ESSENTIAL POWER

Kimberly D. Bose, Secretary
Federal Energy Regulatory Commission
888 First Street, N.E.
Washington, DC 20426

RE: Indian Orchard Project, FERC No. 10678-001

Dear Secretary Bose:

On September 11, 1992, the Commission issued a license for the continued operation of the Indian Orchard Hydroelectric Project, FERC No. 10678-001, located on the Chicopee River in Hampden County, Massachusetts, to Western Massachusetts Electric Company (WEMCO). Pursuant to Article 408 of the License and in accordance with a Programmatic Agreement (PA) among the Commission, the Massachusetts Historical Commission, and the Advisory Council on Historic Preservation signed in 1996, and following consultation with the Massachusetts State Historic Preservation Office (SHPO), the Licensee filed with the Commission a Cultural Resources Management Plan (CRMP) on June 2, 1998. On November 17, 1998 the Commission issued an order approving the CRMP.

The current licensee, Essential Power Massachusetts LLC (formally NAEA Energy Massachusetts, LLC) owns and operates the Indian Orchard Hydroelectric Project.

It is our intention to replace the minimum flow apparatus, currently twin culverts, with a new bottom discharge min flow gate that will more adequately meet the needs of our station. It will occupy the same location as the current min flow gate. The new gate will be carved out of the canal wall and rock anchors will be utilized to meet stability issues (see attached stability analysis).

It is our intention to begin this work on or around September 9th, 2013. During this time we will isolate our canal from the river, allowing all water from the river to pass over the dam. This will meet our min flow requirements for the duration of the work.

We anticipate that this letter will satisfy all notification requirements. If there are any questions concerning the project you can contact me at my office number, 413 730 4721 or my email kim.marsili@essentialpowerllc.com.

Sincerely,

Kim Marsili
Station Manager

cc: Brona Simon, MHC
cc: John Bahrs, VP. PGS. Essential Power LLC™
cc: Patrick Brown, Director Compliance Essential Power LLC™
cc: Melissa Grader U.S. Fish and Wildlife Service
cc: Caleb Slater PhD Mass division of Fisheries and Wildlife
cc: Robert Kubit P.E. MassDEP Division of Watershed Management

QUALITY CONTROL AND INSPECTION PROGRAM

INDIAN ORCHARD MINIMUM FLOW GATE PROJECT

Prepared for:

Essential Power Energy Massachusetts, LLC
West Springfield, Massachusetts

Prepared by:

Kleinschmidt

Pittsfield, Maine
www.KleinschmidtUSA.com

August 2, 2013

QUALITY CONTROL AND INSPECTION PROGRAM

INDIAN ORCHARD MINIMUM FLOW GATE PROJECT

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August 2, 2013

QUALITY CONTROL AND INSPECTION PROGRAM

ESSENTIAL POWER ENERGY MASSACHUSETTS, LLC

INDIAN ORCHARD MINIMUM FLOW GATE PROJECT

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LIST OF APPENDICES

QUALITY CONTROL AND INSPECTION PROGRAM

ESSENTIAL POWER ENERGY MASSACHUSETTS, LLC

INDIAN ORCHARD MINIMUM FLOW GATE PROJECT

Essential Power Energy Massachusetts, LLC (EP) will be removing a portion of the canal wall and replacing the existing corrugated steel drain pipe with a new concrete trough and a single steel gate with a new gate operator at the Indian Orchard facility. In accordance with the Order and Section 12(a)(2) of the FERC's regulations, EP has prepared this Quality Control and Inspection Program (QCIP) for the construction work.

EP proposes to commence construction activities in 2013. The estimated length of time to complete the repair work is 5 months. The project design engineers are Kleinschmidt Associates of Pittsfield, Maine. Kleinschmidt Associates also have a regional office in Essex, CT.

1.0 ORGANIZATION CHART

Observation of construction activity will be conducted periodically by a Resident Project Representative (RPR) employed by EP. The RPR's primary contact with the construction work force will be through the Construction Supervisor. Other specialized representatives, as discussed in Item 2 below, will be present to assist the RPR in specialized monitoring tasks.

The Project Quality Control Team will consist of the RPR, and the concrete testing agency.

2.0 NUMBER AND SPECIALTIES OF FIELD REPRESENTATIVES

Observation and monitoring of construction activities will be conducted in the field by the RPR on a periodic basis. The RPR will observe and report on compliance with contract documents. Concrete sampling and testing will be conducted by an independent testing laboratory. No blasting is anticipated.

Supervision and inspection will be conducted by the RPR.

3.0 DUTIES AND RESPONSIBILITIES

Attached as Appendix A2 to this report are resumes of the RPR and key engineering personnel assigned to the project. Any change in personnel, responsibilities, or in the scope of activities will be noted in the quarterly reports which will be filed with the Regional Director.

The RPR will be at the construction site during times of major construction activities and will report on progress and potential problems to the project design engineer and EP. The concrete testing agency will frequent the project site only during those times when construction activities which they have been assigned to monitor are occurring. They will report on testing results to the RPR.

The contractor will be responsible for the safety of all personnel at the construction site. Contractor adherence to applicable safety requirements, including the Temporary Construction Emergency Action Plan for this project work, is required by the contract specifications.

The duties and responsibilities of the RPR are outlined in Appendix A1 of this report. The RPR shall have the authority to stop construction activities for non-compliance with the quality control and sediment control plans.

4.0 FIELD TESTS

Field tests to be performed will consist of concrete sampling and testing. Taking of fresh concrete samples will be performed by the testing agency. Details regarding the frequency of testing and monitoring will be discussed on the drawings and in the monitoring activities report which will be submitted to the Commission. As a minimum, one sample consisting of four cylinders will be taken on any day concrete is placed, and not less than one sample per 100 cubic yards per day, or at such other times when changes or alterations in mixtures occur. Monitoring of form removal, surface defects, etc., will be done by the RPR.

The Contractor shall perform load testing of the rock anchors. The RPR shall monitor testing and data collected, such as elongation data shall be provided to the RPR for review and acceptance.

5.0 FIELD LABORATORY FACILITIES

No field laboratory facilities are planned.

6.0 COMMERCIAL TESTING SERVICES

The testing of the concrete samples will be performed by a local independent material testing firm.

7.0 USE OF CONSULTANTS

The Project Owner does not anticipate using any additional consultants other than those described above.

8.0 SCHEDULE OF CONSTRUCTION

1) Award of Contractor's Contract xxxxxx 2013
2) Mobilization xxxxxx 2013
3) Demolition xxxxxx 2013
4) Concrete Work xxxxxx 2013
5) Gate Installation and Testing xxxxxx 2013
6) Demobilization xxxxxx 2013

Observation of construction activities will cover, among other things, the following items:

a. Temporary Access road to the canal wall
b. Demolition work
c. Placement of reinforcing steel
d. Placement of concrete
e. Construction and removal of formwork

9.0 EROSION CONTROL AND OTHER ENVIRONMENTAL MEASURES

A separate soil erosion and sedimentation plan will be incorporated into the work.

APPENDIX A1

DUTIES AND RESPONSIBILITIES OF THE RESIDENT PROJECT REPRESENTATIVE

(Later)

APPENDIX A2

RESUMES

(Later)

SECTION 01590 – SOIL EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.0 RELATED DOCUMENTS

Drawings and general provisions of Contract, including Terms and Conditions and other Specification Sections apply to work of this section.

1.1 DESCRIPTION OF WORK

The work consists of providing sedimentation basin, silt fences, hay bale dikes, erosion control facilities and/or other approved measures necessary to prevent water contamination or disturbance of sediments.

1.2 QUALITY ASSURANCE

Codes and Standards: Comply with permits and local, state and federal governing regulations regarding water quality and disposal of canal dredged material.

PART 2 – PRODUCTS

2.0 SILT FENCE

Provide silt fence conforming to the following:

A. Equivalent opening size of a U.S. standard sieve size of 40 (max.), 70 (min.).

B. Mullen Burst Strength – 200 psi.

C. Grab strength – 120 lbs. min.

D. Spun-Bonded nylon fabric reinforced with polyester netting, or polypropylene fabric with 2” x 4” 12 Ga. woven wire backing fence.

E. Acceptable Manufacturer: Subject to compliance with requirements, provide silt fences from one of the following:

Harris Silt Fence, By Amoco Fabrics and Fibers
MIRAFI 100X, by Celanese

2.1 SUPPORT POSTS

Six inch minimum in length, spaced 6' o.c. max.

2.2 HAY BALE DIKE

Provide clean, seed free hay bales which are locally available.

2.3 SEDIMENTATION BASIN

Sediment laden water shall not be released into any waterway. Contractor shall provide appropriately sized sedimentation basin or other approved sediment removal devices for his dewatering or water diversion activities.

Location and details of sedimentation basin or other devices shall be submitted to Owner for his approval prior to dewatering activities.

2.4 TURBIDITY CURTAIN

As needed, provide a pre-manufactured turbidity curtain of continuous construction for the project site. The turbidity curtain shall consist of an impervious membrane, with an integral foam filled billet flotation system and a continuous integral weight system to prevent movement of the curtain base. The curtain shall be capable of withstanding the flow velocity of the canal without sustaining a blow-by of the contained sediment laden water.

A. Acceptable Manufacturer: Subject to compliance with requirements, provide turbidity curtain from available manufacturers:

Cormier Turbidity Curtain – A.H. Harris
Lagoon Baffles – Slickbar Products Corp. – Seymour, CT.

PART 3 – EXECUTION

3.0 INSTALLATION

A. Silt Fence/Hay Bale Dike: Install in accordance with manufacturers recommendations prior to beginning clearing operations in the affected areas.

a. Maintenance – The Contractor shall remove accumulated sediment from the silt fence when the accumulation reaches 30% of the capacity of the fence. The hay bale dike shall be removed/replaced when deterioration of the effluent quality is evident. The silt fence or hay bale dike shall be maintained until project completion.

B. Turbidity Curtain: Install in accordance with manufacturer's recommendations. Remove site debris which may puncture membrane during installation process. Do not drag membrane along ground. Provide adequate anchorage at either end of membrane to prevent movement from intended location.

3.1 INSPECTION

Contractor shall inspect all soil erosion and sediment control measures at least once per week and immediately following rainstorms or other periods of heavy runoff.

Contractor shall provide one individual to inspect soil erosion and sediment control measures.

Contractor shall have adequate men, equipment, and extra materials at the site to facilitate immediate repairs during rainstorms to the specified soil erosion and sediment control measures.

The Contractor shall maintain a weekly log of the condition of the soil erosion and sediment control measures noting deficiencies, additional repair/replacement work necessary, and dates and times of inspection. If corrective work is required, the weekly log shall indicate dates of observance and completion of corrective work. Upon completion of Contractor's activities, Contractor shall provide the weekly log to the Owner and the log shall become the property of the Owner.

END OF SECTION

TEMPORARY CONSTRUCTION EMERGENCY ACTION PLAN

INDIAN ORCHARD MINIMUM FLOW GATE PROJECT

Prepared for:

Essential Power Energy Massachusetts, LLC
West Springfield, Massachusetts

Prepared by:

Kleinschmidt

Pittsfield, Maine
www.KleinschmidtUSA.com

August 2, 2013

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TEMPORARY CONSTRUCTION EMERGENCY ACTION PLAN

ESSENTIAL POWER ENERGY MASSACHUSETTS, LLC

INDIAN ORCHARD MINIMUM FLOW GATE PROJECT

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TEMPORARY CONSTRUCTION EMERGENCY ACTION PLAN

ESSENTIAL POWER ENERGY MASSACHUSETTS, LLC

INDIAN ORCHARD MINIMUM FLOW GATE PROJECT

Essential Power Energy Massachusetts, LLC (EP) will be providing a minimum flow gate system at the project's canal including mobilization, demobilization of utilities, care of water, cofferdams, and required hardware and equipment. In accordance with the Order and Section 12(a)(2) of the FERC's regulations, EP has prepared this Temporary Construction Emergency Action Plan (TCEAP) for the construction work.

1.0 PROPOSED IMPROVEMENTS

The project has a required minimum flow release of 247 cfs. The present method of passing flow is through two sections of corrugated steel pipe that is located through the canal wall. The two sections of piping are degraded and flow through the pipe appears to be partially blocked. In order to provide a more constant flow rate, a gate system will be installed in the canal wall, replacing the piping and gate currently installed.

2.0 DESCRIPTION OF PROPOSED CONSTRUCTION ACTIVITIES

2.1 GATE

The proposed gate system consists of a new 9 ft high x 7 ft wide opening in the canal wall, replacing the existing flow piping. Gate system guides and seals will be installed in the opening structure.

2.2 CONSTRUCTION

The new gate opening in the existing canal wall will require dewatering of the canal to allow the gate system to be installed. Water leakage into the canal may require installation of a cofferdam or a simple sand bag barrier to establish a working area around the existing spillway.

Approximately nine (9) rock anchors will be installed along the canal wall to improve canal wall stability. Details and approximate locations are shown in the drawing package.

2.3 SITE ACCESS

Access to the work will be along the downstream face of the project's canal wall.

A crane pad will be placed and below the canal wall to support installation of the new gate system. Demolition will be performed primarily with hand operated jack hammers. Demolition material will be loaded by crane on to a truck for removal to a suitable disposal site.

2.4 CONSTRUCTION SCHEDULE

Construction is scheduled to occur later. Approximate dates for each phase of construction are as follows:

1) Project planning and mobilization xxxxxx 2013
2) Prepare construction access and staging xxxxxx 2013
3) Demolition xxxxxx 2013
4) Construct opening xxxxxx 2013
5) Install gate system xxxxxx 2013
6) Site demobilization xxxxxx 2013

3.0 SAFETY PRECAUTIONS AND EMERGENCY ACTION PLAN

Safety precautions being proposed to protect those individuals working at the construction site during the construction period include:

- In case of an emergency, the construction superintendent will be responsible for immediately notifying the Owner's supervisory personnel.
- A specific individual shall be designated and made responsible for coordinating the safety program and rescue operations.
- Comply with other EP, State, or Federal OSHA-required equipment, or any equipment or procedures which will enhance and improve the overall safety of the Contractor's or the Owner's personnel.
- An automatic visual/audible alarm system will be utilized at the site to alert the work force to a rise in canal water elevation. This stand-alone system will also be capable of being manually triggered by workers. The alarm system will be placed in areas where it will be visible and audible to those working in the vicinity of the work area.

- Use of emergency ladders, and the designation of “safe areas”.
- Any construction personnel working around water will be required to wear life jackets.
- All construction personnel will be required to comply with OSHA Regulations when working adjacent to the water.

The contractor will be required to hold informational meetings, prior to initiating any construction activity and periodically thereafter, to inform workers of the actions to be followed should any of the alarms be activated. The workers will be instructed to exit the work area via one of several ladders extending into the work area and will be informed of the “safe areas”. Any new workers joining the crew after construction begins will be given the same instructions prior to their starting work.

In case of an emergency, the construction superintendent will be responsible for immediately notifying EP. They will have the telephone numbers of key emergency response personnel to be contacted and will be responsible for contacting those agencies in the event of an emergency.

In the event of an emergency during construction, EP will be responsible for notifying:

xxxxxxxxxxxxxxxxx Director, FERC NYRO	work: xxx.xxx.xxxx cell: xxx.xxx.xxxx

or

Nicholas A. Hollister Lead Engineer	work: 413.730.4789 cell: 717.580.4352

This TCEAP is for alerting the construction workers and other supervisory personnel in the immediate vicinity of the project to a rise in water level, or any other occurrence that may threaten safety. Further precautions to protect workers will be provided by the contractor in accordance with regulatory and insurance obligations, and EP’s Contractor Safety Work Rules (located elsewhere in this project manual).

CANAL WALL
ROCK ANCHOR SPECIFICATIONS

INDIAN ORCHARD HYDROELECTRIC PROJECT

Prepared for:

Essential Power Energy Massachusetts, LLC
West Springfield, Massachusetts

Prepared by:

Kleinschmidt

Essex, Connecticut
www.KleinschmidtUSA.com

August 2013

CANAL WALL
ROCK ANCHOR SPECIFICATIONS

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Prepared for:

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CANAL WALL
ROCK ANCHOR SPECIFICATIONS

INDIAN ORCHARD HYDROELECTRIC PROJECT

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SECTION 02995 - ROCK ANCHORS (Cement Grouted)

PART I - GENERAL

1.1 Related Documents

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to work of this Section.

B. Construction drawings titled:

EP Energy Massachusetts, LLC
Indian Orchard
Minimum Flow Gate Project

C. Selected existing construction drawings of the project structures, provided for informational purposes.

–No. 58005-10001 Dumped Rockfill at Existing Retaining Wall of Canal Spillway dated June, 5, 1967

1.2 Description of Work

A. Extent of rock anchor work is as shown on the construction drawings and as specified herein.

B. Work involves providing (design, fabricate, furnish, and install ready for intended use) permanent rock anchors with a Design Load of 11,500 plf (pounds per lineal foot) for the existing Canal Wall and 29,000 plf for the proposed trough section of the Canal Wall. The number, spacing, and working load capacity of the anchors shall be determined by the Contractor.

C. Anchors shall be fully bonded, installed and grouted in a corrugated HDPE sheath that extends from the tip of the anchor to the anchor head. Rock anchors may be multi-strand or solid bar at Contractor's option.

D. This specification is intended to serve as a performance specification, to provide the Contractor with the baseline requirements to be used in the Contractor's design and installation of permanent rock anchors.

1.3 Definitions

A. Rock Anchors: Defined as seven (7) wire multi-strand tendon anchors or high strength solid steel bars with threads, and are intended as permanent anchors. The anchors shall be designed, fabricated and installed per these specifications and the requirements of the Post-Tensioning Institute (PTI). The words “Tendon” or Bar” are interchangeable and shall be used in the appropriate context.

B. Consolidation Grouting: Defined as pre-grouting of the anchor hole to ensure/increase water tightness of the hole, and to increase unconfined compressive strength of the canal wall (if needed).

C. Corrosion Protection:

The anchor shall be provided with Multiple Corrosion Protection (MCP) Type II-Class 1 as defined by the PTI.

Or,

The anchor is encased in a cement grout filled corrugated tube, with the corrugated tube extending from the tip of the anchor to the anchor head, and grouted with cement into the anchor hole in two stages for the full height. The first stage will be for the (lower) bond zone located in the foundation rock, the second stage will be for the length of anchor extending from the lower bond zone to the anchor head (stressing zone).

D. Project Site: The space available to Contractor for performance of the work. The extent of project site is shown on the drawings, and may or may not be identical with description of the land upon which project is to be built.

E. Contractor: The firm used to provide the rock anchor work.

F. Approve: Where used in conjunction with Owner's response to submittals, requests, applications, inquiries, reports and claims by Contractor, the meaning of term "approved" will be held to limitations of Owner's responsibilities and duties as specified in Standard Terms and Conditions of a Construction Contract. In no case will "approval" by Owner be interpreted as a release of the Contractor from the Contractor’s responsibilities to fulfill requirements of the contract documents.

G. Directed, Requested, etc.: Where not otherwise explained, terms such as "directed", "requested", "authorized", "selected", "approved", "required", "accepted", and "permitted", mean "directed by Owner", "requested" by Owner", etc. However, no such implied meaning will be interpreted to extend Owner's responsibility into the Contractor's area of construction supervision.

H. Furnish: Except as otherwise defined in greater detail, term "furnish" is used to mean supply and deliver to project site, ready for unloading, unpacking, assembly, installation, etc., as applicable in each instance.

I. Indicated: The term "Indicated" is a cross-reference to graphics, notes or schedules on drawings, to other paragraphs or schedules in the specifications, and to similar means of recording requirements in the contract documents. Where terms such as "shown", "noted", "scheduled", and "specified" are used in lieu of "indicated", it is for purpose of helping reader locate cross-reference, and no limitation of location is intended except as specifically noted.

J. Install: Except as otherwise defined in greater detail, term "install" is used to describe operations at project site including unloading, storing, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, disposal of materials, and similar operations, as applicable in each instance.

K. Provide: Except as otherwise defined in greater detail, term "provide" means furnish and install, complete and ready for intended use, as applicable in each instance.

L. Testing Laboratory: An independent entity engaged to perform specific inspections or tests of the work, either at project site or elsewhere; and to report and (if required) interpret results of those inspections or tests. Testing Laboratory shall be independent of the operations of the Contractor and his suppliers, and sub-contractors. Testing Laboratory will be hired by the Owner, and test results will be reported directly to the Owner and the Design Engineer.

M. Design Engineer/Engineer of Record: Kleinschmidt Associates, 35 Pratt Street, Suite 201, Essex, CT, 860-767-5069, Attn: Harold Thompson, P.E., the entity (person or firm) engaged by Owner for the performance of engineering services as directed by the Owner. The Contractor shall direct all questions to the Owner and/or his designated representative. The services of the design engineer will be available to the Owner for the bidding/construction process. The Design Engineer will perform for the Owner a technical review of the Contractor’s Submittals, and will address technical issue that may arise during construction.

N. Engineer: For the purpose of these Contract Documents, the “Engineer” is the individual as designated and assigned to the project by the Owner. The Design Engineer, *Kleinschmidt Associates*, is not to be assumed as the “Engineer” for purposes of the Contract Documents unless otherwise indicated.

O. Site Inspector: The individual acting as the Engineer's agent at the site. The Site Inspector will act as directed by and under the supervision of the Engineer, and will confer with the Engineer regarding the Site Inspector's actions. Site Inspector's dealings in matters pertaining to the on-site work shall in general be with Engineer and Contractor, keeping Owner advised as necessary. Site Inspector's dealing with subcontractors shall only be through or with the full knowledge and approval of Contractor. Site Inspector shall generally communicate with Owner with the knowledge of and under the direction of Engineer.

1.4 Job Conditions

A. The work does not require the Contractor to provide or allow for any means for de-stressing, restressing, or reloading of the anchors at some future date, nor does the work include installing or providing for long term monitoring of anchor movement, creep, or anchor load. The anchors are fully bonded, and the anchor head and wedges will remain in place and loaded at the completion of the work. The anchor heads will be fully encased in concrete and considered to be inaccessible.

B. Operation of the Indian Orchard Hydroelectric Project

1. Contractor shall coordinate with the Owner to schedule portions of the work during canal outage.

2. Owner anticipates that the Contractor will access the work within the canal. The Owner has not applied for, nor does the Owner intend on applying for any permits for the placement of fill in the waterways to accommodate the Contractor's access to the work.

C. Flood Conditions:

1. The Owner will reimburse the Contractor for limited delays in the work as a result of flooding, as described in PART 4 – MEASUREMENT AND PAYMENT. The Owner is under no obligation to reimburse the Contractor for losses that may result from the Contractor's inactions at securing the work and construction equipment during a flood event.

D. Temporary Utilities/Storage

1. Owner will provide the Contractor with access to 240V, 150 Amp power supply for the Contractor's use. The Contractor is responsible for providing appropriate ground fault protection, fusing and disconnects, and power distribution to locations needed to perform the work.

2. Contractor is responsible for providing telephone and sanitary facilities for use in performance of the work. If Contractor locates field office near the access road into the powerhouse, then he can tap into Owner's exiting potable water supply and sanitary facilities. The gatehouse is not equipped with potable water or sanitary facilities.

3. The Owner will provide the Contractor with access to a designated laydown/storage areas located on the Project grounds near the area of work. Vehicular access to the Project Site is restricted through the Owner's access gates. The Contractor may provide security fencing to meet these needs. The Owner does not warrant or guarantee the safety or security of the Contractor's equipment or materials even if they are located within a security fence.

4. Contractor is responsible for providing all personnel, equipment, and materials trailers as may be required in performance of the work.

1.5 Quality Assurance

A. All work shall be performed by a Contractor with experience in the design, fabrication and installation of rock anchors of the type intended.

B. The Contractor shall utilize a Supervising Engineer and Foreman each with at least 3 years of experience in the installation of permanent rock anchors, and experience with not less than three projects using the type of corrosion protection system(s) being intended or proposed for the work. The Contractor's Supervising Engineer shall be present as necessary, and the Foreman shall be present at all times during execution of the work. Both shall be thoroughly experienced with materials being installed, referenced standards, and requirements of this work. Drilling operators shall have experience installing permanent rock anchors. The Contractor will not be allowed to substitute or otherwise replace the Supervising Engineer or Foreman without the approval of the Owner.

C. The design, fabrication, installation, and testing of the rock anchors shall be done in accordance with these specifications and the "Recommendations for Prestressed Rock and Soil Anchors, Post-Tensioning Manual," Post-Tensioning Institute, Phoenix, Arizona, latest edition.

D. Prior to installation of rock anchors, Contractor shall confirm structural integrity of the existing canal wall against design loads imposed from the rock anchors and approved by the Owner. Also, water-pressure testing and consolidation grouting (if required) of each anchor hole shall be completed.

E. Each rock anchor shall be tested, by either a performance or proof test as specified, and locked-off at the specified working load. Lift-off tests are also required on a limited number of rock anchors.

F. All rock anchor proof and performance testing shall be conducted in the presence of the Owner. Work completed without the Owner’s presence will not be accepted.

G. The Contractor shall monitor and record all data associated with the performance and proof tests, with copies submitted to the Owner for record purposes.

1.6 Submittals

A. With his Bid, the Contractor shall submit the following information:

Name and experience of the Supervising Engineer and Foreman. Their experience list shall clearly identify the type of corrosion protection system used for the referenced projects, and must clearly identify their experience using the type of corrosion protection system(s) being proposed.

A reference list of not less than three projects completed within the last five years by the Contractor using the same corrosion protection system as intended for the work. The list shall identify: the owner, the project, current available contact with telephone number(s), the number and size of the rock anchors, when the work was completed, and the Supervising Engineer and Foreman.

The proposed means to access all areas of the work including a description of the equipment to be used to perform each key portion of the work.

A milestone schedule of the time required to design and install the rock anchors. As a minimum the schedule shall identify the following milestones: Design; shop drawing submittals; fabrication schedule; mobilization; drilling, installing, grouting, and testing of the anchors.

B. The Contractor shall submit to the Owner for review, a plan and detail of the means proposed to remove the fines and cuttings from the drilling fluids prior to return discharge to the river.

C. The Contractor shall obtain Owner's approval prior to the ordering of materials to be used in the anchor manufacture and installation. Owner's approval is contingent upon receipt of approval from the Federal Energy Regulatory Commission (FERC). The Contractor shall submit six (6) copies of the following final design information to the Owner for review and approval, and the Owner will submit same to the FERC for their review and approval:

Details of the rock anchor size, size of anchor hole, embedment length, anchor head, bearing plates and grout pads, material strength, corrosion protection and corrosion protection repair procedure. Include calculations to document the required size of the bearing plate and grout pads, length of the bond zone, and depth of embedment. If the Contractor utilizes a computer program in the sizing and design of any of the anchor components, the Contractor shall provide documentation describing the methods used in the program's computations.

Details of the concrete and reinforcing steel to be used to encase the anchor head. If the details are the same as shown on the construction drawings, then additional details are not required.

Details of the equipment and procedures the Contractor proposes to use for water pressure testing of the rock anchors.

Details of the proposed installation procedures for the rock anchors, including description of equipment to be used in drilling holes, installing and loading the rock anchors.

Details and manufacturer's literature describing the proposed grout material and additives, grouting process, and equipment.

Details of proposed grout mix design including estimated setting time, strength properties, temperature-set time curve, and recommended installation procedures.

Details and proposed method, materials, and equipment for consolidation grouting. Details on consolidation grouting plan within the anchoring structure (if required). Provide the details if the means, methods, and equipment, differ from that used to grout the anchor. Additional design details shall be submitted to the Owner, if unconfined compressive strength of the anchoring structure is deemed inadequate to withstand the imposed anchor loads.

Copies of proof/performance tests sheets to be used to record testing of anchor loads/movements. Contractor may use performance and proof load test sheets which are included at the back of this specification section or the Contractor may submit for the Owner's approval, the Contractor's standard test sheets, if they provide the required information.

D. Prior to testing the rock anchors, submit manufacturer's information for the equipment to be used to conduct performance and proof tests on the rock anchors. Submit diagram(s) showing the geometry of performance and proof test equipment relative to rock anchor, end hardware, method of locking off specified pretension load and calibration data for the system of jack and gauges, including the following:

A calibration, conducted by a certified testing agency, for the complete jacking assembly, together as a unit. Jacks and gauges shall individually be identified (by serial number) and calibrated against known standards at intervals not exceeding six months. Gauges may be calibrated against a master gauge of known accuracy, provided the jacks are calibrated against the same master gauge. The Contractor shall provide a production and master gauge for use with each jacking assembly. The master gauge shall be used to provide calibration checks of the production gauge.

Calibration certificates, including a plot of gauge pressure versus actual jack force for each jacking assembly used, shall be presented thirty (30) days prior to the first performance test.

A diagram of the Contractor's proposed test equipment setup(s) for monitoring the elongation of the anchors during performance and proof tests on rock anchors. The test equipment setup(s) proposed shall be completely independent of the jack, and shall include a micrometer dial gauge, capable of measuring anchor tendon extension to the nearest 0.001 inch and be mounted on an adjustable tripod or other device with flexible extension arms or a "goose neck" to permit rapid alignment of the dial gauge axis with the axis of the rock anchor.

Certified mill reports for each heat or lot of prestressing material used to fabricate rock anchors. Provide certificates upon delivery of the rock anchors to the site.

E. For record Purposes, Contractor shall submit to the Owner, by individual rock anchor, final documentation of:

Elevation (in reference to Mean Sea Level datum) of dam-rock interface encountered when drilling holes,

Bottom (tip) elevation of anchors, length of bond zone, anchor length (from tip to bottom of base plate) and installation angle from vertical,

Findings in drilling holes (if any),

Repairs to the corrosion protection system (if any),

Results of water pressure tests,

Result of all anchor proof, performance, lift-off tests, and actual lock-off load,

Grout take for consolidation grouting (if any) and gallons of water per bag of cement for the consolidation grout,

For those holes that were consolidated with grout, list the depth of hole redrilled,

Grout take for rock anchor grouting and gallons of water per bag of cement for the grout,

Time lapse between installation and grouting.

PART 2 - PRODUCTS

2.1 Materials

All materials shall conform to the requirements of the Post-Tensioning Institutes "Recommendations for Prestressed Rock and Soil Anchors".

2.2 Rock Anchors

A. Tendon: Multiple strand. Grade 270 low relaxation steel, minimum diameter of strand shall be 0.5 inches. Uncoated Strand: Conform to ASTM A416, "Standard Specifications for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete". A minimum of three strands shall be used for tendon anchors.

Bar: High-strength, solid steel bar with threads, Grade 150, ASTM A722.

B. Corrosion Protection:

Fully bonded and encapsulated anchors: Multiple Corrosion Protection (MCP) Type II-Class 1, or where the tendon/bar is fully encased in a cement grout filled corrugated sheathing, with the sheathing extending from the tip of the anchor to the anchor head. The anchor is grouted in two stages. The use of epoxy coated anchors will not be considered.

C. Corrugated Sheathing

Corrugated sheathing shall be HDPE, with a minimum wall thickness of 60 mils. Sheathing shall have an inside diameter that will provide a minimum of ½-inch of grout cover between the outer most anchor tendons and the sheathing. Sheathing shall include spacers to insure a minimum of ½-inch of grout cover between the sheathing and the anchor hole.

D. Anchorages:

1. The bearing plate and any bearing pads shall be fabricated from mild or high strength steel and shall be capable of bearing a minimum of 80 percent (80%) of the guaranteed minimum ultimate tensile strength (GUTS) of the tendon steel elements. The bearing plates in combination with any grout or reinforced concrete bearing pads shall not exceed a bearing pressure of 2,500 psi on the new concrete. Allowable bearing pressure on any proposed grout or reinforced concrete bearing pads shall not exceed the compressive strength of the bearing pads. The need for and design of any spiral reinforcing within any grout or reinforced concrete bearing pad shall be performed by the Contractor.

2. The bearing plate and or the anchor head shall be designed to accommodate all of the grouting tubes that are required for the two stage

grouting of the anchor inside and out of the corrugated sheathing (four grout tubes).

3. Wedges: Shall be designed to preclude premature failure of the pre-stressing steel due to notch or pinching effects. Wedges shall not be reused.

4. Anchorages do not need to be of the restressable or destressable type.

5. Trumpet (if needed) shall be per Contractor's requirements in consideration of the corrosion protection system and the use of bearing pads.

E. Centralizers

Centralizers shall be fabricated from any material, except wood, which is non-detrimental to the prestressing steel elements. The centralizer shall position the tendon in the corrugated sheathing so a minimum of 0.5 inch of grout cover is provided around each anchor strand. Centralizers shall also be used to position the corrugated sheathing in the drill hole so a minimum of 0.5 inch of grout cover is provided between the sheathing and the anchor hole. Centralizers shall be spaced at a maximum of 10-foot intervals.

F. Spacers

Spacers shall be used to separate strands of multi-strand tendons and be spaced at 5 to 10-foot intervals. They shall be fabricated from any material, except wood, which is non-detrimental to the prestressing steel. A combination centralizer/spacer can be used. Provide a minimum of three spacers in the bond zones.

2.3 Mastic Coating

Mastic Coating for anchor heads shall be TC-MASTIC by the Tapecoat Company. Clean anchor head and bearing plates of rust and oils and apply 20 mil wet (12 mil dry) mastic coating.

2.4 Grout

A. Cement Grout for use with rock anchors and consolidation grouting shall be made using Type I, II, or III Portland cement conforming to ASTM C150. Water from the river may be used.

For grouting of rock anchors: Water/cement ratio of 0.35 to 0.40 by weight, and a minimum compressive strength of 3,500 psi at seven days.

For consolidation grouting: Provide a water/cement ratio of 0.50 to 0.60 by weight or as required to provide a water tight anchor hole.

B. Add water reducers, and non-shrinking admixes to the grout to provide a durable, workable material that can be placed without separation or excessive bleeding.

Water Reducing: ASTM C494 Type A
High Range Water-Reducing (Super Plasticer): ASTM C 494, Type F

Or,

Non-shrinking: Non-metallic

C. Prohibited admixtures: Calcium chloride, thyocyanates are not permitted. Admixtures shall not contain fluorides, sulfites, sulphides, nitrates or chlorides as CL, and the total of all chloride ions shall not exceed 0.1 percent by weight.

D. All admixtures shall be compatible for use together, and the admixtures shall also be compatible for use with the proposed corrosion protection systems, and shall not compromise any part of the protection system.

E. Non-Shrink Grout (non-metallic) for use in grouting of reinforcing steel and for use (if needed) to seal top portion of anchor hole.

Factory pre-mixed grout: CRD-C621. Grout shall be suitable for use in freeze-thaw and submerged applications.

2.5 Concrete Materials

A. Concrete for use to encase the anchor heads:

Strength: 4,000 psi, 28 days, 5-7% air entrainment
Cement: Portland Cement, ASTM Type I or II
Coarse aggregate: ¾ inch per ASTM C33, size 67, sieve size 1” to No. 4

B. Concrete for use as a bearing pad beneath the anchor head bearing plates shall meet the Contractor’s requirements for strength.

C. Reinforcing Steel: ASTM A615, Grade 60, deformed.

D. Use air entraining, water reducers, and non-shrinking admixes in the concrete as required to provide a durable, workable material than can be placed without separation or excessive bleeding.

Air Entraining: ASTM C260
Water Reducing: ASTM C494 Type A
High Range Water-Reducing (Super Plasticer): ASTM C494, Type F

Or,

Non-shrinking: Non-metallic

E. Prohibited admixtures: Calcium chloride, thyocyanates are not permitted. Admixtures shall not contain fluorides, sulfites, sulphides, nitrates or chlorides as CL, and the total of all chloride ions shall not exceed 0.1 percent by weight.

F. All admixtures shall be compatible for use together, and the admixtures shall also be compatible for use with the proposed corrosion protection systems, and shall not compromise any part of the protection system.

PART 3 – EXECUTION

3.1 General

A. Contractor shall contain all sediment, drill cuttings, grout, flushing materials and shall prevent any and all such materials associated with the work from entrance into the waterways.

3.2 Rock Anchors

A. General: Rock anchors shall be fabricated and installed in accordance with the Owner reviewed means and methods.

B. Working Load: The rock anchors shall be sized to provide the load shown on the drawings or as otherwise proposed by the Contractor. Working loads shall not exceed 60% GUTS.

C. Maximum Spacing: The anchor spacing shall be as proposed by the Contractor and approved by the Owner to provide a Design Working Load of 11,500 plf at the wall and 29,000 plf at the trough section. Anchor spacing shall not exceed ten feet (10 ft). The tolerance for the location of the anchors is plus or minus 6 inches in any direction.

If a subsurface obstruction is encountered that prevents the drilling of an anchor hole to depth, the Contractor will be allowed to increase the spacing between any two anchors by up to 24-inches (taking into consideration the anchor location tolerances) to allow missing of the obstruction. In adjusting the anchor spacing, no anchor shall be eliminated. Any anchor hole that is abandoned shall be tremie grouted closed.

D. Rock anchor shall be placed in accordance with approved details or the recommendations of the anchor manufacturer.

1. Anchors, especially of the tendon type, shall not be subjected to unintentional sharp bends.

2. Centralizers shall be used to ensure that the tendons/bar do not contact the wall of the drill hole.

3. Provisions shall be made for adequate spacing of the individual tendon/bar elements to achieve proper grout coverage.

4. Care shall be taken not to damage the sheathing and/or centralizers during installation of the anchor.

5. Damage to the corrosion protection system shall be repaired, or the anchor replaced if not repairable. Repairs shall be done by the pre-approved written repair procedure.

6. The anchor shall be installed in the anchor hole just prior to when it will be grouted into place.

7. Tensioning shall not be done until the first stage cement grout has attained 100% of the design strength, but before the second stage cement grout is installed.

8. After placing the second stage grout, the anchor heads and wedges shall be undisturbed and shall remain intact and loaded. Although the anchor is considered to be fully bonded, the permanent anchor heads and wedges will not be removed.

E. Drilling: Drill hole size and length of bond zone shall be in accordance with rock anchor manufacturer's recommendation and,

1. Bond zone shall be designed for 80% GUTS, with a maximum bond stress of 150 psi for rock and 300 psi for concrete.

2. Bond zone shall have a maximum length of 35 feet and a minimum length of 10 feet.

3. Contractor shall undertake means to prevent sand and debris from entering rock anchor holes before and after grouting.

4. Contractor shall size the anchor hole to provide sufficient grout cover over the anchor bar/tendons and corrugated sheathing and to accommodate all grout tubes. Cutting of the corrugated sheathing to allow grout to encapsulate the bar/tendon and the sheathing will not be allowed, with the exception of a single hole of not more than two inches in diameter, to be located within 18 inches of the bottom tip of the sheathing.

5. Anchors shall be installed inclined as shown in the drawing, to an alignment tolerance as specified by PTI, Section 7.3.5,Hole Alignment and Tolerances.

Embedment Length: Embedment length is defined as the depth from the base of the structure to the top of the bond zone. The depth to the tip of the anchor is the embedment length plus one-half of the length of the bond zone. The embedment length of each rock anchor shall determined as follows:

1. The depth of embedment (embedment length) shall be determined by locating the top of the rock anchor's bond zone sufficiently below the dam-foundation interface to provide a rock "pullout" cone with a submerged weight of rock equal to the GUTS of the anchor (based on *Rock Anchors - State of the Art*, G. S. Littlejohn and D.A. Bruce, 1977). Embedment length shall be determined based only on the saturated weight of rock, and shall not include any shear strength of the rock. The depth of embedment shall be adjusted to account for overlapping “pull out” cones and the reduction of cone weight due to the overlapping cones.

2. Angle at apex of pullout cone (angle subtended by wedge): 90^{o} (45^{o} from vertical incline)

F. Installation of anchor grout shall be as follows:

1. Anchors are to be fully bonded and grouted in two stages.

2. Primary grout is defined as that grout that is used in the grouting of a fully bonded anchor.

3. For an anchor grouted in multiple stages, the bottom (first) stage extends from the bottom of the hole to the top of the lower bond zone, and is placed through grout tubes nearly simultaneously on both the inside and outside of the corrugated sheath. First stage grout shall not extend above the top of the lower bond zone.

4. After the anchor is load tested, locked-off and passes final lift-off test, the second stage grout is installed from the top of the first stage grout to the anchor head, placed nearly simultaneously through grout tubes on both the inside and outside of the corrugated sheath by the use of separate grout tubes. Sufficient tubes shall be provided to allow the two stage grouting of the anchor. After the second stage grout has attained 100% of the design strength, the Contractor shall “top off” the hole to eliminate any cavities where water may collect. The anchor head shall remain in place and wedges seated after grouting.

5. Grouts shall be injected via grout tubes at the lowest point of the anchor. Install grout by a means limiting pressure in anchor hole to 5 psi in excess of static grout head. Locate and provide a sufficient number of grout tubes to allow grouting of the inside and outside of the corrugated sheathing in the bond zone without need of cutting the sheathing.

6. Anchor grout shall have a water/cement ratio and strength as defined in Section 2.4 GROUT. Additives to the grout are required to reduce shrinkage, increase fluidity, and reduce water separation or bleeding. Additives used shall be in accordance with manufacturer's recommendations. High energy colloidal or shear mixers shall be used to mix the grout. Contractor shall prevent the grout from freezing, and prevent the temperature of the grout from dropping below the point where chemical reactions are reduced and the grout will not cure thereby negatively impacting its set time and strength.

7. For primary grouts; expansive grouts, accelerators or thixotropic (flow reducing) admixes will not be allowed.

8. For rock anchors using a secondary grout (see construction drawing for location if required) to provide the maximum degree of water tightness in the area of the anchor immediately below the anchor head, the use of an expansive grout will be allowed for the secondary grout. Secondary grout can be a Portland cement grout with additives to install expansive properties, or a

pre-mixed expansive grout. Alternatively, a non-expansive second stage grout could be used and a tertiary expansive grout used to seal the top five feet of the anchor stressing zone.

9. Before and during grouting operations, protect rock anchor hole from being filled with dirt and other debris, water and ice accumulation. All anchor holes shall be flushed clean of debris prior to the start of each grouting phase.

10. Bearing plates, and or the anchor head, shall be provided with sufficient holes to accommodate all grout tubes for all phases of grouting.

11. Grout equipment shall be capable of continuously mixing the grout for the duration of the grouting operation.

G. Testing:

1. Anchors shall not be loaded or tested for a minimum of seven (7) days after the first stage grout has been placed, or until grout cubes indicate that the grout has reached the specified design strength.

2. Testing equipment shall be capable of stressing the whole tendon to the maximum specified test load in one stroke. Stressing of multiple element tendons with a single element jack is not permitted. The gripping of strands, which cause-overlapping wedge bites, or bites below the anchor head is not permitted. The wedges shall be designed and suitable for use with the proposed corrosion protection system. The equipment shall permit the tendon to be stressed in increments so that the load in the tendon can be raised or lowered in accordance with the test specifications, and allow the anchor to be lift-off tested to confirm the lock-off load.

3. A calibration check of the production gauge shall be made daily against the master gauge to verify actual jacking pressures. The master gauge shall be easily spliced into the jacking system in series with the production gage for use in checking calibration of the production gage. The master gauge shall be kept in a safe location away from the immediate work area when not being used. All measuring devices shall be calibrated and recalibrated as necessary to permit the force in the tendon to be accurately measured at all times. Recalibration shall be done routinely as determined necessary by the Contractor or when directed by the Owner.

   Daily calibration checks shall be at the Contractor's expense. If requested by the Owner, the checking of the master gauge's calibration will be at the Owner's expense if the gauge passes the check and at the Contractor's expense if the gauge fails the check.

4. Each rock anchor shall be tested. The maximum test load shall not exceed 80 percent of the guaranteed ultimate tensile strength (GUTS) of the tendon (excludes capacity of the “spare” tendon(s) in each anchor).

Performance Testing is required on two (2) of the rock anchors. The first rock anchor installed shall be subjected to a Performance Test, and additional anchor(s) to be subjected to a Performance Test will be selected by the Owner.

Remaining anchors shall be subjected to Proof Tests.

Lift-off tests are required on the anchors subjected to the performance test.

All testing shall be conducted in the presence of the Owner. Testing schedules shall be submitted to the Owner two (2) weeks prior to testing, to ensure Owner's presence. Tests conducted without Owner's presence will not be accepted.

5. The Lock-off Load (or Transfer Load) shall be the greater of 1.10 times the working load of the anchor, or the lock-off load recommended by the anchor manufacturer, whichever is greater.

   Immediately after locking-off the anchor, perform the initial lift-off test and record the load at lift-off. This load shall be known as the actual lock-off load.

6. The Performance Test shall be made by incrementally loading and unloading the anchor in accordance with the following schedule. At each increment, the movement of the tendon shall be recorded to the nearest 0.001 inch (0.0025 cm) with respect to an independent fixed reference point if possible. The jack load shall be monitored with a pressure gauge or load cell.

   Movement measurements shall be taken at the alignment load and at each load increment.

   Increments of the load shall be:

   (P = working load for the anchor)
   (AL = alignment load)

   Load
   AL
   0.25 P
   AL
   0.25 P
   0.50 P
   AL
   0.25 P
   0.50 P
   0.75 P
   AL
   0.25 P

0.50 P
0.75 P
1.00 P
AL
0.25 P
0.50 P
0.75 P
1.00 P
1.20 P
AL
0.25 P
0.50 P
0.75 P
1.00 P
1.20 P
1.33 P Test load

Adjust to Lock-off load.

The load shall be held at each increment just long enough to obtain the movement reading. Except for the reading of the residual movement at AL, no movement readings need to be taken during unloading of the anchor.

The test load shall be held for 10 minutes. Total movements with respect to a fixed reference point shall be recorded at 1 minute, 2, 3, 4, 5, 6, and 10 minutes. If the total movement between 1 minute and 10 minutes exceeds 0.04 in. (1 mm), the test load shall be held for an additional 50 minutes. Total movements shall be recorded at 15 minutes, 20, 25, 30, 45, and 60 minutes. The Load Hold time shall start when the pump begins to load the anchor from the 1.20P load to the test load.

During the load hold periods, the hydraulic pressure shall not deviate from the test pressure by more than 50 psi and the load shall always be returned to the test load prior to taking the movement reading.

7. The Proof Test shall be performed by incrementally loading the anchor in accordance with the following schedule. At each increment, the movement of the tendon shall be recorded to the nearest 0.001 inch (0.0025 cm) with respect to an independent fixed reference point if possible. The jack load shall be monitored with a pressure gauge or load cell.

The increments of load shall be:

(P = Working Load for the anchor)
(AL = Alignment Load)

Load
AL
0.25 P
0.50 P
0.75 P
1.00 P
1.20 P
1.33 P Test Load (10 minute hold)
Adjust to Lock-off Load

The Load shall be held at each increment just long enough to obtain the movement reading, but no more than 1 minute.

The test load shall be held for 10 minutes. Total movements with respect to a fixed reference point shall be recorded at 1 minute, 2, 3, 4, 5, 6, and 10 minutes. If the movement between 1 minute and 10 minutes exceeds 0.04 in. (1 mm), the test load shall be maintained for 50 more minutes. Additional anchor movements shall be recorded at 15 minutes, 20, 25, 30, 45, and 60 minutes. The period shall start when the pump begins to load the anchor from 1.20P to the test load.

During the load hold periods, the hydraulic pressure shall not deviate from the test pressure by more than 50 psi and the load shall always be returned to the test load prior to taking the movement reading.

The proof test results shall be compared to the performance test results. If there is significant variation from the performance test results, a performance test on the next anchor will be required.

8. Lift-off tests shall be performed between two (2) and seven (7) days of when the load was locked-off in the anchor. The two (2) anchors subjected to the Performance Tests shall be used for the lift-off tests.

9. Acceptance Criteria:

The Owner will evaluate the anchor test results and determine whether the anchor is acceptable. An anchor will be acceptable if all of the following criteria are met:

The total elastic movement obtained from a performance test should exceed 80 percent of the theoretical elastic elongation of the stressing length and be less than the theoretical elastic elongation of the free stress length.

The total movement obtained from a proof test, measured between 50 percent of the design load and the test load should exceed 80 percent of the theoretical elastic elongation of the free stressing length for this respective load range.

The creep rate does not exceed 0.080 inch (2.0 mm)/log cycle during the final log cycle of the performance test or proof test regardless of tendon length and load.

The initial lift-off reading shows an anchor load within 5 percent of the specified Lock-off load.

The Lift-off test shows an anchor load within 10 percent of the specified lock-off load, but no less than 5 percent of the initial lift-off reading.

10. Replace tested anchors that fail or do not meet criteria for acceptance at no additional cost to the Owner.

11. Tendons, or bars, projecting above the anchor head shall not be removed until the Owner has accepted the results of the anchor testing and has authorized, in writing, the Contractor to remove the projections. Tendons and bars shall not be cut for a minimum of seven (7) days after the second stage grout has been placed, or until grout cubes indicate that the grout has reached the specified strength.

    The permanent anchor heads and wedges will not be removed, and the anchor heads and wedges shall be left undisturbed and shall remain intact and loaded.

3.3 Consolidated Grouting

A. General: Each rock anchor hole shall be tested for water-tightness. A water pressure test will be performed for the full length of the anchor hole. Any anchor hole failing the water pressure test shall be grouted, redrilled, and retested. Should a second water-tightness test fail, the entire process shall be repeated. Consolidation grouting shall not commence until approved by the Owner.

B. Pressure Test: The pressure test shall be performed by filling the anchor hole with water and subjecting the hole to a gauge pressure of 5 psi as measured at the top of the hole. If the leakage rate from the hole, over a period of ten minutes, exceeds 0.001 gallons per inch diameter per foot of depth per minute, the hole should be consolidation grouted, redrilled, and retested.

C. Grouting: Consolidation grout shall have a water/cement ratio as defined in Section 2.4 GROUT. Grout may be pumped under pressure into anchor hole. Gauge pressure at the top of the hole shall not exceed 5 psi in excess of the static head.

    1. The Owner reserves the right to stop the grouting operations if the volume of grout pumped into a single hole, at any time, exceeds a volume of 2 times the volume of the hole. Contractor shall immediately notify the Owner if the volume of grout pumped into a single hole exceeds a volume of 2 times the volume of the hole, and propose, and obtain directions as how to proceed with the consolidation of the anchor hole.

2. In the event that cement grout alone will not consolidate the hole, then the Owner may request of the Contractor the addition of additives to the grout in an attempt to expedite consolidation of the hole. The additives may include but are not limited to sand, peastone, thixotropic admixes to reduce flow, or chemical accelerators. The addition of such materials will not be considered as Unit Price work, and payment to the Contractor will be made on a negotiated Time and Materials basis.

D. Redrilling: A consolidation grouted hole shall be redrilled after the grout has had twenty four (24) hours to set up.

E. Unexpected Conditions: The grouting program shall be modified as necessary to accommodate conditions not conducive to the consolidation grouting procedures described in this specification. Changes to the grouting program/procedures shall be approved by the Owner and will be initiated by a Change Order.

3.4 Environmental Controls

A. Provide a means for containment and collection of drill cuttings, drilling and flushing fluids, and fresh grout to prevent those materials from entering directly into the waterways.

B. The Contractor may establish a temporary settling basin, sand filter bed, or other means to remove fines and cuttings from the drilling fluids prior to discharging into the river. The Contractor shall submit to the Owner for review, a plan and detail of the means proposed to remove the fines and cuttings. The plan shall also show the proposed location for the proposed temporary filtering measures, and the proposed location shall not inhibit the Owner's operation of the hydroelectric project.

3.5 Structure Restoration

A. To minimize feathering of the edges, saw cut the perimeter of the anchor head pocket prior to demolition of the existing concrete. Alternatively, the Contractor may propose to the Owner alternate means to providing a vertical edge to minimize feathering.

B. To minimize staining of the existing concrete surfaces as a result of drill and grouting operations, in the area where drilling or grouting operations are occurring, the Contractor shall provide a continuous flow of water across the concrete surface of the dam for a minimum of ten feet on either side of the drill hole. The water shall be of sufficient quantity to dilute and flush the drill cutting fines and fresh grout from the face of the dam to minimize their ability to bond to and stain the existing concrete surfaces. Water shall be contained and disposed of in accordance with Section 3.4.

C. Using Owner approved procedures and materials, plug all holes drilled into the existing concrete by the Contractor to attach any temporary work platforms and equipment use to accommodate the installation of the rock anchors. Use methods and materials that will not result in the material popping out of the patched holes. The color of the patching material should match as close as possible the color of the existing concrete.

PART 4 – MEASUREMENT AND PAYMENT

4.1 Related Documents

Drawings and general provisions of Contact, including Contractor Agreement, General and Supplementary Conditions and other Specification Sections, apply to work of this section.

4.2 Description of Requirements

A. Definition of Payment terms. The Contract to be issued for the work shall be a Unit Price Contract based on the unit prices for quantities incorporated in the work as shown on the Bid Schedule. Payment of work shall be full compensation for costs incurred by the Contractor in providing the work as described in the Contract Documents.

B. Undefined and Contractual Costs. Costs for work not specifically mentioned and which are incidental to the overall conduct of the work, shall be included in the Contractor's Bid Schedule, distributed into the actual Bid item as deemed appropriate. Examples of these types of costs include, but are not limited to, the following:

1. Insurance(s)
2. Construction Permits and Licenses
3. Temporary Facilities & Utilities
4. Traffic Control
5. Surveying
6. Recording and submitting data
7. Coordination with Owner/Engineer
8. Safety and Security
9. Overhead
10. Profit

C. All measurements taken for payment shall be approved by the Owner. The Contractor shall take and submit necessary measurements as required to substantiate request for payments. The Owner may conduct an independent check to confirm Contractors measurements. Measurement and payment will be made per the following Bid Schedule based on the completion and acceptance of the individual work items.

4.3 Measurement

A. Scope, Measurement, and Payment for each of the bid items is as follows:

1.1 ENGINEERING DESIGN

Scope: Includes costs for all labor and expenses for the preparation of Contractor generated design documents and supporting information as required for review and approval by the Owner per Section 1.6 SUBMITTALS.

Measurement: Measurement of work is not required.

Payment: Payment will be made for the lump sum bid, upon submittal of the final design to the Owner.

1.2 MOBILIZATION AND TEMPORARY FACILITIES

Scope: Includes all costs related to moving the Contractor's personnel, materials, and equipment onto the site and establishing appropriate temporary storage and support facilities as needed to perform all aspects of the work. This item also includes but is not limited to all costs related to site preparation, construction of environmental measures, operating costs (communications, power, water, sanitary), maintenance and services to temporary facilities, clean-up, site and structure restoration, and moving the Contractor's materials, equipment and personnel off the site when the work is completed. The gatehouse is not equipped with potable water or sanitary facilities.

Measurement: Measurement of work is not required.

1.3 ROCK ANCHORS

M*obilization of required personnel, equipment, and materials is included in Item 1.2.*

Scope: Includes costs for all labor, equipment, and materials to provide the rock anchors in the structures, including the: demolition of existing concrete for the anchor head pocket, drilling of the anchor hole, the initial water pressure test, all rock anchor materials, the installation and grouting of the anchors, all anchor testing and documentation, and the placement of concrete and reinforcing steel in the anchor head pocket. Excluded are any pressure grouting, redrilling, and additional pressure tests that will be required for each anchor that fails the initial water pressure test.

Measurement: Measurement of the work is not required.

Payment: Payment will be made per the unit price bid per rock anchor.

- 30% of the per rock anchor unit price will be paid upon completion of the drilling of an anchor hole.
- 50% of the per rock anchor unit price will be paid upon installation of a rock anchors and grouting of the anchor's lower bond.
- 10% of the per rock anchor unit price will be paid upon completion of the final lift-off test of an anchor.
- The final 10% of the total price for all of the rock anchors will be paid upon submittal of record information.

1.4 CONSOLIDATION GROUTING FOR ROCK ANCHOR INSTALLATION

Mobilization of required personnel, equipment, and materials is included in Item 1.2.

1.4.1 Consolidation Grout

Scope: Provide all labor, equipment, and materials to provide the grout in-place in the anchor hole(s) with the intent of increasing the water tightness of the hole(s). Excluded is the materials, labor, and equipment needed for the grouting of the rock anchors in the anchor hole.

Measurement: Measurement of work shall be per bag of cement placed in the anchor hole, with one bag cement equal to one cubic foot of grout. Payment will not be made for any cement not placed in the anchor hole.

Payment: Payment will be made upon completion of the consolidation grouting, paid at the unit price bid.

1.4.2 Redrill Anchor Hole

Scope: Provide all labor, equipment, and materials required to redrill rock anchor holes that have been consolidated by grouting.

Measurement: Measurement of this item will be per foot of hole redrilled.

Payment: Payment will be made per foot of hole redrilled, paid at the unit price bid.

1.4.3 Pressure Test

Scope: Provide all labor, equipment, and materials required to setup and conduct water pressure tests (if required) of anchor holes that have been consolidated grouted.

Excluded from this scope of work is the initial water pressure test (see Item 1.3).

Measurement: Measurement of this item will be a count of the number of pressure testes completed.

Payment: Payment will be made upon completion of the pressure tests, paid at the unit price bid.

2.0 FLOOD DELAYS

Scope: Pricing information is requested to allow for costing of unanticipated delays to the work due to flood conditions. A Delay is defined as a flood event that results in the interruption of the work of the equipment and personnel that operate from the reservoir side of the West Non-Overflow Wall. The delays are defined as follows, and must be approved by the Owner prior to invoicing:

- Long Term Delays: A single event that prevents the work from being performed for more than 6 consecutive workdays, and necessitates the removal of equipment, or the construction personnel to leave and return later to the job site.
- Short Term Delays: A single event that interrupts the work for less than 6 consecutive workdays, and requires the securing and non-use of equipment located in the reservoir, but allows personnel to remain on site to conduct other work not impacted by the level of the flood.

Measurement: Measurement of the work is not required.

Payment: Payment will be made per the unit price bid for Short Term or Long Term Delays.

4.4 Bid Schedule

A. The Contractor shall complete the following Bid Schedule (or Contractor's standard form if it provides all of the information as shown on the attached schedule) and include it along with the requirements of Section 1.6A as his bid.

END OF SECTION: 02995- ROCK ANCHORS

CANAL WALL
ROCK ANCHOR SPECIFICATIONS

INDIAN ORCHARD HYDROELECTRIC PROJECT

BID SCHEDULE

a. Contractor shall fill in all of the blank lines of this Bid Schedule.
b. The Contract to be issued for the work will be a Unit Price Contract based on the unit prices as follows:

	Item	Unit Price	Estimated Quantity (1)	Unit	Subtotal	Total
1.1	Engineering Design	$	1	LS	-----	$
1.2	Mobilization & Temporary Facilities	$	1	LS	-----	$
1.3	Rock Anchors	$		EA	-----	$
1.4	Consolidation Grouting (2)	-----	-----		-----	-----
	1.4.1 Consolidation Grout	$		Bags	$	-----
	1.4.2 Redrill Anchor Hole	$		LF	$	-----
	1.4.3 Pressure Test	$		EA	$	-----
	Subtotal 1.4					$
	Subtotal Rock Anchors					**$**
2.0	Delays					
	2a Long Term Delay (>6 days)		1	LS		$_____
	2b Short Term Delay (≤6 days)		3	Days		$_____

(1) Estimated quantities are provided for bid purposes only, and are not guaranteed. Determination of actual quantities and classification are to be made by Owner. No adjustment will be made to the unit or lump sum prices bid due to any increase or decrease in the final quantities actually used in the construction.

(2) Quantity estimates for Bid Schedule Item 1.4 consolidation grouting, redrilling, and pressure testing, are based on the assumption that each of the anchor holes may be subjected to consolidation grouting, redrilling, and retesting one time. The estimated quantities shall be determined by the Contractor. The volume of consolidated grout shall be based on the diameter and length of the hole plus 10%. Pertinent anchor information is a follows:

CANAL WALL
ROCK ANCHOR SPECIFICATIONS

INDIAN ORCHARD HYDROELECTRIC PROJECT

BID SCHEDULE

Anchor Type (bar, tendon)	_____
Size (inches diameter, # stands)	_____
Working Load (kips):	_____
Anchor spacing (feet-inches):	_____
Elevation at bottom anchor head bearing plate:	_____
Elevation at centerline of bond zone:	_____
Elevation at bottom of anchor hole:	_____
Length of bond zone:	_____

Submitted by:

_____
Company

_____
Name

_____
Signature

_____
Title

_____
Date

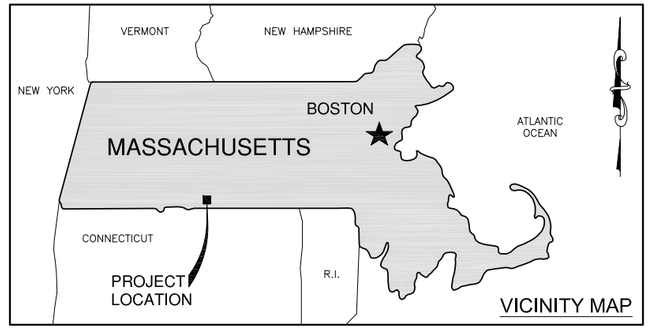
EP ENERGY MASSACHUSETTS LLC

SPRINGFIELD, MA.

INDIAN ORCHARD
MINIMUM FLOW GATE PROJECT

FERC NO. 10678

DRAWING LIST			
SHEET NO.	CONSTRUCTION DRAWINGS	DATE	STATUS
G1-01	GENERAL NOTES	08-01-13	I.F.B.
C1-01	EXISTING OVERALL PLAN AND SECTION	08-01-13	I.F.B.
C2-01	PROPOSED OVERALL PLAN AND SECTION	08-01-13	I.F.B.
C3-01	PROPOSED CONCRETE TROUGH PLAN AND SECTIONS	08-01-13	I.F.B.
S1-01	PROPOSED GATE GUIDE/LIFTING FRAME	08-01-13	I.F.B.
S2-01	PROPOSED GATE ELEVATION AND SECTION	08-01-13	I.F.B.
S2-02	PROPOSED GATE SECTIONS AND DETAILS	08-01-13	I.F.B.
S3-01	PROPOSED GRATING WALKWAY EXTENSION	08-01-13	I.F.B.
S4-01	PROPOSED ROCK ANCHOR PLAN AND SECTIONS	08-01-13	I.F.B.
S4-02	PROPOSED ROCK ANCHOR SECTIONS AND DETAILS	08-01-13	I.F.B.
S4-03	PROPOSED STRAND & SOLID BAR ROCK ANCHOR DETAILS	08-01-13	I.F.B.
E1-01	PROPOSED ELECTRICAL SCHEMATICS	-	LATER



VICINITY MAP

ISSUED
FOR BID
08-01-13

Kleinschmidt

GENERAL NOTES

1. ALL ELEVATIONS ARE IN REFERENCE TO USGS MEAN SEA LEVEL.
2. THESE ARE STANDARD NOTES APPLYING TO ALL WORK. SPECIFIC NOTES SHOWN ON OTHER DRAWINGS OR STATED IN THE VENDOR PROVIDED TECHNICAL SPECIFICATIONS SHALL TAKE PRECEDENCE.
3. CONTRACTOR SHALL SCHEDULE WORK IN COORDINATION WITH THE OWNER TO COMMENCE WORK DURING THE CANAL OUTAGE.
4. CONTRACTOR SHALL DETERMINE LOCATIONS, EXISTING CONDITIONS, AND DIMENSIONS BY THEIR OWN INVESTIGATION.
5. INFORMATION SHOWN ON THESE DRAWINGS IS BASED ON THE ORIGINAL RECORD DRAWINGS AND LIMITED FIELD MEASUREMENTS. FIELD VERIFY ALL DIMENSIONS, AND NOTIFY THE OWNER AND ENGINEER OF SIGNIFICANT DISCREPANCIES.
6. DO NOT SCALE OFF DRAWINGS TO OBTAIN DIMENSIONS, UNLESS NOTED OTHERWISE. ALL DIMENSIONS SHALL BE FROM DETAILS AND NOTES GIVEN IN THIS DRAWING SET. OTHERWISE, USE PRACTICAL ENGINEERING JUDGEMENT TO DETERMINE DIMENSIONS, OR CONSULT WITH THE ENGINEER.
7. CONTRACTOR SHALL BE RESPONSIBLE FOR DETERMINING THE MEANS AND METHODS OF CONSTRUCTION, LOCATING UTILITIES PRIOR TO WORK, AND NOTIFY THE OWNER FOR AN APPROVAL.
8. CONTRACTOR SHALL PROTECT OWNER'S PROPERTY AND ADJACENT PROPERTY FROM DAMAGE CAUSE BY CONSTRUCTION ACTIVITIES. CONTRACTOR SHALL RESTORE SITE TO NEAR ORIGINAL CONDITION AFTER COMPLETION OF THE WORK.
9. UPON COMPLETION OF THE WORK, THE CONTRACTOR SHALL REMOVE ALL UNUSED MATERIALS AND TRASH FROM THE SITE.
10. REMOVAL OF ALL WASTE, CONCRETE RUBBLE AND CONSTRUCTION DEBRIS IS THE RESPONSIBILITY OF THE CONTRACTOR. CONTRACTOR SHALL DISPOSE OF IN AN APPROVE METHOD COMPLYING WITH THE AUTHORITIES HOLDING JURISDICTION.
11. CONTRACTOR SHALL INSPECT THE EXISTING DAM CONDITION IN THE PRESENCE OF THE OWNER PRIOR TO COMMENCEMENT OF DEMOLITION AND AT THE CONCLUSION OF THE WORK.
12. CONTRACTOR SHALL INVESTIGATE THE STRUCTURAL INTEGRITY OF THE EXISTING CANAL WALL AND CONFIRM WITH THE ENGINEER PRIOR TO COMMENCING THE WORK.

SOIL EROSION AND SEDIMENT CONTROL NOTES

1. SEDIMENTATION BASIN: SEDIMENT LADEN WATER SHALL NOT BE RELEASED INTO ANY WATERWAY. CONTRACTOR SHALL PROVIDE APPROPRIATELY SIZED SEDIMENTATION BASIN OR OTHER APPROVED SEDIMENT REMOVAL DEVICES FOR ALL DEWATERING OR WATER DIVERSION ACTIVITIES.
2. HAY BALE DIKE: PROVIDE CLEAN HAY BALE WHICH ARE LOCALLY AVAILABLE
3. SILT FENCE: IF NEEDED TO CONTROL WATER CONTAMINATION, PROVIDE SILT FENCE CONFORMING TO THE FOLLOWING:

A. EQUIVALENT OPENING – SIZE OF A U.S. STANDARD SIEVE
B. SIZE 40 (MAX), 70 (MIN).
C. MULLEN BURST STRENGTH – 200 PSI.
D. GRAB STRENGTH – 120 LBS MIN.
E. SPUN–BONDED NYLON FABRIC – REINFORCED WITH POLYESTER NETTING, OR POLYPROYLENE FABRIC WITH 2"x4" 12 GA. WOVEN WIRE BACKING FENCE.

DEMOLITION NOTES

1. OWNER ASSUMES NO RESPONSIBILITY FOR ACTUAL CONDITION OF ITEMS TO BE DEMOLISHED. CONTRACTOR SHALL EMPLOY DEMOLITION METHODS WHICH MINIMIZE IMPACTS TO THE STRUCTURE BEYOND THE IMMEDIATE WORK AREA. METHODS RESULTING IN JOINT CRACKING OR DISLODGEMENT TO AREAS BEYOND THE DEMOLITION LIMITS SHALL NOT BE EMPLOYED.
2. PROVIDE TEMPORARY BARRICADES AND OTHER FORMS OF PROTECTION AS REQUIRED TO PROTECT OWNER'S PERSONNEL AND GENERAL PUBLIC FROM INJURY DUE TO SELECTIVE DEMOLITION WORK.
3. CEASE OPERATIONS IMMEDIATELY IF ADJACENT STRUCTURES APPEAR TO BE IN DAMAGE. NOTIFY OWNER. PROMPTLY REPAIR DAMAGES CAUSED BY DEMOLITION WORK AT NO COST TO OWNER.
4. PERFORM SELECTIVE DEMOLITION WORK IN A SYSTEMATIC MANNER. USE SUCH METHODS AS REQUIRED TO COMPLETE WORK INDICATED ON CONTRACT DOCUMENTS IN ACCORDANCE WITH DEMOLITION SCHEDULE AND GOVERNING REGULATIONS.
5. ROVIDE SERVICES FOR EFFECTIVE AIR AND WATER POLLUTION CONTROLS AS REQUIRED BY LOCAL AUTHORITIES HAVING JURISDICTION.
6. IF UNANTICIPATED MECHANICAL, ELECTRICAL OR STRUCTURAL ELEMENTS ARE ENCOUNTERED, INVESTIGATE AND MEASURE BOTH NATURE AND EXTENT.
7. REMOVE DEBRIS, RUBBISH AND OTHER MATERIALS RESULTING FROM DEMOLITION OPERATIONS. TRANSPORT AND LEGALLY DISPOSE OF OFFSITE.
8. REPAIR, BY METHODS APPROVED BY THE OWNER, DEMOLITION PERFORMED IN EXCESS OF THAT REQUIRED. RETURN STRUCTURES AND SURFACES TO CONDITION EXISTING PRIOR TO COMMENCEMENT OF SELECTIVE DEMOLITION WORK. REPAIR ADJACENT CONSTRUCTION OR SURFACES SOILED OR DAMAGED BY SELECTIVE DEMOLITION WORK.

EARTHWORK NOTES

1. THE AREAS TO BE OCCUPIED BY THE PROPOSED CONSTRUCTION SHALL BE CLEARED OF ALL VEGETATION, SOIL, AND LOOSE ROCK LESS THAN THE PROPOSED SIZE OF THE RIPRAP; AND ALL OTHER OBJECTIONABLE MATTER AS DETERMINED BY THE OWNER.
2. THE CONTRACTOR SHALL, BY THEIR OWN INVESTIGATION, DETERMINE THE EXTENT OF CLEARING REQUIRED IN ACCORDANCE WITH THE OWNER.
3. DISPOSAL OF MATERIALS FROM EARTHWORK SHALL BE PERFORMED IN ACCORDANCE WITH THE APPROPRIATE GUIDANCE PROVIDED BY THE LOCAL AUTHORITIES HAVING JURISDICTION AND APPROVED BY THE OWNER.
4. PLACING BEDDING MATERIALS:
   A. NO MATERIAL SHALL BE PLACED IN ANY SECTION UNTIL THE EXISTING RIPRAP HAS BEEN REASONABLY CLEANED, TREATED, AND LEVELED.
   B MATERIAL SHALL GENERALLY BE 18" OF SUBBASE AND 6" OF BASE MATERIAL PER AASHTO T27 AND AASHTO T11.
      I. SUBBASE: WELL GRADED CRUSHED COARSE GRAVEL.
      II. BASE: WELL GRADED CRUSHED FINE GRAVEL.
   C. SUCCESSIVE LOADS OF MATERIAL SHALL BE DUMPED IN 6" LIFTS, SO AS TO SECURE THE BEST PRACTICAL DISTRIBUTION OF THE MATERIAL USING PORTABLE PLATE COMPACTOR.
5. CONTRACTOR SHALL PERFORM ALL QUARRY OPERATIONS REQUIRED TO PRODUCE ACCEPTABLE RIPRAP MATERIALS AND PRODUCED MATERIALS SHALL BE SUBJECT TO APPROVAL, IF REQUESTED, BY THE OWNER.

CONCRETE NOTES

1. SURFACE PREPARATION:
   A. ALL LOOSE ROCK, CONCRETE, AND SOIL SHALL BE REMOVED PRIOR TO CONSTRUCTION. REMOVE ANY GREASE, OIL OR OTHER COATINGS ON ANY EXISTING SURFACE.
   B. WHEN CONCRETE IS PLACED DIRECTLY AGAINST ROCK SURFACES, THE SURFACE SHALL BE CLEANED WITH HIGH–PRESSURE WATER TO REMOVE ALL DIRT OR LOOSE MATERIAL.
   C. SURFACE PREPARATION OF EXISTING CONCRETE AND MASONRY SURFACES SHALL REMOVE ALL LOOSE OR DETERIORATED MATERIAL AND VEGETATION. ACCEPTABLE METHODS INCLUDE SANDBLASTING, MECHANICAL CHIPPING, OR HIGH–PRESSURE WATER BLAST (6000 PSI MINIMUM PRESSURE).
2. CONCRETE:
   A. ALL WORK SHALL CONFORM TO ACI 318, ACI 301 AND ACI 347, LATEST EDITIONS.
   B. SPECIFICATIONS:
      I. MINIMUM 28 DAY STRENGTH = 4000 PSI
      II. MAXIMUM WATER/CEMENT RATIO = 0.45
      III. SLUMP 3" MAX.
      IV. AIR CONTENT PROVIDED BY AIR ENTRAINMENT ADMIXTURE 5 % TO 7%.
      V. WATER REDUCING ADMIXTURE AND SUPER–PLAASTICIZER SHALL BE USED AT THE OPTION OF THE CONTRACTOR.
      VI. FLYASH MAY BE USED. ADMIXTURES CONTAINING CALCIUM CHLORIDE SHALL NOT BE USED.
   C. VERTICAL CONCRETE SURFACES SHALL HAVE A SMOOTH FORMED FINISH. HORIZONTAL CONCRETE SURFACES SHALL HAVE A STEEL TROWEL FINISH.

CONCRETE NOTES CONTINUED:

   D. CURE CONCRETE, BY OWNER APPROVED METHOD, FOR 7 DAYS MINIMUM.
   E. REQUIRED FIELD TEST:
      I. SLUMP (FIRST TRUCK PER DAY OR PLACEMENT AREA) ASTM C 143.
      II. AIR CONTENT (FIRST TRUCK PER DAY OR PLACEMENT AREA) ASTM C 173.
      III. COMPRESSIVE STRENGTH CYLINDERS (1 SET PER PLACEMENT) ASTM C 39.
      IV. THREE SPECIMENS TESTED AT 7, 14 AND 28 DAYS (9 SPECIMENS TOTAL).

3. CONCRETE REINFORCEMENT:
   A. SPECIFICATION ASTM A615 GRADE 60, PLAIN
   B. SPLICES SHALL BE ACI CLASS B UNLESS NOTED OTHERWISE.
   C. FIELD BEND REINFORCING BARS TO CLEAR BOXOUTS AND PIPES WHERE REQUIRED. NO CUTTING OF REINFORCEMENT BARS SHALL BE DONE WITHOUT PRIOR APPROVAL OF THE ENGINEER.
   D. HOOKS IN BARS SHALL BE DIMENSIONED AND BENT PER ACI STANDARD HOOKS.
   E. REINFORCEMENT COVER, 3" UNLESS NOTED OTHERWISE ON THE DRAWINGS.
   F. DOWELS
      I. PROVIDE DOWELS OF SIZE AND DIMENSION SHOWN.
      II. CLEAN DRILL HOLES WITH AIR PRESSURE TO REMOVE DUST ANY STANDING WATER. HOLES MAY BE DAMP.
      III. GROUT SHALL BE NON–SHRINK PROPRIETARY CEMENT GROUT (4000 PSI MINIMUM), OR EPOXY GROUT, AT CONTRACTOR'S OPTION. SELECTED GROUT MUST BE SUITABLE FOR USE IN WET HOLES. INSTALL PER MANUFACTURER'S INSTRUCTIONS.
      IV. ENSURE THAT HOLES ARE COMPLETELY FILLED WITH GROUT. WHERE SURFACES ARE VERTICAL, INSTALL DOWELS WITH SLOPE DOWNHILL OR USING MANUFACTURER'S STANDARD HOLE STOPPER AND INJECTION SYSTEM

4. FORMWORK AND CONSTRUCTION JOINTS
   A. CONSTRUCT FORMS TRUE TO LINE AND GRADE, ADEQUATELY BRACED TO MAINTAIN POSITION DURING PLACEMENT OF CONCRETE. WELDING OF FORM TIES TO STRUCTURAL DOWELS IS NOT PERMITTED, THOUGH ADDITIONAL DOWELS MAY BE INSTALLED FOR THAT PURPOSE.
   B. PROVIDE 3/4" CHAMFER ON ALL EXPOSED EDGES, UNLESS NOTED OTHERWISE.
   C. FILL ALL AIR HOLES AND VOIDS LARGER THAN 1/4" AND FILL ALL TIE HOLES. REMOVE ALL FINS AND PROJECTIONS.
   D. CONSTRUCTION JOINTS SHOWN SHALL BE LOCATED AS SHOWN UNLESS OTHERWISE APPROVED BY THE ENGINEER. ADDITIONAL JOINTS MAY BE USED, WHERE THE STRENGTH AND DURABILITY OF THE STRUCTURE IS NOT EFFECTED, SUBJECT TO THE REVIEW OF THE ENGINEER.
   E. REINFORCEMENT SHALL BE CONTINUOUS THROUGH JOINTS UNLESS NOTED OTHERWISE.
   F. CLEAN ALL JOINTS TO REMOVE LAITANCE PRIOR TO NEXT CONCRETE PLACEMENT, USING HIGH–PRESSURE WATER BLAST (3000 PSI MINIMUM), OR SANDBLASTING.

5. WATERSTOPS:
   A. PROVIDE ADHESIVE HYDROPHYLLIC ELASTIC WATERSTOPS WHERE SHOWN HEREIN. END ALL WATERSTOPS 3" FROM EXPOSED FINISHED CONCRETE SURFACE. INSTALL PER MANUFACTURER'S RECOMMENDATIONS. IF DAMAGED BY EXPOSURE TO WATER PRIOR TO CONCRETRE PLACEMENT, REMOVE AND REPLACE WITH SAME KIND. ACCEPTABLE PRODUCTS:
      I. ADEKA ULTRASEAL (TEL: (518) 756–6565)
      II. PARASTOP II (TEL: (800) 658–5500)
      III. WATERSTOP RX (TEL: (312) 966–5720)
   B. PVC WATERSTOPS SALL EXTEND THE ENTIRE LENGTH OF THE JOINT AND SHALL BE SPLICED TO ADJOINING WATERSTOPS AT CORNERS AND INTERSECTIONS WITH THERMAL SLICING. SUPPORT WATERSTOP FROM REINFORCEMENT OR FORMWORK AT MAXIMUM SPACING OF 12" ON CENTER ON EACH EDGE. PROVIDE THOROUGH CONSOLIDATION OF CONCRETE AROUND WATERSTOP AND PREVENT FORMATION OF AIR POCKETS AND VOIDS. FOR WATERSTOPS LOCATED AT THE BASE OF WALL PLACEMENTS, PLACE A NEAT CEMENT MIXTURE JUST PRIOR TO THE REGULAR MIX DESIGN.

STEEL NOTES

1. CONTRACTOR SHALL PERFORM ALL WORK IN ACCORDANCE WITH BEST PRACTICE AND METHODS TO FABRICATE STEEL MEMBERS IN ACCORDANCE WITH THE CONTRACT DOCUMENT.
2. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS TO THE ENGINEER PRIOR TO COMMENCING FABRICATION OF THE STEEL MEMBERS.
3. NEW STEEL MEMBERS SHALL BE FABRICATED IN ACCORDANCE WITH THE LATEST AMERICAN INSTITUTE OF STEEL CONSTRUCTION (AISC) MANUAL OF STEEL CONSTRUCTION, AND OTHER APPLICABLE CODE OF STANDARD PRACTICE.
4. FABRICATE AND ASSEMBLE IN SHOP TO GREATEST EXTENT POSSIBLE. REMOVE OIL, PAINT AND OTHER FOREIGN SUBSTANCES FROM STEEL SURFACES PRIOR TO FABRICATION. ALL MEMBERS, WHILE ASSEMBLED, SHALL BE CHECKED FOR DIMENSIONS, CLEARANCE, TOLERANCES, AND ACCURACY OF ALIGNMENT.
5. AFTER FINAL INSTALLATION AND ASSEMBLY, THE CONTRACTOR SHALL OPERATE THE GATE IN BOTH DIRECTIONS IN DRY AND WITH FULL DIFFERENTIAL HEAD A MINIMUM OF FIVE (5) TIMES IN THE PRESENCE OF THE OWNER.
6. MATERIAL:
   A. STRUCTURAL STEEL SHAPES – ASTM A992, GRADE 50.
   B. STRUCTURAL HSS SHAPES – ASTM A500 GRADE B
   C. STAINLESS STEEL PLATES SHALL BE TYPE 316.
   D. MISC. STEEL SHAPES – ASTM A36 MIN.
   E. BOLTS AND OTHER HARDWARE – ASTM A325 GALVANIZED PER ASTM A153 OR EQUIVALENT.
   F. WELDING – IN ACCORDANCE WITH AWS D1.1 USING E70XX ELECTRODES. ALL SURFACES TO BE WELDED SHALL BE WIRED BRUSHED CLEANED BEFORE WELDING. WELDERS TO BE AWS CERTIFIED.
   G. STRUCTURAL STEEL SHAPES, PLATES AND BARS SHALL BE HOT–DIPPED GALVANIZED PER ASTM A123.
7. TOLERANCES:
   A. OVERALL LENGTH, WIDTH AND DIAGONALS ±1/4"
   B. SEAL MOUNTING SURFACES: FLAT FROM ANY TRUE PLANE OF ±1/8" OVERALL AND ±1/16" IN ANY TWO FOOT LENGTH.
   C. UNSPECIFIED TOLERANCES ±1/8".
   D. RATE OF LEAKAGE SHALL BE 0.1 GALLONS PER MINUTE PER FOOT OF WETTED PERIPHERY, OR LESS.
8. ALL FAYING SURFACES SHALL BE SEAL WELDED WATERTIGHT.
9. BOLTED CONNECTIONS SHALL HAVE A MINIMUM OF 2 BOLTS WITH MINIMUM BOLTS SIZE OF 3/4" DIA., UNLESS NOTED OTHERWISE.
10. GATE DESIGNED FOR 9.5 FEET OF DIFFERENTIAL HEAD.

GATE OPERATION NOTES

1. MINIMUM FLOW REQUIREMENT: 247 CFS
2. PROPOSED GATE DIMENSION IS TO PASS MINIMUM FLOW REQUIREMENT & TO PREVENT DEBRIS CLOGGING. HISTORICAL EVIDENCE & GUIDANCE WERE PROVIDED BY THE OWNER FOR SIZING THE GATE.
3. OPERATIONAL SCENARIOS:

Required gate opening to maintain minimum flow with varied canal water elevations

Canal Elevation (ft, NGVD 29)	Head (Hw) (ft)	Gate Opening (Go) (ft)	% Open	C	H' (Hw-Go/2) (ft)	Q (cfs)
160.40	8.70	2.70	29.2	0.6	7.35	247
160.30	8.6	2.72	29.4	0.6	7.24	247
160.20	8.5	2.74	29.6	0.6	7.13	247
160.10	8.4	2.77	29.9	0.6	7.02	247
160.00	8.3	2.79	30.2	0.6	6.91	247
159.90	8.2	2.81	30.4	0.6	6.80	247
159.80	8.1	2.83	30.6	0.6	6.69	247
159.70	8	2.86	30.9	0.6	6.57	247
159.60	7.9	2.88	31.1	0.6	6.46	247
159.50	7.8	2.91	31.5	0.6	6.35	247
159.40	7.7	2.93	31.7	0.6	6.24	247

Discharge through gate with different opening heights and canal water elevation at El 160.4'

Orifice flow - Gate bottom in water

Canal Elevation (ft, NGVD 29)	Head (Hw) (ft)	Gate Opening (Go) (ft)	% Open	C	H' (Hw-Go/2) (ft)	Q (cfs)
160.40	8.70	1.00	10.8	0.6	8.20	97
160.40	8.70	2.00	21.6	0.6	7.70	187
160.40	8.70	3.00	32.4	0.6	7.20	271
160.40	8.70	4.00	43.2	0.6	6.70	349
160.40	8.70	5.00	54.1	0.6	6.20	420
160.40	8.70	6.00	64.9	0.6	5.70	483
160.40	8.70	7.00	75.7	0.6	5.20	538
160.40	8.70	8.00	86.5	0.6	4.70	585

Contracted weir flow - Gate bottom out of water

Canal Elevation (ft, NGVD 29)	Head (Hw) (ft)	Gate Opening (Go) (ft)	% Open	C	L'(L-(2n*H)) (ft)	Q (cfs)
160.40	8.70	9.00	97.3	2.6	5.26	351
160.40	8.70	9.25	100.0	2.6	7.51	501

NOT FOR CONSTRUCTION

No.	Revision	Date	Drawn	Checked
A	ISSUED FOR BID	08-01-13	CFT	JHL

EP ENERGY MASSACHUSETTS LLC
SPRINGFIELD, MA

INDIAN ORCHARD
MIN FLOW GATE PROJECT

GENERAL NOTES

Kleinschmidt
141 Main Street P.O. Box 650
Pittsfield, Maine 04967
Telephone: (207) 487-3328
Fax: (207) 487-3124
www.KleinschmidtUSA.com

Designed	Drawn	Checked	Project No.	Date Revised	Drawing No.
JHL	CFT	CMV	803-021	06-28-13	G1-01

22x34 = FULL SCALE

CHICOPEE RIVER

FLOW

FLOW

EXISTING DAM
CREST EL. 159.4'
TOP OF FLASHBOARDS EL. 160.9'

DECK
EL. 166.6'

EXISTING GATEHOUSE

A

EXISTING DRAIN GATES
(INVERT EL. 151.7')

TOP OF WALL EL. 160.9'±
(TOP OF WALL SLOPES)

WALKWAY EL. 162.9'

6'-0"

TOP OF ROCK FILL EL. 159.9'

LIMIT OF RIPRAP

SLOPE
1.5:1.0

TOE OF ROCK FILL

EXISTING BUILDING

EXISTING CHAIN LINK FENCE

PROPERTY LINE

ERNEST A. & ISABEL L. WALEN

POWER CANAL
N.P. EL. 160.4'

EXISTING BUILDING

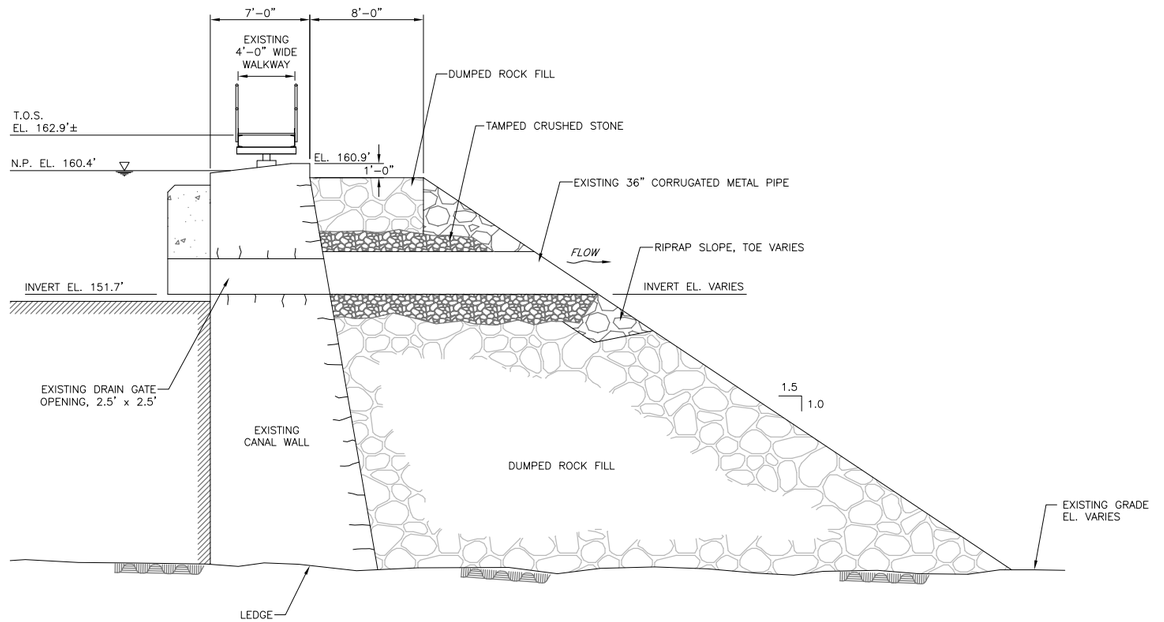
FLOW

PROPERTY LINE

HODGES CARPET CO.

PLAN
1/16"= 1'-0"

16 0 16 32
SCALE IN FEET



SECTION A
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

NOTES:

1. PLAN AND SECTION SHOWN IS FROM RECORD DRAWING NO. 58005-10001 DATED 6/5/1967 BY NORTHEAST UTILITIES SERVICE CO.
2. WALK WAY LAYOUT AND DIMENSIONS ARE FROM FIELD RECONNAISSANCE BY KLEINSCHMIDT.

NOT FOR CONSTRUCTION

No.	Revision	Date	Drawn	Checked
A	ISSUED FOR BID	08-01-13	CFT	JHL

EP ENERGY MASSACHUSETTS LLC
WEST SPRINGFIELD, MASS

INDIAN ORCHARD
MIN FLOW GATE PROJECT

EXISTING
OVERALL PLAN AND SECTION

Kleinschmidt
141 Main Street P.O. Box 650
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Fax: (207) 487-3124
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Designed	Drawn	Checked	Project No.	Date Revised	Drawing No.
JHL	CFT	CMV	803-021	07-31-13	C1-01

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22x34 = FULL SCALE

ERNEST A. & ISABEL L. WALEN

CHICOPEE RIVER

FLOW

FLOW

PROPERTY LINE

EXISTING GATEHOUSE

EXISTING DECK EL. 166.6'

EXISTING DAM
CREST EL. 159.4'
TOP OF FLASHBOARDS EL. 160.9'

NEW STEEL WALKWAY EXTENSION AND STAIRWAY

NEW CONCRETE TROUGH WITH GATE AND REMOTE GATE OPERATOR

A

TOP OF WALL EL. 160.9'± (TOP OF WALL SLOPES)

WALKWAY EL. 162.9'

6'-0"

TOP OF ROCK FILL EL. 159.9'

LIMIT OF EXISTING RIPRAP

SLOPE 1.5:1.0

TOE OF EXISTING ROCK FILL

POWER CANAL
N.P. EL. 160.4'

EXISTING BUILDING

FLOW

EXISTING BUILDING

EXISTING CHAIN LINK FENCE

PROPERTY LINE

HODGES CARPET CO.

PLAN
1/16"= 1'-0"

16 0 16 32
SCALE IN FEET

HIGHEST POSITION OF STEM EL. 181.62'

NEW GATE OPERATOR

TOP OF STEEL FRAME EL. 170.67'

TOP OF GATE FULL UP EL. 170.20'

4'-0" CLEAR

T.O.S. WALKWAY EL. 162.9'±

N.P. EL. 160.4'

EL. 160.9'

TOP OF GATE FULL DOWN EL. 160.95'

BOTTOM OF GATE FULL UP EL. 160.95'

OUTLINE OF EXISTING DRAIN PIPE

FLOW

EXISTING RIPRAP SLOPE, TOE VARIES

INVERT EL. 151.7'

BOTTOM OF GATE FULL DOWN EL. 151.7'

1.5
1.0

NEW BEDDING MATERIAL. SEE "EARTHWORK NOTES 4" ON SHEET G1-01

EXISTING CANAL WALL

EXISTING DUMPED ROCK FILL

EXISTING GRADE EL. VARIES

LEDGE

SECTION A
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

NOT FOR CONSTRUCTION

No.	Revision	Date	Drawn	Checked
A	ISSUED FOR BID	08-01-13	CFT	JHL

EP ENERGY MASSACHUSETTS LLC
SPRINGFIELD, MA

INDIAN ORCHARD
MIN FLOW GATE PROJECT

PROPOSED
OVERALL PLAN AND SECTION

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Designed	Drawn	Checked	Project No.	Date Revised	Drawing No.
JHL	CFT	CMV	803-021	07-31-13	C2-01

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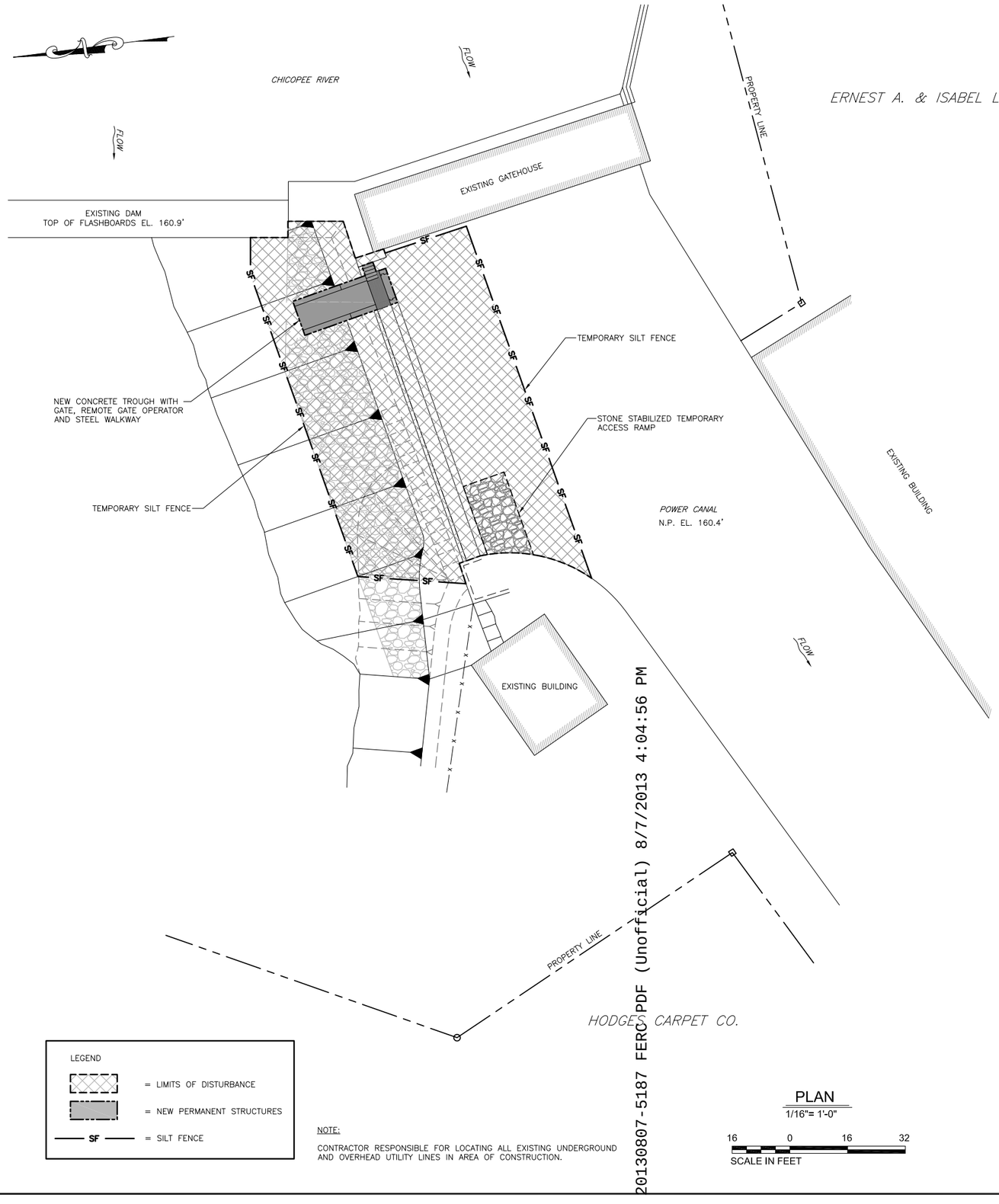
22x34 = FULL SCALE



LEGEND

= LIMITS OF DISTURBANCE

= NEW PERMANENT STRUCTURES

SF = SILT FENCE

NOTE:

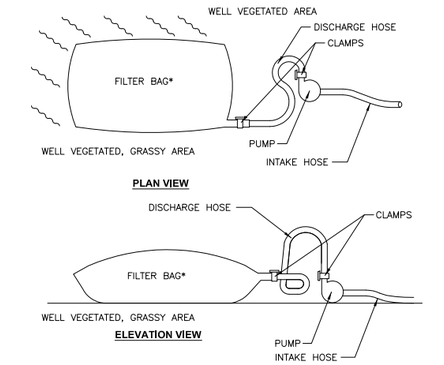
CONTRACTOR RESPONSIBLE FOR LOCATING ALL EXISTING UNDERGROUND AND OVERHEAD UTILITY LINES IN AREA OF CONSTRUCTION.

PLAN

1/16"= 1'-0"

16 0 16 32

SCALE IN FEET



NON-WOVEN GEOTEXTILE FILTER BAG WHICH RETAINS ALL SEDIMENT PARTICLES LARGER THAN 150 MICRONS.

PLACE FILTER BAGS ON STABLE OR WELL VEGETATED AREAS WHICH ARE FLATTER THAN 5% AND WHICH WILL NOT ERODE WHEN SUBJECTED TO BAG DISCHARGES.

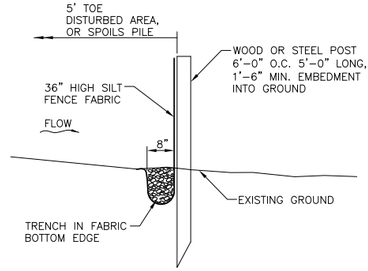
CLAMP PUMP DISCHARGE HOSES SECURELY INTO FILTER BAGS.

LIMIT PUMPING RATE TO 1/2 THE MANUFACTURE'S MAXIMUM PUMPING RATE.

WHEN SEDIMENTS FILL 1/2 THE VOLUME OF A FILTER BAG, IMMEDIATELY REMOVE THAT BAG FROM SERVICE. PROPERLY DISPOSE OF THE SPENT BAGS WITH THEIR SEDIMENTS.

PUMPED WATER FILTRATION BAG

NTS

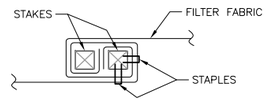


SILT FENCE DETAIL

N.T.S.

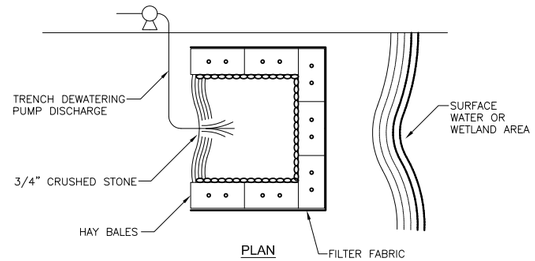
NOTES:

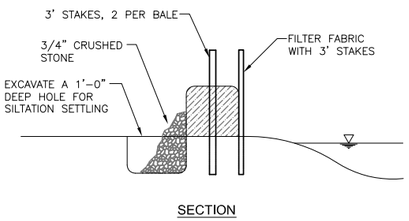
1. PROVIDE SILT FENCE ON DOWNSLOPE SIDE OF SOIL DISTURBANCES OR ALL STOCKPILES UNTIL PERMANENT VEGETATION IS ESTABLISHED.
2. FILTER FABRIC FENCE MUST BE INSTALLED AT EXISTING LEVEL GRADE. BOTH ENDS OF EACH FENCE SECTION MUST BE EXTENDED AT LEAST 8 FEET UPSLOPE AT 45 DEGREES TO THE MAIN FENCE ALIGNMENT.
3. SEDIMENT MUST BE REMOVED WHERE ACCUMULATIONS REACH 1/3 ABOVE THE GROUND HEIGHT OF THE FENCE.
4. SILT FENCE TO BE INSPECTED AFTER EACH RUNOFF EVENT AND AT LEAST WEEKLY.



JOINING FENCE SECTION

N.T.S.





DEWATERING/SETTLING BASIN DETAIL

N.T.S.

NOT FOR CONSTRUCTION

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A	ISSUED FOR BID	08-01-13	CFT	JHL

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EP ENERGY MASSACHUSETTS LLC
SPRINGFIELD, MA

INDIAN ORCHARD
MIN FLOW GATE PROJECT

SOIL AND EROSION CONTROL
PLAN & DETAILS

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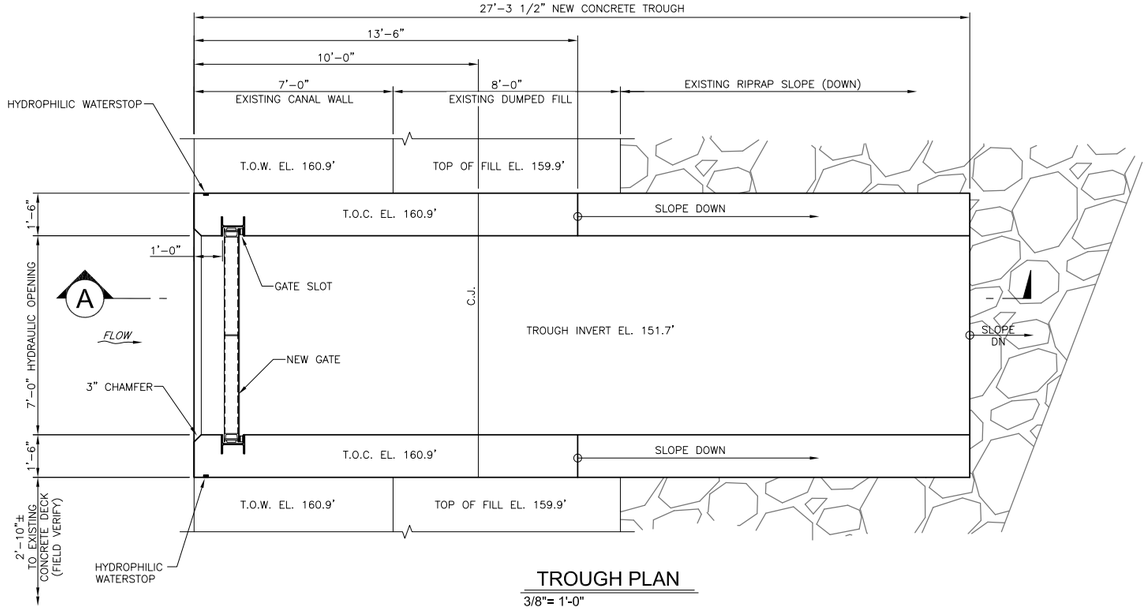
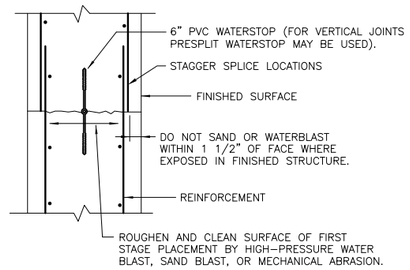
22x34 = FULL SCALE

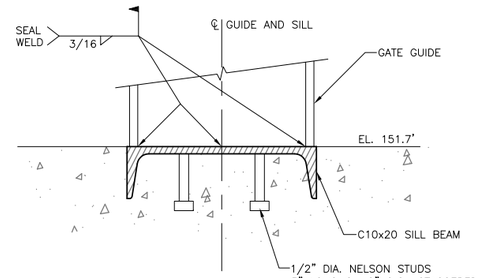


TROUGH PLAN
3/8"= 1'-0"



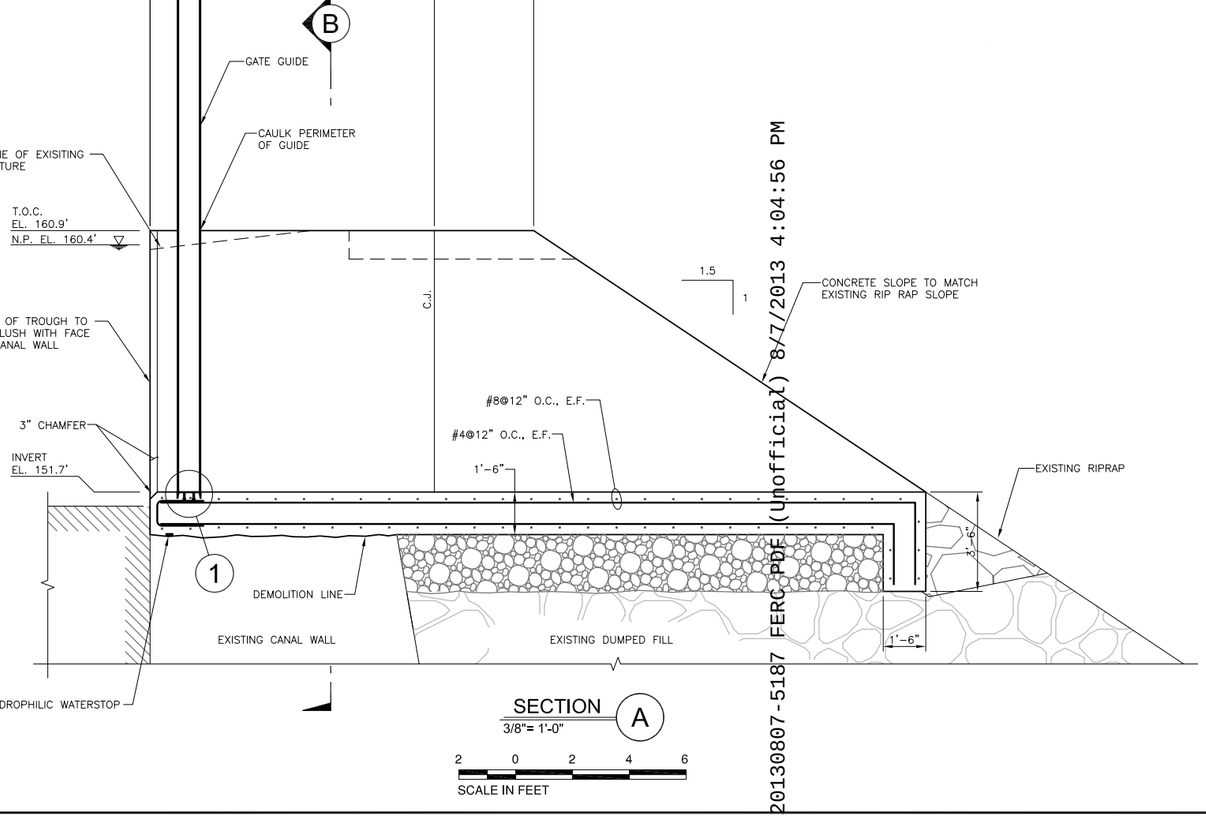
NOTE: LOCATE JOINTS WHERE SHOWN ON DRAWINGS.

CONSTRUCTION JOINT DETAIL
N.T.S.



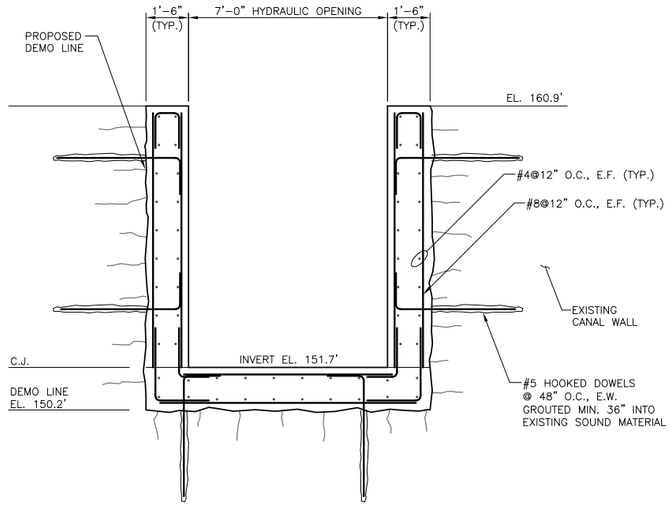
DETAIL 1
3"= 1'-0"

3 0 3 6 9
SCALE IN INCHES



SECTION A
3/8"= 1'-0"

2 0 2 4 6
SCALE IN FEET



SECTION B
3/8"= 1'-0"

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A	ISSUED FOR BID	08-01-13	CFT	JHL

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EP ENERGY MASSACHUSETTS LLC
SPRINGFIELD, MA

INDIAN ORCHARD
MIN FLOW GATE PROJECT

PROPOSED
CONCRETE TROUGH PLAN AND SECTIONS

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Project No.	Date Revised	Drawing No.
803-021	06-28-13	C3-01

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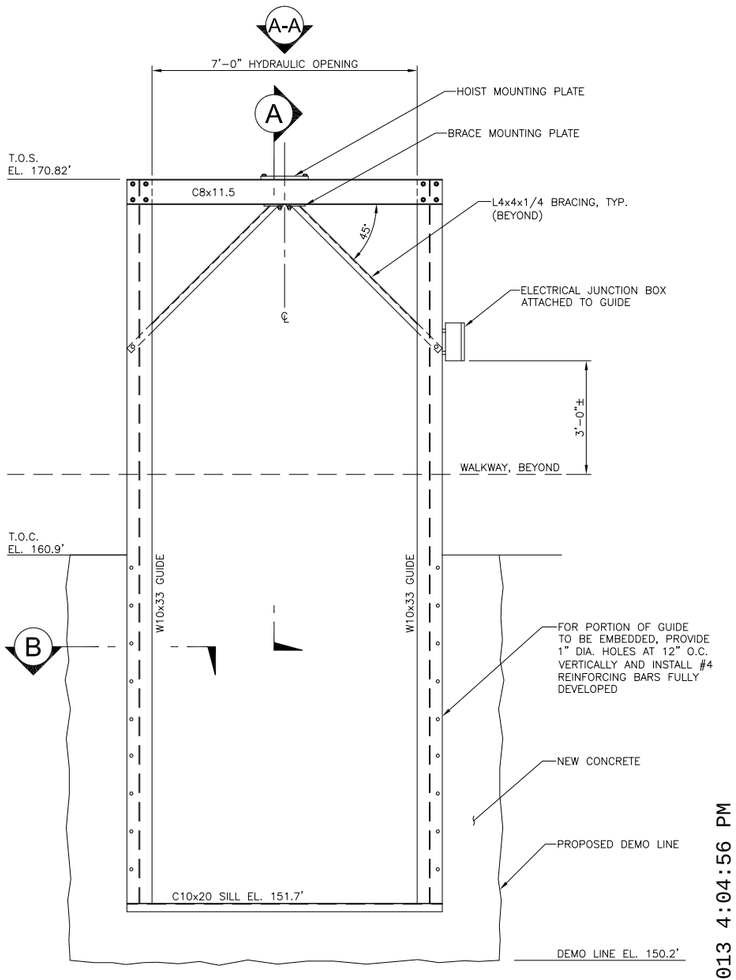
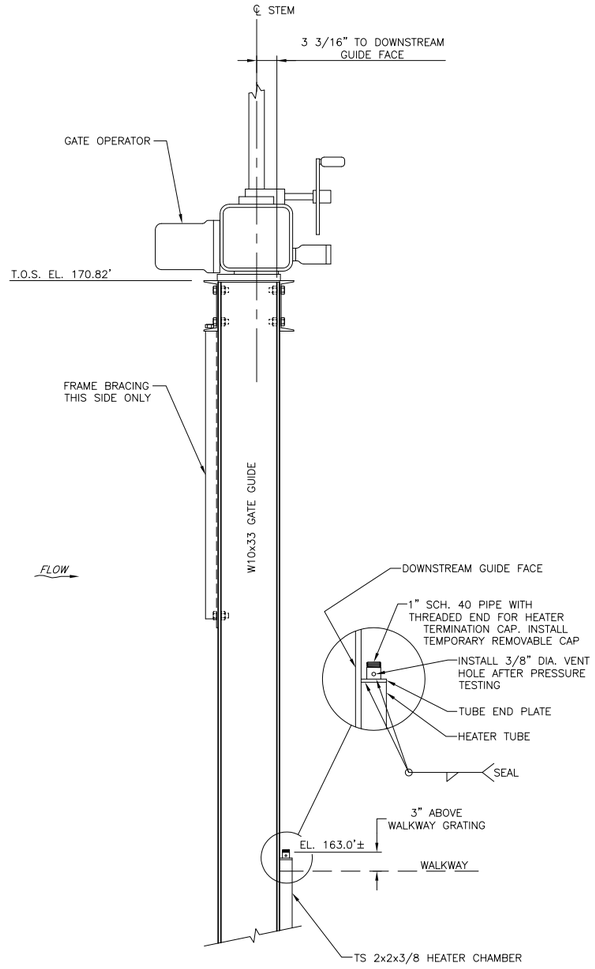


GUIDE/LIFTING FRAME
ELEVATION LOOKING UPSTREAM
1/2"= 1'-0"

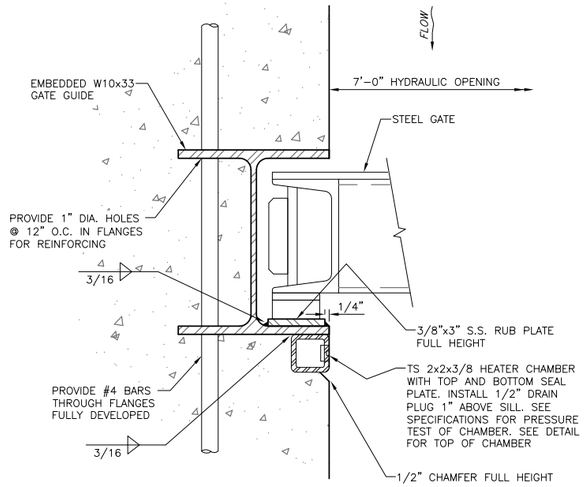
2 0 2 4
SCALE IN FEET



SECTION A
1"= 1'-0"

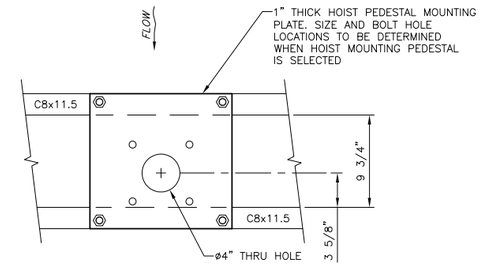
NOTE:
PROVIDE ELECTRIC SCREW
STEM GATE OPERATOR TO
RATED CAPACITY OF 5 TONS.

1 0 1 2
SCALE IN FEET



SECTION B
3"= 1'-0"

3 0 3 6 9
SCALE IN INCHES



VIEW A-A
1 1/2"= 1'-0"

8 0 8 16
SCALE IN INCHES

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EP ENERGY MASSACHUSETTS LLC
SPRINGFIELD, MA

INDIAN ORCHARD
MIN FLOW GATE PROJECT

PROPOSED
GATE GUIDE/LIFTING FRAME

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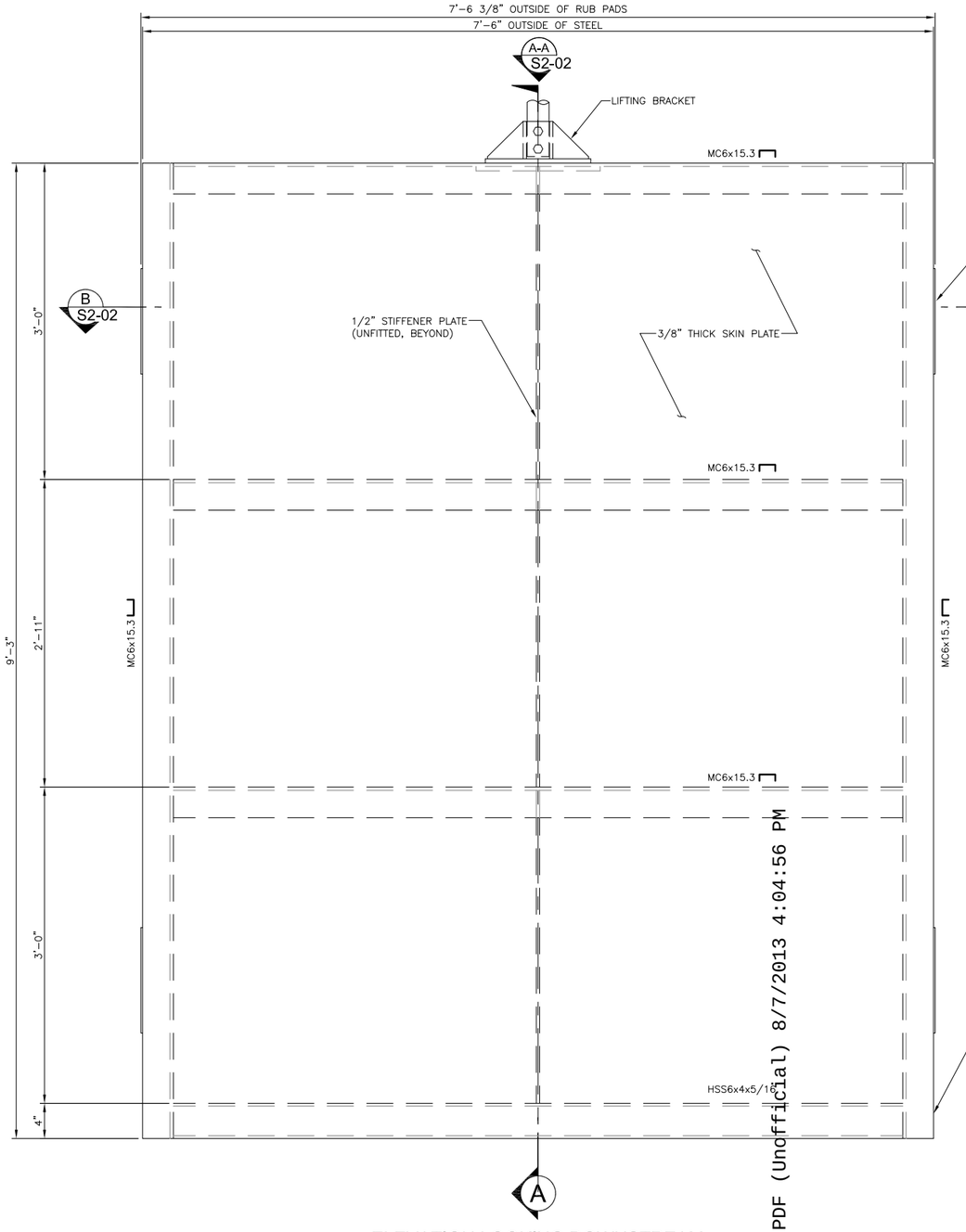
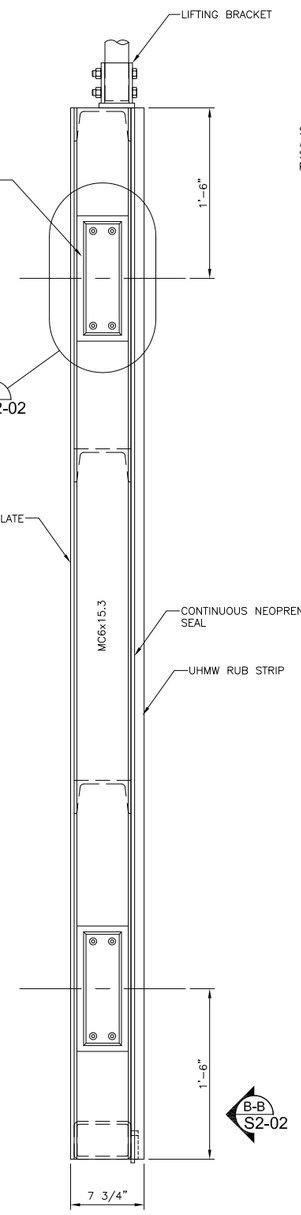
Project No.	Date Revised	Drawing No.
803-021	06-28-13	S1-01

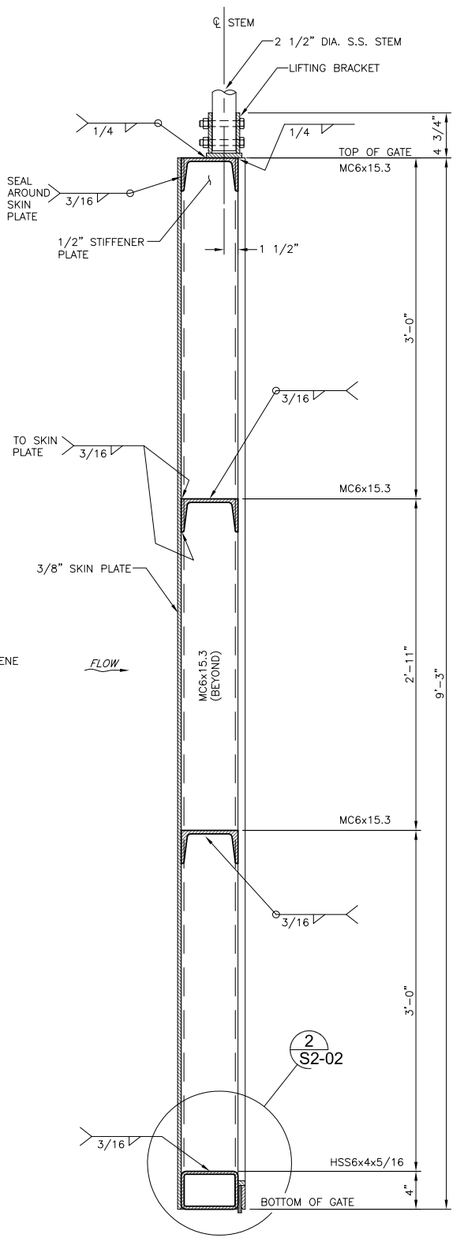
22x34 = FULL SCALE



ELEVATION LOOKING DOWNSTREAM
1 1/2"= 1'-0"



SIDE ELEVATION
1 1/2"= 1'-0"



SECTION A
1 1/2"= 1'-0"

8 0 8 16
SCALE IN INCHES

NOT FOR CONSTRUCTION

No.	Revision	Date	Drawn	Checked
A	ISSUED FOR BID	08-01-13	CFT	JHL

EP ENERGY MASSACHUSETTS LLC
SPRINGFIELD, MA

INDIAN ORCHARD
MIN FLOW GATE PROJECT

PROPOSED
GATE ELEVATION AND SECTION

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JHL	CFT	CMV	803-021	06-28-13	S2-01

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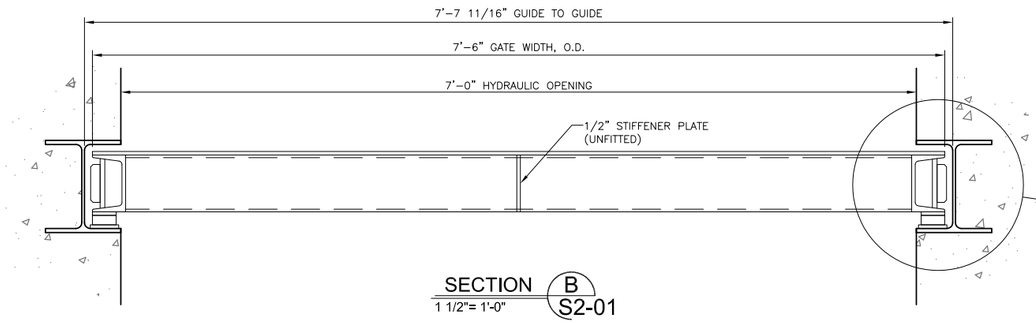
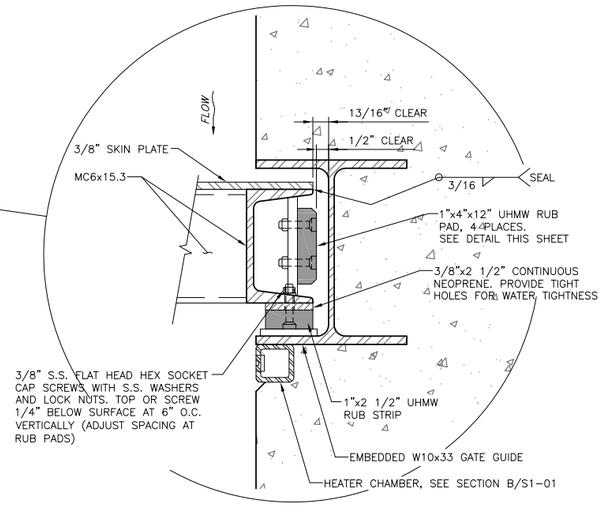
22x34 = FULL SCALE

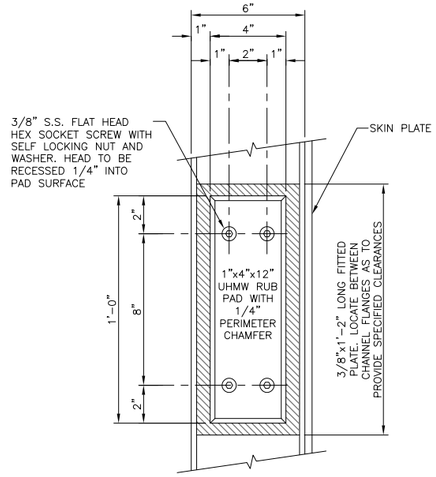


SECTION B
1 1/2"= 1'-0"
S2-01

8 0 8 16
SCALE IN INCHES

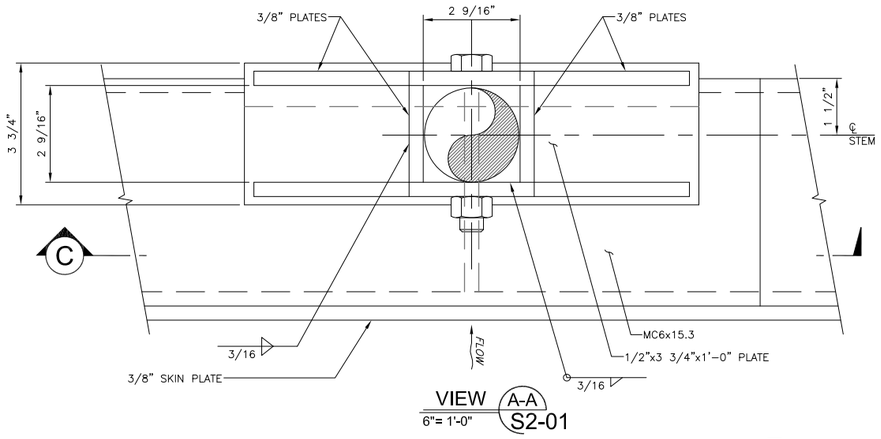


3 0 3 6 9
SCALE IN INCHES

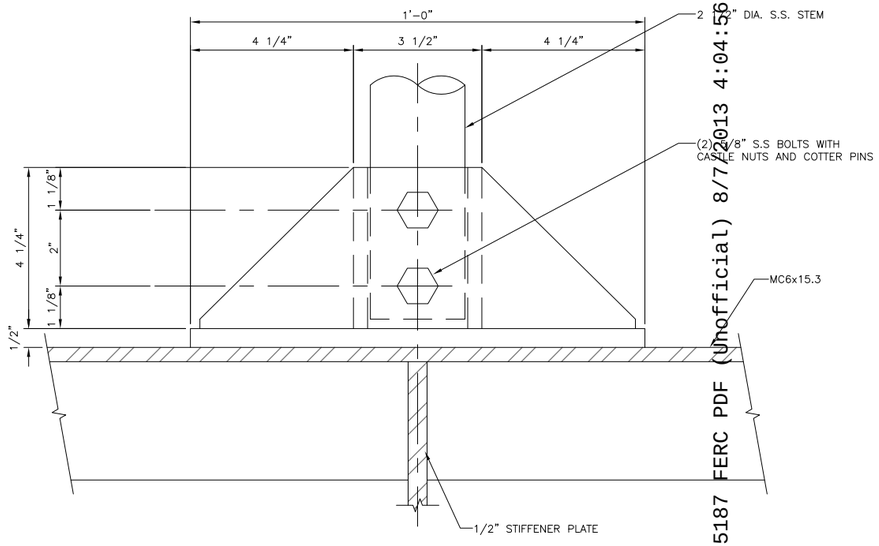


DETAIL 1
3"= 1'-0"
S2-01

3 0 3 6 9
SCALE IN INCHES

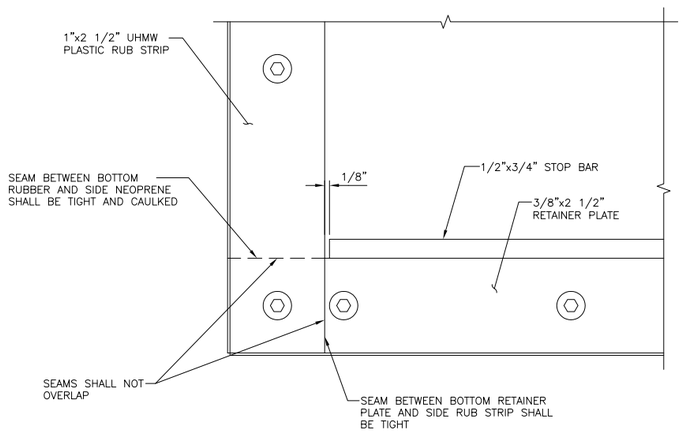


VIEW A-A
6"= 1'-0"
S2-01



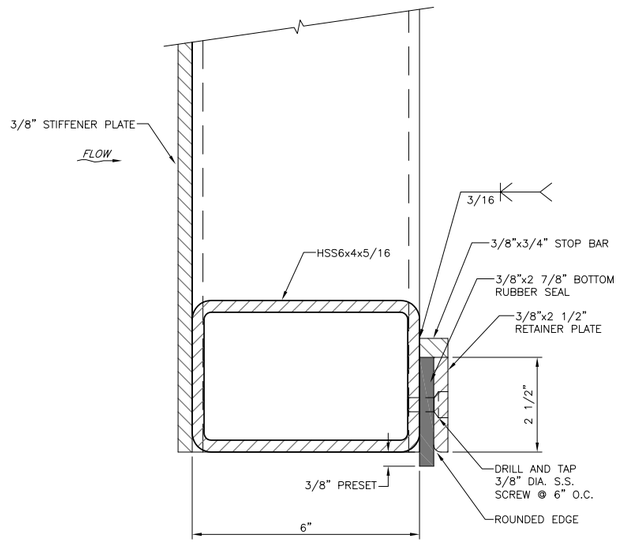
SECTION C
6"= 1'-0"

2 0 2 4
SCALE IN INCHES



VIEW B-B
6"= 1'-0"
S2-01

2 0 2 4
SCALE IN INCHES



DETAIL 2
6"= 1'-0"
S2-01

2 0 2 4
SCALE IN INCHES

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A	ISSUED FOR BID	08-01-13	CFT	JHL

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EP ENERGY MASSACHUSETTS LLC
SPRINGFIELD, MA

INDIAN ORCHARD
MIN FLOW GATE PROJECT

PROPOSED
GATE SECTIONS AND DETAILS

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Project No.	Date Revised	Drawing No.
803-021	06-28-13	S2-02

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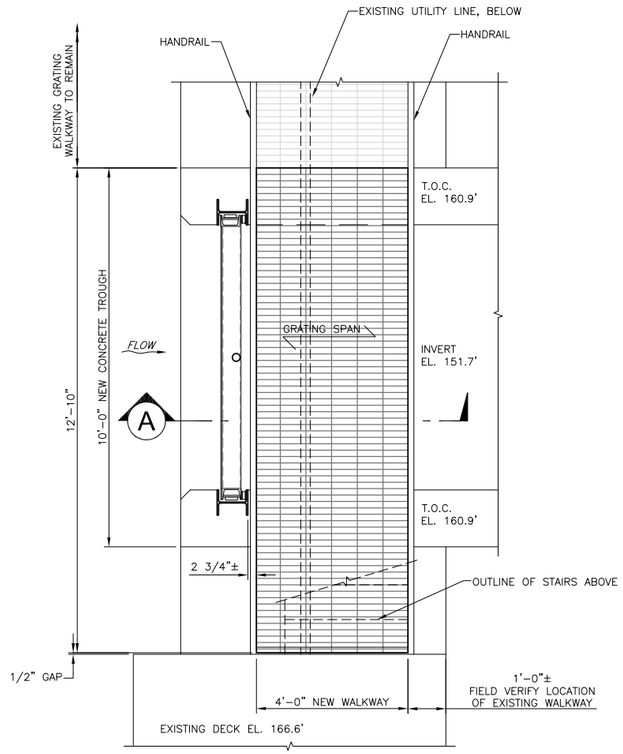
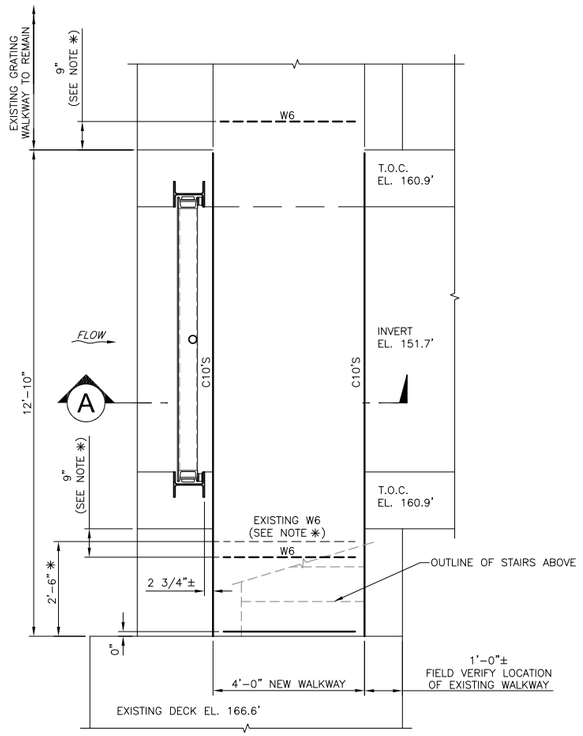


GRATING PLAN

1/2"= 1'-0"

2 0 2 4

SCALE IN FEET



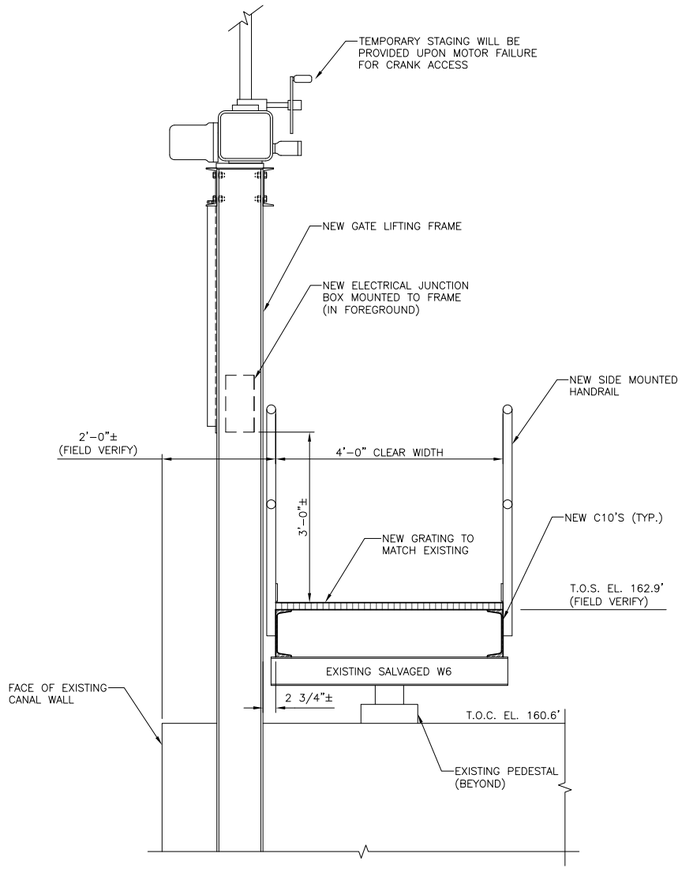
FRAMING PLAN
T.O.S. EL. 162.9'±

1/2"= 1'-0"

2 0 2 4

SCALE IN FEET

✳ CONTRACTOR TO SALVAGE EXISTING W6'S. IF SALVAGING IS NOT POSSIBLE, NEW W6 SHALL BE USED WITH NEW LOCATION



SECTION A

3/4"= 1'-0"

1 0 1 2 3

SCALE IN FEET

NOTES:

1. CONTRACTOR SHALL VERIFY GRATING AND MEMBER SIZING FOR THE EXISTING WALKWAY.
2. SALVAGE AND REUSE EXISTING WALKWAY TO THE GREATEST EXTENT POSSIBLE.
3. REPLACE IN KIND WHEN EXISTING MEMBERS CAN NOT BE REUSED.

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EP ENERGY MASSACHUSETTS LLC
SPRINGFIELD, MA

INDIAN ORCHARD
MIN FLOW GATE PROJECT

PROPOSED
GRATING WALKWAY EXTENSION

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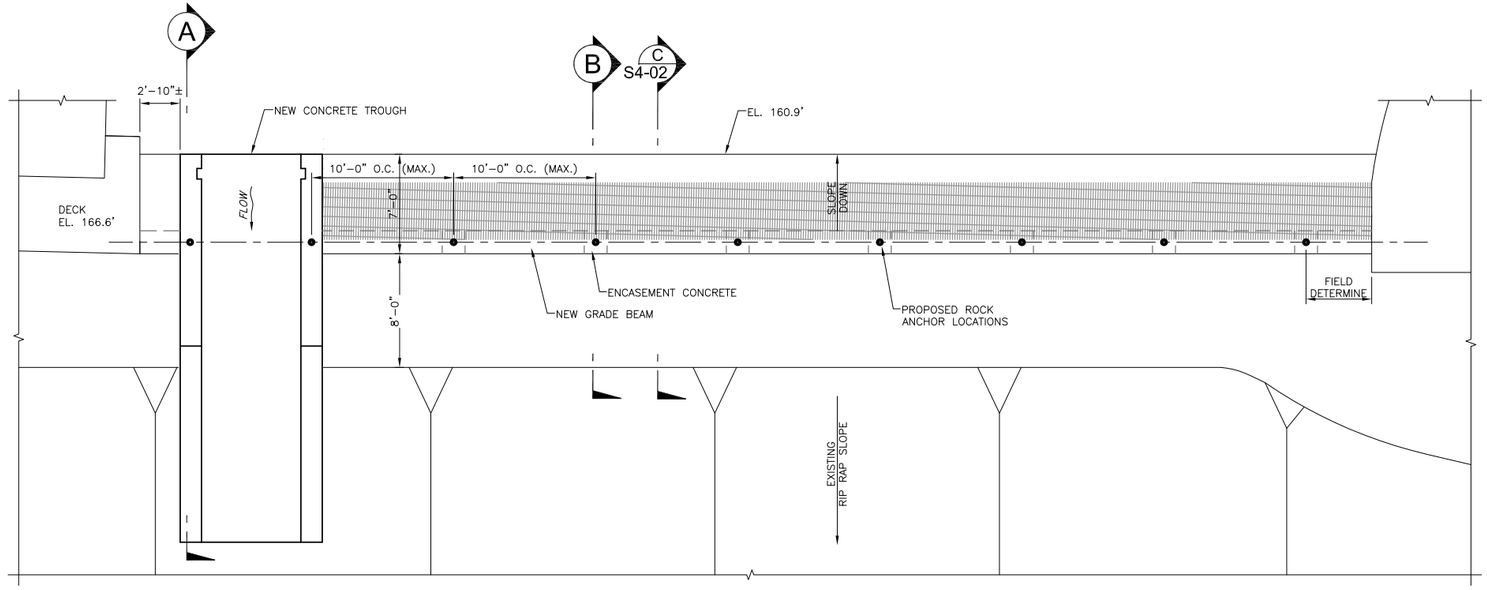
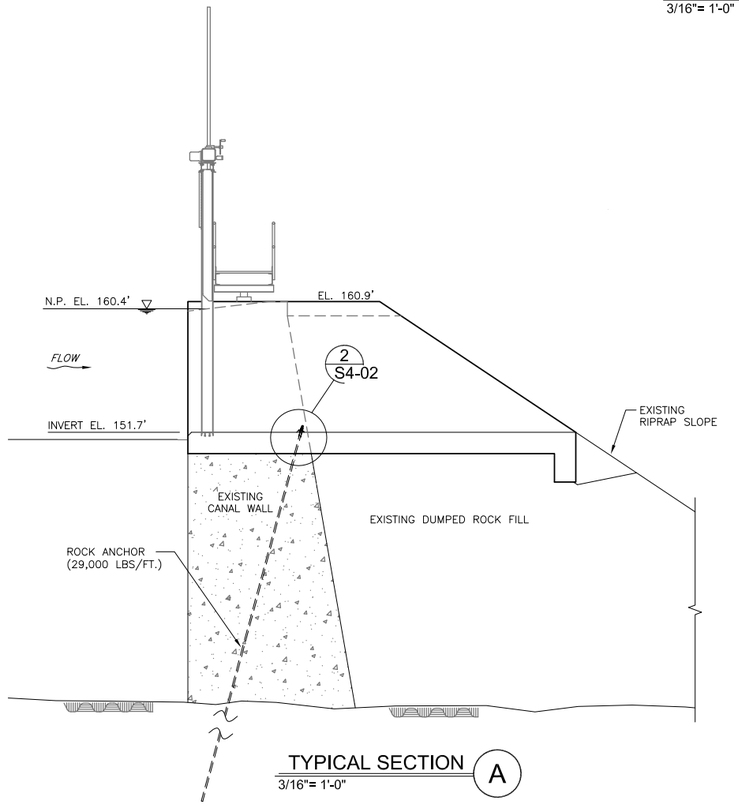


PROPOSED ROCK ANCHOR LAYOUT

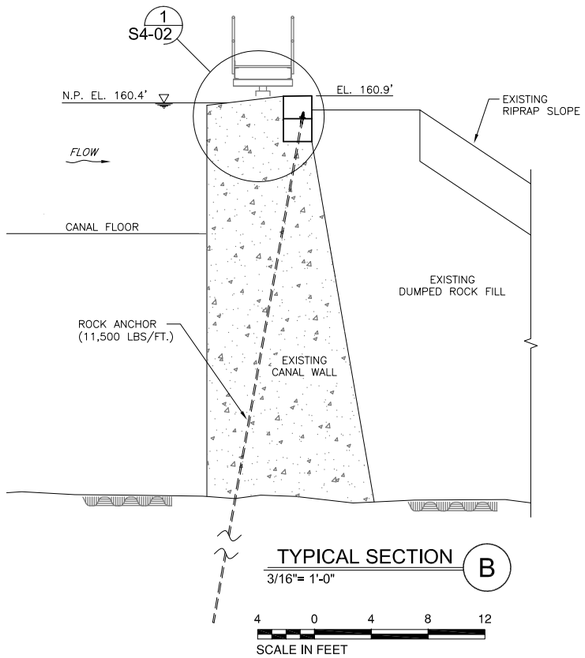
3/16"= 1'-0"



TYPICAL SECTION A

3/16"= 1'-0"

NOTE:
PROPOSED ROCK ANCHORS WITHIN THE TROUGH IS ENCASED BY THE NEW PIERS.



TYPICAL SECTION B

3/16"= 1'-0"

4 0 4 8 12

SCALE IN FEET

ROCK ANCHOR NOTES:

1. NUMBER, SIZE, AND SPACING OF ROCK ANCHORS DEPENDS UPON CONTRACTOR'S DESIGN AS STATED IN SPECIFICATION.
2. APPLY BONDING AGENT TO ALL CONCRETE SURFACES JUST PRIOR TO PLACEMENT OF ENCASEMENT CONCRETE.
3. ENCASEMENT CONCRETE: 4,000 PSI MIN, 28 DAYS, 5–7% AIR ENTRAINMENT, NON–SHRINK.
4. ANCHOR:
   - A. ANCHORS SHALL BE FULLY BONDED MULTIPLE CORROSION PROTECTION (MCP) TYPE II – CLASS 1 PER POST–TENSIONING INSTITUTE (PTI) OR APPROVED EQUAL.
   - B. ANCHORS SHALL BE GROUTED IN TWO STAGES. BOTTOM (FIRST) STAGE EXTENDS FROM BOTTOM OF HOLE TO THE TOP OF THE BOND ZONE, INSIDE AND OUTSIDE OF THE CORRUGATED TUBE. AFTER ANCHOR IS LOAD TESTED, LOCKED–OFF, AND PASSES FINAL LIFT–OFF TEST, THE SECOND STAGE GROUT SHALL BE INSTALLED FROM THE TOP OF THE FIRST STAGE GROUT TO THE ANCHOR HEAD, INSIDE AND OUTSIDE OF TUBE. ANCHOR HEADS SHALL NOT BE REMOVED AND THE TENDON WEDGES OR ANCHOR NUT SHALL BE LEFT ENGAGED AND SEATED.
   - C. ANCHORS:
     - I. FOR TENDONS, UNCOATED 7–WIRE, MINIMUM DIAMETER OF 0.57, 270 KSI LOW RELAXATION STEEL, ASTM A416. EPOXY COATED STRANDS SHALL NOT BE USED.
     - II. FDR BARS, 1" DIA. MIN, 150 KSI STEEL WITH UPSET THREADS, ASTM A722. EPOXY COATED BARS SHALL NOT BE USED.
   - D. MAXIMUM DESIGN BOND STRESS
     - I. ROCK, 150 PSI
     - II. CONCRETE, 300 PSI
   - E. DESIGN:
     - I. DESIGN LOAD SHALL BE LESS THAN 60% OF MIN. ANCHOR TENSILE STR.
     - II. LOCK–OFF LOAD SHALL BE LESS THAN 70% OF MIN. ANCHOR TENSILE STR.
     - III. MAX. TEST LOAD SHALL BE LESS THAN 80% OF MIN. ANCHOR TENSILE STR.
   - F. BOND ZONE LENGTH BASED ON 80% GUARANTEED ULTIMATE TENSILE STRENGTH (GUTS). MINIMUM BOND ZONE LENGTH OF 10 FT. MAXIMUM BOND LENGTH OF 35 FT. CONTRACTOR TO ESTABLISH SIZE OF ANCHOR HOLE
   - G. ANCHOR GROUT: 7–DAY, 3500 PSI MIN. 0.35 TO 0.40 W/C RATIO (BY WEIGHT) WITH WATER REDUCING AGENT.
   - H. BEARING PLATES: MILD OR HIGH STRENGTH STEEL, SIZED TO PROVIDE MAXIMUM BEARING PRESSURE OF 2500 PSI AT 80% GUTS.
5. CONTRACTOR SHALL VERIFY AND CONFIRM STRUCTURAL INTEGRITY OF THE EXISTING CANAL WALL WITH THE ENGINEER PRIOR TO COMMENCING THE WORK.

NOT FOR CONSTRUCTION

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JHL	CFT	LLC

EP ENERGY MASSACHUSETTS LLC
SPRINGFIELD, MA

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MIN FLOW GATE PROJECT

PROPOSED
ROCK ANCHOR PLAN AND SECTIONS

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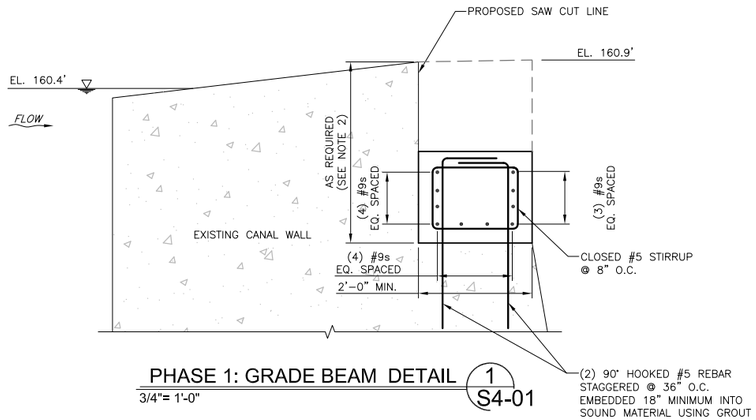
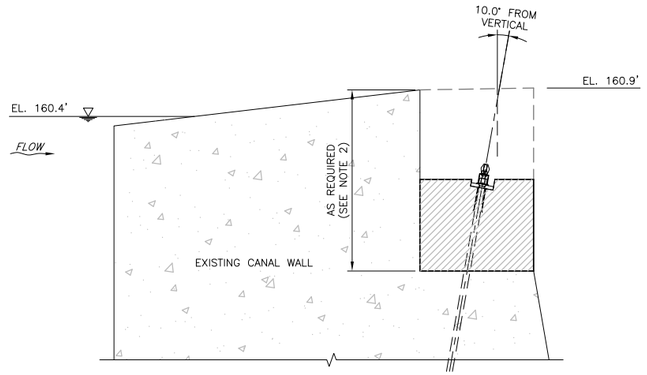
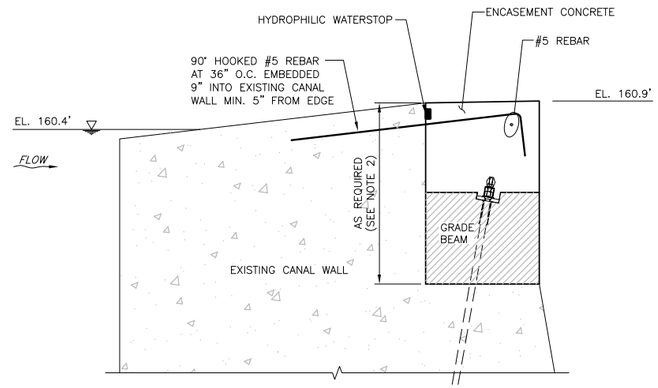
Project No.	Date Revised	Drawing No.
803-021	06-28-13	S4-01



PHASE 1: GRADE BEAM DETAIL 1 S4-01
3/4"= 1'-0"



PHASE 2: ROCK ANCHOR DETAIL 1 S4-01
3/4"= 1'-0"

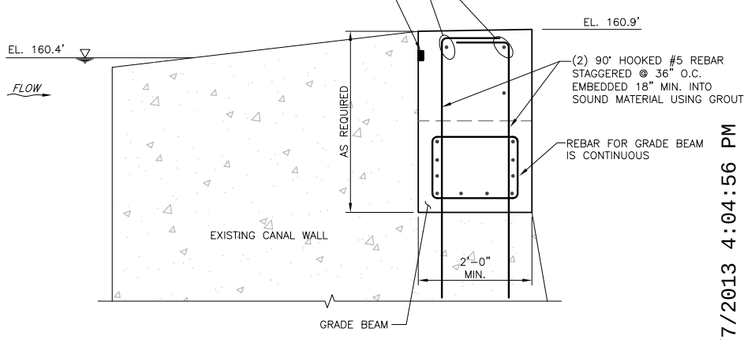


PHASE 3: ENCASEMENT CONCRETE DETAIL 1 S4-01
3/4"= 1'-0"

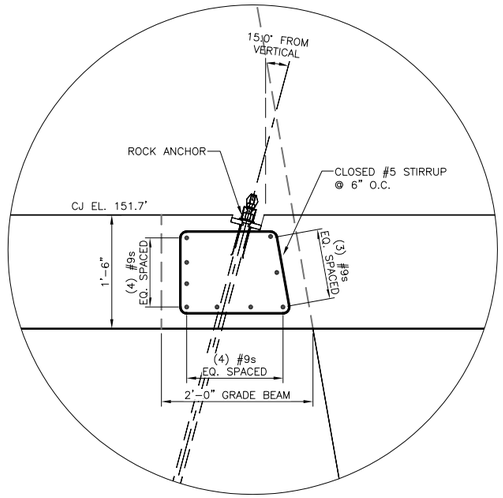
NOTES:

1. CONTRACTOR TO DETERMINE WIDTH OF ENCASEMENT CONCRETE PER ANCHOR INSTALLATION REQUIREMENTS
2. PROPOSED SAW CUT DEPTH SHALL BE DETERMINED TO PROVIDE FULL ENCLOSURE OF THE ANCHOR HEAD WITHIN THE ENCASEMENT CONCRETE

1 0 1 2 3
SCALE IN FEET



SECTION C S4-01
3/4"= 1'-0"



DETAIL 2 S4-01
1"= 1'-0"

NOT FOR CONSTRUCTION

No.	Revision	Date	Drawn	Checked
A	ISSUED FOR BID	08-01-13	CFT	JHL

EP ENERGY MASSACHUSETTS LLC
SPRINGFIELD, MA

INDIAN ORCHARD
MIN FLOW GATE PROJECT

PROPOSED
ROCK ANCHOR SECTIONS AND DETAILS

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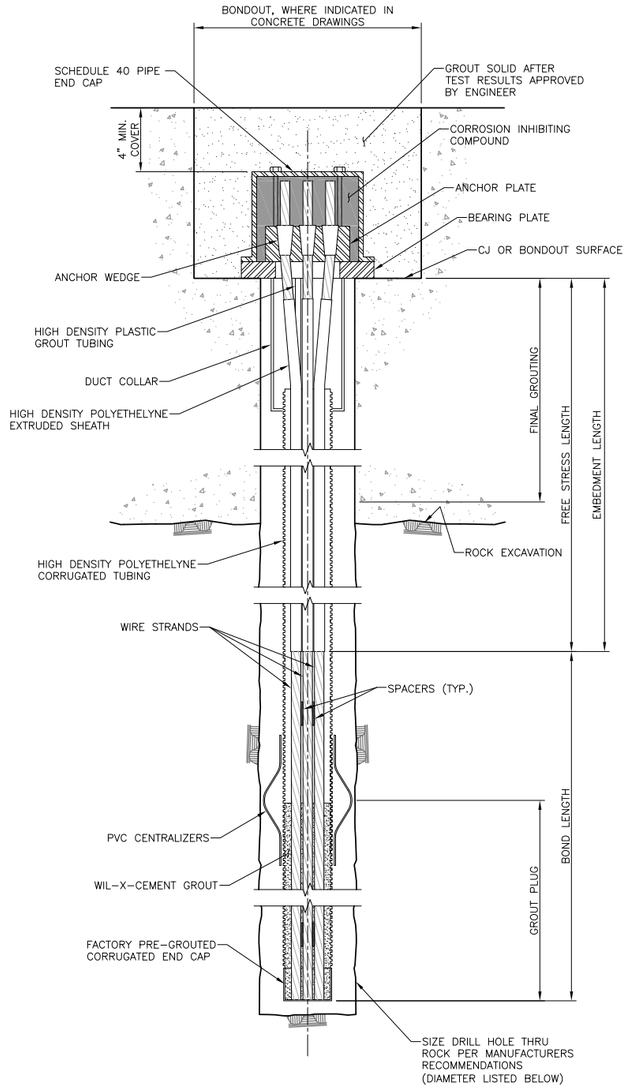
Designed	Drawn	Checked
JHL	CFT	LLC

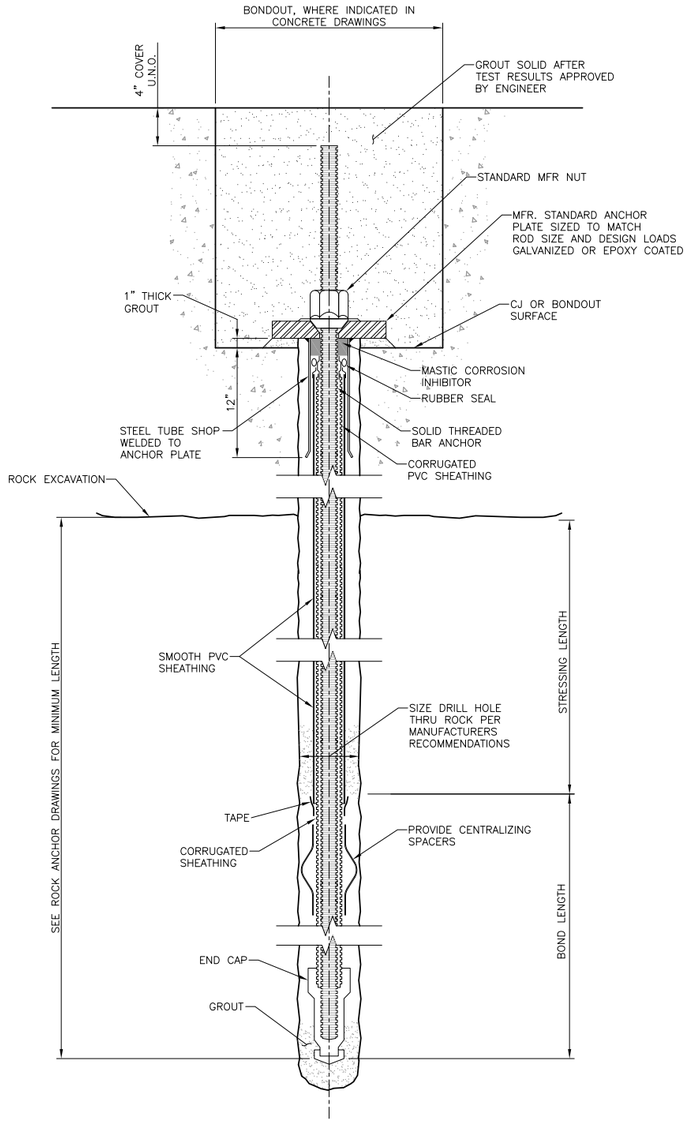
Project No.	Date Revised	Drawing No.
803-021	06-28-13	S4-02



STRAND ANCHOR DETAIL (TENSIONED)

N.T.S.

NOTE:
ROCK ANCHORS TO BE DESIGNED BY MANUFACTURER AND APPROVED BY ENGINEER PER SPECIFICATION



SOLID BAR ANCHOR DETAIL (TENSIONED)

N.T.S.

NOT FOR CONSTRUCTION

No.	Revision	Date	Drawn	Checked
A	ISSUED FOR BID	08-01-13	CFT	JHL

EP ENERGY MASSACHUSETTS LLC
SPRINGFIELD, MA

INDIAN ORCHARD
MIN FLOW GATE PROJECT

PROPOSED
STRAND & SOLID BAR ROCK ANCHOR DETAILS

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Designed	Drawn	Checked	Project No.	Date Revised	Drawing No.
JHL	CFT	LLC	803-021	07-31-13	S4-03

Project: Indian Orchard Canal Wall	By: JHL	Date: 5/22/13
Subject: Stability Analysis	Checked: CMV	Date: 7/12/13

Stability Analysis (Gravity Method)

Indian Orchard Canal Spillway Wall was analyzed as a simple gravity structure. The stability was analyzed utilizing Kleinschmidt's in-house, dam stability computer program KASTABLE. The selection of the analyzed sections were made to represent the most typical sections along the entire canal wall structure: 1) existing canal wall section and 2) modified gated canal wall section. Proposed modification of the canal wall will replace the existing two low level outlet pipes with gated spillway chute.

This stability analysis will be an update to the initial analysis from the 1989 CSIR. An excerpt of the original stability is included as an attachment to this analysis (Attachment A). The initial analysis concluded that the canal wall did not meet adequate factors of safety against overturning during the normal conditions. With the proposed modifications, which will require removing some portions of the canal wall, existing stability will be adversely impacted. Therefore, new stability analysis will utilize rock anchors along the canal wall as a mitigating measure to proposed modifications and for stabilizing the entire canal wall to meet the current guidelines.

Assumptions

1) See Attachment A for design parameters & geometry from Table 1 & 2 in the initial analysis in 1989 and Attachment B for proposed modifications.
2) Cohesionless analysis with structure founded on rock.
3) Full uplift varying linearly from heel to toe.
4) At-rest earth pressure on both sides of the canal wall. Dumped rock & riprap backfill with internal angle of friction of 40 degrees.
5) Canal wall will act monolithic and rotate about the toe.
6) Ice and seismic conditions were considered but not developed. Ice condition can be prevented/controlled by operating the canal intake gates, upstream of the canal wall. Post seismic condition is expected to remain relatively the same as normal condition. Initial analysis states seismic acceleration of 0.1g, which should not produce significant internal stress to cause localized failure.
7) Strength of existing masonry canal wall is adequate to transfer the loads applied by the post-tensioned rock anchors to the foundation.

Conclusion

The revised analysis indicate that canal wall will require approximately 11.5 kips per foot of anchoring along the existing section of the canal wall. The modified gated section of the canal wall will require 29 kips per foot of anchorage to meet the current FERC Engineering Guidelines for the Evaluation of Hydropower Projects, Chapter 3 Gravity Dams. See following stability analysis for additional details.

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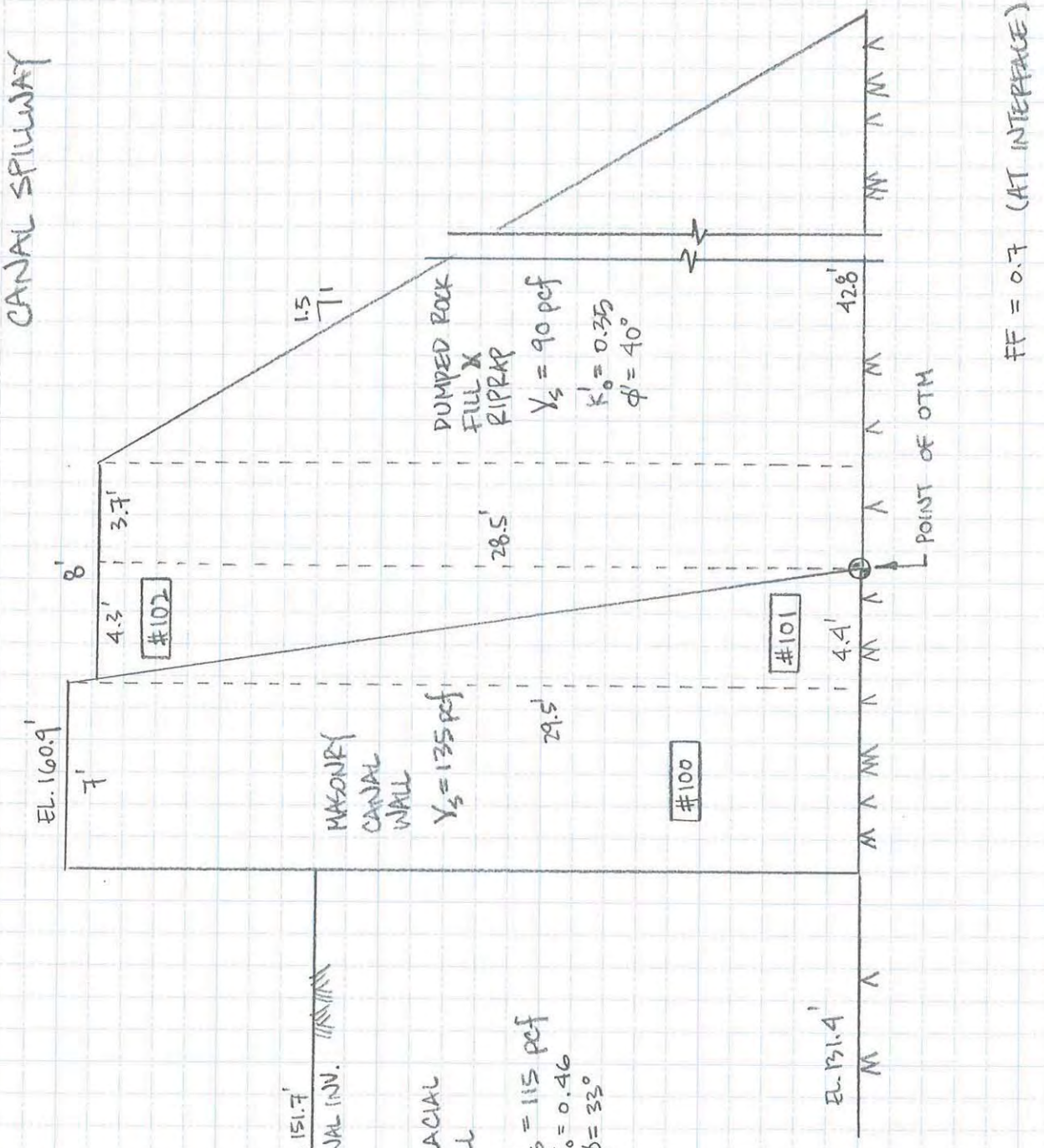
Project No.: 803.021

Project: INDIAN ORCHARD SPILLWAY CANAL

By: JHL Date: 5/17,13

Subject: STABILITY ANALYSIS

Checked: CMV Date: 7/12/13



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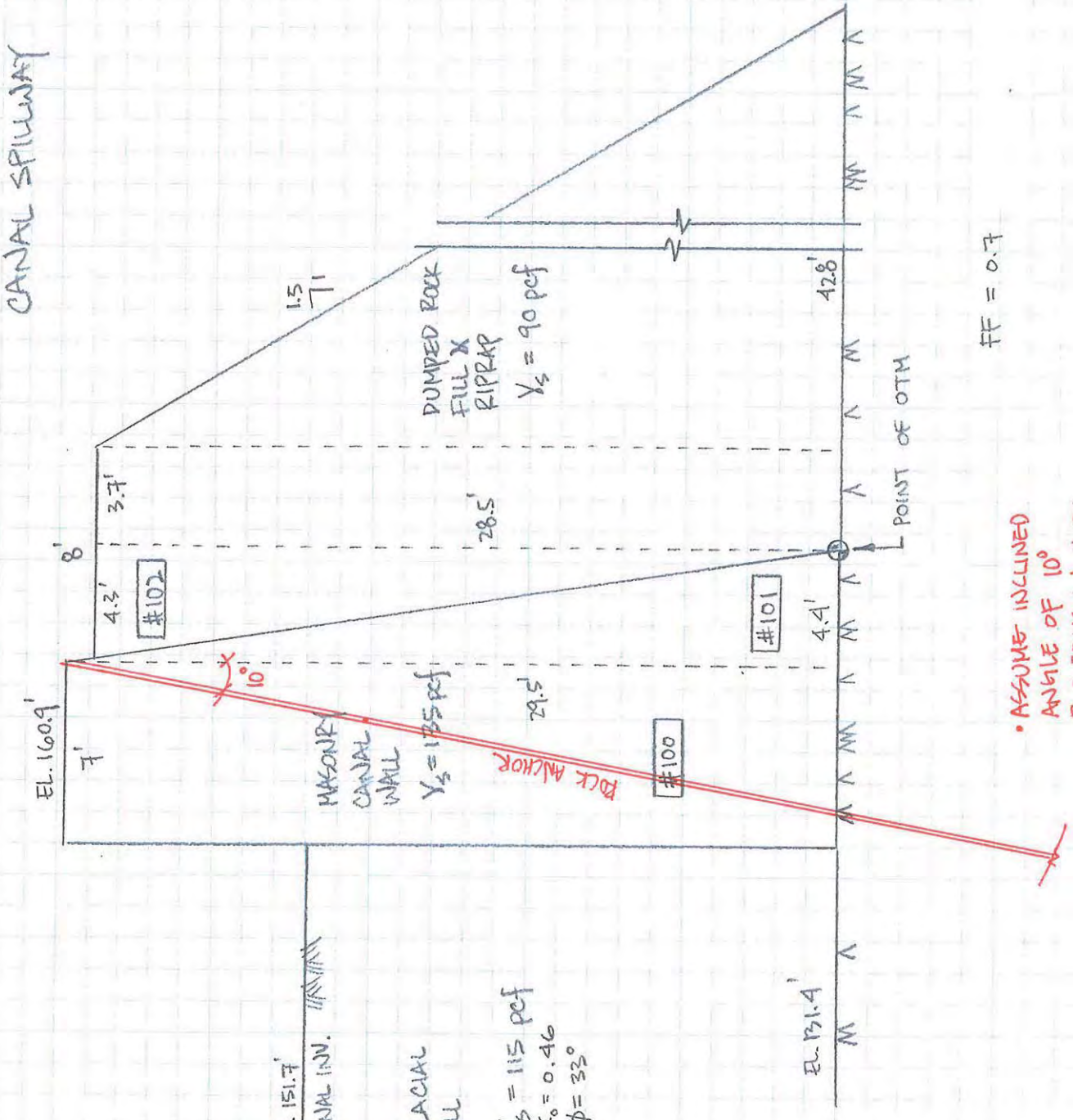
Subject: STABILITY ANALYSIS

Checked: CMV Date: 7/12/13



File Name: Stability_Wall Section.dam
Job Name: Indian Orchard
Job Number: 203.021
Comments:

Kleinschmidt Associates
KAStable 1.06
Date: 5/20/13
By: JHL
Reviewed by: CMV
Date: 7/12/13

-- STABILITY ANALYSIS SUMMARY TABLE --

LOAD CASE	V	H	H/V	SLIDE SF	M+	M-	M+/M-	M	R	BASE TOE PRESS.	HEEL PRESS.	TENS. ZONE
	KIPS	KIPS			FT-K	FT-K		FT-K	FT	PSI	PSI	FT
FILE NAME: Stability_Wall Section.dam												
Gravity	42.15	0.00	-0.000	Inf	253.84	0.00	-Inf	253.84	6.02	21.33	30.03	0.00
Normal	37.89	-17.34	0.458	1.530	484.09	-409.70	1.182	74.39	1.96	89.35	0.00	5.51
PMF	32.69	0.94	-0.029	24.410	470.64	-223.71	2.104	246.94	7.55	0.50	39.34	0.00

File Name: Stability_Wall Section.dam
Job Name: Indian Orchard
Job Number: 203.021
Comments:

Kleinschmidt Associates
KAStable 1.06
Date: 5/20/13
By: JHL
Reviewed by: CMV
Date: 7/12/13

SECTION DATA - Gravity

ID NO.	BASE (FT)	ALTITUDE (FT)	DEPTH (FT)	UNIT WT. (PCF)	SHP	DIR	DISTANCE (FT)	FORCE (KIPS)	MOMENT (FT-KIPS)	ARM (FT)
100	7.00	29.50	1.00	135.0	0	V	4.40	27.88	220.23	7.90
101	4.40	29.50	1.00	135.0	2	V	0.00	8.76	25.70	2.93
102	4.30	28.50	1.00	90.0	1	V	0.00	5.51	7.90	1.43

SUM OF SECTIONAL FORCES

	CASE	VERTICAL FORCE (KIPS)	HORIZONTAL FORCE (KIPS)	POSITIVE MOMENT (FT-K)	NEGATIVE MOMENT (FT-K)
SUBTOTAL	Gravity	42.15	0.00	253.84	0.00
TOTAL	Gravity	42.15	0.00	253.84	0.00

LOAD CASE CONSTANTS - Gravity

STABILITY CASE CONSTANTS		
Friction Factor, FF:	0.70	
Shear Friction Value, CV:	0.00	PSI
DIMENSIONAL CASE CONSTANTS		
Width, W1:	1.00	FT
Width, W2:	0.00	FT
Length, L1:	11.40	FT
Length, L2:	0.00	FT
Length, L3:	0.00	FT
Slope of Base, (Angle):	0.00	Degrees
Underdrain, (Y Yes, N No):	N	
Dist. Toe to Drain, DT:	0.00	FT
Method, (1 = FERC, 2 = ACoE):	N/A	
Height of Drainage Gallery, H4:	0.00	

FINAL RESULTS OF STABILITY ANALYSIS - Gravity

V=	42.15	KIPS
H=	0.00	KIPS
H/V=	-0.000	
SLIDING S.F.=	Inf	
M+=	253.84	FT-K
M-=	0.00	FT-K
SUM.M=	253.84	FT-K
M+/M-=	-Inf	
R=	6.02	FT from Toe
Tension Zone=	0.00	FT
Toe Pressure=	21.33	PSI
Heel Pressure=	30.03	PSI

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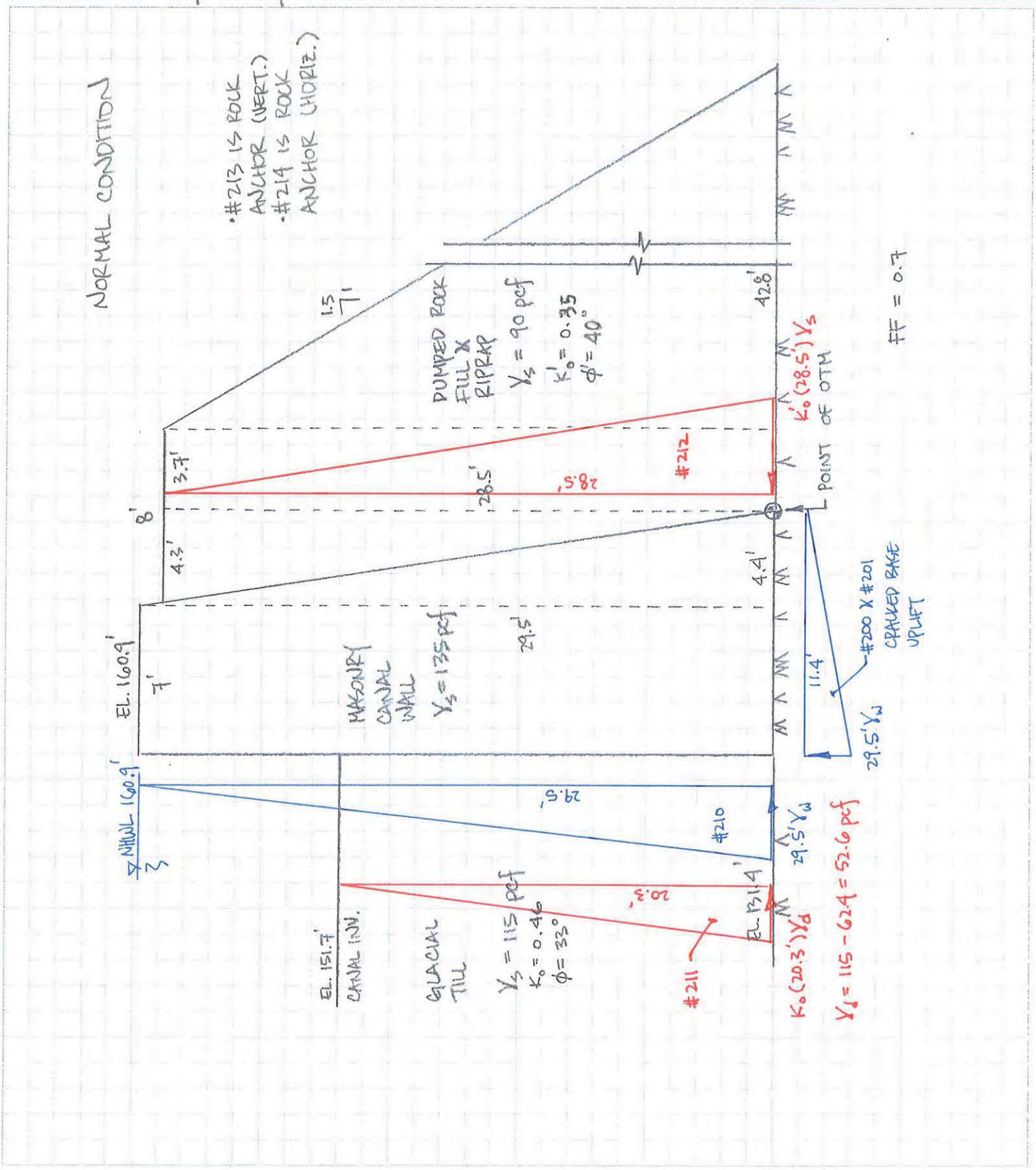
Project No.: 803.021

Project: INDIAN ORCHARD SPILLWAY CANAL

By: JHL Date: 5/17/13

Subject: STABILITY ANALYSIS

Checked: CMV Date: 7/12/13



File Name: Stability_Wall Section.dam
Job Name: Indian Orchard
Job Number: 203.021
Comments:

Kleinschmidt Associates
KAStable 1.06
Date: 5/20/13
By: JHL
Reviewed by: CMV
Date: 7/12/13

SECTION DATA - Normal

ID NO.	BASE (FT)	ALTITUDE (FT)	DEPTH (FT)	UNIT WT. (PCF)	SHP	DIR	DISTANCE (FT)	FORCE (KIPS)	MOMENT (FT-KIPS)	ARM (FT)
200	5.51	29.50	1.00	-62.4	0	V	5.89	-10.14	-87.67	8.65
201	5.89	29.50	1.00	-62.4	2	V	0.00	-5.42	-21.29	3.93
210	29.50	29.50	1.00	-62.4	1	H	0.00	-27.15	-266.99	9.83
211	20.30	20.30	1.00	-24.2	1	H	0.00	-4.99	-33.73	6.77
212	28.50	28.50	1.00	31.5	1	H	0.00	12.79	121.53	9.50
213	1.00	1.00	1.00	11300.0	0	V	3.90	11.30	49.72	4.40
214	1.00	1.00	1.00	2000.0	0	H	29.00	2.00	59.00	29.50

SUM OF SECTIONAL FORCES

	CASE	VERTICAL FORCE (KIPS)	HORIZONTAL FORCE (KIPS)	POSITIVE MOMENT (FT-K)	NEGATIVE MOMENT (FT-K)
SUBTOTAL	Gravity	42.15	0.00	253.84	0.00
	Normal	-4.26	-17.34	230.25	-409.70
TOTAL	Normal	37.89	-17.34	484.09	-409.70

LOAD CASE CONSTANTS - Normal

STABILITY CASE CONSTANTS		
Friction Factor, FF:	0.70	
Shear Friction Value, CV:	0.00	PSI
DIMENSIONAL CASE CONSTANTS		
Width, W1:	1.00	FT
Width, W2:	0.00	FT
Length, L1:	11.40	FT
Length, L2:	0.00	FT
Length, L3:	0.00	FT
Slope of Base, (Angle):	0.00	Degrees
Underdrain, (Y Yes, N No):	N	
Dist. Toe to Drain, DT:	0.00	FT
Method, (1 = FERC, 2 = ACoE):	N/A	
Height of Drainage Gallery, H4:	0.00	
LOAD CASE CONSTANTS		
Drain Efficiency, DE:	0.00	%
Headpond:	29.50	
Tailwater:	0.00	
Length, L4:	0.00	FT
Length, L5:	0.00	FT
Additional Sliding Resistance(s):	0.00	KIPS

FINAL RESULTS OF STABILITY ANALYSIS - Normal

V=	37.89	KIPS
H=	-17.34	KIPS
H/V=	0.458	
SLIDING S.F.=	1.530	
M+=	484.09	FT-K
M-=	-409.70	FT-K
SUM.M=	74.39	FT-K
M+/M-=	1.182	
R=	1.96	FT from Toe
Tension Zone=	5.51	FT
Toe Pressure=	89.35	PSI
Heel Pressure=	0.00	PSI

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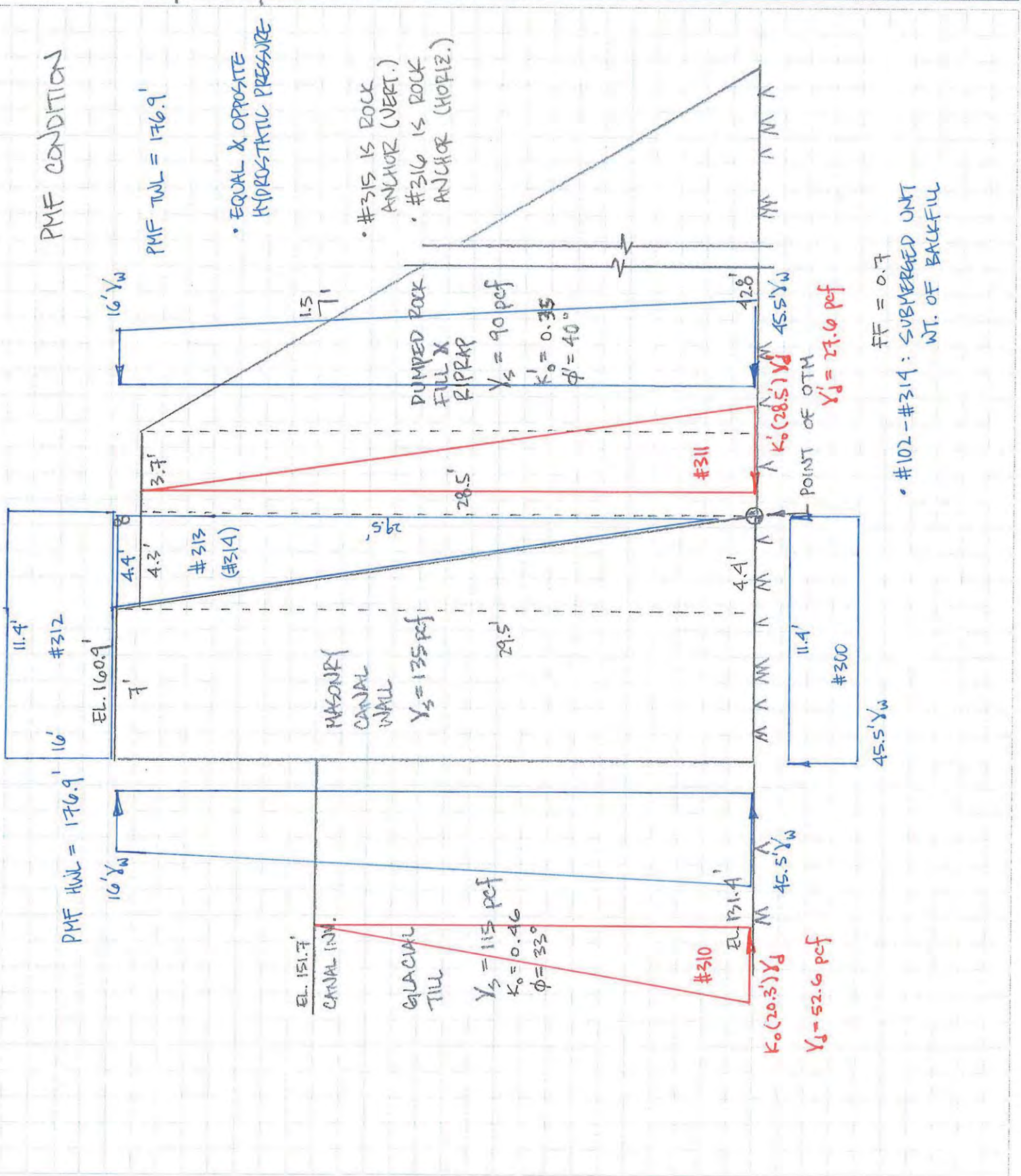
Project No.: 803.021

Project: INDIAN ORCHARD SPILLWAY CANAL

By: JHL Date: 5/17/13

Subject: STABILITY ANALYSIS

Checked: CMV Date: 7/12/13



File Name: Stability_Wall Section.dam
Job Name: Indian Orchard
Job Number: 203.021
Comments:

Kleinschmidt Associates
KAStable 1.06
Date: 5/20/13
By: JHL
Reviewed by: CMV
Date: 7/12/13

SECTION DATA - PMF

ID NO.	BASE (FT)	ALTITUDE (FT)	DEPTH (FT)	UNIT WT. (PCF)	SHP	DIR	DISTANCE (FT)	FORCE (KIPS)	MOMENT (FT-KIPS)	ARM (FT)
300	11.40	45.50	1.00	-62.4	0	V	0.00	-32.37	-184.49	5.70
310	20.30	20.30	1.00	-24.2	1	H	0.00	-4.99	-33.73	6.77
311	28.50	28.50	1.00	9.7	1	H	0.00	3.92	37.27	9.50
312	11.40	16.00	1.00	62.4	0	V	0.00	11.38	64.88	5.70
313	4.40	29.50	1.00	62.4	1	V	0.00	4.05	5.94	1.47
314	4.30	28.50	1.00	-62.4	1	V	0.00	-3.82	-5.48	1.43
315	1.00	1.00	1.00	11300.0	0	V	3.90	11.30	49.72	4.40
316	1.00	1.00	1.00	2000.0	0	H	29.00	2.00	59.00	29.50

SUM OF SECTIONAL FORCES

	CASE	VERTICAL FORCE (KIPS)	HORIZONTAL FORCE (KIPS)	POSITIVE MOMENT (FT-K)	NEGATIVE MOMENT (FT-K)
SUBTOTAL	Gravity	42.15	0.00	253.84	0.00
	PMF	-9.46	0.94	216.81	-223.71
TOTAL	PMF	32.69	0.94	470.64	-223.71

LOAD CASE CONSTANTS - PMF

STABILITY CASE CONSTANTS

Friction Factor, FF:	0.70	
Shear Friction Value, CV:	0.00	PSI

DIMENSIONAL CASE CONSTANTS

Width, W1:	1.00	FT
Width, W2:	0.00	FT
Length, L1:	11.40	FT
Length, L2:	0.00	FT
Length, L3:	0.00	FT
Slope of Base, (Angle):	0.00	Degrees
Underdrain, (Y Yes, N No):	N	
Dist. Toe to Drain, DT:	0.00	FT
Method, (1 = FERC, 2 = ACoE):	N/A	
Height of Drainage Gallery, H4:	0.00	

LOAD CASE CONSTANTS

Drain Efficiency, DE:	0.00	%
Headpond:	45.50	
Tailwater:	0.00	
Length, L4:	11.40	FT
Length, L5:	0.00	FT
Additional Sliding Resistance(s):	0.00	KIPS

FINAL RESULTS OF STABILITY ANALYSIS - PMF

V=	32.69	KIPS
H=	0.94	KIPS
H/V=	-0.029	
SLIDING S.F.=	24.410	
M+=	470.64	FT-K
M-=	-223.71	FT-K
SUM.M=	246.94	FT-K
M+/M-=	2.104	
R=	7.55	FT from Toe
Tension Zone=	0.00	FT
Toe Pressure=	0.50	PSI
Heel Pressure=	39.34	PSI

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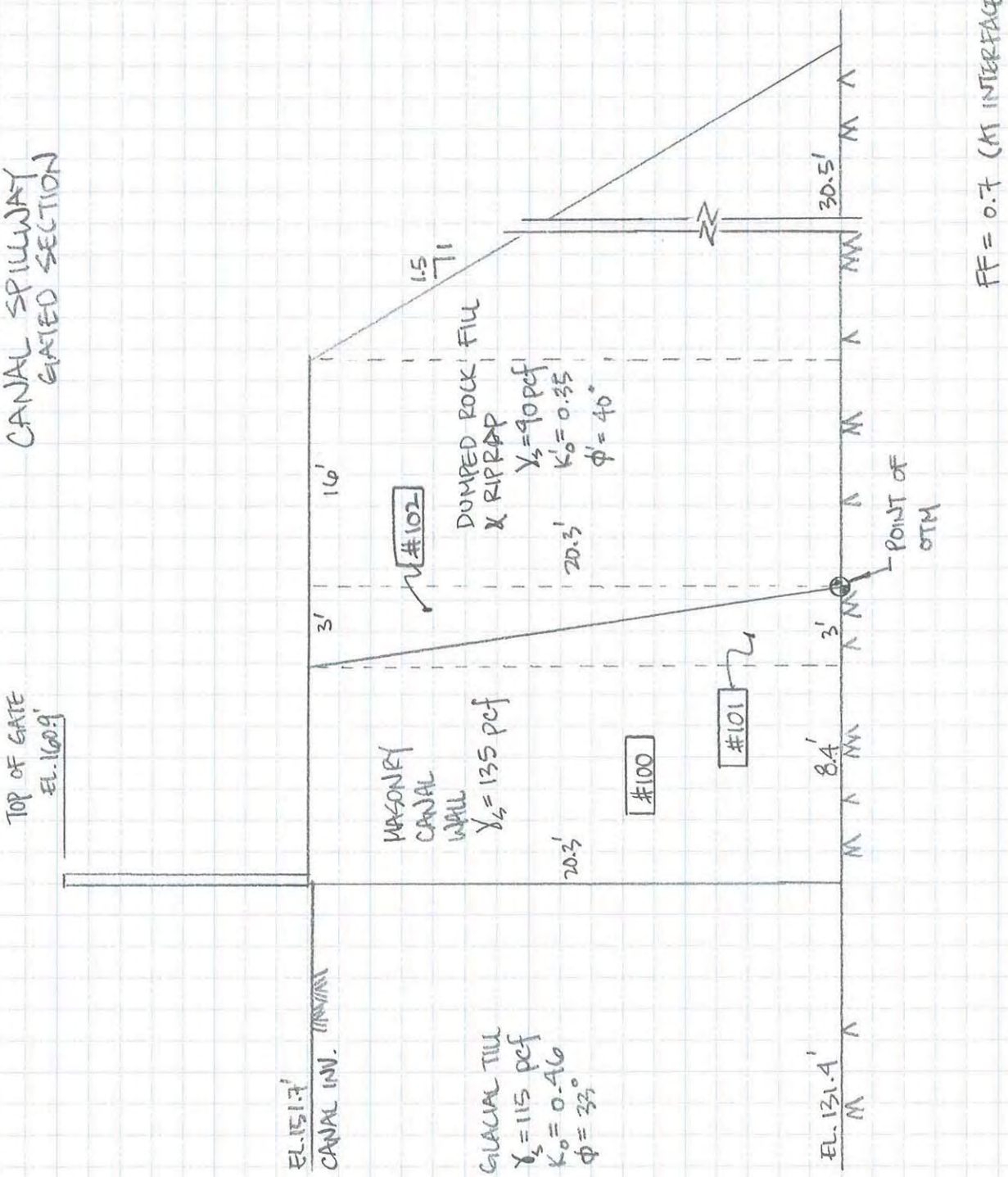
Project No.: 803.021

Project: INDIAN ORCHARD SPILLWAY CANAL

By: JHL Date: 5/21/13

Subject: STABILITY ANALYSIS

Checked: CMV Date: 7/12/13



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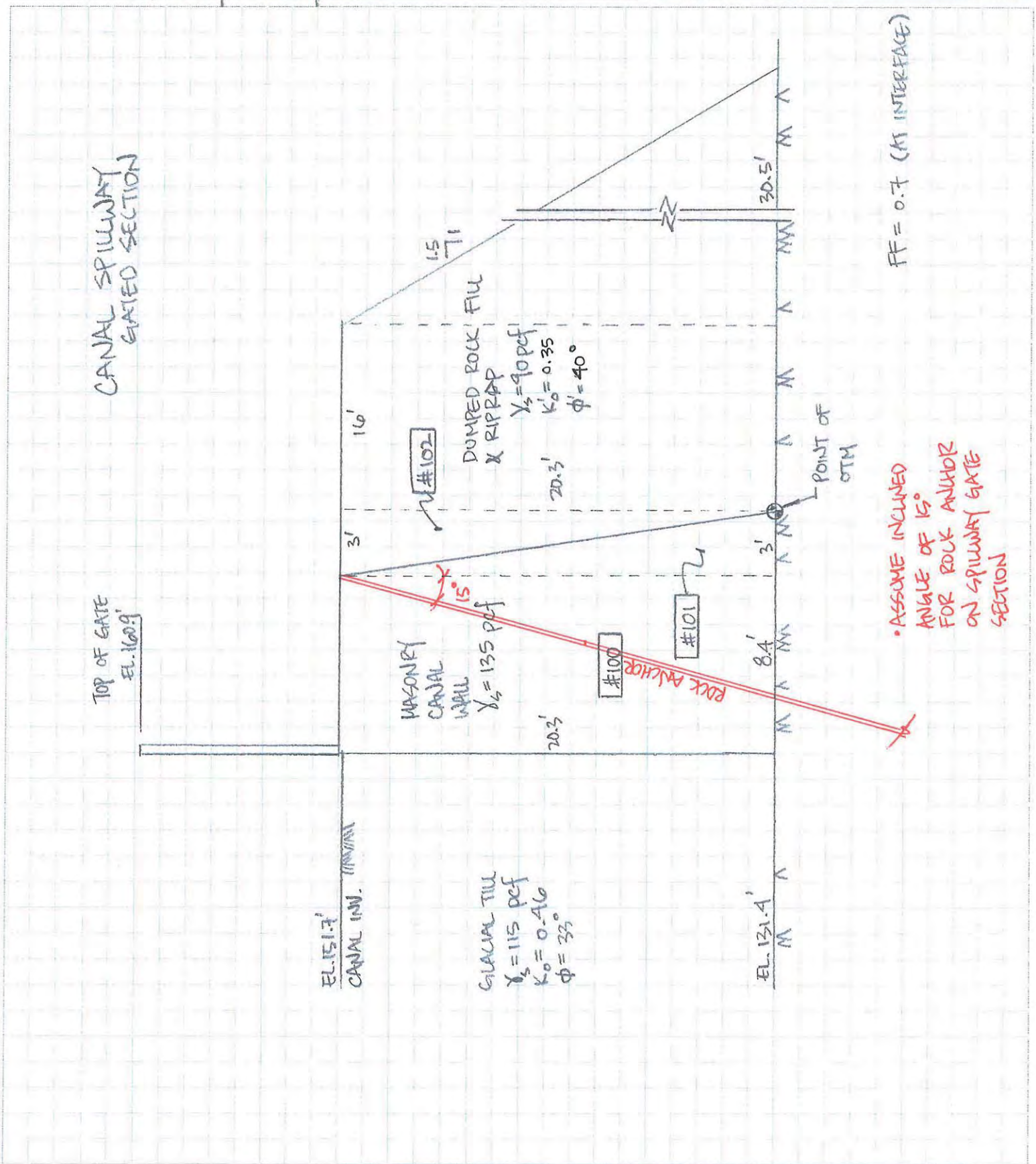

File Name: Stability_Spillway Section.dam
Job Name: Indian Orchard
Job Number: 203.021
Comments:

Kleinschmidt Associates
KAStable 1.06
Date: 5/20/13
By: JHL
Reviewed by: CMV
Date: 7/12/13

-- STABILITY ANALYSIS SUMMARY TABLE --

LOAD CASE	V	H	H/V	SLIDE SF	M+	M-	M+/M-	M	R	BASE TOE	PRESS. HEEL	TENS. ZONE
	KIPS	KIPS			FT-K	FT-K		FT-K	FT	PSI	PSI	FT
FILE NAME: Stability_Spillway Section.dam												
Gravity												
	29.87	0.00	-0.000	Inf	176.71	0.00	-Inf	176.71	5.92	16.13	20.26	0.00
Normal												
	39.62	-18.15	0.458	1.530	456.88	-417.63	1.094	39.24	0.99	185.20	0.00	8.43
Normal												
	44.24	-15.51	0.350	2.000	456.88	-339.04	1.348	117.83	2.66	76.90	0.00	3.41
PMF												
	43.43	4.50	-0.104	6.750	528.61	-218.23	2.422	310.38	7.15	6.31	46.60	0.00

File Name: Stability_Spillway Section.dam
Job Name: Indian Orchard
Job Number: 203.021
Comments:

Kleinschmidt Associates
KAStable 1.06
Date: 5/20/13
By: JHL
Reviewed by: CMV
Date: 7/12/13

SECTION DATA - Gravity

ID NO.	BASE (FT)	ALTITUDE (FT)	DEPTH (FT)	UNIT WT. (PCF)	SHP	DIR	DISTANCE (FT)	FORCE (KIPS)	MOMENT (FT-KIPS)	ARM (FT)
100	8.40	20.30	1.00	135.0	0	V	3.00	23.02	165.75	7.20
101	3.00	20.30	1.00	135.0	2	V	0.00	4.11	8.22	2.00
102	3.00	20.30	1.00	90.0	1	V	0.00	2.74	2.74	1.00

SUM OF SECTIONAL FORCES

	CASE	VERTICAL FORCE (KIPS)	HORIZONTAL FORCE (KIPS)	POSITIVE MOMENT (FT-K)	NEGATIVE MOMENT (FT-K)
SUBTOTAL	Gravity	29.87	0.00	176.71	0.00
TOTAL	Gravity	29.87	0.00	176.71	0.00

LOAD CASE CONSTANTS - Gravity

STABILITY CASE CONSTANTS		
Friction Factor, FF:	0.70	
Shear Friction Value, CV:	0.00	PSI
DIMENSIONAL CASE CONSTANTS		
Width, W1:	1.00	FT
Width, W2:	0.00	FT
Length, L1:	11.40	FT
Length, L2:	0.00	FT
Length, L3:	0.00	FT
Slope of Base, (Angle):	0.00	Degrees
Underdrain, (Y Yes, N No):	N	
Dist. Toe to Drain, DT:	0.00	FT
Method, (1 = FERC, 2 = ACoE):	N/A	
Height of Drainage Gallery, H4:	0.00	

FINAL RESULTS OF STABILITY ANALYSIS - Gravity

V=	29.87	KIPS
H=	0.00	KIPS
H/V=	-0.000	
SLIDING S.F.=	Inf	
M+=	176.71	FT-K
M-=	0.00	FT-K
SUM.M=	176.71	FT-K
M+/M-=	-Inf	
R=	5.92	FT from Toe
Tension Zone=	0.00	FT
Toe Pressure=	16.13	PSI
Heel Pressure=	20.26	PSI

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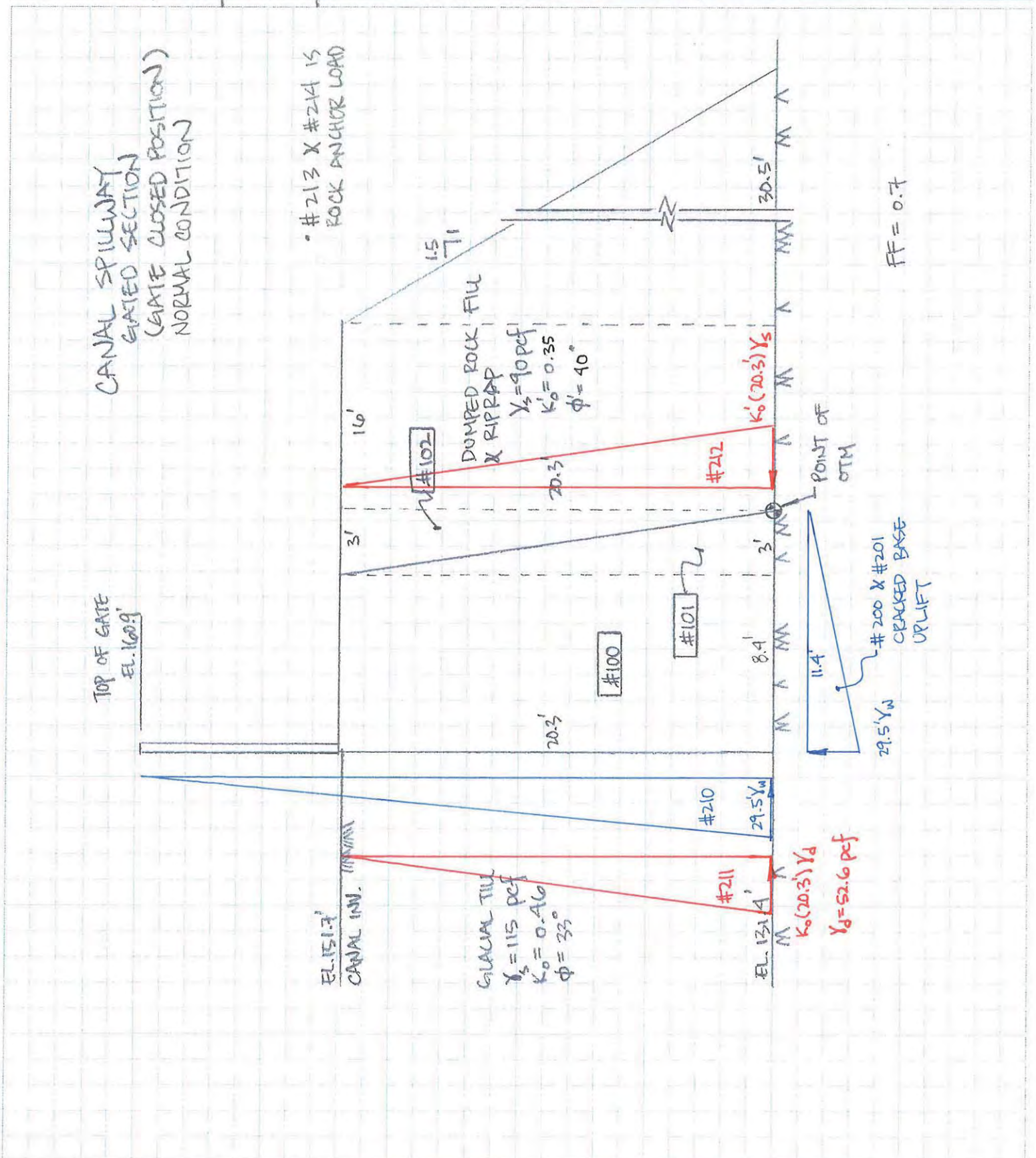
Project No.: 803.021

Project: INDIAN ORCHARD SPILLWAY CANAL

By: JHL Date: 5/21,13

Subject: STABILITY ANALYSIS

Checked: CMV Date: 7/12/13



File Name: Stability_Spillway Section.dam
Job Name: Indian Orchard
Job Number: 203.021
Comments:

Kleinschmidt Associates
KAStable 1.06
Date: 5/20/13
By: JHL
Reviewed by: CMV
Date: 7/12/13

SECTION DATA - Normal

ID NO.	BASE (FT)	ALTITUDE (FT)	DEPTH (FT)	UNIT WT. (PCF)	SHP	DIR	DISTANCE (FT)	FORCE (KIPS)	MOMENT (FT-KIPS)	ARM (FT)
200	8.43	29.50	1.00	-62.4	0	V	2.97	-15.51	-111.49	7.19
201	2.97	29.50	1.00	-62.4	2	V	0.00	-2.74	-5.42	1.98
210	29.50	29.50	1.00	-62.4	1	H	0.00	-27.15	-266.99	9.83
211	20.30	20.30	1.00	-24.2	1	H	0.00	-4.99	-33.73	6.77
212	20.30	20.30	1.00	31.5	1	H	0.00	6.49	43.92	6.77
213	1.00	1.00	1.00	28000.0	0	V	2.50	28.00	84.00	3.00
214	1.00	1.00	1.00	7500.0	0	H	19.80	7.50	152.25	20.30

SUM OF SECTIONAL FORCES

	CASE	VERTICAL FORCE (KIPS)	HORIZONTAL FORCE (KIPS)	POSITIVE MOMENT (FT-K)	NEGATIVE MOMENT (FT-K)
SUBTOTAL	Gravity	29.87	0.00	176.71	0.00
	Normal	9.75	-18.15	280.17	-417.63
TOTAL	Normal	39.62	-18.15	456.88	-417.63

LOAD CASE CONSTANTS - Normal

STABILITY CASE CONSTANTS		
Friction Factor, FF:	0.70	
Shear Friction Value, CV:	0.00	PSI
DIMENSIONAL CASE CONSTANTS		
Width, W1:	1.00	FT
Width, W2:	0.00	FT
Length, L1:	11.40	FT
Length, L2:	0.00	FT
Length, L3:	0.00	FT
Slope of Base, (Angle):	0.00	Degrees
Underdrain, (Y Yes, N No):	N	
Dist. Toe to Drain, DT:	0.00	FT
Method, (1 = FERC, 2 = ACoE):	N/A	
Height of Drainage Gallery, H4:	0.00	
LOAD CASE CONSTANTS		
Drain Efficiency, DE:	0.00	%
Headpond:	29.50	
Tailwater:	0.00	
Length, L4:	0.00	FT
Length, L5:	0.00	FT
Additional Sliding Resistance(s):	0.00	KIPS

FINAL RESULTS OF STABILITY ANALYSIS - Normal

V=	39.62	KIPS
H=	-18.15	KIPS
H/V=	0.458	
SLIDING S.F.=	1.530	
M+=	456.88	FT-K
M-=	-417.63	FT-K
SUM.M=	39.24	FT-K
M+/M-=	1.094	
R=	0.99	FT from Toe
Tension Zone=	8.43	FT
Toe Pressure=	185.20	PSI
Heel Pressure=	0.00	PSI

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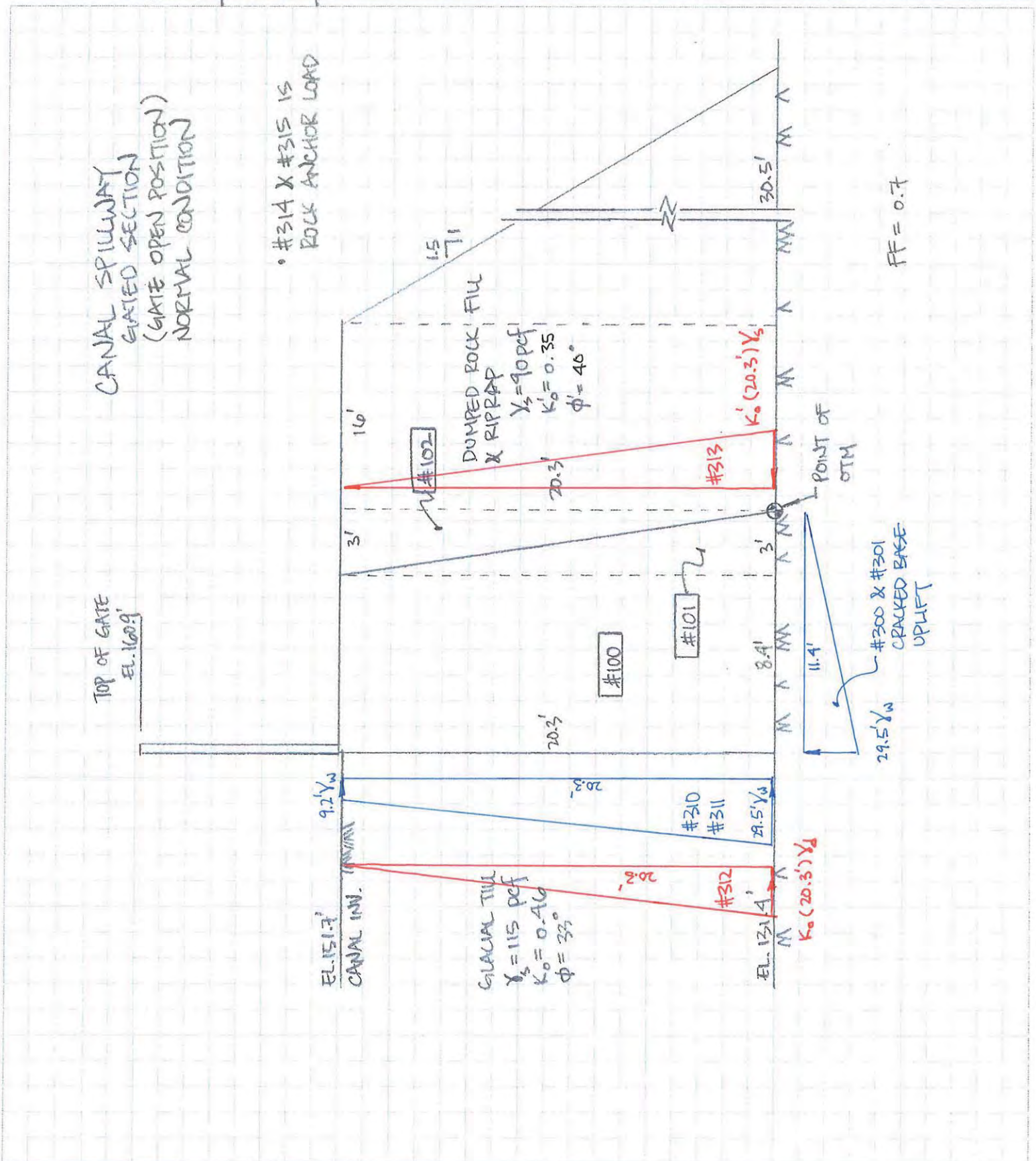
Project No.: 803.021

Project: INDIAN ORCHARD SPILLWAY CANAL

By: JHL Date: 5/21/13

Subject: STABILITY ANALYSIS

Checked: CMV Date: 7/12/13



File Name: Stability_Spillway Section.dam
Job Name: Indian Orchard
Job Number: 203.021
Comments:

Kleinschmidt Associates
KAStable 1.06
Date: 5/20/13
By: JHL
Reviewed by: CMV
Date: 7/12/13

SECTION DATA - Normal

ID NO.	BASE (FT)	ALTITUDE (FT)	DEPTH (FT)	UNIT WT. (PCF)	SHP	DIR	DISTANCE (FT)	FORCE (KIPS)	MOMENT (FT-KIPS)	ARM (FT)
300	3.41	29.50	1.00	-62.4	0	V	7.99	-6.27	-60.84	9.70
301	7.99	29.50	1.00	-62.4	2	V	0.00	-7.36	-39.19	5.33
310	20.30	9.20	1.00	-62.4	0	H	0.00	-11.65	-118.29	10.15
311	20.30	20.30	1.00	-62.4	1	H	0.00	-12.86	-87.00	6.77
312	20.30	20.30	1.00	-24.2	1	H	0.00	-4.99	-33.73	6.77
313	20.30	20.30	1.00	31.5	1	H	0.00	6.49	43.92	6.77
314	1.00	1.00	1.00	28000.0	0	V	2.50	28.00	84.00	3.00
315	1.00	1.00	1.00	7500.0	0	H	19.80	7.50	152.25	20.30

SUM OF SECTIONAL FORCES

	CASE	VERTICAL FORCE (KIPS)	HORIZONTAL FORCE (KIPS)	POSITIVE MOMENT (FT-K)	NEGATIVE MOMENT (FT-K)
SUBTOTAL	Gravity	29.87	0.00	176.71	0.00
	Normal	14.37	-15.51	280.17	-339.04
TOTAL	Normal	44.24	-15.51	456.88	-339.04

LOAD CASE CONSTANTS - Normal

STABILITY CASE CONSTANTS		
Friction Factor, FF:	0.70	
Shear Friction Value, CV:	0.00	PSI
DIMENSIONAL CASE CONSTANTS		
Width, W1:	1.00	FT
Width, W2:	0.00	FT
Length, L1:	11.40	FT
Length, L2:	0.00	FT
Length, L3:	0.00	FT
Slope of Base, (Angle):	0.00	Degrees
Underdrain, (Y Yes, N No):	N	
Dist. Toe to Drain, DT:	0.00	FT
Method, (1 = FERC, 2 = ACoE):	N/A	
Height of Drainage Gallery, H4:	0.00	
LOAD CASE CONSTANTS		
Drain Efficiency, DE:	0.00	%
Headpond:	29.50	
Tailwater:	0.00	
Length, L4:	0.00	FT
Length, L5:	0.00	FT
Additional Sliding Resistance(s):	0.00	KIPS

FINAL RESULTS OF STABILITY ANALYSIS - Normal

V=	44.24	KIPS
H=	-15.51	KIPS
H/V=	0.350	
SLIDING S.F.=	2.000	
M+=	456.88	FT-K
M-=	-339.04	FT-K
SUM.M=	117.83	FT-K
M+/M-=	1.348	
R=	2.66	FT from Toe
Tension Zone=	3.41	FT
Toe Pressure=	76.90	PSI
Heel Pressure=	0.00	PSI

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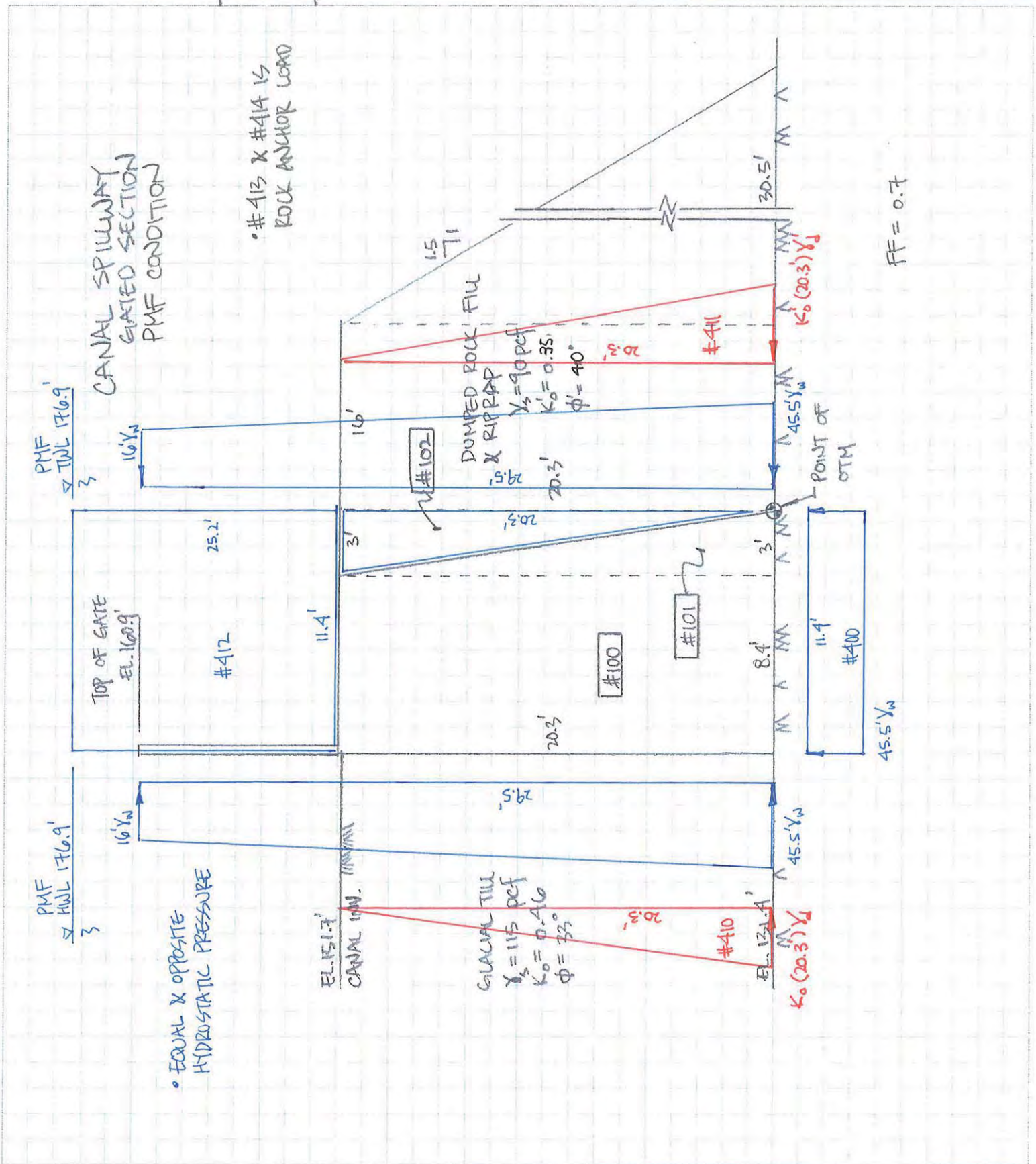
Project No.: 803.021

Project: INDIAN ORCHARD SPILLWAY CANAL

By: JHL Date: 5/21/13

Subject: STABILITY ANALYSIS

Checked: CMV Date: 7/12/13



File Name: Stability_Spillway Section.dam
Job Name: Indian Orchard
Job Number: 203.021
Comments:

Kleinschmidt Associates
KAStable 1.06
Date: 5/20/13
By: JHL
Reviewed by: CMV
Date: 7/12/13

SECTION DATA - PMF

ID NO.	BASE (FT)	ALTITUDE (FT)	DEPTH (FT)	UNIT WT. (PCF)	SHP	DIR	DISTANCE (FT)	FORCE (KIPS)	MOMENT (FT-KIPS)	ARM (FT)
400	11.40	45.50	1.00	-62.4	0	V	0.00	-32.37	-184.49	5.70
410	20.30	20.30	1.00	-24.2	1	H	0.00	-4.99	-33.73	6.77
411	20.30	20.30	1.00	9.7	1	H	0.00	1.99	13.47	6.77
412	11.40	25.20	1.00	62.4	0	V	0.00	17.93	102.18	5.70
413	1.00	1.00	1.00	28000.0	0	V	2.50	28.00	84.00	3.00
414	1.00	1.00	1.00	7500.0	0	H	19.80	7.50	152.25	20.30

SUM OF SECTIONAL FORCES

	CASE	VERTICAL FORCE (KIPS)	HORIZONTAL FORCE (KIPS)	POSITIVE MOMENT (FT-K)	NEGATIVE MOMENT (FT-K)
SUBTOTAL	Gravity	29.87	0.00	176.71	0.00
	PMF	13.56	4.50	351.90	-218.23
TOTAL	PMF	43.43	4.50	528.61	-218.23

LOAD CASE CONSTANTS - PMF

STABILITY CASE CONSTANTS		
Friction Factor, FF:	0.70	
Shear Friction Value, CV:	0.00	PSI
DIMENSIONAL CASE CONSTANTS		
Width, W1:	1.00	FT
Width, W2:	0.00	FT
Length, L1:	11.40	FT
Length, L2:	0.00	FT
Length, L3:	0.00	FT
Slope of Base, (Angle):	0.00	Degrees
Underdrain, (Y Yes, N No):	N	
Dist. Toe to Drain, DT:	0.00	FT
Method, (1 = FERC, 2 = ACoE):	N/A	
Height of Drainage Gallery, H4:	0.00	
LOAD CASE CONSTANTS		
Drain Efficiency, DE:	0.00	%
Headpond:	45.50	
Tailwater:	0.00	
Length, L4:	11.40	FT
Length, L5:	0.00	FT
Additional Sliding Resistance(s):	0.00	KIPS

FINAL RESULTS OF STABILITY ANALYSIS - PMF

V=	43.43	KIPS
H=	4.50	KIPS
H/V=	-0.104	
SLIDING S.F.=	6.750	
M+=	528.61	FT-K
M-=	-218.23	FT-K
SUM.M=	310.38	FT-K
M+/M-=	2.422	
R=	7.15	FT from Toe
Tension Zone=	0.00	FT
Toe Pressure=	6.31	PSI
Heel Pressure=	46.60	PSI

Kleinschmidt	Project No.: 803.021	
Project: Indian Orchard Canal Wall		
Subject: Stability Analysis		

Attachment A (1989 Stability Analysis)

WESTERN MASSACHUSETTS ELECTRIC COMPANY

WEST SPRINGFIELD, MASSACHUSETTS

FIRST SAFETY INSPECTION REPORT INDIAN ORCHARD HYDROELECTRIC PROJECT

AUGUST, 1989

FEDERAL ENERGY REGULATORY COMMISSION NUMBER UL-88-35-00

TABLE 3.4

WESTERN MASSACHUSETTS ELECTRIC COMPANY
WEST SPRINGFIELD, MASSACHUSETTS

INDIAN ORCHARD PROJECT
FERC NO. 10678-MA

Stability Analysis Summary

CANAL SPILLWAY

STABILITY CASE	V (KIPS)	H (KIPS)	H/V	SAFETY FACTOR	M+ (FT-KIPS)	M- (FT-KIPS)	M+/M-	M (FT-KIPS)	R (FT)	R (%)	BASE PRESS. (PSI) TOE	HEEL	LENGTH OF TENSION ZONE
Canal Spillway													
GRAVITY	42.15	-3.28	0.08	9.01	253.84	-22.17	11.45	231.67	5.50	48.2	28.	23.	0.00
NORMAL POND	42.15	-30.43	0.72	2.02	253.84	-289.16	0.88	-35.32	-0.84	-7.4	-233.	0.	13.91
EARTHQUAKE	42.15	-34.94	0.83	1.49	253.84	-345.93	0.73	-92.09	-2.18	-19.2	-89.	0.	17.95
ICE	42.15	-27.48	0.65	2.24	253.84	-246.82	1.03	7.02	0.17	1.5	1,172.	0.	10.90
PMF	25.37	-3.28	0.13	12.47	955.26	-827.88	1.15	127.38	5.02	44.0	21.	10.	0.00
FLOOD OF REC	28.92	-14.49	0.50	2.95	373.89	-370.05	1.01	3.84	0.13	1.2	1,009.	0.	11.00

Note: Sliding safety factors computed by hand to account for frictional resistance provided by dumped rockfill and riprap on the downstream face (see calculation page CSR-6).

241-167-80-11
005-241.WP/241-167(H)

April 1994

KLEINSCHMIDT ASSOCIATES
CONSULTING ENGINEERS

CS-1

KLEINSCHMIDT ASSOCIATES
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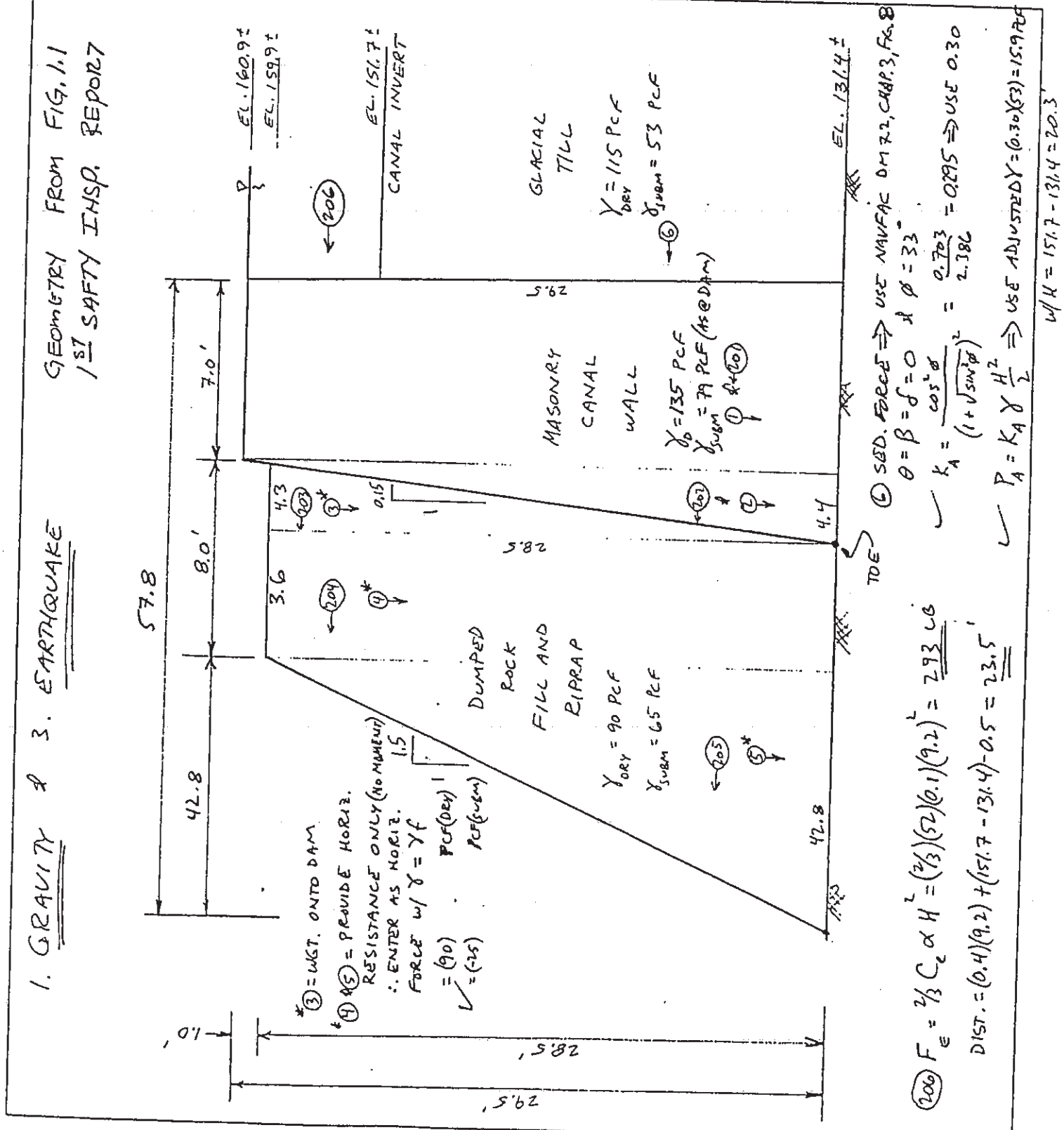
CALCULATION SHEET

Page:	CS - 1
Project No.:	241-106-20-23
Project:	INDIAN ORCHARD
By: JHC	Date: 7/30/92
Subject:	STABILITY - CANAL SPILLWAY
Checked: GEC	Date: 8/1/92

1. GRAVITY & 3. EARTHQUAKE

GEOMETRY FROM FIG. 1.1
1ST SAFTY INSP. REPORT



⑥ SED. FORCE ⇒ USE NAVFAC DM 7.2, CHAP. 3, FIG. 8
$\theta = \beta = \delta = 0$ & $\phi = 33°$

$K_A = \frac{\cos^2\phi}{(1+\sqrt{\sin^2\phi})^2} = \frac{0.703}{2.186} = 0.295 \Rightarrow$ USE 0.30

$P_A = K_A \gamma \frac{H^2}{2} \Rightarrow$ USE ADJUSTED $\gamma = (6.30)(53) = 159$ PCF

W/ $H = 151.7 - 131.4 = 20.3'$

⑳ $F_E = \frac{2}{3} C_E \alpha H^2 = (\frac{2}{3})(52)(0.1)(9.2)^2 = 293$ LB

DIST. $= (0.4)(9.2) + (151.7 - 131.4) - 0.5 = 23.5'$

CS-2

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CALCULATION SHEET

Page: CS-2

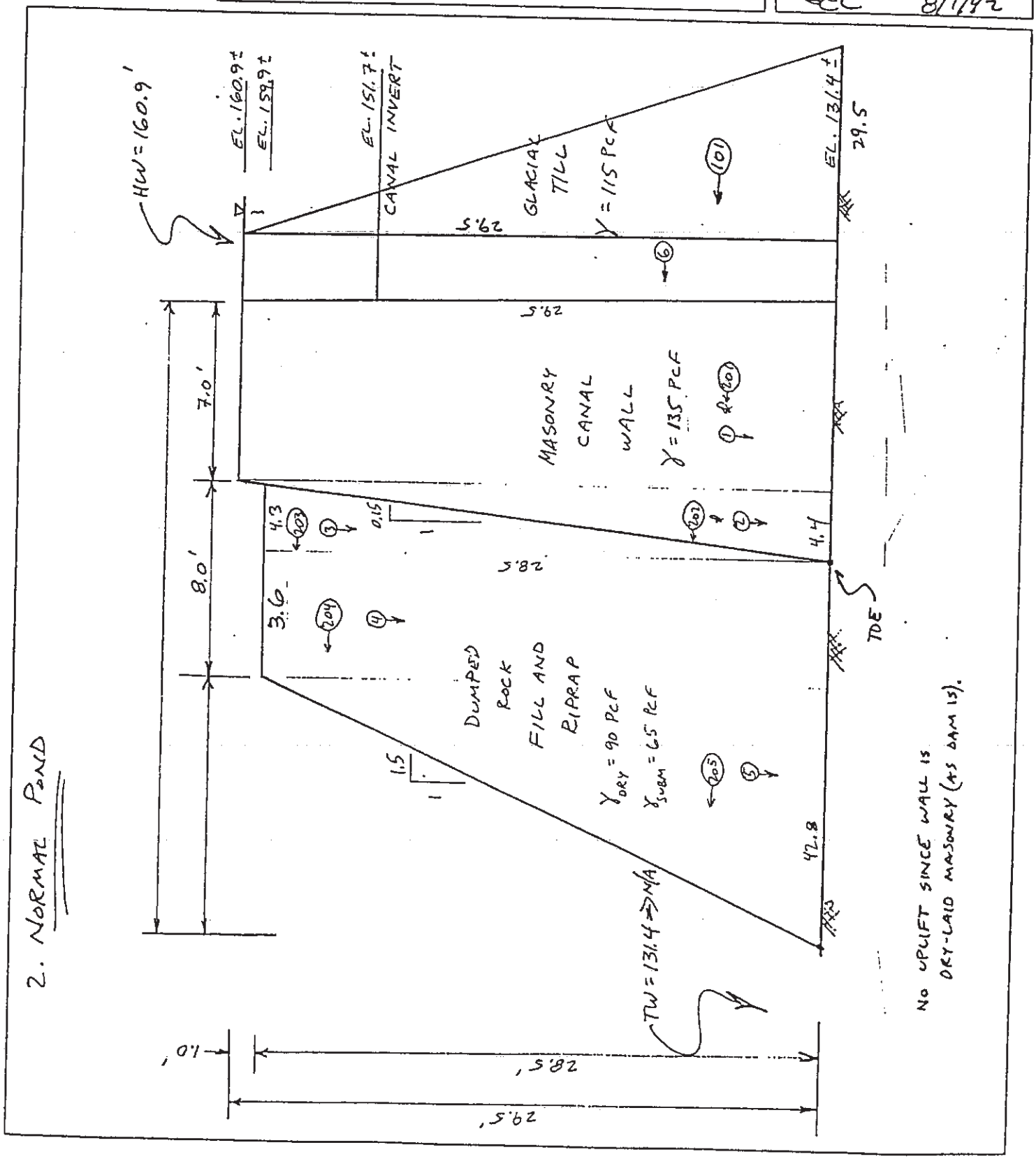
Project No.: 241-106-20-23

Project: INDIAN ORCHARD

By: JHC Date: 7/30/92

Subject: STABILITY - CANAL SPILLWAY

Checked: CEC Date: 8/1/92



CS-3

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CALCULATION SHEET

Page: CS-3

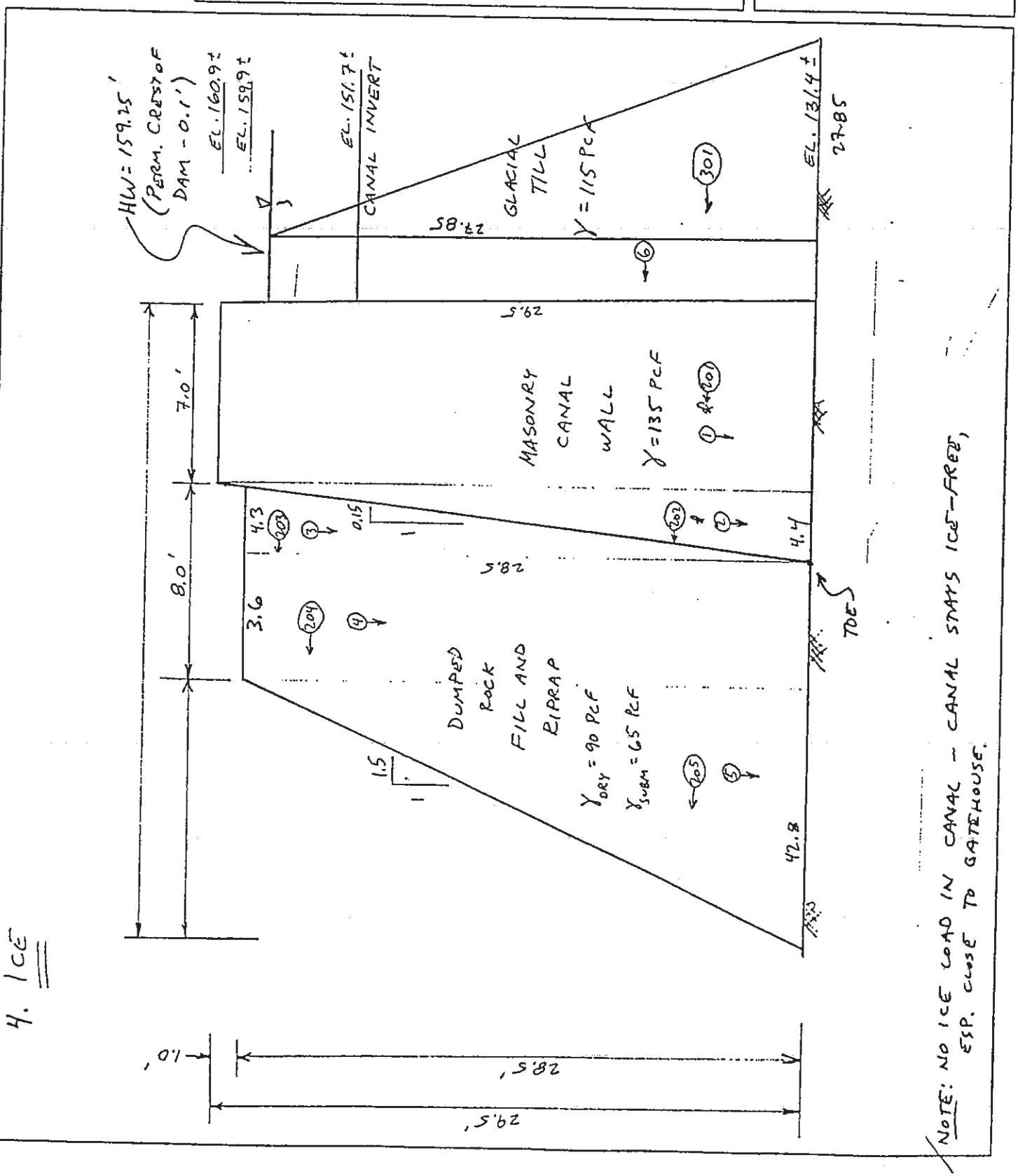
Project No.: 241-106-20-23

Project: INDIAN ORCHARD

By: JHC Date: 7/30/92

Subject: STABILITY - CANAL SPILLWAY

Checked: Date:



CS-4

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CALCULATION SHEET

Page: CS-4

Project No.: 241-106-20-23

Project: INDIAN ORCHARD

By: JHC Date: 7/30/92

Subject: STABILITY - CANAL SPILLWAY

Checked: GEC Date: 8/1/92

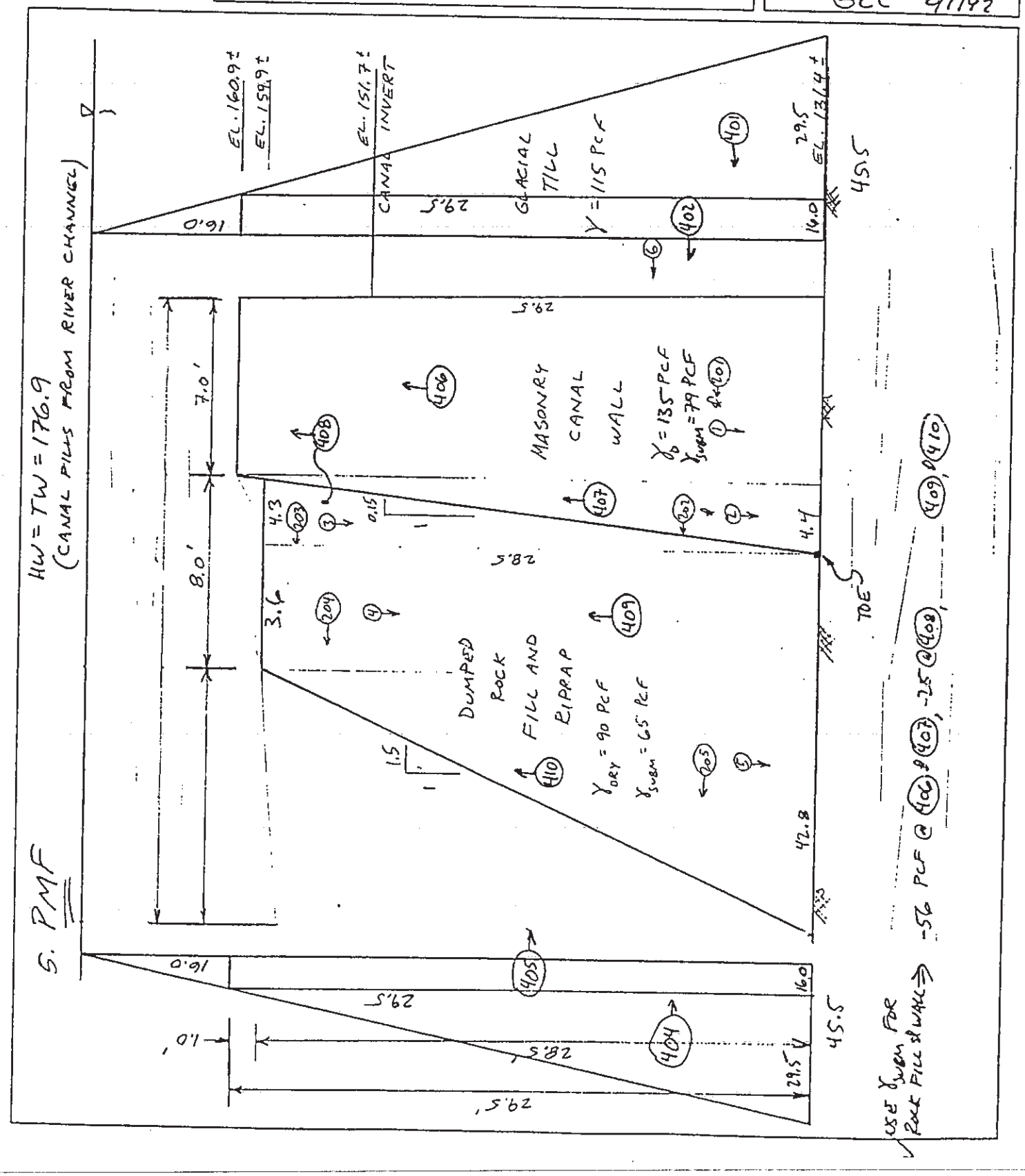


TABLE 1.0

WESTERN MASSACHUSETTS ELECTRIC COMPANY
WEST SPRINGFIELD, MASSACHUSETTS

INDIAN ORCHARD PROJECT
FERC NO. 10678-MA

STABILITY ANALYSIS
Nomenclature and Assumptions

1. NOMENCLATURE

V = Summation of vertical forces
H = Summation of horizontal forces
$\frac{H}{V}$ = Coefficient of sliding
S_{s-f} = Shear friction factor of safety
M+ = Resisting moments
M- = Overturning moments
M = Summation of moments
R = Location of resultant of forces from toe of structure
R% (of base) = Location of resultant from toe expressed as percentage of the base. Values between 33.3 and 66.7 represent the middle third of the base.
N.A. = Value not appropriate

2. LOADING CONDITIONS

Uplift

Uplift was assumed to vary from full headpond pressure at the heel to full tailwater pressure at the toe. Full headpond pressure was included across any tension zone. No uplift in "drained" structures - dry-laid masonry in spillway sections (see text).

Ice Loading

Canal Gatehouse: 5,000 pounds per linear foot applied at elevation of permanent spillway crest.

Spillway: 2,500 pounds per linear foot applied at permanent spillway crest (reduced ice forces due to 45° slope of upstream face).

Canal Spillway: No ice force since canal remains ice-free adjacent to gatehouse.

Earthquake Loading

Ratio of earthquake acceleration to gravity g = 0.10
Earthquake factor C_e = 52.0

Table 1 (Cont.)

3. SLIDING SAFETY FACTOR

$$S_{s-f} = \frac{FV + CA}{H}$$

F = Friction Factor
Spillway: 0.7 (spillway/bedrock or w/in spillway)
0.5 (shear plane in bedrock)
Canal Gatehouse: F = 0.65 (soil/soil contact)

C = Shear Friction Factor = 0 pounds per square inch (psi)

A = Area of Base in Compression (square inches)

4. UNIT WEIGHTS

Concrete Dam - 150 pounds per cubic foot (PCF)
Masonry Dam - 135 PCF (dry)
79 PCF (submerged)
Bedrock - 150 PCF (dry)
Gatehouse Foundation Fill - 115 PCF (saturated)
- 53 PCF (submerged)
Silt - 38 PCF (submerged)
Water - 62.4 PCF

5. STRENGTH OF MATERIALS (ASSUMED)

Rock: Sandstone, ultimate compressive strength - 8,000 PSI

Allowable bearing stress is determined by dividing the ultimate strength by the appropriate factor of safety.

6. SAFETY FACTORS

As recommended in FERC's "Engineering Guidelines for the Evaluation of Hydropower Projects".

	Gravity Structure Factors of Safety with Respect to Hazard Classification[1]	
Loading Condition	Low	High
Normal Pond	2.0	3.0
PMF, Flood	1.25	2.0
Earthquake	>1.0	>1.0

[1] Safety factors apply to the calculation of stress and the Shear Friction Factor of Safety within the structure and at the dam/foundation interface only.

TABLE 2.0

WESTERN MASSACHUSETTS ELECTRIC COMPANY
WEST SPRINGFIELD, MASSACHUSETTS

INDIAN ORCHARD PROJECT
FERC No. 10678-MA

STABILITY ANALYSIS
LOADING CONDITIONS

NORMAL POND	Headwater	Tailwater
Main Spillway	161.0	None
Canal Gatehouse	161.0	161.0
Canal Gatehouse, Dewatered Canal	161.0	None
Canal Spillway	160.9	None

EARTHQUAKE
Normal Pond, same as above (HW & TW)
Earthquake acccleration value: 0.10 g

ICE
Ice force of 2,500 pounds per linear foot at permanent crest of dam, El. 159.35'.
Ice force of 5,000 pounds per linear foot at canal gatehouse, El. 159.35'.
Ice force of 0 pounds per linear foot at canal spillway.

Main Spillway	159.35	None
Canal Gatehouse	159.35	159.35
Canal Spillway	159.25	None

F.B. + 3' (Headpond 3' over flashboards, 6,920 cfs)		
Main Spillway	164.0	140.0

100-Year Flood (31,000 cfs)		
Main Spillway	167.8	150.0

250-Year Flood (45,000 cfs)		
Main Spillway	170.2	154.2

500-Year Flood (60,200 cfs)		
Main Spillway	172.4	158.5
Canal Gatehouse	172.4	161.0

PMF (Probable Maximum Flood) (183,600 cfs)		
Main Spillway	187.1	176.9
Canal Gatehouse	187.1	176.9
Canal Spillway	176.9	176.9

POF (Point of Failure)
Section is unstable at pond elevation 0.10 ft higher than headpond elevation listed below:

Canal Gatehouse	171.2	161.0

Kleinschmidt		
	Project No.: 803.021	
Project: Indian Orchard Canal Wall		
Subject: Stability Analysis		

Attachment B (Proposed Modifications)

CHICOPEE RIVER

N

PLAN
FEET
0 20 40 60 80 100 120
SCALE ONE INCH = 20 FEET

LENGTH 401'
CREST OF DAM
51'-0"
18'-0"

Existing Canal Wall

HEADGATE BUILDING
WALKWAY EL 166.83
LIMIT OF RIPRAP
DRAWN GATES
TOP OF DUMPED ROCK FILL EL 159.5±
TOP OF WALL EL. 160.9±
SLOPE 1SH TO 1V
CANAL SPILLWAY
TOE OF DUMPED ROCK FILL
CANAL
BUILDING
PROPERTY LINE
MILL BUILDING

ELEVATION A-A
FEET
0 20 40 60 80 100 120
SCALE ONE INCH = 20 FEET

EL 174.0
EL 166.60
EL 160.80
SANDSTONE WALL
BATTERED FACES
EL 166.83
2'-6" x 6'-0" x 20' DEEP OPENINGS
C.I. GATE OR STOP ON UPSTREAM END.
SANDSTONE LEDGE

SECTION C-C
FEET
0 5 10 15 20 25
SCALE 1/4 INCH = ONE FOOT

EL 166.60

SECTION D-D
FEET
0 10 20 30 40 50 60
SCALE ONE INCH = 10 FEET

TOP OF WALL EL 160.9±
TAMPED CRUSHED STONE
36" CMP
EL VARIES
DRAIN GATE OPENING 2'-6" x 2'-6"
INV. EL 151.7±
RIPRAP
DUMPED ROCK FILL
CANAL WALL
SANDSTONE LEDGE

SECTION F-F
FEET
0 10 20 30 40 50
SCALE 1/8 INCH = ONE FOOT

STONE FILL
SMALL STONE & GRAVEL FILL

FLASHBOARDS
EL. 161.0'

SECTION B-B
FEET
0 5 10 15 20 25
SCALE 1/4 INCH = ONE FOOT

CREST EL 159.95
EL 159.95
2 LAYERS 3" PLANK
6"x6"
6"x6"
MORTISE & TENON JOINT
2-1" ø DOWELS
6'-0" c-c
EL 149.20'
CUT STONE
BATTER 3"/1'-0"
RUBBLE FILL
VARIES - APPROX 26' MAX.
CUT STONE
APPROX 30'

Typical Section

SECTION E-E
FEET
0 10 20 30 40 50 60
SCALE ONE INCH = 10 FEET

TOP OF WALL EL 160.9±
EL 149.5±
DUMPED ROCK FILL
RIPRAP
CANAL WALL
EL VARIES
ROCK FILL
SANDSTONE LEDGE

SECTION G-G
FEET
0 2 4 6 8 10 12
SCALE 1/2 INCH = ONE FOOT

3" BEVEL
12"
EL 174.0'
6'-10"
2'-10"
16"
2'-0"
4'-0"

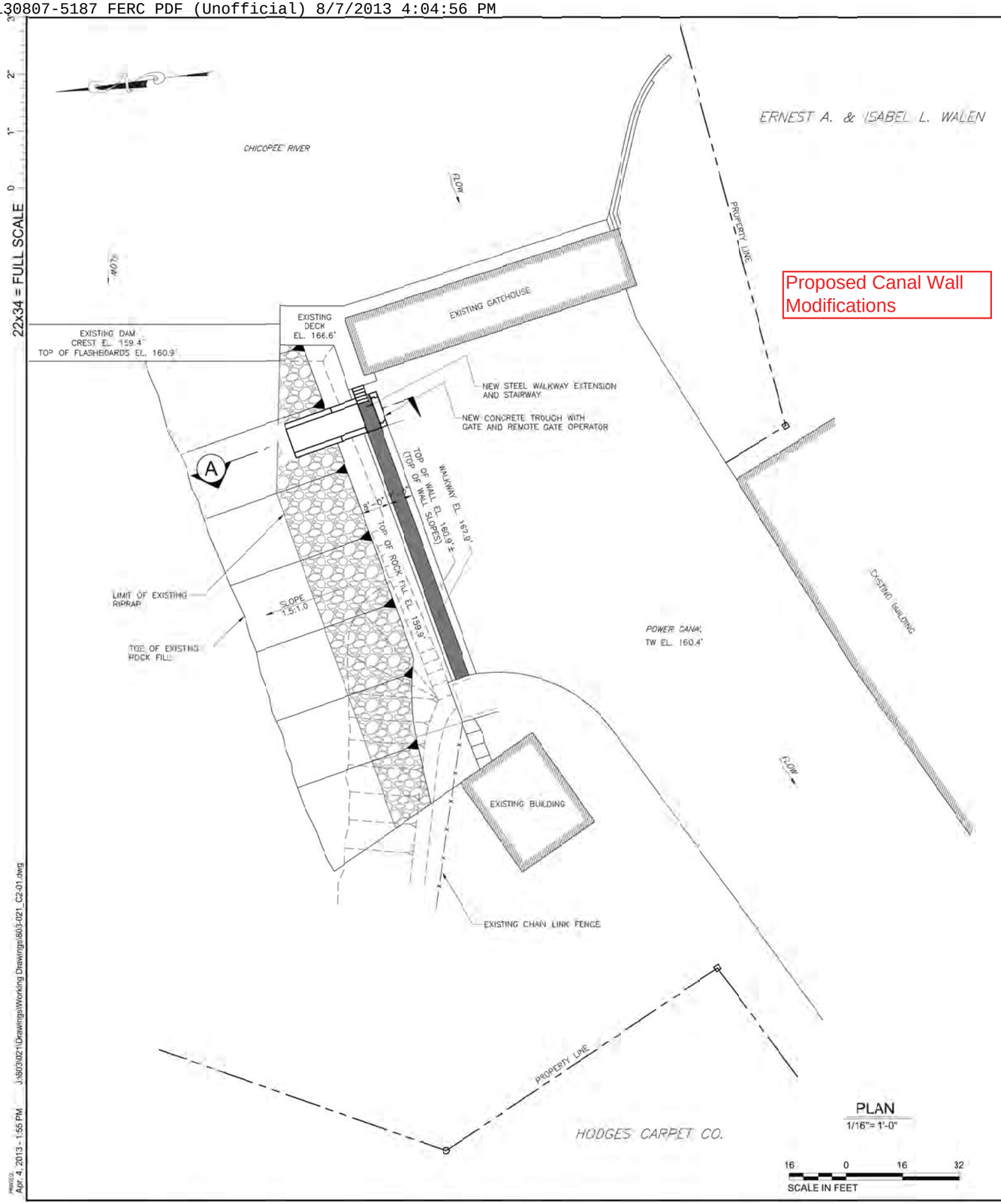
EXHIBIT G - SHEET 1 OF 7
PLAN & SECTIONS OF DAM
FERC PROJECT NO. 10678
INDIAN ORCHARD PROJECT
CONSOLIDATED EDISON ENERGY, INC.
SCALE AS NOTED

FIGURE 2

FERC NO. 10678-001

EXHIBIT G
SHEET 1 OF 7

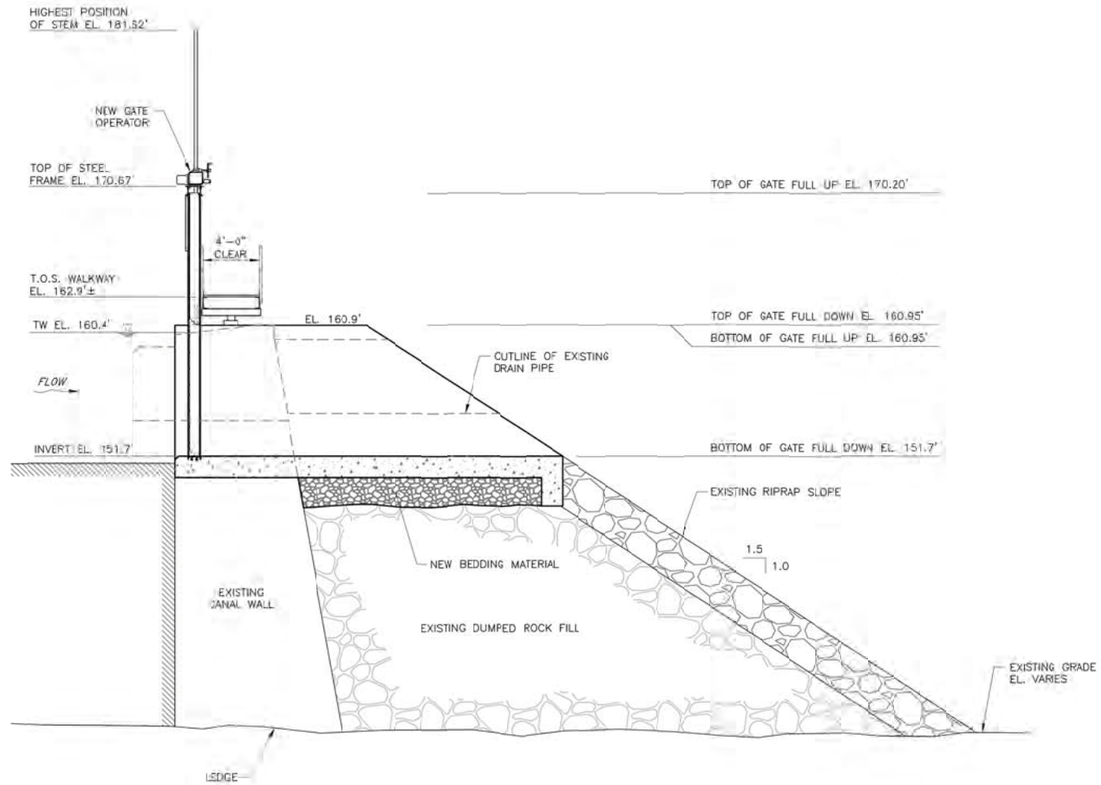
22x34 = FULL SCALE



Proposed Canal Wall Modifications

PLAN
1/16"= 1'-0"

16 0 16 32
SCALE IN FEET



SECTION A
3/16"= 1'-0"

4 0 4 8 12
SCALE IN FEET

PRELIMINARY
NOT FOR
CONSTRUCTION

No.	Revision	Date	Drawn	Checked
A	REVIEW AND COMMENT	04-05-13	CFT	JL

Designed	Drawn	Checked
JL	CFT	HLT

EP ENERGY MASSACHUSETTS LLC
SPRINGFIELD, MA

INDIAN ORCHARD
MIN FLOW GATE PROJECT

PROPOSED
OVERALL PLAN AND SECTION

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Project No.	Date Revised	Drawing No.
803-021	04-04-13	C2-01

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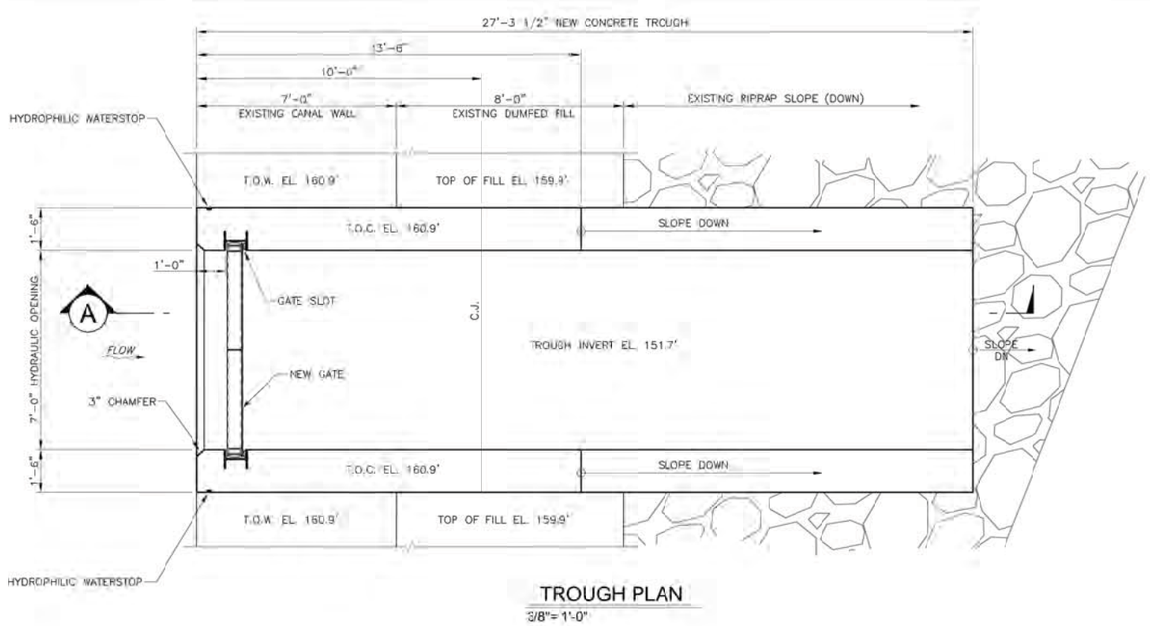
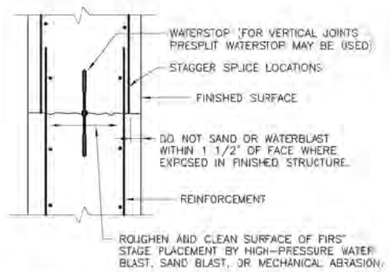
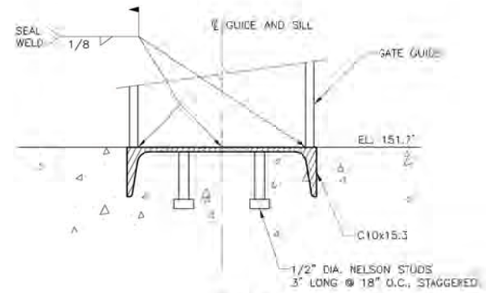


TROUGH PLAN
3/8"= 1'-0"



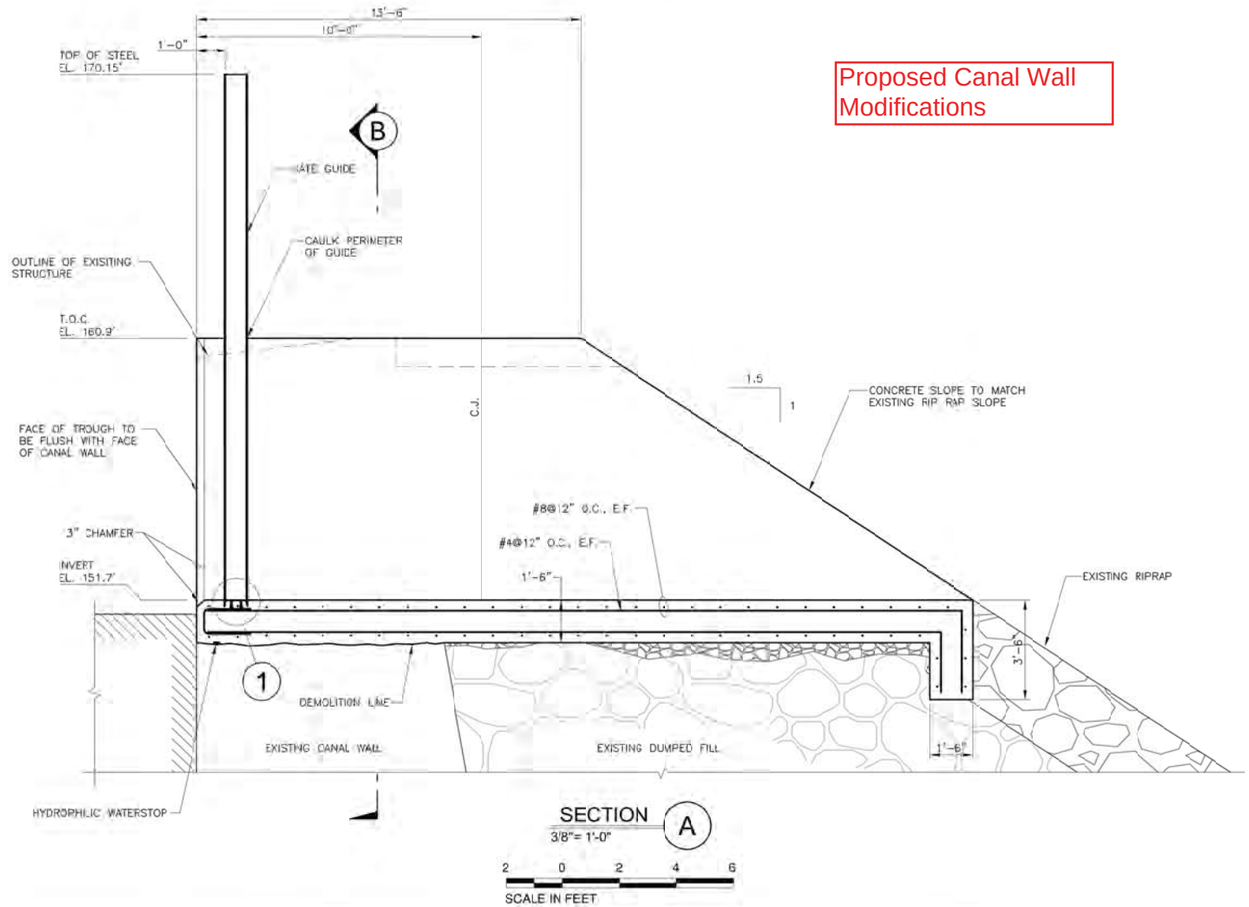
NOTE: LOCATE JOINTS WHERE SHOWN ON DRAWINGS.

CONSTRUCTION JOINT DETAIL
N.T.S.



DETAIL 1
3"= 1'-0"

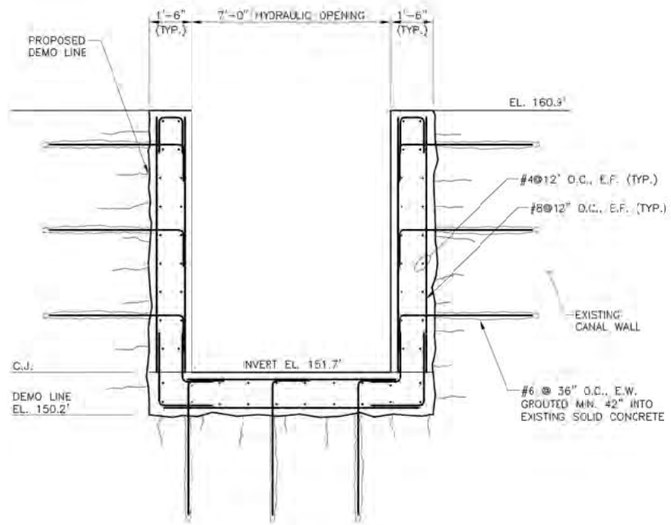
3 0 3 6 9
SCALE IN INCHES



SECTION A
3/8"= 1'-0"

2 0 2 4 6
SCALE IN FEET

PRELIMINARY
NOT FOR
CONSTRUCTION



SECTION B
3/8"= 1'-0"

No.	Revision	Date	Drawn	Checked
A	REVIEW AND COMMENT	04-05-13	CFT	JL

Designed	Drawn	Checked
JL	CFT	HLT

EP ENERGY MASSACHUSETTS LLC
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INDIAN ORCHARD
MIN FLOW GATE PROJECT

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CONCRETE TROUGH PLAN AND SECTIONS

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Project No.	Date Revised	Drawing No.
803-021	04-04-13	C3-01

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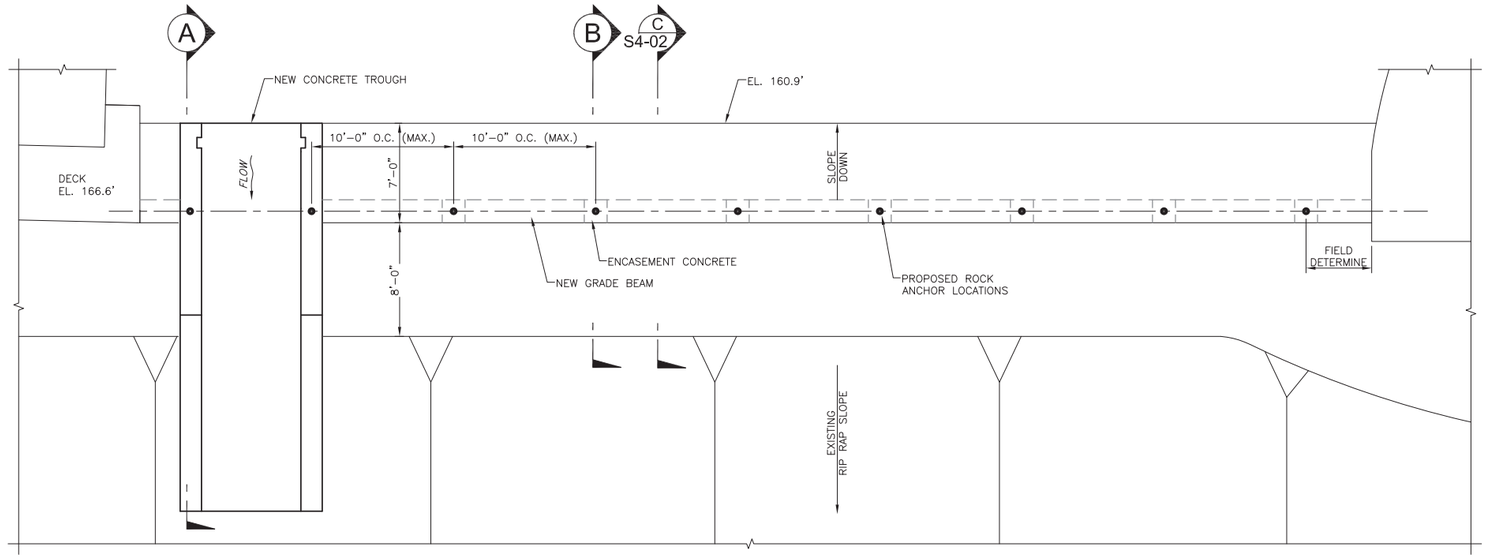
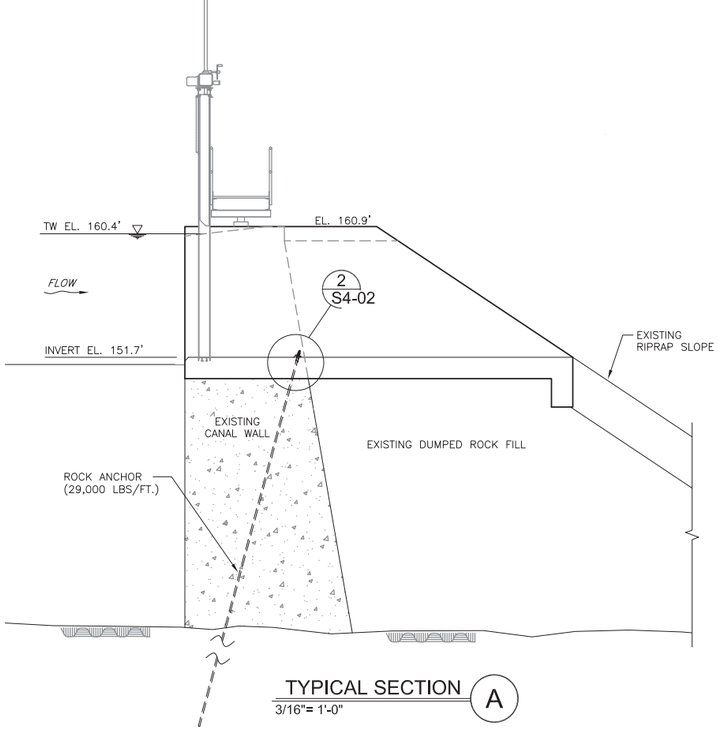
22x34 = FULL SCALE



PROPOSED ROCK ANCHOR LAYOUT

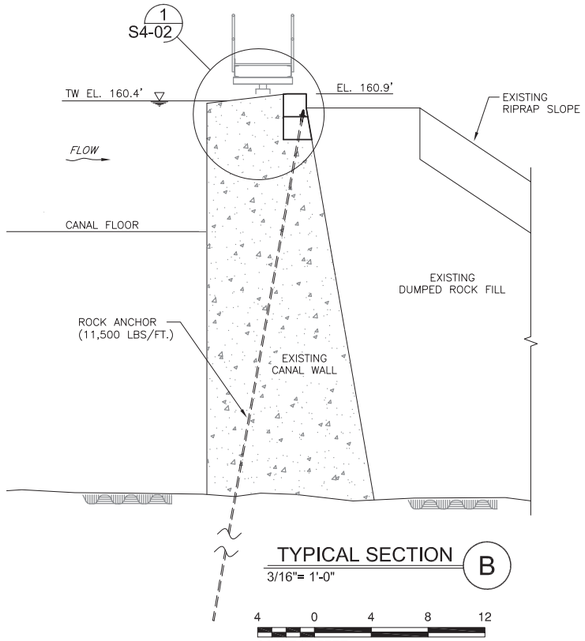
3/16"= 1'-0"



TYPICAL SECTION A

3/16"= 1'-0"

NOTE:
PROPOSED ROCK ANCHORS WITHIN THE TROUGH IS ENCASED BY THE NEW PIERS.



TYPICAL SECTION B

3/16"= 1'-0"

4 0 4 8 12

SCALE IN FEET

ROCK ANCHOR NOTES:

1. NUMBER, SIZE, AND SPACING OF ROCK ANCHORS DEPENDS UPON CONTRACTOR'S DESIGN AS STATED IN SPECIFICATION.
2. APPLY BONDING AGENT TO ALL CONCRETE SURFACES JUST PRIOR TO PLACEMENT OF ENCASEMENT CONCRETE.
3. ENCASEMENT CONCRETE: 4,000 PSI MIN, 28 DAYS, 5–7% AIR ENTRAINMENT, NON–SHRINK.
4. ANCHOR:
   - A. ANCHORS SHALL BE FULLY BONDED MULTIPLE CORROSION PROTECTION (MCP) TYPE II – CLASS 1 PER POST–TENSIONING INSTITUTE (PTI) OR APPROVED EQUAL.
   - B. ANCHORS SHALL BE GROUTED IN TWO STAGES. BOTTOM (FIRST) STAGE EXTENDS FROM BOTTOM OF HOLE TO THE TOP OF THE BOND ZONE, INSIDE AND OUTSIDE OF THE CORRUGATED TUBE. AFTER ANCHOR IS LOAD TESTED, LOCKED–OFF, AND PASSES FINAL LIFT–OFF TEST, THE SECOND STAGE GROUT SHALL BE INSTALLED FROM THE TOP OF THE FIRST STAGE GROUT TO THE ANCHOR HEAD, INSIDE AND OUTSIDE OF TUBE. ANCHOR HEADS SHALL NOT BE REMOVED AND THE TENDON WEDGES OR ANCHOR NUT SHALL BE LEFT ENGAGED AND SEATED.
   - C. ANCHORS:
     - I. FOR TENDONS, UNCOATED 7–WIRE, MINIMUM DIAMETER OF 0.57, 270 KSI LOW RELAXATION STEEL, ASTM A416. EPOXY COATED STRANDS SHALL NOT BE USED.
     - II. FDR BARS, 1 3/4" DIA. MIN, 150 KSI STEEL WITH UPSET THREADS, ASTM A722. EPOXY COATED BARS SHALL NOT BE USED.
   - D. MAXIMUM DESIGN BOND STRESS
     - I. ROCK, 150 PSI
     - II. CONCRETE, 300 PSI
   - E. DESIGN:
     - I. DESIGN LOAD SHALL BE LESS THAN 60% OF MIN. ANCHOR TENSILE STR.
     - II. LOCK–OFF LOAD SHALL BE LESS THAN 70% OF MIN. ANCHOR TENSILE STR.
     - III. MAX. TEST LOAD SHALL BE LESS THAN 80% OF MIN. ANCHOR TENSILE STR.
   - F. BOND ZONE LENGTH BASED ON 80% GUARANTEED ULTIMATE TENSILE STRENGTH (GUTS). MINIMUM BOND ZONE LENGTH OF 10 FT. MAXIMUM BOND LENGTH OF 35 FT. CONTRACTOR TO ESTABLISH SIZE OF ANCHOR HOLE
   - G. ANCHOR GROUT: 7–DAY, 3500 PSI MIN. 0.35 TO 0.40 W/C RATIO (BY WEIGHT) WITH WATER REDUCING AGENT.
   - H. BEARING PLATES: MILD OR HIGH STRENGTH STEEL, SIZED TO PROVIDE MAXIMUM BEARING PRESSURE OF 2500 PSI AT 80% GUTS.
5. CONTRACTOR SHALL VERIFY AND CONFIRM STRUCTURAL INTEGRITY OF THE EXISTING CANAL WALL TO DETERMINE THE APPLICABILITY OF IMPOSED LOADS FROM THE ROCK ANCHORS.

PRELIMINARY
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CONSTRUCTION

No.	Revision	Date	Drawn	Checked
A	REVIEW AND COMMENT	05-23-13	CFT	JL

Designed	Drawn	Checked
JL	CFT	HLT

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PROPOSED
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Project No.	Date Revised	Drawing No.
803-021	05-23-13	S4-01

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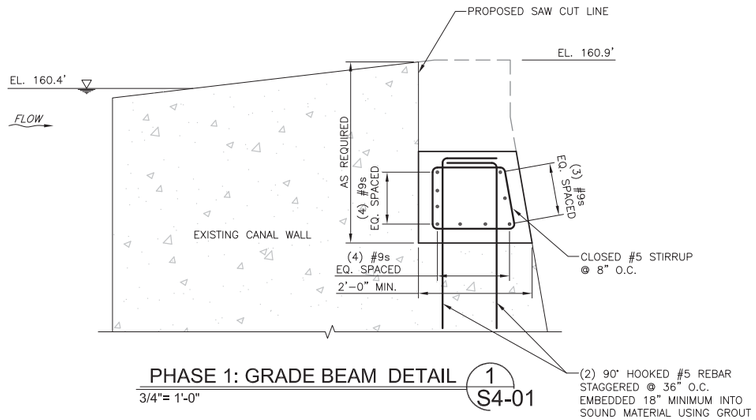
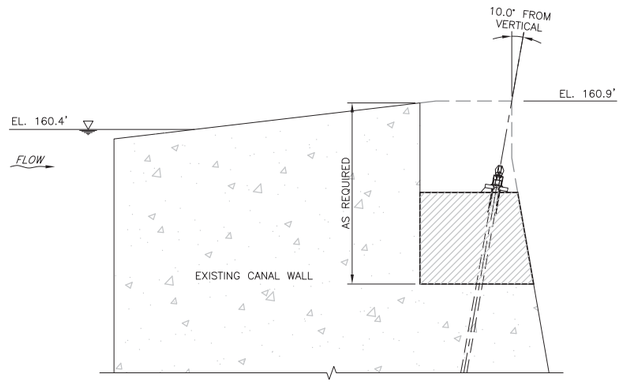
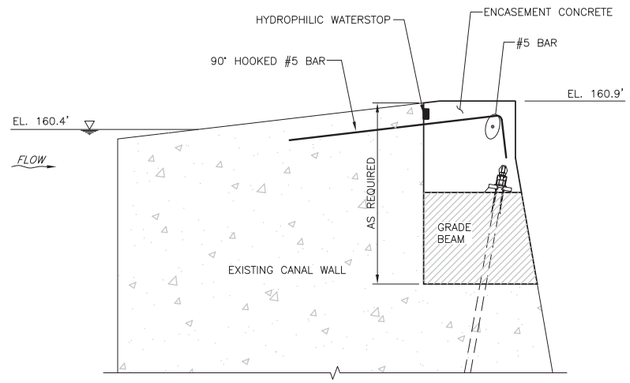


PHASE 1: GRADE BEAM DETAIL 1 S4-01
3/4"= 1'-0"



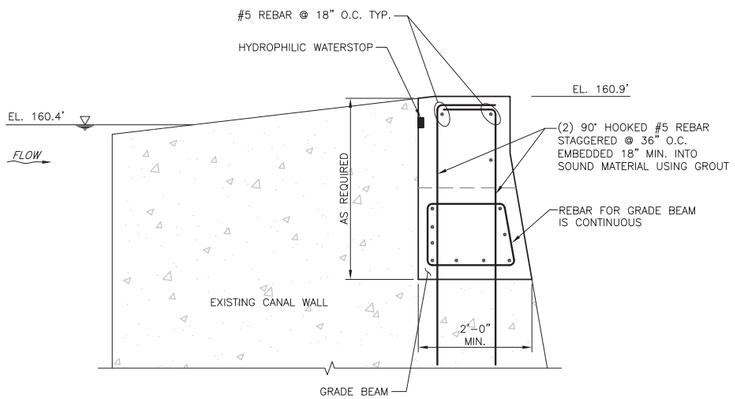
PHASE 2: ROCK ANCHOR DETAIL 1 S4-01
3/4"= 1'-0"



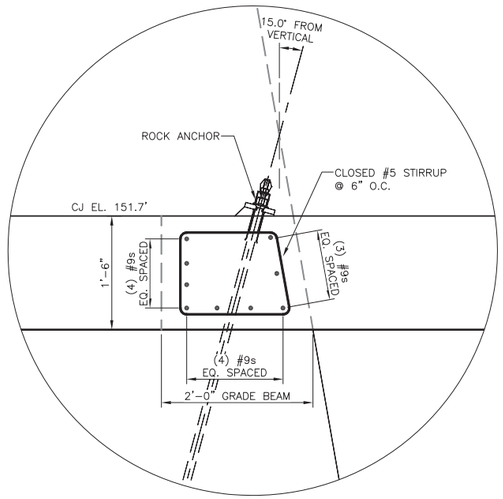
PHASE 3: ENCASEMENT CONCRETE DETAIL 1 S4-01
3/4"= 1'-0"

NOTE:
CONTRACTOR TO DETERMINE WIDTH OF ENCASEMENT CONCRETE PER ANCHOR INSTALLATION REQUIREMENTS

1 0 1 2 3
SCALE IN FEET



SECTION C S4-01
3/4"= 1'-0"



DETAIL 2 S4-01
1"= 1'-0"

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CONSTRUCTION

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A	REVIEW AND COMMENT	05-23-13	CFT	JL

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PROPOSED
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