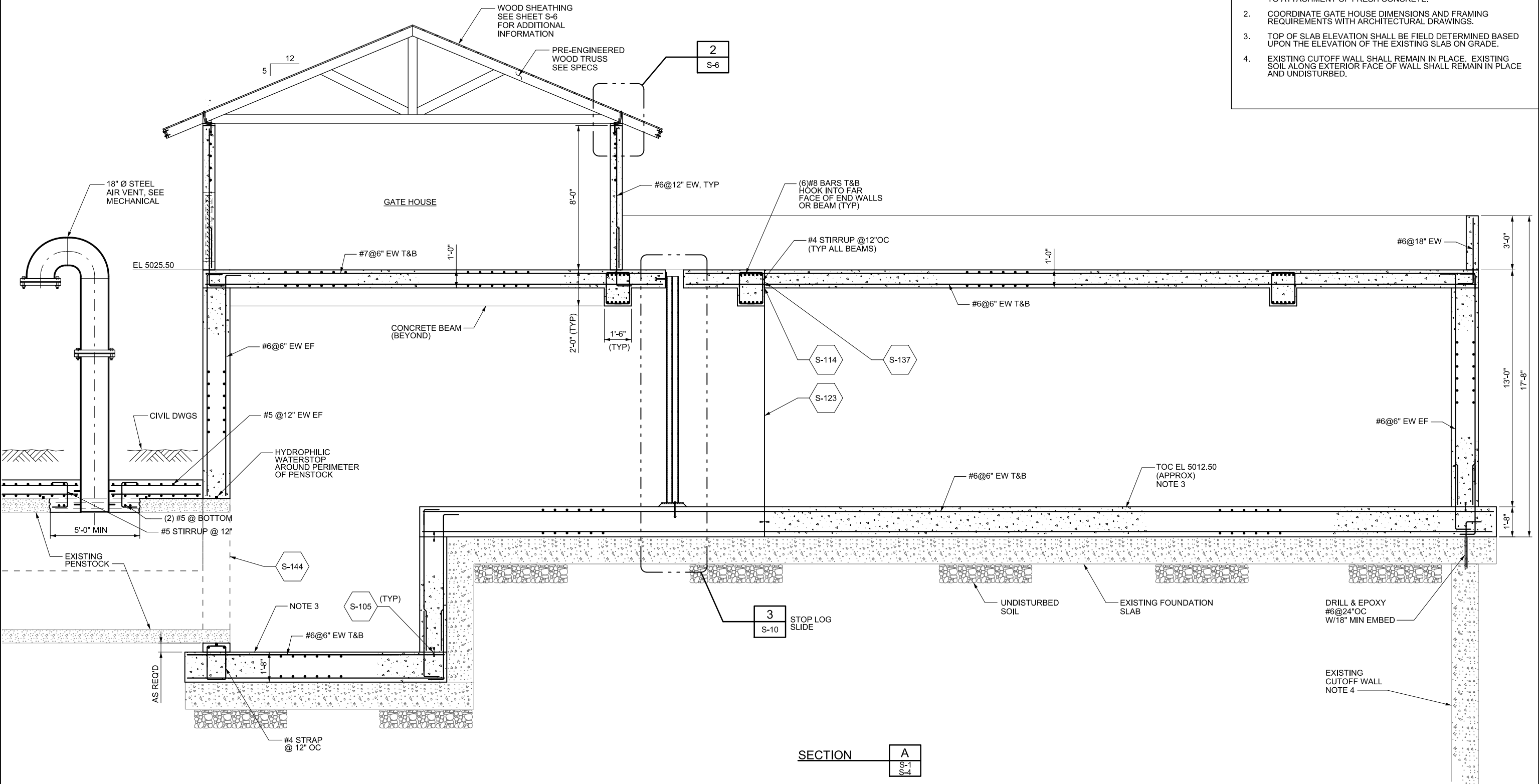


Plot Date: 25-JAN-2018 10:24

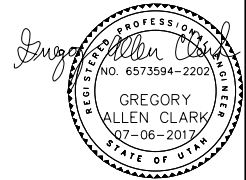
User: gclark

File: S-07.dgn Model: Layout1 ColorTable: bw.ctb DesignScript: MWH_Iplot_PenTable_20121212.dgn PlotScale: 0.166667:1

- GENERAL SHEET NOTES**
1. LOCATION AND TYPE OF EXISTING CUTOFF WALL IS ASSUMED. ENGINEER SHALL INSPECT CONDITION OF CUTOFF WALL PRIOR TO ATTACHMENT OF FRESH CONCRETE.
 2. COORDINATE GATE HOUSE DIMENSIONS AND FRAMING REQUIREMENTS WITH ARCHITECTURAL DRAWINGS.
 3. TOP OF SLAB ELEVATION SHALL BE FIELD DETERMINED BASED UPON THE ELEVATION OF THE EXISTING SLAB ON GRADE.
 4. EXISTING CUTOFF WALL SHALL REMAIN IN PLACE. EXISTING SOIL ALONG EXTERIOR FACE OF WALL SHALL REMAIN IN PLACE AND UNDISTURBED.



SECTION **A**
S-1
S-4



REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE	3/8" = 1'-0"
WARNING	IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED	G. CLARK
DRAWN	S. STARK
CHECKED	G. CLARK

ISSUED FOR CONSTRUCTION - JUNE 2017

ANY PRINT NOT BEARING THIS STAMP MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.

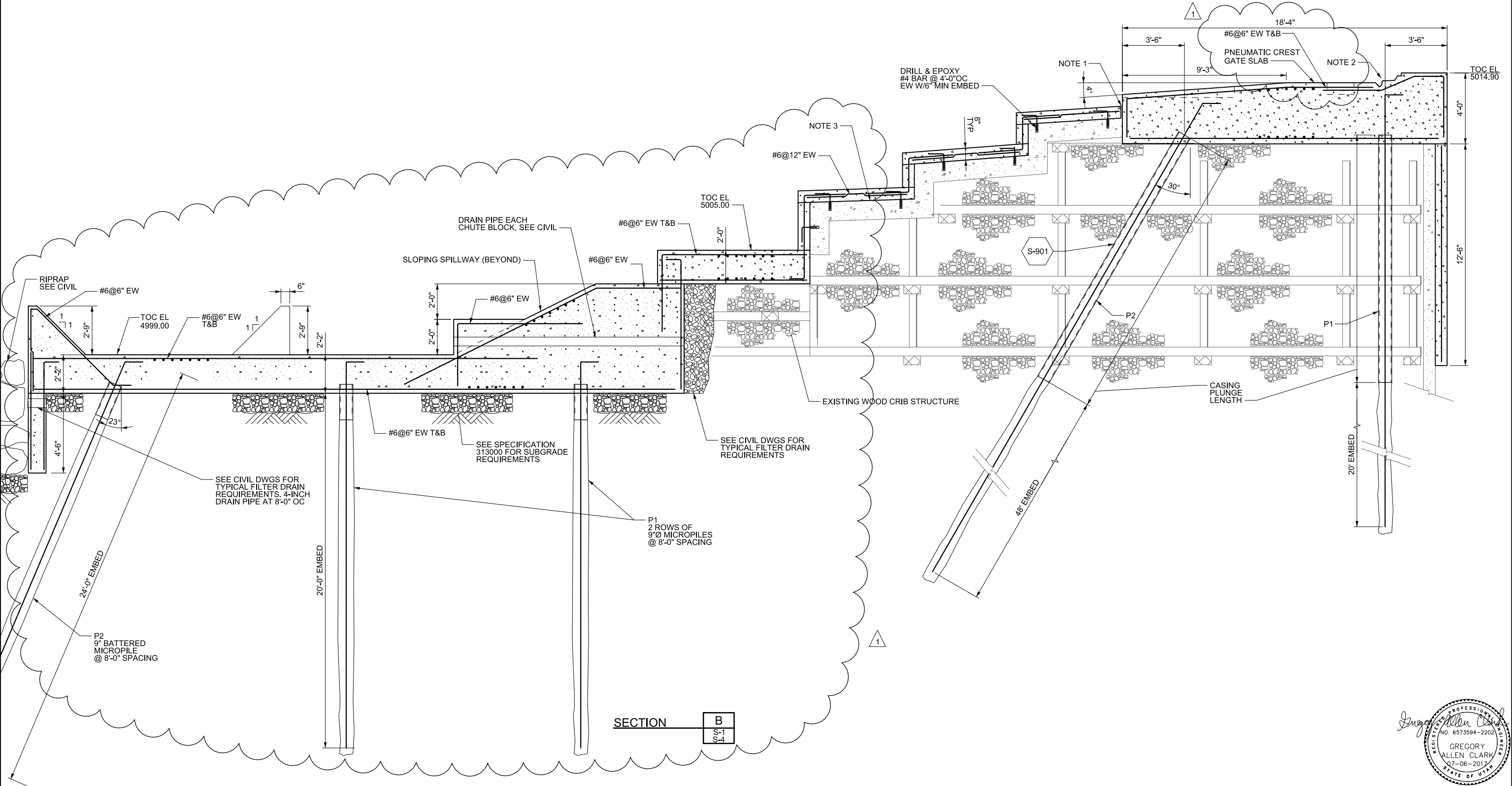


HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

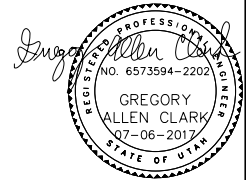
LOGAN CITY
STRUCTURAL
LOGAN 3RD DAM
SECTIONS AND DETAILS - I

SHEET
S-7

- ### GENERAL SHEET NOTES
1. PROVIDE 1-INCH GAP BETWEEN EDGE OF PNEUMATIC CREST GATE SLAB AND EXISTING/PROPOSED SPILLWAY SLAB. PROVIDE BACKER ROD WITH SEALANT.
 2. COORDINATE SLAB GEOMETRY REQUIREMENTS WITH MECHANICAL DRAWINGS AND PNEUMATIC CREST GATE SUPPLIER.
 3. EXISTING FACE OF CONCRETE SLAB SHALL BE PRESSURE WASHED TO INCLUDE APPLICATION OF A BONDING AGENT. SEE SPECIFICATIONS.



SECTION B



REV	DATE	BY	DESCRIPTION
1	1-25-18	GAC	DCN 1

SCALE	3/8" = 1'-0"
WARNING	IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED	G. CLARK
DRAWN	S. STARK
CHECKED	G. CLARK

ISSUED FOR CONSTRUCTION - JUNE 2017

ANY PRINT NOT BEARING THIS STAMP MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.



HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

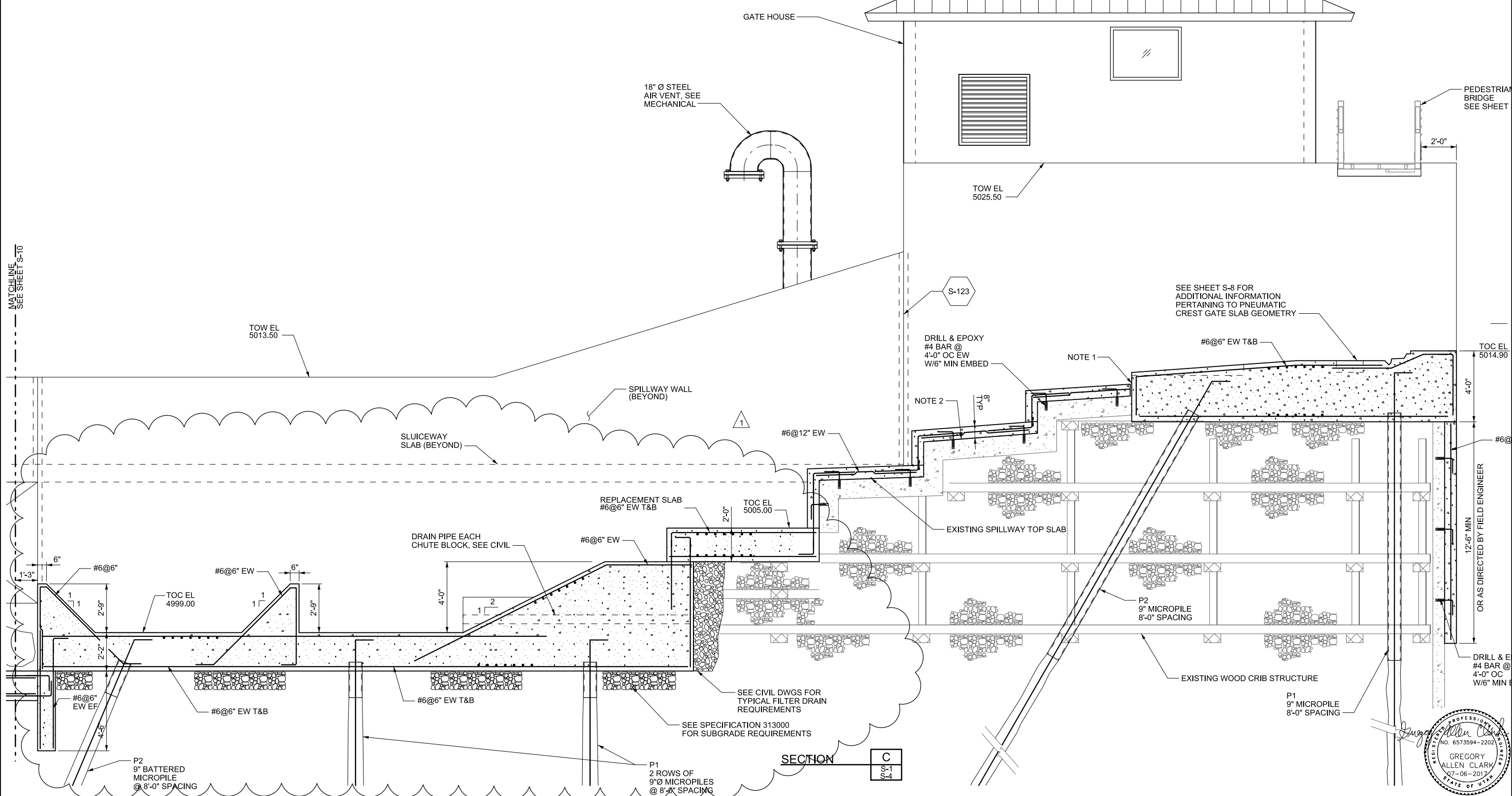
LOGAN CITY
STRUCTURAL
LOGAN 3RD DAM
SECTIONS AND DETAILS - II

SHEET
S-8

GENERAL SHEET NOTES

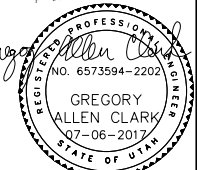
1. PROVIDE 1-INCH GAP BETWEEN EDGE OF PNEUMATIC CREST GATE SLAB AND EXISTING/PROPOSED SPILLWAY SLAB. PROVIDE BACKER ROD WITH SEALANT.
2. EXISTING FACE OF CONCRETE SLAB SHALL BE PRESSURE WASHED TO INCLUDE APPLICATION OF BONDING AGENT. SEE SPECIFICATIONS.

Plot Date: 26-JAN-2018 10:51
 User: gclark



MATCHLINE
 SEE SHEET S-10

File: S-09.dgn Model: Layout1 ColorTable: bw.ctb DesignScript: MWH_Iplot_PenTable_20121.dgn PlotScale: 0.166667:1



REV	DATE	BY	DESCRIPTION
1	1-25-18	GAC	DCN 1

SCALE	3/8" = 1'-0"
-------	--------------

WARNING	IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE
---------	--

DESIGNED	G. CLARK
DRAWN	S. STARK
CHECKED	G. CLARK

ISSUED FOR CONSTRUCTION - JUNE 2017

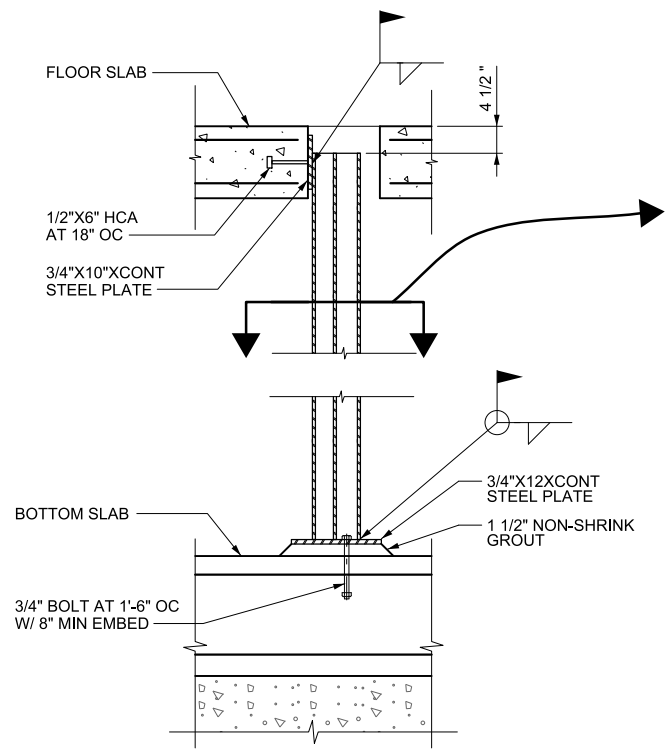
ANY PRINT NOT BEARING THIS STAMP MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.



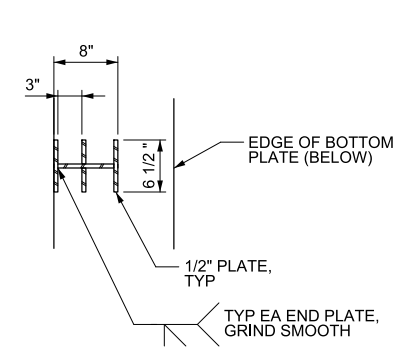
HYDRO NO. 2
 LOGAN 3RD DAM AND SURGE TANK
 IMPROVEMENT PROJECT

LOGAN CITY
 STRUCTURAL
 LOGAN 3RD DAM
 SECTIONS AND DETAILS - III

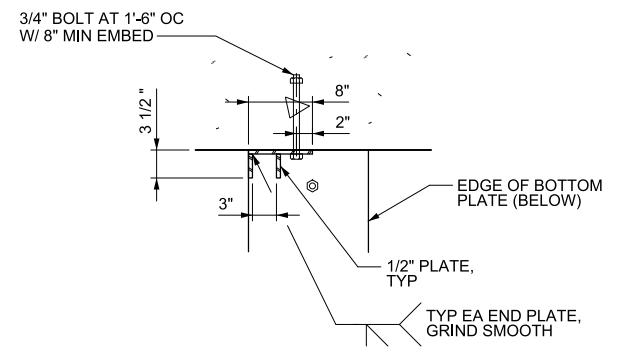
SHEET
 S-9



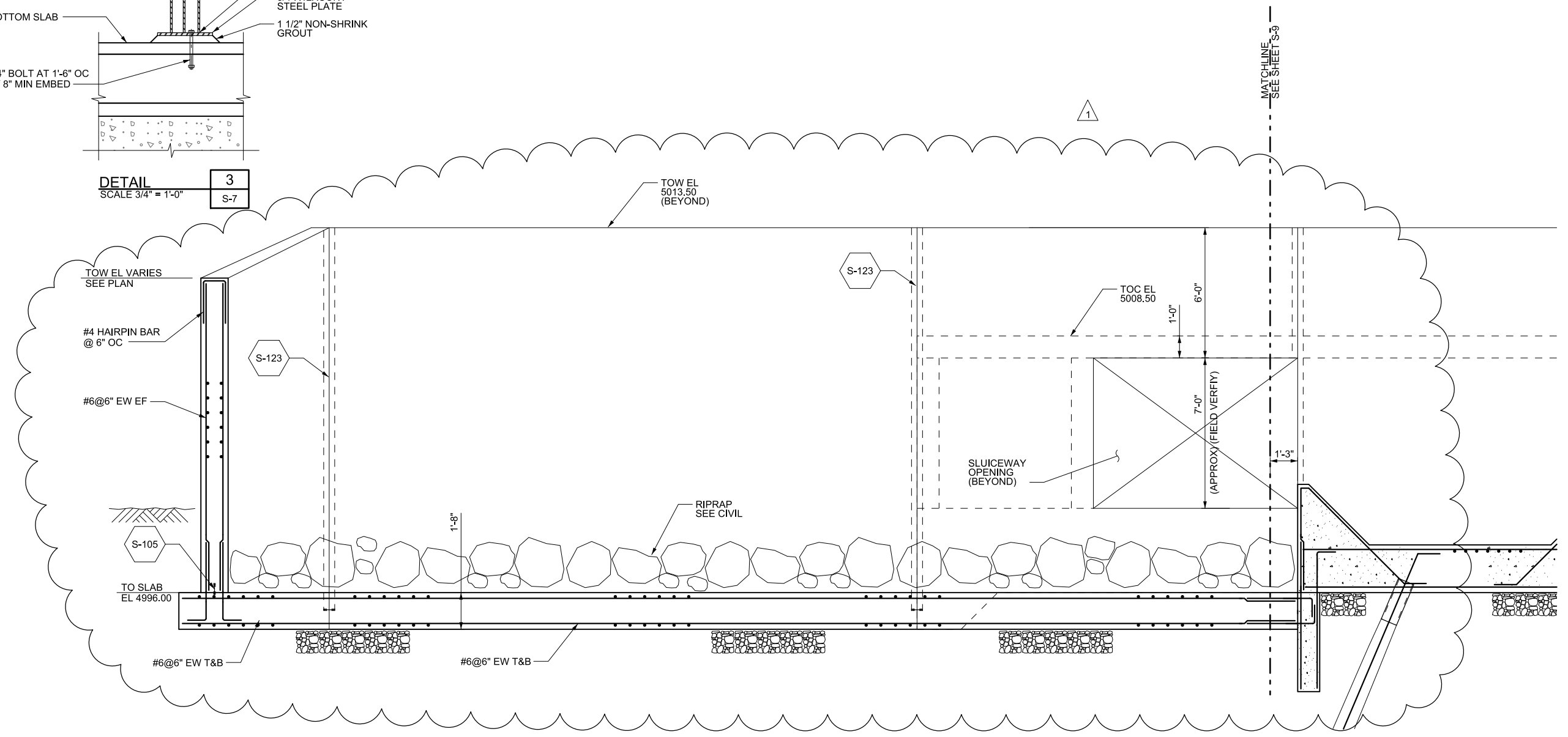
DETAIL 3
SCALE 3/4" = 1'-0"
S-7



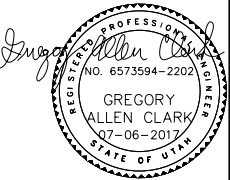
MIDDLE SUPPORT



END SUPPORT



SECTION C
S-1
S-4



REV	DATE	BY	DESCRIPTION
1	1-25-18	GAC	DCN 1

SCALE	3/8" = 1'-0"
WARNING	IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED	G. CLARK
DRAWN	S. STARK
CHECKED	G. CLARK

ISSUED FOR CONSTRUCTION - JUNE 2017

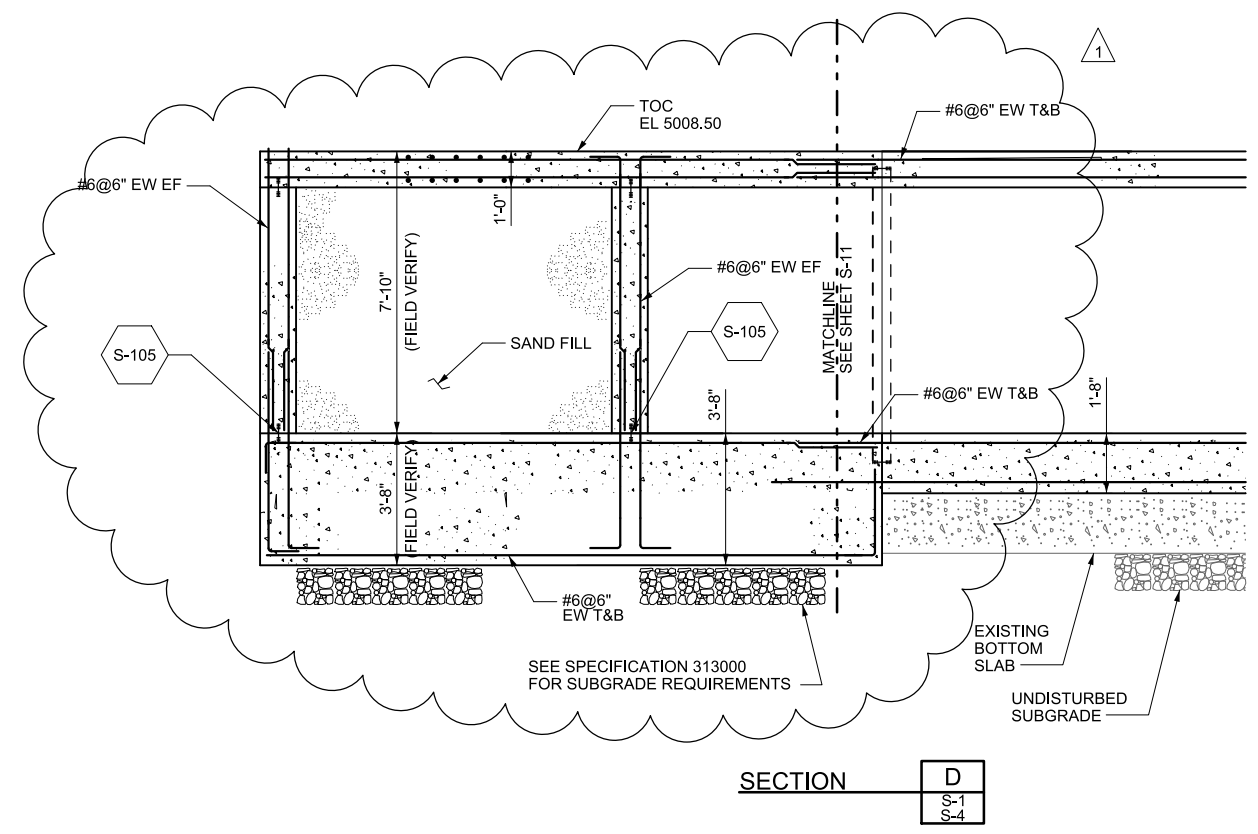
ANY PRINT NOT BEARING THIS STAMP MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.



HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY
STRUCTURAL
LOGAN 3RD DAM
SECTIONS AND DETAILS - IV

SHEET
S-10



REV	DATE	BY	DESCRIPTION
1	1-25-18	GAC	DCN 1

SCALE
3/8" = 1'-0"

WARNING
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED G. CLARK
DRAWN S. STARK
CHECKED G. CLARK

ISSUED FOR CONSTRUCTION - JUNE 2017

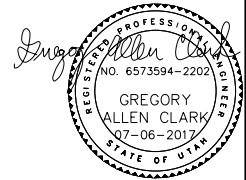
ANY PRINT NOT BEARING THIS STAMP MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.



HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

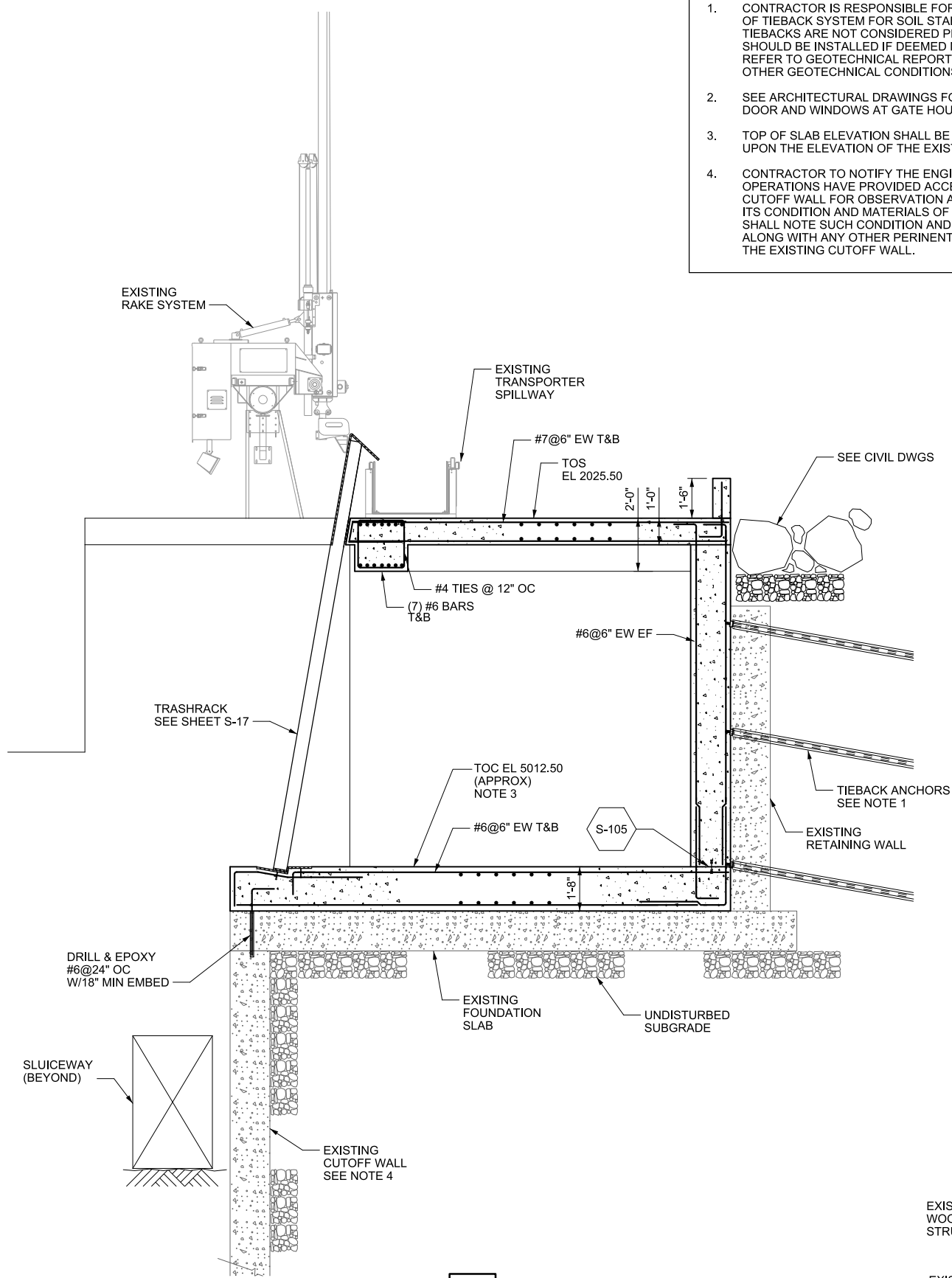
LOGAN CITY
STRUCTURAL
LOGAN 3RD DAM
SECTIONS AND DETAILS - VI

SHEET
S-12

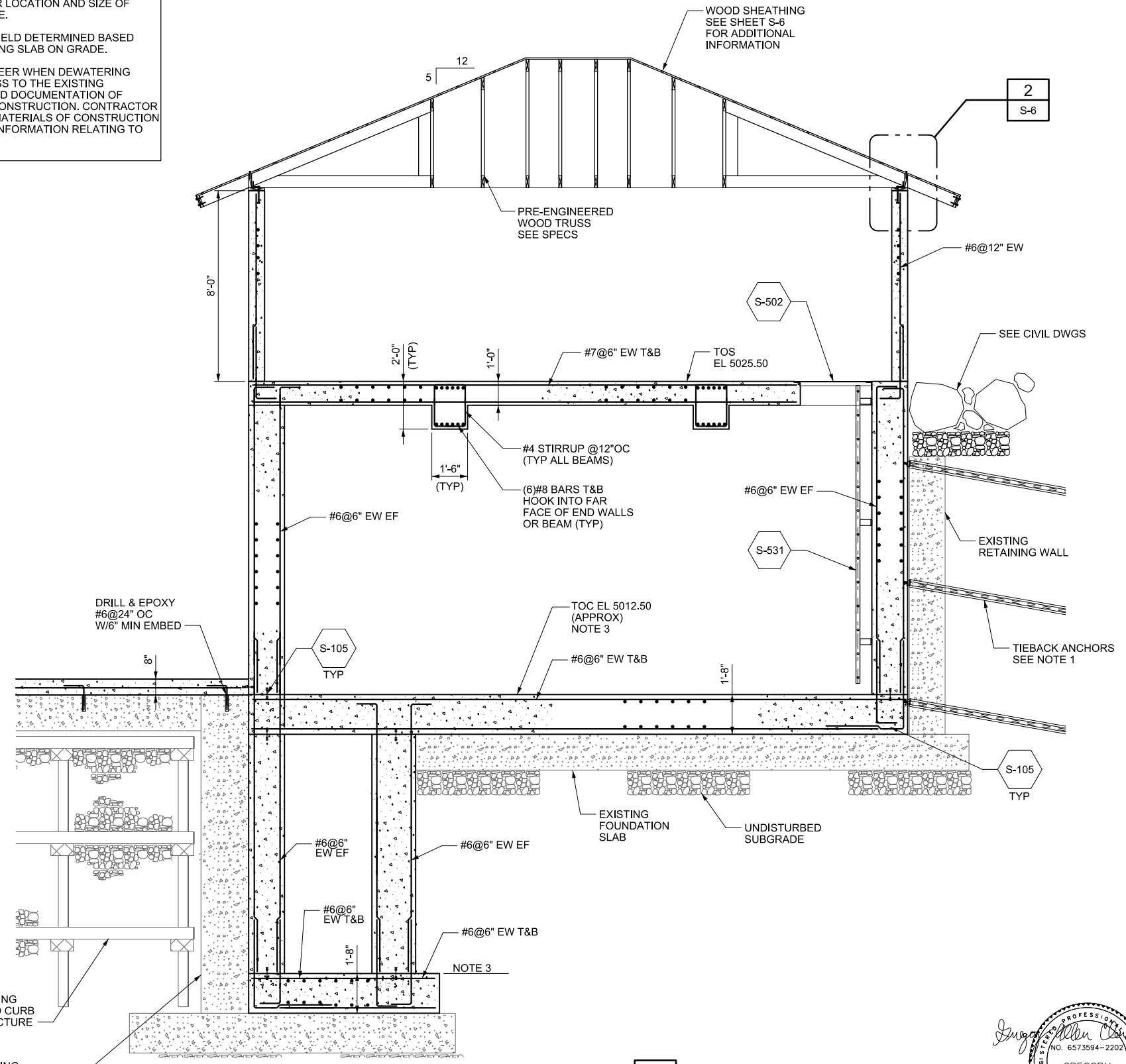


GENERAL SHEET NOTES

1. CONTRACTOR IS RESPONSIBLE FOR DESIGN AND INSTALLATION OF TIEBACK SYSTEM FOR SOIL STABILITY IN ADJACENT HIGHWAY. TIEBACKS ARE NOT CONSIDERED PERMAANANT FEATURES AND SHOULD BE INSTALLED IF DEEMED NECESSARY BY CONTRACTOR. REFER TO GEOTECHNICAL REPORT FOR DESIGN CRITERIA AND OTHER GEOTECHNICAL CONDITIONS.
2. SEE ARCHITECTURAL DRAWINGS FOR LOCATION AND SIZE OF DOOR AND WINDOWS AT GATE HOUSE.
3. TOP OF SLAB ELEVATION SHALL BE FIELD DETERMINED BASED UPON THE ELEVATION OF THE EXISTING SLAB ON GRADE.
4. CONTRACTOR TO NOTIFY THE ENGINEER WHEN DEWATERING OPERATIONS HAVE PROVIDED ACCESS TO THE EXISTING CUTOFF WALL FOR OBSERVATION AND DOCUMENTATION OF ITS CONDITION AND MATERIALS OF CONSTRUCTION. CONTRACTOR SHALL NOTE SUCH CONDITION AND MATERIALS OF CONSTRUCTION ALONG WITH ANY OTHER PERINENT INFORMATION RELATING TO THE EXISTING CUTOFF WALL.



SECTION E
S-1
S-4



SECTION F
S-1
S-4

REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE	WARNING
3/8" = 1'-0"	IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED	G. CLARK
DRAWN	S. STARK
CHECKED	G. CLARK

ISSUED FOR CONSTRUCTION - JUNE 2017

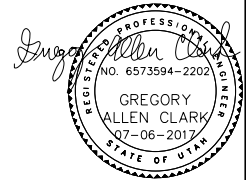
ANY PRINT NOT BEARING THIS STAMP MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.



HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY
STRUCTURAL
LOGAN 3RD DAM
SECTIONS AND DETAILS - VII

SHEET
S-13

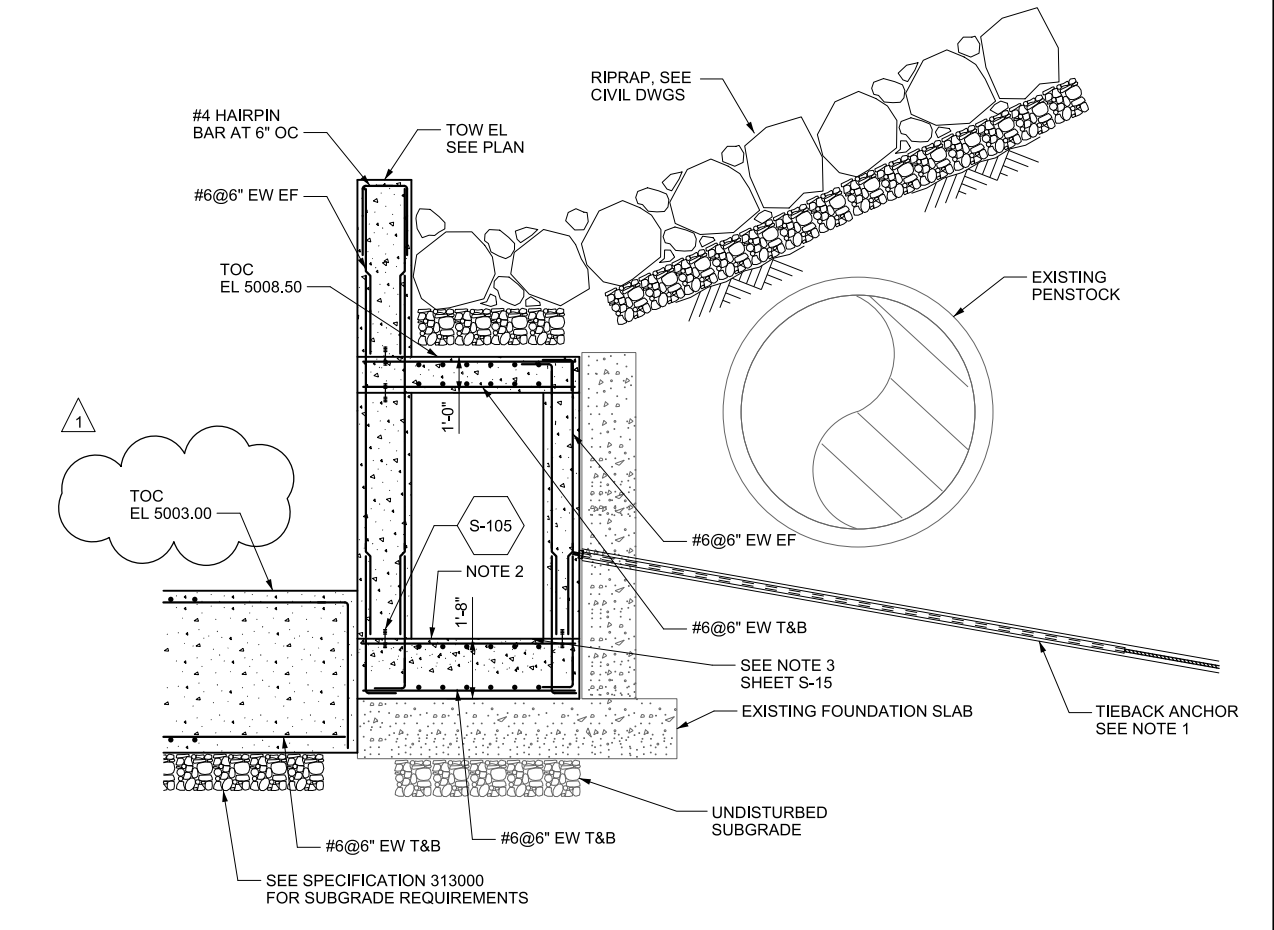
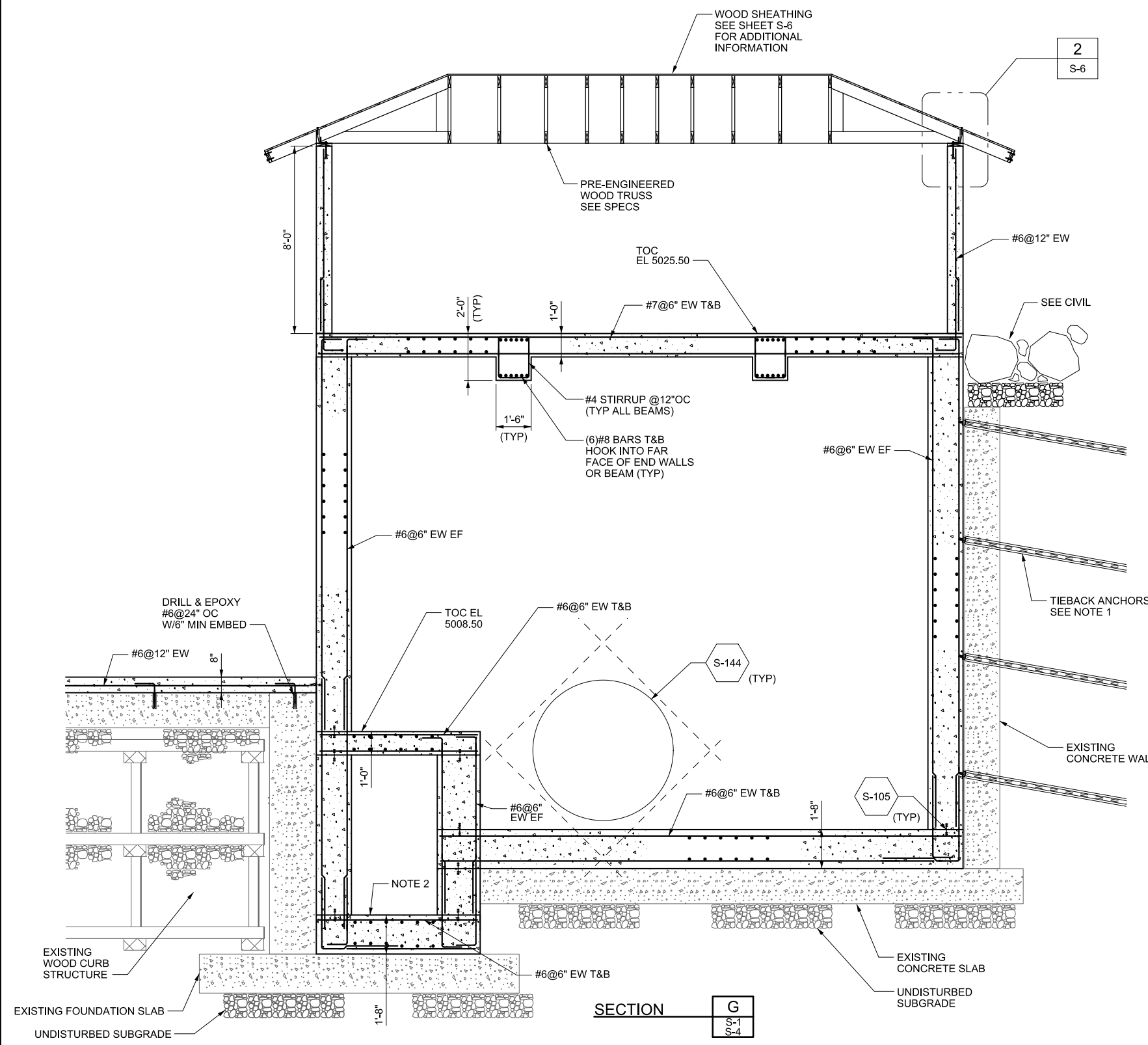


Pkt Date: 25-JAN-2018 10:25

User: gclark

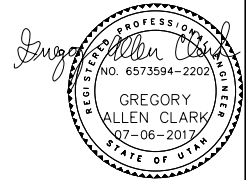
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- GENERAL SHEET NOTES**
- CONTRACTOR IS RESPONSIBLE FOR DESIGN AND INSTALATION OF TIEBACK SYSTEM FOR SOIL STABILITY IN ADJACENT HIGHWAY. TIEBACKS ARE NOT COONSIDERED PERMAANANT FEATURES. REFER TO GEOTECHNICAL REPORT FOR DESIGN CRITERIA AND OTHER GEOTECHNICAL CONDITIONS.
 - TOP OF SLAB ELEVATION SHALL BE FIELD DETERMINED BASED UPON THE ELEVATION OF THE EXISTING SLAB ON GRADE



SECTION **G**
S-1
S-4

SECTION **H**
S-1
S-4



REV	DATE	BY	DESCRIPTION
1	1-25-18	GAC	DCN 1

SCALE
3/8" = 1'-0"

WARNING
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED G. CLARK
DRAWN S. STARK
CHECKED G. CLARK

ISSUED FOR CONSTRUCTION - JUNE 2017

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HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY
STRUCTURAL
LOGAN 3RD DAM
SECTIONS AND DETAILS - VIII

SHEET
S-14

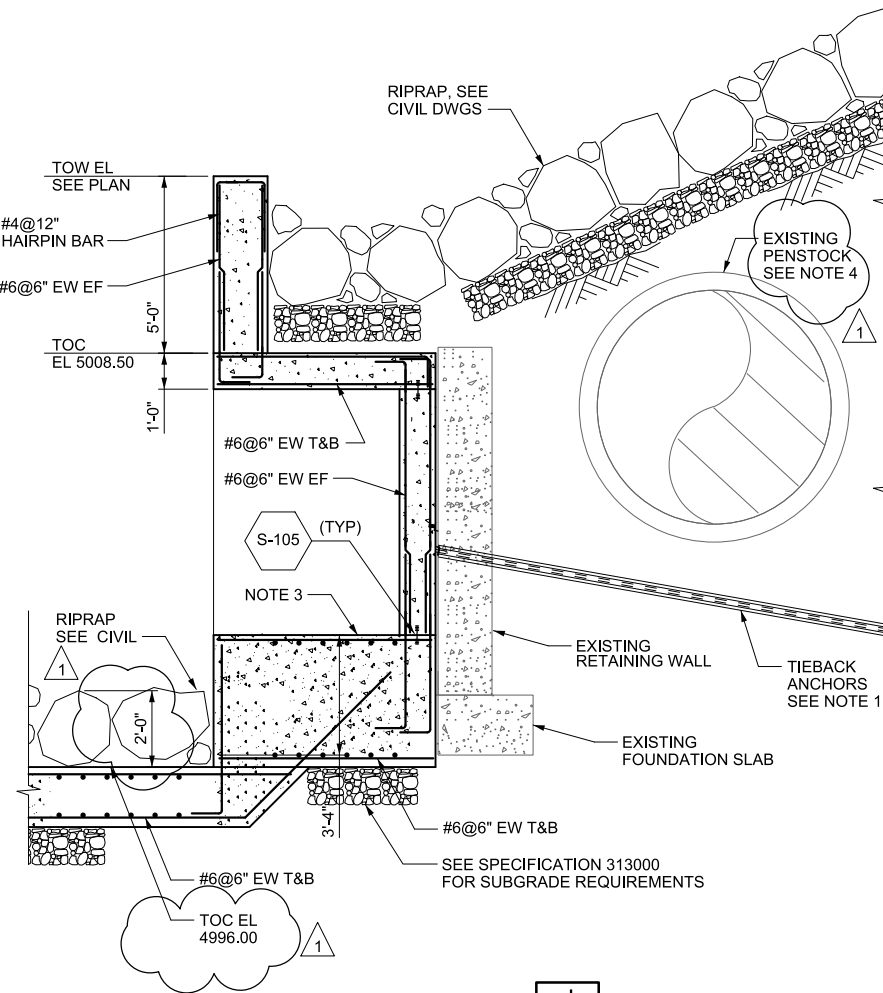
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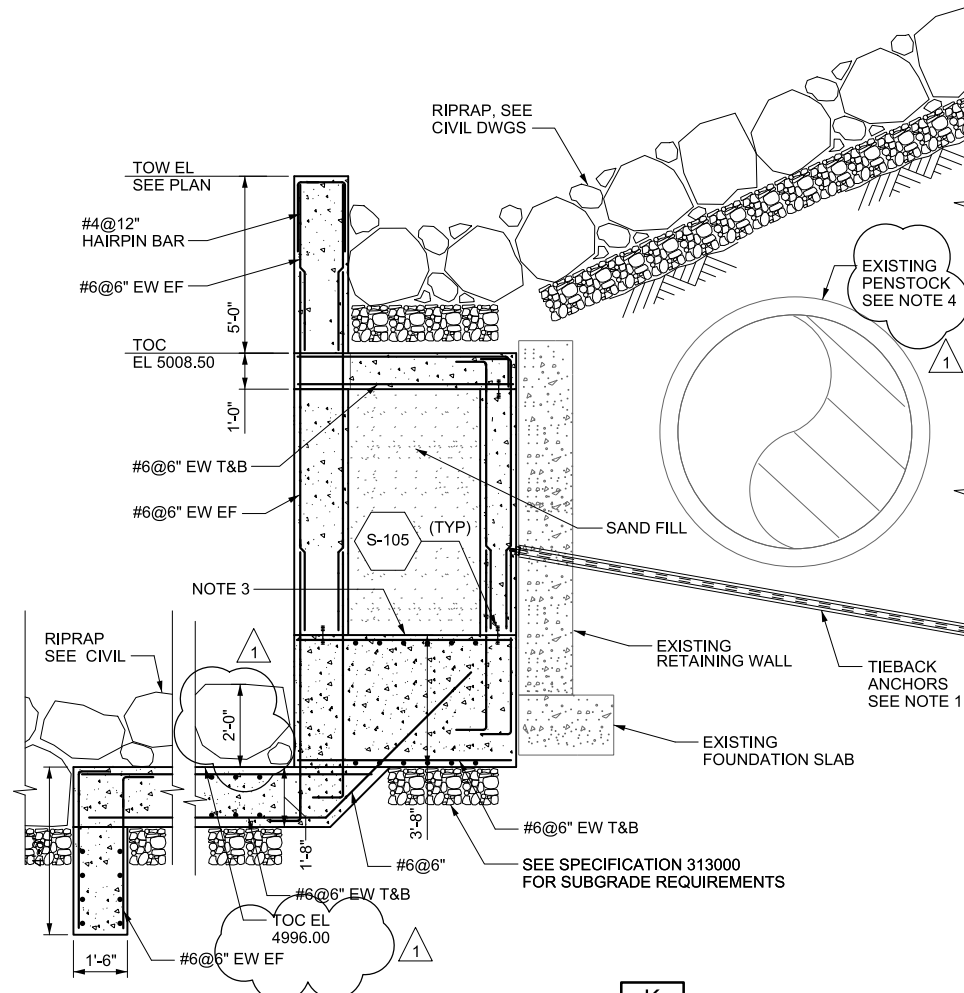
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GENERAL SHEET NOTES

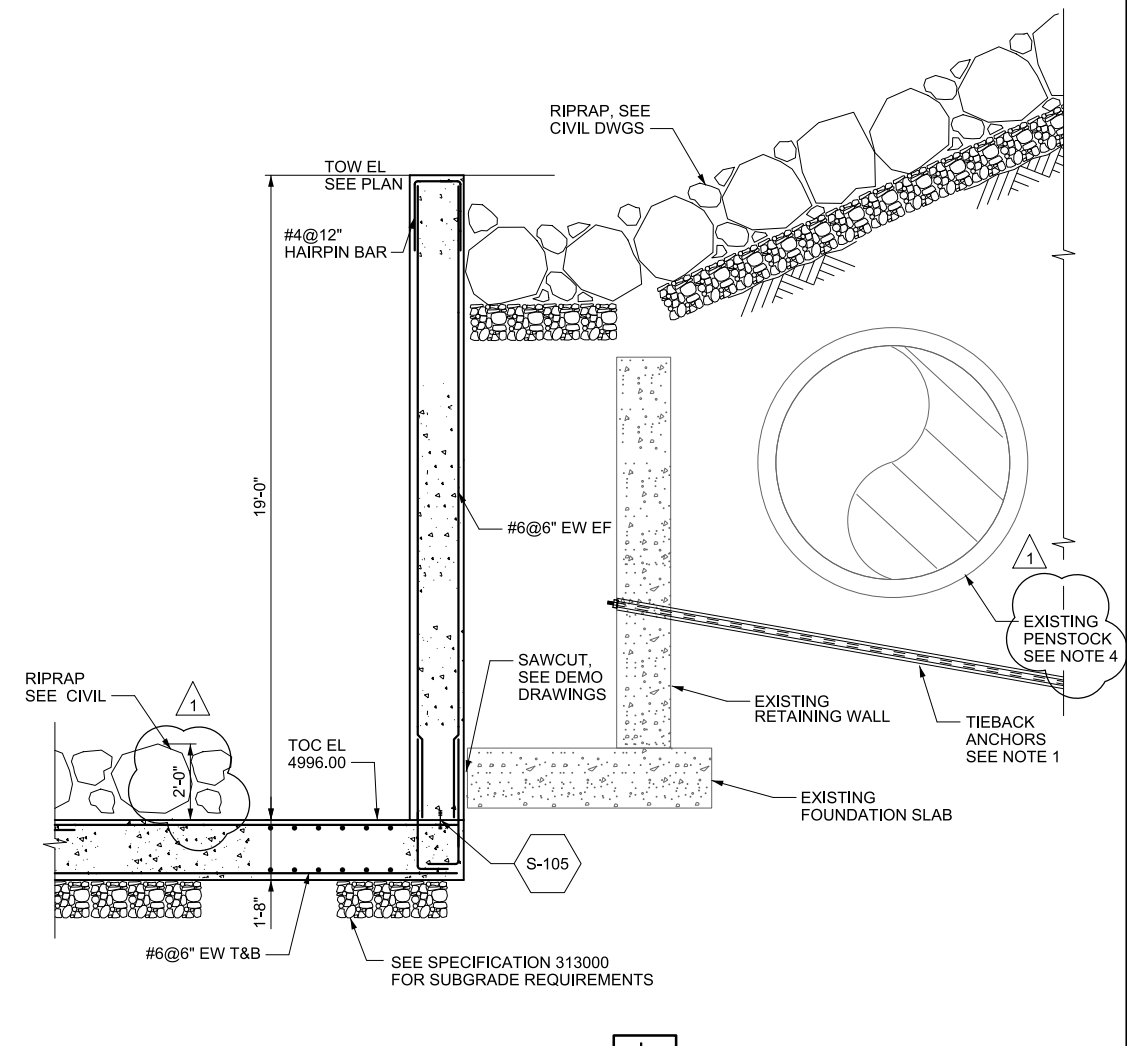
- CONTRACTOR IS RESPONSIBLE FOR DESIGN AND INSTALLATION OF TIEBACK SYSTEM FOR SOIL STABILITY IN ADJACENT HIGHWAY. TIEBACKS ARE NOT CONSIDERED PERMANENT FEATURES. REFER TO GEOTECHNICAL REPORT FOR DESIGN CRITERIA AND OTHER GEOTECHNICAL CONDITIONS.
- SEE MECHANICAL DRAWINGS FOR SIZE AND LOCATION OF PENETRATIONS IN CONCRETE WALLS AND SLABS.
- TOP OF SLAB ELEVATION SHALL BE FIELD DETERMINED BASED UPON THE ELEVATION OF THE EXISTING SLAB ON GRADE.
- CONTRACTOR SHALL PERFORM POTHOLING TO ACCURATELY LOCATE THE EXISTING PENSTOCK. CONTRACTOR SHALL EMPLOY PROPER MEASURES TO MINIMIZE LOAD AND PRESERVE STRUCTURAL INTEGRITY OF THE EXISTING PENSTOCK THROUGHOUT CONSTRUCTION.



SECTION J
S-3



SECTION K
S-3



SECTION L
S-3

REV	DATE	BY	DESCRIPTION
1	1-25-18	GAC	DCN 1

SCALE	3/8" = 1'-0"
WARNING	IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED	G. CLARK
DRAWN	S. STARK
CHECKED	G. CLARK

ISSUED FOR CONSTRUCTION - JUNE 2017

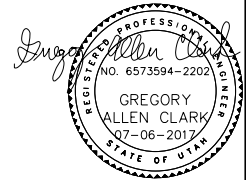
ANY PRINT NOT BEARING THIS STAMP MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.



HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

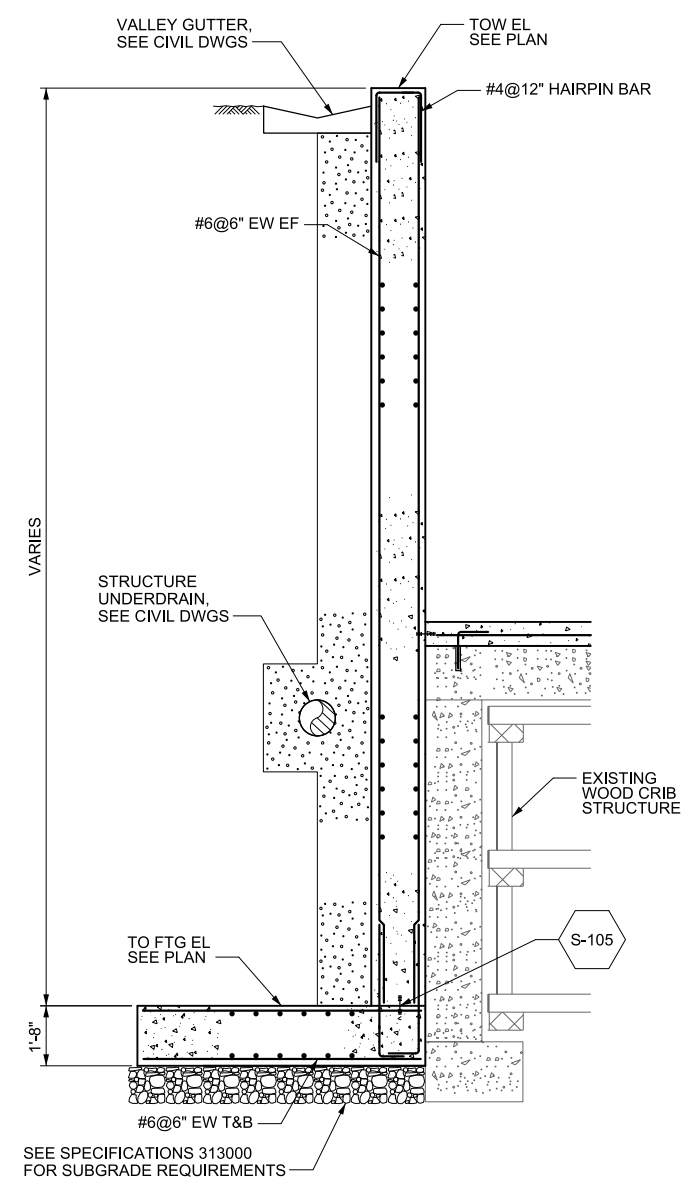
LOGAN CITY
STRUCTURAL
LOGAN 3RD DAM
SECTIONS AND DETAILS - IX

SHEET
S-15



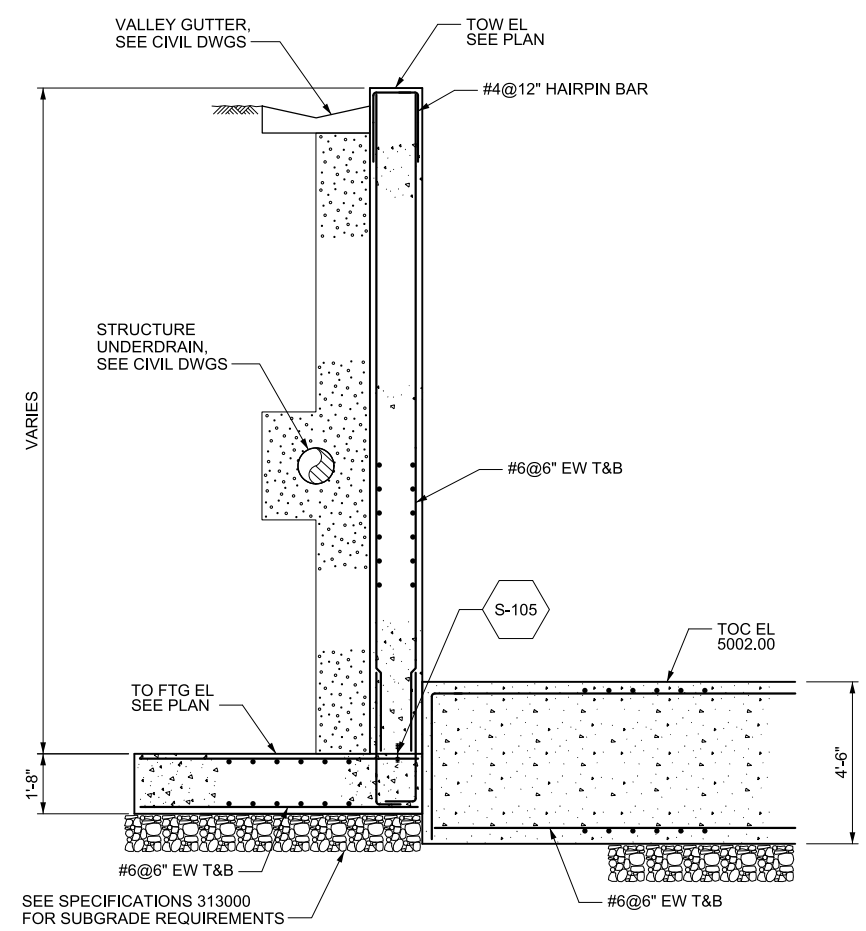
GENERAL SHEET NOTES

- CONTRACTOR IS RESPONSIBLE FOR DESIGN AND INSTALLATION OF TIEBACK SYSTEM FOR SOIL STABILITY IN ADJACENT HIGHWAY. TIEBACKS ARE NOT COONSIDERED PERMAANANT FEATURES. REFER TO GEOTECHNICAL REPORT FOR DESIGN CRITERIA AND OTHER GEOTECHNICAL CONDITIONS.



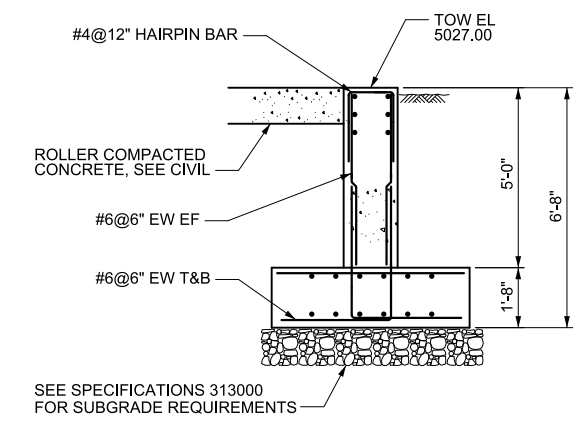
SECTION

M
S-2
S-5



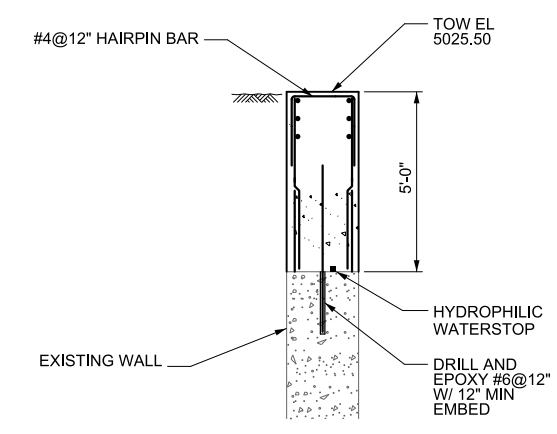
SECTION

N
S-2
S-5



SECTION

P
S-1
S-4



SECTION

Q
S-5

REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE	WARNING
3/8" = 1'-0"	IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED <u>G. CLARK</u>
DRAWN <u>S. STARK</u>
CHECKED <u>G. CLARK</u>

ISSUED FOR CONSTRUCTION - JUNE 2017

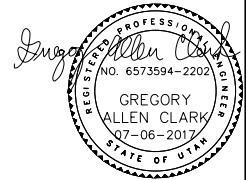
ANY PRINT NOT BEARING THIS STAMP MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.



HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY
STRUCTURAL
LOGAN 3RD DAM
SECTIONS AND DETAILS - X

SHEET
S-16



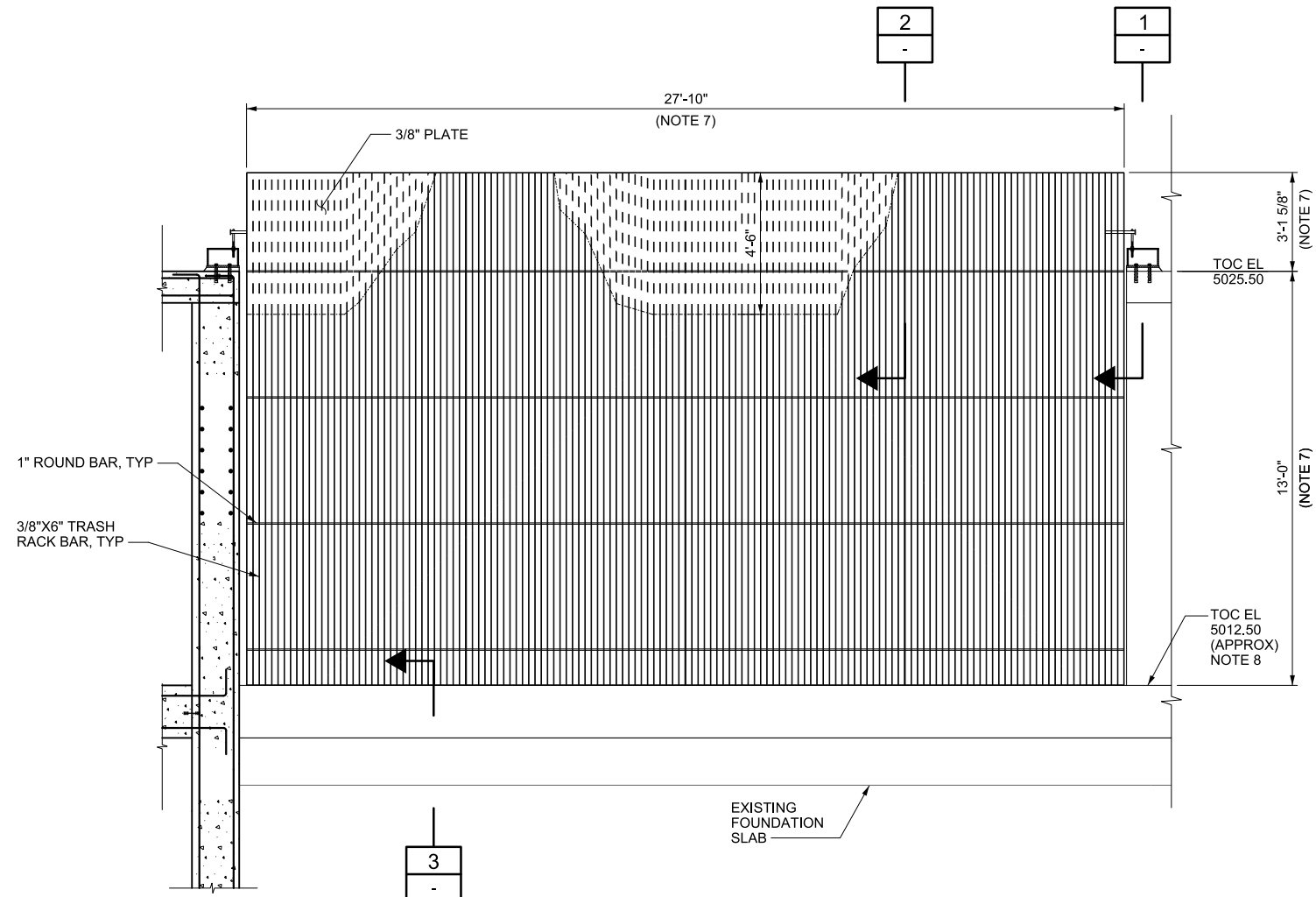
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User: gdark

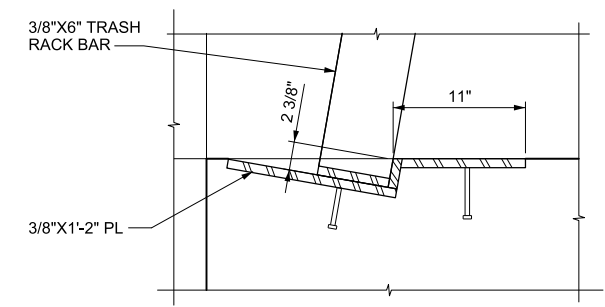
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GENERAL SHEET NOTES

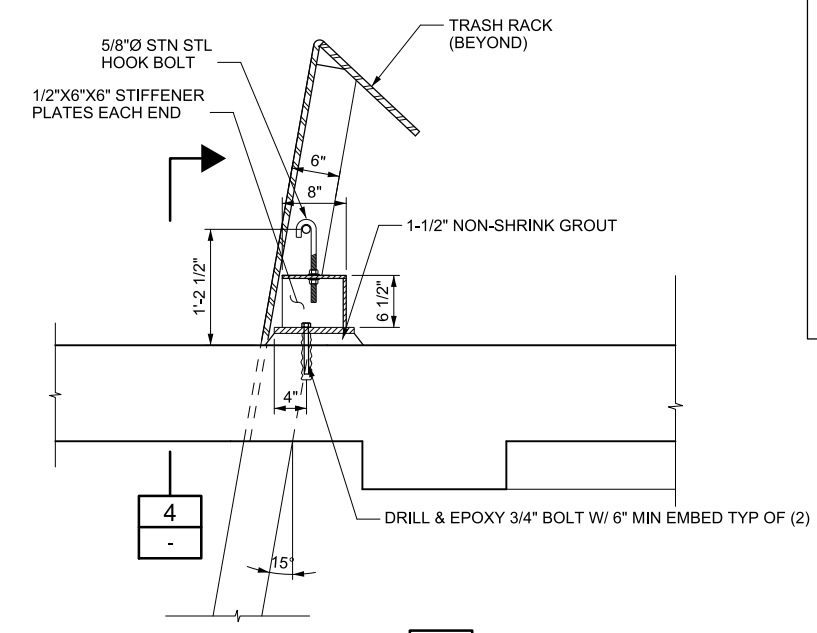
- UNLESS OTHERWISE NOTED, ALL TRASHRACK PANEL METAL FABRICATIONS SHALL BE NON-COATED STEEL.
- ALL CONNECTION HARDWARE, INCLUDING ANGLE CLIPS, HOOK BOLTS, BEAMS, PLATES, AND WASHERS SHALL BE GALVANIZED STEEL.
- BOLTS CONNECTING SCREENS SHALL BE 1/2"x1 1/2" HEX HEAD SS WITH STAINLESS LOCK WASHER AND NUT WITH STAINLESS FLAT WASHER HEAD. BOLTS TO BE SPACED AT 2'-0" ON CENTER WITH CENTERLINE OF BOLT AT 2 1/2" FROM UPSTREAM FACE OF FLAT BAR.
- 1 1/2" DIA HOLE TO BE DRILLED IN OPPOSITE BAR FOR INSTALLATION OF 1/2" DIA SS SCREEN CONNECTOR BOLTS.
- CONTRACTOR TO FIELD VERIFY OPENING DIMENSIONS PRIOR TO FABRICATION.
- PLATE SHALL BE ATTACHED ON THE DOWNSTREAM SIDE OF THE TRASH RACK PANELS, PRIOR TO ASSEMBLY OF PANELS.
- CONTRACTOR SHALL FIELD VERIFY DIMENSIONS OF TRASH RACK PRIOR TO FABRICATION.
- TOP OF SLAB ELEVATION SHALL BE FIELD DETERMINED BASED UPON THE ELEVATION OF THE EXISTING SLAB ON GRADE.



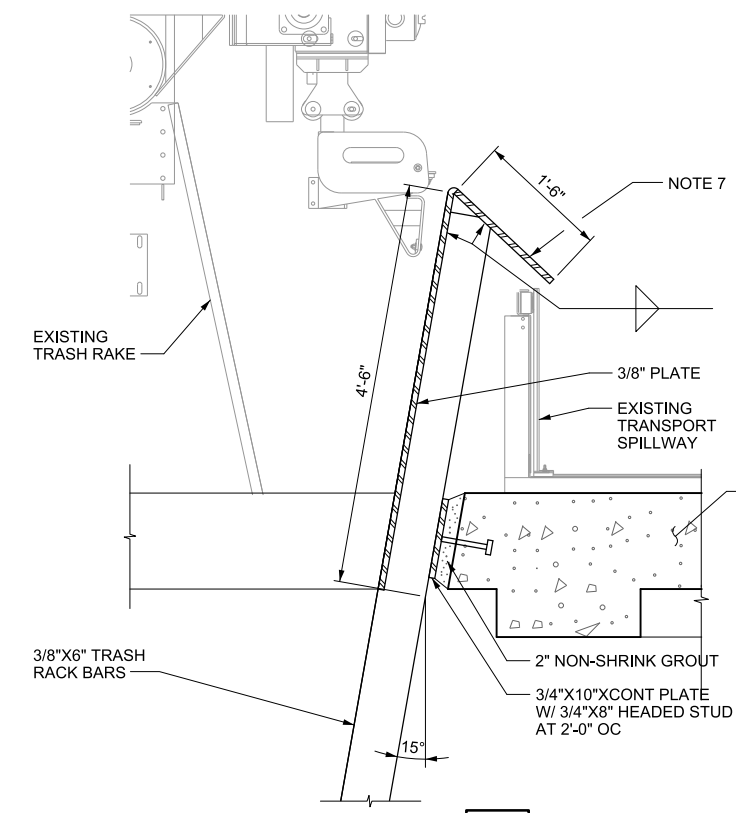
ELEVATION
SCALE 3/8" = 1'-0"



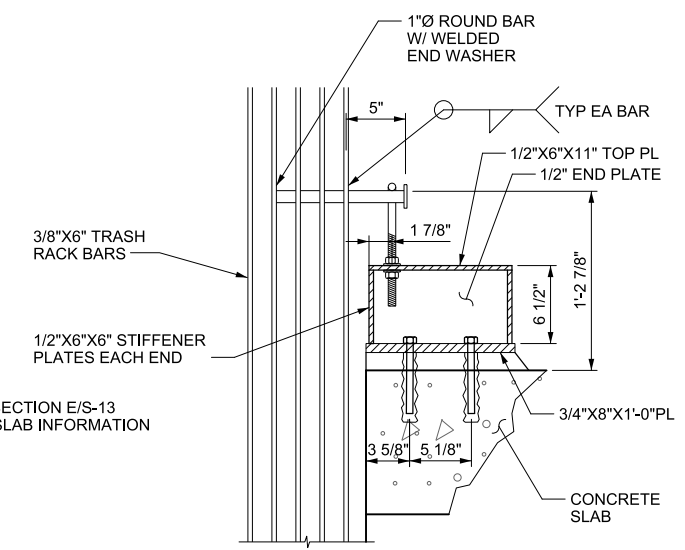
DETAIL 3
SCALE 1-1/2" = 1'-0"



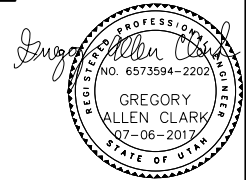
DETAIL 1
SCALE 1" = 1'-0"



DETAIL 2
SCALE 1" = 1'-0"



DETAIL 4
SCALE 1" = 1'-0"



REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE
AS NOTED

WARNING
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED G. CLARK
DRAWN S. STARK
CHECKED G. CLARK

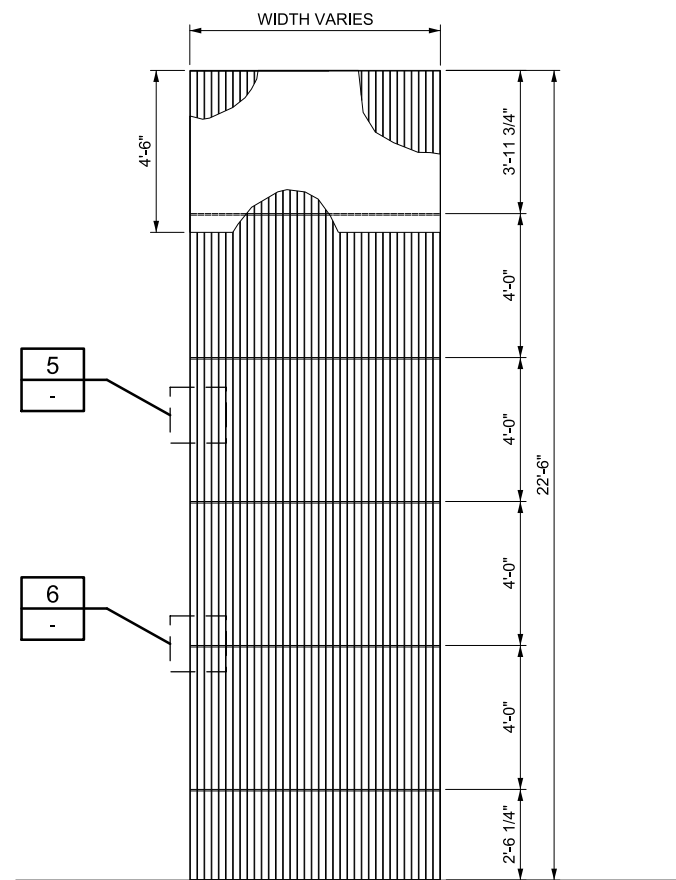
ISSUED FOR CONSTRUCTION - JUNE 2017
ANY PRINT NOT BEARING THIS STAMP MAY CONTAIN DATA THAT IS POTENTIALLY INACCURATE OR INCOMPLETE AND IS NOT TO BE RELIED UPON WITHOUT THE EXPRESS WRITTEN CONSENT OF THE PREPARER.



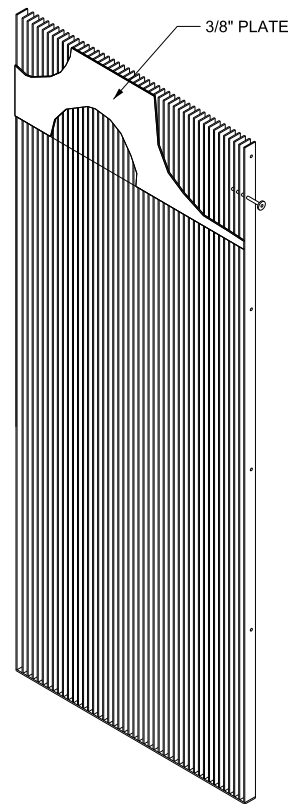
HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY
STRUCTURAL
LOGAN 3RD DAM
TRASH RACK DETAILS - I

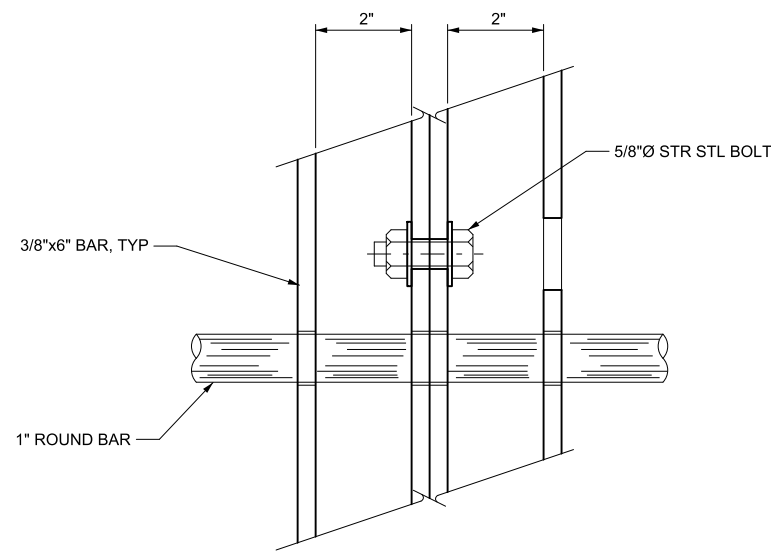
SHEET
S-17



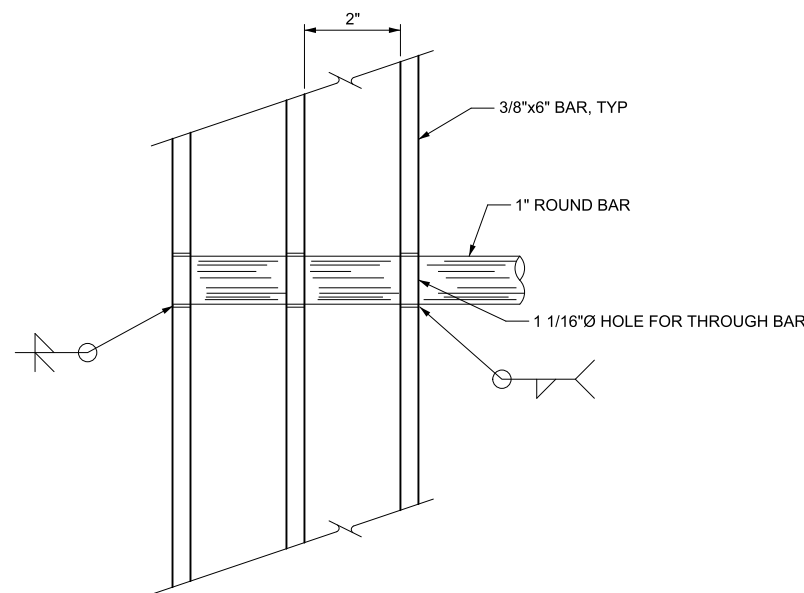
TRASHRACK ELEVATION
SCALE: 3/8" = 1'-0"



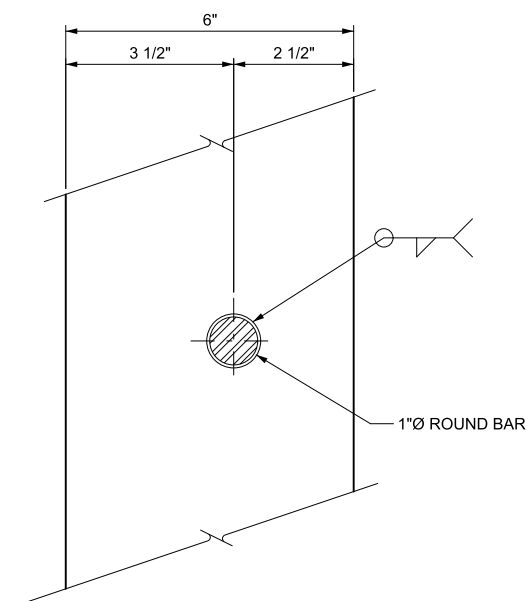
TRASHRACK ISOMETRIC
NOT TO SCALE



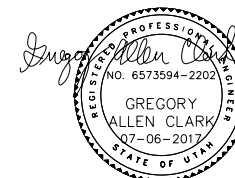
DETAIL 5
SCALE: 6" = 1'-0"



DETAIL 6
SCALE: 6" = 1'-0"



DETAIL 7
SCALE: 6" = 1'-0"



REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE AS NOTED

WARNING
0 1/2 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED G.CLARK
DRAWN S.STARK
CHECKED G.CLARK

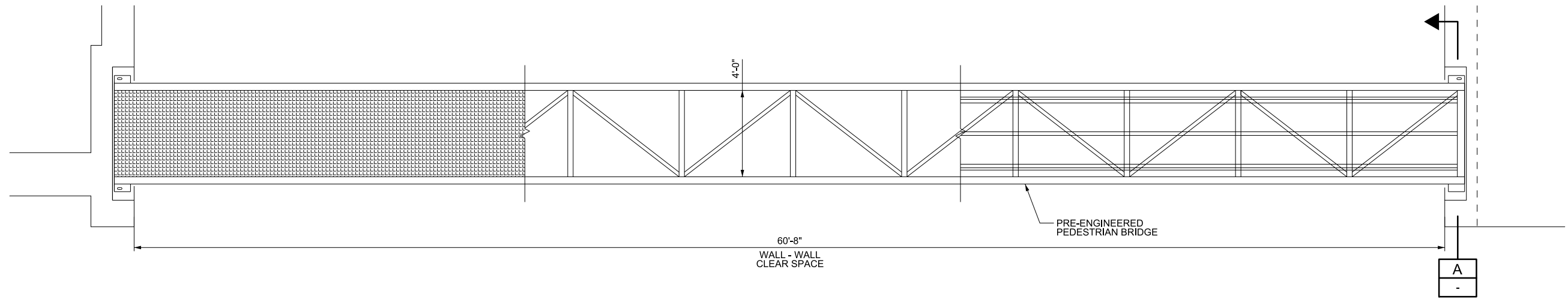
ISSUED FOR CONSTRUCTION - JUNE 2017
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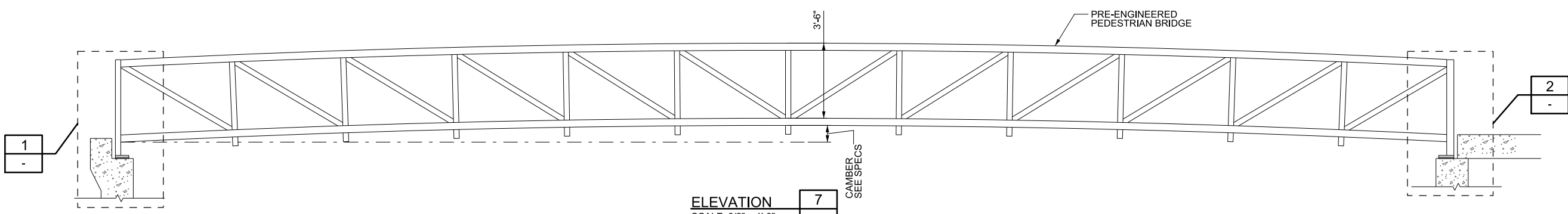
HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY
STRUCTURAL
LOGAN 3RD DAM
TRASH RACK DETAILS - II

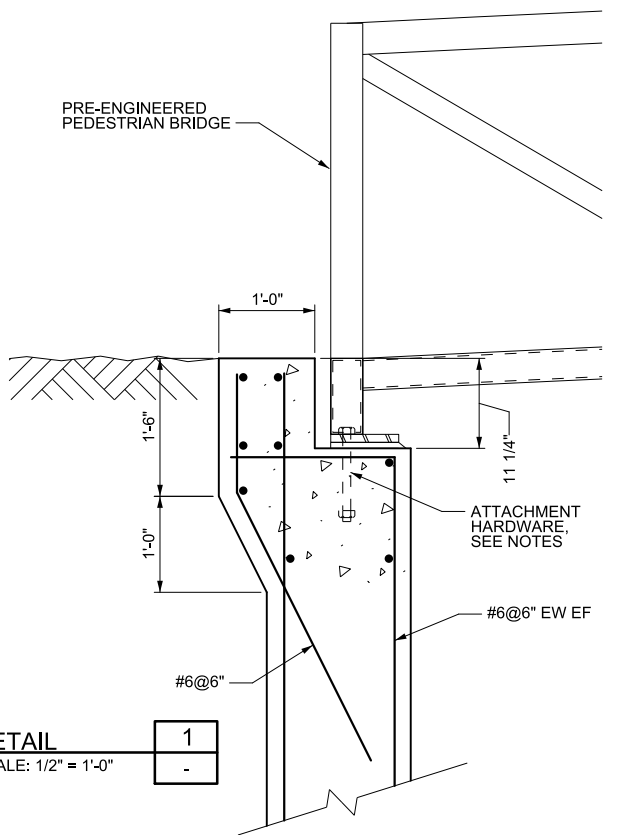
SHEET
S-18



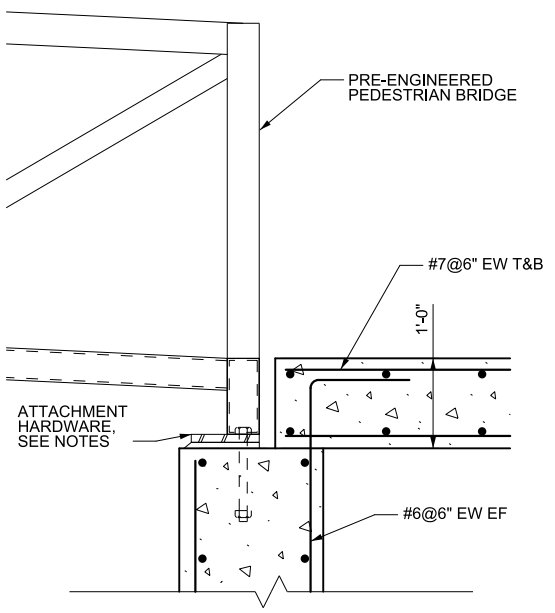
PLAN
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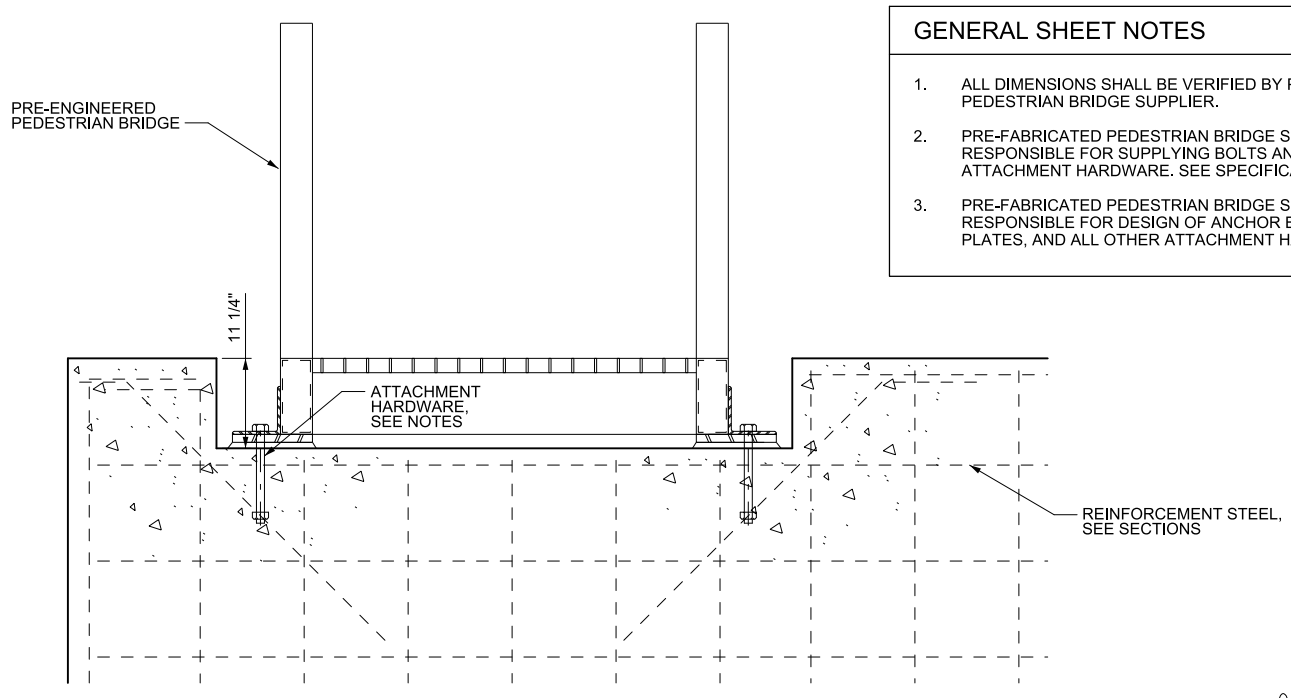
ELEVATION
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DETAIL
SCALE: 1/2" = 1'-0"



DETAIL
SCALE: 1" = 1'-0"



SECTION
SCALE: 1" = 1'-0"

- GENERAL SHEET NOTES**
1. ALL DIMENSIONS SHALL BE VERIFIED BY PRE-FABRICATED PEDESTRIAN BRIDGE SUPPLIER.
 2. PRE-FABRICATED PEDESTRIAN BRIDGE SUPPLIER IS RESPONSIBLE FOR SUPPLYING BOLTS AND ASSOCIATED ATTACHMENT HARDWARE. SEE SPECIFICATIONS.
 3. PRE-FABRICATED PEDESTRIAN BRIDGE SUPPLIER IS RESPONSIBLE FOR DESIGN OF ANCHOR BOLTS, BEARING PLATES, AND ALL OTHER ATTACHMENT HARDWARE.

REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE
AS NOTED

WARNING
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE

DESIGNED G. CLARK
DRAWN S. STARK
CHECKED G. CLARK

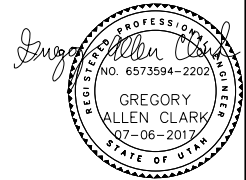
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HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY
STRUCTURAL
LOGAN 3RD DAM
PEDESTRIAN BRIDGE PLAN AND SECTIONS

SHEET
S-19



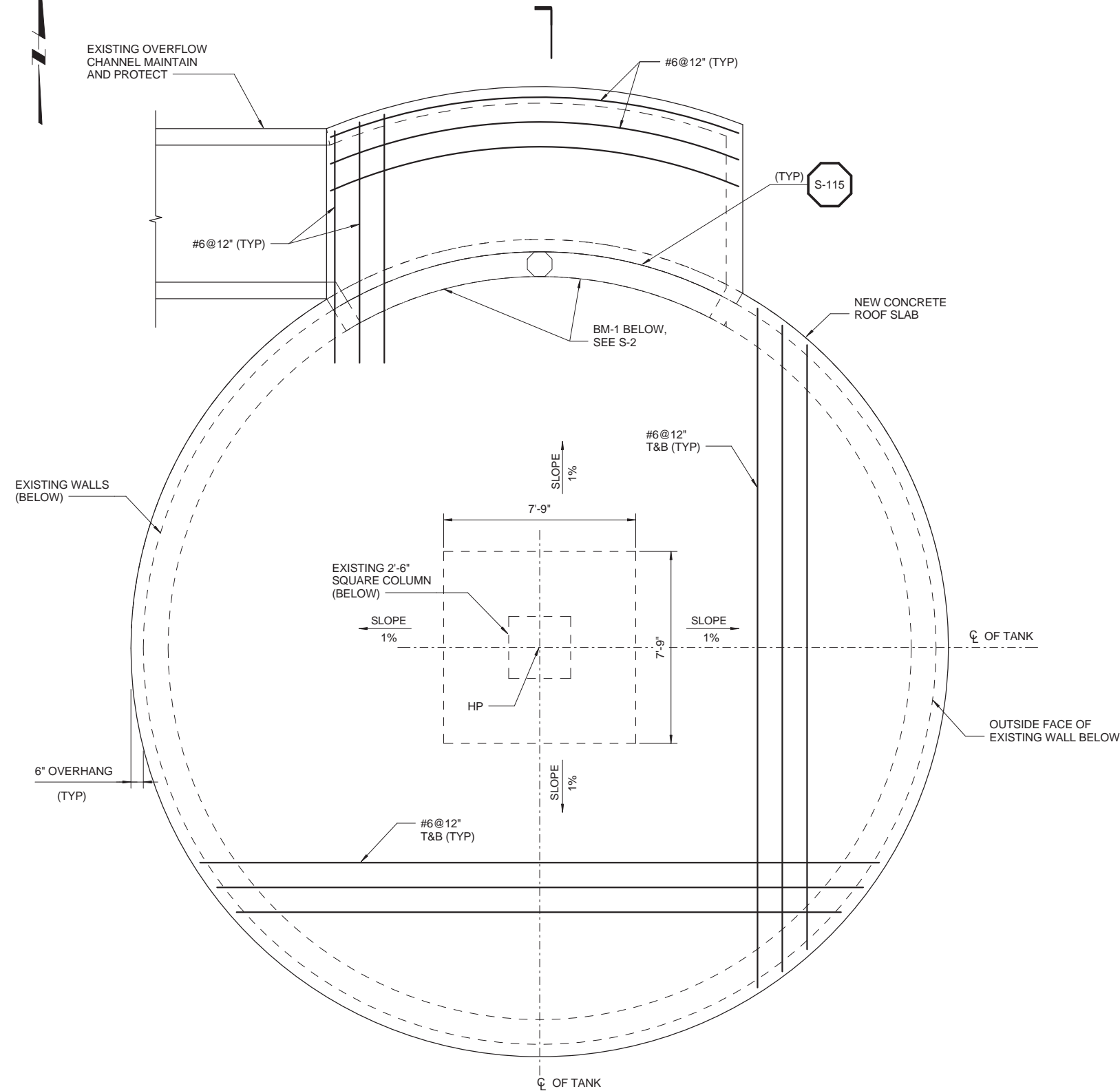
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USER : R BHAT

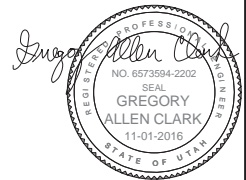
C:\pwworkdir\01409003\Surge Tank.rvt

GENERAL SHEET NOTES

1. SEE VICINITY MAP ON SHEET G-2 FOR SURGE TANK LOCATION.
2. EXISTING STRUCTURAL DIMENSIONS, CONFIGURATION AND ELEVATIONS ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.
3. ROOF REINFORCEMENT SHOWN IS TYPICAL THROUGHOUT THE ROOF SLAB. ALL REINFORCEMENT SHALL BE CONTINUES WITHOUT LAPS UNO.



TOP PLAN
SCALE: 3/8" = 1'-0"



REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE
AS SHOWN

WARNING
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CHECKED G CLARK

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HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

CITY OF LOGAN
STRUCTURAL
LOGAN 3RD DAM
SURGE TANK - TOP PLAN

SHEET
S-20
10501046

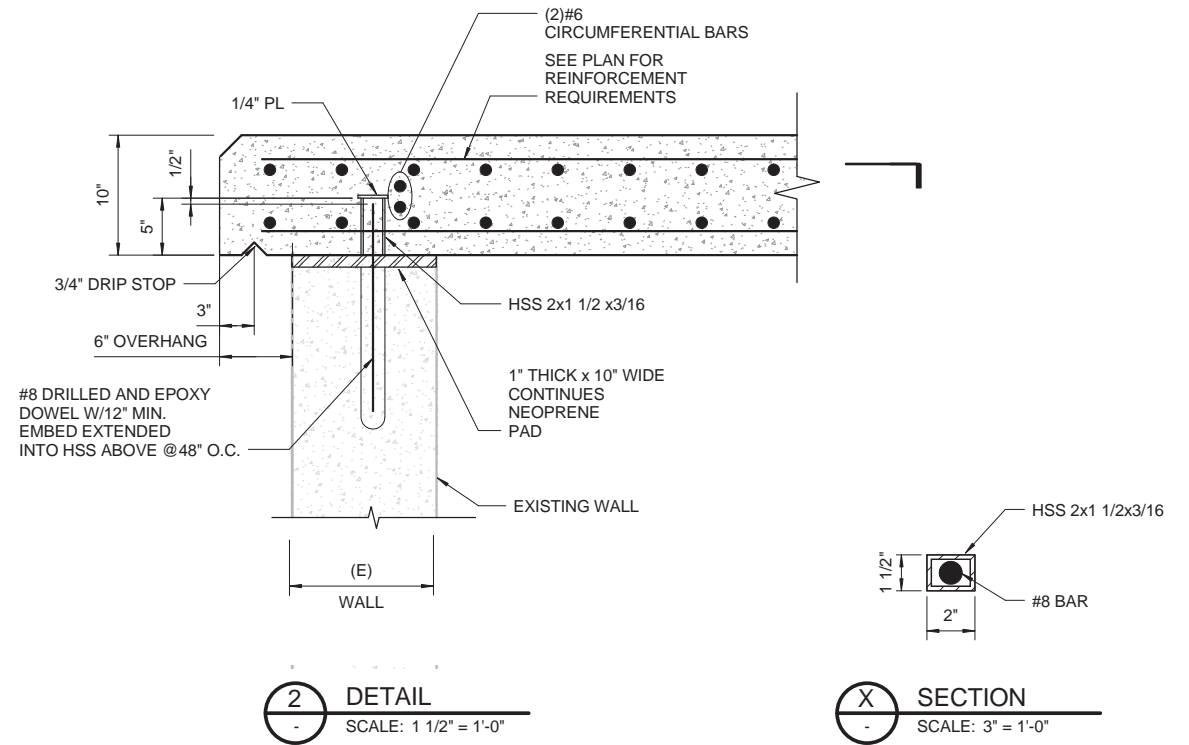
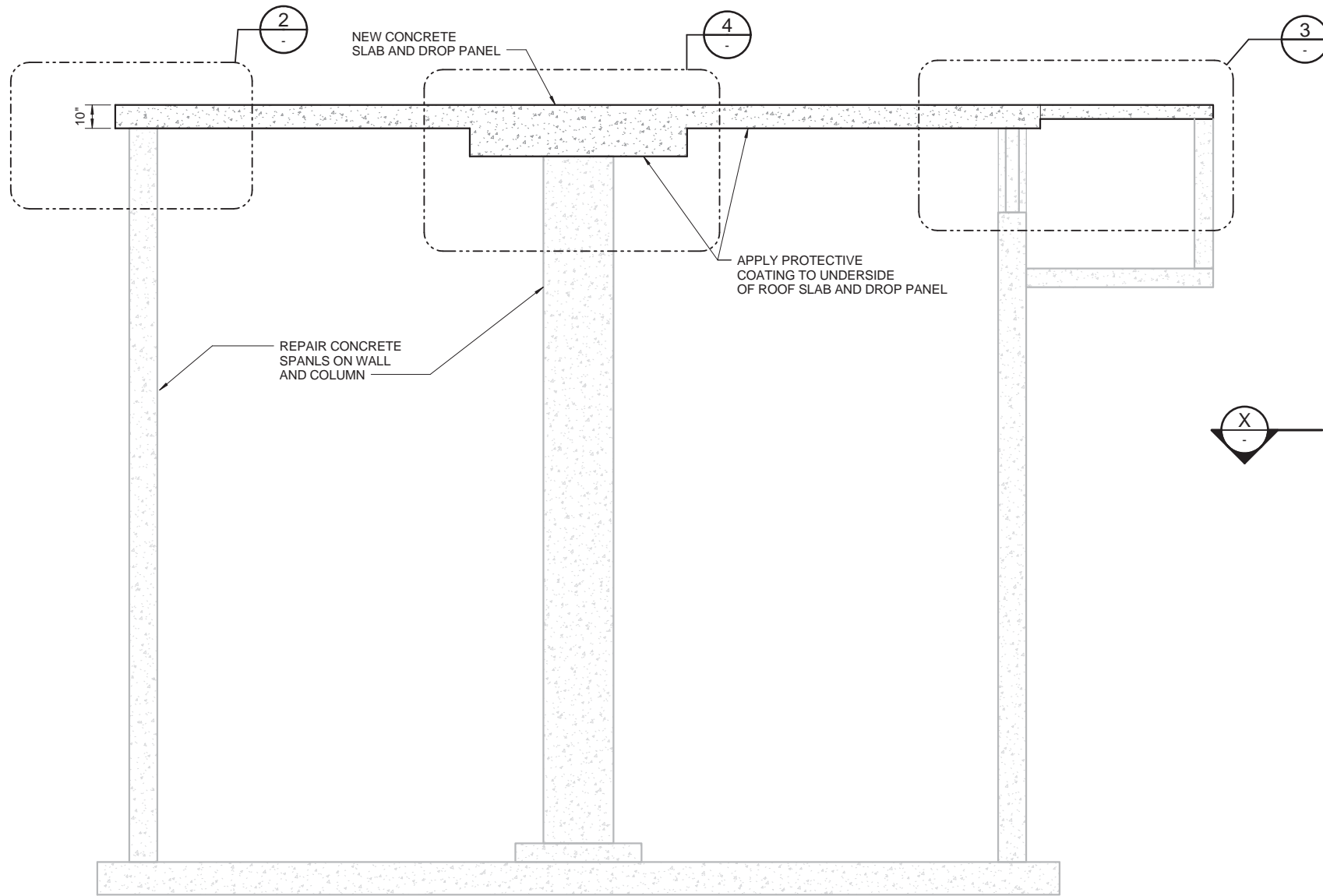
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USER : R BHAT

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GENERAL SHEET NOTES

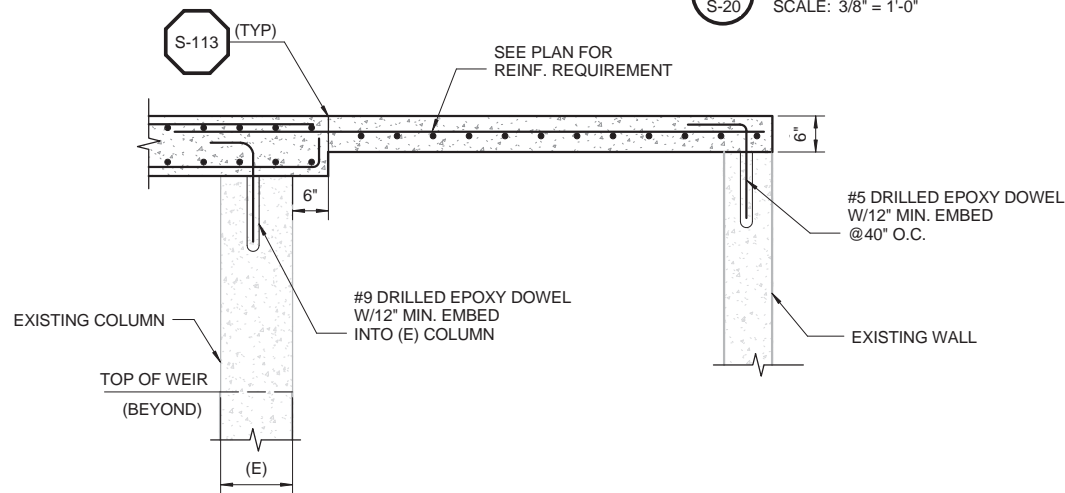
- EXISTING STRUCTURAL DIMENSIONS, CONFIGURATION AND ELEVATIONS ARE APPROXIMATE. THE CONTRACTOR SHALL CONFIRM AND COORDINATE ALL CONTROLLING FIELD DIMENSIONS AND CONDITIONS BEFORE ORDERING OR FABRICATING ANY MATERIALS.



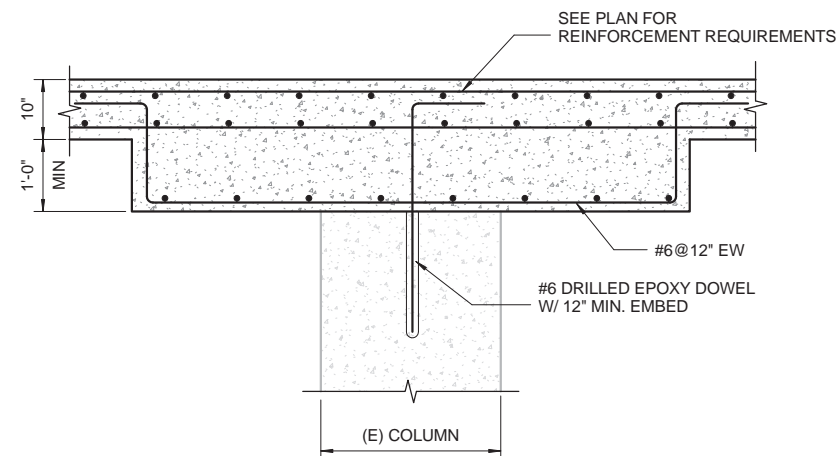
2 DETAIL
SCALE: 1 1/2" = 1'-0"

X SECTION
SCALE: 3" = 1'-0"

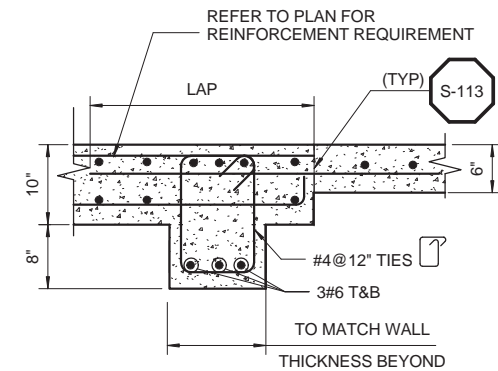
B SECTION
S-20 SCALE: 3/8" = 1'-0"



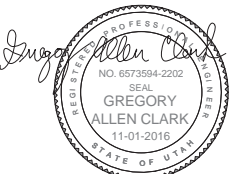
3 DETAIL
SCALE: 3/4" = 1'-0"



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

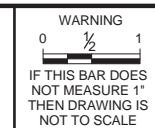


BM-1 DETAIL
SCALE: 1" = 1'-0"



REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE
AS SHOWN



DESIGNED G CLARK
DRAWN R BHAT
CHECKED G CLARK

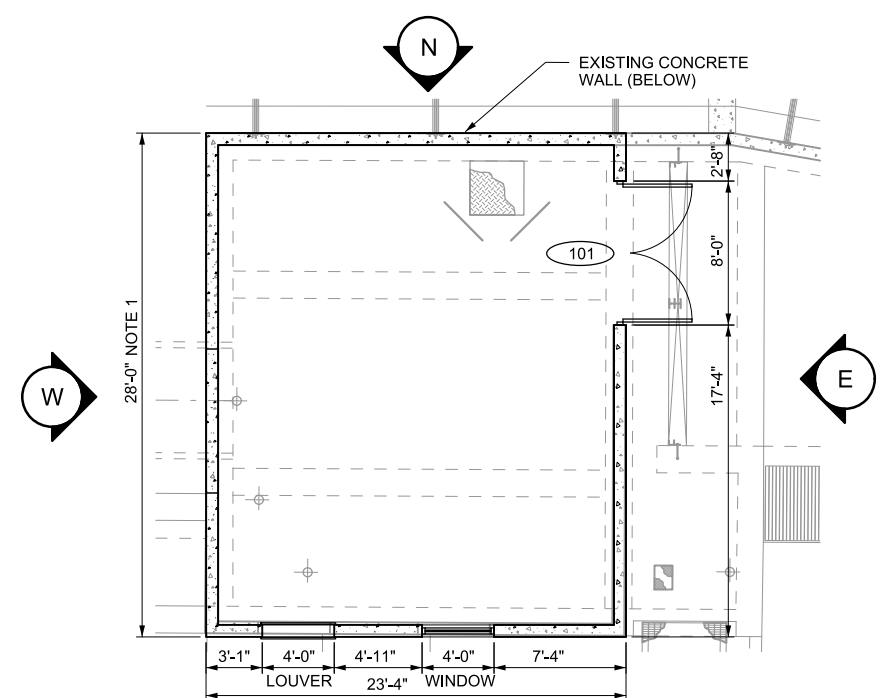
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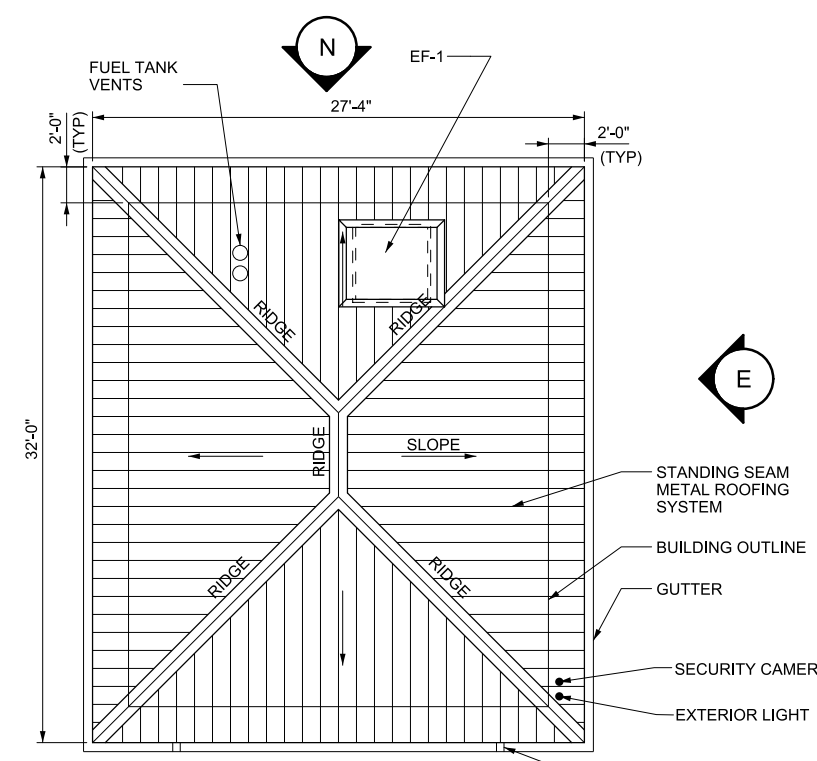
HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

CITY OF LOGAN
STRUCTURAL
LOGAN 3RD DAM
SURGE TANK - SECTIONS AND DETAILS - I

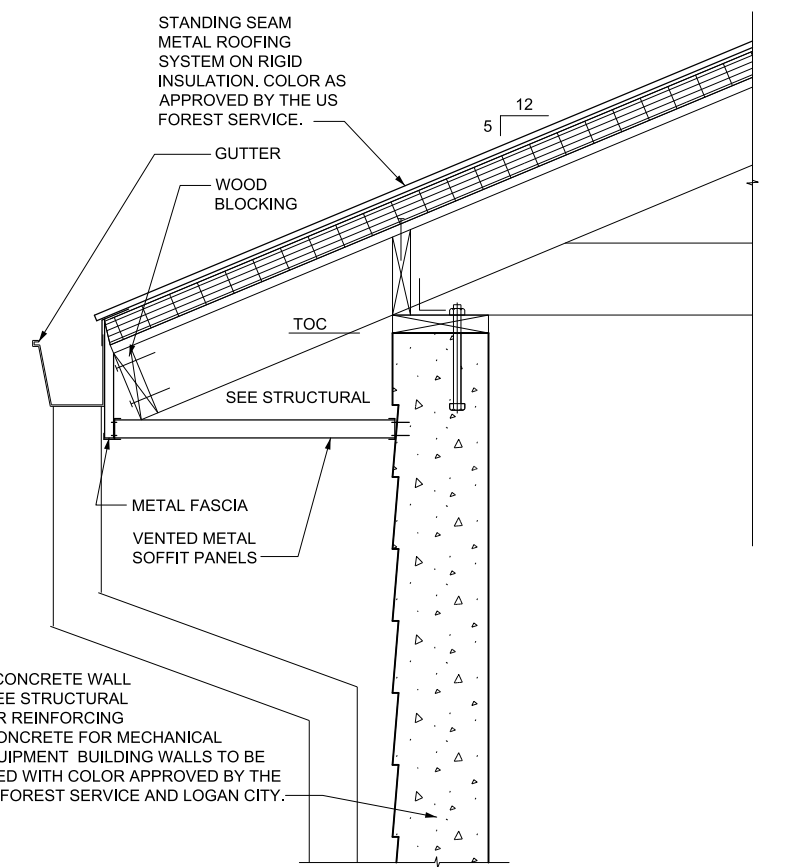
SHEET
S-21
10501046



FLOOR PLAN
SCALE: 3/16" = 1'-0"

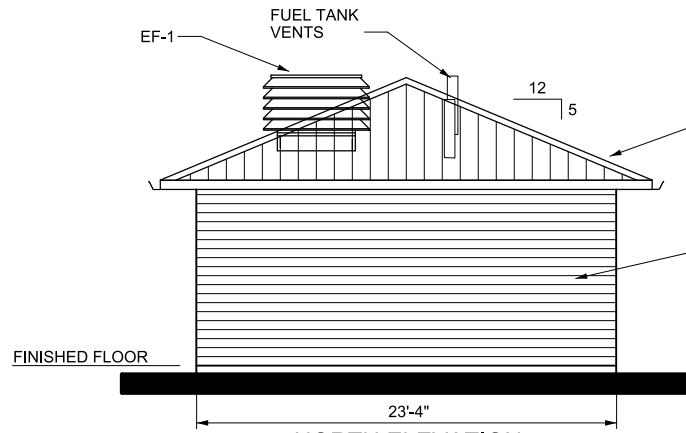


ROOF PLAN
SCALE: 3/16" = 1'-0"

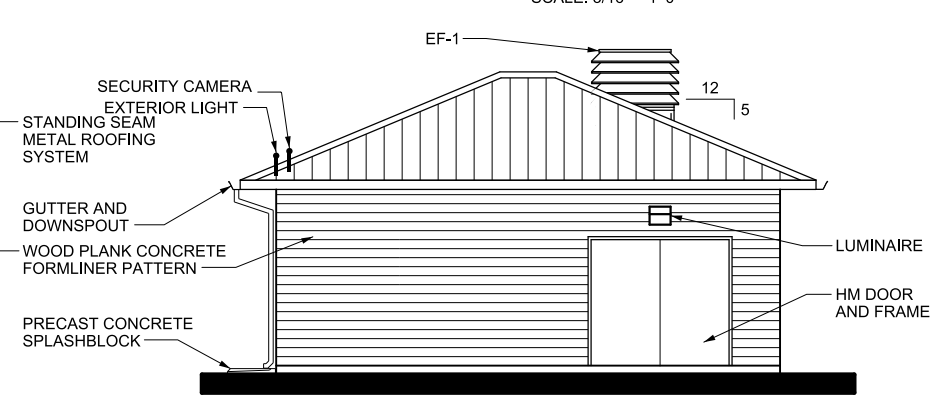


SECTION
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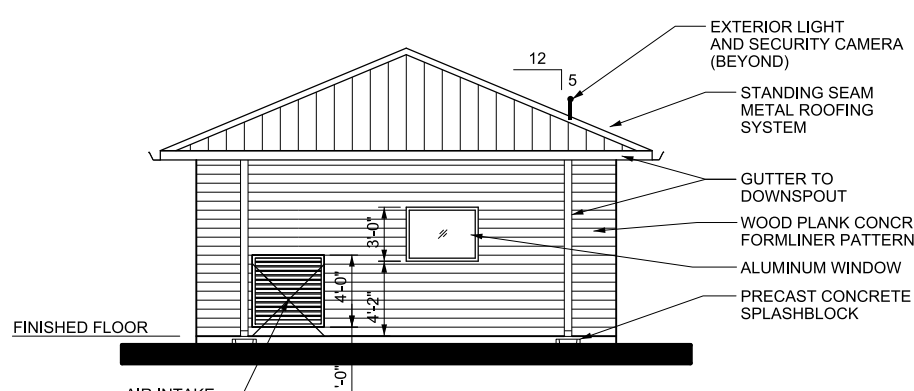
SHEET NOTES:
1. CONTRACTOR TO FIELD VERIFY BUILDING DIMENSION BASED ON LOCATION OF EXISTING CONCRETE WALLS (NORTH AND SOUTH)



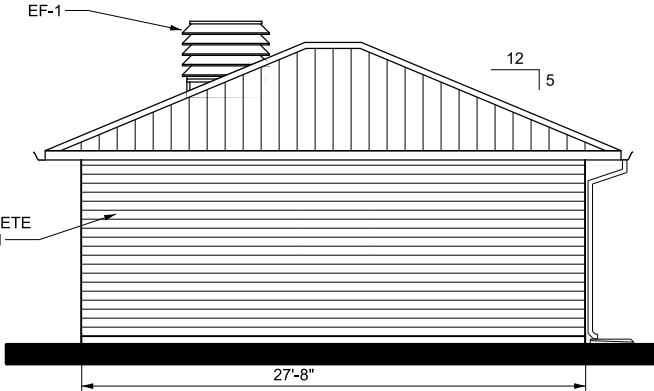
NORTH ELEVATION
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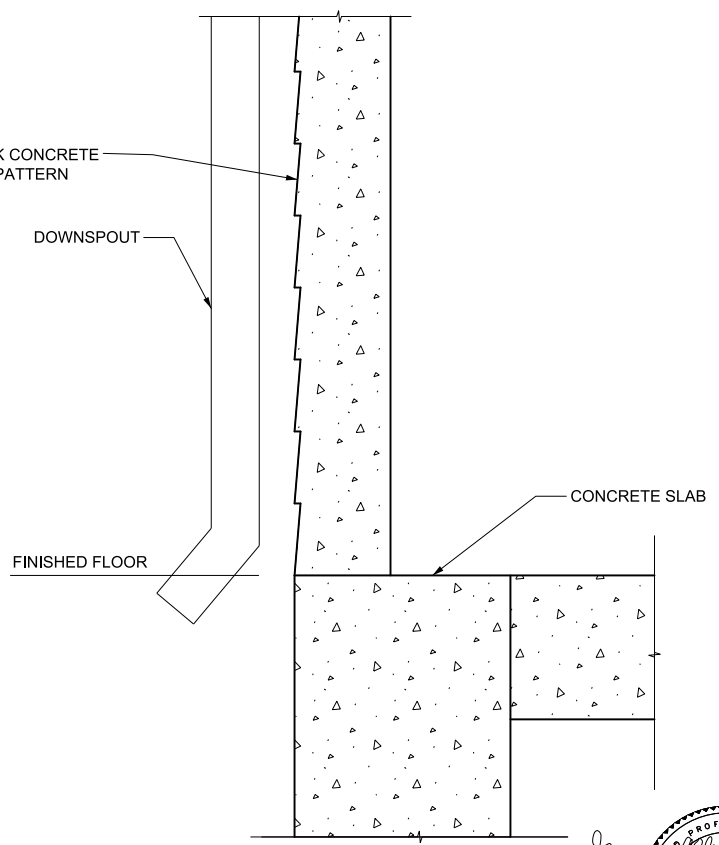
EAST ELEVATION
SCALE: 3/16" = 1'-0"



SOUTH ELEVATION
SCALE: 3/16" = 1'-0"



WEST ELEVATION
SCALE: 3/16" = 1'-0"



REV	DATE	BY	DESCRIPTION
1	12-22-17	GAC	CONFORMED SET

SCALE	AS SHOWN
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DESIGNED	G. CLARK
DRAWN	G. CLARK
CHECKED	C. DALLAS

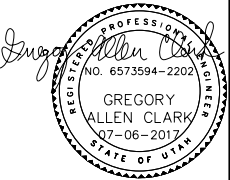
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HYDRO NO. 2
LOGAN 3RD DAM AND SURGE TANK
IMPROVEMENT PROJECT

LOGAN CITY
STRUCTURAL
LOGAN 3RD DAM
FLOOR AND ROOF PLANS, EXTERIOR ELEVATIONS, AND WALL SECTION

SHEET
S-22



SECTION 03 01 30 - CONCRETE REPAIR AND REHABILITATION

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. Remove, repair, or rehabilitate new and existing concrete members and surfaces as indicated.
- B. Provide all materials and equipment necessary to accomplish the WORK.
- C. Repair damage to concrete and concrete surfaces which show signs of distress such as spalling or freeze/thaw damage.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- | | |
|---------------|--|
| ACI 201.1R-08 | Guide for Making a Condition Survey of Concrete in Service |
| ACI 546R-14 | Concrete Repair Guide |

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with the requirements of SECTION 01 33 00 – CONTRACTOR SUBMITTALS.
- B. Shop Drawings
 - 1. Submit Shop Drawings for strengthening required around new openings.
 - 2. Submit detailed drawings showing proposed methods for supporting existing structural elements and/or gate equipment.
- C. Concrete Repair Products and Procedures
 - 1. Submit a comprehensive plan for each repair method indicated within this Section, the plan shall include the following:
 - a. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each product.
 - b. Curing products and procedures for each repair method for which curing is recommended by the manufacturer.

1.4 QUALIFICATIONS OF CONCRETE RESTORATION FIRMS

- A. The concrete restoration WORK shall be performed by an experienced firm customarily engaged in performing similar repair work on cast-in-place concrete structures.
- B. The restoration firm shall have completed at least 5 similar projects in the last 5 years.
- C. The restoration firm shall be certified by the manufacturer of the repair materials.

1.5 QUALITY ASSURANCE

A. Field Tests of Cement Based Mortars and Grouts

1. The ENGINEER may take compression test specimens during construction from the first placement of each type of mortar or grout, and at intervals thereafter as selected by the ENGINEER in order to ensure continued compliance with the indicated requirements.
2. The CONTRACTOR shall assist the ENGINEER in obtaining specimens for testing.
3. The compression tests and fabrication of specimens for repair mortar and non-shrink grout will be performed as specified in ASTM C 109.
4. A set of 5 specimens will be made for testing at 7 days, 28 days, and additional time periods as appropriate.
5. Any material, already placed, which fails to meet the indicated performance requirements is subject to removal and replacement as part of the WORK.
6. The cost of laboratory tests on mortar and grout will be paid by the OWNER, but the CONTRACTOR shall be responsible for the cost of any additional tests and investigation on the WORK that does not meet the indicated requirements.
7. The CONTRACTOR shall supply all necessary materials for fabricating the test specimens.

B. Repair Concrete: Repair concrete shall be tested as required in SECTION 03 31 00 – CAST-IN-PLACE CONCRETE.

C. Epoxy Grout: Epoxy grout shall be tested as required in SECTION 03 60 00 – GROUTING.

D. Construction Tolerances: Construction tolerances shall comply with the requirements of Section 03 31 00 – CAST-IN-PLACE CONCRETE, except as otherwise indicated.

PART 2 -- PRODUCTS

2.1 REPAIR MORTAR

- A. Provide repair mortar as a pre-packaged, 2-component, polymer-modified, cementitious, non-sag mortar, specifically formulated for the repair of surface defects.
- B. Provide the mortar with a penetrating corrosion inhibitor.
- C. Repair mortar shall have the following properties:

Physical Property	Value	ASTM Standard
Compressive Strength (min.)		C-109
at 7 days	6000 psig	
at 28 days	7000 psig	
Bond Strength (min.)	C-882 (modified)	
at 28 days	2200 psig	
Freeze/Thaw resistance (min.)	C-666	
300 cycles	98 percent	

- D. Provide a minimum repair thickness of 1/4 inch, unless otherwise indicated.
- E. Repair Mortar shall be **SikaTop 123 Plus**, by **Sika Corporation**, or equal.

2.2 NON-SHRINK GROUT

- A. Provide non-shrink grout conforming to the requirements of SECTION 03 60 00 – GROUTING.

2.3 CONCRETE MATERIALS

A. Cement

- 1. Use Type II Portland cement unless otherwise indicated.
- 2. Where repairs are to be made on wall surfaces open to view and above normal water surface elevations, blend white Portland cement with the Type II cement as needed in order to match the color of the adjacent existing concrete surface.

B. Structural Repair Grout

- 1. Where required, provide structural repair grout meeting the requirements of SECTION 03 60 00 – GROUTING.
- 2. Provide a minimum repair thickness of 3 inches.

C. Cement Grout

- 1. Provide cement grout that meets the requirements of Section 03 60 00 – GROUTING.
- 2. Provide a minimum repair thickness of one inch.

- D. Miscellaneous Materials: For concrete construction materials not covered specifically in this Section, conform to the requirements of SECTION 03 31 00 – CAST-IN-PLACE CONCRETE.

2.4 AGGREGATE

- A. Obtain the written permission of the manufacturer and ENGINEER before using aggregate to extend repair mortar and grout products.
- B. If allowed and unless otherwise indicated, provide aggregate consisting of 3/8-inch clean, washed gravel or crushed stone as required in SECTION 03 31 00 – CAST-IN-PLACE CONCRETE.

2.5 BONDING AGENT AND ANTI-CORROSION COATING

- A. Provide a bonding agent that is a solvent-free, moisture-tolerant, epoxy-modified, cementitious product, specifically formulated as a bonding agent and anti-corrosion coating.
- B. Bonding Agent shall be **Armatec 110 EpoCem**, by **Sika Corporation**, or equal.

2.6 EPOXY GROUT

- A. Provide an epoxy grout conforming to the requirements of SECTION 03 60 00 – GROUTING.

2.7 EPOXY RESIN

- A. Use epoxy resin for structural crack repair.
- B. For crack injection, provide a 2-component, moisture-tolerant, low-viscosity, high-strength epoxy resin adhesive that is specially formulated for that usage.
- C. Provide a minimum bond strength of 2900 psi when tested per ASTM C 882 at 14 days, moist cured.
- D. Epoxy Resin shall be **Sikadur 35, Hi-Mod LV**, by **Sika Corporation**, **KEMKO 068 LoVis IR**, by **ChemCo Systems, Inc.**, or equal.

2.8 PROTECTIVE COATING

- A. Waterproofing
 - 1. Provide a 2-component, polymer-modified, cementitious waterproofing and protective slurry mortar for concrete.
 - 2. Apply the material in 2 coats, with a coverage of 40 sq ft/gal/coat.
 - 3. Waterproofing shall be **Sika Top Seal 107**, by **Sika Corporation**, or equal.

2.9 FORMWORK

- A. Where needed, provide formwork that meets the requirements of SECTION 03 11 00 – CONCRETE FORMING.

2.10 REINFORCEMENT STEEL

- A. Where required, provide reinforcing steel that meets the requirements of Section 03 21 00 – REINFORCEMENT STEEL.

2.11 POLYURETHANE SEALANT

- A. Provide a 2-part polyurethane, gun-grade sealant.
- B. Polyurethane Sealant shall be **Sikaflex – 2C**, by **Sika Corporation**, or equal.

2.12 POLYURETHANE CHEMICAL GROUT

- A. Use polyurethane chemical grout for non-structural crack repair.
- B. Polyurethane Chemical Grout shall be **SikaFix HH**, by **Sika Corporation**, **Flex LV PURE**, by **WR Grace/De Neef**, **Flex SLV PURE**, by **WR Grace/De Neef**, or equal.

2.13 HYDROPHILIC WATERSTOP

- A. Provide hydrophilic waterstop of the type which expands in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.
- B. Provide hydrophilic waterstop that is bentonite-free, and manufactured from chloroprene rubber and modified chloroprene rubber with hydrophilic properties.
- C. Hydrophilic Waterstop shall be **Hydrotite RSS-040 P**, by **Greenstreak Group, Inc.**, **KM 4mm String**, by **Adeka Ultra Seal**, or equal.

2.14 HIGH STRENGTH EPOXY GEL

- A. High-Strength Epoxy Gel for crack surface sealing shall be **Denepox Rapidgel**, by **WR Grace/De Neef**, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Repairs
 1. Repair techniques will be reviewed during the pre-construction meeting between the CONTRACTOR, ENGINEER, and OWNER.
 2. The CONTRACTOR shall be familiar with the cause of deteriorated concrete and shall choose the right equipment, repair materials and techniques to be used for each particular repair.
 3. Choose repair materials to match the adjacent concrete surface in color and texture.
 4. Apply repair materials in strict accordance with the manufacturer's printed instructions, including temperature and moisture requirements throughout application and curing.

5. Protect adjacent portions of the structure, including all valves, pipes, mechanical equipment, and filter media from debris generated by repair activities.
6. For portions of the structure that are not identified to be repaired, maintain in their original condition.

B. Structural Stability

1. Use caution not to weaken the structural capacity of a beam, column, wall, slab, walkway, or other concrete member during concrete removal.
2. For severely deteriorated concrete members, consult with the ENGINEER before removing a major portion of any structural member.
3. Shoring may be required in order to support the structure and to protect workers.

C. Shoring

1. Provide shoring below any structure being repaired prior to the start of the work, including surface preparation and concrete removal.
2. Design the shoring to adequately distribute the load to the structure in such a manner as to avoid damage to the structure.
3. Maintain the shoring in place until all repairs are completed and structurally repaired areas have achieved their full 28-day design strengths.

D. Provide off-site disposal of debris generated as a result of repair procedures.

E. Provide concrete construction procedures not specifically addressed in this Section in accordance with the requirements of SECTION 03 31 00 – CAST-IN-PLACE CONCRETE.

3.2 REPAIR SEQUENCING

A. Unless otherwise indicated, perform concrete repairs in the following sequence, with no activity in an area being started until previous activities in that area have been completed, including curing, cleanup, and the like:

1. removal of equipment, miscellaneous metals, and other surface features that would interfere with the repair;
2. removal of concrete sections which require complete replacement;
3. surface preparation hydroblasting over the entire area to be repaired;
4. embedded metal repair;
5. crack repair;
6. spalled and delaminated concrete repair;
7. scaled concrete;
8. pop-out repair, and repair of other surface damage, deterioration, or defects;

9. patching of holes in concrete;
 10. replacement of concrete sections which require complete replacement;
 11. new construction;
 12. application of protective coatings;
 13. expansion joint repair; and,
 14. installation of traffic topping.
- B. For areas which require combinations of spalled and delaminated concrete repair, scaled concrete, and pop-out repair, perform these repairs at the same time.
- C. Limit the size of the repair area in order to permit the repairs to be performed together, without sacrificing the quality of the individual repairs.

3.3 EMBEDDED METAL REPAIR

- A. Unless otherwise indicated, repair anchor bolts and other embedded metal, except rebar, that are exposed at the concrete surface and are showing signs of corrosion, as follows:
1. Cut off or otherwise remove corroded metal fastened at the surface;
 2. Burn back embedded metals to a depth of at least 1.5 inches beyond the surface of sound concrete;
 3. Chip away unsound concrete around the embedded metal.
 4. Apply epoxy grout to the repair area until level with the surface of the surrounding sound concrete.
- B. Unless otherwise indicated, repair embedded rebar that is exposed at the concrete surface following the procedures outlined in the appropriate concrete repair subsection, below.

3.4 CRACK REPAIR

- A. Structural Cracks - Structural Cracks are defined as follows:
1. All cracks where reinforcing steel is passing across the crack, including erratic cracks, and cracks at construction joints.
 2. Cracks identified by the ENGINEER as structural cracks.
 3. Repair structural cracks with epoxy resin.
- B. Non Structural Cracks - Non Structural Cracks are defined as follows:
1. Cracks occurring at flexible joints, contraction joints or expansion joints.
 2. Cracks identified by the ENGINEER as nonstructural cracks.

3. Repair non-structural cracks with polyurethane chemical grout.

C. Efflorescence

1. Prior to the crack repair, clean efflorescence from the cracks and the surrounding area.
2. Clean the efflorescence by light hydro-blasting or scrubbing.

D. Pressure Injection:

1. General

- a. The indicated repair materials have been selected to minimize the loss of material during the injection process. The areas selected for crack repair are to be identified by the CONTRACTOR, ENGINEER or CONSTRUCTION MANAGER and be determined prior to leak tests and roof membrane installation. The injection of cracks may also be required as a result of the leak test.
 - b. In order to avoid excessive loss of injected material at the lower exposed portions of the cracks, space the injection ports a distance no greater than the thickness of the wall being repaired.
2. Open through thickness structural cracks are to be repaired to deliver a water tight hydraulic structure. All 3 foot long minimum or greater through thickness cracks greater than a minimum 15 mil thickness in the walls are to be injected unless they do not accept grout. All 2 foot long minimum through thickness cracks greater than 10 mil thickness in the foundation, water conduits, floor slabs and roof are to be injected unless they do not accept grout. Perform structural crack repairs by pressure injection in accordance with the manufacturer's directions, and in accordance with the following basic procedure:
- a. Remove unsound and foreign materials from the crack in a manner that does not trap debris in the crack and prevent the flow of repair materials.
 - b. Remove any contamination by flushing with water or solvent, allowing adequate time for air-drying or blow out the solvent with compressed air. For potable water applications, any solvents must be fully flushed from the joint unless NSF/ANSI Standard 61 approved.
 - c. Install the injection ports in accordance with the manufacturer's directions.
 - d. Sealing
 - 1) Seal the surface in order to keep the pressure injecting materials from leaking out before it has set or gelled.
 - 2) Seal a surface by brushing an epoxy over the surface of the crack and allowing it to harden, or use high injection pressures to cut-out the cracks in a 'V' shape, fill with an epoxy, and strike off flush with the surface.
 - 3) Surface patching or sealant shall be performed where needed to provide for complete penetration of the injected polyurethane grout and to prevent wastage. Seal surface of crack with fast setting hydraulic

cement or high strength epoxy gel. The floor surface along the cracks shall be cleaned and all wasted grout and surface seal material shall be completely removed from the concrete surface following completion of the repair work

- e. Inject the repair materials, with consideration of the following items:
 - 1) Carefully select the pressure of the hydraulic pump or other device, because too much pressure can extend the existing cracks and cause more damage.
 - 2) For vertical cracks, start by pumping material into the entry port at the lowest elevation until the material level reaches the entry port above, then cap the lower injection port and repeat the process at successively higher ports until the crack has been completely filled.
 - 3) For horizontal cracks, start at one end of the crack and work to the other end, filling the crack until the pressure can be maintained.
 - 4) For very fine cracks, start the injection of repair material at the widest end and proceed toward the thinner end, using low-viscosity repair material.
 - f. Cleanup
 - 1) Remove the surface seal by grinding or other appropriate means.
 - 2) Coat fittings and holes at injection ports with an epoxy patching compound.
 - 3) If crack repairs are part of repair for surface defects, painting with epoxy is not necessary and surface preparation may be started after crack repairs have been completed.
3. Open through thickness non-structural cracks are to be repaired to deliver a water tight hydraulic structure. Open through thickness cracks with lengths of at least 3 feet on each side of the wall and roof, at least 2 feet of length on the foundation or floor slab are to be injected unless they do not accept grout. All 3 foot long minimum or greater through thickness cracks greater than a minimum 15 mil thickness in the walls are to be injected unless they do not accept grout. All 2 foot long through thickness cracks greater than 10 mil thickness in the floors and roof are to be injected unless they do not accept grout. Perform non-structural crack repairs in accordance with the manufacturer's directions, and in accordance with the following basic procedure:
- a. Remove unsound and foreign materials from the crack in a manner that does not trap debris in the crack and prevent the flow of repair materials.
 - b. Remove contamination by flushing with water or solvent, allowing adequate time for air-drying or blow out the solvent with compressed air. Any solvents must be fully flushed from the joint unless NSF/ANSI Standard 61 approved.
 - c. Install the injection ports in accordance with the manufacturer's directions.
 - d. Moisture

- 1) For non-structural cracks, moisture must be present for the chemical grout to react.
 - 2) Prior to injecting the repair materials, inject the crack with a small amount of water in order to completely moisten the crack.
- e. Inject the repair materials, with consideration of the following items:
- 1) Carefully select the pressure of the hydraulic pump or other device, because too much pressure can extend the existing cracks and cause more damage.
 - 2) For vertical cracks, start by pumping material into the entry port at the lowest elevation until the material level reaches the entry port above, cap the lower injection port and repeat the process at successively higher ports until the crack has been completely filled, and then, starting again at the lowest port, re-inject into all ports in order to ensure that all voids are properly sealed off.
 - 3) For horizontal cracks, start at one end of the crack and work to the other end, filling the crack until the pressure can be maintained.
 - 4) For very fine cracks, start the injection of repair material at the widest end and proceed toward the thinner end.
- f. Cleanup
- 1) Remove excess surface material by grinding or other appropriate means.
 - 2) Coat fittings and holes at injection ports with an epoxy patching compound.
 - 3) If crack repairs are part of repair for surface defects, painting with epoxy is not necessary and surface preparation may be started after crack repairs have been completed.

3.5 SPALLED AND DELAMINATED CONCRETE REPAIR

A. Repair spalls and delaminated concrete using repair mortar.

B. Surface Preparation

1. Remove all delaminated concrete and all unsound concrete beyond the spalled or delaminated area.
2. Boundaries
 - a. Determine the boundaries of the patch by sawcuts to a depth of at least 1/4 inch up to one inch deep.
 - b. Refer to the Structural Drawings for sawcut locations.
 - c. Where the sawcut locations are not shown on the Drawings, the boundaries shall be layouts designed to reduce boundary edge length.

- d. Avoid excessive or complex edge conditions.
3. Sawcuts
- a. Perform sawcuts perpendicular to the surface or slightly undercut.
 - b. Construct sawcuts in maximum 1/4-inch increments.
 - c. After each incremental cut, inspect the cut surface in order to ensure that the existing reinforcement has not been cut.
 - d. If at any depth the reinforcement becomes exposed, terminate the sawcut and notify the ENGINEER.
4. Chip away concrete within the repair area to a depth sufficient to expose sound concrete over the entire repair area, or to a minimum depth required by repair mortar, whichever is greater.
5. Base the selection of partial depth concrete removal equipment on the size of repair area, depth of concrete to be removed, and the location of the deteriorated concrete such as wall, slab-on-grade, underside or top of elevated slab.
6. Removal
- a. The maximum allowable pneumatic chipping hammer shall be a 30-lb class hammer.
 - b. Hydroblast removal shall use a maximum pressure of 40,000 psig.
 - c. Sand blasting is not permitted.
 - d. Hydroblast concrete removal is recommended for large area of surface defects.
 - e. Remove water blasting debris daily in order to prevent it from setting up.
 - f. If a chipping hammer is used, ensure that the existing reinforcement is not damaged during the concrete removal operations.
 - g. Remove protrusions, such as mortar spatter or fins, by grinding or by striking with a hammer or other tool.
7. Reinforcement
- a. Remove concrete from around reinforcement when the rebar is rusted, more than half the rebar perimeter is already exposed, the concrete bond around the rebar is broken, or if the concrete is unsound or honey-combed.
 - b. Remove concrete in order to provide a clear space of minimum one inch on all sides of the reinforcement, such that the rebar can be cleaned and the repair material will completely surround the rebar.
 - c. Clean exposed reinforcement by water blasting or wire brushing.

- d. After fully exposing and cleaning the reinforcement, check for steel deterioration, and if the cross-sectional area of the steel has been reduced by more than 10 percent, whether by deterioration, surface preparation, or a combination of both, provide additional reinforcement.
- e. Consult with the ENGINEER before adding or replacing rebar.

C. Repairing Surface Defects

1. Clean the concrete surface after removing unsound concrete, repairing cracks, and cleaning the reinforcement.
2. Ensure that the concrete surface and reinforcement are free of form-release agents, curing compounds, surface hardeners, oils, grease, food, chemicals, and other contaminants.
3. Remove dust, including new dust generated by surface preparation or scarifying.
4. Prior to application of the bonding agent, apply anti-corrosion coating to exposed rebar in accordance with the manufacturer's recommendations, allow the coating to dry, reapply the coating, and allow to dry again.
5. Prior to applying the repair mortar, apply bonding agent in accordance with the manufacturer's recommendations.
6. Repair Mortar
 - a. Apply repair mortar in accordance with the manufacturer's recommendations.
 - b. The thickness of each lift of repair mortar shall be in accordance with the manufacturer's recommendations, with the minimum thickness being not less than 1/4 inch.
7. Fully consolidate the repair mortar, working the material into the substrate to completely fill all pores and voids in the area to be filled.
8. Bring the repair surface into alignment with the adjacent existing surfaces in order to provide a uniform, even surface.
9. Match the repair surface to adjacent existing surfaces in texture by applying necessary coatings and surface treatments.
10. Float-finish the repaired surface using wood or sponge floats.
11. For repaired surfaces to receive a protective coating, brush-finish the surface in order to produce a roughened substrate for the coating.
12. Minimum and maximum ambient and surface temperatures shall be as recommended by repair material manufacturer.

D. Curing

1. Curing of repair mortar to receive waterproofing shall be as follows:

- a. Keep the mortar continuously wet by the application of water for a minimum period of at least 7 consecutive days, beginning immediately after the mortar has reached final set;
 - b. Weight the curing blankets or otherwise held them in place in order to prevent being dislodged by wind or other causes, and to be substantially in contact with the concrete surface;
 - c. Ensure that edges are continuously held in place; and,
 - d. Keep the curing blankets and concrete continuously wet by the use of sprinklers or other means, both during and after normal working hours.
2. If the repair mortar is not to receive waterproofing, provide curing in accordance with the manufacturer's recommendations except that the minimum cure period shall be 7 days.
 3. During cold weather, maintain the repair material temperature above 50 degrees F for at least 3 days after placement.

3.6 SCALED CONCRETE REPAIR

A. Repair scaling and pop-outs using repair mortar.

B. Surface Preparation

1. Prior to repair, prepare the surface in accordance with the repair mortar manufacturer's recommendations with the following minimum requirement.
2. Remove unsound concrete from surfaces by high-pressure water blasting, using a minimum pressure of 10,000 psig and maximum pressure of 40,000 psig.
3. Clean exposed reinforcement by water blasting or wire brushing.

C. Repairing Surface Defects

1. Clean the concrete surface after removing unsound concrete, repairing cracks, and cleaning reinforcement.
2. Ensure that the concrete surface and reinforcement are free of form-release agents, curing compounds, surface hardeners, oils, grease, food, chemicals, and other contaminants.
3. Remove dust, including new dust generated by surface preparation or scarifying.
4. Prior to application of the bonding agent, apply anti-corrosion coating to exposed rebar in accordance with the manufacturer's recommendations, allow the coating to dry, reapply the coating, and allow to dry again.
5. Prior to applying the repair mortar, apply bonding agent in accordance with the manufacturer's recommendations.
6. Apply repair mortar in accordance with the manufacturer's recommendations, using a minimum repair material thickness of 1/4 inch.

7. Fully consolidate the repair material, working the material into the substrate to completely fill all pores and voids in the area to be filled.
 8. Bring the repair surface into alignment with the adjacent existing surfaces in order to provide a uniform, even surface.
 9. Match the repair surface to adjacent existing surfaces in texture by applying necessary coatings and surface treatments.
 10. Float-finish the repaired surface using wood or sponge floats.
- D. Provide strip joint in newly placed mortar at the location of repaired cracks.
- E. Curing
1. Curing of repair mortar to receive waterproofing shall be as follows:
 - a. Keep the mortar continuously wet by the application of water for a minimum period of at least 7 consecutive days, beginning immediately after the mortar has reached final set;
 - b. Weight the curing blankets or otherwise held them in place in order to prevent being dislodged by wind or other causes, and to be substantially in contact with the concrete surface;
 - c. Ensure that edges are continuously held in place; and,
 - d. Keep the curing blankets and concrete continuously wet by the use of sprinklers or other means, both during and after normal working hours.
 2. If the repair mortar is not to receive waterproofing, provide curing in accordance with the manufacturer's recommendations except that the minimum cure period shall be 7 days.
 3. During cold weather, maintain the repair material temperature above 50 degrees F for at least 3 days after placement.

3.7 POP-OUT REPAIR, AND REPAIR OF OTHER SURFACE DAMAGE, DETERIORATION, OR DEFECTS

- A. Repair pop-outs and other surface damage, deterioration, and defects which are 1/4 inch deep or shallower, using the procedures described under "SCALED CONCRETE REPAIR," above.
- B. Repair other pop-outs and surface damage, deterioration, and defects using the procedures described under "SPALLED AND DELAMINATED CONCRETE REPAIR," above.

3.8 REPLACEMENT OF CONCRETE SECTIONS WHICH REQUIRE COMPLETE REPLACEMENT

- A. Refer to the Structural Drawings for locations where the level of concrete deterioration is such that complete removal and replacement of the deteriorated section is required.

- B. At these locations, remove the deteriorated concrete in accordance with the details on the Structural Drawings and the requirements of this Section.
- C. Limits
 - 1. The limits of concrete removal shall be as indicated on the Structural Drawings.
 - 2. If no limits of removal are indicated, determine the limits in accordance with the procedures described under “Boundaries – Spalled and Delaminated Concrete Repair.”
- D. Provide sawcuts in accordance with the procedures described under “Sawcuts – Spalled and Delaminated Concrete Repair.”
- E. After removal of the concrete, prepare the area and provide repair concrete in accordance with the details on the Structural Drawings and the requirements of this Section.
- F. Unless otherwise indicated, match the finished cross-section of the repaired concrete to the cross-section of the adjacent undamaged concrete.

3.9 PATCHING OF HOLES IN CONCRETE

A. General

- 1. For the purposes of this Section, holes are defined as penetrations completely through the concrete member and with interior surfaces approximately perpendicular to the surface of the existing member.
- 2. Interior surface areas which are inclined and do not meet this criteria shall be chipped as needed to meet this requirement.
- 3. The perimeter of holes at the surface shall form a regular shape composed of curved or straight line segments.
- 4. Provide the minimum depth of placement for the material used; score the existing concrete by sawcutting, and chip as needed to meet this requirement.
- 5. Roughen the interior surface of holes less than 12 inches in diameter to a minimum of 0.125-inch amplitude, and roughen larger holes to a minimum of 0.25-inch amplitude.
- 6. At holes, coat the existing surface to be repaired with a bonding agent.

- B. Patching Small Holes: For holes which are less than 12 inches in their least dimension and extend completely through concrete members, fill with non-shrink grout.

C. Patching Large Holes

- 1. Fill holes which are larger than 12 inches in their least dimension with structural repair grout.
- 2. Provide large holes which are normally in contact with water or soil with hydrophilic waterstop placed in a groove.

3. Alternatively, bond the hydrophilic waterstop to the surface using an epoxy grout which completely fills all voids and irregularities beneath the waterstop material.
4. Install the waterstop in accordance with the requirements of Section 03 32 00 – JOINTS IN CONCRETE.
5. Provide reinforcing steel in layers matching existing reinforcement location, size, spacing and cover requirements unless directed otherwise by the ENGINEER.

3.10 APPLICATION OF PROTECTIVE COATINGS

A. Waterproofing

1. Apply waterproofing in accordance with the manufacturer's printed instructions.
2. Do not begin waterproofing WORK until repairs and new construction in the affected area have been completed and adequately cured.

3.11 EXPANSION JOINT REPAIR

A. Repair deteriorated expansion joints as follows:

1. Completely remove existing sealant;
2. Remove defective backer materials in the joint;
3. Sand-blast the joint and prepare the surface in accordance with the sealant manufacturer's instructions;
4. Prepare the wall surface on each side of the joint in accordance with the expansion joint manufacturer's instructions;
5. Ensure that the prepared surface is clean, sound, and bare concrete;
6. Place backer material in the joint;
7. Apply a primer recommended by the sealant manufacturer;
8. Fill the joint with polyurethane sealant;
9. Allow a minimum of 3 days curing prior to installing the expansion joint; and,
10. Install the expansion joint in accordance with the manufacturer's instructions.

- END OF SECTION -

SECTION 03 11 00 - CONCRETE FORMING

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall furnish concrete formwork, bracing, shoring, and supports for cast-in-place concrete and shall design and construct falsework, all in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - CONTRACTOR SUBMITTALS.
- B. Manufacturer's information demonstrating compliance with requirements for the following:
1. Form ties and related accessories, including taper tie plugs, if taper ties are used.
 2. Form gaskets.
 3. Form release agent, including NSF certification if not using mineral oil.
 4. Manufacturer's design information on formwork, form materials, and locations for use.

1.3 QUALITY ASSURANCE

- A. Tolerances: The variation from required lines or grade shall not exceed 1/4-inch in 10- feet, non-cumulative, and there shall be no offsets or visible waviness in the finished surface. Other tolerances shall be within the tolerances of ACI 117 - Standard Tolerances for Concrete Construction and Materials

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Except as otherwise expressly accepted by the O, lumber brought on the Site for use as forms, shoring, or bracing shall be new material. Forms shall be smooth surface forms and shall be of the following materials:

Walls	Steel, fiberglass, or plywood panel
Columns	Steel, plywood or fiberglass
Roof and floor	Plywood
All other WORK	Steel panels, fiberglass, plywood or tongue and groove lumber

- B. Water-based form release agent shall be **Clean Strip J1EF** by **Dayton Superior**, or equal.

2.2 FORM AND FALSEWORK MATERIALS

- A. Materials for concrete forms, formwork, and falsework shall conform to the following requirements:
1. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with U.S. Product Standard PS 20 - American Softwood Lumber Standard
 2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork, shall conform to the requirements of PS 1 – Construction and Industrial Plywood, for Concrete Forms, Class I, and shall be edge sealed.
 3. Form materials shall be metal, wood, plywood, or other material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade indicated. Metal forms shall accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.
 4. Steel leave in place forms shall not be used.
- B. Unless otherwise indicated, exterior corners in concrete members shall be provided with 3/4-inch chamfers or be tooled to 1/2-inch radius. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.
- C. Forms and falsework to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 50 psf minimum. The minimum design load for combined dead and live loads shall be 100 psf.

2.3 FORM TIES

- A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to insure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties or other removable form tie fasteners having a circular cross-section shall not exceed 1-1/2 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming. Form ties for water-retaining structures shall have integral waterstops that tightly fit the form tie so that they cannot be moved from mid-point of the tie. Form ties shall be **ST-4 Hex Head Snaptie** by **MeadowBurke**, **Snap-Ties** by **Dayton/Richmond**, or equal.
- B. Removable taper ties may be used when approved by the ENGINEER. A preformed neoprene or polyurethane tapered plug sized to seat at the center of the wall shall be inserted in the hole left by the removal of the taper tie. Use **HD-9 Taper-Tie** by **MeadowBurke**, **Taper-Tie** by **Dayton/Richmond**, or equal.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of forms, and any forms that are unsafe or inadequate in any respect shall promptly be removed from the WORK and replaced. Provide worker protection

from protruding reinforcement bars in accordance with applicable safety codes. A sufficient number of forms of each kind shall be available to permit the required rate of progress to be maintained. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state, and Federal regulations. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by CONTRACTOR's personnel and by the ENGINEER and shall be in sufficient number and properly installed. During concrete placement, the CONTRACTOR shall continually monitor plumb and string line form positions and immediately correct deficiencies.

- B. Concrete forms shall conform to the shape, lines, and dimensions of members required, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly-placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.
- C. Forms shall be removed unless approved otherwise by the ENGINEER.

3.2 FORM DESIGN

- A. Forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete. The forms shall be tight so as to prevent the loss of water, cement, and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1- to 1-1/2-inch diameter polyethylene rod held in position to the underside of the wall form. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the ENGINEER. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, form windows shall be provided in the size and spacing needed to allow placement of concrete to the requirements of Section 03 31 00 - Cast-in-Place Concrete. The size, number, and location of such form windows shall be as acceptable to the ENGINEER.

3.3 CONSTRUCTION

- A. Vertical Surfaces: Vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is indicated. Not less than 1-inch of concrete shall be added to the indicated thickness of a concrete member where concrete is permitted to be placed against trimmed ground in lieu of forms. Permission to do this on other concrete members will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.
- B. Construction Joints: Concrete construction joints will not be permitted at locations other than those indicated, except as may be acceptable to the ENGINEER. When a

second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

C. Form Ties

1. Embedded Ties: Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties that cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.
2. Removable Ties: Where taper ties are approved for use, the larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink or regular cement grout for above-grade walls that are dry on both sides. Exposed faces of walls shall have the outer 2-inches of the exposed face filled with a cement grout that shall match the color and texture of the surrounding wall surface.

3.4 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to the ENGINEER. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the ENGINEER.

3.5 REMOVAL OF FORMS

Careful procedures for the removal of forms shall be strictly followed, and this WORK shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted. In the case of roof slabs and above-ground floor slabs, forms shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 75 percent of the 28 Day strength in Section 03 31 00. No forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained 75 percent of the 28 Day strength and has been in place for a minimum of 7 Days. The time required to establish said strength shall be as determined by the ENGINEER who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than the 7 Day minimum, then that time shall be used as the minimum length of time. Forms for vertical walls of

waterholding structures shall remain in place at least 36 hours after the concrete has been placed. Forms for parts of the WORK not specifically mentioned herein shall remain in place for periods of time as recommended in ACI 347 - Guide to Formwork for Concrete.

3.6 MAINTENANCE OF FORMS

- A. Forms shall be maintained in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Before concrete is placed, the forms shall be thoroughly cleaned. The form surfaces shall be treated with a nonstaining mineral oil or other lubricant acceptable to the ENGINEER. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the CONTRACTOR shall perform the oiling at least 2 weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.7 FALSEWORK

- A. Falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time.
- B. Falsework shall be placed upon a solid footing, safe against undermining, and be protected from softening. When the falsework is supported on timber piles, the maximum calculated pile loading shall not exceed 20 tons. When falsework is supported on any portion of the structure which is already constructed, the load imposed by the falsework shall be spread, distributed, and braced in such a way as to avoid any possibility of damage to the structure.

- END OF SECTION -

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SECTION 03 21 00 - REINFORCEMENT STEEL

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. Provide reinforcement steel and appurtenant WORK, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with the requirements of SECTION 01 33 00 – CONTRACTOR SUBMITTALS.

- B. Shop Drawings

- 1. Furnish shop bending diagrams, placing lists, and drawings of reinforcement steel prior to fabrication.

- 2. Diagrams

- a. The shop bending diagrams shall show the actual lengths of bars to the nearest inch, measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface.
- b. Include bar placement diagrams that clearly indicate the dimensions of each bar splice.

- 3. Reinforcement

- a. Details of the concrete reinforcement steel and concrete inserts shall be submitted at the earliest possible date after receipt by the CONTRACTOR of the Notice to Proceed.
- b. Said details of reinforcement steel for fabrication and erection shall conform to ACI 315 - Details and Detailing of Concrete Reinforcement, and the indicated requirements.

- 4. Mechanical Couplers

- a. Where mechanical couplers are required or permitted to be used to splice reinforcement steel, submit the following items:
 - 1) manufacturer's literature containing instructions and recommendations for installation for each type of coupler used;
 - 2) certified test reports that verify the load capacity of each type and size of coupler used; and
 - 3) Shop Drawings that show the location of each coupler with details of how they are to be installed in the formwork.

5. Welding

- a. If reinforcement steel is to be spliced by welding at any location, submit mill test reports containing the information necessary for determination of the carbon equivalent per AWS D1.4 - Structural Steel Welding Code - Reinforcing Steel.
- b. Submit a written welding procedure for each type of weld for each size of bar which is to be spliced by welding; merely a statement that AWS procedures will be followed is not acceptable.
- c. If reinforcement steel is spliced by welding at any location, submit certifications of procedure qualifications for each welding procedure and certification of welder qualifications, for each welding procedure and for each welder performing on the WORK.

1.3 QUALITY ASSURANCE

A. Materials Testing

1. If requested by the ENGINEER, furnish samples from each heat of reinforcement steel in a quantity adequate for testing.
2. Costs of initial tests will be paid by the OWNER.
3. Costs of additional tests if material fails initial tests shall be the CONTRACTOR's responsibility.

B. Welding

1. Welder qualifications and procedure qualifications shall be as indicated in AWS D1.4.
2. If requested by the ENGINEER, furnish samples of each type of welded splice in a quantity and of dimensions adequate for testing.
3. At the discretion of the ENGINEER, radiographic testing of direct butt-welded splices will be performed.
4. Provide assistance necessary to facilitate testing.
5. Repair welds that fail to meet AWS D1.4.
6. The costs of testing will be paid by the OWNER, but the costs of tests that show failure to meet requirements shall be the CONTRACTOR's responsibility.

PART 2 -- PRODUCTS

2.1 REINFORCEMENT STEEL

- A. Reinforcement steel for cast-in-place reinforced concrete construction shall conform to the following requirements:
 1. Bar and spiral reinforcement shall conform to ASTM A 615 - Deformed and Plain Billet - Steel Bars, for Grade 60 reinforcement, unless otherwise indicated.

2. Welded Reinforcement

- a. Bar and spiral reinforcement that is welded shall conform to ASTM A 706 - Low Alloy Steel Deformed and Plain Bars for Concrete Reinforcement, for Grade 60 reinforcement, unless otherwise indicated.
- b. The carbon equivalent in reinforcing that is welded shall not exceed 0.55 percent.

3. Welded Wire Reinforcement

- a. Welded wire reinforcement shall conform to ASTM A 185 - Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete Reinforcement, and the indicated Details.
- b. Welded wire reinforcement with longitudinal wire of W4 size wire and smaller shall be in flat sheets or in rolls with a core diameter of not less than 10-inches.
- c. Welded wire reinforcement with longitudinal wires larger than W4 size shall be in flat sheets only.

B. Accessories

1. Accessories shall include necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement.
2. Bar Supports
 - a. Bar supports shall meet the requirements of the CRSI Manual of Standard Practice, including special requirements for supporting epoxy-coated reinforcing bars.
 - b. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating that extends at least 1/2 inch from the concrete surface.
 - c. Plastic shall be gray in color.
3. Concrete Blocks
 - a. Concrete blocks (dobies) used to support and position reinforcement steel shall have the same or higher compressive strength as required for the concrete in which they are located.
 - b. Wire ties shall be embedded in concrete block bar supports.

- C. Epoxy coating for reinforcing and accessories, where indicated, shall conform to ASTM A 775 - Epoxy - Coated Reinforcing Steel Bars.

2.2 MECHANICAL COUPLERS

- A. Mechanical couplers shall be provided where indicated and where approved by the ENGINEER.

- B. The couplers shall develop a tensile strength that exceeds 125 percent of the yield strength of the reinforcement bars being spliced at each splice.
- C. Multi-Component Couplers
 - 1. Where the type of coupler used is composed of more than one component, components required for a complete splice shall be provided.
 - 2. This shall apply to mechanical splices, including those splices intended for future connections.
- D. Connection
 - 1. The reinforcement steel and coupler used shall be compatible for obtaining the required strength of the connection.
 - 2. Straight threaded type couplers shall require the use of the next larger size reinforcing bar or shall be used with reinforcing bars with specially forged ends which provide upset threads which do not decrease the basic cross section of the bar.
- E. Couplers shall be **Lenton Form Saver** by **Erico Products, Dowel Bar Splicer System** by **Dayton/Richmond**, or equal.

2.3 WELDED SPLICES

- A. Welded splices shall be provided where indicated and where approved by the ENGINEER.
- B. Welded splices of reinforcement steel shall develop a tensile strength that exceeds 125 percent of the yield strength of the reinforcement bars that are connected.
- C. Materials as required to conform the welded splices to AWS D1.4 shall be provided.

2.4 EPOXY GROUT

- A. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled.
- B. Epoxy grout shall be in conformance with the requirements of Section 036000 – Grout.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the Building Code and the indicated supplementary requirements.

3.2 FABRICATION

- A. General
 - 1. Reinforcement steel shall be accurately formed to the dimensions and shapes indicated, and the fabricating details shall be prepared in accordance with ACI

315 and ACI 318 - Building Code Requirements for Reinforced Concrete, except as modified by the Drawings.

2. Bars shall be bent cold.
3. Bars shall be bent in accordance with the requirements of ACI 318.
4. Fabricate reinforcement bars for structures in accordance with accepted bending diagrams, placing lists, and placing drawings.

B. Fabricating Tolerances

1. Bars used for concrete reinforcement shall conform to the following fabricating tolerances:
 - a. Sheared Length: plus and minus one inch
 - b. Depth of Truss Bars: plus zero, minus 1/2 inch
 - c. Stirrups, Ties and Spirals: plus and minus 1/2 inch
 - d. Other Bends: plus and minus one inch

3.3 PLACEMENT

- A. Reinforcement steel shall be accurately positioned as indicated, and shall be supported and wired together to prevent displacement using annealed iron wire ties or suitable clips at intersections.
- B. Reinforcement steel shall be supported by concrete, plastic or metal support spacers, or metal hangers that are sufficiently strong and rigid to prevent any displacement of the reinforcement steel.
- C. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous.
- D. Concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties that are embedded in the blocks.
- E. For concrete over formwork, provide concrete, metal, plastic, or other acceptable bar chairs and spacers.
- F. Limitations on the use of bar support materials shall be as follows.
 1. Concrete Dobbies
 - a. permitted at any location except where architectural finish is required
 - b. required for slabs on grade and surfaces in contact with or above ozonated process water
 2. Wire bar supports will be permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
 3. Plastic bar supports will be permitted at every location except on-grade.

- G. Tie wires shall be bent away from the forms in order to provide the required concrete coverage.
 - H. Bars additional to those indicated that may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR at no additional expense to the OWNER.
 - I. Except where in conflict with the Building Code, unless otherwise indicated reinforcement placing tolerances shall be within the limits in Section 7.5 of ACI 318.
 - J. Moving Bars
 - 1. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items.
 - 2. If bars are moved more than one bar diameter or enough to exceed the above tolerances, the resulting arrangement of bars shall be as reviewed and accepted by the ENGINEER.
 - K. Welded Wire Reinforcement
 - 1. Welded wire reinforcement placed over horizontal forms shall be supported on slab bolsters.
 - 2. Slab bolsters shall be spaced not more than 30-inch on centers, shall extend continuously across the entire width of the reinforcement mat, and shall support the reinforcement mat in the plane indicated.
 - 3. Welded wire reinforcement placed over the ground shall be supported on wired concrete blocks (dobies) spaced not more than 3 feet on centers in any direction.
 - 4. The construction practice of placing welded wire fabric on the ground and hooking into place in the freshly placed concrete shall not be used.
 - L. Storage and Handling
 - 1. Store reinforcement and accessories so that they are not exposed to moisture.
 - M. Accessory Spacing
 - 1. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars.
 - 2. When used to space the reinforcing bars from wall forms, the forms and bars shall be located such that there is no deflection of the accessory when the forms are tightened into position.
- 3.4 SPACING OF BARS
- A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars, nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than one inch.

- B. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one inch.
- C. In columns, the clear distance between longitudinal bars shall be not less than 1-1/2 times the bar diameter, nor less than 1-1/2 times the maximum size of the coarse aggregate, nor less than 1-1/2 inches.
- D. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

3.5 SPLICING

A. General

- 1. Reinforcement bar splices shall only be used at indicated locations.
- 2. When it is necessary to splice reinforcement at points other than where indicated, the character of the splice shall be as reviewed and accepted by the ENGINEER.
- 3. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.

B. Splices of Reinforcement

- 1. The length of lap for reinforcement bars, unless otherwise indicated, shall be in accordance with ACI 318, Section 12.15.1 for a Class B splice.
- 2. Welded Wire Reinforcement
 - a. Laps of welded wire reinforcement shall be in accordance with ACI 318.
 - b. Adjoining sheets shall be securely tied together with No. 14 tie wire, one tie for each 2 running feet.
 - c. Wires shall be staggered and tied in such a manner that they cannot slip.
- 3. Splices in column spiral reinforcement, when necessary, shall be made by welding or by a lap of 1-1/2 turns.

C. Bending or Straightening

- 1. Reinforcement shall not be straightened or re-bent in a manner which will injure the material.
- 2. Bars shall be bent or straight as indicated.
- 3. Do not use bends different from the bends indicated.
- 4. Bars shall be bent cold, unless otherwise permitted by the ENGINEER.
- 5. No bars partially embedded in concrete shall be field-bent except as indicated or specifically permitted by the ENGINEER.

D. Couplers

- 1. Couplers that are located at a joint face shall be of a type that can be set either flush or recessed from the face as indicated.

2. The couplers shall be sealed during concrete placement to completely eliminate concrete or cement paste from entering.
 3. Couplers intended for future connections shall be recessed a minimum of 1/2 inch from the concrete surface.
 4. After the concrete is placed, the coupler shall be plugged with plastic plugs which have an O-ring seal and the recess filled with sealant to prevent any contact with water or other corrosive materials.
 5. Threaded couplers shall be plugged.
- E. Unless indicated otherwise, mechanical coupler spacing and capacity shall match the spacing and capacity of the reinforcing indicated for the adjacent section.

3.6 CLEANING AND PROTECTION

- A. Reinforcement steel shall always be protected from conditions conducive to corrosion until concrete has been placed around it.
- B. The surfaces of reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.
- C. Where there is delay in depositing concrete, the reinforcement shall be re-inspected and, if necessary, re-cleaned.

3.7 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

A. Hole Preparation

1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 1/4 inch greater than the diameter of the outer surface of the reinforcing bar deformations.
2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless indicated otherwise.
3. The hole shall be drilled by methods that do not interfere with the proper bonding of epoxy.
4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling, and the location of holes shall be adjusted to avoid drilling through or nicking any existing reinforcing bars.
5. The hole shall be blown clean with clean, dry compressed air to remove dust and loose particles.

B. Embedment

1. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole.

2. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets.
3. The hole shall be filled to a depth that insures excess material will be expelled from the hole during dowel placement.
4. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with epoxy.
5. The bar shall be inserted slowly enough to avoid developing air pockets.

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SECTION 03 31 00 - CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. Provide cast-in-place concrete, as indicated in accordance with the Contract Documents.
- B. The following types of concrete are covered in this Section:
 - 1. Structural Concrete
 - a. Regular Mix: Roof, floor slabs, columns, walls, pavements, and other concrete items not indicated otherwise in the Contract Documents.
 - b. Thick Section Mix: For 12-inch and thicker walls, slabs on grade, pavements, and footings. This type of concrete may be used at the indicated locations at the CONTRACTOR's option if the ENGINEER agrees.
 - c. Pea Gravel Mix: At the bottom 6 inches of walls.
 - 2. Other Concretes
 - a. Sitework Concrete: Concrete to be used for curbs, gutters, catch basins, sidewalks, fence and guard post embedment, underground duct bank encasement, and other concrete appurtenant to electrical facilities, unless otherwise indicated.
 - b. Lean Concrete
 - 1) Concrete to be used for thrust blocks, pipe trench cut-off blocks, and cradles that are indicated as unreinforced
 - 2) Lean concrete shall be used as protective cover for dowels intended for future connections.
- C. The term "hydraulic structure" shall mean environmental engineering concrete structures for the containment, treatment, or transmission of water, wastewater, other fluids, or gases.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 – CONTRACTOR SUBMITTALS.
- B. Mix Designs
 - 1. Prior to beginning the WORK and within 14 Days of the Notice to Proceed, submit preliminary concrete mix designs which shall show the proportions and gradations of materials proposed for each class and type of concrete.
 - 2. Mix designs shall be checked through trial batch and laboratory testing by an independent testing laboratory acceptable to the ENGINEER.

3. Costs related to trial batch and related laboratory testing shall be CONTRACTOR's responsibility as part of the WORK.
4. Since laboratory trial batches require 35 calendar days to complete, the CONTRACTOR shall test a minimum of 2 mix designs for each class of concrete.

C. Delivery Tickets

1. Where ready-mix concrete is used, the CONTRACTOR shall furnish delivery tickets at the time of delivery of each load of concrete.
2. Each ticket shall show the state-certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, the amount of water in the aggregate added at the batching plant, and the amount allowed to be added at the Site for the specific design mix.
3. In addition, each ticket shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the Site, when unloading began, and when unloading was finished.

D. Test Data: Test data relating to the cement, aggregate, and admixtures shall be less than 6 months old.

E. Furnish the following submittals in accordance with ACI 301 – Structural Concrete:

1. mill tests for cement
2. admixture certification, including chloride ion content
3. aggregate gradation test results and certification
4. materials and methods for curing

1.3 CONCRETE CONFERENCE

A. The ENGINEER will chair a meeting to review the detailed requirements of the CONTRACTOR's proposed concrete design mixes and to determine the procedures for producing proper concrete construction no later than 14 Days after the Notice to Proceed.

B. Parties involved in the concrete WORK shall attend the conference, including the following at a minimum:

1. CONTRACTOR's representative
2. testing laboratory representative
3. concrete subcontractor
4. reinforcing steel subcontractor and detailer
5. concrete supplier
6. admixture manufacturer's representative

- C. The conference shall be held at a time and place proposed by the CONTRACTOR and accepted by the ENGINEER.
- D. The conference shall be held at least 5 Days after acceptance.

1.4 QUALITY ASSURANCE

A. General

- 1. Tests on component materials and for compressive strength and shrinkage of concrete shall be performed as indicated.
- 2. Tests for determining slump shall be in accordance with ASTM C 143 – Test Method for Slump of Hydraulic Cement Concrete.
- 3. Testing for aggregate shall include sand equivalence, reactivity, organic impurities, abrasion resistance, and soundness, according to ASTM C 33 – Concrete Aggregates.
- 4. The cost of trial batch laboratory tests on cement, aggregates, and concrete shall be the CONTRACTOR's responsibility.
- 5. The cost of laboratory tests on field-placed cement, aggregates, and concrete and the cost of Special Inspections required by Code will be the OWNER'S responsibility.
- 6. The CONTRACTOR shall be responsible for the cost of any tests and investigations of WORK that is determined to be Defective WORK.
- 7. The testing laboratory shall meet or exceed ASTM C 1077 – Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction and Criteria for Laboratory Evaluation.
- 8. Concrete for testing shall be furnished by the CONTRACTOR, and the CONTRACTOR shall assist the ENGINEER in obtaining samples and disposal and cleanup of excess material.

B. Inspections

- 1. Continuous inspection by a special inspector approved by the local building department having jurisdiction and by the ENGINEER will be required where necessary to conform to Code requirements.
- 2. Costs of the special inspector shall be paid by the CONTRACTOR.
- 3. Inspection reports shall be submitted to the ENGINEER.
- 4. The special inspector shall observe the following for conformance to the Contract Documents:
 - a. the preparation and taking of required test specimens; and,
 - b. placement of concrete, except sitework concrete fully supported on earth.

C. Field Compression Tests

1. Compression test specimens shall be taken during construction from the first placement of each type of concrete and at intervals thereafter as selected by the ENGINEER to insure continued compliance with the Specifications.
2. Each set of specimens shall be a minimum of 5 cylinders.
3. Compression test specimens for concrete shall be made in accordance with Section 9.2 of ASTM C 31 – Practices for Making and Curing Concrete Test Specimens in the Field.
4. Specimens shall be 6-inches diameter by 12-inches tall cylinders.
5. Compression tests shall be performed in accordance with ASTM C 39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.
6. One test cylinder shall be tested at 7 Days, and 2 test cylinders tested at 28 Days.
7. The remaining cylinders shall be held to verify test results, if needed.

D. Evaluation and Acceptance of Concrete

1. Evaluation and acceptance of the compressive strength of concrete shall be in accordance with ACI 318 – Building Code Requirements for Reinforced Concrete, Chapter 5 "Concrete Quality," and as indicated.
2. A statistical analysis of compression test results shall be performed according to ACI 214 – Recommended Practice for Evaluation of Strength Test Methods.
3. The standard deviation of the test results shall not exceed 640 psi, when ordered at equivalent water content as estimated by slump.
4. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for subsequent batches of the type of concrete affected.
5. When the standard deviation of the test results exceeds 640 psi, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than 500 psi below or the average of any 3 consecutive tests being below the required compressive strength is 1 in 100.
6. The required average strength shall be calculated by Criterion No. 3 of ACI 214 using the actual standard deviation.
7. Concrete that fails to meet the ACI requirements and the indicated requirements is subject to removal and replacement.

E. Shrinkage Tests

1. Drying shrinkage tests shall be performed for the trial batches indicated in the Article below entitled "Trial Batch and Laboratory Tests," for the first placement of each class of structural concrete except pea gravel mix, and during placement to determine continued compliance.

2. Neither structural pea gravel nor structural C-R pea gravel mix need to be tested for shrinkage.
 3. Drying shrinkage specimens shall be 4-inch by 4-inch by 11-inch prisms with an effective gauge length of 10-inches, and fabricated, cured, dried, and measured in accordance with ASTM C 157 – Test Method for Length Change of Hardened Hydraulic Cement Mortar and Concrete, modified as follows:
 - a. Specimens shall be removed from molds at an age of 23 hours, plus or minus one hour, after trial batching, and shall be placed immediately in water at 70 degrees F, plus or minus 3 degrees F, for at least 30 minutes.
 - b. Specimens shall be measured within 30 minutes thereafter to determine original length and then shall be submerged in saturated lime water at 73 degrees F, plus or minus 3 degrees F.
 - c. Measurement to determine expansion expressed as a percentage of original length shall be made at age 7 Days.
 - d. This length at age 7 Days shall be the base length for drying shrinkage calculations ("0" days drying age).
 - e. Specimens then shall be stored immediately in a humidity control room maintained at 73 degrees F, plus or minus 3 degrees F, and 50 percent relative humidity, plus or minus 4 percent, for the remainder of the test.
 - f. Measurements to determine shrinkage, expressed as percentage of base length, shall be performed and reported separately for 7, 14, 21, and 28 Days of drying after 7 Days of moist curing.
 4. The drying shrinkage deformation of each specimen shall be computed as the difference between the base length (at "0" days drying age) and the length after drying at each test age.
 5. The average drying shrinkage deformation of the specimens shall be computed to the nearest 0.0001 inch at each test age.
 6. If the drying shrinkage of any specimen departs from the average of that test age by more than 0.0004 inch, the results obtained from that specimen shall be disregarded.
 7. Results of the shrinkage test shall be reported to the nearest 0.001 percent of shrinkage.
 8. Compression test specimens shall be taken in each case from the same concrete used for preparing drying shrinkage specimens.
 9. These tests shall be considered a part of the normal compression tests for the project.
 10. Allowable shrinkage limitations are indicated in PART 2 - PRODUCTS, below.
- F. Aggregate Testing: Aggregate testing shall be performed for the trial batch in the Article below entitled "Trial Batch and Laboratory Tests" prior to construction and every 12 months during construction to determine continued compliance.
- G. Construction Tolerances

1. The CONTRACTOR shall set and maintain concrete forms and perform finishing operations to ensure that the completed WORK is within tolerances.
2. Surface defects and irregularities are defined as finishes and are different from tolerances.
3. Tolerance is the permissible variation from lines, grades, or dimensions indicated on the Drawings.
4. Where tolerances are not indicated, permissible deviations shall be in accordance with ACI 117 – Standard Tolerance for Concrete Construction and Materials.
5. The following non-cumulative construction tolerances apply to finished walls, columns and slabs unless otherwise indicated:

ITEM	TOLERANCE
Variation of the constructed linear outline from the established position in plan.	in 10 feet: 1/4 inch in 20 feet or more: 1/2 inch
Variation from the level or from the grades indicated.	in 10 feet: 1/4 inch in 20 feet or more: 1/2 inch
Variation from plumb	in 10 feet: 1/4 inch in 20 feet or more: 1/2 inch
Variation in the thickness of slabs and walls.	minus 1/4 inch plus 1/2 inch
Variation in the locations and sizes of slabs and wall openings	plus or minus 1/4 inch

PART 2 -- PRODUCTS

2.1 CONCRETE MATERIALS

A. General

1. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage.
2. Cement reclaimed from cleaning bags or leaking containers shall not be used.
3. Cement shall be used in the sequence of receipt of shipments.

B. Materials and storage of materials shall comply with ACI 301, as applicable.

C. Materials for concrete shall conform to the following requirements:

1. Cement
 - a. Cement shall be standard brand Portland cement conforming to ASTM C 150 – Portland Cement, for Type II or Type V.
 - b. A minimum of 85 percent of cement by weight shall pass a 325 screen.

- c. A single brand of cement shall be used throughout the WORK, and prior to its use, the brand shall be accepted by the ENGINEER.
- d. The cement shall be suitably protected from exposure to moisture until used.
- e. Cement that has become lumpy shall not be used.
- f. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling.
- g. Certified mill test reports, including fineness, for each shipment of cement to be used shall be submitted to the ENGINEER, if requested, regarding compliance with the Specifications.

2. Water

- a. Water for mixing and curing shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts, and other impurities.
- b. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies.
- c. Agricultural water with high total dissolved solids (greater than 1000 mg/L TDS) shall not be used.

3. Aggregates

- a. Aggregates shall be obtained from pits acceptable to the ENGINEER, shall be non-reactive, and shall conform to ASTM C 33 – Concrete Aggregates.
- b. The maximum size of coarse aggregate shall be as indicated, and the substitution of lightweight sand for fine aggregate will not be permitted.
- c. Coarse Aggregates
 - 1) Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock, or a combination thereof.
 - 2) The coarse aggregates shall be prepared and handled in 2 or more size groups for combined aggregates, with a maximum size greater than 3/4 inch.
 - 3) When the aggregates are proportioned for each batch of concrete, the 2 size groups shall be combined (also refer to the Article below entitled "Trial Batch and Laboratory Tests").
- d. Fine Aggregates
 - 1) Fine aggregates shall be natural sand or a combination of natural and manufactured sand that is hard and durable.
 - 2) When tested in accordance with ASTM D 2419 – Test Methods for Sand Equivalent Value of Soils and Fine Aggregate, the sand equivalency shall not be less than 75 percent for an average of 3 samples, nor less than 70 percent for an individual test.

- 3) The gradation of fine aggregate shall conform to ASTM C 33 when tested in accordance with ASTM C 136 for the fineness modulus of the sand used, including the optional grading in Section 6.2.
 - 4) The fineness modulus of sand used shall not be greater than 3.1.
 - 5) When tested in accordance with ASTM C 33, the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.
- e. Combined Aggregates
- 1) Combined aggregates shall be well graded from coarse to fine sizes and shall be uniformly graded between screen sizes to produce concrete that has optimum workability and consolidation characteristics.
 - 2) Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.
 - 3) When tested in accordance with ASTM C 33, the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions or 10.5 percent after 100 revolutions.
- f. When tested in accordance with ASTM C 33, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.
- g. When tested in accordance with ASTM C 33, the loss resulting after 5 cycles of the soundness test shall not exceed 10 percent for fine aggregate and 12 percent for coarse aggregate when using sodium sulfate.
4. Ready-mixed concrete shall conform to the requirements of ASTM C 94 – Ready Mixed Concrete.
5. Admixtures
- a. Admixtures shall be compatible and shall be furnished by a single manufacturer capable of providing qualified field service representation.
 - b. Admixtures shall be used in accordance with manufacturer's recommendations.
 - c. If the use of an admixture is producing an inferior end result, the CONTRACTOR shall discontinue use of the admixture.
 - d. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion, and shall be non-toxic after 30 days.
- e. Air Content
- 1) An air-entraining agent meeting the requirements of ASTM C 260 – Air Entraining Admixtures for Concrete shall be used.
 - 2) The OWNER reserves the right, at any time, to sample and test the air-entraining agent.

- 3) The air-entraining agent shall be added to the batch in a portion of the mixing water.
 - 4) The solution shall be batched by means of a mechanical batcher capable of accurate measurement.
 - 5) Air content shall be tested at the point of placement.
 - 6) The air entraining agent shall be Micro-Air by Master Builders; Daravair by W.R. Grace; Sika AEA-15 by Sika Corporation; or equal
- f. Set-Controlling and Water-Reducing Admixtures
- 1) Admixtures may be added at the CONTRACTOR's option, subject to the ENGINEER's approval, to control the set, effect water reduction, and increase workability.
 - 2) The cost of adding an admixture shall be the CONTRACTOR's responsibility.
 - 3) Concrete containing an admixture shall be first placed at a location determined by the ENGINEER.
 - 4) Admixtures shall conform to ASTM C 494 – Chemical Admixtures for Concrete.
 - 5) The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.
 - 6) Concrete shall not contain more than one water-reducing admixture, unless it can be demonstrated that the proposed mix will meet the indicated drying shrinkage requirements.
 - 7) The set-controlling admixture may be either with or without water-reducing properties.
 - 8) Where the air temperature at the time of placement is expected to be consistently greater than 80 degrees F, a set-retarding admixture such as **Plastocrete 161MR by Sika Corporation, Pozzolith or Delvo by BASF, Daratard by W.R. Grace**, or equal shall be used.
 - 9) Where the air temperature at the time of placement is expected to be consistently less than 40 degrees F, a non-corrosive set accelerating admixture such as **Plastocrete 161FL by Sika Corporation, Pozzutec 20 by BASF, Daraset by W.R. Grace**, or equal shall be used.
 - 10) Mid-Range Water Reducers
 - a) General use water-reducing admixtures shall be mid-range and shall conform to ASTM C 494, Type A and F.
 - b) Use Daracem by **W.R. Grace**, **Polyheed by BASF**, **Sikament by Sika Corporation**, or equal.

- c) The quantity of admixture used and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations.

11) High-Range Water Reducers

- a) High-range water reducers shall conform to ASTM C 494, Type F or G.
- b) Use **ADVA** by **W.R. Grace**, **ViscoCrete** by **Sika Corporation**, **Glenium** by **BASF**, or equal.
- c) The high-range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified.
- d) No more than 14 ounces of water reducer per sack of cement shall be used.
- e) The water reducer shall be considered as part of the mixing water when calculating the water/cement ratio.
- f) If the high-range water reducer is added to the concrete at the Site, it may be used in conjunction with the same water reducer added at the batch plant.
- g) Concrete shall have a slump of 3 inches, plus or minus 1/2 inch, prior to adding the high-range water reducing admixture at the Site.
- h) The high-range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician.
- i) A standby system shall be provided and tested prior to each day's operation of the primary system.
- j) Concrete shall be mixed at mixing speed for a minimum of 70 mixer revolutions or 5 minutes after the addition of the high-range water reducer, unless recommended otherwise by the manufacturer.

g. Other Admixtures

1) Flyash

- a) Flyash shall not be used for concrete sections containing process water in water or wastewater treatment plants or potable water.

For other concrete, fly ash may be substituted for not more than 15 percent, by weight, of cement in structural concrete and not more than 30 percent, by weight, for sitework concrete, and not more than 50 percent, by weight, of cement in other concrete.

- b) Fly ash shall conform to ASTM C618 and shall not have loss-on-ignition greater than 3 percent.

- c) The water/cement ratio shall be calculated based on cement plus fly ash.
- 2) Ground Blast Furnace Slag Cement
- a) Slag cement shall not be used for concrete sections containing process water in water or wastewater treatment plants or potable water.
 - b) Slag cement shall conform to ASTM C989 – Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars, Grade 100 or 120.
 - c) Blended cements shall conform to ASTM C595 – Blended Hydraulic Cements, Type 1S, or ASTM C1157 – Performance Specification for Hydraulic Cement.
 - d) Slag cement substitution, if used, shall be not less than 25, nor more than 50 percent by weight of cement.
 - e) Slag cement substitution shall not be used with fly ash substitution.
 - f) The water/cement ratio shall be calculated based on cement plus slag cement.
- 3) Fiber reinforcing
- a) Fiber-reinforced concrete shall be furnished where indicated.
 - b) Fiber reinforcement shall be synthetic fiber reinforcement.
 - c) Use **Fibermesh 300**, as manufactured by **Propex**, or equal.
 - d) Fiber reinforcing shall be batched at the plant at a rate of 1.5 pounds per cubic yard of concrete.
 - e) Material: 100-percent virgin homopolymer polypropylene-fibrillated fibers; containing no reprocessed olefin materials
 - f) Conformance: ASTM C 1116, Type III
 - g) Fire Classifications: UL Report File No. R8534-11; Southwest Certification Services (SWCS), Omega Point Laboratories No. 8662-1
 - h) Fiber Length: one inch
 - i) Alkali Resistance: alkali-proof
 - j) Absorption: nil
 - k) Specific Gravity: 0.91
 - l) Melting Point: 324 degrees F (162 degrees C)

h. Corrosion Inhibitor

- 1) The corrosion inhibitor shall be **DCIS** by **W.R. Grace**, or equal.
- 2) Mixing water shall be adjusted for the admixture in accordance with the manufacturer's recommendations.

2.2 CURING MATERIALS

A. General: Curing compounds shall be resin-based and shall be compliant with local VOC requirements, unless otherwise indicated herein.

B. Regular Curing Compound

1. Regular curing compound shall be white-pigmented and shall conform to ASTM C 309 - Liquid Membrane-Forming Compounds for Curing Concrete, Type 2, Class B.
2. Sodium silicate compounds will not be accepted.
3. The concrete curing compound shall be:
 - a. Kurez VOX White Pigmented by Euclid Chemicals Company;
 - b. L&M Cure R-2 by L&M Construction Chemicals;
 - c. 1200-White by W.R. Meadows;
 - d. Kure-N-Seal WB White Pigmented by Sonneborn/Degussa Building Systems;
 - e. or equal.

C. Dissipating Curing Compound

1. When the curing compound must be removed for finishes or grouting, compounds shall be of a dissipating type, conforming to ASTM C 309, Type 1 or 2, Class B.
2. The dissipating curing compound shall be:
 - a. Korez DR VOX by Euclid Chemical Company;
 - b. L&M Cure R-2 by L & M Construction Chemicals;
 - c. 1100-Clear by W.R. Meadows;
 - d. or equal.

D. Concrete Curing Blanket

1. Polyethylene Sheets
 - a. Polyethylene sheets for use as concrete curing blanket shall be white and shall have a nominal thickness of 6 mils.

- b. The loss of moisture when determined in accordance with ASTM C 156 – Test Method for Water Retention by Concrete Curing Materials, shall not exceed 0.055 grams per square centimeter of surface.

2. Polyethylene-Coated Waterproof Paper

- a. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, shall have a nominal thickness of 2-mils, and shall be permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A – Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant).
- b. The loss of moisture, when determined in accordance with ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.

3. Polyethylene-Coated Burlap

- a. Polyethylene-coated burlap for use as concrete curing blanket shall be 4 mils thick, with white opaque polyethylene film impregnated or extruded into one side of the burlap.
- b. The burlap shall weigh not less than 9 ounces per square yard.
- c. The loss of moisture, when determined in accordance with ASTM C 156, shall not exceed 0.055 grams per square centimeter of surface.

E. Curing Mats

1. Curing mats for use in Curing Method 6, below, shall be heavy shag rugs or carpets or cotton mats quilted at 4 inches on center.
2. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.

F. Evaporation Retardant

1. An evaporation retardant shall be used.
2. The evaporation retardant shall be:
 - a. Confilm by MBT/Degussa Building Systems;
 - b. Eucobar by Euclid Chemical Company;
 - c. E-CON by L & M Construction Chemicals, Inc.;
 - d. or equal.

2.3 NON-WATERSTOP JOINT MATERIALS

- A. Materials for non-waterstop joints in concrete shall conform to the following requirements:
 1. The preformed joint filler shall be a non-extruding neoprene sponge or polyurethane type conforming to Section 03 32 00– JOINTS IN CONCRETE.

2. The elastomeric joint sealer shall conform to Section 07 92 13 – SEALANTS AND CAULKING.
3. Mastic Joint Sealer
 - a. The mastic joint sealer shall be a material:
 - 1) that does not contain evaporating solvents;
 - 2) that will tenaciously adhere to concrete surfaces;
 - 3) that will remain permanently resilient and pliable;
 - 4) that will not be affected by the continuous presence of water;
 - 5) that will not in any way contaminate potable water;
 - 6) and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement from expansion and contraction.
 - b. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants.
 - c. The sealer shall be capable of meeting the indicated test requirements, if testing is required by the ENGINEER.

2.4 MISCELLANEOUS MATERIALS

A. Dampproofing Agent

1. The dampproofing agent shall be an asbestos-free, fibered asphalt emulsion intended for cold application to green concrete, both above- and below-grade.
2. Dampproofing shall meet the requirements of ASTM D 1227 – Emulsified Asphalt Used as a Protective Coating for Roofing, Type II, Class I.
3. Dampproofing shall be:
 - a. Hydrocide 700 Series by Sonneborn/Degussa Building Systems;
 - b. Sealmastic by W. R. Meadows;
 - c. HE 789 by Henry Company;
 - d. or equal.

B. Bonding Agents

1. Bonding agents shall be epoxy adhesives.
2. Bonding agents for bonding freshly-mixed, plastic concrete to hardened concrete shall be:
 - a. Sikadur 32 Hi-Mod Epoxy Adhesive by Sika Corporation;

- b. Concreive Liquid (LPL) by MBT/Degussa Building Systems;
 - c. BurkEpoxy MV by Edoco;
 - d. or equal.
3. Bonding agents for bonding hardened concrete or masonry to steel shall be:
- a. Sikadur 31 Hi-Mod Gel by Sika Corporation;
 - b. BurkEpoxy NS by Edoco;
 - c. Concreive Paste (LPL) by MBT/Degussa Building Systems;
 - d. or equal.
- C. Colorant for duct bank concrete shall be an integral red oxide coloring pigment used in the proportion of 8 pounds per cubic yard of concrete.

2.5 CONCRETE DESIGN REQUIREMENTS

A. General

- 1. Concrete shall be composed of cement, admixtures, aggregates, and water of the qualities indicated.
- 2. The exact proportions in which these materials are to be used for different parts of the WORK shall be determined during the trial batches.
- 3. In general, the mix shall be designed to produce a concrete capable of being deposited to obtain maximum density and minimum shrinkage, and, where deposited in forms, to have good consolidation properties and maximum smoothness of surface.
- 4. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items.
- 5. The proportions shall be changed whenever necessary or desirable to meet the required results, and such changes shall be subject to review by the ENGINEER.

B. Fine Aggregate Composition

- 1. In mix designs for structural concrete, except for 1/2-inch and 3/8-inch maximum size aggregate, the percentage of fine aggregate in total aggregate by weight shall be as indicated in the following table:

FINE AGGREGATE	
Fineness Modulus	Percent (maximum)
2.7 or less	41
2.7 to 2.8	42
2.8 to 2.9	43
2.9 to 3.1	44

2. For other concrete, the maximum percentage of fine aggregate of total aggregate by weight shall not exceed 50 percent.
- C. Duct Bank Concrete
1. Duct bank concrete shall contain an integral red-oxide coloring pigment.
 2. The concrete shall be dyed red throughout.
 3. Using a surface treatment to color duct banks will not be accepted.
- D. Water/Cement Ratio
1. The indicated water/cement ratio is for a saturated-surface dry condition of aggregate.
 2. Throughout every Day, the added batch water shall be adjusted for the total free water in the aggregates, which shall be determined as follows:
 - a. The total moisture content of all aggregate shall be calculated by ASTM C 566
– Test Method for Total Moisture Content of Aggregate by Drying.
 - b. Subtract the moisture absorbed by the coarse aggregate, calculated by ASTM C 127 – Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.
 - c. Subtract the moisture absorbed by the fine aggregate, calculated by ASTM C 128 – Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Fine Aggregate.
- E. Concrete Property Tables
1. The maximum cement contents (determined from the maximum W/C Ratios and maximum Water Contents given in the Concrete Property Tables below) are intended to minimize drying shrinkage and heat of hydration of the concrete.
 2. It is understood that the indicated maximum cement contents may require additional water reducing agent for the workability required by the CONTRACTOR'S methods, and may not result in the least costly concrete mix for the required concrete strength.
 3. If the CONTRACTOR wishes to increase the maximum cement content for any mix, the CONTRACTOR must notify the ENGINEER in writing and submit the request within 30 days of the Notice to Proceed.
 4. Increases in cement content shall be at the CONTRACTOR'S expense.

STRUCTURAL CONCRETE				
Type of WORK	Regular Mix (roof, floor slabs, walls, pavements, and other concrete items not categorized elsewhere)	Thick Section Mix (12-inch and thicker walls, slabs on grade, pavements, and footings)	Congested Section Mix (Use where indicated or at the CONTRACTOR's Option and approved by the ENGINEER)	Pea Gravel Mix (concrete at the bottom 6 inches of waterstopped walls) At the CONTRACTOR's option, superplastic Regular Mix may be substituted for the first lift
Min 28 Day Compressive Strength, psi	4500	4500	5000	5000
Max Aggregate Size, in	1	1-1/2	1/2	3/8
Cement Content per cubic yard, lb, minimum	564	564	600	752
Water content per cubic yard, lb, maximum	254	254	240	301
Max W/C Ratio by weight	0.42	0.42	0.40	0.40
Total Air Content, percent	4.5 to 7.5, severe	4 to 7, severe	5.5 to 8.5, severe	6 to 9, severe
Slump	4 inches +/- 1 in with high-range water reducer: 7 inches +/- 2 in	4 inches +/- 1 in with high-range water reducer: 7 inches +/- 2 in	with high-range water reducer: 7 inches +/- 2 in	with high-range water reducer: 7 inches +/- 2 in

Type of WORK	Sitework Concrete (curbs, gutters, sidewalks, catch basins, fence embedments, encasements, and ductbanks)	Lean Concrete (thrust blocks, pipe trench cut-off blocks, and cradles)
Min 28 Day Compressive Strength, psi	3000	2000
Max Aggregate Size, in	1	1
Cement Content per cubic yard, lb, minimum	470	376
Water content per cubic yard, lb, maximum	254	270
Max W/C Ratio by weight	0.45 frost or sulfates	0.60
Total Air Content, percent	4 to 7 severe	4.5 to 7.5 severe
Slump	4 inches +/- 1 in ductbanks and encasements: 5 inches +/- 1 in	4 inches +/- in

NOTE: The CONTRACTOR is cautioned that the limiting parameters above are not a mix design. Admixtures may be required to achieve workability required by the CONTRACTOR's construction methods and aggregates. The CONTRACTOR shall be responsible for providing concrete with the required workability and strength.

F. Adjustments to Mix Design

1. The CONTRACTOR may elect to decrease the water/cement ratio to achieve the strength and shrinkage requirements and/or add water reducers, as required to achieve workability.
2. The mixes shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish, and the CONTRACTOR shall be entitled to no additional compensation because of such changes.
3. Any changes to the accepted concrete mix design shall be submitted to the ENGINEER for review and shall be tested again in accordance with the indicated requirements.

2.6 CONSISTENCY

- A. The quantity of water in a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete that can be worked properly into place without segregation and which can be compacted by vibratory methods to give the desired density, impermeability, and smoothness of surface.

- B. The quantity of water shall be changed as necessary, with variations in the nature or moisture content of the aggregates, in order to maintain uniform production of a desired consistency.
- C. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143 – Test Method for Slump of Hydraulic Cement Concrete.
- D. The slumps shall be as indicated with the concrete properties.

2.7 TRIAL BATCH AND LABORATORY TESTS

- A. The CONTRACTOR shall only use a mix design for construction that has first met the trial batch testing requirements.
- B. Before placing any concrete, a testing laboratory selected by the ENGINEER shall prepare a trial batch of each class of structural concrete, based on the preliminary concrete mixes submitted by the CONTRACTOR.
- C. Aggregate Proportions
 - 1. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the required properties.
 - 2. If one size range produces an acceptable mix, a second size range need not be used.
 - 3. Such adjustments will be considered refinements to the mix design and will not be the basis for extra compensation to the CONTRACTOR.
 - 4. Concrete shall conform to the indicated requirements whether the aggregate proportions are from the CONTRACTOR's preliminary mix design or whether the proportions have been adjusted during the trial batch process.
 - 5. The trial batch shall be prepared using the aggregates, cement, and admixture proposed for the project.
- D. The trial batch materials shall be of a quantity such that the testing laboratory can obtain 3 drying shrinkage and 6 compression test specimens from each batch.

The determination of compressive strength shall be made by testing 6-inch diameter by 12-inch high cylinders, which have been made, cured, and tested in accordance with ASTM C 192 – Practice for Making and Curing Concrete Test Specimens in the Laboratory, and ASTM C 39.

- E. The testing schedule shall be 3 compression test cylinders tested at 7 Days and 3 at 28 Days.
- F. The average compressive strength for the 3 cylinders tested at 28 Days for any given trial batch shall be not less than 125 percent of the indicated compressive strength.
- G. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C 136 – Method for Sieve Analysis of Fine and Coarse Aggregates, and values shall be provided for percent passing each sieve.

2.8 SHRINKAGE LIMITATION

A. General

- 1. The CONTRACTOR shall only use a mix design for construction that has first met the trial batch shrinkage requirements.
- 2. Shrinkage limitations shall apply only to structural concrete.

B. Maximum Shrinkage

- 1. The maximum concrete shrinkage for specimens cast in the laboratory from the trial batch, as measured at 21-Day drying age or at 28-Day drying age, shall be 0.036 percent or 0.042 percent, respectively.
- 2. Standard deviation will not be considered.
- 3. The maximum concrete shrinkage for specimens cast in the field shall not exceed the trial batch maximum shrinkage requirement by more than 25 percent.

C. If the required shrinkage limitation is not met during construction, the CONTRACTOR shall take any or all of the following actions to reestablish compliance:

- 1. changing the source of aggregates, cement and/or admixtures;
- 2. reducing water/cement ratio;
- 3. washing of coarse and/or fine aggregate to reduce fines;
- 4. increasing the number of construction joints;
- 5. modifying the curing requirements; or
- 6. other actions to minimize shrinkage or the effects of shrinkage.

2.9 MEASUREMENT OF CEMENT AND AGGREGATE

A. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the CONTRACTOR and acceptable to the ENGINEER.

B. Weighing Tolerances

Material	Percent of Total Weight
Cement	1
Aggregates	3
Admixtures	3

2.10 MEASUREMENT OF WATER

A. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the ENGINEER and capable of measuring the water in variable amounts within a tolerance of one percent.

- B. The water feed control mechanism shall be capable of being locked in position in order to constantly deliver the required amount of water to each batch of concrete.
- C. A positive, quick-acting valve shall be used for a cut-off in the water line to the mixer, and the operating mechanism shall prevent leakage when the valve is closed.

2.11 READY-MIXED CONCRETE

A. General

1. At the CONTRACTOR'S option, ready-mixed concrete may be used if it meets the indicated requirements as to materials, batching, mixing, transporting and placement, and is in accordance with ASTM C 94 and the following supplementary requirements.
2. Ready-mixed concrete shall be delivered to the WORK, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever occurs first.
3. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted.
4. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted.
5. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the ENGINEER.

B. Counters

1. Truck mixers shall be equipped with electrically-actuated counters by which the number of revolutions of the drum or blades may be readily verified.
2. The counter shall be of the resettable, recording type and shall be mounted in the driver's cab.
3. The counters shall be actuated at the time of starting the mixers at mixing speeds.

C. Mixing

1. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment.
2. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed.
3. Materials, including the mixing water, shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.

D. Uniformity

1. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading.
 2. If slump tests taken at approximately the 1/4- and 3/4-point of the load during discharge result in slumps differing by more than one inch when the required slump is 3 inches or less, or if they differ by more than 2 inches when the required slump is more than 3 inches, the mixer shall not be used on the WORK unless the causative condition is corrected and satisfactory performance is verified by additional slump tests.
 3. Mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
- E. Each batch of ready-mixed concrete delivered to the Site shall be accompanied by a delivery ticket that is furnished to the ENGINEER in accordance with the Paragraph in Part 1 of this Section entitled "Delivery Tickets."

PART 3 -- EXECUTION

3.1 PROPORTIONING AND MIXING

- A. Proportioning of the mix shall conform to ACI 301.
- B. Mixing shall conform to ACI 301.
- C. Slumps shall be as indicated.
- D. Re-tempering of concrete or mortar that has partially hardened will not be permitted.

3.2 PREPARATION OF SURFACES FOR CONCRETING

A. General

1. Earth surfaces shall be thoroughly wetted by sprinkling prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon.
2. The surface shall be free from standing water, mud, and debris at the time of placing concrete.

B. Joints in Concrete

1. Construction joints are defined as concrete surfaces upon which or against which concrete is to be placed, but placement of concrete has been stopped or interrupted and the ENGINEER has determined that the new concrete cannot be incorporated integrally with the concrete previously placed.
2. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bonding.

3. Except where coated joint surfaces have been indicated, the joint surfaces shall be cleaned of laitance, loose or defective concrete, foreign material, and be roughened to a minimum 1/4-inch amplitude.
4. Cleaning and roughening shall be accomplished by hydroblasting or sandblasting (exposing aggregate) followed by thorough washing.
5. Pools of water shall be removed from the surface of construction joints before the new concrete is placed.
6. Gravel
 - a. After the surfaces have been prepared, each approximately horizontal construction joint shall be covered with a 6-inch lift of a pea gravel mix.
 - b. The gravel mix shall be placed and spread uniformly.
 - c. Wall concrete shall follow immediately and shall be placed upon the fresh pea gravel mix.

C. Placement Interruptions

1. When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means that will secure proper union with subsequent WORK.
2. Such construction joints shall be made only where acceptable to the ENGINEER.

D. Embedded Items

1. No concrete shall be placed until the formwork, the installation of parts to be embedded, the reinforcement steel, and the preparation of surfaces involved in the placing have been completed and accepted by the ENGINEER at least 4 hours before the placement of concrete.
2. Surfaces of forms and embedded items that have become encrusted with dried grout from previous usage shall be cleaned before the surrounding or adjacent concrete is placed.
3. Inserts or other embedded items shall conform to the indicated requirements.
4. Reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms at locations as indicated or shown by Shop Drawings, and shall be acceptable to the ENGINEER before any concrete is placed.
5. Accuracy of placement shall be the responsibility of the CONTRACTOR.

E. Casting New Concrete Against Old Concrete

1. Where concrete is to be cast against old concrete (defined as any concrete which is greater than 60 Days old), the surface of the old concrete shall be thoroughly cleaned and roughened by hydroblasting or sandblasting to expose aggregate.
2. The joint surface shall be coated with an epoxy bonding agent unless determined otherwise by the ENGINEER.

F. Water

1. No concrete shall be placed in any structure until water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes or other means, and carried out of the forms, clear of the WORK.
2. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set.
3. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete.
4. Pumping or other necessary dewatering operations for removing ground water, if required, shall be subject to review by the ENGINEER.

G. Corrosion Protection

1. Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be positioned and supported prior to placement of concrete such that there will be a minimum of 2 inches clearance between said items and any part of the concrete reinforcement.
2. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.

H. Openings for pipes, inserts for pipe hangers and brackets, and anchors shall be provided, where practicable, during the placement of concrete.

I. Anchor bolts shall be accurately set and shall be maintained in position by templates while embedded in the concrete.

J. Cleaning: The surfaces of metalwork to be in contact with the concrete shall be thoroughly cleaned of dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.3 HANDLING, TRANSPORTING, AND PLACING

A. General

1. The placement of concrete shall conform to the applicable portions of ACI 301 and the indicated requirements.
2. No aluminum materials shall be used in conveying any concrete.

B. Non-Conforming WORK or Materials

1. Concrete which during or before placing is found not to conform to the indicated requirements will be rejected and shall be immediately removed from the WORK.
2. Concrete that is not placed in accordance with these requirements or which is of inferior quality shall be removed and replaced.

C. Unauthorized Placement

1. No concrete shall be placed except in the presence of an authorized representative of the ENGINEER.

2. The CONTRACTOR shall notify the ENGINEER in writing at least 24 hours in advance of the placement of any concrete.

D. Placement in Wall and Column Forms

1. Concrete shall not be dropped through reinforcement steel or into any deep form, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete.
2. In such cases, means such as hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation.
3. In no case shall the free fall of concrete below the ends of ducts, chutes, or buggies exceed 4 feet in walls and 8 feet in columns.
4. Concrete shall be uniformly distributed during the process of deposition, and in no case after deposition shall any portion be displaced in the forms more than 6 feet in the horizontal direction.
5. Concrete in wall forms shall be deposited in uniform horizontal layers not deeper than 2 feet, and care shall be exercised to avoid inclined layers or inclined construction joints except where such are required for sloping members.
6. Each layer shall be placed while the previous layer is still soft.
7. The rate of placing concrete in wall forms shall not exceed 5 feet of vertical rise per hour.
8. Sufficient illumination shall be provided in the interior of forms such that the concrete at the places of deposit is visible from the deck or runway.

E. Casting New Concrete Against Old Concrete

1. An epoxy adhesive bonding agent shall be applied to the old surfaces according to the manufacturer's written recommendations.
2. This provision shall not apply to joints where waterstop has been provided.
3. Refer to Section 03 32 00 – JOINTS IN CONCRETE, for other requirements.

F. Conveyor Belts and Chutes

1. Ends of chutes, hopper gates, and other points of concrete discharge throughout the CONTRACTOR's conveying, hoisting, and placement system shall be designed and arranged such that concrete passing from them will not fall separated into whatever receptacle immediately receives it.
2. Conveyor belts, if used, shall be of a type acceptable to the ENGINEER.
3. Chutes longer than 50 feet will not be permitted.
4. The minimum slopes of chutes shall be such that concrete of the indicated consistency will readily flow in them.

5. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted.
6. Conveyor belts and chutes shall be covered.

G. Placement in Slabs

1. Concrete placement in sloping slabs shall proceed uniformly from the bottom of the slab to the top for the full width of the placement.
2. As the WORK progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.

H. Temperature of Concrete

1. The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 50 degrees F.
2. For sections less than 12 inches thick, the temperature of concrete when placed shall be not less than 55 degrees F.

I. Hot or Cold Weather Procedures

1. If required by the ENGINEER, the CONTRACTOR shall submit detailed procedures for the production, transportation, placement, protection, curing, and temperature monitoring of concrete during hot or cold weather.
2. The submittal shall include procedures to be implemented upon abrupt changes in weather conditions or equipment failures.
3. The CONTRACTOR shall not be entitled to additional compensation for satisfying the hot weather placement or the cold weather placement requirements below.

J. Hot Weather Placement

1. If the temperature of the concrete is 85 degrees F or greater, the time between introducing the cement into the aggregates and discharge shall not exceed 45 minutes.

If the concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, the CONTRACTOR shall employ effective means such as pre-cooling of aggregates, using ice as mixing water, or placing at night as necessary to maintain the temperature of the concrete below 90 degrees F as it is placed.

2. During the curing period, the maximum temperature decrease measured at the surface of the concrete shall not exceed 50 degrees F in 24 hours nor 5 degrees F in one hour.

K. Cold Weather Placement

1. The placement of concrete shall conform to ACI 306.1 – Cold Weather Concreting, and the following requirements:

- a. Remove snow, ice, and frost from the surfaces, including reinforcement, against which concrete is to be placed.
- b. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6 inches.
- c. Reinforcement and embedded items shall be warmed to above 32 degrees F prior to concrete placement.
- d. Maintain the concrete temperature above 50 degrees F for at least 72 hours after placement.
- e. Concrete ingredients shall not be heated more than necessary to prevent the temperature of the mixed concrete, as placed, from falling below the minimum temperature criterion.

3.4 PUMPING OF CONCRETE

- A. General: If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- B. Pumping Equipment
 1. The pumping equipment shall have 2 cylinders and shall be designed to operate with one cylinder in case the other one is not functioning.
 2. In lieu of this requirement, the CONTRACTOR may have a standby pump on the Site during pumping.
 3. The minimum diameter of the hose conduits shall be in accordance with ACI 304.2R – Placing Concrete by Pumping Methods.
 4. Pumping equipment and hose conduits that are not functioning properly shall be replaced.
 5. Aluminum conduits for conveying the concrete will not be permitted.
- C. Field Control: Concrete samples for slump, air content, and test cylinders shall be taken at the placement end of the hose.

3.5 ORDER OF PLACING CONCRETE

- A. General
 1. The order of placing concrete in the WORK shall be acceptable to the ENGINEER.
 2. In order to minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints at the indicated locations.
- B. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 5 Days for hydraulic structures and 2 Days for all other structures before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the 2 adjacent wall panels have cured at least 10 Days for hydraulic structures and 4 Days for all other structures.

C. Concrete Surfaces

1. The surface of the concrete shall be level whenever a run of concrete is stopped.
2. For a level, straight joint on the exposed surface of walls, a wood strip at least 3/4- inch thick shall be tacked to the forms on these surfaces.
3. The concrete shall be carried approximately 1/2 inch above the underside of the strip.
4. The strip shall be removed one hour after the concrete is placed, and any irregularities in the edge formed by the strip shall be leveled with a trowel and laitance shall be removed.

3.6 TAMPING AND VIBRATING

A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted throughout the entire depth of the layer which is being consolidated, into a dense and homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete.

B. Vibrators

1. Vibrators shall be Group 3 in accordance with ACI 309 – Consolidation of Concrete, high speed power vibrators (8000 to 12,000 rpm) of an immersion type in sufficient number and with at least one standby unit as required.
2. Group 2 vibrators may be used only at specific locations when accepted by the ENGINEER.

C. Waterstops

1. Care shall be exercised when placing concrete around waterstops.
2. The concrete shall be carefully worked by rodding and vibrating to make sure that air and rock pockets have been eliminated.
3. Where flat-strip type waterstops have been placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that air and rock pockets have been eliminated.
4. Concrete that is surrounding the waterstops shall be given additional vibration over and above that used for adjacent concrete placement to ensure complete embedment of the waterstops in the concrete.

D. Concrete in Walls

1. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against each surface.
2. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly.

3. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the required results within 15 minutes after concrete of the prescribed consistency has been placed in the forms.
4. The vibrating head shall not contact the surfaces of the forms.
5. Care shall be exercised not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.7 FINISHING CONCRETE SURFACES

A. General

1. Concrete surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface.
2. Allowable deviations from plumb or level and from the alignment, profiles, and dimensions are defined as tolerances and shall be as indicated.
3. These tolerances are to be distinguished from irregularities in finish as indicated.
4. Aluminum finishing tools shall not be used.

B. Formed Surfaces

1. No treatment shall be required after form removal except for curing, repair of defective concrete, and treatment of surface defects.
2. Surface holes larger than 3/4 inch in diameter or deeper than 1/2 inch are defined as surface defects in exposed walls.

C. Unformed Surfaces

1. General
 - a. After proper and adequate vibration and tamping, unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools.
 - b. Immediately after the concrete has been screeded it shall be treated with a liquid evaporation retardant, and the retardant shall be used again after each operation as necessary to prevent drying shrinkage cracks.
2. The classes of finish for unformed concrete surfaces are defined as follows:
 - a. Finish U1
 - 1) Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8 inch.
 - 2) No further special finish is required.
 - b. Finish U2

- 1) After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades.
 - 2) Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted.
 - 3) Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture.
 - 4) Surface irregularities shall not exceed 1/4 inch.
 - 5) Joints and edges shall be tooled where indicated or as determined by the ENGINEER.
- c. Finish U3
- 1) After the Finish U2 surface has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks.
 - 2) The finish shall be smooth and free of irregularities.
- d. Finish U4
- 1) Trowel the Finish U3 surface to remove local depressions or high points.
 - 2) In addition, the surface shall be given a light broom finish with brooming perpendicular to drainage unless otherwise indicated.
 - 3) The resulting surface shall be sufficiently rough to provide a nonskid finish.
- e. Unformed surfaces shall be finished according to the following schedule:

UNFORMED SURFACE FINISH SCHEDULE	
Area	Finish
grade slabs and foundations to be covered with concrete or fill material	U1
water bearing slabs with slopes 10 percent and less	U3
water bearing slabs with slopes greater than 10 percent	U4
slabs not water bearing	U4
top surface of walls	U3

3.8 CURING AND DAMPPROOFING

- A. General: Concrete shall be cured for not less than 7 Days after placement, in accordance with the methods indicated below for the different parts of the WORK.

Surface to be Cured or Dampproofed	Method
unstripped forms	1
construction joints between footings and walls, and between floor slab and columns	2
encasement and ductbank concrete and thrust blocks	3
concrete surfaces not specifically indicated in this Paragraph	4
floor slabs on grade in hydraulic structures	5
slabs not on grade	6
wall sections with forms removed	6

B. Method 1

1. Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removal.
2. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed.
3. If forms are removed within 7 Days of placing the concrete, curing shall be continued in accordance with Method 6, below.

C. Method 2

1. The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed.
2. No curing compound shall be applied to surfaces cured under Method 2.

D. Method 3

1. The surface shall be covered with moist earth not less than 4 hours nor more than 24 hours after the concrete is placed.
2. Earthwork operations that may damage the concrete shall not begin until at least 7 Days after placement of the concrete.

E. Method 4

1. The surface shall be sprayed with a liquid curing compound.
2. The compound shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film that will seal thoroughly.
3. Seal Protection

- a. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the 7-Day curing period.
 - b. If the seal is damaged or broken before expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.
4. Wherever curing compound has been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, such compound shall be entirely removed by wet sandblasting just prior to the placing of new concrete.
 5. Application Schedule
 - a. The curing compound shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces and within 2 hours after removal of forms.
 - b. Repairs to formed surfaces shall be made within the 2 hour period; provided, however, that any such repairs which cannot be made within the said 2 hour period shall be delayed until after the curing compound has been applied.
 - c. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet-sandblasted to remove the curing compound.
 6. At locations where concrete is placed adjacent to a panel which has been coated with curing compound, the panel shall have curing compound reapplied to an area within 6 feet of the joint and to any other location where the curing membrane has been disturbed.
 7. Prior to final acceptance of the WORK, visible traces of curing compound shall be removed in such a manner that does not damage the surface finish.

F. Method 5

1. Until the concrete surface is covered with curing compound, the entire surface shall be kept damp by applying water using nozzles that atomize the flow such that the surface is not marred or washed.
2. The concrete shall be given a coat of curing compound in accordance with Method 4, above.
3. Not less than one hour nor more than 4 hours after the curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle, and concrete-curing blankets shall be placed on the slabs.
4. Curing Blankets
 - a. The curing blankets shall be laid with the edges butted together and with the joints between strips sealed with 2-inch wide strips of sealing tape or with edges lapped not less than 3 inches, and fastened together with a waterproof cement to form a continuous watertight joint.

- b. The curing blankets shall be left in place during the 7-Day curing period and shall not be removed until after concrete for adjacent WORK has been placed.
- c. If the curing blankets become torn or otherwise ineffective, the CONTRACTOR shall replace damaged sections.
- d. During the first 3 Days of the curing period, no traffic of any nature and no depositing, temporary or otherwise, of any materials will be permitted on the curing blankets.
- e. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be permitted only on top of plywood sheets 5/8-inch minimum thickness, laid over the curing blanket.
- f. The CONTRACTOR shall add water under the curing blanket as often as necessary to maintain damp concrete surfaces.

G. Method 6

- 1. Method 6 shall apply to both walls and slabs.
- 2. The concrete shall be kept continuously wet by the application of water for a minimum period of at least 7 Days, beginning immediately after the concrete has reached final set or the forms have been removed.
- 3. Until the concrete surface is covered with the curing mats, the entire surface shall be kept damp by applying water using nozzles that atomize the flow such that the surface is not marred or washed.
- 4. Curing Mats
 - a. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period.
 - b. The curing mats shall be weighted or otherwise held substantially in contact with the concrete surface to prevent dislodging by wind or other causes.
 - c. Edges shall be continuously held in place.
- 5. The curing mats and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours.
- 6. Immediately after the application of water has terminated at the end of the curing period, the curing mats shall be removed, the entire concrete surface shall be wetted, and curing compound shall be immediately applied to the entire surface in accordance with Method 4, above.
- 7. The CONTRACTOR shall dispose of excess water from the curing operation in order to avoid damage to the WORK.

H. Dampproofing

- 1. The exterior surfaces of roof slabs to be buried and walls to be backfilled shall be dampproofed as follows.

2. Asphalt Emulsion

- a. Immediately after the completion of curing, the surface shall be sprayed with a dampproofing agent consisting of an asphalt emulsion.
- b. Application of the agent shall be in 2 coats.
- c. The first coat shall be diluted to 1/2 strength by the addition of water, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution.
- d. The second coat shall consist of an application of the undiluted material, and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon.

3. Whitewash

- a. As soon as the material has taken an initial set, the entire area thus coated shall be coated with whitewash.
- b. Any formula for mixing the whitewash may be used if it produces a uniformly-coated white surface and remains until placing of the backfill.
- c. If the whitewash fails to remain on the surface until the backfill is placed, the CONTRACTOR shall apply additional whitewash.

3.9 PROTECTION

- A. The CONTRACTOR shall protect the concrete against damage until final acceptance.
- B. Weather Protection
 1. Fresh concrete shall be protected from damage due to rain, hail, sleet or snow.
 2. The CONTRACTOR shall provide such protection while the concrete is still plastic and whenever precipitation is imminent or occurring.

3.10 CURING DURING COLD WEATHER

- A. Water curing of concrete may be reduced to 6 Days during periods when the mean daily temperature in the vicinity of the Site is less than 40 degrees F, provided that during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing has been temporarily discontinued.
- B. Compound-Cured Concrete
 1. Concrete that is to be cured by an application of curing compound shall require no additional protection from freezing if the protection at 50 degrees F for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces.
 2. Otherwise, the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50 degrees F.

- C. Concrete cured by water shall be protected against freezing temperatures for 72 hours immediately following the 72 hours of protection at 50 degrees F.
- D. Discontinuance of Protection
 - 1. Discontinuance of protection against freezing temperatures shall be such that the drop in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F in 24 hours.
 - 2. In the spring, when the mean daily temperature rises above 40 degrees F for more than 3 successive Days, the required 72-hour protection at a temperature not lower than 50 degrees F may be discontinued for as long as the mean daily temperature remains above 40 degrees F, provided that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.
- E. Artificial Heat
 - 1. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying.
 - 2. The use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound, provided that the use of curing compound for such surfaces is otherwise permitted.

3.11 TREATMENT OF SURFACE DEFECTS

- A. General
 - 1. Surface defects are defined in Finishing Concrete Surfaces, above.
 - 2. As soon as forms are removed, the exposed concrete surfaces shall be carefully examined and any irregularities shall be immediately rubbed or ground in order to secure a smooth, uniform, and continuous surface satisfactory to the Engineer.
 - 3. Plastering or coating of surfaces to be smoothed will not be permitted.
 - 4. No repairs shall be made until after inspection by the ENGINEER.
 - 5. In no case will extensive patching of honeycombed concrete be permitted.
 - 6. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall be repaired as indicated below.
 - 7. Concrete containing extensive voids, holes, honeycombing, or similar depression defects shall be completely removed and replaced.
 - 8. Repairs of surface defects shall be performed promptly.
- B. Preparation
 - 1. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 1/2-inch over the entire area.

2. Feathered edges will not be permitted.
3. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be prepared for bonding by the removal of laitance and soft material, plus not less than 1/32-inch depth of the surface film from hard portions by means of an efficient sandblast.
4. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar such that while the repair material is being applied the surfaces underneath will remain moist but not so wet as to overcome the suction upon which a good bond depends.

C. Materials

1. The material used for repair shall consist of a mixture of one sack of cement to 3 cubic feet of sand.
2. For exposed walls, the cement shall contain such a proportion of Atlas White Portland cement as is required to make the color of the patch match the color of the surrounding concrete.

D. Holes

1. Holes left by tie-rod cones shall be reamed with suitably toothed reamers in order to leave the surfaces of the holes clean and rough.
2. Holes then shall be repaired in an approved manner with dry-packed cement grout.
3. Holes left by form-tying devices having a rectangular cross section and other imperfections having a depth greater than their least surface dimension shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.

E. Repairs

1. Repairs shall be built up and shaped in such a manner that the completed WORK will conform to the indicated requirements, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures.
2. The surfaces of repaired concrete shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

F. Cracks: Prior to putting any structure in service, cracks shall be repaired in accordance with the requirements of Section 03 01 30 – CONCRETE REPAIR AND REHABILITATION.

3.12 CONCRETE REPAIR AND REHABILITATION

- A. All defects and repairs not covered under Treatment of Surface Defects shall be repaired per Section 03 01 30 - CONCRETE REPAIR AND REHABILITATION.

3.13 CARE AND REPAIR OF CONCRETE

- A. The CONTRACTOR shall protect concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until Final Acceptance.

- B. Particular care shall be exercised in order to prevent the drying shrinkage damage of concrete and to avoid roughening or otherwise damaging the concrete surface.
- C. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed WORK, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be repaired or removed and replaced with acceptable materials to the satisfaction of the ENGINEER.

3.14 CONCRETE WASHOUT

- A. No concrete washout shall occur on U.S. Forest Service lands.

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SECTION 03 32 00 - JOINTS IN CONCRETE

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall provide joints in concrete, complete and in place, in accordance with the Contract Documents.
- B. Joints in concrete structures shall be the types defined below and will be permitted only where indicated, unless specifically accepted by the ENGINEER.

1.2 TYPES OF JOINTS

A. Construction Joints

- 1. When fresh concrete is placed against a hardened concrete surface, the joint between the pours shall be defined as a construction joint.
- 2. Unless otherwise indicated, joints in water-bearing members shall be provided with a waterstop and/or sealant groove of the shape indicated.

B. Contraction Joints

- 1. Contraction joints are similar to construction joints except that the fresh concrete shall not bond to the hardened surface of the earlier pour.
- 2. The slab reinforcement shall be stopped 4-1/2 inches from the joint; which is provided with a sleeve-type dowel, in order to allow shrinkage of the concrete of the later pour.
- 3. Waterstop and/or sealant groove shall be provided where indicated.

C. Expansion Joints

- 1. In order to allow the concrete to expand freely, a space shall be provided between the 2 pours, and the joint shall be formed as indicated.
- 2. The space shall be obtained by placing a filler joint material against the earlier pour to act as a form for the later pour.
- 3. Unless otherwise indicated, expansion joints in water bearing members shall be provided with a center-bulb type waterstop.
- 4. Provide premolded expansion joint material with the edge at the indicated distance below or back from the finished concrete surface.
- 5. Provide a slightly tapered, dressed and oiled wooden strip secured to or placed at the edge of the expansion joint during concrete placement, and remove the strip later to form a space for the sealing material.
- 6. The space so formed shall be filled with a joint sealant material as indicated below. In order to keep the 2 wall or slab elements in line, the joint shall also be provided with a sleeve-type dowel as indicated.

D. Control Joints

1. The function of the control joint is to provide a weaker plane in the concrete where shrinkage cracks would likely occur.
2. Formed Groove
 - a. A groove, of the shape and dimensions indicated, shall be formed or saw-cut in the concrete and the groove shall then be filled with a joint sealant material.
 - b. The formed groove shall be placed in the first of the two sections cast at the control joint, in order to assure that the sealant bonds to the second section across the joint and not to the cement paste from the first pour.

1.3 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with the requirements of Section 01 33 00 – CONTRACTOR SUBMITTALS.
- B. Shop Drawings
 1. Furnish placement drawings showing the location and types of joints for each structure.
 2. Test Reports
 - a. Furnish certified test reports from the sealant manufacturer on the actual batch of material supplied, demonstrating compliance with the indicated requirements.
 - b. Furnish the test reports before using the sealant on the Project.
 3. Welding Certification
 - a. Furnish copies of the waterstop welding certification by manufacturer or authorized agent of the manufacturer.
 - b. Every person who is to be involved with waterstop installation shall be required to have individual certification on file with the ENGINEER, stating that the named individual is certified and trained to install waterstop in accordance with the manufacturer's recommendations and specifications.
 4. Furnish manufacturer's information demonstrating compliance of the following with the indicated requirements:
 - a. bearing pad
 - b. neoprene sponge
 - c. preformed joint filler
 - d. backing rod
 - e. waterstop

- f. slip dowels
- g. PVC tubing

C. Samples

1. Prior to production of the material required under this Section, submit qualification samples of waterstops which accurately represent the material being provided.
2. Such samples shall be extruded or molded sections of each size or shape to be installed.
3. The balance of the material to be used shall not be produced until after the ENGINEER has reviewed the qualification samples.

D. Certificates

1. Furnish written certification from the manufacturer, as an integral part of the shipping form, that the material shipped to the Site meets or exceeds the indicated physical property requirements.
2. Supplier certificates will not be accepted.

1.4 QUALITY ASSURANCE

A. Waterstop Inspection

1. Waterstop field joints shall be subject to inspection, and no such WORK shall be scheduled or started without having made prior arrangements with the ENGINEER for the required inspections.
2. Provide not less than 24 hours' notice for the scheduling of such inspections.
3. Field joints in waterstops shall be subject to inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects that would reduce the potential resistance of the material to water pressure at any point.
4. Defective field joints shall be replaced with material that passes inspection, and faulty material shall be removed from the Site and destroyed.

B. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:

1. offsets at joints greater than 1/16 inch or 15 percent of material thickness at any point, whichever is less
2. exterior cracking at the joint due to incomplete bond, which is deeper than 1/16 inch or 15 percent of material thickness at any point, whichever is less
3. any combination of offset or exterior cracking that will result in a net reduction in the cross-section of the waterstop in excess of 1/16 inch or 15 percent of material thickness at any point, whichever is less
4. misalignment of the joint which results in misalignment of the waterstop in excess of 1/2 inch in 10 feet
5. porosity in the welded joint as evidenced by visual inspection

6. bubbles or inadequate bonding which can be detected with a penknife test. (If, while prodding the entire joint with the point of a penknife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)
7. visible signs of separation when the cooled splice is bent by hand at any sharp angle
8. evidence of burned material

C. Waterstop Samples

1. Prior to use of the waterstop material in the field, a sample of a prefabricated (shop made fitting) mitered cross and a tee constructed of each size or shape of material to be used shall be submitted.
2. Samples shall be prefabricated (shop made fitting) so that the material and workmanship represent the fittings to be provided.
3. In addition, field samples of prefabricated fittings (crosses, tees, and the like) will be selected at random by the ENGINEER for testing by a laboratory at the OWNER's expense.
4. When tested, the tensile strength across the joints shall be at least 1120 psi for PVC waterstops.

D. Construction Joint Sealant

1. The CONTRACTOR shall prepare adhesion and cohesion test specimens at intervals of 5 Days while sealants are being installed.
2. The sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:
 - a. Sealant specimen shall be prepared between 2 concrete blocks (1-inch by 2-inch by 3-inch).
 - b. Spacing between the blocks shall be one inch.
 - c. Coated spacers (2-inch by 1-1/2-inch by 1/2-inch) shall be used to set and hold sealant cross-sections of 1/2-inch by 2-inch with a width of one inch.
 - d. The sealant shall be cast and cured in accordance with the manufacturer's recommendations, except that the curing period shall be not less than 24 hours.
 - e. Following the curing period, the gap between the blocks shall be widened to 1- 1/2 inches, and spacers shall be used to maintain this gap for 24 hours prior to inspection for failure.

1.5 SPECIAL CORRECTION OF DEFECTS REQUIREMENT

- A. The CONTRACTOR shall furnish a 5-year written warranty of the entire sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that the CONTRACTOR agrees to repair or replace, to the satisfaction of the OWNER, any defective areas which become evident within the 5-year period.

PART 2 -- PRODUCTS

2.1 WATERSTOPS

A. PVC Waterstops

1. Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the indicated requirements of this Section.
2. No reclaimed or scrap material shall be used.
3. The CONTRACTOR shall obtain from the waterstop manufacturer and shall furnish to the ENGINEER for review, current test reports and a written certification of the manufacturer that the material to be shipped to the Site meets the physical requirements as outlined in the U.S. Army Corps of Engineers Specification CRD-C572-PVC Waterstops, and those indicated.
4. Flatstrip and Center-Bulb Waterstops
 - a. Flatstrip and center-bulb waterstops shall be manufactured such that at no place shall the thickness of waterstops, including the center bulb type, be less than 3/8 inch.
 - b. The waterstop shall be provided with hog rings installed at 12 inches on centers along the waterstop.
 - c. Shapes shall be as indicated, or as acceptable to the ENGINEER.
5. Retrofit Waterstops
 - a. Retrofit waterstops and batten bars shall be as indicated or as acceptable to the ENGINEER.
 - b. The waterstop shall be supplied as a complete system including waterstop, SS batten bar, SS anchor bolts, and epoxy gel.
6. When tested in accordance with the indicated test standards, the waterstop material shall meet or exceed the following requirements:

Physical Property, Sheet Material	Value	ASTM Std.
Tensile Strength-min, psi	2000	D 638, Type IV
Ultimate Elongation-min, percent	350	D 638, Type IV
Low Temp Brittleness, max degrees F	-35	D 746
Stiffness in Flexure, min, psi	600	D 747
Accelerated Extraction (CRD-C572)		
Tensile Strength-min, psi	1500	D 638, Type IV
Ultimate Elongation, min, percent	300	D 638, Type IV

Effect of Alkalies (CRD-C572)		
Change in Weight, percent	plus 0.25/minus 0.10	-----
Change in Durometer, Shore A	plus and minus 5	D 2240
Finish Waterstop		
Tensile Strength-min, psi	1400	D 638, Type IV
Ultimate Elongation, min percent	280	D 638, Type IV

B. Preformed Hydrophilic Waterstop

1. Hydrophilic (bentonite-free) waterstops shall be Hydro-Flex Waterstop as manufactured by Henry Co., or Earthshield Type 20, as manufactured by JP Specialties, or equal.
2. The cross-sectional area of the waterstop shall not be less than 0.5 square inch.
3. Hydrophilic waterstop shall be the type that expands in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.
4. The waterstop shall be manufactured from butyl rubber with hydrophilic properties.
5. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.
6. The minimum expansion ratio of modified chloroprene shall be not less than 2-to-1 volumetric change in distilled water at 70 degrees F (21 degrees C).
7. The bonding agent for hydrophilic waterstop shall be the manufacturer's recommended adhesive for wet, rough concrete.

- C. When types of waterstops not listed above are indicated, they shall be subjected to the same requirements as those listed in this Section.

2.2 JOINT SEALANT FOR WATER-BEARING JOINTS

- A. The joint sealant shall be a polyurethane polymer designed for bonding to concrete which is continuously submerged in water.
- B. No material will be accepted which has an unsatisfactory history as to bond or durability when used in the joints of water-retaining structures.
- C. Joint sealant material shall meet the following requirements (73 degrees F and 5 percent R.H.):

Work Life, minutes	45 - 180
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Time to Reach 20 Shore A Hardness (at 77 degrees F, 200 gram quantity), max	24 hours
Ultimate Hardness (ASTM D 2240, Shore A)	20 - 45
Tensile Strength (ASTM D 412), min	175 psi
Ultimate Elongation (ASTM D 412), minimum	400 percent
Tear Resistance (Die C, ASTM D 624), pounds per inch of thickness, min	75
Color	Light Gray

D. Polyurethane sealants for waterstop joints in concrete shall conform to the following requirements:

1. Sealant shall be 2-part polyurethane with the physical properties of the cured sealant conforming to or exceeding the requirements of ASTM C 920 – Elastomeric Joint Sealant, or Federal Specification TT-S-0227 E(3) - Sealing Compound, Elastomeric Type, Multicomponent, for Caulking, Sealing, and Glazing Buildings and Other Structures, for 2-part material, as applicable.
2. For vertical joints and overhead horizontal joints, only "non-sag" compounds shall be used, conforming to the requirements of ASTM C 920, Class 25, Grade NS, or Federal Specification TT-S-0227 E(3), Type II, Class A.
3. For plane horizontal joints, use the self-leveling compounds meeting the requirements of ASTM C 920 Class 25, Grade P, or Federal Specification TT-S-0227 E(3), Type I.
4. For joints subject to either pedestrian or vehicular traffic, a compound providing non-tracking characteristics and having a Shore A hardness range of 35 to 45 shall be used.
5. Primer materials, if recommended by the sealant manufacturer, shall conform to the printed recommendations of the manufacturer.

E. Sealant Manufacturers

1. Sealants shall be PSI-270 as manufactured by Polymeric Systems Inc., Sikaflex 2C, as manufactured by Sika Corporation, Pelseal (with Viton) 2112/2012, or equal.

2.3 JOINT MATERIALS

A. Bearing Pad

1. The bearing pad shall be neoprene conforming to ASTM D 2000 - Standard Classification System for Rubber Products in Automotive Applications, BC 420, 40 durometer hardness, unless otherwise indicated.

B. Neoprene Sponge

The sponge shall be neoprene, closed-cell, expanded, conforming to ASTM D 1056- Flexible Cellular Materials - Sponge or Expanded Rubber, Type 2C5-E1.

C. Joint Filler

1. Joint filler for expansion joints in waterholding structures shall be neoprene conforming to ASTM D 1056, Type 2C5-E1.
2. Joint filler material in other locations shall be of the preformed non-extruding type, constructed of cellular neoprene sponge rubber or polyurethane of firm texture.
3. Bituminous fiber type will not be accepted.
4. Non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction, for Type I, except as otherwise indicated.

2.4 BACKING ROD

- A. The backing rod shall be an extruded closed-cell, polyethylene foam rod.
- B. The rod material shall be compatible with the joint sealant material, and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi.
- C. The rod shall be 1/8 inch larger in diameter than the joint width except that a one-inch diameter rod shall be used for a 3/4-inch wide joint.

2.5 SLIP DOWELS

- A. Slip dowels in joints shall be smooth epoxy-coated bars conforming to ASTM A 775 - Epoxy Coated Reinforcing Steel Bars.

2.6 PVC TUBING

- A. PVC tubing in joints shall be SDR 13.5, conforming to ASTM D 2241 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

PART 3 -- EXECUTION

3.1 GENERAL

- A. Waterstops shall be embedded in the concrete across joints as indicated.
- B. Waterstops shall be fully continuous for the extent of the joint.
- C. Splices necessary to provide such continuity shall conform to the printed instructions of the waterstop manufacturer.
- D. The CONTRACTOR shall take suitable precautions and provide means to support and protect the waterstops during the progress of the WORK, and shall repair or replace any waterstops damaged during progress of the WORK at no additional cost to the OWNER.

- E. Waterstops shall be stored so as to permit free circulation of air around the waterstop material.
- F. When any waterstop is installed in the concrete on one side of a joint while the other portion of the waterstop remains exposed to the atmosphere for more than 2 Days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure time until the exposed portion of waterstop is embedded in concrete.

3.2 SPLICES IN PVC WATERSTOPS

- A. Splices in PVC waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations.
- B. It is essential that:
 - 1. The material shall not be damaged by heat sealing.
 - 2. The splices shall have a tensile strength of not less than 80 percent of the unspliced material.
 - 3. The continuity of the waterstop ribs and of its tubular center axis shall be maintained.
 - 4. No edge welding will be accepted.
- C. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.
- D. Other Joints
 - 1. Joints with waterstops involving more than 2 ends to be jointed together, and joints that involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections, shall be prefabricated prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint.
 - 2. Upon inspection and approval, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt-welded to the straight run portions of waterstop in place in the forms.
- E. Where a centerbulb waterstop intersects and is jointed with a non-centerbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material if needed.

3.3 JOINT CONSTRUCTION

- A. Setting Waterstops
 - 1. In order to eliminate faulty installation that may result in joint leakage, particular care shall be taken as to the correct positioning of the waterstops during installation.
 - 2. Adequate provisions shall be made to support and anchor the waterstops during the progress of the WORK and to ensure proper embedment in the concrete.
 - 3. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints.

4. The center axis of the waterstops shall be coincident with the joint openings.
5. Thoroughly work the concrete in the vicinity of joints for maximum density and imperviousness.

B. Waterstop Placement

1. In placing waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed.
2. Waterstops shall be held in place with light wire ties on 12-inch centers, which shall be passed through hog rings at the edge of the waterstop and tied to the curtain of reinforcing steel.
3. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked.
4. In placing concrete around horizontal waterstops with their flat face in a horizontal plane, the concrete shall be worked under the waterstops by hand in order to avoid the formation of air and rock pockets.

C. In placing centerbulb waterstops in expansion joints, the centerbulb shall be centered on the joint filler material.

D. Waterstop in vertical wall joints shall terminate 6 inches from the top of the wall, where such waterstop does not connect with any other waterstop and is not to be connected to a future concrete placement.

E. Joint Location

1. Construction joints and other types of joints shall be provided where indicated.
2. If not indicated, construction joints shall be provided at a 40-foot maximum spacing.
3. The location of joints, regardless of type, shall be submitted for acceptance by the ENGINEER.

F. Joint Preparation

1. Special care shall be used in preparing concrete surfaces at joints where bonding between 2 sections of concrete is required.
2. Unless otherwise indicated, such bonding shall be required at every horizontal joint in walls.
3. Surfaces shall be prepared in accordance with Section 03 31 00 – CAST-IN-PLACE CONCRETE.

G. Retrofit Joint Preparation

1. Existing surfaces to receive a retrofit waterstop shall be clean and free from any loose or foreign material.
2. The surface shall be given a light sandblast or hydroblast finish to 1/8-inch amplitude prior to the application of epoxy and waterstop.

H. Construction Joint Sealant

1. Construction joints in water-bearing floor slabs and elsewhere as indicated shall be provided with tapered grooves which shall be filled with a construction joint sealant.
2. The material used to form the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant.
3. After removing the forms from the grooves, laitance and fins shall be removed, and the grooves shall be sand blasted.
4. The grooves shall be allowed to thoroughly dry, after which they shall be blown out and immediately thereafter they shall be primed and filled with the construction joint sealant.
5. The primer shall be furnished by the sealant manufacturer, and no sealant shall be used without a primer.
6. Care shall be used to completely fill the sealant grooves.
7. Areas designated to receive a sealant fillet shall be thoroughly cleaned as outlined for the tapered grooves prior to application of the sealant.

I. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application.

J. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the sealant.

K. The sealant shall achieve final cure at least 7 Days before the structure is filled with water.

L. The sealant shall be installed by a competent waterproofing specialty contractor with a successful record of performance in similar installations.

M. Mixing

1. Catalyst-cured, 2-part materials shall be thoroughly and uniformly mixed, and special care shall be taken to properly mix the sealer before its application.
2. Before any sealer is placed, the CONTRACTOR shall arrange to have workers performing the WORK carefully instructed on the proper method of mixing and application by a representative of the sealant manufacturer.

N. Failure to Cure

1. Any joint sealant that fails to fully and properly cure after the manufacturer's recommended curing time for the conditions of the WORK shall be completely removed, and the groove shall be thoroughly sandblasted to remove traces of the uncured or partially cured sealant and primer.
2. The groove shall be re-sealed with the indicated joint sealant.

3. Costs of such removal, joint treatment, re-sealing, and appurtenant WORK shall be the CONTRACTOR's responsibility as part of the WORK.

O. Hydrophilic Waterstop

1. Where a hydrophilic waterstop is indicated, it shall be installed in accordance with the manufacturer's instructions and recommendations except as may be modified in this Section.
2. When requested by the ENGINEER, the CONTRACTOR shall arrange for the manufacturer to furnish technical assistance in the field.
3. Hydrophilic waterstop shall only be used where complete confinement by concrete is provided.
4. Hydrophilic waterstop shall not be used in expansion or contraction joints nor in the first 6 inches of a non-intersecting joint.
5. Location
 - a. The hydrophilic waterstop shall be located as near as possible to the center of the joint, and it shall be continuous around the entire joint.
 - b. The minimum distance from the edge of the waterstop to the face of the member shall be 5 inches.
6. Placement
 - a. Where the thickness of the concrete member to be placed on the hydrophilic waterstop is less than 12 inches, the waterstop shall be placed in grooves formed or ground into the concrete.
 - b. The groove shall be at least 3/4 inch deep and 1-1/4 inches wide.
 - c. When placed in the groove, the minimum distance from the edge of the waterstop to the face of the member shall be 2-1/2 inches.
7. Where a hydrophilic waterstop is used in combination with PVC waterstop, the hydrophilic waterstop shall overlap the PVC waterstop for a minimum of 6 inches and shall be adhered to PVC waterstop by a single component water-swelling sealant as recommended by the manufacturer.
8. The hydrophilic waterstop shall not be installed where the air temperature falls below the manufacturer's recommended range.
9. Preparation
 - a. The concrete surface under the hydrophilic waterstop shall be smooth and uniform, and the concrete shall be ground smooth if needed.
 - b. Alternatively, the hydrophilic waterstop shall be bonded to the surface using an epoxy grout that completely fills voids and irregularities beneath the waterstop material.
 - c. Prior to installation, the concrete surface shall be wire brushed to remove any laitance or other materials that may interfere with the bonding of epoxy.
10. Securing

- a. The hydrophilic waterstop shall be secured in place with concrete nails and washers at 12-inch maximum spacing.
- b. The above requirement shall be in addition to the adhesive recommended by the manufacturer.

P. Retrofit Waterstop

1. Retrofit waterstops shall be set in a bed of epoxy over a sandblasted surface with stainless steel batten bars and 1/4-inch diameter stainless steel anchors at 6 inches on-center, staggered, and in accordance with the manufacturer's written recommendations.

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SECTION 03 60 00 - GROUTING

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall provide grout, complete and in place, in accordance with the Contract Documents
- B. The following types of grout are covered in this Section:
 - 1. Cement Grout
 - 2. Non-Shrink Grout - Class I (cement-based)
 - 3. Non-Shrink Grout - Class II (cement-based)
 - 4. Non-Shrink Epoxy Grout
 - 5. Epoxy Anchor Grout for Post Installed Adhesive Anchors
 - 6. Structural Repair Grout

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - CONTRACTOR SUBMITTALS.
 - 1. Certified testing lab reports for tests indicated herein.
 - 2. Test results and service report from the field tests and the demonstration and training session verifying the requirements indicated herein.
 - 3. Certifications that grouts used on the project contain no chlorides or other chemicals that cause corrosion.
 - 4. Manufacturer's literature containing instructions and recommendations on the mixing, handling, placement, curing, and appropriate uses for each type of grout used in the WORK, and location of use. The current ICC-ES or IAPMO-UES report shall be submitted for all epoxy anchor grouts for adhesive anchors.
 - 5. Manufacturer's certification that its non-shrink grout does not contain aluminum, zinc, or magnesium powders as a method of expansion.
 - 6. Submit manufacturer's written warranty as indicated herein.
 - 7. Name and telephone number of grout manufacturer's representative who will give on-Site service. The representative shall have at least one year of experience with the indicated grouts.

1.3 QUALITY ASSURANCE

A. Field Tests

1. Compression test specimens will be taken from the first placement of each type of grout, and at intervals thereafter selected by the ENGINEER. The specimens will be made by the ENGINEER or its representative.
2. Compression tests and fabrication of specimens for cement grout and cement based non-shrink grout will be performed in accordance with ASTM C 1107 – Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink), at intervals during construction selected by the ENGINEER. As a minimum, a set of 3 specimens will be made for testing at 7 Days, 28 Days, and each additional time period as appropriate.
3. Compression tests and fabrication of specimens for topping grout and concrete/grout fill will be performed in accordance with Section 03 31 00 - CAST-IN- PLACE CONCRETE, at intervals during construction selected by the ENGINEER.
4. Compression tests and fabrication of specimens for epoxy grouts will be performed in accordance with ASTM C 579 – Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes, Method B, at intervals during construction selected by the ENGINEER. A set of 3 specimens will be made for testing at 7 Days and each earlier time period as appropriate.
5. The cost of laboratory tests on grout will be paid by the OWNER except where test results show the grout to be defective. In such case, the CONTRACTOR shall pay for the tests, removal and replacement of Defective Work, and re-testing, all as part of the WORK.
6. The CONTRACTOR shall assist the ENGINEER in obtaining specimens for testing and shall furnish materials necessary for fabricating the test specimens.

B. Construction Tolerances: Construction tolerances shall be as indicated in Section 03 31 00 – CAST-IN-PLACE CONCRETE unless indicated otherwise.

C. Pre-Installation Demonstration and Training

1. Cement and Epoxy-Based Non-Shrink Grouts
 - a. The grout manufacturer shall give a demonstration and training session for the cement based non-shrink and epoxy grouts to be used on the project, before any installation of grout is allowed.
 - b. Training session shall use a minimum of 5 bags of cement-based non-shrink class I grout mixed to fluid consistency. Tests shall be conducted for flow cone and bleed tests. Six cubes for testing at 1, 3, and 28 Days shall be made. The remaining grout shall be placed, and curing may be initiated on actual project placements such as baseplates and tie holes to provide on-the-job training for the CONTRACTOR and ENGINEER. The CONTRACTOR employees who will be doing the grouting shall participate in this training and demonstration session. The training session shall include methods for curing the grout.

- c. The manufacturer shall mix enough cement-based non-shrink class II grout for a minimum of 15 tie holes and shall train the CONTRACTOR'S employees in how to perform the WORK and cure the grout. The CONTRACTOR shall have the employees assisting in the mixing and sealing of the tie holes.
- d. If the project includes patching, throughbolt holes, epoxy anchors, and/or blockouts, the manufacturer shall also train the CONTRACTOR'S employees in the mixing and curing of the epoxy grouts for each of these applications.
- e. The CONTRACTOR shall transport the test cubes to an independent test laboratory, obtain the test reports, and report these demonstration and training test cube strengths to the ENGINEER.

2. Epoxy Anchor Grout for Adhesive Anchors

- a. Special inspection for all adhesive anchor installations shall be provided:
 - 1) As recommended or required by the ICC-ES or IAPMO-UES report.
 - 2) As required by the enforceable building code.
 - 3) As otherwise indicated in the Contract Documents.
- b. The most stringent of the above requirements shall be used. The cost of special inspection of adhesive anchors shall be paid for by the OWNER.
- c. Before installing adhesive anchors in the WORK, adhesive anchor installers shall be trained and qualified at the Site by the manufacturer's representative. Training and qualification for each installer shall include at least:
 - 1) Hole drilling procedure, hole preparation and cleaning techniques, adhesive injection technique and dispenser training/maintenance, rebar dowel preparation and installation, and proof loading/torquing.
 - 2) Anchors installed in both the vertical and horizontal positions in a mock-up concrete panel of adequate size and thickness. Anchors shall be tested in tension. A minimum of 3 anchors shall be tested for each installation position.
 - 3) Anchors shall be tested at 2 times the published allowable tension load or 1-1/4 times the maximum design strength of the anchors in tension as indicated in the ICC-ES or IAPMO-UES report. The test load need not exceed 80 percent of the nominal yield strength of the anchor, based on steel strength, as determined by ACI 318 Appendix D.
 - 4) If any of the 3 test bolts in any installation position fail to reach the test loads, the installer shall be re-tested with the same procedure. Re-testing is required only for the failed installation position.
 - 5) An installer who has 3 consecutive successful bolt tests in the first or second trial is considered qualified for adhesive anchor installation for this project. The manufacturer's representative shall issue a certificate to the qualified installer, and a copy of the certificate shall be filed with the CONTRACTOR and be submitted to the ENGINEER.

- 6) The test anchor size shall be the largest size adhesive anchor used on the project. The anchor embedment length and edge distances shall be adequate to resist the test loads listed above.
- 7) Each installer shall be re-qualified every 6 months for the duration of the project by the same qualifying procedure.
- 8) The certification of each qualified installer shall be available for verification at the Special Inspector's request.
- 9) Defective anchors noted by the Special Inspector shall be replaced and re-installed by the CONTRACTOR without any additional compensation.

1.4 SPECIAL CORRECTION OF DEFECTS PROVISIONS

A. Manufacturer's Warranty

1. Furnish one year warranty for WORK provided under this Section.
2. Manufacturer's warranty shall not contain a disclaimer limiting responsibility to the purchase price of products or materials.

PART 2 -- PRODUCTS

2.1 APPLICATION

- A. Unless indicated otherwise, grouts shall be provided as listed below whether indicated on the Drawings or not.

Application	Type of Grout
Anchor bolts, anchor rods and reinforcing steel required to be set in grout.	Epoxy Anchor Grout
Filling blockout spaces for embedded items such as railing posts, gate guide frames, etc.	Non-Shrink - Class I (Class II where placement time exceeds 20 min.)
Under precast concrete elements	Non-Shrink - Class II
Surface repairs	Cement Grout
Repair of small (largest dimension less than 12 inches) holes and defects in concrete members which are not water bearing and not in contact with soil or other fill material	Non-Shrink - Class I or Non-Shrink - Class II or Structural Repair Grout

Repair of small (largest dimension less than 12 inches) holes and defects in concrete members which are water bearing or in contact with soil or other fill materials	Non-Shrink - Class II or Structural Repair Grout
Repair of large (largest dimension greater than 12 inches) holes and defects in concrete members.	Structural Repair Grout
Any application not listed above, where grout is indicated	Non-Shrink Class I, unless specifically indicated otherwise

2.2 CEMENT GROUT

- A. Cement grout shall be composed of one part cement, 3 parts sand, and the minimum amount of water necessary to obtain the desired consistency. Where needed to match the color of adjacent concrete, white portland cement shall be blended with regular cement as needed. The minimum compressive strength at 28 Days shall be 4000 psi.
- B. Cement grout materials shall be as indicated in Section 03 31 00 – CAST-IN-PLACE CONCRETE.

2.3 NON-SHRINK GROUTS (cement-based)

- A. General
 - 1. Cement-based non-shrink grout shall be a prepackaged, inorganic, fluid, non-gas liberating, non-metallic, cement type grout requiring only the addition of water. Cement from kilns burning metal-rich hazardous waste fuel shall not be used.
 - 2. Manufacturer's instructions shall be printed on each bag or other container in which the materials are packaged. The specific formulation for each class of non-shrink grout shall be as recommended by the manufacturer for the particular application.
 - 3. Grout shall not contain chlorides or additives that may contribute to corrosion.
 - 4. Grout shall be formulated to be used at any consistency from fluid to plastic.
 - 5. Cement-based non-shrink grout shall have the following minimum properties when tested at a fluid consistency, at 28 Days:
 - a. Minimum tensile splitting strength of 500 psi per ASTM C 496 - Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
 - b. Minimum flexural strength of 1000 psi per ASTM C 580 - Standard Test Method for Flexural Strength and Modulus of Elasticity of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.

- c. Minimum bond strength (concrete to grout) of 1900 psi per modified ASTM C 882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
- d. Grout shall be certified for use in freeze/thaw environments.

B. Non-Shrink Grout – Class I

1. Non-Shrink Grout – Class I shall have a minimum 28 Day compressive strength of 5000 psi when mixed at a fluid consistency.
2. Non-Shrink Grout – Class I shall meet the requirements of ASTM C 1107, Grade B or C, when mixed to fluid, flowable, and plastic consistencies.
3. Non-Shrink Grout – Class I shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C 827 – Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures. The grout when tested shall not bleed or segregate at maximum allowed water.
4. Non-Shrink Grout – Class I shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C 1090 – Standard Test Method for Measuring Changes in Height of Cylindrical Specimens from Hydraulic-Cement Grout.
5. Furnish certification that the non-shrink property of grout is not based on gas production or gypsum expansion.
6. Non-Shrink Grout – Class I shall be **Five Star Grout** by **Five Star Products**, **Sikagrout 212** by **Sika Corporation**, **Duragrout** by **L&M Construction Chemicals**; **High-Flow Grout** by **Euclid Chemical Company**, **CG 200 PC** by **Hilti**, or equal.

C. Non-Shrink Grout – Class II

1. Non-Shrink Grout – Class II shall be a high precision, fluid, extended working time grout. The minimum 28-Day compressive strength shall be 7500 psi, when mixed at a fluid consistency.
2. Non-Shrink Grout – Class II shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C 827.
3. Non-Shrink Grout – Class II shall have no shrinkage (0.0 percent) and a maximum of 0.3 percent expansion in the hardened state when tested in accordance with ASTM C 1090.
4. Non-Shrink Grout – Class II shall have an extended working time of 30 minutes minimum when mixed to a fluid consistency as defined in ASTM C 827 at temperature extremes of 45 to 90 degrees F in accordance with ASTM C 1107.
5. Non-Shrink Grout – Class II shall meet the requirements of ASTM C 1107, Grade B or C when tested using the amount of water needed to achieve fluid consistency per ASTM C 939.

6. The grout when tested shall not bleed or segregate at maximum allowed water content.
7. Provide certification that its non-shrink property is not based on gas production or gypsum expansion.
8. Non-Shrink Grout – Class II shall be Masterflow 928 by BASF, Five Star Fluid Grout 100 by **Five Star Products**, **Crystex** by **L&M Construction Chemicals**, or equal.

2.4 NON-SHRINK EPOXY GROUT

- A. Non-shrink epoxy grout shall be a flowable, non-shrink, 100 percent solids system. The epoxy grout system shall have 3 components: resin, hardener, and specially blended aggregate, each premeasured and prepackaged. The resin component shall not contain any non-reactive diluents. Resins containing butyl glycidyl ether (BGE) or other highly volatile and hazardous reactive diluents are not acceptable. Variation of component ratios is not permitted unless specifically recommended by the manufacturer. Manufacturer's instructions shall be printed on each container in which the materials are packaged.
- B. Epoxy grout shall have a maximum early age height change of 4.0 percent expansion, and shall have no shrinkage (0.0 percent) in accordance with ASTM C 827, (modified for epoxy grouts by using an indicator ball with a specific gravity between 0.9 and 1.1).
- C. Epoxy grout shall have a negligible (less than 0.0006 in/in) length change after hardening, and a coefficient of thermal expansion less than 0.00003 in/in F when tested according to ASTM C 531 – Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
- D. The epoxy grout shall develop a minimum compressive strength of 9000 psi in 24 hours and 13,000 psi in seven days when tested in accordance with ASTM C 579, method B.
- E. The mixed epoxy grout shall have a minimum working life of 90 to 120 minutes at 70 degrees F.
- F. The effective bearing area shall be a minimum of 95 percent EBA in accordance with ASTM C 1339 – Standard Test Method for Flowability and Bearing Area of Chemical-Resistant Polymer Machinery Grouts, for bearing area and flow.
- G. The chemical formulation of the epoxy grout shall be that recommended by the manufacturer for the particular application. Do not reduce aggregate loading or add solvents to increase flowability.
- H. Non-shrink epoxy grout shall have the following minimum properties when tested at 7 Days:
 1. Minimum bond strength to concrete of 3000 psi per ASTM C 882 modified.
 2. Minimum bond strength to steel of 1700 psi per ASTM C 882 modified.
 3. Minimum flexural strength of 2500 psi per ASTM C 580.

4. Minimum tensile strength of 2000 psi per ASTM C 307 -- Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.

I. Non-shrink epoxy grout shall be Five Star DP Epoxy Grout by Five Star Products, Inc., Masterflow 648 CP Plus by BASF, Sikadur 42 Grout-Pak by Sika Corporation, or equal.

2.5 EPOXY ANCHOR GROUT

A. Epoxy anchor grout for use in concrete shall be certified for use in resisting seismic loads in cracked concrete applications in accordance with ICC-ES AC 308.

B. Epoxy anchor grout shall conform to ASTM C 881 – Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete, Type IV, Class A, B and C, Grade 3 with the exception of gel time.

C. Heat deflection temperature per ASTM D 648 – Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position shall be a minimum 120 degrees F.

D. Manufacturer shall certify that the epoxy anchor grout will maintain 100 percent of its capacity up to a short term temperature of 110 degrees F and 50 percent of its capacity up to a short term temperature of 150 degrees F.

E. Grout shall come in a 2 chambered cartridge with a metering system that provides the proper ratio of hardener and resin. The grout shall also come with a static mixer nozzle to thoroughly mix the hardener and resin together.

F. Epoxy anchor grout shall be capable of being used in submerged applications once cured.

G. Compressive strength per ASTM D 695 – Standard Test Method for Compressive Properties of Rigid Plastics shall be 10,000 psi minimum.

H. Whenever possible, overhead anchors subject to vibration, anchors in fire-resistive construction or high fire risk areas, and anchors subject to working or operating temperatures above 100 degrees F shall be cast-in-place anchors. Whenever cast-in-place anchors cannot be used in these applications, use cement based non-shrink grout and oversized holes.

I. Embedment of adhesive anchors/rebar shall be deep enough to develop the anchor/rebar unless otherwise noted on the Contract Documents... Embedment shall not exceed 67 percent of the member depth.

J. Epoxy anchor grout shall be **Pure110+** by **Powers Fasteners**; **HIT-RE 500-SD** by **Hilti**, **SET-XP** by **Simpson Strong-Tie**, or equal.

2.6 CONCRETE/GROUT FILL

A. Where fill thickness is 3-inches or greater, structural concrete as indicated in Section 03 31 00 - CAST-IN-PLACE CONCRETE, may be used when accepted by the ENGINEER. Fiber reinforcing shall be as indicated below.

B. Coarse aggregate shall be graded as follows:

U.S. Standard Sieve Size	Percent By Weight Passing
1/2 in	100
3/8 in	90-100
No. 4	20-55
No. 8	5-30
No. 16	0-10
No. 30	0

C. Final mix design shall be as determined by trial mix design as indicated in Section 03 31 00 – CAST-IN-PLACE CONCRETE, except that drying shrinkage tests are not required.

D. Strength: Minimum compressive strength of topping grout and concrete/grout fill at 28 Days shall be 4500 psi.

2.7 STRUCTURAL REPAIR GROUT

A. Structural repair grout shall be an extended set, pre-packaged cement based mortar requiring only the addition of potable water. The material shall not contain any chlorides or lime other than the amounts contained within the hydraulic cement composition.

B. Structural repair grout shall have a minimum compressive strength per ASTM C 109 of 6,000 psi at 7 days.

C. Structural repair grout shall have a minimum bond strength per ASTM C 882 of 2,000 psi at 1 day.

D. For repairs larger than 2 cubic feet in volume, the structural repair grout may be extended by the addition of clean, damp, coarse aggregate per the manufacturer's written recommendations.

E. Structural repair grout shall be **Structural Concrete ES** by **Five Star Products**, or equal.

2.8 CURING MATERIALS

A. Curing materials shall be in accordance with Section 03 31 00 – CAST-IN-PLACE CONCRETE and as recommended by the manufacturer of prepackaged grouts.

2.9 CONSISTENCY

A. The consistency of grouts shall be that necessary to completely fill the space to be grouted for the particular application. Dry pack consistency is defined such that the grout is plastic and moldable but will not flow. Where "dry pack" is called for in the

Contract Documents, it shall mean a grout of that consistency; the type of grout to be used shall be as indicated herein for the particular application.

- B. The slump for topping grout and concrete/grout fill shall be adjusted to match placement and finishing conditions but shall not exceed 4-inches.

2.10 MEASUREMENT OF INGREDIENTS

- A. Measurements for cement grout shall be made accurately by volume using containers. Shovel measurements shall not be allowed.
- B. Prepackaged grouts shall have ingredients measured by means recommended by the manufacturer.

PART 3 -- EXECUTION

3.1 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Grout shall be stored in accordance with manufacturer's recommendations.

3.2 GENERAL

- A. CONTRACTOR shall arrange for the manufacturer of prepackaged grouts to provide on- Site technical assistance within 72 hours of request, as part of the WORK.
- B. Grout shall not be placed until base concrete or masonry has attained its design strength, unless authorized otherwise by the ENGINEER.
- C. When cementitious grouts are used on concrete surfaces, the concrete surface shall be saturated with water for 24 hours prior to placement. Upon completion of the saturation period, excess water shall be removed with clean, oil free compressed air prior to grouting. Concrete substrate shall not be wet prior to placement of epoxy grouts.
- D. Surface preparation, curing, and protection of cement grout shall be in accordance with Section 03 31 00 – CAST-IN-PLACE CONCRETE. The finish of the grout surface shall match that of the adjacent concrete unless otherwise indicated.
- E. Surfaces that will be in contact with grout shall be free of dirt, loose rust, oil, wax, grease, curing compounds, laitance, loose concrete, and other deleterious materials.
- F. Shade the WORK from sunlight for at least 24 hours before and 48 hours after grouting.
- G. Contact the grout manufacturer's representative for assistance on hot and cold weather grouting techniques and precautions if applicable.

3.3 GROUTING PROCEDURES

- A. General: Mixing, surface preparation, handling, placing, consolidation, curing, and other means of execution for prepackaged grouts shall be done according to the instructions and recommendations of the manufacturer.
- B. Structural, equipment, tank, and piping support bases shall be grouted, unless indicated otherwise.
 - 1. The original concrete shall be blocked out or finished off a sufficient distance below the plate to provide for a minimum one-inch thickness of grout or other thickness if indicated.
 - 2. After the base plate has been set in position at the proper elevation by steel wedges or double nuts on the anchor bolts, the space between the bottom of the plate and the original pour of concrete shall be filled with non-shrink-type grout through a headbox of appropriate size. The mixture shall be of a fluid consistency and poured continuously into the space between the plate and the base concrete. Forms for grout shall be tight against retaining surfaces, and joints shall be sealed as recommended by the grout manufacturer to be liquid-tight. Forms shall be coated as recommended by the grout manufacturer for easy form release. Where this method of placement is not practical or where required by the ENGINEER, alternate grouting methods shall be submitted by the CONTRACTOR for acceptance by the ENGINEER.
 - 3. Concrete equipment pads for equipment bases that will be epoxy-grouted shall be sized so that, when the equipment base is fully grouted, the epoxy grout is stopped not less than 4-inches from the edge of the pad.
- C. For execution of grout products for repair of large and small diameter holes, refer to Section 03 01 30 - CONCRETE REPAIR AND REHABILITATION.
- D. Drilled Anchors and Reinforcing Bars
 - 1. General
 - a. Drilled anchors and reinforcing bars shall be installed in strict accordance with the manufacturer's instructions and applicable ICC-ES or IAPMO-UES report requirements. Holes shall be drilled, brushed and cleaned in accordance with the manufacturer's instructions. Drilled anchors shall be installed in concrete having a minimum age of 21 days at the time of anchor installation. Anchors shall not be loaded until the grout has cured for the full cure time indicated by the manufacturer and reached its indicated strength in accordance with the manufacturer's instructions.
 - b. The CONTRACTOR shall identify the position of reinforcing steel and other embedded items prior to drilling holes. Care shall be exercised in drilling to avoid damaging existing reinforcing or embedded items. The location of drilled holes shall be adjusted to avoid drilling through or cutting any existing reinforcing bars or embedded items. Notify the ENGINEER if reinforcing steel or other embedded items are encountered during drilling. Take precautions as necessary to avoid damaging prestressing tendons, electrical and communications conduit, and piping.

2. The following requirements apply to adhesive anchors installed using cement based non-shrink grout and epoxy anchor grout:
 - a. Unless otherwise indicated, when adhesive anchors are used to resist tensile forces in structural applications, the minimum depth of embedment shall be greater than or equal to the development length (l_d) determined in accordance with ACI 350 for a cast in place reinforcing bar of the same diameter and grade, unless it can be shown by calculation that the anchor spacing and edge distance is sufficient to develop the tensile strength of the anchor in a lesser depth of embedment. Calculations shall be submitted in accordance with Section 01 33 00 – CONTRACTOR SUBMITTALS.
 - b. Core drilling of holes is not allowed.
 - c. Relocation of drilled holes and adjustments or modifications to anchored or fastened items shall be considered part of the WORK and shall be provided at no additional cost to the OWNER.
 - d. All abandoned drilled holes shall be filled with Epoxy Anchor Grout.
3. Epoxy Adhesive Anchors
 - a. Grout shall be proportioned and mixed per the manufacturer's instructions.
 - b. Holes shall be dry.
4. Cement Based Non-Shrink Grout used for Anchorage
 - a. In places of high temperature or fire hazard, anchor bolts and anchor rods shall be grouted in using cement based non-shrink grout, Class I.
 - b. When the anchor bolt or anchor rod diameter is one-inch or less, the hole diameter shall be a minimum of 2-inches. When the anchor bolt/rod diameter is greater than one-inch, the hole diameter shall be at least twice the anchor bolt/rod diameter.
 - c. Drilled holes shall be saturated with water for not less than 24 hours before installation of anchor/rod/rebar.
 - d. The non-shrink grout shall be placed in the holes in a non-sag (trowelable) consistency. The grout shall be placed in the holes before the anchor bolt/rod and then the anchor bolt/rod inserted and vibrated to ensure proper coverage.

3.4 CONSOLIDATION

- A. Grout shall be placed in such a manner, for the consistency necessary for each application, to assure that the space to be grouted is completely filled.

3.5 CURING

- A. Cement based grouts shall be cured per 03 31 00 – CAST-IN-PLACE CONCRETE and per the manufacturer's recommendations.

- END OF SECTION -

SECTION 31 10 00 - SITE PREPARATION

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. In its initial move onto the Site, the CONTRACTOR shall protect existing terrain, access roads, and vegetative areas in accordance with the Contract Documents. Permanent works shall be performed within the FERC Boundary and Special Use area for Logan Hydro No. 2. Works performed outside of the FERC Boundary shall be performed within the requirements of the Temporary Special Use Permit.

1.2 SITE INSPECTION

- A. Prior to moving onto the Site, the CONTRACTOR shall inspect the Site conditions and review maps of the Site and facilities delineating the OWNER's property and right-of-way lines.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 PRIMARY SITE ACCESS

- A. In accordance with the United States Forest Service Management Plans, the CONTRACTOR shall not develop any new roadways into the site, but may improve on existing access roads both downstream and upstream from the dam. The upstream access roadway is described as the south trail around impounded reservoir

Direct site access along the north side (Hwy 89) is only allowed if the CONTRACTOR obtains permission from Utah Department of Transportation. The existing access road through the Gus Lind Camping area may be improved to allow for access downstream from Logan 3rd Dam. Any improvements to the access road downstream from Logan 3rd Dam are considered permanent measures and do not need to be removed at the end of construction.

The walking trail along the south side of the impoundment above Logan 3rd Dam may be improved in accordance with the Contract Drawings. These improvements should only be considered temporary. All surface aggregate and/or geotextile shall be removed at the end of construction. The edges (sides) of the path should be revegetated in accordance with specification 31 35 28 – Erosion Control (Vegetative).

- B. **Utility Interference:** Where existing utilities interfere with the WORK, notify the utility owner and the ENGINEER before proceeding in accordance with the General Conditions.

3.2 CLEARING, GRUBBING, AND STRIPPING

- A. Construction areas shall be cleared of grass and weeds to at least a depth of 6-inches and cleared of structures, pavement, sidewalks, concrete or masonry debris, trees, logs, upturned stumps, loose boulders, and any other objectionable material of any kind which would interfere with the performance or completion of the WORK, create a hazard to safety, or impair the subsequent usefulness of the WORK, or obstruct its operation. Loose boulders within 10-feet of the top of cut lines shall be incorporated in landscaping or removed from the Site. Trees and other natural

vegetation outside the actual lines of construction shall be protected from damage during construction.

- B. Within the limits of clearing, the areas below the natural ground surface shall be grubbed to a depth necessary to remove stumps, roots, buried logs, and other objectionable material. Septic tanks, drain fields, and connection lines and any other underground structures, debris or waste shall be removed if found on the Site. Objectionable material from the clearing and grubbing process shall be removed from the Site and wasted in approved safe locations.
- C. The entire area to be affected by construction shall be stripped to a depth of 2-1/2 feet below the existing ground contours. The stripped materials shall be stockpiled and incorporated into landscaped areas or other non-structural embankments.
- D. Unless otherwise indicated, native trees larger than 3-inches in diameter at the base shall not be removed without the ENGINEER's approval. The removal of any trees, shrubs, fences, or other improvements outside of rights-of-way, if necessary for the CONTRACTOR's choice of means and methods, shall be arranged with the owner of the property, and shall be removed and replaced, as part of the WORK.

3.3 OVEREXCAVATION, REGRADING, AND BACKFILL UNDER FILL AREAS

- A. After the fill areas have been cleared, grubbed, and excavated, the areas to receive fill will require overexcavation, regrading, and backfill, consisting of the removal and/or stockpiling of undesirable soils. The ground surface shall be recontoured for keying the fill and removing severe or abrupt changes in the topography of the Site. The overexcavated volumes to a level 2-1/2 feet below the existing ground contours shall be backfilled.
- B. After removal of organic laden soil, the remaining soils that will require removal from the bedrock surface prior to the placement of embankment fill include:
 - 1. Topsoil: This soil mantles the siltstone/claystone which comprises much of the hillslope on the southern, approximately two-thirds of the plant site.
 - 2. Colluvium: This material is also present on the hillsides and covers the valley floor of the Site.
 - 3. Artificial Fill (Quarry Waste): Most of this material is present on the west side of the plant site near Rosalind Lane.
- C. Any undesirable topsoil and colluvium shall be removed to the level designated by the ENGINEER and stockpiled for subsequent use as the first material to be placed in the compacted fill.
- D. Any steep, very abrupt rock faces and irregularly shaped rock outcrops of bedrock shall be regraded as directed by the ENGINEER.

- END OF SECTION -

SECTION 31 23 19 - DEWATERING

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall dewater trench and structure excavations, in accordance with the Contract Documents. The CONTRACTOR shall secure all necessary permits to complete the requirements of this Section of the Specifications.
- B. During the construction of the facilities authorized by this license, the CONTRACTOR shall maintain, immediately below the point of diversion in the Logan River, the following continuous minimum flows or the natural flows, whichever are less, as measured immediately below the point of proposed diversion:

January through March	33 cfs
April	31 cfs
May through June	30 cfs
July	31 cfs
August through November	33 cfs
December	36 cfs

cfs = cubic feet per second

- C. The CONTRACTOR shall provide a dewatering plan and cofferdam design that is stamped by a registered engineer in the State of Utah. The CONTRACTOR shall design, construct, operate, and maintain cofferdams and dewatering systems, water quality systems and protective works of sufficient size and capacity to permit construction in the work areas and structure excavations to occur in the dry, in accordance with the Contract Documents. The CONTRACTOR's designs shall accommodate the possibility of highly porous materials or fractured that are expected in a natural river environment.

The CONTRACTOR may elect to estimate any geotechnical parameters which may be required for the design of a cofferdam, so long as those assumptions are substantiated through testing and/or other means acceptable to the ENGINEER once construction has commenced. It shall be the CONTRACTOR's responsibility to review previous records and perform any additional investigations or surveys necessary and to provide designs for dewatering systems which meet the requirements of these specifications. The CONTRACTOR is responsible for any costs associated with the collection and testing of soils, rocks or other related subsurface materials within the reservoir.

- D. Refer to Section 01 14 00 Construction Constraints for additional information.
- E. The CONTRACTOR shall coordinate with the ENGINEER and resource agencies to facilitate the OWNER'S and resource agencies' program to conduct fish rescue from any pool to be isolated or dewatered. All fish salvage activities shall be included in the CPM schedule. Provide 2 weeks' notice prior to the installation of cofferdams or dewatering facilities to arrange for fish removal operations. CONTRACTOR will be

requested to assist in fish removal through providing lifting with excavators and control of water during salvage and dewatering operations.”

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 – CONTRACTOR SUBMITTALS.
- B. Prior to commencement of excavation, the CONTRACTOR shall submit to the ENGINEER, FERC, State of Utah Division of Water Rights – Dam Safety and the State of Utah Division of Wildlife Resources, a detailed plan and operation schedule for dewatering of excavations and lowering of the upstream reservoir at Logan 3rd Dam (dam). The detailed plan shall include the design basis, drawings, and specifications as well as mitigation measures to prevent settlement of nearby structures (including Highway 89), maintaining minimum instream flows past the dam, reservoir dewatering rates (drawdown rate), fish capture and release program, and a contingency plan for restoring nearby structures if settlement is observed as a result of the CONTRACTOR’s dewatering operations. The CONTRACTOR shall coordinate work activities with the Utah Division of Wildlife Resources (DWR) to minimize stress and mortality rate on fish living in the reservoir. DWR has agreed to work with the CONTRACTOR by providing necessary field personnel to monitor fish habitat and perform electric shocking and relocation of fish as necessary to mitigate mortality and minimize biological stress. It is the CONTRACTORS responsibility to report construction activities (two-weeks prior) to DWR and coordinate efforts for DWR to perform their work. The CONTRACTOR's dewatering plan is subject to review by the ENGINEER, State of Utah Division of Water Rights – Dam Safety, and Utah Division of Wildlife Resources.
- i. The dewatering plan as a minimum shall also include:
- a. Descriptions of all proposed cofferdams, groundwater and surface water control facilities including, but not limited to, equipment, methods, standby equipment and power supply, means of measuring discharge due to dewatering, pollution control facilities, discharge locations to be utilized.
 - b. Drawings showing locations, dimensions, and relationships of elements of each system.
 - c. Design calculations demonstrating adequacy of proposed dewatering systems and components including contingency equipment if inflow exceeds the CONTRACTOR’s estimates.
 - d. Back-up Dewatering provisions for the event of power or equipment failure.
 - e. Cofferdam structural design and calculations by a Professional Engineer registered in the State of Idaho.
 - f. Detailed installation removal procedures.
 - g. Water quality protection measures to be employed for ground preparation work or work within Ordinary High Water that must be completed outside of dewatered areas.
 - h. Emergency Actions Procedures and safety features for work within dewatered areas. Sample placards of evacuations routes.
 - i. Contractor’s Water Operations Coordinator and contact information.
 - j. Narrative describing in detail the installation and removal sequence for the cofferdam and any temporary construction necessary for the installation or removal. The narrative shall include discussion of preparatory activities including demolition, access and staging for equipment, environmental

protections, details of floating stock or equipment deployed upstream of the dam and anticipated durations of each activity.

- ii. If the dewatering and/or cofferdam system is modified during installation or operation revise or amend and resubmit an updated Plan.

1.3 QUALITY CONTROL

- A. It shall be the sole responsibility of the CONTRACTOR to control the rate and effect of the dewatering in such a manner as to avoid all objectionable settlement and subsidence of structures and the adjacent roadway, and to not strand fish within water pockets in the reservoir during drawdown or pools downstream from the dam.
- B. All dewatering operations shall be adequate to assure the integrity of the finished project and livelihood of aquatic resources within the reservoir and shall be the responsibility of the CONTRACTOR.
- C. All structures or facilities that are located within the radius of influence of the CONTRACTOR's dewatering operation shall have reference points established and observed at frequent intervals to detect any settlement which may develop. The responsibility for conducting the dewatering operation in a manner which will protect adjacent structures and facilities rests solely with the CONTRACTOR. The CONTRACTOR shall survey, record and report the reference points on a daily basis, and submit the written log to the ENGINEER at the completion of construction. The ENGINEER shall be immediately notified should any sign of settlement is observed. The cost of repairing any damage to adjacent structures and restoration of facilities shall be the responsibility of the CONTRACTOR.
- D. Dewatering shall also consider potential soil movement (migration of materials) within the embankment foundation for the roadway. Drawdown of the reservoir shall be performed at a rate that is agreed to by DWR and does not cause potential for soil movement and erosion.
- E. Discharge from any dewatering operation shall be continuously monitored for turbidity in accordance with the State of Utah, Department of Environmental Quality - 401 Water Quality Certification attached as Appendix A to these specifications.

PART 2 -- PRODUCTS

2.1 EQUIPMENT

- A. Dewatering, where required, may include the use of well points, sump pumps, temporary pipelines for water disposal, rock or gravel placement, and other means. Standby pumping equipment shall be maintained on the Site. Pumping units shall be equipped with necessary screening to prevent the entrainment of fish or other related aquatic resources.

PART 3 -- EXECUTION

3.1 GENERAL REQUIREMENTS

- A. The CONTRACTOR shall provide all equipment necessary for dewatering. It shall have on hand, at all times, sufficient pumping equipment and machinery in good working condition and shall have available, at all times, competent workmen for the

operation of the pumping equipment. Adequate standby equipment shall be kept available at all times to insure efficient dewatering and maintenance of dewatering operation during power failure.

- B. The CONTRACTOR shall provide all necessary equipment and perform continuous monitoring for turbidity at dewatering discharge locations in accordance with State of Utah Department of Environmental Quality, 401 Certification.
- C. Groundwater must be maintained two-feet below the bottom of the excavation before excavation work is to begin.
- D. Dewatering for structures and pipelines shall commence when groundwater is first encountered, and shall be continuous until such times as water can be allowed to rise in accordance with the provisions of this Section or other requirements.
- E. At all times, site grading shall promote drainage. Surface runoff shall be diverted from excavations. Water entering the excavation from surface runoff shall be collected in shallow ditches around the perimeter of the excavation, drained to sumps, and be pumped or drained by gravity from the excavation to maintain a bottom free from standing water.
- F. Dewatering shall at all times be conducted in such a manner as to prevent the removal of fines and preserve the undisturbed bearing capacity of the subgrade soils at proposed bottom of excavation. Dewatering and associated drawdown of the reservoir shall be performed at a rate that is agreed upon with the ENGINEER, State of Utah Division of Wildlife Resources, State of Utah Division of Water Rights, and does not result in migration of soils (fines) within the embankment of the roadway or adjacent soils.

Contact: Clint Brunson
clintbrunson@utah.gov
Northern Region Fisheries Biologist
(385) 389-4624

- G. If foundation soils are disturbed or loosened by the upward seepage of water or an uncontrolled flow of water, the affected areas shall be excavated and replaced with ~~drain rock~~ Type D (Structural Backfill).
- H. The CONTRACTOR shall maintain the water level below the bottom of excavation in all work areas where groundwater occurs during excavation construction, backfilling, and up to acceptance.
- I. Flotation shall be prevented by the CONTRACTOR by maintaining a positive and continuous removal of water. The CONTRACTOR shall be fully responsible and liable for all damages which may result from failure to adequately keep excavations dewatered.
- J. The CONTRACTOR shall provide two week (minimum) notification to DWR prior to any lower the reservoir and shall provide DWR with the opportunity to shock and remove fish as necessary for safe handling and transport. The CONTRACTOR shall be aware of any potential actions resulting in mortality of fish or other aquatic resources and shall be in continuous communication with DWR for prevention of mortality.

- K. If well points or wells are used, they shall be adequately spaced to provide the necessary dewatering and shall be sandpacked and/or other means used to prevent pumping of fine sands or silts from the subsurface. A continual check by the CONTRACTOR shall be maintained to ensure that the subsurface soil is not being removed by the dewatering operation.
- L. The CONTRACTOR shall dispose of water from the WORK in a suitable manner without damage to adjacent property. CONTRACTOR shall be responsible for obtaining any permits that may be necessary to dispose of water. No water shall be drained into WORK built or under construction without prior consent of the ENGINEER. Water shall be filtered using an approved method to remove sand and fine-sized soil particles before disposal into any drainage system.
- M. The release of groundwater to its static level shall be performed in such a manner as to maintain the undisturbed state of the natural foundation soils, prevent disturbance of compacted backfill and prevent flotation or movement of structures, pipelines, and sewers.
- N. Dewatering of trenches and other excavations shall be considered as incidental to the construction of the WORK and all costs thereof shall be included in the various contract prices in the Bid Forms, unless a separate bid item has been established for dewatering.

- END OF SECTION -

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SECTION 31 30 00 - EARTHWORK

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall perform earthwork as indicated and required for construction of the WORK, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

A. CONTRACTOR's Detailed Plan

1. The CONTRACTOR, prior to beginning any trench or structure excavation 5 feet deep or deeper, shall submit to the OWNER an exaction plan and shall be in receipt of the OWNER's written acceptance of the CONTRACTOR's detailed plan showing the design of shoring, bracing, sloping of the sides of excavation, or other provisions for worker protection against the hazard of caving ground during the excavation of such trenches or structure excavation.
2. The CONTRACTOR, prior to beginning demolition and removal of concrete, shall submit to ENGINEER a detailed plan for design and installation of a tieback (soil-nail) system adjacent to Highway 89. The tieback system should be designed in accordance with loads provided on the Contract Drawings. The tieback system should be considered temporary and would be installed to maintain the soil beneath the existing roadway. Design and installation of the temporary tieback system shall be at the expense of the CONTRACTOR. The proposed tiebacks (or similar system) may be left in place by the CONTRACTOR following construction.
3. The CONTRACTOR's plan shall be prepared and signed and sealed by a Professional Engineer experienced in the field of geotechnical engineering and licensed in the State of Utah.

B. Samples

1. The CONTRACTOR shall submit samples of materials proposed for the WORK in conformance with the requirements of Section 01 33 00 – CONTRACTOR SUBMITTALS.
2. The CONTRACTOR shall submit the results of soil laboratory gradation testing of the in-situ materials on which protective filter materials will be placed directly against as shown for underdrain systems in DRAWINGS. Protective filter materials shall not be placed for underdrain systems until written acceptance of adequate filter compatibility is provided by the ENGINEER.
3. Sample sizes shall be as determined by the testing laboratory.

PART 2 -- PRODUCTS

2.1 FILL AND BACKFILL MATERIAL REQUIREMENTS

A. General

1. Fill, backfill, and embankment materials shall be selected or shall be processed and clean fine earth, rock, gravel, or sand, free from grass, roots, brush, other vegetation and organic matter.
2. Fill and backfill materials that are to be placed within 6 inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension larger than 3 inches.

B. Suitable Materials

1. Materials not defined below as unsuitable will be considered as suitable materials and may be used in fills, backfilling, and embankment construction, subject to the indicated requirements.
2. If acceptable to the ENGINEER, some of the material listed as unsuitable may be used when thoroughly mixed with suitable material to form a stable composite.
3. Mixing or blending of materials to obtain a suitable composite is the CONTRACTOR's option but is subject to the approval of the ENGINEER.
4. Suitable materials may be obtained from on-Site excavations, may be processed on-Site materials, or may be imported.
5. If imported materials are required by this Section or are required in order to meet the quantity requirements of the WORK, the CONTRACTOR shall provide the imported materials as part of the WORK.

C. The following types of materials are defined as follows:

Type A: Not used

Type B (Class I Crushed Stone): Manufactured angular, crushed stone, crushed rock, or crushed slag with the following gradation requirements. The material shall have a minimum sand equivalent value of 75.

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	30 - 50
No. 200	0 - 5

Type C (Protective Filter Sand): Sand meeting the following gradation requirements (same modified gradation requirements of ASTM C 33- Fine Aggregate):

Sieve Size	Percentage Passing
3/8-inch	100
No. 4	95 - 100

No. 8	80 - 100
No. 16	50 - 85
No. 30	25 - 60
No. 50	5 - 30
No. 200	0 - 10
No. 100	0-10
No. 200	0 – 5 (in place) 0-2 (in stockpile)

Type D (Structural Backfill): Structure backfill shall consist of the existing, on-site soils excavated adjacent to the structure to be backfilled. Existing, on-site soils containing deleterious materials or having a fines content (% passing the No. 200 sieve) greater than 50% is not suitable for structure backfill use. Additionally, if the material has particle sizes greater than 6 inches, these oversize rocks shall be removed from the structure backfill prior to placement.

Type E: Not used.

Type F (~~Course Drain Rock~~) (**Gravel**): Crushed rock or gravel meeting the following gradation requirements:

Sieve Size	Percentage Passing
2-inch	100
1-1/2 inch	90 - 100
1-inch	20 - 55
3/4-inch	1 - 15
No. 200	0 - 3

Type G (Aggregate Base): Crushed rock aggregate base material of such nature that it can be compacted readily by watering and rolling to form a firm, stable base for pavements. At the option of the CONTRACTOR, the grading for either the 1-1/2 inch maximum size or 3/4-inch maximum size gradation shall be used. The sand equivalent value shall be not less than 22, and the material shall meet the following gradation requirements:

	Percentage Passing	
Sieve Size	1-1/2 inch Max Gradation	3/4-inch Max Gradation

2-inch	100	-
1-1/2-inch	90 - 100	-
1-inch	-	100
3/4-inch	50 - 85	90 – 100
No. 4	25 - 45	35 – 55
No. 30	10 - 25	10 – 30
No. 200	2 - 9	2 – 9

Type H (Drain Rock): Drain rock shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall meet the following gradation requirements (same gradation requirements of ASTM C 33 - Coarse Aggregate Size Number & 89):

Sieve Size	Percentage Passing
1/2-inch	100
3/8-inch	85 – 100
No. 4	10 – 30
No. 8	0 – 10
No. 16	0 – 5

Sieve Size	Percentage Passing
1/2-inch	100
3/8-inch	90 – 100
No. 4	20 - 55
No. 8	5 - 30
No. 16	0 – 10
No. 50	0 - 5

2.2 MATERIALS TESTING

A. Samples

1. Soils testing of samples submitted by the CONTRACTOR will be performed by a testing laboratory of the OWNER's choice and at the CONTRACTOR's expense.
 2. The ENGINEER may direct the CONTRACTOR to supply samples for testing of any material used in the WORK.
- B. Particle size analysis of soils and aggregates will be performed using ASTM D 422 - Standard Test Method for Particle-Size Analysis of Soils.
- C. Determination of sand equivalent value will be performed using ASTM D 2419 - Standard Test Method for Sand Equivalent Value of Soils and Fine Aggregate.
- D. Unified Soil Classification System
1. References in this Section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487.
 2. The CONTRACTOR shall be bound by applicable provisions of ASTM D 2487 in the interpretation of soil classifications.
- 2.3 IDENTIFICATION TAPE
- A. Unless otherwise indicated, identification tape shall be placed above buried pipelines that are not comprised of magnetic components at least in part.
 - B. Identification tape shall be 6-inches wide, yellow in color, composed of polyethylene, and provided with an integral metallic wire.
 - C. Tape shall be labeled with CAUTION – BURIED UTILITIES.

PART 3 -- EXECUTION

3.1 EXCAVATION AND BACKFILLING - GENERAL

- A. General
1. Except when specifically provided to the contrary, excavation shall include the removal of materials, including obstructions, that would interfere with the proper execution and completion of the WORK.
 2. The removal of such materials shall conform to the lines and grades indicated or ordered.
 3. Unless otherwise indicated, the entire Site shall be stripped of vegetation and debris and shall be grubbed, and such material shall be removed from the Site prior to performing any excavation or placing any fill.
 4. The CONTRACTOR shall furnish, place, and maintain supports and shoring that may be required for the sides of excavations.
 5. Excavations shall be sloped or otherwise supported in a safe manner in accordance with applicable state safety requirements and the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).

6. The CONTRACTOR shall provide quantity surveys where so required to verify quantities for Unit Price Contracts.
7. Surveys shall be performed prior to beginning WORK and upon completion by a surveyor licensed in the state where the Site is located.
8. Application of backfill shall be as follows below:

Unpaved surface of access roadways. Roadway around south side of reservoir and downstream of dam.	G
Pipe zone and bedding around solid PVC pipe	B
Trench zone backfill except as identified below	A through H or mixture thereof.
Trench and final backfill under structures	A through H or mixture thereof.
Structural backfill around structures, behind walls	D
Beneath footing of spillway training walls or soil retaining walls	G, H
Under structures where ground water is removed to allow placement of concrete	F, underlain by non-woven filter fabric
All other structures	G, H
Protective Filter Sand, beneath Roller Compacted Concrete (RCC), in vertical underdrain behind left training wall of spillway, and in underdrain upstream of chute blocks in spillway	C
Drainrock around perforated drain pipe in underdrains.	H

B. Removal and Exclusion of Water

1. The CONTRACTOR shall remove and exclude water, including stormwater, groundwater, irrigation water, subsurface seepage from Logan River, and wastewater, from excavations.
2. Dewatering wells, wellpoints, sump pumps, or other means shall be used to remove water and continuously maintain groundwater at a level at least 2 feet below the bottom of excavations before the excavation WORK begins at each location. CONTRACTOR shall refer to the requirements of the 401 Water Quality Certification No. FERC-P-4258 for discharge requirements.

3. Water shall be removed and excluded until backfilling is complete and field soils testing has been completed.

3.2 OVER-EXCAVATION

A. Indicated

1. Where areas are indicated to be over-excavated, excavation shall be to the depth indicated, and backfill shall be installed to the grade indicated. Over-excavation may be required at locations where excessive seeps are discovered. A known location for a seep is along the existing left training wall of the spillway.

B. Not Indicated

1. When ordered to over-excavate areas deeper and/or wider than required by the Contract Documents, the CONTRACTOR shall over-excavate to the dimensions ordered and backfill to the indicated grade.

C. Neither Indicated nor Ordered

1. Any over-excavation carried below the grade that is neither ordered or nor indicated shall be backfilled and compacted to the required grade with the indicated material as part of the WORK

3.3 ROCK EXCAVATION

A. Rock excavation shall include removal and disposal of the following items:

1. boulders measuring 1/3 of a cubic yard or more in volume;
2. blasting is NOT permitted for soil or rock excavation or for any other purpose;
3. concrete or masonry structures that have been abandoned; and,
4. conglomerate deposits that are so firmly cemented that they possess the characteristics of solid rock and cannot be removed using conventional equipment as herein defined and require systematic drilling and blasting for removal.

B. Scope and Payment

1. Rock excavation shall be performed by the CONTRACTOR, provided that if the quantity of rock excavation is affected by any change in the scope of the WORK an appropriate adjustment of the Contract Price will be made under a separate Bid Item if such Bid Item has been established.
2. Otherwise, payment will be made in accordance with a negotiated price.

C. Explosives and Blasting: Blasting will not be permitted.

3.4 DISPOSAL OF EXCESS EXCAVATED MATERIAL

- #### A. Unless otherwise indicated, excess excavated material shall be the property of the CONTRACTOR.

- B. The CONTRACTOR shall be responsible for the removal and disposal of excess excavated material.
- C. Material shall be disposed of at an approved on-Site disposal area or off-Site at a location arranged by the CONTRACTOR in accordance with laws and regulations regarding the disposal of such material.

3.5 BACKFILL

A. General

- 1. Backfill shall not be dropped directly upon any structure or pipe.
- 2. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed.
- 3. Backfill around water-retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed.
- 4. Backfill material used as drainrock is detailed on the Contract Drawings.

B. Pre-Placement Conditions

- 1. Immediately prior to placement of backfill materials, the bottoms and sidewalls of trenches and structure excavations shall have any loose, sloughing, or caving soil and rock materials removed. Except for drainrock materials being placed in over-excavated areas or trenches, backfill shall be placed after water is removed from the excavation and the trench sidewalls and bottom have been dried to a moisture content suitable for compaction. All excavations must be set to the specified grade prior to backfill.
- 2. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of backfill materials.

C. Layering

- 1. Backfill materials shall be placed and spread evenly in layers.
- 2. When compaction is achieved using mechanical equipment, the layers shall be evenly spread such that when compacted, each layer shall not exceed 6 inches in thickness.

D. During spreading, each layer shall be thoroughly mixed as necessary in order to promote uniformity of material in each layer.

E. Moisture Content

- 1. Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.
- 2. Where the backfill material moisture content is too high to permit the indicated degree of compaction, the material shall be dried until the moisture content is satisfactory.

3. The acceptable range of moisture content for backfill is -2% to +2% of optimum moisture content. The CONTRACTOR is responsible for determining the maximum dry density and should provide that information to the ENGINEER for review and approval.

3.6 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION AND BACKFILL

A. Excavation Beneath Structures and Embankments

1. Except where indicated otherwise for a particular structure or where ordered by the ENGINEER, excavation shall be carried to an elevation 6 inches below the bottom of the footing or slab and brought back to grade with compacted materials acceptable for placement beneath structures.

Subgrade preparation for footings shall include a minimum 6-inch over-excavation and backfill with ASTM C33 sand. Following adequate compaction of the fill material, the footing shall be cast directly on the ASTM C33 sand.

2. The area where a fill or embankment is to be constructed shall be cleared of vegetation, roots, and foreign material.
3. Where indicated or ordered, areas beneath structures or fills shall be over-excavated.
4. The subgrade areas beneath embankments shall be excavated to remove not less than the top 6 inches of native material and where such subgrade is sloped, the native material shall be benched.
5. When such over-excavation is indicated, both the over-excavation and the subsequent backfill to the required grade shall be performed by the CONTRACTOR.
6. After the required excavation or over-excavation for fills and embankments has been completed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density.
7. The acceptable range of moisture content for backfill is -2% to +2% of optimum moisture content. The CONTRACTOR is responsible for determining the maximum dry density and should provide that information to the ENGINEER for review and approval.

B. Notification of ENGINEER

1. The CONTRACTOR shall notify the ENGINEER at least 3 Days in advance of completion of any structure or roadway excavation and shall allow the ENGINEER a review period of at least one day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

Prior to placement of cast-in-place concrete foundations, the prepared subgrade shall be inspected by the State of Utah, Division of Water Rights, including written approval from the State of Utah. The CONTRACTOR shall notify the State of Utah seven working days prior to placement of any foundation.

C. Compaction of Fill, Backfill, and Embankment Materials

1. Each layer of backfill materials as defined herein, where the material is graded such that 10 percent or more passes a No. 4 sieve, shall be mechanically compacted to the indicated percentage of density.
2. Equipment that is consistently capable of achieving the required degree of compaction shall be used, and each layer shall be compacted over its entire area while the material is at the required moisture content.
3. Each layer of coarse granular backfill materials shall have less than 10 percent passing the No. 4 sieve and shall be compacted in accordance with Paragraph 3.6.H of this section.

D. Flooding, ponding, and jetting shall not be used for fill on roofs, backfill around structures, backfill around reservoir walls, for final backfill materials, or aggregate base materials.

E. Heavy Equipment

1. Equipment weighing more than 10,000 pounds shall not be used closer to walls than a horizontal distance equal to the vertical depth of the fill above undisturbed soil at that time.
2. Hand-operated power compaction equipment shall be used where the use of heavier equipment is impractical or restricted due to weight limitations.

F. Layering

1. Embankment and fill material shall be placed and spread evenly in approximately horizontal layers.
2. Each layer shall be moistened and aerated as necessary.
3. Unless otherwise approved by the ENGINEER, no layer shall exceed 6 inches of compacted thickness.
4. The embankment and fill shall be compacted in conformance with Paragraph K, below.

G. Embankments and Fills

1. When an embankment or fill is to be constructed and compacted against hillsides or fill slopes steeper than 4:1, the slopes of the hillsides or fills shall be horizontally benched in order to key the embankment or fill to the underlying ground.
2. A minimum of 12 inches perpendicular to the slope of the hillside or fill shall be removed and re-compacted as the embankment or fill is brought up in layers.
3. Material thus cut shall be re-compacted along with the new material.

4. Hillside or fill slopes 4:1 or flatter shall be prepared in accordance with Paragraph A, above.

H. Compaction Requirements

1. The following compaction requirements shall be in accordance with ASTM D 1557 - Test Method for Laboratory Compaction Characteristics of Soils Using Modified Effort (56,000 ft - lbf/ft³) (2,700 kN-m/m³) where the material is graded such that 10 percent or more passes a No. 4 sieve and in accordance with ASTM D 4253 - Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table, and D 4254 - Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density, where the material is coarse granular backfill materials with less than 10 percent passing the No. 4 sieve:

Location or Use of Fill or Backfill	Percentage of Maximum Dry Density	Percentage of Relative Density
Embankments and fills not identified otherwise	95	65
Embankments and fills beneath paved areas or structures	95	70
Backfill beneath structures and hydraulic structures	95	70
Backfill on reservoir of structure roof	90	55
Topsoil	80	NA
Aggregate base or subbase	95	NA

3.7 PIPELINE AND UTILITY TRENCH EXCAVATION AND BACKFILL

A. General

1. Unless otherwise indicated or ordered, excavation for pipelines and utilities shall be open-cut trenches with minimum widths as indicated.

B. Trench Bottom

1. Except where pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe.
2. Excavations for pipe bells and welding shall be made as required.
3. Where pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe bedding.

C. Open Trenches

1. The maximum amount of open trench permitted in any one location shall be 500 feet or the length necessary to accommodate the amount of pipe installed in a single Day, whichever is greater.
2. Trenches shall be fully backfilled at the end of each Day or, in lieu thereof, shall be covered by heavy steel plates adequately braced and capable of supporting vehicular traffic in those locations where it is impractical to backfill at the end of each Day.
3. These requirements for backfilling or use of steel plate will be waived in cases where the trench is located further than 100 feet from any traveled roadway or occupied structure; in such cases, however, barricades and warning lights meeting appropriate safety requirements shall be provided and maintained.

D. Embankments, Fills and Structural Backfills

1. Where pipelines are to be installed in embankments, fills, or structure backfills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.
2. Upon completion of the embankment or structural backfill, a trench conforming to the appropriate detail may be excavated and the pipe may be installed.

E. Trench Shield

1. If a moveable trench shield is used during excavation operations, the trench width shall be wider than the shield such that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls and causing sloughing or caving of the trench walls.
2. If the trench walls cave or slough, the trench shall be excavated as an open excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.
3. If a moveable trench shield is used during excavation, pipe installation, and backfill operations, the shield shall be moved by lifting the shield free of the trench bottom or backfill and then moving the shield horizontally.
4. The CONTRACTOR shall not drag trench shields along the trench causing damage or displacement to the trench sidewalls, the pipe, or the bedding and backfill.

F. Placing and Spreading Of Backfill Materials

1. Each layer of coarse granular backfill materials with less than 10 percent passing the No. 4 sieve shall be compacted by means of at least 2 passes from a vibratory compactor that is capable of achieving the required density in 2 passes and that is acceptable to the ENGINEER.
2. Where such materials are used for pipe zone backfill, vibratory compaction shall be used at vertical intervals of the lesser of:
 - a. one-half the diameter of the pipe; or
 - b. 24 inches, measured in the un-compacted state.

3. In addition, these materials shall be subjected to vibratory compaction at the springline of the pipe and the top of the pipe zone backfill, regardless of whether that dimension is less than 24 inches or not.
4. Each layer of backfill material with greater than 10 percent passing the No. 4 sieve shall be compacted using mechanical compactors suitable for the WORK.
5. The material shall be placed and compacted under the haunch of the pipe and up each side evenly so as not to move the pipe during the placement of the backfill.
6. The material shall be placed in lifts that will not exceed 6 inches when compacted to the required density.

G. Mechanical Compaction

1. Backfill around and over pipelines that is mechanically compacted shall be compacted using light, hand-operated vibratory compactors and rollers that do not damage the pipe.
2. After completion of at least 2 feet of compacted backfill over the top of pipeline, compaction equipment weighing no more than 8,000 pounds may be used to complete the trench backfill.

H. Pipe And Utility Trench Backfill

1. Pipe Zone Backfill

a. Definitions

- 1) The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane below the bottom surface of the pipe and a plane at a point above the top surface of the pipe as indicated.
- 2) The bedding is defined as that portion of pipe zone backfill material between the trench subgrade and the bottom of the pipe.
- 3) The embedment is defined as that portion of the pipe zone backfill material between the bedding and a level line as indicated.

b. Final Trim

- 1) After compacting the bedding, the CONTRACTOR shall perform a final trim using a stringline for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe.
- 2) Excavation for pipe bells and welding shall be made as required.

c. The pipe zone shall be backfilled with the indicated backfill material.

- d. Pipe zone backfill materials shall be manually spread evenly around the pipe, maintaining the same height on both sides of the pipe such that when compacted the pipe zone backfill will provide uniform bearing and side support.

- e. The CONTRACTOR shall exercise care in order to prevent damage to the pipeline coating, cathodic bonds, and the pipe itself during the installation and backfill operations.
- 2. Trench Zone Backfill
 - a. After the pipe zone backfill has been placed, backfilling of the trench zone may proceed.
 - b. The trench zone is defined as that portion of the vertical trench cross-section lying as indicated between a plane above the top surface of the pipe and a plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade.
 - 3. Final Backfill
 - a. Final backfill is defined as backfill in the trench cross-sectional area within 18 inches of finished grade, or if the trench is under pavement, backfill within 18 inches of the roadway subgrade.
- I. Identification Tape
 - 1. Install identification tape as indicated.
 - 2. Terminate the tape in a precast concrete box either adjacent to or part of the valve box, manhole, vault, or other structure into which the non-metallic pipe enters or at the end of the non-metallic pipeline.
 - 3. The termination box shall be covered with a cast iron lid.
 - 4. The box shall be located at grade in paved areas or 6 inches above grade in unpaved areas.
 - J. Trench Shield
 - 1. If a moveable trench shield is used during backfill operations, the shield shall be lifted to a location above each layer of backfill material prior to compaction of the layer.
 - 2. The CONTRACTOR shall not displace the pipe or backfill while the shield is being moved.
 - K. Compaction Requirements

The following compaction test requirements shall be in accordance with ASTM D 1557 - Test Method for Laboratory Compaction Characteristics of Soils Using Modified Effort (56,000 ft - lbf/ft³) (2,700 kN-m/m³) where the material is graded such that 10 percent or more passes a No. 4 sieve, and in accordance with ASTM D 4253- Standard Test Method for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table, and D 4254 - Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density where the material is coarse granular backfill materials with less than 10 percent passing the No. 4 sieve.

Location or Use of Fill or Backfill	Percentage of Maximum Dry Density	Percentage of Relative Density
Pipe embedment backfill for flexible pipe.	95	70
Pipe bedding and over-excavated zones under bedding for flexible pipe, including trench plugs.	95	70
Pipe embedment backfill for steel yard piping	---	70
Pipe zone backfill portion above embedment for flexible pipe	95	70
Pipe embedment backfill for rigid pipe	90	55
Pipe zone backfill portion above embedment for rigid pipe.	95	70
Pipe bedding and over-excavated zones under bedding for rigid pipe.	95	70
Final backfill, beneath paved areas or structures.	95	70
Final backfill, not beneath paved areas or structures.	90	55
Trench zone backfill, beneath paved areas and structures, including trench plugs.	95	70
Trench zone backfill, not beneath paved areas or structures, including trench plugs.	95	70

3.8 FIELD TESTING

A. General:

1. Field soils testing will be performed by a testing laboratory of the OWNER's choice at the OWNER's expense, except as indicated below.

B. Density

1. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with Method C of ASTM D 1557.

2. Where cohesionless, free draining soil material is required to be compacted to a percentage of relative density, the calculation of relative density will be determined in accordance with ASTM D 4253 and D 4254.
3. Field density in-place tests will be performed in accordance with ASTM D 1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand Cone Method, ASTM D 2922 - Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth), or by such other means acceptable to the ENGINEER.

C. Remediation

1. In case the test of the fill or backfill shows non-compliance with the required density, the CONTRACTOR shall accomplish such remedy as may be required to ensure compliance.
2. Subsequent testing to show compliance shall be by a testing laboratory selected by the OWNER and paid by the CONTRACTOR.

D. CONTRACTOR's Responsibilities

1. The CONTRACTOR shall provide test trenches and excavations, including excavation, trench support and groundwater removal for the OWNER's field soils testing operations.
2. The trenches and excavations shall be provided at the locations and to the depths as required by the OWNER.
3. Lawn areas destroyed by test trenching and excavation shall be re-graded and re-landscaped with hydroseeding.

- END OF SECTION -

SECTION 31 35 26 - EROSION CONTROL BARRIER (SILT FENCE)

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall submit an Erosion and Sediment Control Plan to the US Forest Service and Project ENGINEER for approval prior to construction. The plan may include BMP measures including erosion control barriers, revegetation, straw-waddles, straw bales, etc.

1.2 CONTRACTOR SUBMITTALS

- A. Submittals shall be in accordance with Section 01 33 00 – CONTRACTOR SUBMITTALS.
- B. Product Data: Manufacturer's catalog sheets on geotextile fabrics.

PART 2 -- PRODUCTS

2.1 FABRIC

- A. Fabric may be woven or non-woven, made from polypropylene, polyethylene, or polyamid, and shall contain sufficient UV inhibitors so that it will last for 2 years in outdoor exposure.
- B. Fabric shall have the following properties:

Parameter	Standard Method	Value
Grab tensile strength	ASTM D 4632	100 lb
Burst strength	ASTM D 3786	200 psi
Apparent opening size	ASTM D 4751	Between 200 and 70 sieve size

- C. Fabric Manufacturer, or equal

1. Mirafi

2.2 POSTS

- A. Posts shall be wood, at least 2-inches by 2-inches, at least 6-feet long.

2.3 FENCING

- A. Woven wire fabric fencing shall be galvanized, mesh spacing of 6-inches, maximum 14- gauge, at least 30-inches tall.

2.4 FASTENERS

- A. Fasteners to wood posts shall be steel, at least 1-1/2 inches long.

PART 3 -- EXECUTION

3.1 PREPARATION

- A. Provide erosion control barriers at the indicated locations and as required to prevent erosion and silt loss from the Site.
- B. CONTRACTOR shall not commence clearing, grubbing, earthwork, or other activities which may cause erosion until barriers are in place.

3.2 INSTALLATION

- A. Barrier systems shall be installed in such a manner that surface runoff will percolate through the system in sheet flow fashion and allow sediment to be retained and accumulated.
- B. Attach the woven wire fencing to the posts that are spaced a maximum of 6 feet apart and embedded a minimum of 12-inches. Install posts at a slight angle toward the source of the anticipated runoff.
- C. Trench in the toe of the filter fabric barrier with a spade or mechanical trencher so that the downward face of the trench is flat and perpendicular to the direction of flow. Lay fabric along the edges of the trench. Backfill and compact.
- D. Securely fasten the fabric materials to the woven wire fencing with tie wires.
- E. Reinforced fabric barrier shall have a height of 18-inches.
- F. Provide the filter fabric in continuous rolls and cut to the length of the fence to minimize the use of joints. When joints are necessary, splice the fabric together only at a support post with a minimum 6-inch overlap and seal securely.

3.3 MAINTENANCE

- A. Regularly inspect and repair or replace damaged components of the barrier. Unless otherwise directed, maintain the erosion control system until final acceptance; then remove erosion and sediment control systems promptly.
- B. Remove sediment deposits when silt reaches a depth of 6-inches or 1/2 the height of the barrier, whichever is less. Dispose of sediments on the Site, if a location is indicated on the Drawings, or at a site arranged by the CONTRACTOR which is not in or adjacent to a stream or floodplain.

- END OF SECTION -

SECTION 31 35 28 - EROSION CONTROL (VEGETATIVE)

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall provide erosion protection including fertilizing, seeding, and mulching for all disturbed areas that are not to be paved or otherwise treated in accordance with the Contract Documents. CONTRACTOR shall provide a list of seed and fertilizer types to the Logan District, US Forest Service office, and ENGINEER for final approval. Additional information pertaining to Erosion Control measures is provided on Drawing C-1 of the Contract Drawings.
- B. The CONTRACTOR shall submit an Erosion and Sediment Control Plan, including the use of BMP's other than vegetation, to be reviewed and approved by the US Forest Service and project ENGINEER prior to construction.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. Fertilizer: Fertilizer shall be a commercial, chemical type, uniform in composition, free-flowing, conforming to state and federal laws and suitable for application with equipment designed for that purpose. Fertilizer shall have a guaranteed analysis showing not less than 11 percent nitrogen, 8 percent available phosphoric acid, and 4 percent water soluble potash.
- B. Seed: Seed shall be delivered in original unopened packages bearing an analysis of the contents. Seed shall be guaranteed 95 percent pure with a minimum germination rate of 80 percent. CONTRACTOR shall submit information on seed type to the Logan District, US Forest Service office and ENGINEER for approval.
 1. Seed mix shall be equal parts by weight of fescue and perennial ryegrass or perennial ryegrass and barley.
- C. Mulch: Mulch shall be a fibrous, wood cellulose product produced for this purpose. It shall be dyed green and shall contain no growth or germination inhibiting substances, and shall be manufactured so that when thoroughly mixed with seed, fertilizer, and water, in the proportions indicated it will form a homogenous slurry which is capable of being sprayed. The mulch shall be Silva Fiber as manufactured by **Weyerhaeuser Company**; Conwood Fiber as manufactured by **Consolidated Wood Conversion Corp.**; or equal.
- D. Erosion Control Fabric:
 1. Materials: As provided by supplier.
 2. Anchorage Devices: Nine-inch, 2-legged staples from the manufacturer or staples of the proper length as recommended by the manufacturer for specific soil condition.
- E. Manufacturers, or Equal
 1. **North American Green**
 2. **Synthetic Industries**

PART 3 -- EXECUTION

3.1 GENERAL

- A. Weather Conditions: Fertilizing, seeding, or mulching operations will not be permitted when wind velocities exceed 15 miles per hour or when the ground is frozen, unduly wet, or otherwise not in a tillable condition.
- B. Soil Preparation: The ground to be seeded shall be graded in conformance with the Drawings and shall be loose and reasonably free of large rocks, roots, and other material which will interfere with the work.
- C. Method of Application: Fertilizer, seed, and mulch may be applied separately (Dry Method), or they may be mixed together with water and the homogeneous slurry applied by spraying (Hydraulic Method), except that all slopes steeper than 3 units horizontal to 1 unit vertical shall be stabilized by the Hydraulic Method.

3.2 DRY METHOD

- A. Fertilizing: The fertilizer shall be spread uniformly at the rate of 800 lbs per acre (approximately 1 lb per 55 square feet). The fertilizer shall be raked in and thoroughly mixed with the soil to a depth of approximately 2-inches prior to the application of seed or mulch.
- B. Seeding: The seed shall be broadcast uniformly at the rate of 60 lbs/acre (approximately 1 lb per 730 sq ft). After the seed has been distributed it shall be incorporated into the soil by raking or by other approved methods.
- C. Mulch Application: Mulch shall be applied at the rate of 1,500 lb (air dried weight) per acre (approximately 1 lb per 30 sq ft).

3.3 HYDRAULIC METHOD

- A. The hydraulic method consists of the uniform application by spraying of a homogeneous mixture of water, seed, fertilizer, and mulch. The slurry shall be prepared by mixing the ingredients in the same proportions as indicated above. The slurry shall have the proper consistency to adhere to the earth slopes without lumping or running. Mixing time of materials shall not exceed 45 minutes from the time the seeds come into contact with the water in the mixer to the complete discharge of the slurry onto the slopes, otherwise the batch shall be recharged with seed. The mixture shall be applied using equipment containing a tank having a built-in, continuous agitation and recirculation system, and a discharge system which will allow application of the slurry to the slopes at a continuous and uniform rate. The application rates of the ingredients shall be the same as those specified for the Dry Method. The nozzle shall produce a spray that does not concentrate the slurry nor erode the soil.

3.4 WATERING

- A. Upon completion of the erosion control seeding, the entire area shall be soaked to saturation by a fine spray. The new planting shall be kept watered by a sprinkling system on the Site during dry weather or whenever necessary for proper establishment of the planting until final project acceptance. At no time shall the planting be allowed to dry out. Care shall be taken to avoid excessive washing or puddling on the surface and any such damage caused thereby shall be repaired by the CONTRACTOR.

3.5 MAINTENANCE PRIOR TO FINAL ACCEPTANCE

- A. The CONTRACTOR shall maintain the planted areas in a satisfactory condition until final acceptance of the project. Such maintenance shall include the filling, leveling, and repairing of any washed or eroded areas, as may be necessary, and sufficient watering to maintain the plant materials in a healthy condition. The ENGINEER may require replanting of any areas in which the establishment of the vegetative ground cover does not appear to be developing satisfactorily.

3.6 MAINTENANCE AFTER FINAL ACCEPTANCE

- A. The CONTRACTOR shall water the permanently planted areas sufficiently to maintain the plant materials in a healthy condition during the 1 year correction period.

- END OF SECTION -

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SECTION 31 35 30 - REVEGETATION BY TRANSPLANTING AND SEEDING

PART 1 -- GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Preparation of soil.
 - 2. Transplanting salvaged root wads.
 - 3. Transplanting willow cuttings.
 - 4. Transplanting propagated plugs.
 - 5. Seeding disturbed uplands.

1.2 PAYMENT

- A. Furnishing and installing vegetation transplants are paid for at a lump sum price.
- B. Seeding disturbed upland areas are paid for at a lump sum price.

1.3 SUBMITTALS

- A. General: See Division 1- General Requirements.
- B. Product certificates signed by manufacturers certifying that their products comply with specified requirements.
 - 1. Manufacturer's certified information, analysis & product data for standard products.
 - 2. Analysis for other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- C. Certification of seed from seed vendor for specified seed stating the botanical and common name and percentage by weight of species, statement of weed free, and percentage of purity and germination. Include the year of production and date of packaging.
- D. Certificates: Certify and Warrant that products in this section meet or exceed to be true to name; harvested, dried, cleaned, stored, and shipped as applicable, in a manner to ensure maximum viability, obtained from a reputable supplier to be approved by ENGINEER. Products must meet recognized tolerances, as applicable, for purity and percent germination as described under State and Federal Seed Laws. Include the year of production and date of packaging.
- E. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and address of architects and owners, and other information specified. See "Quality Assurance" article in this section for additional CONTRACTOR requirements.
 - 1. Installer company specializing in performing riparian vegetation transplant installation with a minimum of two years' of experience. Provide proof of five or more successful riparian vegetation installations.
- F. Transplanting schedule indicating anticipated dates and locations for each type of planting.

- G. Maintenance Instructions: Typewritten recommended seasonal procedures to be provided by CONTRACTOR to OWNER for maintenance of exterior transplanted plants during a calendar year. Include recommendations for care of trees and planted areas to promote healthy, vigorous growth and avoid susceptibility to disease. Submit before expiration of required maintenance periods.

1.4 COORDINATION

- A. Permanent transplanting operations shall be limited to the following periods:
 - 1. Spring: March 15 to May 17.
 - 2. Fall: September 1 to October 31.
 - 3. See Execution article of this section for additional transplanting schedule requirements.
- B. Seeding operations shall be limited to the following period:
 - 1. Spring: March 15 to May 17.

1.5 QUALITY ASSURANCE

- A. Grading Tolerances: CONTRACTOR is responsible for meeting and maintaining the grading tolerances outlined in these specifications throughout the course of this work. OWNER and ENGINEER reserve the right to conduct a survey of the elevations of the field or spot check elevations of the field grading. If the grade tolerances are outside those specified in these documents, the CONTRACTOR is responsible for meeting the tolerances outlined in these documents.
- B. Installer Qualifications: A qualified landscape installer, with a minimum of two years' experience, who has completed native transplanting work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment, is required. Qualified landscape installer must provide examples of five or more successful native plant transplant installations. Installer's Field Supervision: CONTRACTOR shall provide an experienced full-time supervisor on project site when exterior transplanting is in progress.

1.6 PROJECT CONDITIONS

- A. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify ENGINEER before planting.
- B. Erosion Control: All biodegradable coir logs (only in areas where specified) to be installed immediately following transplant installation or seeding.

1.7 WARRANTY

- A. All permanent transplanted areas shall have a warranty period of 2 years from the date of substantial completion with seasonal foliage growth on transplanted cuttings and 20 stems per square foot for transplanted plugs.
- B. All permanent seeded areas shall have a warranty period of 2 years from the date of substantial completion with a minimum 85 percent aerial coverage of the specified seed mix.
- C. Correct defective work within a 1-year period after date of substantial completion, within the transplant schedule outlined in these specifications.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Collect native willow cuttings from existing dormant willows growing in Logan Canyon. Select mature, vigorous donor plants for harvesting cuttings. Cut willow shaft at base with diagonal (45 degree to shaft axis) cut to mark basal end of cutting. Cut willow shaft at top at 90 degrees to shaft axis. Cuttings shall be no longer than 18 inches, no shorter than 12 inches, and have minimum diameter of ½-inch. Each cutting shall include at least two live nodes. Immediately soak live cuttings in fungicide solution for one (1) hour prior to storing. Store live cuttings in portable coolers with damp peat moss covering the cuttings, within refrigerated coolers at 35 degrees Fahrenheit. Cuttings should be kept moist at all times during storage. One week before transplanting willow cuttings, soak cuttings in water for seven days completely submerged and then pack in coolers with fresh moist peat moss. Immediately deliver live cuttings to Project site in portable coolers packed with fresh moist peat moss.
- B. Deliver native plant plugs propagated from seed or collected from native sources and divided to propagate plant plugs in containers labeled with species name, seed planting date or native plant dividing date, and location of propagation. CONTRACTOR shall store, protect and handle products using good horticultural practices.
- C. If collecting wild plants for native plant dividing, no more than ¼ of the plants in a source area should be collected. Excavate source area plugs to a depth of six (6) inches. Store excavated plugs in a cool location during transport. Native plant plugs may be split into smaller units (minimum 2.4 inches x 2.4 inches), with healthy rhizomes and tops. Clip leaves and stems to 6 to 10 inches, which allows the plant to allocate more energy into root production. Plant divided plants or plugs into moist soil in greenhouse as soon as possible after collection to maintain plant viability. Remove weeds or other plant species in plugs by hand and discard. Harvest native plant plugs from greenhouse soil after 120 days and keep roots in moist soil for transport to Project site.
- D. If seeds are used to grow native plants, the seeds must be germinated in a greenhouse. Seeds need light, moisture and heat for germination. Soak the clean seeds in water for seven (7) days. Place soaked seeds on greenhouse soil surface and press lightly into soil to assure good soil contact. Do not cover seed with soil. Soil must be kept moist. Greenhouse must be kept hot (90 to 100 degrees Fahrenheit). Seeds begin to germinate in approximately one week. Maintain soil moisture until plants are ready to be transplanted. Seedlings cannot withstand long periods without water while growing in the greenhouse. Plants are ready in 120 days to come out as plugs; grow plugs in greenhouse an additional 120 days before transport to Project site for transplanting.

- E. Cut existing deciduous trees in Temporary Construction Work Area to two (2) feet from ground surface. Mark remaining deciduous tree trunks at the ground surface with a horticultural marking paint. Excavate remaining marked trunk and root ball intact with soil and transport to temporary tree root ball stockpile area in construction staging area for temporary storage in pit excavated into existing soil. Place root ball within excavated pit such that attached remaining tree trunk mark is at soil surface. Place soil over root ball up to painted mark on trunk to protect root ball during winter storage. When ready to transplant, re-excavate stored remaining tree trunks with attached root balls and transport to restored Temporary Construction Work Area for transplanting.

PART 2 -- PRODUCTS

2.1 NATIVE PLANT PLUGS PROPAGATED BY SEED:

- A. Type "A" Seed Mixture:

<u>Seed Type</u>	<u>Proportion By Weight</u>	<u>Minimum Purity</u>	<u>Minimum Germination</u>
<i>Juncus arcticus</i> Willd. ssp. <i>littoralis</i> (Engelm.) Hulten Mountain rush	100%	95%	80%
Number of native plant plugs delivered to <u>Project for transplanting:</u> 2600			

2.2 NATIVE PLANT PLUGS DIVIDED FROM COLLECTED WILD PLANTS:

- A. Species:

<u>Scientific name</u>	<u>Common Name</u>	<u>USDA-NRCS Plant Symbol</u>	<u>Alternate Names</u>
<i>Juncus arcticus</i> Willd. ssp. <i>littoralis</i> (Engelm.) Hulten	Mountain rush	JUARL	Arctic rush, Baltic rush
Number of native plant plugs delivered to <u>Project for transplanting:</u> 2600			

2.3 NATIVE PLANT WILLOW CUTTINGS FROM COLLECTED WILD PLANTS:

A. Species:

<u>Scientific name</u>	<u>Common Name</u>	<u>USDA-NRCS Plant Symbol</u>	<u>Alternate Names</u>
<i>Salix drummondiana</i> Barratt ex Hook.	Drummond willow	SADR	beautiful willow, blue willow, handsome willow
Number of willow Cuttings delivered to <u>Project for transplanting:</u> 900			

2.4 UPLAND SEED MIXTURE:

A. Type "B" Seed Mixture:

The Type "B" Seed Mixture will be representative of two existing plant species growing in the Temporary Construction Work Area. This seed mixture will be identified following Forest Service field review of the Temporary Construction Work Area during the 2018 spring season. The two most prevalent upland grass species growing on the Temporary Construction Work Area will be identified and provided by ENGINEER to CONTRACTOR for purchase of an upland seed mixture consisting of the two identified upland grass species. The area to be broadcast seeded is approximately 0.9 acre. The application rate is 40 pounds of Pure Live Seed (PLS) per acre.

2.5 FUNGICIDE:

A. Banrot 40 WP (wetable powder):

Banrot 40 WP shall be mixed at a concentration of one (1) teaspoon per one (1) gallon of water.

PART 3 -- EXECUTION

3.1 BED PREPARATION:

- A. After grading and compaction operations in Temporary Construction Work Area are complete, loosen soil to depth of four (4) inches by scarifying and remove large rocks, debris, and clods. Perform scarification perpendicular to slope in restored backfill within Temporary Construction Work Area. Spread stockpiled topsoil, if applicable, evenly over scarified soil in the Temporary Construction Work Area. Excavate holes for the stored root balls with attached tree trunks at locations shown on the drawings.
- B. Grade riparian wetland restoration areas adjacent to impoundment to elevation 5024.0 feet NAVD88. Scarify soil surface to a depth of three (3) inches.

3.2 TRANSPLANTING:

A. General Requirements:

- a. Planting bars must be used to install all transplanted plants, unless otherwise indicated.
- b. Transplanted plants must be installed during the period March 15 to May 17.

- c. Transplanting plants into frozen ground or when temperature is 35 degrees F or lower is prohibited.
- d. Water all transplanted plants following installation in soil.
- e. Install protective construction fencing around transplanted area to help prevent trampling during plant establishment.
- f. Install biodegradable coir logs between water's edge and transplanted plants to help control soil erosion and transport into the water.

B. Native Plant Plugs:

- a. Transplant native plant plugs such that roots are installed into flooded, saturated or moist soil.
- b. Soil must be filled into planting hole following installation of native plant plug. Lightly press soil around the plant stem, avoiding injury to the plant stem.
- c. Install native plant plugs at a density of three (3) plugs per square foot, equally spaced apart from other native plant plugs.

C. Willow Cuttings:

- a. Transplant willow cuttings such that greater than 50 percent of the cutting shaft is installed into flooded, saturated, or moist soil.
- b. Install willow cuttings with diagonal cut end down and perpendicular cut end up, with cutting shaft protruding from soil no more than three (3) inches.
- c. Soil must be completely filled into planting hole following installation of cutting shaft. Firmly pack soil around the cutting shaft to match the surrounding ground and avoid creating any void spaces around the cutting.
- d. Install willow cuttings at a density of one (1) cutting per square foot, equally spaced apart from other cuttings.

D. Cut Deciduous Trees With Attached Root Balls:

- a. Transplant cut deciduous trees with attached root balls into holes excavated in prepared soil within the Temporary Construction Work Area, at the locations indicated on the Drawings.
- b. Install the root ball completely into the excavated hole such that the bottom of the root ball is resting on soil in the bottom of the excavated hole. The painted mark on the attached trunk should be located at the ground surface at the top of the excavated hole. The tree trunk should be vertical.
- c. Backfill the hole with excess soil excavated from the hole, compacting the soil around the root ball and tree trunk in lifts not exceeding one (1) foot deep. Water the backfilled soil following placement of each lift to moisten the soil. Avoid over-watering resulting in soil saturation or standing water. The backfilled soil should extend to the top of the excavated hole and match the painted mark on the vertically aligned tree trunk. The tree trunk should extend above the soil finish grade by approximately 24 inches.

- d. Form a six-inch high soil berm around the tree trunk with a diameter matching the diameter of the excavated transplanting hole. The soil berm is intended to capture water and allow it to seep into the soil placed around the root ball and tree trunk. Water the soil within the berm.

3.6 SEEDING:

A. General Requirements:

- a. Broadcast upland seed mixture uniformly at prescribed rates during planting season, March 15 through May 17.
- b. Seeding on frozen ground, snow-covered ground or when temperature is 35 degrees F or lower is prohibited.
- c. Seed all disturbed upland areas not covered by live plant cuttings.
 - 1. Type B seed shall be broadcast in the Temporary Construction Work Area.

3.3 RAKING: Immediately after broadcast seeding, hand rake upland grass seed into soil throughout the Temporary Construction Work Area.

3.4 MAINTENANCE OF SEEDED AREAS:

- A. Maintain all seeded areas by watering, and replanting as necessary to establish a uniformly dense stand of specified grass and until accepted.
- B. Scattered bare spots, smaller than one square foot will be allowed up to five (5%) percent of the seeded areas.
- C. Re-seed as directed by the OWNER at no additional cost, any areas failing to establish a stand. Re-seeding will conform in all respects to these specifications.
- D. Repair any damage to the work areas resulting from erosion and/or equipment at no additional cost. Repair damage, including regrading, reseeding, etc. as necessary, before significant damage occurs.

3.5 LIMITS OF SEEDING: Seeding limits are generally within the work area limits shown on the Drawings. No payment will be made for areas disturbed beyond these limits.

PART 4 -- MEASUREMENT AND PAYMENT

- 4.1 TYPE A SEED: Measurement will not be made. Payment is included in the contract lump-sum price for native plant restoration.
- 4.2 TYPE B SEEDING: Measurement will not be made. Payment is included in the contract lump sum price for Temporary Construction Work Area revegetation.

END OF SECTION

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SECTION 31 37 00 - RIPRAP

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall provide riprap, including associated earthwork, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

ASTM C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 535	Standard Test Method for Resistance to Degradation of Large Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
AASHTO T 85	Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate
AASHTO T 210	Method of Test for Aggregate Durability Index.

1.3 CONTRACTOR SUBMITTAL

- A. Furnish submittals in accordance with Section 01 33 00 – CONTRACTOR SUBMITTALS.
- B. Testing certificates from a qualified testing agency shall be submitted prior to acceptance of the rock source to verify the conformity to the requirements of the Contract Documents.

PART 2 -- PRODUCT

2.1 STONES FOR RIPRAP

- A. Stones shall be graded in size to produce a reasonably dense mass. Riprap shall consist of dense, natural rock fragments. Stones shall be resistant to weathering and to water action; free from overburden, spoil, shale, and organic material; and shall meet the gradation requirements below. Shale and stones with shale seams are not acceptable.
- B. Riprap shall conform to the size types as follows:

1. Type I (48~~24~~-inch Average Size):

Diameter	Percentage Passing
72 30 -inch (maximum size)	95 - 100
48 24 -inch	25 - 75
32 12 -inch	15 - 25

426-inch (minimum size)	0 - 5
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2. Type II (306-inch Average Size):

Diameter	Percentage Passing
5612-inch (maximum size)	95 - 100
306-inch	25 - 75
184-inch	15 - 25
422-inch (minimum size)	0 - 5

- C. The greatest dimension of 50 percent of the stones shall be at least two-thirds but not more than 1-1/2 times the diameter of the average size. Neither the breadth nor thickness of any piece of riprap shall be less than one-third its length. Material shall be of shapes which will form a stable protection structure of required depth. Rounded boulders or cobbles shall not be used.
- D. Stones shall consist of durable, sound, hard, angular rock meeting the following requirements for durability absorption ratio, soundness test, and abrasion test:

Durability Absorption Ratio	Acceptability
Greater than 23	Passes
10 to 23	Passes only if Durability Index is 52 or greater
Less than 10	Fails

Durability Absorption Ratio	<u>Durability Index (Coarse)</u> % absorption + 1
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- E. The durability index and percent absorption shall be determined by AASHTO T 210 and AASHTO T 85, respectively. The minimum apparent specific gravity of the stones shall be 2.5 as determined by AASHTO T 85.
- F. Stones shall have less than 10 percent loss of weight after five cycles, when tested per ASTM C 88.
- G. Stones shall have a wear not greater than 40 percent, when tested per ASTM C 535.
- H. Control of gradation shall be by visual inspection. The CONTRACTOR shall furnish a sample of the proposed gradation of at least 5 tons or 10 percent of the total riprap weight, whichever is less. If approved, the sample may be incorporated into the finished riprap at a location where it can be used as a frequent reference for judging the gradation of the remainder of riprap.

- I. The acceptability of the stones will be determined by the ENGINEER prior to placement. Any difference of opinion between the ENGINEER and the CONTRACTOR shall be resolved by dumping and checking the gradation of two random truckloads of stones. Arranging for and the costs of mechanical equipment, a sorting site, and labor needed in checking gradation shall be the CONTRACTOR's responsibility.

2.2 FILTER MATERIAL

- A. Filter material shall be clean and free from organic matter. It shall be crushed rock or gravel, durable and free from slaking or decomposition under the action of alternate wetting or drying. The material shall be uniformly graded and shall conform to the following gradation:

- 1. Type 1

Size	Percentage Passing
3-inch	85 – 100
1-1/2 inch	45 – 75

PART 3 -- EXECUTION

3.1 SURFACE PREPARATION

- A. Surfaces to receive riprap shall be smooth and firm, free of brush, trees, stumps, and other objectionable material, and shall be brought to the line and grade indicated.
- B. If a boulder is encountered during excavation of areas where large riprap is to be placed, the CONTRACTOR shall excavate around the boulder. If the boulder is larger than the largest allowable stone size for that area, the CONTRACTOR shall break up the boulder to an acceptable size or remove it entirely.
- C. Prior to placement of the geotextile, the surface shall be prepared to a smooth condition free of debris, depressions, or obstructions which may damage the geotextile. The geotextile shall be overlapped a minimum of 2-feet at longitudinal and transverse joints. Upstream sheets shall overlap downstream sheets. For slope placement, each strip shall overlap the next downhill strip. The geotextile shall be anchored using key trenches or aprons at the crest and toe of the slope. Pins may be used in securing the geotextile during installation. In no instance shall the geotextile be left exposed to sunlight longer than 7 Days. Overexposed geotextile shall be removed and replaced.

3.2 PLACEMENT OF FILTER BLANKET

- A. Area of riprap placement shall be excavated to the bottom of the filter blanket as indicated and in accordance with Section 31 30 00 – EARTHWORK. After the excavation has been completed, the top 12-inches of exposed surface shall be scarified, brought to optimum moisture content, and compacted to 95 percent of maximum density. The finished grade shall be even, self-draining, and in conformance with the slope of the finished grade.

- B. Placement of filter material shall be in accordance with Section 31 30 00 – EARTHWORK. Filter material shall be placed, spread, and compacted in lifts not to exceed 12-inches.
- C. The CONTRACTOR shall remove any portion of the filter blanket that has been disturbed to the degree that the layers become mixed. Replace the removed portion with the required sizes.
- D. Filter material shall be placed as follows, unless otherwise indicated.
 - 1. For Type I and Type II riprap, use 12-inches of Type 1 filter material.
- E. No filter material is required if riprap is placed directly on bedrock.

3.3 PLACEMENT OF RIPRAP

- A. Placement of riprap shall begin at the toe of the slope and proceed up the slope. The stones may be placed by dumping and may be spread by bulldozers or other suitable equipment as long as the underlying material is not displaced. Stones shall be placed so as to provide a minimum of voids. Smaller stones shall be uniformly distributed throughout the mass. Sufficient hand work shall be done to produce a neat and uniform surface, true to the lines, grades, and sections indicated.
- B. Where riprap is placed over a geotextile fabric, the riprap shall be placed so as to avoid damage to the geotextile. Stones shall not be dropped from a height greater than 3-feet, nor shall large stones be allowed to roll downslope.
- C. Thickness of riprap layer shall be 2x (Average Size) riprap.

- END OF SECTION -

31 51 00 - EARTH ANCHORS

PART 1 -- GENERAL

1.1 THE SUMMARY

- A. The CONTRACTOR shall provide earth anchors for the tie-back retaining wall, complete and in place, in accordance with the Contract Documents. Tie-back anchors beneath U.S Highway 89 shall be used as temporary measures for pinning the existing retaining wall during construction. The tie-back anchors shall be considered temporary and only used during construction. Following construction, the CONTRACTOR shall leave the tie-back anchors in-place, or as otherwise indicated by Utah Department of Transportation.
- B. The CONTRACTOR shall locate the existing penstock (vertical and horizontal) and prepare a plan for installation of tie-backs, including methodology for installation, that ensures that the penstock and adjacent U.S. 89 Highway will not be jeopardized. CONTRACTOR shall prepare design drawings and calculations (stamped by a registered engineer in the State of Utah) and submit to ENGINEER for approval.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards:

ACI 318	Concrete Construction
ASTM A 123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM A 153	Zinc Coating (Hot Dip) on Iron and Steel Hardware
ASTM A 385	Practice for Providing High-Quality Zinc Coatings (Hot-Dip)
ASTM A 722	Uncoated High-Strength Steel Bar for Prestressing Concrete
ASTM D 512	Test Methods for Chloride Ion in Water
ASTM D 922	Nonrigid Vinyl Chloride Polymer Tubing
PCI	Recommended Practice for Grouting of Post-Tensioned Concrete

1.3 CONTRACTOR SUBMITTALS

- A. Submittals shall be made in accordance with Section 01 33 00 - Contractor Submittals.
- B. The following submittals and specific information shall be provided.
 - 1. Complete data, detailed drawings, and installation drawings covering the earth anchors together with all components and accessories, stamped by a registered engineer in the State of Utah.
 - 2. All welds shall be properly identified on the detailed shop drawings.
 - 3. Submittals for the anchor rods shall include mill certificates as specified.
 - 4. Submittal showing installation procedure for tie-back anchors along U.S. Highway 89.

5. Submittal showing location of existing penstock and proposed location of tie-back anchors (horizontal and vertical).
6. Stamped design calculations by a registered engineer in the State of Utah.

1.4 QUALIFICATIONS

- A. The CONTRACTOR shall provide the services of a supervising engineer, registered in the State of Utah, with at least 3 years of experience in the design and construction of temporarily anchored walls. A foreman or superintendent experienced in the grouting of tiebacks shall be present while this work is performed.
- B. Drilling operators and foremen shall have a minimum of 1 year of experience installing permanent anchors. The CONTRACTOR shall submit satisfactory documentation showing that project personnel have appropriate qualifications.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. Anchor rods shall be of high-strength steel, uncoated; ASTM A 722, Type II (deformed). Dywidag Systems International Threadbars, Advanced Construction Enterprises ACE Allthread, or equal.
- B. Miscellaneous metal components, including enclosure tubes, wedge plates, anchor plates, bearing plates, couplers, and nuts, shall be carbon steel, hot-dip galvanized after fabrication in conformity with ASTM A 123, A 153, and A 385.
- C. Sheathing, including end cap, grout tube, sealing cap, and similar accessories shall be of PVC, minimum compressive strength of 50 ksi, minimum tensile strength of 7 ksi; smooth and corrugated shapes as shown.
- D. Corrosion inhibitors shall be mastic with maximum chlorides per ASTM D 512, 10 ppm; maximum nitrates per ASTM D 922, 10 ppm; maximum sulfides per ALPHA "Sulfide in Water," 10 ppm. **Visconorust 31664**, or equal. May be omitted by OWNER.
- E. Grout Additive shall be Sika Intraplast N or equal.

2.2 GROUT

- A. Grout shall be composed of portland cement, water, and an additive as indicated. Cement and water shall be as specified in Section 03 31 00 - Cast-in-Place Concrete.
- B. The proportions of cement, water, and additive shall, unless otherwise specified, conform to manufacturer's recommendations and the requirements of ACI 318 to produce a cement-rich grout with a compressive strength of not less than 5,000 psi at 28 days. Maximum chloride ion content of the grout shall not exceed the limits of ACI 318, Table 4.5.4.
- C. Tests of trial mixes for the cement-rich grout shall be performed to prove sufficient strength. Test reports shall be submitted for approval to the ENGINEER prior to use.

2.3 DESIGN CRITERIA

The CONTRACTOR is responsible for obtaining all necessary geotechnical information for design of the proposed earth anchor system.

2.4 FABRICATION

- A. Mill Certificates: For each heat of prestressing steel, mill certificates shall be submitted to the ENGINEER, showing ultimate force, yield force, and percent of elongation at rupture.
- B. General: All joints shall be made watertight by epoxy bonding compounds or equivalent, as approved by the ENGINEER.
- C. Anchorage and Couplers: Anchorage components shall develop at least 95 percent of the minimum ultimate strength of the bar tendon. Couplers shall develop the minimum ultimate strength of the tendon.
- D. Corrosion Protection:
 - 1. Corrosion protection of tie-back anchors is not required.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Installation of the earth anchors shall be in accordance with the instructions, procedures, and details shown and specified.
- B. General:
 - 1. Anchor tendons shall be placed in accordance with the manufacturer's recommendations and secured in place by approved supports. Care shall be taken that the anchor tendon is centered in the hole for the entire bond length.
 - 2. The CONTRACTOR shall include, in the bid, provisions to support any drilled holes that may cave in during construction.
- C. Grouting:
 - 1. The annular space between the anchor rod and the corrugated sheathing shall be grouted with noncorrosive grout over its full length prior to installation. The anchor load shall be transferred to the ground by bond. Anchor tendons shall not be bonded to the ground in the range of the free stressing length and shall stay permanently free for load checking and eventual necessary load adjustments, if desired.
 - 2. The grouting equipment shall be capable of continuous mechanical mixing to produce a grout free of lumps and undispersed cement. A manifold system with a series of valves and calibrated pressure gauge shall permit continuous circulation and pumping of grout with accurate control of grout pressure.
 - 3. Grouting operations shall be in accordance with the PCI "Recommended Practice for Grouting of Post-Tensioned Concrete" and the manufacturer's recommendations.
 - 4. Grout shall be injected at the lowest point of the drilled hole. Grouting shall proceed such that the hole is filled to prevent air voids. The hole shall be filled progressively from bottom to 2-feet above the bond length.

5. The free length shall be filled with a "Weak Grout" as shown.

- D. Corrosion Protection: The exposed end of the tieback shall be painted with two coats of commercial quality zinc-rich paint and covered with a galvanized steel enclosure tube secured to the bearing plate. The void within the steel tube shall be filled with corrosion inhibiting mastic by pressure injection at the low end and venting at the high end.

3.2 LOAD MONITORING DEVICES

- A. Permanent load cells shall be furnished and installed at the anchor locations shown. The load cells shall be annular in shape and hermetically sealed, with the center hole of adequate size to accommodate the tendon. The tendon shall be concentrically located in the annular space and the axes of the tendon and load cell shall be parallel to prevent eccentric loading.
- B. All necessary hardware and/or adapters required by the manufacturer for proper functioning of the load cells shall be provided. Permanent load cells shall be installed after all required tests have been successfully performed on the anchor. The capacity of each load cell shall be at least 125 percent of the design load.
- C. Weatherproof and waterproof terminal boxes and conduit to group instrument leads shall be furnished and installed at the locations shown.
- D. Unless otherwise approved by the ENGINEER, load cells shall be as manufactured by:

1. **Transducers, Inc.**

14030 Bolsa Lane
Cerritos, CA 90701
Phone: (213) 693-8872

2. **Geokon Incorporated**

48 Spencer Street
Lebanon, NH 03776

3. or equal

3.3 STRESSING AND TESTING

- A. Anchor Stressing: Stressing shall not start before the grout and the adjacent concrete lagging has reached a minimum compressive strength of 3,500 psi and 1,000 psi, respectively, and has set for at least 3 days after its placement in the drilled hole. A minimum of three grout cubes and concrete cylinders must have been tested and two must have reached the specified strength. Test reports shall be submitted to the ENGINEER for approval prior to stressing.
- B. Testing of Anchors: Testing of anchors shall be performed in accordance with the procedure shown.

- END OF SECTION -

SECTION 31 63 33 – DRILLED MICROPILES

PART 1 -- GENERAL

1.1 SUMMARY

- A. Section includes design and construction of micro-piles for foundation support.
 - 1. CONTRACTOR's design, installation and testing responsibility shall be as described in Appendix C of Federal Highway Administration publication "Micropile Design and Construction Reference Manual (2005)", Report No. FHWA-NHI-05-039 (FHWA) unless otherwise indicated.
 - 2. Section 1.5 of FHWA shall not apply.

1.2 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Related Requirement:
 - 1. Section 31 30 00 - EARTHWORK for backfill and subgrade preparation.
 - 2. Section 03 31 00 - CAST-IN-PLACE CONCRETE for structural concrete.

1.3 AVAILABLE INFORMATION

- A. Geotechnical Data (test boring and laboratory test results only) as presented in the geotechnical report.

1.4 MEASUREMENT AND PAYMENT

- A. Micro-piles shall be paid for on a "per pile" basis, with a predetermined cased and uncased lengths, and an add/deduct figure per lineal foot of cased and uncased lengths as required to develop the load capacities. Contract price per linear foot of cased and uncased lengths shall include all engineering and design services, supervision, labor, materials, products, accessories, tools, equipment, and incidentals to perform all work necessary to install and test the micro-piles, and pile-top attachments.
 - 1. Base Bid: Base bid on the number of verification and production micro-piles, and minimum cased and uncased lengths indicated.
 - 2. Add/Deduct Payment: Add/deduct payment per lineal foot based on actual total net lengths of cased and uncased lengths used to develop the load capacities as per data from the installation records.
 - 3. CONTRACTOR shall prepare and submit to the City Representative full-length installation records for each micro-pile installed. The records shall be submitted within one work shift after pile installation is completed.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with this work to attend including the following:
 - a. CONTRACTOR's superintendent.
 - b. Independent testing and inspection agency and City's geotechnical engineer.
 - c. Micro-pile engineer-of-record.
 - d. Micro-pile installer's on-site superintendent.
2. Review existing dam layout, geotechnical engineering work, verification and proof tests, vibration measurements, monitoring of vibration and ground movements, drilling, grouting, special inspection, testing and inspection agency's procedures for field quality control, micro-pile installation tolerances and plumbness measurements, core steel installation, and corrosion protection of steel casing and core steel.

1.6 SUBMITTALS

- A. Submittals shall be in accordance with Specification Section 01 33 00 CONTRACTOR SUBMITTALS.
- B. Installer Qualifications: Provide a list of five similar projects successfully completed, including names and resumes of the engineer in responsible charge, on-site superintendent, and drill rig operators. Provide contact information of the CLIENT for each project listed.
- C. Product Data: For each micro-pile components and grout material proposed.
 1. If polymer drilling fluid is proposed, include data in submittal.
- D. Equipment and Construction Procedures: Detailed description of equipment (including calibrations) and procedures proposed for installation of micro-piles, including drill type and size, methods of placement of steel casing and core steel reinforcement, and methods for missing and placing grout.
 1. Proposed equipment and methods of controlling and disposal of drilling spoils, fluids, and grout.
 2. Proposed methods for controlling location of core steel reinforcement within the pile cross-section.
 3. Proposed methods to continuously monitor vibrations, and ground settlements and movements to ensure that damage to existing buildings, structures, and site improvements is prevented.
 4. Proposed methods for establishing and controlling micro-pile location and elevations in the field.
- E. Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing installation and material requirements.
 1. Include all micro-pile components, pile-top attachment, and core steel reinforcement corrosion protection. Show details of core steel reinforcement and steel casing splices.

- F. Proposed Quality Control (QC) Procedures: Include procedures and frequency for sampling and testing of grout. If CONTRACTOR proposes using polymer drilling fluid, also include procedures and frequency for sampling and maintaining viscosity of drilling fluid as part of QC submittal. Use of bentonite-containing drilling fluid is not allowed.
- G. Proposed load testing procedures, materials, equipment, including diagrams and calculations for the test frame, and measures proposed for isolation of the ultimate load test pile above the micro-pile penetrating elevation.
- H. Material Certificates.
 - 1. Permanent and casing.
 - 2. Polymer Based Drilling Fluid (if used).
 - 3. Deformed reinforcement bars, including couplers.
 - 4. Cement.
 - 5. Aggregate for grout.
 - 6. Reinforcement bar double corrosion protection encapsulation sheathing.

1.7 QUALITY ASSURANCE

- A. Design, install, and test micro-piles in accordance with FHWA-NHI-05-039, "Micro-pile Design and Construction Reference Manual" dated December 2005, unless otherwise noted.
- B. Installer Qualifications: An entity (subcontractor) that has designed, installed, and tested micro-piles on at least 5 similar projects in the last 5 years involving at least 50 micro-piles each of similar capacity to those indicated.
 - 1. The ENGINEER in responsible charge shall have at least 5 years of experience in micro-pile design with the subcontractor
 - 2. The on-site foreman and drill rig operators shall have at least 5 years of experiences in micro-pile installation with the subcontractor.
- C. Welding: Qualify procedures and personnel according to AWS D 1.1, "Structural Welding Code – Steel".

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, handle and store materials at project site to prevent cracking, distorting, warping, or other physical damage.

PART 2 -- PRODUCTS

2.1 MATERIALS

- A. Reinforcement Bars: ASTM A 615, Grade 60.
- B. Steel Casing: API 5CT (N-80).

- C. Portland Cement: ASTM C 150, Type II or V.
- D. Fly Ash: ASTM C 618, Class F.
- E. Silica Fume: ASTM C 1240, amorphous silica.
- F. Normal-Weight Aggregates: ASTM C 144.
- G. Water: Potable.
- H. Drilling Fluid (if used): Polymer based only.

2.2 ACCESSORIES

- A. Couplers: Manufacturer's standard. Coupler shall develop the ultimate tensile stress of the core steel reinforcement.
- B. Double Corrosion Encapsulation Sheathing: ASTM D3350.
- C. Centralizers: Heavy plastic, wheel type.
- D. Postgrout tubes (if used): Schedule 40 PVC pipe maximum diameter 1-1/4 inch. Sleeved intervals in the uncased bond zone shall not exceed 5 feet.

2.3 GROUT MIXES

- A. Prepare design mixes with strength adequate for the loads imposed, and of a consistency to allow free flow of grout. Minimum 28 day compressive strength of grout shall be 4,000 psi.

PART 3 -- EXECUTION

3.1 PREPARATION

- A. Carefully review available data and site conditions prior to start of design.
- B. Carefully examine adequacy of support conditions along drilling and other construction equipment path of travel.
- C. Provide measures for control and disposal of drilling spoils, fluids, and grouts.
 - 1. All permits for disposal of drilling spoils, fluids, and grouts shall be acquired and all fees paid for by the CONTRACTOR.
 - 2. Discharge of substances into the reservoir or the river is not allowed.
- D. Provide layout and elevation control for micro-piles.

3.2 INSTALLATION TOLERANCE

- A. Install micro-piles not more than 3 inches horizontally from indicated plan location.
- B. Piles shall be plumb within 2 percent of the design alignment.
- C. Top elevation of pile shall be plus 1 inch or minus 1 inch from elevation indicated.

- D. Centerline of core steel reinforcement shall not be more than ½ inch from indicated location.

3.3 INSTALLATION

- A. General: Select drilling method and grouting procedure to be used. Piles installed when the City Representative or City's designated Geotechnical Engineer are not present will be rejected. Replacement pile shall be at CONTRACTOR's expense.

- B. Drilling: Drilling equipment and methods shall be suitable for drilling in the conditions to be encountered without causing damage to adjacent buildings, structures, utilities and site improvements. CONTRACTOR should review available geotechnical data indicated in Paragraph 1.4

1. The use of vibratory pile driving hammers to advance casing shall not be permitted.
2. The use of bentonite-containing drilling fluids shall not be permitted. Use only drilling fluid that has been submitted, reviewed, and accepted by the City Representative or City's designated Geotechnical Engineer.
3. Provide permanent steel casing from the bottom of the pile cap down to the bottom of the plunge depth in the alluvium. Minimum permanent casing length shall be as indicated on the Drawings.

- C. Placement of reinforcement: Reinforcement may be placed either prior to grouting or placed into the grout-filled hole.

1. Reinforcement shall be free of soil, mud, grease, oil or any other substance that might contaminate the grout or reduce bond.
2. Centralizers shall be provided at 10-foot maximum vertical spacing on core steel reinforcement. The upper and lower most centralizers shall be located a maximum of 5 feet from the top and bottom of the micro-pile.
3. Core steel reinforcement with centralizers shall be lowered into the stabilized drill holes to the desired depth without difficulty. Partially inserted steel reinforcements shall not be driven or forced into the hole such that there will be no interconnection or damage to piles in which the grout has not achieved final set.
4. Core steel reinforcement double corrosion protection must extend a minimum of 5 feet into the permanent casing.
5. Splice reinforcement and casing as required. Splicing method shall maintain alignment between the spliced sections. Stagger splices 2 feet minimum.

- D. Grouting

1. Grout shall be placed in the load transfer bond length the same day that hole is drilled.
2. Provide mixing and placing equipment adequate to produce lump-free grout, and to measure grout quantity and pressure during grouting. Pressure gauges shall be provided at the grout pump and at the injection head.

3. Grout shall be injected from the lowest point of the drill hole. Injection shall continue until uncontaminated grout flows from the top of the pile.
 4. Post-grouting, if used, shall be performed in accordance with the approved submittals.
- E. Grout sampling and testing: Sample and test grout for compressive strength in accordance with ASTM C 109 for each production micro-pile.
1. Test grout consistency per ASTM C188 just prior to placement in each micro-pile.
- F. Installation Records: Provide installation records in the form of installation logs as included in FHWA Appendix C. Provide separate log for each micro-pile.

3.4 PILE LOAD TESTS

- A. General: Provide all required testing equipment, gauges, frames, and accessories for a complete testing system. Provide personnel as required to record loads and displacements. Installation and testing will be observed by the City Representative.
- B. Verification Load Tests:
1. Perform pre-production verification pile load testing in accordance with ASTM D 3689 to verify the design of the pile system and the construction methods proposed prior to installation of production piles. One (1) sacrificial verification test pile of the same design as the type P1 pile at the southeast corner, and one (1) sacrificial verification test pile of the same design as the type P2 at the northwest corner shall be constructed in conformance with the approved shop drawings.
 - a. Test type P1 verification pile to maximum test load (MTL) of 47 kips in compression.
 - b. Test type P2 verification pile to maximum test load (MTL) of 111 kips in compression.
 - c. The verification pile load tests shall be made by incrementally loading the micro-pile in accordance with the following cyclic load schedule. Each load increment shall be held for a minimum of 1 minute. Pile top movement shall be measured at each load increment. The load-hold period shall start as soon as each test load increment is applied. The verification test pile shall be monitored for creep at the 0.55 MTL. Pile movement during the creep test shall be measured and recorded at 1, 2, 3, 4, 5, 6, 10, 20, 30, 50, and 60 minutes. The alignment load shall not exceed 2 percent of the maximum test load. Dial gauges shall be reset to zero after the initial alignment load is applied.

AL = Alignment Load		MTL = Maximum Test Load	
Step	Loading	Applied Load	Minimum Hold Time (minute)
1	Apply AL (0.02 MTL)		1
2	Cycle 1	0.10 MTL	1
		0.20 MTL	1
		AL	1
3	Cycle 2	0.10 MTL	1
		0.20 MTL	1
		0.30 MTL	1
		AL	1
4	Cycle 3	0.10 MTL	1
		0.20 MTL	1
		0.30 MTL	1
		0.40 MTL	1
		AL	1
5	Cycle 4	0.10 MTL	1
		0.20 MTL	1
		0.30 MTL	1
		0.40 MTL	1
		0.55 MTL	60 (Creep Test Load Hold)
		0.70 MTL	1
		0.80 MTL	1
		0.90 MTL	1
		1.00 MTL	10
AL	1		

d. Acceptance criteria for micro-pile verification load tests are:

- 1) The piles shall sustain the first compression at 40 percent maximum test load with no more than 0.75 inches for type P1 pile and 0.75 inches for type P2 pile total vertical movements at the top of the piles, relative to the position of the top of the piles prior to testing.
- 2) At the end of the 0.55 MTL creep test load increment, test piles shall have a creep rate not exceeding 0.040 in./log cycle time from 1 to 10 minutes or 0.080 in./log cycle time from 6 to 60 minutes. The creep rate shall be linear or decreasing throughout the creep load hold period.
- 3) Failure is defined as the load at which further increase in the test load simply results in continued pile movement.

e. The CONTRACTOR shall provide the City a written report confirming micro-pile geometry and construction details within 7 working days after the completion of verification load testing. This written confirmation will either confirm the bond lengths as shown in the shop drawings for micro-piles or propose modifications based upon the results of the verification tests.

f. If a verification-tested micro-pile fails to meet the acceptance criteria, the CONTRACTOR shall modify the design, the construction procedure, or both. The modifications may include modifying the installation methods or increasing the bond length. Any modification that necessitates changes to the structure design shall require the City Representative's prior review and acceptance. Any modification of design or construction procedures or cost of additional verification test piles and load testing shall be at the CONTRACTOR's

expense. At the completion of verification testing, test piles shall be removed down to the elevation specified by the City Representative.

2. Perform vibration analysis and testing during Verification Load Testing to confirm micro-pile installation induced ground motion will not cause damage to the buildings, structures, non-structural components, utilities, and site improvements.

C. Proof Load Testing: Perform proof load tests on the first set of production pile types P1 and P2 prior to installation of the remaining production piles in that group. The first set of production piles is the number required to provide the required reaction capacity for the proof test piles. Proof testing shall be conducted at a frequency of 5 percent of each of the subsequent production piles types P1 and P2 at locations as designated by the City Representative to test loads as follows:

1. Test type P1 production piles to maximum proof test load of 47 kips in compression; and type P2 production piles to maximum proof test load of 111 kips in compression.
2. The production pile load tests shall be made by incrementally loading the micro-pile in accordance with the following schedule:

AL = Alignment Load			MTL = Maximum Test Load
Step	Loading	Applied Load	Minimum Hold Time (minute)
1	Apply AL (0.02 MTL)		1
2	Load Cycle	0.15 MTL	1
		0.30 MTL	1
		0.45 MTL	1
		0.60 MTL	1
		0.80 MTL	10 or 60 minute Creep Test*
		1.00 MTL	1
3	Unload Cycle	AL	1

* Depending on performance, either a 10 minute or 60 minute creep test shall be performed at the 0.80 MTL. Where the pile top movement between 1 and 10 minutes exceeds 0.04 in., the maximum test load shall be maintained an additional 50 minutes. Movements shall be recorded at 1, 2, 3, 5, 10, 20, 30, 50, and 60 minutes. The alignment load shall not exceed 2 percent of the maximum test load. Dial gauges shall be reset to zero after the initial alignment load is applied.

3. Acceptance criteria for micro-pile proof load tests are:
 - a. The piles shall sustain the first tension of 60 percent of the production pile maximum test loads with no more than 0.75 inches for type P1 pile and 0.75 inches for type P2 pile total vertical movements at the top of the piles, relative to the position of the top of the piles prior to testing.
 - b. At the end of the 0.8 MTL creep test load increment, production test piles shall have a creep rate not exceeding 0.040 in./log cycle time (1 to 10 minutes) or 0.080 in./log cycle time (6 to 60 minutes). The creep rate shall be linear or decreasing throughout the creep load hold period.
 - c. Failure is defined as the load at which further increase in the test load simply results in continued pile movement.

4. If a proof-tested micro-pile fails to meet the acceptance criteria, the CONTRACTOR shall immediately proof test another pile of that pile type. For failed piles and further construction of other piles, the CONTRACTOR shall modify the design or construction procedure, or both. The modifications may include installing replacement micro-piles, modifying the installation methods, or increasing the bond length. Any modification that necessitates changes to the structural design shall require the City Representative's prior review and acceptance. Any modification of design or construction procedures or cost of additional proof test piles and load testing shall be at the CONTRACTOR's expense. No extension of time will be provided for replacing or installing additional pile.

3.5 TESTING AND INSPECTION

- A. City designated Geotechnical Engineer will:
 1. Review submittals for conformance with the requirements of Contract Documents.
 2. Observe pile installation.
 3. Observe and record results of pile load testing.
 4. Perform final determination of the acceptability of piles installed; assign reduced capacity to piles that fail to comply with specified requirements.
- B. The City's Testing Agency will perform compressive strength tests on grout samples in accordance with ASTM C109 (cubes). Test grout for production piles at 3, 7, and 28 days.

- END OF SECTION -