Krebs Engineering, Inc.
2100 Riverhaven Drive, Suite 100
Birmingham, AL 35244
205-987-7411
April 8, 2021

ADDENDUM NO. 1

CONTRACT NO.: 20021
OWNER: Madison Utilities
PROJECT: Quarry Water Treatment Plant Expansion

BID DATE: April 21, 2021
TO: ALL PROSPECTIVE CONTRACTORS AND SUPPLIERS

The changes, modifications, and/or additions covered by and set forth in this Addendum No. 1 shall become part of and be incorporated in the Contract Documents for the above referenced project:

BIDDING REQUIREMENTS TO BE REVISED BY ADDENDUM:

AD1.1 INSTRUCTIONS TO BIDDERS

1. The Contractor is responsible for obtaining and coordinating a Building Permit through the City of Madison. The Owner will pay all fees associated with this permit directly to the City of Madison.

SPECIFICATIONS TO BE REVISED BY ADDENDUM:

AD1.2 PROPOSAL FORM

1. Replace this specification in its entirety with attached.

AD1.3 SECTION 01 23 00 - ALTERNATES

1. Replace this specification in its entirety with attached.

AD1.4 SECTION 26 36 25 – MANUAL TRANSFER SWITCH

1. Replace this specification in its entirety with attached SECTION 26 36 23 – AUTOMATIC TRANSFER SWITCH. Note that the specification to be replaced is the first occurrence of the Manual Transfer Switch specification. The Manual Transfer Switch specification that follows the one being replaced is to remain part of the Contract Documents.

SPECIFICATIONS TO BE ADDED BY ADDENDUM:

AD1.5 SECTION 26 24 19 – MOTOR CONTROL CENTERS

DRAWINGS TO BE REVISED BY ADDENDUM:

AD1.6 Remove Sheet C2-01, SITE DEMOLITION PLAN, and replace with attached.

AD1.7 Remove Sheet C2-02, SITE EROISION CONTROL PLAN AND DETAILS, and replace with attached.

AD1.8 Remove Sheet C3-01, OVERALL SITE PLAN, and replace with attached.

AD1.9 Remove Sheet C3-02, OVERALL GRADING AND DRAINAGE PLAN, and replace with attached.

AD1.10 Remove Sheet C3-03, PARTIAL SITE GRADING AND DRAINAGE PLAN, and replace with attached.

AD1.11 Remove Sheet C3-04, PARTIAL SITE GRADING AND DRAINAGE PLAN, and replace with attached.

AD1.12 Remove Sheet C3-09, YARD PIPING PROFILES, and replace with attached.

AD1.13 Remove Sheet C3-10, YARD PIPING PROFILES, and replace with attached.

AD1.14 Remove Sheet C3-11, YARD PIPING PROFILES, and replace with attached.

AD1.15 Remove Sheet C5-01, EX. FILTER LAYOUT KEENE PLANT, and replace with attached.

AD1.16 Remove Sheet C5-05, EX. FILTER BUILDING MODIFICATIONS PLAN AND NEW FILTER BUILDING SECTION, and replace with attached.

AD1.17 Remove Sheet C5-06, NEW FILTER BUILDING SECTIONS, and replace with attached.

AD1.18 Include note on Sheet S5-01 to read: “See Supplemental Geotechnical Report for undercut and backfill requirements for the Filter Building.”

AD1.19 Remove Sheet C6-02, EXISTING FINISHED WATER PUMPING STATION DEMOLITION SECTION, and replace with attached.

AD1.20 Remove Sheet DT-04, MISCELLANEOUS DETAILS, and replace with attached.

APPEDICES TO BE ADDED BY ADDENDUM:

AD1.21 APPENDIX B – SUPPLEMENTAL GEOTECHNICAL ENGINEERING REPORT AND RECOMMENDATION

This Addendum No. 1 shall be attached to the front of your set of specifications and made a part of the Contract Documents. Receipt of this Addendum No. 1 shall be acknowledged on Page of the Proposal Form.

Krebs Engineering, Inc.

By_____

Caleb L. Leach, P.E.
Associate

THIS IS THE LAST PAGE

Attachments to Addendum No. 1 preceding this page:

PROPOSAL FORM – 5 pages
SECTION 01 23 00 – ALTERNATES – 2 pages
SECTION 26 36 25 – MANUAL TRANSFER SWITCH – 9 pages
SECTION 26 24 19 – MOTOR CONTROL CENTERS – 12 pages
C2-01 – SITE DEMOLITION PLAN – 1 page
C2-02 – SITE EROSION CONTROL PLAN & DETAILS – 1 page
C3-01 – OVERALL SITE PLAN – 1 page
C3-02 – OVERALL SITE GRADING &DRAINAGE PLAN – 1 page
C3-03 – PARTIAL SITE GRADING & DRAINAGE PLAN – 1 page
C3-04 - PARTIAL SITE GRADING & DRAINAGE PLAN – 1 page
C3-09 – YARD PIPING PROFILES – 1 page
C3-10 – YARD PIPING PROFILES – 1 page
C3-11 – YARD PIPING PROFILES – 1 page
C5-01 – EX. FILTER LAYOUT KEENE PLANT – 1 page
C5-05 – EX. FILTER BUILDING MODIFICATIONS PLAN AND NEW FILTER BUILDING SECTION – 1 page
C5-06 – NEW FILTER BUILDING SECTIONS – 1 page
C6-02 – EXISTING FINISHED WATER PUMPING STATION DEMOLITION SECTION – 1 page
DT-04 – MISCELLANEOUS DETAILS – 1 page
APPENDIX B – SUPPLEMENTAL GEOTECHNICAL ENGINEERING REPORT AND RECOMMENDATION – 35 pages

A total of 81 pages or sheets of drawings (including this page) have been included in Addendum No. 1.

General Contractors are requested to return this page as an acknowledgement that you have received this Addendum by e-mail. This will NOT be mailed. A copy of this Addendum may be picked up at the office of the Engineer.

Return to Return to Alabama Graphics Digital Plan Room.

Received By_____

Contractor_____

Date_____

PROPOSAL FORM

MADE BY _____

ADDRESS _____

TO: **Madison Utilities**

The undersigned, as Bidder, proposes and agrees, if this Bid is accepted, to enter into a Contract with **Madison Utilities** in the form of Contract specified and shown in the attached Contract Documents, to furnish all necessary materials, equipment, machinery, tools, apparatus, means of transportation, and labor necessary to complete the construction of a **Quarry Water Treatment Plant Expansion, Krebs Project No. 20021** as described in the Advertisement for Bids, and in the Contract Documents, which are hereby referred to and made a part of the same extent as if fully set out herein, and in full and complete accordance with the shown, noted, described and reasonably intended requirements of the Contract Documents, to the full and entire satisfaction of the Owner, with a definite understanding that no money will be allowed for extra work except as set forth in the attached Instructions to Bidders, General Conditions, and other Contract Documents, based on the following pricing:

PROPOSAL FORM

ITEM NO.	APPROXIMATE QUANTITIES	DESCRIPTION OF ITEM	UNIT PRICE	TOTAL PRICE FOR ITEM
1.	Complete	**Quarry WTP Expansion:** Furnish and Install all labor, materials, equipment and appurtenances for the construction of the WTP upgrade/expansion, including demolition, sitework, yard piping, clearwells, FWPS, filters, Filter Building, and other modifications/improvements. Lump Sum	Lump Sum	$
2.	Complete	**Electrical:** Furnish and install all labor, materials, equipment and appurtenances for the electrical work associated with this project. Lump Sum	Lump Sum	$
3.	Complete	**WTP SCADA System:** Furnish and install all labor, materials, equipment and appurtenances for the SCADA System work as specified herein. Lump Sum	Lump Sum	$
4.	Complete	**WTP FENCE:** Install an architectural fence, including 2 vehicular entry gates as specified along the west boundary of the property line.	Lump Sum	$

		Lump Sum		

5.	Complete	**WTP Landscaping:** Allowance item for landscaping improvements along the existing berm and in front of the Admin Building Lump Sum	Lump Sum	$15,000
6.	200	Undercut (Below Subgrade) Unsuitable Soils, Haul, and Dispose Off-Site, as directed by the Engineer	CY	$
7.	200	Backfill Undercut Areas w/ Crushed Stone (Including Hauling and Compaction), as directed by the Engineer	CY	$
8.	200	Backfill Undercut Areas w/ suitable Soil from On-Site (Including Hauling and Compaction), as directed by the Engineer	CY	$
			Total Amount of Base Bid	$

BASE BID: For construction complete as shown and specified in table above, the sum of

_____

Dollars $

ALTERNATES: If alternates as set forth in the Contract Documents are accepted, the following adjustments are to be made to the Base Bid.

ITEM NO.	ALTERNATE DESCRIPTION	TOTAL ADD OR DEDUCT PRICE FOR ITEM
A1.	Install 2 new filters, in lieu of relocating and rehabilitating the 2 existing filters at the Keene WTP Lump Sum	$

ITEM NO.	ALTERNATE DESCRIPTION	TOTAL DEDUCT IN CONTRACT TIME
A2.	Reduction in Contract Time for both the Substantial Completion and Final Completion if Alternate No. 1 is accepted Calendar Days	Days

BASE BID plus Alternate No. 1: For construction complete as shown and specified in table above (Base Bid plus Alternates), the sum of

_____

Dollars $

ADDENDA: The Bidder acknowledges receipt of Addenda Nos. _____ , _____ , _____ , _____,_____, _____, _____ .

The award of the Contract will be based on the total/sum of the base bid price and the alternates (if any) selected by the Owner. The Owner will receive bids and all pricing will be read aloud, but the project will not be awarded until the bids are evaluated and a determination is made on which alternates are selected. Once the Alternates have been selected, the final bid amount will be calculated (base bid price plus adjustments for any alternate selected) for each bid submitted, and if an award is made, the project will be awarded to the responsive bidder with the lowest final bid amount.

The Bidder declares that he/she has examined the site of the work, and has familiarized himself/herself with the existing and proposed/new facilities (including the location, nature, sizes/dimensions, current and intended future use, etc.). The Bidder declares that he/she has fully informed himself/herself of conditions that would affect the proposed work, that, prior to the tender of his/her bid, he/she has examined the Contract Documents for the work and has read all special instructions and provisions contained in the Documents, and that he/she has satisfied himself/herself with respect to the quality and extent of work to be performed. The Bidder declares that the firm, the project manager and the superintendent are qualified and meet or exceed the experience requirements as outlined in the Instructions to Bidders and/or elsewhere in the Contract Documents.

The Bidder declares that he/she understands that, when quantities of work for which unit price bids are requested in the Proposal, such quantities are approximate only and are subject to either increase or decrease, that, should the quantities of any of the work items be increased, the Bidder proposes to perform the additional work at the unit prices bid by him, that, should the quantities of any of the work items be decreased, payment will be made only for the actual quantities of work performed and such payment will be based upon the unit prices bid by him/her, and that he/she shall make no claim for profits anticipated on the decrease in quantities of work. Actual quantities will be paid for as the work progresses, in accordance with the provisions of the Contract Agreement, and such quantities shall be subject to final measurements and determinations made upon completion of the work.

The Bidder understands that the Owner reserves the right, in the Owner's discretion, to reject any or all bids, to waive any informality in any bid, and to accept any bid considered to be advantageous to the Owner.

The Bidder agrees that his/her bid shall be valid for a period of sixty (60) calendar days after the date set for receipt of bids, and shall not be withdrawn for a period of sixty (60) calendar days after the date set for receipt of bids.

The Bidder has attached hereto a Bid Bond executed by a Surety Company authorized to do business in the state in which the project is located (with valid Power-of-Attorney attached), or a cashier's check drawn on a bank in the state in which the project is located, in favor of (made payable to) **Madison Utilities**, the amount of 5% of the bid amount (total), but in no event more than $10,000.

The Bidder agrees that, should he/she be notified that his/her Bid on the work has been accepted, he/she will, within ten (10) days from receipt of such notice, execute the formal Contract Agreement bound herein, and will furnish with the Contract evidence of Insurance Coverage of his/her construction operations and all of his/her operations associated with the project, all in accordance with the requirements of the General Conditions.

The Bidder further agrees that, in case of failure on his/her part to execute said Contract Agreement, and to furnish all Bonds required by the Contract Documents, within ten (10) consecutive calendar days after receipt of notice of award of Contract to him, the monies payable to the Obligee of his/her Bid Bond, in accordance with the terms and conditions of the Bond, shall be paid to the Owner as liquidated damages for the delay and additional expense to the Owner caused by such failure on the part of the Bidder.

The Bidder hereby agrees that, should the work under the Contract be awarded to him/her, he/she will commence work under this Contract on or before a date to be specified in written "Notice to Proceed" given by the Owner, and that he/she will achieve Substantial Completion of the Contract within **730** consecutive calendar days following the Notice to Proceed, and will achieve Final Completion of the Contract within **760** consecutive calendar days following the Notice to Proceed. The Bidder agrees to pay, as liquidated damages, the sum of **$1,500** for each consecutive calendar day after the date set for Substantial Completion of the work until such time as Substantial Completion has been achieved. Once Substantial Completion has been achieved, the Bidder will not be assessed additional liquidated damages unless and until he/she fails to meet the Final Completion Date. If the Bidder fails to meet the Final Completion date, then he/she agrees to pay, as liquidated damages, the sum of **$1,000** for each consecutive calendar day after the date set for Final Completion of the work, all as provided in the General Conditions. At no time shall the Bidder pay more than **$1,500** per calendar day for liquidated damages. **The Bidder agrees that, once the Substantial and/or Final Completion dates have passed, the Owner/Engineer will begin deducting liquidated damages from the monthly progress payments.** The Bidder further agrees that he/she will not make any claim for extra compensation should completion of work under the Contract be effected in advance of the time specified hereinabove.

The undersigned Bidder states that he/she fully understands the meaning of "low, responsive, responsible Bidder", as defined in these Documents, and that these criteria will be applied in the evaluation of this Bid.

The undersigned, as Bidder, hereby declares that the name (or names) of the only person (or persons) interested in this Proposal, as principal (or principals), is (or are) as herein below set out and that no person other than that (or those) herein below stated has any interest in this Proposal, or in the Contract to be entered into; that this Proposal is made without connection with any other person, firm or corporation making a proposal; and that it is in all respect fair and in good faith, without collusion or fraud.

Following are the names and addresses of all persons, firms, and corporation interested in the foregoing bid:

_____

_____

_____
(Type or Print Name and Address of Firm)

_____
(Type or Print Contractor License No.)

_____
(Type or Print Name and Title of Officer/Legal Representative of Firm Submitting Bid)

_____
(Signature of Officer/Legal Representative of Firm Submitting Bid)

_____
(Type or Print Date)

SECTION 01 23 00 – ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. The Owner reserves the right to select or reject alternates that are considered to be advantageous to the Owner.
B. No adjustments to the pricing for other components of the Work will be made.
C. No adjustments to the schedule or Contract completion dates will be made unless specifically identified for an alternate.
D. Only those alternates selected by the Owner and incorporated into the Contract Agreement are included in the Work.

1.2 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

1.3 SCHEDULE OF ALTERNATES

A. The alternates shown in the Proposal Form are listed and described below:

1. Alternate No. 1 – Install two (2) new filters in the New Filter Building to meet the Specification 44 32 00 – Filter Equipment and Media in lieu of relocating the exiting filters from the Keene WTP. The new filters shall include new stainless steel tanks, upflow clarifiers, troughs, and misc. appurtenances as required to supply complete filtration units.
2. Alternate No. 2 – Reduction in Contract Time if the Owner chooses to accept Alternate No. 1. This reduction in Contract Time provide by the Contractor will be revised and executed as part of the Contract Documents. Contractors can insert 0 days if no reduction in Contract Time will be offered if Alternate No. 1 is accepted.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 23 00

SECTION 26 36 23 - AUTOMATIC TRANSFER SWITCHES

PART 1 - GENERAL

1.1. SCOPE

A. Provide complete factory assembled power transfer equipment with field programmable digital electronic controls designed for fully automatic operation and including: voltage sensors on all phases of both sources, power switch mechanism, permanently attached manual operation provisions, positive mechanical and electrical interlocking, and mechanically held contacts for both sources.

B. The generator set manufacturer shall warrant transfer switches to provide a single source of responsibility for all the products provided. Technicians specifically trained to support the product shall service the transfer switches.

1.2. CODES AND STANDARDS

A. The automatic transfer switch installation and application shall conform to the requirements of the following codes and standards:
1. CSA 282, Emergency Electrical Power Supply for Buildings
2. NFPA70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
3. NFPA99 – Essential Electrical Systems for Health Care Facilities
4. NFPA110 – Emergency and Standby Power Systems. The transfer switch shall meet all requirements for Level 1 systems.
5. IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
6. NEMA ICS10-1993 – AC Automatic Transfer Switches.

B. The transfer switch assembly shall comply with the following standards:
1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
2. EN55011, Class B Radiated Emissions
3. EN55011, Class B Conducted Emissions
4. IEC 1000-4-5 (EN 61000-4-5); AC Surge Immunity.
5. IEC 1000-4-4 (EN 61000-4-4) Fast Transients Immunity
6. IEC 1000-4-2 (EN 61000-4-2) Electrostatic Discharge Immunity
7. IEC 1000-4-3 (EN 61000-4-3) Radiated Field Immunity
8. IEC 1000-4-6 Conducted Field Immunity
9. IEC 1000-4-11 Voltage Dip Immunity.
10. IEEE 62.41, AC Voltage Surge Immunity.
11. IEEE 62.45, AC Voltage Surge.
12. UL1008 – Transfer Switches. Transfer switches shall be UL1008 (latest edition) listed. UL1008 transfer switches may be supplied in UL891 enclosures if necessary to meet the physical requirements of the project.

C. The transfer switch manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.3. ACCEPTABLE MANUFACTURERS

A. Cummins/Onan

B. Caterpillar

C. Generac

D. Kohler

E. Zenith

F. Russelectric

G. ASCO

H. Eaton

PART 2 - PRODUCTS

2.1. POWER TRANSFER SWITCH

A. Ratings
1. Refer to the project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, voltage and ampere ratings, enclosure type, and accessories.
2. Main contacts shall be rated for 600 Volts AC minimum.
3. Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure supplied, in ambient temperatures of -40 to +60 degrees C, relative humidity up to 95% (non-condensing), and altitudes up to 10,000 feet (3000M).
4. Transfer switch equipment shall have withstand and closing ratings (WCR) in RMS symmetrical amperes equal to or greater than the required ratings shown on the drawings (at the specified voltage). The transfer switch shall be third party listed and labeled for use with the specific protective device(s) (both normal and emergency) installed in the application. All rating information including associated overcurrent devices shall be submitted with shop drawings. Where WCR is dependent on setting of upstream overcurrent device, transfer switch shall be field marked with the required settings of the associated device. When a power distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. The transfer switch and its upstream protection shall be coordinated.

B. Construction
1. Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the source 1 and source 2 positions. The transfer switch shall be specifically designed to transfer to the best available source if it inadvertently stops in a neutral position.
2. Transfer switches shall be of the Programmed (Delayed) Transition type. Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick-break, quick-make

over-center contact mechanisms. Transfer switches over 1000 amperes shall be equipped with manual operators for service use only under de-energized conditions.

3. The switch shall completely disconnect the load from both sources for an adjustable period of time to allow regenerative voltage to decay to a safe level prior to connecting to the new source.
4. Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
5. All wiring shall be UL listed 105 degree C, 600 volt rated, and sized as required. Each wire, device or function shall be identified with a source and destination by silk-screen or similar permanent identification. Circuit boards shall be connected wiring harnesses by means of locking disconnect plug(s), to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism.
6. Bus structures shall be constructed from silver plated copper or tin plated aluminum with bolted joints for all three phases, with a full neutral, and a 1/4 x 2 inch ground bus extending through all sections.
7. The framework and all other sheet metal components of the system shall be primed with a rust-inhibiting primer, and finished with two coats of satin finish ANSI 61 gray enamel, or manufacturer's standard color.
8. All door mounted control components shall be industrial type oil-tight devices with contact ratings a minimum of twice the maximum circuit ampacity they are controlling. Toggle switches and other light duty and durability control devices are not acceptable. Indicator lamps shall be high intensity LED type devices. Indicator lamp condition (on or off) shall be easily visible in bright room lighting conditions.
9. Power transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation or shall be indicated by mechanical flags. Barriers shall be provided to prevent inadvertent contact with any voltage of greater than 50VDC.
10. Transfer switches shall be 4-pole with a switched neutral pole. The neutral pole shall be of the same construction and have the same ratings as the phase poles. All poles shall be switched simultaneously using a common crossbar. Equipment using overlapping neutral contacts is not acceptable.

C. Connections

1. Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
2. Transfer switch shall be provided with AL/CU compression lugs suitable for the quantities and sizes of power conductors required.

2.2. TRANSFER SWITCH CONTROL

A. Operator Panel. Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be permanently labeled for switch and control functions. The operator panel shall be provided with the following features and capabilities.

1. High intensity LED lamps to indicate the source that the load is connected to (source 1 or source 2); and which source(s) are available. Source available LED indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.

2. High intensity LED lamps to indicate that the transfer switch is “not in auto” (due to control being disabled or due to bypass switch (when used) enabled or in operation) and “Test/Exercise Active” to indicate that the control system is testing or exercising the generator set.
3. “OVERRIDE” pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation.
4. “TEST” pushbutton to initiate a preprogrammed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load.
5. “RESET/LAMP TEST” pushbutton that will clear any faults present in the control, or simultaneously test all lamps on the panel by lighting them.
6. The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. This information shall be available via an operator display panel.
7. Vacuum fluorescent alphanumeric display panel with push-button navigation switches. The display shall be clearly visible in both bright (sunlight) and no light conditions. It shall be visible over an angle of at least 120 degrees. The Alphanumeric display panel shall be capable of providing the following functions and capabilities:
    a. Display source condition information, including AC voltage for each phase of normal and emergency source, frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance. Line to neutral voltages shall be displayed for 4-wire systems.
    b. Display source status, to indicate source is connected or not connected.
    c. The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:
        1) Set nominal voltage and frequency for the transfer switch.
        2) Adjust voltage and frequency sensor operation set points.
        3) Set up time clock functions.
        4) Set up load sequence functions.
        5) Enable or disable control functions in the transfer switch, including program transition.
        6) Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.
    d. Display Real time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall be incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.
    e. Display service history for the transfer switch. Display source connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.
    f. Display fault history on the transfer switch, including condition, and date and time of fault. Faults to include controller checksum error, low controller DC voltage, ATS fail to close on transfer, ATS fail to close on retransfer, battery charger malfunction, network battery voltage low, network communications error.

B. Internal Controls

1. The transfer switch control system shall be configurable in the field for any operating voltage level up to 600VAC. Provide RMS voltage sensing and metering that is accurate to within plus or minus 1% of nominal voltage level. Frequency sensing shall be accurate to within plus or minus 0.2%. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
2. Transfer switch voltage sensors shall be close differential type, providing source availability information to the control system based on the following functions:
    a. Monitoring all phases of the normal service (source 1) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of normal voltage level).
    b. Monitoring all phases of the emergency service (source 2) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of pickup voltage level).
    c. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for voltage imbalance.
    d. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for loss of a single phase.
    e. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for phase rotation.
    f. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for over voltage conditions (adjustable for dropout over a range of 105 to 135% of normal voltage, and pickup at 95-99% of dropout voltage level).
    g. Monitoring all phases of the normal service (source 1) and emergency service (source 2) for over or under frequency conditions.
3. The transfer control shall incorporate a series of diagnostic LED lamps.
4. The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature, and adjusting the time period to a specific value. A phase band monitor or similar device is not an acceptable alternate for this feature. The program/delayed transition time setting (time in which load is not connected to either source during transfer) shall be initially set at 10 seconds to allow motors to properly decay per MG-1 standard
5. The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a range from 0-120 seconds); retransfer (adjustable in a range from 0-30 minutes); and generator stop (cooldown) (adjustable in a range of 0-30 minutes).
6. The transfer switch shall be configurable to accept a relay contact signal from an external device to prevent transfer to the generator service.
7. The control system shall be designed and prototype tested for operation in ambient temperatures from -40C to +70C. It shall be designed and tested to comply with the requirements of the noted voltage surge and RFI/EMI standards.
8. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.

C. Control Interface

1. The transfer switch shall provide an isolated relay contact for starting of a generator set. The relay shall be normally held open, and close to start the generator set. Output contacts shall be form C, for compatibility with any generator set.
2. The integrity of the generator remote start circuit shall be monitored for broken, disconnected or shorted wires. Loss of integrity shall start the generator.
3. Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.
4. The transfer switch shall provide additional relay contacts to indicate the following conditions: Utility Source Available, Load Connected to Utility, Generator Source Available, Load Connected to Generator, Pre-Transfer Warning (adjustable 0-59 second time delay).

2.3. ENCLOSURE

A. Enclosures shall be UL listed. The enclosure shall provide wire bend space in compliance to the latest version of NFPA70. The cabinet door shall include permanently mounted key type latches.

B. If not specifically indicated otherwise on plans, transfer switch equipment enclosures shall meet the following minimum requirements:
1. For dry interior locations: NEMA 1 or better (unless shown otherwise on plans).
2. For wet interior (pump stations, etc.) or exterior locations: NEMA 3R or better (unless shown otherwise on plans).

C. The cabinet shall provide code-required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches with manual operating handles and/or non key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

D. Note size and access requirements for the transfer switch (and associated equipment) and provide equipment that will fit into the space allowed and comply with code-specified access requirements.

2.4. BATTERY CHARGING

A. The transfer switch/generator set combination shall be provided with a battery charger for the generator set starting batteries. Refer to Generator Sets Specification Section 26 32 13 for specific requirements. Supply power failed indication shall be displayed on the ATS control panel.

2.5. SEQUENCE OF OPERATION

A. Programmed (Delayed) Transition Sequence of Operation
1. Normal State:
a. Transfer switch normally connects an energized utility power source (source 1) to loads and a generator set (source 2) to the loads when normal source fails. The normal position of the transfer switch is connected to source 1 (connected to the utility), and no start signal is supplied to the genset.

2. Normal Power Failure and Restoration:
    a. When the transfer switch senses a power failure on source 1, it shall complete a pre-programmed time delay start sequence, and then send a start signal to the generator set.
    b. The generator set shall immediately start and accelerate to rated voltage and frequency.
    c. The transfer system shall complete a programmable time delay sequence, and then transfer to source 2 by delayed (programmed) transition. The transfer switch shall accomplish this by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later (to allow motor loads to decay per NEMA MG-1 standard).
    d. On return of source 1 to acceptable voltage and frequency levels, the control system shall initiate a time delay retransfer sequence. On completion of the time delay sequence, the transfer switch shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later (to allow motor loads to decay per NEMA MG-1 standard). The timing sequence for the contact operation shall be programmable in the controller. The control system shall transfer loads back to source 1 in the reverse sequence to that which was used to connect loads to source 2.
    e. If the generator set fails during this period and normal source is available, the transfer switch shall automatically reconnect the system loads to the normal service.
    f. The transfer switch shall operate the generator set unloaded for a cooldown period, and then remove the start signal from the generator set.
3. Generator Set Exercise (Test) With Load Mode (Delayed (programmed)Transition). The control system shall be configurable to test the generator set under load. In this mode, the transfer switch shall control the generator set in the following sequence:
    a. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
    b. The transfer switch shall issue a compatible start command to the generator set as follows:
        1) On generators rated 50kW and greater, the transfer switch shall cause the generator set to start and run at idle until it has reached normal operating temperature. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.
        2) On generators rated less than 50kW, the generator set shall immediately start and accelerate to rated voltage and frequency.
    c. When the control systems senses the generator set at rated voltage and frequency, it shall operate to connect the loads to the generator set by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later (to allow motor loads to decay per NEMA MG-1 standard). The timing sequence for the contact operation shall be programmable in the controller.
    d. The generator set shall operate connected to the load for the duration of the exercise period.

e. On completion of the exercise period, the transfer switch shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later (to allow motor loads to decay per NEMA MG-1 standard). The timing sequence for the contact operation shall be programmable in the controller.

f. The transfer switch shall operate the generator set unloaded for a cooldown period, and then remove the start signal from the generator set.

g. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

h. If the generator set fails during the exercise period and normal source is available, the transfer switch shall automatically reconnect the system loads to the normal service.

4. Generator Set Exercise (Test) Without Load Mode. The control system shall be configurable to test the generator set without transfer switch load connected. In this mode, the transfer switch shall control the generator set in the following sequence:

a. Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.

b. The transfer switch shall issue a compatible start command to the generator set as follows:

1) On generators rated 50kW and greater, the transfer switch shall cause the generator set to start and run at idle until it has reached normal operating temperature. When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.

2) On generators rated less than 50kW, the generator set shall immediately start and accelerate to rated voltage and frequency.

c. When the control systems senses the generator set at rated voltage and frequency, it shall operate the generator set unloaded for the duration of the exercise period.

d. At the completion of the exercise period, the transfer switch shall remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

PART 3 - EXECUTION

3.1. POWER COMPANY APPROVAL

A. The transfer switch shall be designed to meet all applicable power company requirements for connection to the power company's system, and if applicable, shall be on the power company's approved list of automatic transfer switches. Contractor shall ensure that transfer switch is specifically approved by power company for connection to their system prior to purchasing the transfer switch.

3.2. FACTORY TESTING

A. The transfer switch manufacturer shall perform a complete operational test on the

transfer switch prior to shipping from the factory. A certified test report shall be submitted. Test process shall include calibration of voltage sensors.

3.3. SERVICE AND SUPPORT

A. The manufacturer of the transfer switch shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

B. The transfer switch shall be serviced by a local service organization that is trained and factory certified in both generator set and transfer switch service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

C. The manufacturer shall maintain model and serial number records of each transfer switch provided for at least 20 years.

D. After generator set installation, the generator set supplier shall conduct a complete operation, basic maintenance, and emergency service seminar for up to 5 persons employed by the facility owner. The seminar shall include instruction on operation of the transfer equipment, normal testing and exercise, adjustments to the control system, use of the PC based service and maintenance tools provided under this contract, and emergency operation procedures. The class duration shall be at least 4 hours in length, and include practical operation with the installed equipment.

3.4. WARRANTY

A. The automatic transfer equipment shall be warranted (by the generator supplier when a generator is supplied within the project) for a period of not less than 2 years from the date of commissioning against defects in materials and workmanship.

B. The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.

END OF SECTION 26 36 23

SECTION 26 24 19 - MOTOR CONTROL CENTERS

PART 1 - GENERAL

1.1. DESCRIPTION

A. This section includes requirements for motor control centers (MCC's) and all required control devices as shown on the drawing and specified to be part of the MCC equipment. The MCC shall be 277/480 V, 3-Phase, 4-Wire, 60 Hz unless otherwise indicated.

1.2. SUBMITTALS

A. Submittals shall be furnished in accordance with Specification Section 26 05 00.

B. Submittals shall show separate views of the elevation, profile and conduit openings. The elevation shall show the section identification and the unit identification. The drawings shall give dimensions of size and location of the following:
   1. Vertical section height, width and depth
   2. Mounting channels
   3. Conduit openings top and bottom
   4. Wireway openings in sides
   5. Horizontal buss
   6. Ground buss

C. The submittals shall contain a summary of the design specification containing but not limited to the following:
   1. NEMA type enclosure and class of wiring
   2. Rated buss voltage
   3. Current ratings for horizontal buss, vertical busses and ground buss
   4. Buss material and plating

D. Buss bracing and sheet circuit rating

E. The submittals shall contain a listing of all modifications, options and special equipment.

F. The submittals shall contain a listing of each unit containing but not limited to the following:
   1. Unit Location
   2. Nameplate
   3. Major contents of unit (fuse starter, CB switch, M.C.P., etc.) complete with NEMA size and heater rating or current rating.
   4. Size of load served (H.P. KVA, KW, etc.).

G. Provide the following for each starter/controls unit:
   1. A job-specific, custom wiring diagram
      a. The wiring diagram shall clearly show all control components (whether the components are mounted internal or external to the MCC enclosure).
      b. All wires and terminal blocks shall be clearly labeled.

c. Diagram shall be in accordance with NEMA/ICS standards.

2. Size, type and rating of all system components.
3. Unit frontal elevation and dimension drawings.
4. Internal component layout diagrams.
5. Manufacturer's product data sheets for all components.

H. Submittals shall be complete and electrical contractor shall review and approve all accessories required for control wiring prior to submittal

1.3. REGULATORY REQUIREMENTS

A. The MCC shall conform to Underwriters Laboratory (UL) 845, current revision, CSA, EEMAC, NEMA ICS-2, the latest version of the National Electrical Code, and the Canadian Electrical Code. The MCC shall be manufactured in an ISO 9001 certified facility.

1.4. WARRANTY

A. An eighteen-month warranty shall be provided on materials and workmanship from date of owner acceptance/substantial completion after completion of startup.

PART 2 - PRODUCT

2.1. MANUFACTURERS

A. Square 'D' or Cutler Hammer.

B. Additions to existing MCCs shall be the same as the original manufacturer.

2.2. MATERIALS

A. Steel material shall comply with UL 845 and CSA requirements.

B. Each MCC shall consist of one or more vertical sections of heavy gauge steel bolted together to form a rigid, free-standing assembly. A removable 7 gauge structural steel lifting angle shall be mounted full width of the MCC shipping block at the top. 10 gauge bottom channel sills shall be mounted underneath front and rear of the vertical sections extending the full width of the shipping block. Vertical sections made of welded side-frame assembly formed from a minimum of 12 gauge steel. Internal reinforcement structural parts shall be of 12 and 14 gauge steel to provide a strong, rigid assembly. The entire assembly shall be constructed and packaged to withstand normal stresses included in transit and during installation.

C. Each entire MCC assembly (including all sub-components) shall be rated to withstand (and provide proper breaker functionality within) the fault current ratings listed on the plans. When a power distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. The fault current ratings listed shall be assumed to be at the input terminals of the associated MCC.

2.3. MCC FINISH

A. All steel parts shall be provided with UL and CSA listed acrylic/alkyd baked enamel paint finish, except plated parts used for ground connections. All painted parts shall undergo a multi-stage treatment process, followed by the finishing paint coat.

B. Pre-treatment shall include:
   1. Hot alkaline cleaner to remove grease and oil.
   2. Iron phosphate treatment to improve adhesion and corrosion resistance.

C. The paint shall be applied using an electro-deposition process to ensure a uniform paint coat with high adhesion.

D. The standard paint finish shall be tested to UL 50 per ASTM B117 (5% ASTM Salt Spray) with no greater than 0.125 in (3 mm) loss of paint from a scribed line.

E. Paint color shall be #49 medium light gray per ANSI standard Z55.1-967 (60-70 gloss) on all surfaces unless specified otherwise. Paint color of additions to existing MCCs shall match that of the existing MCC. Control station plates and escutcheon plates shall be a contrasting gray.

2.4. STRUCTURES

A. Structures shall be totally enclosed, dead-front, free-standing assemblies. Structures shall be capable of being bolted together to form a single assembly.

B. The overall height of the MCC shall not exceed 90 in (2286 mm) (not including base channel or lifting angle). Lifting angles, of 3 in (76 mm) in height, shall be removable. The total width of one section shall be 20 in (508 mm); (widths of 25 in (630 mm), 30 in (760 mm), and 35 in (890 mm) can be used for larger devices). The total depth of each section shall be 20 in (508 mm) unless shown otherwise.

C. Structures shall be NEMA/EEMAC type 1 unless shown/specified otherwise.

D. Each 20 in wide standard section shall have all the necessary hardware and bussing for modular plug-in units to be added and moved around. All unused space shall be covered by hinged blank doors and equipped to accept future units. Vertical bus openings shall be covered by manual bus shutters.

E. Each section shall include a top plate (single piece or two-piece). NEMA/EEMAC type 12 shall also include a bottom plate. Top and bottom plates shall be removable for ease in cutting conduit entry openings.

F. All MCC components, terminations, wiring, etc. shall be fully accessible from the front of the MCC unless noted otherwise.

2.5. WIREWAYS

A. Structures shall contain a minimum 12 in (305 mm) high horizontal wireway at the top of each section and a minimum 6 in (152 mm) high horizontal wireway at the bottom of each section. These wireways shall run the full length of MCC to allow room for power and control cable to connect between units in different sections.

B. A full-depth vertical wireway shall be provided in each MCC section that accepts

modular plug-in units. The vertical wireway shall connect with both the top and bottom horizontal wireway. The vertical wireway shall be 4 in (102 mm) wide minimum with a separate hinged door. There should be a minimum of 80 in^2 (516 cm^2) of cabling space available for 20-inch-deep sections. Access to the wireways shall not require opening control unit doors. Structures that house a single, full section control unit are not required to have vertical wireways. Those control units shall open directly into the MCC horizontal wireways.

C. All wireway doors shall be hinged and shall be held shut by captive hardware.

2.6. BARRIERS

A. All power bussing and splice connections shall be isolated from the unit compartments and the wireways. The horizontal bus shall be mounted onto a glass filled polyester support assembly that braces the bus against the forces generated during a short circuit. The horizontal bus shall be isolated from the top horizontal wireway by a two-piece rigid non-conductive barrier. The barrier design shall allow qualified personnel to slide the barriers both left and right, to allow access to the bus and connections for maintenance without having to remove the barrier. Barrier sliding shall occur via an upper and lower track system.

B. The vertical bus shall be housed in a molded glass-filled polyester support that provides bus insulation and braces the bus against the forces generated during a short circuit. These supports shall have openings every 3 in (75 mm) for unit stab-on connections. Each opening shall be provided with a manual shutter to close off the stab opening. These shutters shall be attached to the structure so that when they are removed (to allow a stab connection) they are retained in the structure and are readily accessible for use should a plug-in unit be removed from the MCC.

C. Barriers shall be provided in the vertical structure and unit designs to prevent the contact of any energized bus or terminal by a fishtape inserted through the conduit or wireway areas.

2.7. BUSSING

A. All bussing and connectors shall be tin-plated copper.

B. The main horizontal bus shall be rated as indicated on plans and shall extend the full length of the MCC. Bus ratings shall be based on 65° C maximum temperature rise in a 40° C ambient. Provisions shall be provided for splicing additional sections onto either end of the MCC.

C. The horizontal bus splice bars shall be pre-assembled into a captive bus stack. This bus stack is installed into the end of the MCC power bus to allow the installation of additional sections. The main bus splice shall utilize four bolts, two on each side of the bus split, for each phase. Additional bolts shall not be required when splicing higher amperage bus. The splice bolts shall secure to self clenching nuts installed in the bus assembly. It shall be possible to maintain any bus connection with a single tool.

D. A neutral bus and/or neutral lugs (with amperage rating equal to that of the main horizontal bus) shall be provided for all 4-wire motor control centers.

E. Each section that accepts plug-in units shall be provided with a vertical bus for distributing power from the main bus to the individual plug-in starter units. This bus shall be of copper and plating as the main bus, and shall be rated 300 A or 600 A continuous based on UL standards (and the associated loads connected to the bus). The vertical bus shall be connected directly to the horizontal bus stack without the use of risers or other intervening connectors. It shall be possible to maintain the vertical to horizontal bus connection with a single tool. "Nut and bolt" bus connections to the power bus shall not be permitted. When a back-to-back unit arrangement is utilized, separate vertical bus shall be provided for both the front and rear units.

F. A tin-plated copper ground bus shall be provided that runs the entire length of the MCC. The ground bus shall be rated for 25% (minimum) of the main horizontal bus amperage. Compression lugs shall be provided in the MCC for a ground cable, sized to accommodate the grounding connections shown on plans. The ground bus shall be provided with six (6) holes for each vertical section to accept customer-supplied ground lugs for any loads requiring a ground conductor.

G. Each vertical section shall have a tin-plated copper vertical ground bus that is connected to the horizontal ground bus. This vertical ground bus shall be installed so that the plug-in units engage the ground bus prior to engagement of the power stabs and shall disengage only after the power stabs are disconnected upon removal of the plug-in unit.

H. The system shall be rated for an available short circuit capacity as indicated on plans. When a power distribution system electrical study (including short circuit stud, etc.) is a part of the project, contractor shall further verify that all proposed equipment is properly rated (per the results of the study) prior to submitting shop drawings. Interrupting ratings shall be full ratings. Series ratings will not be allowed unless specifically shown otherwise on drawings.

2.8. TYPICAL UNIT CONSTRUCTION

A. Units with circuit breaker disconnects through 400 A frame, and fusible switch disconnects through 400 A, shall connect to the vertical bus through a spring reinforced stab-on connector. Units with larger disconnects shall be connected directly to the main horizontal bus with appropriately sized cable or riser bus.

B. All circuit breakers rated (or able to be adjusted to) 1200A or higher shall be electronic trip and shall be provided with arc energy-reducing maintenance switching (with local status indicator) to reduce arc flash energy per NEC 240.87 requirements.

C. All circuit breakers shall have adjustable magnetic trip settings. Provide a field adjustable breaker to allow for one breaker for each NEMA size starter. The adjustment range shall include current range to encompass the entire range of each size starter. There shall also be adjustments to select either standard or high inrush magnetic settings, from 6 times to 13 times motor full load current. If a standard, non adjustable, magnetic only trip breaker is furnished for a combination starter unit, the manufacturer shall include in the bid cost to furnish and install replacement breakers at jobsite if equipment changes dictate.

D. All conducting parts on the line side of the unit disconnect shall be shrouded by a suitable insulating material to prevent accidental contact with those parts.

E. Unit mounting shelves shall include hanger brackets to support the unit weight during installation and removal. All plug-on units shall use a twin-handle camming lever located at the top of the bucket to rack in and out the plug-on unit. The cam lever shall work in conjunction with the hanger brackets to ensure positive stab alignment.

F. A lever handle operator shall be provided on each disconnect. With the unit stabs engaged onto the vertical phase bus and the unit door closed, the handle mechanism shall allow complete ON/OFF control of the unit. All circuit breaker operators shall include a separate TRIPPED position to clearly indicate a circuit breaker trip condition. It shall be possible to reset a tripped circuit breaker without opening the control unit door. Clear indication of disconnect status shall be provided, by adhering to the following operator handle positions:
   1. Handle "On" position shall be up or to the left and within 45 degrees of being parallel to the face of the equipment.
   2. Handle "Off" position shall be down or to the right and within 45 degrees of being parallel to the face of the equipment.
   3. The minimum separation between the "On" and "Off" positions shall be 90 degrees.
   4. On Circuit Breaker disconnects, the handle "Tripped" position shall be perpendicular to the face of the equipment +/- 30 degrees. Minimum separation between "On" and "Tripped" shall be 30 degrees. Minimum separation between "Tripped" and "Off" shall be 45 degrees.

G. A mechanical interlock shall prevent the operator from opening the unit door when the disconnect is in the ON position. Another mechanical interlock shall prevent the operator from placing the disconnect in the ON position while the unit door is open. It shall be possible for authorized personnel to defeat these interlocks.

H. A non-defeatable interlock shall be provided to prevent installing or removing a plug-in unit unless the disconnect is in the OFF position.

I. The plug-in unit shall have a grounded stab-on connector which engages the vertical ground bus prior to, and releases after, the power bus stab-on connectors.

J. Provisions shall be provided for locking all disconnects in the OFF position with up to three padlocks.

K. Handle mechanisms shall be located on the left side to encourage operators to stand to the left of the unit being switched.

L. Unit construction shall combine with the vertical wireway isolation barrier to provide a fully compartmentalized design.

M. All unit doors shall be hinged and shall be held shut by captive hardware.

N. Interiors of all units shall be painted white.

2.9. COMPONENTS FOR TYPICAL UNITS

A. Circuit Breakers
   1. Where the highest continuous current trip setting for which the actual overcurrent device installed in a circuit breaker is rated (or can be adjusted to is 1200A or

higher, breakers shall be electronic trip and shall be provided with arc energy-reducing maintenance switching (with local status indicator) to reduce arc flash energy per NEC 240.87 requirements.

2. Circuit breakers shall be quick-make and quick-break, whether actuated automatically or manually. Circuit breakers shall have inverse time tripping characteristics with automatic release which shall trip free of the handle. Circuit breaker handles shall be three distinct positions—"OFF", "ON", and "TRIPPED". When a circuit breaker opens on overload or short circuit, the operating handle shall automatically assume the "TRIPPED" position.

B. Combination Starters

1. All combination starters shall utilize a unit. Magnetic starters shall be furnished in all combination starter units unless specifically shown otherwise. All starters shall utilize full NEMA/EEMAC rated contactors (size 1 minimum).
2. Starters shall be provided with a three-pole, external (door mounted) manual reset, solid state overload relay . Solid state overload relay shall have switch-selectable trip class and shall provide protection from:
   a. Overload.
   b. Phase Unbalance.
   c. Phase Loss.
   d. Ground Fault (Class II detection).
3. Unless specifically shown otherwise, each combination starter shall be furnished with a control circuit transformer including two primary protection fuses and one secondary fuse (in the non-ground secondary conductor). The transformer shall be sized to accommodate the contactor(s) and all connected control circuit loads (including motor space heaters and other similar loads where specified). The transformer rating shall be fully visible from the front when the unit door is opened. Unless otherwise indicated, control voltage shall be 120V AC. Control power shall be provided by individual unit control power transformers.
4. When a unit control circuit transformer is not provided, the disconnect shall include an electrical interlock for disconnection of externally powered control circuits.
5. Auxiliary control circuit interlocks shall be provided where indicated. Auxiliary interlocks shall be field convertible to normally open or normally closed operation.
6. NEMA/EEMAC Size 1-4 starters shall be mounted directly adjacent to the wireway so that power wiring (motor leads) shall connect directly to the starter terminals without the use of interposing terminals. Larger starters shall be arranged so that power wiring may exit through the bottom of the starter cubical without entering the vertical wireway.
7. Each starter shall be equipped with a minimum of the following control devices:
   a. Door-mounted reset button.
   b. Two (2) field-reversible (N.O./N.C.) auxiliary contacts
   c. For reversing and two-speed starters: Four (4) field-reversible (N.O./N.C.) auxiliary contacts
   d. Additional control devices as indicated on plans.

C. Terminal Blocks

1. Wiring within all units shall be type B, with unit-mounted control terminal blocks for each field wire.
2. Terminal blocks shall be the pull-apart type 600 volt and rated at 25 amps. All current carrying parts shall be tin plated. Terminals shall be accessible from inside the unit when the unit door is opened. Terminal blocks shall be DIN rail

mounted with the stationary portion of the block secured to the unit bottom plate. The stationary portion shall be used for factory connections, and shall remain attached to the unit when removed. The terminals used for field connections shall face forward so they can be wired without removing the unit or any of its components.

D. Nameplates
1. Each unit shall be properly labeled with an engraved phenolic nameplate with a white background and black letters.
2. Each pilot device shall be properly labeled with a legend plate or an engraved phenolic nameplate.

E. Wiring
1. All wiring shall be identified on each end with hot stamped or shrink tube type permanent wire markers to correspond with numbering shown on wiring diagrams.

F. Wiring Diagram
1. A job-specific, custom wiring diagram for each unit shall be provided to the contractor prior to installation for making the appropriate electrical connections. The wiring diagram shall clearly show all control components connected to each unit (whether the components are mounted internal or external to the soft start enclosure). All wires and terminal blocks shall be clearly labeled. A laminated copy of the final wiring diagram for each unit shall be installed inside the door of the associated unit.

G. Control Components:
1. All pushbuttons, pilot lights, selector switches and other control devices shall be separate, standard size (full 30mm) and shape, heavy duty oil-tight units.
2. All pilot lights to be cluster LED type & push to test.
3. Relays:
   a. Control relays shall have the following characteristics, unless noted otherwise:
      1) General purpose, plug-in type.
      2) Minimum mechanical life of 10 million operations.
      3) Coil voltage as indicated or required by application.
      4) Single-break contacts rated 12 amperes, resistive at 240 volts.
      5) Contacts as shown on wiring diagrams plus a minimum of one (1) spare N.O. contact and one (1) spare N.C. contact. At a minimum, each individual relay shall have 3PDT contacts. Where required, multiple control relays shall be provided (to provide the required quantities of contacts) for each “relay” function shown on plans/diagrams.
      6) Furnished with RC transient suppressor to suppress coil-generated transients to 200% of peak voltage.
      7) LED on/off indicator light and manual operator.
      8) Industry standard wiring and pin terminal arrangements.
      9) Equal to Square D 8501KP series with matching plug-in socket.
   b. Interposing/isolation relays used to isolate input/output field wiring from PLC inputs/outputs shall be terminal-block style. Terminal-block style relays shall have the following characteristics, unless noted otherwise:
      1) Minimum mechanical life of 10 million operations.

2) Single-break contacts rated 6 amperes, resistive at 120 volts.
3) One (1) N.O. contact per relay.
4) Furnished with integral transient protection.
5) LED on/off indicator light.
6) DIN-rail mounted.
7) Equal to Square D type Zelio RSL.

c. Timer relays shall be electronic, adjustable plug-in devices meeting the following characteristics, unless noted otherwise:
1) General purpose, plug-in type.
2) Minimum mechanical life of 10 million operations.
3) Single-break contacts rated 10 amperes, resistive at 240 volts.
4) Contacts as shown on wiring diagrams plus a minimum of one (1) spare N.O. contact and one (1) spare N.C. contact. At a minimum, each relay shall have DPDT contacts (2 N.O. & 2N.C.). Where required, multiple timer or control relays shall be provided (to provide the required quantities of contacts) for each “relay” function shown on plans/diagrams.
5) Rotary-thumbwheel adjustments for time value, timing range and function.
6) Time value adjustments from .05 seconds to 999 hours
7) Selectable Timing Functions, including the following:
(a) On Delay
(b) Interval
(c) Off Delay
(d) One Shot
(e) Repeat Cycle-Off
(f) Repeat Cycle-On
(g) On/Off Delay
(h) One Shot Falling Edge
(i) Watchdog
(j) Trigger On Delay
8) Accuracy shall be $\pm$ 2% and repeatability shall be $\pm$ 0.1%.
9) Furnished with integral transient protection.
10) LED indicator light(s) for “timing” and “on/off status”
11) Held in place with hold-down spring
12) Equal to Square D type JCK with matching plug-in socket.

2.10. QUALITY CONTROL

A. The entire MCC shall go through a quality inspection before shipment. This inspection shall include:
1. Physical Inspection of:
a. Structure.
b. Electrical conductors, including:
1) bussing.
2) general wiring.
3) units.
2. Electrical Tests
a. General electrical tests include:
1) power circuit phasing.
2) control circuit wiring.
3) instrument transformers.

4) meters.
5) ground fault system.
6) device electrical operation.

b. AC dielectric tests shall be performed on the power circuit.

3. Markings/Labels, include:
   a. instructional type.
   b. Underwriters Laboratory (UL)/Canadian Standards Association (CSA).
   c. inspector's stamps.
4. The manufacturer shall use integral quality control checks throughout the manufacturing process to ensure that the MCC meets operating specifications.

B. The motor control center design shall be in accordance with the latest applicable standards of NEMA and Underwriters Laboratories.

2.11. SPECIAL REQUIREMENTS

A. Where the schedules and diagrams show deviations from these Specifications, the schedules and diagrams shall take precedence, but only for the particular feature.

PART 3 - EXECUTION

3.1. PACKING/SHIPPING

A. The MCC shall be separated into shipping blocks no more than three vertical sections each. Shipping blocks shall be shipped on their sides to permit easier handling at the jobsite. Each shipping block shall include a removable lifting angle, which shall allow an easy means of attaching an overhead crane or other suitable lifting equipment.

3.2. STORAGE

A. If the MCC cannot be placed into service reasonably soon after its receipt, store it in a clean, dry and ventilated building free from temperature extremes. Acceptable storage temperatures shall be determined by the manufacturer. Anti-condensation space heaters shall be provided during equipment storage as directed by the manufacturer.

3.3. LOCATION

A. Motor control centers shall not be placed in hazardous locations. The area chosen shall be well ventilated and totally free from humidity, dust and dirt. Where the minimum temperature of the area is less than 0° C (32° F), space heaters shall be provided within the motor control center. Where the minimum temperature of the area is greater than 40° C (104° F) ventilation fans and/or air conditioning units shall be provided within the motor control center as required to provide adequate cooling for each unit. For indoor locations, protection shall be provided to prevent moisture entering the enclosure .

B. Motor control centers shall be located in an area with a minimum of 4 ft (1219 mm) of free space in front of front-of-board construction. This free space shall give adequate room to remove and install units. A minimum of 0.5 in (13 mm) space should be provided between the back of front-of-board MCCs and a wall, 6 in (152 mm) required for damp locations.

C. The MCCs shall be assembled in the factory on a smooth level surface so that all sections are properly aligned. A similar smooth and level surface shall be provided for installation. An uneven foundation will cause misalignment of shipping blocks, units, and doors. The surface under a MCC shall be of a non-combustible material unless bottom plates are installed in each vertical section.

3.4. INSTALLATION

A. Motor control centers shall be installed on six inch thick concrete pads unless specifically shown otherwise. Pad shall extend a minimum of four inches to all sides and shall have beveled edges.

B. Orientation of motor control centers shall be as shown on the Engineer's drawings. Space requirements are critical on this project and therefore special care shall be taken to insure that equipment will fit in the designated space. To insure proper coordination, the MCC manufacturer shall submit with shop drawings a 1/2"=1'-0" scale floor plan of each electrical room showing all columns, doors, walls and proposed equipment. Manufacturer shall not bid equipment that will not fit in available space.

C. All motor control center dimensions and clearances shall be carefully checked and coordinated with the proper trades to insure proper mounting space and support prior to roughing in equipment.

D. Motor control centers shall be grounded in two places as specified on drawings.

E. Verify all accessories as shown on drawings. Perform all necessary additions and modifications to make the motor control center to the Engineer's drawings.

F. A job-specific, custom wiring diagram for each unit shall be provided to the contractor prior to installation for making the appropriate electrical connections. The wiring diagram shall clearly show all control components connected to each unit (whether the components are mounted internal or external to the soft start enclosure). All wires and terminal blocks shall be clearly labeled. A laminated copy of the final wiring diagram for each unit shall be installed inside the door of the associated unit.

G. Operations and Maintenance Manuals and a listing of the nearest and most convenient source of replacement parts and service shall be provided to the owner for all MCC components, control wiring, etc.

H. Operations and Maintenance Manuals shall include hardcopy printouts of all device settings and programming.

I. For safety, reliability, and continuity of warranty, any modifications, alterations, etc. required to conform to the requirements of this specification shall be performed by the MCC manufacturer only. Distributor modifications, third party packaging, etc. of a manufacturer's standard product are specifically disallowed.

J. Services shall include a minimum of eight (8) hours of field/classroom training for owner's personnel on routine operation and maintenance of the specified units.

3.5. SPARE PARTS

A. The following spare parts shall be provided at no extra cost to the Owner:
   1. One of each type and size of control fuse.

END OF SECTION 26 24 19

GEOTECHNICAL ENGINEERING STUDY
Quarry Water Treatment Plant Expansion
Huntsville, Alabama
Project No: 0229
April 7, 2021

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Geotechnical Testing & Environmental Consultants

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April 7, 2021

Madison Utilities
Dunlop Boulevard Southwest
Madison, Alabama

ATTN: Mr. Jason Leggett, P.E.

SUBJECT: Report for Geotechnical Engineering Study
Quarry Water Treatment Plant Expansion
Madison, Alabama
GTEC Job No. 0229

Ladies & Gentlemen:

GTEC has completed the geotechnical engineering study for the above referenced project. We provided our services in accordance with our Proposal 0229-P, dated March 15, 2021, and authorized by Mr. Emory DeBord on March 16, 2021. The purpose of our services was to explore the subsurface soil conditions and groundwater level, and provide foundation, and site preparation recommendations. This report presents our understanding of the project, the results of the field exploration and laboratory testing, and discusses our conclusions and recommendations. After you have reviewed our report, we recommend a telephone call to discuss our recommendations.

GTEC thanks you for the opportunity to serve you and looks forward to continued involvement on this project and future projects. Please contact the project personnel below with questions concerning this project.

Respectfully submitted,

GTEC,

Anna R. Yarbrough, E.I.
Staff Engineer

ALABAMA LICENSED No. 29582 PROFESSIONAL ENGINEER JEREMY CALVIN JESS

Jeremy C. Jess, P.E.
Principal Engineer

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Boring Location Map
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1.0 EXECUTIVE SUMMARY

GTEC has completed subsurface studies for the proposed Quarry Water Treatment Plant Expansion. This expansion project includes construction of a proposed finished water pumping station including two new clearwells to the north, and a new filter building after demolishing the existing clearwell to the south.

The on-site soils are suitable for support of proposed clearwell provided the specific recommendations and considerations within this report are followed and understood. It appears that the onsite soils from the clearwell excavation are suitable for use as structural fill; however, the deeper soils at the site should only be used in deep fill lifts greater than 5-ft and non-structural areas. Bedrock is not expected to be encountered by excavators in the new clearwell area, but dense chert layers may be encountered.

GTEC recommends demolishing the existing clearwell and finished water pump station to a depth of 10-ft, relocating all underground piping, and undercutting the area to 10-ft. once complete the remaining depth of the clearwell will need to be backfilled with No. 57 stone under the supervision of GTEC. From the undercut and demolition depth of 10-ft below current grade GTEC recommends covering the area with a geotextile fabric and then filling with structural fill. The demolition of the existing clearwell is next to an existing filter building. To protect existing foundations, the excavation should not be within an imaginary 1:1 slope down and away from the building foundation. Once backfilling is complete the area should rest for 30 days before excavating the filter building foundations. The new foundations should be typical shallow foundations bearing in the new fill. Specific recommendations for foundation design and site earthwork are given in the body of this report.

2.0 INTRODUCTION

GTEC has completed a geotechnical engineering study for the planned expansion to the Quarry Water Treatment Plant on Dunlop Boulevard Southwest in Madison, Alabama. This work was authorized on March 16, 2021 by Mr. Emory DeBord, General Manager, of Madison Utilities.

The purposes of this study were to:

1) Explore the general nature of the subsurface conditions based on soil test across the site:

2) Provide a professional opinion regarding the suitability of the site for the intended construction;

3) Provide foundation design information and guidelines; and

4) Identify likely foundation construction or site development problems.

This report outlines the services provided, describes the surface and subsurface conditions and the site geology, and addresses the items listed above.

Assessment of the environmental aspects of this site, including previous land use or the determination of the presence of any chemical, industrial, or hazardous waste is beyond the scope of this study.

3.0 EXPLORATION METHODS

Subsurface conditions at the site of development were investigated by drilling soil test borings. Locations for the borings are shown in the appendices on Drawing 0229-1. The borings were advanced using a track-mounted drilling rig with hollow stem continuous flight augers. Samples of the soils were taken using a split spoon sampler which was driven into the soil by dropping a 140-pound hammer through a free fall of 30 inches (ASTM D1586). The split spoon sampler captures

soils to facilitate subsequent laboratory soils testing. The procedure to drive the split spoon sampler 18 inches into the soil, and to record the number of blows required to drive the sampler each 6-inch increment, is known as a standard penetration test (SPT). The number of blows required for the sampler to penetrate the final 12 inches ("N" value) gives an indication of the consistency or relative density of the soils found.

The unconfined compressive strength (Qp) of cohesive soil samples was measured in the field with a calibrated pocket penetrometer. This test involved pushing a spring-loaded piston, 0.25 inches in diameter, into an SPT sample and measuring the spring deflection, which has been correlated to unconfined compressive strength. Results of the SPT tests, Qp tests, and sampling locations in each boring is recorded by a GTEC field engineer and are presented in the appended Logs of Borings. The logs contain information concerning the boring method, dates, sample depths, and descriptions of the soils and other characteristics encountered during drilling. The field engineer classified the soil in general accordance with ASTM D2488, which utilizes the Unified Soil Classification System (USCS, as per ASTM D2487), and prepared the final Log of Borings that were the basis for engineering evaluation and recommendations. The group symbol for each soil type is indicated in the Log of Borings. The final boring logs represent GTEC's interpretation of the contents of the field logs based on the results of the engineering review and laboratory testing of the field samples. Borings were backfilled two days later with auger cuttings.

4.0 SITE CONDITIONS

The subject expansion area for the proposed two clearwells and finished water pumping station is north of the existing filter building; the subject expansion area for the proposed new filter building is to the south of the existing filter building at the plant on Dunlop Boulevard. The expansion area for the proposed clearwells and finished water pumping station is very flat (Photograph 1), the expansion area for the proposed filter building is currently occupied by an existing finished water pump station and clearwell (Photograph 2). An asphalt-paved service driveway is along the perimeter of the property and passes between the existing filter building and the location of the

proposed two clearwells and finished water pumping station. The pre-treatment basin to the north is still in service. Some settlement cracking was evident on the brick of the existing finished water pump station (Photograph 3).

PHOTOGRAPH 1

Description: Viewing south toward proposed location of Finished Water Pumping Station and Clearwells

PHOTOGRAPH 2

Description: Viewing eastward toward the location of the proposed Filter Building

PHOTOGRAPH 3

Description: Viewing north of service road along east side of the Filter Building

5.0 SUBSURFACE CONDITIONS

Topsoil was encountered at the surface in each boring ranging in thickness from 3 to 10 inches. Three general clay soil layers were encountered below the topsoil. Plasticity and gravel content both increase with depth at the site. Auger refusal, interpreted to be bedrock, was encountered between 22 and 39 feet below the existing ground surface. Specific soil properties for each layer encountered are presented below along with a summary of laboratory tests data from select samples. Each of the borings had a clay layer encountered below the topsoil surface and extended on average 12 to 18 feet. The soil consisted of low plasticity, cherty sandy clay that was yellowish red in color. Standard penetration test (SPT) values in this layer ranged from 5 to 27 blows per foot (bpf) with an average of 12 bpf. Pocket penetrometer test values ranged from 2 to 4.5 tons per square foot (tsf) with an average of 3.2 tsf. Natural moisture contents ranged from 18 to 33 percent with an average of 25 percent. Borings B-1 and B-2 encountered mostly residual soils beneath the topsoil while B-3 through B-6 encountered soil and gravel fill from the construction of the plant. Borings B-2 through B-5 had layers that consisted of low plasticity, sandy silty clay that was yellowish red in color. Standard penetration test (SPT) values in this layer ranged from 6 to 9 blows per foot (bpf) with an average of 7 bpf. Pocket penetrometer test values ranged from 1.5 to 3.5 tons per square foot (tsf) with an average of 2.3 tsf. Natural moisture contents ranged from 17 to 27 percent with an average of 24 percent. The following table is a summary of the Atterberg limit tests performed on soil samples from this layer.

Boring Number	Sample Depth (feet)	Water Content (%)	Plastic Limit	Liquid Limit
B-1	3.5 to 5.0	31	34	49
B-2	1.5 to 3.0	24	27	40
B-2	8.5 to 10.0	25	36	49

Below the aforementioned low plastic clay soils, we encountered soils that consisted of high plasticity, cherty sandy clay that was yellowish red in color and extended on average 12 to 24 feet below topsoil. SPT values in this layer ranged from 8 to 73 bpf with an average of 19 bpf. Pocket

penetrometer test values ranged from 1.5 to 4.5 tsf with an average of 3.0 tsf. Natural moisture contents ranged from 17 to 47 percent with an average of 30 percent. Borings B-4 and B-5 had layers that consisted of high plasticity, sandy silty clay that was yellowish red in color. SPT values in this layer ranged from 7 to 100+ bpf with an average of 39 bpf. Pocket penetrometer test values ranged from 1.25 to 4.5 tsf with an average of 3.0 tsf. Natural moisture contents ranged from 19 to 27 percent with an average of 23 percent. The following table is a summary of the Atterberg limit tests performed on soil samples from this layer.

Boring Number	Sample Depth (feet)	Water Content (%)	Plastic Limit	Liquid Limit
B-1	8.5 to 10.0	23	42	58

Borings B-2 and B-4 had a layer that consisted of gravelly cherty clay encountered between 22 and 24 feet below topsoil and extended until auger refusal between 35 and 39 feet, that was gray and yellowish red in color. Standard penetration test (SPT) values in this layer ranged from 7 to 36 blows per foot (bpf) with an average of 21 bpf. Pocket penetrometer test values were difficult to obtain due to the gravel sized chert, however a penetrometer value of 3.0 tons per square foot (tsf) was gathered. Natural moisture contents ranged from 14 to 33 percent with an average of 26 percent. Boring B-1 encountered a dense chert layer at 24 feet below topsoil that extended 4 feet. After the dense chert layer we encountered a layer of low plasticity cherty clay that was mottled black and tan in color. SPT values in this layer ranged from 15 to 27 bpf with an average of 21 bpf. The pocket penetrometer test value from this layer was 4.5 tsf. Natural moisture contents was 25 percent.

Auger refusal was encountered between 22-ft and 39-ft below the surface. Groundwater was encountered between 22 and 30 feet below the surface during drilling. Because of the geology of this region, the groundwater levels are generally a function of seasonal precipitation and locally heavy rainfall events. Consequently, the groundwater levels can and do fluctuate with time.

6.0 SITE GEOLOGY

Published information indicates the subject site is underlain by the Fort-Payne Chert. According to the United States Geological Survey, the Fort-Payne Chert consists of very light to light-olive-gray, thin to thick-bedded, fine to coarse-grained bioclastic (abundant pelmatozoans) limestone containing abundant nodules, lenses and beds of light to dark-grey chert. The upper part of the formation locally consists of light-bluish-gray laminated siltstone containing vugs lined or filled with quartz and scattered throughout the formation are interbeds of medium to greenish-gray shale, shaly limestone and siltstone.

7.0 PROPOSED CONSTRUCTION

Currently, GTEC, LLC understands that Madison Utilities has proposed an expansion to the Quarry Water Treatment Plant on Dunlop Boulevard Southwest in Madison, Alabama. This project includes constructing a 17,296 square-foot finished water pumping station including 2 new clearwells has been proposed to the north of the existing filter building. The proposed clearwell consists of cast-in-place concrete walls bearing 34 feet below current grade. We expect pumping equipment and water within the finished water pumping station and clearwells to apply 2000 pounds per square foot upon the mat foundation and the wall loads to be less than 4 kips per linear foot.

This project also includes constructing a new 10,290 square-foot filter building by demolishing and back filling the current clearwell to the south of the existing filter building. The proposed filter building consists of a pre-engineered metal building and will have a finished floor elevation near the existing grade. The existing clearwell currently bear about 20-ft below the existing grade, so demolishing the walls and backfilling the structure to near the current grade is planned. We expect wall loads to be less than 2 kips per linear foot, and the column loads to be less than 100 kips, atop a shallow foundation. Filters will be relocated from an existing water plant into the proposed filter building supported by a mat foundation. OMI Geotechnical Engineering Study

7339 dated September 17, 2015 was provided by Madison Utilities for additional subsurface information.

8.0 BASIS FOR RECOMMENDATIONS

The following recommendations are based on the subsurface data, and experience with similar geologic environments. Because the structural elements of the design greatly influence the design recommendations, GTEC must be provided the opportunity to review the following comments and recommendations if locations, elevations, and loadings differ from what is described in the project information. Our recommendations for the proposed development are based on data presented in this report, which includes soil borings spaced across the project site. However, subsurface variations can exist within the spacings at a site which may not be indicated by the boring and laboratory soils testing programs. If such variations or unexpected conditions are encountered in the future, or if the project information is incorrect or changed, we should be informed immediately since the validity of our recommendations may be affected.

9.0 DESIGN RECOMMENDATIONS

This section includes recommendations for the design of the Quarry Water Treatment Plant Expansion in two areas onsite. The project will begin with a new finished water pumping station including two new clearwells to the north of the existing filter building. The foundations will bear on residual soils, and the wall will retain earth to the exterior and contain varying levels of water on the interior. Once the new finished water pumping station and new clearwells are complete the old clearwell will be taken out of commission and demolition will begin. The below grade clearwell will be backfilled, and then the new pre-engineered metal building housing the filters will be constructed on the fill. The new building will bear on shallow spread footings and a mat foundation will support the filter equipment.

GTEC recommends the schedule include the finished Filter Building pad be allowed to rest for 30 days after completed earthwork prior to pouring the first foundations to allow a portion of the settlement to occur prior to setting the column anchor bolts.

The following subsections will describe our recommendations for each step of the planned construction.

9.1 Earthworks Recommendations

This section will describe the topsoil removal, demolition recommendations, and fill specifications for the proposed finished water pumping station and clearwells.

9.1.1 Topsoil

Topsoil and unsuitable soils removal should extend at least five feet beyond structure and pavement limits. Topsoil thicknesses among our borings ranged from 3 to 10 inches, so we recommend an average of 7 inches of stripping for the project.

9.1.2 Demolition of Existing Structures

The area of the new filter building has the old clearwell, old finished water pump station, existing underground piping, and connection vaults. These items should be vacated and demolished. GTEC recommends cutting the area to elevation 613, which is about 10-ft below the existing grade. This cut will remove the majority of the existing piping, vaults, clearwell backfill, and pump station backfill. The clearwell and pump station walls should be demolished to this elevation, disposed offsite. We recommend drilling vent holes with 2-inch diameter and 5-foot center pattern in the slab to remediate buoyancy and water pressure with fluctuating ground water levels. Then the interior of the wells should be backfilled with No. 57 stone. The stone backfill should be placed and compacted as outlined in the next subsection.

GTEC understands that one existing pipeline in the northeast corner of the proposed filter building is needed to remain. GTEC recommends a sleeve to allow differential movement

between the pipe and the new foundations. Other underground utility lines should be relocated or capped off outside the construction area. Any abandoned utility pipes should be filled-in under pressure with cement grout with a minimum 28-day compressive strength of 500 pounds per square inch (psi).

GTEC recommends that demolition and excavations should stop when encroaching on structures that will be retained. An encroachment is an excavation within an imaginary plane extending 1(H):1(V) down and away from the retained building foundation. Shoring may be required if additional soils judged by GTEC to be unsuitable are present beyond the imaginary 1:1 line.

9.1.3 Stone Backfill for proposed Filter Building

Upon completion of required demolition to the existing clearwell and pump station, and appropriate vent holes have been drilled. GTEC recommends utilizing No. 57 stone to fill the wells to the top of the remaining walls at elevations 613-ft. Stone backfill should be densified under the supervision of GTEC. The observation of the construction process for backfill should be performed on a full-time basis to ensure adequate consolidation of the stone and proper compaction of the soil backfill. Each 6-to-8-inch layer should be densified with vibratory compaction. The number of passes is dependent on the layer thickness and the weight of the equipment. We recommend using a self-propelled compactor such as a 1-ton, twin-drum Ramex (or similar). The Geotechnical Engineer should observe placement of the first few lifts to assist in determining the approximate number of compactor passes which appear to accomplish adequate compaction. In areas not accessible to the Ramex compactor, hand compaction equipment such as vibra-plates, should be used. If hand operated equipment is used, then thinner 4 to 6-inch lifts will be required. The maximum lift thickness in these areas should not exceed 6-inches. Heavy equipment may damage the well walls if allowed within 5 feet of the walls. Upon appropriate compaction of stone backfill, we recommend using a geotextile fabric with filter properties such as Mirafi® 135N before continuing with the overlying soil fill layer. Structural soil fill specifications have been outlined in the following section.

9.1.4 Structural Fill

These structural fill requirements are applicable for both the finished water pumping station and clearwells as well as the filter building. Structural fill is defined as inorganic natural soil free of deleterious materials and debris. Structural fill should have a maximum particle size of 3 inches or less, and a maximum dry density of at least 95 pounds per cubic foot (pcf) when tested by the standard Proctor method (ASTM D-698). The material should have a liquid limit no higher than 50, and plasticity index no higher than 30. Soil fill for building and pavement areas should be placed in relatively thin (8-inch or less) layers and compacted to a minimum of 98 percent of the soil's maximum dry density as determined by the soil's standard Proctor moisture-density relationship test.

9.2 Foundations Design

This section will illustrate the foundation design requirements for the proposed filter building and the proposed finished water pumping station and clearwells.

9.2.1 Finished Water Pumping Station and Clearwells Foundations Design

Provided the project site is prepared as recommended, the proposed structures may be supported on their mats and perimeter walls bearing on a densified crushed stone layer over lying residual soils. Based on the preliminary structural plans, we recommend that foundations may be designed for a maximum allowable bearing pressure of up to 2,000 pounds per square foot (psf).

9.2.2 Filter Building Foundations Design

Once the building pad is complete and the fill has rested for 30 days construction of the foundations as outline below may begin. Based on an anticipated structural column load of 100 kips, the recommended fill placement, and the subsurface conditions encountered in our test borings; we recommend that shallow foundations bearing within the fill be designed for a maximum allowable bearing pressure of up to 3,000 pounds per square foot (psf). Continuous wall foundations should have a minimum width of 18 inches and column foundations should have a minimum width of 24 inches**.** Foundations should bear at a depth of at least 18 inches below the finish exterior site grades

to lessen the potential for damage from seasonal moisture variation and for bearing capacity considerations. Based on the boring data, assumed structural loading, and provided the site is prepared as recommended, we estimate total foundation settlements would be less than 1-inch, with differential settlement of 1/2 of the estimated total settlement.

9.3 Site Seismic Category

Based on the field boring data and the requirements of the International Building Code (IBC) Section 1613, the site of finished water pumping station and clearwells meets the requirements of a Site Class C; the site of filter building meets the requirements of a Site Class D. The IBC contains a provision for using other design values, if a site-specific assessment is conducted. GTEC can provide these services, if requested.

9.4 Slabs on Grade

Concrete slabs not structurally supported as part of the building may be placed on properly compacted controlled structural fill over an approved soil subgrade following subgrade preparation as discussed in Section 6. A standard modulus of subgrade reaction ("k") of 115 pounds per square inch per inch (psi/in) may be used for the design of the slabs-on-grade. Slabs should be structurally isolated (float freely) from the foundations to allow for differential movement between the slabs and the structure. A four-inch thick layer of open-graded coarse aggregate such as No. 57 or No. 67 should be placed beneath the floor slab. This granular base would function as a leveling and load distributing material as well as a capillary break beneath the slab. A vapor retarder should be used beneath slabs that will be covered by tile, wood, carpet, impermeable coatings, or if other moisture-sensitive equipment or materials will be in contact with the slab. However, the use of vapor retarders may result in excessive curling of concrete slabs during curing. We refer the concrete slab designer to ACI 302.1R-04, Sections 4.1.5 and 11.11, for further discussion on vapor retarders, curling, and the means to lessen potential concrete shrinkage and curling.

Proper jointing of the concrete slabs-on-grade can reduce cracking. ACI suggests that unreinforced, plain concrete slabs may be jointed at spacing of 24 to 36 times the slab thickness, up to a maximum spacing of 15 feet. Slab construction should incorporate isolation joints along walls and column locations to allow minor movements to occur without damage. Utility or other construction excavations in the prepared subgrade should be backfilled to a controlled fill criterion to provide uniform support.

9.5 Clearwell - Below Grade Walls

Permanent below grade walls planned for the structures should be designed to resist at-rest earth pressures. Earth pressures on the walls will be a function of the excavation shape and the extent to which the retained soil can be replaced by granular material below the water table as described below. We have assumed drainage cannot be provided; therefore the wall design will also need to include hydrostatic pressures. We recommend designs consider a seasonal high groundwater level of about 20 feet below the ground surface. Surcharge loads have not been factored into the lateral earth pressure parameters presented below. The fill material used behind the walls should be reviewed and approved by the Geotechnical Engineer prior to their placement. The following earth pressure coefficients are recommended for below grade wall. Once the structural design is complete the backfill material requirement must be outlined in the structural plans. Using a 1 horizontal to 1 vertical (1H:1V) wedge of select material can significantly reduce the horizontal loads on the wall. The following earth pressure coefficients are recommended for below grade wall design if select washed aggregate is used.

Below Grade Wall Parameters		
Description	Soil USCS = CL	No. 57 Stone
At-Rest Backfill Coefficient (Equivalent Fluid Pressure)	0.66 (90 psf)	0.43 (43 psf)
Active Backfill Pressure Coefficient (Equivalent Fluid Pressure)	0.49 (61 psf)	0.27 (27 psf)
Angle of Internal Friction	20	35 degrees
Back Slope Profile	Horizontal	Horizontal
Unit Weight	125	100

To limit water infiltration behind the walls, the upper two feet of backfill should consist of select soil fill compacted to 98 percent standard Proctor and slopes should promote drainage away from the clearwell walls and into stormwater drainage systems. We recommend the structural soil fill be placed in accordance with the Earthwork Recommendations section of this report.

9.6 Pavement Thickness Recommendations for Service Driveways

Stripped and excavated pavement areas should extend at least 5 feet beyond the pavement limits. The excavated area should be evaluated by the geotechnical engineer as discussed in the Earthwork Recommendations section who may recommend undercutting prior to continuing with grading and replacement. The site is known to have trench cut for piping and utilities and these trenches must be over excavated and improved for roadbed support. A properly prepared, uniform subgrade is critical to long-term pavement life. The pavement design for the planned parking area should consider whether the pavement will be subjected to light-duty or medium-duty traffic. A light duty pavement section can be used where traffic is expected to primarily consist of autos and occasional light service vehicles. A medium-duty pavement section should be used where the traffic will also consist of occasional light and medium service vehicles.

CBR testing was not part of our scope of services for this project. Pavement designs are normally based on a design CBR (DCBR) value. A DCBR value of 4 considering subgrade improvement has

been estimated for this site. For this analysis, GTEC was not provided with traffic data. Using the assumed traffic type and the DCBR value, the following light- and medium-duty pavement sections are recommended for the project:

Asphalt Pay Item	Light Duty (inches)	Medium Duty (inches)
424A340 Superpave Bituminous Wearing Surface, 1/2" Max Agg Size, ESAL Range A/B	1	1.5
424B635 Superpave Bituminous Upper Binder, 3/4" Max Agg Size, ESAL Range A/B	2	2.5
ALDOT 825, Type B compacted to 100% ASTM D-1557, 6-inch lift	6	6

10.0 CONSTRUCTION CONSIDERATIONS

The principal purpose of this section is to comment in general on the items related to earthwork, foundation construction, and pavement placement. It is valuable that GTEC's geotechnical engineer be retained to provide soil-engineering services during the construction phases of the project. The geotechnical engineer can also assist in interpretation of differing subsurface conditions that may be encountered and recommend remedial work, if needed.

10.1 Site Preparation

The two portions of the project include the new clearwell and the filter building. The two areas are very different and preparing the site for the two structures is outline in the prior design sections with additional details within this section.

In general, the entire construction area should be stripped of grass, trees, stumps, vegetation, organic-laden soils, debris or any other deleterious materials to a minimum of 5 feet outside the structural limits for buildings and paved areas. Depressions or low areas resulting from stripping and or clearing operations should be backfilled to prevent ponding with approved structural fill

and compacted in accordance with the recommendations presented in this report. We recommend site preparation be monitored by the geotechnical engineer or their representative to verify that the recommendations presented herein are implemented.

The new Clearwell will bear about 27-ft below the existing surface. Auger refusal was encountered about 35-ft below the surface, so competent rock excavation is not anticipated. Some dense chert layers were encountered in Boring B-2 near the bearing elevation. GTEC anticipates these dense cherts layers can be excavated with typical excavators.

Prior to construction of the filter building, the existing structures, vaults, and any underground utilities should be demolished as outlined in Section 9.1.2 and removed from the construction limits. Underground utility lines should be relocated or capped off outside the construction area. All utility excavations should be backfilled with properly compacted structural fill. Any abandoned utility pipes, if left in place outside of building footprints, should be filled-in under pressure with cement grout with a minimum 28-day compressive strength of 500 pounds per square inch (psi).

Structures that are to remain should be protected from undermining while excavating. GTEC recommends excavation limits stay beyond an imaginary plane that extends 1(H):1(V) away and down from the structures' foundations. Shoring may be required if additional soils judged by GTEC to be unsuitable are present beyond the imaginary 1:1 line. The area should also be protected from erosion due to water leaks or weather events.

The final building pad for the new filter building must be allowed to rest for 30 days after final compaction testing before constructing the new foundations.

10.2 Structural Fill Placement and Compaction

Prior to fill placement, representative samples of each structural fill material should be collected and tested by GTEC to determine the material's moisture-density characteristics (including the maximum dry density, optimum water content, gradation and Atterberg limits). These tests are

needed for quality control of the structural fill and to determine if the fill material meets project specification requirements as outlined in the Earthwork Recommendations section of Chapter 9 in this report. Successful reuse of the excavated, on-site soils as compacted structural fill will depend on the water content and the plasticity of the soils encountered during excavation. Once fill placement begins, a qualified soils technician should perform field density tests to document the degree of compaction being obtained in the field. Structural fills should be placed in thin (6 to 8-inch) loose lifts and compacted to 98 percent of the soil's standard Proctor maximum dry density (ASTM Test MethodD698) at or near optimum water content: maximum deviation of ±3 percent. Some manipulation of the water content (such as wetting or drying) may be required during the filling operation to obtain the required degree of compaction. The manipulation of the water content is highly dependent on weather conditions and site drainage conditions. Therefore, the grading contractor should be prepared to both dry and wet the fill materials to obtain the specified compaction during grading. Areas where No. 57 stone backfill is specified as discusses in Chapter 9 should be observed by GTEC full-time during placement of any lifts.

10.3 Surface Water Control

If free water is allowed to stand on stable subgrade soils, these soils can absorb water, freeze, swell, and experience a reduction in their support capability. As a result, we recommend that the subgrade surface be graded to provide positive drainage away from the construction areas and towards suitable drainage handling areas, such as a perimeter ditch, French drain, culvert, or retention pond. Trapped or perched water conditions could develop during periods of inclement weather and during seasonally wet periods. Such conditions could cause seepage into excavations and deeper cuts. Therefore, grading of the project should be performed in such a manner to prevent ponding of water and promote runoff away from construction areas. If site grading is performed during the seasonally wet months or after extended periods of inclement weather, wet and water softened near surface soil conditions should be expected.

10.4 Excavations

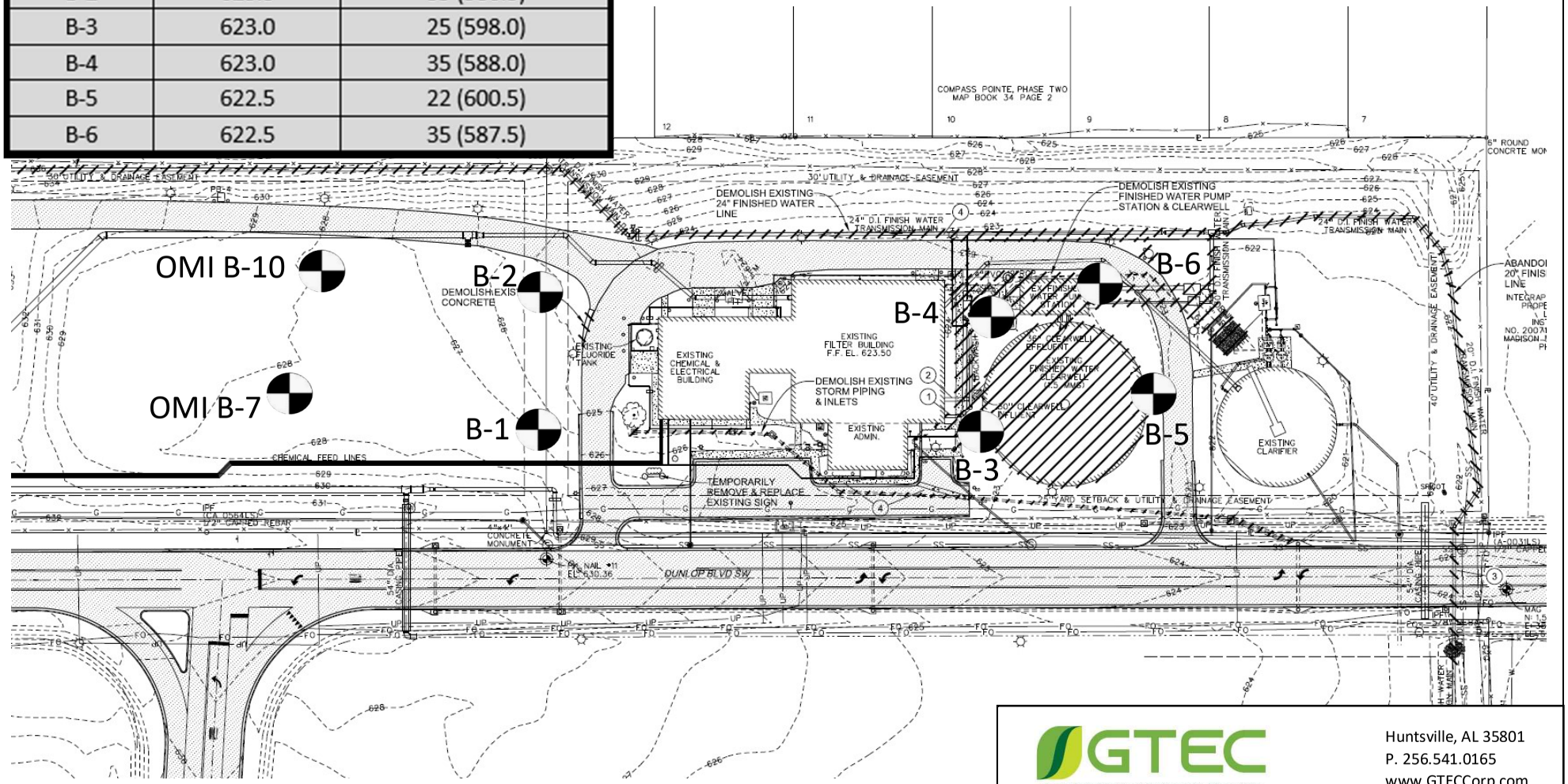
Excavations required for construction of this project must be performed in accordance with the United States Department of Labor, Occupational Safety and Health Administration (OSHA) guidelines (29 CFR 1926, Subpart P, Excavations) or other applicable jurisdictional codes for permissible temporary side-slope ratios and or shoring requirements. The OSHA guidelines require daily inspections of excavations, adjacent areas and protective systems by a "competent person" for evidence of situations that could result in caveins, indications of failure of a protective system, or other hazardous conditions. Excavated soils, equipment, building supplies, etc., should be placed away from the edges of the excavation at a distance equaling or exceeding the depth of the excavation. The contractor is responsible for providing the "competent person" and all aspects of site excavation safety.

11.0 LIMITATIONS

There are important limitations to this and all geotechnical studies. This report has been prepared for the exclusive use of the Madison Utilities, or their agents, for specific application to the proposed Quarry Water Treatment Plant Expansion project in Madison, Alabama, in accordance with generally accepted soil and geotechnical engineering practices. No other warranty, express or implied, is made. Our conclusions and recommendations are based on design information furnished to us; the data obtained from the field testing program, and generally accepted geotechnical engineering practice. The findings and recommendations do not reflect variations in subsurface conditions, which could exist in unexplored areas of the site. Regardless of the thoroughness of a subsurface exploration, there is the possibility that conditions in other areas will differ from those at the boring locations or that the construction process has altered the soil conditions. Therefore, our experienced geotechnical engineers should evaluate executed construction to verify that the conditions anticipated in design actually exist. Otherwise, we assume no responsibility for construction compliance with the design concepts, specifications, or recommendations. In the event that changes are made in the design or location of the improvements, the recommendations presented in this report shall not be considered valid

unless the changes are reviewed by our firm and conclusions of this report modified or verified in writing. If this report is copied or transmitted to a third party, it must be copied or transmitted in its entirety, including text, attachments, and enclosures. Interpretations based on only a part of this report may not be valid.

Boring Number	Boring Elevation	Auger Refusal – ft (Elevation)
OMI B-7	631.0	Terminated 40 (591)
OMI B-10	631.0	Terminated 40 (591)
B-1	627.0	33.5 (593.5)
B-2	625.5	39 (586.5)
B-3	623.0	25 (598.0)
B-4	623.0	35 (588.0)
B-5	622.5	22 (600.5)
B-6	622.5	35 (587.5)



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P. 256.541.0165
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Legend:

- Boring Location (B-X)

BORING LOCATION MAP

SCALE: N.T.S.

GTEC Project No: 0229	
Project Name: Quarry Water Treatment Plant	
Location: Madison, Alabama	
Drawn By: ARY	Date: 03-30-2021
Drawing No. 0229-1	

LOG OF BORING NO.B-1

Geotechnical Testing & Environmental Consultants

Project No.: 0229
Project Name: Quarry Water Treatment Plant Expansion
Project Location: Dunlop Blvd

Driller: South Bros.
Drill Make: CME 45-C
Hammer: Auto
Hammer Efficiency: 89%

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SPT N Value (Uncorrected)	Pp (tsf)	Water Content (Percent)	Liquid Limit	Plastic Limit	Percent Passing No. 200	Rock Core Recovery (Percent)	Rock Quality Designation	Fractures per Foot
			Elevation=627									
0			TOPSOIL	5	2.0	19						
			CHERTY SANDY CLAY, 10% gravel sized chert, 10% sand, 80% fines, low plasticity, yellowish red, firm to very stiff, moist, residuum, CL	12	3.25	25						
				9	4.0	31	49	34				
6			CHERTY SANDY CLAY, 10% sand, 15% gravel sized chert, 75% fines, high plasticity, reddish yellow, very stiff to hard, moist, residuum, CH	16	4.5	32						
				20	4.5	23	58	42				
12												
			CHERTY SANDY CLAY, 10% gravel sized chert, 10% sand, 80% fines, high plasticity, reddish yellow, very stiff, moist, residuum, CH	13	4.25	32						
18												
				15	3.5	35						
24			DENSE CHERT LAYER	15	--							
			CHERTY CLAY, 10% sand, 15% gravel sized chert, 75% fines, low plasticity, mottled black and tan, hard, moist, residuum, CL	27	4.5	25						
30												
			AUGER REFUSAL @ 33.5-ft									
36												

COMPLETION DEPTH: 33.5ft
DATE: 03-19-2021

DEPTH TO WATER INITIAL: Dry
FINAL: Dry @ 33-ft

LOG OF BORING NO.B-2

GTEC
Geotechnical Testing & Environmental Consultants

Project No.: 0229
Project Name: Quarry Water Treatment Plant Expansion
Project Location: Dunlop Blvd

Driller: South Bros.
Drill Make: CME 45-C
Hammer: Auto
Hammer Efficiency: 89%

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SPT N Value (Uncorrected)	Pp (tsf)	Water Content (Percent)	Liquid Limit	Plastic Limit	Percent Passing No. 200	Rock Core Recovery (Percent)	Rock Quality Designation	Fractures per Foot
			Elevation=625.5									
0			TOPSOIL	6	2.5	21						
			SANDY SILTY CLAY, 10% sand, 90% fines, low plasticity, red, stiff, moist, residuum, CL	6	1.5	24	40	27				
				12	3.5	25						
6			CHERTY SANDY CLAY, 10% sand, 15% gravel sized chert, 75% fines, low plasticity, yellowish red, very stiff, moist, residuum, CL	18	4.25	27						
				16	4.5	25	49	36				
12			CHERTY CLAY, 10% sand, 20% gravel sized chert, 70% fines, high plasticity, gray and yellowish red, very stiff to hard, moist, residuum, CH	22	3.0	35						
18				14	2.0	31						
24				13	1.5	36						
			CLAYEY GRAVEL, 10% sand, 20% fines, 70% gravel sized chert, white and gray, medium dense, moist, residuum GC	18	--	14						
30				7	--	21						
36			AUGER REFUSAL @ 39-ft									

COMPLETION DEPTH: 39 -ft
DATE: 03-19-2021

DEPTH TO WATER INITIAL: Dry
FINAL: Dry

LOG OF BORING NO.B-3

GTEC
Geotechnical Testing & Environmental Consultants

Project No.: 0229
Project Name: Quarry Water Treatment Plant Expansion
Project Location: Dunlop Blvd

Driller: South Bros.
Drill Make: CME 45-C
Hammer: Auto
Hammer Efficiency: 89%

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SPT N Value (Uncorrected)	Pp (tsf)	Water Content (Percent)	Liquid Limit	Plastic Limit	Percent Passing No. 200	Rock Core Recovery (Percent)	Rock Quality Designation	Fractures per Foot
0			*Elevation=623*									
			TOPSOIL	8	4.5	18						
			SANDY CLAY, 15% sand, 85% fines, low plasticity, red, stiff, moist, FILL, CL	6	3.0	26						
			CHERTY SANDY CLAY, 5% gravel sized chert, 15% sand, 80% fines, low plasticity, yellowish red, stiff, moist, FILL, CL	11	3.0	28						
6				11	2.5	20						
				7	--	23						
12												
				6	2.75	23						
18			CHERTY SANDY CLAY, 5% gravel sized chert, 15% sand, 80% fines, high plasticity, yellowish red, very stiff, moist, residuum, CH	15	3.5	25						
24				73	--	17						
			AUGER REFUSAL @ 25-ft									
30												
36												

COMPLETION DEPTH: 25 -ft
DATE: 03-19-2021

DEPTH TO WATER INITIAL: Dry
FINAL: Dry

LOG OF BORING NO.B-4

Geotechnical Testing & Environmental Consultants

Project No.: 0229
Project Name: Quarry Water Treatment Plant Expansion
Project Location: Dunlop Blvd

Driller: South Bros.
Drill Make: CM 45-C
Hammer: Auto
Hammer Efficiency: 89%

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SPT N Value (Uncorrected)	Pp (tsf)	Water Content (Percent)	Liquid Limit	Plastic Limit	Percent Passing No. 200	Rock Core Recovery (Percent)	Rock Quality Designation	Fractures per Foot
			Elevation=623									
0			TOPSOIL	6	--							
			SANDY SILTY CLAY, 15% sand, 85% fines, low plasticity, red, very stiff, moist, FILL, CL	9	3.5	26						
				10	2.5	30						
6			CHERTY SANDY CLAY, 5% gravel sized chert, 15% sand, 80% fines, low plasticity, yellowish red, very stiff, moist, FILL, CL	12	2.75	28						
			CHERTY SANDY CLAY, 10% gravel sized chert, 15% sand, 75% fines, low plasticity, yellowish red, very stiff, moist, FILL, CH	13	2.5	30						
12												
			SANDY SILTY CLAY, 15% sand, 85% fines, low plasticity, red, very stiff, moist, CH	9	3.0	27						
18												
			CHERTY SANDY CLAY, 15% sand, 85% fines, high plasticity, dark brown, very stiff, moist, residuum, CH	14	3.0	18						
			CLAYEY CHERTY GRAVEL, 10% sand, 30% clay, 60% gravel sized chert, low plasticity, white and gray, very stiff to hard, wet, GC	36	--	33						
24												
				18	3.0	30						
30												
				25	--	31						
36			BORING TERMINATED @ 35-ft									

COMPLETION DEPTH: 35 -ft
DATE: 03-19-2021

DEPTH TO WATER INITIAL: 22-ft
FINAL: Moist to 15-ft

LOG OF BORING NO.B-5

GTEC
Geotechnical Testing & Environmental Consultants

Project No.: 0229
Project Name: Quarry Water Treatment Plant Expansion
Project Location: Dunlop Blvd

Driller: South Bros.
Drill Make: CM 45-C
Hammer: Auto
Hammer Efficiency: 89%

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SPT N Value (Uncorrected)	Pp (tsf)	Water Content (Percent)	Liquid Limit	Plastic Limit	Percent Passing No. 200	Rock Core Recovery (Percent)	Rock Quality Designation	Fractures per Foot
0			*Elevation=622.5*									
			TOPSOIL	6	2.5	17						
			SANDY CLAY, 15% sand, 85% fines, low plasticity, red, stiff, moist, FILL, CL	6	2.0	27						
				7	1.75	26						
6			CHERTY SANDY CLAY,5% gravel sized chert, 15% sand, 80% fines, high plasticity, yellowish red, stiff, moist, FILL, CH	8	2.0	26						
				8	2.0	27						
12			SANDY CLAY, 15% sand, 85% fines, high plasticity, red, stiff to hard, moist, residuum, CH	7	1.25	24						
18				100+	4.5	19						
24			AUGER REFUSAL @ 22-ft									
30												
36												

COMPLETION DEPTH: 22 -ft
DATE: 03-19-2021

DEPTH TO WATER INITIAL: Dry
FINAL: Dry

LOG OF BORING NO.B-6

GTEC
Geotechnical Testing & Environmental Consultants

Project No.: 0229
Project Name: Quarry Water Treatment Plant Expansion
Project Location: Dunlop Blvd

Driller: South Bros.
Drill Make: CM 45-C
Hammer: Auto
Hammer Efficiency: 89%

DEPTH, FT	SYMBOL	SAMPLES	DESCRIPTION OF MATERIAL	SPT N Value (Uncorrected)	Pp (tsf)	Water Content (Percent)	Liquid Limit	Plastic Limit	Percent Passing No. 200	Rock Core Recovery (Percent)	Rock Quality Designation	Fractures per Foot
			Elevation=622.5									
0			TOPSOIL	8	--							
			CRUSHED LIMESTONE GRAVEL, backfill around vault, FILL	5	--							
				2	--							
6				2	--	39						
			CHERTY SANDY CLAY, 5% gravel sized chert, 5% gravel sized chert, 10% sand, 85% fines, low plasticity, yellowish red, very stiff to hard, moist, FILL, CL	8	3.25	25						
12				9	2.25	24						
18			CHERTY SANDY CLAY, 10% gravel sized chert, 10% sand, 80% fines, low plasticity, yellowish red, very stiff, moist, residuum, CL	13	4.0	28						
24			CHERTY SANDY CLAY, 5% gravel sized chert, 15% sand, 80% fines, high plasticity, mottled black and tan, very stiff, wet, residuum, CH	20	3.25							
				14	2.75	47						
30			CHERTY SANDY CLAY, 10% gravel sized chert, 10% sand, 80% fines, low plasticity, yellowish red, very stiff, wet, residuum, CL	20	2.75	33						
36			BORING TERMINATED @ 35-ft									

COMPLETION DEPTH: 35 -ft
DATE: 03-19-2021

DEPTH TO WATER INITIAL: 30-ft
FINAL: Dry

BORING LEGEND

SOIL SYMBOLS

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAIN SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVELS 50% OR MORE OF COARSE FRACTION RETAINED ON #4 SIEVE	CLEAN GRAVELS	GW	WELL-GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN 50% OF COARSE FRACTION PASSES #4 SIEVE	CLEAN SANDS	SW	WELL-GRADED SANDS AND GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS AND GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAIN SOILS 50% OR MORE PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50% OR LESS		ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS
			CL	INORGANIC CLAYS OR LOW TO MEDIUM PLASTICITY, GRAVELLY OR SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAY
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, MUCK AND OTHER HIGHLY ORGANIC SOILS

OTHER COMMONLY USED SOIL SYMBOLS

- TOPSOIL OR CULTIVATED ZONE
- ASPHALT
- CONCRETE
- FILL

ROCK SYMBOLS

- LIMESTONE
- SANDSTONE
- CONGLOMERATE
- SHALE

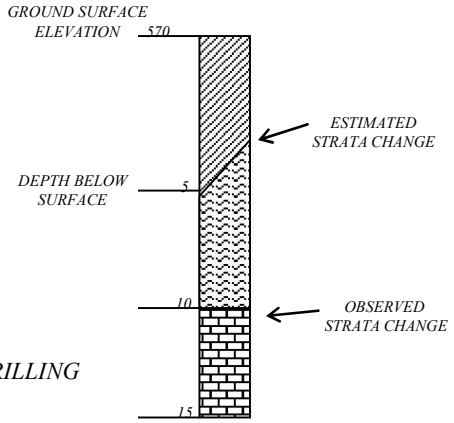
SOIL SAMPLE TYPES

- SPLIT SPOON SAMPLE
- UNDISTURBED SAMPLE
- ROCK CORE

OTHER SYMBOLS

- 85 — RQD – ROCK QUALITY, PERCENT
- NQ — CORE BIT SIZE DESIGNATION
- 95 — RECOVERY, PERCENT
- GROUNDWATER LEVEL DURING DRILLING
- EXTENDED GROUNDWATER LEVEL

KEY TO BORING RECORDS



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www.GTECcorp.com

BORING LEGEND

SOIL SYMBOLS

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES
COARSE GRAIN SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVELS 50% OR MORE OF COARSE FRACTION RETAINED ON #4 SIEVE	CLEAN GRAVELS	GW	WELL-GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
			GP	POORLY GRADED GRAVELS AND GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES	GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS MORE THAN 50% OF COARSE FRACTION PASSES #4 SIEVE	CLEAN SANDS	SW	WELL-GRADED SANDS AND GRAVELLY SANDS, LITTLE OR NO FINES
			SP	POORLY GRADED SANDS AND GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES	SM	SILTY SANDS, SAND-SILT MIXTURES
			SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAIN SOILS 50% OR MORE PASSES NO. 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50% OR LESS		ML	INORGANIC SILTS, VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS
			CL	INORGANIC CLAYS OR LOW TO MEDIUM PLASTICITY, GRAVELLY OR SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDS OR SILTS, ELASTIC SILTS
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAY
			OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, MUCK AND OTHER HIGHLY ORGANIC SOILS

OTHER COMMONLY USED SOIL SYMBOLS

- TOPSOIL OR CULTIVATED ZONE
- ASPHALT
- CONCRETE
- FILL

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- CONGLOMERATE
- SHALE

SOIL SAMPLE TYPES

- SPLIT SPOON SAMPLE
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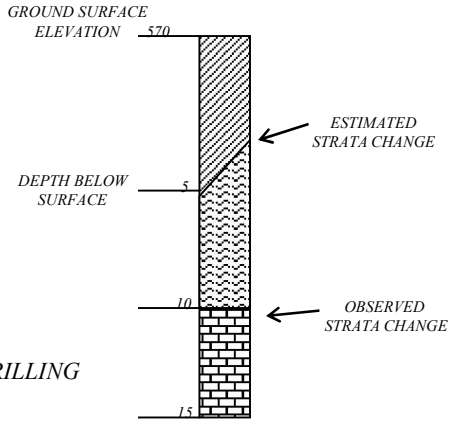
- EXTENDED GROUNDWATER LEVEL

KEY TO BORING RECORDS



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FIELD PROCEDURES

SOIL TEST BORING, ASTM D-1586
The borings were made with a hollow-stem auger powered by a motor-driven drill rig. At regular intervals, soil samples were obtained through the hollow augers with a standard 1.4-inch I.D., 2.0- inch O.D. split-tube sampler. The sampler was initially seated 6 inches to penetrate any loose cuttings; then driven an additional foot with blows of a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler the final foot was recorded and is designated as the *standard penetration resistance*. Penetration resistance, when properly evaluated, is an index to soil strength and density. In the field, the driller logged and described the samples as they were obtained. Representative portions of each soil sample were then sealed in labeled glass jars or plastic bags and transported to our laboratory. The samples were examined by a geotechnical engineer or engineering geologist to visually check the field descriptions. Boring data, including sample intervals, penetration resistances, soil descriptions, and groundwater level are shown on the attached Logs of Borings.

LABORATORY PROCEDURES

MOISTURE CONTENT OF SOILS,
ASTM D-2216,
The moisture content of soils is an indicator of various physical properties, including strength and compressibility. Selected samples obtained during exploratory drilling were taken from their sealed containers. Each sample was weighed and then placed in an oven heated to 110°C + 5°. The sample remained in the oven until the free moisture had evaporated. The dried sample was removed from the oven, allowed to cool, and re-weighed. The moisture content was computed by dividing the weight of evaporated water by the weight of the dry sample. The results, expressed as a percent, are shown on the attached Logs of Borings.

ATTERBERG LIMITS DETERMINATION,
ASTM D-4318,
Representative samples were subjected to Atterberg limits testing to determine the soil's plasticity characteristics. The plasticity index (PI) is the range of moisture content through which the soil deforms as a plastic material. It is bracketed by the liquid limit (LL) and the plastic limit (PL). The liquid limit is the moisture content at which the soil becomes wet enough to flow as a viscous fluid. To determine the liquid limit, a soil specimen is first washed through a No. 40 sieve. The materials finer than the No. 40 sieve are retained and dried until the soil is in a viscous fluid state. A portion of this soil is then placed in a brass cup of standardized dimensions. A groove is cut through the middle of the soil specimen with a grooving tool of standard dimensions. The cup is attached to a cam that lifts the cup 10 mm, and then allows the cup to fall onto a hard rubber base. The cam is rotated at about 2 cps until the two halves of the soil specimen come in contact at the bottom of the groove for a distance of 1/2 inch. The number of

blows required to achieve this 1/2-inch contact is recorded, and part of the specimen is subjected to a moisture content determination. The remainder of the specimen is allowed to air dry for a short time, and the grooving process and cam action repeated. This testing sequence is repeated until more than 25 blows is required to achieve the required groove contact. After the number of blows vs. moisture content for the various test points are plotted on arithmetic graph paper, the moisture content corresponding to 25 blows is designated the liquid limit.

The plastic limit (PL) is the lowest moisture content at which the soil is sufficiently plastic to be manually rolled into threads 1/8" in diameter. The plastic limit is determined by taking a pat of soil remaining from the liquid limit test, and repeatedly rolling, kneading, and air drying it until the soil breaks into threads about 1/8 inches in diameter and 3/8 inches long. The moisture content of these soil threads is then determined and is designated the plastic limit. The results of the liquid and plastic limits tests are tabulated on the attached Logs of Borings.